SIBOGA-EXPEDITIE

UITGEGEVEN DOOR

de Maatschappij voor Wetenschappelijk Onderzoek in de Tropen

ONDER REDACTIE VAN

Dr. MAX WEBER† Dr. L. F. DE BEAUFORT† Dr. J. H. STOCK

MONOGRAPHIE XXXIX, C4 (= Livraison 148)

THE DECAPODA BRACHYURA OF THE SIBOGA EXPEDITION

PART VIII

MAJIDAE

BY

D. J. G. GRIFFIN and H. A. TRANTER

The Australian Museum, Sydney, Australia

LEIDEN
E. J. BRILL
1986

John S Garth

For guidance, stimulating
ideas and much more!

28 May 1988
Helen Tranter

SIBOGA-EXPEDITIE

SIBOGA-EXPEDITIE MONOGRAPHIEËN

UITKOMSTEN OP ZOÖLOGISCH, BOTANISCH, OCEANOGRAFISCH EN GEOLOGISCH GEBIED

verzameld in de Oost-Indische Archipel 1899-1900 aan boord H.M. Siboga onder commando van Luitenant ter zee 1e kl. G. F. TYDEMAN

Résultats des explorations zoologiques, botaniques, océanographiques et géologiques entreprises aux Indes Orientales en 1899-1900 à bord du SIBOGA

UITGEGEVEN DOOR

de Maatschappij voor Wetenschappelijk Onderzoek in de Tropen

ONDER REDACTIE VAN

DR. MAX WEBER†
Hoogleraar in Amsterdam
Leider der Expeditie

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With 112 text figures and 22 plates



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PRINTED IN THE NETHERLANDS BY E. J. BRILL

We would like to dedicate this report to

JOHN S. GARTH

Allan Hancock Foundation, University of Southern California

John Garth, over more than a quarter of a century, has carefully studied the majid spider crabs of the 'New World'. His synthesis of the classifications of Balss and Alcock, based on traditional regard for characters such as orbit, rostrum and abdomen and, most of all, his attention to the challenge posed by features of the male first pleopod have provided the stimulus for our approach to this study.

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THE DECAPODA BRACHYURA OF THE SIBOGA EXPEDITION

MAJIDAE

BY

D. J. G. GRIFFIN & H. A. TRANTER

(Text figures 1-112, plates 1-22)

INTRODUCTION

In March 1899 the Dutch research vessel the 'Siboga' entered the waters of Indonesia. Its collections, made from depths of 10 to 5,684m over the next 12 months, were returned to Amsterdam and over the next fifty years were the subject of numerous extensive reports: decapod Crustacea figured prominently amongst them. The spider crabs, however, were only briefly treated: Ihle & Ihle-Landenberg (1931), in a report outside the Siboga series, described a few new species of one of the subfamilies. The collections were also studied by A. Milne Edwards, Bouvier and Ihle but none of the studies were brought to a conclusion (Prof. J. H. Stock, pers. comm.).

Dr. Th. Mortensen conducted expeditions throughout the Indo-West Pacific over a period of 32 years. No attempt has been made previously to work up this spider crab material gathered in the Zoological Museum at the University of Copenhagen and its size and geographic scope makes inclusion of it in the present study almost mandatory.

Mrs. Mariel King, an American philanthropist, sponsored several small expeditions to the Pacific. One of these covered the Philippines — Moluccas area in 1970. Worked over briefly by the late Dr. R. Serène when he was a UNESCO consultant in Singapore, it was subsequently made available to us by Dr. B. R. Wilson, then of the Western Australian Museum.

Dr. L. B. Holthuis with other members of staff of the Rijksmuseum van Natuurlijke Historie, Leiden, visited West Irian (then Netherlands New Guinea) from October 1954 to May 1955 and the spider crabs collected on that expedition have been made available to us by Dr. Holthuis.

These collections, together with material from the Australian Museum, form the basis of the present report.

The Indo-West Pacific spider crab fauna has been treated in several major reports since Herbst, Fabricius and Latreille described the animals collected by early voyagers. The Japanese fauna is undoubtedly the best known through comprehensive treatments by Sakai (1938; 1965a; 1976) following the classic studies by De Haan (1833-50) and those of Miers (1879b), Parisi (1915), Balss (1924), Rathbun (1932) and Yokoya (1933); that additional species and genera await discovery has been shown by studies of the Japanese fauna by Takeda *et al.* (1969 *et seq.*).

The extensive studies by Mary J. Rathbun represent at least fifty per cent of the reports on the fauna of other areas. Her studies on the crabs of the Philippines (1916), the western Indian Ocean (1911), Hawaii (1906), Siam (1910), eastern Australia (1918) and north western Australia (1914; 1924) are basic to studies of any other local fauna. Only the earlier studies of Miers, referred to above, have contributed a similar amount to our knowledge of the Indo-West Pacific spider crab fauna. Smaller, or more local studies of the South African fauna by Barnard (1950; 1955), of the Red Sea by Parisi (1915), Balss (1929), Guinot (1962a, 1962b) and Griffin and Tranter (1974), of 'Indian Seas' by Henderson (1893), Alcock (1895), Borradaile (1903) and Chhapgar (1957), of Australia by Haswell (1882) a century ago and of New Zealand by Bennett (1964) and Griffin (1966b) — also have formed the basis for understanding regional faunas.

The present classification of the family owes more to the work of Alcock (1895) through important modification by Balss (1929) and Garth (1958) than to the earlier classifications of H. Milne Edwards (1834), Dana (1851b) and Miers (1879c).

In his review of Pacific American species Garth (1958: 7-9) has emphasized the multiple characters employed by Balss — the interantennular spine, degree of fusion of the rostral spines, coalescence of the abdominal segments and presence or absence of a supplementary spine (the intercalated spine) above the orbit between the eave or the antorbital spine anteriorly and the postorbital spine posteriorly — which form the basis of the present classification. Stephensen (1945) and Garth (1958) have given considerable emphasis to the form of the first pleopod of the male. Garth noted that divisions within subfamilies proposed by Balss on the basis of the intercalated spine, were not congruent with divisions based on male first pleopod form. Garth (1958: 13) went on to say that he would make further application of the groupings based on male first pleopods were it not for (i) the fact that each sub-

family in the existing scheme contained species with pleopods which did not fit into major groupings and (ii) absence of knowledge of the 'Old World' (and presumably Indo-Pacific) species: a new system could lead to confusion were it based solely on the 'New World' fauna.

The present collections are important, therefore, because together with that from recently studied material from the Philippines, Red Sea and Indian Ocean and on-going studies of Japanese, Australian and New Zealand faunas, they represent the most comprehensive ones ever assembled from the Indo-Pacific region. Over 2,000 specimens have been examined, the largest collection studied since those of the 'Alert' (1878-1882) and the 'Challenger' (1874-1876) and those accumulated by the Smithsonian Institution through expeditions of the 'Albatross', the 'Sealark' and others collected in the early part of the century. They provide the opportunity to examine whether Garth's proposals derived from the Pacific fauna may be extended to that of the Indo-West Pacific and, through recent studies by Monod (1956), Forest & Guinot (1966) and Williams (1965), to the 'Old World'.

The present report deals with all genera represented in the Indo-West Pacific except those of the subfamily Oregoniinae and the inachine genera *Macrocheira* and *Pyromaia*. The Oregoniinae are boreal animals: this report is not concerned with that area. We have nothing of substance to add to previous treatments (e.g. Sakai) of the two inachine genera. Generic rearrangements and more appropriate alignment of certain genera between subfamilies are explored; higher classification and overall evolutionary patterns will be covered separately.

In the systematic account the subfamilies are arranged in the order that has been used in most large studies, beginning with the Inachinae and concluding with the Mithracinae. Within each subfamily the genera are arranged in alphabetical order as are the species in each genus. Each account includes a reference to only the original description and major subsequent accounts. The carapace length (cl.) is given and this measurement includes the rostrum unless otherwise stated. The data are grouped under the museum where the material is housed. Where there are particular catalogue numbers for specimens the number is given after the abbreviation of the museum concerned. The abbreviations used are as follows:

Zoological Museum, Amsterdam — ZMA
Zoological Museum, University of Copenhagen — ZMC
Smithsonian Institution, Washington — USNM
British Museum (Natural History), London — BMNH
Rijksmuseum van Natuurlijke Historie, Leiden — RMNH
Zoological Survey of India, Calcutta — ZSC
National Institute of Oceanology, Jakarta — NIO, Jakarta
South African Museum, Cape Town — SAM, Cape Town
The Australian Museum, Sydney — AM
Museum of Victoria, Melbourne — NMV
Western Australian Museum, Perth — WAM
South Australian Museum, Adelaide — SAM

Representative specimens of many of the species studied have been retained by the Australian Museum and these are listed in the Appendix. We thank the authorities of the museums concerned.

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We wish to express our appreciation to Dr. J. S. Garth for the helpful discussions we had with him during his visit to Australia in 1979.

Photographs were taken by the Australian Museum photographers Mr. Greg Millen and Mr. John Fields.

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This study commenced in 1970 whilst D. J. G. G. was on a Visiting Postdoctoral Research Associateship at the Smithsonian Institution, administered by the Institution's Office of Academic Programs, and travel to Europe and India was supported by a grant from the Smithsonian Institution's Office of International Activities Foreign Currency Program: additional financial assistance was provided by the New South Wales Government and the Trustees of the Australian Museum.

KEY TO THE SUBFAMILIES OF THE MAJIDAE IN THE INDO-WEST PACIFIC

The following key to the subfamilies is included as a practical guide for those using the keys to identify specimens

rather than as a statement about relationships of the subfamilies.

1 Eyes without orbits, or with incomplete or commencing orbits; basal antennal article generally rather slender 2
— Eyes with nearly complete, or complete, orbits; basal antennal article moderately to very broad 6
2(1) Male abdomen terminally broadened, seventh segment subquadrate and inserted deeply into sixth segment; male first pleopod longitudinally grooved, with rows of filamentous setae on either side of the groove ..... *Oregoniinae*
— Male abdomen not terminally broadened, seventh segment subtriangular and not inserted deeply into sixth segment; male first pleopod exceedingly varied but not as in Oregoniinae 3
3(2) Eyes without orbits; eyestalks generally long, either non-retractile, or retractile against an acute postorbital spine affording no concealment; basal antennal article usually extremely slender and sometimes free distally; merus of third maxilliped often not as wide as ischium ..... *Inachinae*
— Eyes with at most commencing orbits; eyestalks variously elongate, usually retractile (unless very short), postorbital lobe often distinct and affording some protection; basal antennal article not extremely slender, always fused distally; merus of third maxilliped as wide as ischium 4
4(3) Eyes without true orbits, supraorbital eave and postorbital lobe very weakly developed or absent; or orbit with either a prominent eave or with a moderate postorbital lobe; intercalated spine not present; eyestalks variously elongate 5
— Eyes with commencing orbits having, in addition to the supraorbital eave which is sometimes produced into a preorbital spine, a prominent postorbital process, often cupped, to receive the retracted eyestalk; an intercalated spine sometimes present; eyestalks short ..... *Pisinae*
5(4) Eyestalks long, orbit usually extravagantly expanded above and partially protected by a long hornlike supraorbital spine; postorbital spine lacking or small and remote from eye ..... *Tychinae*
— Eyestalks short, little movable and either protected by a small preorbital spine and/or postorbital spine or sunk in the sides of the rostrum ..... *Epialtinae*
6(1) Basal antennal article not specially expanded to form a floor to the orbit, which is formed above by a supraorbital eave and a postorbital lobe usually separated by a hiatus, sometimes an intercalated spine between the two ..... *Majinae*
— Basal antennal article expanded to form a floor to the orbit which is formed above by a supraorbital eave and an adjacent postorbital lobe, intercalated spine sometimes present ..... *Mithracinae*

SYSTEMATIC ACCOUNT
SUBFAMILY INACHINAE

Inachinae Alcock, 1895: 160, 162, 168. — Rathbun, 1925: 11. — Garth, 1958: 36-37. — Griffin, 1966b: 264.

Eyes without orbits; eyestalks generally long, either non-retractile, or retractile against sides of carapace, or against an acute postocular spine affording no concealment. Basal article of antenna extremely slender throughout its extent, and usually long. (Alcock, modified, as quoted by Garth).

Pleopod 1 not usually very stout, usually straight or weakly curved, rarely twisted, aperture terminal or subterminal, sometimes a slit, often protected by a flap, apex simple or with a lobe.

This subfamily is generally regarded as a discrete group of small majids with long eyestalks unprotected above by orbits and with a slender basal antennal article, long spindly legs, some with a double rostrum and others with a single rostrum; the first pleopod of the male is generally simple, the opening subterminal and sometimes protected by a flap. However, over the years the subfamily has become cluttered, in our view, by various species with long eyestalks but not necessarily resembling other inachines in other characteristics. We take the opportunity here to remove a number of genera to other subfamilies:

Lambrachaeus ramifer is not a majid at all.

Anacinetops stimpsoni and the Australian and southeast Pacific species of *Naxia* are transferred to the Majinae but *Trichoplatus* is resurrected to accommodate the radically different species *T. huttoni* from New Zealand.

New genera are proposed for *Aepinus indicus* Alcock (*Sunipea*), *Inachoides dolichorhynchus* Alcock (*Chorinachus*) and *Pseudocollodes demani* Balss (*Rhinospinosa*), since each of these species is regarded as generically distinct from the type species of those genera from American waters.

Although we retain in this subfamily *Encephaloides armstrongi* and '*Collodes*' *malabaricus* their affiliations need further consideration: the former is probably a pisine.

Affiliations of a number of other species groups also need examination. *Eurypodius* species have an unusual male first pleopod, *Cyrtomaia* and *Platymaia* species have at least superficial resemblances to *Chionoecetes* of the Oregoniinae and males of *Oncinopus* and *Macrocheira* species have peculiar twisted first pleopods unlike those of any other majids. The relationships of *Paratymolus*, *Camposcia* and *Ephippias* are also unclear to us at this time.

KEY TO THE INDO-WEST PACIFIC GENERA OF THE INACHINAE

1 Distal margin of basal antennal article extending forward no further than half diameter of eyestalk, free 2
— Distal margin of basal antennal article at least level with, usually extending forward beyond, anterior margin of eyestalk, free or fused to front 4
2(1) Rostrum of two blunt lobes; carapace without spines; interantennular partition weakly developed ..... *Oncinopus*
— Rostrum of two slender spines; carapace with at least a few spines; interantennular partition well developed and bearing a spine at its apex ventrally 3
3(2) Carapace narrowly pyriform; fourth pair of ambulatory legs with toothed ventral edge of dactyl folding back against ventral edge of propod; small species (cl. up to about 20mm) ..... *Grypachaeus*
— Carapace subcircular; fourth pair of ambulatory legs with dactyl normal; very large species (cl. more than 250mm) ..... *Macrocheira*
4(1) Green (antennal) gland immediately at the proximal junction of the basal antennal article 5
— Green (antennal) gland distinct and more or less distant from junction of basal antennal article and epistome 9
5(4) Rostrum of two short blunt lobes (sometimes with spinules); interantennular partition lacking a spine; carpus of cheliped with one large spine on inner margin, otherwise a few tubercles .. *Paratymolus*
— Rostrum of two slender spines (sometimes with accessory spines): interantennular partition with a well developed, sometimes bifid, spine at its apex ventrally; carpus of cheliped with many spines or tubercles 6
6(5) Carapace circular to subcircular 7
— Carapace pyriform 8
7(6) Basal antennal article free distally; interantennular spine horizontal, often long; propodi of ambulatory legs flattened ..... *Platymaia*

— Distal margin of basal antennal article fused to front; interantennular spine deflexed, often short; propodi of ambulatory legs cylindrical ..... *Cyrtomaia*
8(6) Supraorbital eave moderately produced, margin convex, smooth; propodi of all ambulatory legs flattened and strongly widened distally..... *Trichoplatus*
— Supraorbital eave weakly produced, margin nearly straight, spinous; propodi of ambulatory legs cylindrical ..... *Pleistacantha*
9(4) Third maxilliped with merus as broad as the ischium; basal antennal article usually flattened ventrally 10
— Third maxilliped with merus narrower than ischium; basal antennal article usually cylindrical or subcylindrical..... 15
10(9) Rostrum single, if long sometimes apically bifid..... 11
— Rostrum of two spines or fused only in basal half..... 13
11(10) Carapace with branchial regions extremely elevated and approximated in the midline; rostrum broad, beak-like, basal width about two thirds length ..... *Encephaloides*
— Carapace with branchial regions not greatly elevated or approximated in the midline; rostrum slender from the base, spine-like..... 12
12(11) Carapace narrowly pyriform; rostrum more than half postrostral carapace length, lateral margins spinulous, often apically bifid..... *Chorinachus*
— Carapace broad; rostrum less than a quarter postrostral carapace length, lateral margins smooth, apically acute..... *Pyromaia*[1])
13(10) Rostral spines separate from base; supraorbital eave lacking a preorbital spine and an antorbital lobe; intestinal region with a large blunt medial lobe on posterior margin; large species (cl. 30-120mm)..... *Ephippias*
— Rostral spines fused for about the basal half; supraorbital eave with a preorbital spine and often a small antorbital lobe; intestinal region with a slender medial spine or low tubercle on posterior margin; small species (cl. up to 12mm)..... 14
14(13) Postorbital lobe rudimentary; hepatic margin with a slender spine.. *Sunipea*
— Postorbital lobe prominent; hepatic margin lacking a spine..... *Collodes*[1, 2])
15(9) Upper orbit with a postorbital lobe or spine against which the eyestalk retracts..... 16
— Upper orbit lacking a postorbital lobe or spine, eyestalk, if movable, retracting against hepatic margin 19
16(15) Eyestalks long, curved; carapace dorsally smooth ..... *Camposcia*
— Eyestalks short, nearly straight; carapace with two spines dorsally in midline..... 17
17(16) Postorbital lobe cupped, basally broad in lateral view and anteriorly concave ..... *Inachus*
— Postorbital lobe spine-like, conical or subconical 18
18(17) Rostrum of two slender spines, apices acute; interantennular spine short, not visible in dorsal view ..... *Achaeopsis*
— Rostrum hardly produced beyond antennal fossa, of two short lobes, apices rounded; interantennular spine relatively long, exceeding rostral lobes, visible in dorsal view (fig. 15b) .. *Rhinospinosa*
19(15) Rostrum lacking; interantennular partition lacking; supraorbital eave rudimentary, not produced (fig. 11e)..... *Chalaroachaeus*
— Rostrum present; interantennular partition present; supraorbital eave narrow 20
20(19) Eyestalk with cornea small, almost immovable; epistome in a plane which is almost at right angles to the basal antennal article ..... *Physachaeus*
— Eyestalk with cornea not particularly small, movable; epistome in the same plane as the basal antennal article 21
21(20) Rostrum of two substantial contiguous spines, apices acute, produced well beyond antennal fossae; basal antennal article fused proximally with the epistome, usually free anteriorly.... *Macropodia*
— Rostrum of two short lobes, apices usually rounded or blunt, often hardly more than a thickened anterior border of antennal fossae, if produced sometimes contiguous; basal antennal article fused proximally to the epistome and also anteriorly..... 22
22(21) Ambulatory legs very slender and usually three to five times carapace length; first pleopod of male simple with a subterminal aperture; third segment of male abdomen not noticeably longer than fourth and fifth segments, smooth or sometimes with spinules on inflated lateral surfaces, without a transverse ridge..... *Achaeus*
— Ambulatory legs only moderately slender, length less than twice carapace length; first pleopod of male complex, aperture surrounded by lobes; third segment of male abdomen longer than fourth or fifth segments, arched, with a transverse ridge ..... *Prosphorachaeus*

[1]) from the literature (*Pyromaia* — Garth, 1958; *Collodes* — Alcock, 1895).
[2]) *C. malabaricus* only, not American species.

Achaeus Leach, 1817

Type species. — *Achaeus cranchii* Leach, 1817 by monotypy.

Remarks. — This is one of the most speciose of the Indo-Pacific spider crab genera. No less than 27 species are now recognised from the Indo-West Pacific, seven, including a new species described here, having been discovered in the last 15 years; an additional seven species are known from the eastern Atlantic. The genus thus rivals the similarly small *Podochela* in the eastern Pacific and west Atlantic.

The most recent treatments of this genus have dealt with Australian, New Zealand, South African and Japanese species. In an account of the then known Australian species Griffin (1970c) drew attention to the existence of three groups of species distinguished by first pleopods of the males. One of these groups, with strongly twisted pleopods has been removed to a new genus, *Prosphorachaeus*, by Takeda. Those remaining generally have the first pleopod of the male weakly curved outwards distally, the aperture usually being a simple slit near the apex. In some however, the opening is very prominent and in two it is protected by a flap as is characteristic of *Podochela* and some other American Inachinae. We have not seen fit to divide the genus up further, considering the presence of the flap to be a development confined to a few species otherwise very similar to other species of the genus.

Six of the species included in the key we know only from the literature. They are *A. anauchen* Buitendijk, 1939; *A. inimicus* Rathbun, 1911; *A. brevidactylus* Sakai, 1938; *A. boninensis* Miyake & Takeda, 1969; *A. varians* Takeda & Miyake, 1969; and *A. spinosus* Miers, 1879b.

Distribution. — Indo-West Pacific and eastern Atlantic.

KEY TO INDO-WEST PACIFIC SPECIES OF *ACHAEUS*

1 Supraorbital eave with one, or sometimes two or three, large spines 2
— Supraorbital eave smooth, or with four or more spinules or tubercles 8
2(1) Epistome absent; a prominent ridge across carapace between hepatic regions ..... *A. anauchen*[3])
— Epistome present; gastric regions without a prominent transverse ridge..... 3
3(2) Basal antennal article with three to four long spines; branchial region with five to six spines on, or close to, margin..... 4
— Basal antennal article with one to two long spines and sometimes two to four small spines; branchial margin with one to two tubercles or spines 5
4(3) Rostral spines slender, blunt, separated by a narrow slit; postorbital region with about four short spines laterally; hepatic margin with four to five short spines ..... *A. spinossisimus*
— Rostral spines slender, acuminate, separated from base by a broad U-shaped hiatus; postorbital region with one long spine laterally; hepatic margin with one long spine on margin and one subhepatic spine..... *A. erythraeus*

5(3) Postorbital neck short, carapace widening immediately behind eave; hepatic region strongly produced, margin with one anterior spine and one to two spines at the apex 6
— Postorbital neck at least moderately long, carapace constricted behind eave; hepatic region weakly or moderately produced, margin without anterior spine, apex with one spine and sometimes one to two additional smaller spines 7
6(5) Basal antennal article with two distal spines, otherwise spinulous; eyestalk with spinules and tubercle at extremity ..... *A. inimicus*[3])
— Basal antennal article with one distal spine, otherwise with two spinules; eyestalk with narrow process on anterior surface at distal third..... *A. akanensis*
7(5) Eyestalk with very small anterior tubercle or none at all; interantennular partition thin, shallow and ungrooved; lateral margin of postorbital neck smooth or with one spinule; adult male cheliped merus cylindrical, very slender in proximal third ..... *A. cadelli*
— Eyestalk with a well developed, narrow anterior tubercle; interantennular partition thick, deep and grooved; lateral margin of postorbital neck with one to five spinules; adult male cheliped merus trigonal, stoutness uniformly increasing distally..... *A. curvirostris*
8(1) Carapace without spines or tubercles dorsally or with only very low suppressed tubercles on gastric and cardiac region 9
— Carapace prominently tuberculate and sometimes bearing spines 15
9(8) Hepatic lobe strongly produced outwards and markedly convex, rounded or truncate..... 10
— Hepatic lobe not markedly produced outwards, subacute, obtuse or a low convexity 12
10(9) Carapace with a low tubercle on gastric and cardiac regions; dactyls of first two pairs of ambulatory legs terminally broadened ..... *A. brevidactylus*[3])
— Carapace smooth; dactyls of first two pairs of ambulatory legs slender..... 11
11(10) Rostrum deeply divided by a V-shaped notch, apically rounded, most of the margin spinulous; dactyl of last pair of legs semicircular ..... *A. lacertosus*
— Rostrum hardly divided apically by a very broad U-shaped notch, a few small spinules on distal part of margin; dactyl of last pair of legs weakly curved ..... *A. villosus*
12(9) Dactyls of last pair of ambulatory legs very weakly curved with one robust subterminal tooth; branchial regions with low tubercles ..... *A. laevioculis*
— Dactyls of last pair of ambulatory legs strongly curved with five or more robust teeth ventrally; branchial regions smooth 13
13(12) Hepatic lobe a smooth, low convexity; basal antennal article granulate; postorbital neck short..... *A. japonicus*
— Hepatic lobe subacute, sometimes with one or more tubercles; basal antennal article smooth or with up to four small spines; postorbital neck moderately long 14
14(13) Rostrum of two short, slender, subacute lobes separated by a very narrow slit; first free segment of antenna with a lateral spine; lateral margin of antennal fossae outwardly splayed ..... *A. barnardi*
— Rostrum broad, blunt, apically undivided or with a very shallow notch; first free segment of antenna smooth; lateral margins of antennal fossae not outwardly splayed..... *A. lorina*
15(8) Carapace with four to nine long spines dorsally..... 16
— Carapace with one to two long spines or with blunt tubercles or granules dorsally 17
16(15) Margin of supraorbital eave with many blunt spinules; rostral lobes with a few blunt spinules; branchial regions with two long spines submedially behind single cardiac spine ..... *A. superciliaris*
— Supraorbital eave with a few minute spinules midway along; rostral lobes with an apical spine; branchial regions with two long spines on each side near lateral margin, cardiac region with a pair of submedial spines..... *A. boninensis*[3])
17(15) Rostral lobes apically acute or subacute..... 18
— Rostral lobes apically blunt or rounded 24
18(17) Rostral lobes narrow, contiguous, separated only by a narrow V-shaped notch..... 19
— Rostral lobes moderately broad at base, well separated from base or by a broad apical concavity..... 20
19(18) Gastric and cardiac regions each with a single slender spine; basal antennal article with closely spaced tubercles on lateral margin as well as tubercles on ventral surface ..... *A. pugnax*
— Gastric and cardiac regions each with a large conical tubercle; basal antennal article smooth..... *A. dubia*
20(18) Postorbital region very short; hepatic region weakly or moderately produced and broad, laterally truncate or with blunt lobes 21
— Postorbital region moderately long; hepatic region produced, narrow and apically subacute to acute 23
21(20) Eyestalk with a row of three to four spines anteriorly; basal antennal article with a strong anterolateral spine as well as spinules on lateral and medial edges; dactyl of second ambulatory leg broadest subterminally..... *A. robustus*
— Eyestalk smooth; basal antennal article with tubercles but without spines or spinules; dactyl of second ambulatory leg tapering distally, not subterminally broadened..... 22
22(21) First pleopod of male flattened and spatulated at the tip ..... *A. tuberculatus*
— First pleopod of male widened distally, and ventrally produced and convex at the tip..... *A. varians*[3])
23(20) Protogastric and branchial regions smooth; supraorbital eave with posterior and sometimes anterior spinules; first pleopod of male with aperture at tip of sternal surface, not surrounded by a flap of tissue..... *A. brevifalcatus*
— Protogastric and branchial regions with tubercles; supraorbital eave lacking spinules; first pleopod of male with aperture subterminal and partly surrounded by a flap of tissue ..... *A. podocheloides*
24(17) Postorbital region not constricted; margins of rostral lobes and supraorbital eave spinulous ..... *A. paradicei*
— Postorbital region constricted; margins of rostral lobes smooth, supraorbital eave smooth or with a few anterior spinules 25
25(24) Cardiac tubercle without a secondary tubercle on posterior slope; postorbital 'neck' short; last segment of male abdomen subtriangular ..... *A. spinosus*[3])
— Cardiac tubercles with a secondary tubercle on posterior slope; postorbital 'neck' long; last segment of male abdomen distally truncate or weakly concave 26
26(25) Dactyl of last ambulatory leg only weakly curved, with minute teeth ventrally; dactyl of male chela with two large teeth .. *A. serenei*
— Dactyl of last ambulatory leg strongly curved with robust recurved teeth ventrally; dactyl of male chela with one large tooth ..... *A. brevirostris*

Achaeus akanensis Sakai, 1938
(Figs. 1, 5a, b)

Achaeus akanensis Sakai, 1938: 224-225, text fig. 15; 1976: 165, text fig. 88. — Griffin, 1976: 183.

Material examined. — 7 ♂♂, 3♀♀ (1 ovig.), 2.5-6.5 mm, ovig. ♀, 5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 260, Kai Is., 2.3 miles (∼ 3.7km) N 63°W from north point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90m, Blake dredge, sand, coral and shells, 16 and 18 December, 1899; 1 spec. — Stn. 282, anchorage between Nusa Besi and NE point of Timor, 08°25.2′S 127°18.4′E, 27-54m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Sagami Sea, Okinose, 180m, dredge, 23 June 1914; 1 spec.

Danish Kei Islands Expedition: Banda, off Neira, ca. 15m, dive, sand, 9 June 1922; 1 spec. — Banda, off Neira, 13m, dive, sand, 12 June 1922; 3 specs.

'Galathea' Expedition: Stn 675, Kermadec Group, Raoul I., 29°13′S 177°57′W, 60m, trawl, stones, 3 March 1952; 2 specs.

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[3]) from the literature

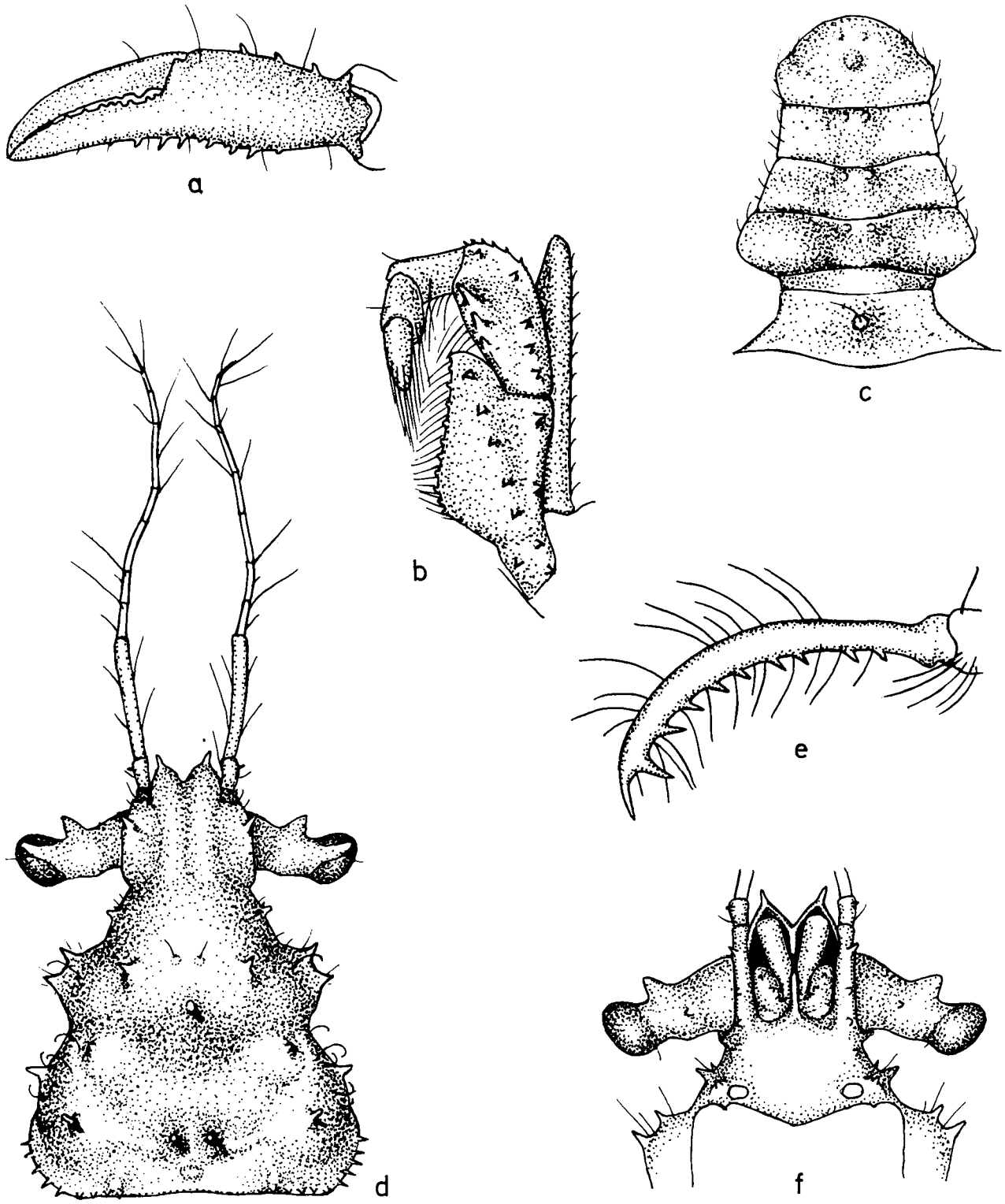


Fig. 1. *Achaeus akanensis* (male, 3.5 mm, Banda, ZMC) (a) left chela; (b) left third maxilliped; (c) male abdomen; (d) carapace, dorsal view; (e) dactyl of left fourth ambulatory leg; (f) orbits, ventral view.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. OG I, S of Obi I., south coast of Gomumu I., 01°52′S 127°36′E, 6m, corals, 23 May 1970; 1 spec.

Remarks. — These specimens agree well with the short description of the female holotype given by Sakai (1938; 1976; "male holotype" in the text is clearly a printing error) and with the two specimens previously recorded from the Philippine Islands (Griffin, 1976), in the apical spine on the rostrum, the spine on the supraorbital eave and the short postorbital neck. In the two male specimens from the Kermadec Group (3.5, 5.0 mm) there are tubercles, not spines,

dorsally on the carapace; in most of the remaining specimens the carapace tubercles are surmounted by a small spine, but these are broken off in some specimens. In two other male specimens, one from Kai Islands and one from Japan, there are strong spines on the carapace. The adult male of *A. akanensis* has never been described. Two of the males — the specimen from Japan (6.5 mm) and the larger specimen from the Kermadec Group (5.0 mm) — of our present series appear to be adult since the cheliped is enlarged and there is a wide gape between the fingers with one large basal tooth on the dactyl. In the male from the Kai Islands (4 mm) with strong carapace spines, the cheliped is somewhat enlarged and there are two teeth on the dactyl in the gape: we consider this specimen to be subadult. In both our specimens from Japan and the one from the Kai Islands the ambulatory legs are missing but as they agree in respect of other characters with the rest of the specimens in this series we have considered them to be conspecific.

In this series there is a broad tubercle surmounted by a group of curled hairs just behind the anterior margin on each rostral lobe. The anterior process on the eyestalk is narrow, rounded apically or subacute and with a small apical spine in some specimens. The postorbital neck is short, very short in the females, with one lateral spinule in most specimens; in the specimen from Kai Islands there are three small spinules and in the specimen from Japan about eight small spinules on the lateral margin. The hepatic region is strongly produced with one or two spines at the apex of the margin and a spine, which is usually subequal to that on the apex, on the anterior margin. There is a spine midway along the pterygostomian margin and one to three submarginal spines anteriorly on the branchial region. There are strong spinules posterolaterally on the carapace margin.

The protogastric spines or tubercles are smaller than the mesogastric spine or tubercle, not subequal as in the holotype. There are two submedial tubercles or spines on the cardiac region and a low tubercle on the posterior slope. The cardiac spines are sometimes weakly divergent, but in the specimen from Japan are strongly divergent. There are three tubercles or spines dorsally on each branchial region, the largest being either that at the same level as the cardiac region or the spine above the last ambulatory leg.

There is a long spine on the basal antennal article at the distal two thirds and two to four small spines proximal to it. Ventrally on the first free segment of the antenna there is a spinule at the anterolateral angle.

The chelipeds are large and stout in our male from Japan (6.5 mm) and in the larger of our males from the Kermadecs (5.0 mm). The merus of the cheliped in the adult male is subtrigonal with small spines on the three ridges and a subterminal spine dorsally. There is a spinulous ridge on the inner face of the carpus and three to four dorsal spines. The palm of the chela is one and a half times longer than the height with small spinules on the dorsal and ventral margins. The fingers are shorter than the palm and separated by a wide gape in the proximal two thirds; there is a large basal tooth on the fixed finger and a similar large tooth in front of it on the dactyl. The cheliped of our male from Kai Islands (4.0 mm) is not so stout, the palm is twice as long as high, the gape between the fingers is in the proximal third and there are two large teeth on the dactyl in the gape.

There is a subterminal tooth on the dactyl of the second ambulatory leg. In our specimens from the Philippine Islands (Griffin, 1976), Moluccas, Banda and Timor, the dactyl of the fourth ambulatory leg is moderately curved with about five small teeth along its length, the subterminal being the largest. In our specimens from the Kermadecs the fourth dactyl is more strongly curved, the teeth are more uniform in size and the subterminal tooth is more robust.

The third segment of the male abdomen is spinulous laterally in the larger males (greater than 3.5 mm); the last segment is wider than long, narrower in the distal half, with the anterior margin broadly rounded. The first pleopod of the male is only slightly broadened towards the blunt apex; the aperture is a lateral slit near the apex on the abdominal surface. The pleopod is curved inward distally in our two males from Kai Islands and Japan, while in the remaining five males the pleopod is nearly straight with only the apex turned inwards.

This species is very similar to *A. inimicus* Rathbun, known only from the holotype (♀, 5.4 mm, Mauritius), in the carapace spines; the absence of a postorbital neck in the female; and the curved dactyl of the fourth leg. *A. inimicus* as described by Rathbun (1911: 246, pl. 20 fig. 3) differs from *A. akanensis* only in the presence of spinules on the eyestalk rather than an anterior process; and in the basal antennal article having two long distal spines rather than one. It might well be that the two species are synonymous. (Buitendijk's, 1939, poor specimen of *A. inimicus* seems to agree with our *A. akanensis* specimens.)

A. akanensis is distinguished from *A. curvirostris* (A. Milne Edwards) and *A. cadelli* Alcock which also have a spine on the supraorbital eave by having a much shorter postorbital neck than in those two species.

Distribution. — Japan, Philippine Islands, Moluccas, Banda, Kai Islands, Timor, Kermadec Group.

Achaeus brevifalcatus Rathbun, 1911

Achaeus brevifalcatus Rathbun, 1911: 244-246. — Miyake & Takeda, 1969: 23-27, fig. 1. — Griffin, 1970c: 112-113, figs. 9, 10, 14b, c. — Sakai, 1976: 160.

Material examined. — 4♂♂, 1♀ (ovig.), 5-8 mm, ovig. ♀, 7 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 289, S coast of Timor, 09°0.3′ S 126°24.5′ E, 112 m, trawl, mud, sand and shells, 20 January 1900; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java - S. Africa Expedition: Stn. 47, Mauritius, N of Port Louis, ca. 234 m, Sigsbee trawl, mud, coral, 6 November 1929; 2 specs.

Remarks. — These specimens agree well with those previously described in the strongly produced hepatic region with marginal spines; the apical spine on the rostral lobes and the strongly curved dactyl of the fourth ambulatory leg.

There is a smaller spine medial to the apical spine on the rostrum in two of the specimens from Timor, while in one of the specimens from Mauritius, the male, there is a small tubercle lateral to the apical spine. In all five specimens the supraorbital eave is nearly smooth with a few posterior spinules and laterally behind the orbits there are spinules. In one of the specimens from Mauritius, the female, there are small spinules on the eystalk near the anterior tubercle. In all of the specimens there is a distal spine on the basal antennal article with, in some, one to four very small spines proximal to it. The third segment of the male abdomen is spinulous in two of the specimens but bears only a few spinules in the other two.

This species is similar to *A. podocheloides* Griffin and *A. boninensis* Miyake & Takeda, in having the hepatic region strongly produced and the dactyl of the fourth leg strongly curved. However, in those two species there are three tubercles or spines dorsally on each branchial region, while in *A. brevifalcatus* there is only one such tubercle — above the last ambulatory leg.

Distribution. — Mauritius, Seychelles, Red Sea, Timor, Japan, Hawaii.

Achaeus brevirostris (Haswell, 1879)

Stenorhynchus brevirostris Haswell, 1879: 408-409; 1880b: 432, pl. 27 fig. 5.
Achaeus brevirostris. — Griffin & Yaldwyn, 1965: 46-48 (lit.). — Griffin, 1970c: 98-101, figs 1a, 2, 15e, f: 1976: 183.

Material examined. — 14♂♂, 11♀♀ (6 ovig.), 5-10 mm, smallest ovig. ♀, 6 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 162, West Irian Jaya, west coast Salawatti, between Loslos and Broken Is., 18 m, dredge, coarse and fine sand with clay and shells, 18 August 1899; 2 specs. — Stn. 253, Kai Is., 05°48.2′S 132°13′E, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 1 spec. — Stn. 274, Aru Islands, 05°28.2′S 134°52.9′E, 57 m, Blake dredge, sand and shells, stones, 26 December 1899; 1 spec.
Singapore, 1903-1907; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 11, Kai Is., off Toeal, 20 m, trawl, fine sand, 9 April 1922; 3 specs. — Stn. 14, Kai Is., S of Doe Roa, 40 m, trawl, sand, 10 April 1922; 3 specs. — Stn. 20, Kai Is., Doe Roa Bassin, 50 m, trawl, sand, 14 April 1922; 1 spec. — Stn. 31, Kai Is., Doe Roa Bassin, 50 m, trawl, sand, 18 April 1922; 1 spec. — Stn. 35, Kai Is., Bay north of Noehoe-Roa, 35 m, trawl, sand, 23 April 1922; 1 spec. — Stn. 38, Kai Is., NE of Doe Roa, 35 m, trawl, sand, 24 April 1922; 2 specs. — Stn. 40, Kai Is., N of Doe Roa, 25 m, trawl, sand, 25 April 1922; 1 spec. — Stn. Pt. 19.4, Kai Is., off Toeal, 20 m, trawl, sand, 12 May 1922; 2 specs. — Stn. 60, Kai Is., S of Doe Roa, 25 m, dredge, gravel, shells *Lithothamnion*, 14 May 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition - Moluccas: Stn. KR VI, Kai Is., N of Nuhu Rowa, N of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 2 specs. — Stn. A III, Aru, Trangan, 3-4 miles (∿ 5-6.5 km) W of Tg. Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 3 specs.

Remarks. — These specimens agree well with those previously discussed. It was remarked before that on the chela there is sometimes a second tooth on the dactyl in the gape. In this series this second tooth was present in six males (6.5-7.0 mm), and there was only one proximal tooth on the dactyl in seven males (7.0-10 mm); this variation therefore appears to be related to size.

In the present series the rostral lobes are shorter than in the specimens previously described from Australia, and in a few specimens are separated only by a shallow notch. In most of these specimens there are one or two small tubercles on the basal antennal article and sometimes there are distal granules; in three specimens the basal antennal article is smooth and in one male (ZMA, Singapore) there is a small spine instead of a distal tubercle. There is a very small, recurved, subterminal tooth on the dactyl of the second ambulatory leg in all except one of the fourteen specimens which have a complete dactyl. On the ventral edge of the fourth dactyl there are five to eight pairs of small teeth proximally and five to eight unpaired, larger, recurved teeth distally. The gonopores of the female are near the midline and open anteriorly.

This species is very similar to *A. serenei* n.sp. and the differences which distinguish it are discussed under that species.

Distribution. — Zanzibar, Thailand, Singapore, Java, Australia, Kai Is., Aru, Sulu Archipelago.

Achaeus cadelli Alcock, 1895

Achaeus cadelli Alcock, 1895: 171, pl. 5 fig. 1. — Rathbun, 1911: 246.

Material examined. — 2♂♂, 6 ovig. ♀♀, 6-8.5 mm, smallest ovig. ♀, 6 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 82, Sunda Strait, 06°38′S 105°21′E, 35 m, trawl, sandy mud, 30 July 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition - Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg Tutuhuhur, 03°15′S 128°8′E, 27-54 m, dredge hauls 8-19, sand, *Lithothamnion* and rubble or shelly grit, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N of Nuhu Rowa, N of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge, sand and rubble, 11 June 1970; 1 spec. — Stn. KR IX, Kai Is., N end of Kai Dulah, 05°31′S 132°48′E, 18-21 m, dredge, sand and coarse sand, 12 June 1970; 1 spec. — Stn. AM II, Aru, Maikoor, approx. 8 miles (∿ 13 km) SW Tg. Ratoe, centred at 06°7′S 133°57′E, 45 m, dredge hauls 4-5, sand and rubble, 18 June 1970; 3 specs. — Stn. AM II (as above), 59-63 m, dredge hauls 8-11, sand and rubble, 18 June 1970; 1 spec.

Remarks. — These specimens agree well with that described and figured by Alcock (1895) except that, but for one

specimen, the rostral ridges are blunt and smooth, not carinate and spinulous. In that specimen (ovig. ♀, Sunda Strait) there is one short spine on the rostral ridge. One of us (D.J.G.G.) has examined a specimen of *A. cadelli* (male, 7.2 mm, Port Blair, Andamans, ZSC 1024/7) from the type locality, and the rostral lobes of this specimen have little trace of the serrations mentioned by Alcock.

In our specimens the rostrum is divided only apically into two very short triangular spines, separated by a shallow, broad U-shaped hiatus. The interantennular partition is not grooved ventrally. The supraorbital eave is smooth except for a single spine in the anterior half. The region behind the eave is constricted, smooth laterally or with one spinule, and broadening gradually to the hepatic region. There is one spine on the hepatic margin and two very small tubercles on the branchial submargin. There are two to four pairs of very small submedial protogastric tubercles anteriorly; a larger lateral protogastric tubercle ahead of the hepatic region and a posterior mesogastric tubercle. The cardiac region is strongly elevated with a pair of high submedial tubercles, sharp in one specimen, and a small medial tubercle on the posterior slope. There are two tubercles, one in front of the other, on the dorsal branchial region, and a tubercle or short spine at the posterolateral angle of the intestinal region.

The basal antennal article is long, reaching almost to the apex of the antennular fossa, slender, smooth except for two long spines, one midway along and one on the distal margin. The merus of the cheliped of the adult male is slender in the proximal third and widened in the distal two thirds. On the fixed finger of the adult male chela of our specimens there is a large basal tooth with a larger tooth on the distal edge of the gape; on the dactyl there is, in one specimen, one large tooth, in the other specimen two large teeth, opposite the hiatus between the large teeth on the fixed finger. The dactyl of the fourth ambulatory leg is almost straight, only weakly curved distally, and smooth or at least without prominent spines.

There are six segments in the male abdomen and the third segment is smooth. The first pleopod of the male is widened distally and the broad apex is curved inwards. The aperture is anterior and subterminal on the lateral margin of the abdominal surface.

The female abdomen is of six free segments and the female gonopore is large and opens laterally.

This species resembles *A. curvirostris* (A. Milne Edwards) in having a single spine on the supraorbital eave and in having the carapace constricted behind the eave into a postorbital 'neck'. *A. cadelli* can be distinguished from *A. curvirostris* by the points listed below, in addition to the characters of the rostrum mentioned above. The distinguishing character for *A. cadelli* is given first in each case and the corresponding character for *A. curvirostris* follows enclosed in brackets.

1. The interantennular partition is thin, shallow, not grooved and barely separates the antennular fossae anteriorly (the antennular fossae are separated anteriorly by a thick, deep, grooved interantennular partition).
2. The basal antennal article is long, reaching almost to the anterior margin of the antennular fossa, with two long spines, one midway and one on the distal margin (basal antennal article only reaching three quarters of antennular fossa, one long spine at distal two thirds); there are one to three small spinules on the posterior part of the article in both species.
3. The hepatic region is weakly produced with one small spine (hepatic region moderately produced with one large and one to two smaller spines).
4. The eyestalk is short with a pronounced constriction just beyond the base and there is only a very small anterior tubercle or none at all (eyestalk is moderately long with only a weak constriction and a well developed, narrow, anterior tubercle).
5. In the adult male the cheliped merus is cylindrical, very slender in the proximal third; on the fixed finger there are two large teeth separated by a wide hiatus (the merus is stout and trigonal, the stoutness uniformly increasing distally; on the fixed finger there are moderately large proximal teeth close together).
6. The third segment of the male abdomen is smooth (the third segment of the male abdomen is laterally spinulous).

These records extend the range of this species which was previously known only from Amirante and the Andamans in the Indian Ocean.

Distribution. — Amirante, Andamans, Sunda Strait, Ceram, Aru, Kai Islands.

Achaeus curvirostris (A. Milne Edwards, 1873)

Stenorhynchus curvirostris A. Milne Edwards, 1873: 253. — Haswell, 1882: 2.
Stenorhynchus fissifrons Haswell, 1879: 409.
Achaeus tenuicollis Miers, 1886: 9, pl. 1 figs 3a-c. (Not *Achaeus tenuicollis*. — Stephensen, 1945: 97, fig. 18A-B = *Macropodia formosa* Rathbun.)
Achaeus fissifrons. — Griffin & Yaldwyn, 1965: 38-43, figs 1-8. — Griffin, 1970c: 101-102, fig. 13b, c.
Achaeus curvirostris. — Griffin, 1974: 4.

Material examined. — 3♂♂, 7♀♀ (6 ovig.), 5-8 mm, smallest ovig. ♀, 5.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Islands, Sapeh Strait, 08°23.5′ S 119°4.6′ E, 69 m, dredge, coral and shells, 14 April 1899; 3 specs. — Stn. 310, E coast of Sumbawa, Sapeh Bay, 08°30′ S 119°7.5′ E, 73 m, dredge, sand with few pieces of dead coral, 12 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 2 specs.
'Galathea' Expedition: Stn. 675, Kermadec Group, Raoul I., 29°13′ S 117°57′ W, 60 m, sledge trawl, 3 March 1952; 4 specs.

Remarks. — These specimens agree well with those previously described and figured. In all our specimens there is a high tubercle on the anterior of the eyestalk and the supraorbital eave is smooth except for the single spine. On the postorbital neck there are two to five spinules, but in two of the specimens from the Kermadec Group there is only one spinule. All four specimens from the Kermadec Group have one high cardiac tubercle, while in the other specimens there are two low cardiac tubercles.

We have examined the specimens from the Iranian Gulf identified by Stephensen (1945) as *Achaeus tenuicollis* (3♂♂,

4♀ ♀, 8-12.5 mm) and they are not conspecific with this material; they are *Macropodia formosa* Rathbun.

Buitendijk (1939) recorded a specimen from the Sulu Islands as *A. lorina* which agreed with three specimens previously described as *A. lorina* by De Man (1902). One of us (D.J.G.G.) has examined all four specimens and they are all *A. curvirostris*.

A. curvirostris can be distinguished from *A. cadelli* Alcock which also has a spine on the supraorbital eave and the carapace constricted to form a neck, by its shorter basal antennal article; by the more strongly produced hepatic region with two to three spines rather than one spine and by the third segment of the male abdomen which is spinulous rather than smooth. These differences are discussed more fully under *A. cadelli*.

A. curvirostris can be distinguished from *A. akanensis* Sakai, by the presence of a postorbital neck (very small or absent in *A. akanensis*) and by the smaller hepatic spines (two strong hepatic spines directed obliquely forward in *A. akanensis*).

Distribution. — Widespread Indo-West Pacific: eastern Africa and the Philippine Islands, Japan, western and eastern Australia and New Zealand.

Achaeus japonicus De Haan, 1839

Inachus (Achaeus) japonicus De Haan, 1839: 99-100, pl. 29 fig. 3.
Achaeus japonicus. — Ortmann, 1893: 33-34. — Sakai, 1938: 211-212, fig. 5, pl. 22 fig. 1; 1976: 158-159, pl. 49 fig. 1. — Takeda, 1973b: 36.

Material examined. — 12 ♂♂, 21 ♀ ♀ (12 ovig.), 7.9-17.2 mm, smallest ovig. ♀, 13 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Misaki, ca. 18 m, 30 April 1914; 1 spec. — Japan, NW Kyushu, 33°51′N 130°3′E, 47 m, dredge, 18 May 1914; 2 specs.

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' Expedition: Stn. 3707, Japan, off Honshu I., 113-135 m, 8 May 1900; 1 spec. (USNM 49076, det. M. Rathbun). — Stn. 3730, Japan, off Honshu, 61 m, 16 May 1900; 27 specs. (USNM 49081, det. M. Rathbun).

Japan, Obama, 108 m, coll. F. Baker, May 1914; 2 specs. (USNM 48847, det. T. Sakai).

Remarks. — These few specimens agree well with those previously described especially by Sakai (1938). The margin on the supraorbital eave and the postorbital region are sometimes minutely tuberculate; the basal antennal article is tuberculate distally and along the lateral edge.

Distribution. — Japan and Hong Kong.

Achaeus lacertosus Stimpson, 1907

Achaeus lacertosus Stimpson, 1907: 20, pl. 3 fig. 7. — Stephensen, 1945: 98, fig. 18C. — Griffin & Yaldwyn, 1965: 44-46 (lit.). — Griffin, 1970c: 105-108, figs 1b, 5, 14a, d; 1972: 69; 1974: 6. — Sakai, 1976: 159-160, text-fig. 82.

Material examined. — 21 ♂♂, 29 ♀ ♀ (19 ovig.) 4-6 mm, smallest ovig. ♀, 4 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Sumbawa, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 3 specs. — Makassar, 27-32 m, May 1899; 1 spec. — Aru, Jedan I.; 1 spec.

Java Sea, Jakarta, otter trawl, 'Rambang', May 1907; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Ambon, Ambon Bay, 90 m, dredge, sand, stones, 2 March 1922; 1 spec. — Stn. 10, Kai Is., off Doelah, 50 m, dredge, fine sand, 6 April 1922; 1 spec. — Stn. 14, Kai Is., S of Doe Roa, 40 m, trawl, sand, 10 April 1922; 1 spec. — Stn. 30, Kai Is., between Doe Roa and Kai Doelah, 40 m, trawl, sand, shells, 18 April 1922; 1 spec. — Stn. 61 Kai Is., between Doe Roa and Kai Doelah, 50 m, trawl, 14 May 1922; 1 spec. — Stn. 64, Java Sea, 05°51′S 106°22′E, 35 m, trawl, sandy mud, shells, 26 July 1922; 2 specs. — Stn. 72, Java Sea, 05°41′S 105°57′E, 35 m, trawl, stones, 28 July 1922; 1 spec. — Stn. 106, Java Sea, 05°50′S, 106°16′E, 13 m, trawl, mud, 5 August 1922; 1 spec.

Mortensen Java - S. Africa Expedition: Stn. 5, Java, 08°23′S 114°29′E, 70 m, trawl, sand, 5 April 1929; 3 specs. — Stn. 8, Java, 08°23′S, 114°24′E, 50 m, trawl, dredge, hard bottom, 6 April 1929; 19 specs.

Singapore, at low tide, 1903-1907; 1 spec. — Singapore, at low tide, 1 September 1908; 1 spec.

Formosa Strait, 23°8′N 117°30′E, 43 m, 23 January 1912; 2 specs.

South India, Pamban Passage, 5 m, coll. H. Lemche, 8 October 1951; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 48-41 m, dredge haul 4, coarse foramniferal and shell sand, 1 June 1970; 1 spec. — Stn. CP I, (as above), 25-63 m, dredge hauls 8-19, sand, *Lithothamnion* and rubble, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N of Du Rowa I., N of Nuhu Rowa, 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 4 specs. — Stn. AN I, Aru, SW of Tg. Ngabordamlu, S Trangan I., centred near 06°58′S 134°5′E, 25-29 m, dredge hauls 1-3, coral, sponge, mud, broken shell, 20 June 1970; 1 spec. — Stn. A III, Aru, Trangan, 3-4 miles (∿ 5-6.5 km) W of Tg. Lelar, 04°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 1 spec.

Remarks. — These specimens agree well with those previously described in the prominent spinules on the anterior edge of the rostrum; the long slender eyestalk with fine spinules but without an anterior lobe; the smooth carapace; the hepatic region expanded but not sharp nor with tubercles; and the strongly curved dactyl of the fourth ambulatory leg.

The present series shows the considerable variation in spinulation of the supraorbital eave, hepatic margin and posterolateral margins as commented on previously (Griffin, 1970c).

We have examined the specimens from the Iranian Gulf (6 ♂♂, 2♀ ♀, (1 ovig.) 5-8.5 mm, ovig. ♀, 7.5 mm, Stn. 15; ZMC) identified as this species by Stephensen (1945) and they are conspecific with our material. There are spinules on the anterior margin of the rostral lobes and the basal antennal article is smooth with distal granules. The supraorbital eave is smooth or with some very small spinules posteriorly, and the few spinules on the hepatic region, posterolaterally on the carapace and on the carapace margin are also very small.

This species is distinguished from *A. japonicus* De Haan by the long, slender eyestalk with spinules (eyestalk short without

spinules in *A. japonicus*); from *A. barnardi* Griffin by the broad rostral lobes with prominent spinules (narrow, smooth rostral lobes in *A. barnardi*); and from *A. villosus* Rathbun and *A. robustus* Yokoya by the fourth dactyl which is strongly curved rather than weakly curved as in those two species.

Distribution. — Widespread Indo-West Pacific: South Africa, Iranian Gulf, South India, Java Sea, northern Australia, Kai Is., Aru, Japan.

Achaeus lorina (Adams & White, 1848)

(Figs. 2c-e, 5c, d)

Inachus lorina Adams & White, 1848: 3-4, pl. 2 fig. 2.
Achaeus lorina. — Griffin, 1968a: 79 (in discussion); 1976: 183-184.

Material examined. — 1 ♂, 6 mm, 1 ovig. ♀, 6.5 mm.

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Danish Kei Island Expedition: Banda, off Kombir, ca. 70-90 m, dredge, sand, 7 June 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 25-63 m, dredge hauls 8-19, coarse sand, *Lithothamnion* and rubble, 2 June 1970; 1 spec.

Remarks. — Comparison of these specimens with the original description, with drawings of the holotype (♂, 11 mm (approx.), 'Eastern Seas', BM(NH)) of *Inachus lorina* by Dr. A. L. Rice (unpublished)) and with the female (ovig., 10.5 mm, North Balabac Strait, USNM 49837) discussed previously (Griffin, 1968a; 1976) shows their agreement in the following characters. The rostral lobes are broad, smooth and separated at most by a notch; the supraorbital eaves are smooth and subparallel; there is a postorbital neck; the carapace is smooth with only five tubercles (a small medial tubercle posteriorly on the elevated gastric region, a pair of submedial cardiac tubercles and a tubercle above the last ambulatory leg); the ambulatory legs are long, the first leg being above five and a half times carapace length; on the male chela there is a large tooth at the base of each finger.

Our specimens show the following differences from the holotype and the female from North Balabac Strait. The basal antennal article is smooth or with minute tubercles, not with two spines; the eyestalk is slightly longer and more slender; the dactyls of the third and fourth ambulatory legs are slightly more curved, though still with the greatest curve in the proximal half; and our specimens, though mature, are smaller (less than 2/3) than those two specimens.

The rostral lobes of our female specimen are separated by a notch while in the male there is no notch and the anterior margin is entire and uniformly convex. There is a small anterior lobe on the eyestalk of our male specimen but it is indistinct in the female. There is a low tubercle anteriorly on the submargin of the branchial region. The basal antennal article is smooth in our male while in the female there is a very small tubercle at about the distal quarter, with a smaller tubercle just posterior and medial to it. The original description refers to the antenna as being scarcely half as long as the carapace but the figure (given by Adams & White) shows only one segment present beyond the peduncle. In our male specimen the antenna is complete and is slightly longer (1.1) than the carapace length.

On the cheliped in both our specimens there are only a few small spines amongst the two rows of long hairs on the merus, rather than the long spines on the cheliped of the female from North Balabac Strait. The palm of the male chela is smooth, increasing in height distally, the ventral and dorsal edges blunt with long hairs, about two and a half times as long as the distal height. The fingers are about two thirds the length of the palm, directed slightly downwards towards the fixed finger; a wide gape is present in the proximal half with a large tooth proximally on each finger. The ambulatory legs are complete in our male specimen but incomplete or missing in our female specimen. There are about sixteen teeth ventrally along the length of the fourth dactyl, the proximal ones being very small.

In our male specimen the abdominal segments are broader than those figured for the holotype by Adams & White. The first pleopod of the male is curved inwards, apically flattened and subtruncate, the aperture is at the tip of the sternal surface near the medial edge.

This species is similar to *A. brevifalcatus* Rathbun in the smooth supraorbital eave, few carapace tubercles, a large basal tooth on each finger of the male chela, long ambulatory legs, curved fourth dactyl, and in the shape of the first pleopod of the male. It is distinguished from that species by the rostral lobes which are broad, smooth and weakly separated (subacute, with an apical spine and separated by a V-shaped hiatus in *A. brevifalcatus*); the hepatic region weakly produced (strongly produced with apical spines in *A. brevifalcatus*); the absence of spinules on the carapace or carapace margins and very few on the male sternum (spinules laterally on the postorbital neck, posterolaterally on the carapace and carapace margins and on the male sternum in *A. brevifalcatus*).

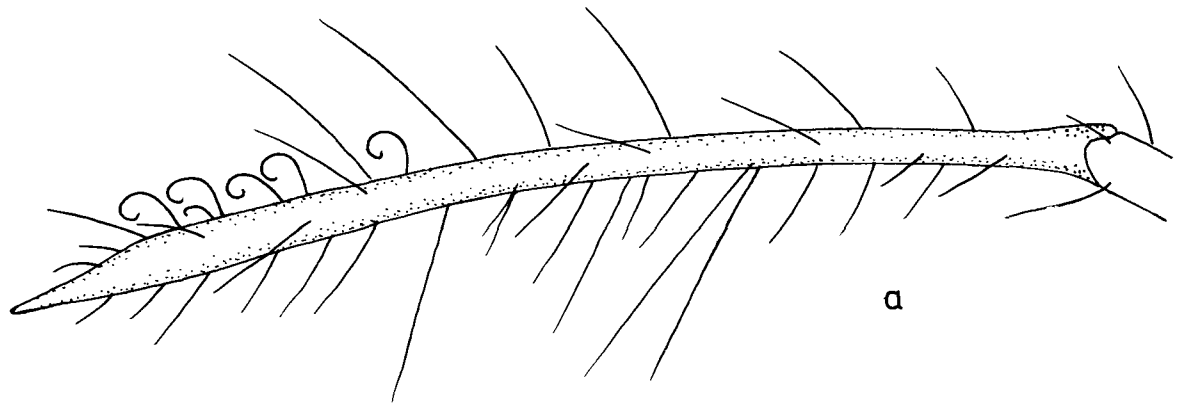
A. lorina is distinguished from *A. brevirostris* (Haswell) and *A. serenei* n.sp. by having a longer, more slender eyestalk; by having five rather than twelve tubercles on the carapace and by the first pleopod of the male which curves inward distally and lacks the tufts of long hairs present on the pleopod of the other two species.

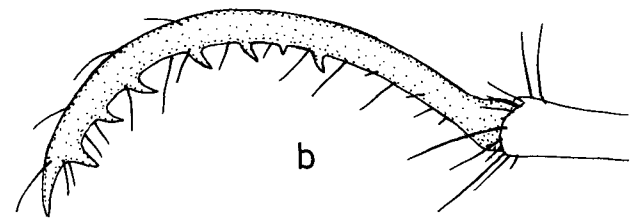
Distribution. — Philippine Islands, Ceram, Banda.

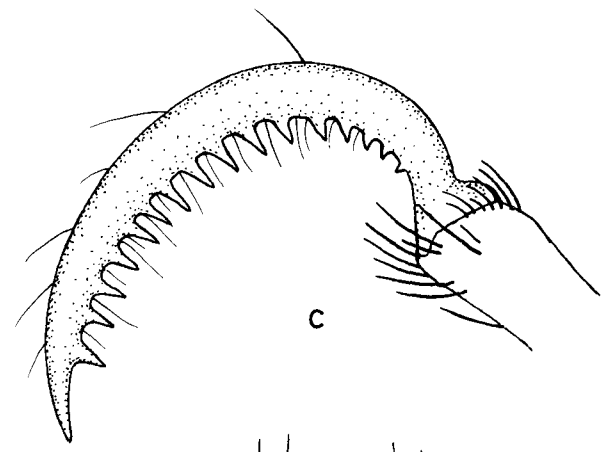
Achaeus paradicei Griffin, 1970

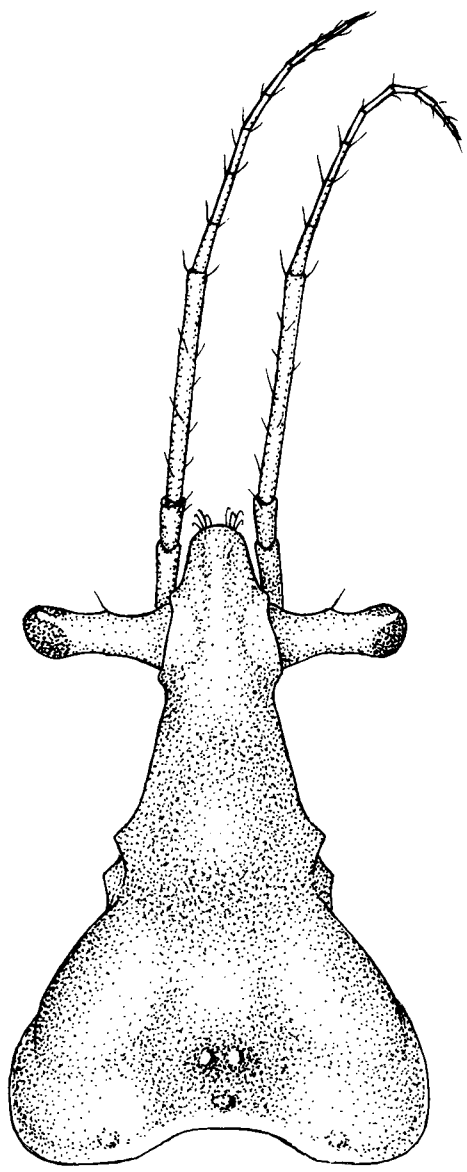
Achaeus sp. Griffin & Yaldwyn, 1965: 38. — Griffin, 1966b: 276; 1966d: 38.
Achaeus paradicei Griffin, 1970c: 108-109, figs. 3b, 6, 15b, c; 1976: 184.

Material examined. — 6 ♂♂, 7 ovig. ♀♀, 4.5-7 mm, smallest ovig. ♀, 5 mm.









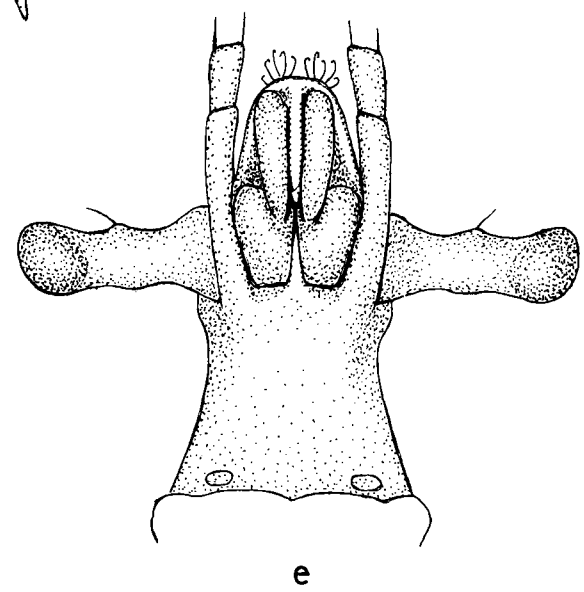


Fig. 2. *Achaeus robustus* (female, 4.5 mm, Kai Is., ZMA) (a) dactyl of left second ambulatory leg; (male, 4.5 mm, Kai Is., ZMA) (b) dactyl of left fourth ambulatory leg; *A. lorina* (male, 6.0 mm, Ceram, NIO Jakarta) (c) dactyl of left fourth ambulatory leg; (d) carapace, dorsal view; (e) orbits, ventral view.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Is., Sapeh Strait, 08°23.5′ S 119°4.6′ E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. — Stn. 164, Irian Jaya, off Salawati, 01°42.5′ S 130°47.5′ E, 32 m, dredge, small stones and shells, 20 August 1899; 1 spec.
Makassar Strait, Donggala, 34 m; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Ambon, Ambon Bay, 90 m, stones, sand, 2 March 1922; 1 spec.
Mortensen Java - S. Africa Expedition: Stn. 8, E Java, 08°23′S 114°24′ E, ca. 50 m, trawl, dredge, hard bottom, 6 April 1929; 5 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition - Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′ S 128°8′ E, 48-63 m, dredge hauls 2-3, coarse foramniferal sand and shell sand, 1 June 1970; 1 spec. — Stn. KN II, Kai Is., west coast Nuhu Tjut, off Elat Bay, 05°40′ S 132°59′ E, 48-63 m, dredge hauls 3-4, rubble, fan coral, sand and green algae, 13 June 1970; 1 spec. — Stn. AW I, Aru, W. Wokam, off west coast of Wasir I., 05°30′ S 134°12′ E, 39-72 m, dredge hauls 7-10, sand and shell rubble, 15 June 1970; 1 spec. — Stn. AM II, Aru Is., Maikoor, approx. 8 miles (∿ 13 km) SW of Tg. Ratoe, centred at 06°7′ S 133°57′ E, 45 m, dredge hauls 4-5, sand and rubble, 18 June 1970; 1 spec.

Remarks. — These specimens agree well with the type series previously described and figured (Griffin, 1970c). Within the present series there are some small variations in the carapace spines and tubercles. The rostral lobes are broad, blunt and spinulous in eight of the specimens; in the remainder they are slightly narrowed or subacute at the apex, often with a longer apical spinule. There are often one or two spinules on the triangular lobe on the anterior margin of the eyestalk. In several of our specimens there is a spinule larger than the rest midway along the supraorbital eave. There are two to four spines on the margin of the hepatic region, sometimes the spines are bifid or spinulous. The spines, three to five in number, anteriorly on the submargin of the branchial region are small in the females but much more pronounced and visible dorsally in the males. However, in one male there is only one large spine and two very small spines.

There is a mesogastric spine present in all our specimens, short in the females, usually with apical spinules; moderate to long in the males and with two apical spinules in one male. The cardiac region is tumid with two tubercles which are low and granular in most specimens, but sharp or with spinules in three of the males. The three tubercles dorsally on the branchial region are usually very small, but sometimes the anterior or the posterior or both are more pronounced. On the basal antennal article there is a large distal spine directed forward, often with a small spine near its base; three to five small spines on the lateral edge (six to eight in the type series) and three small spines on the medial edge. The chela of the adult male agrees with that of the holotype in all except one specimen (cl. 6.0 mm) from Aru in which although the chela is enlarged there is no gape between the fingers. The gonopore of all the female specimens is an anterolateral opening.

Distribution. — Northeastern Australia, Aru Is., Kai Is., western Irian Jaya, Ambon, Ceram, Lesser Sunda Is., Java, Makassar Strait, Sulu Archipelago.

Achaeus pugnax (De Man, 1928)

Achaeopsis pugnax De Man, 1928: 7-14, figs. 1a-i.
Achaeus stenorhynchus Rathbun, 1932: 29.
Achaeus pugnax. — Sakai, 1938: 222-223, text-fig. 12, pl. 23 fig. 2; 1976: 163-164, text-fig. 86b, pl. 50 fig. 3. — Griffin, 1970c: 113-116, figs. 7b, 11, 15a,d.

Material examined. — 10 ♂♂, 7 ♀♀ (3 ovig.) 5.5-12 mm, smallest ovig. ♀, 8 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 302, Timor, N of Roti I., 10°27.9′ S 123°28.7′ E, 216 m, trawl, sand and coral sand, 2 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, 23 miles (37 km) NW ¾W of Goto, 32°49′ N 128°14′ E, 207 m, trawl, 14 May 1914; 1 spec. — Japan, off Misaki, 144-180 m, dredge, 19 June 1914; 2 specs. — Japan, Sagami Sea, Okinose, 180 m, 23 June 1914; 1 spec. — Japan, Sagami Bay, 540 m, dredge, 28 June 1914; 1 spec. — Japan, Sagami Bay, 540 m, 29 June 1914; 1 spec.

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' NW Pacific Expedition: Stn. 4895, Japan, Eastern Sea, 10-20 miles (16-32 km) SW of Goto I., 171 m, 9 August 1906; 1 spec. (USNM 49831, det. M. Rathbun as *A. stenorhynchus*). — Stn. 4900, Eastern Sea, 10-20 miles (16-32 km) SW of Goto I., 250 m, 9 August 1906; 7 specs. (USNM 48257, det. M. Rathbun as *A. stenorhynchus*). — Stn. 4904, Eastern Sea, 10-20 miles (16-32 km) SW of Goto I., 192 m, 10 August 1906; 1 spec. (USNM 49856, det. M. Rathbun as *A. stenorhynchus*). — Stn 4903, Eastern Sea, 10-20 miles (16-32 km) SW of Goto I., 250 m, 10 August 1906; 1 spec. (USNM 49878, det. M. Rathbun as *A. stenorhynchus*).

Remarks. — This species was described in detail earlier (Griffin, 1970c). The males in this series possess the distinctive first pleopod with curved tip and terminal aperture. The present series shows variation in spinulation of the postorbital area and branchial margin previously noted in Australian material.

Distribution. — Western Australia, Timor, Japan.

Achaeus robustus Yokoya, 1933
(Fig. 2a, b)

Achaeus robustus Yokoya, 1933: 136, fig. 48. — Sakai, 1938: 212; 1976: 159, text fig. 81. — Takeda & Miyake, 1969: 481-483. — Takeda, 1973b: 36, fig. 4.
Achaeus sp. Griffin, 1970c: 116-117, figs. 12, 13e, f.

Material examined. — 4 ♂♂, 6 ♀♀ (4 ovig.) 3.5-5.5 mm, smallest ovig. ♀, 5.0 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Is., Sapeh Strait, 08°23.5′ S 119°4.6′ E, 69 m, dredge, corals and shells, 14 April 1899; 3 specs. — Stn.

260, Kai Is., 2.3 miles (3.7 km) N 63°W from N point Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, Blake dredge, sand, coral and shells, 16/18 December 1899; 3 specs. — Stn. 289, S coast of Timor, 09°0.3′S 126°24.5′E, 112 m, trawl, mud, sand and shells, 20 January 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Banda, off Kombir, 75-90 m, dredge, sand and stones, 3 June 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AW I, Aru, W Wokam, off W coast Wasir I., 05°30′S 134°12′E, 39-72 m, dredge hauls 7-10, sand and shell rubble, 15 June 1970; 2 specs.

Remarks. — These specimens agree well with the holotype, figured by Yokoya, in the carapace shape and in length and form of the ambulatory legs, and with the redescription given by Takeda & Miyake (1969). They agree, with the exception of the smooth rostral lobe, with the three specimens described as *Achaeus* sp. by Griffin (1970c): there were no ambulatory legs with those three specimens and only a few specimens of this present series were complete enough to show the unusual second ambulatory leg so much longer than the first leg. Takeda (1973b), in his description of *A. robustus* from the Tsushima Islands did not refer to the length of the second ambulatory leg. Previous descriptions have been based on a few specimens and with this larger series we are able to describe some of the variations within the species.

The rostral lobes are smooth in only one specimen in this present series, in four specimens there is a small apical spine, and in five specimens there is a long apical spine.

In all the specimens there are horizontal spinules along the margin of the supraorbital eave, the posterior ones being larger. On the eyestalk there is a row of three to four spines, increasing in size laterally. The eyestalk appears smooth in the figure given by Takeda (1973b) but Takeda & Miyake (1969), in the redescription of the species, refer to small spinules on the lower anterior surface of the eyestalk.

There is a large, spinulous, metagastric tubercle which is armed with a very small spine in three specimens, with a longer spine in four specimens and without a spine in the remainder. On the cardiac region there is a high spinulous tubercle which is armed with two very small submedial spines in four of the specimens.

There are two to three spines, usually long, on the margin of the pterygostomian region. There are no spines anteriorly on the submargin of the branchial region.

All the males in this series are smaller (3.5-4.5 mm) than the ovigerous females (5.0-5.5 mm), their chelipeds are slender, and it is possible they are not adult. There is a row of long spines dorsally and ventrally on the merus; on the carpus there are a few small spinules. The palm is spinulous on the dorsal and ventral margins; length about twice the height. The fingers are slender, weakly incurved distally, slightly longer than the palm, with very slight, well spaced teeth along their length and a narrow gape between them. This agrees with the figure given by Takeda (1973b).

The first ambulatory leg is about twice the carapace length, the dactyl nearly straight and tapering to a sharp, curved apex. The second ambulatory leg is much longer than the first, three and a half to four times carapace length, the dactyl is slightly swollen in the distal quarter and tapers to a blunt, narrow apex. The third and fourth ambulatory legs are slightly shorter than the first leg; the dactyl of the fourth leg is weakly curved with seven to eight very small teeth well spaced along the ventral edge in the distal half.

The first pleopod of the male has been figured previously (Griffin, 1970c: fig. 13e, f; Takeda, 1973b: 4F). It is straight, broadening slightly near the truncate apex; the aperture is a wide opening in the anteromedial angle protected by a small lateral flap which was neither described nor figured by Takeda. The female gonopore is near the midline and opens anteriorly.

This species is similar to *A. villosus* Rathbun but is distinguished from it by the much shorter first ambulatory leg and the unusual broad dactyl of the second leg. The differences between the two species are discussed more fully under *A. villosus*.

A. robustus is distinguished from *A. lacertosus* Stimpson by the spines rather than small spinules on the eyestalk and the weakly curved dactyl of the fourth ambulatory leg.

Distribution. — Japan, East China Sea, Banda, Kai Islands, Aru, Timor, Sumbawa, north Western Australia.

Achaeus serenei new species
(Figs. 3, 5e, f)

Material examined. — 5 ♂♂, 3 ♀♀ (1 ovig.), 8.5-14 mm, ovig. ♀, 12.5 mm.

Holotype. — Male, cl. 11.5 mm, West Malay Peninsula, Thailand, north of Phuket, 08°22′ N 98°15′E, 15 m, coarse '*Amphioxus*' sand, 9 May 1966; 5 Thai Danish Expedition, Stn. 1176. (ZMC).

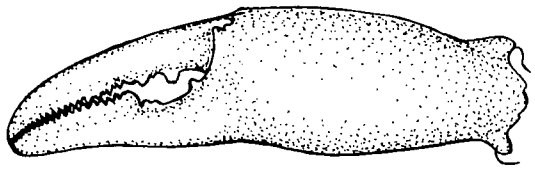
Paratypes. — As listed below.

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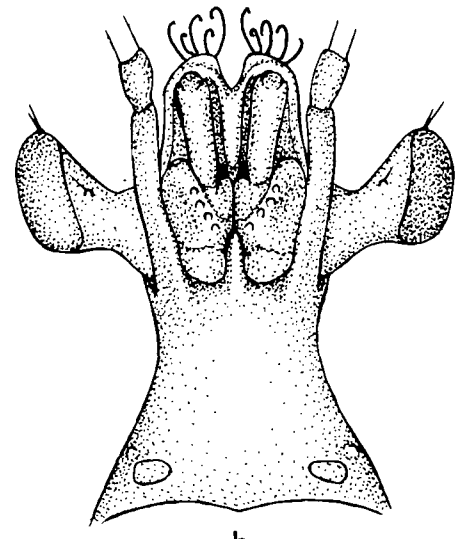
Mortensen Pacific Expedition: Philippine Islands, Sulu Archipelago, off Jolo, 22-40 m, *Lithothamnion* bottom, 17 March 1914; 1 spec.

Danish Kei Islands Expedition: Stn. 64, Java Sea, 05°51′S 106°22′E, 35 m, trawl, sandy mud, shells, 26 July 1922; 1 spec. — Stn. 66, Java Sea, 05°54′S 106°12′E, 24 m, trawl, sandy mud, shells, 27 July 1922; 1 spec. — Stn. 67, Java Sea, 05°48′S 106°12′E, 38 m, trawl, sand, 27 July 1922; 1 spec. — Stn. 75, Sunda Strait, 06°10′S 105°44′E, 40 m, trawl, sand, shells, 29 July 1922; 1 spec. — Stn. 84, Sunda Strait, 05°55′S 105°31′E, 38 m, trawl, sandy mud, pumice, 31 July 1922; 1 spec. — Stn. 90, Sunda Strait, 05°55′S 105°30′E, 36 m, trawl, dredge, hard bottom, 1 August 1922; 1 spec.

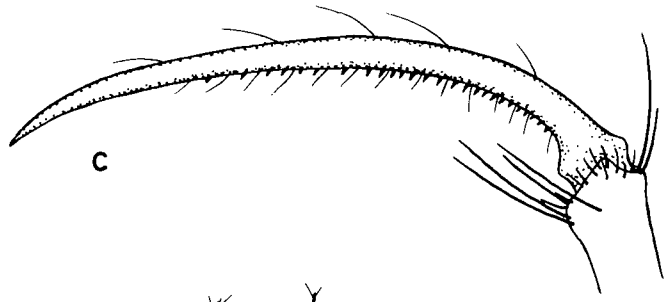
Description. — Carapace elongate, greatest width about two thirds (0.6-0.7) carapace length. Dorsal surface with 12 blunt tubercles, otherwise smooth. Branchial and cardiac regions well demarcated by broad groove from surrounding regions,



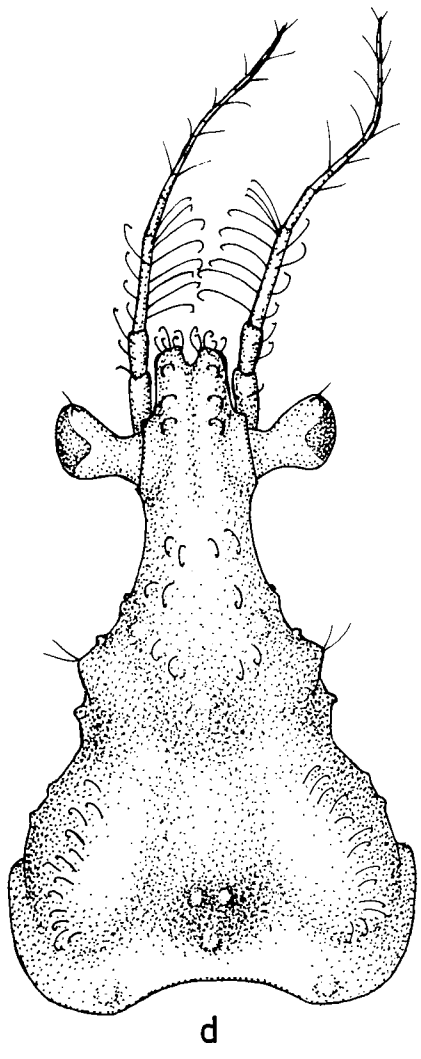
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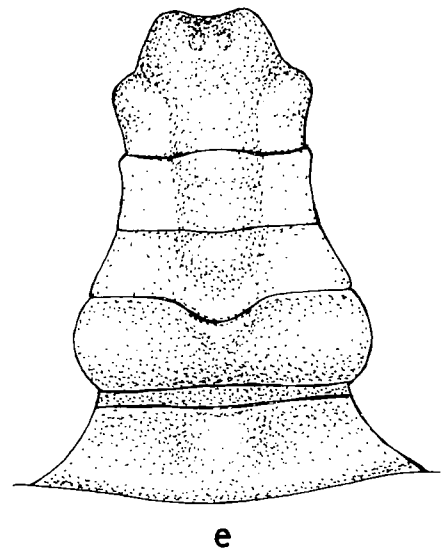
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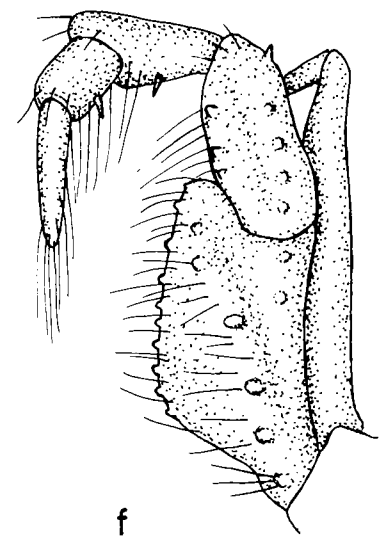
c



d



e



f

Fig. 3. *Achaeus serenei* (holotype) (a) left chela; (b) orbits, ventral view; (c) dactyl of left fourth ambulatory leg; (d) carapace, dorsal view; (e) male abdomen; (f) left third maxilliped.

otherwise ill-defined. Curled hairs grouped along edges of rostral spines, protogastric region and margin of branchial region.

Rostral lobes moderately long, separated by a narrow U-shaped hiatus in distal third, rounded or truncate apically.

Supraorbital eave unarmed. Eyestalks short and stout, a small tubercle midway along anterior surface (in five specimens but not in holotype), a small blunt tubercle opposite on ventral surface, and a tubercle above cornea at distal extremity of eyestalk; cornea large, circular, obliquely subterminal.

Region between eave and hepatic region long in male, broadening regularly, constricted, slightly shorter in female.

Hepatic regions weakly inflated, laterally acute with one tubercle; a small tubercle on anterior margin. Pterygostomian region with a small tubercle midway along margin and visible in dorsal view behind hepatic region.

Branchial regions swollen, bearing laterally two small tubercles, sometimes obscure, just forward of widest part of carapace. Posterolateral margins smooth in adults.

Dorsal surface of carapace with a low, broadbased tubercle far back on mesogastric region, tumid cardiac region with two blunt tubercles side by side and a low medial intestinal tubercle on posterior slope. Two small tubercles on protogastric regions laterally, well forward of mesogastric tubercle. Six similar tubercles laterally on branchial regions, three on each side in a semi-circle, one anteriorly, one opposite cardiac tubercles, and one near posterior margin above base of last ambulatory leg.

Antennular fossae large, oval. Basal segment of each antennule usually bearing four or five small spinules along medial edge. Interantennular partition a narrow, compressed, triangular lobe.

Basal antennal articles smooth or with one or two very small tubercles in proximal half. Antennae very long, two-thirds length of carapace, bearing numerous long hairs.

Epistome longer than wide in male, as long as wide in female, a small spine or tubercle just forward of, and lateral to, green gland opening.

Ischium of third maxillipeds with two oblique rows of small spines on each side of a shallow longitudinal groove; medial edge with about nine very small well spaced teeth. Merus with about three small spines laterally beside shallow central groove; distal edge irregularly crenulate with about two or three small spines slightly laterally; medial edge with two to four spines. Palp long and stout, laterally, medially and apically fringed by long hairs; carpus bearing a small spine medially near distal edge, propodus with a similar medial spine about midway along. Exopodite smooth.

Thoracic sternum in male with a transverse row of four tubercles near anterior end of abdominal fossa; one tubercle on second and third segments and three tubercles on fourth segment near edge of abdominal fossa.

Chelipeds in male long and robust. Ischium subtrigonal, merus subcylindrical, carpus subcylindrical, chela compressed. Merus with some small tubercles and spines on ventral surface and four very small tubercles, one proximal, one midway along and two distal, on dorsal surface. Carpus with small tubercles and spines ventrally. Chela with palm twice as long as high, with a few spinules dorsally and ventrally. Fingers slightly shorter than palm, gaping proximally, incurved distally and acute, inner edges toothed; fixed finger with a large tooth at base, a smaller double tooth separated from it by a concavity, proximal part of distal portion usually enlarged; dactyl with two large teeth distal to proximal tooth of fixed finger; distal parts of both fingers with irregular teeth along adjacent inner edges. Ventromedial edge of merus, medial surface of carpus and ventral edge of chela with large and small straight hairs. Cheliped of female slightly longer than (1.25) carapace, slender; merus subcylindrical, with several, scattered short spines ventrally; similar spines ventrally on carpus; palm with small spines dorsally and ventrally; fingers as long as palm, almost meeting along toothed cutting edges.

Ambulatory legs very long and slender, first longest, about four and a half times carapace length, remaining legs decreasing regularly in length, fourth shortest, three to three and a half times carapace length; curled hairs singly along carpus and propodus dorsally, long straight hairs ventrally. Dactyls of first two legs long and almost straight, weakly curved distally and unarmed, bearing long straight hairs; dactyls of third and fourth legs weakly curved, bearing short hairs and very small teeth ventrally along proximal three quarters, distally smooth; teeth in two rows each of about twenty teeth in proximal half, more distal teeth in a single row.

Male abdomen narrow, all segments except last clearly wider than long; third segment with strongly convex lateral edges. Last segment longest, length slightly less than or subequal to width, narrower in distal half, distal margin truncate or weakly concave. Surface elevated in midline, bearing a wide medial elevation distally on first and on third to fifth segments and on last segment a central tubercle and a transverse pair of smaller tubercles not far from distal edge; third segment laterally inflated, smooth. Female abdomen broad, elongate subovate, elevated in midline.

Male first pleopod moderately slender, bulbous basally, weakly expanded and slightly outwardly curved distally, tip rounded (broader than in *A. brevirostis*), aperture subterminal, a long slit at end of groove extending along medial surface; two rows of long hairs near tip, one on medial surface, one on lateral surface, pleopod otherwise naked.

Female gonopore an oval aperture, opening anteromedially near midline.

Remarks. — This species is very similar to *A. brevirostris* (Haswell) in the smooth, blunt rostral spines, smooth supraorbital eave, presence of a postorbital neck in the male and carapace with only low tubercles. It is distinguished from that species by the dactyl of the fourth leg which is only weakly curved with minute teeth on the proximal three quarters

and smooth distally, while in *A. brevirostris* the fourth dactyl is quite strongly curved with robust, recurved spines which are larger in the distal half. The first pleopod of the male in *A. serenei* is more broad apically than in *A. brevirostris* bearing a row of hairs on both medial and lateral surfaces but lacking the tuft of hairs on the sternal surface present in *A. brevirostris*. In *A. serenei* the chela of the male has two teeth on the dactyl in the gape which is in the proximal third, not one large tooth as in *A. brevirostris*. In subadult males of *A. brevirostris* there are sometimes two teeth on the dactyl but the gape occupies the proximal half. In the female of *A. serenei* there is a postorbital neck and the gonopores open anteromedially, while in *A. brevirostris* there is only a very short neck in the female and the gonopores open anteriorly.

This species is distinguished from *A. podocheloides* Griffin which also has a smooth eave, by the rounded (not pointed) rostral lobes; by the weakly (not strongly curved) fourth dactyl; and by the less strongly produced hepatic region. Of the species with a weakly curved fourth dactyl, *A. serenei* is distinguished from *A. tuberculatus* Miers by the absence of tubercles on the eave and from *A. brevidactylus* Sakai by the apically narrow, rather than broad, dactyls of the first two pairs of ambulatory legs.

This species is named in honour of the late Dr. R. Serène of Paris, formerly the UNESCO Science Regional Expert for South East Asia who made a major contribution to carcinological taxonomy in the South East Asian region.

Distribution. — West Malay Peninsula, Sunda Strait, Sulu Archipelago.

Achaeus superciliaris (Ortmann, 1893)

Achaeopsis superciliaris Ortmann, 1893: 36-37, pl. 3 figs. 3, 3a. — Rathbun, 1906: 877.

Achaeus superciliaris. — Sakai, 1938: 219-220, text-fig. 10, pl. 21 fig. 5; 1976: 162-163, text-fig. 86a, pl. 50 fig. 1. — Takeda & Miyake, 1969: 488-489.

Material examined. — 57 ♂♂, 48 ♀♀ (22 ovig.), 3.2-9.0 mm, smallest ovig. ♀, 3.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Sagami Sea, 720 m, 1-7 June 1914; 1 spec. — Japan, off Misaki, 144-180 m, 19 June 1914; 2 specs. — Sagami Sea, Okinose, 180 m, dredge, 23 June 1914; 16 specs. — Sagami Sea, Okinose, 540 m, 28 June 1914; 20 specs. — Sagami Bay, 540 m, dredge, 29 June 1914; 44 specs.

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' Expedition: Stn. 3700, Japan, off Honshu I., 113 m, 7 May 1900; 6 specs. (USNM 49517). — Stn. 3702, Japan, off Honshu I., 74-56 m, 7 May 1900; 1 spec. (USNM 49881). — Stn. 3763, Japan, off Honshu I., 88-93 m, 22 May 1900; 2 specs. (USNM 49880). — Stn. 3727, Japan, off Honshu I., 61 m, 16 May 1900; 1 spec. (USNM 49882).

'Albatross' Expedition: Stn. 3939, Hawaiian Is., Laysan I., 1902; 12 specs. (USNM 29738) (all specs. det. M. Rathbun as *Achaeopsis* sp.).

Remarks. — The first pleopod of the male has been figured by Sakai (1938, text fig. 10b), the apex of the pleopod is blunt and the aperture is immediately subterminal on the abdominal surface, near the lateral margin.

One of us (D.J.G.G.) has examined specimens from Hawaii identified as this species by Rathbun (3 ♂♂, 9 ovig. ♀♀, 3.2-4.3 mm, USNM 29738; 1 ♂, 3.4 mm, USNM 29739) and confirmed the identification. The many blunt spinules around the orbit immediately set this species apart from other species of *Achaeus*.

Distribution. — Japan, East China Sea, Hawaii.

Achaeus tuberculatus Miers, 1879

Achaeus tuberculatus Miers, 1879b: 25. — Shen, 1937: 285-286, text-fig. 4. — Sakai, 1938: 214-215, text-fig. 7, pl. 22 fig. 3; 1976: 160-161, text-fig. 83, pl. 49 fig. 2. — Takeda & Miyake, 1969: 483-484. — Takeda, 1973b: 37-38.

Material examined. — 13 ♂♂, 8 ovig. ♀♀, 7-11.6 mm, smallest ovig. ♀, 7.0 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Misaki, 5 m, 26 April 1914; 1 spec. — Japan, Korea Strait, 33°41′N 128°50′E, 135 m, trawl, sand, 17 May 1914; 1 spec. — Japan, W. of Shimonoseki, 34°11′N 130°2′E, 101 m, dredge, sand, 18 May 1914; 1 spec. — Japan, Misaki, off the station, 45 m, dredge, 9 June 1914; 9 specs.

Nagasaki, coll. James Jordan, 1 July 1911; 1 spec.

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' Expedition: Stn. 3725, Japan, off Honshu I., 15 May 1900; 1 spec. (USNM 49099, det. M. Rathbun).

'Albatross' NW. Pacific Expedition: Stn. 4832, Japan, Hondo, Nanao to Isuruga, 137 m, 23 July 1906; 1 spec. (USNM 49857, det. M. Rathbun). — Stn. D. 4815, North West Pacific; 1 spec. (USNM unreg., det. T. Sakai).

Japan, Tara Ibusuki, in prawn net, coll. T. Urita; 1 spec. (USNM 48460, det. M. Rathbun). — Japan, Hakodate; 1 spec. (USNM 49859, det. M. Rathbun). — Japan, Mogi; 1 spec. (USNM 49860, det. M. Rathbun). — Japan, Obama, 108 m, coll. F. Baker, May 1914; 2 specs. (USNM ex. 48847, det. T. Sakai as *A. japonicus*).

Remarks. — These specimens agree with the material described by Miers in that the cardiac tubercle is prominent, there is a broad lobe on the hepatic region, smooth eyestalks and curved, but not falcate fourth ambulatory dactyls. That the species is distinct from the smooth *A. spinosus* and *A. japonicus* has never been disputed. Sakai (1938) observes that the cardiac tubercle is sometimes bifurcate although Miers originally stated that it was not.

The present specimens also agree with that figured by Shen (1937) and by Sakai (1938). The fingers of the chela of the male gape weakly and the dactyl bears two or three larger teeth proximally. The first pleopod of the male is weakly curved distally, apically rounded, without lobes.

The species is further characterised by the rostral lobes being tuberculate, the edges of the supraorbital eave being tuberculate, the basal antennal article having prominent tubercles towards both medial and lateral edges, by the ster-

num in the male being tuberculate especially around the abdominal fossa and by the posterolateral margin of the carapace being minutely spinulous, although in some specimens the spinules are very few in number; the stout merus of the cheliped in the male is tuberculate.

Comparison of this material with Takeda & Miyake's (1969) *A. varians* suggests to us that a distinction from *A. tuberculatus* is not well made. However, the two species may be separated by the first pleopods of the male: there are no significant differences in features of the carapace, orbit, male abdomen, ambulatory legs and cheliped of the male.

Distribution. — Endemic to Japan.

Achaeus villosus Rathbun, 1916
(Figs. 4, 5g, h)

Achaeus villosus Rathbun, 1916: 528. — Griffin, 1976: 184, fig. 1a.

Material examined. — 2 ♂♂, 2 ♀♀ (1 ovig.), 5.5-7.5 mm, ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 133, north Moluccas, Salibabu I., anchorage off Lirung, up to 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 1 spec. — Stn. 285, anchorage S. coast of Timor, 08°39.1′S 127°4.4′E, 34 m, dredge, on limit between mud and coral, *Lithothamnion*, 18 January 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 82, Sunda Strait, 06°38′S 105°21′E, 35 m, trawl, 30 July 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AH I, E. of Ambon, Haruku I., near Tg. Bt. Kapal, 108-113 m, dredge haul 4, shell sand and rubble, 31 May 1970; 1 spec.

Remarks. — These specimens agree well with the holotype (♂, 8.3 mm, Sulu Archipelago, USNM 4807) previously discussed (Griffin, 1976), in the short, stout eyestalk, in the rostral lobes being only apically separate, in the very weakly curved dactyl of the third ambulatory leg, in the second free segment of the antenna being less than twice as long as the first, and in the carapace with fine spinules but no tubercles or spines.

In this series there are long straight hairs anteriorly on the eyestalk with small spinules among them. There is an oblique row of spinules and long hairs from the posterior margin of the orbital eave outwards to the anterior margin of the hepatic region. The cardiac region is broadly elevated in the two females and is higher than the gastric region. This elevation is without the fine carapace spinules.

There is an oblique row of spinules from the base of the spinulous basal antennal article to the outer edge of the green gland.

The palm of the larger male (7.0 mm) is enlarged, highest about halfway along its length, length about one hand a half (1.7) times the greatest height. The fingers are slightly shorter (0.9) than the palm, there is a moderate gape between them in the proximal half, and in the gape there are two large teeth on the dactyl and four irregular sized teeth on the fixed finger. The fourth ambulatory leg is missing from the holotype. In these specimens the fourth leg is about twice as long as the carapace, two thirds the length of the first ambulatory leg and seven eighths the length of the third leg; the fourth dactyl is slender, nearly straight, with three or four minute teeth in the distal half.

The first three segments of the male abdomen are spinulous; the last segment is bluntly triangular, the length slightly less than the basal width.

The first pleopod of the male is curved inward distally, the apex truncate, the aperture anteriorly on the abdominal surface is subcircular with a raised rim. The female gonopore is an oval aperture near the midline which opens anteriorly and laterally.

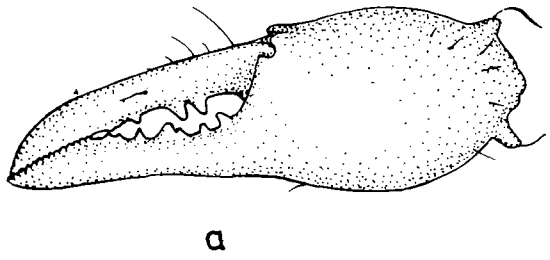
This species is similar to *A. robustus* Yokoya in having small carapace spinules on much of the carapace surface and in having the third segment of the antenna only one and a half times longer than the second segment. *A. villosus* is distinguished from *A. robustus* by the relative lengths of the first two pairs of ambulatory legs. In *A. villosus* the first leg is about three and a half times the carapace length and slightly longer than the second leg while in *A. robustus* the first leg is only twice the carapace length and less than two thirds the length of the second leg. As well, in *A. villosus* the eyestalk is shorter, there is no apical spine on the rostral lobes nor a distal spine on the basal antennal article and the gastric and cardiac elevations are much lower and broader than in *A. robustus*.

A. villosus differs from *A. brevidactylus* Sakai in having the dactyls of the first two pairs of ambulatory legs slender and acute at the tip, not broad and blunt; in having the triangular last segment of the male abdomen more rounded apically and in having the first pleopod of the male curved inwards at the tip, rather than straight as shown in Sakai's figure (1938: text fig. 8e).

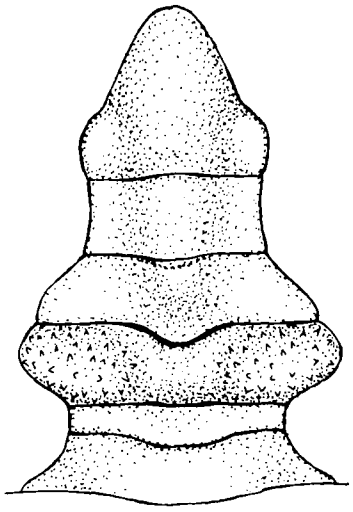
A. villosus is distinguished from *A. lacertosus* Stimpson, *A. barnardi* Griffin and *A. japonicus* De Haan by having the dactyl of the fourth ambulatory leg weakly curved, not strongly curved as in those three species. It is further distinguished from *A. lacertosus* by the short, stout eyestalk (long and slender in *A. lacertosus*); from *A. barnardi* by the broad rostral lobes separated only by a notch (slender rostral lobes in *A. barnardi*); and from *A. japonicus* by the spinulous carapace (smooth in *A. japonicus*).

This species was previously known only from the type locality, Sulu Archipelago.

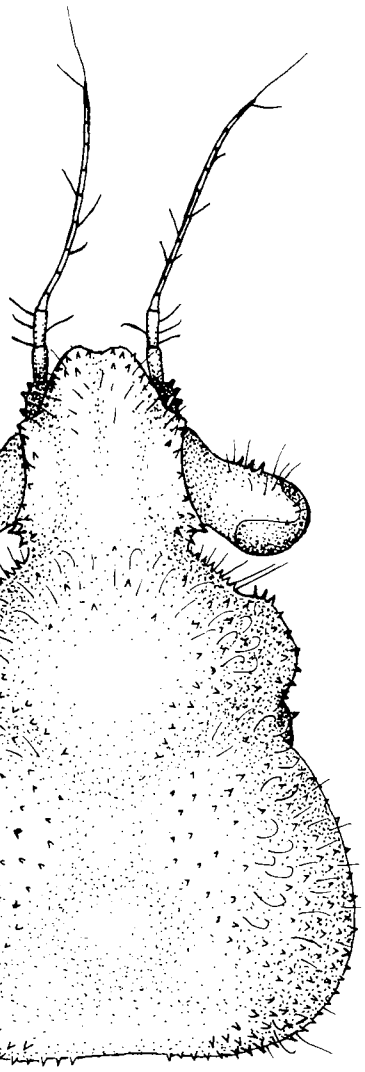
Distribution. — Sulu Archipelago, north Moluccas, Ambon, Timor, Sunda Strait.



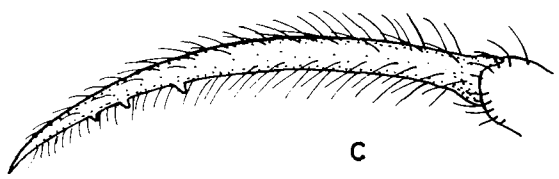
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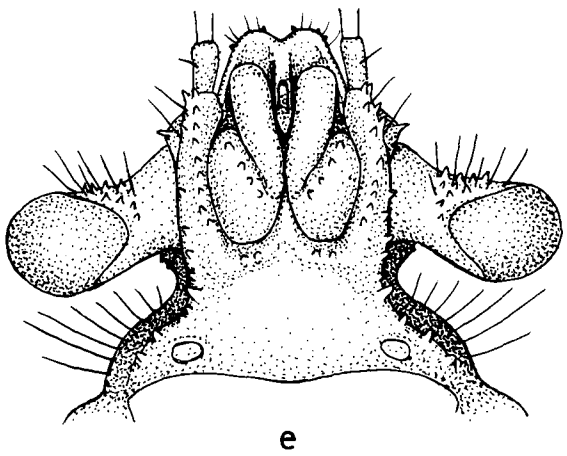
b



d



c



e

Fig. 4. *Achaeus villosus* (male, 7 mm, Sunda Strait, ZMC) (a) left chela; (b) male abdomen; (female, ovig., 7.5 mm, Ambon, NIO Jakarta) (c) dactyl of left fourth ambulatory leg; (male, 5.5 mm, Salibabu I., ZMA) (d) carapace, dorsal view; (e) orbits, ventral view.

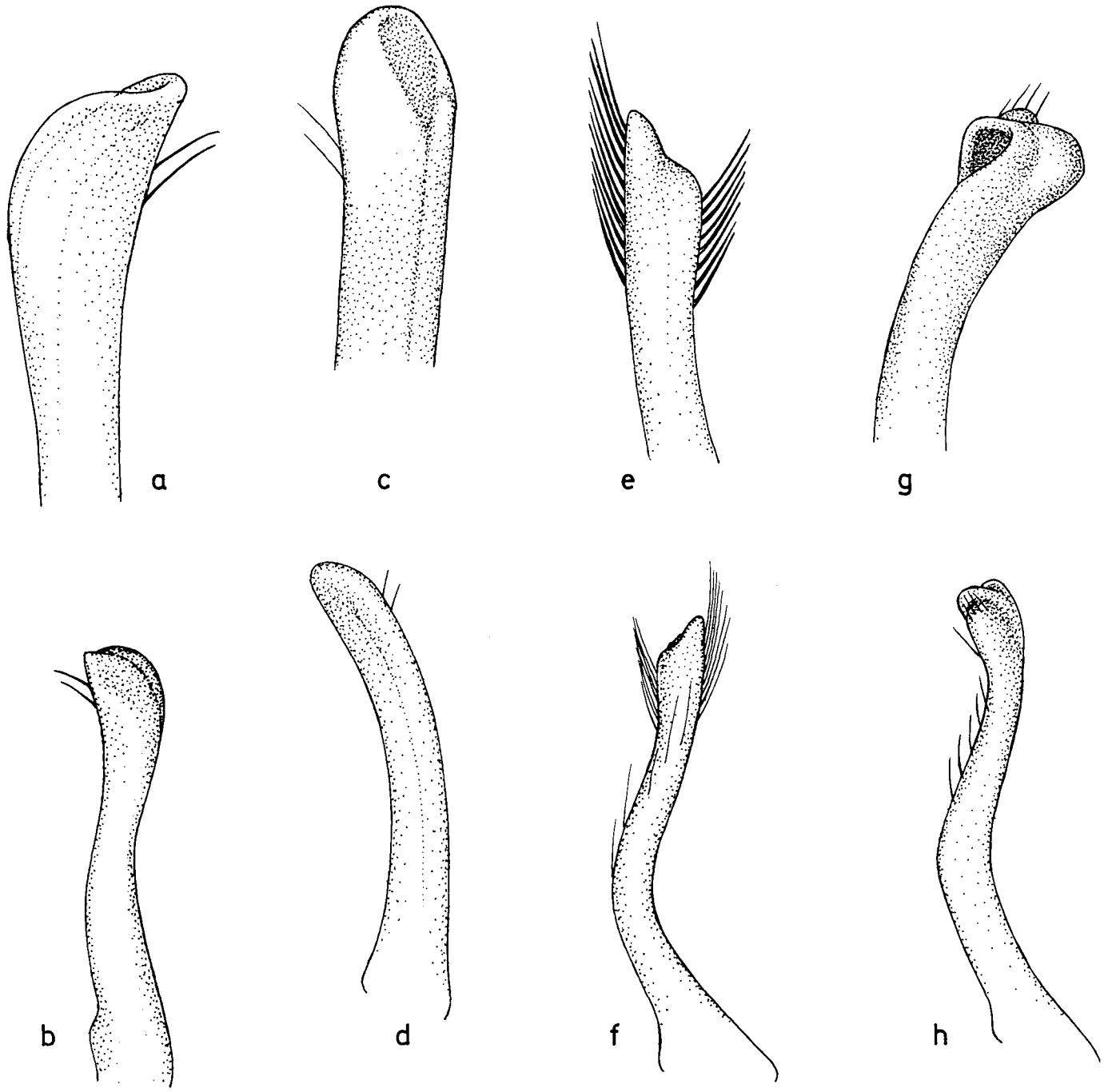


Fig. 5. Left first pleopod of male of *Achaeus akanensis* (3.5 mm, Banda, ZMC) (a) sternal tip of pleopod, (b) abdominal view of same; *A. lorina* (6 mm, Ceram, NIO Jakarta) (c) sternal tip of pleopod, (d) abdominal view of same; *A. serenei* (holotype) (e) sternal tip of pleopod, (f) abdominal view of same; *A. villosus* (7 mm, Sunda Strait, ZMC) (g) sternal tip of pleopod, (h) abdominal view of same.

Achaeopsis Stimpson, 1857

Type species. — *Achaeopsis spinulosus* Stimpson, 1857, by monotypy.

Remarks. — This genus was discussed in detail recently (Griffin, 1966d). Species of *Achaeopsis* are distinguished by the prominent postorbital spine which is slender and not excavated. There are six free abdominal segments in both sexes. The first pleopod of the male curves outwards distally and the aperture is subterminal on the abdominal surface.

This is the only majid genus containing a species [*A. thomsoni* (Thomson)] occurring in both the west and east Atlantic, and in the Indian Ocean. The records of *A. thomsoni* from off southern Australia are here reidentified as *A. ramusculus* (Baker) and the record from off Sydney is strongly doubted. The range of *A. rostrata* Sakai from Japan is extended to include the Kai Islands.

Manning & Holthuis (1981) make a stronger case than has been made previously for the retention of *Dorhynchus* as a

distinct genus. In our opinion *A. ramusculus* (Baker), *A. rostrata* Sakai and *A. thomsoni* (Thomson) are congeneric. We have not examined specimens of *A. spinulosus* Stimpson.

Distribution. — West and east Atlantic, Indo-West Pacific.

KEY TO SPECIES OF *ACHAEOPSIS*

1	Rostral spines short, not extending beyond end of peduncle of second antenna; meri of ambulatory legs lacking a distal spine.... 2
—	Rostral spines long, extending distinctly beyond end of peduncle of second antenna; meri of ambulatory legs with a well developed distal spine dorsally..... 3
2(1)	Rostral spines outwardly curved distally, lacking spinules marginally; supraorbital spine less than a third postorbital in length ..... *A. spinulosus*[4])
—	Rostral spines incurved distally, lateral margins with spinules; supraorbital spine about as long as postorbital ..... *A. rostrata*
3(1)	Protogastric regions each with a single strong spine; a spine or tubercle near anteromedial angle of branchial region ... *A. thomsoni*
—	Protogastric regions smooth; anteromedial angle of branchial region smooth ..... *A. ramusculus*

Achaeopsis ramusculus (Baker, 1906)

Stenorhynchus ramusculus Baker, 1906: 104-106, pl. 1 figs. 1, 1a.
Achaeopsis thomsoni. — Rathbun, 1918: 4. (Not *Dorhynchus thomsoni* Thomson, 1873.)
Achaeopsis ramusculus. — Hale, 1927: 124, fig. 121. — Griffin, 1966d: 35-37, fig. 4.

Material examined. — 3 ♂♂, 6.4-9.0 mm.

NATIONAL MUSEUM OF NEW ZEALAND, WELLINGTON

New Zealand, Bay of Plenty, 15 miles (∿ 24 km) N 50°E of Plate I., 540-576 m, 29 September 1962; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

'Endeavour' Expedition: Western Australia, Great Australian Bight, 60-80 miles (96-128 km) W of Eucla, 144-216 m, March 1912; 2 specs. (AM P. 4524; E. 3175).

Remarks. — We have examined two of the specimens from the 'Endeavour' collection identified by Rathbun (1918) as *Achaeopsis thomsoni*. These specimens have a terminal spine on the meri of the ambulatory legs, the rostral spines are subparallel, exceed the peduncle of the antenna and on each spine there are two ventral spinules, the proximal one near the lateral margin of the spine. However, there is a low tubercle not a spine on the protogastric region and the anteromedial angle of the branchial region is smooth. Also the larger specimen (7.5 mm) appears to be adult as the cheliped is enlarged, while in *A. thomsoni* adults are much larger (16-30 mm). The cheliped is less than twice (1.8) as long as the postrostral carapace length while in adult males of *A. thomsoni* the cheliped is two and a half to three times the postrostral carapace length. On this basis we have reidentified these specimens as *A. ramusculus*.

[4]) from the literature (Barnard, 1950).

We have also examined a specimen from Bay of Plenty, New Zealand which agrees well with the other specimens of *A. ramusculus* but in which the rostral spines are weakly divergent in the proximal half and strongly divergent in the distal half; there is a ventral spinule at about the distal third on one spine (left) but the other spine is smooth.

Distribution. — South Australia, New Zealand.

Achaeopsis rostrata Sakai, 1932

Achaeopsis rostrata Sakai, 1932: 45-46, text fig. 3a-c; 1976: 167, text figs. 90a, b. — Suzuki & Kurata, 1967: 89, 96.

Material examined. — 2 ♂♂, 5-7 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 59, Kai Islands, 05°28′S 132°36′E, 385 m, trawl, corals and sponges, 12 May 1922; 2 specs.

Remarks. — These specimens agree well with those described by Sakai (1932; 1976). In neither of the specimens do the rostral spines exceed the end of the antennal peduncle, nor is there a terminal spine on the meri of the ambulatory legs, and to this extent they agree with both *A. rostrata* and *A. spinulosus*. The smaller specimen (infected with a bopyrid parasite) is subadult, the rostral spines each have two small lateral accessory spines and the tips are incurved. In the larger, adult, male the tips of the rostral spines are broken and there is one small lateral accessory spine on each rostral spine. In both specimens the supraorbital spine and the postorbital spines are subequal and there is a well developed protogastric spine. There is no spine on the anteromedial branchial region. The cheliped of the larger male is about two and a quarter (2.3) times the postrostral carapace length.

This species has previously been recorded only from Japan.

Distribution. — Japan, Kai Islands.

Achaeopsis thomsoni (Thomson, 1873)

Dorhynchus thomsoni Thomson, 1873: 175-176, fig. 34.
Achaeopsis thomsoni. — Rathbun, 1925: 29-30, fig. 7, pl. 10. — Barnard, 1950: 25-26, fig. 4d, e. [Not *A. thomsoni*. — Rathbun, 1918: 4 = *A. ramusculus* (Baker).]

Material examined. — 33 ♂♂, 17 ♀♀ (1 ovig.), 7.5-28.5 mm, ovig. ♀, postrostral cl. 13 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java - S. Africa Expedition: Stn. 55, South Africa, 34°05′S 18°01′E, 212 m, dredge, mud, 17 December 1929; 1 spec. — Stn. 56, South Africa, N of Cape Town, 34°17′S 17°58′E, 288 m, trawl and dredge, 18 December 1929; 8 specs. — Stn. 57, South Africa, N of Cape Town, 34°21′S 17°57′E, 320 m, trawl, mud, 18 December 1929; 37 specs. — Stn. 58, South Africa, N of Cape Town, 34°23′S 18°08′E, 228 m, dredge, muddy sand and stones, 18 December 1929; 1 spec. — Stn. 59, South Africa, N of Cape Town, 34°24′S 18°16′E, 239 m, dredge, muddy sand, 18 December 1929; 3 specs.

Remarks. — In this large series the rostral spines are longer than the antennal peduncle but vary in some other aspects. The spines may be subparallel and separate or may be contiguous and sometimes divergent apically; there are usually one or two spinules ventrally on each spine but sometimes one spine is smooth. There is a protogastric spine and usually a spine near the anteromedial angle of the branchial region. There is a terminal spine, sometimes with one or two additional spines on the merus of each ambulatory leg. The cheliped of the adult male is about two and a half to three (2.4-2.9) times the postrostral carapace length.

We have examined the specimens from the Great Australian Bight identified as *A. thomsoni* by Rathbun (1918). We identify these specimens as *A. ramusculus* (Baker) and they are discussed under that species. The badly damaged specimen dredged by the 'Challenger' from off Sydney, which Miers (1886) provisionally identified as *A. thomsoni* has "one, not two spines, on each branchial region" and a postrostral carapace length of 7.5 mm. The rostrum of this specimen is broken and the ambulatory legs missing. It is possible that this specimen may be one of the west Pacific species of *Achaeopsis*, either *A. ramusculus* or *A. rostrata* Sakai, both of which lack a spine near the anteromedial angle of the branchial region and as adults have a carapace length of about 7-9 mm. The occurrence of *A. thomsoni* in Australian waters is thus in doubt and needs to be confirmed by further material.

Distribution. — West and east Atlantic and Indian Ocean.

Camposcia Latreille, 1829

Type species. — *Camposcia retusa* Latreille, 1829, by monotypy.

Remarks. — In this monotypic genus the rostrum is very short, the eyestalks are long and recurved and there is no interantennular partition. The anterior margin of the narrow basal antennal article is fused to the carapace. The abdomen of the male is wide and covers most of the sternum; the sixth segment is wider (1.25) than the third segment and the abdominal fossa is wide and shallow. The first pleopod of the male is straight, curves outward distally and has long hairs along both margins.

Distribution. — Throughout the Indo-West Pacific.

Camposcia retusa Latreille, 1829

Camposcia retusa Latreille, 1829: 60. — Sakai, 1965a: 69, pl. 30 fig. 1; 1976: 170-171, pl. 48 fig. 4. — Takeda, 1973a: 94-95, fig. 4 A, B. — Griffin, 1974: 7.

Material examined. — 6 ♂♂, 9 ♀♀ (3 ovig.) 9.5-27.5 mm, smallest ovig. ♀, 21,5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Ambon reef; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 104, Java Sea, 05°52′S 106°4′E, 38 m, trawl, stones, 4 August 1922; 1 spec.

Mortensen Java - S. Africa Expedition: Mauritius, Cannoniers Point, coral reef, 17 September 1929; 1 spec. — Mauritius, Cannoniers Point, coral reef, October 1929; 1 spec.

Nicobar Is. Sambelong, coll. Reinhardt, 'Galathea', 1845-7; 1 spec.

Samoa Is. Museum Godeffroy; 1 spec.

5 Thai Danish Expedition: Stn. 1173, West Malay Peninsula, SE corner Goh Similan I., shore collecting and skindiving to 1-2 m, 8 March 1966; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AH II, E of Ambon, Haruku I., Haruku Strait, N side of Tg. Bt. Kapal, 03°37′S 128°35′E, intertidal, corals, 31 May 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Lord Howe I., lagoon, coll. J. Booth, 29 March 1963; 1 spec. (AM P. 32088). — Christmas I. (Indian Ocean), Flying Fish Cove, 1 m, on coral after dark, coll. J. Tranter, 3 April 1981; 2 specs. (AM P. 32087).

Remarks. — The first pleopod of the male of *C. retusa* has been figured by Takeda (1973a). There are long hairs on both margins of the pleopod except in the distal fifth which is weakly curved outwards. The aperture is a subterminal slit on the sternal surface and the apex is subacute.

On the margin between the eave and the small preorbital spine there is a low elongate ridge which is more pronounced in some specimens.

Distribution. — Throughout the Indo-West Pacific from South Africa and the Red Sea to Australia and Japan.

Chalaroachaeus De Man, 1902

Type species. — *Chalaroachaeus curvipes* De Man, 1902, by monotypy.

Remarks. — This monotypic genus is distinguished from species of *Achaeus* and *Prosphorachaeus* by the absence of a rostrum and an interantennular partition and by the rudimentary orbital eave which covers only the base of the eyestalk. The basal antennal article is cylindrical but not free distally. The green gland is quite distinct from the base of the article and lies midway between the article and the anterior margin of the mouthfield. The male is unknown. Female abdomen of six free segments.

Distribution. — West Pacific.

Chalaroachaeus curvipes De Man, 1902
(Fig. 11d, e)

Chalaroachaeus curvipes De Man, 1902: 657-662, pl. 22 figs. 30, 30a-i.

Material examined. — 1 ovig. ♀, 3.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 133, Molucca Sea, Kepulauan Talaud, Salibabu I., anchorage off Lirung, up to 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 1 spec.

Remarks. — This specimen agrees well with the specimen (ovig. female, 3.75 mm, Ternate) figured by De Man (1902). The ambulatory legs are long and slender, the fourth leg about three and a half times the carapace length. The basal antennal article is smooth except for a small spine laterally near the base. The merus of the third maxilliped is suboval, narrower than the ischium, with three small spines near the lateral margin. On the ischium there is an oblique row of small spines from near the base to the anteromedial angle and a larger spine near the lateral margin about midway along. The pleopods of the adult female are lamellate and the gonopores are large and open laterally. The few eggs with the specimen are large (about 1 mm diameter) in relation to its size.

This species was previously known only from the type specimen.

Distribution. — Moluccas: Ternate, Salibabu I.

Chorinachus new genus
(Fig. 15e)

Type species. — *Inachoides dolichorhynchus* Alcock & Anderson 1894, by present designation.

Description. — Carapace slender pyriform, surface with scattered short spines and sharp tubercles. Rostrum long, spines fused for most of their length, small accessory spines present. Orbit of a weakly expanded eave and a small postorbital spine remote from eye; preorbital spine small, antorbital spine lacking. Eyestalks short. Interantennular partition without a spine. Basal antennal article narrow, with a strong anterolateral spine. Antenna excluded from orbit. Anterior margin of mouthfield deeply concave. Merus of third maxilliped strongly produced at anterolateral angle and posterior part of medial margin produced. Cheliped of male with small spines on merus, carpus and dorsally on palm; palm somewhat inflated. Ambulatory legs slender with few small spines. Male abdomen of seven free segments, female abdomen with segments 4-6 fused. First pleopod of male with large terminal aperture.

Remarks. — Examination of specimens of *Inachoides dolichorhynchus* reported on previously (Griffin, 1974; Griffin & Tranter, 1974) and comparison of this species with the descriptions and figures of east Pacific species of *Inachoides* has led us to the opinion that they are not congeneric. We have therefore established the new, presently monotypic genus *Chorinachus*. In *I. microrhynchus* Milne Edwards & Lucas and *I. laevis* Stimpson, the rostrum is a single spine and the carapace is short and very broad. In *C. dolichorhynchus*, on the other hand, the rostrum comprises two spines fused for most of their length but apically separate and the carapace is slender pyriform. The first pleopod of the male of *I. microrhynchus*, figured by Garth (Garth, 1958), tapers distally and has a subterminal aperture with a broad flap as have many other east Pacific Inachinae. The first pleopod of the male of *C. dolichorhynchus*, figured here (fig. 15e), is broad and widens to a truncate apex with a terminal aperture.

The name is derived from the Greek *choris* — apart.

Distribution. — Indian Ocean: Red Sea, Mozambique Channel, Bay of Bengal.

Collodes Stimpson, 1860

Type species. — *Collodes granosus* Stimpson, 1860, by monotypy.

Remarks. — This genus has been discussed in detail by Garth (1958) who suggested that *Collodes malabaricus* Alcock, the only Indo-west Pacific species of this genus, may not be congeneric with the American species. *Collodes malabaricus* was included in the genus *Collodes* by Alcock (1895) but the first pleopod of the male is described by Stephensen (1945) as being similar to that of *Menaethiops nodulosa*. The pleopod of species of *Menaethiops* is apically produced into two lobes, one lateral and one medial; while the pleopod of species of *Collodes*, as figured by Garth (1958), is apically subacute with a low, broad lobe well behind the apex on the medial edge, adjacent to the aperture. It seems that this species is possibly not in the right genus or even perhaps the right subfamily, but examination of further specimens would be necessary to determine where it should be placed.

Cyrtomaia Miers, 1886

Type species. — *Cyrtomaia murrayi* Miers, 1886, by designation of Guinot & Richer de Forges, 1982b.

Remarks. — *Cyrtomaia* species are best represented in the west Pacific with only two species, *C. smithii* and *C. lamellata* occurring in Hawaii and five, *C. murrayi*, *C. suhmi*, *C. goodridgei*, *C. gaillardi* and *C. granulosa* occurring in the Indian Ocean. In this study we have reduced both *Echinomaia hispida* Borradaile and *C. platypes* Yokoya to synonymy with *C. lamellata* Rathbun. We regard *C. suhmi curviceros* Bouvier as not even a distinct subspecies and *C. curviceros* as recognised by Sakai (1976) is therefore included within *C. suhmi*. Our study and recent studies by Guinot & Richer de Forges (1982b) show that the type series of *Cyrtomaia smithii tenuipedunculata* Ihle & Ihle-Landenberg represents two species. One of the specimens is identifiable as *C. horrida*: the other four represent, in the view of Guinot & Richer de Forges a distinct species, *Cyrtomaia tenuipedunculata*.

All of the type material of the new *Cyrtomaia* species described in 1931 by Ihle & Ihle-Landenberg (*C. smithii tenuipedun-*

culata, *C. horrida pilosa*, *C. bicornis*, *C. balssi*) from the 'Siboga' Expedition could not be located when this study was commenced and due to a misunderstanding we were not notified when it was subsequently located. This material has been studied by Guinot & Richer de Forges and included in their review of the genus *Cyrtomaia* (1982b); they also examined the type material of most other described species. In general it seems that important conclusions are drawn by these authors from the study of only a few specimens or in some cases one specimen. More species are recognised by Guinot & Richer de Forges than we would be prepared to recognise with the limited amount of material of the, often very variable, species in this genus.

We presently recognise 17 species of *Cyrtomaia* most of which, in our opinion, need to be more accurately defined by examining more specimens from a range of geographical areas.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *CYRTOMAIA*

1 Antennal peduncle prominently flattened 2
— Antennal peduncle cylindrical 3
2(1) Basal antennal article bearing three simple spines ..... *C. balssi*[5])
— Basal antennal article with denticulate lobes or spines .. *C. lamellata*
3(1) Supraorbital eave with an anterior spine 4
— Supraorbital eave unarmed 5
4(3) A sharp spine in the centre of the upper orbit ..... *C. murrayi*
— A blunt tubercle in the centre of the upper orbit ..... *C. ericina*[5])
5(3) Protogastric spines of extreme length, greatly exceeding all other spines and generally produced forward or obliquely forward beyond margin of carapace 6
— Protogastric spines not of extreme length, seldom exceeding other spines of carapace, short or suberect 12
6(5) Carapace densely covered by variously sized spines and spinules between major spines ..... *C. echinata*
— Carapace smooth, with a few tubercles or granular between major spines 7
7(6) Branchial region with at least an anterior spine 8
— Branchial region with only tubercles ..... *C. bicornis*
8(7) Carapace surface densely and coarsely granular; posterior mesogastric spine with a flanking spine or tubercle 9
— Carapace surface smooth or finely granular; posterior mesogastric spine lacking a flanking spine or tubercle 10
9(8) Tomentum scanty (especially on large specimens); rostral spines longer than the interantennular spine ..... *C. horrida*
— Tomentum well developed; rostral spines shorter than the interantennular spine ..... ?*C. pilosa*[5])[6])
10(8) Eyestalk occupying more than half of orbit; a tubercle midway between protogastric and anterior branchial spine ..... *C. maccullochi*
— Eyestalk occupying less than half of orbit; a spine midway between protogastric and anterior branchial spine 11
11(10) Carapace surface smooth; rostral spines slightly arched .... *C. suhmi*
— Carapace surface densely covered with fine granules; rostral spines horizontal ..... *C. gaillardi*[5])
12(5) Protogastric and other spines extremely short 13
— Protogastric and a few other spines at least moderately developed 14
13(12) Basal antennal article with 3 lateral and one medial spine; a spine in centre of upper orbit ..... *C. smithii*
— Basal antennal article with 3 lateral spines only; no spine or tubercle in centre of upper orbit ..... *C. granulosa*[5])
14(12) Carapace with granular surface and sometimes prominent granular or spinulous ridges; branchial spines shorter than or subequal to protogastric spines 15
— Carapace with prominent spines but surface otherwise smooth; anterior branchial spine longer than protogastric spines . *C. owstoni*
15(14) Basal antennal article with 4 strong spines ..... *C. ihlei*[5])
— Basal antennal article with 3 strong spines 16
16(15) Eyestalk smooth except for distal process; rostral spines shorter than interantennular spine 17
— Eyestalk with granules; rostral spines longer than interantennular spine ..... *C. intermedia*
17(16) Ridge from protogastric spine to middle of upper orbit with sharp spines ..... *C. tenuipeduculata*[5])
— Ridge from protogastric spine to middle of upper orbit with high tubercles and/or blunt spinules ..... *C. goodridgei*

[5]) from the literature (Ihle & Ihle-Landenberg, 1931; Guinot & Richer de Forges, 1982b).
[6]) probably a synonym of *C. horrida*, based on the literature.

Cyrtomaia bicornis Ihle & Ihle-Landenberg, 1931 (Pl. 3)

Cyrtomaia bicornis Ihle & Ihle-Landenberg, 1931: 156-157. — Guinot & Richer de Forges, 1982b: 49-51, figs. 27A-C, 28A-B.

Material examined. — 1 ovig. ♀, postrostral cl. 24 mm.

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Mortensen Java - S. Africa Expedition: Stn. 15, Java, 07°29′S 114°49′E, ca. 240 m, Sigsbee trawl, sand and mud with concretions, 10 April 1929; 1 spec.

Remarks. — This specimen agrees well with the holotype, an ovigerous female, described by Ihle & Ihle-Landenberg and figured by Guinot & Richer de Forges.

The carapace, the ambulatory legs and the chelipeds are densely covered with broad, rounded granules. The rostral spines are broken but are separated at the base by a U-shaped hiatus; the interantennular spine is also broken at the apex. Although only the bases of the protogastric spines remain they are clearly parallel and directed forwards.

Anteriorly on the branchial region there is a tubercle rather than a spine and on the cardiac region there are two granular tubercles. There is a very low tubercle just anterior to the mesogastric spine and also on the ridge between the protogastric spine and the well developed, laterally directed spine in the orbit. The postorbital spine is longer than the other carapace spines except the protogastrics. There are low tubercles on the two weakly developed, transversely oblique ridges which are midway between the protogastric spine and the anterior branchial tubercle.

The pterygostomian region is granular and the granules increase in size and number laterally to form a marginal ridge. The abdomen is granular with a well developed tomentum, the only spine is a small anterior medial one on the sixth segment. There are curled hairs dorsally on the meri of the third pair of ambulatory legs and on the carpi of the third and fourth pairs.

This species is similar to *C. intermedia* Sakai but can be distinguished from it by the protogastric spines which are

directed forwards and subparallel rather than suberect and divergent; by the presence of anterior branchial and cardiac tubercles instead of spines and by the ornamentation of the carapace which comprises prominent, rounded, closely spaced granules rather than small scattered granules.

This is only the second record of this species. The male has not yet been described.

Distribution. — Indonesia: off Roti I., Timor; off NE Java.

Cyrtomaia goodridgei McArdle, 1900
(Pl. 1)

Cyrtomaia goodridgei McArdle, 1900: 472-474. — Alcock & McArdle, 1902; pl. 59 figs. 1, 1a-c — MacGilchrist, 1905: 251-253. — Alcock, Annandale & MacGilchrist, 1907: pl. 78 figs. 2, 2a. — Guinot & Richer de Forges, 1982b: 35-36, fig. 18.

Material examined. — 2 ♀♀ (1 ovig.) 13.5-38 mm, 1 damaged spec. 13 mm, 2 juv., 6-7 mm; ovig. ♀, 38 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 259, Kai Islands, 05°29′S 132°52′E, 487 m, trawl with dredge, sand and dead coral, 16 December 1899; 2 specs.

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Mortensen Pacific Expedition: Philippine Islands, 25 miles (40 km) E of Zamboanga, 360-450 m, dredge, 4 March 1914; 1 spec. — Japan, Sagami Sea, ca. 942 m, 26 June 1914; 1 spec.

Danish Kei Islands Expedition: Stn. 1, Kai Is., 05°34′S 132°50′E, 370-400 m, tangles, mud, 30 March 1922; 1 spec.

Remarks. — The 38 mm ovigerous female from Zamboanga agrees closely with the holotype (♂, 33 mm, off Sri Lanka, ZSC 3744/10) and the ovigerous female figured by Alcock, Annandale & MacGilchrist. There are strong tuberculate ridges extending obliquely along the anterior part of each branchial region; there are spinulous ridges from the protogastric spine to the upper orbit and to the postorbital spine; the protogastric spines are erect, almost parallel and only slightly longer than the branchial spines. The basal antennal article has three long slender spines directed ventrally. The pterygostomian region is quite flat and smooth and the lateral margin consists of a narrow ridge of two to three long spines, several small spines and long hairs.

The major difference between our specimens and the holotype is the presence in the upper orbit of a well developed spine. This spine is directed forward in the same plane as the rostral spines.

Two immature specimens (cl. 13 mm) one from the Kai Islands and one from the Sagami Sea are clearly conspecific with the other specimens.

Two juvenile specimens (cl. 6-7 mm) taken by the 'Siboga' in the Kai Islands may belong to this species also. There are small spinules on the eave but this may be a juvenile character.

This species is distinguished from *C. horrida* Rathbun by having shorter more erect protogastric spines, shorter rostral spines, smooth eyestalks, and a stronger spinulous ridge between the protogastric spine and the upper orbit. The spine in the margin of the upper orbit is directed forward not obliquely ventrally as in *C. horrida*.

C. tenuipedunculata is similar in having smooth eyestalks, suberect protogastric spines and short rostral spines. However, the photographs of that species published by Guinot & Richer de Forges (1982b) show quite prominent acute spines on the ridge between the protogastric spine and the upper orbit. This feature would seem to distinguish *C. tenuipedunculata* from our specimens of *C. goodridgei*.

Distribution. — Sri Lanka, Bay of Bengal, Andaman Sea, Kai Islands, Philippine Islands, Japan.

Cyrtomaia horrida Rathbun, 1916

Cyrtomaia horrida Rathbun, 1916: 532-533. — Yokoya, 1933: 145. — Sakai, 1938: 242; 1976: 180-181, pl. 60. — Griffin, 1976: 188, fig. 3. — Guinot & Richer de Forges 1982b: 36-40, figs. 19A-E, 20A-B, 23C, C1, E.

Cyrtomaia Smithii tenuipedunculata Ihle & Ihle-Landenberg, 1931: 152-154 (in part, 1 ♂ spec. only); new synonymy. (Not *Cyrtomaia smithii* Rathbun, 1906.)

Material examined. — 7 ♂♂, 3 ovig. ♀♀, 41-61 mm, smallest ovig. ♀, 41mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 253, Kai Is., 05°48′S 132°13′E, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 1 spec. (ZMA unreg., det. Ihle & Ihle-Landenberg as "*C. Smithii* Rathbun *tenuipedunculata*").

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Mortensen Java - S. Africa Expedition: Stn. 3, Java, 07°42′S 114°00′E, 450 m, Sigsbee trawl, mud with corals, 4 April 1929; 1 spec. — Stn. 11, Java, 08°30′S 114°38′E, ca. 450 m, Sigsbee trawl, 7 April 1929; 1 spec. — Stn. 15, Java, 07°29′S 114°49′E, ca. 24 m, Sigsbee trawl, sand with mud and concretions, 10 April 1929; 3 specs.

Danish Kei Islands Expedition: Stn. 29, Kai Is., 05°38′S 132°53′30″E, 430 m, trawl, sand, 17 April 1922; 1 spec. — Stn. 50, Kai Is., 05°34′S 132°25′40″E, 233 m, trawl, sand, 4 May 1922; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

South China Sea, 16°09.4′N, 114°31.6′E to 16°11′N, 114°29.7′E, 266-295 m, Granton trawl, white muddy sand, Fisheries Research Station, Hong Kong, 12 June 1964; 2 specs. (AM P. 20207).

Remarks. — These specimens agree closely with the holotype from the Philippine Islands (USNM 47321).

The pterygostomian region is smooth and flat and the ridge on the lateral margin consists of two or three irregular rows of spines and tubercles.

The sternum of the female is granular with medial spines. The lateral margin has a row of spines with the last and largest at the base of the cheliped and another single spine at the base of the first ambulatory leg.

The abdomen of the female is covered with numerous small spines which are larger than elsewhere on the sixth segment laterally. There are two small spines centrally on the seventh segment and small anterior medial spines on all other segments.

Ventrally on the merus of the third ambulatory legs there are spinules and granules and on the fourth ambulatory legs granules with a few spinules.

The third and fourth pairs of ambulatory legs of the ovigerous female from Java are covered with short hairs which are less pronounced in other specimens.

The first pleopod of the male is broad basally, narrowing gradually at first, but more abruptly in the distal quarter. It curves outwards slightly to the sub-acute tip which is flattened on the anterior surface. *Cyrtomaia suhmi*, *C. smithii* and *C. owstoni* have a similar type of pleopod.

The male (ZMA unreg.) from the Kai Islands ('Siboga' Stn. 253) is clearly conspecific with the other specimens. Ihle & Ihle-Landenberg included this specimen in their new subspecies *C. smithii tenuipedunculata* but with reservations because of its long protogastric spines. There is a short spine on either side of the mesogastric spine and a short spine in front of the mesogastric spine but posterior to the level of the protogastric spines. There are granules on the eyestalk. The rostral spines are broken. The photographs of the lectotype of *C. tenuipedunculata* published by Guinot & Richer de Forges (1982b) show a species with much shorter protogastric spines and a small mesogastric spine which is anterior to the level of the protogastric spines. In the lectotype, according to the figure, the eyestalks are smooth. All the specimens described as *C. smithii tenuipedunculata* by Ihle & Ihle-Landenberg have well developed carapace spines and so are clearly distinguished from adults of *C. smithii* in which all the carapace spines are very reduced.

We can see no reason for elevating *Cyrtomaia horrida pilosa* Ihle & Ihle-Landenberg to specific status as suggested by Guinot & Richer de Forges (1982b). The type specimen is an immature female which Ihle & Ihle-Landenberg compared with Rathbun's original unillustrated description. Specimens of *C. horrida* have a distinct tomentum and the denseness of the tomentum seems to vary with sex, age and locality. There are many granules on the eyestalk and the distal tubercle in *C. horrida* so the presence of three granules on the apex of the tubercle in *C. pilosa* does not represent a distinguishing feature. However, as we have not been able to examine the type specimen of *C. horrida pilosa* we do not include it in our synonymy of *C. horrida*.

This species differs from *C. goodridgei* McArdle in having much longer protogastric spines, longer rostral spines, more spines on the sternum and in lacking strong ridges on the anterior half of the carapace.

Distribution. — Java, Kai Islands, Philippine Islands, South China Sea, Japan.

Cyrtomaia intermedia Sakai, 1938

Cyrtomaja intermedia Sakai, 1938: 241-242, pl. 35 fig. 3.
Cyrtomaia intermedia Sakai, 1976: 179-180, fig. 95. — Guinot & Richer de Forges, 1982b: 57, fig. 34.

Material examined. — 1 ♀ (dry) postrostral cl. 21 mm.

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Japan, Tosa Bay, 270-360 m, coll. K. Kurohara (donated M. Takeda), 20 March 1959; 1 spec. (AM P. 20208).

Remarks. — This dry specimen of an immature female agrees quite well with the holotype of the species, a large adult male (cl. 37 mm). The rostral spines are broken but are separated at the base by a V-shaped hiatus. The protogastric spines are also incomplete, they are probably shorter than in the holotype but they are clearly slightly divergent and suberect. There are scattered small, blunt granules over the whole carapace, short cardiac spines (broken) and an anterior branchial spine (also broken). There are granules on the eyestalk, particularly on the distal process. There is a broad tubercle with three granules just anterior to the mesogastric spine and a tubercle on the low ridge between the protogastric spine and the well developed spine in the centre of the orbit. The postorbital spine is longer than the other carapace spines except the protogastrics. There are a few small granules on the pterygostomian region and the granules increase in size and number laterally to form a marginal ridge. The abdomen is not present with the specimen. Whilst the rostral and protogastric spines are slightly shorter than shown in Sakai's figure we have no doubt that this specimen represents *C. intermedia*.

Distribution. — Japan.

Cyrtomaia lamellata Rathbun, 1906

Cyrtomaia lamellata Rathbun, 1906: 879, fig. 36. — Guinot & Richer de Forges, 1982b: 66-69, figs. 42, 43, 44, 52A, A1.
Echinomaia hispida Borradaile, 1916: 104, fig. 13; new synonymy.
Cyrtomaja hispida. — Balss, 1929: 3-4.
Cyrtomaia platypes Yokoya, 1933: 145-146, fig. 52. — Sakai, 1938: 242-243. — Takeda & Miyake, 1969: 501-503, fig. 11f-g. — Takeda & Kurata, 1976: 24, pl. 2 fig. 1. — Guinot & Richer de Forges, 1982b: 71-78, figs. 47, 48A-B, 49C-E; new synonymy.
Cyrtomaia hispida. — Bennett, 1964: 30-32, figs. 10-16, 110. — Griffin, 1966d: 28-29. — Sakai, 1976: 181-182, text fig. 96. — Guinot & Richer de Forges, 1982b: 69-71, figs. 45A-B, 46A-B, 49A-B, F, 52B, B1.

Material examined. — 4 ♂♂, 4 ♀♀ (3 ovig.), 7.5-15.5 mm, smallest ovig. ♀, 11.5 mm.

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Mortensen Pacific Expedition: Japan, 32°15′N 128°12′E, 162 m, 15 May 1914; 3 specs.

NATIONAL MUSEUM OF NEW ZEALAND, WELLINGTON

NZOI: New Zealand: Stn. F923, off North Cape, 34°07.5′S 172°46.7′E, 143-216 m, 13 October 1968; 2 specs. — Stn. F932, off North Cape, 34°26.7′S 173°07.5′E, 113-115 m, 15 October 1968; 2 specs.

N.Z. Marine Dept., New Zealand, 10 miles (∿ 16 km) NNE of Flat Head, Northland, 148-157 m, 16 June 1963; 1 spec. (Cr. 1703).

Remarks. — The three species *Cyrtomaia lamellata* Rathbun, 1906, *Cyrtomaia hispida* (Borradaile, 1916), and *Cyrtomaia platypes* Yokoya, 1933, agree in many features which distinguish them from other species.

1) There are denticulate spines on the basal antennal article;
2) There are flattened lobes on the peduncle segments of the antenna;
3) There is no spine in the centre of the upper border of the orbit;
4) The interantennular spine is broad and its upper surface is granular;

Specimens from Japan collected by the Mortensen Pacific Expedition were compared with specimens from off New Zealand and there is agreement in many features. Slight differences were noted as follows: There are three tubercles dorsally on the cornea of the eye of the New Zealand specimens and two tubercles on the specimens from Japan. In the specimens from New Zealand, the carapace is granular in the male, posteriorly granular in the female, and the ridges from the protogastric spine to the rostrum, to the postorbital spine and to the mesogastric spine are well developed, especially in the male. The specimens from Japan have a smoother carapace and the ridges are less evident especially between the protogastric and mesogastric spines. On the dorsal branchial region of the Japanese specimens, the anterior spine is followed by a smaller spine and two to four tubercles, while on the New Zealand specimens the spine is followed only by three tubercles, two of which are very low.

The specimens were also compared with photographs of the type material of *C. hispida* (Borradaile) in the British Museum (Natural History) (reg. no. 1917.1.29.157-158, 2 males).

The specimen (ovig. female, Z.M. Berlin 5291) determined by Balss (see Balss, 1929) as *C. hispida* (Borradaile) and collected by the 'Gazelle' at Atapupu, Timor has been examined. It has three dorsal tubercles on the eye, denticulate lobes on the basal antennal article, granular ridges on the protogastric region and a very small posterior branchial spine, similar to the New Zealand specimens. This specimen was also examined by Ihle & Ihle-Landenberg (1931) who used it as the basis for their diagnosis of *C. hispida* (1931: 159), and who included Timor in their distribution of *C. hispida*. They compared this specimen with their new species *C. balssi* and distinguished the two species. They did not regard them as synonymous as stated by Guinot & Richer de Forges (1982b).

The syntypes of *C. lamellata* Rathbun (USNM 29701; 29702; 29737, 1 ♂, 3 ♀♀, 11.5-13 mm, Hawaiian Islands) have been examined, together with specimens (USNM 47295, 1 ♂, 6 ♀♀) collected at Goto Island by the 'Albatross' and identified by Rathbun as *C. lamellata*. This is the same locality as that from which the type material of *C. platypes* Yokoya (1933: 145) was taken. A specimen (1 adult ♂, Zool. Staatssammlung, Munich) identified by Yokoya as *C. platypes* and also from this locality [Goto Island, Japan, 152 m, S.S. Soyo-Maru, Stn. 448 (date on label — 14 March 1934)] has been examined also. The differences between these specimens and those mentioned above are not great enough to justify their being placed in separate species and it is concluded that they are all members of one species ranging widely in the west Pacific from the Hawaiian Islands to New Zealand, New Caledonia, Timor and Japan. Sakai (1976) has already conceded that *C. platypes* is probably a synonym of *C. hispida* and Takeda & Kurata (1976) have also considered this possibility although they did not have the opportunity to examine material from New Zealand.

Guinot & Richer de Forges (1982b) in their review of the genus *Cyrtomaia* consider *C. lamellata*, *C. platypes* and *C. hispida* as three valid species and they note the differences from the type and topotypic specimens of *C. platypes* of material from the Ogasawara Islands and off New Caledonia. Some variation could be expected over the geographic range of each species but because so few specimens have been collected neither the distribution nor variation of these species is known. In our opinion, the concept of three distinct species — one in Hawaii, one in New Zealand and one in Japan is mistaken and these species in fact represent the extremes of geographic distribution of a single wide ranging species.

Guinot & Richer de Forges (1982b) listed the differences between *C. platypes* and *C. hispida* and also between *C. platypes* and *C. lamellata*. We have considered all these differences in our comparison of our specimens from Japan collected by the Mortensen Pacific Expedition with specimens from off New Zealand and only five of them we regard as important. The first of these is the number of eyestalk tubercles. On the one hand there is *C. hispida* with three dorsal tubercles on the eyestalk and on the other hand *C. platypes* and *C. lamellata* with only two dorsal tubercles. The New Caledonian material (Guinot & Richer de Forges, 1982b) and our material from New Zealand show that there can be additional granules or variation in the size of the tubercles in different specimens from the same locality. However this remains the most distinct feature which might indicate that there could be two species.

The other four differences can be grouped together. *C. hispida* differs from *C. platypes* in having —

a) shorter rostral spines;
b) shorter, blunter postorbital and hepatic spines;
c) a posterior branchial tubercle rather than a spine;
d) a less distinct upper row of lateral branchial tubercles.

This kind of general difference in which *C. hispida* has several spines and tubercles which are less pronounced could be attributed to geographic variation.

There is a similarity in the ornamention of the basal antennal article. In all the specimens the medial distal lobe is slightly larger, and has more teeth which are more acute than has the lateral distal lobe. The subproximal lobe is simple, varying only in length. In our male from Japan the lobes on the basal antennal article are as figured by Guinot & Richer de Forges (1982b) but in both the Japanese females the distal

lobes are broader and resemble the lobes on the basal antennal article of the male from New Zealand. The ornamentation of the basal antennal article of *C. lamellata* does not seem significantly different from that of *C. platypes*.

The main difference cited between *C. lamellata* and *C. platypes* is the relative sizes of the anterior and posterior branchial spines. Examination of the syntypes of *C. lamellata* and the photograph of *C. lamellata* given by Guinot & Richer de Forges show that the posterior branchial spine is about half as long as the anterior spine. In our Japanese specimens the posterior spine is a quarter to a third the length of the anterior spine.

The first pleopod of our male specimens from both Japan and New Zealand have a lobe on the abdominal margin of the apex, although this is less elongate in the New Zealand specimens. Guinot & Richer de Forges (1982b: fig. 52) show a lobe on the first pleopod of *C. platypes* but not on the pleopod of *C. hispida*.

Distribution. — Japan, Ryukyu Is., Ogasawara Is., Timor, New Caledonia, New Zealand and Hawaii.

Cyrtomaia maccullochi Rathbun, 1918

Cyrtomaia maccullochi Rathbun, 1918: 4-7, figs. 1-2, pls. 1-2. — Griffin, 1966b: 273 (in key). — Guinot & Richer de Forges, 1982b: 26-30, figs. 13A-B, 14A-B, 23A.

Material examined. — 3 ♀♀, postrostral cl. 37.5-cl. 53.5 mm.

South China Sea, 16°20′N 114°39′E, 285-389 m, Agassiz trawl, white muddy sand, Fisheries Research Station, Hong Kong, 20 June 1964; 1 spec. (AM P. 20205).

Great Australian Bight, 33°28′S 127°15′E to 33°31′S 127°19′E, 640-650 m, otter trawl, J. R. Paxton, 'Dmitry Mendeleev', 28 February 1976; 2 specs. (AM P. 21964).

Remarks. — The two specimens (adult females) from the Great Australian Bight agree well with the type series (AM E. 3683, E. 5660, E. 6263 (holotype), E. 6264, AM P. 4499-4501; USNM 53416, 53418).

In all these specimens the carapace is quite densely covered with granules, the eyestalk occupies more than half the width of the orbit and there is a low, broad tubercle between the large protogastric spine and the anterior branchial spine. There is a tubercle, often low, in front of the mesogastric spine and usually two tubercles behind the anterior branchial spine, though in the holotype and in one small male there is a short spine and a tubercle. There are four spines on the basal antennal article and sometimes a small tubercle as well. There is no spine in the centre of the orbit of any of the specimens but there is a ridge of larger granules from the protogastric spine to the orbit and in some specimens these larger granules are present on the orbital margin.

The pterygostomian region of all specimens is flat and smooth with a lateral margin of two or three spines, many small tubercles and a row of long setae. The lateral margin of the sternum is unarmed except for a spine at the base of the cheliped. On one female from South Australia there is also a spine at the base of the first ambulatory leg.

The abdomen of the female is covered with sharp granules which become spinous laterally, especially on the sixth segment. There is a pair of small spines centrally on the seventh segment and small anteromedial spines on all other segments.

There are granules on the merus and carpus of the third and fourth pairs of ambulatory legs, usually more pronounced ventrally on the merus and dorsally on the carpus.

The specimen from the South China Sea, also an adult female, differs in several features from specimens in the type series. However, we include it, with reservations, under *C. maccullochi* as there is insufficient material to justify the description of a new species.

In this specimen the rostral spines are long (one third postrostral carapace length), slender and close together but weakly divergent in the distal third. The rostral spines in the type series are shorter, further apart and parallel except in one ovigerous female (AM P. 4499) where they are weakly divergent at the tip.

On the low ridge from the protogastric spine to the border of the upper orbit there are two small tubercles in front of the spine and a small tubercle and a large granule on the edge of the orbit. The basal antennal article has three short spines but lacks the small proximal spine on the lateral edge present in the type series. The eyestalk occupies slightly less than half of the orbital width and there are three small tubercles behind the anterior branchial spine. The abdomen is covered with small spines which are of almost uniform size rather than larger laterally.

Sakai (1976) regards *C. maccullochi* as conspecific with large specimens of *Cyrtomaia* from Japan, which he has identified as *C. curviceros* Bouvier, which also possess long parallel protogastric spines. These Japanese specimens appear to be conspecific with those we have described as *C. suhmi* and are discussed further under that species. The specimen figured by Sakai (1976: pl. 61) differs from the type series of *C. maccullochi* in having more divergent rostral spines, eyestalks which occupy less than half the width of the orbit and a short spine between the protogastric and anterior branchial spines. *C. maccullochi* is in our view a valid, distinct species.

This species has been dealt with recently by Guinot & Richer de Forges (1982b). They have retained *C. maccullochi* as a valid species, noting its subparallel rostral spines and dense granules on the carapace surface. We find that it is not always easy to determine the presence or absence of the anterior mesogastric tubercle, the third character used by these authors to distinguish *C. maccullochi* from *C. curviceros*. As stated above, we regard *C. curviceros* as conspecific with *C. suhmi* and discuss this further under *C. suhmi*.

We have compared this series of *C. maccullochi* with a large series of specimens we have described as *C. suhmi* from off the eastern Australian coast. The two species are similar but can be distinguished by the following points:

1) the carapace is granular (smooth in *C. suhmi*);
2) there is a low tubercle (rather than a spine as in *C. suhmi*) between the protogastric spine and the branchial spine;
3) the eyestalk occupies more than half (0.6) the width of the orbit which is about as wide (1.1) as the interorbital region (in *C. suhmi* the eye occupies less than half (0.4) the width of the orbit which is clearly wider (1.3) than the interorbital region — measurements taken from above the eyestalk on eave and the tip of the postorbital spine);
4) there are small spines laterally on the female abdomen (not present in *C. suhmi*);
5) there is a lateral spine on the fourth to sixth segments of the male abdomen (not present in *C. suhmi*);
6) the distal height of the cheliped palm in adult males (only 2 specimens from the type series) is 3 times the proximal height (distal height 2 to $2^1/_2$ times proximal height in *C. suhmi*);
7) the rostral spines are subparallel and horizontal (at least weakly divergent and arched in *C. suhmi*).

Guinot & Richer de Forges (1982a; 1982b) have described a new species *Cyrtomaia gaillardi*, from Madagascar which is similar to *C. maccullochi* in having a granular carapace surface and subparallel, horizontal rostral spines. However, the adult males are much larger, the eyestalk is shorter than half the orbital width and there is a spine rather than a tubercle between the protogastric spine and the anterior branchial spine. The palm of the chela is much higher distally in both species but it is not clear what the ratio of proximal to distal height is in *C. gaillardi*.

Distribution. — Southern Australia, South China Sea.

Cyrtomaia murrayi Miers, 1886
(Fig. 9h, i, Pl. 2)

Cyrtomaia murrayi Miers, 1886: 15, pl. 3 fig. 1. — Barnard, 1950: 33, fig. 6d. — Sakai, 1976: 180, pl. 62. — Guinot & Richer de Forges, 1982b: 16-18, figs. 5A-B, 6A-B, 7A-B.

Material examined. — 14♂♂, 3 ♀♀ (+ 3 damaged), 6-30.5 mm.

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Danish Kei Islands Expedition: Stn. 5, Kai Is., 05°31′30″S 132°26′E, 250-90 m, trawl, sand, 4 April 1922; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

C.S.I.R.O. 'Diamantina': Western Australia: Geraldton, NW Bluff Pt., 27°40′S 113°03′E, 140 m, dredge or M.W. trawl, 22 August 1963; 1 spec. (WAM 207-67). — N of Pt. Cloates, 22°52′S 113°29′E, 146 m, triangle dredge, small catch of crustaceans and shells, 6 October 1963; 1 spec. (WAM 60-67). — W of Dirk Hartog I., 25°30′S 112°08′E, 200-0 m, oblique M.W. trawl, 8 October 1963; 1 spec. (WAM 13-67). — W of Bluff Pt., 27°40′S 113°20′E, 141 m, beam trawl, mass of sponge and Bryozoa, 10 October 1963; 10 specs. (WAM 285-67, 301-67). — SW Dongara, 29°50′S 112°24′E, 140-144 m, triangle dredge, mainly sponges, 11 October 1963; 1 spec. (WAM 66-67).

Western Australia: NW of Rottnest I., 186-190 m, 'Bluefin', sponge, 15 September 1965; 1 spec. (WAM 220-73). — W of west end of Rottnest I., 160 m, 'Bluefin', 16 September 1965; 2 specs. (WAM 223-73, 90-71).

THE AUSTRALIAN MUSEUM, SYDNEY

South China Sea, 19°05′N 112°10′E, 193 m, Agassiz trawl, muddy sand, Fisheries Research Station Hong Kong, 12 March 1965; 2 specs. (AM P. 20206).

Remarks. — These specimens agree well with the syntypes (2 ♂, cl. 18.8, 22.9 mm, Kai Islands, 'Challenger' Stn. 192, 05°49′15″S, 132°14′15″E, BMNH 84: 31) examined by one of us (D.J.G.G.) and with those specimens described and figured by Sakai (1976).

The spines of the basal antennal article vary; distally in four of the specimens (cl. 9-13 mm) there is a large spine bifid near its apex, while in 12 other specimens (cl. 6-9 mm) there is a long spine with an accessory spine near the base.

In our specimens the preorbital spine is about a third the length of the postorbital spine. All the specimens have some kind of spine in the centre of the orbit but this varies from very short (about a quarter the length of the preorbital spine) to subequal to the preorbital spine.

The pterygostomian region is flat and smooth with two spines on the lateral margin.

The specimen described by Barnard (1950) has two subequal tubercles on each cardiac elevation; our specimens have a well developed cardiac spine with a small tubercle on the anterior slope and up to ten smaller tubercles and granules, mostly on the lateral slope. There are 20 to 40 small spinules and granules on the lateral part of the branchial region and many small granules on the medial branchial region. There are fewer granules and smaller spinules on smaller specimens.

While the figures given by Miers (1886) and Sakai (1976) show quite distinct spinules on the carpus of the third and fourth ambulatory legs, in our specimens of cl. 6-13 mm there are at most six very small spinules on the dorsal margin of the carpus and in some specimens only a row of sharp granules.

Guinot & Richer de Forges (1982a; 1982b) also examined one of Miers' syntypes of *C. murrayi* from the Kai Islands and compared it with the holotype, the only specimen, of their new species *Cyrtomaia ericina* from New Caledonia. The principal features used to distinguish these two species are the presence on the orbital margin of a blunt tubercle in *C. ericina* rather than a sharp spine as in *C. murrayi* and by the weaker spinulation of the carpus of the third and fourth ambulatory legs. Our series shows that these two features vary within *C. murrayi* as does the bifid distal spine on the basal antennal article. These two species will only be clearly distinguished when a series of specimens of *C. ericina* has been examined.

C. murrayi is distinguished from other *Cyrtomaia* species (except *C. ericina*) by the presence of 1) a spine on the posterior margin of the carapace; 2) spines dorsally on the meri of ambulatory legs three and four; 3) a preorbital spine on the eave; 4) two subequal mesogastric spines; 5) two pairs of protogastric spines.

Distribution. — East Africa (Mozambique), Western Australia, Kai Islands, South China Sea, Japan.

Cyrtomaia owstoni Terazaki, 1903

Cyrtomaia owstoni Terazaki, 1903: 239, fig. (not seen). — Sakai, 1938: 240-241, pl. 35 fig. 1; 1976: 179, pl. 59. — Takeda & Miyake, 1969: 500-501, fig. 11 d, e. — Serène & Lohavanijaya, 1973: 46-47, figs. 73-78, pl. 7C,

D. — Griffin, 1976: 188. — Guinot & Richer de Forges, 1982b: 61-63, figs. 38A-D, 39A-B.
Cyrtomaia horrida japonica Balss, 1924: 23.
Cyrtomaia septemspinosa Rathbun, 1932: 30.

Material examined. — 3 ♀♀ (2 ovig.), 15.5-20 mm, smaller ovig. ♀, 15.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: 16 miles (∿25.6 km) W by S of Bonomisaki, Japan, 360 m, trawl no. 2, 13 May 1914; 2 specs. — Sagami Bay, 720 m, 1-7 July 1914; 1 spec.

Remarks. — The three long slender spines on the basal antennal article are subequal, whereas Sakai (1938) described the distal spine as much larger than the others.

There are three long spines and long hairs on the lateral margin of the pterygostomian region, but the surface is smooth as it is in *Cyrtomaia goodridgei*. In *Cyrtomaia lamellata* and *C. bicornis* on the other hand, the pterygostomian region is granular with a granular ridge on the lateral margin. These species all belong to the group that have short, slender, curved, suberect, divergent protogastric spines.

The branchial spines are longer than the protogastric spines. There is no spine or tubercle on the intestinal region.

The abdomen of the female is granular with a spine medially on segment one and with very small spines laterally and medially on segments two to six.

Distribution. — Philippine Islands, South China Sea, southern Japan.

Cyrtomaia suhmi Miers, 1886
(Fig. 9e-g)

Cyrtomaia suhmi Miers, 1886: 16-17, pl. 3 fig. 2. — Alcock, 1899: 45. — Ihle & Ihle-Landenberg, 1931: 157. — Griffin, 1974: 9-10. — Griffin & Brown, 1976: 252-253, fig. 6. — Guinot & Richer de Forges, 1982b; 21-24, figs. 10, 11A-B, 23B.
Cyrtomaia Suhmi typica Doflein, 1904: 54-55, pl. 19 figs. 1, 2.
Cyrtomaia Suhmi curviceros Bouvier, 1915b: 9-15, pl. 1.
Cyrtomaia curviceros. — Sakai, 1976: 181, pl. 61. — Guinot & Richer de Forges, 1982b: 24-26, fig. 12A-D.

Material examined. — 12♂♂, 5 ovig. ♀♀, 17.5-89.5 mm, smallest ovig, ♀, 78 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 314, Flores Sea, 07°36′S 117°30′E, 694 m, trawl, fine sandy mud, 17 February 1900; 1 spec. (ZMA De.100.624) (det. Ihle).

THE AUSTRALIAN MUSEUM, SYDNEY

F.R.V. Kapala: New South Wales: E of Clarence R., 29°26′S 153°49′E to 29°20′S 153°50′E, 450 m, prawn trawl, 12 October 1975; 2 specs. (AM P.21678-9). — SE of Clarence R., 29°41′S 153°45′E to 29°32′S 153°47′E, 407-399 m, prawn trawl, 10 October 1975; 4 specs. (AM P.21674-7). — NE of Wooli, 29°52′S 153°43′E to 29°46′S 153°45′E, 495 m, 10 October 1975; 2 specs. (AM P.21664-5). — E. of Wooli, 29°52′S 153°43′E to 29°51′S 153°43′E, 495 m, 23 August 1977; 1 spec. (AM P.26578). — NE of North Solitary Islands, 360 m, 18 August 1978; 1 spec. (AM P.29936). — SE of Crowdy Head, 31°55′S 153°08′E to 31°57′S 153°07′E, 396-540 m, demersal fish trawl, 10 September 1975; 1 spec. (AM P.21130). — E. of Seal Rocks, 32°32′S 152°53′E to 32°25′S 152°57′E, 360 m, demersal fish trawl, 10 September 1975; 1 spec. (AM P.21571). — E of Sydney, 540 m, 6 September 1978; 1 spec. (AM P.29937). — E of Kiama, 34°36′S 151°16′E to 34°45′S 151°13′E, 495 m, demersal prawn trawl, 21 August 1975; 1 spec. (AM P.21074). — E of Brush I., 35°35′S 150°47′E to 35°29′S 150°44′E, 504-576 m, 9 June 1976; 1 spec. (AM P.24393); 1 spec. (AM P.24395).

Remarks. — *Cyrtomaia suhmi curviceros* appears to be the adult of the immature specimens described originally as *C. suhmi*. The holotype of *C. suhmi* described by Miers (male, postrostral cl. 25 mm, BMNH 84.31), 'Valdivia' specimens described by Doflein (2 females, 11.6, 25 mm, ZM Berlin 13615 and unreg.) and the 'Siboga' Expedition specimen from Java described by Ihle & Ihle-Landenberg (ZMA De. 100.624) have been examined and all are immature. There is no size given for the male collected off the south Indian coast described by Alcock. These small specimens have been compared with the large specimens of *Cyrtomaia* collected from the Andaman Sea by the 'Anton Bruun' (USNM 135119) (Griffin, 1974), those collected from off the east Australian coast by the F.R.V. 'Kapala' and that from Japan (Mus. Milan 1576-8) collected by Parisi and identified as *C. suhmi curviceros* by Bouvier. The locality from which Bouvier's original material came is not clear but was indicated as "?Japan".

All specimens and previously described material have in common a smooth carapace, parallel or subparallel protogastric spines, a well developed slender mesogastric spine, a single spine between the protogastric spine and the branchial spine and, in addition to the anterior branchial spine, two smaller posterior spines or tubercles. The pterygostomian region is flat and on the lateral margin there is only a weak ridge with scattered granules, up to four tubercles, some high, and a short posterior spine. The eyestalk in adults occupies less than half the width of the orbit. On the basal antennal article there are four spines, one medial and three on the lateral margin, of which the proximal is sometimes much smaller than the others; behind the anterolateral spine there is a tubercle or short spine. In the immature male (cl. 17.5 mm) from the 'Siboga' Expedition the proximal spine is very much smaller than the spine in front of it and there is no tubercle behind the anterolateral spine.

Most of the specimens previously described have no spine in the orbit between the eave and the postorbital spine, but there is a granule in this postion in the holotype (Guinot & Richer de Forges, 1982b: fig. 11) and a small spine in the juvenile specimen from Java (Ihle & Ihle-Landenberg, 1931). In the specimens from off the eastern Australian coast there is a small spine about a third the length of the postorbital spine. The spine in the orbit of *Cyrtomaia* and similarly *Platymaia* doesn't constitute a more useful distinguishing feature than the other small carapace spines. Where this is the only difference between two described species we do not regard this as being sufficient to validly distinguish them.

Sakai (1976) elevated *C. curviceros* to specific status and regards *C. maccullochi* as a synonym of this species. However,

we find nothing in his notes or figure to validly distinguish his specimens from *C. suhmi*. The characters which distinguish these Japanese specimens from *C. maccullochi* are discussed under that species.

It is concluded that all these specimens belong to *C. suhmi* and that Bouvier's subspecies does not, in fact, exist as a separate, distinct subspecies or species.

This species has been dealt with recently by Guinot & Richer de Forges (1982b) who regard *C. suhmi* and *C. curviceros* as separate species although suggesting that the holotype of *C. suhmi* Miers may indeed be a younger specimen of *C. curviceros*. They note the very long cheliped merus in Bouvier's holotype and also the absence of a spine between the protogastric spine and the anterior branchial spine. In the figure given by Sakai (1976) of a smaller male, identified by him as *C. curviceros*, the merus of the first ambulatory leg is slightly longer than the cheliped merus and there is a small spine between the protogastric and the anterior branchial spine. An adult male of *C. suhmi* from the eastern Australian coast has the merus of the first ambulatory leg more than one and a third (1.4) times as long as the cheliped merus and in some adults there is a high tubercle rather than a spine between the protogastric and anterior branchial spine. In the series from eastern Australia there is sometimes, behind the anterior branchial spine, a spine and a tubercle and sometimes two tubercles as shown in Bouvier's figure of *C. suhmi curviceros*. The basal antennal article of Bouvier's holotype has four lateral spines and one medial spine. In the eastern Australian *C. suhmi* there are three lateral spines, one medial spine and a high tubercle behind the anterolateral spine. This high tubercle is represented by a short spine in Bouvier's holotype as can be seen in the photograph of the holotype given by Guinot & Richer de Forges (1982b: fig. 12C).

Guinot & Richer de Forges (1982a; 1982b) have described a new species, *C. gaillardi*, which is similar to *C. suhmi* in size and general appearance and it also has a small spine in the orbit and a spine between the protogastric and anterior branchial spine. It is, however, densely covered with granules and the rostral spines appear to be horizontal rather than arched as in *C. suhmi*.

C. suhmi is similar to *C. maccullochi* but in the latter species the carapace is granular, not smooth as in *C. suhmi*. Other differences between the two species are discussed further under *C. maccullochi*.

Distribution. — Southern India, Bay of Bengal, Indonesia, eastern Australia and Japan.

Encephaloides Wood-Mason, 1891

Type species. — *Encephaloides armstrongi* Wood-Mason, 1891, by monotypy.

Remarks. — The one species contained in this genus has been discussed recently (Griffin, 1974) and the first pleopod of the male figured. This species is distinguished by its beak-like rostrum, the enlarged efferent branchial openings and the inflated branchial regions which meet dorsally in the midline. The narrow basal antennal article is fused proximally and distally and the flagellum of the antenna excluded from the orbit. The supraorbital eave is weakly expanded and the postorbital lobe, in the form of a conical tubercle, is remote from the eye. The first pleopod of the male is broad and straight with an elongate lobe on the medial edge just before the apex; the aperture is on the anterior margin of the lobe. The first pleopods lie near the lateral margins of the abdominal fossa rather than near the midline. These features, especially the form of the orbit and the first pleopod of the male, lead us to the view that this genus may be better placed in the Pisinae.

Distribution. — Gulf of Oman, Bay of Bengal.

Ephippias Rathbun, 1918

Type species. — *Ephippias endeavouri* Rathbun, 1918, by monotypy.

Remarks. — In this monotypic genus the supraorbital eave is not expanded and there are neither preorbital nor antorbital spines or lobes; the postorbital spine is small and remote from the eye. The basal antennal article is slender with one large anterior spine and the antenna is excluded from the orbit. The first pleopod of the male curves outward distally and the aperture is a subterminal slit.

Distribution. — Indo-West Pacific, but restricted to Australian waters.

Ephippias endeavouri Rathbun, 1918
(Fig. 9c, d)

Ephippias endeavouri Rathbun, 1918:9-11, pl. 15. — McNeill, 1920: 109. — Hale, 1927:131-132, fig. 131. — Montgomery, 1931:416. — Balss, 1935a:119. — Griffin, 1966b:274 (in key).

Material examined. — 3♂♂, 2♀♀, 27.5-114.5 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

New South Wales, near Grafton, off Minnie Waters, 18 m, crayfish pot, coll. K. Knox and G. Biddle, 1964; 1 spec. (AM P.15991). — South Australia, northern Great Australian Bight, Deal Island, Cape Northumberland, 32°24′S 133°30′E, coll. P. Symonds, 'Explorer', 23 August 1973; 3 specs. (AM P.20152). — Great Australian Bight, 32°43′S 125°43′E to 32°45′S 125°43′E, 43 m, coll. G. Maxwell, CSIRO F.R.V. 'Soela', Stn. 14, 18 January 1980; 1 spec. (AM P.32086).

Remarks. — In *E. endeavouri* the orbit is not expanded and the first pair of ambulatory legs is twice as long as the chelipeds and much longer and stouter than the other pairs of legs. The first pleopod of the male of *E. endeavouri* has not previously been figured. We have figured the pleopod of a specimen (114.5 mm) from New South Wales. The pleopod narrows and curves outwards just before the subacute apex; the aperture is a subterminal slit on the medial edge.

Distribution. — Restricted to Australia, from the northwest around the southern coasts to northern New South Wales.

Grypachaeus Alcock, 1895

Type species. — *Grypachaeus hyalinus* Alcock, 1895, by monotypy.

Remarks. — In 1978 Takeda described a second species of this genus from the Ryukyu Islands, *G. tenuicollis* Takeda.

In this genus the basal antennal article is similar to the second and third peduncle segments, the proximal margin is fused to the epistome but the distal margin is free and doesn't extend to the anterior margin of the eyestalk. The propodus and dactyl of the fourth leg, which is subchelate, are armed with numerous spinules ventrally.

The first pleopod of the male has a large subterminal aperture.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *GRYPACHAEUS*

1 Rostral spines with a strong accessory spine at base and a few spinules distally; hepatic margin with 2 or 3 spines; cheliped palm strongly spinulous (male) or with 3 or 4 dorsal spines (female)..... *G. hyalinus*
- Rostral spines with 2 strong accessory spines distally; hepatic margin with one large spine; cheliped palm with a few conical tubercles (male)... ..... *G. tenuicollis*[7])

Grypachaeus hyalinus (Alcock & Anderson, 1894)

Achaeus hyalinus Alcock & Anderson, 1894:205.
Grypachaeus hyalinus. — Alcock, 1895:177-178, pl. 3 figs. 4, 4a.
Gryphachaeus (sic) *hyalinus*. — Griffin, 1974:14, fig. 1e, f; 1976:190.

Material examined. — 3♀♀ (1 ovig.), postrostral cl. 6.5-14 mm, ovig. ♀, postrostral cl. 14 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 289, south coast of Timor, 09°0.3′S 126°24.5′E, 112 m, trawl, mud, sand and shells, 20 January 1900; 2 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

South China Sea, 128-174 m, trawl, Fisheries Research Station, Hong Kong, December 1963; 1 spec. (AM P.29934).

Remarks. — These specimens agree with those previously discussed (Griffin, 1974; 1976). The two specimens from Timor have not been well preserved and are somewhat distorted, and one is infected with a sacculina parasite. The rostral spines of this species are longer and more slender than shown in the figure by Alcock (1895, fig. 4). In adult specimens the carapace is wider in females (about 2/3 postrostral carapace length) than in males (about $^1/_2$ postrostral carapace length).

This species is distinguished from *G. tenuicollis* Takeda (Takeda, 1978) by the following points:

1. the rostral spines have a few small spinules in addition to a basal accessory spine (2 strong accessory spines in *G. tenuicollis*);
2. there are 2 or 3 spines on the hepatic margin (1 large spine in *G. tenuicollis*);
3. the cheliped palm is strongly spinous (few and small spines on the palm of *G. tenuicollis*);
4. first pleopod of the male straight or slightly curved laterally, the rim of the aperture not projecting (apex strongly curved medially and the rim of the aperture projecting and acute in *G. tenuicollis*);
5. last segment (6 and 7 fused) of male abdomen with lateral edges concave and distal width less (0.8) than proximal width (in *G. tenuicollis* the lateral edges are parallel and the distal and proximal widths subequal).

Distribution. — N. of Mombasa, mouth of Gulf of Aden, off Sri Lanka, Timor, Philippine Islands, South China Sea.

Inachus Weber, 1795

Type species. — *Cancer scorpio* Fabricius, 1779 (= *Cancer dorsettensis* Pennant, 1777) by subsequent designation of H. Milne Edwards, 1837.

Remarks. — This genus is reasonably well represented in the eastern Atlantic. Only *I. dorsettensis* and *I. guentheri* occur in the Indo-west Pacific, the latter extending to Lourenco Marques, the former to the mouth of the Gulf of Aden and the Seychelles. Males of *Inachus* species have first pleopods which are similar to those of *Achaeus* and its relatives.

Distribution. — East Atlantic and western Indian Ocean.

KEY TO INDIAN OCEAN SPECIES OF *INACHUS*

(modified from Barnard, 1950)

1 Protogastric regions smooth or with 2 small spinules; mesogastric spine larger than cardiac spine; branchial region with a spinule or tubercle near cardiac spine, anteriorly smooth ..... *I. guentheri*
- Protogastric regions with 4 tubercles or small spines (in a transverse row); mesogastric spine subequal to cardiac spine; branchial region with a short spine near cardiac spine and a tubercle anteriorly ..... *I. dorsettensis*

Inachus guentheri (Miers, 1879)

Achaeopsis guentheri Miers, 1879a:2-3, pl. 4 figs. 1, 1a.
Inachus guentheri. — Barnard, 1950:27-29, fig. 5a-c. — Monod, 1956: 529-531, figs. 723-730. — Griffin, 1974:18-19.

Material examined. — 1 ovig. ♀, 13.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java — S. Africa Expedition: Stn. 43, Mauritius, off Tombeau Bay, ca. 234 m, swabs, 11 October 1929; 1 spec.

Remarks. — This specimen agrees well with those previously described. There is a strong mesogastric spine, but on the cardiac region there is a short spine rather than a tubercle and only a low tubercle on its posterior slope. In our specimen there is a spinule on the supraorbital eave and on the rostral

[7]) from the literature

spines apically and a pair of spinules distally on the postorbital lobe. The hepatic margin is spinulous and there is a small spinule on the protogastric and branchial regions. There is a sharp tubercle on the posterior margin of the antennal fossa. There are proximal and distal spinules on the basal antennal article but only granules along the rest of its length.

Distribution. — Atlantic and Indian Ocean coasts of southern Africa; Mauritius.

Lambrachaeus Alcock, 1895

Type species. — *Lambrachaeus ramifer* Alcock, 1895, by monotypy.

Remarks. — As previously remarked, the single contained species is unique amongst those presently contained in the Majidae in that the male has a long second pleopod. Alcock saw similarities with *Macropodia* (as *Leptopodia*) and *Metoporaphis*. Yet, in fact, the similarities are general: long rostrum, poorly developed orbits, long ambulatories. We, therefore, propose to exclude this genus from the Majidae.

Distribution. — Indo-West Pacific.

Lambrachaeus ramifer Alcock, 1895

Lambrachaeus ramifer Alcock, 1895:168-169, pl. 3 fig. 1. — Rathbun, 1911:244. — Edmondson, 1952:82-83, fig. 9a-d. — Griffin & Tranter, 1974:172-173, fig. 2a-c. — Kensley, 1977a:323-327, figs. 1-2.

Material examined. — 1 ♂, 24 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Hawaii, off Honolulu, 19-72 m, dredge, 5 May 1915: 1 spec.

Remarks. — In this specimen, an adult male, the rostrum is about as long as the postrostral carapace length (11.5 mm). As was noted and figured previously (Griffin & Tranter, 1974) this species is unique among known majids in having the second pleopod of the male as long as the first. In addition the antenna is very small; the very short basal segment is articulated near the green gland and free distally; the second and third peduncle segments are also short and slender and only reach the anterior margin of the eyestalk. This is quite distinct from the superficially similar *Stenorhynchus* in which there is a long basal antennal article fused proximally and distally and the green gland is at the base of the 'neck' just in front of the mouthfield.

The cheliped is longer and heavier than the following ambulatory legs and the fingers are bent at an angle to the palm. However, there is only a commencing orbit with a slender postorbital spine and there are curled hairs on the protogastric region and on the merus of the cheliped.

Distribution. — Red Sea, east coast of South Africa, Amirante Islands, Andaman Islands, Maldive Islands, Hawaii.

Macropodia Leach, 1814

Type species. — *Cancer rostratus* Linnaeus, 1761, as *Macropodia longirostris* (Fabricius, 1775) by monotypy (see Rathbun, 1897:155).

Remarks. — This genus is well represented in the eastern Atlantic and Mediterranean and species from these areas have been treated extensively by Forest (1964, 1978) and Forest & Zariquiey Alvarez (1964). Species from the western Indian Ocean were dealt with by Griffin (1974).

The generally long, contiguous rostral spines, distinguish species of this genus from *Achaeus* and its relatives, the males of which have similar first pleopods. The basal antennal article is distally free, not fused to the carapace as it is in *Achaeus*.

Distribution. — Eastern Atlantic, Mediterranean, western Indian Ocean.

KEY TO INDIAN OCEAN SPECIES OF *MACROPODIA*

1 Basal antennal article smooth or with minute denticles; lateral margins of antennal fossae not splayed outwards ..... *M. formosa*
\- Basal antennal article with one or more spines; lateral margins of antennal fossae splayed outwards 2
2 (1) Rostrum long, exceeding antennal peduncle; basal antennal article with one spine ..... *M. falcifera*[8])
\- Rostrum short, not reaching end of antennal peduncle; basal antennal article with 3 spines ..... *M. intermedia*

Macropodia formosa Rathbun, 1911

Macropodia formosa Rathbun, 1911:242-244, fig. 1. — Griffin, 1974:19, fig. 4c-d.

Achaeus tenuicollis. — Stephensen, 1945:97, fig. 18 A, B. [Not *Achaeus tenuicollis* Miers, 1886 = *Achaeus curvirostris* (A. Milne Edwards).]

Material examined. — 3♂♂, 4♀♀, 8-12.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Expedition to Iran: Iranian Gulf, Stn. 24, 29°07'N 49°56'E, 40 m, sandy clay, 13 March 1937; 4 specs. — Iranian Gulf, Stn. 25, 63 nautical miles W 1/2S of Bushire, 49 m, sand with some clay, 14 March 1937; 3 specs. (all previously det. K. Stephensen, as *Achaeus tenuicollis* Miers).

Remarks. — These specimens agree well with the specimens of *Macropodia formosa* collected by the *Anton Bruun* and described previously (Griffin, 1974). The short rostral spines are contiguous, there is a mesogastric spine and a cardiac spine in the midline and the supraorbital eave and the basal antennal article are both smooth.

Distribution. — Western Indian Ocean: off S. Africa, south of Gulf of Aden, Iranian Gulf and Cargados Carajos.

[8]) From the literature (Barnard, 1950).

Oncinopus De Haan, 1839

Type species. — *Inachus (Oncinopus) aranea* De Haan, 1839 by monotypy.

Remarks. — The first species of this genus, *O. aranea* De Haan was described from Japan in 1839 and the second species *O. neptunus* was described by Adams & White (1848) from the Philippine Islands (Sea of Mindoro). A third *O. subpellucidus* was described from Port Jackson, Australia by Stimpson (1857) but later Haswell (1880) described *O. angulatus*, also from Port Jackson, perhaps without knowing of Stimpson's species, for in 1882 Haswell listed *O. angulatus* as a synonym of *O. subpellucidus*. However, all these species were amalgamated by Miers (1884) who considered that the characters which has been used to distinguish the three—length of ambulatory leg; size of male chela; size of rostral lobes—were not consistent. Subsequent authors (Henderson, 1893; Ortmann, 1893; Alcock, 1895; Sakai, 1938; 1965a) followed Miers and *O. aranea* was regarded as a wide ranging variable species until Takeda & Miyake (1969) examined the first pleopod of the male in a number of specimens. They found that the pleopod of males from Port Jackson agreed with that of the type of *O. neptunus* but differed from that of specimens from Japan. The Japanese specimens were considered to be *O. aranea* and a new species *O. angustifrons* was described from the East China Sea.

The type material of *O. subpellucidus* is no longer in existence. We have examined the type material of *O. angulatus* (2♂♂, 10, 12.5 mm, 1♀, 12 mm, dry, glued to glass) and compared it with a large number of specimens from Port Jackson. We are convinced that *O. angulatus*, and thus presumably *O. subpellucidus*, is conspecific with *O. neptunus*.

The records of *O. aranea* by several earlier authors cannot, therefore, be regarded as valid (eastern Australia (Miers); Sri Lanka, Gulf of Martaban (Henderson); Laccadives, Maldives, Sri Lanka, Andamans, Malay Peninsula (Alcock); Japan (Ortmann) (Sakai)) until the specimens are re-examined. Records of specimens identified since the study of Takeda & Miyake (1969)—including this paper—indicate that all three species occur in Japan, Philippine Islands and Kai Islands; *O. aranea* has also been collected from northeastern Australia, Lesser Sunda and Sunda Islands; while *O. neptunus* is widespread in the Indo-West Pacific including east Africa, Sri Lanka and Hawaii. The distribution of each species is listed in detail in the accounts.

In this genus the basal antennal article is very slender, free distally and doesn't even reach the anterior margin of the eyestalk. There is only a weakly developed interantennular partition and no interantennular spine. The first pleopod of the male is twisted about three times, this is much more twisted than is usual in majids.

In this report we describe a new species of *Oncinopus* which is clearly distinguished from the three other known species by its relatively long, dorsoventrally flattened rostral lobes and the broad interorbital region of the carapace.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *ONCINOPUS*

1 Rostral lobes broad, dorsoventrally flattened, separated by a narrow hiatus, inner margins of lobes parallel, outer margins curved, converging distally; interorbital region broad, concealing most of unretracted eyestalk ..... *O. postillonensis*
– Rostral lobes weak and narrow or triangular, not dorsoventrally flattened, separated by a broad hiatus, lobes divergent or outer margins parallel; interorbital region only concealing basal part of unretracted eyestalk 2
2 (1) First pleopod of male only slightly widened before apex, aperture on abdominal surface; female gonopore a simple ventral opening, not elevated ..... *O. neptunus*
– First pleopod of male strongly widened before apex or with a lateral lobe; female gonopore at least weakly elevated 3
3 (2) First pleopod of male strongly widened subapically; female gonopore on a weak elevation, opening more posteriorly than medially ..... *O. angustifrons*
– First pleopod of male with a beak-like lateral lobe subapically; female gonopore distinctly elevated and opening medially ..... *O. aranea*

Oncinopus angustifrons Takeda & Miyake, 1969

Oncinopus angustifrons Takeda & Miyake, 1969:478-481 figs. 4, 5c, d. — Sakai, 1976:156.

Material examined. — 3♂♂, 4♀♀ (2 ovig.), 6-10.5 mm, smallest ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 260, Kai Is., 2.3 miles (∿ 3.7 km) N 63°W from the north point of Nuhu Jaan, 05°36.5'S 132°55.2'E, 90 m, dredge, sand, coral and shells, 16/18 December 1899; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Philippine Is., San Bernadino Strait, 12°27'N 124°3'E, 90-180 m, 3 August 1911; 1 spec.

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 1 spec.

Danish Kei Islands Expedition: Stn. 24, Kai Is., 05°37'S 132°56'E, 100 m, hard bottom, 15 April 1922; 1 spec.

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Mariel King Memorial Expedition — Moluccas: Stn. AM II, Aru Is., Maikoor, approx. 8 miles (∿ 13 km) SW of Tg. Ratoe, centred near 06°7'S, 133°57'E, 45-75 m, dredge hauls 1-4, sand and rubble, 18 June 1970; 1 spec. — Aru, 54-63 m, dredge, sand and rubble, June 1970; 1 spec.

Remarks. — the males of this species can be distinguished from those of *O. aranea* and *O. neptunus* by the first pleopod of the male (Takeda & Miyake, 1969). Our male specimens of *O. angustifrons* are from Kai Islands and Aru. The females of this species can usually be distinguished from those of *O. neptunus* and *O. aranea* by the shape of anterior carapace and rostral lobes. In *O. angustifrons* the anterior part of the carapace is tapered strongly from the broad hepatic region to the constriction behind the rostral lobes which are directed obliquely outwards. In *O. aranea* the anterior part of the carapace is not so strongly tapered and the rostral lobes are less constricted basally, while in *O. neptunus* the lateral margins in front of the hepatic region are only weakly convergent or almost subparallel, the rostral lobes are parallel and directed forward. Mature females agreeing closely with the female figured by Takeda & Miyake (1969: fig. 4b) have a gonopore on a weak elevation and opening more posteriorly than medially. In *O.*

neptunus the gonopore is a simple ventral opening and in *O.* ***aranea*** it is distinctly elevated and opens medially.

These records extend the range of this species previously known only from off Japan.

Distribution. — Japan, Philippine Islands, Kai Islands, Aru.

Oncinopus aranea De Haan, 1839

Inachus (Oncinopus) aranea De Haan, 1839:100, pl. 29 fig. 2.
Oncinopus aranea. — Takeda & Miyake, 1969:477, 481, fig. 5, e, f. — Sakai, 1976:155-156, pl. 48 fig. 1.

Material examined. — 6 ♂♂, 14♀♀ (7 ovig.) 5.5-11 mm, smallest ovig. ♀, 6 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 65a, Flores Sea, Tanahdjampea, near 07°S 120°34′E, from 400 m, dredge, pale grey mud changing to coral, 6 May 1899; 1 spec. — Stn. 99, Sulu Archipelago, anchorage off North Ubian, 06°07.5′N 120°26′E, 16-23 m, dredge, townet, *Lithothamnion* bottom, 29 June 1899; 3 specs. — Stn. 260, Kai Is., 2.3 miles (∼ 3.7 km) N 63°W from N point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, dredge, sand, coral and shells, 16/18 December 1899; 1 spec. — Stn. 315, Flores Sea, Paternoster Is., (Kepulauan Tengah), anchorage E of Sailus Besar, up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 2 specs. — Lesser Sunda Islands, Haingsisi; 2 specs.

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Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 2 specs.

Mortensen Java - S. Africa Expedition: Stn. 5, Bali Strait, 08°23′S 114°29′E, 70 m, trawl, sand, 5 April 1929; 1 spec.

Danish Kei Islands Expedition: Stn. 83, Sunda Strait, 06°42′S 105°17′E, 45 m, trawl, sandy mud, 30 July 1922; 1 spec. — Stn. 93, Sunda Strait, Lampung Bay, 05°44′S 105°30′E, 3 m, dredge, 1 August 1922; 1 spec.

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Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg Tutuhuhur, 03°15′S 128°8′E, 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 3 specs.

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Queensland: Off Moreton Bay, 27°27′22″S 153°39′E, 75 m, coll. W. F. Ponder, 'Kimbla', 29 March 1969; 2 specs (AM P.29931). — Coral Sea, Saumarez Reef, near 21°40′S 153°40′E, 8 m, in cave at night, coll. N. Coleman, 17 August 1977; 1 spec. (AM P.29930).

Remarks. — The males of this species can be distinguished from those of *O. neptunus* and *O. angustifrons* by the form of the first pleopod of the male (Takeda & Miyake, 1969). Our male specimens of *O. aranea* are from Ceram, Sulu Archipelago and the eastern coast of Australia.

Females were associated with the males of this species on the basis of their similarity in the shape of the anterior carapace and the rostral lobes. The anterior part of the carapace is not as strongly tapered as in *O. angustifrons* but not almost subparallel or only weakly tapered as in *O. neptunus*. The rostral lobes are usually blunt, directed forward and slightly outwards and only weakly constricted basally. In *O. neptunus* the rostral lobes are parallel and directed forwards and in *O. angustifrons* the rostral lobes are strongly constricted at the base.

In mature females of this species the gonopore is on a distinct elevation and the opening is more medial than posterior; in *O. angustifrons* the elevation is not as prominent and the opening is more posterior than medial; while in *O. neptunus* there is a simple unelevated ventral opening.

Distribution. — Eastern Australia, Kai Islands, Ceram, Lesser Sunda Islands, Sunda Islands, Sulu Archipelago, Japan.

Oncinopus neptunus Adams & White, 1848

Oncinopus neptunus Adams & White, 1848:1-3, pl. 2 figs. 1, 1a, b. — Takeda & Miyake, 1969:477, 478, figs. 3, 5a, b. — Griffin, 1974:22. — Takeda, 1977:120-121, pl. 12A.
Oncinopus subpellucidus Stimpson, 1857:221; 1907:34.
Oncinopus angulatus Haswell, 1880b:433-434.

Material examined. — 11♂♂, 27♀♀ (12 ovig.), 5-13 mm, smallest ovig. ♀, 6.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 43, Flores Sea, Postillon Islands, anchorage off Pulu Sarassa, to 36 m, dredge, coral, 4-5 April 1899; 1 spec. — Stn. 99, Sulu Archipelago, anchorage off North Ubian, 06°07.5′N 120°26′E, 16-23 m, dredge, townet, *Lithothamnion* bottom, 29 June 1899; 4 specs. — Stn. 282, anchorage between Nusa Besi and NE point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Aru, Jedan, 1899; 1 spec. Java Sea, otter trawl, 'Rambang', April-May 1907; 1 spec. — Aru, Jedan, 10 December 1907; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, sand, coral, 19 March 1914; 1 spec. — Honolulu, 18-72 m, coral, 5 May 1915; 4 specs.

Danish Kei Islands Expedition: Off Neira Banda, ca. 20 m, dive, sand, 1 June 1922; 1 spec. — Stn. 67, Java Island, 05°48′S 106°12′E, 38 m, trawl, sand, 27 July 1922; 1 spec. — Stn. 72, Java Sea, 05°41′S 105°57′E, 35 m, stones, 28 July 1922; 1 spec. — Stn. 82, Sunda Strait, 06°38′S 105°21′E, 35 m, trawl, sandy mud, 20 July 1922; 1 spec. — Stn. 90, Sunda Strait, 05°55′S 105°30′E, 36 m, hard bottom, 1 August 1922; 2 specs. — Stn. 91, Sunda Strait, 05°53′S 105°27′E, 42 m, dredge, mud, 1 August 1922; 2 specs. — Stn. 106, Java Sea, 05°50′S 106°16′E, 32 m, sand, 5 August 1922; 3 specs.

'Galathea' Expedition: Stn. 330, 5 miles (8 km) SE. of Singapore, 40 m, trawl, sand and coral, 15 May 1951; 1 spec.

Sri Lanka, 61 m, don. Indian Museum; 1 spec. (previously det. as *O. aranea*).

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Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, 03°15′S 128°10′E, 25-36 m, dredge hauls 8-19, coarse sand, *Lithothamnion* and rubble, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N of Nuhu Rowa, N of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 2 specs. — Stn. KR VII, Kai Is., between Du Rowa and Kai Dulah Is., 05°32′S 132°46′E, 32-36 m, dredge haul 3, muddy sand and sponge, 11 June 1970; 1 spec. — Stn. AM II, Aru, 8 miles (13 km) SW of Tg Ratoe, Maikoor, 06°07′S 133°57′E, 25 m, dredge haul 15, *Lithothamnion* nodules, 18 June 1970; 1 spec. — Stn. AN 1,

Aru Is., S Trangan I., Tg. Ngabordamlu, 06°58′S 134°05′E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 3 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Noumea: Fosse aux Canards, 25 m, coll. Catala, 1972; 1 spec. (AM P.29933).

New South Wales: Byron Bay, Julian Rocks, 18 m, on sponge, coll. N. Coleman, May 1975; 1 spec. (AM P.23817). — Port Jackson, coll. R. Kuiter, October 1976; 1 spec. (AM P.29932).

Remarks. — The males of this species are distinguished from those of *O. aranea* and *O. angustifrons* by the form of the first pleopod of the male (Takeda & Miyake, 1969). Our male specimens of *O. neptunus* are from Hawaii, Noumea, eastern Australia, Ceram, Timor, Sunda Islands, Sulu Archipelago and Sri Lanka. The females were associated with the males of this species on the basis of specimens from Port Jackson; all males of *Oncinopus* from Port Jackson in the Australian Museum collection are *O. neptunus*. In this species the female gonopore is a simple, ventral opening which is not elevated; in *O. angustifrons* the gonopore is slightly elevated and opens posteriorly rather than medially and in *O. aranea* there is a distinct elevation and the opening is medial.

Among the specimens which can be identified as *O. neptunus* on the basis of the male pleopod or female gonopore there is some variation in the form of the rostral lobes. In *O. aranea* and *O. angustifrons* the small rostral lobes are the angles formed laterally when the front is folded downwards. In some specimens of *O. neptunus* this is also true but the folded front is usually more robust than that found in *O. aranea* and *O. angustifrons*. In other specimens of *O. neptunus* the rostral lobes are distinct structures produced forward from these angles and about equal in length to the width of the hiatus between them. The rostral lobes are either blunt, triangular, each about as long as its basal width and with a broad V-shaped hiatus between them or narrow basally, hardly tapering, each about twice as long as the basal width and with a broad U-shaped hiatus between them. The different types of rostral lobes do not seem to be restricted to particular geographic areas. In our series there are specimens with very weakly developed rostral lobes from Hawaii, Noumea, Sulu Archipelago, Timor and Java Sea; specimens with broad triangular rostral lobes from eastern Australia, Ceram, Sunda Strait and Sri Lanka; and specimens with narrow rostral lobes from Aru, Java Sea and Singapore. Although there are three different kinds of rostral lobes there is no justification for considering these specimens as belonging to more than one species. The same kind of first pleopod of the male is found in specimens with each of the different rostral lobes.

In the pleopod of the adult male of *O. neptunus* there are two close coils just beyond the broad base and the pleopod is twisted distally. In the immature male (with a slender chela) there is one open coil between the base and the twisted distal half.

Distribution. — East Africa, Red Sea, Arabian Sea, Sri Lanka, Straits of Malakka, Sunda Islands, Timor, Ceram, Banda, Kai Islands, Sulu Archipelago, Japan, Noumea, Hawaii and eastern Australia.

Oncinopus postillonensis new species
(Fig. 6)

Material examined. — 2 ♂♂, 2 ♀♀ (1 ovig.) 5-6 mm, ovig. ♀, 6.5 mm.

Holotype. — Male, cl. 6.0 mm, Flores Sea, Postillon Is., anchorage off Pulu Sarassa, up to 36 m, dredge, coral, 4/5 April 1899; 'Siboga' Expedition, Stn. 43. Zoological Museum, Amsterdam.
Paratypes. As listed below:

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'Siboga' Expedition: Stn. 96, Sulu Archipelago, SE side of Pearl Bank, 15 m, dredge, townet, *Lithothamnion*, 27 June 1899; 1 spec. — Stn. 301, Timor, E coast of Roti I., Pepela Bay, 10°38′S 123°25.2′E, 22 m, dredge, mud, coral and *Lithothamnion*, 30 January 1900; 1 spec. — Stn. 315, Flores Sea, Paternoster Is., anchorage east of Sailus Besar, up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 1 spec.

Description. — Carapace of almost uniform width anteriorly, widened posteriorly; carapace width about 0.7 (male) to 0.8 (female) postrostral carapace length. Surface smooth with only two low tubercles.

Rostrum of two broad parallel lobes, dorsoventrally flattened, separated by a narrow U-shaped hiatus; length about one fifth (0.2) postrostral carapace length; medial margins with curled hairs.

Interorbital region broad, concealing most of eyestalk, only terminal cornea visible dorsally; lateral margin weakly elevated above eyestalk; eyestalk short and stout.

Hepatic margin very weakly produced.

Branchial region with longitudinal rows of curled hairs on dorsal margin.

Gastric regions elevated with a low, round posterior mesogastric tubercle. Cardiac region with a low, weakly bilobed tubercle. Intestinal region smooth.

Basal antennal article slender, smooth, distally free; second segment longer (1.5) than basal segment and more slender; third segment much shorter (0.3) than second and articulated with it at right angles (antennal filament directed laterally).

Third maxilliped smooth, ischium with a low ridge parallel and near to lateral margin; anterolateral angle of merus weakly produced, rounded.

Pterygostomian region narrow, smooth; margin weakly indicated, smooth. Sternum smooth; anterior apex with a narrow medial ridge separating lateral depressions.

Merus and carpus of male cheliped smooth with a row of long plumose hairs ventrally on outer face and a row of shorter hairs dorsally; chela with a row of short plumose hairs dorsally and ventrally; palm about three times as long as high; fingers about half as long as palm, weakly incurved; a very narrow, smooth gape between fingers in proximal two thirds.

First, ambulatory leg about twice (2.1) postrostral carapace length, smooth, propod and dactyl dorsoventrally flattened, length of propod about three times greatest width; anterior

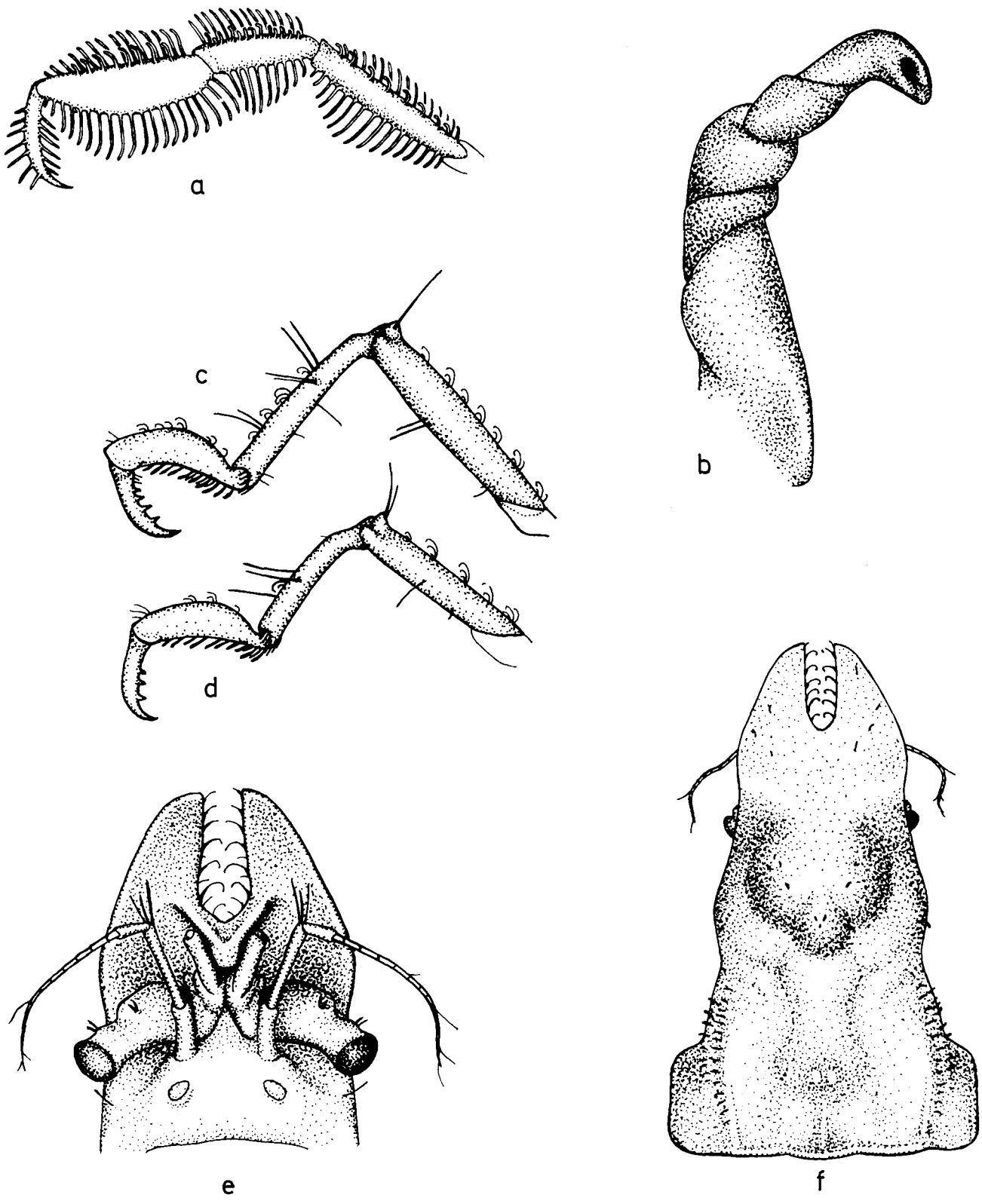


Fig. 6. *Oncinopus postillonensis* (holotype) (a) left first ambulatory leg, dorsal view; (b) left first pleopod, abdominal view; (c) left third ambulatory leg; (d) left fourth ambulatory leg; (e) orbits, ventral view; (f) carapace, dorsal view.

and posterior margins of all leg segments with a fringing row of long plumose hairs; a row of curled hairs dorsally on merus and carpus, anteriorly on propod and dactyl. Fourth ambulatory leg about half as long as first leg and slightly longer (1.1) than postrostral carapace length; merus, carpus and propod with groups of curled hairs dorsally; propod with a row of short plumose hairs ventrally; dactyl subchelate with three to five small teeth ventrally along its length.

Male abdomen of seven segments, third segment with lateral margin strongly produced, convex; fourth and fifth

segments with a large medial tubercle anteriorly and a rounded elevation laterally; sixth segment about two thirds as wide as third segment, width about five times length, a small medial tubercle anteriorly, and a small rounded elevation at anterolateral angle; seventh segment about three times wide as long.

First pleopod of male similar to that of other species of *Oncinopus*, twisted, with aperture terminal and abdominal.

Female abdomen of seven segments, smooth, a medial tubercle on third to fifth segments; a low medial ridge on sixth and seventh segments. Female gonopore a round aperture opening ventrally.

Remarks. — This species is distinguished from other known species of *Oncinopus* by the long, dorsoventrally flattened rostral lobes; by the broad interorbital region which conceals most of the eyestalk and by the presence on the first and second ambulatory legs of two fringing rows of evenly spaced hairs with setose margins.

We have in the collection another specimen (ovig. ♀, cl. 5 mm, Mortensen Pacific Expedition, Mindoro, Puerto Galera, 9 m, 3 February 1914, ZMC) in which the interorbital region is broad, concealing most of the unretracted eyestalk but which is not conspecific with *O. postillonensis*. The rostrum comprises two broad truncate lobes each about as wide as long, their lateral margins parallel and separated by a narrow medial slit. This specimen lacks the anterior interantennular partition present in *O. postillonensis* and the fringing hairs on the first and second pairs of ambulatory legs do not have such setose margins. The gastric regions are strongly elevated. This specimen appears to be a new species of *Oncinopus* but the material would not justify a full description.

Distribution. — Flores Sea, Timor, Sulu Archipelago.

Paratymolus Miers, 1879

Type species. — *Paratymolus pubescens* Miers, 1879, by monotypy.

Remarks. — In this genus the basal antennal article is not fused anteriorly to the carapace, the rostral lobes are only weakly developed and the abdomen in both males and females is triangular, with segments 3-5 fused in the male. The first pleopod of the male differs from that of most majids and the relationship of *Paratymolus* to other genera needs to be studied further.

P. latipes Haswell 1880 and *P. sexspinosus* Miers 1884 are recognisably distinct species. The status of *P. bituberculatus* Haswell 1880 and *P. hastatus* Alcock 1895, both possible synonyms of *P. pubescens*, is uncertain. We here describe and figure five kinds of male first pleopods of specimens which belong to a 'pubescens' group but we cannot yet satisfactorily distinguish them as distinct species using other characters.

Distribution. — Indo-West Pacific.

PARTIAL KEY TO SPECIES OF *PARATYMOLUS*

1 Carapace with several dorsal tubercles .....*P. pubescens* species group
- Carapace dorsally smooth 2
2 (1) anterolateral margin behind orbit with three spines; rostral lobes apically truncate with a medial and a lateral spine; second segment of antennal peduncle at least 2/3 as long as last segment of peduncle; first pleopod of male short and broad .....*P. latipes*
- Anterolateral margin behind orbit with two blunt tubercles (or one tubercle and one spine); rostral lobes apically convex with a small spine on the lateral slope; second segment of antennal peduncle only about $^1/_2$ as long as last segment; first pleopod of male long and slender.....*P. sexspinosus*

Paratymolus latipes Haswell, 1880
(Figs. 7h, 11b)

Paratymolus latipes Haswell, 1880a:303-304, pl. 16 figs. 3-5; 1882: 143. — Griffin, 1966:276 (in key).
Paratymolus latipes var. *quadridentata* Baker, 1906:107-108, pl. 1 fig. 2. — Hale, 1927: 123, fig. 119.

Material examined. — 6♂♂, 7♀♀ (6 ovig.), 4-10 mm, smallest ovig. ♀, 7.0 mm.

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New South Wales: Port Stephens Heads, September 1919; 1 spec. (AM P.4868). — Port Stephens, off Red Rocks, 6-12.5 m, dredge, 30 August 1920; 2 specs. (AM P.4927). — Off Norah Head, 47-68 m, coll. F. A. McNeill and A. A. Livingstone, June 1921; 1 spec. (AM P.5352). — Port Jackson, off Sow and Pigs Shoal, 10 m, 1929; 4 specs. (AM P.9400). — Port Jackson, off Chinaman's Beach, dredge, dead shells and sand, 8 May 1971; 1 spec. (AM P.23821). — Near Sydney, Bondi Beach, January 1922; 3 specs. (AM P.5651). — Near Sydney, 2 km E of Long Bay, 66 m, dredge, 23 May 1973; 1 spec. (AM P.20695).

Remarks. — Haswell (1880a) described this species as having a lateral spine on each rostral lobe and Baker (1906) described *P. latipes quadridentata* from South Australia as having two spines on each rostral lobe. All the specimens of *P. latipes* in the collection at the Australian Museum have two spines on each rostral lobe, one lateral and one medial or else it can be seen obviously where they have been broken off.

The first pleopod of the male of this species has not previously been figured. The pleopod is short, straight, broad and robust with setae anteriorly on the medial and lateral margins and on the sternal surface. The apex is nearly truncate with a small area of pale-brown chitin-like surface with a straight sternal edge. The aperture is indistinct but appears to lie on the sternal surface just below this straight, sharp edge.

The sixth segment of the male abdomen is about one and a half times as long and one and a half times as wide as the seventh segment. The abdomen of the adult female is triangular with seven free segments.

Distribution. — Restricted to Australia, southeast and south to southwest Australia.

Paratymolus pubescens Miers, 1879
(Fig. 7a-e)

Paratymolus pubescens Miers, 1879b:45-46, pl. 2 figs. 6, 6a, b. — Ortmann, 1893:35, pl. 3 figs. 2, 2i; 1894:38. — Rathbun, 1910:317. — Sakai,

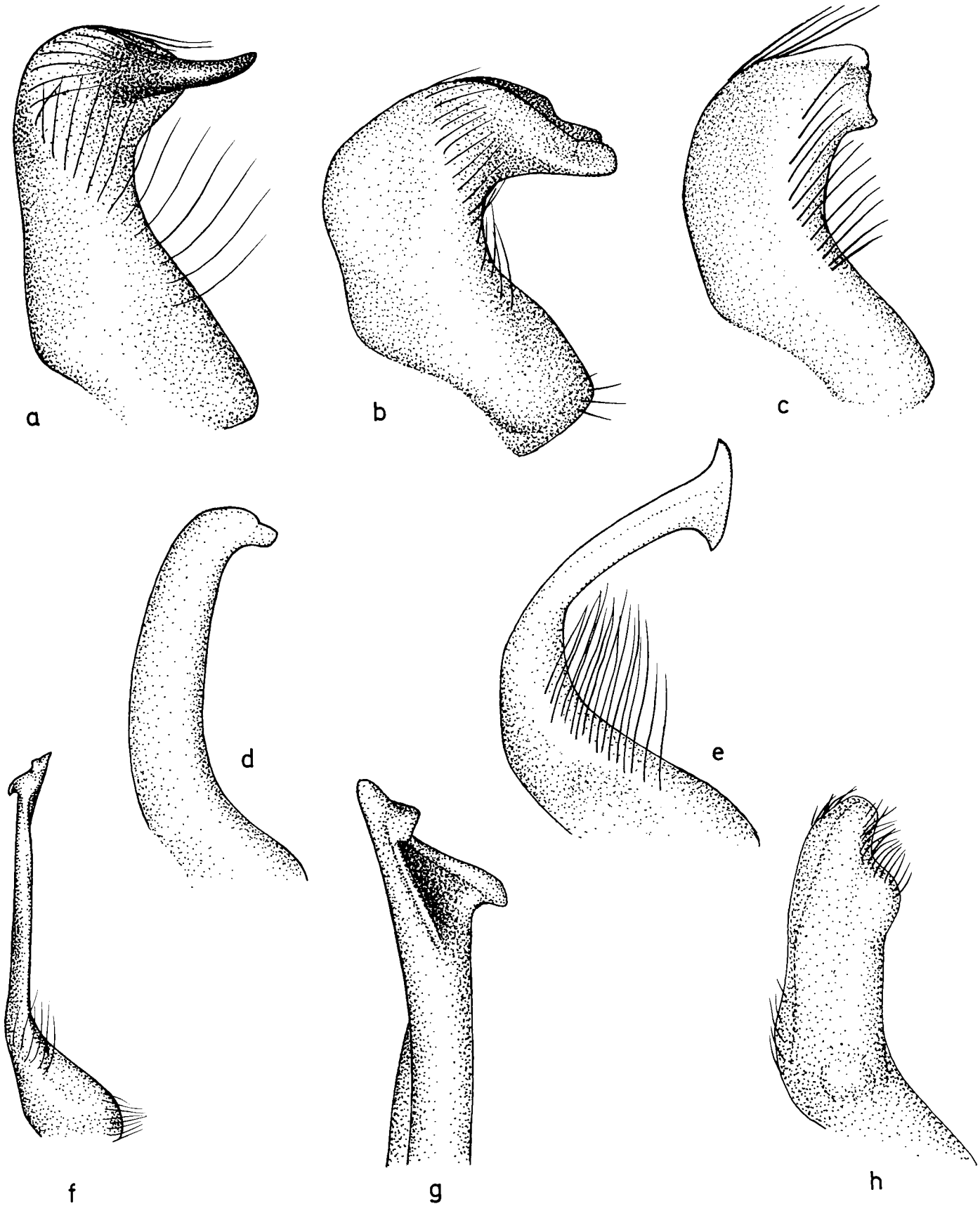


Fig. 7. *Paratymolus* '*pubescens*' group; left first pleopod of male, abdominal view: (a) 4.5 mm, Zamboanga, ZMC; (b) 4 mm, Salibabu I., ZMA; (c) 5.5. mm, Misaki, ZMC; (d) 3.5 mm, Singapore, ZMC; (e) 4 mm, Gulf of Thailand, ZMC. Left first pleopod of male of *P. sexspinosus* (6 mm, Aru, NIO Jakarta) (f) abdominal view of pleopod, (g) sternal tip of same; *P. latipes* (8 mm, AM P. 9400, in part) (h) abdominal view of pleopod.

1938:208-209, text fig. 4, pl. 21 fig. 1; 1965a:66, pl. 26 figs. 3, 4; 1976: 156-157, pl. 48 fig. 3. — Barnard, 1955:9-12, figs. 1, 2.

Material examined. — 5♂♂, 15♀♀ (7 ovig.), 3.5-6 mm, smallest ovig. ♀, 4 mm.

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'Siboga' Expedition: Stn. 49a, Sumbawa, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. — Stn. 99, Sulu Archipelago, anchorage off North Ubian, 06°07.5′N 120°26′E, 16-23 m, dredge, townet, 28-30 June 1899; 1 spec. — Stn. 133, North Sulawesi, Salibabu I., anchorage off Lirung, up to 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 1 spec. — Stn. 258, Kai Is., Tual anchorage, 22 m, reef exploration, dredge, *Lithothamnion*, sand and coral, 12/16 December 1899; 1 spec. — Aru Is., Jedan; 1 spec. — Banda; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Siam Expedition: Singapore, 4-5 m, 4 December 1899; 1 spec. (det. M. Rathbun). — Gulf of Thailand, Koh Kahdat, 7-9 m, sand, stones, coral, 15-18 February 1900; 1 spec. (det. M. Rathbun). — Gulf of Thailand, Tung Kaben, 11 m, dredge, sand and mud, 22 February 1900; 1 spec. (det. M. Rathbun).

Mortensen Pacific Expedition: Philippine Islands, Zamboanga, 5-9 m, sand, 1 March 1914; 2 specs. — Japan, Misaki, Aburazebo, 5.5 m, dredge, 2 May 1914; 1 spec.

Mortensen Java — S. Africa Expedition: Stn. 8, Java, 08°23′S 114°24′E, ca. 50 m, trawl, dredge, hard bottom, 6 April 1929; 1 spec.

Singapore, low water, 12 December 1906; 1 spec. — Singapore, low water, 22 July 1907; 1 spec. — South India, Pamban Passage, 5 m, coll. H. Lemche, 9 October 1951; 1 spec.

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Mariel King Memorial Expedition — Moluccas; Stn. CP I, Ceram, Piru Bay, off Tg Tutuhuhur, 03°15′S 128°8′E, 25-63 m, dredge hauls 8-19, sand, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N of Nuhu Rowa, N of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 1 spec.

Remarks. — This species has been described and figured in some detail by Barnard (1955) and Sakai (1938; 1965a; 1976). Both Ortmann (1894) and Barnard suggest that *P. bituberculatus* Haswell 1880 is probably a synonym of *P. pubescens*. Barnard also regarded *P. hastatus* Alcock 1895 as probably belonging to this species. Takeda (1977) described and figured a specimen from the Ogasawara Islands which he identified as *P. bituberculatus* and which he distinguished from *P. pubescens* by the strong tubercle on the eave; more prominent hepatic tubercle directed obliquely forward; and a greater number of larger tubercles on the cheliped, including a large terminal tubercle on the upper border of the palm. The only first pleopod of the male figured for any of these three species is that given for *P. pubescens* by Barnard (1955: fig. 2).

In this present series of 20 specimens there are five males and fifteen females. In three of these males the first pleopod is short and broad and in two males the first pleopod is long and slender. Of the males in the short pleopod group—in one (N. Sulawesi) the apex of the pleopod tapers laterally as in the specimen figured as *P. pubescens* by Barnard; in one (Japan) the apex of the pleopod is truncate and lateral and agrees with that of a male from Japan (AM G.468, in part) in the collection of the Australian Museum identified as *P. pubescens*; and in the remaining one (Zamboanga) the apex bears a strong, laterally directed spine. Of the two males in the long pleopod group, one (Gulf of Thailand) has the pleopod apex broad and truncate, while in the other (Singapore) the pleopod apex is narrow and convex.

Such pleopod differences would normaly indicate five clearly distinguishable species. We have examined these specimens in detail to determine what other differences distinguish them and find very few. Between the two pleopod groups there are small differences in the number and size of tubercles on the dorsal margin of the branchial region, in the direction of the spine on the cheliped carpus and, with one exception, in the presence or absence of large teeth on the dactyls of the ambulatory legs. There are none of the differences one would expect to find in shape and ornamentation of the rostral lobes, supraorbital eave, hepatic lobes, carapace generally and adult male chela, features which distinguish *Achaeus* species from one another.

In all the specimens in this series there is a tubercle or a tuft of large setae on the supraorbital eave, a small tubercle on the margin behind the orbit, a larger tubercle on the margin of the hepatic region, and dorsally a protogastric tubercle. The rostral lobes are usually separated by a small notch. In many specimens there is, concealed within the groups of large setae, a small spinule which has not been figured or described by previous authors. Such a spinule is often present on the anterior margin of the rostral lobes, the apex of the hepatic tubercle and on the merus and carpus of the cheliped.

The characters of the male specimens with different kinds of pleopods are summarised in table form and then discussed in detail.

We consider first the specimens with the short male pleopod. In the specimen from N. Sulawesi and the two specimens from Japan there is a mesogastric and a cardiac tubercle on the midline, there are two to three low tubercles on the dorsal margin of the branchial region and one small submarginal tubercle laterally. The male from Zamboanga differs from these in having no mesogastric tubercle, the cardiac tubercle is very low and there are two small submarginal tubercles laterally on the branchial region. In these four males the long spine on the carpus of the cheliped is directed forward, or slightly upward, and concealed behind the palm of the chela. Ventrolaterally on the merus of the cheliped there are three tubercles in the males from Japan and Zamboanga, but four larger setae in the male from Sulawesi. In all four males there are low tubercles or groups of setae on the outer face of the palm but the anterodorsal angle is not strongly produced. In the males from Japan and Zamboanga the first ambulatory leg is about twice the carapace length and in the male from N. Sulawesi it is more than three times the carapace length. The dactyls of the ambulatory legs in the specimen from N. Sulawesi are armed ventrally with many minute teeth; in the specimens from Japan with minute teeth and two larger recurved teeth; in the specimen from Zamboanga with

	Japan (fig. 7c)	N. Sulawesi (fig. 7b)	Zamboanga (fig. 7a)	Singapore (fig. 7d)	Gulf of Thailand (fig. 7e)
first pleopod	short, broad	as for Japan		long, slender	as for Singapore
mesogastric tubercle	1	1	0	1	1
cardiac tubercle	1	1	1 very low	1	1
tubercles on branchial dorsal margin	2-3	2-3	2	4	4
tubercles on branchial submargin	1	1	2	1	1
cheliped carpus spine	obliquely forward, hidden	as for Japan		almost vertical, visible	as for Singapore
cheliped merus ventrolateral margin	3 tubercles	4 large setae	3 tubercles	3 curved spinules	3 curved spinules
anterodorsal angle of palm strongly produced	no	no	no	no	no
$\frac{\text{amb leg 1}}{\text{cl}}$	2	3	2	2	3
teeth on dactyls of amb. legs	minute and 2 larger recurved	minute	2 large recurved	2 large recurved	2 large recurved

two very large recurved teeth, the proximal longer than the height of the dactyl.

The two males from Singapore and Gulf of Thailand with long first pleopods are similar in several respects. Both have a mesogastric and a cardiac tubercle on the midline, four tubercles on a ridge on the dorsal margin of the branchial region and a small submarginal tubercle laterally. The long spine on the cheliped carpus is nearly vertical or directed slightly forward, but not hidden behind the palm of the chela. There are three curved spinules ventrolaterally on the cheliped merus, two to three spinules on the outer face of the palm but the anterodorsal angle of the palm is not produced into a large tubercle. The dactyls of the ambulatory legs are armed ventrally with two large recurved teeth, the proximal longer than the height of the dactyl and twice as long as the distal tooth. In the male from Singapore the first ambulatory leg is slightly more than twice the carapace length and in the male from the Gulf of Thailand it is about three times the carapace length. The second last segment of the abdomen is very broad, almost three times as wide as the last segment in the specimen from the Gulf of Thailand, but only about twice as wide as the last segment in the specimen from Singapore.

Of the females in this series there are only three which we are able to confidently consider as conspecific with a particular male — one female conspecific with the male from Zamboanga and collected at the same station; the female registered with the male from Japan (AM G.468); and a female from the Gulf of Thailand which appears to be conspecific with the male from there. There are thirteen females from eleven stations which we do not feel confident in assigning to any of the males described. Five of these specimens (from Singapore, Java Sea, Sapeh Strait, South India) agree with each other in having a large mesogastric tubercle; a distinct row of three or four tubercles on the dorsal branchial margin; and the long spine on the cheliped carpus somewhat curved upwards, but not vertical. In these points they resemble the males from the Gulf of Thailand and Singapore and three of these females (from Singapore and South India) have two large recurved teeth on the ambulatory dactyls but cannot be assigned with certainty to either species represented by these males. The female from Sapeh Strait differs in having small teeth on the ambulatory dactyls and the specimen from Java Sea has the ambulatory legs missing.

Six of the females (from Aru, Kai Islands and Banda) agree with each other in having a small or indistinct mesogastric tubercle; one or two indistinct tubercles on the dorsal branchial margin; the long spine on the cheliped carpus horizontal and concealed behind the palm; and very small straight teeth with one or two slightly larger recurved teeth on the ambulatory dactyls. In these points they are similar to the males from N. Sulawesi and Japan but again there are insufficient distinguishing characters to assign them to either.

In two of our females (from Sulu Archipelago and Ceram) the mesogastric tubercle is small or indistinct; there are one or two low tubercles dorsally on the carapace margin; the spine on the cheliped carpus is nearly vertical and the teeth on the ambulatory dactyls are small. In these respects these specimens resemble the specimen from east Africa figured by Barnard. In the specimen from Ceram the ambulatory legs are longer (amb. leg 1 = 3 × cl.) than in the specimen from Sulu Archipelago (amb. leg 1 = 2 × cl.).

In this series of specimens the chela is more elongate in the female than in the male, the fingers are equal to the length of the palm in the female, while in the male the fingers are shorter (about 0.8) than the palm. In the females the cheliped and ambulatory legs are shorter in relation to the carapace length than they are in the male.

We feel there is no good purpose to be served in trying to assign these specimens to previously described species or to describe new species from this small and confusing sample of material. The relationships within the genus and the relationship of *Paratymolus* to other genera need to be studied more thoroughly. Beyond that, it is even possible that this genus should not be included in the Majidae because of the unusual pleopods of the males. Two other species of this genus *P. latipes* Haswell and *P. sexspinosus* Miers, discussed separately, are clearly distinguished by their smooth dorsal carapace from the specimens we have discussed under *P. pubescens*. The first pleopod of the male of *P. latipes* is short and broad, while that of *P. sexspinosus* is long and slender.

A female of *P. bituberculatus* Haswell was recently reported from Japan by Takeda (1977), but until a male specimen and its first pleopod are adequately described we feel the status of this species is uncertain.

Distribution. — This species (or group of species) is widely distributed throughout the Indo-West Pacific. (The distribution of any contained individual species is uncertain.)

Paratymolus sexspinosus Miers, 1884
(Fig. 7f, g)

Paratymolus sexspinosus Miers, 1884:261-262, pl. 27 fig. B. — Sakai, 1938: 209, pl. 21 fig. 2; 1976:157, pl. 48 fig. 2. — Griffin, 1966b:276 (in key).

Material examined. — 3♂♂, 2♀♀ (1 ovig.), 4-7.5 mm, ovig. ♀, 6.5 mm.

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Mariel King Memorial Expedition — Moluccas: Stn. A III, Aru, Trangan, 3-4 miles (∿ 5-6.5 km) W Tg. Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 3 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia: Broome, near entrance to Roebuck Bay, 9-11 m, dredge, coll. A. A. Livingstone, 26 September 1929; 1 spec. (AM P.13985). — 2 miles (∿ 3 km) S of Carnarvon, 7.5 m, on algae, coll. N. Coleman, 17 June 1972; 1 spec. (AM P.25101).

Remarks. — This species is distinguished from *P. pubescens* Miers by its smooth carapace without gastric, cardiac or branchial tubercles and from *P. latipes* Haswell by the presence of two blunt tubercles, not three sharp spines, on the anterolateral margin behind the orbit. The anterior margin of each rostral lobe is convex and there is a very small spine or tubercle on the lateral margin at the base of the curve in our specimens. This is clearly different from the rostral lobe of *P. latipes* in which the anterior margin is truncate with a spine at both the medial and lateral angles.

The first pleopod of the male of this species has not previously been figured. The pleopod is slender and straight, the apex obliquely truncate, with the medial angle produced into a ventrally curved lobe. The aperture is subterminal on the medial surface behind the lobe. This kind of pleopod is quite different from that in *P. latipes* where the first pleopod is broad and short.

The seventh segment of the male abdomen is small, only about a third as long and half as wide as the sixth segment. The abdomen of the adult female is triangular with seven free segments.

Distribution. — Japan, Aru Islands, NE and NW Australia, south India.

Physachaeus Alcock, 1895

Type species. — *Physachaeus ctenurus* Alcock, 1895, by present designation.

Remarks. — Only two species of this genus are known, *P. ctenurus* and *P. tonsor*, both described by Alcock. *Achaeus* (?) *longipes* Capart, from the Atlantic, which was tentatively included in this genus by Monod (1956) and others, has now been placed by Manning & Holthuis (1981) in a new genus *Capartiella*. *Physachaeus* species are distinguished from *Capartiella longipes* by the short almost immovable eyestalks and the double rostrum.

P. ctenurus is the better known species and is therefore chosen as the type species of the genus, neither Alcock nor subsequent authors having made any designation.

Distribution. — Indo-West Pacific.

Physachaeus ctenurus Alcock, 1895
(Fig. 8, 15f, g)

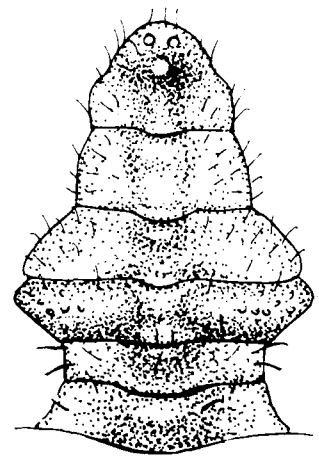
Physachaeus ctenurus Alcock, 1895:175-176, pl. 3 figs. 2, 2a-b. — Doflein, 1904:71-72, pl. 24 figs. 1-4, pl. 42 figs. 1-7. — Kemp & Sewell, 1912:30.

Material examined. — 1♂, 4♀♀ (3 ovig.) 6.5-8.5 mm, smallest ovig. ♀, 8.0 mm.

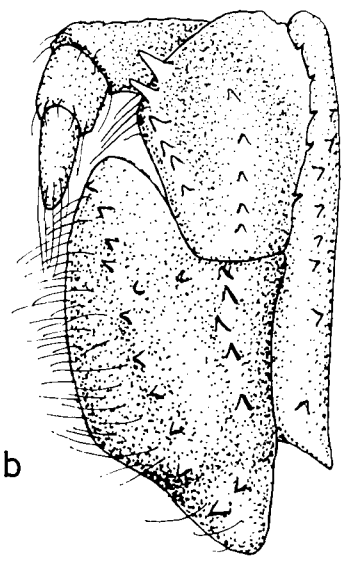
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Andaman Sea, 450 m; 1 spec.

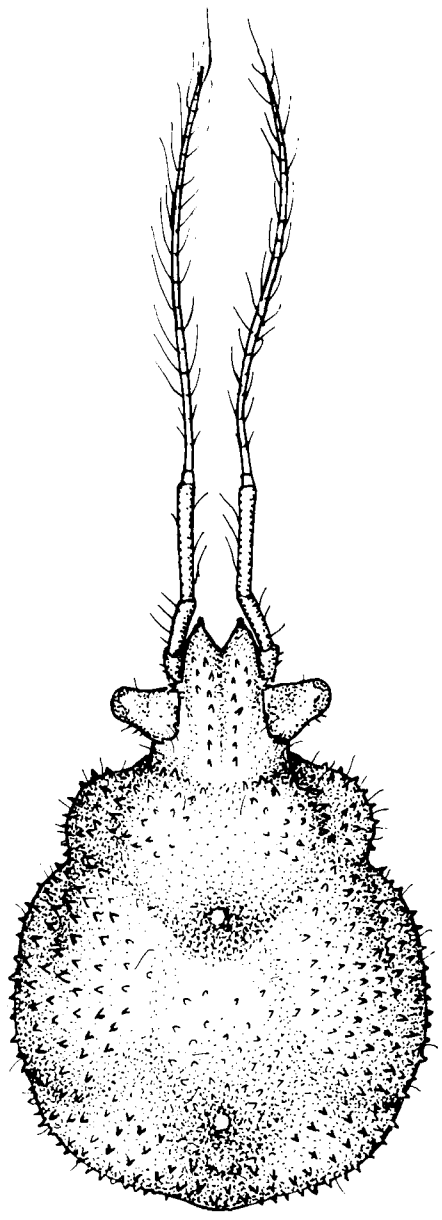
Mortensen Pacific Expedition: Mindanao, 7 miles (∿ 11 km) S of Olutanga, ca. 540 m, trawl, 8 March 1914; 1 spec. — Japan, 16 miles (∿ 26 km) W by S of Bonomisaki 360 m, trawl, 13 May 1914; 2 specs.



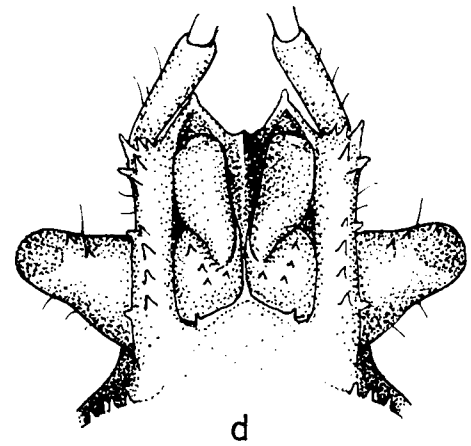
a



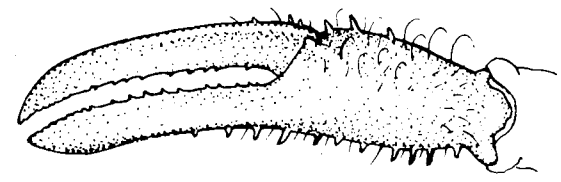
b



c



d



e

Fig. 8. *Physachaeus ctenurus* (male, 6.5 mm, Japan, ZMC) (a) male abdomen; (b) left third maxilliped; (c) carapace, dorsal view; (d) orbits, ventral view; (e) left chela.

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Andaman Sea, 428-495 m, 'Investigator'; 1 spec. (AM P.2688).

Remarks. — These specimens agree well with those figured and described by Alcock and by Doflein and with type material (1 ♂, 1 ovig. ♀, 7.3, 8.3 mm, Andaman Sea, BMNH 96.5.14.8) examined by one of us (Griffin in 1970). In all our specimens there is a blunt protogastric tubercle, a short mesogastric spine and a longer cardiac spine with a low transverse tubercle on the posterior slope. In the male specimen the apex of the rostral lobes exceeds the distal margin of the basal antennal article, but in all the female specimens the apex is level with the distal margin. The basal antennal article is not completely smooth in any of the

specimens: there are at least some granules and sometimes spines along the length of the basal antennal article in all the specimens. Alcock describes the distal end of the basal antennal article as fused to the rostral lobes. However, it is not actually fused as it is in *Achaeus*: the distal end of the basal antennal article is broadened and simply overlaps the rostral lobe dorsally, also being partly secured there by the spinulous lobe in front of the orbit. In the Japanese specimens the distal end of the basal antennal article is quite free and adjacent to the rostral lobe.

The first pleopod of the male is broad, curving only weakly outwards distally, the apex is blunt with a subterminal aperture on the medial edge of the abdominal surface and with a small flap on the proximal margin of the aperture. In our male specimen the tip of the pleopods is not covered by the last segments of the abdomen.

The abdomen of the female has the last three segments coalesced with a suture visible in the midline between the fifth and sixth segments; the narrow medial ridge terminates in a tubercle or short spine, in front of which is a transverse row of four small spines; beyond this row of spines the abdomen is abruptly curved dorsally.

Our specimens from Mindanao and Japan differ from those from the Andaman Sea in width of the rostral lobes, length of the basal antennal article and degree of spinulation. In our specimens from the Andaman Sea the basal antennal article is long (length is 7 to 8 times width) and the ventral interorbital area (between the lateral margins of the basal antennal articles) narrows anteriorly to about three quarters (0.7 to 0.8) of the proximal width. In the Pacific specimens, especially those from Japan, the basal antennal article is not so long (length is 5 to 6 times width) and the ventral interorbital area is almost square and does not narrow anteriorly. The rostral lobes of our specimens from the Andaman Sea are basally narrow and hardly tapering; they are separated by a narrow U-shaped hiatus and there is a deep narrow groove between the rostral ridges. The rostral lobes of the specimens from Japan are broad, triangular, separated by a wide V-shaped hiatus and there is a broad, shallow groove between the rostral ridges. The Japanese specimens are more spinulous than the specimens from the Andaman Sea, and also somewhat more spinulous than the specimen from Mindanao. In the Japanese specimens there are well developed spinules along the length of the basal antennal article, there are also spinules on the basal segment of the antennule, on the posterior margin of the antennal fossa and ventrally on the eyestalk. In both the male and immature female from Japan there is a row of spinules on the first sternite, across the anterior margin of the abdominal fossa, and there are also spinules on the midline.

This species was previously known only from the Indian Ocean and these specimens extend the range to the west Pacific. We are unable to say, from the study of the small number of specimens we have on hand whether there are consistent differences between populations in various parts of the total geographic range, as now known, which would warrant the recognition of distinct species. We have figured the male specimen from Japan.

Distribution. — East coast of Africa, SW coast of India, Andaman Sea, Nicobar Islands, Sumatra, Philippine Islands, Japan.

Platymaia Miers 1886

Type species. — *Platymaia wyvillethomsoni* Miers, 1886, by monotypy.

Remarks. — Like *Cyrtomaia* this genus is principally West Pacific. Of the six species only *P. turbynei* and *P. alcocki* occur in the Indian Ocean. Most confusion between species has concerned *P. wyvillethomsoni, P. remifera* and *P. alcocki*. One species was described from New Zealand in 1963, the first to be added to the genus since 1916 when Rathbun added three to the Philippines Indonesian fauna. However, it is possible that a further species remains to be described from Australia and New Zealand: an intensely spinous species quite different from *P. fimbriata*.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *PLATYMAIA*

1 Carapace surface granular or smooth, with or without a few small spines or tubercles; carapace usually subcircular.....2
\- Carapace surface spinulous or with at least 10 prominent spines; carapace usually subpyriform 5
2 (1) Interantennular spine well over twice length of rostral spines, rostral spines longer than postorbital spine 3
\- Interantennular spine no more than $1^1/_2$ times length of rostral spines, rostral spines equal to or shorter than postorbital spine 4
3 (2) A transverse row of 3 spines on gastric regions, mesogastric spine at same level as protogastric spines; branchial regions inflated posteriorly; first segment of abdomen of male with a single spine.....*P. maoria*
\- Mesogastric spine at a level posterior to protogastric spines; branchial regions not inflated posteriorly; first segment of abdomen in male with 3 spines in a transverse row .....*P. bartschi*
4 (2) Protogastric ridge running forward on each side of midline bearing one or two spines as well as tubercles; branchial regions separated from mesogastric region by shallow groove, not approximated in midline; palm of chela of male no more than $1^1/_2$ times height .....*P. wyvillethomsoni*
\- Protogastric ridge tuberculate, lacking spines; groove on each side of mesogastric region deep, branchial regions approximated in midline; palm of chela of male at least twice as long as high.....*P. alcocki*
5 (1) Carapace with numerous small spines in addition to larger spines; postorbital spine subequal to rostral spines; interantennular spine $2^1/_2$ to 3 times length of rostral spines.....*P. fimbriata*
\- Carapace surface smooth between major spines; postorbital spine greatly reduced, much smaller (0.25) than rostral spines; interantennular spine no more than twice length of rostral spines.....*P. turbynei*

Platymaia bartschi Rathbun, 1916
(Fig. 10e, f, Pl. 4a)

Platymaia bartschi Rathbun, 1916:529-530. — Sakai, 1965b:39, 43, Frontispiece 3; 1976:176, pl. 56. — Griffin, 1976:205.

Material examined. — 3 ♂♂, 59.5-65 mm, 1 juv. ♀, 16 mm.

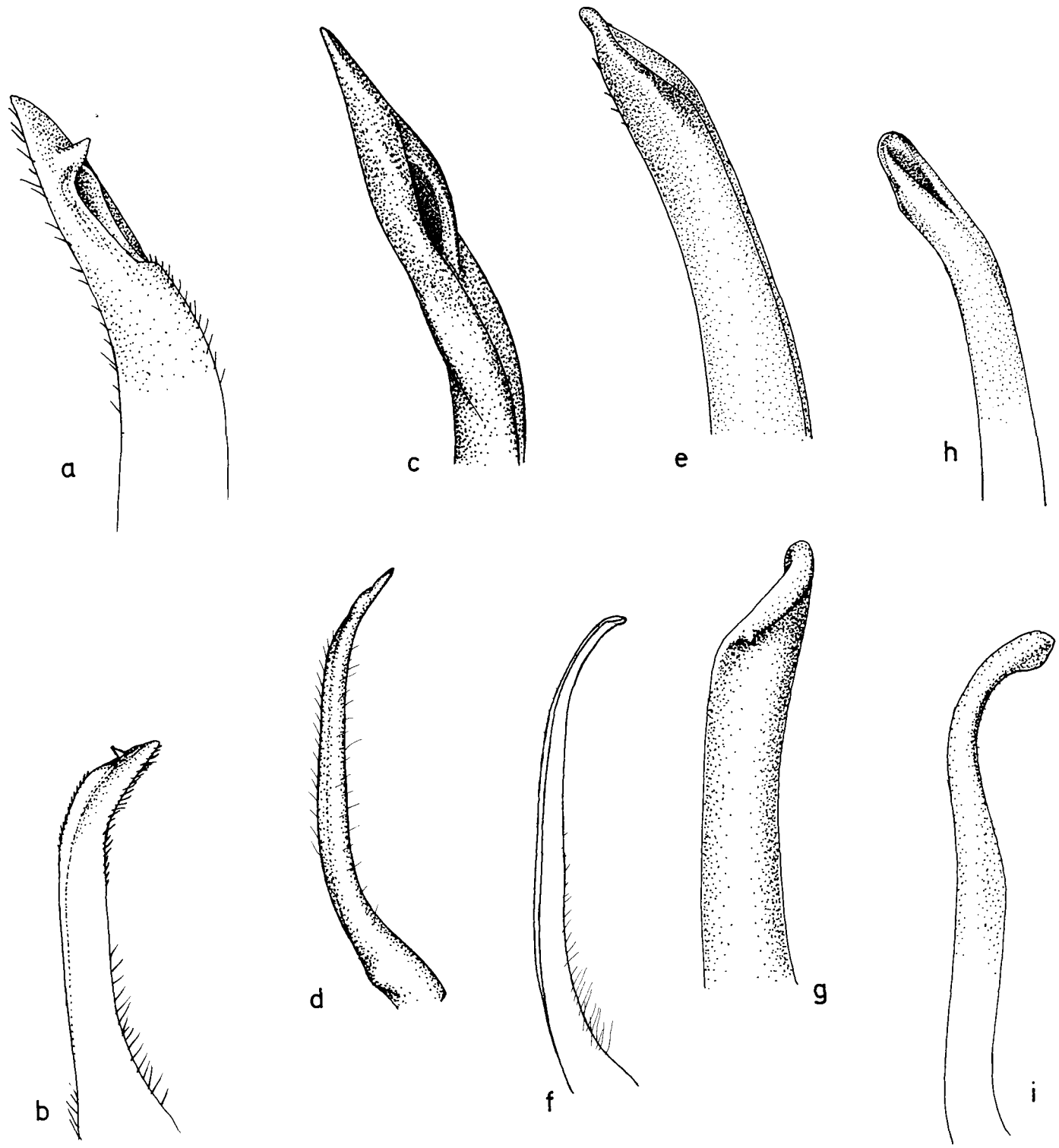


Fig. 9. Left first pleopod of male of *Pleistacantha cervicornis* (25 mm, New Caledonia, ZMC) (a) sternal tip of pleopod, (b) abdominal view of same; *Ephippias endeavouri* (114.5 mm, AM P.15991) (c) sternal tip of pleopod, (d) abdominal view of same; *Cyrtomaia suhmi* (AM P. 21572) (e) sternal tip of pleopod, (f) abdominal view of same, (g) abdominal tip of same; *C. murrayi* (WAM 13-67) (h) sternal tip of pleopod, (i) abdominal view of same.

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South China Sea, 16°09′N 114°31′E to 16°11′N 114°28′E 266-295 m, Granton trawl, fine, white, muddy sand, Fisheries Research Station Hong Kong, 12 June 1964; 1 spec. (AM P.20245). — South China Sea, 16°10′N 114°29′E to 16°11′N 114°26′E, 302-306 m, Agassiz trawl, fine, white, muddy sand, Fisheries Research Station Hong Kong, 12 June 1964; 1 spec. (AM P.20244). — South China Sea, 21°12′N 116°06′E to 21°13′N 116°02′E, 274-284 m, Granton trawl, sandy mud, Fisheries Research Station Hong Kong, 23 August 1964; 1 spec. (AM P.20246). — South China Sea, 20°06′N 115°04′E to 20°04′N 115°03′E, 454-461 m, Agassiz trawl, sandy mud, Fisheries Research Station Hong Kong, 22 August 1964; 1 spec. (AM P.20247).

Remarks. — This species is similar to *Platymaia wyvillethomsoni* and *P. alcocki* but may be distinguished by the following characters:-

a) the greater length (more than twice) of the interantennular spine in relation to the rostral spines; in *P. wyvillethomsoni* the interantennular spine is one and a half times the length of the rostrum and in *P. alcocki* equal to the rostrum;
b) the rostral spines are straight, weakly divergent and not broad basally;
c) the margins of the supraorbital eave are smooth—without spines, spinules or tubercles—and parallel to each other;
d) the gastric regions are strongly elevated, and the protogastric ridges are low, smooth or with very low tubercles, without prominent spines or tubercles;
e) the apex of the tip of the first pleopod of the male is directed laterally, not curved up as in the other two species.

The characters which distinguish *P. bartschi* and *P. maoria* Dell are discussed under that species.

The juvenile male in our series agrees well with juvenile specimens from the same area identified as *P. bartschi* by Rathbun (USNM, 47340, 26 juv.). Juveniles have twelve prominent carapace spines as well as spines on the lateral branchial margin. In the adults these spines are represented only by tubercles or are absent altogether. On the gastric regions there are two mesogastric spines, one anterior protogastric spine and two small spinules in front of it and almost on the edge of the orbit. There are two spines on the cardiac region: an anterior and posterior spine and a lateral spine on the intestinal region.

Distribution. — Philippine Islands, South China Sea, Japan.

Platymaia fimbriata Rathbun, 1916
(Fig. 10i, j)

Platymaia fimbriata Rathbun, 1916:531-532. — Ihle & Ihle-Landenberg, 1931:149-152. — Sakai, 1965b:39, 43, pl. 5 fig. 5; 1976:177-178, pl. 58. — Takeda & Miyake, 1969:497-498. — Griffin, 1976:206, fig. 9.

Material examined. — 6♂♂, 11♀♀ (8 ovig.), 14.5-51 mm, smallest ovig. ♀, 34.5 mm.

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'Siboga' Expedition: Stn 38, Bali Sea, 07°35.4′S, 117°28.6′E, 521 m, trawl, coral, 1 April 1899; 4 specs (ZMA De. 100.622, det. Ihle). — Stn 178, Ceram Sea, 02°40′S. 128°37.5′E, 835 m, deep sea trawl, blue mud, 2 September 1899; 1 spec. (ZMA De. 100.623, det. Ihle). — Stn 262, Kai Is, 05°53′S 132°48.8′E, 560 m, trawl, solid bluish grey mud, upper layer more liquid and brown mud, 18 December 1899; 1 spec. (ZMA De. 100.452, det. Ihle).

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F.R.V. Kapala: New South Wales: Off Point Danger, 28°06′S 153°59′E to 27°59′S 153°59′E, 405 m, trawl, 2 June 1978; 2 specs (AM P.29938). — Off Point Danger, 28°01′S 154°0′E to 27°58′S 154°0′E, 540 m, trawl, 17 August 1978; 1 spec. (AM P.29939). — NE of Wooli, 29°52′S 153°43′E to 29°46′S 153°45′E, 495 m, trawl, 10 October 1975; 3 specs (AM P.21689); 1 spec. (AM P.21797). — E of Clarence River, 29°26′S 153°49′E to 29°20′S 153°50′E, 450 m, trawl, 12 October 1975; 1 spec. (AM P.21693). — E of Wooli, 29°52′S 153°43′E to 29°51′S 153°43′E, 495 m, trawl, 23 August 1977; 3 specs (AM P.29946).

Remarks. — The specimens from ZMA were described by Ihle & Ihle-Landenberg (1931). The specimens from Australian waters agree with those previously described, though in a few of these specimens the carapace is less spinulous and on the dorsal surface of the third and fourth pairs of ambulatory legs there are only granules and a few very small spines. The interantennular spine is curved downwards at the apex. The previously known range of this species is extended.

Distribution. — Eastern Australia, Indonesia, Philippine Islands and Japan.

Platymaia maoria Dell, 1963
(Fig. 10g, h, Pl. 5a)

Platymaia maoria Dell, 1963:247-251, figs 4-13.

Material examined. — 9♂♂, 3♀♀ (3 ovig.), 38-59.5 mm, smallest ovig. ♀, 52.5 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

F.R.V. Kapala: New South Wales: Off Point Danger, 28°06′S 153°59′E to 27°59′S 153°59′E, 405 m, trawl, 2 June 1978; 1 spec. (AM P.29943): 3 specs. (AM P.29944). — Off Point Danger, 28°01′S 154°0′E to 27°58′S 154°0′E, 540 m, trawl, 17 August 1978; 3 specs. (AM P.29942). — E of Clarence river, 29°26′S 153°49′E to 29°20′S 153°50′E, 450 m, trawl, 12 October 1975; 1 spec. (AM P.21692). — NE of Wooli, 29°41′S 153°45′E to 29°32′S 153°47′E, 495 m, trawl, 10 October 1975; 1 spec. (AM P.21694); 1 spec. (AM P.21798). — E of Wooli, 29°52′S 153°43′E to 29°51′S 153°43′E, 495 m, trawl, 23 August 1977; 1 spec. (AM P.29945). — Off Cape Hawke, 32°15′S 153°02′E, 450 m, trawl, 5 April 1978; 1 spec. (AM P.29941).

Remarks. — These specimens agree well with the original description. This species is distinguished from *P. wyvillethomsoni* by the mesogastric spine which is level with the protogastric spine (not posterior to it) and forms a transverse row of three spines; there is one spine, not three, on the first abdominal segment of the male; the tip of the first pleopod of the male is directed laterally and straight (not abruptly curved forward); the eyes (cornea) are proportionately larger (length about $^3/_4$ interorbital width, not less than 2/3 as in *P. wyvillethomsoni*); and the branchial region is more inflated laterally, especially posteriorly. (The presence or absence of a marginal spine on the supraorbital eave is not a reliable character for distinguishing *P. wyvillethomsoni*.)

This species is distinguished from *P. bartschi* by the presence of a transverse row of three spines on the gastric region; the absence of a weakly tuberculate protogastric ridge; the presence of one spine not three on the first abdominal segment of the male; and by having distinct spines rather than tubercles on the carapace.

In *P. turbynei* there is a similar transverse row of three spines on the gastic region, but the carapace surface in that species is quite smooth (not granular) and the carapace is clearly longer than broad.

This species was previously known only from New Zealand.

Distribution. — New Zealand, eastern Australia.

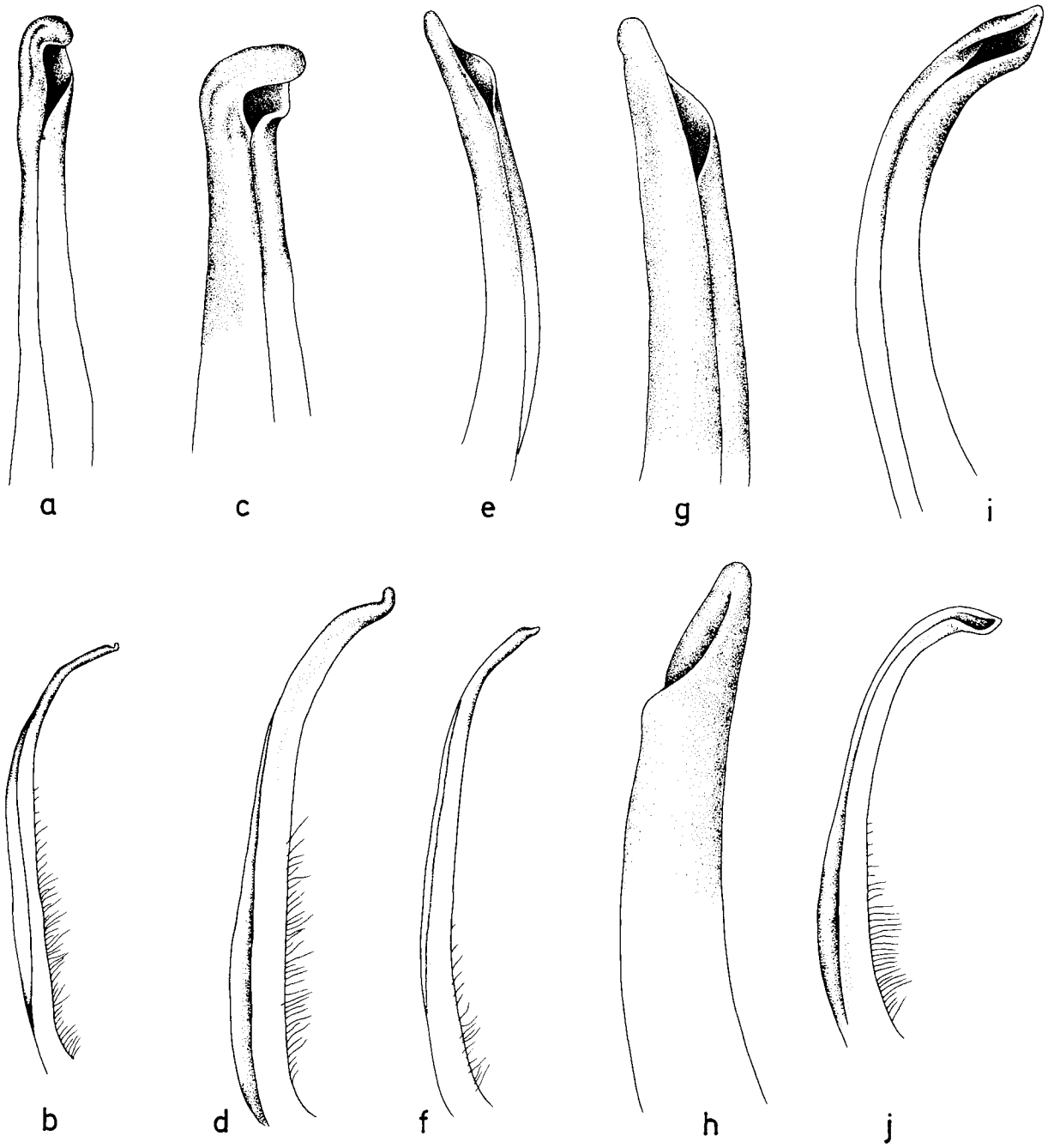


Fig. 10. Left first pleopod of male of *Platymaia alcocki* (62.5 mm, AM P.17794) (a) sternal tip of pleopod, (b) abdominal view of same; *P. wyvillethomsoni* (35 mm, AM P. 20744) (c) sternal tip of pleopod, (d) abdominal view of same; *P. bartschi* (65 mm, AM P. 20245) (e) sternal tip of pleopod, (f) abdominal view of same; *P. maoria* (38 mm, AM P.21694) (g) sternal tip of pleopod, (h) abdominal tip of same; *P. fimbriata* (32.5 mm, Ceram Sea, ZMA De. 100.623) (i) abdominal tip of pleopod, (j) abdominal view of same.

Platymaia wyvillethomsoni Miers, 1886 (Fig. 10c, d, Pl. 5b)

Platymaia wyvillethomsoni Miers, 1886:13-14, pl. 2 fig. 1. — Rathbun, 1918:7-9, pls. 3, 4, 14. — Ihle & Ihle-Landenberg, 1931:148-149. — Miyake, 1936:417-418, fig. 1, pl. 28 fig. 3. — Sakai, 1938:238-239, pl. 24 fig. 2.

Platymaia remifera Rathbun, 1916:530-531. — Serène & Lohavanijaya, 1973:48-49, figs. 79-92, pl. 8A-C.

Platymaia alcocki. — Seno & Konno, 1954:85-88, fig. 1, pl. 2. — Takeda & Miyake, 1969:498-500, figs. 10a, b, 11a-c. — Sakai, 1976:176-177, fig. 94a, pl. 57. (Not *Platymaia alcocki* Rathbun, 1916.[9])

Platymaia wyvillethomsoni. — Griffin, 1976:206, 208. — Sakai, 1976:177, text-fig. 94b.

Material examined. — 19♂♂, 18♀♀ (2 ovig.), 15-51.5 mm, 1 juv. 9 mm, smaller ovig. ♀, 32.5 mm.

[9]) The name *alcocki* was first used in 1916 although Rathbun (1918) cites the name as a *nom. nov.*

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'Siboga' Expedition: Stn. 12, Bali Sea, 07°15′S 115°15.6′E, 289 m, trawl, mud and broken shells, 14 March 1899; 1 spec. (ZMA De.100.675, det. Ihle). — Stn. 139, Moluccas, 00°11′S 127°25′E, 397 m, trawl, mud, stones and coral, 4 August 1899; 1 spec. (ZMA De.100.636, det. Ihle).

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Mortensen Pacific Expedition: Philippine Is., 25 miles (40 km) E by S of Zamboanga, 290-360 m, Sigsbee trawl, 3 March 1914; 1 spec. — Philippine Is., 15 miles (24 km) W ½S of Jolo, 450 m, Sigsbee trawl, soft bottom, 27 March 1914; 6 specs. — Near Nagasaki, 9 miles (~ 14 km) W by N ½N of Bonomisaki, 243 m, trawl, 13 May 1914; 1 spec. — Japan, 23 miles (~ 37 km) NW ¾W of Goto, 32°49′N 128°14′E, 207 m, trawl, sand, 14 May 1914; 1 spec. — Japan, ca. 32°17′N 128°11′E, 198 m, trawl, sand, 14 May 1914; 2 specs.

Mortensen Java — S. African Expedition: Stn. 15, Bali Sea, 07°29′S 114°49′E, ca.240 m, Sigsbee trawl, sand and mud with concretions, 10 April 1929; 2 specs.

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South China Sea: 19°09′N 112°31′E, 184-194 m, prawn trawl, hard sand, University Hong Kong Fisheries Research Unit, 22 July 1958; 2 specs. (AM P.20242). — South China Sea, 16°09′N 114°31′E to 16°11′N 114°28′E, 266-295 m, Granton trawl, fine, white, muddy sand, Fisheries Research Station Hong Kong, 12 June 1964; 1 spec. (AM P.20243).

Queensland: SE Noosa Heads, 26°33′S 153°50′E, 270 m, coll. A. J. Bruce, F. V. Nimbus, Stn. 13, 27 July 1968; 2 specs. (AM P.17882). — SE Noosa Heads, 26°27′S 153°50′E, 266 m, coll. A. J. Bruce, F. V. Nimbus, Stn. 55, 5 August 1968; 1 spec. (AM P.17881).

New South Wales: E of Kiama, 34°38′S 151°15′E to 34°46′S 151°13′E, 450-432 m, trawl, F.R.V. Kapala, 30 June 1975; 1 spec. (AM P.20744). — SE of Coffs Harbour, 30°26′S 153°24′E to 30°20′S 153°26′E, 263-252 m, trawl, F.R.V. Kapala, 14 October 1975; 1 spec. (AM P.21695). — Off Port Stephens, 32°33′S 152°53′E to 32°30′S 152°53′E, 360 m, F.R.V. Kapala, 29 March 1978; 1 spec. (AM P.29940).

Western Australia: Great Australian Bight, 33°18′S 127°19′E to 33°20′S 127°29′E, 300-310 m. otter trawl, coll. J. Paxton, 'Dmitry Mendeleev', 27 February 1976; 14 specs. (AM P.21955).

Remarks. — Japanese authors (e.g. Sakai, 1976) still use the presence or absence of a small spine proximally on the supraorbital eave as the basis for distinguishing *P. wyvillethomsoni* from *P. alcocki* Rathbun. However, it has been shown previously (Griffin, 1974; 1976) that this is not a reliable character for distinguishing the two species. Other characters of *P. alcocki*, referred to by Rathbun (1916:530)—the approximation of the branchial regions in the midline; the interantennular spine subequal to the rostral spines; the palm of the chela more than twice as long as high—have proved to be much more reliable in distinguishing that species from *P. wyvillethomsoni*. Of the 37 specimens in this series 13 are without any spine on the supraorbital eave while the rest, including 14 small specimens (15-18 mm) from the Great Australian Bight, have a small tubercle or spinule on the orbit. Of the 66 specimens from the Philippine Islands reported previously (Griffin, 1976) 27 have a spine of some sort on the supraorbital eave. Of 10 specimens of *P. alcocki* from the Indian Ocean (Griffin, 1974) all but the three smallest specimens have one to five spinules or small tubercles laterally on the supraorbital eave.

The two species can be distinguished by the following characters: —

Character	*P. wyvillethomsoni*	*P. alcocki*
Interantennular spine	1½ × rostral spines	equal to rostral spines
Protogastric region	2 spines or 1 spine & anterior tubercle	tubercular ridge without spines
Branchial regions	not approximating in midline; no ridge between dorsal tubercles	approximating in midline; ridge between dorsal tubercles
Palm of adult male chela	dorsal length = 1½ × height	dorsal length more than twice height.
Seventh segment female abdomen	free edge without medial notch	free edge with medial notch
cl. ovigerous females	24-38 mm	58-65 mm

We have figured the carapace, first left pleopod and chela of the male of *P. alcocki* (Pl. 4b; figs. 10a, b; 11c).

It is quite clear from the very large series of specimens we have examined that *P. wyvillethomsoni* is a western Pacific species and that *P. alcocki* occurs in the Indian Ocean.

Distribution. — West Pacific from South Australia through Indonesia and the Philippine Islands to Japan.

Pleistacantha Miers, 1879

Type species. — *Pleistacantha sanctijohannis* Miers, 1879, by monotypy.

Remarks. — In this genus the basal antennal article is very slender and not fused distally to the carapace. There is a well developed, usually bifid, interantennular spine, and in addition to the rostral spines there is a short spine at or near the apex of each antennular fossa. The first pleopod of the male has a subterminal aperture near the medial edge and in five species there is a slender process just in front of the aperture.

P. terribilis Rathbun is here shown to be a synonym of *P. cervicornis* Ihle & Ihle-Landenberg. The sub-species *P. sanctijohannis erecta* described by Ihle & Ihle-Landenberg and elevated to a species by Guinot & Richer de Forges (1982a) is not given status by us.

All of the type material of the new *Pleistacantha* species described in 1931 by Ihle & Ihle-Landenberg (*P. cervicornis*; *P. sanctijohannis erecta*) from the 'Siboga' Expedition could not be located when this study was commenced and due to a misunderstanding we were not informed when it was eventually located. This material has been studied by Guinot & Richer de Forges (1982a).

When Miers (1886) described *Ergasticus naresii* from the Admiralty Islands he placed it in the genus *Ergasticus* on the basis of the rostral spines only having accessory spines near the base; the female abdomen having six, not seven, free segments and the merus of the third maxilliped being produced and rounded at the anterolateral angle. The type and only other species of the genus *Ergasticus* is *E. clouei* Studer,

1883 from the Mediterranean. Some later authors (Doflein 1904; Bouvier, 1922) regarded the genus *Ergasticus* as synonymous with *Pleistacantha* while others (Ihle & Ihle-Landenberg, 1931; Balss, 1957) regarded *E. naresii* as belonging to *Pleistacantha* and *E. clouei* as representing a distinct genus. Bouvier (1940) has retained both species in *Ergasticus*. The characters of *E. naresii* which Miers listed as distinguishing that species from *Pleistacantha* are also found in other species of the latter, expanded, genus as it is presently known or are characters which are very variable within the genus. In *P. simplex* Rathbun there are no spines, only a few long setae, on the rostral spines above the base; there are only six free abdominal segments in the females of *P. sanctijohannis*, *P. cervicornis* and *P. exophthalmus* Guinot & Richer de Forges and the degree to which the anterolateral angle of the third maxilliped is produced varies from narrow to broadly triangular. The interantennular spine is undivided in *E. naresii, P. cervicornis* and *P. exophthalmus* while in other species it varies from basally divided (*P. simplex*) to apically bifid (*P. japonica* (Yokoya)). One of us (D. J. G. G.) has examined the holotype of *Ergasticus naresii* (♀, cl. 9.0 mm, BMNH 84.31): we believe that the distinctions made by Miers do not justify placing this species in a separate genus and that it should be included in *Pleistacantha*.

The first pleopod of the male of *E. clouei* also has a narrow process just in front of the subterminal aperture. In *E. clouei* the carapace is smooth between the spines, the antennular fossa is surrounded by a rim and the accessory spine at the base of the rostral spine does not arise from the edge of the fossa.

Two species of *Pleistacantha* are widespread throughout the Indo-West Pacific while the other six species appear to be restricted to the West Pacific.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *PLEISTACANTHA*

1 Interantennular spine simple 2
- Interantennular spine bifurcate at least apically 4
2 (1) Carapace granular with about 9 longer spines; rostral spines with only 1 or 2 accessory spines near the base ..... *P. naresii*
- Carapace and legs densely covered by long spines and spinules; rostral spines each with at least 4 long accessory spines along their length 3
3 (2) Rostral spines at least 1/3 postrostral carapace length, clearly exceeding interantennular spine ..... *P. cervicornis*
- Rostral spines less than 1/4 postrostral carapace length, subequal to interantennular spine ..... *P. exophthalmus*[10])
4 (1) Rostral spines adjacent in proximal half or more; carapace spinulous with a few prominent spines dorsally and on anterior and posterior branchial margins ..... *P. sanctijohannis*
- Rostral spines separate from base; carapace spinulous, sometimes with a few prominent spines but not on posterior branchial margin ... 5
5 (4) Rostral spines short, about 1/4 postrostral carapace length with 2 or 4 accessory spines including those at the base 6
- Rostral spines at least 1/3 postrostal carapace length with 9-12 accessory spines including those at the base 7
6 (5) Interantennular spine bifid from the base; rostrum with accessory spines only at the base; carapace surface with sharp tubercles or short spines, but no prominent spines ..... *P. simplex*
- Interantennular spine bifid at the tip; rostrum with accessory spines beyond the base; carapace surface spinulous with a few more prominent spines ..... *P. japonica*[10])
7 (5) Interantennular spine usually bifid for no more than distal third; spines of carapace including several prominent ones on gastric, cardiac and branchial region; size intermediate (about 40 mm cl.).. *P. oryx*
- Interantennular spine bifid for at least the distal half; spines of carapace of uniform size; a large species (up to 130 mm cl.).. *P. moseleyi*

[10]) from the literature (Guinot & Richer de Forges, 1982a).

Pleistacantha cervicornis Ihle & Ihle-Landenberg, 1931 (Figs. 9a, b, 11a, Pl. 6)

Pleistacantha cervicornis Ihle & Ihle-Landenberg, 1931: 161-163. — Guinot & Richer de Forges, 1982a, 1107-1109, figs. 7B, 8B, B1, pl. 4 fig. 1, 1a.
Pleistacantha terribilis Rathbun, 1932: 30. — Sakai, 1938: 237; 1976: 175, pl. 54 fig. 2. — Guinot & Richer de Forges, 1982a, 1109-1110, figs. 7C, 8C, C1, pl. 4 fig. 2, 2a; new synonymy.

Material examined. — 2 ♂♂, 1 ♀, 9.5.5-25 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 4, Kai Islands, 05°31′40″S 132°26′E, 250 m, Sigsbee trawl, sand, 3 April 1922; 1 spec.
'Dana' Expedition: Stn. 3606, New Caledonia, 20°48′S 164°13′E, 490 m, 26 November 1928; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

FRV 'Kapala': New South Wales, N of North Solitary I., 29°47′S 153°41′E to 29°49′S 153°40′E, 234 m, prawn trawl, 19 April 1978; 1 spec. (AM P.29935).

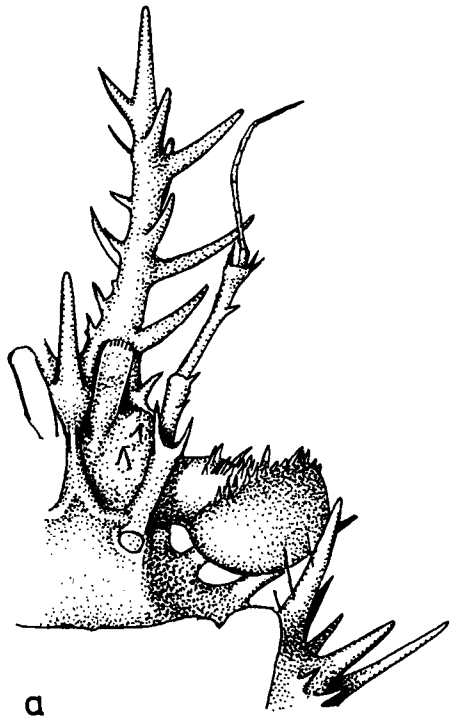
Remarks. — These specimens have been compared with the holotype (USNM 48263) of *P. terribilis* and 13 other specimens from Japan identified by Rathbun and Sakai, and they agree closely. The basal antennal article has two spines anteriorly. The interantennular spine is straight but in the larger specimen it is weakly upcurved at the tip as in some of the larger Japanese specimens.

The anterolateral angle of the merus of the third maxilliped is strongly produced into a triangular process about as long as the margin of the merus proper and armed with two or three teeth on each edge.

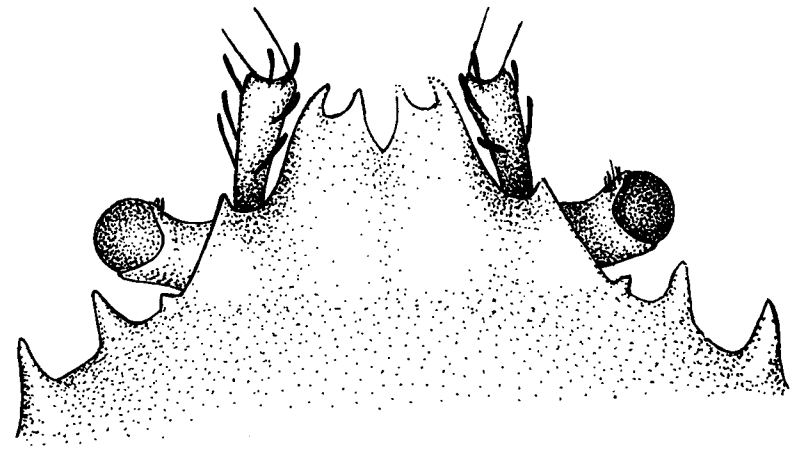
The dactyls of the ambulatory legs lack the large spines of the other segments, but are armed with long hairs and small spinules on at least the proximal half. Rathbun regarded the presence of these spinules as one of the characters distinguishing *P. terribilis* from *P. cervicornis*. However, it seems likely that Ihle was referring to the absence of long spines on the dactyls, rather than the dactyls being completely unarmed.

The rostral spines are equal to half the postrostral carapace length as in the specimens described by Ihle & Ihle-Landenberg. In Japanese specimens the rostrum varies in length from a third to half the postrostral carapace length.

The palm of the cheliped of the 'Dana' specimen from New Caledonia (cl. 25 mm) is three times as long as its distal height; in other male specimens the palm is shorter (only two to two and a half times as long as its distal height). This



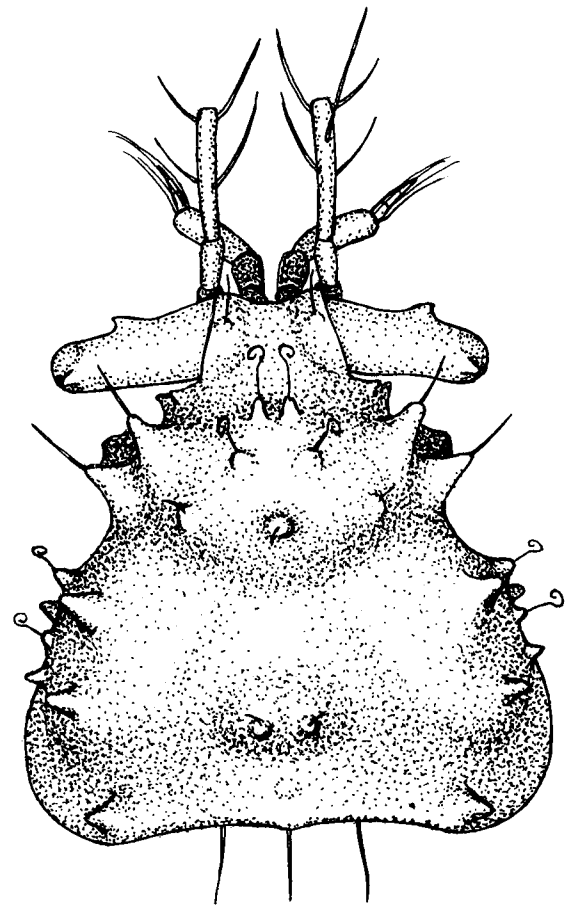
a



b

c

d



e

Fig. 11. *Pleistacantha cervicornis* (male, 25 mm, New Caledonia, ZMC) (a) left orbit, ventral view; *Paratymolus latipes* (male, 8 mm, AM P. 9400, in part) (b) anterior carapace, dorsal view; *Platymaia alcocki* (male, 62.5 mm, AM P.17794) (c) left chela of adult male; *Chalaroachaeus curvipes* (female, 3.5 mm, Salibabu I., ZMA) (d) dactyl of left fourth ambulatory leg; (e) carapace, dorsal view.

character varies with age and it cannot be regarded as of specific importance.

The first pleopod of the 'Dana' specimen is the same as that of the holotype of *P. terribilis*, with a small process near the apex.

Guinot & Richer de Forges (1982a) examined two specimens of *P. terribilis* (one the holotype) and two of the syntypes of *P. cervicornis* from the Kai Islands and found very little to distinguish the two species, suggesting only three features which may possibly separate the two. They considered that *P. cervicornis* has longer rostral spines, a more curved interantennular spine and an oval rather than round corneal region of the eye. As well as the present specimens, one each from the Kai Islands, New Caledonia and Australia, we have examined 14 specimens from Japan identified as *P. terribilis* (one the holotype). Firstly these 17 specimens are conspecific. Secondly they agree well with the syntypes of *P. cervicornis* described and figured by Guinot & Richer de Forges (1982a). In Japanese specimens the rostrum is only sometimes less than half the postrostral carapace length, the interantennular spine is curved in some specimens and the oval cornea is only slightly less elongate than in the specimens from the Kai Islands and other localities.

It is concluded that *P. cervicornis* Ihle & Ihle-Landenberg and *P. terribilis* Rathbun are conspecific; the former name has precedence. The species is characterised by the extraordinarily spiny nature of the body and appendages.

Two specimens identified by Takeda & Miyake (1969: 494-497, fig. 9c-d, pl. 18 fig. A) as *Pleistacantha japonica* (Yokoya) are regarded by Sakai (1976) as conspecific with *P. terribilis*. We can see no good reason for such a view and Guinot & Richer de Forges (1982a) have come to the same conclusion. The specimen figured by Takeda & Miyake in pl. 18 fig. A is a syntype of *P. japonica* and the two more recent specimens are certainly not *P. terribilis (P. cervicornis* as here understood). The first pleopod of the male, as figured by Takeda & Miyake, lacks the small process present in *P. cervicornis*; there are only four accessory spines on each rostral spine (10 to 12 in *P. cervicornis*); the interantennular spine is bifid at the tip (undivided in *P. cervicornis*); the basal antennal article has four prominent spines (only two anterior spines in *P. cervicornis*); and the specimen figured by Takeda & Miyake does not appear to have the long, robust spines so typical of *P. cervicornis*.

Distribution. — Japan, Kai Islands, New Caledonia, eastern Australia.

Pleistacantha oryx Ortmann, 1893

Pleistacantha oryx Ortmann, 1893: 39. — Sakai, 1965a: 69-70, fig. 10a, b, d, pl. 30 fig. 2; 1976: 172-174, fig. 93, pl. 55. — Griffin, 1974: 28; 1976: 209.
Pleistacantha orynx (sic). — Takeda & Miyake, 1969: 492-493.
Pleistacantha moseleyi. — Sakai, 1938: 234-236, fig. 20, pl. 34 figs. 2, 3. (Not *Pleistacantha moseleyi* Miers, 1886.)

Material examined. — 11 ♂♂, 8 ♀♀ (6 ovig.), 10-65.5 mm, smallest ovig. ♀, 22 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 260, Kai Is., 2.3 miles (∿ 3.7 km) N63°W from N point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, dredge, sand, coral and shells, 16/18 December 1899; 1 spec. — Stn. 302, Timor Sea, between Timor and Roti, 10°27.9′S 123°28.7′E, 216 m, trawl, sand and coral sand, 2 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: East China Sea, 32°17′N 128°11′E, 198 m, trawl no. 6, 14 May 1914; 1 spec. — Japan, Sagami Bay, Okinose, 180 m, 23 June 1914; 2 specs. — Japan, Sagami Sea, Okinose, 540 m, 28 June 1914; 6 specs. — Okinose, Japan, 540 m, 29 June 1914; 2 specs. — Japan, Misaki, 360 m, 30 June 1914; 2 specs. — Japan, Sagami Bay, 720 m, 2 July 1914; 1 spec. — Japan, Nagasaki, 1 spec.

Mortensen Java — S. Africa Expedition: Stn. 15, Bali Sea, 07°29′S 114°49′E, ca. 240 m, Sigsbee trawl, sand and mud with concretions, 10 April 1929; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. TS V, Tanimbar, Selaru, 3 miles (∿ 5 km) NW of Tg Tuwau, 08°12′S 130°49′E, 144 m, dredge hauls 3-4, mud and rubble, 27 June 1970; 1 spec.

Remarks. — This species has been dealt with previously (Griffin, 1974; 1976) and this series confirms the distinguishing features already noted.

In most adult specimens of *P. oryx* the interantennular spine is divided only for the distal third or less, while in *P. moseleyi* it is usually divided for at least the distal half. However, as shown in Sakai's figure (1965a: fig. 10b, c), the interantennular spine tapers much more in *P. oryx* than it does in *P. moseleyi* and this distinction is also important. In this series, of eight adults, five have the spine divided for the distal third, in the other three for less than a third; of seven immature specimens, five have the spine divided for less than the distal half and in two for the distal half. That is, the spine is more strongly divided in the younger specimens.

In *P. oryx* there are several prominent spines which stand out above the smaller spines on the carapace surface, whilst in *P. moseleyi* the carapace is covered with spines of more uniform size. In *P. oryx* there are four prominent gastric spines and an anterior branchial spine which are all about two thirds the length of the postorbital spine. These long spines are about four times as long as the general carapace spines (similar spines in *P. moseleyi* are about twice as long as small spines). The cardiac region has a pair of prominent spines which are a little more than half as long as the postorbital spine and there is a similar sized pair of spines on the intestinal region. There is a posterior branchial spine, slightly shorter than the cardiac spines and just anterolateral to them. The branchial regions are only moderately elevated and do not approximate in the midline, the cardiac region is as high or slightly higher than the branchial regions. In *P. moseleyi* the medial margins of the branchial regions are elevated and approximate in the midline, the cardiac region being depressed. There is a prominent terminal spine of the meri of all the ambulatory legs,

whereas in *P. moseleyi* this spine is small. The merus of the third maxilliped has the anterolateral angle produced into a narrow spined lobe whereas in *P. moseleyi* the anterolateral angle is a right angle.

The length of the rostral spines is about half (0.46-0.58) the postrostral carapace length in the ovigerous females and about three quarters (0.68-0.78) the postrostral carapace length in the adult males. All the series have rostral spines divergent in the distal half and in most they are weakly divergent proximally, but in two specimens they are parallel and in one large female (cl. 65.5 mm) they are widely divergent from the base. This large specimen has most carapace spines longer and more robust than in the other specimens, but the four large gastric spines and the two anterior branchial spines are at least four times as long as the other carapace spines. A large male from Nagasaki has similar robust carapace spines and a few larger, prominent spines but the rostrum and interantennular spine are broken off. The chelipeds are enlarged, the length of the palm is equal to the postrostral carapace length and it is increased distally to one and a half times the proximal height. A similar specimen, also from the East China Sea, was reported on by Takeda & Miyake (1969) and another large female (cl. 60.5 mm) has been figured by Sakai (1938: pl. 34 fig. 3, as *P. moseleyi*; 1976: fig. 93, as *P. oryx*). Smaller females (postrostral cl. 20-24.5 mm) with less divergent rostral spines and less prominent carapace spines are also ovigerous. In the smaller adult males (postrostral cl. 23-30 mm) the palm is increased distally to one and a half times the proximal height but the length is only about two thirds the postrostral carapace length. On the male chela there is a large double tooth near the base of the movable finger.

Distribution. — Indo-West Pacific; from Japan, East China Sea and Philippine Islands through Java and the Andaman Sea to the West Arabian Sea.

Pleistacantha sanctijohannis Miers, 1879

Pleistacantha sancti-johannis Miers, 1879b: 24-25, pl. 1 fig. 1. — Sakai, 1965a: 70-71, pl. 30 fig. 3.
Pleistacantha sanctijohannis. — Griffin, 1976: 209. — Sakai, 1976: 172, pl. 53 fig. 2.

Material examined. — 15 ♂♂, 21 ♀♀ (5 ovig.), 12-22 mm, smallest ovig. ♀, 17 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Japan, Nagasaki, coll. James Jordan, 1 July 1911; 2 specs.
Mortensen Pacific Expedition: East China Sea, 32°17′N 128°11′E, 198 m, trawl no. 6, 14 May 1914; 1 spec. — East China Sea, 33°41′N 128°50′E, 135 m, trawl, 17 May 1914; 1 spec. — Japan, off Misaki, 144-180 m, 19 June 1914; 15 specs. — Japan, Sagami Bay, Okinose, 180 m, 23 June 1914; 7 specs. — Japan, Sagami Sea, Okinose, 540 m, 28 June 1914; 2 specs. — Japan, Okinose, 540 m, 29 June 1914; 6 specs. — Japan, Misaki, 360 m, 30 June 1914; 2 specs.

Remarks. — This species has been discussed recently elsewhere (Griffin, 1976). One small specimen (♂, 12.0 mm), in which the rostral spines are parallel but well separated from the base and divergent at the tips, may still be distinguished from *P. oryx* by the presence of two strong posterior branchial spines, absent in that species.

In 1931, Ihle & Ihle-Landenberg described a subspecies *P. sanctijohannis erecta* based on two specimens, collected by the 'Siboga' Expedition between Timor and Roti Island, which they distinguished by the nearly vertical rostral spines. In the figure of the holotype of *P. sanctijohannis* by Miers (1879b) the rostral spines are only slightly elevated. We have not had the opportunity to examine the type specimens of *P. sanctijohannis erecta* but one of them, now in poor condition, has been described recently, as *P. erecta*, by Guinot & Richer de Forges (1982a) with a photograph showing the strongly elevated rostral spines. We have examined the angle of elevation of the rostral spines of 34 specimens of *P. sanctijohannis* from Japan. In nine specimens the angle is similar to that in Miers' figure, in five specimens the rostral spines are nearly vertical, while in the majority of specimens (20) the angle of the rostral spines is somewhere between these two. Clearly the degree of elevation of the rostral spines is not a valid distinguishing feature.

In these specimens the rostral spines usually diverge at about the distal third but sometimes sooner. The large carapace spines are as prominent as in the photograph of *P. erecta* in lateral view (Guinot & Richer de Forges, 1982a). In the younger males the chelipeds are slender.

P. sanctijohannis was collected in the Mindoro region of the Philippines by the 'Albatross' Expedition (Griffin, 1976: 209) and has been reported from the South China Sea (Serène & Lohavanijaya, 1973) so it is already known outside Japanese waters.

As we have not examined the type specimens of *P. sanctijohannis erecta* Ihle & Ihle-Landenberg we have not included it in the synonymy of *P. sanctijohannis*; however, we can see no reason to consider it a separate subspecies or species.

Distribution. — Philippine Islands, Japan, S. China Sea, Kai Islands.

Pleistacantha simplex Rathbun, 1932

Pleistacantha simplex Rathbun, 1932: 30-31. — Sakai 1935: 68-69, fig. 4, pl. 8 fig. 2; 1965a: 71, pl. 31 fig. 1; 1976: 174-175, pl. 54 fig. 1. — Takeda & Miyake, 1969: 494, fig. 9a, b.

Material examined. — 8 ♂♂, 14 ♀♀ (9 ovig.), 5.5-10.5 mm, smallest ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 105, Sulu Archipelago, 06°08′N 121°19′E, 275 m, dredge, coral bottom, 4 July 1899; 4 specs. — Stn. 156, Straits of Bougainville, 00°29.2′S 130°5.3′E, 469 m, dredge, coarse sand and broken shells, 15 August 1899; 1 spec. — Stn. 253, Kai Is., 05°48.2′S 132°13′S, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, 32°49′N 128°14′E, 23 miles (∿ 37 km) NW 3/4 W of Goto, 207 m, trawlings 4-5, 14 May 1914; 1 spec. — Japan, off Misaki, 144-180 m, 19 June 1914; 4 specs. — Japan, Okinose, Sagami Bay, 180 m, 23 June 1914; 2 specs. — Japan, Okinose, Sagami Sea, 540 m, 28 June 1914; 2 specs. — Japan, Okinose, 540 m, 29 June 1914; 2 specs. — Japan, Misaki, 360 m, 30 June 1914; 2 specs. — Sagami Sea, June 1914; 1 spec.

Remarks. — The specimens agree well with the holotype (♂, 10.5 mm, SW of Goto I., Japan, USNM 48251) but the spines on the supraorbital eave are longer, like the specimen figured by Sakai (1935: text fig. 4). The parallel spines on the eave may be horizontal or directed slightly upwards or downwards. The rostral spines also vary from being directed almost horizontally forwards to tilting upwards at an angle of 45° and from subparallel to moderately divergent.

The basal antennal article has a medial and a lateral spine on the anterior edge and a small spine laterally at its midpoint. The flagellum is longer than half the postrostral carapace length and carries scattered long and short setae. The branches of the bifid interantennular spine may be parallel or slightly incurved at the tips.

In the male there is a row of strong spines on the posterior border of the first sternite and two small spines anteriorly in the medial line. The other sternal segments each have a spine at the base of the leg and at the edge of the abdominal cavity. The abdomen has anterior medial tubercles on segments 1-6 and there are rounded lateral elevations on the third segment.

The records from Indonesia are the first from outside the Japanese region.

Distribution. — Japan, East China Sea, Indonesia.

Prosphorachaeus Takeda & Miyake, 1969

Type species. — *Achaeopsis suluensis* Rathbun, 1916, by monotypy.

Remarks. — This genus is distinguished from species of *Achaeus* by the complex first pleopods of the male and by the broad arching abdomen that covers them. For each known species of *Prosphorachaeus* the first pleopod and the abdomen of the male are quite distinctive, but in many other characters—the rostral lobes, the eyestalks, carapace shape and ornamentation—the species are all very similar and the females of each species are less easily distinguished from each other.

Relatively few specimens of these small fragile species have been collected and this series of specimens would seem to indicate that there are probably many more species to be collected and described. No species of *Prosphorachaeus* have been recorded previously from Indonesia. Two new species are described here from Indonesia, both of which are represented in the Kai Islands and yet another female specimen, also from the Kai Islands, is not conspecific with either. Some female specimens in this collection which do not agree with previously known or newly described species are discussed under *P. suluensis*.

Distribution. — Western Pacific.

KEY TO SPECIES OF *PROSPHORACHAEUS*

1 Basal antennal article with spinules on both lateral and medial margins; surface of sternum spinulous; pterygostomian margin with a spinulous tubercle ..... *P. multispina*
- Basal antennal article with spinules in a single row, often saw-like; surface of sternum lacking spinules; pterygostomian margin with a smooth tubercle 2

2 (1) Anterior lobe on eyestalk apically acute or subacute; rostral lobes apically sharp, usually with a small apical spine; branchial region with a central dorsal tubercle or spine 3
- Anterior lobe on eyestalk apically blunt; rostral lobes apically rounded, sometimes with small spinules; branchial region lacking a distinct central dorsal tubercle or spine ..... *P. suluensis*

3 (2) Basal antennal articles oblique; merus of third maxilliped subtriangular, medial margin angular; sternum with one to two medial spines; first pleopod of male stout, unlobed ..... *P. galatheae*
- Basal antennal articles subparallel; merus of third maxilliped suboval, medial margin curved (fig. 13); sternum with a medial ridge anteriorly; first pleopod of male very broad, with three prominent lobes (fig. 14) ..... *P. sumbawa*

Prosphorachaeus multispina new species
(Fig. 12)

Material examined. — 6 ovig. ♀♀, 3-4 mm, smallest ovig. ♀, 3 mm.

Holotype. Female, cl. 3.0 mm, ovigerous, Kai Islands, 05°36′S 132°55′E, 85 m, trawl, sand, 9 May 1922; Danish Kei Islands Expedition Stn. 53, Zoological Museum, University of Copenhagen.

Paratypes. As listed below.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 51, Madura Bay and other localities in southern Molo Strait, 69-91 m, dredge and trawl, sand with shells and stones, 19 April 1899; 2 specs. — Stn. 260, Kai Is., 2.3 miles (∿ 3.7 km) N 63°W from north point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, Blake dredge, sand, coral and shells, 16/18 December 1899; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 53, data as for holotype; 1 spec.

Description. — Carapace broad, width about four fifths (0.85) postrostral carapace length; surface finely granular with two medial spines and spinules on carapace margin.

Rostral spines short, broad, about one tenth postrostral carapace length; apex bluntly pointed and with a spinule; separated by a V-shaped notch; lateral margins with small blunt spinules.

Supraorbital eave with several small, well spaced spinules along its margin; antorbital angle produced, acute, spinulous. Eyestalk moderately stout, long, with a flattened, subtriangular, apically sharp process in distal half of anterior surface and a narrow ventral tubercle. Cornea terminal and ventral. Region behind eave only shortly constricted, lateral margin in front of hepatic region with two to three spinules.

Hepatic region swollen with about five sharp spines on margin, some additional smaller spines above and below.

Branchial submargin with a row of three to four sharp, mostly bifid, spines anteriorly; below them another group of three similar spines just above base of cheliped; large spinules along carapace margin.

Gastric regions weakly elevated; protogastric region smooth with a group of curled hairs laterally; a long upright mesogastric spine posteriorly. Cardiac region weakly elevated with a long upright spine. Intestinal region smooth, spinules along posterior carapace margin.

Dorsal branchial region smooth with a short, backwardly directed spine above base of last ambulatory leg.

Basal antennal article slender with about eight large sharp spinules on lateral edge, three or four similar spinules near medial edge centrally. Epistome wider than long.

Pterygostomian margin with several small spinules and midway along its length a stout spine with accessory spinules.

Sternum of female deeply excavated anteriorly, a large tubercle in midline, surface of sternum spinulous.

Merus of female cheliped with a row of spinules dorsally and a ventral row of spinules on both inner and outer faces; carpus with a row of spinules dorsally and a few spinules on inner margin; palm with a dorsal and a ventral row of spinules, length more than twice height; fingers about as long as palm with almost no gape between them, both fingers only very weakly denticulate along their length.

Ambulatory legs very slender, merus and propod with a ventral row of spinules; carpus with a few lateral spinules; groups of curled hairs dorsally; merus without a terminal spine. First ambulatory leg about twice postrostral carapace length, fourth leg about three quarters first; dactyl of fourth leg nearly straight, distally curved, smooth or with two minute teeth distally.

Female abdomen with six segments, surface with spinules, larger laterally on last fused segment. On anterior margin of first segment a medial tubercle, on second segment a short spine, on third segment a medial lobe with three short spines, in fourth and fifth segments with a medial spinulous ridge, last fused segment with a triangle of three spines centrally, base forward, largest spine at apex.

Female gonopore a large semi-circular aperture opening ventrally. Eggs large, diameter about 0.5 mm.

Remarks. — *P. multispina* is distinguished from other known species of *Prosphorachaeus* by the presence of many more spinules and spines, some of the spines being bifid or spinulous. There are spinules along the whole of the lateral margin of the basal antennal article and also on part of the medial margin. On the pterygostomian margin there are spinulous tubercles rather than a smooth ridge and a smooth posterior tubercle as in other species. The sternum is spinulous with a central spinulous tubercle (smooth with a ridge and/or spine in other species).

Distribution. — Java, Kai Islands.

Prosphorachaeus suluensis (Rathbun, 1916)

Achaeopsis suluensis Rathbun, 1916:535.
Achaeus suluensis. — Sakai, 1938:220-222, fig. 11, pl. 22 fig. 2; 1965a:68, pl. 28 fig. 2.
Prosphorachaeus suluensis. — Takeda & Miyake, 1969: 490-491, fig. 8. — Takeda, 1973b:38. — Griffin, 1976:209. — Sakai, 1976: 166, fig. 89a-c, pl. 50 fig. 2.

Material examined. — 1 ♂, 2 ♀♀ (1 ovig.) 4.5-5 mm, ovig. ♀, 4.5 mm.

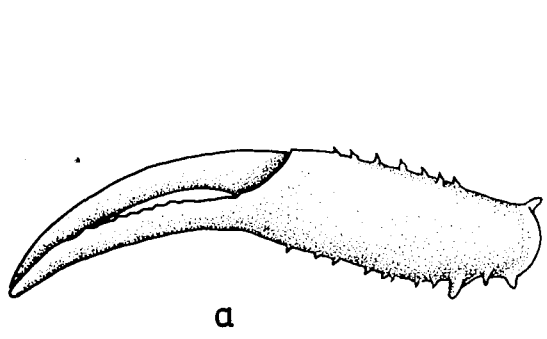
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Mortensen Pacific Expedition: Japan, Misaki, 5.5 m, 26 April 1914: 1 spec. — Misaki, about 36 m, dredge, 25 May 1914; 2 specs.

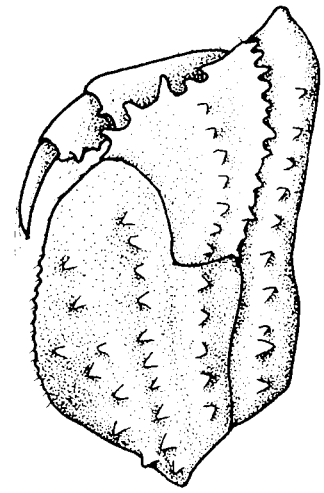
Remarks. — These specimens agree with those described and figured by Sakai (1938; 1976) and by Takeda & Miyake (1969) and the male is clearly distinguished by the form of the first pleopod and the abdomen. The description of the female holotype by Rathbun (1916) is now inadequate to distinguish *P. suluensis* from the other known species of *Prosphorachaeus* and some comments should be made. Takeda & Miyake (1969) have already referred to the lack of a postorbital spine in this genus. The two small spinules behind the orbit noted by Rathbun are present in some of our specimens but neither is large enough to be considered as a postorbital spine such as is found in *Achaeopsis*. Rathbun described the supraorbital eave as 'entire' but in our specimens, as in those described by Sakai (1938), the margin is spinulous. Also in our specimens and in that figured by Takeda & Miyake (1969) there is no tubercle on the posterior slope of the cardiac spine. The basal antennal articles in our specimens from Japan are subparallel, not 'very oblique' as Rathbun described for this species. On the abdomen of our females there is a tubercle or short spine on the first segment, a short spine on the second and third segments, a low ridge on the fourth and fifth segments and a triangle of a short spine and two tubercles on the last fused segment. The female gonopores are submedial apertures opening medially.

In these collections there are also five ovigerous female specimens (two from the Sulu Archipelago and three from Indonesia) which agree as well with Rathbun's description of *P. suluensis* as do the two females we have from Japan but in these five specimens the basal antennal article is either strongly or moderately oblique. However, we cannot say that these five specimens are conspecific with each other as there are differences in the position of the female gonopore and small differences in the basal antennal article. The abdomen of these females differs from that of our Japanese specimens in having a smaller spine or a tubercle on the first two segments and a ridge rather than a short spine on the third segment.

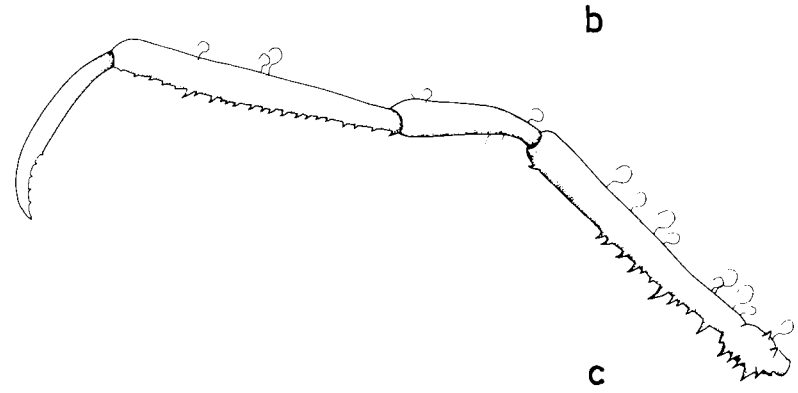
It appears that the Japanese specimens, Rathbun's material and our five females may represent two or three very similar species in which the females are not easily distin-



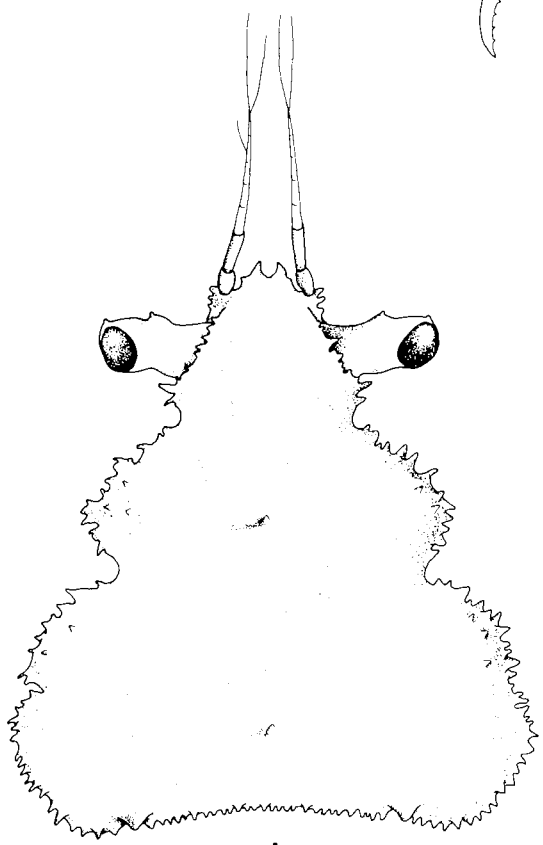
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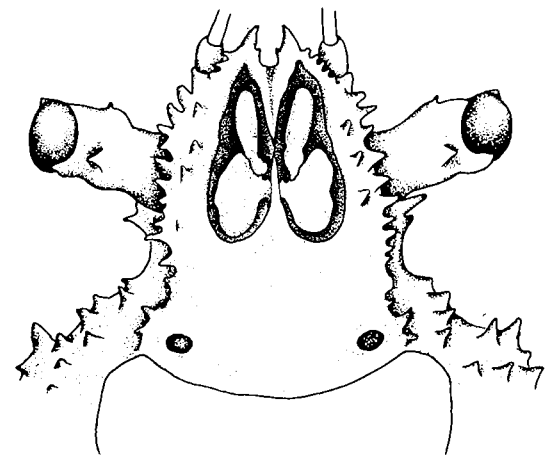
b



c



d



e

Fig. 12. *Prosphorachaeus multispina* (holotype, female) (a) left chela; (b) left third maxilliped; (c) left first ambulatory leg; (d) carapace, dorsal view; (e) orbits, ventral view.

guished. The status of these specimens will only be determined through examination of further material.

The data for these five specimens are as follows: —

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 37, Flores Sea, Paternoster Is., Sailus Ketjil, 27 m and less, dredge, coral and coral sand, 30/31 March 1899; 1 spec. — Stn. 109, Sulu Archipelago, anchorage off Pulu Tongkil, 13 m, dredge, townet, *Lithothamnion* bottom, 5/6 July 1899; 1 spec. — Stn. 301, E coast of Roti I., Pepela Bay, 10°38′S 123°25′E, 10-25 m, dredge, 30 January 1900; 1 spec.

Sulu Archipelago; 1 spec.

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Danish Kei Islands Expedition: Stn. 11, Kai Is., off Toeal, 20 m, trawl, sand, 9 April 1922; 1 spec.

The five specimens have the following characters in common: —

1) cornea of the eyestalk ovate and relatively small;
2) basal antennal article oblique with a single row of, mostly, small teeth;
3) sternum with a medial ridge but without a spine or tubercle;
4) branchial region without a central dorsal tubercle;
5) no (or a very small) tubercle behind the cardiac spine;
6) no tubercle or spine on carapace above the base of the last leg (or tubercle small or blunt).

However, there are also differences among these five specimens. In one of the specimens from the Sulu Archipelago ('Siboga' Stn. 109) the gonopores are submedial and open medially and the distal part of the basal antennal article is laterally compressed. In the other specimen from the Sulu Archipelago and the specimen from Timor ('Siboga' Stn. 301) the distal part of the basal antennal article is similarly compressed but the gonopores are laterally placed and open laterally, and on the third maxilliped there are two to four spinules on the exognath. The distal part of the basal antennal article is not laterally compressed in the remaining two specimens from the Flores Sea ('Siboga' Stn. 37) and the Kai Islands (Kei Is. Exped. Stn. 11), the gonopores are laterally placed and open ventrally and there are six spinules on the exognath of the third maxilliped.

Which of these differences are merely variations, perhaps geographic, and which are valid specific differences will only be determined by further study of more specimens, including males.

P. suluensis, as currently understood, is distinguished from other described species of *Prosphorachaeus* by the form of the first pleopod and the abdomen of the male. It is also distinguished by the blunt lobe on the anterior margin of the eyestalk (rather than acute or subacute); by the rostral lobes which are rounded with small spinules rather than subacute with an apical spine and also the branchial region lacks the central dorsal tubercle present in *P. galatheae* and *P. sumbawa*.

Distribution. — Sulu Archipelago, Japan.

Prosphorachaeus sumbawa new species
(Figs 13, 14)

Material examined. — 1 ♂, 2 ♀♀, 3-3.5 mm.

Holotype. — Male, 3.0 mm, Indonesia, Sumbawa, Sapeh Strait, 08°23′S 119°4′E, 69 m, dredge, coral and shells, 14 April 1899, 'Siboga' Expedition, Stn. 49a. Zoological Museum, Amsterdam.
Paratypes. — As listed below.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 310, Sumbawa, Sapeh Strait, 08°30′S 119°7′E, 73 m, dredge, sand with dead coral, 12 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 26, Kai Is, 05°38′S 132°55′20″E, 90 m, trawl, sand, 16 April 1922; 1 spec.

Description. — Carapace broad, width only slightly less (0.9) than postrostral carapace length; surface smooth or with fine granules laterally; margins with spinules; two long medial spines.

Rostral spines short, broad, about one sixth (0.15) postrostral carapace length, separated in distal half by a V-shaped notch; apex subacute, armed with a spinule; lateral margins only weakly spinulous, proximal angle curved outwards.

Orbital eave with several small, well spaced spinules along its margin; antorbital angle moderately produced, rounded, weakly spinulous. Eyestalks stout, long, a flattened subtriangular process midway along anterior surface and a ventral tubercle. Cornea terminal and ventral. Region behind orbits only shortly constricted.

Hepatic region swollen with three to four spinules on margin and a few smaller spinules above and below.

Branchial submargin with two to three short spines anteriorly and two to three smaller spines below them on epimeral ridge.

Gastric regions weakly elevated, protogastric region with a group of curled hairs laterally, a small tubercle on margin of mesogastric region; a long upright mesogastric spine posteriorly. Cardiac region elevated with a long upright spine. Intestinal region smooth with spinules along posterior carapace margin.

Dorsal branchial region with a small central tubercle; a small spine and some spinules above the base of the last ambulatory leg.

Basal antennal article slender, straight (not oblique) with a large spinule (bifid in holotype) at about distal third; one to three smaller spinules along proximal two thirds.

Pterygostomian margin with a narrow ridge anteriorly and a short posterior spine.

Ischium of third maxilliped with five tubercles on a ridge parallel to lateral margin and a diagonal ridge of similar length, of six to eight smaller tubercles. Merus narrower than ischium, longer than broad, anterolateral angle only very weakly produced, margin spinulous; medial margin with spinules and two spines; a row of three to four tubercles parallel to lateral margin; first segment of palp with small spinules on distal margin.

There are no chelipeds or ambulatory legs with holotype. Merus of cheliped of adult female paratype with a row of spines dorsally and ventrally on outer face; no terminal spine or tubercle; a few spinules ventrally on inner face; carpus with two rows of spines, one dorsally and one obliquely on inner face; chela slender, length of palm about one and a half times height, dorsal and ventral margins with a row of spines; fingers slender, length about one and a half times palm, weakly incurved, smooth, a narrow gape between fingers in proximal half.

Male sternum smooth, anterior half deeply excavate with a medial ridge; posterior half of sternum elevated towards recurved transverse ridge on anterior margin of abdominal

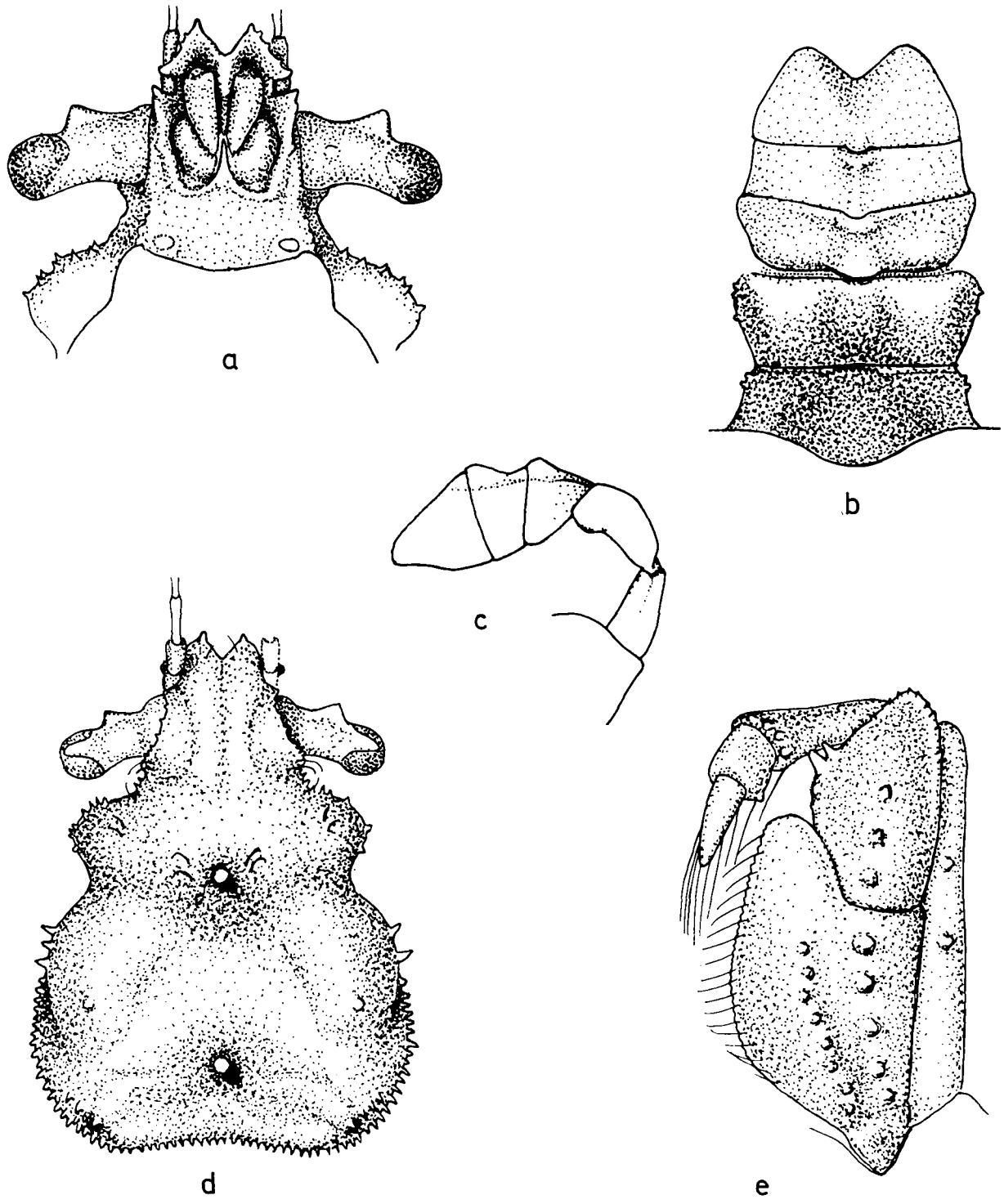


Fig. 13. *Prosphorachaeus sumbawa* (holotype) (a) orbits, ventral view; (b) male abdomen, (c) lateral view of same; (d) carapace, dorsal view; (e) left third maxilliped.

fossa. Anterior of abdominal fossa with a triangular medial lobe, posterior apex of lobe with a spine; abdominal fossa approximately square, deeply excavate into two anterior and two posterior depressions.

Male abdomen of five segments; first segment with spinules on lateral margin and medially on anterior margin; third segment large, abruptly curved, rigid, with lateral elevations, width about three times length; width of last fused segment slightly less than (0.9) third segment, length about half (0.5) width, two elevated lobes anteriorly separated by a broad V-shaped notch.

Female abdomen of six segments, surface with some spinules; segments one to four with a medial elevation anteriorly, armed with a small spine in segments one and two and with a group of three short spines in segments three and four; fifth segment with an unarmed medial ridge; last fused

segment with a central triangle of three spines, base forward.

First pleopod of male very broad, lobed, calcified at base; medial lobe ventral in position, curved strongly inward and then produced forward with a blunt apex; lateral lobe dorsal in position, short and apically blunt; between lateral and medial lobes a cylindrical process divided into three apically.

Female gonopore a broad oval aperture, opening anteriorly.

Remarks. — This species is distinguished from other described species of *Prosphorachaeus* by the form of the first pleopod of the male and the male abdomen. As well it is distinguished from *P. suluensis* by the more acute rostral lobes with a small apical spine and by the presence of a central dorsal branchial tubercle; it is distinguished from *P. galatheae* by the subparallel basal antennal articles (rather than oblique) and the presence of a medial sternal ridge (rather than a

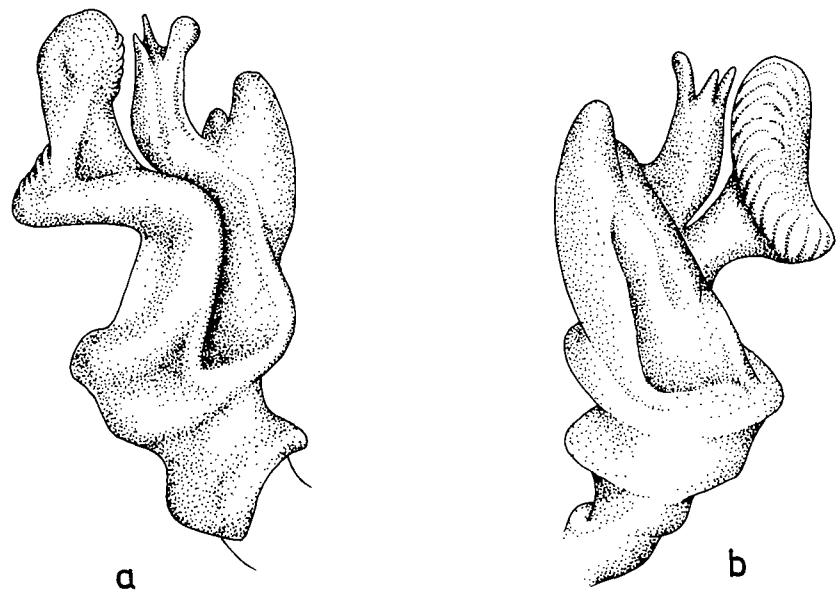


Fig. 14. Left first pleopod of male of *Prosphorachaeus sumbawa* (holotype) (a) abdominal view, (b) sternal view.

spine); and it is distinguished from *P. multispina* by having fewer spines and spinules especially on the basal antennal article and on the pterygostomian margin.

Distribution. — Sumbawa (Sapeh Strait), Kai Islands.

Rhinospinosa new genus

Type species. — *Pseudocollodes demani* Balss, 1929, by present designation.

Description. — Carapace pyriform with a few spines medially and elsewhere on the dorsal surface and posterior margin; orbit spinulous. Rostrum hardly developed beyond anterior margins of antennular fossae; interantennular spine projecting forward as a single short spine armed with lateral spinules near base. Orbit open above and below, eave not developed, a prominent postorbital spine. Basal antennal article narrow, spinous. Abdomen of six segments in both sexes, sixth and seventh fused. First pleopod of male almost straight, not tapering, apically blunt, opening medial, large, subapical, a prominent flap extending along abdominal surface of aperture.

Remarks. — The reasons for establishing a new genus to accommodate Balss' species is dealt with under *R. demani*.

The new name refers to the short rhinoceros-like interantennular spine; gender feminine.

Distribution. — West Pacific: Japan and East China Sea.

Rhinospinosa demani (Balss, 1929) new combination (Fig. 15b, c)

Pseudocollodes demani Balss, 1929: 4, fig. 2. — Yokoya, 1933: 146, text-fig. 53. — Sakai, 1938: 225-227, text-figs. 16a, b; 1976: 167-168, text-fig. 91. — Takeda & Miyake, 1969: 491-492.
Achaeopsis atypicus Rathbun, 1932: 29-30.

Material examined. — 1 ♂, 9.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Pacific Expedition: Japan, off Danjo Group, 32°15′N 128°12′E, 162 m, dredge, 15 May 1914; 1 spec.

Remarks. — This species was placed by Balss in the genus *Pseudocollodes* Rathbun, of which the type is *P. complectens* Rathbun (1911). This latter species has been shown (Griffin, 1974) to be synonymous with *Inachus dorsettensis* (Pennant) and is not congeneric with Balss' species. Manning & Holthuis (1981) suggest that *I. complectens* and *I. dorsettensis* may be

distinct species and that the specimens figured by Monod (1956) and Barnard (1950) as *I. dorsettensis* may have been misidentified. Their redescription of *I. complectens* is awaited. Balss' species differs from other inachines principally in having a produced spinulous interantennular spine, a feature mentioned by Rathbun as a principal reason for the setting up of the genus *Pseudocollodes*; however, in *Inachus dorsettensis* the interantennular spine is much less prominent. In this species the orbit bears two strong spines followed by spinules, an unusual feature, and in addition the strong hepatic lobe is depressed and at a lower level than the remainder of the carapace margin. In a number of other respects this species is similar to species of *Achaeus* and *Achaeopsis*.

Our specimen agrees well with specimens previously described and figured by other authors and with the holotype (female, ovig., 9.0 mm, Misaki, ZSM. 2571) examined by one of us (D.J.G.G., 1970). Just behind the spine on the supraorbital eave, in our specimen, there is another smaller spine; there is an accessory spine on the postorbital spine, almost equal to it in length and only slightly more slender. There is a spine on the carapace just above the base of the fourth ambulatory leg. The abdomen on our specimen differs somewhat from that described by Yokoya. There is a slender medial spine on the first segment and several spinules laterally on the third segment. The sixth and seventh segments are fused and no junction is visible: there is a robust spine as shown in Yokoya's figure, but the spine is just forward of the mid-point of the last segment. There is a rounded elevation followed by a notch on the lateral margin just behind the spine: this interruption may mark the junction of the sixth and seventh segments. We consider the figure of the male abdomen given by Yokoya to be incorrect. The female abdomen as figured by Balss (1929) and described by Rathbun (1932, as *Achaeopsis atypicus*) has six free segments and the fused last segment is spinulous.

The aperture of the first pleopod of the male is subterminal on the medial edge of the sternal surface with a broad flap abdominal to it. The pleopod has been figured in abdominal view by Sakai (1938: fig. 16b).

Distribution. — Japan and East China Sea.

Sunipea new genus

Type species. — *Apocremnus indicus* Alcock, 1895 by present designation.

Description. — Carapace slender pyriform, surface with few spines or tubercles. Rostrum fused basally, divergent distally, spinules on margins. Orbit of a moderately expanded eave with a slender preorbital spine and small antorbital lobe; lacking a postorbital lobe. Eyestalks with anterior process and terminal tubercle above cornea. Interantennular partition without a spine. Basal antennal article moderately broad with strong anterolateral spine, a suborbital lobe present. Antenna excluded from orbit. Merus of third maxilliped strongly produced at anterolateral angle, and posterior part of medial margin produced. Cheliped of male with tubercles on merus and carpus, palm smooth, dorsally carinate. Ambulatory legs slender with some tubercles. Male abdomen of seven free segments, female abdomen with junction of segments 4 and 5, and 5 and 6, indistinct. First pleopod of male apically truncate with a terminal aperture.

Remarks. — *Sunipea indicus* was considered congeneric with *Aepinus septemspinosus* (A. Milne Edwards) from the Atlantic Ocean by Alcock (1895) and Rathbun (1925) but, as discussed previously (Griffin, 1974), the two differ from each other in several important features. In *Aepinus septemspinosus* the rostrum is extremely short and rounded, the basal antennal article is truncate, there is no suborbital lobe or tubercle, the abdomen of the male is six segmented and the first pleopod of the male is hardly expanded apically. In addition the palm of the cheliped of the male of *A. septemspinosus* has rows of granules or tubercles, while that of *S. indicus* is smooth and dorsally and ventrally carinate. We consider these differences to be sufficient to separate these species at the generic level; we have accordingly established the new, presently monotypic genus *Sunipea*. The name is an anagram of *Aepinus* and of masculine gender as is *Aepinus*.

Distribution. — Indo-West Pacific.

Sunipea indicus (Alcock, 1895) new combination (Fig. 15a, d)

Apocremnus indicus Alcock, 1895: 188-189, pl. 4 figs. 2, 2a.
Aepinus indicus. — Griffin, 1972: 68-69, fig. 3; 1974: 6-7. — Griffin & Tranter, 1974: 164-165. — Takeda, 1977: 122, fig. 4B.

Material examined. — 6 ♂♂, 12 ♀♀ (7 ovig.) 4.5-8.5 mm, smallest ovig. ♀, 6.0 mm.

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'Siboga' Expedition: Stn. 49a, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 11 specs. — Stn. 260, Kai Is., 2.3 miles (∿3.7 km) N63°W. from N. point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, dredge, sand, coral and shells, 16/18 December 1899; 4 specs.

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Danish Kei Islands Expedition: Stn. 24, Kai Is, 05°37′S 132°56′E, 100 m, trawl, hard bottom, 15 April 1922; 2 specs. — Stn. 53, Kai Is., 05°36′S 132°55′E, 85 m, trawl, sand, 9 May 1922; 1 spec.

Remarks. — In general these specimens agree with those recently discussed. The rostral spines are outwardly curved distally with spinules on the margins. In some specimens the apex of the rostral spines is knobbed while in other specimens the apex is sharp and finely bifid. There is a mesogastric spine or tubercle. The cardiac region is weakly elevated and smooth or with a small tubercle.

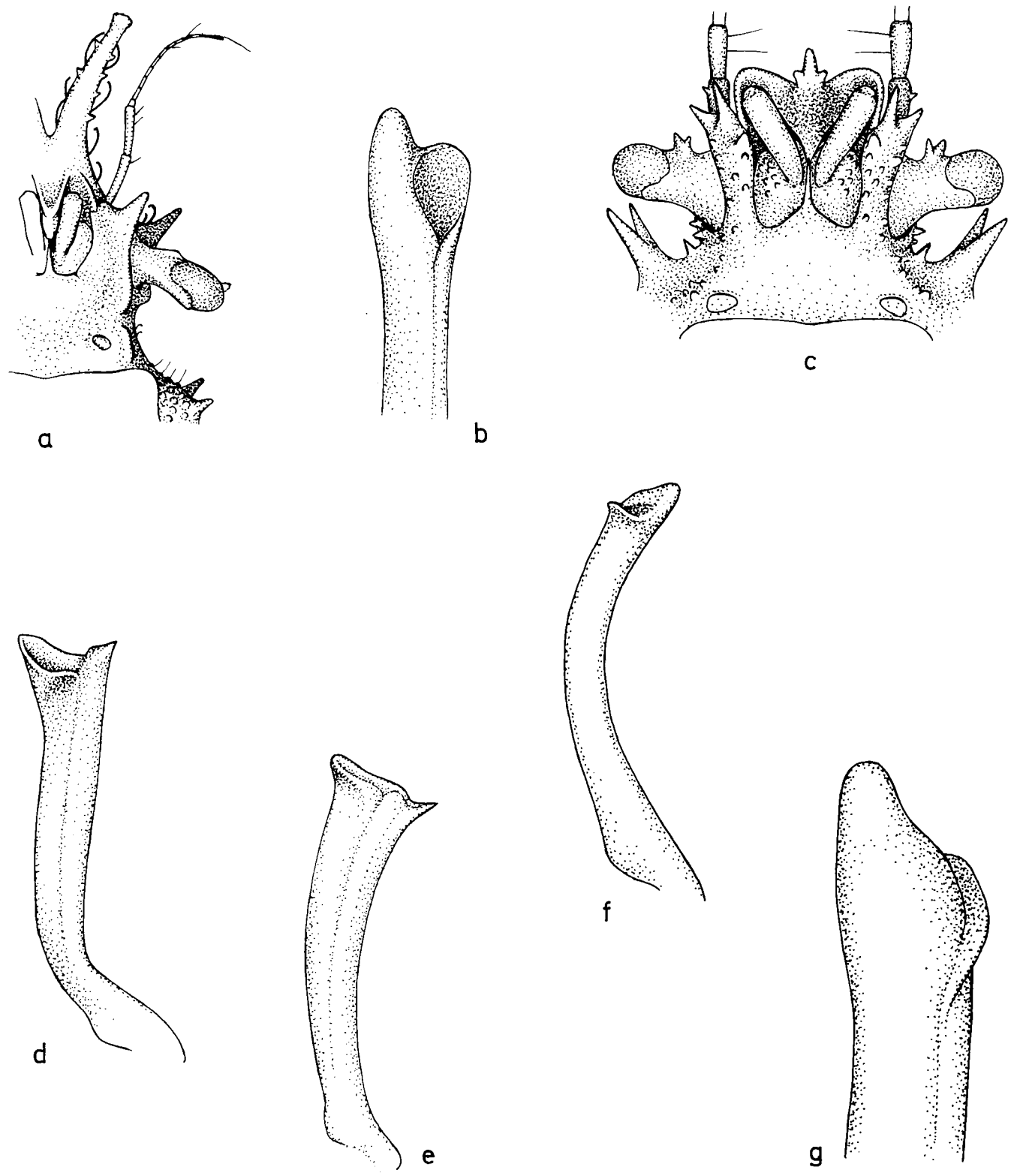


Fig. 15. *Sunipea indicus* (male, 8.5 mm, Sapeh Strait, ZMA) (a) left orbit, ventral view; *Rhinospinosa demani* (male, 9.5 mm, Japan, ZMC) (b) left first pleopod, sternal tip; (c) orbits, ventral view; *Sunipea indicus* (as above) (d) left first pleopod, abdominal-medial view; *Chorinachus dolichorhynchus* (male, 6 mm, Red Sea, AM P. 25237) (e) left first pleopod, abdominal view; *Physachaeus ctenurus* (male, 6.5 mm, Japan, ZMC) (f) left first pleopod, abdominal view, (g) sternal tip of same.

The first pleopod of the male is broad, straight and apically truncate. There is a widely gaping terminal aperture on the medial two thirds of the apical margin.

Distribution. — Indo-West Pacific: from East Africa and Red Sea to Sumbawa, N. Australia, Kai Is., Philippine Is., and Ogasawara Is.

Trichoplatus A. Milne Edwards, 1876

Type species. — *Trichoplatus huttoni* A. Milne Edwards, 1876, by monotypy.

Remarks. — The unusual spider crab restricted to New Zealand and now returned to *Trichoplatus* is distinguished by its unusual orbit, narrow straight-sided basal antennal article, strongly expanded ambulatory propodi, six segmented abdomen in the male and female and crested third maxilliped. In addition, the first pleopod of the male is quite unlike that in any species of *Naxia*.

T. huttoni was, as reported by Griffin (1966d) included within *Naxia* Latreille (herein transferred to the Majinae) by Richardson although, under the names *Halimus hectori* and *Halimus rubiginosus* it was in effect regarded as congeneric with the species now placed in *Naxia*. Bennett (1964) retained *Trichoplatus* as an independent genus; Griffin (1966d) subsequently argued against that. Bennett has also suggested that *T. huttoni* is related to *Eurypodius*.

Distribution. — Restricted to New Zealand.

SUBFAMILY TYCHINAE

Tychinae Dana, 1851b: 431. — Williams, Shaw & Hopkins, 1977: 885.
Stenocionopinae Miers, 1879: 652.
Maiinae Alcock, 1895: 161, 166, 246 (in part: the Stenocionopoida)
Ophthalmiinae Balss, 1929: 6 (name substituted for Stenocionopinae Miers to conform with substitution of *Ophthalmias* for *Stenocionops* (Rathbun, 1897: 157)). — Garth, 1958: 161. — Griffin, 1966b: 264.

The orbit consists, if complete, of a supraocular eave and a postocular spine, while the intercalated spine is lacking ... Longer spinous outgrowths on the supraocular eave and on the postocular spine are for the most part present. The shape of the body is elongate, somewhat truncate in front, often provided behind with a median spine or outgrowth (Balss, as quoted by Garth).

Pleopod 1 generally slender, weakly curved, sometimes adjacent about a third from base, apices outcurved (lyrate), aperture terminal or subterminal with at most poorly developed flaps or lobes.

Basically, tychines are majids with extravagant orbits: they were, in Alcock's time, classified with the majines and the mithracines. However, the Indo-West Pacific species — *Stilbognathus*, *Criocarcinus* and probably *Picroceros* — differ from the east Pacific and Atlantic genera — *Tyche*, *Pytho*, *Picroceroides* and others — in the degree of expansion of the basal antennal article and absence of a postorbital lobe. In Indo-West Pacific species the basal antennal article is relatively narrow and the postorbital lobe is lacking or is small and remote from the eye. New world species, on the other hand, often have broad basal antennal articles which partially close the orbit below through approximation to the postorbital lobe. Whether there are differences in the first pleopods of the male which would substantiate separation at the subfamily level awaits further study.

We have removed from the subfamily the genera *Pseudomicippe* (including *Zewa*) and *Microhalimus* to the Majinae and *Cyclocoeloma* to the Mithracinae. *Stilbognathus* has been expanded to include those species previously recognised as the distinct *Ophthalmias*.

KEY TO INDO-WEST PACIFIC GENERA OF TYCHINAE

1		Orbit without a postorbital lobe (a broad lobe on posterior part of eave in *S. tycheformis*); branchial margin with one spine anteriorly; posterior carapace margin with a broad based medial lobe or spine ..... *Stilbognathus*
—		Slender postorbital lobe remote from eyestalk; branchial margin with two to three spines; posterior carapace margin with one or two cylindrical spines 2
2	(1)	Rostral spines short and strongly deflexed; supraorbital eave with three short spines on lateral margin; hepatic margin without a spine ..... *Criocarcinus*
—		Rostral spines long, horizontal; supraorbital eave with a single antorbital spine; hepatic margin with a long spine ..... *Picroceros*

Criocarcinus H. Milne Edwards, 1834

Type species. — *Cancer superciliosus* Linnaeus, 1767, by later designation of H. Milne Edwards

Remarks. — This monotypic genus is distinguished by the extraordinarily produced orbit and very short rostrum. The eave is a ventrally open tube, the lateral margin dorsally bearing three spines.

Distribution. — Andaman Sea, western Pacific from Japan south through Indonesia to eastern Australia.

Criocarcinus superciliosus (Linnaeus, 1767)
(Fig. 16c, d)

Cancer superciliosus Linnaeus, 1767: 1047. — Herbst, 1790: 227, pl. 14 fig. 89.
Criocarcinus superciliosus. — A. Milne Edwards, 1872: 242-243, pl. 12 figs. 3, 3a-e. — Alcock, 1895: 247. — Sakai, 1938: 251-252, text fig. 26; 1976: 191-192, text fig. 101, pl. 67 fig. 1. — Griffin, 1966b: 277 (in key). — Dai et al., 1978: 225-226, 230, text fig. 2a, b, pl. 1 fig. 2.

Material examined. — 6 ♂♂, 8 ♀♀ (2 ovig.), 8-37.5 mm, smaller ovig. ♀, 32.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 37, Flores Sea, Paternoster Is., Sailus Ketjil, close to reef, up to 27 m, dredge, coral and coral sand, 30/31 March 1899; 1 spec. — Stn. 78, Borneo Bank, Lumu-Lumu shoal, 34 m, shore exploration, coral and coral sand, 10/11 June 1899; 1 spec. (ZMA De.100.821, det. Ihle). — Stn. 131, N. Sulawesi, Karakelong Is., anchorage off Beo, 13 m, reef exploration, mud and sand, 24/25 July 1899; 1 spec. — Stn. 133, N. Sulawesi, Salibabu I., anchorage off Lirung, up to 36 m., trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 1 spec. (ZMA De.100.724, det. Ihle as *Micippa philyra*). — Stn. 174, north coast of Ceram, Waru Bay, 18 m, dredge, townet and reef exploration, mud, 28/29 August 1899; 1 spec. (ZMA De.100.791, det. Ihle). — Stn. 193, Moluccas, Sanana Bay, east coast of Sula Besi, 22 m, reef exploration, mud, 13/14 September 1899; 1 spec. (ZMA De.100.822, det. Ihle). — Stn. 206, S. Sulawesi, Buton Strait, 04°58′S 122°42′E, 51 m, trawl, fine green mud, 21 September 1899; 1 spec. (ZMA De.100.864, det. Ihle). — Stn. 277, Banda Sea, Damar I., Kulewatti Bay, 45 m, reef exploration, sand, white, black and mixed, 9/11 January 1900; 1 spec. — Kai Is., Elat Reef; 1 spec. (ZMA De.100.640, det. Ihle). — Haingsisi Reef; 2 specs. (ZMA De.100.823, det. Ihle).

Off Sumatra, Pulu Hinako, 00°52′N 97°20′E, coll. De Ewaan; 1 spec. (ZMA De.100.863, det. Ihle).

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Ex. Natural Science Foundation: Irian Jaya, Padaido Is., $^1/_2$ mile (0.8 km) east of Oerif Isle, Mios Woendi Lagoon, 6-9 m, coll. Ostheimer, Orr and Powell, Stn. 465-4, 1956; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland, Lizard I., off Research Station, at low tide, coll. H. Tranter, 5 May 1977; 1 spec. (AM P.29929).

Remarks. — These specimens agree well with those described and figured by A. Milne Edwards and by Sakai. In younger animals (cl. 8-10 mm) the dorsal spine of the supraorbital eave is much longer than the ventral spines which are hardly produced at all. Our specimens have a tubercle or short spine on the margin of the orbit between the postorbital spine and the eave. There are two or three tubercles on the anterior margin of the postorbital spine, but in small specimens (cl. 8-16 mm) these tubercles are very low.

There is a spine on the anterior submargin of the branchial region, and a large tubercle or short spine on the submargin below the epibranchial spine. The spines of the carapace are knobbed. The spine on the posterior margin of the carapace is directed upward and backward, but is very short in smaller specimens.

As well as the medial and lateral spines on the anterior margin of the basal antennal article there is usually a tubercle of variable size on the lateral margin.

The outer margin of the ischium of the third maxilliped is more strongly concave in our specimens than is shown in the figure given by A. Milne Edwards.

Segments four, five and six of the female abdomen are fused.

The first pleopod of the male has not been figured previously. The tip is rounded on the medial margin and the lateral margin is produced to form an acute apex.

Distribution. — Andaman Sea, western Pacific from Japan and China through Sulawesi, Moluccas, Kai Is. and Timor to NE. Australia and New Caledonia.

Picroceros A. Milne Edwards, 1865

Type species. — *Picroceros armatus* A. Milne Edwards, 1865, by monotypy.

Remarks. — There is but one species in this genus confined to the western Pacific. It is distinguished by its orbit of eave, intercalated spine and postorbital lobe, the eave enormously expanded at the antorbital angle. The pleopod is very unusual.

Distribution. — Western Pacific from Japan south to NE. Australia and Lord Howe Island.

Picroceros armatus A. Milne Edwards, 1865 (Fig. 16e, f)

Picroceros armatus A. Milne Edwards, 1865: 137, pl. 3 figs. 1, 1a, b; 1872: 244-246, pl. 12 figs. 2, 2a-c, pl. 13. — Sakai, 1938: 247-249, text fig. 24, pl. 35 fig. 2; 1976: 190-191, pl. 66 fig. 2. — Griffin, 1966b: 277 (in key).

Material examined. — 1 ♀, postrostral cl. 11 mm.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. KN IV, Kai Is., E. side of Mitduan Reef, W. coast of Nuhu Thut, 05°32′S 133°E, 36-56 m, dredge hauls 3-4, sand, coral rubble and sponge, 13 June 1970; 1 spec.

Remarks. — This immature specimen agrees well with those previously figured. The first pleopod of an adult male of *Picroceros armatus* from Lord Howe Island (AM P.14027) is figured. On the medial edge of the tip of the pleopod there are two lobes, of which the posterior is the longer; the apex is rounded.

Distribution. — Western Pacific: Japan, Kai Is., New Caledonia, Vanuatu, NE. Australia and Lord Howe Island.

Stilbognathus von Martens, 1866

Type species. — *Stilbognathus erythraeus* von Martens, 1866 by monotypy.

Remarks. — Miers (1879c), Alcock (1895), Balss (1929), and Garth (1958) placed together a number of genera of spider crabs with an expanded supraorbital eave but relatively narrow lower orbital floor, long eyestalks, anteriorly contricted carapace and, often, truncate front. This group known now as the Tychinae (from *Tyche* Bell) but previously as the Ophthalmiinae (from *Ophthalmias* Rathbun substituted for *Stenocionops* Latreille) includes a number of genera in the east Pacific, west Atlantic and Indo-Pacific. Among these are the genera *Tyche*, *Ophthalmias* and *Stilbognathus* von Martens.

Species of each of these genera were described as early as the mid 1800's by Bell, White, A. Milne Edwards, Miers and von Martens. By the time Rathbun (1925) published her monographic treatment of the American oxyrhynchs the genus *Tyche* included two species in the western hemisphere

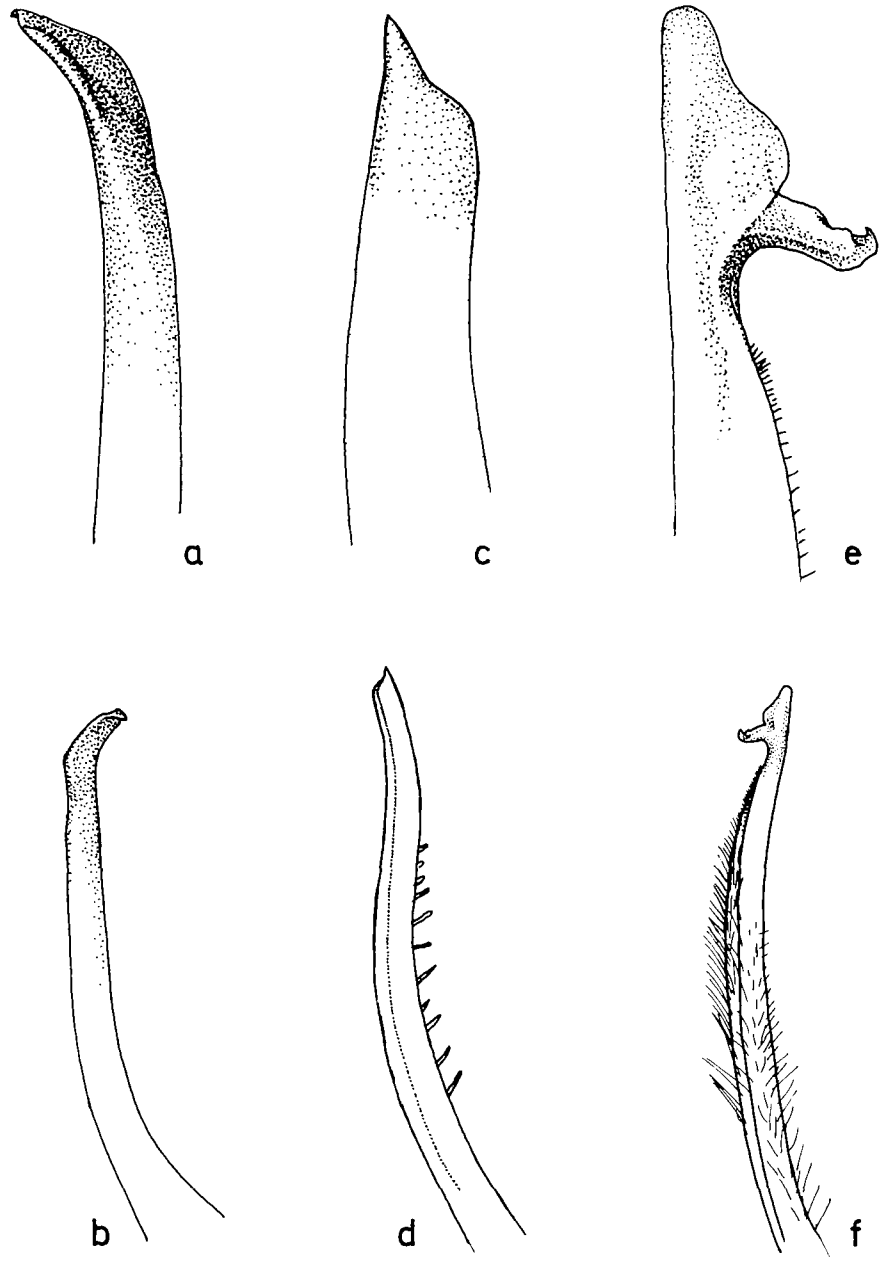


Fig. 16. Left first pleopod of male of *Stilbognathus martensii* (21.4 mm, Mauritius, ZMC) (a) sternal tip of pleopod, (b) abdominal view of same; *Criocarcinus superciliosus* (37.5 mm, AM P.29929) (c) sternal tip of pleopod, (d) abdominal view of same; *Picroceros armatus* (150 mm, AM P.14027) (e) sternal tip of pleopod, (f) abdominal view of same.

characterized by (1) a supraorbital hood comprising an eave produced anteriorly into a stout, forwardly directed spine and separated behind by a narrow fissure from an expanded hepatic lobe; (2) short subparallel rostral spines; (3) a peculiar third maxilliped in which a process of the exognath projected posteriorly from the base or curved round and fitted into a groove in the ischium of the endognath; (4) a carapace produced and flattened posteriorly; (5) a variously elevated branchial margin; and (6) an abdomen of seven free segments in both sexes.

The genus *Stilbognathus* included by 1925, three species from the western Indian Ocean. These were characterized by (1) a supraorbital hood comprising only an eave produced into a spine; (2) moderately long subparallel rostral spines (except in one species — see below); (3) a third maxilliped with the ischium and merus elevated at their junction as an almost circular glistening boss; (4) a carapace produced posteriorly as a short spine; (5) normal branchial margin; and (6) an abdomen of seven free segments in the male but only five in the female (segments 4-6 fused). One of these three, *Stilbognathus*

tycheformis from Mauritius, described by Bouvier (1915a), has a prominent flattened lobe on the posterior part of the supraorbital hood; this has been regarded as a postorbital lobe and this feature has been considered to ally this species with those of *Tyche*. The endognath of the third maxilliped in *S. tycheformis* is elevated and shiny as in other species of *Stilbognathus* and the rostral spines are short. By 1925 the genus *Ophthalmias* included two species, one confined to the Red Sea and one occurring as far east as Japan, differing from *Stilbognathus* in having longer rostral and orbital spines and lacking an elevation on the third maxillipeds.

Seven species of these three genera have been described since 1925. Monod (1939) described a species from Guadeloupe, *Tyche margaritifera*, which differed from other *Tyche* species in having a strong epibranchial spine, a prominent elevation on the merus of the third maxilliped and a rostrum fused for the basal two thirds. Garth (1952) described *Stilbognathus burryi* from off Florida as being similar to *Tyche margaritifera* but with the abdomen of the female possessing only five free segments. Because of this the species was placed in *Stilbognathus* and not *Tyche*. Williams, Shaw & Hopkins (1977) have shown that Garth's species is conspecific with Monod's and placed it in a new genus, *Stilbomastax*.

At the present time the four genera contain 14 species. The largest genus, *Tyche*, contains five species confined to the Americas. The genus *Ophthalmias* includes three species confined to the Indo-West Pacific. The genus *Stilbognathus* possesses four species in the western Indian Ocean. In the current classification the number of free segments in the abdomen of the female and the presence or absence of an elevation on the merus of the third maxilliped have been considered to be of almost paramount importance. The former character has been used to separate *Stilbomastax margaritifera* from other tychines from the Americas and the latter character has been used to distinguish species of *Stilbognathus* from other Indo-West Pacific species which have been placed in *Ophthalmias*.

Stilbomastax margaritifera differs from species of *Tyche* in the form of the rostrum, the epibranchial spine and the excrescence of the merus of the third maxilliped and agrees with species of *Stilbognathus* in possessing an excrescence on the third maxilliped merus and in the abdomen of the female having five free segments. There are obvious differences in the nature of the rostrum and the orbit.

The development of an excrescence on the third maxilliped is not confined to the group of species under discussion; it occurs in several species of *Leptomithrax* but not all of them. Its significance is doubtful; it is hardly a sufficiently important character to separate species into different genera. The prolongation of the exognath is not found in any group of species other than those now placed in *Tyche*.

The fusion of segments of the abdomen is a feature found in several subfamilies. Within the Indo-Pacific genus *Hyastenus* the females of the species usually possess seven free abdominal segments but *H. diacanthus* possesses only five. There is thus no reason to consider the reduction in the number of abdominal segments a character sufficiently important to count against those of the rostrum and orbit.

Numerical taxonomic analysis of the 13 species using up to 96 characters reveals the existence of two distinct groups and possibly four subgroups. In the groupings species of *Stilbognathus* are mixed in with *Opthalmias* species. The characters contributing to this grouping are mainly those classically used in the classification of majid spider crabs and especially those concerned with the carapace.

There is, in our view therefore, no good reason to continue with the anomalous situation outlined above. Clearly, the species at present separated into *Stilbognathus* and *Ophthalmias* should, with the possible exception of *S. tycheformis* be in the one genus.

Distribution. — One species (*S. cervicornis*) widespread throughout the Indo-West Pacific, the remaining species known only from the western Indian Ocean and Red Sea.

KEY TO SPECIES OF *STILBOGNATHUS*

1		Posterior angle of eave produced as a large lobe; rostrum short ..... *S. tycheformis*
—		Posterior angle of eave not produced; rostrum half as long as postrostral carapace length or longer 2
2(	1)	Ischium of third maxilliped anteriorly elevated, round and shiny 3
—		Ischium of third maxilliped with anterior margin flat 5
3(	2)	Notch on medial margin of merus of third maxilliped with a tooth or lobe (i.e. medial margin trilobed); ischium with long, very narrow groove ..... *S. martensii*
—		Notch on medial margin of merus of third maxilliped lacking a tooth or lobe; ischium with a broad groove 4
4(	3)	Merus of third maxilliped strongly arched, only outer blunt corner flat; groove of ischium short ..... *S. erythraeus*
—		Merus of third maxilliped with flat triangular anterolateral angle; groove of ischium long ..... *S. soikai*
5(	2)	Rostral spines straight and divergent; anterior marginal branchial spine long; posterior carapace margin with a medial spine ..... *S. longispinus*
—		Rostral spines subparallel or incurved; anterior marginal branchial spine of moderate length; posterior carapace margin with a medial lobe 6
6(	5)	Medial lobe on posterior carapace margin with apex acute or subacute ..... *S. curvirostris*
—		Medial lobe on posterior carapace margin with apex blunt, rounded ..... *S. cervicornis*

Stilbognathus cervicornis (Herbst, 1803) new combination

Cancer cervicornis Herbst, 1803: 49-50, pl. 58 fig. 2.
Ophthalmias cervicornis. — Guinot, 1962a: 46, fig. 33. — Griffin, 1974: 22, figs. 5, 7a-c.

Material examined. — 1 ♀, 32 mm.

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Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 25-63 m, dredge hauls 8-19, coarse sand, rubble, *Lithothamnion*, 2 June 1970; 1 spec. (prev. det. Serène).

Remarks. — This specimen agrees with others recently discussed (Griffin, 1974). The supraorbital spines are very slightly longer than the eyestalks; the medial lobe on the posterior carapace margin is blunt; on the third maxilliped the surface of the ischium is flat, not grooved, and the medial margin of the merus is bilobed.

Distribution. — Indo-West Pacific from eastern Africa through Sri Lanka, southeast India, Indonesia and Japan to Hawaii.

Stilbognathus martensii Miers, 1884
(Fig. 16a, b)

Stilbognathus martensii Miers, 1884: 521-522, pl. 46 fig. B, b, b′. — Garth, 1952: 252 (in key). — Griffin, 1974: 22 (in discussion).
Ophthalmias martensi. — Guinot, 1962a: 49, 51 (in discussion).
Ophthalmias cervicornis. — Rathbun, 1911: 254-255. (Not *Cancer cervicornis* Herbst, 1803.)

Material examined. — 1 ♂, 1 ♀, 21.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Java-S. Africa Expedition: Stn. 45, Mauritius, between Gunner's Quoin and Flat I., ca. 54 m, trawl and dredge, sand and corals, 16 October 1929; 2 specs.

Remarks. — These specimens agree with those described by Miers. The supraorbital spine is shorter than the eyestalk; there is a large tuberculate lobe submarginally on the hepatic region; on the posterior carapace margin there is a dorsoventrally flattened medial lobe which is apically narrow.

The ischium of the third maxilliped is elevated and shiny on the anterior margin and produced forward into the posterior margin of the merus. The fused basis is elevated and produced towards the midline, separated from the rest of the ischium by a transverse extension of the very narrow longitudinal groove. There is a small rounded posterolateral lobe on the ischium. The merus is only moderately elevated on the posterior margin; the medial margin is trilobed and the anterolateral angle is produced into a flat triangular lobe.

The first pleopod of the male has not been figured before. It is almost straight, curving weakly laterally only near the truncate apex. There is a small process on the medial edge of the apex and the lateral margin is curved sternally just behind the tip.

Distribution. — Known only from the western Indian Ocean: Amirante Is., Providence I., and Mauritius.

SUBFAMILY EPIALTINAE

Epialtidae Macleay, 1838: 56.
Acanthonychinae Alcock, 1895: 160, 164, 190. — Rathbun, 1925: 140. — Garth, 1958: 181-182. — Griffin, 1966b: 264.
Epialtinae. — Manning & Holthuis, 1981: 255.

Eyes without true orbits; the eyestalk very short or sometimes even obsolescent, either concealed beneath a forwardly-produced supraocular spine, or sunk in the sides of a huge beak-like rostrum; a postocular spine or process sometimes present, but not excavated for the reception of the retracted eye. Basal antennal article truncate triangular. External maxillipeds with the merus as broad as the ischium. Dactyli of the ambulatory legs prehensile or subchelate; the last three pairs of legs often disproportionately short compared with the (first) pair. (Alcock, as quoted by Garth.)

Pleopod 1 usually slender, weakly curved, aperture usually terminal, apex simple, curved or expanded into lobes, rarely with a slender process.

The majids contained in this subfamily are characterized by a sunken orbit and short, often immobile, eyestalks and many species have a prominent beaked rostrum. That the group is a diverse one is confirmed by the different first pleopods of the male; there are four distinct types exemplified by *Pugettia* with two elongate apical lobes, both medial (scyriform); *Menaethiops* with two triangular apical lobes, one lateral and one medial; *Acanthonyx* with the apex rounded medially and produced laterally; and *Xenocarcinus* with no apical lobes but with a slender, forwardly produced, process. Garth has already drawn attention to the diversity of male pleopods both in the subfamily and within several genera and to the similarity of some species previously placed in this subfamily to species of Pisinae — also a diverse group. At this time we have removed from the Epialtinae *Cyphocarcinus* to the Mithracinae and *Sphenocarcinus* and some species previously placed in *Pugettia* to the Pisinae, the latter being placed within the genus *Rochinia*. From the Pisinae we have withdrawn *Perinia*.

KEY TO INDO-WEST PACIFIC GENERA OF EPIALTINAE

1		Anterior part of carapace ahead of orbits strongly produced laterally completely concealing antennae, anterior margin broad, convex, entire (lacking any rostral lobe or spine) ..... *Cyclonyx*
—		Anterior part of carapace ahead of orbits not produced laterally, flagellum of antenna usually visible dorsally, anterior margin with a single rostrum or with two spines or lobes 2
2(	1)	Rostrum single or secondarily bifurcate 3
—		Rostrum of two spines or lobes, spines generally divergent but sometimes contiguous (*Menaethiops*) 6
3(	2)	Carapace ovate-cylindrical; postorbital lobe close to eye, anteriorly 'cupped'; rostrum stout, cylindrical (except in *X. truncatifrons*) ..... *Xenocarcinus*
—		Carapace pyriform to subtriangular, sometimes with large lateral lobes; postorbital lobe absent or small and simple; rostrum rarely cylindrical, or if so very slender 4
4(	3)	Preorbital angle of eave not produced or dorsoventrally flattened; rostrum large and beak-like, subrectangular to subtriangular in cross-section (short in some females) ..... *Simocarcinus*
—		Preorbital angle of eave dorsoventrally flattened, produced as a spine or lobe or at least a blunt right angle; rostrum usually slender, laterally or dorsoventrally flattened, narrowly ovate in cross-section 5
5(	4)	Branchial margin with two small lobes or tubercles; a small lateral lobe just behind the eye; propod of first ambulatory leg ventrally smooth without lobe or tuft of setae; sexes similar ..... *Menaethius*

— Branchial margin with one lobe, often very large; no lateral lobe just behind the eye; propod of first ambulatory leg with a ventral tuft of setae and sometimes a lobe, in the distal half; sexes dissimilar ..... *Huenia*

6(2) Hepatic lobe laterally produced and expanded in both sexes and separated from a similarly expanded branchial lobe by a shallow concavity or closed fissure; carapace broader than long ..... *Sargassocarcinus*

— Hepatic lobe of variable size but, if present, quite distinct from any branchial lobe or spine; carapace at least as long as broad 7

7(6) Orbit comprising a continuous rim around the eye without hiatus or suture above or below; eye retractile against the rim; meri of first two pairs of ambulatory legs with two blade-like lobes or high tubercles on dorsal margin and tubercles on outer face ..... *Perinia*

— Orbit not comprising a continuous rim, a distinct hiatus present above and below or else eye not retractile against a postorbital lobe; meri of ambulatory legs smooth or with only a terminal tubercle or lobe 8

8(7) Postorbital lobe either a small tubercle or absent or, if large, fused to supraorbital eave 9

— Postorbital lobe well developed, distinct from eave, sometimes fused to hepatic-spine or lobe 10

9(8) Carapace pyriform; hepatic and branchial margins with tubercles or short spines; postorbital lobe fused to supraorbital eave; ambulatory legs not subchelate, sixth segment cylindrical ..... *Menaethiops*

— Carapace subrectangular or suboval; hepatic and branchial margins with lobes; postorbital lobe small or absent, antorbital angle of eave not produced; ambulatory legs subchelate, sixth segment with ventral setiferous projection ..... *Acanthonyx*

10(8) Rostral spines slender, at least $^1/_4$ postrostral carapace length, hepatic lobe directed laterally, slender or dorsoventrally flattened but never laterally flattened; dorsal carapace usually with a few tubercles or short spines ..... *Pugettia*

— Rostral and hepatic lobes both very short (about $^1/_8$ postrostral carapace length) or both broad and dorsoventrally flattened or, if rostral spines long and slender (*A. lappacea*), hepatic lobes laterally flattened and directed straight forward; carapace dorsally usually smooth ..... *Antilibinia*

Acanthonyx Latreille, 1825

Type species. — *Maja lunulata* Risso, 1816, by monotypy.

Remarks. — A complete review of this genus is required to resolve several taxonomic difficulties. We have examined only a few of the described species and have followed previous authors, such as Ortmann (1894), Stephensen (1945), Tirmizi & Serène (1971), in including species of the genus *Dehaanius* Macleay in the genus *Acanthonyx*. Where the degree of fusion of the segments of the male abdomen is not distinct or consistent, such a character is not sufficient on its own as a distinction between genera. However, if future examination shows that among the species included in *Acanthonyx* there are some in which there are always two abdominal segments clearly fused and others in which there is never any indication of fused segments then it could be appropriate to recognise two distinct genera to contain the species. In *A. lunulatus* the fourth and fifth segments are clearly fused and Garth (1958), Chace (1966) and Manning & Holthuis (1981) have described the other five known Atlantic species as also having the fourth and fifth segments fused. In the four Indian Ocean species (*A. elongatus*, *A. quadridentatus*, *A. limbatus*, *A. euryseroche*) that we have examined the sutures between the segments are often indistinct. However, on the basis of the orbit, first pleopod of the male as well as other characteristics we presently consider these four species and *A. lunulatus* to be congeneric. Barnard (1950) states that in *A. scutellatus*, *A. dentatus* and *A. undulatus* the male abdomen has seven segments but does not say if the sutures are equally distinct.

Ten of the species, including the type species *A. lunulatus*, have no postorbital lobe, while in five species a postorbital lobe is present. All the species have a preorbital lobe except *A. simplex* Dana (1855: pl. 5 fig. 4a-d) which has been recorded only once from Hawaii, the only record of this genus from the western Pacific. One species, *A. petiveri*, occurs on both the Pacific and Atlantic coasts of America; five species occur in the eastern Atlantic and Mediterranean; and eight species, including one newly described, are known from the Indian Ocean.

Distribution. — East and west Atlantic, Mediterranean Sea, Indian Ocean, west and east Pacific Ocean.

KEY TO INDO-WEST PACIFIC SPECIES OF *ACANTHONYX*
(modified from Tirmizi & Serène (1971))

1 Carapace without a preorbital spine ..... *A. simplex*[11])

— Carapace with a distinct preorbital spine 2

2(1) Carapace without a distinct postorbital tooth 3

— Carapace with a distinct postorbital tooth 6

3(2) Three large triangular teeth on lateral border of carapace 4

— Two or only one large triangular tooth on lateral border of carapace 5

4(3) Hepatic lobe elongate, apex truncate or subacute, directed obliquely upwards; carapace tubercles well marked; rostrum about $^1/_4$ postrostral carapace length ..... *A. limbatus*

— Hepatic lobe broad triangular, horizontal; carapace tubercles indistinct; rostrum less than $^1/_5$ postrostral carapace length ..... *A. euryseroche*

5(3) Posterolateral tooth of carapace triangular, nearly as large as anterolateral tooth, and separated from one another by a deep concavity ..... *A. elongatus*[12])

— Posterolateral tooth feeble, lateral borders of carapace slightly concave, nearly subparallel ..... *A. scutellatus*[11])

6(2) Lateral teeth of carapace salient, triangular, pointed and separated from one another by concavities 7

— Lateral teeth of carapace short, truncate, not separated from one another by concavities 8

7(6) Carapace with two lateral teeth, a third medial one faintly indicated ..... *A. dentatus*[11])

— Carapace with four lateral teeth ..... *A. quadridentatus*

8(6) Outline of carapace oval, lateral border convex *A. consobrinus*[11,13])

— Outline of carapace sub-rectangular, lateral borders nearly straight and subparallel ..... *A. undulatus*[11,13])

Acanthonyx euryseroche new species
(Figs. 17, 18a, b, Pl. 7)

Material examined. — 14 ♂♂, 7 ♀♀ (1 ovig.), 8-18.5 mm, ovig. ♀, 18 mm.

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[11]) From the literature. (Dana, 1852; Barnard, 1950; Tirmizi & Serène, 1971)

[12]) Includes *A.* aff. *elongatus* Tirmizi & Serène;

[13]) These two very similar species never properly compared.

THE AUSTRALIAN MUSEUM, SYDNEY

Holotype. — Male, cl. 16.5 mm, Western Australia, south of Northwest Cape, Warroora, 23°29′S 113°48′E, shore reef, low tide on algal covered limestone, coll. N. Coleman, 28 June 1972; The Australian Museum, Sydney (AM P.29842).

Paratypes. — Western Australia, data as for holotype; 1 spec. (AM P.19418); 3 specs (AM P.19419); 16 specs. (AM P.29843).

Description. — Carapace broad, width equal to about three quarters (0.74) postrostral carapace length; surface smooth but not shiny, a few small tubercles, each surmounted by a group of setae.

Rostral spines weakly deflexed, basally broad, each tapering to a narrow apex, sometimes apically incurved; a row of curled hairs dorsally on proximal third of each spine; length less than a fifth (0.16) postrostral carapace length.

Orbital eave moderately expanded, surmounted by tuft of stout setae; preorbital spine blunt, directed forward and slightly outward, but hardly upward; lateral margin of eave concave with sometimes a very small swelling posteriorly. Eyestalks short, slender, and except for terminal cornea, concealed under eave.

Hepatic margin produced into a flat, broad, triangular, apically blunt lobe, length about half basal width, posterior margin weakly convex, longer than anterior margin and subparallel to midline of carapace. Branchial margin with three lateral lobes, anterior one very small, sometimes indistinct, two posterior lobes subequal, short, blunt, less than half size of hepatic lobe. All marginal lobes surmounted by a tuft of stout setae. A smooth ridge on lateral carapace margin.

Gastric regions weakly elevated; a small protogastric tubercle surmounted by a tuft of stout setae opposite hepatic lobe, a row of curled hairs in front of tubercle; a small posterior mesogastric tubercle.

Cardiac region only very weakly elevated, with a small medial tubercle; intestinal region with a low central tubercle; a low ridge along posterior carapace margin, continuous with that on lateral margin.

Branchial regions dorsally smooth except for a very small tubercle midway between cardiac tubercle and posterior branchial lobe.

Basal antennal article smooth, a central depression in proximal half; basally broad, narrower distally, anterolateral angle not produced.

Pterygostomian region smooth, margin with a tubercle in distal half. Third maxilliped smooth, anteromedial angle of ischium slightly overlapping posteromedial border of merus; merus broad, subquadrate, anterolateral angle produced and rounded, notch anterior, shallow.

Cheliped about three quarters postrostral caparace length. Merus of adult male smooth, a proximal seta dorsally and a small, blunt, terminal tubercle surmounted by a group of stout setae; carpus with a blunt ridge dorsally; palm smooth, length about one and a half (1.4) times height; fingers short, hardly gaping proximally, less than two thirds palm (0.62), uniform small teeth along cutting edge of both fingers.

Ambulatory legs smooth, merus of first leg with a seta midway dorsally, and a group of setae on a low terminal tubercle; propod with a compressed, obtusely triangular lobe about midway along ventral margin, setae along distal margin of lobe; a similar lobe on propodi of second to fourth pairs of legs; dactyli of ambulatory legs with a double row of about ten small teeth ventrally along their length. First ambulatory leg slightly greater (1.1) than postrostral carapace length, fourth leg less than two thirds (0.6) length of first.

Male sternum smooth, a pair of small, circular, submedial pits just behind anterior margin, a shallow central depression in front of abdominal fossa.

Male abdomen of seven segments, junctions visible between all segments, sixth segment less than half width of third segment; sixth and seventh segments both about as wide as long. In half the males junctions between fourth and fifth segments are less pronounced.

Female abdomen smooth, segments four to six fused with no suture lines visible.

First pleopod of male straight, broad, slightly narrowed before broad apex; anterior margin recurved ventrally, medial angle rounded, lateral angle subacute; aperture subterminally on sternal surface.

Female gonopore a narrow slit opening anteriorly.

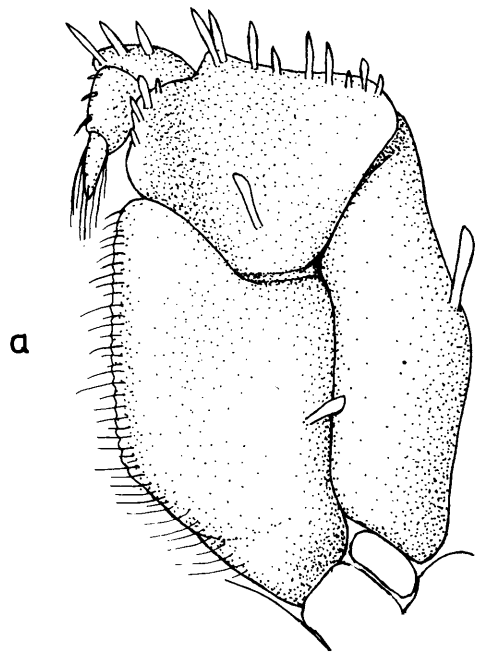
Remarks. — This species resembles *A. limbatus* A. Milne Edwards in lacking a postorbital spine and in having three well developed lateral lobes on the carapace. However, it differs from *A. limbatus* as figured by A. Milne Edwards (1862: pl. 17 fig. 4), *A.* (*limbatus*?) figured by Stephensen (1945: fig. 19) and our specimen of *A. limbatus* from India in having a flat, broad, triangular hepatic lobe rather than a truncate or subacute, elongate tooth.

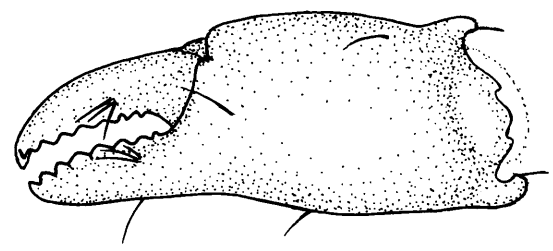
A. limbatus and the new species can be distinguished by the following additional points:

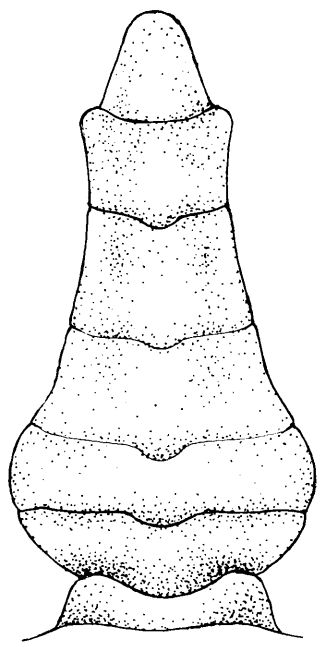
(1) the carapace tubercles are small and indistinct (well marked in *A. limbatus*);
(2) the rostral spines are less than one fifth postrostral carapace length (about a quarter postrostral carapace length in *A. limbatus*);
(3) the preorbital spine and hepatic lobe are horizontal (directed obliquely upwards in *A. limbatus*);
(4) the basal antennal article has a central depression proximally (absent in *A. limbatus*);
(5) the cheliped is shorter than, and first ambulatory leg equal to, the postrostral carapace length (cheliped slightly greater than, and first ambulatory leg one and a half times postrostral carapace length in *A. limbatus*).

Even in our largest male of *A. euryseroche* (cl. 18 mm), which appears to be adult, there are uniform teeth along the dactyl of the cheliped, whereas there is a large low tooth on the dactyl of our adult male of *A. limbatus*.

The name is derived from the Greek *eurys* — broad and *exochos* — projecting, referring to the broad lobes on the lateral margins.







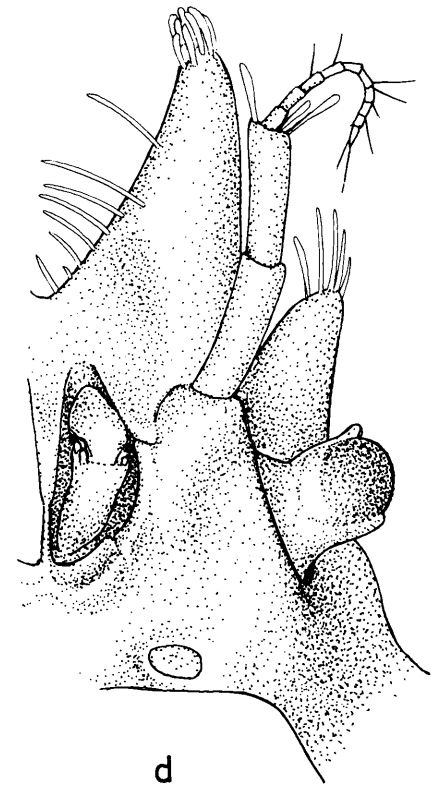


Fig. 17. *Acanthonyx euryseroche* (holotype) (a) left third maxilliped; (b) left chela of male; (c) male abdomen; (d) left orbit, ventral view.

Distribution. — Known only from Warroora, Western Australia.

Acanthonyx limbatus A. Milne Edwards, 1862

Acanthonyx limbatus A. Milne Edwards, 1862: 7-8, pl. 17 figs. 4, 4a-b. — Tirmizi & Serène, 1971: 23 (in key).
Acanthonyx (*limbatus?*). — Stephensen, 1945: 102-105, figs. 19A-H.

Material examined. — 1 ♂, 17 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

South India, Pamban Passage, 3.6 m, April 1889; 1 spec.

Remarks. — This specimen agrees well with that from the Gulf of Iran figured in detail by Stephensen (1945) and with the specimen described and figured by A. Milne Edwards (1862).

The rostral spines are a quarter postrostral carapace length. There are two very small convex lobes posteriorly on the orbital eave. The hepatic lobe is narrow, truncate, about as long as it is wide basally. The cheliped of this adult male is slightly longer (1.2) than the postrostral carapace length; there is a large low tooth on the dactyl in the narrow gape between the fingers. The first ambulatory leg is one and a half times the

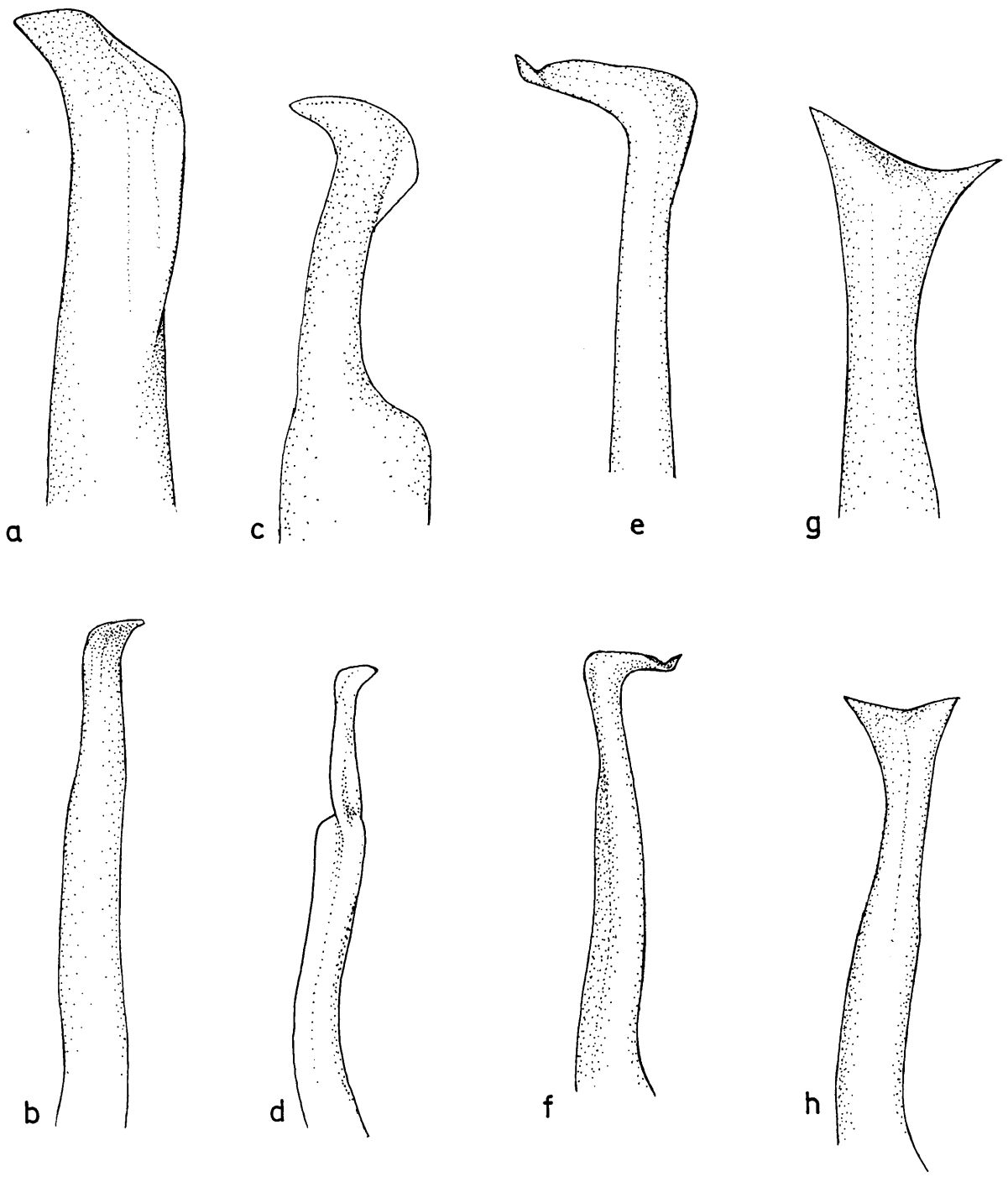


Fig. 18. Left first pleopod of male of *Acanthonyx euryseroche* (holotype) (a) sternal tip of pleopod, (b) abdominal view of same; *Menaethius orientalis* (8.5 mm, Roti I., ZMA) (c) sternal tip of pleopod, (d) abdominal view of same; *Sargassocarcinus sublimus* (7.5 mm, Japan, USNM 48248) (e) sternal tip of pleopod, (f) abdominal view of same; *Menaethiops xiphias* (holotype) (g) sternal tip of pleopod, (h) abdominal view of same.

postrostral carapace length and the fourth leg is about two thirds (0.66) the first.

In our specimen the segments of the male abdomen are not as clearly separated as in that figured by Stephensen (his fig. 19), the junctions between both segments four and five, and segments five and six, are very indistinct and barely visible. On the first pleopod of the male the aperture is on the sternal surface just before the anterior margin; there is a small, rounded lobe on the proximal edge of the aperture.

A. limbatus and *A. euryseroche* are distinguished from other known species of *Acanthonyx* by the absence of a postorbital spine together with the presence of three well developed lateral lobes on the carapace. The differences which distinguish *A. limbatus* from *A. euryseroche* are discussed under that species.

Distribution. — Indian Ocean: Ile de la Réunion, Gulf of Iran, NE. and southern India.

Antilibinia Macleay, 1838

Type species. — *Antilibinia smithii* Macleay, 1838, by monotypy.

Remarks. — The type species of this genus is a large, shallow water crab from the eastern coast of southern Africa. The other three species, including one newly described here, are small species found at depths of 200 m or more in the western Pacific.

The first pleopod of the male of *A. smithii* has been figured by Barnard (1950: fig. 7d): it is similar to that of some species of *Acanthonyx*. The pleopod of the adult male is "not known" for any of the western Pacific species so we are unable to compare it with that of the type species.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *ANTILIBINIA*

1	Carapace subcircular; a tubercle or short spine on branchial margin at point of greatest width; a large (up to 70 mm cl.), shallow water species ..... *A. smithii*
—	Carapace suboval, branchial margin smooth or with an indistinct tubercle or tubercles; small (about 14 mm cl.), deep water species 2
2(1)	Rostrum about 1/6 postrostral carapace length; postorbital and hepatic lobes very short and subequal ..... *A. gilloloensis*
—	Rostrum at least 1/3 postrostral carapace length; hepatic lobe much longer than postorbital lobe 3
3(2)	Rostral spines slender; preorbital, postorbital and hepatic spines narrow and laterally compressed; carapace with numerous long, straight hairs ..... *A. lappacea*
—	Rostral spines broad, dorsoventrally flattened; preorbital, postorbital and hepatic lobes broad and dorsoventrally flattened; carapace with few hairs ..... *A. polita*

Antilibinia lappacea Rathbun, 1918

Antilibinia lappacea Rathbun, 1918: 12-14, fig. 3, pl. 7 fig. 3. — Hale, 1927: 133-134, fig. 133. — Griffin, 1966b: 267-268, 277 (in key).

Material examined. — 1 ♀, 13.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Danish Kei Islands Expedition: Stn. 56, Kai Is., 05°30′20″S 132°51′E, 345 m, trawl, mud, 10 May 1922; 1 spec.

Remarks. — This specimen agrees very well with the holotype (ovig. ♀, postrostral cl. 13 mm, AM E.3659) from the Great Australian Bight. The only differences are very slight. The preorbital spine and the postorbital lobe are slightly shorter and broader than in the holotype and the tubercles on the pterygostomian margin are not as strongly developed. Our specimen is infected with a sacculina parasite, but the abdomen is the same as in the holotype (an ovigerous female); the fifth and sixth segments appear fused but the line between them is still visible.

This species has previously been known only from the holotype.

There is no good reason as far as we can see to regard *Pisidarum* sp., figured and briefly described by Serène & Vadon (1981: 128, pl. 4 fig. F), as anything other than an *Antilibinia* and most probably *A. lappacea*.

Distribution. — Great Australian Bight; Kai Islands.

Antilibinia polita new species
(Fig. 19, Pl.8)

Material examined. — 1 ♂, 6.5 mm, 1 ♀, 14 mm.

Holotype. — Female, adult, cl. 14 mm, Mindanao, Moro Gulf, 07°25′N 123°14′E, 450 m, Sigsbee trawl, 9 March 1914, Mortensen Pacific Expedition 1914-16; Zoological Museum, University of Copenhagen.
Paratype. — Male, cl. 6.5 mm, data as for holotype.

Description. — Carapace broad, width equal to 0.8 postrostral carapace length, anteriorly elevated, smoothly sloped, regions not defined at all; surface shiny, no tomentum, a small protogastric group of curled hairs and curled hairs along subbranchial region.

Rostral spines broad, dorsoventrally flattened, fused in proximal half, lateral edges parallel, separated in distal half by a broad V-shaped hiatus, length about one third (0.3) postrostral carapace length; spines apically blunt in holotype, acute in small male.

Orbital eave moderately expanded, preorbital lobe broad, about as long as basal width, directed obliquely forward and outwards, apex blunt (acute in small male); no antorbital lobe; postorbital lobe short, about as long as basal width, subequal to preorbital lobe, apex blunt (acute in small male).

Hepatic margin produced laterally into a broad, triangular lobe, dorsoventrally flattened, posterior margin longer than anterior. Subhepatic region smooth. Branchial margin with a very small convex lobe, almost continuous with posterior margin of hepatic lobe. Branchial submargin with a row of five small tubercles on epimeral ridge; a low posterolateral ridge just above carapace margin, epibranchial tubercle very small, indistinct.

Highest elevation of carapace in posterior mesogastric region, carapace sloping evenly to posterior carapace margin which is slightly thickened; cardiac region marked only by indistinct lines.

Basal antennal article smooth, flat except for a very shallow depression centrally in proximal half; broad basally and narrowing slightly distally; anterolateral angle produced forward to a sharp spine in small male, but to a short blunt tooth in adult female; a small tubercle just lateral to green gland.

Pterygostomian region smooth except for a lateral tubercle near margin and about halfway along; margin with four or five blunt tubercles. Third maxilliped smooth, a low ridge close and parallel to lateral margin of ischium; anterolateral angle of merus only slightly produced and rounded, notch shallow.

Merus of cheliped of adult female (holotype) dorsally sharp, with two small compressed lobes proximally and a blunt terminal spine; a small proximal tubercle ventrally; carpus with a large convex carinate ridge dorsally. Palm with dorsal and ventral margins rounded, length one and a half times height; fingers shorter (0.8) than palm with a narrow gape between them in proximal half; two or three large teeth on each finger in gape and broad low teeth on both fingers where they meet in distal half.

Ambulatory legs smooth, meri with a blunt terminal spine; carpus of second to fourth pairs of ambulatory legs with a small proximal tubercle dorsally; dactyl of fourth leg with three very small distal teeth ventrally and a long curved terminal spine. First leg about one and a half times postrostral carapace length, fourth leg about three quarters length of first leg.

Male sternum smooth, small triangular area elevated on anterior margin.

Male abdomen of seven segments, smooth; sixth segment about one and a half times as wide as long, seventh segment about as wide as long; third segment more than one and a half times (1.7) wider than sixth segment.

Abdomen of adult female smooth, fifth and sixth segments fused, junction between them visible only on midline.

First pleopod of juvenile male straight with a simple blunt apex.

Female gonopore a simple, circular aperture, opening ventrally.

Remarks. — This species is very similar to *A. lappacea* Rathbun, especially in the shape of the carapace, but it can be distinguished from that species by the following features: —

(1) the rostral spines are broad and dorsoventrally flattened, fused in the proximal half; in *A. lappacea* the rostral spines are slender and fused only in the proximal quarter to third;
(2) the preorbital, postorbital and hepatic spines are short, broad and dorsoventrally flattened (as in *Huenia*); in *A. lappacea* these spines are long and narrow or laterally flattened;
(3) the carapace with very few hairs; in *A. lappacea* there are numerous long, straight hairs on the carapace.

A. gilloloensis Rathbun is distinguished from *A. polita* by having: (1) much shorter rostral spines (about one seventh or less of postrostral carapace length); (2) the regions clearly defined on the carapace; (3) the carapace covered with a short tomentum; and (4) by the absence of a terminal spine on the merus of the ambulatory legs.

The female of *A. gilloloensis* is unknown, and the first pleopod of the male has not been described or figured. The male of *A. lappacea* is unknown and the male of *A. polita* is only a juvenile, so we are unable to make any comparison between the pleopods of the western Pacific species of this genus and that of *A. smithii* Macleay from East Africa figured by Barnard (1950: fig. 7). As previously observed (Griffin, 1966b) a new genus may be required for the western Pacific species.

In both *A. lappacea* and *A. polita* the fifth and sixth segments of the female abdomen are fused. In these two species it is interesting to note the form of the adult female cheliped which has a strongly carinate carpus, a short, high palm and a gape between the fingers as in adult males of species of other genera.

The name of the new species refers to the characteristic polished appearance (from *polio*, *-itus* (L.) make smooth).

Distribution. — Known only from the type locality, Moro Gulf, Mindanao, Philippine Islands.

Cyclonyx Miers, 1879

Type species. — *Huenia frontalis* White, 1847, by monotypy.

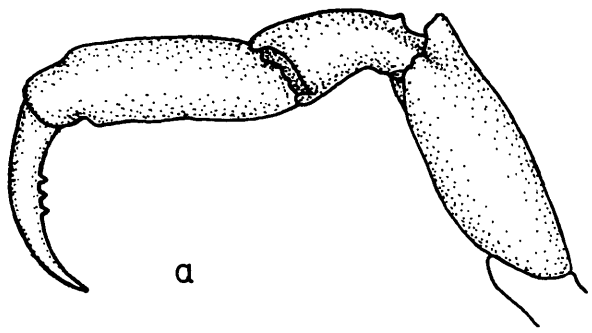
Remarks. — The single species of this genus has not been reported since its original description and Miers (1879a) has commented on the poor condition of the holotype. In *Cyclonyx frontalis* the carapace is expanded in front of a narrow orbital recess and completely conceals the antennae. There is no preorbital angle. While this species resembles *Huenia brevifrons* Ward in the broad lateral lobes on the carapace, the anterior of the carapace is quite distinct from that seen in species of *Huenia*. As our knowledge of this species is so poor we cannot comment further on its relationship to other species and genera.

Distribution. — Locality unknown.

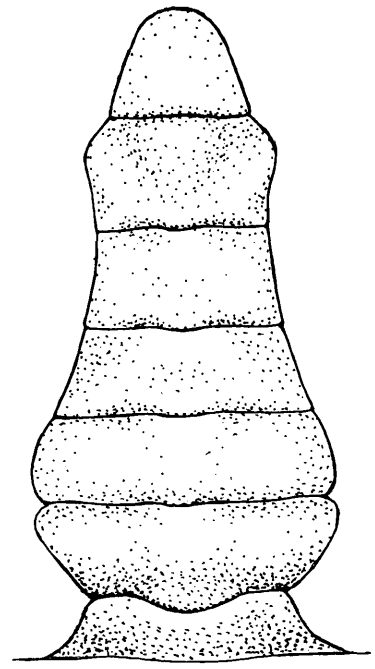
Huenia De Haan, 1839

Type species. — *Maja* (*Huenia*) *proteus* De Haan, 1839, by monotypy.

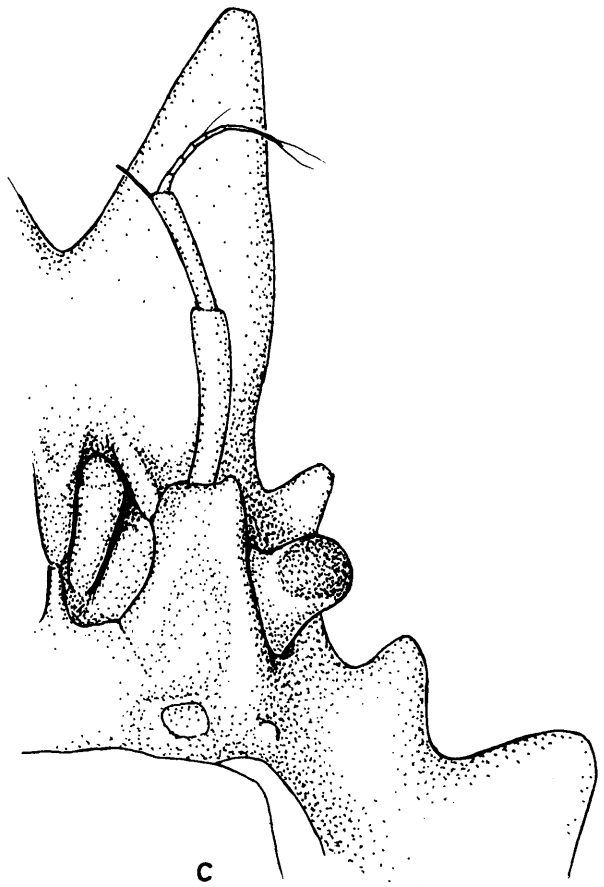
Remarks. — The members of this genus are sexually dimorphic and mimic the algae amongst which they live. Early authors, such as De Haan (1839) Adams & White (1848) and Dana (1852), described several species in this genus and also varieties of *H. proteus* De Haan based on the various carapace shapes. Miers (1879a, 1879c) removed from this genus, to genera of their own, those species which lacked a preorbital spine and he also described a new species, *H. pacifica*, distinct from the similar *H. proteus* and *H. grandidierii* A. Milne Edwards. Miers (1884) later suggested that the varieties *heraldica*, *elongata* and *tenuipes* were all forms of *H. proteus*. Some recent authors, including Barnard (1950), Takeda (1973a) and Sakai (1976), have regarded *H. pacifica* and *H. grandidierii* as synonyms of *H. proteus* but the present treatment recognises the three species described by Miers as distinct. Two other distinct species, *H. bifurcata* Streets and *H. brevifrons* Ward, are recognised by us. *H. proteus* is widespread in the Indo-west Pacific, *H. pacifica* occurs in the western Pacific and *H. grandidierii* appears to be restricted to the western Indian Ocean.



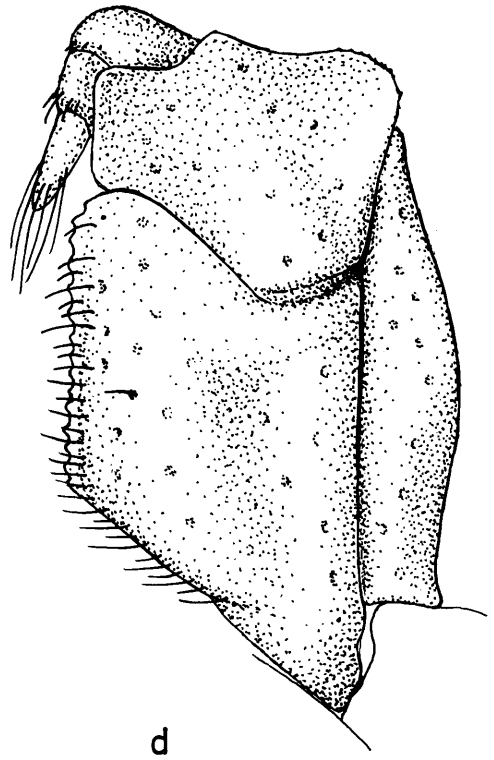
a



b



c



d

Fig. 19. *Antilibinia polita* (holotype) (a) left fourth ambulatory leg; (male, 6.5 mm, Mindanao, ZMC) (b) male abdomen; (holotype) (c) left orbit, ventral view; (d) left third maxilliped.

In southern Australian waters where *H. proteus* and *H. pacifica* are absent the genus is represented by three species — *H. bifurcata* off the coast of New South Wales and *H. australis* and *H. halei* around the southern coastline and in Tasmania. A third new species, *H. keelingensis*, is described from the Cocos Keeling Islands. This genus is apparently closely associated with particular kinds of algae, notably *Halimeda*, and it is probable that the distribution of the species of *Huenia* is correlated with the distribution of species of algae.

The first pleopod of the male in most species is weakly

broadened at the tip and curves slightly outwards, but in the Australian species the tip is more strongly expanded and quite strongly curved outwards.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *HUENIA*

1	Preorbital angle narrow, a laterally flattened or cylindrical spine	2
—	Preorbital angle broad, dorsoventrally flattened	4
2(1)	Posterior margin of carapace convex; branchial lobe of female subacute	*H. grandidierii*
—	Posterior margin of carapace straight; branchial lobe of female truncate or extremely broad	3
3(2)	Carpus of first ambulatory leg carinate	*H. proteus*
—	Carpus of first ambulatory leg lacking any carina	*H. pacifica*
4(1)	Preorbital lobe weakly developed, very broad, angle obtuse or a short spine projecting forward from lobe	5
—	Preorbital lobe strongly developed and projecting forward, angle acute or subacute	7
5(4)	Rostrum distally very narrow; carpus of ambulatory legs dorsally flattened	*H. keelingensis*
—	Rostrum evenly tapering, distally blunt or rounded; carpus of ambulatory legs cylindrical or carinate	6
6(5)	Ambulatory legs strongly carinate	*H. brevifrons*
—	Ambulatory legs cylindrical	*H. aff. brevifrons*
7(4)	Rostrum distally flattened dorsoventrally, bifurcate	*H. bifurcata*
—	Rostrum cylindrical or subcylindrical, at most weakly notched apically	8
8(7)	Ambulatory legs cylindrical; rostrum narrowed distinctly in distal quarter	*H. australis*
—	Ambulatory legs with at least carpus prominently carinate dorsally; rostrum evenly tapering distally	*H. halei*

Huenia australis new species
(Figs. 20, 22f, 25c, d, h)

Material examined. — 5 ♂♂, 5 ♀♀, 10-26 mm.

Holotype. — Male, cl. 21.5 mm, west coast of South Australia, Whittlebee Point, 28 February 1975 coll. W. Zeidler. South Australian Museum SAM C3877.

Paratypes. — As listed below:

SOUTH AUSTRALIAN MUSEUM, ADELAIDE

South Australia, Port Willunga; 1 spec. (SAM C1107, prev. det. as *H. proteus*). — W. coast South Australia, (as for holotype); 1 spec. (SAM C3878).

MUSEUM OF VICTORIA, MELBOURNE

Victoria, Westernport, Shoreham, intertidal, 5 March 1967; 1 spec. — Bass Strait, Deal I., 10-30 m, coll. S. Shepherd, 7 May 1974; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Tasmania, Port Arthur; 1 spec. (AM P.4479); 1 spec. (AM P.6044). — Southwest Tasmania, dredged in shallow water; 1 spec. (AM P.29856). — Western Australia, Rob I., off Cape le Grande, 15 m, coll. A. Kuiter, 20 March 1978; 1 spec. (AM P.29857). — Western Australia, Perth, Carnac I., 6 m, reef, living on algae, coll. N. Coleman, 23 January 1972; 1 spec. (AM P.23814).

Description. — Carapace broad, lateral margin produced on each side into two lobes, carapace width between lobes about two thirds postrostral carapace length, surface smooth, minutely pitted.

Rostral spine a quarter to a third postrostral carapace length, narrow basally and tapering slightly to a deep, blunt apex; weakly deflexed; slightly deeper basally than distally, dorsal surface narrow just behind apex (sometimes almost triangular in cross-section); curled setae on basal half.

Preorbital spine large, dorsoventrally flattened, apically blunt; length equal to or greater than the basal width of the rostrum.

Mesogastric region with a low tubercle posteriorly. Protogastric regions each with a low tubercle forward of the mesogastric tubercle and forming with it an inverted triangle. Cardiac region with a low tubercle. Intestinal region smooth, posterior margin of carapace convex, curved downward over abdomen.

Hepatic margin produced laterally to form a subacute triangular lobe of variable size, small and narrow to broad and blunt, sometimes with a small lobe on anterior margin. Branchial margin in both sexes produced to form a broad triangular lobe with a small lobe on anterior margin.

Basal antennal article smooth, laterally rounded (not with a sharp ridge as in *H. bifurcata*), no anterolateral tubercle. Third maxilliped smooth, anterolateral angle of merus weakly produced and rounded.

Pterygostomian region and margin smooth, without tubercles. Sternum smooth.

Merus of cheliped of adult male smooth, with a strong, blunt, terminal spine; carpus with a well developed lateral ridge and a small dorsal tubercle; palm smooth, not carinate, fingers short, gaping for proximal half, coarsely toothed distally, dactyl with prominent tooth in gape. Merus of first ambulatory leg smooth, cylindrical with a strong, blunt terminal spine; carpus with a small dorsal tubercle midway, not carinate; propod with a small lobe ventrally, bearing a small tuft of setae at about distal third. Second to fourth pairs of ambulatory legs not carinate, meri with a terminal tubercle, carpi sometimes with a small dorsal lobe, propodi with a small tuft of setae surmounting a weak lobe at distal half or third. (One adult female (AM P.4479, Tasmania) has a small group of setae dorsally on cheliped palm, and also on some segments of ambulatory legs.)

Male abdomen smooth, sixth and seventh segments both about as long as wide.

First pleopod of male expanded distally, anterior margin with a transparent crest produced laterally, hook-like.

Female abdomen smooth, segments four to six fused. Female gonopore a slit, opening anteromedially.

Remarks. — None of our preserved or dried specimens have retained any colour, but a colour slide from the Tasmanian Museum of an adult male of this species (about 36 mm, Tasmania, due east of Schouten I., 110 m, dredged, on seaweed, coll. H. J. Rattenbury, 20 February 1977, photo N. R. Kemp) shows it to be red with a large medial white patch, extending from just in front of the anterior gastric tubercles to the posterior carapace margin.

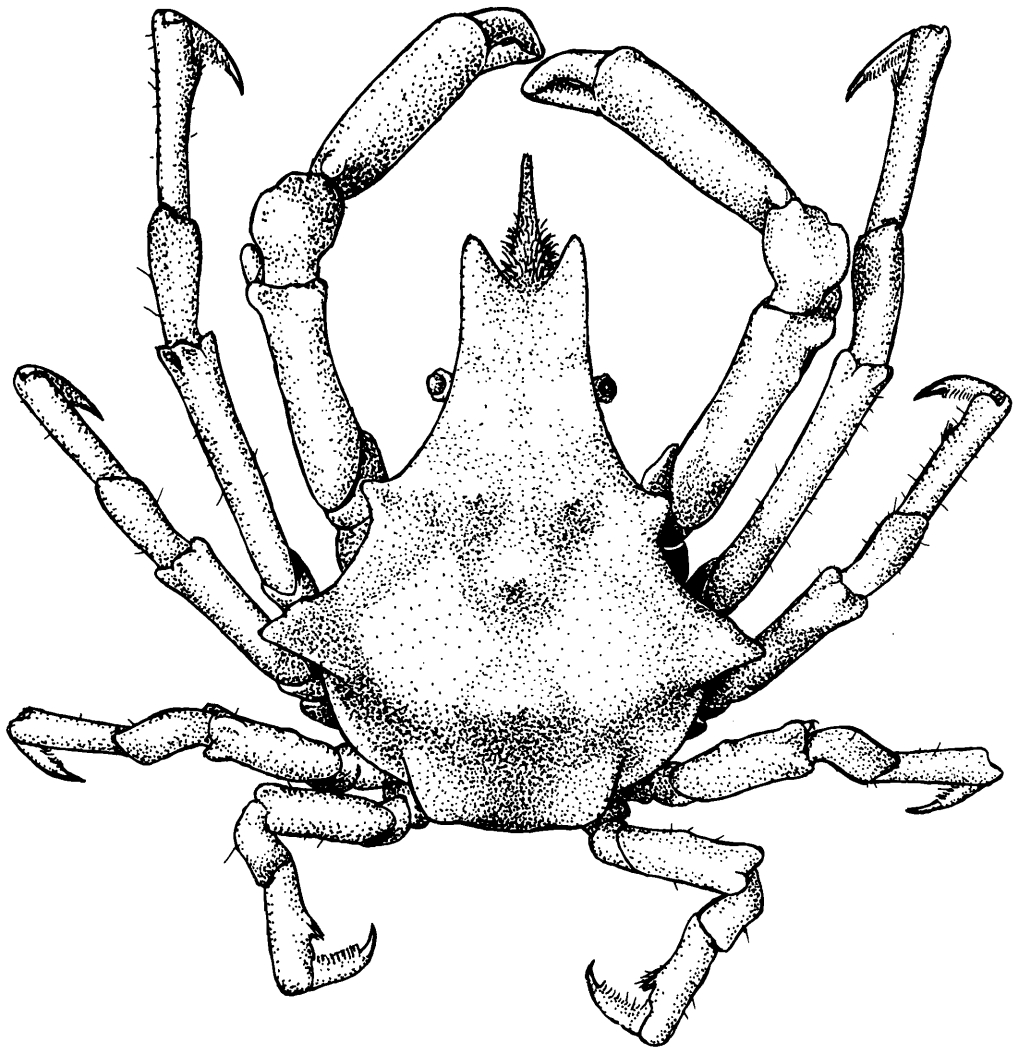


Fig. 20. *Huenia australis* (holotype) whole animal, dorsal view.

This species resembles *H. halei* and the characters of the rostrum and the ambulatory legs which distinguish it are discussed under that species.

Distribution. — Southern Australia: Southern Western Australia, South Australia, Victoria and Tasmania.

Huenia bifurcata Streets, 1870
(Fig. 25a, b, g)

Huenia bifurcata Streets, 1870: 107. — Haswell, 1882: 8-9. — Griffin, 1966b: 278 (in key), pl. 15 figs. d, e.

Material examined. — 28 ♂♂, 15 ♀♀ (9 ovig.), 4.0-28.5 mm, smallest ovig. ♀, 13.5 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Holbourne I., 19°44′S 148°22′E; 1 spec. (AM P.6759). New South Wales: Off Woody Head, 29°22′S 153°22′E, in prawn trawl, 1962; 1 spec. (AM P.27145). — Iluka Bluff, near mouth of Clarence R., intertidal, coll. A. A. Cameron, 16 August 1966; 1 spec. (AM P.16002). — Off entrance to Clarence R., in prawn trawl net; 1 spec. (AM P.11895). — Port Stephens, 6-12 m; 1 spec. (AM P.4921). — Broken Bay, near Sandy Point, March 1926; 3 specs. (AM P.8620). — Collaroy, Long Reef; 4 specs. (AM P.8621). — Collaroy Beach, in sponge, coll. P. Colman, 30 August 1969; 1 spec. (AM P.27146). — Port Jackson; 1 spec. (AM P.288); 3 specs. (AM P.1911); 1 spec. (AM P.1912). — Port Jackson, Bottle and Glass Rocks; 3 specs. (AM P.8614). — Bottle and Glass Rocks, intertidal, under stones, 27 May 1926; 1 spec. (AM P.9226). — Port Jackson, off Sow and Pigs Shoal, 4-5 m; 1 spec. (AM P.9350). — Sow and Pigs Reef, 5 m, coll. F. A. McNeill, 1926; 1 spec. (AM P.8716). — Between Sow and Pigs Reef and Green Point, dredged, 25 August 1923; 1 spec. (AM P.6484). — North Bondi, 5 m, in brown algae, coll. R. H. Kuiter, 1 October 1978; 1 spec. (AM P.29853). — Near Sydney, La Perouse, Bare I., coll. A. Healy, 17 September 1968; 1 spec. (AM P.16346). — Shellharbour; 3 spec. (AM P.6306). — Shellharbour, intertidal; 2 specs. (AM P.8432). — Bass Point, 7 m, coll. A. Kuiter, 10 February 1979; 1 spec. (AM P.29854). — Montague I., 36°15′S 150°14′E, 15 m, algal washings, coll. A. Kuiter, December 1978; 10 specs. (AM P.29855).

Remarks. — These specimens agree well with the brief description given by Streets (1870) and the specimens previously figured (Griffin, 1966b). In this series, as is usual, the rostrum is short, one fifth to one quarter postrostral carapace length and similar in both sexes, basally deep but distally shallow and bifurcate, distally much wider than deep and rostral length about twice (1.7 to 2.5) the distal width.

Ventrally the rostrum is narrowest about halfway along. The preorbital spine is large, broad and dorsoventrally (but not laterally) flattened.

The lateral hepatic lobe is absent from the male, broad and blunt with a small lobe on the anterior margin in the female, truncate in adult females, subacute in juveniles. The branchial lobe is broad, truncate and weakly bilobed in both sexes. The posterior margin of the carapace is smooth, convex, projecting backward, laterally slightly raised but without tubercles.

The cheliped merus is smooth, with a strong, blunt terminal spine; the carpus is very strongly carinate laterally, the palm is not carinate. The merus of the first ambulatory leg has a strong, compressed terminal spine, the carpus bears a small, dorsal, compressed triangular lobe, the propod is compressed and widened at about the distal third to form a small ventral lobe which bears a tuft of setae. Ambulatory legs two to four are somewhat compressed, the meri being carinate with a terminal lobe; the carpi are carinate; the propodi weakly carinate with a tuft of setae at the distal third or half (referred to as a 'spine' by Streets).

The male abdomen is smooth the sixth and seventh segments each being about as wide as long. The first pleopod of the male is expanded distally, with a transparent crest across the anterior margin.

This species is distinguished from all other known species of *Huenia* by the distally broad and bifurcate rostrum.

Distribution. — East Australian coast from Townsville (Queensland) to Bega (N.S.W.).

Huenia brevifrons Ward, 1941
(Fig. 21b, c)

Huenia proteus. — Borradaile, 1903: 686 (in part), fig. 124, pl. 47 fig. 2. — Sankarankutty, 1961: 132-133, fig. 2, C, D. (Not *Maja* (*Huenia*) *proteus* De Haan, 1839.)

Huenia brevifrons Ward, 1941: 3, figs. 3, 4. — Sakai, 1976: 208-209, pl. 71 fig. 5. — Takeda, Okamoto & Fukuda, 1976: 103-108, figs. 1-6, pl. 1. — Chen, 1980: 122-123, fig. 6.

Material examined. — 1 ♀, 14.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 144, South Moluccas, anchorage north of Salomakiaee (Damar) I., reef exploration, 7-9 August 1899; 1 spec.

Remarks. — This specimen, an adult female, agrees with the holotype (a small immature female, 9.7 mm, Gulf of Davao, Philippines, 1936; AMNH 8328, no ambulatory legs) which has been examined by one of us (D.J.G.G.). In our specimen the hepatic lobe is strongly convex anteriorly and produced forward and the branchial lobe is posteriorly rounded. (In the holotype the hepatic lobe is convex but not produced forward and the branchial lobe has a sharp posterior angle.)

In our specimen the carapace width (15 mm) is greater than the postrostral carapace length (11.5 mm). The rostrum is short, triangular, its length (3 mm) subequal to basal width (3.2 mm), not deflexed; the dorsal surface is concave, the apex broad and rounded, apical depth about half apical width. The supraorbital region is broad, width (4.75 mm) greater than twice the length (2 mm). The preorbital spine is small, acute and directed forwards. The gastric regions have three broad tubercles in a triangle, apex posteriorly; the cardiac region bears a low tubercle. The intestinal region has the posterior margin produced backwards and the posterolateral margin weakly upturned. Only the cheliped and first ambulatory leg are present with the specimen. The cheliped merus is carinate dorsally and ventrally, with three lobes on each edge; the carpus is carinate; the palm is strongly carinate dorsally and sharp ventrally. The first ambulatory leg is short (about three quarters cl.), the merus and carpus compressed and carinate; the propod is strongly compressed, about one and a half times as long as high, with a small tuft of setae on the distal ventral angle. The abdomen of the female has segments 4-6 fused.

Sakai (1976) suggests that because the 'leaf-like' specimen figured by Borradaile (1903: 686 (in part), fig. 124, pl. 47 fig. 2) doesn't have a preorbital spine it is not a *Huenia*. In Borradaile's specimen the preorbital angle is a blunt right angle and not produced into a spine, but this cannot be regarded as the same thing as 'lacking a preorbital spine' (e.g. as in *Simocarcinus*). It seems clear, as noted by Takeda et al. (1976), that these 'leaf-like' specimens are not Huenia proteus but *Huenia brevifrons* Ward (or a closely related species) as is also the specimen figured as *H. proteus* by Sankarankutty (1961: 132-133, fig. 2, C. D). The pleopod of the male of *H. brevifrons* figured by Takeda et al. (1976: fig. 6) is similar to the pleopod of *Huenia proteus*.

The specimens described by Sakai (1976) and Takeda et al. (1976) are all from Ishigaki I. in the Ryukyu Islands. It seems reasonable to assume that Sakai's specimen (cw. 12 mm) is an adult of the same species as Takeda's specimen (cw. 5 mm). If this is so, then there is a marked increase in the carination of the ambulatory legs with increasing size.

We have also examined a specimen from Heron I., Queensland, (immature female, cl. 9.5 mm, reef, August 1962, AM P.29848) which resembles *H. brevifrons* in many features, but the differences (particularly in the legs) from our other specimen make us doubt that they are conspecific. In carapace shape the Heron I. specimen resembles the immature males described by Takeda et al; However, the ambulatory legs are cylindrical in the Heron I. specimen and not even weakly carinate as in Takeda's specimen. The holotype of *H. brevifrons* is an immature female only slightly larger than the Heron I. specimen, but according to Ward, the ambulatory legs (now missing) are short and compressed. The carapace width (8 mm) of the specimen from Heron I. is nearly equal to the postrostral carapace length (8.5 mm). The rostrum is short (1 mm), triangular, as long as it is wide basally with a flat dorsal surface, and weakly deflexed from the supraorbital region; the apex is blunt, slightly deeper than

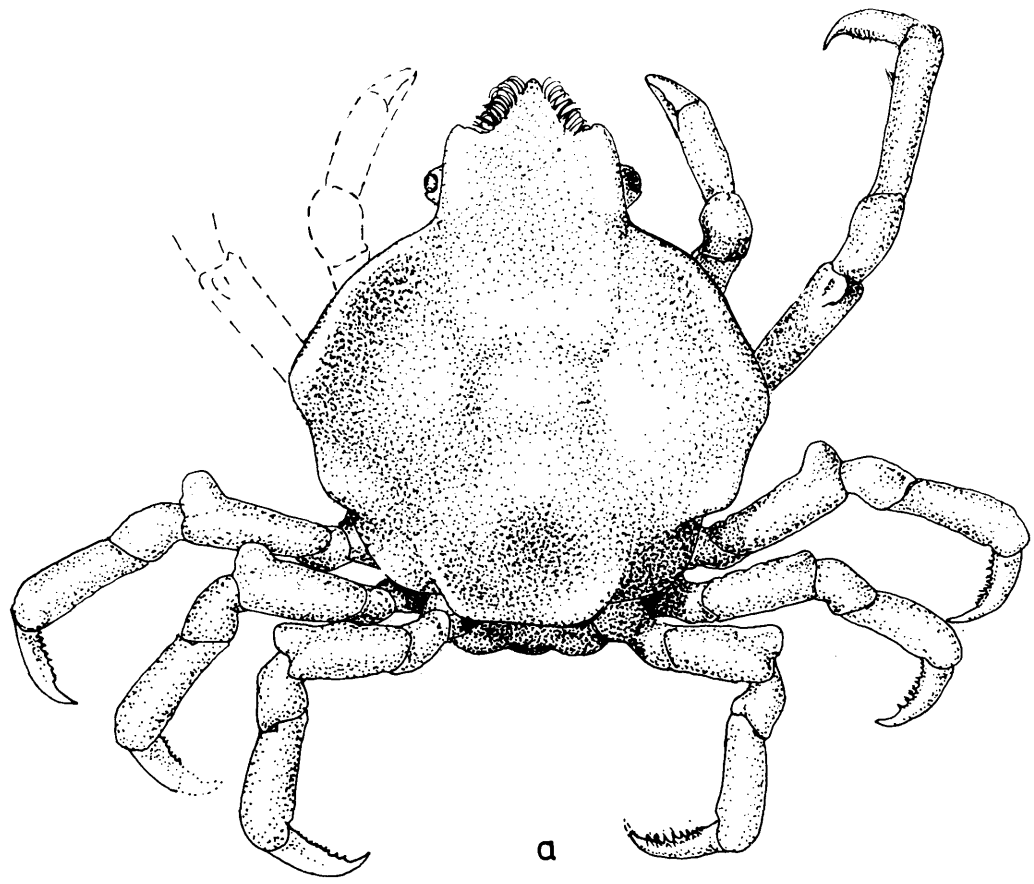


Fig. 21. *Huenia* aff. *brevifrons* (female, imm., 9.5 mm, AM P.29848) (a) whole animal, dorsal view; *Huenia brevifrons* (female, ad., 14.5 mm, South Moluccas, ZMA) (b) right first ambulatory leg; (c) carapace, dorsal view.

wide, but not compressed. The preorbital angle is sharp but not produced into a spine. The cheliped is smooth, not compressed or carinate. The first ambulatory leg is about as long as the carapace, the propod (length = 3 x height) bearing a small tuft of setae (but no lobe) ventrally at about the distal third. The meri of the ambulatory legs each bear a large, blunt, terminal spine, decreasing in size from legs 1-4. The abdomen has segments 4-6 fused.

The specimen of *H. brevifrons* figured by Chen (1980) seems to agree with that figured by Takeda et al. The merus of the cheliped is not carinate.

Distribution. — Maldive and Laccadive Islands, South Moluccas, Philippine Islands (Mindanao), China, Japan.

Huenia grandidierii A. Milne Edwards, 1865 (Fig. 24e)

Huenia grandidierii A. Milne Edwards, 1865: 143-144, pl. 4 fig. 2.
Huenia grandidieri. — Ortmann, 1894: 39.
Huenia proteus. — Barnard, 1950: (in part) fig. 9F. (Not *Maja* (*Huenia*) *proteus* De Haan, 1839.)

Material examined. — 5 ♂♂, 6 ♀♀ (4 ovig.), 4.5-22 mm, smallest ovig. ♀, 12 mm.

ZOOLOGICAL MUSEUM, COPENHAGEN
'Galathea' Expedition: Stn. 255, Kenya, Mombasa, 04°05'S 39°41'E, 0 m, corals, 22 March 1951; 4 specs. — Stn. 256, Kenya, Mombasa, 04°05'S 39°41'E, 1-2 m, triangle dredge, corals, 22 March 1951; 7 specs.

Remarks. — The females of our series agree quite well with the holotype figured by A. Milne Edwards except that the hepatic lobes in our specimens are directed more laterally than anterolaterally. The rostrum is short, about $^1/_3$ or less of the postrostral carapace length (males 0.33-0.37, females 0.2-0.31), weakly deflexed, not increasing in depth distally. The preorbital spine is more strongly developed and the rostrum is narrower basally than in *H. proteus*, the preorbital spine being approximately half as long as the basal width of the rostrum (approx. $^1/_4$ basal rostral width in *H. proteus*).

In the males in our series the marginal hepatic lobe is small and rounded or only a tubercle in the two smallest specimens (sometimes very small indeed in specimens from Somalia). The branchial lobe in males is subacute with a smaller lobe on the anterior margin (approaching bilobed in a few specimens). In females the marginal hepatic lobe is almost quadrangular, truncate, the lateral edge crenate, or nearly entire in adult specimens, directed outwards and slightly forwards and upwards; the lobe is sometimes rounded in specimens from Somalia. The branchial lobe in females is acute to subacute, with a smaller lobe on its anterior border. All specimens, both male and female, have a tubercle on the lateral margin halfway between the branchial and hepatic lobes.

There are three tubercles on the gastric regions forming an inverted triangle, one tubercle on the cardiac region and a very small medial tubercle on the posterior margin. The posterior margin of the carapace is convex, the margin is slightly expanded on each side of the midline.

The merus of the cheliped of the adult male is cylindrical (not carinate), with a moderately sized terminal tubercle or spine; the carpus has a sharp ridge laterally; the chela is somewhat compressed but not dorsally sharp; there is an extremely wide gape between the fingers in large males with a truncate tubercle on the dactyl in the gape, only the distal third of the fingers being toothed and adjacent. In our series the merus of the first ambulatory leg (the holotype is without ambulatory legs) is cylindrical with a blunt, compressed terminal spine (more pronounced in the female); the carpus has a longitudinal ridge or tubercle on the anterior edge; the propod is expanded slightly distally, with a tuft of setae ventrally at the distal quarter, but is not produced into a definite lobe; there is no tuft of setae dorsally on the propod. The meri of the second to fourth ambulatory legs have one or two small dorsal lobes and a short, compressed terminal lobe; the carpi sometimes have a tubercle but are not carinate dorsally; the propodi have a tuft of setae on the ventral surface (on second leg at the distal third, on third and fourth legs nearer the distal half), but are not produced as a lobe.

The first pleopod of the male is of the same kind as in *Huenia proteus* which has been figured by Takeda (1973a: fig. 2A, B).

We have also examined a large series of this species from Somalia (30 ♂♂, 20 ♀♀ (6 ovig.), 7.5-20 mm) collected by Dr. M. Vannini of the Istituto di Zoologia dell'Università, Florence.

Huenia grandidierii is distinguished from *H. proteus* and *H. pacifica* by the branchial lobe of the female which is subacute (not truncate); the lack of carination on the ambulatory legs, particularly the carpi and propodi of the second to fourth ambulatory legs which are not at all carinate or dorsally sharp; and the posterior margin of the carapace which is convex (not straight).

Distribution. — East African coast: Tanzania, Kenya, Somalia.

Huenia halei new species (Figs. 22a-e, g, 25e, f, i)

Huenia proteus. — Hale, 1927: 133, fig. 132. (Not *Maja* (*Huenia*) *proteus* De Haan, 1839.)

Material examined. — 6 ♂♂, 12 ♀♀ (1 ovig.), 9.5-21 mm, ovig. ♀, 20 mm.

Holotype. — Male, cl. 20 mm, Victoria, Western Port, Hastings, north of French I., 5-9 m, dredge, 5 September 1914; Mortensen Pacific Expedition 1914-16. Zoological Museum, University of Copenhagen. Donated to The Australian Museum, Sydney (AM P.34580).
Paratypes. — As listed below:

ZOOLOGICAL MUSEUM, COPENHAGEN
Mortensen Pacific Expedition: Victoria, Western Port, 9-18 m, algae, 6 September 1914; 1 spec.

SOUTH AUSTRALIAN MUSEUM, ADELAIDE
South Australia: St. Vincent's Gulf; 7 specs. (SAM C1105). — Backstairs Passage; 2 specs. (SAM C1106). — Encounter Bay; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY
Victoria, Port Phillip; 1 spec. (AM G.612, prev. det. *H. bifurcata*). — Victoria; 1 spec. (AM G.5947). — South Australian coast; 2 specs. (AM P.155).

WESTERN AUSTRALIAN MUSEUM, PERTH
Western Australia: 2 miles (∿ 3 km) NW. of Busselton Jetty, 22-23 m, on *Posidonia* and sand, coll. B. R. Wilson on 'Lancelin', 12 April 1963; 1 spec. (WAM 98-67). — W. of Garden I., 32°13.01'S 115°31.05'E, to 32°10.5'S 115°33.45'E, 27-33 m, coll. L. Marsh and M. H. Shepherd, F. R. V. 'Flinders', 8 March 1972; 1 spec. (WAM 71-72).

Description. — Carapace broad, lateral margin produced on each side into two lobes, carapace width between lobes about two thirds postrostral carapace length in males and 0.8-0.9 postrostral carapace length in females, surface smooth, minutely pitted.

Rostral spine 0.2-0.3 postrostral carapace length, tapering from base to an acute point, deflexed, much deeper basally than distally, narrow and uniformly rounded (i.e. circular in cross-section) behind apex, curled setae on basal half.

Preorbital spine broad, dorsoventrally flattened, apically acute or subacute.

Mesogastric region with a small tubercle posteriorly. Protogastric regions with two smaller tubercles forward of mesogastric and forming with it an inverted triangle. Cardiac region with a low tubercle. Intestinal region smooth, posterior margin of carapace convex, sometimes produced backwards over abdomen, posterolateral angles rounded, raised.

Hepatic lobe in males broad and rounded (sometimes truncate), branchial lobe larger and less rounded than hepatic, weakly bilobed. Hepatic lobe in females very broadly rounded, posteriorly not distinctly separated from base of branchial lobe which, as in males, is weakly bilobed. (In some females the hepatic lobe is nearly as large as the branchial lobe and the lateral edges of the two are continuous.)

Basal antennal article smooth with a moderately sharp lateral ridge and a small anterolateral tubercle.

Pterygostomian region and margin smooth, without tubercles.

Merus of cheliped of adult male dorsally sharp with a blunt compressed terminal spine; carpus with a well developed ridge and a tubercle; palm dorsally sharp, fingers short, gaping in proximal half, coarsely toothed distally, dactyl with prominent tooth in gape.

Merus of first ambulatory leg weakly compressed, or at least dorsally sharp, with a strong, blunt, compressed terminal spine; carpus carinate or at least with a compressed dorsal lobe; propod hardly widening distally, with a tuft of setae ventrally at about distal third and usually a very small dorsal lobe just proximal to tuft. Ambulatory legs 2-4 at least weakly compressed, merus, carpus and propod carinate, merus with a strong blunt terminal lobe, propod with a tuft of setae ventrally at about distal half.

Male abdomen smooth, sixth segment about as long as wide, length of seventh segment slightly less (about 0.8) than width.

First pleopod of male expanded distally, anterior margin with a broad transparent crest.

Remarks. — This species resembles *H. australis* but is distinguished from it in that the ambulatory legs are at least weakly compressed and the carpi are carinate (in *H. australis* the legs are cylindrical and the carpi are not carinate); the rostrum is uniformly rounded (i.e. circular in cross-section) just behind the apex (in *H. australis* the rostrum is dorsally narrowed near the apex); the hepatic lobe is broader and much more rounded in both sexes of this species and the tip of the first pleopod of the male is not produced laterally to form a hook as it is in *H. australis*.

In some (four) specimens the apex of the rostrum is minutely bifurcate, but not nearly to the same extent as in *H. bifurcata* in which the apex of the rostrum is broadly and deeply bifurcate, several times wider than deep and the rostrum narrow ventrally midway along. The rostrum of this species is similar to that of *H. keelingensis* but it is distinguished from that species by the much larger preorbital spines and the carinate carpus of the ambulatory legs (carpus dorsally flattened in *H. keelingensis*).

Adult females of this species often have a very broad carapace as do females of *H. brevifrons*. However, the much larger preorbital spines and the narrow rostrum distinguish the new species from *H. brevifrons*.

This species is named for H. M. Hale, Director of the South Australian Museum from 1931 to 1960, author of the comprehensive handbook 'The Crustaceans of South Australia' and many other studies on Australian Crustacea.

Distribution. — Southern Australia: from Westernport, Victoria through South Australia to Garden I., southern Western Australia.

Huenia keelingensis new species
(Fig. 23)

Material examined. — 1 ♂, 12.5 mm, 1 ♀, 12 mm.

Holotype. — Male, 12.5 mm, 'Cocos Is., Sumatra', 6 May 1926, dry. South Australian Museum, SAM C1140, prev. det. as *Huenia proteus*.
Paratype. — Female, 12 mm, data as for holotype, South Australian Museum, SAM C 3880, prev. det. as *Huenia proteus*.

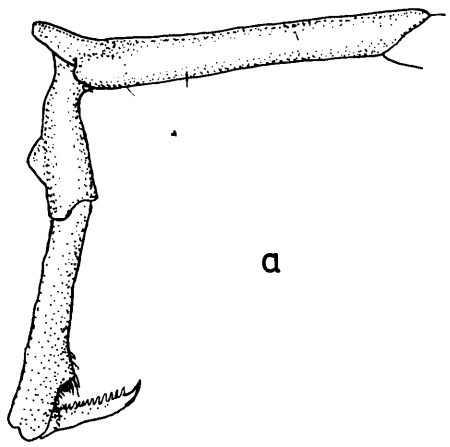
Description. — Carapace broad, width behind hepatic lobes nearly three quarters postrostral carapace length, surface smooth, minutely pitted (as in other species).

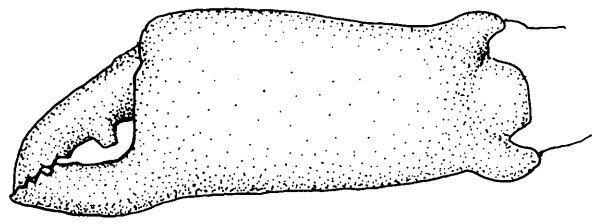
Rostral spine short, less than one fifth postrostral carapace length, basally a broad triangle with marginal curled hairs, weakly depressed medially; distal half at lower level, narrow, tapering to an acute, slightly upcurved apex (i.e. apex similar to *H. halei*). Preorbital spine small in the male; preorbital angle in the female only sharp, not produced to a spine.

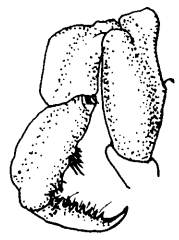
Mesogastric region with a small distinct tubercle posteriorly in male. Protogastric regions with a submedial tubercle just forward of mesogastric tubercle. Gastric tubercles indistinct in female. Cardiac region with a low tubercle. Intestinal region smooth, no medial tubercle, posterior margin of carapace curved, convex, produced backwards.

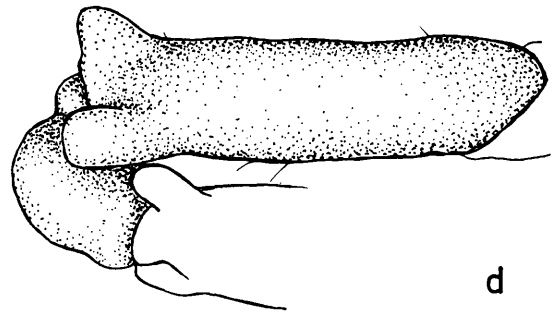
Hepatic margin in both sexes produced into a rounded lobe (slightly larger in female). Branchial margin produced as a rounded lobe, smaller than hepatic lobe.

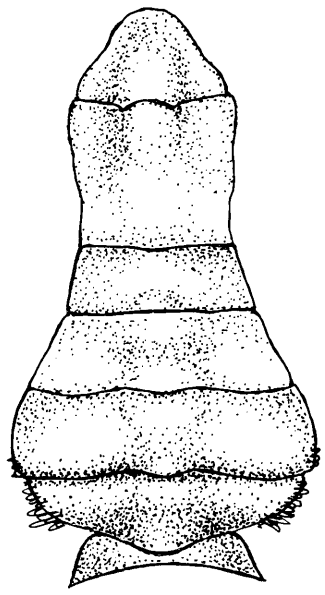
(As the specimens are glued to a card the basal antennal article, abdomen and other ventral characters were not seen.).

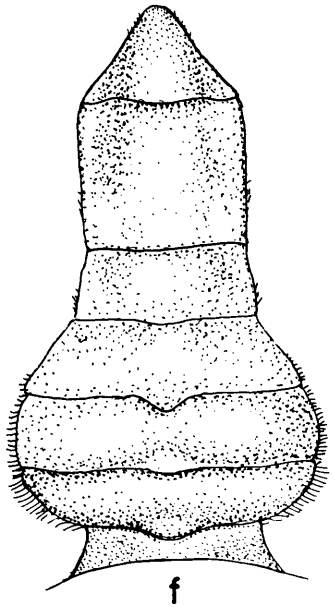












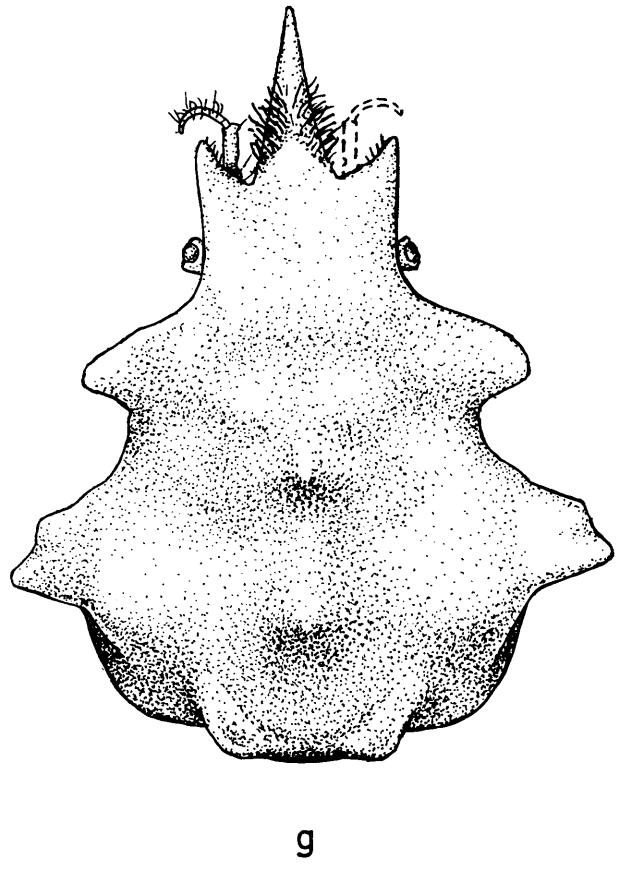


Fig. 22. *Huenia halei* (holotype) (a) left first ambulatory leg; (male, 21 mm, AM G. 612) (b) left fourth ambulatory leg; (holotype) (c) left chela; (d) left cheliped, merus and carpus; (e) male abdomen; *H. australis* (holotype) (f) male abdomen; *H. halei* (holotype) (g) carapace, dorsal view.

Merus of cheliped of adult male smooth, broad, no terminal spine or tubercle; carpus with indistinct ridge, not carinate; palm dorsally sharp only in proximal half, no tubercles on inner face; fingers gaping, a large tubercle on dactyl in gape.

First ambulatory leg as long as postrostral carapace length, smooth, not carinate, low terminal ridge or tubercle on merus; carpus strongly flattened on dorsal surface; propod weakly compressed, a tuft of setae on distal third on ventral surface. Ambulatory legs two to four very similar to each other, approximately same length (nearly $^3/_4$ postrostral carapace length); merus carinate; carpus dorsally flattened; propod cylindrical with a small tuft of setae at about distal half.

Remarks. — This species resembles *Huenia brevifrons* Ward in several features:
(1) there is a broad carapace in both sexes;
(2) the hepatic lobe is larger than the branchial lobe;
(3) the rostrum is basally a short broad triangle;
(4) preorbital spine short or only a sharp angle;
(5) posterior margin of carapace produced backwards.
It differs from *H. brevifrons* as follows:
(1) the rostrum is produced distally, the distal half narrow and tapering, with an acute apex;
(2) the carpus of each of the ambulatory legs is dorsally flattened, not compressed or carinate.

In our specimen of *H. brevifrons* from the South Moluccas the cheliped merus is carinate dorsally and ventrally with three lobes on each edge but in the present species the cheliped merus is smooth, broad, dorsally rounded, without any terminal tubercle or spine. In the specimen (female, 9.5 mm, AM P.29848) similar to *H. brevifrons* from Heron I. (and discussed under that species) the ambulatory legs are cylindrical with a strong terminal lobe on the meri; in the present species the meri of legs two to four are carinate and the carpi dorsally flattened.

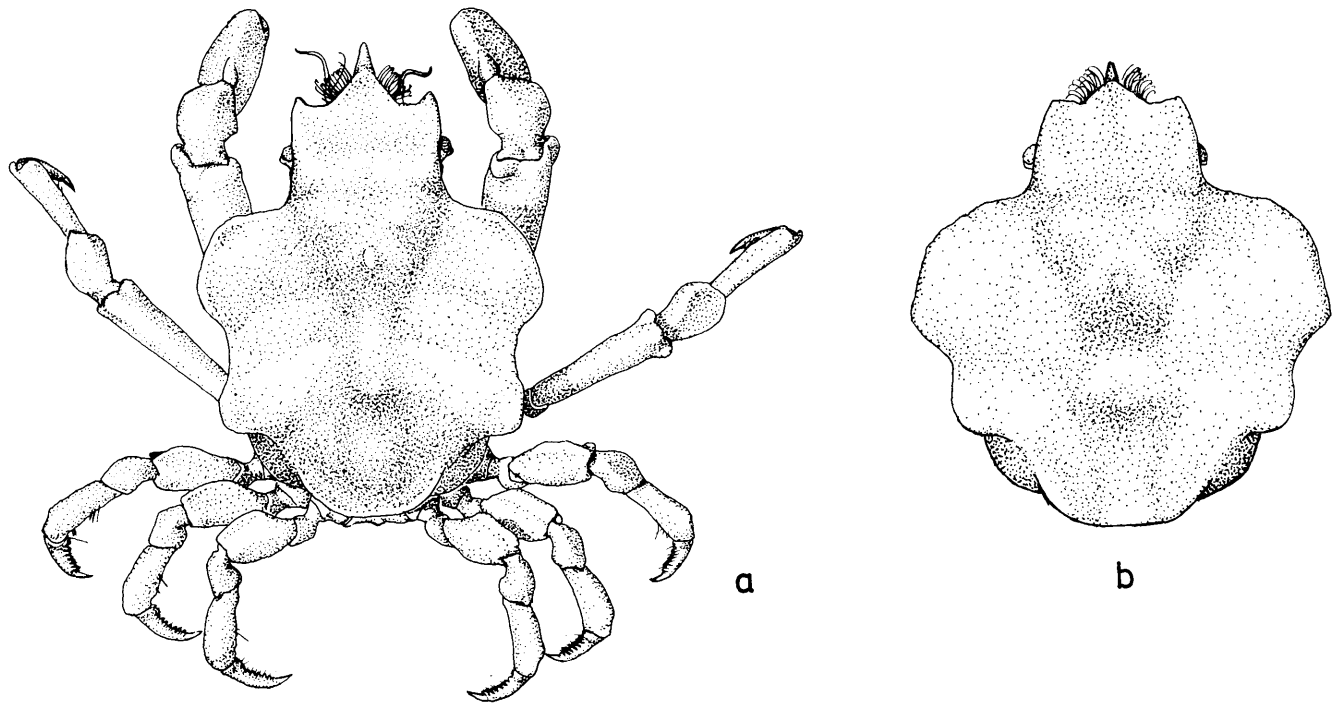


Fig. 23. *Huenia keelingensis* (holotype) (a) whole anaimal, dorsal view; (paratype, female) (b) carapace, dorsal view.

With the specimen on the card are two small branches of *Halimeda*-like weed, and there is also some attached to the rostrum of the female.

The name of this new species refers to the type locality, Cocos Keeling Islands, Indian Ocean (12°05′S 96°53′E).

Distribution. — Known only from 'Cocos Is., Sumatra'.

Huenia pacifica Miers, 1879
(Fig. 24a, b)

Huenia pacifica Miers, 1879a: 5-6, pl. 4 fig. 3.

Material examined. — 14 ♂♂, 15 ♀♀ (5 ovig.), 8.5-19 mm, smallest ovig. ♀, 14 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 37, Flores Sea, Paternoster Is., Sailus Ketjil, close to reef, 27 m, dredge, coral and coral sand, 30/31 March 1899; 8 specs. (ZMA De.100.832 in part, det. Ihle as *H. proteus*). — Stn. 64, Flores Sea, Tanah Djampeah, Kambargi Bay, 32 m, trawl, dredge and shore exploration, coral and coral sand, 4/5 May 1899; 3 specs. (ZMA De.100.796, det Ihle as *H. proteus*). — Stn. 99, Sulu Archipelago, anchorage off North Ubian, 06°7.5′N 120°26′E, 16-23 m, dredge, townet, *Lithothamnion* bottom, 28/30 June 1899; 9 specs. — Stn. 253, Kai Is., 05°48.2′S 132°13′E, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 1 spec. —

Stn. 313, Sumbawa, Saleh Bay, anchorage east of Dangar Besar, 36 m, dredge, trawl, and reef exploration, sand, coral and mud, 14/16 February 1900; 1 spec. (ZMA De.100.707, det. Ihle as *H. proteus*).

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: N. end of Albany Passage, dredged, coll. M. Ward, August-September 1928; 1 spec. (AM P.19475). — dredged off Lindeman I., coll. M. Ward, December 1928; 1 spec. (AM P.13996). — Between Bundaberg and Gladstone, found in nets; 1 spec. (AM P.17108). — Lady Elliot I., coll. C. Wright, 1964; 1 spec. (AM P.17250). — Whitsunday Group, Black I., near Langford Reef, shallow water, coll. N. Coleman, November 1969; 2 specs. (AM P.19523), (AM P.19504).

Remarks. — These specimens agree well with the syntypes of *Huenia pacifica* (BMNH 56.105, 1 ♂, 20.1 mm, 1 ovig. ♀, 13.4 mm, Fiji Is.) examined by one of us (D.J.G.G.).

In our series the rostrum is slightly less broad and less deep basally than in *H. proteus*. In adult males the rostrum is about $^2/_3$ postrostral carapace length but in smaller males (e.g. 11 mm cl.) only about $^1/_2$ postrostral carapace length. In females the rostrum is about $^1/_3$ postrostral carapace length. Again in males the rostrum is horizontal or weakly deflexed and the distal depth is subequal to the proximal depth, but in adult females it is up to twice as deep distally. The preorbital spine is about $^1/_4$ basal rostral width and directed forwards and slightly outwards.

There are three tubercles on the gastric regions but often only the posterior medial one is distinct. There is a cardiac tubercle and in some specimens a small medial tubercle on the posterior margin. The posterior margin of the carapace is straight rather than convex and not produced backwards over the abdomen. The lateral hepatic lobe in males is very small, but usually present, and the branchial lobe is triangular and subacute. (There are no specimens that we have seen that have the large hepatic lobe sometimes found in males of *H. proteus*.) The lateral hepatic lobe in females is broadly rounded anterolaterally, but more sharply angled posteriorly; there is a small anterior tubercle on the lobe. The branchial lobe is smaller than the hepatic lobe and truncate or occasionally weakly bilobed.

The cheliped merus of adult males is cylindrical with a low terminal tubercle; there is a low ridge on the carpus; the palm of the chela is not strongly compressed or carinate (length approximately twice height) and sometimes there are one or two small tubercles on the inner face of the palm, the fingers gape moderately and there is a large truncate tooth on the movable finger in the gape. The merus of the first ambulatory leg is cylindrical, slender (length about nine times height), with a short blunt terminal spine, longer in females: the carpus is not carinate and dorsally there is a small tubercle at about the distal third on the anterior edge. The propod is widened at the distal third to about $1^1/_2$ times its proximal width and at the widest point there is a ventral tuft of setae (but not a strong ventral lobe as in *H. proteus*), and dorsally there is a group of several setae just proximal to the ventral tuft. Ambulatory legs two to four are weakly compressed, the meri bearing two small (sometimes indistinct) dorsal tubercles and a laterally compressed terminal lobe; the carpi are weakly carinate; the propodi are carinate (but not as strongly as in *H. proteus*), about three times as long as high, the ventral margin bearing a tuft of setae midway along (but no ventral lobe) and another smaller tuft proximally.

The first pleopod of the male is curved outward distally, anteriorly truncate, anterior margin recurved.

In this series, additional to the specimens listed above, there are two lots of specimens which differ significantly from *H. pacifica* but the number of specimens is too small to justify describing them as new species so we have included here a brief description of them. In these specimens the rostrum is more slender basally than in *H. proteus* and the legs are not strongly carinate as in that species.

In the first group there are four male specimens, as follows:

ZMC: Mortensen Pacific Expedition: Mindanao, Zamboanga, 5-9 m, sand, 1 March 1914; 1 spec. (adult) 13 mm; Danish Kei Is. Expedition: Banda, off Neira, about 5 m, sand, 9 June 1922; 1 spec. (adult) 10.5 mm.

ZMA: 'Siboga' Expedition: Stn. 37, Flores Sea, Paternoster Islands, Sailus Ketjil, close to reef, 27 m, dredge, coral and coral sand, 30-31 March 1899; 1 spec. 13 mm (De.100.832 in part). — Stn. 80, Makassar Strait, Borneo Bank, 02°25′S 117°43′E, 50 m, trawl, fine coral sand, 13 June 1899; 1 spec., 12 mm (De.100.629 in part).

These specimens, although small, are adult or subadult. The branchial lobe is subacute as in males of *H. pacifica* and the rostrum is longer than half the postrostral carapace length as in adult males of *H. pacifica* but there is no hepatic lobe, which, even if small, is always present in males of *H. pacifica*. The ambulatory legs are slender, not at all compressed or carinate and on the meri the terminal tubercle is very small or absent. In typical *H. pacifica* ambulatory legs 2-4 have the meri weakly compressed with a distinct terminal lobe and the carpi and propodi are moderately carinate. In the specimens from Zamboanga and Makassar Strait there is no terminal tubercle on the merus of the cheliped as there is in typical *H. pacifica*. There are two small tubercles on the inner face of the cheliped palm only in the largest male.

The second group is also of four male specimens —

ZMA: 'Siboga' Exped.: Stn. 37, Flores Sea, Paternoster Islands, Sailus Ketjil, close to reef, 27 m, dredge, coral and coral sand, 30/31 March 1899; 1 spec., 13 mm (De.100.832 in part). — Stn. 282, Anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and lithothamnion, 15/17 January 1900; 1 spec., 10.5 mm. — Stn. 315, Flores Sea, Anchorage E. of Sailus Besar, Paternoster Is., up to 36 m, dredge, coral and lithothamnion, 17/18 February 1900; 1 spec. (adult), 13 mm.

WAM: Sulu Archipelago, $1^1/_2$ miles (∼ 2.4 km) W. of Doc Can I., B. R. Wilson on 'Pele', 2 February 1964; 1 spec., 12.5 mm.

The rostrum in these specimens is slender, only about half the postrostral carapace length; distally slightly deeper (by about $^1/_4$) than proximally. The preorbital spines are directed straight forward so that their lateral edges are parallel to one another, not directed slightly outwards as in typical *H. pacifica*. The carapace shape is less triangular than in typical *H. pacifica*, the hepatic width is about two thirds branchial width. There is a small, broad, rounded hepatic lobe, slightly smaller or equal to the branchial lobe which is also broad, not triangular and subacute as in the typical *H. pacifica*. On the

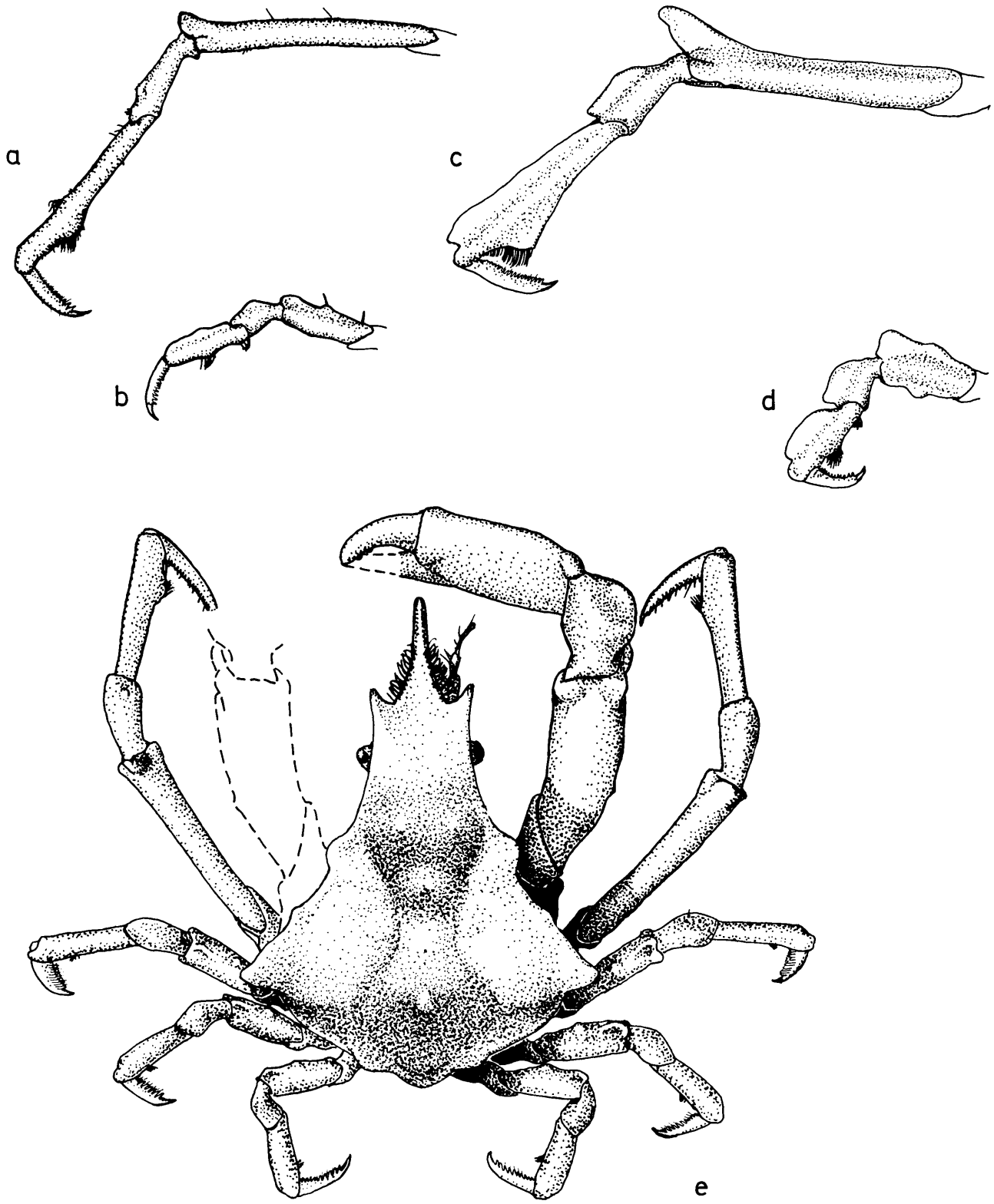


Fig. 24. *Huenia pacifica* (male, 17.5 mm, Sulu Archipelago, ZMA) (a) left first ambulatory leg; (b) left fourth ambulatory leg; *H. proteus* (male, ca. 26 mm, Japan, ZMC) (c) left first ambulatory leg; (d) left fourth ambulatory leg; *H. grandidierii* (male, 22 mm, Mombasa, ZMC) (e) whole animal, dorsal view.

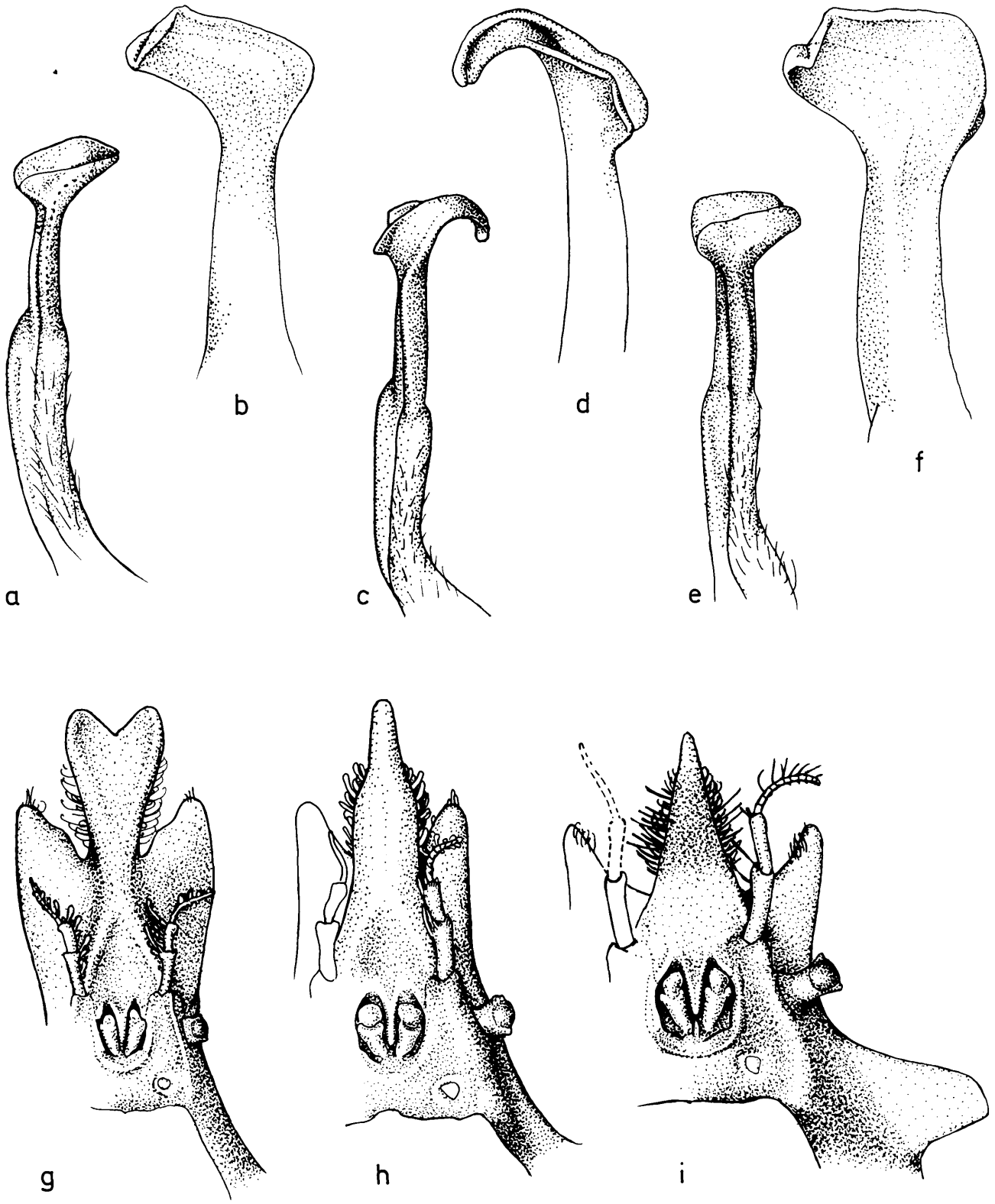


Fig. 25. Left first pleopod of male of *Huenia bifurcata* (30 mm, AM P.1912) (a) abdominal view of pleopod (b) sternal tip of same; *H. australis* (holotype) (c) abdominal view of pleopod, (d) sternal tip of same; *H. halei* (holotype) (e) abdominal view of pleopod, (f) sternal tip of same. *H. bifurcata* (AM P. 1912) (g) left orbit, ventral view; *H. australis* (holotype) (h) left orbit, ventral view; *H. halei* (holotype) (i) left orbit, ventral view.

cheliped there is no terminal tubercle on the merus and no ridge on the carpus (both present in the typical form of *H. pacifica*), and there is a very small tubercle on the inner face of the palm. Only the specimen from Paternoster I. has ambulatory legs with it, but the first ambulatory leg is missing. The legs, as in typical *H. pacifica*, are weakly carinate, the propod having tufts of setae proximally and at the distal third on the ventral margin but no ventral lobe. The shape of the lateral lobes and the rostrum which deepens distally distinguish these specimens from males of typical *H. pacifica*, *H. proteus* and *H. grandidierii*.

We also have a single specimen from Singapore (Hamburg Museum, Ex. K240, ♂, 25 mm) probably adult, without any legs (which makes the identification of this specimen difficult), but in the long, slender rostrum it resembles *H. pacifica*. The rostrum is basally very narrow, less than half the supraorbital width; about $^2/_3$ the length of the carapace behind the rostrum, no deeper distally than proximally and weakly deflexed in the distal half. The preorbital spines are long (approx. 1.5 mm), directed forward and slightly outward. There are three distinct tubercles on the gastric region and a cardiac tubercle. The posterior margin of the carapace is convex (rather than straight as it is in *H. pacifica* and *H. proteus*), with a medial tubercle and a small triangular lobe at the posterolateral angle. Both lateral lobes are subacute, the hepatic lobe about half the size of the branchial lobe and between them on the margin there is a small tubercle (not present in *H. pacifica*). Like *H. grandidierii* but unlike *H. proteus* and other *H. pacifica*, the posterior margin of the carapace is convex in this specimen.

It was suggested by Miers (1884: 520) and by Ortmann (1894: 39) that *H. pacifica* may be synonymous with *H. grandidierii* A. Milne Edwards, because both have a relatively narrow rostrum and three distinct gastric tubercles. However, both these characters vary within our series. In *H. pacifica* the ambulatory legs are weakly compressed or carinate (not cylindrical), there is no tubercle midway on the lateral margin, and the posterior margin of the carapace is straight (not convex). In the females of *H. pacifica* the branchial lobe is truncate (not subacute as in *H. grandidierii*).

We have distinguished *H. pacifica* from *H. proteus* by the much less carinate legs, particularly the absence of any carination on the carpus of the first ambulatory legs, and by the propod of the first ambulatory leg which is only moderately widened distally (width at distal third = $1^1/_2$ times proximal width not twice width as in *H. proteus*). There is a great deal of variation within each species of this genus some of which is due to age and sex and the separation of young or incomplete specimens of this species from *H. proteus* remains difficult.

Distribution. — Fiji Is., Sulu Archipelago, Flores Sea, Kai Is., NE. Australia.

Huenia proteus De Haan, 1839
(Fig. 24c, d)

Maja (*Huenia*) *proteus* De Haan, 1839: 95-96, pl. 23 figs. 4-6(a) (b).
Huenia proteus. — Adams & White, 1848: 21-23, pl. 4 figs. 4-6. — Takeda, 1973a: 98-99, fig. 2A, B. — Griffin, 1976: 190. — Sakai, 1976: 207-208, text fig. 112a-c, pl. 71 figs. 1, 2.

Material examined. — 7 ♂♂, 9 ♀♀ (4 ovig.), 15.5-29 mm, smallest ovig. ♀, 16 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 43, Flores Sea, Postillon Is., anchorage off Pulu Sarassa, 30 m, dredge, coral, 4/5 April 1899; 1 spec. (ZMA De.100.706, det. Ihle). — Stn. 96, Sulu Archipelago, SE. side of Pearl Bank, 15 m, dredge, townet, *Lithothamnion*, 27 June 1899; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Misaki, 36 m, dredge, sand, 25 May 1914; 1 spec. — Misaki, Amburatsubo, ca. 9 m, sand, 6 June 1914; 1 spec. — Misaki, Amburatsubo, 24 June 1914; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: off NW. coast, Maud's Landing, 18 m, Honolulu dredge, weed, sand and rock, coll. Royce on 'Davena', 20 May 1960; 1 spec. (WAM 234-67). — 10 miles (16 km) W. of Gordon Bay (N.W. Australia), 27 m, coral and sponge, coll. R. W. George on 'Dorothea', 14 October 1962; 1 spec. (WAM 172-67). — Dampier Archipelago, Kendrew I. (N.W. Australia), 20°28′30″S 116°32′E, weed washings from Boat Bay, Crown of Thorns Survey, 23 October 1974: 1 spec. (WAM 67-77).

Sulu Archipelago: NE. of Siasi, 21 m, on *Lithothamnion* and algae, coll. B. R. Wilson on 'Pele', 17 February 1964; 1 spec. (WAM 34-67). — Tawi Tawi Bay, about 9 miles (∿ 14 km) from Bongao Light, 16-30 m, dredge, sand, coll. B. R. Wilson on 'Pele', 29 February 1964; 2 specs. (WAM 11-67).

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia: Broome, dredged off Gantheaume Point, 7 m, coll. A. A. Livingstone, August 1929; 1 spec. (AM P.13995). — northern side of Point Cloates (N.W. Australia), 22°41′S 113°39′E, 4 m, lee side of reef, 'Ningaloo' Expedition, 23 August 1968; 1 spec. (AM P.27144).

Queensland: (locality unknown), coll. M. Ward; 1 spec. (AM P.13997). — Heron I., under rocks near reef edge, 12 August 1960; 1 spec. (AM P.27142).

Remarks. — Because of the considerable variation in this genus with age, sex and possibly also with location, previous authors have determined that *H. grandidierii* A. Milne Edwards and *H. pacifica* Miers were only variants of *H. proteus*. Our study of this series of specimens from several localities in the Indo-Pacific region indicates consistent differences not related to sex, age or location which lead us to distinguish *H. grandidierii* and *H. pacifica* from *H. proteus*; the differences are discussed under the former two species.

The specimens of *H. proteus* in our series agree well with the type material as figured by De Haan. The rostrum of the males is 0.35-0.5 postrostral carapace length and that of the females 0.3-0.4 postrostral carapace length. In the males the rostrum is no deeper distally than basally, but in females it is up to twice as deep distally as basally. The preorbital spine is short, about $^1/_4$ or less of the basal rostral width, directed forward and slightly outward, and sometimes has a small proximal dorsal tubercle.

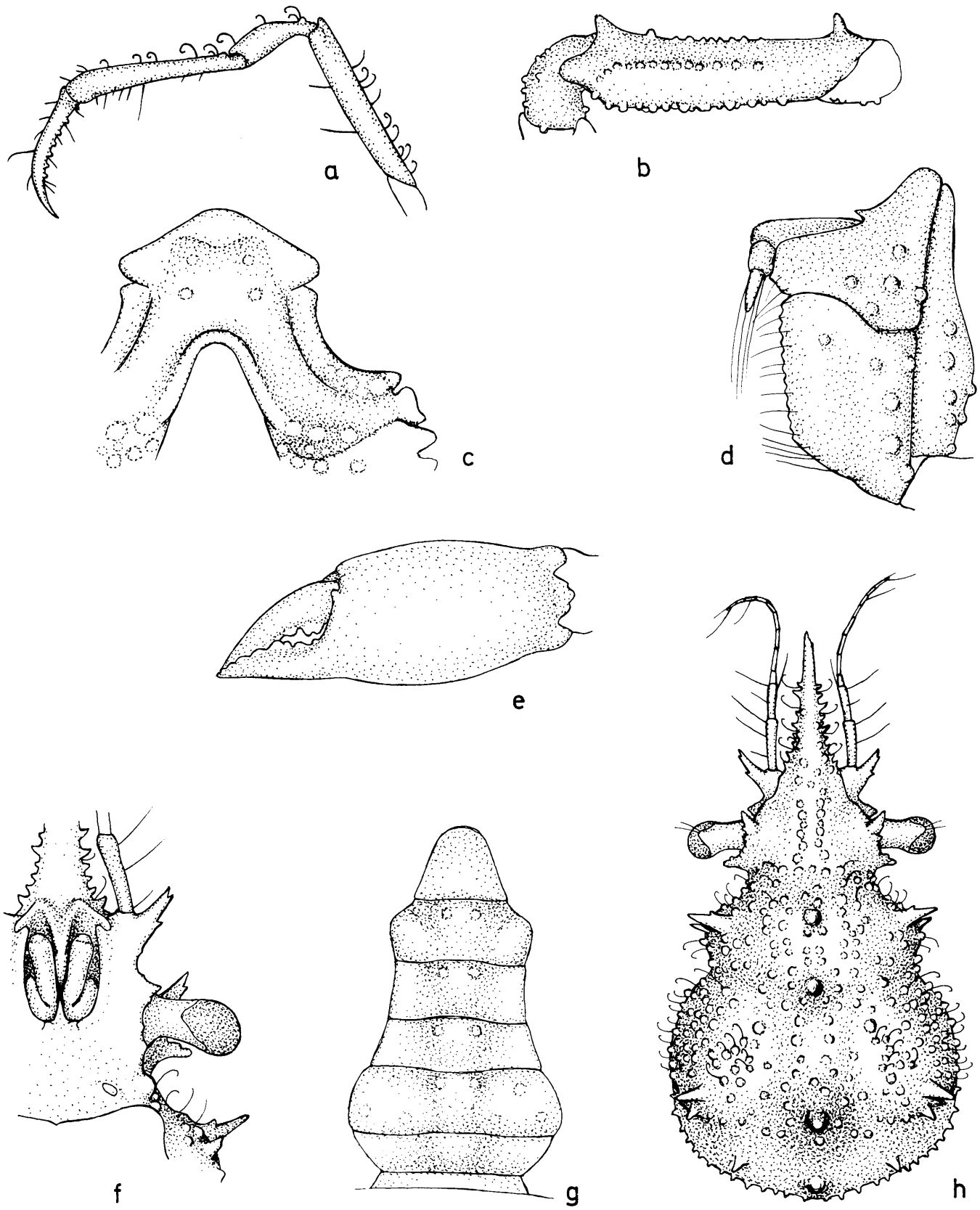


Fig. 26. *Menaethiops xiphias* (female, ovig., 4 mm, Sapeh Strait, ZMA) (a) left fourth ambulatory leg; (male, 4 mm, Sapeh Strait, ZMA) (b) left cheliped, merus and carpus; (holotype) (c) male sternum; (d) left third maxilliped; (male, as above) (e) left chela; (holotype) (f) left orbit, ventral view; (g) male abdomen; (h) carapace, dorsal view.

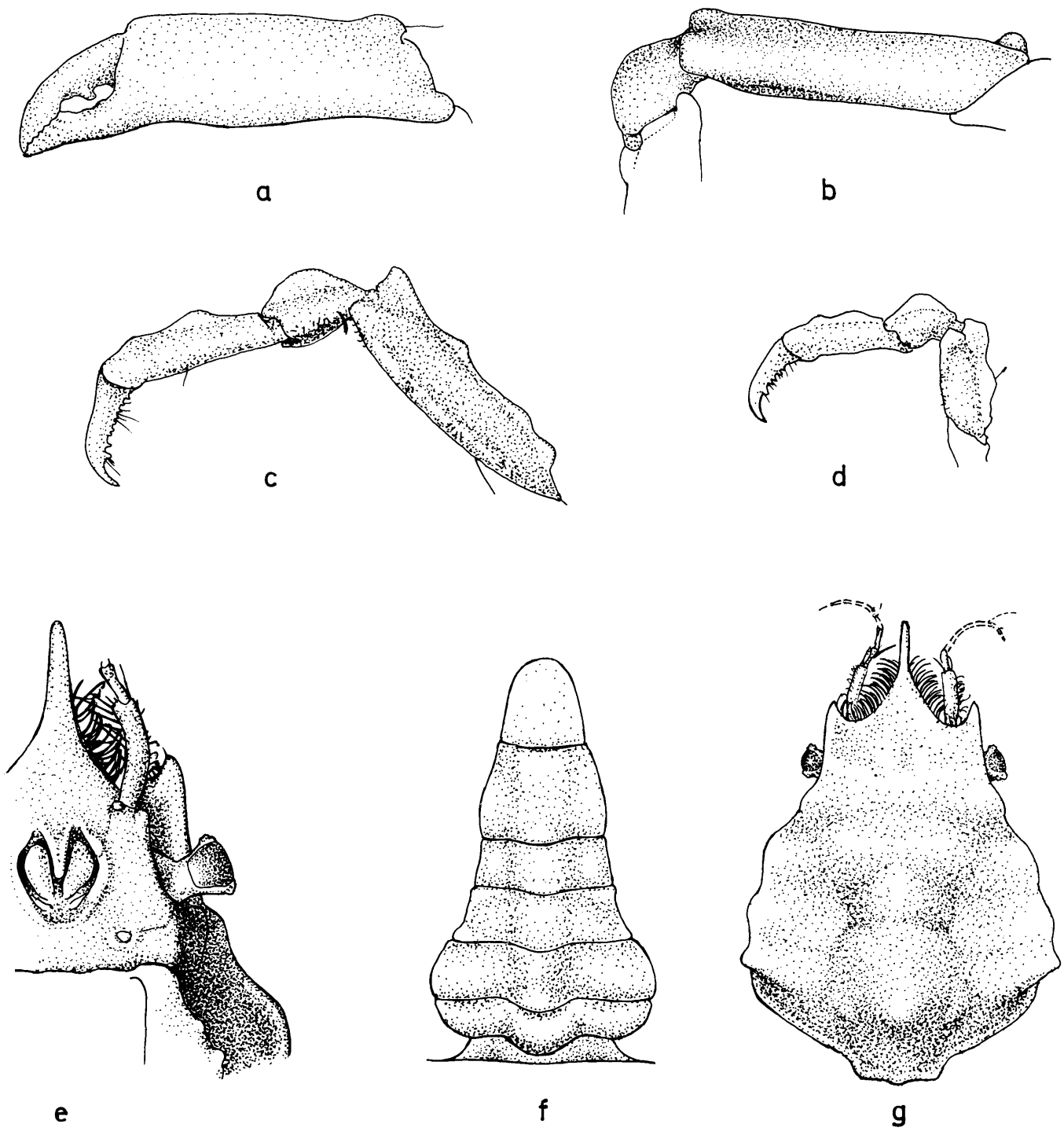


Fig. 27. *Menaethius orientalis* 8.5 mm, Roti I. (a) left chela; (b) left cheliped, merus and carpus; (c) left first ambulatory leg; (d) left fourth ambulatory leg; (e) left orbit, ventral view; (f) male abdomen; (g) carapace, dorsal view.

In the males the lateral hepatic lobe is small and blunt or of moderate size and truncate although sometimes only a tubercle even in adults; the branchial lobe is either truncate or subacute, and there is often a small tubercle on the margin between the lobes. In the female the hepatic lobe is rounded, sometimes elongate longitudinally; the branchial lobe is truncate and often the two lobes meet or overlap. There is no tubercle on the margin between the lobes in the female.

In most specimens the three gastric tubercles are small and indistinct, in some the posterior (mesogastric) tubercle is distinct, and in two specimens all three are well developed. The posterior margin of the carapace is straight (not convex), usually smooth but sometimes with a small tubercle on the midline and one at each posterolateral angle.

The cheliped merus of the male has a laterally compressed terminal spine and the carpus is carinate; the palm of the

chela is carinate with two compressed dorsal lobes, one midway and one distally; there are 1-3 tubercles on the inner face of the palm.

The merus of the first ambulatory leg is usually compressed (sometimes weakly), with a compressed terminal spine, the carpus is carinate with one or two dorsal lobes, the propod is strongly compressed, widened strongly at the distal third to about twice the proximal width to form a ventral lobe with a tuft of setae; dorsally there is usually a much smaller lobe just proximal to the ventral lobe. Ambulatory legs 2-4 are compressed, the meri carinate and produced to a terminal lobe; carpi carinate; propodi carinate, more than half as wide as long, the ventral margin with a small tuft of setae on the proximal angle and a larger tuft halfway along (only sometimes on a lobe on leg four).

The first pleopod of the male has been figured by Takeda (1973a); the apex is curved outwards and grooved, the sternal side of the groove is produced into a broad lobe on the medial margin.

Distribution. — Japan, Sulu Archipelago, Flores Sea, North Western Australia, Queensland. (Other localities previously listed by several authors for this species cannot be confirmed. The following records of *H. proteus* are now considered invalid:

Maldive and Laccadive Islands: Borradaile, 1903: fig. 124, pl. 47 fig. 2. Sankarankutty, 1961: fig. 2C = *H. brevifrons.*
Delagoa Bay: Barnard, 1950: fig. 9f = *H. grandidierii.*
South Australia: Hale, 1927: fig. 132 = *H. halei*, n.sp.
Red Sea: Griffin & Tranter, 1974: 169 = *Menaethius orientalis.*)

Menaethiops Alcock, 1895

Type species. — *Menaethiops bicornis* Alcock, 1895, by monotypy.

Remarks. — In *Menaethiops* the eave, particularly the postorbital region, is modified. Alcock considered that this genus lacked a postorbital lobe but later authors, including Balss (1929) and Guinot (1962a), regarded the postorbital lobe as fused with the supraorbital eave. This can be seen in *M. dubia* Balss in which the posterior part of the eave is continued around behind the eye. In *M. nodulosa* (Nobili) and *M. okai* Sakai the posterior part of the eave is clearly at an angle to the rest of the eave. In this genus the basal antennal article is broad and the anterolateral angle is produced, often as a large spine visible dorsally. In this respect it differs from other genera in the subfamily in which the article is without distal expansions. The first pleopod of the male is apically produced into two lobes, one lateral and one medial: these may be subequal or one lobe may be up to twice as large as the other.

In this genus there are a number of similar species, some of apparently restricted distribution, from the east coast of Africa, Madagascar, the Red Sea, Iranian Gulf and Arabian Sea. One species, *M. okai*, is known only from Japan. From the present collection we describe a new species from Sapeh Strait in Indonesia which is similar to *M. okai* and thus extend the known range of the genus.

Distribution. — Indo-West Pacific,? west Atlantic.

KEY TO THE INDO-WEST PACIFIC SPECIES OF *MENAETHIOPS*

1	Dorsal hepatic region with a prominent slender spine directed principally outwards 2
—	Dorsal hepatic region with a tubercle, short spine, or blunt, forwardly directed lobe 3
2(1)	Carapace with only a few tubercles as well as spines; posterior angle of eave directed obliquely backwards; branchial and cardiac regions equally elevated ..... *M. okai*
—	Carapace with many sharp tubercles as well as spines; posterior angle of eave directed laterally; cardiac region more elevated than branchial regions ..... *M. xiphias*
3(1)	Preorbital angle of eave not produced, smooth ... *M. fascicularis*[14])
—	Preorbital angle of eave produced (or with a tubercle) 4
4(3)	Rostral spines contiguous to apex 5
—	Rostral spines at least apically separate 8
5(4)	Lateral margin of basal antennal article with 2 subequal teeth in distal half, one of them anterolateral; proximal part of margin concave 6
—	Lateral margin of basal antennal article with single tooth in distal half, rest of margin straight or with small notch or concavity midway along 7
6(5)	Hepatic region with a large, blunt, forwardly directed lobe; branchial region with 3 or 4 tubercles or spines ..... *M. contiguicornis*[14])
—	Hepatic region with 2 short spines; branchial region with one tubercle ..... *M. bicornis*
7(5)	Posterior angle of supraorbital border (eave) produced, narrow, subacute, the anterior margin forming an angle with lateral margin of eave; rostrum exceeding second segment of peduncle of flagellum only in some adult males ..... *M. dubia*
—	Posterior angle of supraorbital border (eave) produced, broad, blunt, the curved margin confluent with lateral margin of eave; rostrum exceeding second segment of peduncle of flagellum except in juveniles ..... *M. ninnii*
8(4)	Preorbital spine directed obliquely forward, margin of supraorbital eave concave; eyestalk smooth, without a spine; first sternite of male with a granular ridge 9
—	Preorbital spine directed straight forward; margin of supraorbital eave almost straight; eyestalk with a distal spine near cornea; first sternite of male smooth 11
9(8)	Rostral spines divergent distally; anterolateral angle of basal antennal article with slender acute spine ..... *M. delagoae*[14])
—	Rostral spines separate distally but lateral margins parallel; anterolateral angle of basal antennal article with a stout, subacute spine 10
10(9)	Rostrum of about 1/2 postrostral carapace length; first sternite of male with a very strong oblique granular ridge between chelipeds ..... *M. acutifrons*[15])
—	Rostrum of about 1/3 postrostral carapace length; first sternite a moderate oblique granular ridge between chelipeds ..... *M. brevicornis*[14,15])
11(8)	Lateral margin of basal antennal article with small tooth behind anterolateral spine, proximal part of margin concave. *M. nodulosa*
—	Lateral margin of basal antennal article behind anterolateral spine straight or weakly concave ..... *M. natalensis*[14])

Menaethiops xiphias new species
(Figs. 18g, h; 26)

Material examined. — 2 ♂♂, 1 ovig. ♀, 4 mm.

Holotype. — Male, cl. 4 mm, Indonesia, Lesser Sunda Islands, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 'Siboga' Ex-

[14]) From the literature (see Guinot, 1962a).
[15]) These two species may prove to be synonymous.

pedition, Stn. 49a, 14 April 1899. Zoological Museum, Amsterdam. Paratypes. —

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a (as for holotype); 2 specs.

Description. — Carapace narrow pyriform, width about two thirds (0.66) postrostral carapace length; surface with many small sharp tubercles and a few short spines.

Rostrum of a single spine, broad basally then tapering rapidly to a slender spine; lateral margin with about five to seven small sharp ventral spinules in proximal two thirds; length about one third (0.33) postrostral carapace length.

Orbital eave moderately expanded, an upright spine midway along eave and a laterally directed spine on posterior angle of eave (corresponding to postorbital spine); margin of eave crenulate. Eyestalks moderately long, slender, cornea terminal and obliquely ventral.

Hepatic region weakly produced and rounded; a sharp, slender spine anteriorly on margin, directed outward and slightly upward and forward, bearing a small accessory proximal spinule on anterior margin; subhepatic region with two short spines (anterior larger) directed obliquely downward.

A small sharp spine on branchial submargin just above cheliped base, posterolateral branchial region smooth above carapace margin; margin spinulous.

Gastric regions only weakly elevated on midline; protogastric region with scattered sharp tubercles; two short, slender mesogastric spines, weakly directed backward and two pairs of submedial tubercles between them; urogastric region with three pairs of submedial tubercles.

Cardiac region strongly elevated bearing a long slender spine on summit, longer than other carapace spines; several tubercles at base of spine.

Intestinal region smooth except for a central spine and a short posterolateral spine. Posterior carapace margin spinulous.

Dorsal branchial region tuberculate, a slightly larger tubercle near anteromedial angle; a short, slender epibranchial spine.

Basal antennal article smooth, flat, elongate; anterolateral angle produced as a large spine, a small accessory spine proximally on posterior margin; a short spine midway along lateral margin, a small lateral tubercle basally. Epistome smooth, a tubercle lateral to green gland.

Pterygostomian region smooth, three large tubercles on margin. Ischium of third maxilliped with a row of three tubercles near lateral margin; junction with merus curved in medial half and overlapping merus; merus with row of three tubercles near lateral margin, one proximal tubercle on lateral margin and one midway along posterior margin; anterolateral angle strongly produced, lobe rounded apically. Exognath with a longitudinal row of five tubercles in proximal half, two small proximal tubercles on lateral margin.

First sternite of male smooth except for two pairs of submedial tubercles just behind anterior margin and a diagonal ridge of three to four tubercles near posteromedial angle; a narrow ridge around anterior margin of abdominal fossa and a ridge on lateral margin terminating in a few tubercles posteriorly. Sternal segments two to four each with three to four tubercles and also a ridge on edge of abdominal fossa in segments three and four.

Merus of cheliped of adult male with four longitudinal rows of small tubercles, one dorsally, two ventrally and one midway on outer face, dorsal margin bearing also a large proximal tubercle and a sharp, curved, terminal spine; carpus with two ridges of small sharp tubercles, one lateral and one medial and ventral; palm somewhat compressed, dorsal and ventral margins weakly convex, sharp, with a few small proximal tubercles; length about one and a half times greatest height; fingers short, about half as long as palm, a moderate gape between them in proximal half, large teeth on both fingers in gape — dactyl with a double proximal tooth and a smaller tooth distal to it, fixed finger with two proximal teeth and a large distal tooth; tip of dactyl behind that of fixed finger. Length of cheliped about one and a quarter times postrostral carapace length.

First ambulatory leg about one and two thirds postrostral carapace length, merus slender, smooth with a low terminal tubercle; carpus with a tubercle dorsally in proximal half, propodus and dactyl slender. Fourth ambulatory leg about half as long as first, dactyl of fourth leg with six very small, well spaced teeth ventrally along its length.

Male abdomen of seven segments, a pair of submedial tubercles near anterior margin of each segment except seventh; tubercles laterally in segments three to six; third segment about one and a half times as wide as sixth segment; sixth segment about twice as wide as long; seventh segment about as wide as long.

First pleopod of male straight, slightly narrower just before apex which is produced into two short triangular lobes, medial lobe slightly longer and narrower than lateral lobe.

Female abdomen smooth, segments four to six fused. Female gonopore a circular aperture opening anteriorly and slightly medially.

Remarks. — We have compared these specimens of *M. xiphias* with specimens of *M. okai* Sakai (1 ♂, 1 ♀, Japan, AM P.10558) in the Australian Museum and they resemble each other in the following points:

(1) the contiguous rostral spines with lateral spinules;
(2) the slender hepatic, cardiac and epibranchial spines;
(3) the spinules on the posterior carapace margin (small in *M. okai*);
(4) the shape of the basal antennal article;
(5) the female abdomen with five free segments.

M. xiphias is distinguished from *M. okai* by the presence of numerous sharp tubercles on all of the carapace except the intestinal region while in *M. okai* there are only a few tubercles; also the spine on the posterior angle of the eave is directed

laterally in *M. xiphias* but obliquely backward in *M. okai*; and the branchial regions are lower than the cardiac region in *M. xiphias* while in *M. okai* they are rounded and as elevated as the cardiac region.

These two species of *Menaethiops* differ from the species we have examined from the Red Sea and Somalia (*M. acutifrons*, *M. nodulosa*, *M. ninnii*, *M. dubia*) in having spinules laterally on the rostrum and the abdomen of the female with five rather than seven free segments.

The specific name refers to the similarity of the spined rostrum to the 'sword' of a swordfish (genus *Xiphias*).

Distribution. — Known only from the type locality Sapeh Strait, Indonesia.

Menaethius H. Milne Edwards, 1834

Type species. — *Pisa monoceros* Latreille, 1825, by monotypy.

Remarks. — This genus is widespread and common throughout the Indo-west Pacific. There is some geographic variation and early authors described several species which have since been synonymized with *M. monoceros* (listed by Sakai, 1976). We have here included as a new species of this genus a series of specimens from a wide range of localities in the Indo-west Pacific which while they have a strong similarity to *M. monoceros* in a number of characters, including the orbit and the first pleopod of the male, are consistently distinguished from *M. monoceros* by the carinate ambulatory legs. Sakai (1969) described a species *Epialtus orientalis* from Japan which closely resembles this series of specimens: the only differences appear to be the absence of a tooth on the dactyl of the cheliped in Sakai's specimen (present in ours) and a male abdomen with 6 free segments rather than 7 free segments as in our specimens. On this basis we do not consider our series of specimens to be a new species but at most probably conspecific with *Epialtus orientalis*. However, we believe from examination of our specimens and taking into consideration the first pleopod of the male, that they belong in the genus *Menaethius* rather than *Epialtus*. We have given a description and figures of our specimens.

The first pleopod of the male of *M. monoceros* has been figured by Forest & Guinot (1961). The pleopod is broad and from about the distal quarter is flattened laterally rather than dorsoventrally and so appears to narrow abruptly; the broad apex is laterally subacute. There is a similar male pleopod in *Huenia* and *Simocarcinus*.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *MENAETHIUS*

1 Rostrum a slender stylus, basally narrow; dorsal branchial region with rounded elevations and sometimes a tubercle; ambulatory legs not carinate ..... *M. monoceros*

— Rostrum with a broad triangular base and distally slender; dorsal branchial region flat and smooth; ambulatory legs carinate ..... *M. orientalis*

Menaethius monoceros (Latreille, 1825)

Pisa monoceros Latreille, 1825: 139-140.
Menaethius monoceros. — Forest & Guinot, 1961: 14, figs. 9a-b. — Griffin, 1974: 21; 1976: 200. — Sakai, 1976: 205-206, pl. 70 fig. 1.

Material examined. — 70 ♂♂, 63 ♀♀ (41 ovig.), 5.5-27.5 mm, smallest ovig. ♀, 9 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 37, Flores Sea, Paternoster Is., Sailus Ketjil, close to reef, 27 m, or less, dredge, coral and coarse sand, 30/31 March 1899; 1 spec. (ZMA De.100.832 (in part)). — Stn. 43, Flores Sea, Postillon Is., anchorage off Pulu Sarassa, 0.3 m, coral, 4/5 April 1899; 1 spec. (ZMA De.100.690, det. Ihle). — Stn. 71, near Makassar, Pulu Barang, May 1899; 1 spec. — Stn. 127, Celebes Sea, Great Sangir I., Taruna Bay, reef exploration, 20/21 July 1899; 2 specs. (ZMA De.100.839, det. Ihle). — Stn. 131, Karakelang Is., anchorage off Beo, 13 m, reef exploration, mud and sand, 24/25 July 1899; 8 specs. — Stn. 133, Salibabu I., anchorage off Lirung, up to 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 2 specs. — Stn. 144, Halmahera Sea, anchorage N. of Damar I., reef exploration, coral, 7/9 August 1899; 2 specs. — Stn. 162, W. coast of Salawatti, between Loslos and Broken Is., 18 m, dredge, south island reef, coarse and fine sand with clay and shells, 18 August 1899; 3 specs. — Stn. 169, W. coast of Irian Jaya, anchorage off Atjatuning, 57 m, trawl, dredge and reef exploration, mud, 23/25 August 1899; 1 spec. — Stn. 172, Ceram Sea, anchorage between Gisser I. and Ceram Laut, 18 m, reef exploration, coral and *Lithothamnion* bottom, 26/28 August 1899; 9 specs. (ZMA De.100.795, det. Ihle). — Stn. 174, N. coast of Ceram, Waru Bay, reef, 28/29 August 1899; 1 spec. — Stn. 229, Banda Sea, 04°23′S 128°45.5′E, townet, brown and grey mud with sand, 14 November 1899; 2 specs. — Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Stn. 315, Flores Sea, Paternoster Is., anchorage E. of Sailus Besar, up to 36 m, coral and *Lithothamnion*, 17/18 February 1900; 1 spec. — Ambon, reef, 1899; 1 spec. — Ambon, reef, 1899; 2 specs. (ZMA De.100.689, det. Ihle). — Banda, shore, 1899; 2 specs. — Banda, reef, 1899; 1 spec. (ZMA De.100.710, det. Ihle). — Savu Sea, Seba I., 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Philippine Islands, Mindoro, Puerto Galero, 9 m, dredge, 1 February 1914; 1 spec. — Philippine Islands, Mindoro, Puerto Galera, ca. 9 m, 3 February 1914; 2 specs. — Hawaii, Hilo, 7 April 1915; 1 spec.

Danish Kei Islands Expedition: Ambon, Saparoea Bay, 18-27 m, 9 March 1922; 1 spec. — Banda, Lantor, shore at low tide, 7 June 1922; 1 spec.

'Dana' Expedition: Stn. 3617, New Caledonia, Noumea Harbour, 0.2 m, coral, sand and stones, 3 December 1928; 1 spec.

Mortensen Java-South Africa Expedition: Mauritius, Cannonier's Point, collecting on the reef and beach, 17 September 1929; 1 spec. — Mauritius, off Black River, 9-18 m, dredge, 21 September 1929; 1 spec. — Mauritius, Flat I., 17 October 1929; 2 specs. — Mauritius, Grand Bay, ca. 3-5 m, dredge, sand, 25 October 1929; 2 specs. — Mauritius, off Cannonier's Point, ca. 2-5 m, dredge, sand, 26 October 1929; 2 specs.

'Galathea' Expedition: Stn. 224, Madagascar, Diego Suarez, Bay at Cape Diego, 0.3 m, hand collecting, rocks with corals, 3 March 1951; 1 spec.

South India, Pamban Pass, 5 m, coll. H. Lemche, Stn. 24, 9 October 1951; 1 spec.

Tonga: Nukualofa, tidal zone, ebb tide, coll. S. Mielche, January 1956; 2 specs. — N. Tonga, Niuatobutabu, 15°58′S 173°48′W, tidal flat with coral and mud, coll. T. Wolff, 1 June 1965; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, Biak I., naval barracks W. of Sorido village, on coral reef off the shore, coll. L. D. Brongersma and W. J. Roosdorp, 28 April 1952; 1 spec.

Netherlands New Guinea Expedition: Stn. N628, Irian Jaya, N. of Jayapura, Pacific O. coast, beach at Base G, slow spider crabs from among corals fished up from reef and carried to shore, coll. L. B. Holthuis, 12 November 1954; 1 spec. — Irian Jaya, N. of Jayapura, reef (by Base G), crabs among coral, coll. L. B. Holthuis, 27 November 1954; 3 specs. — Stn. 683, Irian Jaya, Biak I., W. of Sorido, reef in front of naval barracks, in coral, January 1955; 21 specs. — Biak, W. of Sorido, reef near naval barracks, February 1955; 20 specs. — Stn. 743, N. Irian Jaya, Jayapura, surroundings Base G, coll. G. van Hout, March 1955; 1 spec. — Biak I., W. of Sorido, reef near naval barracks, April 1955; 1 spec. — Biak, I., W. of Sorido, reef near naval barracks, 2 May 1955; 1 spec.

Ex Natural Science Foundation: Stn. 490, Irian Jaya, Padaido Group, Wamsoi Lagoon, 1 mile (1.6 km) E. of Dauwi, 54-90 m, coll. Ostheimer, Orr, Powell, 4 February 1956; 1 spec. — Stn. 576, Irian Jaya, Supiori I., 1 mile (1.6 km) W. of Sowek, 6 March 1956; 1 spec. (AM P.27148).

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas, 1970: Stn. TS IV, Tanimbar, Selaru, N. side of Labuan Olendir, 08°07′S 130°59′E, reef collecting, 26 June 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Heron I., under coral head, 12 August 1960; 1 spec. (AM P. 27147). — Heron I., reef, coll. R. Manning, August 1962; 1 spec. (AM P.27148).

Lord Howe Island: southern end of lagoon, coll. J. Booth, May 1962; 1 spec. (AM P.27149); 1 spec. (AM P.27150). — Sylph's Hole, Old Settlement, found in dead coral, coll. J. Booth, October 1962; 2 specs. (AM P.27151). — coll. J. Booth, 29 March 1963; 1 spec. (AM P.27152). — Ned's Beach, 0-1 m, reef flat, under coral rubble, coll. S. C. Oldfield, 26 January 1979; 2 specs. (AM P.29844). — Ned's Beach, low tide, coll. N. Coleman, 17 February 1979; 1 spec. (AM P.29845).

Hawaii, reef at Waikiki, under stones near shore, coll. M. Ward, 24-30 August 1927; 4 specs. (AM P.31030).

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: Shark Bay, approx. 2 miles (∿ 3 km) N. of Denham in clumps of pearl shell on exposed sand flat, low tide, coll. B. R. Wilson, 28 July 1959; 1 spec. (WAM 89-71). — Shark Bay, near bar of South Passage, 11 m, Honolulu dredge, sand and weed, coll. R. W. George, 'Davena', 14 May 1960; 5 specs. (WAM 96-71). — Shark Bay, 1 mile (1.6 km) W. of Cape Peron, coll. R. McKay, 30 June 1962; 1 spec. (WAM 78-71). — Rottnest I., NW. Point, 18 November 1963; 1 spec. (WAM 235-73). — Barrow I., Shark Point, intertidal rock flat, WAM and USNM Barrow I. Expedition, Stn. 8, 17 September 1966; 1 spec. (WAM 81-71).

Remarks. — The length of the rostrum in this series is variable, from a quarter to two thirds postrostral carapace length. In most specimens there is a small blunt tooth at the anterolateral angle of the basal antennal article. Specimens in this series from Hawaii have a much more slender, more prominent preorbital lobe than in other specimens, also the rostrum is wider basally and the anterolateral angle of the basal antennal article is obtuse.

Distribution. — Widespread throughout the Indo-West Pacific from the Red Sea and eastern Africa to Japan, Australia and Hawaii.

Menaethius orientalis (Sakai, 1969) new combination
(Figs. 18c, d, 27)

Epialtus orientalis Sakai, 1969: 252-253, text fig. 4a; 1976: 206, text fig. 111.

Material examined. — 4 ♂♂, 6 ♀♀ (4 ovig.) 5.5-11 mm, smallest ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 109, Sulu Archipelago, anchorage off Pulu Tongkil, 13 m, dredge, townet, *Lithothamnion* bottom, 5/6 July 1899; 1 spec. — Stn. 133, Molucca Sea, Salibabu I., anchorage off Lirung, 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 1 spec. — Stn. 282, Timor Sea, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 2 specs. — Stn. 301, Timor Sea, E. coast of Roti I., Pepela Bay, 10°38′S 123°25.2′E, 22 m, dredge, reef exploration, mud, coral and *Lithothamnion*, 30 January 1900; 1 spec. — Stn. 315, Flores Sea, Paternoster Is., anchorage E. of Sailus Besar, up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S. Africa Expedition: Stn. 44, N. of Mauritius, between Gunner's Quoin and Flat I., 45 m, trawl, coral, 15 October 1929; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Tasman Sea, Middleton Reef, 54-72 m, triangle dredge, coll. R. J. MacIntyre, CSIRO Stn G3/280/60, 26 November 1960; 1 spec. (AM P.29846).

Queensland, Lizard Island, 36 m, in coral blocks, coll. P. Hutchings and P. Weate, 9 January 1975; 1 spec. (AM P.29847).

Description. — Carapace broad, width 0.8 to 0.9 postrostral carapace length, hepatic region as wide as branchial region, lateral margins produced into three small lobes, carapace surface smooth.

Rostrum a single short spine, one sixth to nearly one third (0.16 to 0.3) postrostral carapace length, base broadly triangular, distal half uniformly slender.

Preorbital spine triangular, dorsoventrally flattened, ventral surface smooth and flat; no antorbital lobe; postorbital lobe low, rounded. Eyestalks short, movable; cornea terminal, lateral margin truncate.

Hepatic margin with a broad rounded lobe; branchial margin with two small lobes, posterior one triangular, anterior one also triangular or blunt and rounded. All three lobes equally produced laterally beyond lateral margin of carapace; lobes with a pair of apical setae in some specimens.

Gastric regions with a weak, trilobed, medial elevation, broader anteriorly (or three indistinct tubercles in a few specimens). Cardiac region more strongly elevated than gastric regions. Intestinal region with a weak central elevation, posterior margin truncate, posterolateral angles blunt. Branchial regions dorsally flat and smooth.

Basal antennal article smooth, flat, anterolateral angle with a small triangular spine directed forward; first movable segment of antenna about twice as long as following segment; tip of antenna reaching or exceeding apex of rostrum.

Third maxilliped smooth, anterolateral angle of merus moderately produced and rounded.

Margin of pterygostomian region with two tubercles.

Merus of cheliped of largest male (probably adult) cylindrical, a large proximal tubercle dorsally, another smaller tubercle in front of it on inner face and a low terminal tuber-

cle; carpus smooth; palm moderately compressed, more than twice as long as high, a moderate gape between fingers with a large tooth on dactyl and a few small teeth along fixed finger in gape. In females and subadult males cheliped merus similar to that of ambulatory legs — carinate with four dorsal lobes (including terminal lobe), but carpus not carinate.

Merus of first ambulatory leg carinate with four dorsal lobes (including terminal lobe), carpus strongly carinate, propod carinate midway along dorsal border, otherwise sharp. Second and third ambulatory legs shorter and with only three dorsal lobes on merus; fourth ambulatory leg with only two dorsal lobes on merus. Dactyl of fourth leg with a pair of very small subterminal teeth and four or five similar teeth more proximally.

Male abdomen smooth, seven free segments, sixth and seventh segments both about as long as wide.

First pleopod of male narrowed abruptly at distal third, curved outwards at tip to a subacute lateral apex; medial border of tip broadly curved with a transparent crest.

Female abdomen smooth, segments four to six fused. Gonopore of female is a simple oval which opens anteromedially.

Remarks. — Included in this species are the specimens from the Red Sea (2 ovig. ♀♀, 7, 12 mm) with a narrow rostrum and carinate legs previously identified as *Huenia proteus* by Griffin & Tranter (1974).

This species has the following characters in common with *M. monoceros*:

(1) there is a prominent preorbital lobe and a small lateral lobe just behind the eye;
(2) the eyes are movable on short eyestalks;
(3) the rostrum is slender, at least distally, and dorsoventrally not laterally flattened;
(4) there are two subequal lobes or tubercles (anterior and posterior) on the branchial margin;
(5) the propod of the first ambulatory leg is smooth ventrally (there is no tuft of setae as in *Huenia* species);
(6) the male abdomen consists of seven free segments, while in the female segments three to six are fused;
(7) the shape of the carapace is the same in both sexes;
(8) the first pleopod of the male has a similar form in both species.

These specimens are very similar to that described by Sakai (1969, 1976) as *Epialtus orientalis*. The major difference is in the male abdomen which has seven segments in our specimens while in *Epialtus orientalis* there are only six abdominal segments and on this basis Sakai included his species in the genus *Epialtus*. However, our specimens also differ from east Pacific species of *Epialtus* in the very slender rostrum, the well developed preorbital spine and in the form of the first pleopod of the male, so we would not include them in the genus *Epialtus*. While we believe that this series of specimens is most probably conspecific with Sakai's species, we feel they are better placed in the genus *Menaethius*. The major difference between *M. orientalis* and *M. monoceros* is the presence in *M. orientalis* of carinate ambulatory legs but the legs are not compressed and there is no prominent tuft of setae ventrally on the propod as in *Huenia* or *Epialtus*.

In this series the eyestalks are short but movable and the carapace shape is similar in both sexes.

These specimens resemble *Menaethius inornatus* Dana, (Dana, 1852: 125; 1855: pl. 5) from Hawaii in carapace shape. However, we are not sure of the status of that species: the original description is brief — the male abdomen is not described — and there were no legs with Dana's specimen.

Distribution. — Tasman Sea, NE. Australia, Timor, Moluccas, Sulu Archipelago, Mauritius, Red Sea, Japan.

Perinia Dana, 1852

Type species. — *Perinia tumida* Dana, 1852, by monotypy.

Remarks. — This monotypic genus was included in the Pisinae by Balss (1929) and subsequent authors have also included it in that subfamily. However, *Perinia* does have characters in common with some genera of the Epialtinae i.e. *Acanthonyx*, *Menaethius* and *Huenia*. In *Perinia* the margin of the orbit is continuous, enclosing the eyestalk, with no hiatus or suture above or below. The eyestalk is short and stout, the eye almost immovable and the small postorbital elevation does not afford any protection for the eye. In the Pisinae there is a cupped postorbital lobe into which the eye retracts; the postorbital lobe is usually separated from both the supraorbital eave and the basal antennal article by a distinct hiatus or, in the few species where there is no hiatus there is always a slit or suture. Peyrot-Clausade & Serène (1976) figured the first pleopod of the male of *P. tumida* and remarked on its similarity to the pleopod of *Menaethius monoceros* and suggested that perhaps this species belonged in the Acanthonychinae (now Epialtinae) rather than the Pisinae. Despite the fact that the male first pleopod also resembles that of pisines such as *Rochinia*, we take the view that because of the orbital features, *Perinia* is most appropriately placed in the Epialtinae. In general carapace form it resembles *Menaethius* species.

Distribution. — Indo-West Pacific.

Perinia tumida Dana, 1852

Perinia tumida Dana, 1852: 114-115; 1855: pl. 4 fig. 1a-f. — Sakai, 1938: 294-296, text-fig. 40; 1976: 233-234, pl. 81 fig. 2. — Peyrot-Clausade & Serène, 1976: 1349-1350, pl. 1 D, pl. 4A. — Chen, 1980: 124-125, text fig. 8, pl. 1 fig. 4.

Material examined. — 3 ♂♂, 9 ♀♀ (7 ovig.), 5-9.5 mm, smallest ovig. ♀, 5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Hawaii, Hilo, 15 April 1915; 1 spec. — Honolulu, April 1915; 5 specs.

Mortensen Java-S. Africa Expedition: Mauritius, Flat I., 17 October 1929; 1 spec.

Fiji Islands, lagoon at Wailangilala I., 16°45′S 179°06′W, 1-2 m, in corals, coll. T. Wolff, 14 May 1965; 3 specs.

MUSÉUM NATIONAL D'HISTOIRE NATURELLE, PARIS

'Calypso' Red Sea Expedition: Red Sea, Abulot, on corals, 1952; 2 specs.

Remarks. — These specimens agree with others previously examined. The rostrum is short, about a tenth postrostral carapace length, comprising two broad dorsoventrally flattened lobes separated by a U-shaped hiatus. The apices of the lobes are subacute and slightly incurved. The meri and carpi of the ambulatory legs are armed with a dorsal spine and there are tubercles on the outer face of the meri.

Distribution. — Throughout the Indo-West Pacific from East Africa and Red Sea to Japan, Australia and the Central Pacific.

Planotergum Balss, 1935

Type species. — *Planotergum mirabile* Balss, 1935, by monotypy.

Remarks. — The relationships of this monotypic genus were discussed in detail by Serène (1965). We agree with Serène that this species probably does not belong to the Majidae — the form of the orbit, especially the suborbital lobe; the absence of an epistome; the form of the ambulatory legs and the very small seventh segment of both the male and female abdomen distinguish it from any other majid. The first pleopod of the male is unknown, as the only male reported on so far is that figured by Balss (1935b). In the collection at the Australian Museum there are two specimens of *Planotergum mirabile*, one from Roebuck Bay, Western Australia, the other from Keppel Islands, Queensland; both are females.

Distribution. — Northwest and northeast Australia, Java Sea.

Pugettia Dana, 1851

Type species. — *Pugettia gracilis* Dana, 1851, by subsequent designation of Miers (1879).

Remarks. — This genus is one of the few with species present in both the east and west Pacific; it appears to be confined to the north Pacific. There are six species of *Pugettia* in the east Pacific (*P. producta* (Randall) occurring as far north as Alaska), all with scyriform first pleopods in the male. There are 12 species in the west Pacific (*P. quadridens* (De Haan) occurring in northern Japan), of which six have a scyriform first pleopod in the male, whilst in four we do not know what the pleopod is like and in one (*P. kagoshimensis* Rathbun) the first pleopod of the male is truncate (B. Kensley, pers. comm.).

In the present revision two species with a truncate first pleopod in the male have been removed from the genus — *P. sagamiensis* Gordon with large carapace tubercles and *P. mosaica* Whitelegge with long carapace spines. It is possible that *P. kagoshimensis* with long carapace spines and bifid cardiac and intestinal spines should also be removed from this genus. So far only females are known of the Philippine species. *P. leytensis* Rathbun and *P. mindanaoensis* Rathbun: the latter differs from other *Pugettia* species in several important characteristics.

Sakai (1976) has suggested that *P. elongata* Yokoya may be a variety or even a synonym of *P. minor* Ortmann and also that *P. marissinica* Takeda & Miyake is a synonym of *P. similis* Rathbun. However, as descriptions of both *P. elongata* and *P. similis* are very brief and we have not examined either of these two species we are unable to comment on their validity and we have included them in the key.

Distribution. — East and west Pacific.

KEY TO WEST PACIFIC SPECIES OF *PUGETTIA*

1	Rostrum longer than 1/2 postrostral carapace length, spines strongly divergent; hepatic and branchial spines very long and slender; cardiac process bifid ..... *P. kagoshimensis*[16])
—	Rostrum generally less than 1/2 postrostral carapace length, spines moderately divergent; hepatic and branchial spines short; cardiac region smooth or with single spine or tubercle 2
2(1)	Carapace smooth with regions poorly defined; postorbital lobe not keeled or laterally flattened; hepatic spine smaller than postorbital lobe; branchial submargin with flat suboval plate just above carapace margin ..... *P. mindanaoensis*
—	Carapace with regions well defined, usually with tubercles or short spines; postorbital lobe keeled or laterally flattened; hepatic spine at least equal to postorbital lobe; branchial submargin with tubercles but without a flat plate 3
3(2)	Hepatic and postorbital lobes partly or completely fused 4
—	Hepatic and postorbital lobes distinct 8
4(3)	Hepatic and postorbital lobes completely fused to form a winglike plate; meri of ambulatory legs trigonal ..... *P. incisa*
—	Hepatic and postorbital lobes not completely fused nor forming a wing-like plate; meri of ambulatory legs not trigonal 5
5(4)	Postorbital lobe much smaller than hepatic spine 6
—	Postorbital lobe and hepatic spine subequal 7
6(5)	Rostrum more than 1/3 postrostral carapace length; hepatic and branchial margin each with a slender, acuminate spine; dorsal surface of carapace even and smooth ..... *P. quadridens pellucens*[16])
—	Rostrum no more than 1/4 postrostral carapace length; hepatic and branchial margins each with a broad triangular lobe; dorsal surface of carapace usually with at least six tubercles ..... *P. quadridens quadridens*
7(5)	Postorbital tooth and hepatic spine both small, lateral margin in front of hepatic spine straight; dorsal branchial region without any tubercle anteriorly; merus of male cheliped with irregularly dentate carina on dorsal margin ..... *P. elongata*[16])
—	Postorbital tooth and hepatic spine both prominent, separated by a definite concavity; dorsal branchial region with a tubercle anteriorly; merus of male cheliped with three to four dorsal tubercles and a terminal spine ..... *P. intermedia*
8(3)	Rostral spines strongly divergent, about 1/4 postrostral carapace

[16]) From the literature

	length; hepatic spine long and subcylindrical, branchial spine shorter, stouter and more conical than hepatic spine	*P. leytensis*[16])
—	Rostral spines divergent or weakly divergent, 1/3 to 1/2 postrostral carapace length; hepatic spine smaller than or subequal to branchial spine	9
9(8)	Branchial region with anteromedial tubercles	*P. nipponensis*
—	Branchial region without anteromedial tubercles	10
10(9)	Cardiac region elevated, smooth; rostrum about 1/3 postrostral carapace length	*P. minor*
—	Cardiac region with a short spine on summit; rostrum about 1/2 postrostral carapace length	11
11(10)	Antorbital angle of eave produced to a small, obtuse lobe	*P. marissinica*
—	Antorbital angle of eave not produced	*P. similis*[16])

Pugettia incisa (De Haan, 1850)
(Fig. 28g, h)

Pisa (*Menoethius*) *incisus* De Haan, 1850: 98, pl. 24 fig. 3.
Pugettia incisa. — Ortmann, 1893: 44-45. — Yokoya, 1933: 148. — Sakai, 1938: 254-255, text-fig. 27; 1965a: 72, pl. 32 figs. 1, 2; 1976: 195-196, text-fig. 102, pl. 68 fig. 3. — Takeda & Miyake, 1969: 505-506. — Takeda, 1973b: 39-40.
Pugettia cristata Gordon, 1931: 555-557, text-figs. 33b, 34d, e.

Material examined. — 7 ♂♂, 2 ♀♀ (1 ovig.), 6.5-20 mm, ovig. ♀, 20 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Pacific Expedition: Japan, 33°51′N 130°03′E, 47 m, dredge, 18 May 1914; 2 specs.
Japan: Hirado, 33°10′N 129°18′E, 72 m; 1 spec. — Nagasaki, coll. James Jordan: 1 spec. — Off Nagasaki, 32°48′N 129°37′E, 72 m, Capt. Christensen, "Store Nordiske", 23 April 1912; 2 specs.
Formosa Strait, 63 m; 3 specs.

Remarks. — In this species the postorbital lobe and hepatic spine are fused to form a single plate with a straight lateral margin. This character distinguishes it from all other species in the genus.

There is a posterior medial tubercle on the mesogastric region. In four specimens there is a small lateral tubercle anterior to that and in four specimens there is a very small anterior medial tubercle. The large cardiac spine is subequal to the epibranchial spine, each arising from a conical elevation. There is sometimes a low tubercle on the anterior branchial region and a very small tubercle anteriorly on the branchial submargin. There is a medial tubercle on the intestinal region.

There are three tubercles on the margin of the pterygostomian region and a similar tubercle in line with them on the anterior angle of the epimeral ridge.

The basal antennal article has a small tooth on the anterolateral angle, the lateral margin curves outward slightly at the base and the proximal angle is rounded. The narrow ridge near the medial margin extends a short way onto the epistome.

The merus of the cheliped is trigonal with a terminal spine, the dorsal carina is entire and the ventral ridges are each armed with three low teeth. In one specimen (♂, 20 mm, Japan), the dorsal ridge is armed with three low teeth and the inner ventral ridge is entire. The outer face of the merus is slightly raised, but smooth, in the lower half. It is not ridged as in *P. intermedia*. The carpus of the cheliped in the male has two crests dorsally and another on the inner margin. In the two female specimens only one crest, the dorsal, is distinct. The palm of the chela in the male is laterally compressed (ht = 3/4 l), there is a dorsal carina and the ventral margin is sharp.

The meri of the ambulatory legs are trigonal and laterally compressed. The carpi are widened with two ridges, and the propodi laterally compressed with a rounded dorsal ridge.

The first pleopod of the male has not been figured before. At the tip there is a broad triangular lateral lobe, a long slender medial lobe, and a small triangular lobe on the ventral surface. In most other species of *Pugettia* there are two medial lobes on the pleopod. In *P. quadridens* the ventral medial lobe of the pleopod is about half as long as the dorsal lobe, but in *P. intermedia*, *P. minor*, *P. nipponensis* and *P. marissinica* the two medial lobes of the pleopod are subequal.

Gordon (1931) has considered *P. cristata* as being close to *P. incisa* but differing from it by the presence, in the former, of crests on the meri of the ambulatory legs. In *P. incisa*, as figured by De Haan (1850: pl. 24 fig. 3), the merus of the first ambulatory leg is clearly sharp. Of our specimens, the male (17 mm) from Nagasaki has a blunt ridge on the dorsal margin of the merus, while the male (20 mm) from Hirado and the specimens from Formosa Straits have a distinct carina on the merus. Thus it seems that *P. cristata* is a synonym of *P. incisa* as noted by Sakai.

Distribution. — Japan, East China Sea, Formosa Strait, Amoy.

Pugettia intermedia Sakai, 1938 new status
(Fig. 28a, b)

Pugettia minor. — Shen, 1937: 287-289, text-fig. 5a, d, f, g. (Not *Pugettia minor* Ortmann, 1893.)
Pugettia quadridens intermedia Sakai, 1938: 258-259, pl. 36 fig. 2; 1965a: 72-73, pl. 32 fig. 3; 1976: 197, text-fig. 103b.

Material examined. — 1 ♂, 4 ♀♀ (2 ovig.), 7-32.5 mm, smaller ovig. ♀, 27 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Formosa Strait: 23°57′N 118°33′E, 50 m, April 1897; 2 specs. — 23°08′N 117°30′E, 43 m, 23 January 1912; 2 specs.
Japan, S. of Goto Retto, 32°48′N 129°37′E, 72 m, Capt. Christensen, 'Store Nordiske', 23 April 1912; 1 spec.

Remarks. — This species is very close to *Pugettia quadridens*. The two species have been compared by Shen (1937), who figured this species under the name *Pugettia minor*, and by Sakai (1938) who gave it only subspecific status. As the geographic range of both the nominate form of *P. quadridens* and *P. intermedia* includes Japan and North China, the two

[16]) From the literature.

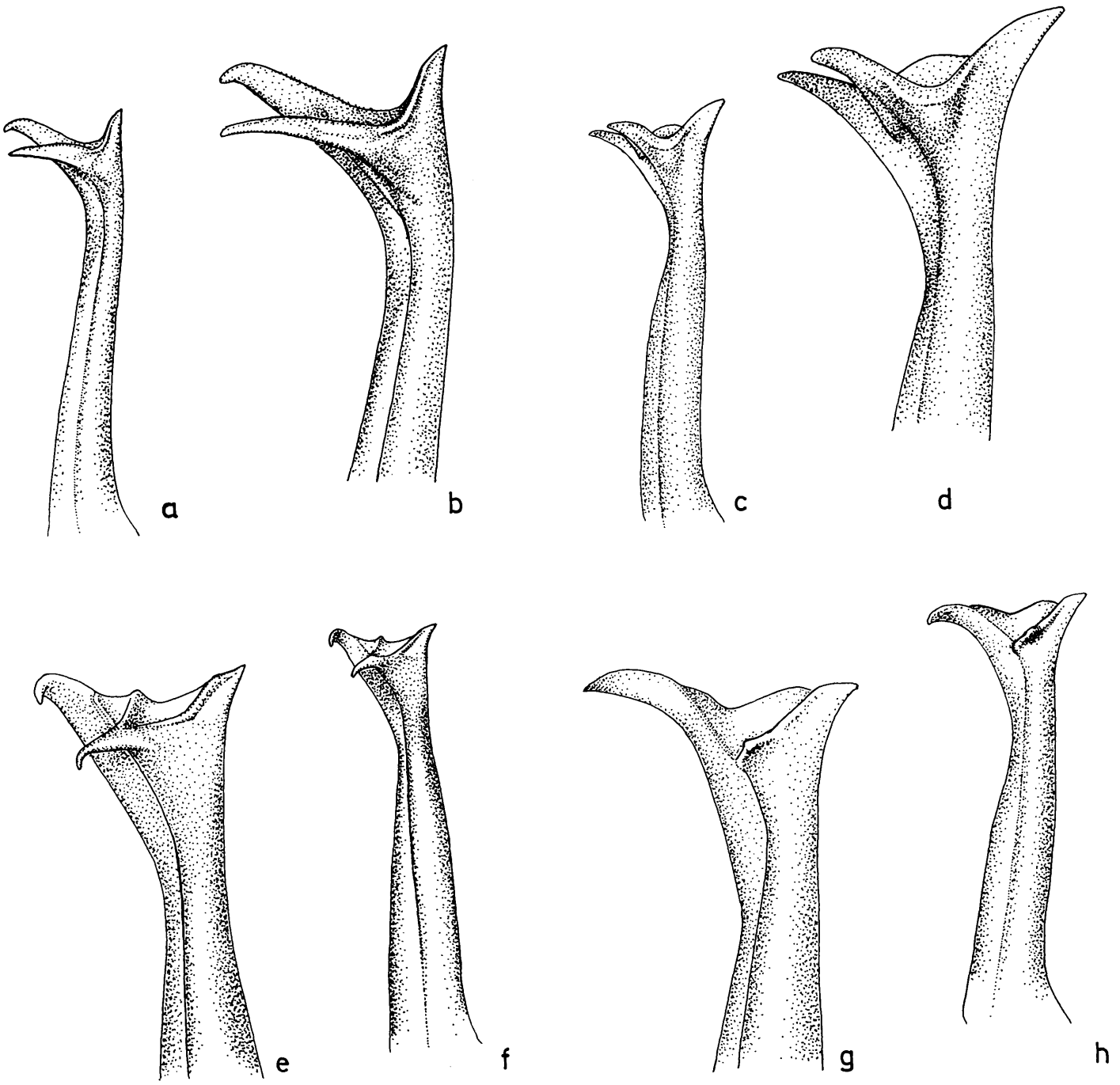


Fig. 28. Left first pleopod of male of *Pugettia intermedia* (32.5 mm, Formosa Strait, ZMC) (a) abdominal view of pleopod, (b) abdominal tip of same; *P. marissinica* (12 mm, Japan, ZMC) (c) abdominal view of pleopod, (d) abdominal tip of same; *P. quadridens* (21 mm, Nagasaki, ZMC) (e) abdominal tip of pleopod, (f) abdominal view of same; *P. incisa* (17 mm, Nagasaki, ZMC) (g) abdominal tip of pleopod, (h) abdominal view of same.

cannot be regarded validly as separate subspecies of the same species: they must be considered specifically distinct.

P. intermedia can be distinguished from *P. quadridens quadridens* by the following points (characters of *P. intermedia* given first):

(1) The two medial lobes of the first pleopod of the male are subequal; in *P. quadridens* the ventral lobe is only about half the length of the dorsal lobe (Shen, 1937: text fig. 5g, h).

(2) The postorbital lobe and the hepatic spine are subequal; in *P. quadridens* the postorbital lobe is much smaller than the hepatic spine.

(3) There are four small tubercles on the branchial submargin above the epimeral ridge; in *P. quadridens* there is only one or two such tubercles.

(4) The lateral gastric tubercles, if present, lie just in front of the posterior medial tubercle; in *P. quadridens* they lie just behind the anterior medial tubercle.

(5) There is a strong ridge or row of tubercles halfway down the outer face of the merus of the cheliped; in *P. quadridens* this ridge if present is very low and smooth.

The differences in the basal antennal article and sternal plate, figured by Shen, have not been found to be consistent. These are characters which, in this genus, generally show considerable variability.

Distribution. — Japan, N. China, Formosa Strait.

Pugettia marissinica Takeda & Miyake, 1972
(Fig. 28c, d)

Pugettia marissinica Takeda & Miyake, 1972b: 260-262, fig. 4. — Takeda, 1973b: 40.

Material examined. — 1 ♂, 5 ♀♀ (2 ovig.), cl. 11 — postrostral cl. 14 mm, smaller ovig. ♀, 13.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Formosa Straits, 45 m, 23 May 1897; 1 spec.
Mortensen Pacific Expedition: SE. of Goto, 32°15′N 128°12′E, 162 m, dredge, 15 May 1914; 1 spec.
Japan: SE. of Goto, 32°15′N 128°20′E, 180 m, Capt. H. Christensen, 17 April 1926; 3 specs. — 32°21′N 128°41′E, 177-198 m, 8 July 1928; 1 spec.

Remarks. — These specimens agree well with those figured and described by Takeda & Miyake as *P. marissinica*. Sakai (1976: 200, text fig. 107a, b) includes, without discussion, *P. marissinica* as a synonym of *P. similis* Rathbun, and this appears probable from the sketch of the type (fig. 107a). However, that sketch does not show the small, blunt antorbital angle present in our specimens and figured by Takeda & Miyake (as fig. 4A). Since *P. similis* has never been adequately described and Sakai has given no reasons for regarding the two species as synonymous, we will continue, for the present, to regard these specimens as *P. marissinica* and we include some descriptive notes on them.

The preorbital angle of the eave is sharp and produced forward, and the antorbital angle is produced to a small obtuse lobe. In lateral view the postorbital lobe is about as long as its basal width and curved downwards distally.

In most specimens the gastric regions are smooth, but in one specimen (male, 12 mm, 32°15′N 128°12′E) there are four very small tubercles, and in another (imm. ♀, 11 mm) there are two small medial tubercles. The hepatic spine is more slender than the postorbital lobe and smaller than the epibranchial spine.

There is a small tubercle on the branchial region, halfway between the epibranchial spine and the cardiac region and, in one specimen, there is also a tubercle on each side of the posterior margin of the cardiac region. There is a row of two to four small tubercles anteriorly on the branchial submargin.

On the intestinal region there is a medial tubercle, and on either side a low ridge just above the posterior margin of the carapace.

There is a blunt anterolateral tooth on the basal antennal article, the lateral margin is straight and without a proximal tooth.

On the pterygostomian margin there are three or four compressed tubercles and a similar tubercle in line with them on the anterior angle of the epimeral ridge.

The cheliped merus has a terminal spine and four ridges. The dorsal ridge is armed with two short proximal teeth and a longer distal tooth. Halfway down the outer face there is a low roughened ridge. Ventrally, the outer ridge is sharp with three short teeth, and the inner ridge is low with three granules.

The ambulatory legs are as described by Takeda & Miyake. The first ambulatory leg is as long as the cheliped and the carapace, not longer than them, as in *P. nipponensis*. The specimen from Formosa Straits has a more pronounced terminal spine on the meri of the ambulatory legs.

The first pleopod of the male has not been figured or described for either *P. similis* or *P. marissinica*, so we take this opportunity to figure the pleopod of one of our adult male specimens (12 mm, 32°15′N 128°12′E). The pleopod is scyriform like that of *P. minor* and *P. nipponensis*, that is, there is a broad triangular lateral lobe and two slender medial lobes.

This species was previously known only from the type locality, Tsushima Islands.

Distribution. — Japan: Tsushima Islands, SE. of Goto, Formosa Straits.

Pugettia mindanaoensis Rathbun, 1916
(Fig. 29)

Pugettia mindanaoensis Rathbun, 1916: 538-539. — Griffin, 1976: 210.

Material examined. — 1 ♀, 9 mm.

SMITHSONIAN INSTITUTION, WASHINGTON
'Albatross' Expedition: Stn. 5172, Sulu Archipelago, near Jolo, 06°03′15″N 120°35′30″E, 572 m, 5 March 1908; 1 spec., USNM 48244, det. Rathbun.

Remarks. — This small female was reported on previously (Griffin, 1976) but not figured. It agrees well with the holotype (♀, 15 mm, off N. Mindanao, USNM 48208). In this specimen there is a sharp preorbital spine, a very weak antorbital convexity and a broad postorbital lobe, in lateral aspect the length about equal to the basal width. The hepatic region is elevated, distinct from the postorbital lobe, with a small, sharp dorsal spine. The branchial region has a very small epibranchial spine, not 'moderate sized' as in the holotype, and there is no tubercle on the inner angle of the branchial region as in the holotype. Rathbun described 'a tubercle on the anterior part of the subbranchial region' of the holotype which in this specimen is in the form of a flat suboval plate, broader anteriorly, carinate on the anterior and dorsal edges. The male of this species is unknown.

This species is distinguished from others in the genus, except *P. quadridens pellucens*, by the absence of any spines or

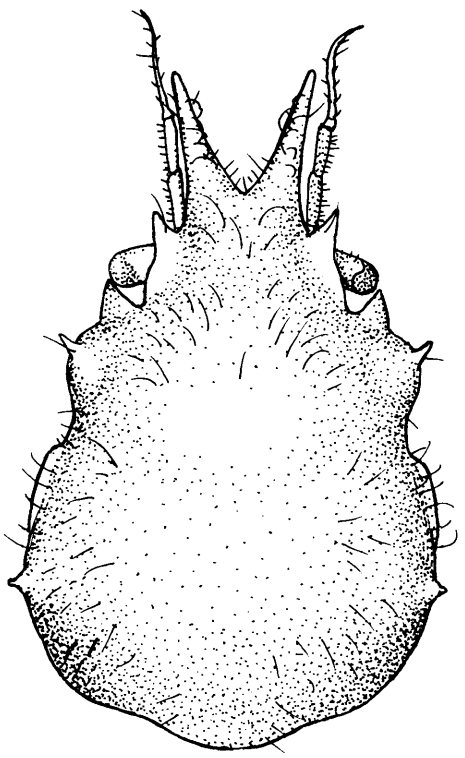


Fig. 29. *Pugettia mindanaoensis* (female, 9 mm, Sulu Archipelago, USNM 48244) carapace, dorsal view.

tubercles on the gastric, cardiac or intestinal regions. It is distinguished from *P. quadridens pellucens* by the much smaller hepatic and branchial spines.

Distribution. — Southern Philippine Islands.

Pugettia minor Ortmann, 1893

Pugettia minor Ortmann, 1893: 44. — Gordon, 1931: 555-556, text figs. 33a, 34a-c. — Sakai, 1938: 260, pl. 25 fig. 2, text fig. 29; 1965a: 72, pl. 31 fig. 4; 1976: 199, pl. 68 fig. 2. — Takeda & Miyake, 1969: 506-507. — Takeda, 1973b: 40, fig. 5. (Not *Pugettia minor* Shen, 1937 = *Pugettia intermedia* Sakai.)

Material examined. — 11 ♂♂, 8 ♀♀ (3 ovig.), 6.5-18.5 mm, smallest ovig. ♀, 9 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, 32°49′N 128°14′E (23 miles NW. 3/4W. of Goto), 207 m, trawl, sand, 14 May 1914; 1 spec. — NW. of Shimonoseki, 34°20′N 130°10′E, 108 m, dredge, 18 May 1914; 1 spec. — off Misaki, 144-180 m, 19 June 1914; 6 specs. — Okinose, Sagami Sea, 180 m, 23 June 1914; 2 specs. — Okinose, Sagami Sea, 540 m, 28 June 1914; 1 spec. — Sagami Bay, 540 m, 29 June 1914; 8 specs.

Remarks. — This species is close to *P. nipponensis* and *P. marissinica* but can be distinguished from them by the presence of a spine (not a tubercle) on both the cardiac and the intestinal region.

The rostral spines are approximately 1/3 the postrostral carapace length and divergent or weakly divergent. The preorbital angle of the eave is produced forward in a sharp spine, but the antorbital angle is, at most, only very weakly produced and rounded. The postorbital lobe is larger than the hepatic spine and, in lateral view, the length is about 1 1/2 to 2 times the basal width.

On the gastric region there is a posterior medial tubercle (very low in some small specimens), and in 7 specimens a very low lateral tubercle just in front of it. On the branchial region there is an epibranchial spine, and a row of two to three tubercles laterally on the submargin, but no anterior branchial tubercles as in *P. nipponensis*. There is a very strong spine on the conically elevated cardiac region. On the intestinal region there is a long medial spine but no pronounced ridge above the posterior margin of the carapace (as there is in the other two species).

On the basal antennal article there is a small anterolateral tooth (which varies in size); the lateral margin is straight and there is sometimes a very small proximal lateral tooth. There are three tubercles on the margin of the pterygostomian region and a similar tubercle in line with them on the anterior angle of the epimeral ridge.

The merus of the cheliped has three or four ridges and a terminal spine. The cheliped of the male as figured by Sakai (1938: pl. 25 fig. 2) and Takeda (1973b: fig. 5) has an uninterrupted carina dorsally on the merus. However, in all except two of our specimens the dorsal crest is made up of two low proximal teeth and a longer distal one, often sharp. Midway down the outer face there is a low smooth ridge (more marked in larger specimens) and ventrally there is a crest with three low teeth. Ventrally on the inner face, the ridge has a low unbroken carina or is armed with three low teeth or granules. On the carpus there are two sharp crests, one dorsal, and one on the inner edge, and between them a lower diagonal crest.

The ambulatory legs are without a ridge or a terminal spine. The first ambulatory leg is subequal to the cheliped and the carapace length.

The first pleopod of the male is similar to that of *P. nipponensis* and *P. marissinica* and has been figured by Sakai (1938: text fig. 29); it is scyriform.

The specimen figured as *P. minor* by Shen (1937) is actually *P. intermedia* and is discussed under that species.

Distribution. — Japan and Yellow Sea.

Pugettia nipponensis Rathbun, 1932

Pugettia nipponensis Rathbun, 1932: 31. — Yokoya, 1933: 152-153. — Sakai, 1938: 261-262, pl. 26 fig. 2, text fig. 30; 1965a: 73, pl. 33 fig. 1; 1976: 200-201, text-fig. 108a, b, pl. 69 fig. 1. — Takeda & Miyake, 1969: 507.

Material examined. — 3 ♂♂, 1 ♀ (ovig.), 15-19 mm, ovig. ♀, 16.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sagami Bay, Misaki, off the station, 144-216 m, swabs, 10 June 1914; 1 spec. — off Misaki, 360 m, dredge, 30 June 1914; 1 spec.

Japan, 32°19′N 128°12′E, 146-346 m, 'Store Nordiske', 17 May 1931; 1 spec.

Danish Kei Islands Expedition: Ambon, Ambon Bay, 234-180 m, stones, 25 February 1922; 1 spec.

Remarks. — This species is close to *P. minor* and *P. marissinica* but is distinguished from them by the presence of tubercles on the anterior branchial region, longer ambulatory legs, and the low dense tomentum on the carapace.

The rostral spines are slender, divergent, and vary in length from $^1/_3$ to $^1/_2$ the postrostral carapace length. The preorbital angle of the eave is produced forward in an acuminate spine but there is no antorbital lobe. The postorbital lobe is longer than broad (l = $1^1/_2$ w approx.), in lateral view.

On the mesogastric region there is a posterior medial tubercle and, with one exception, a small lateral tubercle just in front of it. On the specimen from Ambon there is also a small anterior medial tubercle. The short hepatic spine is about as long as the postorbital lobe and, in all except one specimen, has a small tubercle just above it.

There is a group of two to three tubercles anteriorly on the branchial region. There is a short epibranchial spine, a tubercle medial to it and another elongate tubercle near the rounded cardiac region. Laterally there are three tubercles on the branchial submargin. There is a rounded medial tubercle on the intestinal region, and on either side, a low ridge just above the posterior margin of the carapace.

On the basal antennal article there is a blunt anterolateral tooth, a small proximal lateral tooth (which varies in size), and the margin between them is straight or weakly concave.

There are three tubercles on the margin of the pterygostomian region and in line with them, a similar tubercle on the anterior angle of the epimeral ridge.

The cheliped of the male (18.5 mm) from off Misaki has two ventral teeth on the ischium. On the merus there is a terminal spine, three toothed ridges, and a low smooth ridge midway on the outer face. The dorsal ridge has two proximal teeth and there are three teeth on each of the ventral ridges. There are two sharp crests on the carpus. These teeth and crests are all much blunter and lower on the specimen (♂, 15 mm) from Ambon. The ambulatory legs are long and slender and covered with a low tomentum. The meri lack both a carina and a terminal spine. The first ambulatory leg is longer than the cheliped and up to one and a half times the carapace length.

The first pleopod of the male has been figured by Sakai (1938: text-fig. 30b): it is scyriform.

One specimen (♂, 19 mm, 32°19′N 128°12′E) is noticeably less tuberculate. There is only one distinct tubercle on the gastric region, none above the hepatic spine or just medial to the epibranchial spine.

This species has previously been recorded only from Japan.

Distribution. — Japan, Ambon.

Pugettia quadridens (De Haan, 1850)
(Fig. 28e, f)

Pisa (*Menoethius*) (sic) *quadridens* De Haan, 1850: 97-98, [and as *P.* (*Halimus*) *quadridens* in] pl. 24 fig. 2.
Pugettia quadridens. — Stimpson, 1907: 24-25. — Yokoya, 1933: 148. — Shen, 1937: 287-289, text fig. 5b, c, e, h. — Sakai, 1938: 255-257, pl. 26 fig. 1, text fig. 28; 1965a: 73, pl. 32 figs. 4, 5.
Pugettia quadridens quadridens. — Sakai, 1976: 196-197, text fig. 103a, pl. 68 fig. 1.

Material examined. — 2 ♂♂, 19, 21 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Japan, Nagasaki, coll. James Jordan; 1 spec. — Nagasaki, coll. James Jordan, 1 July 1911; 1 spec.

Remarks. — Our specimens agree with those described and figured by Sakai (1976) as *P. quadridens quadridens*. This species is close to *P. intermedia* (previously considered a subspecies of *P. quadridens*) and the differences in the first pleopod of the male, the postorbital lobe and the carapace tubercles which distinguish them, are discussed under *P. intermedia*.

P. quadridens pellucens Rathbun has subspecific status but as Sakai states it differs from *P. quadridens quadridens* in having the dorsal surface of the carapace smooth, the rostral spines longer and widely divergent in the distal half and the spines on the hepatic and branchial margins are narrow, not laminar. The first pleopod of the male of *P. quadridens pellucens* has not been figured or described. It seems that *P. quadridens pellucens* may prove to be a distinct species but we are unable to comment further without seeing specimens.

Distribution. — Japan, Korea, North China.

Sargassocarcinus Ward, 1936

Type species. — *Sargassocarcinus foliatus* Ward, 1936 (= *Peltinia sublimis* Rathbun, 1916), by monotypy.

Remarks. — Three very similar species have been described by different authors under different names from the Philippine Islands, Japan and Australia. It seems probable that there is, in fact, a single western Pacific species.

Sakai (1965a: 75-76) explained that the name *Sargassocarcinus* must replace the *Peltinia* of Dana which is no longer valid and also why the specimen described by Balss (1924) as *Mimulus cristatus* does not belong in that east Pacific genus. We would add that *Mimulus foliatus* Stimpson differs from *Sargassocarcinus* in having a well developed postorbital lobe and the first pleopod of the male is scyriform. The pleopod of *Sargassocarcinus sublimis* is similar to that of *Huenia proteus* De Haan. The presence of two rostral lobes distinguishes *Sargassocarcinus* from the broad carapaced species of *Huenia* such as *H. brevifrons* in which there is a single rostrum.

Distribution. — Western Pacific.

Sargassocarcinus sublimis (Rathbun, 1916)
(Fig. 18e, f)

Peltinia sublimis Rathbun, 1916: 536-537.
Mimulus cristatus Balss, 1924: 28, pl. 1 figs. 4, 5.

Sargassocarcinus foliatus Ward, 1936: 9, pl. 3 figs. 4-6.
Sargassocarcinus sublimis. — Sakai, 1965a: 75-76, text fig. 11c. — Griffin, 1976: 211.
Sargassocarcinus cristatus. — Sakai, 1965a: 77, text figs 11a, b, pl. 34 fig. 3; 1976: 205, pl. 71 fig. 3; new synonymy.

Material examined. — No new material. 2 ♂♂, 7.5, 8 mm.

SMITHSONIAN INSTITUTION, WASHINGTON
'Albatross' Expedition: Stn. 3730, Japan, off Honshu I., 61-66 m, 16 May 1900; 1 spec. (USNM 48248, det. M. Rathbun, *Peltinia sublimis*).

THE AUSTRALIAN MUSEUM, SYDNEY
Queensland, near Lindeman I., Seaforth Reef, coll. M. Ward, July 1935; 1 spec. (AM P.16297, Paratype, *Sargassocarcinus foliatus* Ward).

Remarks. — We have examined these two specimens and consider them conspecific. They agree in the form of the rostrum, the preorbital lobe, general carapace shape, carapace tubercles, basal antennal article and ambulatory legs. The anterior margin of the hepatic lobe is less sinuous in the Australian specimen than in the specimen from Japan. The paratype of *S. foliatus* (8 mm) is apparently adult, the palm of the chela is one and a half times as long as high and there is a well developed gape between the fingers with a single large tooth on the dactyl. The chela on the Japanese specimen (7.5 mm) is more slender with no gape between the fingers.

These two specimens also agree with the holotype of *S. sublimis* (male, 12 mm, USNM 48247) from Sulu Archipelago, examined by one of us (Griffin in 1970). The specimens do not appear to differ from that figured by Sakai (1965a: text fig. 11a, b, pl. 34 fig. 3) as *S. cristatus* Balss and Sakai has given no distinguishing characters to separate *S. sublimis* and *S. cristatus*. It seems most likely that there is one species *S. sublimis* present in Japan, Philippine Islands and northern Australia.

The first pleopod of the male has not been described or figured before. The pleopod is similar to that of *Huenia proteus*, it is slender, straight, slightly broader where it curves outward near the tip, and then tapers to a narrow apex. The male abdomen has seven free segments.

Distribution. — Japan, Philippine Islands, northern Australia.

Simocarcinus Miers, 1879

Type species. — *Huenia simplex* Dana, 1852, by subsequent designation of Miers (1879).

Remarks. — Miers (1879a, c) removed from the genus *Huenia* the species which lacked a preorbital spine and placed them in two new genera *Trigonothir* and *Simocarcinus*. Laurie (1906) regarded the distinction made by Miers between these two genera as insufficient and, as *Simocarcinus simplex* was quite well known while *Trigonothir* was 'formed for a single male specimen', Laurie chose *Simocarcinus* as the name for the genus. Balss (1938) agreed with Laurie that there should be one genus but regarded *Trigonothir* as the correct name on the basis of page priority. However, the name to be used depends not on page priority but on the first revisor. As Laurie clearly qualifies as the first revisor under Article 24 of the International Rules of Zoological Nomenclature, *Simocarcinus* Miers, 1879 is adopted here.

Although we consider that there are three species in this genus, differentiating between them is sometimes extremely difficult. Discrimination is not assisted by the remarkably similar first pleopods of the males.

Distribution. — Widespread throughout the Indo-West Pacific.

KEY TO SPECIES OF *SIMOCARCINUS*

1	Rostrum length equal to or greater than postrostral carapace length; rostrum in males strongly compressed laterally in distal half, apex deeper than basal portion and without ventral lobes; neither males nor females with hepatic lobes ..... *S. pyramidatus*
—	Rostrum length less than postrostral carapace length; apex of rostrum in males expanded into two lateral lobes ventrally; females with distinct hepatic lobes 2
2(1)	Rostrum with dorsal face tapering towards apex; rostrum in females greater than one fifth postrostral carapace length; length of hepatic lobe of female from anterior to posterior margin about one fifth postrostral carapace length; first ambulatory leg of adult female about 1.5 times as long as cheliped ..... *S. simplex*
—	Rostrum with dorsal face not tapering towards apex; rostrum in females no more than one fifth postrostral carapace length; length of hepatic lobe of female from anterior to posterior margin about one third postrostral carapace length; first ambulatory leg of adult female about as long as cheliped ..... *S. obtusirostris*

Simocarcinus obtusirostris (Miers, 1879)

Trigonothir obtusirostris Miers, 1879a: 4-5, pl. 4 figs. 2, 2a. — Forest & Guinot, 1961: 14-15. — Takeda, 1973a: 100-101, fig. 2D, E, pl. 3 fig. B.
Simocarcinus obtusirostris. — Griffin, 1974: 28-29.

Material examined. — 2 ♂♂, 6 ♀♀ (5 ovig.), 10-22.5 mm, smallest ovig. ♀, 16.5 mm.

MUSEUM OF VICTORIA, MELBOURNE
Queensland, Capricorn Group, Masthead I., coll. J. A. Kershaw, October 1920; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY
Queensland: Capricorn Group, Heron I., on *Halimeda*, coll. I. Bennett, August 1962; 3 specs (AM P.19645). — Heron I., 12 October 1962; 1 spec. (AM P.17019). — Heron I., coral reef flat, January 1955; 1 spec (AM P.12918). — Heron I., on *Halimeda*, coll. D. Henderson, November 1966; 1 spec. (AM P.31032, dry). — Herald Group, Northeast Cay, dead coral washings, coll. D. F. McMichael and J. C. Yaldwyn, 9 November 1964; 1 spec. (AM P.17001).

Remarks. — In the two males of this series the rostrum is about two-thirds the postrostral carapace length while in the females the rostrum varies from a short lobe extending for-

ward about one fifth postrostral carapace length to a lobe which is nearly vertical and hardly produced forward beyond the preorbital region. The rostrum is not strongly compressed and the dorsal surface, especially in the males, is nearly as broad just behind the apex as it is at the base; the apex is blunt. On the other hand, in males of *S. simplex* and *S. pyramidatus* the dorsal surface of the rostrum is tapered and very narrow at the apex.

The hepatic lobe of our female specimens is very broad and the lateral margin of the lobe is inflated. The branchial lobes are not as broad as the hepatic but they are also inflated so that in some specimens they are almost bulbous. In two of our females the hepatic lobes are not extended as far laterally as is usual in this species so that the width across the hepatic lobes is noticeably less than that across the branchial lobes. However, the hepatic lobe is still much broader than it is in *S. simplex*. In our specimens of *S. obtusirostris* the anterior margin of the hepatic lobe is just behind the orbit and the length of the lobe from anterior to posterior margin is about a third of the postrostral carapace length. In *S. simplex* the anterior margin of the lobe is always well behind the orbit and the length of the lobe is about one fifth the postrostral carapace length.

The relationship between the length of the cheliped and the length of the first ambulatory leg is not reliable in the male where the length of the cheliped changes so much with age, but in the adult females of each of these three species of *Simocarcinus* we have found a consistent relationship.

In our adult females of *S. obtusirostris* the first ambulatory leg is stouter and it is also shorter in relation to the cheliped than in *S. simplex* and *S. pyramidatus*. The first ambulatory leg is equal to or only slightly longer (1.0 to 1.2) than the cheliped and the propod of the first leg is about twice (2 to 2.3) as long as high. In adult females of *S. simplex* the first leg is about one and a half times as long as the cheliped and the propod four to five times as long as high; in adult females of *S. pyramidatus* the first leg is twice as long as the cheliped and the propod is very slender, about seven times as long as high.

Balss (1938) considered *Xenocarcinoides rostratus* Borradaile from Funafuti (Kirabati) a synonym of *Trigonothir obtusirostris*. Sakai (1976) considers it a distinct species of *Trigonothir*. *X. rostratus* differs from the present series most noticeably in having the rostrum apically concave dorsally and in apparently possessing a tubercle surmounting the lateral branchial angle. Borradaile states that the abdomen of the male possesses only six segments but his illustration shows seven with the sixth fissured. The figure of *X. rostratus*, as *T. rostratus*, given by Sakai (1976: pl. 70 fig. 2) agrees quite well with specimens of *S. obtusirostris* that we have examined. In our opinion the evidence which distinguishes *X. rostratus* as a distinct species is inadequate and we agree with Balss that it should be regarded as a synonym of *S. obtusirostris*.

These records are the first of this species from Australia.

Distribution. — Indo-West Pacific: Cocos Keeling Islands, NE. Australia (Queensland), Palau, Mariannas, Kirabati, Tuvalu, Tahiti.

Simocarcinus pyramidatus (Heller, 1861)

Huenia pyramidata Heller, 1861: 307-309, pl. 1 fig. 9.
Simocarcinus pyramidatus. — Griffin, 1974: 29. — Griffin & Tranter, 1974: 182.

Material examined. — 6 ♂♂, 1 ♀, 23.5-39 mm.

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: Barrow I., 2-5.5 m, dredge, sand, 5 August 1966; 1 spec. (WAM 239-73). — Exmouth Gulf, 12-18 m, trawl, coll. R. McKay, winter 1960; 1 spec. (WAM 64-77). — Shark Bay, near bar of South Passage, coll. R. W. George on 'Davina', 14 May 1960; 3 specs. (WAM 348-73, in part). — Lancelin I., in craypot, coll. C. Jeffrey, January 1961; 1 spec. (WAM 351-73).

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia, 14 miles (~ 22 km) N. of Point Cloates, 22°30′S 113°42′E, 1.5-3.5 m, box dredge, sand, 'Ningaloo' Expedition, 9 September 1968; 1 spec. (AM P.17870).

Remarks. — In this series of specimens the rostrum is equal to or greater than (up to 1.3 times) the postrostral carapace length. In the males the rostrum is strongly compressed laterally especially in the distal half and ventrally is not expanded into lateral lobes apically. The rostrum is deeper near the apex than in the basal portion and sometimes weakly curved downwards in the distal half. The rostrum of the immature female is not so strongly compressed, the apex is not deepened and there are small lateral lobes on the ventral margin apically.

On the hepatic margin of these specimens (male and female) there is a weak convexity but no hepatic lobe. The anterior margin of the branchial lobe is long and gently curved while the posterior margin is short and nearly at right angles to the midline of the carapace. The branchial lobe is strongly pronounced in five of the males, weak and rounded in the other male and in the immature female.

We have also examined an adult female (cl. 31.5 mm, Mauritius, dry spec.) in the collection of the Australian Museum. It agrees with the immature female of this series in the absence of hepatic lobes and in the shape of the rostrum which is one and a half times the postrostral carapace length.

The specimen described and figured by Sakai (1976) as *Trigonothir longirostris* agrees with specimens of *S. pyramidatus* in the length of the rostrum and absence of hepatic lobes, but the oblique angle of the rostrum and the presence of ventral lobes at its apex would seem to indicate *S. simplex* or a species other than the three dealt with here.

Distribution. — Indian Ocean: Aldabra, Mauritius, Seychelles, Sri Lanka, Nicobar, Cocos Keeling Islands, Western Australia.

Simocarcinus simplex (Dana, 1852)

Huenia simplex Dana, 1852: 133-134, 1855: pl. 6 figs. 3a-c.
Simocarcinus simplex. — Griffin & Tranter, 1974: 182, 185. — Tirmizi, 1978: 311-312, figs. 1-8.
Trigonothir simplex. — Sakai, 1976: 209-210.
Trigonothir camelus. — Sakai, 1976: 211-212, text figs. 114a, b.

Material examined. — 11 ♂♂, 18 ♀♀ (7 ovig.) 10-31 mm, smallest ovig. ♀, 13 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Hawaii, Hilo, 7 April 1915; 1 spec. — Honolulu, April 1915; 5 specs.

South India, Pamban Passage, 5 m, coll. H. Lemche, 9 October 1951; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: Sharks Bay, near bar of South Passage, coll. R. W. George on 'Davina', 14 May 1960; 5 specs. (WAM 348-73, in part). — Abrolhos Islands, East Wallaby I., NE. side of island, on shore platform, coll. E. P. Hodgkin, 5 February 1964; 1 spec. (WAM 326-67).

THE AUSTRALIAN MUSEUM, SYDNEY

Hawaii, reef at Waikiki, amongst weed and under stones, coll. M. Ward, 24-30 August 1927; 16 specs. (AM P.31031).

Remarks. — In most of the males of this series the rostrum is less than half (about 0.4) the postrostral carapace length, but in a few of the larger males it is greater than half (about 0.6). In all the males the distal end of the rostrum is narrow and tapering on the dorsal surface but on the ventral surface is expanded into two horizontal lobes.

In this series the females from Hawaii and one of those from Western Australia have a rostrum that is about one fifth to one third postrostral carapace length, but in the other females from the Indian Ocean the rostrum is about half the postrostral carapace length. In all our females the apex of the rostrum has two horizontal lobes ventrally.

In all our females there is a moderately sized hepatic lobe, the length of the lobe from the anterior to posterior margin being about one fifth the postrostral carapace length.

The branchial lobe in both males and females is blunt and triangular, directed laterally or very slightly forwards, the anterior and posterior margins being subequal.

Distribution. — Indo-West Pacific: Red Sea, Arabian Sea, South India, Western Australia, Japan, Hawaii.

Xenocarcinus White, 1847

Type species. — *Xenocarcinus tuberculatus* White, 1847, by monotypy.

Remarks. — Gordon (1934) clarified the characters distinguishing *X. tuberculatus* White from *X. depressus* Miers and listed the two synonymies, but only commented that *X. conicus* (A. Milne Edwards) was probably a distinct species. The present revision confirms *X. conicus* as a valid species and lists the synonymy of this species. *X. conicus* and *X. tuberculatus* are widespread in the Indo-West Pacific while *X. depressus* appears to be restricted to the West Pacific and *X. monoceros* Sakai to Japan. Species of this genus are distinguished by the single, stout, uncompressed rostrum which is bifurcate or abruptly narrowed apically. The sexes of species of *Xenocarcinus* are not dimorphic. The first pleopod of the male in all known species bears a long slender apical process and is quite different from that of *Acanthonyx*, *Huenia* or *Simocarcinus* species. A pleopod of this kind is found in *Hoplophrys* and the *Hyastenus diacanthus* — *H. aries* group of species within the Pisinae. The pleopod of *X. monoceros* is unknown. There is a very small preorbital lobe in *X. conicus* and *X. monoceros*; the intercalated spine is defined by sutures in *X. conicus*, *X. depressus* and *X. monoceros* but not in *X. tuberculatus*.

X. truncatifrons Balss (1938) is known only from the holotype from the Gilbert Islands but the form of the preorbital region and the position of the curled hairs have more in common with species of *Huenia* such as *H. halei* or *H. australis* than with other species of *Xenocarcinus*. We retain this species in *Xenocarcinus* with reservations.

Distribution. — Widespread in the Indo-West Pacific.

KEY TO SPECIES OF *XENOCARCINUS*

1	Rostrum with apex slender, undivided and on a plane lower than preorbital region 2
—	Rostrum with apex broad, bifid and in the same plane as preorbital region 3
2(1)	Carapace dorsally smooth, width about $^2/_3$ postrostral carapace length; supraorbital eave, intercalated lobe and postorbital lobe not defined; preorbital region truncate, rostrum minute ..... *X. truncatifrons*[17])
—	Carapace dorsally with several low tubercles, width about $^1/_2$ postrostral carapace length; supraorbital eave, intercalated lobe and postorbital lobe well defined by sutures; rostrum about $^1/_4$ postrostral carapace length, broad proximally and tapering abruptly to a medial style ..... *X. monoceros*[17])
3(1)	Rostrum broad, of almost uniform width, divided in the distal third; gastric regions with eight small tubercles ..... *X. depressus*
—	Rostrum markedly narrower distally (about $^1/_3$ basal width), divided only at apex; gastric regions smooth or with two large tubercles 4
4(3)	Gastric region with two large tubercles in the midline; ambulatory legs smooth; anterolateral angle of basal antennal article produced but unarmed ..... *X. tuberculatus*
—	Gastric region elevated but smooth; ambulatory legs armed with spines; anterolateral spine on basal antennal article ..... *X. conicus*

Xenocarcinus conicus (A. Milne Edwards, 1865) (Fig. 30c, d)

Huenioides conica A. Milne Edwards, 1865: 145-146, pl. 4 fig. 3.
Xenocarcinus tuberculatus. — Alcock, 1895: 192. — Alcock & Anderson, 1898: pl. 33 fig. 3, 3a. — Rathbun, 1911: 248-249. — Stephensen, 1945: 109-110, fig. 21C, D. (Not *Xenocarcinus tuberculatus* White, 1847.)
Xenocarcinus tuberculatus var. *alcocki* Laurie, 1906: 371-372.
Xenocarcinus conicus. — Gordon, 1934: 70 (in discussion).
Xenocarcinus nakazawai Sakai, 1938: 325-327, text fig. 52; 1976: 213-214, text fig. 116. — Takeda & Koyama, 1974: 106-107, figs. 1, 2; new synonymy.
Xenocarcinus alcocki. — Sakai, 1965a: 92 (in discussion).

[17]) From the literature.

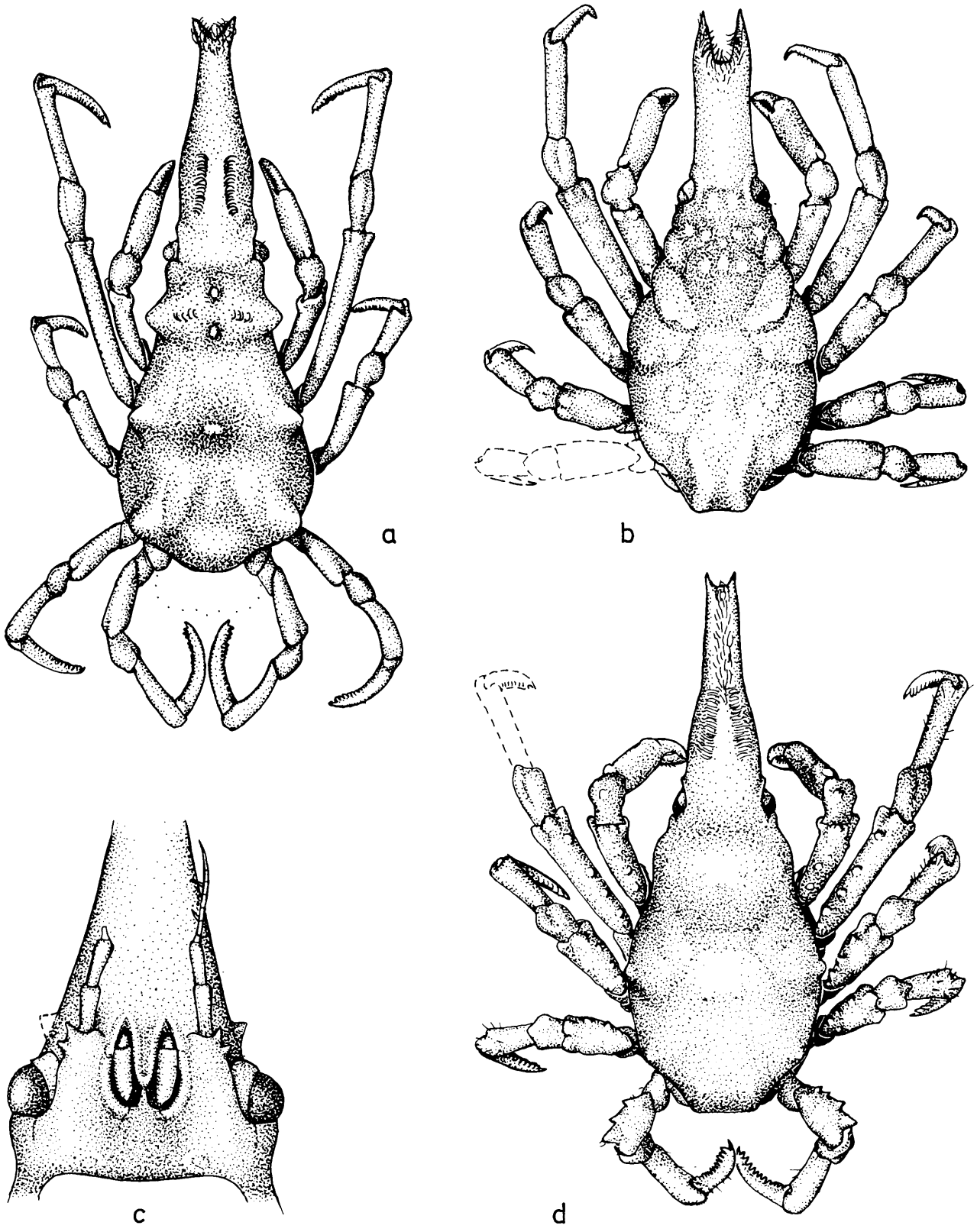


Fig. 30. *Xenocarcinus tuberculatus* (female, ovig., 35 mm, AM P. 11460) (a) whole animal dorsal view; *X. depressus* (female, ovig., 22 mm, Banda, ZMC) (b) whole animal, dorsal view; *X. conicus* (female, ovig., 22 mm, Ile de la Réunion, MNHN) (c) orbits, ventral view; (d) whole animal, dorsal view.

Material examined. — 11 ♂♂, 16 ♀♀ (6 ovig.), 1 juv., 6.5-39.5 mm, smallest ovig. ♀, 13.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 43, Kai Is., 05°30′S 132°45′E, 35 m, trawl, sand, coral, 27 April 1922; 1 spec. — off Neira Banda, ca. 13 m, dive, sand, 12 June 1922; 1 spec. — Kai Is., coll. Th. Mortensen, 1922; 1 spec.

5 Thai Danish Expedition: Stn. 1000, West Malay Peninsula, 07°40′N 98°23′E, 45 m, trawl, 6 January 1966; 1 spec.

Danish Expedition to Iran: Stn. 42 D, Iranian Gulf, 24 nautical miles NE. of Bahrein, 33 m, shells and gravel, 30 March 1937; 16 specs. (det. K. Stephensen (1945) as *X. tuberculatus*).

MUSÉUM NATIONAL D'HISTOIRE NATURELLE, PARIS

'Calypso' Red Sea Expedition: Red Sea, on gorgonid, 27 January 1952; 3 specs.

Aldabra, between main passage and Johnny Channel, 42 m, 13 May 1954; 2 specs.

Ile de la Réunion, 70-80 m, coll. Grueze, 1965; 1 spec.

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA

Off Sri Lanka, 61 m; 1 spec. (ZSC 5454/9, det. Alcock (1895) as *X. tuberculatus*).

THE AUSTRALIAN MUSEUM, SYDNEY

Off Sri Lanka, Pedro Bank; 1 spec. (AM P.29851, dry).

Remarks. — There has certainly been some confusion about the identity of previously described material. On four occasions this species has been recorded as *X. tuberculatus*. Further, it is our view that *X. nakazawai* is in fact a synonym of *X. conicus*.

This species is distinguished from *X. tuberculatus* by the gastric region which is smooth, rather than armed with two large tubercles, by the presence in *X. conicus* of a preorbital tubercle, a tooth on the anterolateral angle of the basal antennal article and a smaller spine or tubercle just behind it, and spines on the meri of the ambulatory legs, features which are all absent in *X. tuberculatus*. It is distinguished from *X. depressus* by the lack of any tubercles anteriorly on the branchial region, by the tapering rostrum (of almost uniform width in *X. depressus*), and the presence of spines not tubercles on the meri of the ambulatory legs. It differs from both these species in having two or three (not one) tubercles on the pterygostomian margin.

Our three specimens from the Red Sea (2 ♂♂, 21.5, 39.5 mm; 1 ovig. ♀, ca. 30 mm), differ from the other specimens only in the longer rostrum, which in the males is equal to, or one and a third times, the postrostral carapace length and in the female three quarters postrostral carapace length. The tubercle behind the anterolateral spine of the basal antennal article, while less pronounced than in other specimens, is still present. In the larger male some of the teeth on the dactyl of the first ambulatory leg have double points.

In all our specimens the intercalated spine is only separated from the orbital eave and the postorbital lobe by fine sutures. The rostrum is covered with a dense tomentum, and tapers distally to an apex of only a quarter to a third the basal width. There are no tubercles anteriorly on the branchial region and the tubercles on the cardiac region are very low.

The dactyl of the first ambulatory leg is armed with eight to fifteen short teeth and the terminal tooth is about the same size. In adult males (17, 39.5 mm) the cheliped carpus is armed with three tubercles; the palm is inflated, there is a strong gape between the fingers and a large tooth on the dactyl in the gape. Segments four to six of the female abdomen are fused. The first pleopod of males agrees with that figured by Stephensen (1945) as *X. tuberculatus*; distally very slender with long setae.

Our specimens from Kai Is. and Malaya agree with those described by Rathbun (1911) as *X. tuberculatus*. It is surprising that Rathbun described her specimens as *X. tuberculatus*, when Laurie (1906), perhaps in insufficient detail, had already recognised his own material and that described by Alcock (1895) as a distinct 'variety'.

Sakai (1965a) has included the specimens recorded by Rathbun with those described by Alcock, Laurie, and Stephensen (1945) in *X. alcocki* Laurie (giving Laurie's 'variety' specific status). Sakai (1976) suggests that Stephensen's specimens may be *X. depressus*; in our opinion they belong to *X. conicus*.

The two specimens described by Alcock and the specimen described by Laurie all have a tapering rostrum and the meri of the ambulatory legs are armed. We have examined the specimen (ovig. ♀, 15.5 mm) from off Sri Lanka, reported on by Alcock and it is conspecific with ours. So also is a specimen (♀, 18 mm) from Pedro Banks, off Sri Lanka (AM P.29851, dry). The sharp tubercle present on the hepatic region in these two specimens is present also on two of the other females we have examined.

We have examined the specimens from the Iranian Gulf (8 ♂♂, 8 ♀♀ (2 ovig.), 10.5-20 mm) which Stephensen identified with some reservations as *X. tuberculatus*, and they are also conspecific with our specimens of *X. conicus*. In all of Stephensen's specimens there is a preorbital tubercle, two spines laterally on the basal antennal article and three tubercles on the pterygostomian margin. The gastric region is almost smooth, slightly elevated, and in five of the specimens there is a pair of very low submedial tubercles. (The large tubercles on the gastric region of *X. tuberculatus* are both in the midline.) There are spines on the meri of the ambulatory legs and the dactyls are armed with up to 14 short teeth and a subequal terminal tooth. The rostrum in all but one of the males is approximately half the postrostral carapace length; in the largest male (cl. 20 mm) it is $^2/_3$ the postrostral carapace length. In the females the rostrum is slightly less than, or equal to, half the postrostral carapace length. In two of the females there is a small sharp tubercle on the hepatic region.

Our specimens also agree quite well with the specimens of *X. nakazawai* described by Sakai (1938; 1976) and by Takeda & Koyama (1974). Sakai has distinguished his species from *X. conicus* on the presence, in *X. nakazawai*, of spines on the meri of the ambulatory legs and a shorter broader rostrum. One of us (D.J.G.G.) has examined the holotype of *X. conicus* (A. Milne Edwards), (Mus. Natn Hist. Nat., Paris, ♂, 17 mm, ?

Indian Ocean): that specimen possesses spines on the meri of the ambulatory legs. Four of our female specimens (11 mm, Banda; 10.5, 11 mm, Aldabra; 22 mm (ovig.), Ile de la Réunion), like the Japanese specimens (both female), have a rostrum equal in length to about half the postrostral carapace length. In the male (17 mm) from West Malay Peninsula, however, the rostrum is like that of the holotype of *X. conicus*, about three quarters postrostral carapace length and very slender distally. The teeth (most commonly nine or ten) on the dactyls of the ambulatory legs are as figured by Sakai (1938). In the Japanese specimens there is an indistinct tooth on the anterolateral angle of the basal antennal article. We therefore regard *X. nakazawai* as conspecific with *X. conicus*.

Distribution. — Western Indian Ocean, Red Sea, Sri Lanka, Malaya, Banda Islands, Kai Islands, Japan.

Xenocarcinus depressus Miers, 1874
(Fig. 30b)

Xenocarcinus tuberculatus. — A. Milne Edwards, 1872: 253-254, pl. 12 fig. 1, 1a-g. (Not *Xenocarcinus tuberculatus* White, 1847.)
Xenocarcinus depressus Miers, 1874: 1-2. — Calman, 1900: 34. — Gordon, 1934: 70-73, figs. 36a-d, 37a. — Balss, 1938: 20. — Takeda, 1973a: 101. — Sakai, 1976: 213, text-fig. 115, pl. 73 fig. 2. — Takeda & Nunomura, 1976: 67.

Material examined. — 1 ♂, 4 ♀♀ (3 ovig.), 13-27 mm, smallest ovig. ♀, 17 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Danish Kei Islands Expedition: off Neira Banda, ca. 20 m, dive, sand, 1 June 1922; 1 spec. — Banda, ca. 20 m, dive, sand, 8 June 1922; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY
Queensland: Bowen, Gould Reef, 8 m, coll. N. Coleman, September 1969; 2 specs. (AM P.29849). — Heron I., 15 m, on gorgonid, coll. N. Coleman, 15 July 1976; 1 spec. (AM P.29850).

Remarks. — These specimens agree well with those figured as *X. tuberculatus* by A. Milne Edwards (1872) and as *X. depressus* by Gordon (1934).

This species can be distinguished from *X. tuberculatus* and *X. conicus* by the shape of the rostrum, the many low tubercles on the carapace, and the presence of tubercles on the meri of the ambulatory legs.

The rostrum is broad, of almost uniform width, and about half the postrostral carapace length, divided in the distal third and the medial edges of the rami are fringed with long setae. In *X. conicus* and *X. tuberculatus*, on the other hand, the rostrum is markedly narrower distally (about $^1/_3$ the basal width), and divided only at the apex.

The intercalated spine is separated from the orbital eave and the postorbital lobe by fine sutures.

Between the orbits there is a pair of small submedial tubercles. In our specimens the 8 small tubercles on the gastric region are not as precisely arranged in two transverse rows as is figured by A. Milne Edwards (pl. 12 fig. 1). In the anterior row of five tubercles, the medial tubercle lies slightly behind the four lateral tubercles and in the posterior row of three tubercles, the medial tubercle lies slightly ahead of the two lateral tubercles.

In *X. tuberculatus*, however, the gastric regions have only two large tubercles and in *X. conicus* the gastric regions are elevated but smooth. In *X. depressus* there are three groups of tubercles, placed anteriorly, centrally, and posteriorly, on the lateral branchial region (none of the other species of *Xenocarcinus* have anterior branchial tubercles), there are two submedial tubercles on the cardiac region and two longitudinal submedial ridges on the intestinal region and there is one small tubercle on the pterygostomian margin.

The basal antennal article narrows evenly from the base and the anterolateral angle is not produced as in *X. tuberculatus*, or armed as in *X. conicus*.

The meri of the ambulatory legs are armed with tubercles, not spines as in *X. conicus*; the ambulatory meri are smooth in *X. tuberculatus*. The dactyl of the first ambulatory leg is as figured by Gordon (1934: fig. 36c): There are about four small distal teeth and a much longer terminal tooth.

The first pleopod of the male has been figured by Gordon.

Distribution. — West Pacific: Okinawa, Palau, Banda. New Caledonia, north and east Australia and Fiji.

Xenocarcinus tuberculatus White, 1847
(Fig. 30a)

Xenocarcinus tuberculatus White, 1847a: 336; 1847c: 119. — Miers, 1874: 1, pl. 2 fig. 1, 1a-e. — Gordon, 1934: 72, figs 37b, c. — Barnard, 1950: 36, fig. 7a, b. — Buitendijk, 1950: 63. — Sakai, 1965a: 91-92 (in part), text fig. 13, pl. 42 fig. 5; 1976: 212-213, pl. 73 fig. 4. — Griffin & Tranter, 1974: 186.

Material examined. — 1 ♂, 12 mm, 1 ovig. ♀, 22 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY
Off Zanzibar, 02°37′S 40°44′E, 150 m, trawl, coll. B. Benbow, 9 February 1976; 1 spec. (AM P.29852).

Remarks. — This species is distinguished by the presence of two strong mesogastric tubercles, a high cardiac elevation and by the completely smooth meri of the ambulatory legs.

The rostrum varies from less than half to two-thirds the postrostral carapace length, narrows distally to about quarter its basal width and is bifid only at the apex. As well as a low tomentum there are two rows of curled hairs in the proximal half and some short hairs at the apex.

The intercalated spine is not defined by sutures in the margin of the upper orbit as in *X. depressus*, *X. conicus* and *X. monoceros*, but appears to be fused with the postorbital lobe.

There is a blunt triangular tubercle on the hepatic region, another laterally on the branchial region, level with the car-

diac spine, and a third on the posterolateral angle of the carapace. The cardiac tubercle varies within the species; it is truncate and weakly bilobed in our specimen from the Sulu Archipelago but sharp and undivided in our specimen from Zanzibar. The specimens described by Sakai (Japan) and Buitendijk (Singapore) have a double cardiac spine, while the holotype, other specimens from the Queensland coast (Aust. Mus.), that figured by Barnard (1950), and those previously examined from the Red Sea have a single conical cardiac spine. There are two submedial tubercles on the intestinal region. There is a single large tubercle on the pterygostomian margin.

The basal antennal article narrows distally and the anterolateral angle is weakly produced but unarmed.

The meri of the ambulatory legs are completely smooth, not armed with tubercles as in *X. depressus*, or spines as in *X. conicus*. The dactyl of the first ambulatory leg is armed with more than twenty small teeth and the terminal tooth is short, as figured by Gordon (1934).

The first pleopod of the male has been figured by Sakai (1965a). The first and second pleopod figured by Stephensen (1945: figs. 21C, D) as *X. tuberculatus* are not of that species but are of *X. conicus* (see remarks under *X. conicus*).

An ovigerous female from Kennedy Sound near Lindeman I., Queensland (35 mm, AM P.11460) was selected for the figure of this species.

Distribution. — Indo-West Pacific: Red Sea and east coast of Africa; Singapore, Sulu Archipelago, Hong Kong, Japan and NE. Australia.

SUBFAMILY PISINAE

Pisinae Alcock, 1895: 165, 200. — Balss, 1929: 11.
Pisinae, sensu restr., + Hyasteniinae Balss, 1929: 11, 14.
Pisinae. — Garth, 1958: 248-249. — Griffin, 1966b: 264.

Eyes with commencing orbits, one of the most characteristic parts being a large, blunt, usually isolated and cupped postocular tooth or lobe into which the eye is retractile, but never to such an extent as to completely conceal the cornea from dorsal view; almost always a prominent supraocular eave, the anterior angle sometimes produced forwards as a spine. Eyestalks short. Basal antennal article broad, at any rate at the base, its anterior angle generally produced to form a tooth or spine. Merus of the external maxillipeds, owing to the expansion of its anteroexternal angle, broader than the ischium, and carrying the palp at its anterointernal angle. Rostrum (except in some *Rochinia* species and in *Neodoclea* among New World forms) two-spined. Legs often very long. (Alcock, as quoted by Garth.)

Pleopod 1 usually slender, rarely stout, at most weakly curved, apical portion sometimes extremely slender, apex simple, truncate or sometimes provided with lobes, aperture usually terminal.

This subfamily contains the largest number of genera and species of any of the majid subfamilies and is one of the few subfamilies well represented in the Indo-west Pacific, east Pacific and east and west Atlantic. Garth has already commented on the fact that there are several types of first pleopods in the males. Yet in other characters, especially those of the orbit, there is surprisingly little diversity, one of the most characteristic features being the 'cupped' postorbital lobe: a number of species possess, on the upper orbital border, an intercalated spine between the eave and postorbital lobe. We find, as did Garth, that this is a feature not correlated with other characters. So far as the diversity of pleopods is concerned we consider that *Scyra* and other forms with a truncate male first pleopod with widely flared tips are probably best considered a separate subfamily but further investigation is required of this point.

We have withdrawn from the Pisinae the genera *Eurynome* (to the Majinae) and *Perinia* (to the Epialtinae). Drastic reorganisation of a number of genera has been undertaken. *Hyastenus*, by far the largest genus in the Indo west Pacific, has been split up with a number of species being placed in three other genera — *Lahaina*, *Giranauria* and *Thusaenys*; *Acanthophrys* has been resurrected as a distinct genus; *Naxioides* has been redefined to include *Chlorinoides tenuirostris* — the species most recently placed in *Chlorinoides* have been placed in a new genus, *Thacanophrys* in the Majinae — and *Sphenocarcinus* along with some species of *Pugettia* now placed in *Rochinia* have been removed from the Epialtinae to the Pisinae. *Encephaloides armstrongi*, retained at this time in the Inachinae, may prove to be placed more appropriately in the Pisinae. *Eurynolambrus australis* is a strange species known only from New Zealand; superficially resembling a parthenopid but lacking a long second pleopod in the male, it has a first pleopod resembling some species of *Tumulosternum* of the Majinae.

KEY TO INDO-WEST PACIFIC GENERA OF THE PISINAE

1		Carapace wider (1.5) than long ..... *Eurynolambrus*
—		Carapace no wider than long 2
2(	1)	Carapace subcircular; rostrum short (up to 0.2 postrostral carapace length) or if longer, spines fused for at least the basal half 3
—		Carapace pyriform; rostrum of varying lengths (0.16 to 1.3 postrostral carapace length) generally separate from base, rarely fused 5
3(	2)	Upper orbit hiatus with an intercalated spine ..... *Phalangipus*
—		Upper orbital hiatus lacking an intercalated spine 4
4(	3)	Anterolateral angle of buccal cavity with a conical tubercle or lobe; pterygostomian margin with a high tubercle ..... *Doclea*
—		Anterolateral angle of buccal cavity rounded, smooth; pterygostomian margin with two to three tubercles ..... *Pisoides*
5(	2)	Orbit closed above (eave, intercalated spine and/or postorbital lobe adjacent); carapace surface with numerous tubercles or spines . 6
—		Orbit open above with a distinct hiatus, hiatus rarely slit-like, if so, then carapace surface with only a few spines or tubercles or else with large flattened plates 8
6(	5)	Upper orbit with an intercalated spine ..... *Tylocarcinus*

— Upper orbit lacking an intercalatad spine 7
7(6) Carapace widened posteriorly, surface with many acuminate spines ..... *Hoplophrys*
— Carapace not widened posteriorly, surface with numerous tubercles but no spines ..... *Leptomaia*
8(5) Rostrum lyre-shaped (lateral edges convex proximally, spines parallel to divergent distally, apices curved outwards) (fig. 55) ..... *Lyramaia*
— Rostrum not lyre-shaped 9
9(8) Supraorbital eave strongly expanded, sometimes bilobed; rostral spines usually less than half postrostral carapace length, divergent from near base; basal antennal article relatively broad, the spine or lobe on the anterolateral angle separated from the base of the flagellum by a notch; (fig. 35) 10
— Supraorbital eave weakly to moderately expanded, rarely bilobed (if bilobed then rostral spines greater than half postrostral carapace length or else not divergent from the base); basal antennal article narrow anteriorly or subrectangular but no broader than long, anterolateral spine if present not separated from base of flagellum by a broad notch 12
10(9) Cupped postorbital lobe narrow (in lateral view), retracted eye protected only on dorsal surface, exposed ventrally (fig. 31). ..... *Acanthophrys*
— Cupped postorbital lobe moderately broad (in lateral view), retracted eye protected equally on dorsal and ventral surfaces (fig. 65) 11
11(10) Mesogastric region with three strong tubercles or short spines; cardiac region with a high tubercle or prominent cylindrical spine; anterolateral angle of basal antennal article with a blunt lobe ..... *Giranauria*
— Mesogastric region smooth or with one to three low tubercles; cardiac region smooth or with only a low tubercle; anterolateral angle of basal antennal article with a triangular spine ..... *Thusaenys*
12(9) Rostral spines with a dorsal accessory spine in distal half; upper orbit with an intercalated spine ..... *Naxioides*
— Rostral spines lacking an accessory spine; upper orbit generally without an intercalated spine 13
13(12) Pterygostomian margin with one long, blunt, conical or compressed spine; lateral margin of basal antennal article with two (distal and proximal) laterally flattened tubercles or else proximal (but not distal) part of margin produced ventrally as a long compressed spine ..... *Austrolibinia*
— Pterygostomian margin with tubercles or a low flat plate, rarely with two short spines; lateral margin of basal antennal article with spines or lobes but not with two laterally flattened tubercles or with a long compressed proximal spine 14
14(13) Rostral spines deflexed, apices upcurved ..... *Micippoides*
— Rostral spines more or less horizontal 15
15(14) Rostral spines very broad, fused in basal half, distally separate and tapering rapidly to a sharp apex ..... *Scyra*
— Rostral spines usually slender, separate from near base, if broad and basally fused then apices broad and blunt 16
16(15) Basal antennal article with a central longitudinal groove, lateral margin with a lobe extending dorsally into orbit and/or anterolateral spine spinulous (fig. 52); meri of at least first two pairs of ambulatory legs with a long terminal spine; upper orbit sometimes with a small intercalated spine ..... *Lahaina*
— Basal antennal article lacking a central longitudinal groove, if lobe present on lateral margin then not extending dorsally into orbit, anterolateral spine if present never spinulous (except rarely in juveniles); meri of ambulatory legs with a terminal tubercle or short spine; upper orbit lacking an intercalated spine 17
17(16) Supraorbital eave with at least a weakly developed antorbital lobe and a hiatus present (keyhole shaped, narrow U-shaped or slit-like) between posterior margin of eave and base of anterior margin of postorbital lobe (fig. 40); postorbital lobe usually convex laterally, never in the form of a plate nor confluent with hepatic spine nor subacute anteriorly in lateral view; ventral margin of postorbital lobe in about the same plane as the basal antennal article; eyestalk with diameter of cornea greater than that of preceding part of eyestalk ..... *Hyastenus*
— Supraorbital eave with a flattened plate or islet or else without an antorbital lobe and a hiatus present (narrow to broad U-shaped) between lateral margin of eave and anterior margin of postorbital lobe (fig. 57); postorbital lobe often flattened laterally, sometimes in the form of a plate and/or confluent with hepatic spine or subacute anteriorly in lateral view; ventral margin of postorbital lobe in a plane well dorsal to that of basal antennal article (fig. 61); eyestalk with diameter of cornea no greater than that of preceding part of eyestalk (fig. 57) 18
18(17) Carapace surface with many small tubercles and a few short spines; lateral margin of basal antennal article with a proximal spine as well as a slender spine at anterolateral angle; first pleopod of male scyriform ..... *Chorilia*
— Carapace surface variously with flattened plates, round islets, long spines or with few tubercles and spines; lateral margin of basal antennal article lacking a proximal spine or lobe, anterolateral angle unarmed or with a short spine; first pleopod of male apically truncate ..... *Rochinia*

Acanthophrys A. Milne Edwards, 1865

Type species. — *Acanthophrys cristimanus* A. Milne Edwards, 1865, by later designation by Miers (1879c).

Remarks. — *Acanthophrys cristimanus* was validly designated type species of the genus by Miers (1879c). However, Bouvier (1906b) stated that *A. cristimanus* belonged to the genus *Lahaina* (type species — *L. ovata* Dana, 1851). *A. cristimanus* and *L. ovata* agree generally in the form of the upper orbital border, the basal antennal article and the third maxilliped. These similarities are also typical of species included in the genus *Hyastenus* s.l. and on that basis *A. cristimanus* and *L. ovata* were transferred to that genus (see Balss, 1935a). By virtue of this, *Acanthophrys* had to be regarded as a synonym of *Hyastenus* and the former name was not available for *Chorinus aculeatus* and similar species despite the strenuous efforts of Bouvier and subsequent authors. For that reason *Chlorinoides* Haswell was, incorrectly as is now realised, applied to that group (Griffin, 1966a). This study reinstates *Acanthophrys* (and *Lahaina*) and redefines the genus *Hyastenus* to exclude species which have relatively extravagantly expanded orbits either dorsally, ventrally or both.

Comparison of the holotype of *Acanthophrys paucispina* Miers (1879a) (♂, cl. 15 mm, Fiji Is., BMNH 56.105), examined by one of us (D.J.G.G.), with *Parazewa bocki* Balss as described and figured by Balss (1938) shows that they are congeneric, perhaps even conspecific. *Parazewa* therefore becomes a junior synonym of *Acanthophrys*. A new species of this genus is described from Lord Howe Island.

Distribution. — Western Pacific.

KEY TO SPECIES OF *ACANTHOPHRYS*

1 Supraorbital eave bilobed, antorbital lobe produced nearly as far laterally as preorbital lobe; cheliped merus of male with a dorsal row of tubercles ..... *A. costatus*
— Supraorbital eave with a strong preorbital lobe but antorbital angle only weakly produced; cheliped merus of male smooth dorsally. 2
2(1) Branchial regions with two spines; cardiac region with a medial spine; intestinal region with a prominent medial spine and a tubercle ..... *A. paucispina*[18])

[18]) Not distinguished here from *A. bocki*

— Branchial regions with tubercles but no spines; cardiac region with submedial tubercles; intestinal region with a medial tubercle only ..... *A. cristimanus*

Acanthophrys costatus new species
(Figs. 31, 32a, b)

Material examined. — 2 ♂♂, 4, 7 mm.

Holotype. — Male, 7.0 mm, Lord Howe I., between Comet Hole and reef, 2-3 m, red and brown algae with some corals, coll. J. K. Lowry, 10 May 1977; The Australian Museum, Sydney, AM P.29920.
Paratype. — Male, 4.0 mm, data as for holotype (AM P.29919).

Description. — Carapace pyriform, width more than three quarters (0.8) postrostral carapace length; surface smooth, two lateral spines and a few well separated tubercles.

Rostral spines short, divergent, fused for less than basal third (0.3), dorsoventrally flat, tapering to a sharp apex, length less than half (0.4) postrostral carapace length.

Orbital eave moderately expanded, bilobed, preorbital lobe broad, triangular, upturned, apex subacute; antorbital lobe a smaller triangle, horizontal; postorbital lobe separated from eave by a narrow U-shaped hiatus, narrow, apex blunt, anterior margin with a process in proximal half. Eyestalks short, moderately slender; cornea small, terminal and ventral.

Hepatic region not elevated, two to four small tubercles on margin and about three small subhepatic tubercles.

Branchial submargin with a high tubercle anteriorly, another tubercle above it near margin; behind these tubercles a row of about four small tubercles each surmounted by curled hairs: anterior branchial margin with two pairs of small adjacent tubercles, surmounted by curled hairs; a blunt spine midway on margin; another blunt spine on posterolateral angle.

Gastric regions elevated, protogastric region with about eight small tubercles in an irregular, longitudinal, double row, each surmounted by curled hairs; a small posterolateral protogastric tubercle, two mesogastric tubercles, one central and one posterior. Urogastric region smooth, flat.

Cardiac region elevated with a transversely elongate tubercle on summit. Branchial regions smooth and flat dorsally. Intestinal region with a medial tubercle near posterior carapace margin. Carapace margin produced, weakly recurved posteriorly.

Basal antennal article broad, smooth, a longitudinal groove centrally; anterolateral angle produced forward into a blunt triangular lobe; distal two thirds of lateral margin straight, produced dorsally, proximal third weakly convex and more strongly produced dorsally; a proximal tubercle in from margin, in line with anterolateral lobe. A high, laterally compressed tubercle lateral to green gland. Postorbital lobe not excavate ventrally, only a low ridge on lower orbit margin.

Pterygostomian region smooth, margin with three large blunt tubercles. Ischium of third maxilliped with a central groove with ridges along its margins, ridge on lateral margin with a few small tubercles; merus with a ridge on posterior margin and a diagonal ridge from posterolateral angle, each ridge with a small tubercle; anterolateral angle produced and rounded. Anterolateral angle of mouthfield produced and rounded.

Cheliped of male slightly longer (1.2) than postrostral carapace length; merus tuberculate, dorsally a small proximal tubercle, three compressed triangular tubercles and a blunt terminal tubercle; midway on outer face a row of four or five low tubercles; ventrally a row of four tubercles on outer face and a row of three tubercles on inner face; carpus with two dorsal ridges, outer ridge with two tubercles, inner ridge entire. Length of palm about twice height, dorsal and ventral margins sharp, dorsal margin with two low lobes; fingers about three quarters length of palm, moderately gaping in proximal half, three small teeth on dactyl in gape, two slightly larger teeth on fixed finger.

Ambulatory legs slender, club setae laterally each arising from a small basal tubercle, groups of curled hairs dorsally; first leg about one and a half (1.5) times postrostral carapace length, merus with a low terminal tubercle; fourth leg about two thirds (0.64) postrostral carapace length, less than half (0.43) length of first leg, dactyl with four very small spines ventrally along its length.

Sternum with marked segmental pits, borders of pits high, a high narrow ridge around anterior margin of abdominal fossa.

Male abdomen of seven segments, smooth, third segment about one and a third (1.3) as wide as sixth segment; sixth segment twice as wide as long; seventh segment about as wide as long.

First pleopod of male narrowing slightly at about distal third, distal quarter strongly curved outwards, aperture terminal and abdominal.

Female of this species is as yet unknown.

Remarks. — *A. costatus* is similar to other species of *Acanthophrys* in having the postorbital lobe with a prominent process on the anterior margin and not excavate ventrally; and the basal antennal article with a blunt anterolateral spine separated by a notch from the base of the flagellum. *A. costatus* is distinguished from other species of *Acanthophrys* by having the supraorbital eave bilobed and the antorbital lobe distinct and produced almost as far laterally as the preorbital lobe. In the other species the edge of the eave is unnotched and in *A. paucispina* and *A. bocki* the preorbital lobe is produced much further laterally than the antorbital angle. In *A. costatus* the exognath of the third maxilliped is less than half as wide as the ischium while in the other species of *Acanthophrys* the exognath is at least half as wide, or equally as wide as the ischium. The merus of the cheliped of the male in *A. costatus* has a dorsal row of compressed tubercles, while in *A. cristimanus* the cheliped merus is smooth.

The postorbital lobe which is not excavate ventrally

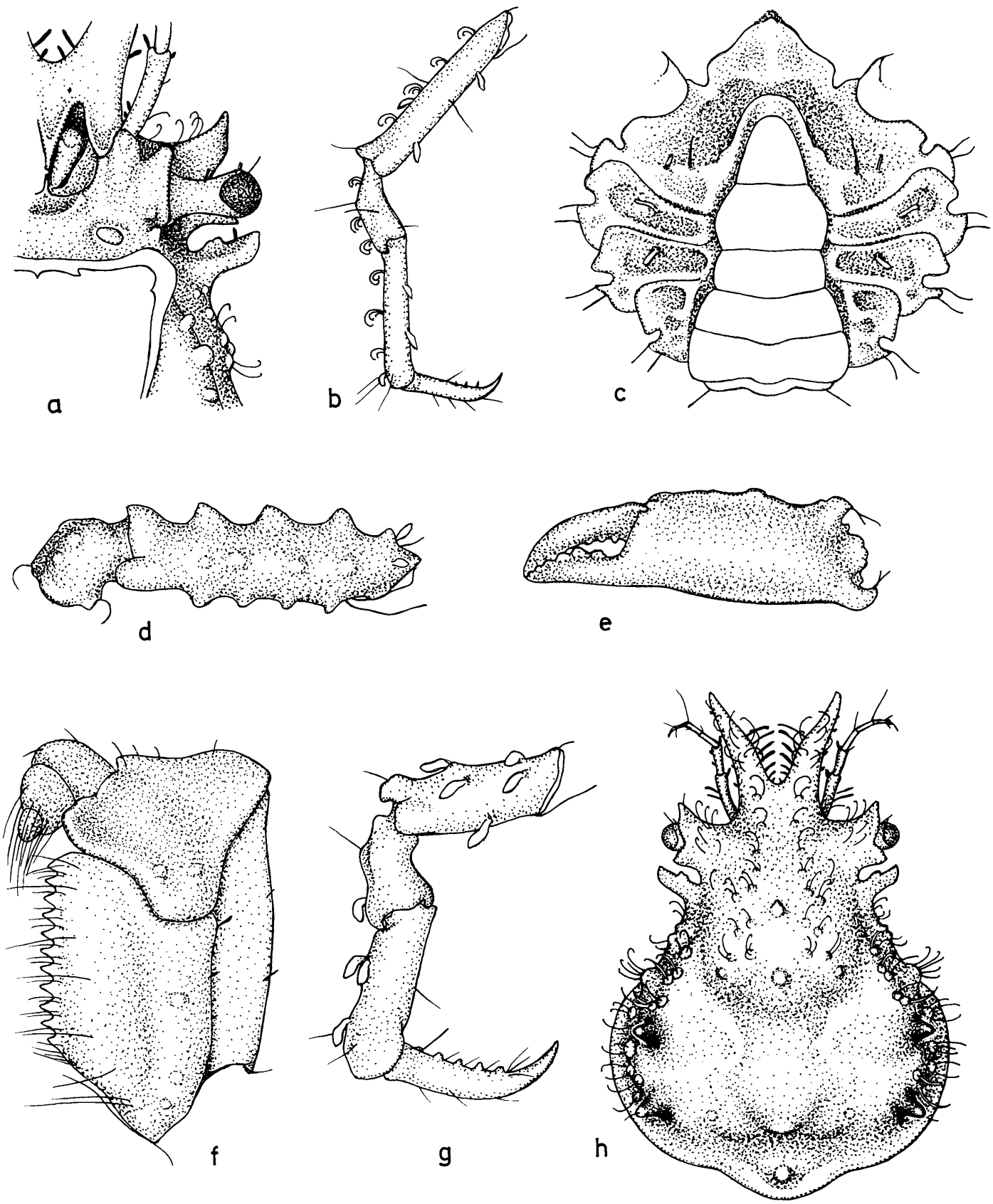


Fig. 31. *Acanthophrys costatus* (holotype) (a) left orbit, ventral view; (b) left first ambulatory leg; (c) male sternum; (d) left cheliped, merus and carpus; (e) left chela; (f) left third maxilliped; (g) left fourth ambulatory leg; (h) carapace, dorsal view.

distinguishes this species from species of *Giranauria* and *Thusaenys* and from *Lyramaia elegans*.

Distribution. — Known only from Lord Howe Island.

Austrolibinia Griffin, 1966

Type species. — *Chorilibinia gracilipes* Miers, 1879, by original designation.

Remarks. — This genus has been discussed recently (Griffin, 1966b). A new species is here described from the east coast of Australia.

The first pleopod of the male of species of *Austrolibinia* is slender and tapers to a simple apex.

Distribution. — Western Indian Ocean, western Pacific.

KEY TO SPECIES OF *AUSTROLIBINIA*

1 Rostrum basally fused, spines strongly divergent distally; cardiac region with one long spine and a small posterior tubercle; lateral margin of basal antennal article with a long compressed proximal lobe directed ventrally ..... *A. gracilipes*

— Rostrum basally fused, spines contiguous to weakly divergent distally; cardiac region with two subequal medial spines; lateral margin of basal antennal article with a short, blunt proximal lobe 2

2(1) Rostral spines separate in distal 1/2 to 1/4, parallel or weakly divergent; hepatic region with a dorsal tubercle; dorsal branchial region with a central tubercle anterior to epibranchial spine ..... *A. andamanica*

— Rostral spines distally contiguous; hepatic region with two tubercles, one above the other; dorsal branchial region with a central spine anterior to epibranchial spine ..... *A. capricornensis*

Austrolibinia andamanica (Alcock, 1892) (Fig. 33e, f)

Chorilibinia andamanica Alcock, 1895: 222, pl. 5 figs. 2, 2a. — Alcock & Anderson, 1896: pl. 20 fig. 4, 4a.
Austrolibinia andamanica. — Griffin, 1966b: 268-269 (note only).

Material examined. — 2 ♂♂, 4 ♀♀, 11.5-25 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Danish Kei Islands Expedition: Stn. 64, Sunda Strait, 05°51′S 106°22′E, 35 m, trawl, sandy mud, shells, 26 July 1922; 1 spec. — Stn. 82, Sunda Strait, 06°38′S 105°17′E, 35 m, trawl, sandy mud, 30 July 1922; 1 spec. — Stn. 106, Sunda Strait, 05°50′S 106°16′E, 32 m, trawl, sand, 5 August 1922; 3 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA
Mariel King Memorial Expedition — Moluccas: Stn. AM II, Aru, Maikoor, approx. 8 miles (∿ 13 km) SW. of Tg Ratoe, 06°07′S 133°57′E, 45 m, dredge hauls 4-5, 18 June 1970; 1 spec.

Remarks. — A new species *A. capricornensis* from North West Islet, Queensland, very similar in general form and appearance to *A. andamanica*, is described elsewhere; the differences which distinguish the two species are discussed under *A. capricornensis*.

A. andamanica and *A. gracilipes* differ from each other in a number of important features. These include the rostral spines which in both are basally fused but are distally straight in *A. andamanica* and strongly outwardly curved in *A. gracilipes*; the orbit in both lacks an intercalated spine but the shape of the postorbital lobe is different, *A. gracilipes* having a sharp keel on the posterior surface whereas *A. andamanica* has a flat elevated lobe on the curved anterior edge.

The basal antennal article in *A. gracilipes* is expanded laterally and at the base strongly produced into an outwardly and ventrally directed lobe, whereas in *A. andamanica* there is a small flattened tubercle on the anterolateral angle and a similar one proximally.

There are differences in the spines on the carapace but the most obvious difference concerns the flattened extension of the posterior margin of the carapace on *A. gracilipes*, lacking in *A. andamanica*.

The chelae of the adult male are not inflated in *A. andamanica* and the length of the palm is six to eight times the height, whereas in *A. gracilipes* the palm is inflated and the length is only two to three times the height. The ambulatory legs of *A. andamanica* have few, if any hairs, whereas in *A. gracilipes* there are closely spaced tufts of curled hairs dorsally on merus, carpus and propod and very closely spaced stout hairs in a line along the anterior and posterior surfaces.

The male first pleopod of *A. andamanica* is distally very slender and straight, whereas in *A. gracilipes* it only tapers at the outwardly curved tip.

The main features in which *A. andamanica* and *A. capricornensis*, differ from *A. gracilipes* are listed in the following table.

	A. andamanica and *A. capricornensis*	*A. gracilipes*
Rostral spines	basally fused, distally weakly divergent or contiguous.	basally fused, distally strongly divergent
Upper orbit hiatus	U-shaped, widening at orbit edge	U-shaped, narrower or closed at orbit edge
Postorbital lobe (laterally)	a flattened plate, bilobed on posterior edge	narrow keel posteriorly, continuing forward ventrally.
Hepatic region	1 dorsal tubercle, or 2 tubercles one above other (short spine in immature animals)	a lateral, longitudinal ridge of 3-4 small tubercles
Protogastric region (at level of first mesogastric spine or tubercle)	a flat, subcircular tubercle	a small, blunt tubercle
Cardiac region	a medial pair of subequal, divergent spines	1 long spine and a small posterior tubercle
Intestinal region	posterior margin of carapace not produced; 1 large medial spine.	posterior margin of carapace produced backward; a compressed, triangular lobe ending in sharp erect spine in the midline.

Branchial region	no spine on carapace margin behind epibranchial spine above amb. leg 3	a short spine on carapace margin behind epibranchial spine above amb. leg 3.
Basal antennal article	small flat tubercle on anterolateral and posterolateral angles	lateral edge expanded; a small anterolateral tooth; a large, blunt, compressed posterolateral lobe, produced laterally and ventrally.
Maxilliped 3	antero-external angle of merus moderately produced, rounded or bluntly angled	antero-external angle of merus strongly produced to a blunt lobe.
Pterygostomian margin	with a strong spine	with a blunt lobe, anteroposteriorly compressed.
Sternum	single spine posteriorly on first sternite, otherwise smooth	single spine posteriorly on first sternite, a pair of flattened plates at base of amb. legs 1-3.
Adult male chela (not known in *A. capricornensis*)	palm slender, length at least 6 x height	palm somewhat inflated, length about 2 x height.
Male abdomen	segment 1 with medial spine or broad lobe; seg. 3 with rounded lateral swelling	segments 2 and 3 with transverse lateral ridge and medial ridge.

In a young male from the Kai Islands and two immature females from the Sunda Strait (Danish Kei Islands Expedition Stn. 106) there is a short spine rather than a tubercle on the hepatic region and anteriorly on the mesogastric region there is not a tubercle, as in the adults, but a short spine, about half the height of the posterior spine.

Distribution. — Andaman Islands, Sunda Strait, Kai Islands.

Austrolibinia capricornensis new species
(Fig. 33a, b, g, h)

Material examined. — 1 ♂, 2 ♀♀, 16.5-20.5 mm.

Holotype. — Female, immature, cl. 20.5 mm, Queensland, Capricorn Group, 12 miles (∿ 20 km) NW. of North-West Islet, about 14 m, January 1931; Australian Museum, Sydney, AM P.10056.
Paratypes. — Male, cl. 16.5 mm, female, immature, cl. 17 mm, Queensland, Capricorn Group, North-West Islet, about 16 m, December 1930-January 1931; Australian Museum, Sydney, AM P.10044.

Description. — Carapace broad, width about four fifths (0.83-0.88) postrostral carapace length; surface covered by a low tomentum; several prominent spines.

Rostral spines slender, parallel, weakly deflexed distally, fused in proximal half, contiguous distally, only separate apically (about distal eighth).

Orbital eave only slightly expanded, preorbital angle produced into a broad, upturned lobe, lateral face of lobe vertical, smooth; antorbital lobe similarly upturned, broad, posterolateral face of lobe vertical, smooth; postorbital lobe separated from antorbital lobe by a narrow U-shaped hiatus; postorbital lobe broad, truncate, a rounded lobe on posterolateral angle.

Eyestalks short, stout, a row of long clubbed setae distally above cornea; cornea large, terminal.

Hepatic region weakly elevated, two blunt tubercles, one above other on margin. Branchial margin with four spines, increasing in size posteriorly, the fourth (epibranchial) more dorsally placed.

Gastric regions elevated, two long mesogastric spines, a small tubercle in front of each of them; a small protogastric tubercle level with anterior mesogastric tubercle, two protogastric tubercles level with first mesogastric spine, lateral one larger, circular and flat on upper surface; a very small tubercle surmounted by a group of curled hairs level with second mesogastric tubercle.

Cardiac region elevated with two large, blunt, medial spines one behind the other, first directed slightly forward and second slightly backward. Branchial region with a very small tubercle at anteromedial angle, another behind it near cardiac region, a small tubercle laterally on anterior margin and a long spine (subequal to epibranchial spine) just behind it.

Intestinal region with a long, backwardly directed, apically sharp, spine on posterior margin, longer than other carapace spines.

Basal antennal article with anterolateral angle produced into a blunt lobe, laterally flattened and subcircular in lateral view; a subrectangular, flattened lobe on proximal half; a small tubercle just lateral to green gland. Postorbital lobe separated from basal antennal article by a long narrow U-shaped hiatus, ventral surface of postorbital lobe with a flat, triangular plate.

Pterygostomian region very narrow, a large, blunt, conical spine on margin.

Third maxilliped covered with tomentum, anterolateral angle of merus produced, rounded. Anterolateral angle of mouthfield with an oblique, flattened plate.

(Chelipeds are missing from the male paratype.) Cheliped of immature female (holotype) smooth, slender, about one and a half times postrostral carapace length, no terminal spine on merus; carpus smooth; palm very slender, length about ten times height; fingers about one third length of palm, a very narrow, unarmed gape between fingers in proximal half, small teeth on cutting edge of both fingers distally.

Ambulatory legs smooth, very slender, first leg more than four times (4.3) postrostral carapace length, merus without a terminal spine; fourth leg about one and a half times postrostral carapace length and about one third of first leg.

Sternum of male smooth except for a short conical spine on posterior ridge of first sternite, near abdominal fossa; shallow intersegmental grooves between remaining segments.

Male abdomen of seven segments, first segment with a short medial spine, remaining segments smooth; third segment with rounded swelling laterally, more than twice (2.3) as

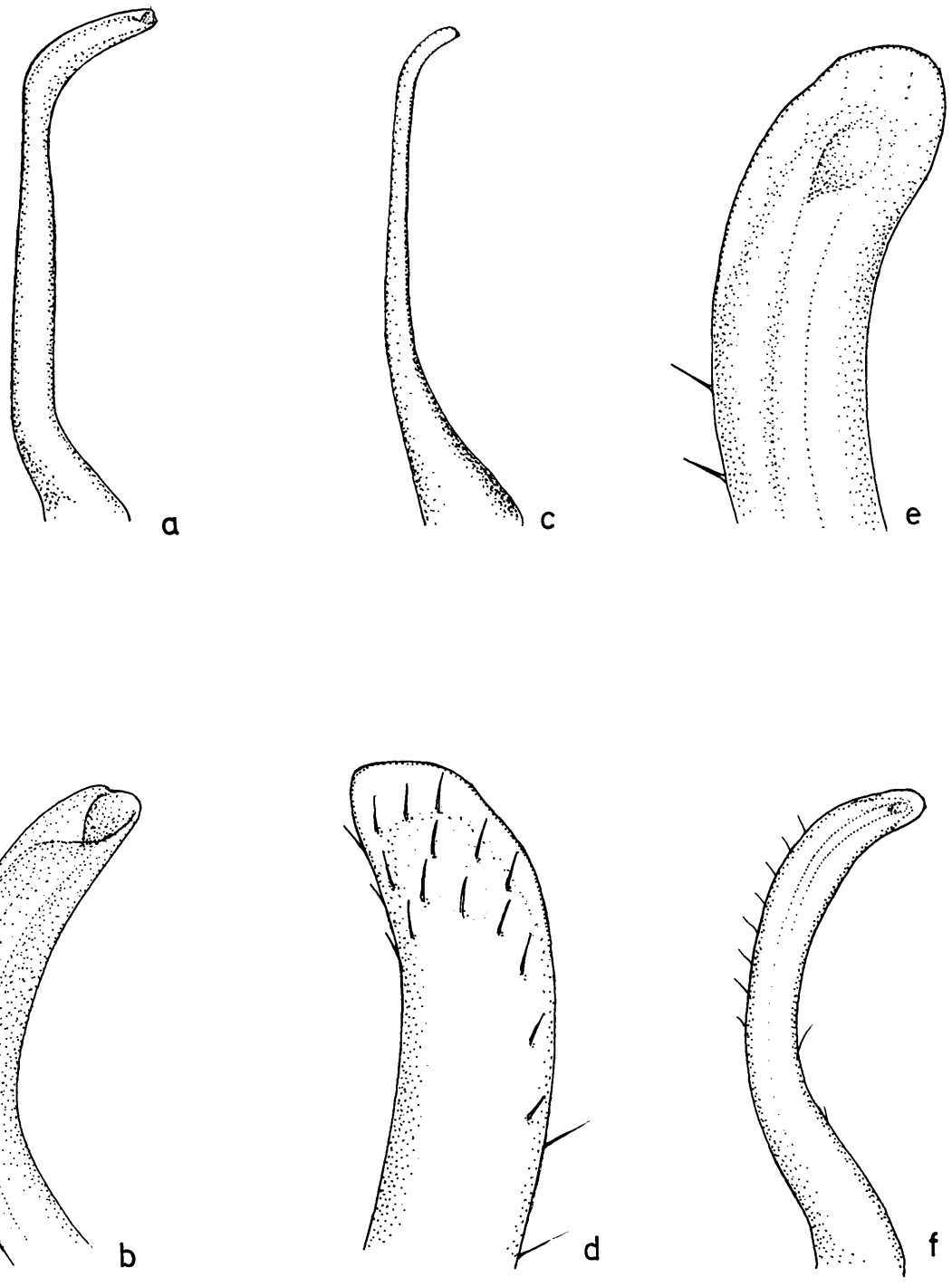


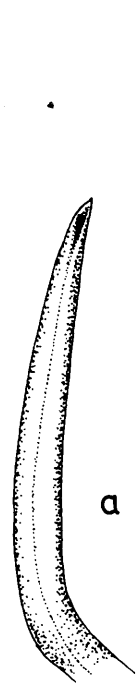
Fig. 32. First left pleopod of male of *Acanthophrys costatus* (holotype) (a) abdominal view of pleopod, (b) abdominal tip of same; *Lyramaia elegans* (13.5 mm, AM P.29949) (c) abdominal view of pleopod; *Leptomaia tuberculata* (11 mm, Kermadec Is., ZMC) (d) sternal tip of pleopod, (e) abdominal tip of same, (f) abdominal view of same.

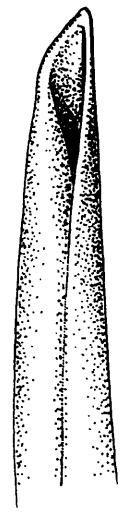
wide as sixth segment; sixth and seventh segments both as wide as long.

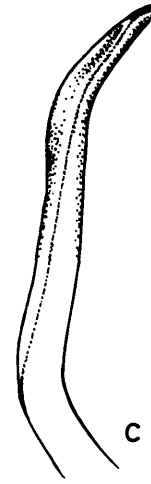
First pleopod of male straight, broad, tapering in distal half to a subacute apex, aperture subterminal on abdominal surface.

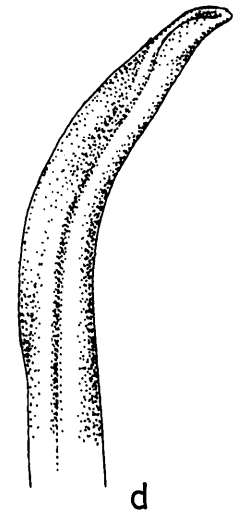
Remarks. — This species is very similar to *Austrolibinia andamanica* (Alcock) and is distinguished from it by the following points:

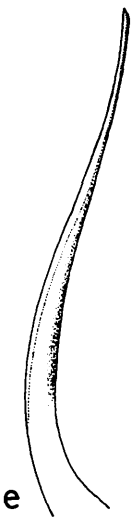
(1) the rostral spines are distally contiguous; parallel but separate in *A. andamanica*;
(2) the hepatic region has two rounded tubercles, one above the other; there is only a dorsal hepatic tubercle in *A. andamanica*;
(3) the mesogastric region has two long spines; there is one long spine and one short spine in *A. andamanica*;
(4) the branchial region has a long dorsal spine in addition to the epibranchial spine; there is only a long epibranchial spine in *A. andamanica*;

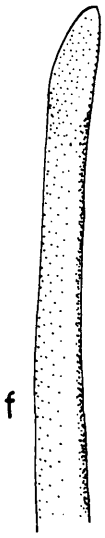


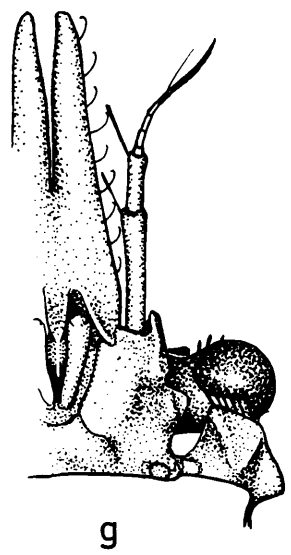












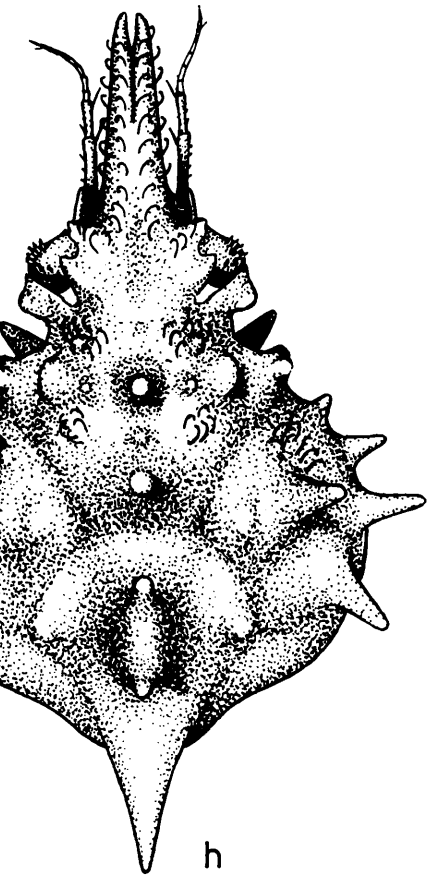


Fig. 33. Left first pleopod of male of *Austrolibinia capricornensis* (16.5 mm, AM P.10044) (a) abdominal view of pleopod, (b) abdominal tip of same; *A. gracilipes* (17 mm, Kai Is., ZMA De.100.830, in part) (c) abdominal view of pleopod, (d) abdominal tip of same; *A. andamanica* (25 mm, Sunda Strait, ZMC) (e) abdominal view of pleopod, (f) sternal tip of same. *A. capricornensis* (holotype, female, imm.) (g) left orbit, ventral view; (h) carapace, dorsal view.

(5) the instestinal spine is larger and more robust than the other carapace spines; the intestinal spine is subequal to the other spines in *A. andamanica*.

This species is distinguished from *A. gracilipes* (Miers) by the rostral spines which are contiguous (strongly divergent in *A. gracilipes*) by the backwardly directed, conical intestinal spine (an erect, compressed spine in *A. gracilipes*); and by the flat subrectangular, proximal lobe on the basal antennal article (a long, ventrally directed, compressed lobe on *A. gracilipes*). The differences between *A. gracilipes* and *A. capricornensis* and *A. andamanica* are considered in more detail under *A. andamanica*.

This species, and to a lesser extent, *A. andamanica*, bear a superficial resemblance to some species of *Phalangipus*, especially *P. hystrix*; however, there are fundamental differences in orbital structure.

Distribution. — Known only from North-West Islet, Capricorn Group, Queensland.

Austrolibinia gracilipes (Miers, 1879)
(Fig. 33c, d)

Chorilibinia gracilipes Miers, 1879a: 7-8, pl. 4 fig. 4; 1884: 192; 1886: 46.
Chlorolibinia gracilipes. — Haswell, 1880b: 439-440.
Austrolibinia gracilipes. — Griffin, 1966b: 269, 283 (in key).

Material examined. — 13 ♂♂, 15 ♀♀ (6 ovig.), 8-20.5 mm, smallest ovig. ♀, 11.0 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 274, vicinity of Kai Islands, 05°28.2′S 134°53.9′E, 57 m, Blake dredge, sand and shells, stones, 26 December 1899; 2 specs. (ZMA De.100.830, det. Ihle).

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition-Moluccas: Stn. AT II, 7-12 miles (11-19 km) W. of Toba I., N. of Aru, 05°23′S 134°17′E, 54-63 m, dredge hauls 3-4, mud, 14 June 1970; 1 spec. — Stn. AW IV, Aru, Wokam, off W. end Udjir I., 05°37′S 134°10′E, 54-65 m, dredge hauls 1-3, mud and fine shelly grit, 16 June 1970; 1 spec. — Stn. AW IV (as above), 68-93 m, dredge hauls 4-7, mud and rubble, 16 June 1970; 2 specs. — Stn. B I, Northern Territory, S. of Bathurst I., Clarence Straits, 12°01′S 130°08′E, dredge, 30 June 1970; 2 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Torres Strait, Albany Passage, 16-21 m, dredged, September 1929; 1 spec. (AM P.29925, dry). — Kennedy Sound, 20°28′S 149°03′E, 3 specs. (AM P.29926, dry). — Cape York, 3 miles (∿ 5 km) E. of Turtle Head I., 18 m, trawl, coll. J. Paxton, 15 February 1979; 4 specs. (AM P.29927).

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: North W.A., near Delambre I., coll. R. W. George, 'Dorothea', 8 October 1962; 1 spec. (WAM 197-67). — North W.A., 36 miles (∿ 57 km) SW. of Adele I., 80 m, coll. R. W. George, 'Dorothea', 17 October 1962; 9 specs. (WAM 297-67). — New Year I., 33°52′S 124°06′E, 72 m, dredge, coll. W. Goode, November 1962; 2 specs. (WAM 214-67).

Remarks. — There are very considerable differences between this species and *A. andamanica* which are dealt with under that species.

Distribution. — NE to NW. Australia, Kai Islands, Aru, Papua-New Guinea.

Chorilia Dana, 1851

Type species. — *Chorilia longipes* Dana, 1851, by monotypy.

Remarks. — This genus which has been discussed in detail recently by Garth (1958) contains a single boreal species with two subspecies — *Chorilia longipes turgida* Rathbun in the eastern Pacific and *C. l. japonica* (Miers) in the western Pacific.

The first pleopod of the male is scyriform.

Distribution. — Northern Pacific.

Doclea Leach, 1814

Type species. — *Doclea rissonii* Leach, 1814 by monotypy.

Remarks. — Many species of this genus have been described more than once under different names. Although all the species of *Doclea* have a similar general appearance, the first pleopods of the males show a range of different forms from simple tapered to elaborately lobed.

D. japonica Ortmann is considered by us as a distinct species and not as a synonym of *D. ovis* (Herbst). *D. profunda* Rathbun (a synonym of *Pugettia mosaica* Whitelegge) is removed to the genus *Rochinia* and discussed under *R. mosaica*. A new species is described here from China. The genus contains eleven species.

In species of *Doclea* the supraorbital eave is only weakly expanded and the preorbital angle is only prominent in one species. The basal antennal article is triangular or subrectangular and the lateral margin is smooth behind the anterolateral spine. There is a high tubercle, usually conical, on the anterolateral angle of the mouthfield and a similar large tubercle on the pterygostomian margin. In seven of the species there is a longitudinal channel edged with long hairs on the pterygostomian region.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *DOCLEA*

1	Pterygostomian region canaliculated	2
—	Pterygostomian region flat	8
2(1)	Epibranchial spines long, at least 1/4 carapace width	3
—	Epibranchial spines short, less than 1/6 carapace width or represented by a tubercle	6
3(2)	Rostrum exceeding peduncle segments of antenna	4
—	Rostrum not exceeding peduncle segments of antenna ..... *D. macracantha*[19])
4(3)	Meri of ambulatory legs with four longitudinal rows of fringing hairs; anterior margin of dorsal branchial region with an acuminate spine; medial spine on posterior carapace margin with an acuminate accessory spine on its base ..... *D. calcitrapa*	

[19]) From the literature, Balss, 1929.

— Meri of ambulatory legs with a uniform tomentum; anterior margin of dorsal branchial region smooth or with tubercles; medial spine on posterior carapace margin lacking an accessory spine 5

5(4) Epibranchial spine with a tubercle just medial to it; intestinal region with two conical, medial spines ..... *D. simeti*

— Epibranchial spine lacking a tubercle just medial to it; intestinal region with one slender spine on posterior carapace margin ..... *D. canalifera*

6(2) Rostrum not exceeding peduncle segments of antenna; intestinal region with a distinct spine ..... *D. brachyrhyncha*

— Rostrum exceeding peduncle segments of antenna; intestinal region with a low tubercle 7

7(6) First pleopod of adult male with a narrow terminal process; female genital openings oval and opening anteriorly ..... *D. ovis*

— First pleopod of adult male with two broad, blunt contiguous lobes; female genital openings subcircular and opening anterolaterally ..... *D. japonica*

8(1) Carapace discoid; length of first ambulatory leg more than twice postrostral carapace length 9

— Carapace globular; length of first ambulatory leg less than twice postrostral carapace length 10

9(8) Lateral carapace margin with three spines; anterior dorsal branchial region smooth or with a low tubercle ..... *D. gracilipes*

— Lateral carapace margin with two spines; anterior dorsal branchial region with a spine ..... *D. rissonii*[20])

10(8) Preorbital angle of eave produced to a short spine; intestinal spine much longer than other carapace spines, deflexed ..... *D. alcocki*

— Preorbital angle of eave not produced at all; intestinal spine no longer than other carapace spines, horizontal ..... *D. muricata*

Doclea alcocki Laurie, 1906
(Fig. 34d, e)

Doclea alcocki Laurie, 1906: 381-382, pl. 1 fig. 5, pl. 2 fig. 2.

Material examined. — 1 ♂, 51 mm, 1 ♀ (ovig.), 53 mm.

ZOOLOGICAL SURVEY, CALCUTTA
Sri Lanka, Pearl Banks, coll. T. Southwell; 2 specs.

Remarks. — These specimens agree well with the holotype from Sri Lanka (BMNH 1907: 5: 22: 129, ♀, cl. 56.5 mm). The strong spine on the posterior margin of the carapace is directed downwards as in the holotype but lacks any tubercles at the base; this form of deflexed posterior spine is characteristic of the species.

The male has not previously been described. The chelae are smooth and bare, moderately robust, the length of the palm is less than twice its distal height and slightly greater than the dactyl. The dactyl bears a large low tooth in the weak proximal gape and both fingers have small teeth distally. The sternum is smooth with well developed marginal ridges on the first sternite and the remaining segments are covered in a dense tomentum. The abdomen is tomentose, smooth and with rounded lateral elevations on the third segment. The first pleopod is broad, straight and curves outward only at the tip which has a broad flap on the anterior edge.

Distribution. — Sri Lanka, Pearl Banks; Gulf of Manaar.

[20]) From the literature, Leach, 1815.

Doclea calcitrapa White, 1847

Doclea calcitrapa White, 1847b: 56. — Adams & White, 1848: 7, pl. 1. fig. 2, 2a-c. — Griffin, 1974: 10; 1976: 190.

Material examined. — 9 ♂♂, 2 ♀♀, 9-16.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Danish Kei Islands Expedition: Stn. 66, Java, Pulo Balu, 05°54′S 106°12′E, 24 m, trawl, sandy mud, shells, 27 July 1922; 3 specs. — Stn. 76, Sunda Strait, 06°08′S 105°44′E, 29 m, Sigsbee trawl, mud, 29 July 1922; 1 spec. — Stn. 110, Sunda Strait, 05°25′S 105°53′E, 12 m, trawl, sandy mud, 12 August 1922; 1 spec. — Stn. 116, Sunda Strait, 05°57′S 106°34′E, 22 m, trawl, sand and shells, 7 August 1922; 1 spec. — Stn. 118, Sunda Strait, 05°54′S 106°40′E, 27 m, trawl, sand and shells, 7 August 1922; 3 specs.
'Galathea' Expedition: Stn. 451, Makassar Strait, 01°25′S 117°05′E, 50-60 m, Sledge trawl 300, mud, 23 August 1951; 1 spec. — Stn. 455, Java Sea, 05°32′S 112°41′E, 66 m, Sledge trawl 100, corallised clay, 26 August 1951; 1 spec.

Remarks. — These immature specimens show some variation from the adults in the relative size of the carapace spines. The cardiac spine is larger and varies from half to three quarters of the epibranchial spine. The anterior cardiac spine, which in the adult is as long as the mesogastric spines, is only a tubercle or small spine. Similarly the accessory spine at the base of the intestinal spine and the anterior marginal branchial spines are much smaller and generally covered by the tomentum.

Distribution. — Bay of Bengal, Andaman Sea, Indonesia, Gulf of Thailand, Philippine Islands.

Doclea gracilipes Stimpson, 1857

Doclea gracilipes Stimpson, 1857: 216; 1907: 6-7, pl. 1 fig. 1. — Chopra, 1935: 470, text-fig. 1c. — Chhapgar, 1957: 412, pl. 3 figs. o, p.

Material examined. — 10 ♂♂, 5 ♀♀ (1 ovig.), 23-38.5 mm, ovig. ♀, 30 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM
Indonesian Archipelago, in the sea. coll. H. M. Tromp, 1909; 1 spec. (unreg., det. J. Roux as *Doclea rissonii*).

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Singapore, 27 November 1907; 1 spec.
'Galathea' Expedition: Malay Peninsula, Pulo Penang, 1951; 13 specs.

Remarks. — The last marginal spine in these specimens varies from slightly shorter than, to about twice as long as the anterior marginal spines.

A specimen from the Zoological Museum Amsterdam indentified as *Doclea rissonii* Leach by J. Roux is clearly conspecific with the other specimens. *Doclea rissonii* as figured by Leach (1814: pl. 74) has two (not three) anterior marginal spines and a spine dorsally on the anterior branchial region; the type material of *D. rissonii* at the British Museum has not been examined. Therefore we can give no useful opinion on the status of Leach's species.

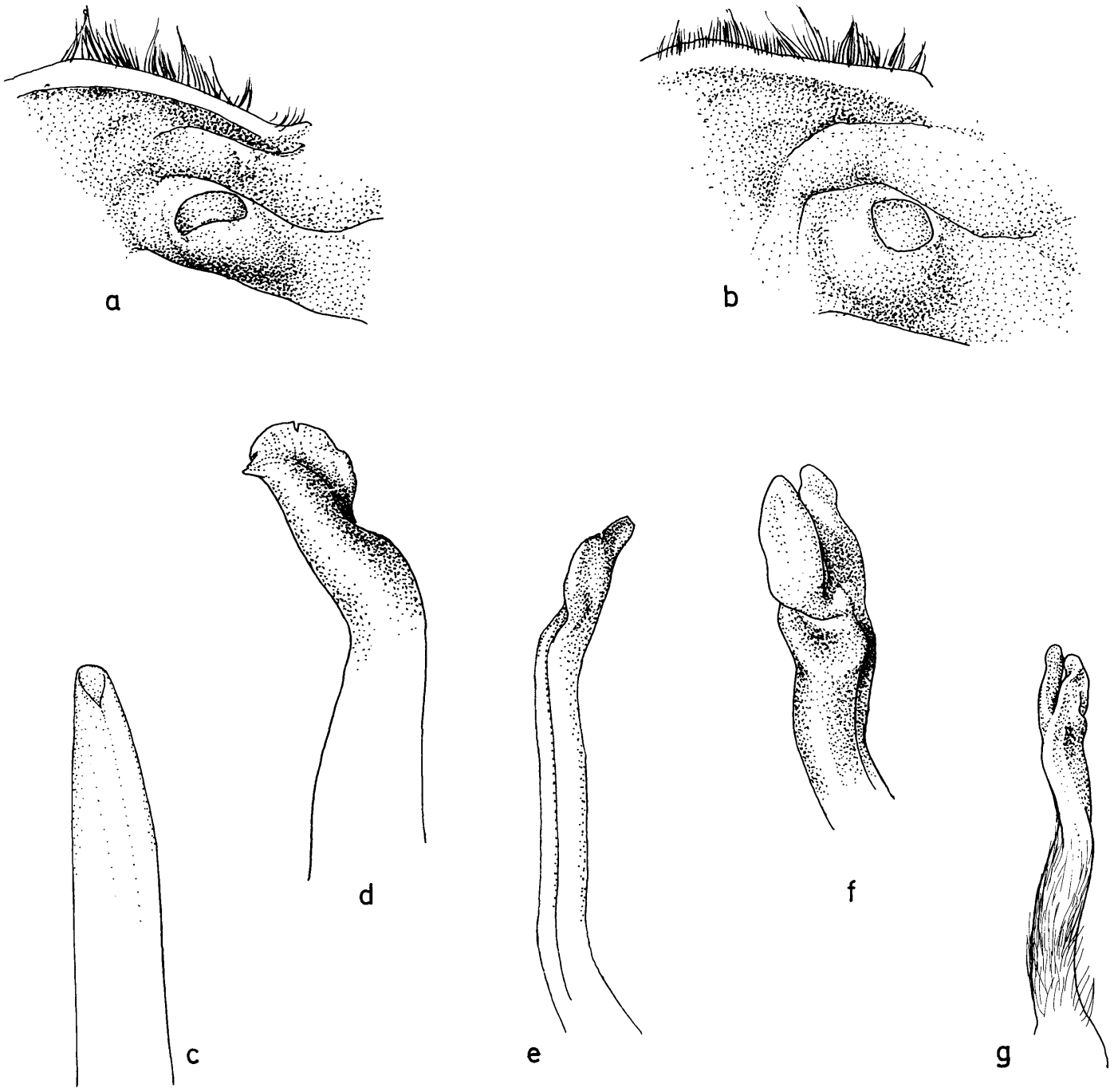


Fig. 34. Female of *Doclea ovis* (ovig., 45 mm, Malay Peninsula, ZMC) (a) left gonopore; *D. japonica* (ovig., 53 mm, USNM 62027) (b) left gonopore. Left first pleopod of male of *D. simeti* (30.5 mm, USNM 57840, in part) (c) abdominal tip of pleopod; *D. alcocki* (51 mm, Pearl Banks, ZSC) (d) sternal tip of pleopod, (e) abdominal view of same; *D. japonica* (64 mm, USNM 58743) (f) sternal tip of pleopod, (g) abdominal view of same.

Distribution. — East and west coasts of India, Andaman Sea, Malay Peninsula, Indonesia, Hong Kong.

Doclea japonica Ortmann, 1893
(Fig. 34b, f, g, Pl. 9)

Doclea japonica Ortmann, 1893: 46-47, pl. 3 fig. 4. (Not *Doclea japonica* Alcock, 1895.)

Doclea canalifera. — Rathbun, 1902b: 29. (Not *Doclea canalifera* Stimpson, 1857.)

Material examined. — 9 ♂♂, 5 ♀♀ (3 ovig.), 26.5-64 mm, smallest ovig. ♀, 51.5 mm.

SMITHSONIAN INSTITUTION, WASHINGTON

Japan, Kii, Wakanoura, coll. Jordan & Snyder, Stanford Univ., 1900; 4 specs. (USNM 26271). — China, Amoy Harbour, S. F. Light, June 1923; 1 spec. (USNM 62028). — China, Chekiang Province, Yenting, exch. National Southeastern Univ. (C. Ping), 18 July 1923; 1 spec. (USNM 59168). — China, Amoy, S. F. Light, 6 June 1924; 3 specs. (USNM 62026-7). — China, Foochow (Fuchou), coll. and don. C. R. Kellogg, 1924; 1 spec. (USNM 58743). (All det. M. J. Rathbun as *D. canalifera*.)

ZOOLOGICAL MUSEUM, HAMBURG

Formosa, Takao, 1 February 1908; 2 specs. (ZM Hamb. K411). — China, Fukien Province, Futschau (?Fuchou), coll. Consul G. Siewssen, 4 September 1913; 2 specs. (ZM Hamb. K430).

Remarks. — These specimens are part of a Smithsonian Institution series from China and Japan identified by Rathbun as *Doclea canalifera* Stimpson (Griffin, 1974: 10), but they lack the long slender epibranchial and intestinal spines of that species.

The type material of *D. japonica* Ortmann comes from Kochi, Japan, very close to where some of these specimens (USNM 26271) were obtained. The figure of *D. japonica* given by Ortmann (1893: pl. 3 fig. 4) shows insufficient detail, and the differences he described in the lengths of the first ambulatory leg and the arrangements of tubercles on the carapace are not adequate to provide a specific distinction from *D. ovis* (Herbst).

Chopra (1935: 467-469, text fig. 1a) has included all the specimens from the Indian coast and the Bay of Bengal previously identified as *D. japonica*, in *D. ovis* and all the males have the characteristic pleopod (with a narrow terminal process) of the latter species.

Our specimens are very close to those of *D. ovis* from the Bay of Bengal and Singapore in carapace shape and ornamentation and form of the legs, but the first pleopod of the male and genital openings of the female are quite different from those of *D. ovis*. The pleopod is broad, almost straight, with a few long setae; the tip consists of two broad, blunt, contiguous lobes (fig. 34f); some immature males (USNM 59168, cl. 43.7 mm; ZM Hamb. K430 cl. 26.4, 33.8 mm) have only the medial lobe fully developed. The female genital openings are round and obliquely laterally placed on the swelling (fig. 34b) while in *D. ovis* they are oval and situated on the anterior face of the swelling.

On the basis of the relatively large number of specimens that we have examined there is no doubt at all that there are two distinct species with the same general appearance but differing markedly in the form of the male first pleopod and shape of the female gonopore; the two are geographically separated — one occurring in the Indian Ocean east to Singapore and one species occurring around Japan and off China. The former species is clearly *D. ovis*. On this basis Ortmann's specimens from Japan must be considered as a separate valid species and Japanese and Chinese animals can be known as *Doclea japonica*. Whilst much of the published information concerning Japanese specimens does not unequivocally confirm this there is nothing to show that the specimens described by Ortmann, and by Sakai (1938: 293, pl. 37 fig. 2; 1976: 231, pl. 80 fig. 2) belong to *D. ovis* as now understood.

Distribution. — Southern Japan, East China Sea to Formosa Strait.

Doclea ovis (Herbst, 1790)
(Fig. 34a)

Cancer ovis Herbst, 1790: 210-211, pl. 13 fig. 82.
Doclea ovis. — Alcock, 1895: 227. — Chopra, 1935: 467-469, text fig. 1a. — Griffin, 1974: 11.

Material examined. — 1 ♀ (ovig.) 45.0 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

5 Thai-Danish Expedition: Stn. 1039, west Malay Peninsula, trawl haul just after leaving station, 24 February 1960; 1 spec.

Remarks. — Our specimen has been compared with a female of *Doclea ovis* from the Bay of Bengal (AM P.17780, cl. 48 mm) and in both the gonopore is oval and situated on the anterior face of the swelling. The gonopore in the very similar species *D. japonica* is round and obliquely laterally placed on the swelling. The differences which separate these two species are discussed further under *D. japonica*.

On the anterior margin of the carapace there are two small spines and a blunt tubercle slightly more dorsally. There is a low tubercle on the intestinal region.

The type locality for this species is given as 'East Indien' (Herbst, 1790).

Distribution. — Malay Peninsula, Singapore, Bay of Bengal.

Doclea simeti new species
(Fig. 34c, Pl. 10)

Material examined. — 1 ♂, 2 ♀♀, 27.5-34.5 mm.

Holotype. — Female, adult, cl. 34.5 mm, China, Tsimei, collected and donated S. F. Light, University of Amoy, June 1923, United States National Museum, Washington, USNM 57840 (1 specimen of 3) previously determined M. J. Rathbun as '*Doclea* near *muricata* and *tetraptera*.'
Paratypes. — Male, cl. 30.5 mm, female cl. 27.5 mm, data as for holotype, USNM 57840 (2 specimens of 3).

Description. — Carapace broad, width nearly equal (0.9) to postrostral carapace length; surface covered with a short dense tomentum of clubbed setae, some low tubercles under tomentum and a few distinct tubercles and spines.

Rostral spines short, length about one fifth (0.2) postrostral carapace length, straight, parallel, apex blunt, fused for proximal half.

Orbital eave slightly expanded, edges of orbital eaves sloping outwards posteriorly; preorbital angle not produced; antorbital angle weakly produced and blunt; postorbital lobe separated from eave by a narrow slit-like hiatus, lobe directed forward, basally broad, apically subacute. Eyestalks short, slender; cornea terminal and ventral.

Hepatic region smooth, not elevated, a low tubercle dorsally on margin.

Branchial submargin with two blunt, conical tubercles anteriorly; an acuminate epibranchial spine, about one quarter width of carapace, directed outward and slightly upward.

Gastric regions elevated, four mesogastric tubercles, first and third small, fourth largest; a group of four low protogastric tubercles on either side of second and third mesogastric tubercles; two low protogastric tubercles on either side of space between third and fourth mesogastric tubercles; a tubercle on urogastric region. Cardiac region with a blunt conical spine; anterior branchial region indistinctly tuberculate near medial angle, a round tubercle laterally; a high tubercle just medial to epibranchial spine; a low tubercle posterolateral of cardiac spine; a small upright spine centrally on intestinal region and a large spine (about half length of epibranchial spine) directed backwards on posterior carapace margin. A narrow band of longer clubbed setae, just above and parallel to posterior carapace margin.

Basal antennal article narrow triangular, a blunt ridge on lateral margin; anterolateral angle produced forward as a short, blunt tooth ventral to first peduncle segment. A tubercle between base of basal antennal article and conical tubercle on anterolateral angle of mouthfield.

Pterygostomian region with a longitudinal channel and a blunt conical tubercle on the margin; channel edged with long hairs, hairs of inner edge on exognath of third maxilliped, and hairs on outer edge of conical tubercle and carapace margin.

Third maxilliped covered with tomentum, anterolateral angle of merus only weakly produced, angular rather than rounded.

Cheliped of male about equal (0.98) to postrostral carapace length, merus smooth, no terminal spine; carpus smooth; palm about twice as long as high; fingers less than three quarters (0.73) length of palm, curved slightly inwards distally, a narrow gape between fingers in proximal third, a few small teeth on fingers in gape and larger teeth on both fingers in distal two thirds.

Ambulatory legs smooth, first leg more than twice (2.3) postrostral carapace length, merus without a terminal tubercle; fourth leg slightly longer (1.2) than postrostral carapace length and about half length of first leg.

Male sternum smooth, a narrow ridge bordering apex of abdominal fossa, ending in a spinule on each side; just behind this spinule and more laterally, on posterior ridge of first sternite, a spine almost covered by tomentum.

Male abdomen of seven segments, smooth, third segment about twice as wide as sixth segment; sixth segment about one and a half (1.4) times wide as long; seventh segment about as wide as long.

Female abdomen of seven segments, second and third segments with a broad, medial tubercle; a low anterior tubercle on segments four to six.

First pleopod of male straight, broad basally but tapering gradually to a narrow, blunt apex; a simple aperture opening terminally on abdominal surface.

Female gonopore a keyhole shaped aperture, narrower medially, opening anteriorly from a broad swelling.

Remarks. — These specimens do not agree with any previously described species of *Doclea*. They are similar to *D. calcitrapa* and *D. canalifera* in having a canaliculated pterygostomian region, the rostrum longer than the peduncle segments of the antennae, large epibranchial and intestinal spines and the first ambulatory legs about equal to twice the carapace length. They can be distinguished from these two species by the tubercles and spines on the carapace which, except for the epibranchial spine, are blunt and conical rather than slender and apically sharp (these spines are covered by tomentum in *D. calcitrapa*); and by the conical tubercle just medial to the epibranchial spine which is absent in the other two species. In addition it is distinguished from *D. calcitrapa* by the rostral spines which are fused for the proximal half and parallel distally instead of being fused for more than the proximal half (0.66) and strongly divergent distally as in *D. calcitrapa*, and from *D. canalifera* by the presence of two spines rather than one on the intestinal region. The species name is an anagram of Tsimei.

Distribution. — Known only from the type locality, Tsimei, China.

Eurynolambrus H. Milne Edwards & Lucas, 1841

Type species. — *Eurynolambrus australis* H. Milne Edwards & Lucas, 1841.

Remarks. — This genus has been dealt with in detail previously (Griffin, 1966d). The study of the post-larval stages of *E. australis* by Krefft (1952) suggested that this genus belonged in the Pisinae. However, the larvae of the oxyrhynchs are so inadequately known that the place of this genus is probably still to be determined. The first pleopod of the male is outwardly curved distally and the aperture is subterminal between the widely expanded lateral part of the apex and the slender medial process which curves over it. This pleopod resembles that of *Tumulosternum parvispinosus* (Ward).

Distribution. — Restricted to New Zealand.

Giranauria new genus

Type species. — *Chorinus verrucosipes* Adams & White, 1848, by present designation.

Description. — Carapace pyriform, surface with many tubercles and some lobes and or spines. Rostrum little more than one third carapace length, of two slender divergent spines. Orbit comprising above an eave separated by a narrow hiatus from postorbital lobe; no intercalated spine. Supraorbital eave expanded, bilobed, both preorbital and antorbital lobes broad. Postorbital lobe strongly produced, apically truncate with a strong apical lobe on posterior margin, a weak proximal lobe on anterior margin. Basal antennal article moderately broad with a broad, blunt

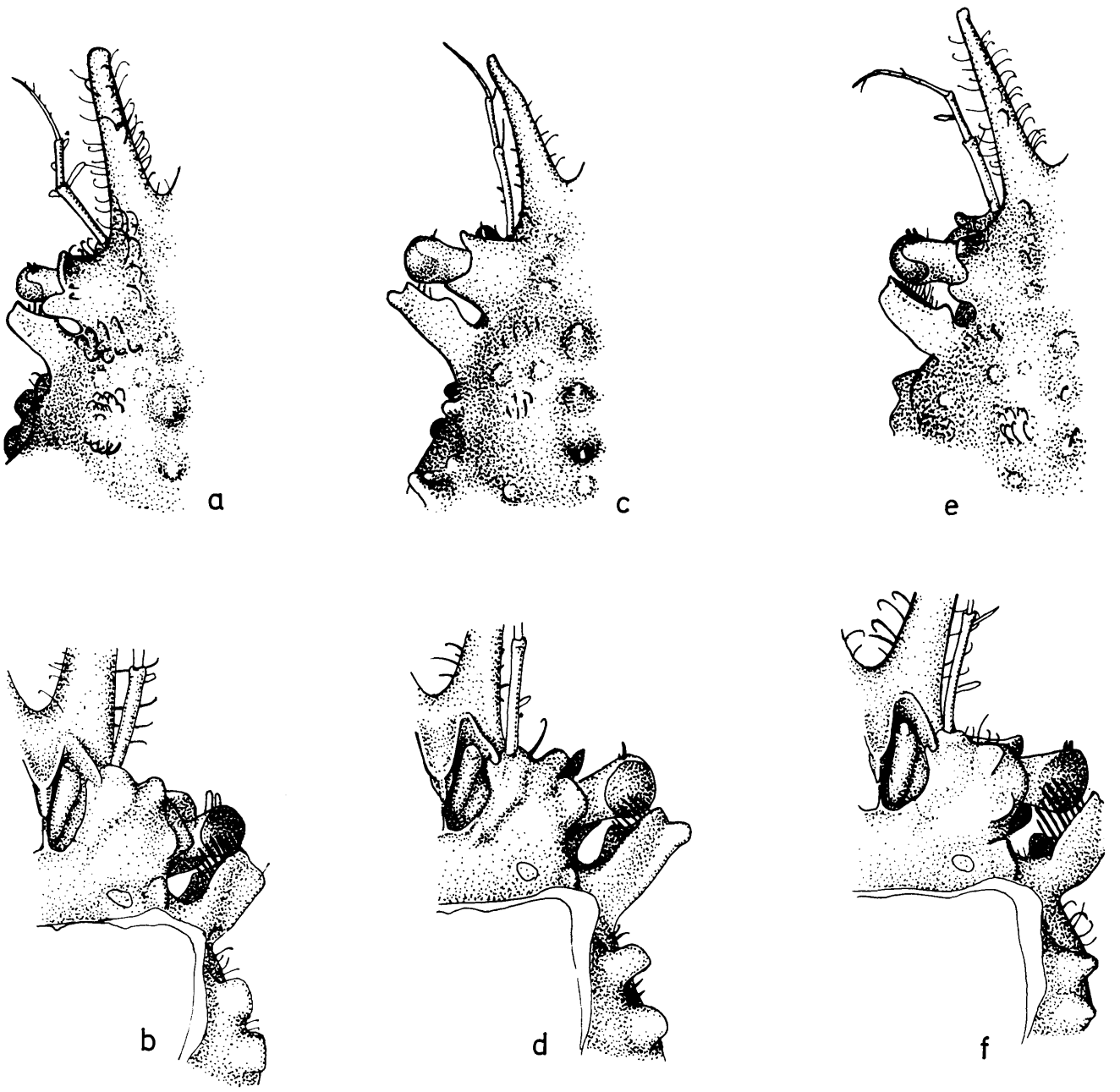


Fig. 35. *Giranauria verrucosipes* (male, 13 mm, Tawi Tawi Bay, WAM 53-67) (a) left orbit, dorsal view, (b) ventral view of same; *G. gracilirostris* (female, ovig., 11 mm, Tamilnadu, ZSC 4533/7) (c) left orbit, dorsal view, (d) ventral view of same; *G. tinaktensis* (male, 10 mm, Ceram, NIO Jakarta) (e) left orbit, dorsal view, (f) ventral view of same.

anterolateral lobe and a strongly produced lateral margin extending dorsally, and sometimes a proximal lobe; separated from postorbital lobe by a broad U-shaped hiatus. Abdomen of seven segments in male.

First pleopod of male moderately stout, distally twisted and apically tapering.

Remarks. — This genus contains three species *G. gracilirostris* (Miers), *G. tinaktensis* (Rathbun) and *G. verrucosipes* (Adams & White) previously included in *Hyastenus*. The species of the new genus are distinguished from all others in the '*Hyastenus*' group by the broad, prominently bilobate eave and broad lobate basal antennal article. A stout twisted pleopod in the male is shared by the three species. Although *Thusaenys pehlevi* has an expanded and bilobed supraorbital eave, it lacks the large cardiac spine and expansion of the basal antennal article typifying *Giranauria* species.

The distribution of this group of species is currently centred on Indonesia and the Philippines.

The name of the genus is derived from letters of the component species; the gender is masculine as is *Hyastenus*.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *GIRANAURIA*

1 Preorbital lobe of supraorbital eave narrow; basal antennal article lacking a lateral lobe proximally, the more dorsal lateral lobe clearly visible in ventral view ..... *G. gracilirostris*

— Preorbital lobe of supraorbital eave broad; basal antennal article with a prominent proximal lateral lobe partly concealing the more dorsal lateral lobe from ventral view 2

2(1) Cardiac spine broadly conical; intestinal spine broad-based, depressed, ridge-like; branchial region posteriorly with a transverse row comprising a small tubercle submedially, a prominent spine and, laterally and below the spine, a small tubercle. *G. verrucosipes*

— Cardiac spine truncate and compressed anteroposteriorly; intestinal spine erect, as long as broad; branchial region posteriorly with a transverse row comprising a prominent tubercle submedially, a prominent spine and, laterally and below the spine, another subequal spine ..... *G. tinaktensis*

Giranauria gracilirostris (Miers, 1879) new combination (Figs. 35c, d, 36a, b)

Hyastenus (*Chorilia*) *gracilirostris* Miers, 1879a: 12, pl. 4 fig. 7.
Hyastenus gracilirostris. — Alcock, 1895: 215.

Material examined. — 4 ♂♂, 3 ♀♀ (2 ovig.), 7.1-11 mm, smaller ovig. ♀, 7.3 mm.

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA
South India, Tamilnadu Coast, Marine Survey; 2 specs. (ZSC 4533/7).

ALLAN HANCOCK FOUNDATION, S. CALIFORNIA
Marshall Islands, Eniwetok Atoll, coll. J. W. Knudsen; 5 specs.

Remarks. — This species is compared with *G. tinaktensis* and *G. verrucosipes* under those species. This species has an unusual disjunct distribution.

Distribution. — Fiji Islands, Marshall Islands, South India.

Giranauria tinaktensis (Rathbun, 1916) new combination (Figs. 35e, f, 36c, d)

Hyastenus tinaktensis Rathbun, 1916: 547-548. — Griffin, 1976: 196, fig. 5(a).

Material examined. — 5 ♂♂, 8 ♀♀ (5 ovig.), 7.5-11.5 mm, smallest ovig. ♀, 9.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM
'Siboga' Expedition: Stn. 313, Sumbawa, Saleh Bay, anchorage E. of Dangar Besar, to 36 m, dredge, trawl and reef exploration, sand, coral and mud, 14/16 February 1900; 2 specs. — Sulu Archipelago; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, off Marungas, ca. 27 m, 19 March 1914; 1 spec.
Danish Kei Islands Expedition: Stn. 35, Kai Is., Bay N. of Noehoe-Roa, 32 m, trawl, sand, 23 April 1922; 1 spec. — Stn. 40, Kai Is., N. of Doe Roa, 25 m, trawl, sand, 25 April 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA
Mariel King Memorial Expedition-Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°08′E, 25-54 m, dredge hauls, 8-19, coarse sand, *Lithothamnion* and rubble or foramniferal sand, 1 June 1970; 3 specs. — Stn. KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 1 spec. — Stn. A III, Aru, Trangan, 3-4 miles (∿ 5-6.5 km) W. of Tg. Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 1 spec.

Remarks. — This species is distinguished by the large truncate cardiac spine which is compressed antero-posteriorly and by the intestinal spine which is broad, triangular and erect. The three species are compared and further differences from *G. gracilirostris* and *G. verrucosipes* discussed under the latter species.

This species was previously known only from the Sulu Archipelago, Philippine Islands.

Distribution. — Sulu Archipelago, Ceram, Kai Islands and Sumbawa.

Giranauria verrucosipes (Adams & White, 1848) new combination (Figs. 35a, b, 36e, f)

Chorinus verrucosipes Adams & White, 1848: 13, pl. 2 fig. 3.
Hyastenus verrucosipes. — Calman, 1900: 36-37, pl. 2 figs. 23-24. — Griffin, 1966b: 281 (in key); 1976: 198.

Material examined. — 21 ♂♂, 19 ♀♀ (15 ovig.), 8-14.5 mm, smallest ovig. ♀, 10 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM
'Siboga' Expedition: Stn. 209, S. Sulawesi, anchorage off S. point of Kabaena I., 22 m, dredge, reef exploration, coarse sand, 23 September 1899; 1 spec. — Stn. 301, S. of Timor, E. coast of Roti I., Pepela Bay, 10°38′S 123°25.2′E, 22 m, dredge, mud, coral and *Lithothamnion*, 30 January 1900; 1 spec. — Sulu Archipelago; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, *Lithothamnion*, 17 March 1914; 4 specs. — Sulu Archipelago, off Jolo, off Marungas, 27-54 m, dredge, 19 March 1914; 5 specs.
Danish Kei Islands Expedition: Stn. 15, Kai Is., S. of Doe Roa, ca. 20-5 m, trawl, sand, 10 April 1922; 1 spec. — Banda, off Kombir, ca. 70-90 m, dredge, sand, 7 June 1922; 2 specs.

WESTERN AUSTRALIAN MUSEUM, PERTH
Sulu Archipelago, Tawi Tawi Bay, about 9 miles (∿ 14.5 km) from Bangao Light, 16-23 m, sand and *Lithothamnion*, coll. B. R. Wilson on 'Pele', 29 February 1964; 1 spec. — (as above), 16-30 m, dredge, sandy bottom, coll. B. R. Wilson on 'Pele', 29 February 1964; 2 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA
Mariel King Memorial Expedition-Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°08′E, 41-48 m, dredge haul 4, coarse Foramnifera and shell sand, 1 June 1970; 1 spec. — Stn. CP I, (as above), 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 6 specs. — Stn. CP I (as above), 25-63 m, dredge hauls 8-19, coarse sand, *Lithothamnion* and rubble, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 32-36 m, dredge haul 1, sand, 10 June 1970: 4 specs. — Stn. KR VI (as above), 32-36 m, dredge haul 2, *Lithothamnion* rubble and sand, 10 June 1970; 1 spec. — Stn. KN II, Kai Is., W. coast of Nuhu Tjut, off Elat Bay, 05°40′S 132°59′E, 48-63 m, dredge hauls 3-4, rubble, fan coral, green algae and sand, 13 June 1970; 1 spec. — Stn. KN II (as above), 48-54 m, dredge haul 6, rubble,

algae and sand, 13 June 1970; 1 spec. — Stn. A III, Aru, Trangan, 3-4 miles (~ 5-6.5 km) W. of Tg. Lelar, 06°46'S 133°58'E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 7 specs.

Remarks. — The preorbital lobe is small, and subequal to the antorbital in *G. gracilirostris* and only slightly upturned, in *G. tinaktensis* it is larger and more upturned, and in *G. verrucosipes* it is much larger than the antorbital lobe and strongly upturned.

On the branchial region in *G. verrucosipes* there is a spine near the anterior margin and an epibranchial spine with a small tubercle just below it. In *G. tinaktensis* the anterior spine is small and the epibranchial spine has a subequal spine just below it. In *G. gracilirostris* the anterior spine is large and the epibranchial spine has a subequal spine just below it. Also in this last species the anterior branchial region is more rounded and elevated.

The large cardiac spine is broadly conical in *G. verrucosipes*, almost cylindrical in *G. gracilirostris*, and truncate and anteroposteriorly compressed in *G. tinaktensis*.

The tubercle in front of the cardiac spine is connected to the last of the three medial gastric tubercles by a narrow ridge in *G. verrucosipes* and *G. gracilirostris*, but not in *G. tinaktensis*.

The intestinal spine is broad, triangular and horizontal or depressed in *G. verrucosipes*, triangular and erect in *G. tinaktensis* and cylindrical and erect in *G. gracilirostris*.

The basal antennal article is produced in a round flattened lobe on the anterolateral angle in the three species of this genus. In addition, there is a proximal lateral lobe in *G. tinaktensis* and *G. verrucosipes*. In the latter, the proximal lobe is smaller than the anterior one (not shown in Calman, 1900: fig. 24). *G. gracilirostris* has no proximal lobe. All three species have a laterally compressed suborbital tooth.

In all three species of this genus the palm of the chela of the adult male is inflated, short (length less than $1^1/_2$ times height), with a tubercle distally near the insertion of the dactyl. There is a moderate gape, a proximal tooth on the dactyl and small teeth distally where the fingers meet. In *G. gracilirostris* there is also a proximal tooth on the fixed finger.

The dactyls of the ambulatory legs are slender and armed with a few very small teeth.

The first pleopod of the male tapers very slightly towards the tip which is lightly curved outwards. The tip is narrower in *G. tinaktensis* and *G. gracilirostris* than it is in *G. verrucosipes*. This type of pleopod is similar to that in *Phalangipus* species, some *Naxioides* species and *Austrolibinia gracilipes*.

Distribution. — Sulu Archipelago, S. Sulawesi, Ceram, Banda, Kai Islands, Timor and N. Australia (Torres Straits).

Herbstia H. Milne Edwards, 1834

Type species. — *Cancer condyliatus* Fabricius, 1787, by monotypy.

Remarks. — In 1873, A. Milne Edwards described *Micropisa crassipes* from Bass Strait, Australia, very briefly and without a figure. Haswell (1882) removed this species from *Micropisa* to *Herbstia*. We have not examined the holotype and the species has not been reported again. The original description is inadequate. Neither *Micropisa* nor *Herbstia* are otherwise represented in the Indo-West Pacific and it is possible that *H. crassipes* should be placed in some other genus if indeed it is a distinct species, rather than a specimen, perhaps juvenile, of a species already known.

Hoplophrys Henderson, 1893

Type species. — *Hoplophrys oatesii* Henderson, 1893, by monotypy.

Remarks. — In this genus there is no hiatus, only a suture, between the supraorbital eave and the postorbital lobe. The basal antennal article is narrow with a long spine at the anterolateral angle and separated from the postorbital lobe by a shallow U-shaped hiatus. The first pleopod of the male is slender in the distal quarter with long setae and resembles the pleopod of some species of *Hyastenus* and *Thusaenys*.

The two described species of this genus are here considered to be conspecific confirming the new synonymy suggested previously (Griffin & Tranter, 1974).

H. oatesii is distinguished from most species in the Pisinae by its numerous carapace spines but it differs from the few other spinous pisines in having no hiatus between the eave and the postorbital lobe and also in lacking a medial intestinal spine, usually strongly developed in other spinous pisines.

Distribution. — Indo-West Pacific.

Hoplophrys oatesii Henderson, 1893 (Fig. 37a)

Hoplophrys oatesii Henderson, 1893: 347-348, pl. 36 figs. 1-4. — Alcock, 1895: 233-234. — Alcock & Anderson, 1898: pl. 34 fig. 1, 1a, 2, 2a. — Rathbun, 1911: 253-254. — Sakai, 1932: 48-49, pl. 2 fig. 4; 1938: 294. — Griffin & Tranter, 1974: 168-169.

Hoplophrys ogilbyi McCulloch, 1908: 51-53, pl. 12 figs. 2, 2a. — Balss, 1938: 22. — Buitendijk, 1939: 238. — Sakai, 1976: 233, pl. 81 fig. 1; new synonymy.

Parazewa palauensis Miyake, 1939: 195-197, text-figs. 12, 13. — Takeda, 1973a: 97; new synonymy.

Material examined. — 6 ♂♂, 4 ♀♀ (1 ovig.), 5-17 mm, ovig. ♀, 17 mm.

Holotype of *Hoplophrys oatesii*. A male cl. 11.5 mm labelled 'Gulf of Martaban, E. W. Oates Esq.' in the collections of the British Museum (Natural History), London, preserved in spirit and registered as 88.34.
Holotype of *Hoplophrys ogilbyi*. A female, cl. 9.6 mm, cw. 7.1 mm, 'Off Moreton Bay, Queensland, in a colony of *Spongodes*, coll. J. D. Ogilby (McCulloch)' in the Queensland Museum's collections, preserved in spirit and registered as W.223. The right rostral spine is broken at the base, the left cheliped carpus and chela is detached, the right cheliped carpus and chela is missing and so is the right first ambulatory, the propodus and dactyl of the right second leg and the whole of the left second leg.

Additional specimens. — 5 ♂♂, 3 ♀♀(1 ovig.).

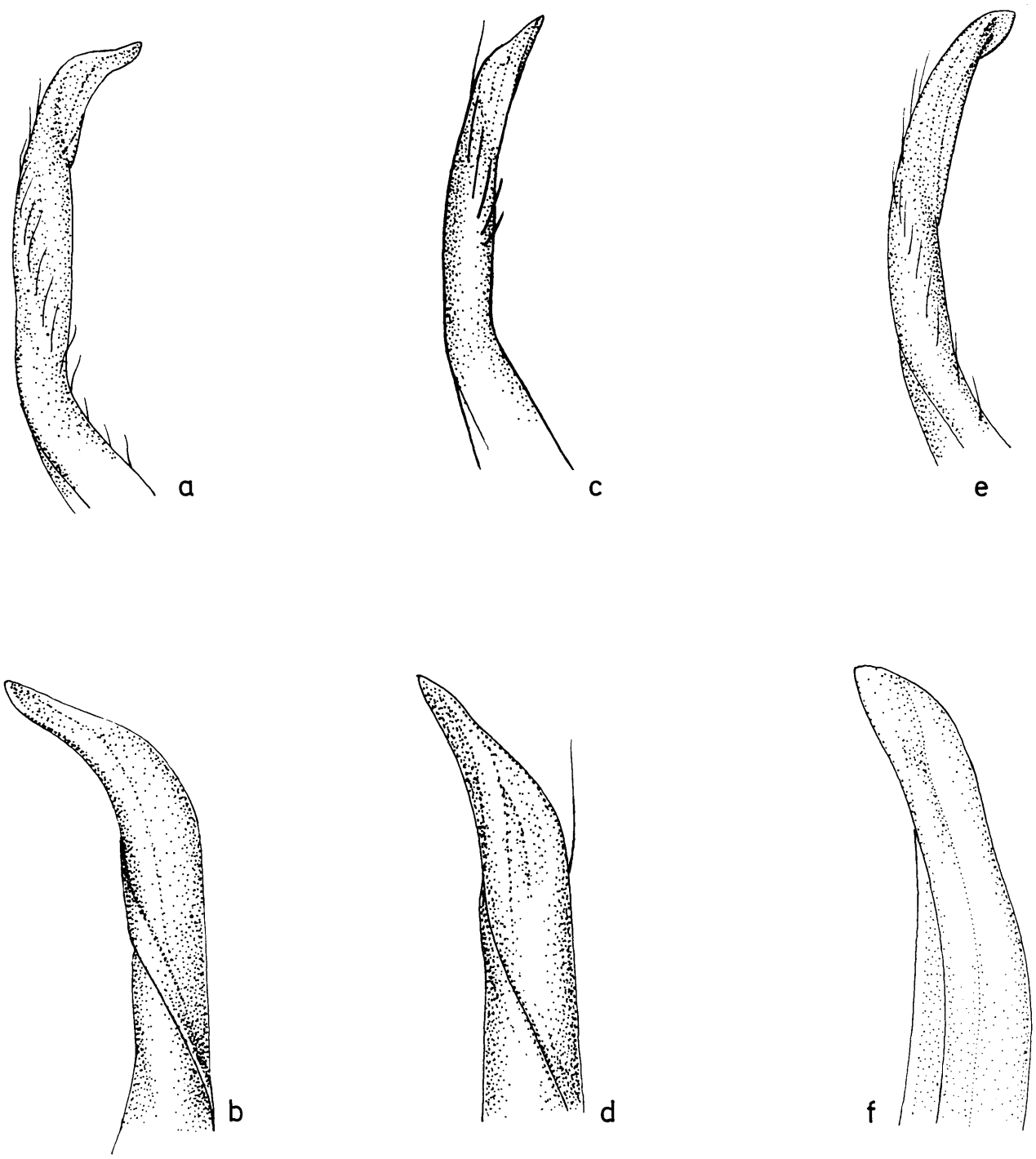


Fig. 36. Left first pleopod of male of *Giranauria gracilirostris* (9.5 mm, Tamilnadu, ZSC 4533/7) (a) abdominal view of pleopod, (b) sternal tip of same; *G. tinaktensis* (10 mm, Ceram, NIO Jakarta) (c) abdominal view of pleopod, (d) sternal tip of same; *G. verrucosipes* (13 mm, Tawi Tawi Bay, WAM 53-67) (e) abdominal view of pleopod, (f) sternal tip of same.

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' Expedition: Stn. 5138, Sulu Archipelago, vicinity of Jolo (Jolo Light), 06°06′N 12°58′50″E, 34 m, sand, coral, 14 February 1908; 1 spec. (USNM 47347).

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 2 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: near Bundaberg, caught while fishing for prawns and scallops, coll. J. Booth; 1 spec. (AM P.23836). — Lizard I., Macgillivray Reef, coll. N. Coleman, 9 November 1975; 1 spec. (AM P.23820). — Lizard I., North Reef, coll. N. Coleman, 22 November 1975; 1 spec. (AM P.23819). — Lizard I., North Point, coll. N. Coleman, 25 November 1975; 1 spec. (AM P.23817).

Noumea: Fosse aux canards, 24 m, 1968; 1 spec. (AM P.23837).

Remarks. — The original description and figures of *H. ogilbyi* given by McCulloch are extremely accurate and detailed. Only the following points require comment. The anterior border of the basal antennal article is slightly more concave than shown in McCulloch's fig. 1a, there is no trace of the ir-

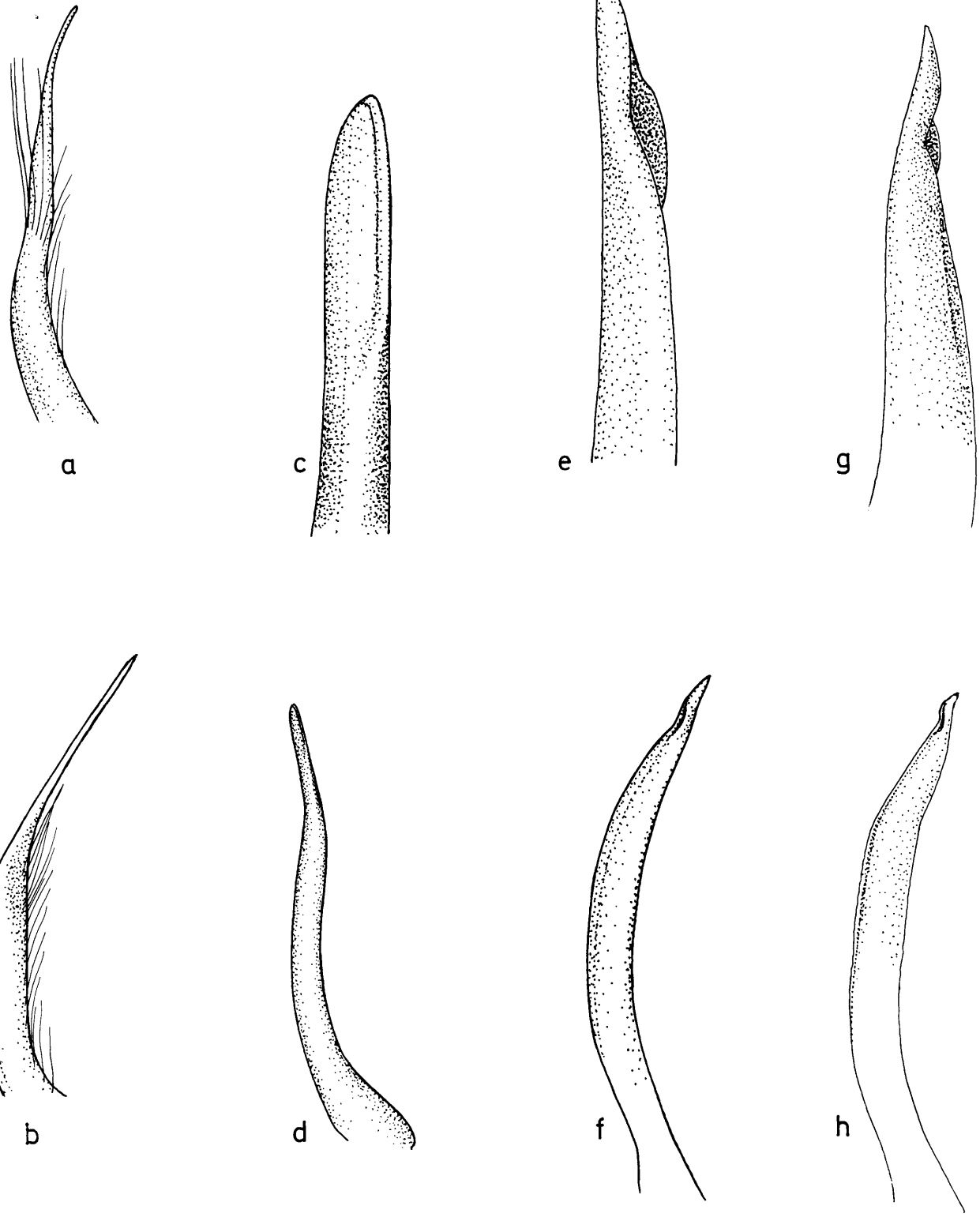


Fig. 37. Left first pleopod of male of *Hoplophrys oatesii* (11 mm, AM P.23819) (a) abdominal view of pleopod; *Lahaina agassizii* (13.5 mm, Banda, ZMC) (b) abdominal view of pleopod; *L. mauritiana* (holotype) (c) abdominal tip of pleopod, (d) abdominal view of same; *Naxioides taurus* (21 mm, Kai Is., NIO Jakarta) (e) sternal tip of pleopod, (f) abdominal view of same; *N. hirta* (34 mm, Timor, ZMA De.100.630) (g) sternal tip of pleopod, (h) abdominal view of same.

regularities on the upper border of the palm of the chela referred to in the description (however this is not typical of the species), the fingers of the chela are inwardly curved, the dactyl does not cross over the fixed finger. The fingers are coarsely toothed in the male and meet along the distal third and distal half in the female, not proximally as stated by McCulloch. The ornamentation of the ambulatory propodi is described by McCulloch as comprising elevated groups of tubercles; more correctly there are some large tubercles with smaller secondary tubercles on them dorsally and on the sides on the carpi as well as the propodi. (In the male specimen from Bundaberg these are rather worn and don't present quite the knobbly appearance of the legs of the female.) On the two anterior pairs of ambulatories the merus has dorsally one spine proximally, two side by side midway along and three side by side on the distal border, the carpus has the same arrangement and the propodus has two pairs of spines, one midway along and one distally. The dactyls of the posterior ambulatories have several small spines proximally on the ventral surface. (In the Bundaberg male (AM P.23836) the dactyls of the first ambulatories have two spines ventrally, one proximally and one midway along. The arrangement of these dactylar spines or spinules is not clearly shown in figures of *H. oatesii*.)

The abdomen is not described by McCulloch. It consists in the female of five segments, the junctions between segments three and four, four and five, and five and six being not very distinct; the abdomen is ovate and the edges are scalloped. The male abdomen consists of seven segments and is widest at the middle of the third segment from which it tapers to the last. There is a flattened subrectangular elevation in the midline of segments three to six distally.

McCulloch suggests that his species differs from *H. oatesii* Henderson in that the spines of the carapace are larger and longer, the epibranchial spine is not bifid, the basal antennal article is more slender and the third maxilliped merus possesses an extra lobe. Comparison of the holotype of *H. ogilbyi* with the holotype of *H. oatesii* and with previous descriptions and figures and present material shows these to be not justifiable as characters separating the species.

There are few consistent differences between the Australian and other specimens available to us and the Japanese female specimen described and figured by Sakai (1932) under the name *Hoplophrys oatesii* but later (1976) with further Japanese specimens, referred to *H. ogilbyi*. Thus, the rostrum is usually directed forward rather than deflexed; the tubercles on the third and fourth ambulatories are more secondarily tuberculate on the carpi and propodi; and the lobe on the dorsal border of the palm of the chela is longer than shown in Sakai's figure. Sakai also shows the postorbital lobe as apically acute but describes it as "not strong, truncated at the tip and excavate at the inner surface" which agrees with the Australian specimens of *H. ogilbyi*.

We consider the material of this genus from the western Indian Ocean and Red Sea east to Japan, Fiji and eastern Australia to represent only one species. There is nothing to suggest that any local population is characterized by differences in length of carapace spines, bifidness of spines, deflexed rostrum or tuberculation of ambulatory legs. Very small specimens lack the posterior branchial spine near the margin found in adults; the ambulatory legs are less tuberculate. These are differences from adult *Hoplophrys oatesii* shown by Miyake's *Parazewa palauensis*; Miyake's species otherwise has the same tubercles on the carapace and agrees in every other way with *Hoplophrys oatesii* as now understood. This name is now added to the synonymy of *Hoplophrys oatesii*.

The species is newly recorded from the Philippine Islands: the 'Albatross' specimen was not included in the account of Philippine Spider Crabs (Griffin, 1976).

Distribution. — Indo-West Pacific, Western Indian Ocean: Providence and Amirante, Red Sea. Off Indian coasts to Gulf of Martaban. Pacific Ocean: Japan, Indonesia, Philippine Islands (Sulu Archipelago), Fiji, eastern Australia.

Hyastenus White, 1847 redefined

Type species. — *Hyastenus sebae* White, 1847, by monotypy.

Description. — Carapace pyriform, variously tuberculate or spinous. Rostrum varying in length. Orbit comprising eave and postorbital lobe separated by a narrow hiatus. Supraorbital eave at most moderately expanded, anterolateral angle weakly produced or bearing a slender preorbital spine, antorbital only weakly, if at all, produced. Postorbital lobe not well developed, anterior margin sometimes with a proximal lobe, posterior margin convex but neither keeled nor lobed.

Basal antennal article generally narrow, anterolateral angle blunt or produced as a small spine, lateral margin usually produced as a convex or triangular lobe, which never extends dorsally; article separated from postorbital lobe by a U-shaped hiatus of varying width.

Abdomen of seven segments in male and generally of seven, but sometimes of five segments in female.

First pleopod of male simple, sometimes with a subapical lobe, sometimes slender or filiform distally.

Remarks. — The genus as redefined is still large (34 species) and contains several groups and subgroups. However, species with relatively extravagantly expanded orbits dorsally, ventrally or both are excluded and removed to the genera *Lahaina*, *Giranauria* or *Thusaenys*. There is an expanded orbit also in *Acanthophrys cristimanus* A. Milne Edwards, included in *Hyastenus* by Balss (1935a) but now removed to a separate genus. Several other species have been removed from the genus. *H. dumerilii* (H. Milne Edwards) is now considered a species of *Tylocarcinus* and *H. macrospinosus* Ward is probably synonymous with it; *H. brevirostris* Doflein has been removed to the genus *Rochinia* and *H. elegans* Miers to the genus *Nax-*

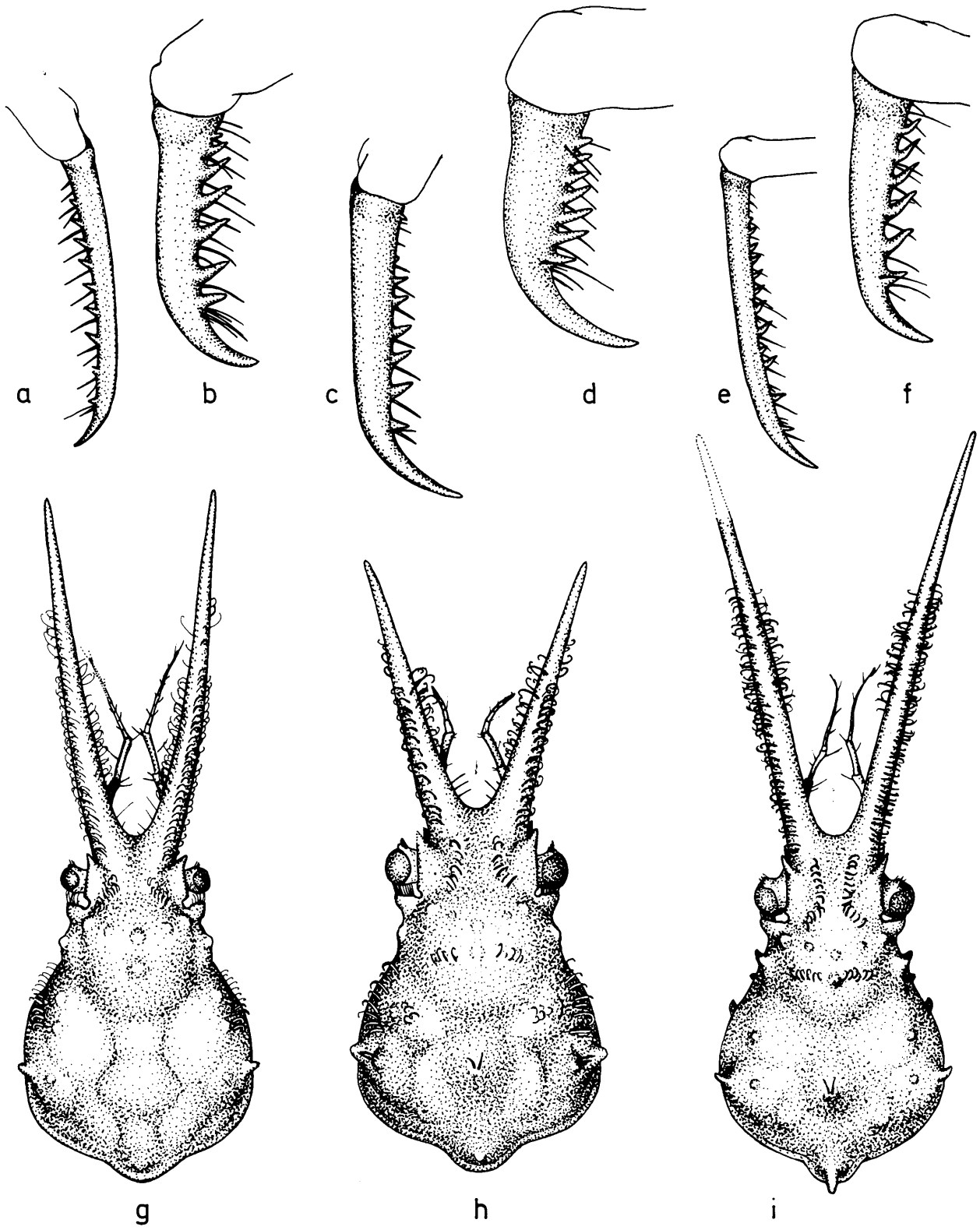


Fig. 38. (*Hyastenus* species of group 1) *Hyastenus borradailei* (male, 35 mm, AM P.29891, in part) (a) dactyl of right first ambulatory leg; (female, ovig., 30 mm, AM P. 29891, in part) (b) dactyl of left fourth ambulatory leg; *H. brockii* (male, 11.5 mm, S. Sulawesi, ZMA) (c) dactyl of left first ambulatory leg; (d) dactyl of left fourth ambulatory leg; *H. uncifer* (male, 17 mm, Haingsisi, ZMA) (e) dactyl of left first ambulatory leg; (f) dactyl of left fourth ambulatory leg; *H. borradailei* (male, as above) (g) carapace, dorsal view; *H. brockii* (as above) (h) carapace, dorsal view; *H. uncifer* (as above) (i) carapace, dorsal view.

ioides. *Pisa sinope*, briefly described but not figured by Adams & White (1848) was included in *Hyastenus* by Miers (1886) and omitted by Balss (1935a) but because the description is so brief we are unable to say anything about its status. The remaining species, including five newly described, appear to fall into three main groups:

Group 1 species

H. ambonensis n.sp.[21])
H. auctus Rathbun
H. bispinosus Buitendijk
H. borradailei (Rathbun)
H. brockii De Man
H. cornigerus Sakai[21])
H. hendersoni Laurie
H. hilgendorfi De Man
H. inermis (Rathbun)
H. kyusyuensis (Yokoya)[21])
H. minutus Buitendijk[21])
H. pleione (Herbst)
H. sebae White
H. subinermis (Zehntner)[21])
H. ternatensis Buitendijk
H. trispinosus Rathbun
H. uncifer Calman
H. whitei Griffin

Group 2 species

H. aries (Latreille)
H. campbelli n.sp.
H. convexus Miers
H. cracentis n.sp.
H. diacanthus (De Haan)
H. elatus n.sp.
H. elongatus (Ortmann)
H. planasius (Adams & White)
H. spinosus A. Milne Edwards

Group 3 species

H. biformis Rathbun
H. fraterculus Rathbun
H. mindoro n.sp.
H. scrobiculatus Rathbun

Ungrouped (insufficiently known)

H. brachychirus Nobili
H. brevicornis Ortmann
H. espinosus Borradaile

Whilst the first pleopod of the male in this genus is simple there are three recognizable types. The first kind of pleopod is one which is usually straight, apically subacute, with a convex lobe behind the apex. The aperture is subterminal near the lobe. The group of species (1) with this kind of pleopod includes the type of the genus *H. sebae*; *H. inermis* is also included in this group, although in that species there is a very large lobe on the pleopod that curves over the abdominal surface.

The second kind of pleopod is slender, often sinuous, apically truncate without a lobe or else distally filiform. The aperture is terminal. The species with this kind of pleopod are listed in group (2). *Hyastenus convexus* which has a slender, straight pleopod with a terminal aperture is included in this group with some reservations.

The third kind of pleopod is one which curves outward distally and tapers only near the apex. There are only four species (group 3) with this kind of pleopod and they are very similar to one another. In this group of species the postorbital lobe is shallow, laterally narrow, and with a proximal process on the anterior margin; the basal antennal article is moderately broad with two large subequal lobes on the lateral margin.

Within the first group (1) there is a set of three very similar species. — *H. borradailei*, *H. brockii* and *H. uncifer* — which are distinguished from other species in this group by their very long slender rostral spines, weakly expanded orbital eave, narrow basal antennal article and short shallow postorbital lobe. However, we have included them in the first group because the pleopods of the males are similar to those of the other species in the group.

We have included in the key three of the species we know only from the literature, though *H. cornigerus* is not distinguished from *H. sebae*. *H. brachychirus* Nobili and *H. brevicornis* Ortmann are omitted from the key. There is only a brief description of the former and possibly it may be a synonym of *H. sebae*, while the latter, although figured, may not be a species of *Hyastenus*. We have also omitted *H. subinermis* Zehntner for while it is more adequately described and would probably key out near *H. trispinosus*, we don't have enough information to distinguish it.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *HYASTENUS*

1 Carapace strongly tuberculate; protogastric and mesogastric regions with 13 or more tubercles; cardiac region with six or more tubercles 2
— Carapace moderately or weakly tuberculate or smooth; protogastric and mesogastric regions with 0-7 tubercles; cardiac region with 0-5 tubercles 3
2(1) Preorbital angle of eave not produced, rounded; anterolateral angle of basal antennal article not produced (fig. 40e); tubercles on dorsal part of hepatic region subequal to dorsal branchial tubercles; epibranchial tubercle subequal to branchial tubercle medial to it ..... *H. whitei*
— Preorbital angle of eave sharp, weakly produced or sometimes a short spine; anterolateral angle of basal antennal article produced as a blunt lobe or spine (fig. 40f); tubercles on dorsal part of hepatic region smaller than dorsal branchial tubercles; epibranchial tubercle or spine higher than branchial tubercle medial to it ... *H. sebae* *H. cornigerus*[22])
3(1) Upper orbital hiatus very narrow, U-shaped (almost slit-like), shallow; lower orbital hiatus a shallow slit (fig. 45e) 4
— Upper orbital hiatus U-shaped or keyhole-shaped, not particularly narrow or shallow; lower orbital hiatus broad U-shaped 6
4(3) Mesogastric region with a large tubercle at the summit and a spine or large tubercle on the anterior slope ..... *H. aries*
— Mesogastric region with a tubercle at the summit and the anterior slope smooth or with a low tubercle 5
5(4) Branchial region with a short epibranchial spine (0.1cw) and a tubercle medial and anterior to it ..... *H. auctus*
Branchial region with a robust epibranchial spine ($^1/_6$ to $^1/_4$ cw) but lacking a tubercle medial to the spine (fig. 45g) ..... *H. elatus*
6(3) Lateral margin of basal antennal article with two lobes of similar shape and size (fig. 50d-f), sometimes, but not always, parallel . 7
— Lateral margin of basal antennal article with anterolateral lobe narrow (or lacking) and margin behind it with a broad, weak to strong, convexity or lobe, or else nearly straight 10
7(6) Rostral spines fused for basal third; intestinal region with a strong, blunt posterior spine (fig. 49f) ..... *H. mindoro*
— Rostral spines separate from the base; intestinal region with a rounded tubercle, sometimes very low 8
8(7) Rostral spines very short, about $^1/_6$ postrostral carapace length; dorsal branchial margin with five to nine tubercles, epibranchial tubercle hardly higher than other tubercles ..... *H. fraterculus*
— Rostral spines $^1/_4$ to $^1/_2$ postrostral carapace length; dorsal branchial margin with two to four tubercles and an epibranchial spine higher than the tubercles 9
9(8) Cardiac region with a pair of submedial tubercles; lobes on lateral

[21]) Pleopod unknown or inadequately known.

margin of basal antennal article apically rounded (fig. 50f) ..... *H. biformis*
— Cardiac region with a medial tubercle; lobes on lateral margin of basal antennal article subacute (fig. 50e) ..... *H. scrobiculatus*
10(6) Anterior half of branchial region with at least one dorsal tubercle (sometimes low) 11
— Anterior half of branchial region devoid of tubercles 19
11(10) Urogastric region with a wide tubercle; mesogastric and protogastric regions with six prominent tubercles arranged in a 'Y' ..... *H. pleione*
— Urogastric region smooth; mesogastric and protogastric regions with low tubercles or no more than four prominent tubercles .. 12
12(11) Branchial submargin with a tubercle above cheliped base and two to five submarginal tubercles behind it ..... *H. hilgendorfi*
— Branchial submargin with a tubercle above cheliped base but no other tubercles 13
13(12) Postorbital lobe long, slender ..... *H. ternatensis*
— Postorbital lobe, short, broad 14
14(13) Basal antennal article with a deep notch on the margin behind the anterolateral spine (fig. 40h); protogastric tubercle behind orbit generally low 15
— Basal antennal article with a shallow concavity on the margin behind the anterolateral spine (fig. 44e); protogastric tubercle behind the orbit generally prominent 16
15(14) Intestinal region with a medial spine; branchial region with a strong epibranchial spine and a tubercle medial to it ..... *H. trispinosus*
— Intestinal region smooth or with a low tubercle; branchial region with a low epibranchial tubercle without a tubercle medial to it ..... *H. convexus*
16(14) Rostral spines $^1/_2$ to $^2/_3$ postrostral carapace length; gastric regions strongly elevated with two prominent mesogastric tubercles; branchial region with a strong epibranchial spine directed laterally (fig. 39d) ..... *H. ambonensis*
— Rostral spines $^2/_3$ to $1^1/_3$ postrostral carapace length; gastric regions weakly to moderately elevated, mesogastric tubercles low or distinct but not prominent; branchial region with a very short epibranchial spine, sometimes curved forwards (fig. 38g-i) 17
17(16) Hepatic margin and intestinal region each with a spine; anterior branchial region with one dorsal tubercle (fig. 38i) ..... *H. uncifer*
— Hepatic margin and intestinal region each with a tubercle; anterior branchial region with two dorsal tubercles 18
18(17) Preorbital spine of eave horizontal; anterior margin of postorbital lobe weakly sinuous; first pleopod of male with a medial lobe behind the apex (fig. 42a) ..... *H. borradailei*
— Preorbital spine of eave slightly upturned; anterior margin of postorbital lobe nearly striaght; first pleopod of male with a lateral lobe behind the apex (fig. 42c) ..... *H. brockii*
19(10) Rostral spines very short, $^1/_6$ to $^1/_4$ postrostral carapace length ... . *H. planasius*
— Rostral spines at least $^1/_3$, more usually $^1/_2$ postrostral carapace length or more 20
20(19) Mesogastric region with one to three tubercles or spines 21
— Mesogastric region smooth 25
21(20) Branchial region with an epibranchial spine 22
— Branchial region with an epibranchial tubercle or smooth but not with a spine 24
22(21) Mesogastric region with a large tubercle or spine at the summit and a spine or large tubercle on the anterior slope ..... *H. spinosus*
— Mesogastric region with a tubercle at the summit, anterior slope smooth or with a very low tubercle 23
23(22) Rostral spines subparallel; carapace narrow posteriorly (cw = 0.6 postrostral carapace length) ..... *H. espinosus*[22])
— Rostral spines divergent; carapace broad posteriorly (cw = 0.7-0.75 postrostral carapace length) ..... *H. diacanthus*[23])
24(21) Rostral spines parallel or weakly divergent (distance between tips about $1^1/_2$ times basal width); anterolateral angle of basal antennal article not produced (fig. 46f) ..... *H. elongatus*[24])
— Rostral spines strongly divergent from base (distance between tips about 3 times basal width); anterolateral angle of basal antennal article with a slender spine ..... *H. kyusyuensis*[22])
25(20) Anterolateral angle of basal antennal article sharp, with a short to moderate spine, sometimes bifid 26
— Anterolateral angle of basal antennal article not produced, rounded, blunt 29
26(25) Preorbital angle of eave produced further laterally than almost obsolete antorbital angle ..... *H. bispinosus*
— Preorbital and antorbital angles of eave about equally produced laterally 27
27(26) Rostral spines abqut $^2/_3$ postrostral carapace length or more; hepatic region with a small tubercle (fig. 44g) ..... *H. cracentis*[25])
— Rostral spines half postrostral carapace length or less; hepatic region smooth 28
28(27) Antorbital angle of eave rounded; anterolateral angle of basal antennal article with one spine; epibranchial spine lacking or very small ..... *H. inermis*
— Antorbital angle of eave acute; anterolateral angle of basal antennal article with two spines; epibranchial spine small but distinct ..... *H. minutus*[26])
29(25) Epibranchial spine robust about $^1/_6$ to $^1/_3$ carapace width; teeth on dactyl of fourth ambulatory leg very small ..... *H. campbelli*
— Epibranchial spine short about $^1/_{12}$ carapace width; teeth on dactyl of fourth ambulatory leg robust ..... *H. hendersoni*

[22]) From the literature.
[23]) *H. elatus* juveniles may key out here.
[24]) Indian O. specimens have a spine on the article — see species account.

Hyastenus ambonensis new species
(Fig. 39d-f)

Material examined. — 2 ♀♀ (1 ovig.), 21, 24 mm, ovig. ♀, 24 mm.

Holotype. — Female, ovigerous, 24 mm, Ambon, Ambon Bay, 90 m, dredge, stones, sand, 3 March 1922, Danish Kei Islands Expedition; Zoological Museum, University of Copenhagen.
Paratype. — Female, adult, 21 mm, data as for holotype; Zoological Museum, University of Copenhagen.

Description. — Carapace pyriform, widening posteriorly, width about two thirds (0.7) postrostral carapace length, surface smooth with a low tomentum, a few tubercles, an epibranchial spine and a posterior intestinal spine.

Rostral spines straight, slender, divergent, apically sharp, length more than half (0.55 to 0.6) postrostral carapace length.

Orbital eave weakly expanded, preorbital angle produced into a short spine directed obliquely forward and upward; antorbital angle produced into a small blunt lobe; postorbital lobe separated from eave by an almost circular hiatus; postorbital lobe short, a proximal lobe on anterior margin. Eyestalks short, moderately slender; cornea terminal.

Hepatic region weakly elevated, a tubercle on margin. Branchial submargin with a small tubercle anteriorly; a strong epibranchial spine directed laterally.

Gastric regions strongly elevated; two strong mesogastric tubercles, posterior on summit of gastric region; a strong lateral protogastric tubercle anteriorly and a very small tubercle just medial to it; urogastric region flat, smooth.

Cardiac region elevated with a low tubercle at summit. Intestinal region with a medial, conical spine, directed upwards and slightly backwards, just above posterior carapace margin.

[25]) Also less tuberculate specimens of *H. trispinosus*, but see fig. 40d.
[26]) Juveniles of some other species may also have a bifid spine on the article.

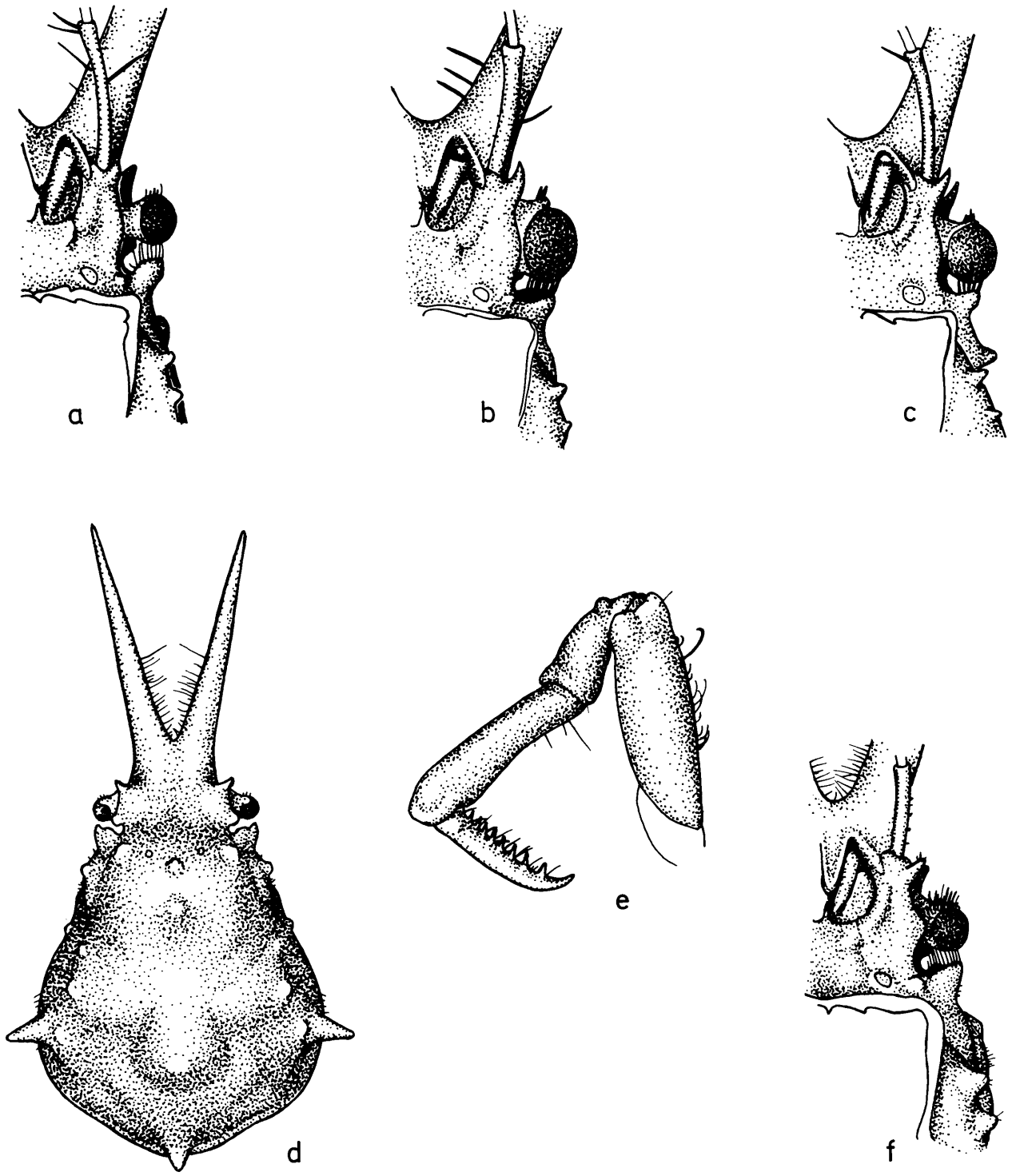


Fig. 39. (*Hyastenus* species of group 1) *Hyastenus borradailei* (male, 35 mm, AM P.29891, in part) (a) left orbit, ventral view; *H. brockii* (male, 11.5 mm, S. Sulawesi, ZMA) (b) left orbit, ventral view; *H. uncifer* (male, 17 mm, Haingsisi, ZMA) (c) left orbit, ventral view; *H. ambonensis* (holotype, female) (d) carapace, dorsal view; (e) left fourth ambulatory leg; (f) left orbit, ventral view.

Branchial region with a lateral tubercle on anterior margin, a slightly larger tubercle centrally and a tubercle just dorsal to epibranchial spine.

Basal antennal article smooth, a ridge along medial edge; a longitudinal groove centrally (wider basally); anterolateral angle produced into a strong spine directed laterally and slightly forward; lateral edge sinuous, convex midway along. A small tubercle lateral to green gland.

Pterygostomian region smooth, margin with two blunt tubercles, anterior slightly larger.

Third maxilliped smooth, a low ridge on posterior margin of merus, anterolateral angle of merus produced and rounded.

Cheliped of ovigerous female slightly shorter (0.9) than postrostral carapace length; merus with three low tubercles and a long acute terminal spine dorsally; a low tubercle in

distal half ventrally on outer edge; carpus with a small lateral tubercle dorsally at about distal third; palm smooth, length about two and a half times height; fingers about two thirds (0.63) length of palm, hardly gaping in proximal third.

First ambulatory leg merus smooth with a blunt terminal tubercle; second ambulatory leg slightly longer (1.1) than postrostral carapace length; fourth ambulatory leg slightly less (0.96) than postrostral carapace length and about four fifths (0.86) of second leg; dactyl of fourth leg with about eight small spines ventrally along its length, proximal spines directed obliquely towards propod. (Only merus of the first leg is present on the holotype.)

Female abdomen of seven segments; a transverse medial tubercle in first to third segments a low medial ridge in remaining segments.

Female gonopore an oval aperture, narrower laterally, and opening anteriorly.

Remarks. — This species most closely resembles *H. trispinosus* Rathbun, but can be distinguished from it by the more strongly elevated gastric region, and the two strong mesogastric tubercles, rather than one or none as in *H. trispinosus*. It is distinguished from *H. hilgendorfi* by the presence of two mesogastric tubercles (rather than only one, or if two, a very low second), and from *H. pleione* by the absence of a transverse tubercle between the gastric and cardiac elevations. It differs from both these species in having no additional submarginal branchial tubercles between that on the anterior margin and the epibranchial spine, whereas the other two species have at least two such tubercles.

Distribution. — Known only from Ambon.

Hyastenus aries (Latreille, 1825)
(Fig. 48h, i)

Pisa aries Latreille, 1825: 140-141.
Chorinus aries. — H. Milne Edwards, 1834: 315-316.
Hyastenus aries. — Alcock, 1895: 211-212. — McCulloch, 1913: 328-329, fig. 44. — Buitendijk, 1939: 239, text figs. 1-2; 1950: 64. — Serène & Lohavanijaya, 1973: 53-54, figs. 109-113, pl. 10A, B.

Material examined. — 32 ♂♂, 28 ♀♀ (3 ovig.), 12-78.5 mm, smallest ovig. ♀, 30 mm.

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'Siboga' Expedition: Stn. 57, Savu Sea, near Sumba I. 10°29′S 121°28.7′E, 1419 m, Foramnifera ooze, 24 April 1899; 1 spec. — Stn. 80, Borneo Bank, 02°25′S 117°43′E, from 50-40 m, trawl, fine coral sand, 13 June 1899; 1 spec. — Ambon; 1 spec. (ZMA De.100.803, det. Ihle as *H. diacanthus*).

Aru Is., Jedan, 10 February 1907; 2 specs. — Java Sea, off Jakarta, otter trawl, 'Rambang', April-May 1907; 1 spec.

N. Sulawesi, Kuandang Bay, 36-81 m, coll. van Nouhuys, 17 April 1914; 1 spec.

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Singapore, shallow water, 1906; 2 specs.

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-45 m, dredge, sand, coral, 19 March 1914; 7 specs. — Sulu Archipelago, off Jolo, ca. 27 m, diving, 19 March 1914; 2 specs.

Danish Kei Islands Expedition: Ambon, Ambon Bay, 12-18 m, sand, 28 February 1922; 3 specs. — Ambon, Ambon Bay, ca. 90-45 m, dredge, stones, sand, 2 March 1922; 2 specs. — Ambon, Ambon reef, ca. 90 m, dredge, sand, stones, 3 March 1922; 1 spec. — Stn. 11, Kai Is., off Toeal, 20 m, trawl, fine sand, 9 April 1922; 1 spec. — Stn. 14, Kai Is., S. of Doe Roa, 40 m, trawl, sand, 10 April 1922; 4 specs. — Stn. 15, Kai Is., S. of Doe Roa, 20-5 m, trawl, sand, 10 April 1922; 1 spec. — Stn. 31, Kai Is., Doe Roa Bassin, 50 m, trawl, sand, 18 April 1922; 1 spec. — Kai Is., off Toeal, ca. 20 m, trawl, sand, 18 April 1922; 2 specs. — Stn. 36, Kai Is., Bay N. of Noehoe-Roa, 35 m, trawl, sand, 23 April 1922; 1 spec. — Kai Is., off Toeal, 20 m, trawl, sand, 12 May 1922; 2 specs. — Stn. 61, Kai Is., between Doe Roa and Kai Doelah, 50 m, trawl, Bryozoans, 14 May 1922; 1 spec. — Makassar, off Samalona, ca. 35 m, sand, shells, 28 June 1922; 1 spec. — Stn. 67, Java Sea, 05°48′S 106°12′E, 38 m, dredge, sand, 27 July 1922; 2 specs. — Stn. 71, Java Sea, 05°40′S 106°08′E, 54 m, trawl, sand, stones, 28 July 1922; 1 spec. — Stn. 72, Java Sea, 05°41′S 105°57′E, 35 m, trawl, stones, 28 July 1922; 2 specs. — Stn. 74, Sunda Strait, 06°03′S 105°54′E, 30 m, trawl, sand, shells, 29 July 1922; 1 spec. — Stn. 89, Java Sea, 05°57′S 105°32′E, 18 m, trawl, sandy mud with pumice, 31 July 1922; 1 spec. — Stn. 103, Sunda Strait, 06°05′S 105°42′E, 52 m, trawl, sand, shells, 4 August 1922; 3 specs. — Stn. 106, Java Sea, 05°30′S 106°16′E, 32 m, trawl, sand, 5 August 1922; 2 specs.

S. of Sumatra, 05°50′S 101°07′08″E, 48 m, sand, mud, 'Store Nordiske', 12 December 1935; 2 specs. — Strait of Malacca, 05°09′08″N 99°48′10″E, 57 m, sand, mud, 'Store Nordiske', 24 December 1935; 3 specs.

'Galathea' Expedition, 1950-52: Singapore, sea off Changi, ca. 10 m, fish trap, 26 June 1951; 1 spec.

5 Thai-Danish Expedition: Stn. 1178, West Malay Peninsula, 08°27′N 98°12′E, 35 m, trawl, 9 March 1966; 1 spec.

'Ostindien'; 1 spec.

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Mariel King Memorial Expedition-Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 1 spec. — Stn. AW I, Aru Is., W. Wokam, off W. coast of Wasir I., 05°30′S 134°12′E, 39-72 m, dredge hauls 7-10, sand and shell rubble, 15 June 1970; 1 spec.

Remarks. — The rostral spines in these specimens vary from subparallel to divergent. They are less than, or equal to, half the postrostral carapace length, except among the largest males (45-78 mm) where six (out of nine in this size range) have rostral spines up to $^3/_4$ postrostral carapace length.

The supraorbital eave is relatively wide and the preorbital angle is rounded, produced a little laterally and sometimes slightly forwards.

There is a tubercle on the summit of the elevated gastric region, and on the anterior slope there is usually a short spine but sometimes a second tubercle subequal in length to that on the summit. There is a low rounded protogastric tubercle. The branchial region is uniformly elevated (in *H. spinosus*, elevated anteriorly and just dorsal to the epibranchial spine), and the epibranchial spine is short, not more than $^1/_6$ of the carapace width. There is sometimes a very small submarginal tubercle near the anterior border of the branchial region. There is a broad medial tubercle, not a spine as in *H. spinosus*, on the slightly elevated intestinal region.

The anterolateral angle of the basal antennal article is rounded and only slightly produced laterally. Behind it on the lateral edge there is a slight concavity, followed by a wide proximal lobe which is produced much further laterally than the anterolateral angle. The suborbital hiatus is a narrow slit in adults and V-shaped in younger specimens.

The palm of the chela is enlarged in males larger than approximately 40 mm.

The first pleopod of the young males is different from that of the adults. In larger specimens (36-78 mm) the distal half to two thirds of the pleopod is uniformly very slender, with long setae at the proximal third and the apex is turned outwards, as figured by Buitendijk (1939: figs. 1,2) and by Serène & Lohavanijaya (1973: figs. 110-112). In smaller specimens (16-39 mm), the pleopod tapers gradually, the two pleopods touch on the medial line just above their base, curve outward slightly and then curve back towards the medial line, sometimes meeting distally. (This is very similar to the first pleopod figured by Buitendijk (1939: fig. 8) for the smaller specimen of *H. diacanthus*.)

The presence of two large tubercles or a tubercle and a spine on the mesogastric region, distinguishes *H. aries* from the two other species where the male has a similar first pleopod, *H. diacanthus* (with one large and one very small tubercle) and *H. campbelli* (with no tubercles). The first pleopod of an immature male of *H. aries* is similar to that of *H. elatus* but in that species the curvature of the pleopod is different and on the gastric region there is one large and one very small tubercle.

There are some anomalies in relating pleopod development to the size of the animal alone. In one male of 56 mm from the Kai Islands, the first pleopod is the same as that described above for smaller (i.e. less than 40 mm) specimens. The palm of the chela is not inflated and there is only a very small proximal gape between the fingers. A smaller male, 45 mm, from the same area, has the adult form of first pleopod, the palm of the chela is inflated and there is a moderate proximal gape between the fingers.

This series includes records for this species from the new localities of Makassar, Kai Islands, Ambon, N. Sulawesi and the Sulu Archipelago. The specimens from N. Sulawesi and Sulu Archipelago (3 ♂♂, 7 ♀♀, cl. 23-78 mm) all have a strongly developed tubercle or a short spine on the intestinal region, and the preorbital angle of the supraorbital eave is produced slightly forwards.

Hyastenus spinosus A. Milne Edwards is closely related to *H. aries*, *H. diacanthus*, *H. elatus*, and *H. campbelli* and because of the presence of two spines on the mesogastric region, is usually considered to be closest to *H. aries*. There were no specimens of *H. spinosus* in the collections studied but an adult male of *H. spinosus* (AM P.2739, 46.5 mm) from the Arabian Sea was compared with the adult males in this series of *H, aries*, and it differed from them in the following respects:

(1) The intestinal and epibranchial spines are longer. The latter are approximately $^1/_4$ carapace width, and the intestinal spine is about half their length.

(2) The first pleopods are gradually tapering (not very slender in the distal half) and meet in the midline only in the distal (not the proximal) half.

(3) The basal antennal article is not so broad proximally, and there is a U-shaped suborbital hiatus.

(4) The segmental ridges on the sternites are more strongly developed.

Laurie (1906) considered *H. consobrinus* A. Milne Edwards, 1895 to be a synonym of *H. spinosus*, but as *H. consobrinus*, which has not been found since, was collected from off the coast of Chile ('Challenger' Expedition, Stn. 306A) and *H. spinosus* is an Indo-West Pacific species it seems unlikely that they are conspecific.

Calman (1913) pointed out that Rathbun (1897) has confused *Pisa aries* Latreille with *Halimus aries* Guérin, an entirely different species. This was discussed in detail by Griffin (1966d).

Distribution. — South India, Singapore, Sulu Archipelago, Sulawesi, Kai Islands, Ambon and north Australia.

Hyastenus auctus Rathbun, 1916
(Figs. 40e, f, 41a, b)

Hyastenus auctus Rathbun, 1916: 543. — Ward, 1941: 1. — Griffin, 1966b: 281, pl. 15 fig. (a); 1976: 190-191.

Material examined. — 4 ♂♂, 5 ♀♀ (2 ovig.), 5.5-31 mm, smaller ovig. ♀, 22.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, ca. 54 m, dredge, sand, coral, 19 March 1914; 7 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA
Mariel King Memorial Expedition-Moluccas: Stn. KN IV, Kai Is., W. coast of Nuhu Tjut, E. side of Mitduan Reef, 05°32′S 133°E, 36-56 m, (?dredge hauls 3-4), 31 June 1970; 2 specs.

Remarks. — This species is distinguished by the very narrow supraorbital and suborbital hiatuses.

The rostral spines are straight, divergent and slightly greater than half the postrostral length.

The gastric region is elevated, with a single medial tubercle and there is a low rounded protogastric tubercle near the orbit. There is a medial tubercle, or short spine, on the intestinal region and a tubercle just above the small epibranchial spine. These tubercles are well developed and acute in adults, but low and rounded in smaller specimens (cl. 9-15 mm).

The basal antennal article is produced slightly forward at the anterolateral angle. The lateral edge is broadly convex in the proximal half, and separated from the postorbital lobe only by a narrow slit.

The first pleopod of the male is produced laterally into a rounded lobe at the base of the tip. It tapers evenly to the apex, or is weakly curved on the medial edge. This type of pleopod is common to several other species of *Hyastenus*, e.g. *H. hilgendorfi*, *H. sebae*, *H. trispinosus*.

In the smallest male (5.5 mm) in the series of specimens from Sulu Archipelago there is a small accessory spine on the

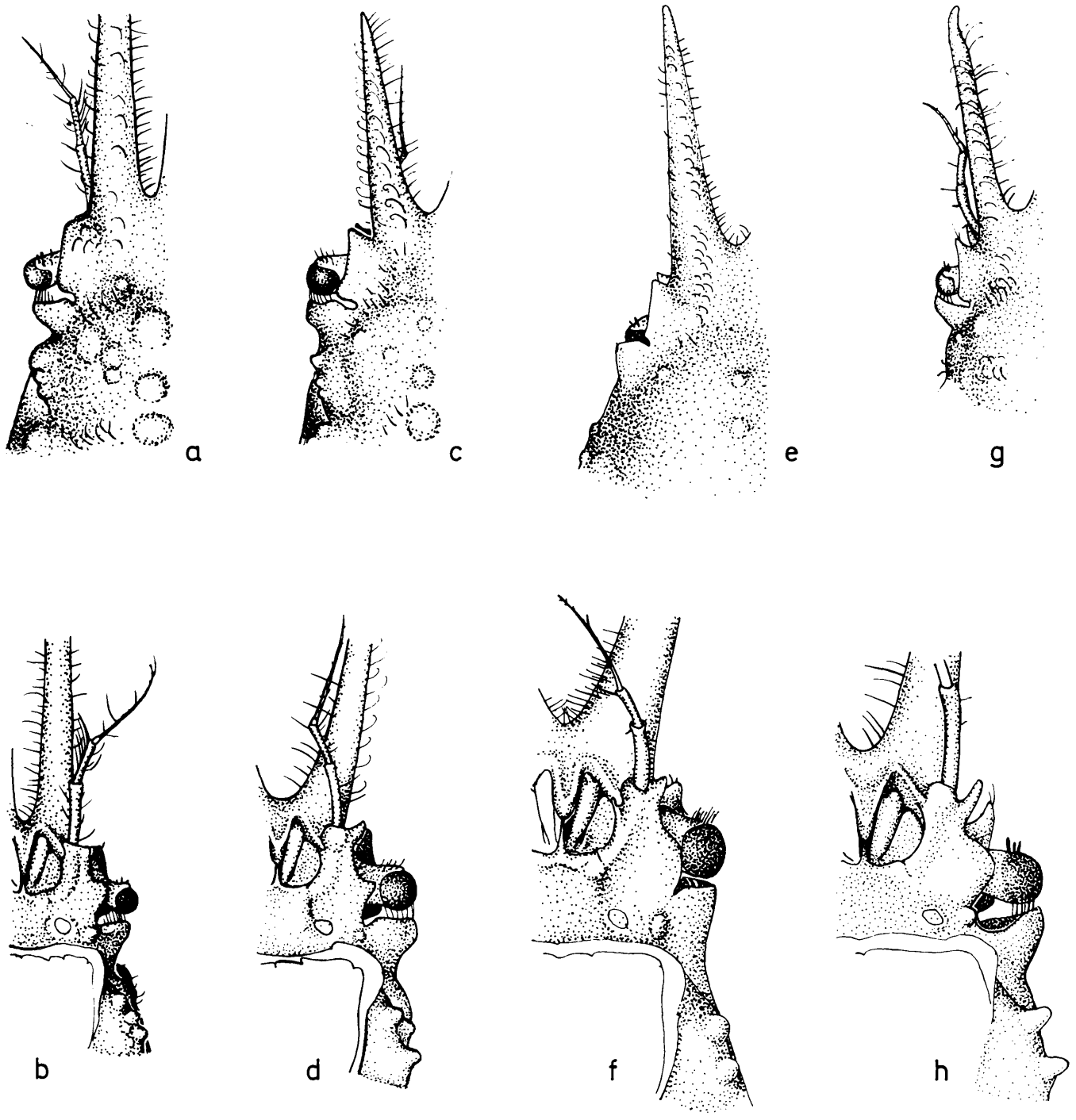


Fig. 40. (*Hyastenus* species of group 1) *Hyastenus whitei* (male, 34.5 mm, Singapore, ZMC) (a) left orbit, dorsal view, (b) ventral view of same; *H. sebae* (male, 22.5 mm, Sulu Archipelago, ZMC) (c) left orbit, dorsal view, (d) ventral view of same; *H. auctus* (male, 28 mm, Sulu Archipelago, ZMC) (e) left orbit, dorsal view, (f) ventral view of same; *H. trispinosus* (male, 12.5 mm, Ambon, ZMA) (g) left orbit, dorsal view, (h) ventral view of same.

anterolateral spine of the basal antennal article and there is a very broad U-shaped hiatus between the basal antennal article and the postorbital lobe. In these features this specimen is similar to *H. minutus* Buitendijk but it differs from the holotype of *H. minutus* (♂, 4.0 mm, Ternate, RML 4309) in having slightly longer, more slender rostral spines and a smaller epibranchial spine. A male of 9 mm from Sulu Archipelago has a small accessory spine on the anterolateral spine of the basal antennal article on the right hand side but not on the left hand side and there is a broad V-shaped lower orbit hiatus; in a small immature female (12.5 mm, Kai Is.) the basal antennal article is similar to the adult and the hiatus of the lower orbit is a narrow V-shaped slit. It is possible that the accessory spine on the anterolateral spine of the basal antennal article in *H. minutus* may also be a juvenile character.

Distribution. — Philippine Islands, Kai Islands, north Western Australia (Cape Jaubert).

Hyastenus biformis Rathbun, 1916
(Figs. 50e, f, 51a, b)

Hyastenus biformis Rathbun, 1916: 545-546. — Griffin, 1976: 191.

Material examined. — 5 ♂♂, 5 ♀♀ (1 ovig.), 5-14 mm, ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM
'Siboga' Expedition: Stn. 64, Flores Sea, Tanahdjampea, Kambaragi Bay, up to 32 m, trawl, dredge and shore exploration, coral, coral sand, 4/5 May 1899; 1 spec. — Stn. 253, Kai Is., 05°48.2′S 132°13′E, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 3 specs. — Stn. 313, Sumbawa, anchorage E. of Dangar Besar, Saleh Bay, up to 36 m, dredge, trawl and reef exploration, sand, coral and mud, 14/16 February 1900; 5 specs.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN
Natural Science Foundation Expedition: Stn. 465-4, Irian Jaya, Padaido I., 1/2 mile (~ 0.8 km) E. of Oerif I., Mios Woendi Lagoon, 6-9 m, coll. Ostheimer, Orr, Powell, 1956; 1 spec.

Remarks. — The two males and four females in this series from Sumbawa and Flores Sea, Indonesia, agree well with the holotype (♂, cl. 13 mm, USNM 48217) from the Sulu Archipelago. The rostral spines are a quarter to a third the postrostral carapace length. The preorbital angle of the supraorbital eave has only a small tubercle and the two lobes on the anterior margin of the postorbital lobe are subequal.

The cardiac region is as strongly elevated as the gastric region. There is a low tubercle on its anterior margin, two submedial tubercles centrally and a medial posterior tubercle.

There are three mesogastric tubercles, not two as in the holotype, and the protogastric tubercle is in line with the anterior of these. On the branchial region there are three to four small tubercles on the margin.

There is a small tubercle low on the margin of the hepatic region. On the branchial submargin there is one small tubercle anteriorly, and in the larger male, another posteriorly.

There are two tubercles on the pterygostomian margin and a small tubercle just dorsal to them.

The tubercles are less pronounced on the female specimens.

The basal antennal article is broad with two blunt subequal lobes on the lateral margin.

On the palm of the male cheliped there is a longitudinal row of sharp granules midway on the inner face, and scattered granules above it and on the dorsal margin.

The specimens from Irian Jaya and Kai Islands (3 ♂♂, 1 ovig. ♀, cl. 5-14 mm) have more tubercles on the carapace. As well as those mentioned, there is an inner pair of protogastric tubercles, there are two or three small tubercles dorsally on the hepatic region and an arc of three or four tubercles on the branchial submargin. The rostral spines are longer (half to two thirds postrostral carapace length) in the two large males (12, 14 mm), and the anterior margin of the postorbital lobe is straighter distally. The lobes on the lateral margin of the basal antennal article are slightly shorter and the anterior one directed more laterally. The first pleopod of the male is not so narrow distally as it is in the holotype and the males from Sumbawa.

H. biformis is similar to *H. fraterculus* but that species has a much shorter rostrum (only about a sixth postrostral carapace length), the preorbital angle is more acute and there are eight to nine tubercles on the branchial margin. *H. scrobiculatus* is distinguished from *H. biformis* by the sharper projections on the lateral margin of the basal antennal article and the presence of only one tubercle on the cardiac region.

This species was previously known only from the Sulu Archipelago, Philippine Islands.

Distribution. — Sumbawa, Flores Sea, Kai Islands, Irian Jaya, Sulu Archipelago.

Hyastenus bispinosus Buitendijk, 1939
(Fig. 41c, d)

Hyastenus bispinosus Buitendijk, 1939: 241, fig. 4, pl. 9 figs. 4, 5.

Material examined. — 3 ♂♂, 1 ovig. ♀, 6-12.5 mm, ovig. ♀, 10.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM
'Siboga' Expedition: Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Ambon, Ambon reef; 2 specs.
Banda, on the shore; 1 spec.

Remarks. — These specimens agree well with the type material at the Rijksmuseum van Natuurlijke Historie, Leiden (RML 4301, 1 (juv.) ♀, 7.5 mm (holotype), 2 ♂♂, 5.5, 6.0 mm (paratypes)).

The preorbital angle of the supraorbital eave is produced obliquely forward, while the antorbital angle is only rounded and not produced. The hiatus between this and the postorbital lobe is narrow and U-shaped.

The gastric regions are strongly elevated with one low rounded protogastric tubercle but no mesogastric tubercles. The cardiac region of the ovigerous female is rounded and slightly elevated.

Most of these specimens are larger than those described by Buitendijk, and in all of them, there is a tubercle just dorsal to the epibranchial spine, which is larger than in the type material.

The basal antennal article has a very short blunt tooth directed forwards on the anterolateral angle, and the proximal part of the lateral margin is broadly convex.

The palm of the chela of the larger males is slightly inflated, its length is approximately twice the width, and there is a small proximal gape between the dactyl and the fixed finger.

The first pleopod of the male is similar to that of *H. sebae*, the tip being produced into a broad lobe on the lateral edge.

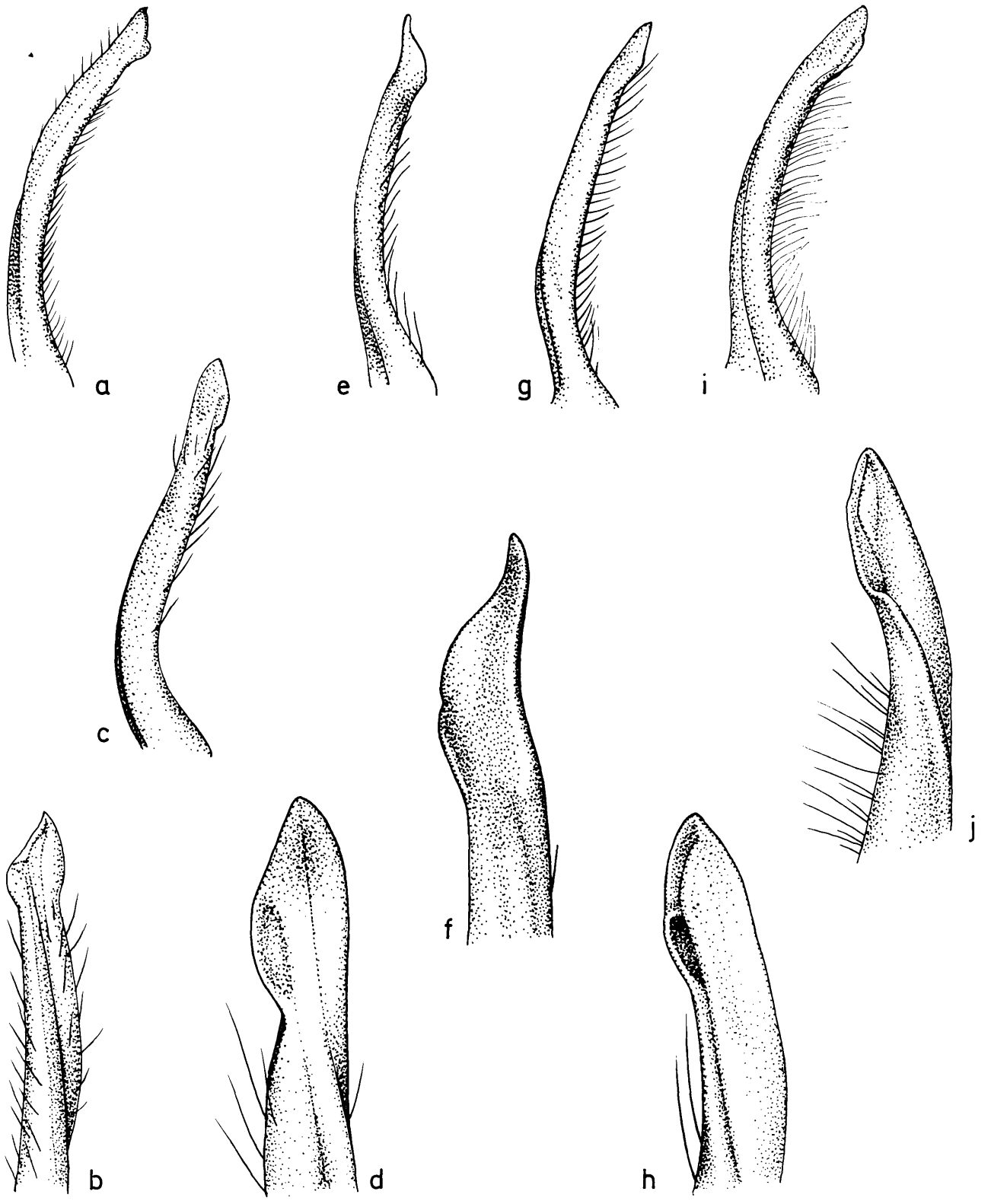


Fig. 41. (*Hyastenus* species of group 1) Left first pleopod of male of *Hyastenus auctus* (28 mm, Sulu Archipelago, ZMC) (a) abdominal view of pleopod, (b) sternal tip of same; *H. bispinosus* (12.5 mm, Ambon Reef, ZMA) (c) abdominal view of pleopod, (d) sternal tip of same; *H. trispinosus* (12.5 mm, Ambon, ZMA) (e) abdominal view of pleopod, (f) sternal tip of same; *H. sebae* (22.5 mm, Jolo, ZMC) (g) abdominal view of pleopod, (h) sternal tip of same; *H. whitei* (34.5 mm, Singapore, ZMC) (i) abdominal view of pleopod, (j) sternal tip of same.

The small male (cl. 6 mm) of which Buitendijk figured the pleopod (text fig. 4) is perhaps an immature animal.

Distribution. — Ambon, Banda, Timor, Lembeh Strait.

Hyastenus borradailei (Rathbun, 1907)
(Figs. 38a, b, g, 39a, 42a, b)

Halimus borradailei Rathbun, 1907: 64; 1911: 251-252, pl. 20 fig. 5.
Hyastenus borradailei. — Rathbun, 1924: 4.
Hyastenus brockii. — Campbell & Stephenson, 1970: 256, 258, fig. 24. — Takeda, 1973a: 103-104, fig. 2C, F, pl. 3 fig. A. (Not *Hyastenus brockii* De Man, 1888.)

Material examined. — 14 ♂♂, 17 ♀♀ (6 ovig.), 8-35 mm, smallest ovig. ♀, 14.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2'S 127°18.4'E, 27-54 m, trawl and dredge, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Stn. 315, Flores Sea, anchorage E. of Sailus Besar, Paternoster Is., up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Banda Sea, Banda, off Neira, 5 m, sand, 9 June 1922; 1 spec. — Banda Sea, Banda, off Neira, 13 m, dive, sand, 12 June 1922; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Moreton Bay, Stradbroke I., subtidal, coll. K. Deacon, September-October 1968; 1 spec. (AM P.16789). — Wistari Reef, from 6 month algal panels, coll. R. Day, 2 July 1974; 1 spec. (AM P.29892). — Heron I., reef, 11 m, off gorgonid coral *Mopsella ellesi*, coll. K. Gillet, December 1961; 1 spec. (AM P.29888). — Heron I., channel, 7.5 m, in cave, at night, coll. R. Day, January 1975; 4 specs. (AM P.29891). — Heron I., reef, 10 m, at night, coll. N. Coleman, July 1976; 1 spec. (AM P.29894). — Heron I., 10 m, reef, coll. N. Coleman, 3 August 1977; 1 spec. (AM P.29893). — Townsville, Broadhurst Reef, 10.5 m, on coral behind SW. face, at night, coll. I. Loch, 11 October 1975; 2 specs. (AM P.24104). — Lizard I., reef, coll. G. Anderson; 1 spec. (AM P.29885). — Lizard I., outside reef between Bird I. and South I., 10.5 m, in blocks of dead *Porites lutea*, coll. P. Hutchings and P. Weate, June 1977; 2 specs. (AM P.29889). — Lizard I., outside reef between Bird I. and South I., 10.5 m, in blocks of dead *Porites lutea*, coll. P. Hutchings and P. Weate, April 1978; 1 spec. (AM P.29890). — Torres Strait, Murray I., coll. M. Ward, 10 November 1930; 2 specs (AM P.29887, dry).

Western Australia: Ninety Mile Beach between Broome and Wallal, about 14 m, dredge, coll. R. Bourne, 1930; 1 spec. (AM P.9916). — Ninety Mile Beach, between Cape Jaubert and Wallal, 9 m, dredge, coll. A. A. Livingstone, September 1929; 2 specs. (AM P.13893). — Ninety Mile Beach, 25 m, from pearl shells, coll. B. E. Bardwell; 7 specs. (AM P.29886, dry, det. M. Ward).

Remarks. — This species was originally figured as *Hyastenus elegans* var. *tenuicornis* by Borradaile (1900: 574, pl. 40 fig. 2) with only a few remarks; Rathbun (1907, 1911) added only a few descriptive notes. The specimen recorded by Rathbun (1907) from the Ellice Is. (Tuvalu) (♀, 9.9 mm, USNM 33391) and the specimen from Amirante figured by Rathbun (1911) (ovig. ♀, 13 mm, USNM 41407) have been examined by one of us (D.J.G.G.).

In the three very similar species *H. borradailei*, *H. brockii* De Man and *H. uncifer* Calman the first pleopod of the male is straight or weakly curved outwards, broad, tapering only near the apex; one of the edges (lateral, medial or sternal) of the tip is straight or weakly convex, the other edge being produced into a broad, rounded lobe. The aperture is on the surface on, or near, the anterior part of this lobe. In *H. brockii* the aperture is on the sternal surface, in *H. uncifer* it is almost lateral, while in *H. borradailei* and *H. 'uncifer'* (as figured by Guinot) the aperture is on the abdominal surface.

The first pleopod of the male in this series of specimens is broad and straight with a sharp or subacute apex on the lateral edge and behind it, on the medial edge, a broad lobe; the aperture is midway along the lobe on the abdominal surface. The first pleopod of the male specimens figured as *H. brockii* by Campbell & Stephenson (1970) and by Takeda (1973a) differ from the pleopod figured by Buitendijk (1939: text fig. 3) for that species. However, the pleopods do agree with the pleopod described above for *H. borradailei* (discussed under *H. brockii*). Therefore we consider Campbell & Stephenson's specimen and Takeda's specimen to be properly referable to *H. borradailei*.

In this series the rostral spines are equal to, or slightly greater than, (1.0 to 1.3) the postrostral carapace length. The preorbital spine is sharp, directed forwards and horizontal; the antorbital angle is only very weakly produced; the anterior margin of the postorbital lobe is slightly sinuous. The eyestalks are only moderately stout and the cornea is not noticeably large. There is a tubercle on the hepatic region and a small tubercle on the branchial submargin anteriorly, which is only about half the size of the anterior pterygostomian tubercle. The six tubercles on the gastric regions are not always all distinct: sometimes the two mesogastric tubercles are low and the inner protogastric tubercle is small. As well as the two anterior tubercles on the dorsal branchial region, there is a tubercle medial to the short epibranchial spine. On the basal antennal article the anterolateral spine is short and directed forwards; the proximal lobe on the lateral margin is weakly convex but extends laterally beyond the anterolateral spine; the postorbital lobe is separated by a shallow U-shaped hiatus. The first ambulatory leg is about twice (1.9 to 2.2) the postrostral carapace length, the merus has a large blunt tubercle; the dactyl is slender (length about ten times height) and armed with eight to ten small spines, all except the most distal being directed obliquely backwards towards the propod. On the dactyl of the fourth ambulatory leg there are five to six long spines, the proximal three to four of which are sloped towards the propod, but not as strongly as those in *H. uncifer*. In three male specimens (16 mm, Sumbawa; 17 mm, Ninety Mile Beach; 35 mm, Heron I.) there is a blunt proximal tubercle dorsally on the palm of the chela.

This species is similar to *H. brockii* but can be distinguished from it by the preorbital spine which is horizontal, rather than upturned; by the sinuous anterior margin of the postorbital lobe (nearly straight in *H. brockii*); and by the first pleopod of the male with a broad medial, rather than a lateral lobe. As well, the eyes are not so large as are those of *H. brockii* and the dactyl of the first ambulatory leg is more slender.

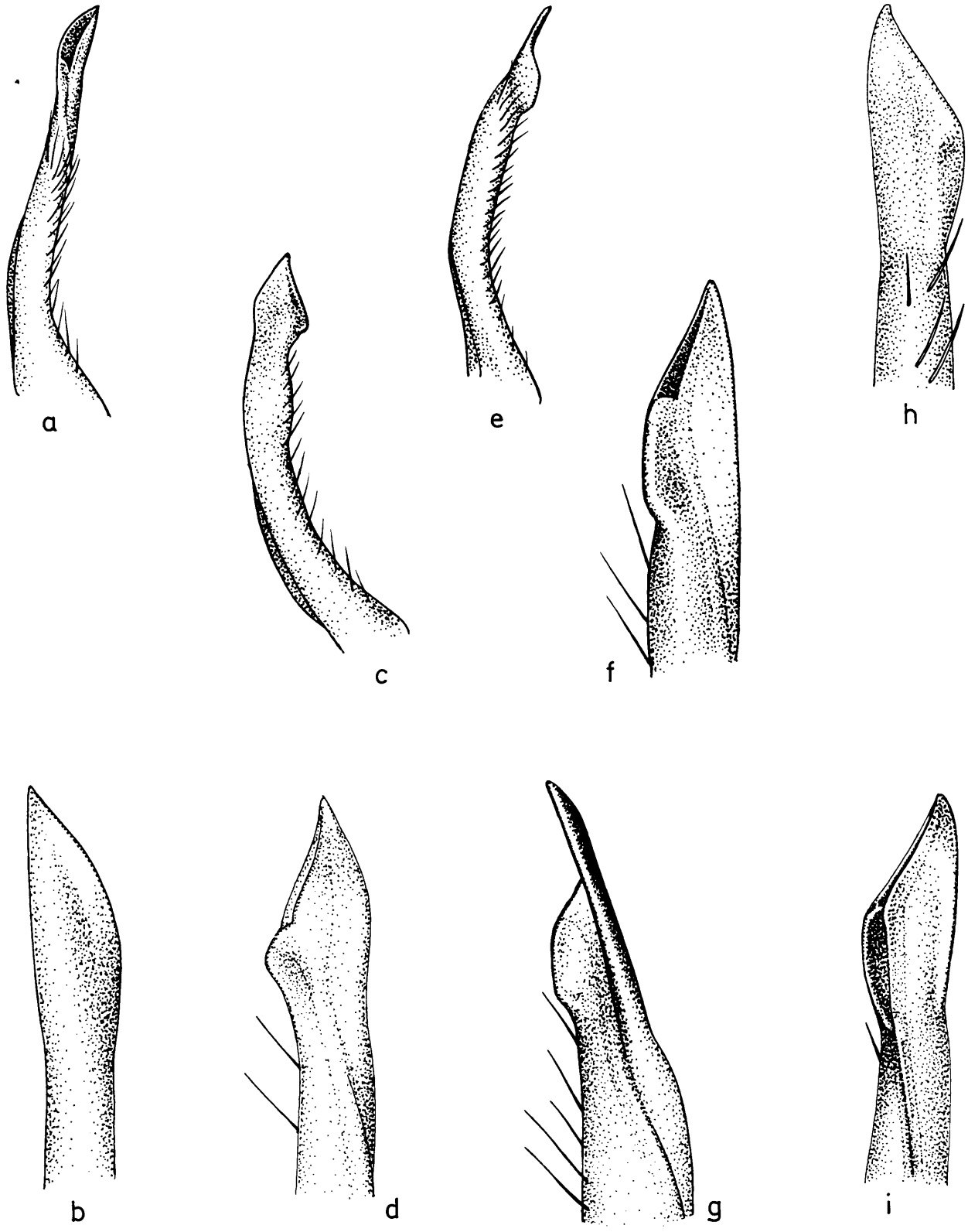


Fig. 42. (*Hyastenus* species of group 1) Left first pleopod of male of *Hyastenus borradailei* (35 mm, AM P.29891, in part) (a) abdominal view of pleopod, (b) sternal tip of same; *H. brockii* (11.5 mm, S. Sulawesi, ZMA) (c) abdominal view of pleopod, (d) sternal tip of same; *H. uncifer* (17 mm, Haingsisi Reef, ZMA) (e) abdominal view of pleopod, (f) tip of pleopod, lateral view, (g) sternal tip of same; *H. hilgendorfi* (28 mm, Jolo, ZMC) (h) abdominal tip of pleopod, (i) sternal tip of same.

The differences which distinguish this species and *H. brockii* from *H. uncifer* are discussed under *H. brockii*.

Distribution. — Amirante, Cargados Carajos, northern Australia from Ninety Mile Beach (Western Australia) to Moreton Bay (Queensland), Indonesia, Tuvalu (Ellice Is.), Japan.

Hyastenus brockii De Man, 1888
(Figs. 38c, d, h, 39b, 42c, d)

Hyastenus Brockii De Man, 1888: 221-223, pl. 7 fig. 1. — Calman, 1900: 36.
Hyastenus brockii. — Buitendijk, 1939: 239-241, text fig. 3.

Material examined. — 3 ♂♂, 8 ♀♀ (2 ovig.), 8-19 mm, smaller ovig. ♀, 15 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM
'Siboga' Expedition: Stn. 66, S. Sulawesi, S. of Saleyer, bank between islands of Bahuluwang and Tambulungen, 8-10 m, dredge, dead coral, *Halimeda*, *Lithothamnion*, 7/8 May 1899; 2 specs. — Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Ambon, Ambon reef; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Danish Kei Islands Expedition: Banda Islands, off Waling, ca. 15 m, sand, 15 May 1922; 2 specs. — Banda, off Neira, ca. 10 m, dive, sand, 5 June 1922; 1 spec. — Banda, off Neira, ca. 15 m, dive, sand, 9 June 1922; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH
Sulu Archipelago, Basilan Straits, W. of Malanipa I., 23 m, sand and rubble, coll. B. R. Wilson, 'Pele', 12 February 1964; 1 spec. (WAM 92-71, in part).

Remarks. — This species is very similar to *Hyastenus borradailei* (Rathbun): unfortunately the original descriptions and figures for both species are inadequate. Buitendijk (1939) identified two specimens (♂, 16 mm, Ternate; ovig. ♀, 16.5 mm, Ambon, RML) as *H. brockii*, and figured the abdominal view of the tip of the left first pleopod of the male. One of us (D.J.G.G.) has examined these specimens. We accept the identification by Buitendijk as valid and regard the male specimens in our series with a similar pleopod (a sharp medial apex, a broad lateral lobe and the aperture on the sternal surface) as belonging to *H. brockii*.

The specimens discribed and figured as *H. brockii* by Campbell & Stephenson (1970: 256, 258, fig. 24) and by Takeda (1973a: 103-104, fig. 2C, F, pl. 3 fig. A) have a first pleopod in the male with a narrow lateral apex, a broad medial lobe and the aperture is on the abdominal surface. These specimens are included by us in *H. borradailei* and are discussed under that species. The differences and similarities of the male pleopods of these two species and *H. uncifer* are discussed under *H. borradailei*.

H. brockii and *H. borradailei* are similar to *H. uncifer* Calman but are distinguished from that species by having a tubercle, rather than a spine, on the hepatic and intestinal regions; the presence of two tubercles, rather than one, on the anterior part of the dorsal branchial region; and the proximal lobe on the basal antennal article is produced further laterally than the anterolateral spine.

The differences which distinguish *H. brockii* from *H. borradailei* are discussed under *H. borradailei*.

In this series the rostral spines are usually shorter (0.66 to 0.75) than the postrostral carapace length but in three specimens they are subequal to the postrostral carapace length. The preorbital spine is sharp, directed forwards and slightly upwards; the anterior margin of the postorbital lobe is nearly straight. The eyestalk is stout and the cornea is conspicuously large as in *H. uncifer*.

On the gastric region of these specimens the protogastric tubercle near the orbit is quite distinct, the inner protogastric tubercle is sometimes absent, and the two mesogastric tubercles are low. The first ambulatory leg is usually less than twice (1.6 to 2.1) the postrostral carapace length, there is a short terminal spine and, in most specimens, a low proximal tubercle on the merus; the dactyl is moderately slender (length about seven times height), with seven to eight straight, or slightly oblique, spines ventrally. On the dactyl of the fourth ambulatory leg there are five to seven long spines of which only some of the proximal ones are directed backwards toward the propod.

Distribution. — Sulu Archipelago, Ternate, Ambon, Banda, Timor, Torres Strait, S. Sulawesi.

Hyastenus campbelli new species
(Figs. 43, 46b, 47h-j)

Hyastenus sp. — Campbell & Stephenson, 1970: 258-259, fig. 27.

Material examined. — 45 ♂♂, 54 ♀♀ (11 ovig.), 9-52 mm, smallest ovig. ♀, 22 mm.

Holotype. — Male, cl. 47.5 mm, Queensland, SE. corner Gulf of Carpentaria, 22 m, coll. D. F. McMichael and J. C. Yaldwyn, December 1963, CSIRO Prawn Survey; The Australian Museum, Sydney, AM P.29906.
Paratypes. — As listed below.

ZOOLOGICAL MUSEUM, AMSTERDAM
Aru Is., Jedan, 10 February 1907; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN
Danish Kei Islands Expedition: Stn. 66, Java, Pula Balu, 05°54′S 106°12′E, 24 m, trawl, sandy mud, shells, 27 July 1922; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN
Irian Jaya, S. of Merauke, 'De Goede Hoop', March-April 1955; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA
Mariel King Memorial Expedition-Moluccas: Stn. AW I, Aru, Wokam, off W. coast of Wasir I., 05°30′S 139°12′E, 54-57 m, dredge haul 5, mud, 15 June 1970; 2 specs. — Stn. AN I, Aru, S. Trangan I., SW. of Tg. Ngabordamlu, centred near 06°58′S 134°05′E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 1 spec. — Stn. A III, Aru, Trangan, 3-4 miles (∿ 5-6.5 km) W. of Tg. Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 1 spec.

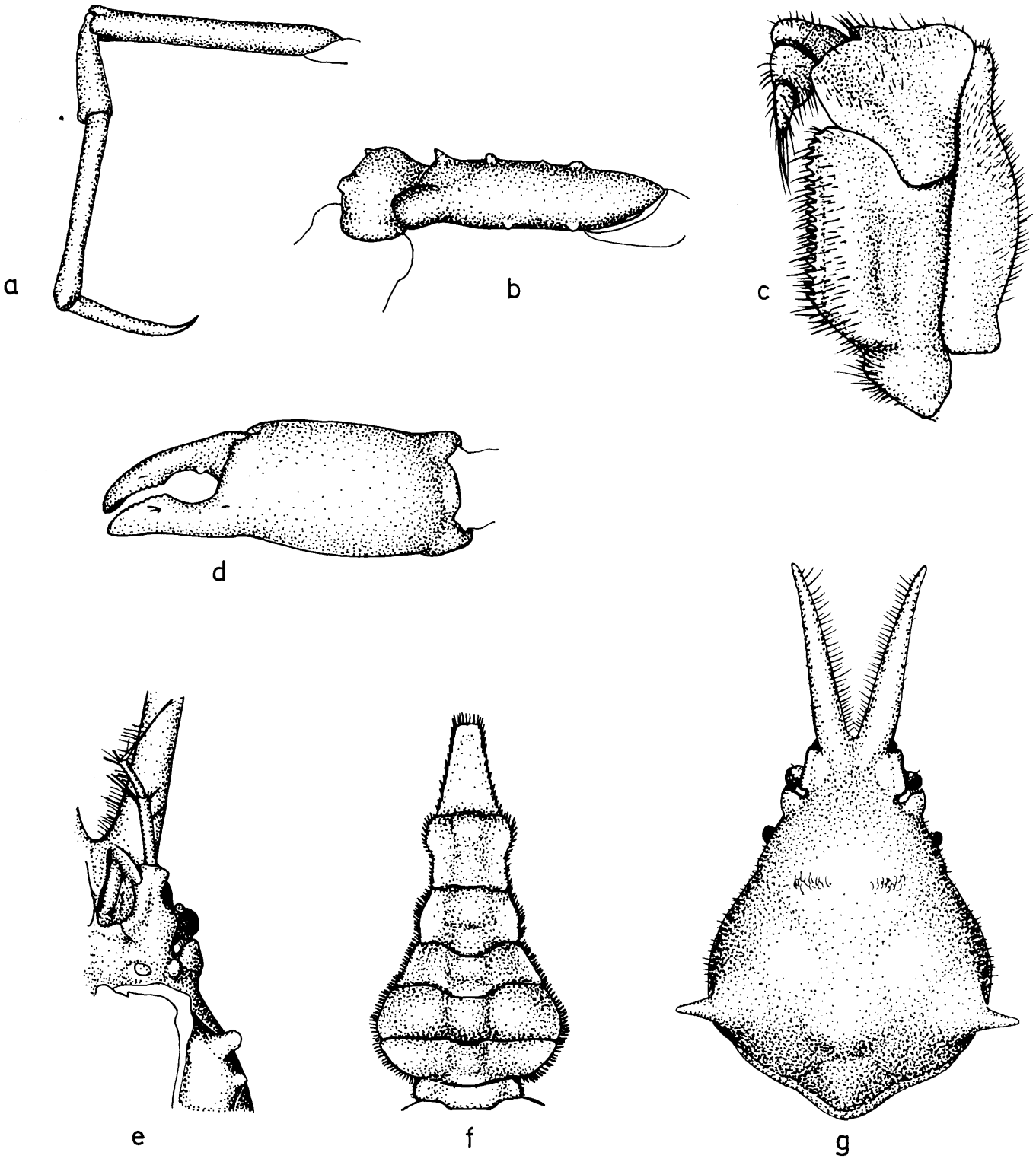


Fig. 43. (*Hyastenus* species of group 2) *Hyastenus campbelli* (holotype) (a) left first ambulatory leg; (b) left cheliped, merus and carpus; (c) left third maxilliped; (d) left chela; (e) left orbit, ventral view; (f) male abdomen; (g) carapace, dorsal view.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: mouth of Mary River, 4 m, 6 June 1946; 3 specs. (AM P.11906). — Off Bundaberg, 14-45 m, coll. A. Carter, December 1963; 1 spec. (AM P.18545). — Port Curtis, 7 m, coll. A. R. McCulloch and E. Troughton, August 1912; 1 spec. (AM P.3150). — Port Curtis, 11 m; 1 spec. (AM P.1960). — Port Curtis, 7 m, coll. A. R. McCulloch and E. Troughton, August 1912; 1 spec. (AM P.3151). — Port Curtis, Facing I., off Gatcombe Head, 16-22 m, dredge, coll. M. Ward, December 1929; 15 specs. (AM P.29908). — Port Curtis, dredged off Gatcombe Head, 16-21 m, coll. M. Ward and W. Boardman, July 1929; 12 specs. (AM P.29904). — Curtis I., northwest Channel, 5.4 m, dredge, coll. M. Ward, 1928; 1 spec. (AM P.29910). — Keppel I., 1 1/2 miles (~ 2.5 km) NW., 12-20 m, coll. W. F. Ponder and T. Nielson, 4 July 1969; 2 specs. (AM P.29909). — Great Keppel I., 8 m, sand and rubble, coll. N. Coleman, 12 September 1974; 2 specs. (AM P.20477). — Swain Reefs, dredged off Gillett Cay, 54-72 m, October 1962; 4 specs. (AM P.29903). — N. of Mackay, Repulse

Bay, 14 m, trawl, October 1954; 1 spec. (AM P.12953). — Whitsunday Group, Black I., near Langford Reef, shallow water, coll. N. Coleman, November 1969; 1 spec. (AM P.19505). — Port Denison, intertidal, among stones and dead coral; 1 spec. (AM P.6954). — Port Denison; 1 spec. (AM P.170). — Port Denison; 3 specs. (AM P.1910). — S. of Townsville, Chunda Bay, 9 m, prawn trawl, coll. C. Wilson, April 1967; 1 spec. (AM P.29907). — Albany Passage, coll. M. Ward, August/September 1928; 21 specs. (AM P.15236). — SE. corner Gulf of Carpentaria, 16°57.3′S 139°40.4′E, 12 m, CSIRO Prawn Survey, Stn. 51, 13 August 1963; 1 spec. (AM P.18593). — SE. corner Gulf of Carpentaria, 17°18.7′S 139°37.8′E, 4 m, CSIRO Prawn Survey, Stn. 449, 8 December 1963; 1 spec. (AM P.18562). — SE. corner Gulf of Carpentaria, CSIRO Prawn Survey, 1963-64; 1 spec. (AM P.18570). — SE. corner Gulf of Carpentaria, data as for holotype; 7 specs. (AM P.29905).

Northern Territory: entrance to Port Darwin, intertidal on rocky reef shore, coll. A. A. Livingstone, June-Ocotber 1929; 2 specs. (AM P.13879).

Western Australia: Broome, June 1932; 2 specs. (AM P.10240). — Broome, dredge, coll. R. Bourne; 1 spec. (AM P.10194). — Near entrance to Roebuck Bay, 9-14 m, *Lithothamnion* reef bottom, coll. A. A. Livingstone, 26 September 1929; 1 spec. (AM P.13884). — Between Cape Bossut and Broome, 9 m, coll. A. A. Livingstone, 11 September 1929; 1 spec. (AM P.13885). — Between Broome and Wallal, (off Ninety Mile Beach), 12 m, dredge, coll. R. Bourne, 1931; 1 spec. (AM P.10022).

WESTERN AUSTRALIAN MUSEUM, PERTH

SE. Gulf of Carpentaria, 16°52′S 140°09′25″E, 4 m, 'Rama', CSIRO Gulf of Carpentaria Prawn Survey, 29 November 1964; 1 spec. (WAM 91-71).

Description. — Carapace pyriform, widening posteriorly, width about three quarters (0.76) postrostral carapace length, surface smooth, covered by a short tomentum; a strong epibranchial spine, no tubercles.

Rostral spines straight, short, less than half (0.4 to 0.47) postrostral carapace length, divergent, cylindrical, tapering to blunt apices.

Orbital eave moderately expanded, preorbital angle not or only weakly produced; margin of eave straight; antorbital angle not produced, rounded; postorbital lobe separated from eave by a narrow U-shaped hiatus; postorbital lobe moderately produced, anterior margin weakly convex. Eyestalks short, moderately slender; cornea terminal.

Hepatic region flat, smooth. Branchial submargin without tubercles; a strong epibranchial spine directed laterally.

Gastric regions hardly elevated, smooth, without tubercles, a transverse row of curled hairs on posterior protogastric region.

Cardiac region smooth, flat, hardly elevated. Intestinal region with a weak central elevation.

Branchial regions smooth, flat.

Basal antennal article narrow, smooth, anterolateral angle only weakly produced laterally, rounded; lateral margin sinuous, weakly concave behind anterolateral angle, proximal two-thirds produced into a broad convex lobe, greatest width at about proximal third; lower orbit hiatus broad, U-shaped. A blunt tubercle lateral to green gland.

Pterygostomian region smooth, margin with two tubercles, anterior about twice as high as posterior.

Third maxilliped smooth, ischium with central groove; anterolateral angle of merus moderately produced and rounded. Anterolateral angle of mouthfield moderately produced, oblique.

Cheliped of male about as long (1.2) as postrostral carapace length; merus with three small tubercles dorsally and a small terminal spine, two small tubercles ventrally on outer face; carpus with two dorsal tubercles; length of palm about one and a half (1.7) times height; fingers about two thirds (0.68) palm, strongly gaping in proximal half, a proximal tooth on dactyl in gape, uniform small teeth on both fingers in distal half.

Ambulatory legs slender, smooth; first leg about twice (2.1) postrostral carapace length, merus with a low terminal tubercle; fourth leg about equal to postrostral carapace length and about half as long as first leg, dactyl smooth.

Sternum of male smooth, first sternite with strong lateral ridge, a ridge around anterior margin of abdominal fossa to posteromedial angle of sternite.

Male abdomen of seven segments, third segment with rounded elevations laterally, width about twice (2.1) that of sixth segment; sixth segment about as wide as long, lateral margin convex in distal half; length of seventh segment about one and a half (1.6) times basal width, tip truncate.

First pleopod of adult male broad in proximal half with many long setae, curved toward midline; distal half filiform, straight. First pleopod of juvenile male tapering gradually, distally slender but not filiform; left and right pleopods meeting on midline not far above their base, curving slightly outwards, and then curving inwards distally, sometimes meeting at apex.

Female abdomen smooth, with a low, broad medial ridge, segments four to six fused, suture visible in midline only, a broad, low tubercle near posterolateral angle of fourth and fifth segments.

Female gonopore a suboval aperture, narrower laterally, margins high and rounded, lateral half of aperture almost covered by a lobe extending forward from posterior margin.

Remarks. — This species is similar to *H. diacanthus* (De Haan), *H. elatus* n.sp. and *H. cracentis* n.sp. but is distinguished from them by the absence of tubercles from both protogastric and mesogastric regions. The other differences which distinguish this species from *H. cracentis* are discussed under that species.

Campbell & Stephenson (1970) have listed the points that distinguish this species from *H. elatus*, which occurs over a similar geographic range, including the U-shaped hiatus on the lower orbit (rather than a slit or narrow V-shaped); and the seventh segment of the male abdomen which is about one and a half times longer than the basal width (rather than wide as long). Campbell & Stephenson also noted that the rostral spines are shorter in this species than in *H. elatus*: whilst this is usually so it is not true for all the specimens in our series. The first pleopod of the adult male of both this species and *H. elatus* are figured by Campbell & Stephenson, and are quite clearly different from each other. As well, it can be pointed out that the margins of the female gonopore are strongly elevated and rounded, not low as in *H. elatus* and *H. diacanthus*.

In this species, as in *H. aries* and *H. diacanthus*, the adult male has a different form of pleopod from that of the young male. The first pleopod of the adult male (cl. 20.5 mm), described by Campbell & Stephenson, is broad proximally and filiform distally. A male (28 mm) from Irian Jaya has a similar pleopod and so do 14 adult males (cl. 30-50 mm) in the Australian Museum's collection. The distal two thirds of the pleopod is even more filiform than that of *H. diacanthus*. The juvenile males from Java (cl. 16.5 mm) and the Gulf of Carpentaria (32 mm), together with others in the Australian Museum (cl. 9-33 mm) have a pleopod which tapers more gradually over the whole length and is slender but not filiform distally; the two pleopods meet on the midline not far above their base, curve slightly outwards at first and then inwards distally, sometimes meeting at their apex.

The new species is named for Mr Bruce Campbell, Queensland Museum, who has made numerous contributions to the knowledge of Moreton Bay and other Queensland species of Brachyura.

Distribution. — Irian Jaya, Aru Islands, Java, northern Australia from Moreton Bay (Queensland) to Ninety Mile Beach (Western Australia).

Hyastenus convexus Miers, 1884
(Fig. 48d, e)

Hyastenus (*Chorilia*) *convexus* Miers, 1884: 196, pl. 18 figs. B, b.
Hyastenus convexus. — De Man, 1902: 664-666, pl. 22 fig. 32. — Balss, 1935a: 123, 124. — Griffin, 1974: 14; 1976: 191-192.
Hyastenus tuberculosus Rathbun, 1916: 543-544.

Material examined. — 24 ♂♂, 24 ♀♀ (10 ovig.), 4-24.5 mm, smallest ovig. ♀, 10.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Sumbawa, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 2 specs. — Stn. 80, Borneo Bank, 02°25′S 117°43′E, from 50-40 m, trawl, fine coral sand, 13 June 1899; 1 spec. (ZMA De.100.629 — in part). — Stn. 204, S. Sulawesi, between islands of Wowoni and Butung, N. entrance of Butung Strait, 04°20′S 122°58′E, 75-94 m, dredge and townet, sand with dead shells, 20 September 1899; 1 spec. — Stn. 274, Aru Is., 05°28.2′S 134°53.9′E, 57 m, Blake dredge, sand and shells, stones, 26 December 1899; 1 spec. — Stn. 299, Timor, S. coast of Roti I., Boeka Bay or Cyrus Bay, 10°52.4′S 123°1.1′E, 34 m, dredge, reef exploration, diving, mud, coral and *Lithothamnion*, 27/29 January 1900; 1 spec.

N. Sulawesi, Kuandang Bay, 540-720 m, coll. van Nouhuys, 20 April 1914; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Japan, off Goto, 33°10′N 129°18′E, 72 m, 7 January 1897; 2 specs. — Formosa Strait, 45 m, 23 May 1897; 2 specs. — off Fuchou, 26°10′N 121°E, 79 m, coll. Capt. Christiansen, 'Store Nordiske', 5 August 1912; 1 spec.

South India, Pamban, 3-5 m, April 1889; 1 spec.

Mortensen Pacific Expedition: Mindanao, 6 miles (∿ 10 km) NNE. of Sacol, ca. 63 m, trawl, 6 March 1914; 1 spec. — Sulu Archipelago, off Jolo, ca. 36 m, dredge, *Lithothamnion*, 17 March 1914; 1 spec. — Sulu Archipelago, off Jolo, 54 m, dredge, sand, coral, 19 March 1914; 3 specs.

Danish Kei Islands Expedition: Ambon, Ambon Bay, ca. 126 m, dredge, sand, stone, 21 February 1922; 4 specs. — Ambon, Ambon Bay, ca. 126 m, dredge, stones, sand, 22 February 1922; 2 specs. — Ambon, Ambon Bay, ca. 126 m, dredge, stones, gravel, 23 February 1922; 1 spec. — Ambon, Ambon Bay, 90 m, dredge, stones, sand, 2 March 1922; 6 specs. — Ambon, Ambon Bay, 90 m, dredge, stones, sand, 3 March 1922; 3 specs. — Stn. 15, Kai Is., S. of Doe Roa, ca. 20-5 m, trawl, sand, 10 April 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AH I, Haruku I., (E. of Ambon) near Tg. Bt. Kapal, 03°36′S 128°24′E, 119-126 m, dredge haul 6, 31 May 1970; 1 spec. — Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°08′E, 36-47 m, dredge hauls 7-9, coral, sponge, coarse sand, *Lithothamnion* and rubble, 1-2 June 1970; 1 spec. — Stn. KR VII, Kai Is., between Du Rowa and Kai Dulah Is., 05°32′S 132°46′E, 32-36 m, dredge haul 3, muddy sand and sponge, 11 June 1970; 1 spec. — Stn. KN II, Kai Is., W. coast of Nuhu Tjut, off Elat Bay, 05°40′S 132°59′E, 48-63 m, dredge hauls 3-4, rubble, fan coral, green algae and sand, 13 June 1970; 1 spec. — Stn. KN II (as above), 81-83 m, dredge haul 5, coarse sand and rubble, barren, 13 June 1970; 1 spec. — Stn. KN II (as above), 48-54 m, dredge haul 6, rubble, algae and sand, 13 June 1970; 3 specs. — Stn. AW I, Aru Is., W. Wokam, off W. coast of Wasir I., 05°30′S 134°12′E, 54-57 m, dredge haul 5, mud, 15 June 1970; 1 spec. — Stn. AW I (as above) 32-39 m, dredge haul 6, sand and shell rubble, 15 June 1970; 1 spec. — Stn. AW IV. Aru Is., Wokam, off W. end Udjir I., 05°37′S 134°10′E, 68-93 m, dredge hauls 4-7, mud and rubble, 16 June 1970; 1 spec. — Stn. AM II, Aru Is., Maikoor, approx. 8 miles (∿ 13 km) SW. of Tg. Ratoe, centred at 06°07′S 133°57′E, 45-75 m, dredge hauls 1-4, sand and rubble, 18 June 1970; 1 spec. — Stn. B, Northern Territory, Clarence Straits, 27-57 m, dredge, mud, 30 June 1970; 1 spec.

Remarks. — In these specimens the rostral spines are slender and divergent, and vary from less than half to just greater than half the postrostral carapace length. The supraorbital eave is expanded, but the preorbital angle is not produced forward except in four specimens (16.5-20 mm) from off southern Japan and the Formosa Straits. The hiatus between the supraorbital eave and the postorbital lobe is keyhole-shaped. The medial part of the 'hole' is circular, or is longer on the anteroposterior axis (not transversely).

The carapace is covered with swollen setae which are longer on the tubercles and angles of the upper orbit. These setae are present in longitudinal rows on the ambulatory legs and cheliped, including the cheliped palm.

There are two mesogastric tubercles and one protogastric tubercle near the orbit. There is a small dorsal tubercle on the rounded hepatic region.

There is a row of three tubercles on the branchial margin, two on the anterior half and the third on the posterior half. This posterior tubercle is never in any way produced to form an epibranchial spine. On the branchial submargin there is only one very small tubercle near the anterior border.

The anterolateral spine of the basal antennal article is blunt, narrow, directed almost laterally and slightly ventrally. The broad proximal lobe on the lateral margin is flat. The suborbital tooth is laterally compressed.

The length of the palm of the cheliped of the adult male is about one and a half times its height and only slightly longer than the fingers. There is a strong gape with a single large tooth close to the base of the dactyl and small teeth distally where the fingers meet. There is a small tubercle on the dorsal edge of the palm in most specimens.

The first pleopod of the male narrows only slightly at the tip and there are a few long setae on the medial edge. This pleopod is similar to that of *Thusaenys calvarius*. That species also has a strong lobe on the anterior margin of the postorbital lobe and there are similarities in the shape of the basal antennal article.

The variation in this species has been previously discussed (Griffin, 1974; 1976). *H. hendersoni*, originally described as a 'variety' of *H. convexus*, is a distinct species not identifiable with *H. convexus*.

Distribution. — Indo-West Pacific from eastern Africa through Indonesia to Australia and E. China Sea.

Hyastenus cracentis new species
(Figs. 44, 47c, d)

Hyastenus diacanthus. — Griffin & Tranter, 1974: 170. (Not *Pisa* (*Naxia*) *diacantha* De Haan, 1839.)

Material examined. — 5 ♂♂, 1 ovig. ♀, 18-36.5 mm, ovig. ♀, 34 mm.

Holotype. — Male, cl. 31.5 mm, Java Sea, Gasper Straits, coll. T. S. Gardner; Zoological Survey of India, Calcutta, ZSC 1377-8/7 (one specimen of two).
Paratypes. — As listed below.

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA

Java Sea, Gasper Straits, coll. T. S. Gardner; 1 ♂, (ZSC. 1377-8/7, one specimen of two). — NE. India, Ganjam coast, 8 miles (∿ 13 km) SE. of Bawanapadu Beacon, 50 m, sand, 'Investigator', Stn. 91, 20 February 1890; 1 ♂, 1 ovig. ♀ (ZSC 4494/10).

ZOOLOGICAL MUSEUM, AMSTERDAM

N. coast of Sumatra, telegraph cable; 1 ♂ (ZMA De.100.715); 1 ♂ (ZMA De.100.802, in part).

Description. — Carapace pyriform, widening posteriorly, width up to three quarters (0.7 to 0.75) postrostral carapace length, surface mostly smooth, a few tubercles near margins covered by a short tomentum, an epibranchial spine.

Rostral spines long, more than three quarters (0.8) postrostral carapace length in male, (0.6 in female), divergent, cylindrical, acuminate.

Orbital eave moderately expanded, preorbital angle hardly produced, almost a right angle; antorbital angle weakly produced, rounded; postorbital lobe separated from eave by a narrow 'keyhole'-shaped hiatus; postorbital lobe only moderately produced, anterior margin weakly convex.

Eyestalks short, moderately slender; cornea terminal and ventral.

Hepatic margin weakly expanded, a low tubercle on margin.

Branchial submargin with one tubercle anteriorly; a strong epibranchial spine directed laterally.

Gastric regions elevated, no mesogastric tubercles; a low protogastric tubercle laterally near postorbital lobe. Cardiac region elevated, rounded, smooth. Intestinal region with a medial tubercle or short spine near posterior carapace margin.

Branchial region smooth except for a rounded tubercle just dorsal to epibranchial spine.

Basal antennal article smooth, a ridge along medial margin; anterolateral angle produced forward and slightly outwards as a short spine; lateral margin sinuous, concave behind spine, proximal half of margin produced as a broad convex lobe; lower orbital hiatus narrow, U-shaped. A rounded tubercle lateral to green gland.

Pterygostomian region smooth, margin with two tubercles, anterior larger.

Third maxilliped smooth, ischium with a narrow central groove; merus with a ridge along posterior margin, anterolateral angle moderately produced and rounded.

Cheliped of male about as long (0.97 to 1.03) as postrostral carapace length; merus with three groups of stout setae dorsally and a strong terminal spine; carpus with a sharp dorsal tubercle at about distal third; palm elongate, length about three times (3.4 to 2.8) height; fingers about half as long as palm, weakly gaping in proximal third, two small teeth on each finger in gape, uniform small teeth on distal two thirds of both fingers.

Ambulatory legs slender, smooth, first leg about twice (1.9 to 2.0) postrostral carapace length, merus with a terminal tubercle; fourth leg about equal to postrostral carapace length and about half as long as first leg, dactyl with seven small spines ventrally along its length.

Sternum smooth, a transverse ridge anteriorly near base of third maxillipeds; a low ridge on anterior border of abdominal fossa.

Male abdomen of seven segments, smooth, a low medial tubercle anteriorly, in all except seventh segment; third segment with rounded elevations laterally, nearly twice (1.9) as wide as sixth segment; sixth segment about one and a half (1.4) times as wide as long, lateral margin convex distally; seventh segment about as wide as long.

First pleopod of male broad, narrower in distal fifth; apex truncate, lateral angle produced forward, subacute, medial angle obtuse.

Female abdomen of seven segments, a medial tubercle in segments one to three, a low medial ridge in remainder.

Female gonopore a pear-shaped aperture narrower laterally, opening ventrally and medially.

Remarks. — This species is similar to *H. campbelli* n.sp. in general appearance and in the absence of any mesogastric tubercles, but it can be distinguished from that species by the following points:

(1) there is a low tubercle on the hepatic region (none in *H. campbelli*);
(2) there is a rounded tubercle just dorsal to the epibranchial spine (none in *H. campbelli*);
(3) there is a tubercle or short spine on the intestinal region (smooth in *H. campbelli*);

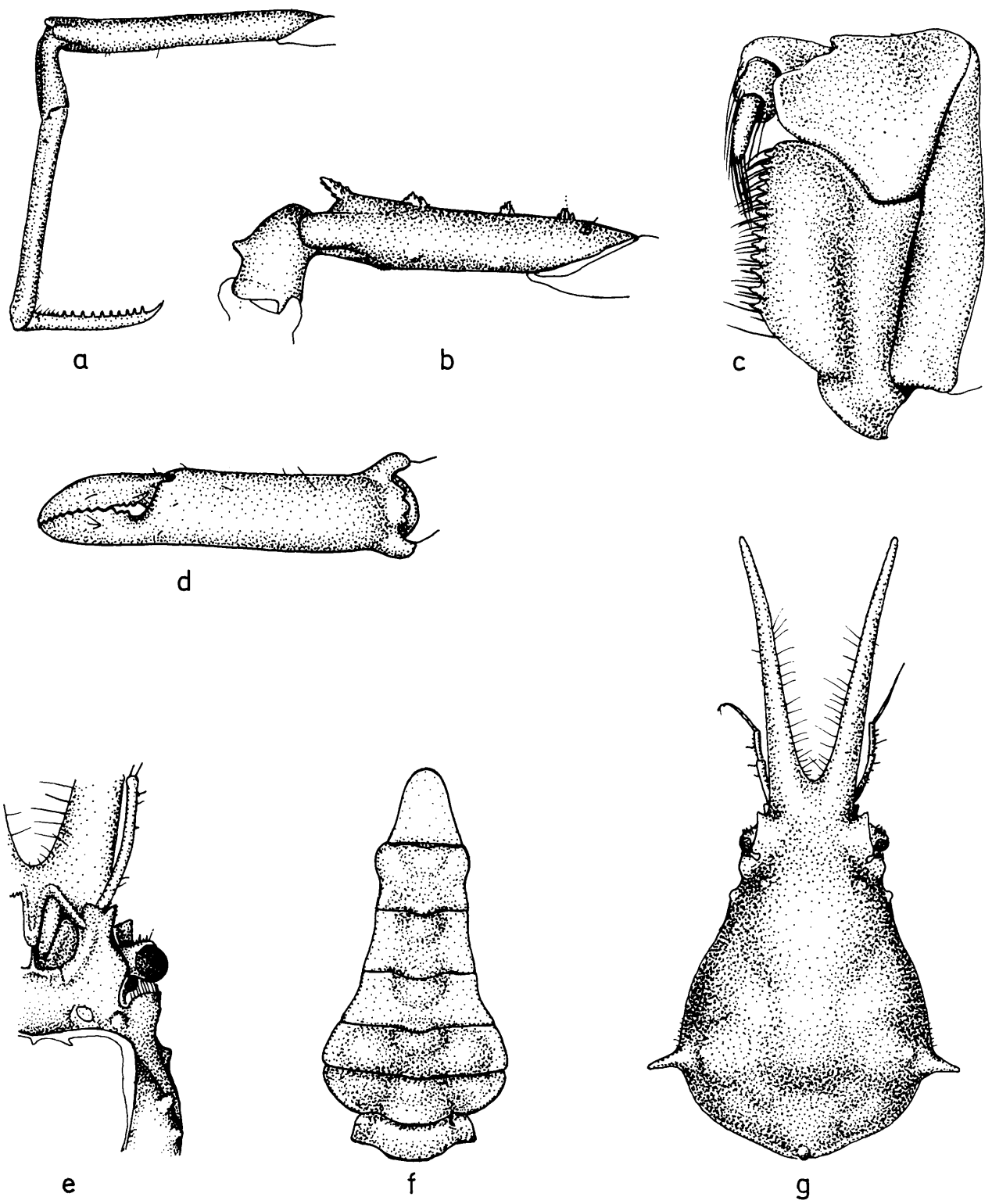


Fig. 44. (*Hyastenus* species of group 2) *Hyastenus cracentis* (holotype) (a) left first ambulatory leg; (male, 36.5 mm, Java Sea, ZSC) (b) left cheliped, merus and carpus; (holotype) (c) left third maxilliped; (male, 36.5 mm, as above) (d) left chela; (holotype) (e) left orbit, ventral view; (f) male abdomen; (g) carapace, dorsal view.

(4) the seventh segment of the male abdomen is about as long as its basal width and rounded apically (one and a half times longer in *H. campbelli* and truncate apically); and
(5) the first pleopod of the adult male tapers gradually and the apex is truncate (the distal half of the adult male first pleopod is filiform in *H. campbelli*).

This species is distinguished from *H. diacanthus* and *H. elatus* by the absence of mesogastric tubercles and the presence of a hepatic tubercle.

The specific name is derived from the Latin *cracentis* — graceful, in reference to the neat form of the carapace of this species.

Distribution. — Java Sea, India, Red Sea.

Hyastenus diacanthus (De Haan, 1839)
(Figs. 46c, 48a-c)

Pisa (*Naxia*) *diacantha* De Haan, 1839: 96-97, pl. 24 fig. 1.
Hyastenus diacanthus. — Sakai, 1938: 279-281, text fig. 36, pl. 29 fig. 2; 1965a: 81, pl. 36 fig. 1; 1976: 225-226, pl. 77 fig. 1. — Buitendijk, 1939: 241-242, text figs 5-8. — Takeda & Miyake, 1969: 508-509.

Material examined. — 17 ♂♂, 20 ♀♀ (6 ovig.), 11-70.5 mm, smallest ovig. ♀, 30.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 273, E. coast of Aru Is. (Pearl banks), anchorage off Pulu Jedan, 13 m, trawl, dredge and divers, sand and shells, 23/26 December 1899; 1 spec.

N. Sulawesi, Kuandang Bay, 36-81 m, coll. van Nouhuys, 18 April 1914; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Japan, Nagasaki, coll. J. Jordan; 1 spec.

E. China Sea, 32°12′N 128°10′E, 180 m, 20 October 1897; 1 spec.

Formosa Strait and S. China Sea: 26°42′N 121°10′E, 77 m, 2 specs. — 63 m, 1 spec. — Namoa I.; 4 specs. — 21°30′N 113°08′E, 36 m, 6 April 1890; 2 specs. — 23°57′N 118°33′E, 50 m, April 1897; 2 specs. — 41-45 m, 23 May 1897; 1 spec. — 45 m, 23 May 1897; 4 specs. — 23°15′N 117°40′E, coll. Capt. Christiansen, 'Store Nordiske', 26 July 1912; 6 specs. — 24°06′N 118°25′E, 36 m, coll. Capt. Christiansen, 'Store Nordiske', 10 August 1912; 8 specs. — 23°34′42″N 119°49′04″E, 108 m, 'Store Nordiske', 26 August 1929; 1 spec.

Danish Kei Islands Expedition: Ambon I., Ambon Bay, 12-18 m, sand, 28 February 1922; 1 spec. — Stn. 108, Java Sea, 05°44′S 105°56′E, 54 m, trawl, sand, stones, 5 August 1922; 1 spec.

Remarks. — This large species has been recorded on many occasions from Japan, China Sea, north Australia, Singapore, Gulf of Thailand and India by many authors. However, several accounts (Sakai, 1934; Buitendijk, 1939; Campbell & Stephenson, 1970; Serène & Lohavanijaya, 1973) over the last 40 years describe and figure, under the same specific name, forms with three quite different male first pleopods.

Buitendijk (1939) has figured and commented on the first pleopod of males from De Haan's type material of this species (RML 742, 6 ♂♂, cl. 20.9-67.1 mm). She found that the first pleopod of a large specimen (35 mm) had a filiform distal half (figs. 5-7); the specimen of 34 mm had a gradually tapering pleopod (fig. 8), and the smallest males are like those figured by Sakai' (i.e. Sakai, 1934: text fig. 9c).

Specimens of *H. diacanthus* in our series, from Japan, Formosa Strait, S. China Sea, N. Sulawesi, Ambon and Java Sea, of less than 32 mm, have (with one exception) a curved pleopod of the kind shown by Sakai and by Buitendijk, i.e. they curve towards the medial line in the distal quarter. In the adult males from these localities the distal half of the first pleopod is filiform. These specimens of *H. diacanthus* s.s. agree in carapace shape and general features with those figured by De Haan and Sakai under that specific name.

Campbell & Stephenson (1970: fig. 26) have figured the first pleopod of a male of *H. diacanthus* from Moreton Bay, in which the distal third is slender but not filiform, and have stated that all 10 males found (cl. 20-70 mm) had this kind of pleopod. Serène & Lohavanijaya (1973: figs. 115-117) have figured the first pleopod of a specimen of *H. diacanthus* from the National Museum of Singapore (cl. 36 mm, no locality given) which is of the same kind as that figured by Campbell & Stephenson, i.e. it tapers fairly evenly, and curves outward in the slender distal third. This kind of pleopod is present in specimens in our series from Aru Islands and Irian Jaya and also in Australian specimens (18-88 mm) in the collection at the Australian Museum. These specimens in which the distal third of the pleopod is slender but not filiform are now considered to be a new species, *Hyastenus elatus* and are discussed further under that name.

The shape of the basal antennal article and the suborbital hiatus also distinguish *H. diacanthus* from *H. elatus*. On the lateral margin of the basal antennal article there is a short blunt anterior tooth which is produced laterally. Between this tooth and the broad proximal lobe there is a distinct concavity. The postorbital lobe is separated from the basal antennal article by a U-shaped hiatus. On the lateral margin of the basal antennal article of *H. elatus* the anterior tooth, if present, is small and not produced laterally. The anterior part of the lateral margin appears nearly straight as there is no concavity between the anterolateral angle and the broad proximal lobe. The proximal lobe extends further laterally than that in *H. diacanthus* and the hiatus separating it from the postorbital lobe is a narrow slit (or V-shaped in young specimens).

The rostral spines are generally less than half or equal to half the postrostral carapace length, though in a few individuals they are $^2/_3$ the postrostral carapace length.

The preorbital angle of the supraorbital eave is usually produced slightly forwards, especially in adult males.

The gastric region is moderately elevated, there is a tubercle on the summit and often a very much smaller rounded tubercle on the anterior slope. The protogastric tubercles, if present, are very low. The cardiac region is moderately elevated and there is a short epibranchial spine.

The first sternite is separated from the anterior abdominal cavity by a pronounced slender ridge. In *H. elatus* this ridge is low and almost disappears at the apex of the abdominal cavity.

The palm of the male chela is enlarged in our three specimens of carapace length greater than 60 mm.

The first pleopod of the immature male differs from that of the adult just as it does in *H. aries*. In the younger specimens (11.5-32 mm, one exception 45 mm), the two pleopods touch on the medial line not far above their base, curve outward slightly, and then curve back toward the medial line often meeting distally. In larger specimens (33.5-70.5 mm) the distal half of the pleopod is filiform with long setae at the base of the filiform extension, and the apex is turned outwards.

The shape of the female gonopore though variable, is usually pyriform, narrowing evenly in the lateral half. The female gonopore in *H. elatus* is more nearly oval.

Distibution. — Japan, Formosa Strait, South China Sea, N. Sulawesi, Ambon, Aru Islands, Java Sea..

Hyastenus elatus new species
(Figs. 45, 46a, 47e-g)

Hyastenus diacanthus. — Campbell & Stephenson, 1970: 258, fig. 26.— Serène & Lohavanijaya, 1973: figs. 114-118, pl. 10 C. (Not *Pisa* (*Naxia*) *diacantha* De Haan, 1839.)

Material examined. — 75 ♂♂, 72 ♀♀ (34 ovig.), 10-88 mm, smallest ovig. ♀, 25 mm.
Holotype. — Male, cl. 66.5 mm, Sydney Harbour, Nelsons Beach, on rocks at low tide, coll. H. Hughes, November 1975; The Australian Museum, Sydney, AM P.29917.
Paratypes. As listed below:

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

S. Irian Jaya, S. coast Dolak (Frederik Hendrik I.), coll. D. Zwollo, 10 February 1955; 1 spec. — SW. Irian Jaya, 8 miles (~ 13 km) S. of Merauke, Gov't trawler, 'De Goede Hoop', coll. L. B. Holthuis, 24 March 1955; 1 spec. — Irian Jaya, S. of Merauke, 'De Goede Hoop', March-April 1955; 1 spec. — Southern Irian Jaya, off Merauke, 1954-1955, donated by Fisheries Station of Jayapura; 1 spec.

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Mariel King Memorial Expedition — Moluccas: Stn. KR VI, Kai Is., N. of Nuha Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 32-36 m, dredge haul 1, sand, 10 June 1970; 1 spec. — Stn. AN I, Aru Is., S. Trangan I., SW. of Tg. Ngabordamlu, centred near 06°58′S 134°5′E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 8 specs.— Stn.A III, Aru, Trangan, 3-4 miles (~ 5-6.5 km) W. of Tg. Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 3 specs. — Stn B, Northern Territory, Clarence Straits, 27-57 m, dredge, mud, 30 June 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

New South Wales: Sydney, Georges River; 1 spec. (AM P. 5748). — Botany Bay, 36-41 m, 'Thetis' Expedition; 1 spec. (AM P. 1100). — Sydney, Port Jackson; 1 spec. (AM G. 1223); 1 spec. (AM G. 4147); 1 spec. (AM G. 4148); 1 spec. (AM G. 5074); 1 spec. (AM P. 141); 1 spec. (AM P. 142); 1 spec. (AM P. 147); 14 specs. (AM P. 179); 1 spec. (AM P. 1352); 1 spec. (AM P. 1353); 1 spec. (AM P. 1354); 1 spec. (AM P. 1356); 1 spec. (AM P. 1358); 1 spec. (AM P. 1359); 1 spec. (AM P. 1360); 1 spec. (AM P. 1361); 1 spec. (AM P. 1362); 1 spec. (AM P. 1476); 1 spec. (AM P. 1477); 1 spec. (AM P. 1478); 1 spec. (AM P. 4725); 1 spec. (AM P. 6746). — Port Jackson, dredge; 1 spec. (AM G. 1140). — Port Jackson, Lane Cove; 1 spec. (AM G. 5019). — Port Jackson, off Fort Denison, coll. C. K. Hills, 8 January 1979; 1 spec. (AM P. 29918). — Port Jackson, Cockatoo I.; 1 spec. (AM P. 2118); 1 spec. (AM P. 2119); 1 spec. (AM P. 3073). — Port Jackson, Lavender Bay Wharf, 19 November 1928; 1 spec. (AM P. 9268). — Port Jackson, Walsh Bay Wharf, 28 January 1934; 1 spec. (AM P. 10456). — Sydney, Parramatta River, entrance of Torban Creek, in fish trap; 1 spec. (AM P. 5176). — Sydney, Parramatta River; 1 spec. (AM P. 5339). — Sydney, Parramatta River, near Hunters Hill, January 1924; 1 spec. (AM P. 6918). — near Grafton, Minnie Waters, intertidal, coll. G. Biddle, February 1964; 1 spec. (AM P. 18516). — Lake Macquarie; 1 spec. (AM G. 5592). — Port Stephens, dredge, January 1920; 1 spec. (AM P. 4851); 1 spec. (AM P. 4852); 1 spec. (AM P. 4853); 1 spec. (AM P. 4855); 2 specs (AM P. 4856). — Port Stephens, Nelson's Bay; 1 spec. (AM P. 4875); 2 specs (AM P. 29916).

Queensland: Moreton Bay, dredged, coll. L. Juesue, 17 August 1966; 1 spec. (AM P. 16561). — Port Curtis, 11 m; 1 spec. (AM P. 1959); 3 specs (AM P. 1961). — Curtis I., Northwest Channel, 5-7 m, dredge, coll. M. Ward, 1928; 1 spec. (AM P. 13880). — Port Curtis, dredged off Gatcombe Head, 16-21 m, coll. M. Ward and W. Boardman, July 1929; 17 specs. (AM P. 29911). — Emu Park, Yeppoon, 14-18 m, trawl, coll. K. McDougall, May-July 1966; 1 spec. (AM P. 16545). — Keppel I., 1½ miles (~ 2.4 km) NW., 12-20 m, coll. W. F. Ponder and T. Nielsen, 4 July 1969; 2 specs (AM P. 17444). — Between North and South Keppel Islands, 22-26 m, coll. W. F. Ponder and T. Nielsen, 25 July 1969; 1 spec. (AM P. 29914). — 1½ miles (~ 2.4 km) NW. of South Keppel I., 13-20 m, coll. W. F. Ponder and T. Nielsen, 25 July 1969; 1 spec. (AM P. 29915). — Swain Reefs, dredged off Gillet Cay, 54-72 m, October 1962; 2 specs. (AM P. 14018). — Lindeman I., dredged, coll. M. Ward, December 1928; 1 spec. (AM P. 13882). — Cumberland Group, between Hayman I. and Eshelby I., 36-45 m, trawl, 14 September 1957; 1 spec. (AM P. 12982). — Magnetic I., Horseshoe Bay 12-21 m, prawn trawl, coll. C. Wilson, April 1967; 1 spec. (AM P. 16676). — Townsville, sandbank off Bohle River, coll. M. Parker, 21-23 October 1965; 1 spec. (AM P. 29913). — N. of Townsville, 9 m, trawl, coll. C. Wilson, April 1967; 1 spec. (AM P. 16677). — Torres Strait, ½ mile (~ 0.8 km) north of Horn I.; 1 spec. (AM P. 11348). — Torres Strait, Albany Passage, coll. M. Ward, August-September 1928; 1 spec. (AM P. 29912). — SE. corner Gulf of Carpentaria, 17°26.2′S 139°59.5′E, 7 m, CSIRO Prawn Survey, Stn.39, 9 August 1963; 2 specs (AM P. 18568). — SE. corner Gulf of Carpentaria, 16°52.5′S 140°34.7′E, 18 m, CSIRO Prawn Survey, Stn.60, 16 August 1963; 1 spec. (AM P. 18574). — SE. corner Gulf of Carpentaria, 17°22.7′S 139°40.4′E, 5 m, CSIRO Prawn Survey, Stn.76, 20 August 1963; 1 spec. (AM P. 18569). — SE. corner Gulf of Carpentaria, 16°24.8′S 140°58′E, 12 m, CSIRO Prawn Survey, Stn.96, 24 August 1963; 1 spec. (AM P. 18571). — SE. corner Gulf of Carpentaria, 17°24.5′S 139°42′E, 5 m, CSIRO Prawn Survey, Stn.547, 10 January 1964; 6 specs. (AM P. 18563). — SE. corner of Gulf of Carpentaria, about 22 m, coll. D. F. McMichael and J. C. Yaldwyn, CSIRO Prawn Survey, December 1963; 5 specs. (AM P. 18572). — Gulf of Carpentaria, off Karumba, 25 m, from hollows in massive sponge, coll. J. C. Yaldwyn and D. F. McMichael, CSIRO Prawn Survey, December 1963; 1 spec. (AM P. 18591).

Western Australia: Broome, June 1932; 1 spec. (AM P. 10261); 1 spec. (AM P. 10262); 1 spec. (AM P. 10263); 1 spec. (AM P. 10264). — Off Cape Bossut, 7 m, dredged, coll. A. A. Livingstone, 9 September 1929; 1 spec. (AM P. 13887). — Ninety Mile Beach, between Broome and Wallal, about 14 m, dredged, coll. R. Bourne, 1930; 3 specs. (AM P. 9917). — Ninety Mile Beach, between Cape Jaubert and Wallal, 5 miles (~ 8 km) offshore, 9 m, dredged, coll. A. A. Livingstone, September 1929; 1 spec. (AM P. 13886). — 30 miles (~ 48 km) south of Carnarvon, 14-18 m, sandy mud with *Posidonia* and *Cymadosia* banks, coll. N. Coleman, 3 June 1972; 4 specs. (AM P. 18844). — Shark Bay, with prawns, 1969; 1 spec. (AM P. 17404). — N. of Perth, CSIRO prawn trawl, coll. K. Godfrey, M. V. 'Lancelin', September 1955 — February 1956; 2 specs. (AM P. 13881).

Description. — Carapace pyriform, widening posteriorly, width about three quarters (0.72 to 0.8) postrostral carapace length; surface smooth, covered with a short dense tomentum; a strong epibranchial spine and a prominent gastric tubercle.

Rostral spines horizontal or weakly curved downward distally; straight or sometimes sinuous distally; divergent to almost subparallel; cylindrical, tapering to an acuminate apex; length ranging from a half to more than two thirds (0.5 to 0.7) postrostral carapace length.

Orbital eave moderately expanded; preorbital angle a blunt right angle, not produced forward even in adult males; antorbital angle weakly produced, rounded; postorbital lobe separated from eave by a narrow U-shaped hiatus; postorbital lobe short, anterior margin weakly convex proximally. Eyestalks short, moderately slender, a thick row of setae distally above cornea; cornea terminal, ventral.

Hepatic region flat, smooth. Branchial submargin smooth, no tubercles; a strong epibranchial spine directed laterally and sometimes weakly curved forwards.

Gastric regions very steeply elevated, a strong mesogastric tubercle at summit of elevation and sometimes a very low tubercle on anterior slope; a low, broad protogastric tubercle near orbit.

Cardiac region only weakly elevated, smooth.

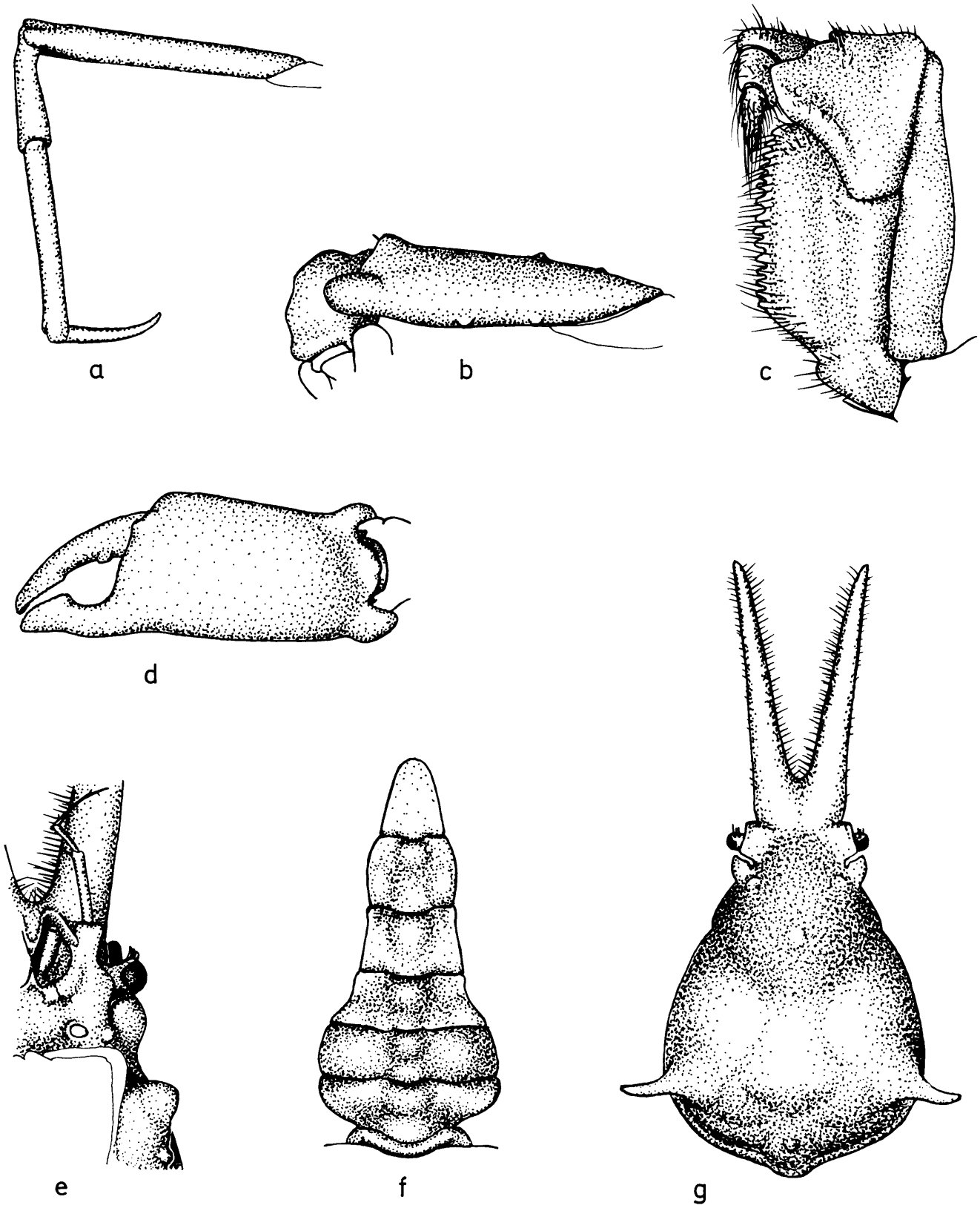


Fig. 45. (*Hyastenus* species of group 2) *Hyastenus elatus* (holotype). (a) left first ambulatory leg; (b) left cheliped, merus and carpus; (c) left third maxilliped; (d) left chela; (e) left orbit, ventral view; (f) male abdomen; (g) carapace, dorsal view.

Intestinal region weakly elevated, smooth or with small central tubercle.

Branchial regions smooth, abruptly convex in front of epibranchial spine.

Basal antennal article narrow, smooth, anterolateral angle blunt, sometimes produced weakly laterally but not forward; lateral margin sinuous, behind angle almost straight, proximal two thirds produced as a broad convex lobe; lower orbit hiatus a slit or, in small specimens, V-shaped and narrow. A blunt tubercle lateral to green gland.

Pterygostomian region smooth, margin with two tubercles, anterior much the larger.

Third maxilliped smooth, ischium with a shallow central groove; merus with a narrow ridge along posterior margin, a broad diagonal ridge forward from posterolateral angle; anterolateral angle only moderately produced and rounded.

Cheliped of adult male about one and a third (1.3) times postrostral carapace length; merus with two small tubercles in proximal half dorsally and a low terminal tubercle; one or two small tubercles ventrally on outer face; carpus with a tubercle on inner face and two to four small tubercles dorsally; length of palm about one and half (1.6) times height; fingers about two thirds (0.62 to 0.67) length of palm, strongly gaping in proximal half, a proximal tooth on dactyl in gape, fixed finger excavate, both fingers with only low teeth distally.

Ambulatory legs slender, smooth; first leg about twice postrostral carapace length, merus with a blunt terminal tubercle; fourth leg equal to or slightly longer (1.2) than postrostral carapace length, about half as long (0.5 to 0.6) as first leg.

Sternum smooth, first sternite with high, narrow lateral ridge, a ridge around anterior margin of abdominal fossa (low at apex of fossa), continuing to posterior edge of sternite.

Male abdomen of seven segments, smooth, segments two to six with a low medial tubercle anteriorly; third segment with rounded elevations laterally, width about twice (2.1) that of sixth segment; sixth segment about one and a third (1.3) times wide as long, lateral margin elevated midway along; length of seventh segment slightly exceeding (1.1 to 1.3) basal width.

First pleopod of male broad, narrower in distal quarter, aperture apical; pleopods curve gradually inward in proximal half, meeting on medial line in third quarter, slightly divergent in distal quarter. First pleopod of young male similar to that of adult male.

Female abdomen with segments four to six fused, suture visible only near midline; a low, broad medial ridge in all segments; a pair of low rounded tubercles laterally near posterior edge of both fourth and fifth segments.

Female gonopore a suboval aperture, laterally narrower and bridged by a narrow lobe; margins flat except at lateral extremity.

Remarks. — This species is very similar to *Hyastenus diacanthus* (De Haan) but is distinguished from that species by the degree of elevation of the gastric regions, the shape of the basal antennal article and form of the male first pleopod. The gastric region is more steeply elevated than in *H. diacanthus* and the cardiac region less elevated than in that species; the branchial region is more convex in front of the epibranchial spine than it is in *H. diacanthus*. The anterolateral angle of the basal antennal article is hardly produced, and, as there is no concavity between this and the broad proximal lobe, the distal half of the lateral margin is nearly straight (not concave as it is in *H. diacanthus*). The proximal lobe extends further laterally than that in *H. diacanthus* and the hiatus between it and the postorbital lobe is only a narrow slit, or in young specimens V-shaped (not U-shaped as in *H. diacanthus*). The first pleopod of the adult male is similar to that of a young male, not markedly different as in *H. diacanthus*; the distal quarter of the pleopod is slender in *H. elatus*, while in adult males of *H. diacanthus* the distal half or more is filiform. The pleopod of the young male of *H. diacanthus* is similar to that of *H. elatus* but they can be distinguished by their different curvature; the two first pleopods of *H. elatus* meet on the midline at about the distal third and beyond this point are straight or weakly divergent; the pleopods of young males of *H. diacanthus* meet at about the proximal third and beyond that point curve laterally and then medially again near the apex.

This species is distinguished from *H. campbelli* n.sp. and *H. cracentis* n.sp. by the presence of a mesogastric tubercle, absent in both those species.

The name of the new species is derived from the Latin word *elatus* meaning high or lofty and refers to the elevated gastric region.

Distribution. — Irian Jaya, Arafura Sea, and northern Australia from north of Perth (W.A.) to Botany Bay (N.S.W.).

Hyastenus elongatus Ortmann, 1893
(Figs. 46e,f, 47a,b)

Hyastenus diacanthus var. *elongata* Ortmann, 1893: 55.
Halimus elongatus. — Rathbun, 1911: 251.
Hyastenus elongatus. — Buitendijk, 1939: 242. — Sakai, 1965a: 81, pl. 36 fig. 2; 1976: 226, pl. 77 fig. 2. — Griffin & Tranter, 1974: 170.

Material examined. — 4 ♂♂, 5 ♀♀ (4 ovig.), 13.5-46.5 mm, smallest ovig. ♀, 26 mm.

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South China Sea: between Amoy and Hong Kong, 23°16′N 117°43′E, 122 m, November 1889; 1 spec. — 23°15′N 117°40′E, coll. Capt. Christiansen, 'Store Nordiske', 26 July 1912; 2 specs. — E. China Sea, 32°12′N 128°10′E, 180 m, 20 October 1897; 1 spec. — S. Japan, off Goto, 33°10′N 129°18′E, 72 m, 7 September 1897; 4 specs. — S. Japan, off Nagasaki, 32°42′54″N 129°44′20″E, 56 m, rocks and sand, 'Store Nordiske', 31 August 1931; 1 spec.

Remarks. — These specimens agree well in the long straight rostral spines, blunt preorbital angle and anterolateral angle of the basal antennal article with a specimen, presumed to be

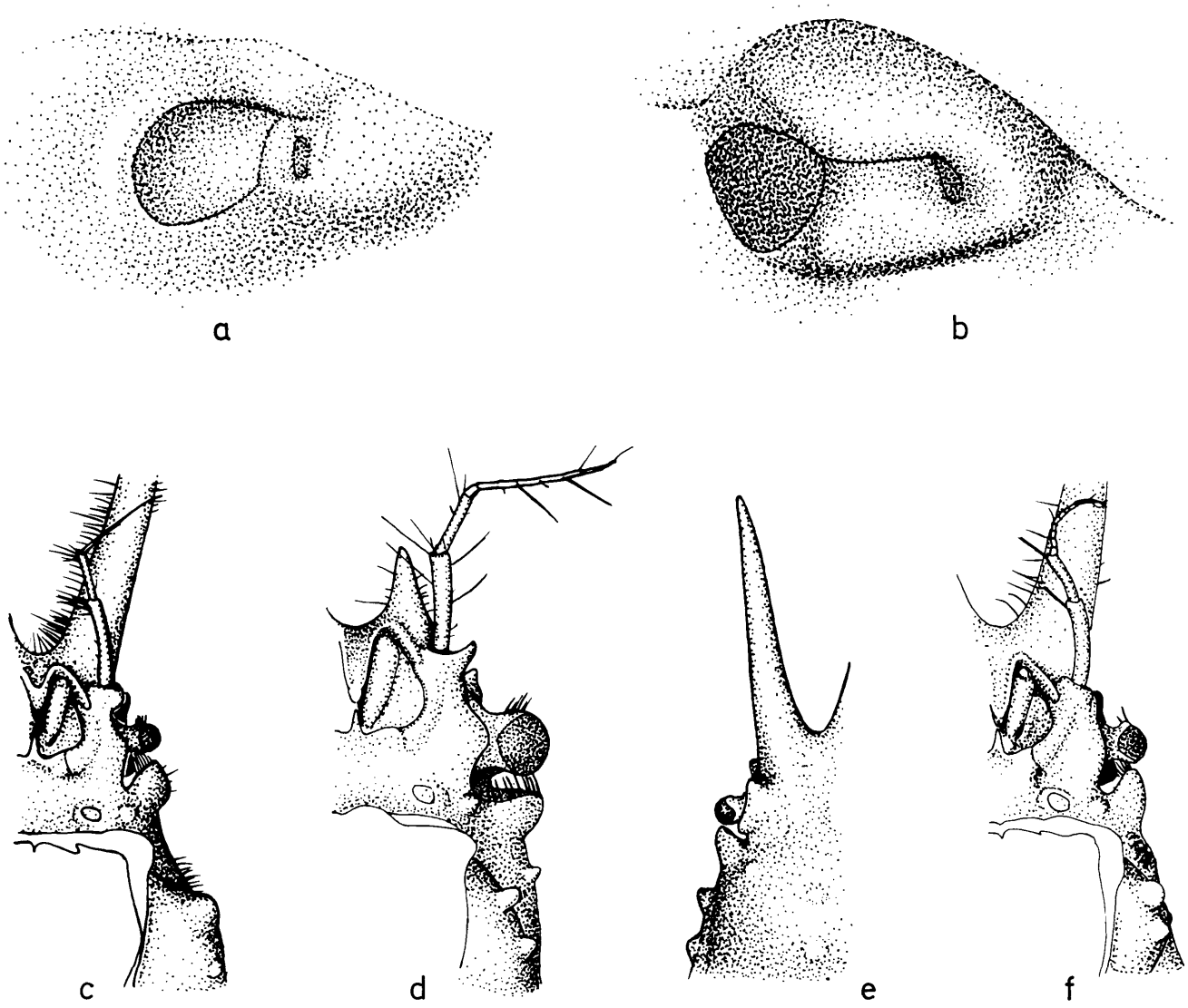


Fig. 46. (*Hyastenus* species of group 2) *Hyastenus elatus* (female, ovig. 55 mm, AM P.18572, in part) (a) left gonopore; *H. campbelli* (female, ovig., 52 mm, AM P.29908, in part) (b) left gonopore; *H. diacanthus* (male, 70.5 mm, N. of Formosa Strait, ZMC) (c) left orbit, ventral view; *H. planasius* (female, ovig., 10 mm, Java, ZMC) (d) left orbit, ventral view; *H. elongatus* (male, 30 mm, S. China Sea, ZMC) (e) left orbit, dorsal view; (f) ventral view of same.

a syntype (ad. ♀, 33.1 mm, Sagami Bay, Strasbourg Museum), which one of us (D.J.G.G.) has examined. Neither the syntype, nor the specimens described by Sakai (1934; 1938) have an epibranchial spine; however, in all except the smallest of our specimens there is a small epibranchial tubercle often covered by the tomentum.

The rostral spines are either parallel or weakly divergent. The length varies from half the postrostral carapace length in smaller individuals (17-30 mm), to nearly equal to the postrostral carapace length in the largest male (46.5 mm).

The supraorbital eave is narrow and the preorbital angle is rounded and not produced. The postorbital lobe is short and broad and not produced far laterally.

The mesogastric region is elevated. There is a low rounded tubercle on the summit, and the anterior slope is smooth or has a low tubercle. There is a low rounded protogastric tubercle. There is a submarginal tubercle on the anterior border of the branchial region, subequal to the posterior tubercle on the pterygostomian margin. There is a low medial tubercle on the intestinal region.

The anterolateral angle of the basal antennal article is not produced, but there is a broad lateral lobe on the proximal half. The greatest width of the basal antennal article does not exceed $1^1/_2$ times its anterior width. There is a wide U-shaped suborbital hiatus.

We have figured the first pleopod of the male which agrees with that figured by Sakai (1934: fig. 9b) but the apex is more slender and the setae are longer and reach the apex or exceed it. The female abdomen has seven segments.

A specimen collected by the 'Albatross' expedition off Honshu (♂, 33.75 mm, USNM 49920) previously identified by Rathbun as *H. diacanthus*, appears to be conspecific with these

specimens. An adult male from Amirante (13.4 mm, USNM 41405) identified as *H. elongatus* by Rathbun, has the same type of pleopod as specimens from China and Japan. However, both this specimen and an ovigerous female (14.5 mm) from the Red Sea (Griffin & Tranter, 1974), have an acute, produced preorbital lobe and a definite anterolateral spine on the basal antennal article.

This species can be distinguished from *H diacanthus*, *H. elatus* and *H. campbelli* by its very narrow supraorbital eave, by the tubercle on the branchial submargin, and by the epibranchial tubercle which is barely visible in this species while the other three species have a quite robust epibranchial spine.

Distribution. — Japan, S. China Sea, Maldive Is, Amirante, Red Sea.

Hyastenus fraterculus Rathbun, 1916
(Figs. 50a,b, 51c,d)

Hyastenus fraterculus, Rathbun, 1916: 546. — Griffin, 1976: 192, fig. 1 (b).

Material examined. — 2 ♂♂, 4 ♀♀ (2 ovig.), 4.5-8.5 mm, ovig. ♀, 8.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 172, Ceram Sea, Geser, anchorage between this island and Seram-laut, 18 m, townet, reef exploration, coral and *Lithothamnion* bottom, 26/28 August 1899; 1 spec. — Stn. 315, Flores Sea, Paternoster Islands, anchorage E. of Sailus Besar, up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 15, Kai Is., S. of Doe Roa, 20-5 m, trawl, sand, 10 April 1922; 1 spec. — Stn. 39 Kai Is., N. of Doe Roa, 60 m, trawl, sand, *Lithothamnion*, 24 April 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition-Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 1 spec.

Remarks. — These specimens agree well with the holotype (♂, 7.5 mm, Sulu Archipelago, USNM 48291), but the smallest female has only four marginal branchial tubercles and the urogastric and cardiac regions are smooth.

The rostrum is very short, less than a sixth postrostral carapace length. There are granules on the rostral ridges.

The postorbital lobe is small and there is a small process on the anterior margin.

There are three mesogastric tubercles and two pairs of protogastric tubercles. There are two to four tubercles on the hepatic region.

There are three tubercles in a triangle on the urogastric region of the females, but in the two males only the posterior medial tubercle is present.

On the cardiac region there are two submedial tubercles and one posterior tubercle. In three of the specimens there are two very small tubercles on the anterior slope.

On the branchial region there is a row of six to nine irregular tubercles on the margin, many small submarginal tubercles and one larger anterior submarginal tubercle in line with the pterygostomian tubercles.

On the intestinal region there is a rounded medial tubercle, and parallel with the posterior margin there is a row of granules or a low ridge.

On the merus of the male cheliped there are four tubercles ventrally on both the inner and outer face, there are two or three tubercles dorsally in the proximal half and a short acute terminal spine; on the palm there is a longitudinal row of sharp tubercles midway on the inner face, some scattered sharp tubercles and granules above them on the upper half and on the dorsal margin; there is a large gape between the fingers with a large double tooth on the dactyl. There are three proximal tubercles on the merus of the first ambulatory leg.

This species is very similar to *H. biformis*, *H. scrobiculatus* and *H. mindoro* but can be distinguished from them by the very short rostral spines and the greater number of tubercles, especially on the branchial margin.

Previously known only from the Sulu Archipelago.

Distribution. — Sumbawa, Kai Islands, Ceram Sea, Sulu Archipelago.

Hyastenus hendersoni Laurie, 1906, new status

Halimus convexus (Miers) var. *hendersoni* Laurie, 1906: 377.

Type material. — Syntypes: 1 ♂, 1 ♀, W. of Cheval Paar; 1♂, 1 ovig. ♀, Gulf of Manaar; 2 ♀♀ (juv.), Cheval Paar; BMNH. 1907. 5.22.116-120. Cotype: 1 ♀ (juv.), Sri Lanka; ZSC 7249/10.

Material examined. — No new material examined.

Remarks. — This species can be distinguished from *H. convexus* Miers by the absence of any mesogastric tubercles (two in *H. convexus*) and the presence of an epibranchial spine rather than a low tubercle. The spines on the dactyl of the fourth ambulatory leg are quite robust in this species, while in *H. convexus* there are only a few small spines distally.

One of us (D.J.G.G.) has examined the syntypes (2 ♂♂, 3 ♀♀, BMNH. 1907.5.22. 116-120). The first pleopod of the male tapers to a point on the medial edge and is expanded to a rounded lobe on the lateral edge just below the apex whereas the first pleopod in *H. convexus* is not expanded distally, the apex is truncate, and there are long setae on the medial edge which exceed the apex. It is our opinion that *H. convexus* var. *hendersoni* is a distinct species, *H. hendersoni*, and not just a variety of *H. convexus*.

The pleopod of a male figured by Monod (1938: fig. 4, H,I) as *H. convexus* var. *hendersoni* does not agree with that of the male syntypes, but does agree with the pleopod of the holotype of *H. inermis* and is discussed further under that species.

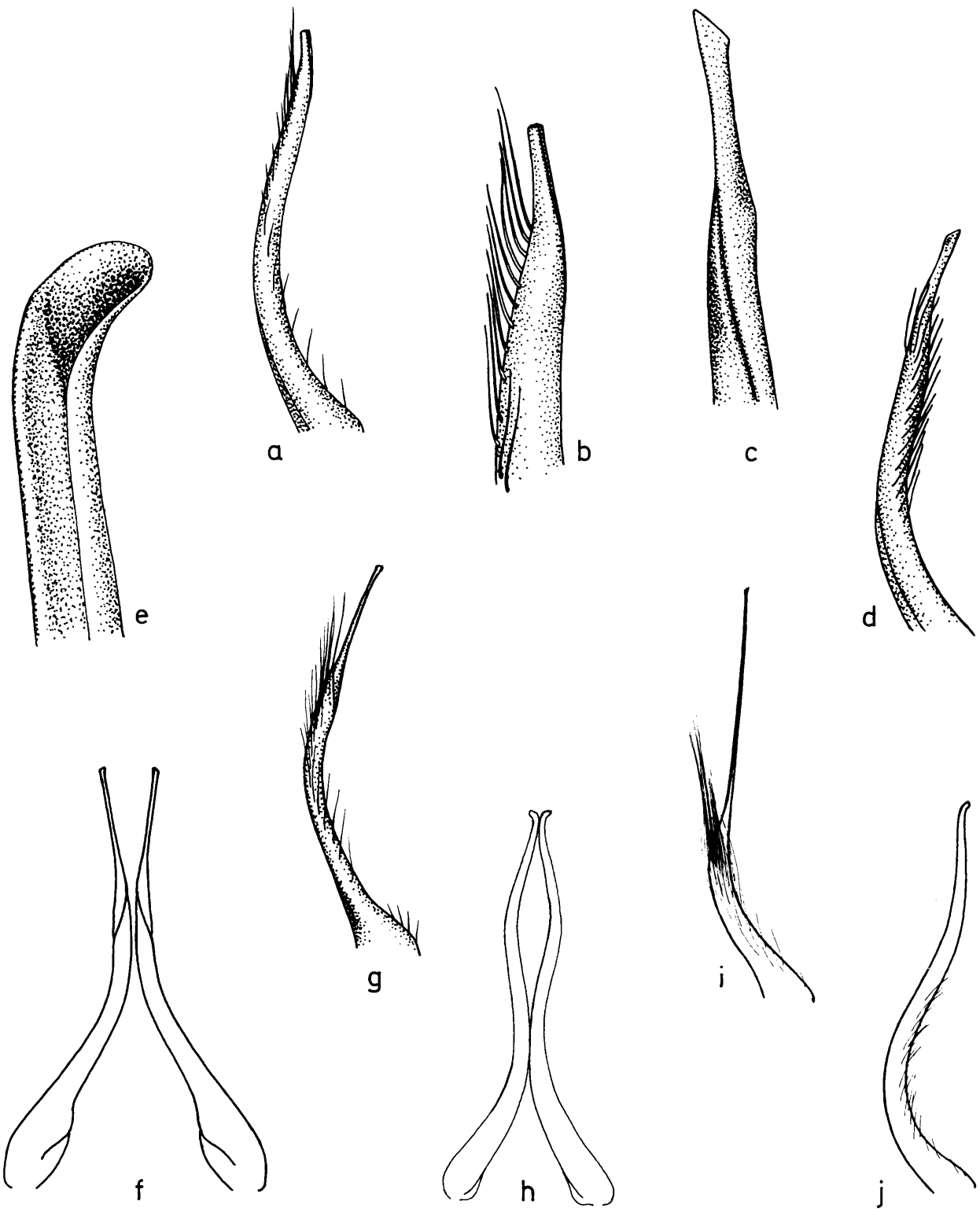


Fig. 47. (*Hyastenus* species of group 2) First pleopod of male of *Hyastenus elongatus* (39 mm, Hong Kong, ZMC) (a) abdominal view of left pleopod, (b) abdominal tip of same; *H. cracentis* (holotype) (c) sternal tip of left pleopod, (d) abdominal view of same; *H. elatus* (holotype) (e) abdominal tip of left pleopod, (f) diagrammatic view of left and right pleopods *in situ*, (g) abdominal view of left pleopod; *H. campbelli* (21 mm, AM P.1910, in part) (h) diagrammatic view of left and right pleopods of immature male *in situ*; (holotype) (i) abdominal view of left pleopod; (AM P.1910, as above) (j) abdominal view of left pleopod.

Laurie has remarked on the similarity of this species to *Hyastenus subinermis* Zehntner, 1894, and to *Halimus espinosus* Borradaile, 1903. However, *H. subinermis* as figured by De Man (1902: pl. 22 fig. 31) has an acuminate preorbital spine and on the basal antennal article there is a strong acuminate anterolateral spine which is visible dorsally. In *H. hendersoni* the preorbital angle of the eave is weakly produced and blunt, and the anterolateral angle of the basal antennal article is produced laterally in a blunt triangular lobe. *H. convexus* is also figured by De Man (1902: pl. 22 fig. 32) on the same plate and the differences from *H. subinermis* in the upper orbit are clearly shown.

We have not examined the type of *Hyastenus espinosus* but from the original description and figure given by Borradaile (1903: 688, pl. 47 figs. a-d) we consider that it differs from *H. hendersoni* in the presence of a tubercle on the summit of the mesogastric region and in the much less divergent rostral spines (the latter noted by Laurie also).

Distribution. — Known only from Sri Lanka: Gulf of Manaar, Cheval Paar.

Hyastenus hilgendorfi De Man, 1887
(Fig. 42 h,i)

Hyastenus hilgendorfi De Man, 1887: 14-18, pl. 1 figs. 3, 4. — Stephensen, 1945: 107, fig. 20 D,E. — Griffin, 1968b: 103-105, fig. 1, pl. 1; 1974: 15; 1976: 192. — Tirmizi & Serène, 1971: 25-27 (in discussion), pl. 2 fig. B. *Halimus hilgendorfi.* — Rathbun, 1906: 881.

Material examined. — 31 ♂♂, 24 ♀♀ (13 ovig.), 6.5-35 mm, smallest ovig. ♀, 12 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Makassar, 27-32 m; 5 specs.

Aru Is., Pulu Jedan, 10 December 1907; 1 spec. — N. Sulawesi, Kuandang, coll. Van Nouhuys, 20 April 1914; 1 spec. — Indonesia, Belitung I., marine growths on buoy, S.S. 'Pharus'; 1 spec. — Borneo, marine growth on buoy, S.S. 'Pharus'; 1 spec. — Sumatra, S.S. 'Pharus'; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Siam Expedition: Gulf of Thailand, dredging in the sound between Koh Mesan and Cap Liant, 16 m, shells and sand, 4 February 1900; 1 spec. — Gulf of Thailand, Koh Kram, 54 m, March 1900; 1 spec.

Mortensen Pacific Expedition: Sulu Archipelago, 15 miles (24 km) W. ½ S of Jolo, 27 March 1914; 1 spec.

Danish Kei Islands Expedition: Kai Is., Vatek opposite Toeal, ca. 2 m, rocky shore, 23 March 1922; 1 spec. — Toeal, 2 m, coral, 26 March 1922; 1 spec. — Vatek, opposite Toeal, ca. 2 m, rocky shore, 28 March 1922; 2 specs. — Stn. 11, off Toeal, 20 m, trawl, 9 April 1922; 4 specs. — Stn. 72, Java Sea, 05°41′S 105°57′E, 35 m, trawl, stones, 28 July 1922; 1 spec. — Stn. 90, Sunda Strait, 05°55′S 105°30′E, 36 m, trawl, dredge hard bottom, coll. Th. Mortensen, 1 August 1922; 1 spec.

'Galathea' Expedition: Stn.332, E. of Singapore, 10 m, fish trap, 15 May 1951; 1 spec.

Formosa Strait, 15 miles (24 km) off Amoy, 14-45 m, stony bottom, 1882; 1 spec. — Strait of Malacca, 05°9′8″N 99°48′10″E, 57 m, sand, mud, 'Store Nordiske', 24 December 1935; 5 specs. — Singapore, shallow water, 27 November 1907; 1 spec. — Singapore, shallow water, 24 January 1910; 3 specs. — Sri Lanka, Trincomalee, 11 m, March 1889; 2 specs. — India, Pamban, 4 m, April 1889; 2 specs. — Gulf of Manaar, Pamban Channel, 5 m, coll. H. Lemche, 8 October 1951; 2 specs. — Gulf of Manaar, Pamban Channel, 5 m, coll. H. Lemche, 9 October 1951; 1 spec.

5 Thai-Danish Expedition: Stn.1009, E. coast Gulf of Thailand 08°43′38″N 98°10′50″E to 08°45′24″N 98°07′48″E, 20-30 m, otter trawl, 8 January 1966; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Hawaiian Islands, off Oahu I., 36-108 m, coll. T. Richert, late 1962; 1 spec. (WAM. 79-71). — Sulu Sea, off Sandakan, Berhala Channel, 5-36 m, coll. B. R. Wilson on 'Pele', 3 March 1964; 9 specs. (WAM. 94-71).

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

SE. Thailand, shallow water between Koh Chang and the coast, among growths of mussels and sponges on stakes on the bottom, coll. van Beusekom, 12 March 1970; 2 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn.AW IV, Aru Is., Wokam, off W. end Udjir I., 05°37′S 134°10′E, 68-93 m, dredge hauls 4-7, mud and rubble, 16 June 1970; 1 spec.

Remarks. — As well as this large series of specimens, others collected by the Danish Expedition to Iran (Stephensen, 1945) and from the Zoological Survey, Calcutta, were examined.

In the series variation was found in rostral length (from less than half to almost 2/3 postrostral carapace length), thickness of rostral spines, how much the preorbital and antorbital angles of the eave are produced, sharpness of the anterolateral angle of the basal antennal article and number of submarginal tubercles on the branchial region. The carapace width varied from 0.69 to 0.8 postrostral carapace length.

There is a tubercle on the summit of the elevated gastric region and sometimes a very low anterior mesogastric tubercle. There is a rounded protogastric tubercle near the orbit and a small tubercle on the hepatic region. On the branchial region there are three to four marginal tubercles and a short epibranchial spine. Between the epibranchial spine and the anterior margin of the branchial region there are three to six submarginal tubercles. The cardiac region is elevated without a tubercle and there is a low tubercle on the intestinal region.

The basal antennal article has, at most, only a small tooth on the anterolateral angle, and proximally it is broadened laterally to form a rounded lobe, the apex of which is at the level of the posterior margin of the antennal fossa.

On the ridge dorsal to the two pterygostomian tubercles, there is sometimes a small tubercle.

In the adult males the cheliped is, with one exception, as figured by Griffin (1968b: fig. 1e), that is, the length of the palm is twice the height and there is only a small gape between the fingers. In one large male (ZMC, cl. 35 mm, off Amoy) the palm is inflated (length is only one and a half times height), there is a definite gape between the fingers and a low swelling proximally on the dactyl, this may be a senescent animal.

The first pleopod of the male has been figured by Monod (1938: fig. 4J), by Stephensen (1945: fig. 20D) and by Griffin (1968b: fig. 1a). The pleopod figured by Buitendijk (1939: figs. 9, 10) as *H. hilgendorfi* and referred to by Tirmizi & Serène (1971) is that of the closely related species *H. trispinosus*. The distal lateral lobe on the first pleopod of *H.*

trispinosus is not as large as that of *H. hilgendorfi*, and beyond it the tip is narrower and curves inward quite strongly. Usually the apex is curved slightly laterally. The specimens from Timor, near Koepang (1♂, cl. 17 mm, 1♀, cl. 15 mm, RML 4304), identified by Buitendijk as *H. hilgendorfi* have been examined and they agree with our specimens of *H. trispinosus*. It is the anterior mesogastric tubercle that is present (not the posterior as in *H. hilgendorfi*) and there is a strong intestinal spine.

There is some variation in the size at which animals reach maturity. Ovigerous females occurred in the size range 12 to 36 mm but there are immature females up to 26 mm in the series. The specimens from Iran have thicker rostral spines, the preorbital lobe is more produced and the anterolateral angle of the basal antennal article is less produced than in those from Singapore. The specimens from the Pearl Banks have moderately thick rostral spines and both the preorbital angle of the eave and the anterolateral angle of the basal antennal article are slightly produced.

The ovigerous female from Oahu Island (WAM 79-71) has been compared with two other female specimens (USNM 29746-7) from Hawaii collected by the 'Albatross' and reported on by Rathbun (1906). The most striking difference that these three specimens show from other specimens of *H. hilgendorfi* are the sharp hepatic spine and the larger protogastric tubercle near the orbit. Also there is only one submarginal tubercle on the branchial region and that is near the anterior border. With so few specimens, none of them male, we continue to regard them, for the present, as a geographical variation of *H. hilgendorfi*.

This species is very close to *H. pleione* and Tirmizi & Serène (1971) have listed several characters which distinguish the species. In *H. hilgendorfi* there is no transverse tubercle between the gastric and cardiac elevations as there is in *H. pleione*, and there are only three (not six) strong tubercles on the gastric region. The variation shown by this large series, indicates however, that the length of the rostral spines is not a reliable character to use. It can be added that the maximum width of the basal antennal article lies further forward in *H. pleione* than in *H. hilgendorfi*, at about the level of the proximal third of the antennal fossa. The first pleopod of the male of *H. pleione* has a constriction below the lateral lobe of the tip; the apex is more slender than that in *H. hilgendorfi* and it is curved laterally.

H. hilgendorfi is also similar to *H. trispinosus*, but in that species there is a strong intestinal spine and if a mesogastric tubercle is present it is the anterior one, level with the protogastric tubercle. Finally, in *H. trispinosus* there is only one submarginal tubercle on the branchial region and that is near the anterior border.

Distribution. — Widespread Indo-West Pacific: E. Africa, Red Sea, Iranian Gulf, S. India, Indonesia, Philippine Islands, Australia, Hawaii.

Hyastenus inermis (Rathbun, 1911)

Halimus inermis Rathbun, 1911: 250-251, pl. 20 fig. 6.
Hyastenus inermis. — Griffin, 1974: 15. — Griffin & Tranter, 1974: 171.

Material examined. — No new material.

Remarks. — This species has a smooth carapace, there is only a low protogastric tubercle near the orbit and sometimes a very small epibranchial spine. It can be distinguished from *H. elongatus* Ortmann by the absence of any mesogastric tubercles (one in that species) and by the much wider supraorbital eave. It is distinguished from *H. hendersoni* Laurie, *H. cracentis* n.sp. and *H. campbelli* n.sp. which also lack mesogastric tubercles, by the lack of an epibranchial spine, while there is a well developed epibranchial spine in those three species.

The first pleopod of the male is distinctive. There is a large distal flap on the medial edge which extends round to the abdominal surface. A similar male pleopod has been figured as *Hyastenus convexus* var. *hendersoni* 'adult form' by Monod (1938: fig. 4, H,I). One of us (D.J.G.G.) has examined the syntypes of *H. hendersoni* (2♂♂, 3♀♀ BMNH. 1907.5.22.116-120) and the first pleopod in the two male specimens is only expanded to a moderate, rounded lobe on the lateral edge. It seems probable that the larger male, of which Monod figured the pleopod, is in fact *H. inermis*.

The palm of the male chela in *H. inermis* has two low tubercles proximally on the dorsal margin. The dactyl of the fourth ambulatory leg has only three or four very small distal spines (the same dactyl in *H. hendersoni* has quite robust proximal and distal spines).

Distribution. — Western Indian Ocean: E. of Mombasa, Seychelles, Amirante, Red Sea.

Hyastenus mindoro new species
(Figs. 49, 51e,f)

Material examined. — 5♂♂, 4♀♀ (4 ovig.), 6-11 mm, smallest ovig. ♀, 6 mm.
Holotype. — Male, 11 mm, Philippine Islands, Mindoro, Puerto Galero, ca. 9 m, 3 February 1914, Mortensen Pacific Expedition; Zoological Museum, University of Copenhagen.
Paratypes. — As listed below:

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Banda Sea, Banda; 2♂♂, 6.5 mm. — Banda Sea, Banda, 9-36 m; 2♀♀ (ovig.), 6.0, 6.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: data as for holotype; 2♂♂, 7.0, 8.5 mm, 2♀♀ (ovig.), 8.0, 8.5 mm.

Description. — Carapace pyriform, narrow behind orbits widened posteriorly across branchial regions, greatest width 0.8 postrostral carapace length, surface smooth with a few tubercles, a strong posterior intestinal spine.

Rostral spines short, about a sixth to a quarter postrostral

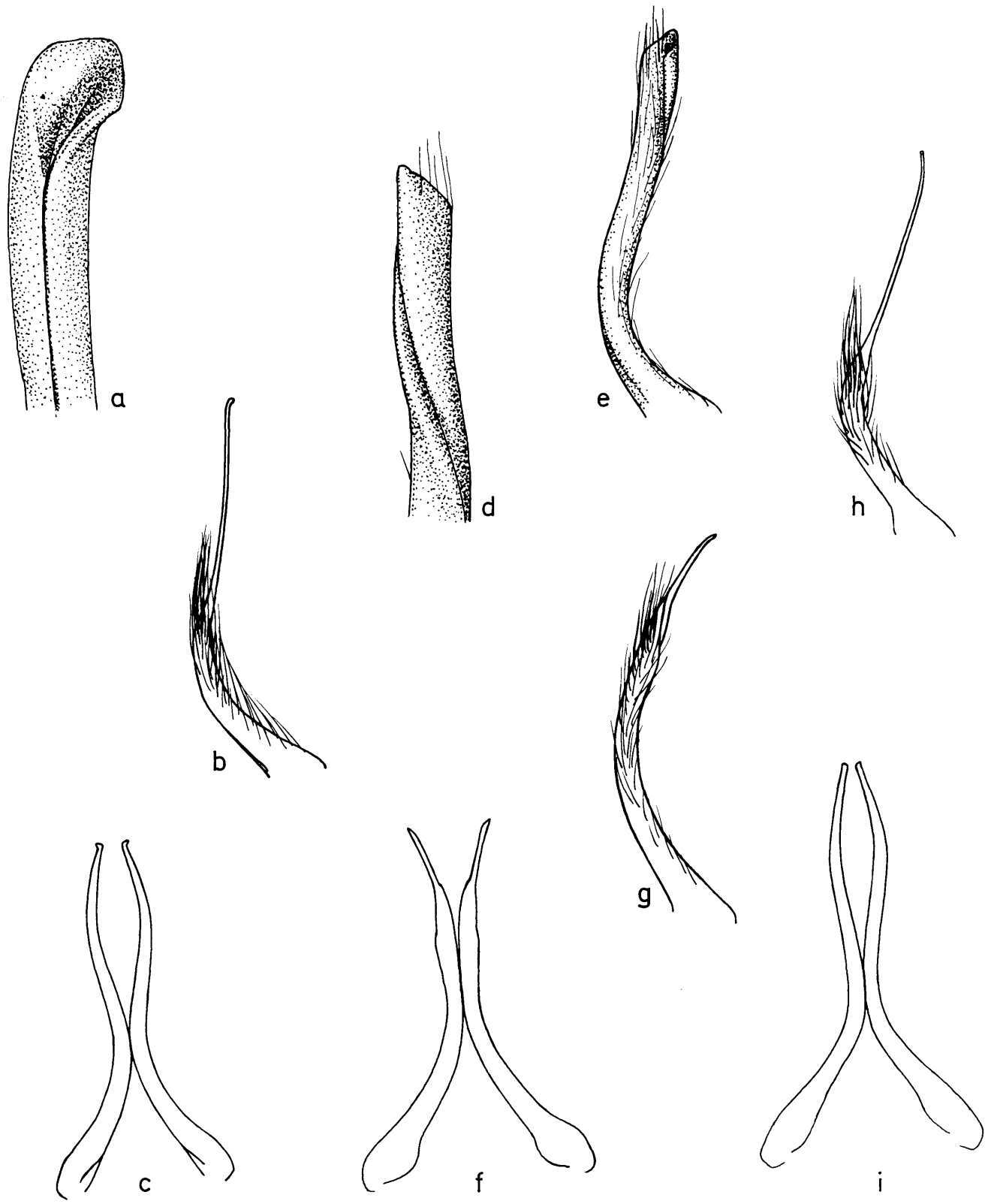


Fig. 48. (*Hyastenus* species of group 2) First pleopod of male of *Hyastenus diacanthus* (70.5 mm, N. of Formosa Strait, ZMC) (a) abdominal tip of left pleopod, (b) abdominal view of same; (20 mm, S. China Sea, ZMC) (c) diagrammatic view of left and right pleopods of an immature male *in situ*; *H. convexus* (20 mm, N. of Formosa Strait, ZMC) (d) sternal tip of left pleopod, (e) abdominal view of same; *H. spinosus* (46.5 mm, AM P.2739) (f) diagrammatic view of left and right pleopods *in situ*, (g) abdominal view of left pleopod; *H. aries* (55.5 mm, Singapore, ZMC) (h) abdominal view of left pleopod; (25.5 mm, Java Sea, ZMC) (i) diagrammatic view of left and right pleopods of an immature male *in situ*.

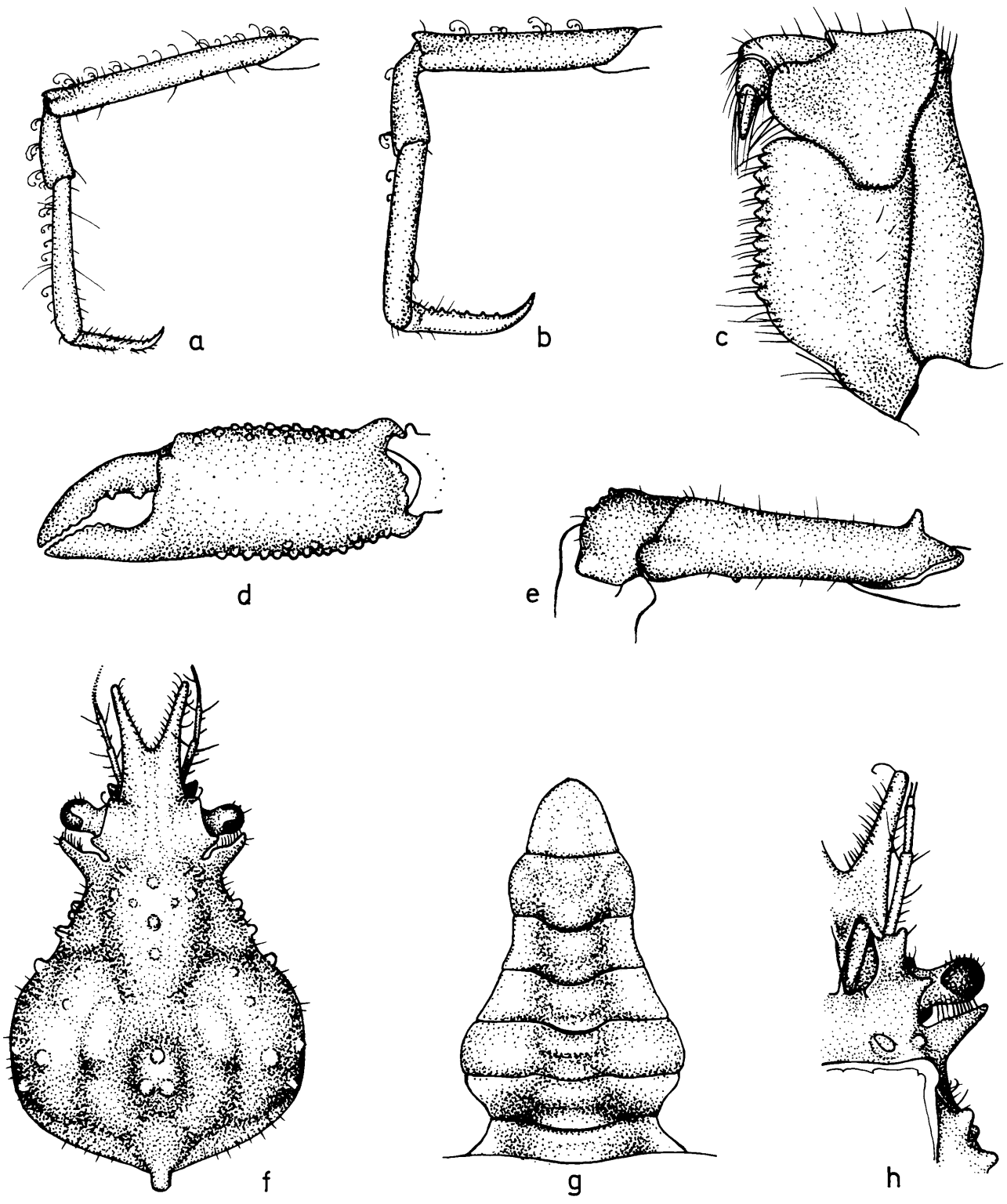


Fig. 49. (*Hyastenus* species of group 3) *Hyastenus mindoro* (female, 8 mm, Mindoro, ZMC) (a) left first ambulatory leg; (b) left fourth ambulatory leg; (holotype) (c) left third maxilliped; (d) left chela; (e) left cheliped, merus and carpus; (f) carapace, dorsal view; (g) male abdomen; (h) left orbit, ventral view.

carapace length, fused for basal third, weakly upcurved; tubercles on rostral ridges.

Orbital eave moderately expanded, preorbital angle only weakly produced not upturned, with a very small lobe or tubercle; antorbital angle a rounded lobe, produced more laterally than preorbital angle; postorbital lobe separated from eave by a narrow U-shaped or keyhole-shaped hiatus; postorbital lobe long, apically narrow, anterior margin with a small proximal lobe, posterior margin straight, apex level with or exceeding antorbital lobe. Eyestalks short, moderately slender; cornea terminal, ventral.

Hepatic region not expanded, smooth, Branchial sub-

margin with a sharp tubercle anteriorly; two short spines one above the other near posterolateral angle, a small tubercle in front of more ventral spine.

Gastric regions weakly elevated; mesogastric region with three medial tubercles; a small protogastric tubercle at a level halfway between first and second mesogastric tubercles and a larger tubercle anterolateral to it.

Cardiac region elevated, higher than gastric region, with a triangle of three strong tubercles, one in front and two behind; sometimes a pair of much smaller submedial tubercles on anterior slope.

Intestinal region with a blunt medial spine, longest carapace spine, just in front of posterior carapace margin.

Anterior branchial region with two small tubercles one behind the other.

Basal antennal article narrow, smooth, medial margin elevated, sharp; anterolateral angle produced into a blunt, triangular spine directed forward and slightly ventrally; a similar spine, directed laterally, on lateral edge about halfway along. A large sharp tubercle lateral to green gland.

Pterygostomian region smooth, margin with two high tubercles, anterior larger, and one or two tubercles just dorsal to them.

Third maxilliped smooth, anterolateral angle of merus moderately produced and rounded. Anterolateral angle of mouthfield produced.

Cheliped of adult male about one and a half (1.4) times postrostral carapace length, merus with a short proximal spine dorsally but no terminal spine, a small tubercle ventrally at about distal third; a longitudinal row of about eight sharp tubercles midway along inner face of merus; carpus with about five well separated tubercles dorsally and a crest of five or six tubercles on inner edge; palm about one and a half (1.7) times as long as high with numerous sharp granules on inner face and on dorsal and ventral margins and a longitudinal row of five or six sharp tubercles midway along inner face; outer face smooth; fingers two thirds length of palm, a large gape between them in proximal half, a large proximal tooth and a smaller distal tooth on dactyl in gape, both fingers with small, uniform teeth on distal half of cutting edge.

Ambulatory legs slender, smooth, first ambulatory leg about one and a half times postrostral carapace length, merus without a terminal spine; fourth leg about two thirds length of first leg, dactyl with about six very small spines ventrally along its length.

Sternum smooth, a low shallow depression on each side in front of abdominal fossa.

Male abdomen of seven segments, smooth; third segment nearly twice (1.8) as wide as sixth segment; sixth segment about one and a half times wide as long; seventh segment as wide as long.

Female abdomen with segments four to six fused; second and third segments with a transverse medial tubercle. Female gonopore a suboval aperture, opening medially.

First pleopod of male broad, curved outwards at about distal third, tapering only just before blunt apex.

Remarks. — This species is similar to *H. biformis*, *H. scrobiculatis* and *H. fraterculus* in the presence of two subequal lateral lobes on the basal antennal article; the presence of tubercles and granules on the inner face of the cheliped palm; and the weakly produced preorbital angle of the eave. It is distinguished from these three species by the rostral spines which are fused for the basal third; the strong posterior intestinal spine, and the longer postorbital lobe which is directed slightly forward.

Distribution. — Philippine Islands, Banda.

Hyastenus planasius (Adams & White, 1848) (Fig. 46d)

Pisa planasia Adams & White, 1848: 9-10, pl. 2 figs. 4, 5.
Hyastenus planasius. — Alcock, 1895: 212. — Buitendijk, 1939: 245, 247, text fig. 13. — Griffin, 1976: 194. (Not *Hyastenus planasius.* — Chhapgar, 1957: 411-412, pl. 3 figs. l-n.)

Material examined. — 9 ♂♂, 16 ♀♀ (11 ovig.), 5.5-15 mm, smallest ovig. ♀, 8 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn.47, Sumbawa, Bay of Bima, near south fort, Bima anchorage, shore exploration, 8/12 April 1899; 1 spec. — Stn.57, Timor Sea, 10°29′S 121°28.7′E, 1419 m, foramniferan ooze, 24 April 1899; 1 spec. — Stn. 310, Flores Sea, 08°30′S 119°7′E, 73 m, dredge, sand with few pieces of dead coral, 12 February 1900; 1 spec.

Java Sea, off Jakarta, otter-trawl, 'Rambang', April-May 1907; 5 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, ca. 21-40 m, dredge, 17 March 1914; 2 specs. — Sulu Archipelago, off Jolo, off Marongas, ca. 54 m, dredge, 19 March 1914; 6 specs.

Danish Kei Islands Expedition: Stn.67, Java 05°48′S 106°12′E, 38 m, trawl, sand, 27 July 1922; 1 spec. — Stn. 72, Java, 05°41′S 105°57′E, 35 m, trawl, stones, 28 July 1922; 2 specs. — Stn. 106, Java Sea, 05°50′S 106°16′E, 32 m, trawl, sand, 5 August 1922; 2 specs.

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Mariel King Memorial Expedition — Moluccas: Stn.CP I, Ceram, Piru Bay, off Tg Tutuhuhur, 03°15′S 128°8′E, 25-54 m, dredge hauls 8-19, coarse sand, grey sand or foramniferal sand, 1 June 1970; 1 spec. — Stn.CP I (as above), 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 1 spec. — Stn.AN I, Aru, S. Trangan I., SW. of Tg. Ngabordamlu, centred near 06°58′S 134°5′E, 25-29 m, dredge hauls 1-3, coral and sponge, mud and broken shell, 20 June 1970; 1 spec. — Stn.AN I (as above), 25-29 m, dredge haul 2, mud and broken shell, 20 June 1970; 1 spec. — Stn.A III, Aru, Trangan, 3-4 miles (~ 5-6.5 km) W. of Tg.Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 1 spec.

Remarks. — These specimens agree well with those figured by Adams & White (1848: pl. 2 figs. 4, 5). The carapace surface is smooth without a dense tomentum, but there are lines of curled hairs on the interorbital region, on the gastric region and along the branchial margin. As well, there are scattered pairs of long setae.

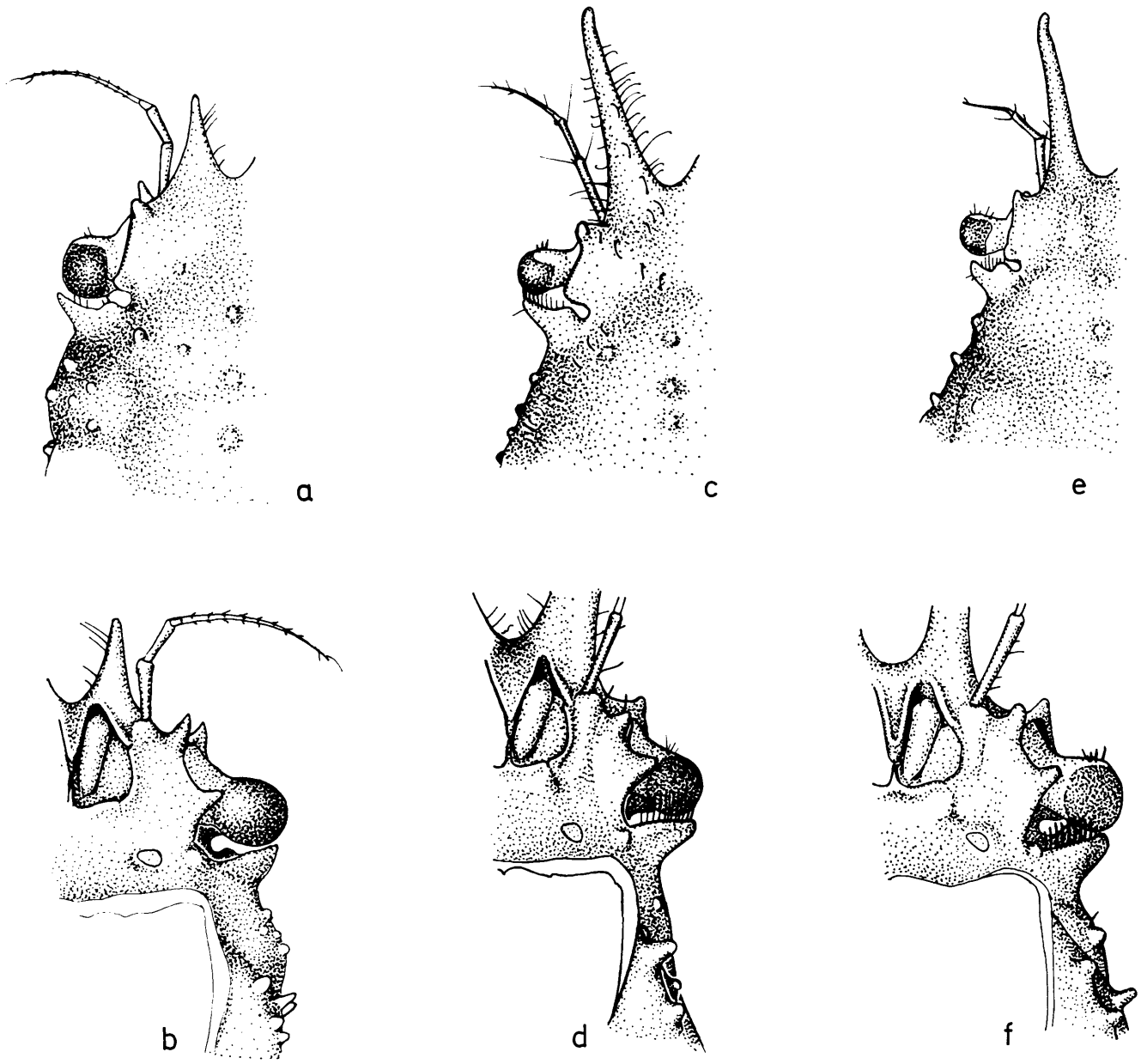


Fig. 50. (*Hyastenus* species of group 3) *Hyastenus fraterculus* (male, 8.5 mm, Kai Is., NIO Jakarta) (a) left orbit, dorsal view, (b) ventral view of same; *H. scrobiculatus* (male, 9.5 mm, Kai Is., NIO Jakarta) (c) left orbit, dorsal view, (d) ventral view of same; *H. biformis* (male, 14 mm, Sumbawa, ZMA) (e) left orbit, dorsal view, (f) ventral view of same.

The rostral spines are very short (a quarter to a third postrostral carapace length) and parallel. The outer margin of the supraorbital eave is slightly concave and the upper orbital hiatus is U-shaped.

There is a small spine on the hepatic region and there is a very small epibranchial spine.

The gastric region is only slightly elevated and the number of mesogastric tubercles varies. Some of these specimens have two very low mesogastric tubercles, some only the posterior one, and some have no mesogastric tubercles. Specimens from the Sulu Archipelago collected by the 'Albatross' expedition (6 ♂♂, 3 ♀♀, cl. 10-15 mm, USNM 49899) have two low mesogastric and two pairs of low protogastric tubercles. Buitendijk (1939) has described specimens from Timor with three faint mesogastric tubercles and one low lateral tubercle on each side.

The cardiac region is smooth and barely elevated, there is a very low tubercle in only four specimens. The intestinal region is flat and without a tubercle.

The anterolateral angle of the basal antennal article has a well developed spine directed obliquely forwards. On the lateral margin there is a broad proximal lobe which is produced as far laterally as is the anterior spine. The orbit is completely open below.

The first pleopod of the male is similar to that figured by Buitendijk, but narrows more gradually toward the tip, and sometimes there is one long seta extending beyond the apex.

The abdomen of the female has segments four to six fused.

The specimens figured by Chhapgar (1957: pl. 3 figs. l,m,n) are dissimilar from our series in carapace shape, form of rostrum and first pleopod of the male and we cannot consider them conspecific, but we are unable to say what species they are.

Distribution. — Northern Indo-West Pacific: Sulu Archipelago, Ceram, Aru Is., Timor Sea, Flores Sea, Java Sea, Gulf of Thailand, Singapore, Mergui, Sri Lanka and South India.

Hyastenus pleione (Herbst, 1803)

Cancer plejone Herbst, 1803: 52-53, pl. 58 fig. 5.
Hyastenus pleione. — De Man, 1888: 225-226, pl. 7 figs. 3, 3a. — Alcock, 1895: 208-209. — Buitendijk, 1939: 247-248, text fig. 14. — Tirmizi & Serène, 1971: 24-27, text fig. 2, pl. 2 fig. 4.

Material examined. — 1♂, 2♀♀, 20-32 mm.

ZOOLOGICAL SURVEY, CALCUTTA

Sri Lanka, Galle, coll. J. A. Anderson; 2 specs. (ZSC.2719/3). — Sri Lanka, Pearl Banks, coll. T. Southwell, 1911; 1 spec.

Remarks. — This species is distinguished from *H. hilgendorfi* as follows: there is a transverse tubercle between the gastric and cardiac elevations (not present in *H. hilgendorfi*), and on the gastric region there are six (not three) strong tubercles arranged in a 'Y'; the two large tubercles on the pterygostomian margin have one or two tubercles medial to them (absent in *H. hilgendorfi* but a small tubercle is sometimes found on the ridge dorsal and lateral to the two large pterygostomian tubercles).

Differences from *H. hilgendorfi* in the shape of the basal antennal article and first pleopod of the male are discussed under that species.

This species has been recently discussed and figured by Tirmizi & Serène (1971) and a detailed synonymy given.

Distribution. — South India, Sri Lanka, Gulf of Manaar, Singapore, Timor, Ambon.

Hyastenus scrobiculatus Rathbun, 1916
(Figs. 50c,d, 51g,h)

Hyastenus scrobiculatus Rathbun, 1916: 547. — Griffin, 1976: 194, fig. 4 (b).

Material examined. — 11♂♂, 10♀♀ (7 ovig.), 6.5-11.5 mm, smallest ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn.14, Kai Is., S. of Doe Roa, 40 m, trawl, sand, 10 April 1922; 5 specs. — Stn.30, Kai Is., between Doe Roa and Kei Doelah, 40 m, trawl, sand, shells, 18 April 1922; 1 spec. — Stn.38, Kai Is., NE. of Doe Roa, 35 m, trawl, sand, coll. Th. Mortensen, 24 April 1922; 1 spec.

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Mariel King Memorial Expedition — Moluccas: Stn.CP I, Ceram, Piru Bay, off Tg.Tutuhuhur, 03°15′S 128°8′E, 25-63 m, dredge hauls 8-19, 2 June 1970; 1 spec. — KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 6 specs. — Stn. KR VII, Kai Is., between Du Rowa and Kai Dulah Is., 05°32′S 132°46′E, 32-36 m, dredge haul 3, muddy sand and sponge, 11 June 1970; 5 specs. — Stn.KR IX, Kai Is., N. end of Kai Dulah, 05°31′S 132°48′E, 18-22 m, dredge, sand, 12 June 1970; 1 spec. — Stn. TS VI, Kai Is., Tanimbar, Selaru, Tg. Tuwau, 08°11′S 130°49′E, snorkeled and hand dredged, 27 June 1970; 1 spec.

Remarks. — These specimens agree well with the holotype (♂, 9.6 mm, Sulu Archipelago, USNM 48218) but the rostral spines in most specimens are weakly divergent, not parallel. In some of the females of this series the urogastric region is less depressed and the dorsal carapace tubercles, especially on the branchial region, are less pronounced.

The rostral spines are about a quarter postrostral carapace length in the females and up to half the postrostral carapace length in the males.

On the preorbital angle of the eave there is a small sharp upturned tubercle, and the antorbital angle is rounded and produced. On the anterior margin of the postorbital lobe there is a small process, which varies in size, more pronounced than in the type material but not as large as in *H. biformis*.

There are three mesogastric tubercles (not four) and a protogastric tubercle level with the space between the first and second tubercle.

The cardiac region is more elevated than the gastric region, there is a tubercle on the summit and in most specimens a low tubercle on the posterior slope.

There are four tubercles, the last sharp, on the branchial margin, but in several specimens only the last two of these are present. Anteriorly, there is a single submarginal tubercle in line with the pterygostomian tubercles.

On the lateral margin of the basal antennal article there are two sharp subequal processes, the anterior is more slender and directed obliquely downwards.

As well as the two usual tubercles on the pterygostomian margin, there is often a third tubercle, level or slightly dorsal, between them.

There is a submarginal tubercle on the hepatic region and in three females there is also a dorsal tubercle. There is a single tubercle on the intestinal region.

There are three or four tubercles ventrally on the inner face of the merus of the cheliped, dorsally there are two proximal tubercles and a short acute terminal spine; midway on the inner face of the palm of the male there is a longitudinal row of two or three tubercles, granules above it, and also along the dorsal edge.

This species is similar to *H. biformis*, *H. fraterculus* and *H. mindoro* but each of these three species has two submedial tubercles on the cardiac region.

This species has been known previously only from the Sulu Archipelago, Philippine Islands.

Distribution. — Kai Islands, Ceram, Sulu Archipelago.

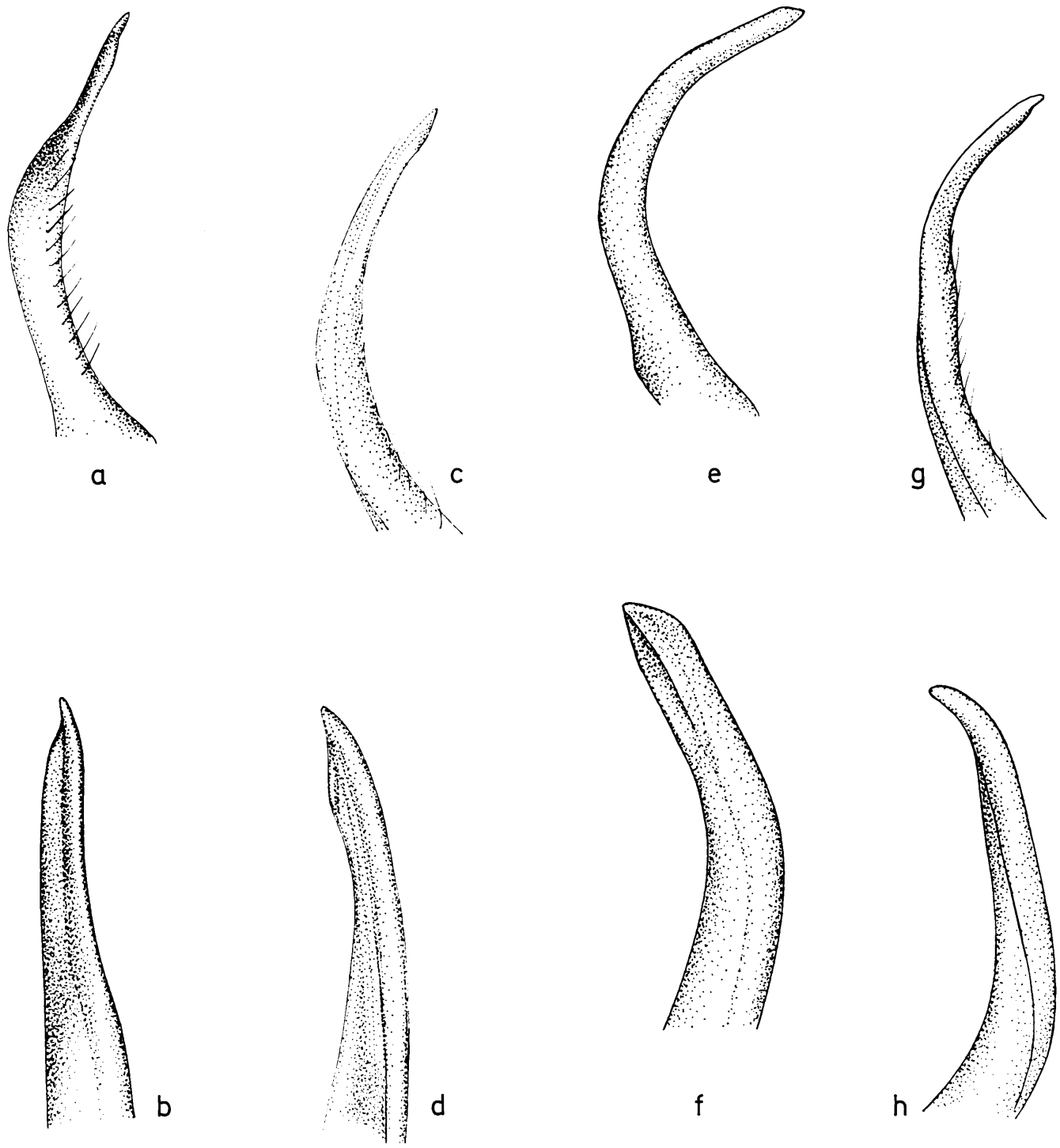


Fig. 51. (*Hyastenus* species of group 3) Left first pleopod of male of *Hyastenus biformis* (14 mm, Sumbawa, ZMA) (a) abdominal view of pleopod, (b) sternal tip of same; *H. fraterculus* (8.5 mm, Kai Is., NIO Jakarta) (c) abdominal view of pleopod, (d) sternal tip of same; *H. mindoro* (holotype) (e) abdomianl view of pleopod, (f) sternal tip of same; *H. scrobiculatus* (11.5 mm, Kai Is., ZMC) (g) abdominal view of pleopod, (h) sternal tip of same.

Hyastenus sebae White, 1847
(Figs. 40c,d, 41g,h)

Hyastenus sebae White, 1847b: 57 (in part). — Griffin, 1976: 194, 196, fig. 6(a).

Hyastenus oryx A. Milne Edwards, 1872: 250-252, pl. 14 fig. 1, 1a-d. — Takeda, 1973a: 104-105, fig. 2 G,H.

Material examined. — 77 ♂♂, 102 ♀♀ (42 ovig.), 5.5-33 mm, smallest ovig. ♀, 11 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn.33, Lombok, Bay of Pidjot, 22 m or less, trawl, dredge and shore exploration, mud, coral and coral sand, 24/26 March 1899; 1 spec. — Stn. 50, W. coast of Flores, Bay of Badjo, up to 40 m, dredge, trawl and shore exploration, mud, sand and shells, 16/18 April 1899; 1 spec. (ZMA De. 100.716). — Stn.64, Flores Sea, Tanahdjampea, Kambaragi Bay, up to 32 m, trawl, dredge and shore exploration, coral, coral sand, 4/5 May 1899; 6 specs. — Stn.65a, S. Sulawesi (Celebes), near 07°S 120°34.5′E, from 400-120 m, dredge, pale grey mud changing to cor-

al, 6 May 1899; 1 spec. — Stn.71 Sulawesi (Celebes), near Makassar, Pulu Barang, shore exploration, 24 May 1899; 1 spec. — Stn.80, Borneo Bank, 02°25′S 117°43′E, from 50-40 m, trawl, fine coral sand, 13 June 1899; 1 spec. (ZMA De. 100.629 (in part)). — Stn.96, Sulu Archipelago, SE. side of Pearl Bank, 15 m, dredge, townet, *Lithothamnion*, 27 June 1899; 1 spec. — Stn.154, Irian Jaya, Straat Bougainville, 00°7.2′N 130°25.5′E, 83 m, decreased to 59 m during haul, dredge, grey muddy sand, shells and *Lithothamnion*, 14 August 1899; 2 specs. — Stn.164, Irian Jaya, between Salawati and Misool, 01°42.5′S 130°47.5′E, 32 m, dredge, sand, small stones and shells, 20 August 1899; 4 specs. — Stn. 172, Ceram, Geser, anchorage between this island and Seram — Laut, reef exploration, coral and *Lithothamnion*, 26/28 August 1899; 1 spec. (ZMA De. 100.725, det. Ihle as *H. oryx*). — Stn.174, N. coast of Ceram, Waru Bay, 18 m, dredge, townet, reef exploration, mud, 28/29 August 1899; 1 spec. — Stn.209, S. Sulawesi, anchorage off S. point of Kabaena I., 22 m, dredge, reef exploration, coarse sand, 23 September 1899; 1 spec. — Stn.253, Kai Is., 05°48.2′S 132°13′E, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 3 specs. — Stn.282, Timor, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Stn.299, Timor, S. coast of Roti I., Boeka or Cyrus Bay, 34 m, dredge, reef exploration, diving, mud, coral and *Lithothamnion*, 27/29 January 1900; 1 spec. — Stn.315, Flores Sea, anchorage E. of Sailus Besar, Paternoster Is., up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 2 specs. — Stn.316, Java Sea, 07°19.4′S 116°49.5′E, 538 m, trawl, fine, dark brown, sandy mud, 19 February 1900; 1 spec. — Stn.322, Java Sea, S. coast of Bawean I., 1½ miles (~ 2½ km) S. of Tandjong Lajar, 32 m, dredge, coral 24 February 1900; 1 spec. (ZMA De. 100.655 (in part)). — Kai Is., Kur I.; 1 spec. — Banda; 1 spec. — Banda, 9-36 m; 2 specs. — Sulawesi, Makassar; 3 specs. — Sulawesi, Makassar, 27-32 m; 1 spec. — Ambon Reef; 1 spec. — Sulu Archipelago; 1 spec.

Banda, on the shore; 1 spec. — Java Sea by Jakarta, trawl, 'Rambang', April-May 1907; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Singapore, 16 April 1907; 1 spec. — Singapore, shallow water, 24 January 1910; 1 spec.

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, ca. 36 m, dredge, *Lithothamnion*, 17 March 1914; 5 specs. — Sulu Archipelago, off Jolo, ca. 54 m, dredge, coral sand, 19 March 1914; 18 specs.

Danish Kei Islands Expedition: Banda, off Neira, 13 m, dive, sand, 12 February 1922; 2 specs. — Ambon, Ambon Bay, 13-18 m, sand, 28 February 1922; 1 spec. — Kai Is., Toeal, ca. 2 m, sand, 21 March 1922; 6 specs. — Kai Is., off Toeal, ca. 1-2 m, 31 March 1922; 1 spec. — Stn.10 Kai Is., off Doelah, 50 m, dredge, fine sand, 6 April 1922; 1 spec. — Stn.11, Kai Is., off Toeal, 20 m, trawl, fine sand, 9 April 1922; 1 spec. — Stn.14, Kai Is., S. of Doe Roa, 40 m, sand, 10 April 1922; 1 spec. — Stn.15, Kai Is., S. of Doe Roa, 5-20 m, sand, 10 April 1922; 2 specs. — Stn.19, Kai Is., off Toeal, 20 m, trawl, sand, 14 April 1922; 3 specs. — Kai Is., Doe Roa Bassin, 50 m, sand, 14 April 1922; 1 spec. — Stn. 30, Kai Is., between Doe Roa and Kei Doelah, 40 m, trawl, sand, shells, 18 April 1922; 7 specs. — Stn. 59, Kai Is., 05°28′S 132°36′E, 385 m, trawl, coral, sponges, 12 May 1922; 1 spec. — Stn. 60, Kai Is., S. of Doe Roa, ca. 25 m, dredge, sand, shells, 14 May 1922; 4 specs. — Stn. pt. 61, Kai Is., between Doe Roa and Kai Doelah, ca. 50 m, trawl, bryozoans, 14 May 1922; 1 spec. — Banda, off Waling, ca. 15 m, sand, 15 May 1922; 1 spec. — Banda, off Neira, ca. 20 m, dive, sand, 1 June 1922; 9 specs. — Banda, off Neira, ca. 10 m, dive, sand, 5 June 1922; 3 specs. — Banda, off Kombir, ca. 70-90 m, dredge, sand, 7 June 1922; 1 spec. — Banda, ca. 20 m, dive, sand, 8 June 1922; 1 spec. — Banda, off Neira, ca. 15 m, dive, sand, 9 June 1922; 1 spec. — Banda, off Neira, ca. 20 m, dive, sand, 10 June 1922; 1 spec. — Banda, off Neira, 13 m, dive, sand, coral, 12 June 1922; 1 spec. — Banda Is., off Waling, 10 m, sand, 15 June 1922; 6 specs. — Sulawesi, Makassar, off Samaloma, ca. 35 m, dredge, sand, mud, 28 June 1922; 1 spec. — Kai Is., Toeal, 0-1 m, 21 July 1922; 1 spec. — Stn. 65, Java Sea, 05°52′05″S 106°17′E, 25 m, sand, 27 July 1922; 1 spec. — Stn.66, Java Sea, 05°54′S 106°12′E, 24 m, trawl, sandy mud, shells 27 July 1922; 2 specs. — Stn.69, Java Sea, 05°47′S 106°17′E, 50 m, sand, 27 July 1922; 1 spec. — Stn.106, Java Sea, 05°50′S 106°6′E, 32 m, sand, 5 August 1922; 3 specs.

'Dana' Expedition: Stn.3617, New Caledonia, Noumea Harbour, 0.2 m, coral, sand, stones, 3 December 1928; 1 spec.

Mortensen Java-S. Africa Expedition: Java Sea, Hoorn, I., shore collecting, 19 April 1929; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: Dampier Archipelago, between Manus and Gidley Is., coll. B. Royce on 'Davena', 1 June 1960; 1 spec. (WAM 83-71). — Dampier Archipelago, Gidley I., 29 m, Honolulu dredge, coral rubble, coll. B. Royce on 'Davena', June 1960; 1 spec. (WAM. 76-71). — Shark Bay, SE. corner of Dirk Hartog I., 3-7 m, dredge, coll. B. R. Wilson and G. W. Kendrick, 5 March 1966; 2 specs. (WAM. 84-71). — Shark Bay, South Passage, mainland side, 3-5 m, sand, 5 March 1966; 1 spec. (WAM 86-71). — Careening Bay, *Posidonia* bank, south sand flat, coll. Marine Science Camp, 29 November 1967; 1 spec. (WAM 75-71). — Bay N. of Pt. Cloates, 22°37′S 113°38.5′E to 22°39′S, 113°40′E, 2-6 m, box dredge, sand, sponge and dead shells, 'Ningaloo', 30 August 1968; 3 specs.

Sulu Archipelago, Basilan Straits, W. of Malanipa I., 23 m, sand and rubble. coll. B. R. Wilson on 'Pele', 12 February 1964; 1 spec. (WAM. 92-71 (in part)).

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Sydney, Museum Godeffroy; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn.CP I, Ceram, Piru Bay, off Tg.Tutuhuhur, 03°15′S 128°8′E, 41-48 m, dredge haul 4, coarse foramniferal and shell sand, 1 June 1970; 1 spec. — Stn.CP I (as above), 36-47 m, dredge hauls 7-9, coral, sponge, coarse sand, *Lithothamnion* and rubble, 1-2 June 1970; 1 spec. — Stn.KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 4 specs. — Stn.KR IX, Kai Is., N. end of Kai Dulah, 05°31′S 132°48′E, 18-21 m, dredge, sand, 12 June 1970; 2 specs. — Stn.KN IV, Kai Is., W. coast of Nuhu Tjut, E. side of Mitduan Reef, 05°32′S 133°E, 36-56 m, dredge hauls 3-4, sand, coral, rubble and sponge, 13 June 1970; 1 spec. — Stn.AW I, Aru Is., W. Wokam, off W. coast of Wasir I., 05°30′S 134°12′E, 32-39 m, dredge haul 6, sand and shell rubble, 15 June 1970; 6 specs. — Stn.AN I, Aru, S. Trangan I., SW. of Tg.Ngabordamlu, centred near 06°58′S 134°5′E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 4 specs. — Stn.AN I (as above), 25-29 m, dredge hauls 1-3, coral, sponge, mud and broken shell, 20 June 1970; 5 specs. — Stn. A III, Aru, Trangan, 3-4 miles (~ 5-6½ km) W. of Tg.Lelar, 06°46′S 133°58′E, 11-14 m, dredge hauls 5-6, sand and rubble, 21 June 1970; 7 specs. — Stn. TS VI, Tanimbar, Selaru, Tg.Tuwau, 08°11′S 130°49′E, snorkeled and hand dredged, 27 June 1970; 1 spec.

Remarks. — This species, like *H. whitei* and *H. cornigerus* is distinguished from other species of *Hyastenus* by a very tuberculate carapace. The characters which separate *H. sebae* and *H. whitei* have been listed previously (Griffin, 1976), but are reiterated briefly here.

This large series of *H. sebae* shows considerable variation in several characters. The rostral spines vary from a third to two thirds the postrostral carapace length. They are usually divergent, but in some specimens with short rostral spines they are subparallel.

The preorbital angle of the supraorbital eave is sharp, slightly produced, and is sometimes a short spine (in *H. whitei* it is rounded and not produced). Opposite the rounded antorbital lobe there is a small process on the anterior margin of the postorbital lobe.

There is a row of three to four tubercles on the branchial margin and a much larger epibranchial tubercle or short spine (in *H. whitei* only a subequal tubercle). Between the epibranchial spine and the anterior margin of the branchial region,

there are three to five small submarginal tubercles (in *H. whitei* only two). On the dorsal part of the hepatic region there is a row of two to three small tubercles, which in nearly all the specimens are smaller than the posterior tubercles of the branchial region. (In *H. whitei* the hepatic and posterior branchial tubercles are subequal.) In this series, a few specimens (from Sulawesi and Western Australia) have hepatic tubercles as large as those of *H. whitei*; however, these specimens also have a strong epibranchial spine. On the intestinal region there is a medial tubercle, low and rounded in most specimens, but in a few almost spine-like.

The anterolateral angle of the basal antennal article is produced as a blunt lobe, small tooth or well developed spine (not produced at all in *H. whitei*). This feature and the shape of the lobe on the lateral margin of the article are very variable.

In some specimens there is a small proximal tubercle on the merus of both the cheliped and the first ambulatory leg.

The first pleopod of the male has been figured by Takeda (1973a).

Both *H. sebae* and *H. whitei* have been found in the Sulu Archipelago but neither have been recorded from Japan. *H. cornigerus* Sakai, from Japan, as described and figured by Sakai (1938: 283-284, fig. 37; 1976: 227-228, fig. 123) is very similar to our specimens of *H. sebae* in general appearance and in number and pattern of carapace tubercles, including the triangle of three tubercles on the urogastric region. We are not able to say, from the description given for *H. cornigerus*, and with the wide variability we have noted among our specimens of *H. sebae*, what the characters are which would separate the two species. Only by examining the two species together could the difference be determined.

Takeda (1973a) recorded *H. sebae* (under the name *H. oryx*) from Palau. In the collections of the Smithsonian Institution is a specimen (1 ovig. ♀, cl. 19.5 mm, acc. no. 206 221) from Palau of *H. sebae* identified by Sakai as *H. cornigerus*.

However, the specimen reported and figured as *H. cornigerus* by Takeda & Kurata (1976: 24-25, fig. 3 E,F, pl. 2 fig. 2) clearly differs from our specimens of *H. sebae* (and, therefore, the material discussed under the name *H. cornigerus* by Sakai) in the large hepatic spine, broad intestinal spine and bilobed orbital eave and, as remarked by Takeda, it resembles species of *Naxioides* especially in the pleopod of the male. Takeda's specimens are similar to the specimen described and figured as *Hyastenus elegans* by Miers (1886: 58-59, pl. 6 fig. 3) and which Miers compared to *H. oryx* (now. *H. sebae*). In the holotype of *H. elegans* (imm, female, cl. 32.7 mm, Kai Is., 252 m, BMNH 84.31) which one of us (D.J.G.G.) has examined, there is an intercalated spine separated from the postorbital lobe only by a narrow slit. In addition a specimen examined at the Zoological Museum, University of Copenhagen (♂, 59.6 mm, E. of Tsu Shima, 113 m, 16 December 1956), which appears to be conspecific with the holotype of *H. elegans* has a pleopod very similar to that figured by Takeda for *H. cornigerus*. The presence of an intercalated spine would mean these specimens do not belong to *Hyastenus*.

Distribution. — Palau, Philippine Islands, Indonesia, North and Western Australia, northern Indian Ocean.

Hyastenus trispinosus Rathbun, 1916
(Figs. 40g,h, 41e,f)

Hyastenus trispinosus Rathbun, 1916: 542-543. — Griffin, 1976: 198, fig. 5(b).

Material examined. — 6 ♂♂, 6 ♀♀ (3 ovig.), 7.5-16 mm, smallest ovig. ♀, postrostral carapace length 8.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn.299, Timor, S. coast of Roti I., Boeka or Cyrus Bay, 10°52.4′S 123°1.1′E, 34 m, dredge, reef exploration, diving to 34 m, mud, coral and *Lithothamnion*, 27/29 January 1900; 2 specs.— Ambon, Ambon reef; 7 specs.

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'Dana' Expedition: Stn.3760, Irian Jaya, Manokwari, 16 July 1929; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, Pacific coast N. of Jayapura, reef near base G, coll. G. van Hout, April 1955; 2 specs.

Remarks. — This species is similar to *H. hilgendorfi*. Like that species it has divergent rostral spines, a protogastric tubercle near the orbit, a row of three tubercles on the branchial region and an epibranchial spine. It is distinguished from *H. hilgendorfi*, by the presence of a strong spine on the intestinal region and the absence of any additional submarginal tubercles between the tubercle on the anterior margin of the branchial region and the epibranchial spine; the mesogastric tubercle, when present is located anteriorly, level with the protogastric tubercle.

On the anterior margin of the postorbital lobe, there is a notch in some specimens which is almost as pronounced as that in *Thusaenys calvarius*, a species which also has a well developed intestinal spine. In *H. trispinosus*, however, the supraorbital eave is longer, the small preorbital spine is directed forward rather than laterally, and the lateral margin of the eave, although slightly concave, is not notched. As well, the branchial regions are elevated, with a strong epibranchial spine, and the gastric and cardiac regions are separated by a depressed urogastric region not present in *T. calvarius*.

The first pleopod of the male is similar to that of *H. hilgendorfi*, but the tip is narrower towards the apex and concave on the medial edge opposite the lateral lobe.

Distribution. — Sulu Archipelago, Ambon, Irian Jaya, Timor, Singapore.

Hyastenus uncifer Calman, 1909
(Figs. 38e,f,i, 39c, 42e-g)

Hyastenus uncifer Calman, 1909: 712, pl. 72 figs. 8, 9.

Material examined. — 3 ♂♂, 2 ♀♀ (1 ovig.) 12-18.5 mm, ovig. ♀, 15 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: South Timor, Haingsisi Reef; 1 spec.
Sumatra, S.S. 'Pharus'; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Banda Is., Waling, ca. 15 m, sand, 15 May 1922; 1 spec. — Banda Is., off Waling, ca. 15 m, dive, sand, coral, 2 June 1922; 1 spec. — Banda, off Neira, 13 m, dive, sand, 12 June 1922; 1 spec.

Remarks. — These specimens agree well with type material (imm. ♀, 11.4 mm, Christmas I., Indian Ocean, ZSC 7250/10) examined by one of us (D.J.G.G.) and with the description given by Calman, in the long slender rostral spines, distinct hepatic and intestinal spine, one dorsal tubercle on the anterior branchial region, and the spines on the dactyls of the ambulatory legs directed backwards towards the propod. The cardiac region is incorrectly shown in Calman's figure of the holotype (pl. 72 fig.8); in his figure there is a strong medial elevation ahead of the level of the epibranchial spine and another behind it, but in fact the urogastric region is smooth and the cardiac elevation is level with the epibranchial spine. As there is no male in the type material the first pleopod of the male must be described from other specimens. In our series there are three males, one from south Timor and two from Banda and we have figured the first pleopod of one of these. The first pleopod is broad and straight, the distal quarter is twisted through 90° to lie in a dorsoventral plane, the narrow apex is sternal and there is a broad lobe behind it on the abdominal surface. Therefore we base our understanding of the male of *H. uncifer* on these specimens.

H. uncifer is similar to *H. brockii* De Man and *H. borradailei* (Rathbun) in the long rostral spines, weakly expanded orbital eave, shallow postorbital lobe and weakly produced proximal margin of the basal antennal article. It differs from those two species by the presence of distinct hepatic and intestinal spines, rather than tubercles; the presence of only one, not two, tubercles on the anterior dorsal branchial region; the tubercle anteriorly on the branchial submargin is as large as the anterior pterygostomian tubercle (not half as large) and is visible dorsally; and the proximal lobe on the lateral margin of the basal antennal article is not produced as far laterally as the strong anterolateral spine (produced further than the spine in the other two species). The differences and similarities of the male pleopods of these three species are discussed under *H. borradailei*.

In this series of specimens the rostral spines are long, about one and a third times (1.2 to 1.4) the postrostral carapace length. The preorbital lobe is directed forwards and obliquely upwards; the antorbital angle is weakly produced; the anterior margin of the postorbital lobe is straight and the orbit below is completely open. The eyestalks are stout and the cornea conspicuously large. There are six distinct tubercles on the gastric region — two mesogastric and two pairs of protogastric tubercles; there is an epibranchial spine and a tubercle above it; none of the specimens have a tubercle in front of the intestinal spine as figured by Calman. The first ambulatory leg is about two and a half (2.4 to 2.6) times the postrostral carapace length, the merus has a slender terminal spine; the dactyl is slender (length about ten times height) with eight to twelve short spines ventrally, the proximal ones directed backwards towards the propod. The dactyl of the fourth ambulatory leg has six to seven long spines of which only the subterminal spine is vertical, all the others are directed backwards towards the propod.

One of us (D.J.G.G.) has examined the specimen (♂, 20.5 mm, USNM 41408) from Diego Garcia, identified as *H. uncifer* by Rathbun (1911: 252, pl. 20 fig. 7) and although we are unable to distinguish it from the males in our series in any other respects, the first pleopods of the males are different. It does agree with that of a male specimen from Aldabra, which we have also examined, and which was figured by Guinot (1962b: fig. 16a, b) as *H. uncifer*. The sharp apex is on the lateral edge of the pleopod and behind it on the medial edge there is a broad lobe which is recurved ventrally; the aperture is subterminal on the medial half of the abdominal surface, while the lateral half of the abdominal surface beside the aperture is elevated. This pleopod is similar to that of *H. borradailei*, but in that species the medial lobe is nearer the apex and the abdominal surface is nearly flat. It seems possible then, that there is another species, very similar to *H. uncifer*, in the western Indian Ocean but more specimens would be necessary to confirm this. We have examined two ovigerous females, one from Aldabra (cl. 23 mm, 23 May 1954; Paris Museum) and one from the Red Sea (cl. 21 mm, Abulat; Paris Museum). The gonopore in these specimens does not differ substantially from the gonopore of the ovigerous female from Sumatra, that is, it is an oval aperture, opening anteromedially with a moderately elevated posterolateral margin. In the specimens from Aldabra and the Red Sea this elevated margin is nearly straight while in the specimen from Sumatra there is an obtuse angle midway along.

Distribution. — Banda, South Timor, Sumatra, Christmas I. (Indian Ocean).

Hyastenus whitei Griffin, 1976
(Figs. 40a,b, 41i,j)

Hyastenus sebae White, 1847b: 57 (in part).
Hyastenus whitei Griffin, 1976: 198-199, fig. 6(b).

Material examined. — 7 ♂♂, 10 ♀♀ (7 ovig.), 12-34.5 mm, smallest ovig. ♀, 18 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 47, Indonesia, Sumbawa, Bay of Bima, near south fort, shore exploration, 8/12 April 1899; 5 specs.

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Singapore, shallow water, 1903-1907; 12 specs.

Remarks. — This species has been previously known as *Hyastenus sebae*. That name belongs now to the species previously known as *Hyastenus oryx* A. Milne Edwards 1872. The reason for the change of name has been explained in detail by Griffin (1976). Both species have a tuberculate carapace, but *H. whitei* may be distinguished by the following combination of characters. There is no preorbital spine, and there is no anterolateral spine on the basal antennal article. The epibranchial tubercle is no larger than the dorsal branchial tubercle above it and the three tubercles on the dorsal part of the hepatic region are as large as the dorsal branchial tubercles. There are only two small submarginal tubercles on the branchial region, both on the anterior half.

The length of the palm of the chela of the largest male (34.5 mm) is four to five times the distal height. There is a small gape between the fingers, and a large proximal tooth on the dactyl.

Distribution. — Indo-West Pacific: Mauritius, Singapore, Indonesia, Philippine Islands.

Lahaina Dana, 1851

Type species. — *Lahaina ovata* Dana, 1851, by monotypy.

Description. — Carapace pyriform. Surface with a few tubercles and small spines including an epibranchial and posterior intestinal spine. Rostrum about as long as carapace, of two distinct, slightly sinuous acuminate spines. Orbit comprising above an eave separated by a U-shaped hiatus from postorbital lobe, a small intercalated spine sometimes present. Supraorbital eave at most only moderately expanded with a slender, acute preorbital spine and a blunt antorbital spine. Postorbital lobe small, laterally flattened, sometimes with a tubercle. Basal antennal article narrow with a strong anterolateral spine, lateral margin at base sometimes produced as a dorsally extending lobe, separated from postorbital lobe by a broad hiatus; a small suborbital tubercle present.

Abdomen of seven distinct segments in male.

First pleopod of male simple, slender distally.

Remarks. — The four species now placed in this genus are distinguished by the relatively narrow orbital eave armed with both preorbital and antorbital spine and the relatively narrow basal antennal article, all have very long rostral spines. Whilst one of the other species groups formerly included in *Hyastenus* (*Giranauria* species) has strong preorbital and antorbital lobes, the orbit (and basal antennal article) is much broader. In most other groups the preorbital and antorbital lobes are small indeed.

Pseudomicippe incerta Balss, 1938, from the Pacific is here shown to be a species related to *Lahaina ovata* of which *Hyastenus tenuicornis* Pocock, 1890, has already been shown to be a synonym (Griffin, 1974). *Naxioides rombloni* Rathbun, 1916, is here considered to be a synonym of *Halimus agassizii* Rathbun, 1902a, and is removed to this genus. A new species of this genus is described from Mauritius.

As now understood *Lahaina* ranges from the Red Sea, Seychelles and Mauritius in the west through the tropical Pacific — Indonesia, the Philippines and nearby areas to the Marshall Islands and Hawaii in the West Pacific.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *LAHAINA*

1	Rostral spines strongly divergent from base; preorbital spine strongly produced, directed obliquely forward or upward; postorbital lobe basally narrow 2
—	Rostral spines only moderately divergent in basal half; preorbital spine small or moderately produced and directed forward; postorbital lobe not basally narrow 3
2(1)	Postorbital lobe strongly produced, apex remote from antorbital lobe, upper orbital hiatus oval; cardiac region weakly elevated with a slender spine; anterior pterygostomian spine slender, straight, spinulous; posterior carapace margin spinulous ..... *L. incerta*
—	Postorbital lobe not strongly produced, apex close to antorbital lobe, upper orbital hiatus subcircular; cardiac region inflated with a strong tubercle at summit; anterior pterygostomian spine robust, strongly curved forwards, smooth; posterior carapace margin smooth ..... *L. ovata*
3(1)	Preorbital spine longer than antorbital lobe; cardiac region with two short medial spines; posterior carapace margin with a row of granules and another row just in from the edge; carapace surface with granules between spines but without a thick tomentum ..... *L. agassizii*
—	Preorbital spine equal to or shorter than antorbital lobe; cardiac region smooth or with a blunt tubercle; posterior carapace margin smooth; carapace surface smooth below a thick tomentum ..... *L. mauritiana*

Lahaina agassizii (Rathbun, 1902) new combination (Figs. 37b, 52b,e)

Halimus agassizii Rathbun, 1902a: 133-134, pl.1 fig. 6. — Laurie, 1906: 377-378.

Naxioides rombloni Rathbun, 1916: 549-551. — Griffin, 1976: 202, fig. 8; new synonymy.

Material examined. — 16 ♂♂, 19 ♀♀ (13 ovig.), 7.5-14.5 mm, smallest ovig. ♀, 9.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 133, N. Sulawesi, anchorage off Lirung, Salibabu I., to 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 2 specs. — Stn. 144, Moluccas, anchorage N. of Damar I., 45 m, dredge, townet and reef exploration, coral bottom and *Lithothamnion*, 7/9 August 1899; 5 specs. — Stn. 154, Irian Jaya, Bougainville Strait, 00°7.2′N 130°25.5′E, 83 m (depth decreased to 59 m), dredge, grey muddy sand, shells and *Lithothamnion*, 14 August 1899; 1 spec. — Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Liththamnion*, 15/17 January 1900; 2 specs. — Stn. 315, Bali Sea, anchorage E. of Sailus Besar, Paternoster Is., to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 5 specs. — ?Haingsisi; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: off Neira Banda, ca. 15 m, sand, dive, 9 June 1922; 2 specs. — Banda, 20 m, coll. Th. Mortensen, June 1922; 1 spec. — Java Sea, 05°41′S 105°57′E, 35 m, coll. Th. Mortensen, 28 July 1922; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

New Caledonia: off Noumea, near Ilôt Amédae, on outside of main reef, 30-35 m, coll. B. Conseil and G. Bargibant, 12 September 1969; 1 spec. (AM P. 29901).

Queensland: Lizard I., outer Yonge Reef, 36 m, dead reef rock covered in *Halimeda* and coralline algae, coll. P. Weate, 9 January 1975; 1 spec. (AM P. 29900). — Lizard Island, outer Yonge Reef, 24 m, reef rock, coll. P. Weate, 13 April 1978; 1 spec. (AM P. 29902).

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: Shark Bay, Dorre I., 4 miles (~ 6 km) W. of C.St.Cricq, 80 m, Honolulu dredge, coll. R. W. George, 'Dorothea', 16 May 1960; 2 specs. (WAM 295-67). — Geraldton, NW. of Bluff Pt., 27°40′S 113°03′E, 140 m, dredge or midwater trawl, sponge and Bryozoa, CSIRO 'Diamantina', 22 August 1963; 1 spec. (WAM 57-67). — NW. of Bluff Pt., 27°18′S 113°16′E, 108 m, triangle dredge, sponges, starfish, Oxystomata, CSIRO 'Diamantina', 9 October 1963: 1 spec. (WAM 127-67). — SW. Geraldton, 29°49′S 114°24′E, 142 m, triangle dredge, sponge and Crustacea, CSIRO 'Diamantina', 1 October 1963; 1 spec. (WAM 72-71). — N. of Cape Leschenault, 31°22′S 115°03′E, 48 m, triangle dredge, huge catch of sponges, CSIRO 'Diamantina', 11 October 1963; 3 specs. (WAM 139-67). — NW. of Jurien Bay, 30°S 114°22′E, 140-150 m, beam trawl, sponge and Bryozoa, CSIRO 'Diamantina', 28 January 1964; 2 specs. (WAM 102-67). — Abrolhos, W. of North I., 108 m, triangle dredge, coll. B. Wilson, CSIRO 'Diamantina', 5 December 1970; 2 specs. (WAM 95-71, in part).

Remarks. — These specimens agree well with the holotype of *Naxioides rombloni* (USNM 48201, ♂, 14.6 mm). They also agree very closely with the holotype of *Halimus agassizii* (MCZ 6714, ♂, 6.7 mm). In these specimens the rostral spines range in length from two thirds of the postrostral carapace to as long as the postrostral carapace. The rostral spines are shorter (half postrostral carapace length) in the small holotype of *H. agassizii* than they are in most of our specimens. Both holotypes have a small intercalated tooth in the upper orbital hiatus.

The antorbital angle of the supraorbital eave is often narrow, acute (down to 45°) and directed posteriorly. The small tooth on the border of the hiatus between the eave and postorbital lobe varies in size; it is absent in two specimens and very small in about 10 specimens. It is more usually midway along the hiatus than close to the postorbital lobe.

The hepatic spine varies in shape, being often quite slender and usually directed posteriorly.

There is a row of granules on the posterior margin of the carapace and a similar row parallel to it commencing at the intestinal spine.

There is a spinule or granules on the dorsal edge of the strong anterolateral spine on the basal antennal article.

The anterolateral angle of the buccal cavity is strongly produced, and so is the anterolateral angle of the merus of the third maxilliped.

The palm of the cheliped of the larger males (11.5-13.5 mm) is inflated, 2 to 2 1/2 times as long as high, the fingers half as long as the palm; there are two shallow longitudinal grooves, one dorsal and one ventral, on the outer surface; there is a moderate gape between the fingers, two large adjacent teeth proximally on the dactyl, and the fixed finger is arched and excavate proximally.

The first pleopod of the male is very slender in the distal half.

The specimens from Western Australia have a more granular carapace and there are two or three pairs of granules on the urogastric region, which is smooth in all other specimens.

This species has several characters in common with *L. ovata.*

a. The postorbital lobe is flattened laterally.
b. There is often a small tooth in the hiatus of the upper orbit.
c. The basal antennal article has a strong longitudinal groove, a strong anterolateral spine with an accessory spinule, and two lateral lobes extending dorsally into the orbit.
d. The sternites of the male have a central row of granules with swollen setae.
e. The first ambulatory leg has a strong terminal spine on the merus.
f. There are longitudinal grooves on the palm of the cheliped and the fixed finger of the adult male is arched and excavate.

Also the suborbital tooth is very small and there is a similar pattern of spines and tubercles on the carapace.

This species can be distinguished from *L. ovata* by the following characters.

a. The rostral spines are less divergent.
b. The proximal lobe on the lateral margin of the basal antennal article is broad and produced laterally (small and directed dorsally in *L. ovata*).
c. The cardiac elevation has two spines rather than one tubercle.
d. There is a strong row of granules on the posterior margin of the carapace.
e. The merus of the first ambulatory leg has a long spine as well as the terminal spine, and there are two spines on the carpus.
f. The merus of the fourth ambulatory leg has a spine dorsally midway along and three spines or tubercles ventrally (only setae in *L. ovata*)
g. The first pleopod of the male of this species is distally very slender while that of *L. ovata* is only slightly narrowed.

This species has been recorded from the Maldive Islands (Rathbun; Garth (unpubl.)) and from the Gulf of Manaar (Laurie). As *Naxioides rombloni* it has been previously known from the Philippine Islands.

Distribution. — Gulf of Manaar, Maldive Islands, Western Australia, Java Sea, Sumbawa, Timor, Queensland, New Caledonia, Banda, Moluccas, Philippine Islands.

Lahaina incerta (Balss, 1938), new combination
(Figs. 52a, d)

Pseudomicippe incerta Balss, 1938: 15-17, pl. 1 fig. 2. — Buitendijk, 1939: 245 (in discussion). — Griffin, 1974: 16 (in discussion).

Material examined. — 1 juv. ♂, 3.0 mm, 2 ♀♀ (1 ovig.) 9.5, 11.5 mm, ovig. ♀, 9.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 144, Moluccas, anchorage north of Damar I., 45 m, dredge, townet and reef exploration, coral and *Lithothamnion*, 7/9 August 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Off Neira Banda, 18 m, sand, 12 June 1922; 1 spec. — Banda Is., 10 m, sand, 15 June 1922; 1 spec.

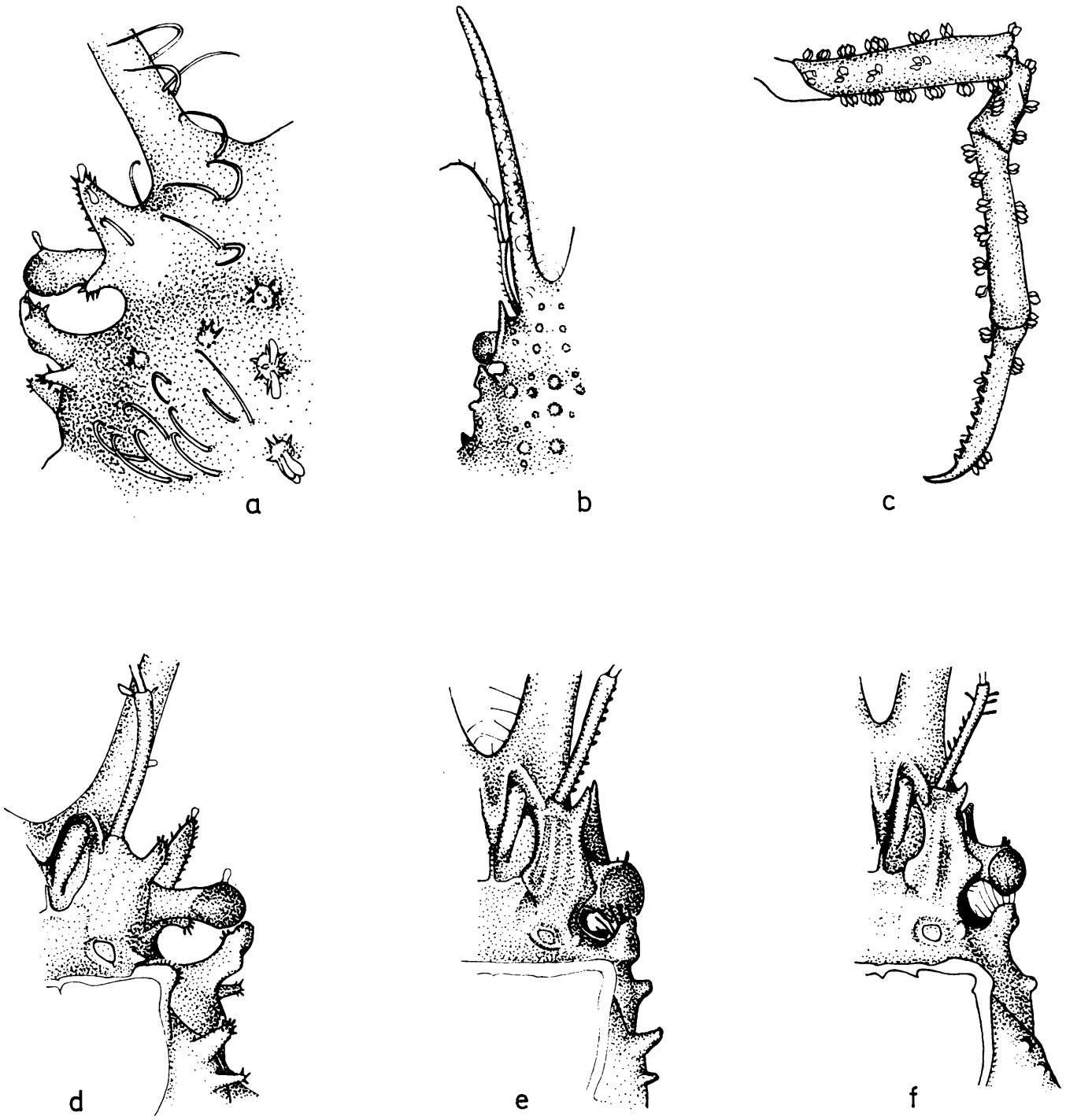


Fig. 52. *Lahaina incerta* (female, 11.5 mm, Damar I., ZMA) (a) left orbit, dorsal view; *L. agassizii* (male, 13.5 mm, Banda, ZMC) (b) left orbit, dorsal view; *L. mauritiana* (holotype) (c) right fourth ambulatory leg; *L. incerta* (as above) (d) left orbit, ventral view; *L. agassizii* (as above) (e) left orbit, ventral view; *L. mauritiana* (as above) (f) left orbit, ventral view.

Remarks. — These specimens have the small spinules distally on the carapace spines, including the small spines on the posterior margin of the carapace, described by Balss as distinguishing this species.

This species is very similar to *L. ovata* but the postorbital lobe is more slender than in that species and produced further laterally, so that the hiatus of the upper orbit is oval rather than round; distally the postorbital lobe is produced dorsally and appears L-shaped in lateral view, rather than subrectangular as in *L. ovata*. Our specimens, like the holotype, lack the small tooth on the margin of the upper hiatus, present in most specimens of *L. ovata.*

There is a slender hepatic spine, armed with spinules, and directed laterally and upward. There are three small spines on the branchial submargin, while in *L. ovata*, though there are sometimes granules, there are no tubercles or spines. On the cardiac region there is a slender spine not a tubercle as in *L. ovata*.

The anterolateral spine of the basal antennal article is directed ventrally and there are several sharp spinules on its dorsal edge. The lateral margin is straight and lacks the two rounded lobes which extend dorsally towards the orbit and the abrupt basal concavity behind the proximal lobe, present in *L. ovata.*

The anterior spine on the pterygostomian margin is straight, slender and armed with spinules, the second spine is similar but smaller; the anterior spine in *L. ovata* is broad, blunt and often curved forward and there is a small tubercle behind it. There is a short spine or tubercle midway on the posterior margin of the merus of the third maxilliped in *L. incerta.*

There is a very long terminal spine on the merus of the first ambulatory leg and another long dorsal spine about midway along. There are also two spines on the carpus. (The first ambulatory leg of the type of *Naxioides rombloni* is similarly armed but in the type of *L. ovata* and *L. mauritiana* there is only a terminal spine on the merus.) The second to fourth ambulatory legs also have a long terminal spine on the merus.

Previously known only from the Marshall Islands.

Distribution. — Banda Islands, Damar I., Marshall Islands.

Lahaina mauritiana new species
(Figs. 37c,d, 52c,f,53)

Material examined. — 2 ♂♂, 3 ♀♀ (2 ovig.), postrostral cl. 6.5 mm, cl. 19-26.5 mm, smaller ovig. ♀, 20 mm.
Holotype. — Male, 26.5 mm, Mauritius, Tombeau Bay, 360 m, Sigsbee trawl, hard bottom with sand, 26 September 1929, Mortensen Java- S. Africa Expedition, Stn. 34; Zoological Museum, University of Copenhagen.
Paratypes. Female, 19 mm; ovig. female, 20 mm, data as for holotype. — Male, postrostral cl. 6.5 mm, ovig, female 21 mm, Mauritius, N. of Port Louis, about 234 m, Sigsbee trawl, 6 November 1929, Mortensen Java-S. Africa Expedition. Stn. 47; Zoological Museum, University of Copenhagen.

Description. — Carapace pyriform, widening posteriorly, width about three quarters (0.7 to 0.75) postrostral carapace length; carapace regions clearly defined and elevated; surface covered with a tomentum of club setae, a few tubercles and short spines.

Rostral spines very long, in adult male slightly greater (1.2) than, or in adult female equal to, postrostral carapace length; slender, divergent; two pairs of submedial tubercles on the rostral ridges.

Orbital eave weakly expanded, preorbital angle produced forward and slightly upward as a small spine; antorbital angle a short, blunt lobe, produced further laterally than preorbital spine; postorbital lobe short, truncate, with a small tubercle laterally, separated from eave by a wide, subcircular hiatus which lacks tooth or spine. Eyestalks short, moderately stout, a row of setae distally above cornea; cornea terminal.

Hepatic region not elevated, a tubercle on margin, subhepatic region smooth.

Branchial submargin with a small tubercle anteriorly; epibranchial spine short, blunt.

Gastric regions elevated; three evenly spaced mesogastric tubercles; a lateral protogastric tubercle at a level halfway between first and second mesogastric tubercles; a more medial protogastric tubercle level with second mesogastric tubercle; urogastric region smooth, depressed.

Cardiac region elevated, rounded, smooth except for a very small tubercle at summit.

Branchial region elevated anteromedially with two small tubercles on lateral part of elevation; a tubercle between epibranchial spine and cardiac region; a weakly elevated, subtriangular area just posterolateral to cardiac region.

Intestinal region elevated, conical with a short, upwardly directed spine at summit.

Basal antennal article narrow, smooth; a longitudinal ridge just in from medial edge and a well marked longitudinal groove centrally; medial edge produced basally over epistome; anterolateral angle produced as a short spine directed obliquely forward; lateral edge with a short, blunt, dorsally directed lobe just behind spine, proximal half produced laterally as a broad lobe with a small flat lobe at its apex. A small tubercle just lateral to green gland.

Pterygostomian region smooth, two tubercles on margin, anterior the larger.

Third maxilliped smooth; ischium with an elongate, central depression, marginal ridges with large club setae, medial half of anterior margin flat, without setae, merus with ridge on posterior margin and diagonal ridge from posterolateral angle, anterolateral angle strongly produced and rounded.

Cheliped of adult male long, twice postrostral carapace length (in adult female about one and a quarter times postrostral carapace length); merus slender, smooth, with scattered groups of club setae, a blunt tubercle on ventral outer edge distally and a small, sharp terminal spine; carpus with a sharp dorsal tubercle in the distal half and a sharp terminal tubercle; palm elongate, slightly higher distally, dorsal and ventral margins broad, length about three and a half (3.4) times distal height, a longitudinal ridge midway along inner and outer face; fingers about one third length of palm, strongly gaping in proximal half, dactyl with two large teeth in gape, fixed finger excavate and unarmed; both fingers with small teeth on cutting edge in distal half, dorsal edge of dactyl and ventral edge of fixed finger broad and weakly grooved.

Ambulatory legs slender, first leg of male about three and a half (3.6) times postrostral carapace length (about two and a half times in female), merus smooth with scattered groups of club setae, a long terminal spine; dactyl long, straight, curved only at tip, unarmed; fourth leg slightly longer (1.3) than postrostral carapace length, about two fifths (0.37) of first leg, dactyl with nine small teeth ventrally along its length.

Sternum smooth, first sternite centrally depressed, a well developed narrow ridge on anterior margin of abdominal fossa.

Male abdomen of seven segments, first segment with a

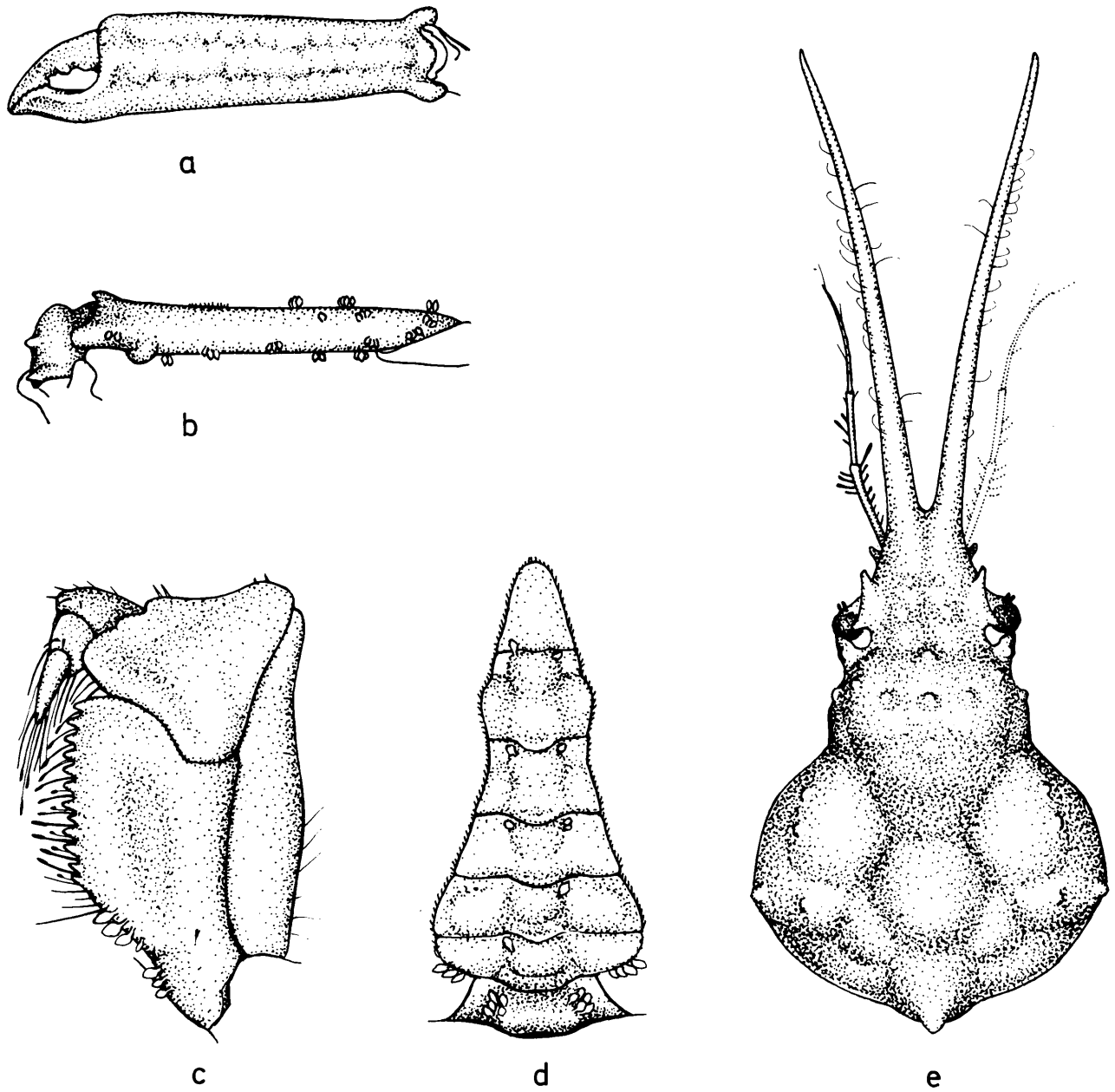


Fig. 53. *Lahaina mauritiana* (holotype) (a) left chela, (b) left cheliped, merus and carpus; (c) left third maxilliped; (d) male abdomen; (e) carapace, dorsal view.

transverse, elongate ridge, second to sixth segments with a rounded, anterior medial tubercle, third segment rounded laterally, sixth segment rounded on lateral margins; third segment less than twice (1.8) as wide as sixth segment, sixth segment only slightly wider (1.1) than long, seventh segment slightly longer (1.2) than wide.

Female abdomen of seven segments, smooth except for a low medial ridge.

First pleopod of male almost straight, narrower in distal quarter, apically blunt.

Female gonopore a keyhole shaped aperture, narrower medially, opening anteriorly and ventrally from a low swelling.

Remarks. — This species shares with *Lahaina ovata* long rostral spines, broad upper orbital sinus, grooved basal antennal article with a spine and two lateral lobes; male chela with elongate palm and a simple, straight pleopod in the male.

This species can be distinguished from *L. ovata* by the moderately divergent rostral spines (strongly divergent in *L. ovata*), the short preorbital spine and anterolateral spine of the basal antennal article (both long spines in *L. ovata*), only moderately produced postorbital lobe (strongly produced laterally and basally narrow in *L. ovata*) and a short blunt anterior pterygostomian tubercle (a long curved lobe in *L. ovata*).

Distribution. — Known only from Mauritius.

Lahaina ovata Dana, 1851

Lahaina ovata Dana, 1851a: 269; 1852: 93-94; 1855; pl. 2 figs. 1a-f.
Hyastenus (*Chorilia*) *ovatus*. — Miers, 1884: 522-523.
Hyastenus (*Chorilia*) *ovatus* var. *tenuirostris* Miers, 1884: 523.
Hyastenus (*Chorilia*) *tenuicornis* Pocock, 1890: 76-77.
Hyastenus tenuicornis. — Alcock, 1895: 215-216. — Alcock & Anderson, 1898: pl. 33 figs. 4,4a. — Takeda, 1977: 122-124, pl. 13 figs. C, D.
Hyastenus ovatus. — Buitendijk, 1939: 244-245. — Griffin, 1974: 15-16, figs. 3a, b, g.

Material examined.— 26 ♂♂, 27 ♀♀ (18 ovig.), 6-17.5 mm, smallest ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn.65a, Flores Sea, very near 07°0′S 120°34.5′E (Stn. 65), from 400 m and pale grey mud, rapidly reducing to 120 m and coral bottom, dredge, 6 May 1899; 1 spec. — Stn. 80, Borneo Bank, 02°25′S 117°43′E, from 50-40 m, trawl, fine coral sand, 13 June 1899; 1 spec. — Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. — Stn. 310, Flores Sea, 08°30′S 119°7.5′E, 73 m, dredge, sand with fine pieces of dead coral, 12 February 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Honolulu, 18-72 m, coral, 5 May 1915; 47 specs.

Danish Kei Islands Expedition: Stn. 71, Java Sea, 05°40′S 106°08′E, 54 m, sand, stones, 28 July 1922; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Hawaii, coll. T. Richert, May 1963; 1 spec. (WAM 80-71).

Remarks. — These specimens agree with those described and discussed fully by Griffin (1974). The triangular preorbital lobe, which is directed obliquely upward and forward, is broad in the specimens from Hawaii and slender in the three females from Borneo Bank, Flores and Java Sea. Also in these three specimens the hepatic spine is longer than in those from Hawaii, and is directed upwards and backwards.

The characters which distinguish this species from *L. incerta*, *L. agassizii* and *L. mauritiana* are discussed under those species.

Distribution. — Widespread Indo-West Pacific: Red Sea and Seychelles area to the Western Pacific and Hawaii.

Leptomaia new genus

Type species. — *Leptomaia tuberculata* new species.

Description. — Carapace narrow pyriform with many low tubercles. Rostrum of two slender divergent spines, about one third postrostral carapace length. Orbit comprising above an eave adjacent to a postorbital lobe, no intercalated spine. Supraorbital eave moderately expanded, preorbital and antorbital angles both produced. Postorbital lobe moderately produced, narrowing distally. Basal antennal article narrow with a strong anterolateral spine and a broad proximal lobe on lateral margin adjacent basally to postorbital lobe. Cheliped merus of male smooth with a terminal spine. Abdomen of seven segments in both sexes.

First pleopod of male simple, broad, curving outward distally, aperture subterminal.

Remarks. — This genus is similar to *Tylocarcinus* in the tuberculate carapace, the basal antennal article with a strong anterolateral spine and a broad proximal lobe adjacent basally to the postorbital lobe; and a slit-like hiatus in the orbit above, but *Leptomaia* lacks the intercalated spine present in *Tylocarcinus*.

L. tuberculata is distinguished from species of *Hyastenus* by the presence of a curved interantennular spine, by the merus of the third maxilliped which is narrow in the medial half and by the almost uniformly narrow abdomen in the male.

The name for the new genus is derived from *leptos* (Greek), meaning thin, delicate, in reference to the narrow carapace of this small animal.

Distribution. — Southwestern Pacific.

Leptomaia tuberculata new species
(Figs. 32d-f, 54)

Material examined. — 3 ♂♂, 3 ♀♀ (1 ovig.), 7.5-15 mm, ovig. ♀, 15 mm. Holotype. — Female, ovigerous, cl. 15.0 mm, Tasman Sea, Middleton Reef, 54-72 m, triangle dredge, coll. R. J. MacIntyre, 26 November 1960, CSIRO Stn. G3/280/60; The Australian Museum, Sydney, AM P. 29923. Paratypes. As listed below:

THE AUSTRALIAN MUSEUM, SYDNEY

Lord Howe I., Tenth of June, 25 m, coll. N. Coleman, 23 February 1979; 1 spec. (AM P. 29924).

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Galathea' Expedition: Stn. 674, Kermadec Is., Raoul Islet, 29°13′S 177°57′W, 75-85 m, dredge, gravel and stones, 3 March 1952; 1 male, 11 mm, 1 female (imm.) 11.5 mm. — Stn. 675, Kermadec Is., Raoul Islet, 29°13′S 177°57′W, 60 m, trawl, stones, 3 March 1952; 1 male, 7.5 mm.

NATIONAL MUSEUM OF NEW ZEALAND, WELLINGTON

New Zealand, W. of Meyer I., dredged, 21.5 m, rocky bottom, coll. W. R. B. Oliver, 19 May 1908; 1 spec.

Description. — Carapace narrow, not widened posteriorly, width less than two thirds (0.56-0.63) postrostral carapace length; surface with scattered low tubercles.

Rostral spines slender, straight, divergent, widely separate from base; length about a third (0.3-0.37) postrostral carapace length; rostral ridges with low tubercles.

Orbital eave moderately expanded, preorbital angle produced into a broad spine, directed obliquely forward and slightly upward (preorbital spine much smaller in small specimens); antorbital angle produced more laterally than preorbital, antorbital lobe short and blunt; postorbital lobe separated from eave by only a narrow slit; postorbital lobe basally broad, narrowing distally laterally keeled, apex subacute.

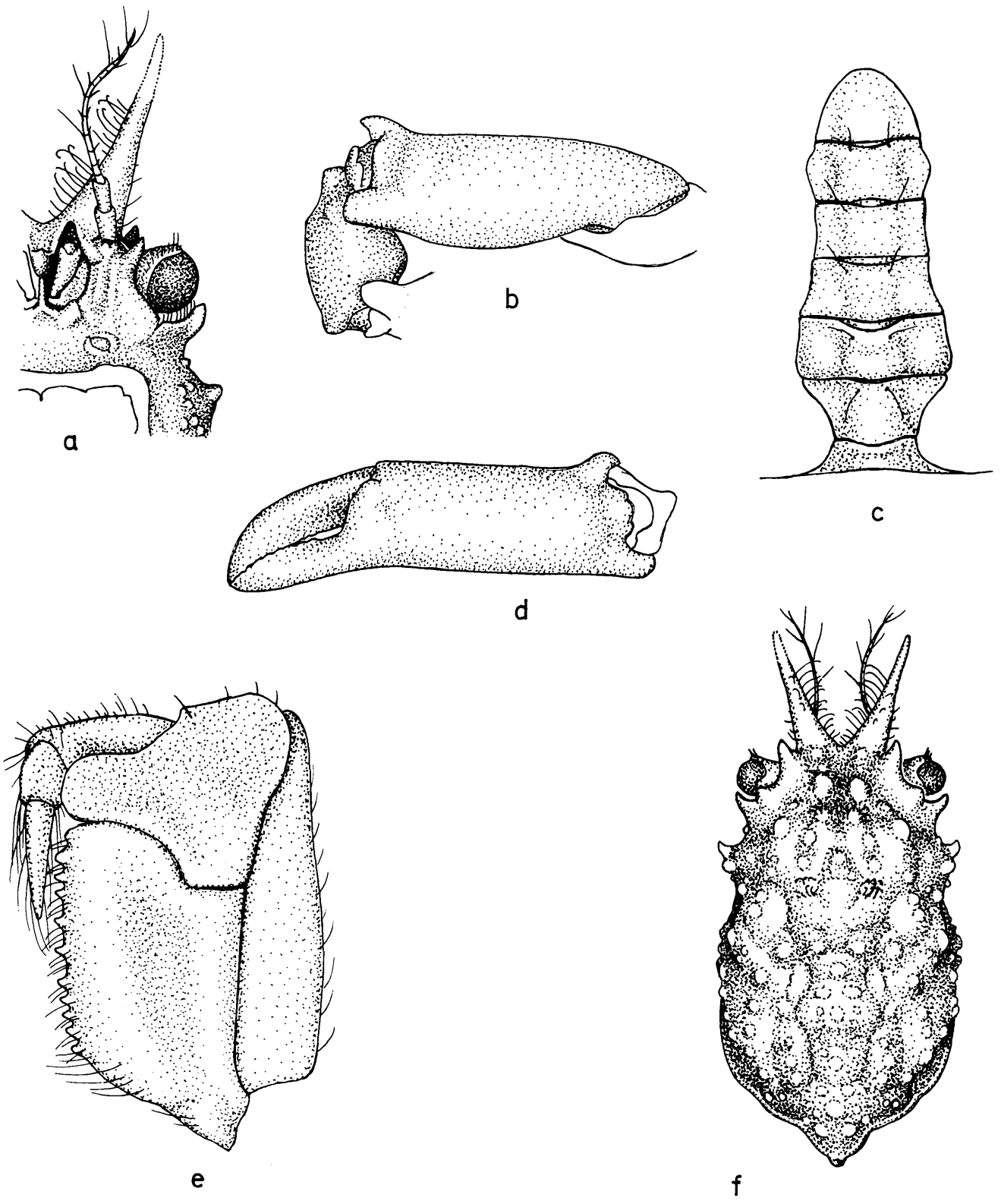


Fig. 54. *Leptomaia tuberculata* (holotype) (a) left orbit, ventral view; (b) left cheliped, merus and carpus; (male 11 mm, Kermadec Is., ZMC) (c) male abdomen; (holotype) (d) left chela; (e) left third maxilliped; (f) carapace, dorsal view.

Eyestalks short, stout, a row of club setae distally above cornea; cornea large, terminal.

Hepatic region weakly elevated, a low tubercle dorsally; a short spine and two tubercles on margin; about seven small subhepatic tubercles (only four in smaller specimens).

Branchial margin with a tubercle on anterior border and a second tubercle behind it; more ventrally an irregular row of about twelve small tubercles extending to posterolateral margin.

Gastric regions elevated, two pairs of protogastric tubercles

anteriorly, forming a transverse row of four tubercles; one tubercle behind lateral tubercle of this row and two tubercles behind medial tubercle; a posterior protogastric tubercle lateral to metagastric region; mesogastric region with two posterior tubercles. Urogastric region with a pair of submedial tubercles anteriorly and a central tubercle.

Cardiac region only weakly elevated, a pair of submedial tubercles anteriorly, just behind them a medial tubercle with two small tubercles on either side; cardiac region centrally smooth; posteriorly a pair of submedial tubercles just in front of a medial tubercle.

Intestinal region weakly elevated, an anterior and posterior pair of submedial tubercles and a central tubercle between them; region produced backward as a broad triangular lobe, a short, blunt spine at its apex.

Dorsal branchial region with a medial and lateral tubercle on anterior border; a central tubercle and behind it an oblique row of three smaller tubercles; a low longitudinal ridge of three small tubercles near cardiac region.

Basal antennal article smooth, a ridge along medial margin and a shallow longitudinal groove centrally; a small anteromedial tubercle; anterolateral angle produced into a strong spine directed obliquely forward and somewhat ventrally; lateral margin concave behind spine, proximal half of margin convex, strongly produced laterally, meeting medial edge of postorbital lobe basally and separated from it on orbital border only by a small V-shaped notch. A low, round tubercle just lateral to green gland.

Pterygostomian region smooth, margin only indistinctly tuberculate.

Third maxilliped smooth, anterolateral angle of merus strongly produced and rounded, broad notch on anteromedial angle.

Cheliped of male (cl. 13 mm) slightly shorter (0.9) than postrostral carapace length; merus smooth with a short, blunt terminal spine; carpus with a small proximal tubercle and a terminal tubercle; palm smooth, length more than one and a half times (1.7) height; fingers about two thirds (0.65) length of palm, a narrow gape between fingers in proximal half, a few low teeth on both fingers in gape and along remainder of cutting edge. Cheliped of holotype (ovig. female) similar but shorter (0.8 postrostral carapace length) and palm more slender (length equal to twice height).

First ambulatory leg slightly longer (1.16) than postrostral carapace length, merus with a low terminal tubercle. Fourth ambulatory leg about three quarters length of first leg, dactyl of fourth leg with about five very small teeth ventrally on distal half.

Male sternum smooth, a narrow ridge on anterior margin of abdominal fossa, a shallow depression lateral to ridge, a ridge on edge of abdominal fossa in third and fourth sternal segments.

Male abdomen of seven segments, smooth, a small anterior tubercle laterally on third segment; third segment one and a quarter times as wide as sixth segment; sixth segment twice as wide as long; seventh segment as wide as long.

Female abdomen of seven segments, smooth except for a low medial ridge.

First pleopod of male broad, curving outward distally but not tapered, apex blunt; aperture subterminal on abdominal surface.

Female gonopore a crescent shaped slit, opening medially and covered by a semicircular lobe.

Remarks. — In some points of general appearance *L. tuberculata* is similar to species of the genus *Eurynome* — the general shape of the orbit, the expanded hepatic lobe and tuberculate carapace, narrowing posteriorly. However, this species differs from known species of *Eurynome* in the presence of a preorbital spine, absence of both an intercalated and a suborbital spine; the presence of a strong anterolateral spine on the basal antennal article; in the adult female the anterior part of the first sternite is not covered by the abdomen; and the fingers of the cheliped are not angled towards the fixed finger.

L. tuberculata is distinguished from *Hyastenus auctus* which also has slit-like hiatuses by the narrow tuberculate carapace and by the postorbital lobe which is narrow distally and laterally keeled.

Distribution. — North of New Zealand and Tasman Sea.

Lyramaia new genus

Type species. — *Tiarinia elegans* Haswell, 1882.

Description. — Carapace pyriform with some tubercles and a few short spines. Rostrum of two broad spines of moderate length. Orbit comprising above an eave separated by a hiatus from postorbital lobe, no intercalated spine. Supraorbital eave moderately expanded, preorbital and antorbital angles weakly produced. Postorbital lobe hardly produced, only weakly excavate. Basal antennal article moderately broad with an anterolateral spine, lateral margin produced and directed dorsally, separated from postorbital lobe by a hiatus. Cheliped merus of male tuberculate, carpus smooth, Male abdomen of seven segments, female abdomen of five segments.

First pleopod of male simple, slender, curved outwards distally.

Remarks. — The orbit in this monotypic genus resembles that in species of *Hyastenus* but the basal antennal article and carapace ornamentation show similarities to species of *Acanthophrys* and *Giranauria*. *Lyramaia elegans* is distinguished from species of *Acanthophrys* and *Giranauria* by the basally fused and broadened rostral spines which conceal the antennae in dorsal view.

The name of the new genus is derived from the Greek *lyra*, a lyre, in reference to the shape of the rostrum.

Distribution. — Known only from the east Australian coast.

Lyramaia elegans (Haswell, 1882) new combination
(Figs. 32c, 55)

Tiarinia elegans Haswell, 1882: 29. — Griffin, 1966b: 288 (in key), pl. 17 fig.b.

Material examined. — 4 ♂♂, 4 ♀♀ (3 ovig.), 8.5-13.5 mm, smallest ovig. ♀, 8.5 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Off Moreton Bay, 27°31′S 153°40′E, 75-79 m, HMAS 'Kimbla' Stn. 1, coll. W. F. Ponder, 29 March 1969; 2 specs. (AM P. 29948). — Off Moreton Bay, 27°27′22″S 153°39′E, 75 m, HMAS 'Kimbla' Stn. 2, coll. W. F. Ponder, 29 March 1969; 5 specs. (AM P. 29950), 1 spec. (AM P. 29949).

Description. — Carapace surface pitted, carapace width two thirds to three quarters postrostral carapace length.

Rostral spines in female about one third and in male about half postrostral carapace length; proximal third broad, fused, surface tuberculate; spines contiguous or separate and parallel, divergent distally with some spinules on medial surface of each spine at divergence; rostral ridges tuberculate.

Supraorbital eave only moderately expanded; preorbital angle weakly produced forward and upturned; antorbital angle is hardly produced, slightly rounded, horizontal; postorbital lobe is separated from eave by a narrow U-shaped hiatus; postorbital lobe slender in male, broader in female with a process on anterior margin. Eyestalks short, moderately slender, smooth; cornea is small, terminal and ventral.

Hepatic region smooth or with one or two small tubercles.

Branchial submargin with a small tubercle anteriorly and, more dorsally, an irregular row of about six to eight small tubercles each surmounted by curled hairs.

Protogastric region with a longitudinal row of three small tubercles near its medial border and a more lateral longitudinal row of four or five tubercles, of which the largest is posterolateral to the anterior mesogastric tubercle; two mesogastric tubercles, longitudinally elongate, posterior usually larger.

Cardiac region with a broad, high, conical spine, directed slightly backwards.

Intestinal region with a central spine or tubercle, posterior carapace margin smooth or weakly crenulate; posterior medial lobe of carapace broader in female than male.

Branchial region elevated, centrally smooth, two strong spines near lateral margin; two to three small tubercles in front of anterior spine.

Basal antennal article not as broad as in *Tiarinia* and separated from postorbital lobe by a U-shaped hiatus; a short, acute anterolateral spine directed forward and separated from base of peduncle by a U-shaped hiatus; a lateral longitudinal ridge behind anterolateral spine and another near medial edge with a deep groove between them; lateral margin convex and directed dorsally beyond lateral ridge.

Third maxilliped ischium with marginal ridges, longitudinally excavate; granules on longitudinal ridges and lateral edge; merus with ridge on posterior edge and a short ridge running forward from posterolateral angle; a granule proximally on lateral edge; anterolateral angle only moderately produced.

Pterygostomian margin with three small tubercles or else two anterior tubercles fused to form one compressed tubercle.

Merus of male cheliped with three low tubercles dorsally and a terminal tubercle, ventrally two rows each of four small tubercles; carpus smooth; palm smooth, length about two and a half (2.5) times height; fixed finger excavate, moderate gape between fingers, three small teeth on dactyl in gape.

Ambulatory legs cylindrical, slender, dorsal surfaces with groups of curled hairs, swollen setae laterally, each arising from a small tubercle; merus with terminal tubercle; dactyl of fourth leg with about seven small teeth ventrally along its length.

Male sternum with first sternite excavate on either side of midline; segments two to five with well marked intersegmental rimmed pits, ridges bordering pits high.

Male abdomen of seven segments, segments two to six with a medial tubercle anteriorly; third segment with a strong lateral tubercle; sixth segment slightly wider (1.2) than long; seventh segment as wide as long.

First pleopod of male simple, slender, curved outwards at tip.

Female abdomen strongly convex, segments four to six fused; surface pitted.

Female gonopore a simple subcircular aperture; eggs large (1 mm diameter).

Remarks. — This species, described briefly by Haswell (1882) and figured by Griffin (1966b) has been known from only one specimen. The holotype (male, 14 mm, AM G. 5140, Broughton I., off Port Stephens, N.S.W.), a dried specimen, mounted on glass, has been detached for further examination and comparison with the new material.

The recently collected specimens and the type of *Tiarinia elegans* differ from other species of *Tiarinia* in having the orbit open above and below; the rostral spines less closely contiguous and segments four to six of the female abdomen fused.

Lyramaia elegans is similar to *Paranaxia serpulifera* (Guérin) in general body shape; in the slender legs; in the rostral spines broadened basally and divergent at the tip; grooved basal antennal article and pitted male sternum. However, in that species there is a strong distal accessory spine on the rostrum; the orbit is closed above and below; there is a long acuminate preorbital spine and a similar single long spine on the pterygostomian margin.

L. elegans is similar to species of *Giranauria* and *Acanthophrys* in general carapace appearance and on the basal antennal article having a U-shaped concavity between the anterolateral spine and the base of the antennal peduncle. In both *L. elegans* and species of *Giranauria* the lateral margin of the basal antennal article is strongly produced and conceals at least the proximal half of the eyestalk, but the anterolateral spine is at the anterior angle of this dorsally produced margin in *L. elegans*

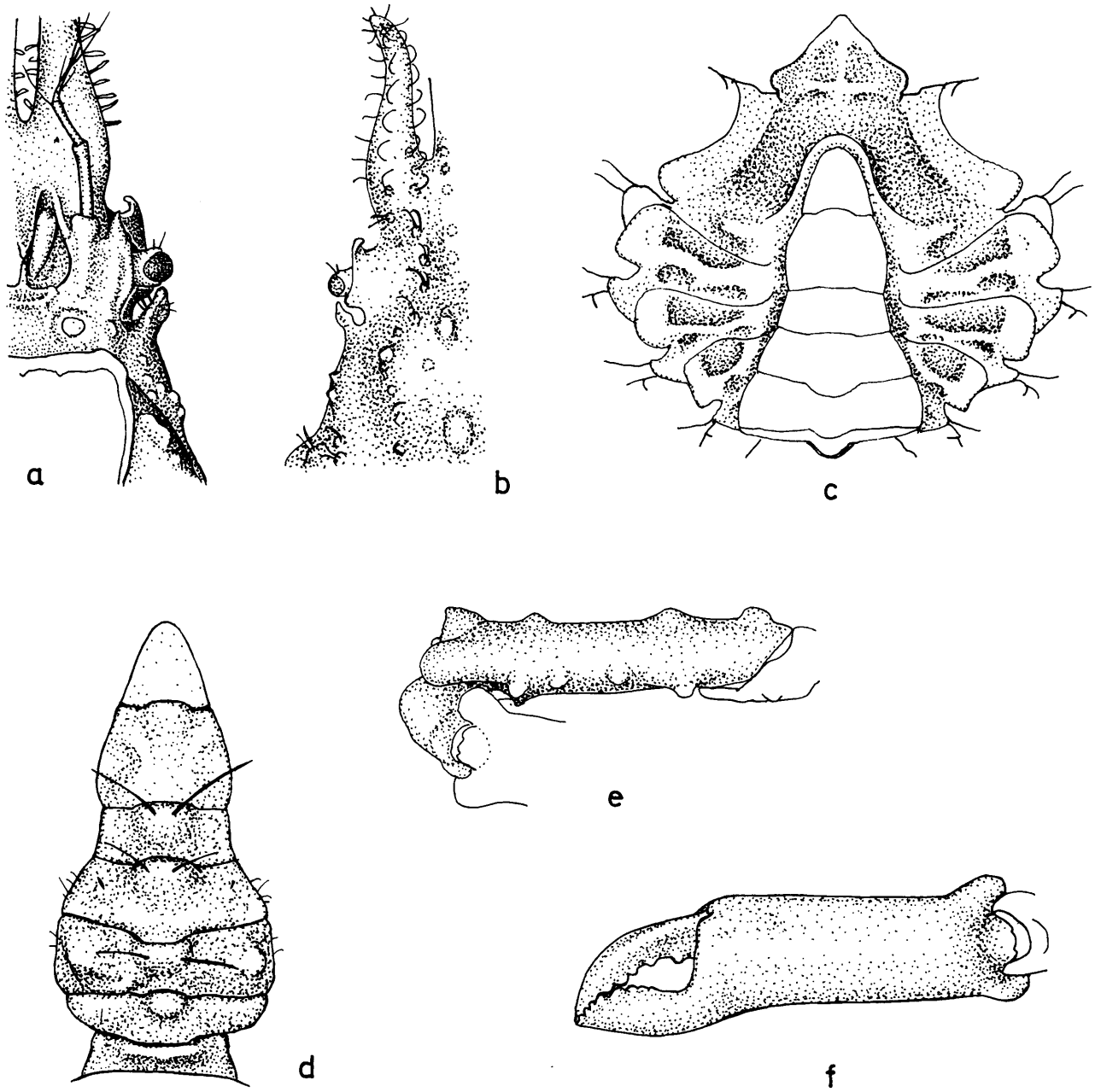


Fig. 55. *Lyramaia elegans* (male, 13.5 mm, off Moreton Bay, AM P.29949) (a) left orbit, ventral view, (b) dorsal view of same; (c) male sternum; (d) male abdomen; (e) left cheliped, merus and carpus; (f) left chela.

while in species of *Giranauria* it is on the ridge parallel to and in from the lateral margin. *L. elegans* is distinguished from species of *Acanthophrys* by the postorbital lobe which is short and excavate (elongate and not ventrally excavate in *Acanthophrys*) and distinguished from species of *Acanthophrys* and *Giranauria* by the basally fused and broadened rostral spines which conceal the antennae in dorsal view.

Distribution. — East Australian coast: off Moreton Bay, Broughton Island.

Micippoides A. Milne Edwards, 1873

Type species. — *Micippoides angustifrons* A. Milne Edwards, 1873, by monotypy.

Remarks. — In this monotypic genus the supraorbital eave is only weakly produced and the preorbital angle not produced at all. There is a narrow slit between the eave and the postorbital lobe. The basal antennal article is broad proximally and narrow and unarmed anteriorly but there is variation in the shape of the lateral margin as Calman (1913) noted. In some specimens the lateral margin is weakly concave just behind the anterolateral angle and very strongly convex at about the proximal third, with only a narrow hiatus between the article and the postorbital lobe. In Calman's specimen from Christmas Island the basal antennal article is subtriangular with hardly any proximal convexity and separated by a U-shaped hiatus from the postorbital lobe. This is more variation than would be expected within a species but few

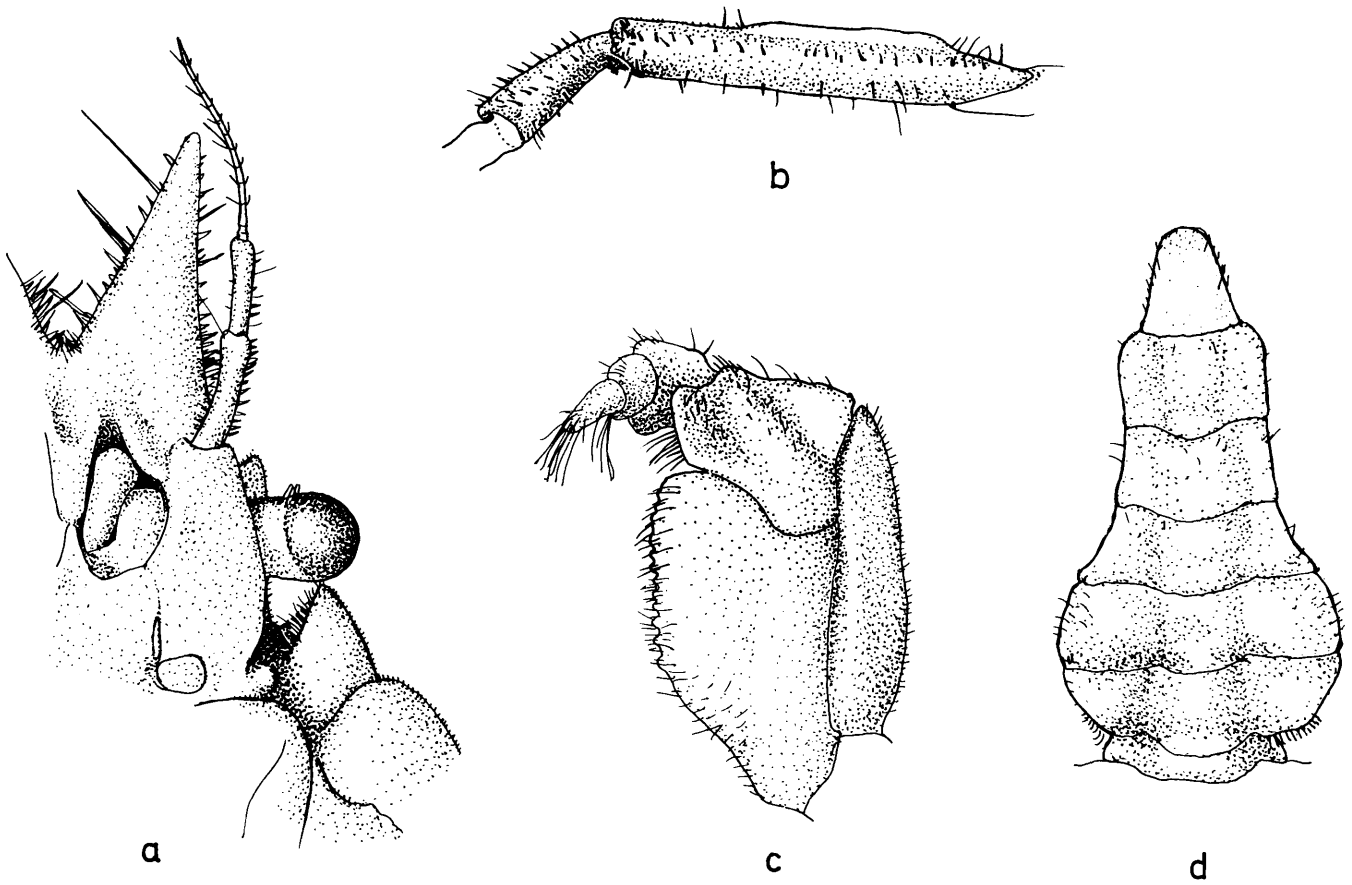


Fig. 56. *Rochinia carinata* (holotype) (a) left orbit, ventral view; (b) merus and carpus of first ambulatory leg; (c) left third maxilliped; (d) male abdomen.

specimens of *M. angustifrons* have been reported and more material from several localities would need to be examined to decide whether or not there are two species in this genus.

The rostral spines are short, deflexed and the apex is upturned. The first pleopod of the male is straight, tapering only near the apex and with a flap from the lateral margin folded across the abdominal surface.

The form of the orbit and the pleopod of the male suggest that this genus is correctly placed in the Pisinae.

Distribution. — Indo-West Pacific.

Naxioides A. Milne Edwards, 1865

Type species. — *Naxioides hirta* A. Milne Edwards, 1865, by monotypy.

Remarks. — The species of this genus are distinguished by the presence, in the upper orbit, of a lobe, either on the inner margin of the hiatus between the eave and the postorbital lobe or at the base of the anterior margin of the postorbital lobe, and referred to as an intercalated spine. In all the known species of this genus there is a small accessory spine on the distal half of the rostral spines. The first pleopod of the male of species of *Naxioides* tapers gradually to an outwardly curved subacute apex. There is usually a subterminal flap near the aperture.

Chlorinoides tenuirostris Haswell (1880b), the type species of the genus *Chlorinoides* Haswell, is now included in the Pisinae. It has in common with species of *Naxioides* an intercalated spine, a small dorsal accessory spine on the rostrum and a first pleopod in the male which is simple and tapers to a sharp apex. The differences between *C. tenuirostris* and *N. hirta* are no greater than those between species already in the genus and therefore we propose to include this species in *Naxioides*. *Naxia cerastes* Ortmann is here shown to be a synonym of *N. tenuirostris*.

N. rombloni Rathbun is here considered to be a synonym of *Lahaina agassizii* and is discussed under that species. A new species of *Naxioides* is described from Western Australia. *N. spinigera* Borradaile is here considered a synonym of N. *taurus* (Pocock).

The holotype of *Hyastenus elegans* Miers (1 ♀, cl. 32.7 mm, Kai Is., BM(NH) 84.31) has been examined by one of us (D.J.G.G.). There is a small accessory spine on the rostral spines and an intercalated spine in the upper orbit. These features, together with the shape of the supraorbital eave and basal antennal article and a general appearance similar to *N. robillardi* indicate that this species would be more correctly placed in the genus *Naxioides*.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *NAXIOIDES*

1 Preorbital angle of eave hardly produced, blunt; basal antennal article moderately broad, anterior margin with a spine near base of antennal peduncle as well as a blunt lobe, slightly more dorsally, at the anterolateral angle ..... *N. hirta*
— Supraorbital eave with an upright preorbital spine, usually long; basal antennal article narrow, anterior margin with a spine or a blunt tooth only at anterolateral angle 2
2(1) Carapace with long spines (14 to 20 or more); cardiac region with a single medial spine..... 3
— Carapace with short spines (14 or less); cardiac region with two medial spines 4
3(2) Antorbital lobe of eave directed obliquely backwards (toward intercalated spine); hepatic margin with two long spines, one above the other; lateral margin of basal antennal article with a long proximal spine directed ventrally..... *N. tenuirostris*
— Antorbital lobe of eave directed laterally; hepatic margin with one long spine; lateral margin of basal antennal article with a short proximal spine or lobe directed laterally ..... *N. robillardi*
4(2) Apex of postorbital lobe reaching at least as far forward as antorbital lobe; hepatic margin with a slender spine; intestinal region not elevated, with a spine posteriorly and a submedial pair of minute tubercles anteriorly..... *N. carnarvon*
— Apex of postorbital lobe not reaching as far as antorbital lobe; hepatic margin with blunt tubercles; intestinal region elevated with a medial spine posteriorly and a submedial pair of high tubercles anteriorly..... 5
5(4) Rostral spines usually 1/2 to 7/8 (rarely less than 1/2) postrostral carapace length; supraorbital spine usually well developed (height = 1-2 times basal width)..... *N. taurus*
— Rostral spines about 1/3 postrostral carapace length; supraorbital spine short (height = basal width)..... *N. investigatoris*[27]

Naxioides carnarvon new species
(Fig. 67c)

Chlorinoides tenuirostris. — Griffin, 1970a: 76. (Not *Chlorinoides tenuirostris* Haswell, 1880 = *Naxioides tenuirostris* (Haswell).)

Material examined. — 2 ♀♀, 20-31.8 mm.
Holotype. — Female, immature, cl. 20 mm, Western Australia, NW. of Carnarvon, 24°59′S 112°27′E, 128 m, beam trawl, CSIRO, HMAS 'Diamantina' 8 October 1963, Western Australian Museum, Perth, (WAM 147-67).
Paratype. Female, ovigerous, cl. 31.8 mm, Western Australia, SW. of Point Cloates, 23°05′S 113°23′E, 131 m, triangle dredge, CSIRO, HMAS 'Diamantina', 7 October 1963; Western Australian Museum, Perth, (WAM 99-67).

Description. — Carapace narrowly pyriform, width about two thirds (0.65) postrostral carapace length; margins and dorsal surface with tubercles and short spines.

Rostrum of two long spines nearly three quarters (0.74) postrostral carapace length; divergent, with an accessory spine on dorsal surface about halfway between base and tip. Rostral ridges between orbits each with four tubercles.

Orbit above comprising a supraorbital eave, intercalated spine and postorbital lobe. Eave with a long, upright preorbital spine and a narrow, subacute antorbital lobe directed obliquely backwards.

Intercalated spine apically acute, separated from eave by a broad U-shaped hiatus and from postorbital lobe by a narrow V-shaped hiatus. Postorbital lobe strongly produced obliquely forward, apex reaching level of antorbital lobe, anterior margin with a very low process, posterior margin with a large lobe near tip, apically subtruncate.

Eyestalks short, moderately slender, cornea large, terminal and ventral.

Hepatic region moderately elevated, a small tubercle dorsally and a slender spine on margin: subhepatic region with, in a row, a low tubercle anteriorly, a short spine behind it and a high tubercle posteriorly.

Branchial submargin with a row of three well spaced tubercles, third near epibranchial spine, three to four granules above this row; another row of three small tubercles near posterolateral carapace margin.

Gastric regions elevated, mesogastric region with an anterior tubercle and three short spines in a row; protogastric regions with two tubercles side by side just behind level of first mesogastric spine and two tubercles behind them a little ahead of level of last mesogastric spine; a small tubercle laterally near margin with branchial region and a pair of submedial tubercles behind last mesogastric spine. Urogastric region with a medial tubercle.

Cardiac region elevated with two short medial spines one behind the other, and two pairs of submedial granules on anterior slope. Intestinal region not elevated, a pair of submedial granules anteriorly, a tubercle near lateral margin and a large conical spine directed backward and upward on posterior carapace margin.

Branchial region with three short spines on lateral dorsal margin, epibranchial longest; a short spine just medial to epibranchial spine and a tubercle between spine and cardiac region; an arc of three tubercles close together centrally on branchial region.

Basal antennal article narrow, smooth, a shallow longitudinal groove centrally; anterolateral angle produced as a long spine directed laterally and somewhat ventrally; lateral margin behind spine straight with a short lobe midway along, lobe anteroposteriorly compressed and apically subtruncate. Postorbital lobe separated from article by a broad U-shaped hiatus; anterior margin of postorbital lobe with a prominent tubercle. A small tubercle lateral to green gland.

Pterygostomian region smooth, margin with two high tubercles.

Third maxilliped ischium smooth with a shallow longitudinal groove; anterolateral angle of merus moderately produced and rounded.

Cheliped of immature female nearly as long as postorbital carapace length, merus with a short proximal spine, a long acuminate terminal spine and two tubercles between them on dorsal margin, two tubercles on ventral margin; carpus with a small anterior tubercle; palm smooth, length three and a half times height, fingers nearly half (0.45) as long as palm, a narrow gape between fingers and low uniform teeth along whole cutting edge of both fingers (tip of dactyl broken).

(Ambulatory legs not with specimen.)

[27]) Not clearly distinguished, see *N. taurus* species account.

Remarks. — A single specimen examined from Western Australia (WAM 99-67), agreeing with *N. tenuirostris* in many features, was previously considered as a variation of that species (Griffin, 1970a). We have since examined a second specimen (WAM 147-67) also from Western Australia, which closely resembles the first; we now consider these two specimens to represent a distinct species. Unfortunately the specimens are not complete. We have figured the carapace of the immature female.

This species is distinguished from *N. tenuirostris* by the shorter carapace spines and the presence of three spines rather than two on the mesogastric region and two spines rather than one on the cardiac region. Also, in *N. carnarvon* the intercalated spine is narrow and apically acute (broad and apically rounded in *N. tenuirostris*); the postorbital lobe is strongly produced, apically subtruncate and has a prominent tubercle on the anterior margin ventrally (moderately produced, apically narrow and without a tubercle ventrally in *N. tenuirostris*); and the anterolateral angle of the mouthfield is smooth (with a blunt spine in *N. tenuirostris*).

N. carnarvon is distinguished from *N. taurus* by the upper orbit which has a narrow intercalated spine and an oblique postorbital lobe which reaches to the level of the backwardly directed antorbital lobe; in *N. taurus* the intercalated spine is moderately broad and both postorbital and antorbital lobes are directed laterally, and not convergent. The anterolateral spine of the basal antennal article in *N. carnarvon* is long, laterally and slightly ventrally directed but not directed forward, while the anterolateral spine in *N. taurus* is usually short and directed forward and only slightly laterally. This species also has a slender spine rather a tubercle on the hepatic margin and lacks the two high tubercles present on the anterior intestinal region in *N. taurus*.

Distribution. — Western Australia, between Point Cloates and Carnarvon.

Naxioides hirta A. Milne Edwards, 1865
(Fig. 37g,h)

Naxioides hirta A. Milne Edwards, 1865: 143, pl. 4 fig. 1 — Sakai, 1938: 270-271, text-fig. 33; 1976: 218, pl. 74 fig. 2. — Barnard, 1950: 52-53, fig. 11d.

Material examined. — 2 ♂♂, 26, 34 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 285, southern coast of Timor, 08°39.1'S 127°4.4'E, 34 m, dredge, on the limit between mud and coral, *Lithothamnion*, 18 January 1900; 1 spec. (ZMA De. 100.630, det. Ihle).

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32'S 132°41'E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 1 spec.

Remarks. — These specimens agree well with the figure and description given by Sakai (1938). The supraorbital eave has an anterior tubercle but no spine. The intercalated spine is small and close to the postorbital lobe. The sternal plate is strongly ridged on the margins. The first pleopod is broad and narrows only gradually towards the acute tip as in other *Naxioides* species.

We have also examined the following specimen — 1 ♀, cl. 11 mm, Sulu Archipelago, anchorage off N. Ubian, 06°7.5'N 120°26'E, 16-23 m, dredge, townet, *Lithothamnion* bottom, 29 June 1899, 'Siboga' Expedition, Stn. 99, ZMA. This specimen agrees well with the specimen (♀, cl. 8.6 mm, Ternate, Senckenberg Museum, Frankfurt 3830) described and figured as "*Naxia*? n.sp.?" (sic) (not "*Naxia* n.sp.?") by de Man (1902: 670-672, pl. 22 figs. 34, 34a-d) and examined by one of us (D.J.G.G.). Although De Man referred to his specimen as a male it is, like ours, an immature female.

Our specimen is similar to *N. hirta* in the rostral spines being parallel behind the accessory spine, the form of the supraorbital eave, the postorbital lobe and the basal antennal article. It differs from *N. hirta* in the rostral spines being shorter and not produced so far beyond the accessory spine; there are epibranchial tubercles rather than spines and there is a small rather than a large medial tubercle near the posterior carapace margin. It is possible that De Man's specimen and our specimen are juveniles of *N. hirta*.

Distribution. — Indo-West Pacific: east Africa to Philippine Islands and Japan.

Naxioides investigatoris (Alcock, 1895)

Naxia investigatoris Alcock, 1895: 218, pl. 4 fig. 3.

Material examined. — 1 ♂, 18.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Off Sri Lanka, 61 m, Indian Museum (ded. 9-1899 u. 23-9-1899); 1 spec. (ZMC unreg., prev. det. as *Naxia investigatoris*).

Remarks. — This specimen has short rostral spines, length about a third postrostral carapace length. The spines are divergent, unarched to the accessory spine and the tips are slightly incurved. The proximal lobe on the lateral margin of the basal antennal article is broad. The spine on the supraorbital eave is short, as high as its basal width, and blunt. The palm of the chela is granular and twice as long as the finger — not noticeably less than twice as long as the fingers, as Alcock described his specimen.

This specimen may be one of Alcock's series. There are two specimens in the BM(NH) (1 ♂, 1 ovig. ♀, cl. 16.1 mm, ? Syntypes, BM(NH) 96.5.14.4-5), examined by one of us (D.J.G.G), which were also collected 'Off Ceylon, 34 fms' — as were Alcock's specimens — and donated by the Indian Museum.

In most specimens of *N. taurus* (Pocock) the rostral spines are longer than half the postrostral carapace length and the supraorbital spine is longer than its basal width but in our

specimens of *N. taurus* there is a lot of variation and in some specimens both the rostral spines and supraorbital spines are short. Such specimens are very similar to this specimen of *N. investigatoris* but we would not be justified, on the basis of this single specimen, in considering *N. investigatoris* as a synonym of *N. taurus*.

Distribution. — Off Sri Lanka, Andaman Islands.

Naxioides robillardi (Miers, 1882)

Naxia (*Naxioides*) *robillardi* Miers, 1882: 339-341, pl. 20 figs. 1, 1a-c.
Naxia mammillata Ortmann, 1893: 56-57, pl. 3 figs. 7, 7a, 7i.
Naxioides mammillata. — Sakai, 1965a: 78, pl. 35 fig. 1; 1976: 217-218, pl. 75 figs. 1, 2. — Serène & Lohavanijaya, 1973: 52, figs. 98-103, pl. 9 figs. C, D. — Takeda, 1973b: 41-42. — Takeda & Kurata, 1976: 27, figs. 3G, H.
Naxioides robillardi. — Griffin, 1974: 21-22.

Material examined. — 1♂, 22.5 mm, 1♀ 43 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S. Africa Expedition: Stn. 47, Mauritius, north of Port Louis, ca. 260 m, Sigsbee trawl, mud and coral, 6 November 1929; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Sulu Archipelago, SW. Pearl Bank, 9 miles (~ 14.5 km) and 242° from Zal Is., 135 m, sponges, coll. B. R. Wilson on 'Pele', 22 February 1964; 1 spec. (WAM 12-67).

Remarks. — The reasons for considering *Naxioides mammillata* (Ortmann) as a synonym of this species have been dealt with recently (Griffin, 1974).

These immature specimens have short spines almost entirely covered by a dense tomentum. There are two small tubercles on the anterior slope of the intestinal region rather than the two spines in adult specimens.

Distribution. — Indo-West Pacific; east Africa to Japan, Philippine Islands and southeast Australia.

Naxioides taurus (Pocock, 1890)
(Fig. 37e-f, Pl. 11)

Naxia taurus Pocock, 1890: 77-78, 79. — Henderson, 1893: 346. — Alcock, 1895: 219-220. — Alcock & Anderson, 1898: pl. 33 figs. 5, 5a. — Calman, 1900: 37.
Naxia cerastes. — Alcock, 1895: 220. — Alcock & Anderson, 1898: pl. 33 figs. 2, 2a. (Not *Naxia cerastes* Ortmann, 1894 = *Naxioides tenuirostris* (Haswell, 1880).)
Naxioides spinigera Borradaile, 1903: 687, pl. 47 figs. 3a-c. — Rathbun, 1911: 253, pl. 20 fig. 8. — Monod, 1938: 107, fig. 5. — Buitendijk, 1939: 238. — Griffin, 1976: 203; new synonymy.
Naxioides taurus. — Griffin, 1966b: 270, 279 (in key). — Sakai, 1976: 218, pl. 74 fig. 1.

Material examined. — 11♂♂, 15♀♀ (4 ovig.), 12.5-32 mm, smallest ovig. ♀, postrostral cl. 13.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 50, west coast of Flores, Bay of Badjo, 40 m, dredge, trawl and shore exploration, mud, sand or shells, 16/18 April 1899; 2 specs. (ZMA De. 100.716 (in part), det. Ihle as *Hyastenus* sp.). — Stn. 80, Makassar Strait, Borneo Bank, 02°25′S 117°43′E, 40-50 m, trawl, fine coral sand, 13 June 1899; 1 spec. (ZMA De. 100.629, det. Ihle as *Naxia* sp.). — Stn. 99, Sulu Archipelago, anchorage off N. Ubian, 06°7.5′N 120°26′E, 16-23 m, dredge, *Lithothamnion*, 28/29 June 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Mindanao, about 6 miles (~ 9.5 km) NNE. of Sacol, ca. 75 m, trawl, 6 March 1914; 2 specs. — Sulu Archipelago, off Jolo, 45-54 m, dredge, 19 March 1914; 4 specs.

Danish Kei Islands Expedition: Stn. 16, Kai Is., 05°32′20″S 132°37′E, 50 m, dredge, sand with *Lithothamnion*, 12 April 1922; 1 spec. — Stn. 31, Kai Is., Doe Roa Bassin, 50 m, trawl, sand, 18 April 1922; 1 spec. — Stn. 68, Sunda Strait, 05°47′S 106°14′E, 55 m, Sigsbee trawl, stones, 27 July 1922; 1 spec. — Stn. 72, Sunda Strait, 05°41′S 105°57′E, 35 m, trawl, stones, 28 July 1922; 1 spec.

ZOOLOGICAL SURVEY, CALCUTTA

'Investigator' Marine Survey: Stn. 175, NE. of Sri Lanka, 08°51′30″N 81°11′52″E, 56 m, 20 April 1894; 2 specs. (ZSC 1139/10).

WESTERN AUSTRALIAN MUSEUM, PERTH

Sulu Archipelago, Sibutu, S. Lagoon, 04°31′N 119°22′E, 18-26 m, dredge, sand and a few coral beds, coll. B. R. Wilson on 'Pele', 25/26 February 1964; 1 spec. (WAM 18-67).

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Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 25-63 m, dredge hauls 8-19, coarse sand, *Lithothamnion* and rubble, 2 June 1970; 1 spec. — Stn. CP I, (as above), 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N. of Nuhu Rowa, N. of Du Rowa I., 05°32′S 132°41′E, 32-36 m, dredge haul 2, *Lithothamnion* rubble and sand, 10 June 1970; 1 spec. — Stn. KR VI, (as above), 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 3 specs. — Stn. KN II, Kai Is., west coast Nuhu Tjut, off Elat Bay, 05°40′S 132°59′E, 54-74 m, dredge hauls 3-4, rubble, fan coral, sand, green algae, 13 June 1970; 2 specs. — Stn. KN II, (as above), 48-54 m, dredge haul 6, rubble, algae and sand, 13 June 1970; 3 specs.

Remarks. — These specimens agree with those figured separately as *Naxia taurus* Pocock and *Naxia cerastes* Ortmann by Alcock & Anderson (1898: pl. 33 figs. 2, 2a, 5, 5a) from the Andaman Islands. These two species have been considered synonymous (Griffin 1966b: 270, 279) under the name *Naxioides taurus*. It must be emphasised that, whatever the animal is that Alcock & Anderson figured as *N. cerastes* it is not the same species as that described from Torres Strait under that name by Ortmann. The conclusion that *N. cerastes* is a synonym of *N. taurus* was based on the Andaman Island material (Alcock, 1895; Calman, 1900). The following discussion does not cover the identity of the true *N. cerastes* which is discussed under *Naxioides tenuirostris* (Haswell).

The present specimens were compared with specimens of *N. spinigera* Borradaile from the Seychelles (USNM 41416) collected by the 'Sealark' (Rathbun, 1911: 253, pl. 20 fig. 8). Borradaile (1903: 687, pl. 47 fig. 3a) described *N. spinigera* from the Maldive Islands as allied to *N. cerastes* Ortmann. In Borradaile's specimens (cl. approx. 18 mm) the rostral spines are greater than half the postrostral carapace length, while large specimens from the Seychelles have the rostral spines

equal to, or less than half, the postrostral carapace length. In the present series the rostrum equals half the postrostral carapace length in the case of the two specimens from Sri Lanka (15, 17 mm) but up to 5/6 or 7/8 (nearly equal) postrostral carapace length on a large male specimen from the Kai Islands.

Comparing the relative size of the rostral spines in published figures and descriptions, the proportion of the rostrum to postrostral carapace length is the same in the figures for *N. cerastes* (Alcock & Anderson, 1898: figs. 2, 2a) and *N. spinigera* as figured by Borradaile, that is three fifths. *N. taurus* as figured by Alcock & Anderson has the rostrum equal to two thirds postrostral carapace length. The female specimen of *N. spinigera* from the Red Sea figured by Monod (1938) has the rostrum less than half the postrostral carapace length. Specimens of *N. taurus* described by Henderson (1893) have the rostrum less than half the postrostral carapace length whereas on the type, which he had seen, it was greater than half as it was also on the specimens described by Calman.

The considerable variation in the rostrum with age and locality, shown also in the present series, makes it an unreliable specific character. The rostrum is slightly arched on all specimens.

In Seychelles specimens the anterior margin of the orbit has a small tooth dorsal to the anterolateral spine of the basal antennal article.

The supraorbital spine, on the anterior half of the eave, varies in height from just greater than its basal width to twice its basal width; on some specimens the tip of the spine is curved forwards. In the specimens from the Seychelles the supraorbital spine is erect but not curved forward at the tip as described for *N. spinigera* (Buitendijk, 1939; Borradaile, 1903). Among the present collection are some from the Sunda Strait, Kai Islands and Mindanao in which the supraorbital spine bends forward slightly at the tip and one specimen (ovig. ♀, cl. 27 mm) from the Kai Islands on which it is bent strongly forward. On no specimen is the tip bent backwards as figured for *N. cerastes* by Ortmann.

The width of the intercalated spine and the angle (acute or subacute) of the tip is variable.

The basal antennal article has a blunt tooth at the anterolateral angle and a broader proximal lateral tooth which is dorsoventrally ridged in larger specimens. In the Seychelles specimens the proximal lateral tooth lies rather more dorsally than the anterolateral tooth.

The arrangement of the carapace spines is the same in all specimens. In the gastric region there is an anterior tubercle followed in the midline by three spines, the last of which is the largest. The cardiac region is elevated and surmounted by two medial tubercles or spines in all specimens. (See remarks of Buitendijk, 1939; none has the single large spine figured for *N. cerastes* by Ortmann.) There is a broad, blunt intestinal spine with two tubercles on the anterior slope.

On the branchial region there are two lateral spines; the posterior is the larger in the Seychelles specimens but the anterior is the larger in most other specimens. There is a third small spine or tubercle lying dorsally and anteriorly from the posterior lateral spine.

The very small specimens from the Seychelles (8-11 mm) have narrow hepatic spines and all carapace spines more slender.

All specimens, except those from the Seychelles, have one or more tubercles proximally on the ischium of the third maxilliped. (One specimen from the Kai Islands (ovig. ♀, cl. 27 mm) has no teeth along the medial edge of the ischium. This is just an abnormal specimen.)

The chelipeds of the males vary with age and size. Specimens of about 22 mm and larger have tubercles on the palm of the chela but specimens of about 20 mm and smaller do not.

The presence of a spine distally on the merus of the ambulatory leg varies with age. All specimens have a spine on the merus of the first ambulatory leg; this is true of the Seychelles specimens, although as Bouvier (1915a) remarked this cannot be seen in the photograph published by Rathbun. Nearly all specimens have a smaller spine on the second ambulatory leg and the larger specimens also have a spine on the merus of the third leg. The dactyls of the ambulatory legs vary from 3/4 of the respective propod to equal to the propod. Bouvier distinguished his variety from Borradaile's species because there were no spines on the ambulatory meri and the dactyls of the ambulatory legs were only 3/4 of the propodi in length. Such distinctions are clearly invalid.

The first pleopod of the male is similar in all specimens: broad, outwardly curved and narrowing abruptly near the tip.

In conclusion it seems there is little reason to separate *N. spinigera* from *N. taurus*. The two names are here considered to apply to the one species, a species distinct from *N. cerastes* Ortmann.

The specimens described and figured by De Man (1902: 667-670, pl. 22 figs. 33, 33a, b) as "*Naxia* n.sp.?" (sic) (not "*Naxia*? n.sp.?") have been examined by one of us (D.J.G.G) and they are both immature females. They agree with other specimens of *N. taurus* that we have examined in the form of the postorbital lobe and basal antennal article and ornamentaion of the carapace, including two medial spines or tubercles on the cardiac region. There are spinules on the margin of the intercalated spine and one of the tubercles on the hepatic margin is much higher than the others but these features are present in other immature specimens of *N. taurus* we have examined. De Man suggested that these two specimens may simply be variations of *N. taurus* and in view of the wide variation we have observed in the series that we have examined we consider they are conspecific with *N. taurus*.

Distribution. — Indo-West Pacific: Red Sea, Mauritius, Seychelles, Sri Lanka, Maldive Islands, Indonesia, North Australia, Philippine Islands and Japan.

Naxioides tenuirostris (Haswell, 1880) new combination

Chlorinoides tenuirostris Haswell, 1880b: 443, pl. 26 fig. 1; 1882: 18. — Griffin, 1966a: 4-9, 12, figs. 2-11. (Not *Chlorinoides tenuirostris*. — Griffin, 1970 = *Naxioides carnarvon.*)

Naxia cerastes Ortmann, 1894: 43, pl. 3 fig. 4; new synonymy. (Not *Naxia cerastes*. — Alcock & Anderson, 1898: pl. 33 figs. 2, 2a = *Naxioides taurus* (Pocock).)

Material examined. — 3 ♂♂, 2 ♀ ♀, 5.5-38.5 mm.

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Mariel King Memorial Expedition-Moluccas: Stn. AN I, Aru, S. Trangan I., SW. of Tg.Ngabordamlu, centred near 06°58'S 134°5'E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 1 spec. — Stn.B I, Northern Territory (Australia), Clarence Straits, S. of Bathurst I., 12°4'S 130°17'E, 52-57 m, dredge, mud and dead shells, 30 June 1970; 4 specs.

Remarks. — These specimens agree with those described and figured in detail by Griffin (1966a). The several species previously regarded as belonging to the genus *Chlorinoides* are discussed under the new generic name *Thacanophrys* in the Majinae.

Naxia cerastes Ortmann as described and figured by Ortmann (1894: 43, pl. 3 fig. 4) agrees in detail with specimens of *Naxioides tenuirostris* (3 ♂♂, 5 ♀ ♀ (1 ovig., 30 mm), 19-31.5 mm, AM P. 13941) we have examined from Torres Strait (the type locality of *N. cerastes*) and it is clear that they are conspecific. The upper spine on the pterygostomian region at the level of the eye referred to by Ortmann, is a ventral hepatic spine, and the five tubercles behind the spine on the angle of the buccal cavity include the one on the pterygostomian margin.

The specimen from off Western Australia previously included as a variation of this species (Griffin, 1970a) is, on the basis of a second specimen, now considered to be a distinct new species *N. carnarvon.*

Distribution. — Northern Australia from Cape York to Bathurst Island, Arafura Sea.

Phalangipus Latreille, 1825

Type species. — *Cancer longipes* Linnaeus, 1758, by later designation of Griffin, 1973.

Remarks. — This genus containing nine species has been dealt with recently in detail (Griffin, 1973) and material from the Zoological Museum, Amsterdam, the Zoological Museum, University of Copenhagen and other collections discussed. Species of this genus are distinguished by the broad carapace; the rostrum of two short spines fused for about the basal half; the orbit with an intercalated spine dorsally and a suborbital lobe ventrally; and by the extremely long slender ambulatory legs.

The first pleopod of the male is simple, tapering to a narrow apex. A similar kind of pleopod is found in species of *Naxioides* and *Austrolibinia.*

A small number of specimens identified recently are included here and the key to species of the genus, published previously, is reproduced.

Distribution. — Indo-West Pacific.

KEY TO THE SPECIES OF *PHALANGIPUS*

1		Branchial region with a subdorsal spine posteriorly in addition to three marginal branchial spines; protogastric region with four pairs of submedial tubercles and two pairs of spines distant from midline; chelipeds of male spinulous, a row of enlarged tubercles on outer surface of palm ..... *P. hystrix*
	—	Branchial region with tubercles dorsally but without any spines except the three marginal ones; protogastric region usually with a pair of tubercles or spines near first mesogastric spine, sometimes with a second pair near third mesogastric spine and one pair distant from midline; chelipeds of male smooth except for terminal spine on merus 2
2(	1)	Supraorbital eave usually with antorbital lobe at posterolateral angle separated from intercalated spine by a narrow V-or U-shaped hiatus (rostral spines of at least moderate length, distance between tips only slightly exceeding depth of hiatus); suborbital lobe usually stout, separated from basal antennal article by narrow hiatus 3
	—	Supraorbital eave without antorbital lobe (if lobe present, rostral spines short, distance between tips twice depth of hiatus); suborbital lobe usually small and slender, separated from basal antennal article by broad U 6
3(	2)	Lateral margins of rostral spines weakly convergent distally or at most subparallel; males with numerous tubercles on sternites two to four ..... *P. trachysternus*
	—	Lateral margins of rostral spines seldom sub-parallel, usually at least weakly divergent distally; males with no more than three tubercles on sternite two, sternites three and four usually smooth 4
4(	3)	Ischium of third maxilliped with lateral ridge elevated basally as a tubercle or lobe; suborbital lobe slender, apically subacute ..... *P. persicus*
	—	Ischium of third maxilliped without lateral basal lobe; suborbital lobe stout, apically blunt 5
5(	4)	Rostrum 0.2 postrostral length or more; major lobe on first sternite of male cylindrical, subacute ..... *P. indicus*
	—	Rostrum no more than 0.1 postrostral length; major lobe on first sternite of male weakly flattened anteroposteriorly, apically rounded ..... *P. malakkensis*
6(	2)	Rostral spines short, distance between tips twice depth of hiatus; suborbital lobe a slender spine; sternum of male naked in adults, major lobe of first sternite cylindrical, acuminate 7
	—	Rostral spines not especially short, distance between tips equal to depth of hiatus; suborbital lobe a very blunt tubercle; sternum of males pubescent in adults, major lobe of first sternite anteroposteriorly flattened, rounded apically 8
7(	6)	Pterygostomian spine cylindrical, acuminate; spines of carapace generally sharp ..... *P. filiformis*
	—	Pterygostomian spine dorsoventrally flattened, blunt apically; spines of carapace generally blunt ..... *P. retusus*
8(	6)	Ischium of third maxilliped generally with a strong lobe at base of lateral ridge; male first pleopod short, straight ..... *P. australiensis*
	—	Ischium of third maxilliped generally without lobe at base of lateral ridge; male first pleopod long, distally outwardly curved *P. longipes*

Phalangipus australiensis Rathbun, 1918

Phalangipus australiensis Rathbun, 1918: 15-16, pl. 6. — Griffin, 1973: 168-172, figs. 1a, 3a,b, 6a, 7a, 8c,d.

Material examined. — 1 ♂, 6.5 mm.

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Mariel King Memorial Expedition — Moluccas: Stn. AW I, Aru, W. Wokam off W. coast of Wasir I., 05°30′S 134°12′E, 32-40 m, dredge haul 6, sand and shell rubble, 15 June 1970; 1 spec.

Remarks. — This small specimen agrees with those previously described (Griffin, 1973).

Distribution. — Aru and northern Australia from Broome (W.A.) through the Gulf of Carpentaria and Queensland to Port Stephens (N.S.W.).

Phalangipus hystrix (Miers, 1886)

Naxia hystrix Miers, 1886: 60-61, pl. 6 fig. 4.
Phalangipus hystrix. — Griffin, 1973: 175-179, figs. 5a-e, 6i, 7i. — Sakai, 1976: 219, pl. 76 fig. 3.

Material examined. — 10 ♂♂, 6 ♀♀, 7-15.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 289, S. coast of Timor, 09°0.3′S 126°24.5′E, 112 m, trawl, mud, sand and shells, 20 January 1900; 3 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AH I, Haruku I. (E. of Ambon), near Tg.Bt.Kapal, 03°36′S 128°24′E, 108-113 m, dredge haul 4, shell, sand and rubble, 31 May 1970; 2 specs. — Stn. CP I, Ceram, Piru Bay, off Tg.Tutuhuhur, 03°15′S 128°8′E, 57-63 m, dredge haul 1, coarse foramniferal and shell sand, 1 June 1970; 1 spec. — Stn.KT II, Kai Is., Tajandu Is., NW. of Walir Is., 05°35′S 132°15′E, 63-84 m, dredge hauls 1-4, coral and limestone rubble, 8 June 1970; 1 spec. — Stn. KN IV, Kai Is., W. coast of Nuhu Tjut, E. side of Mitduan Reef, 05°32′S 133°E, 36-56 m, dredge hauls 3-4, sand, coral rubble and sponge, 13 June 1970; 1 spec. — Stn. AW I, Aru, W. Wokam, off west coast of Wasir I., 05°30′S 134°12′E, 39-72 m, dredge hauls 7-10, sand and shell rubble, 15 June 1970; 2 specs. — Stn. AW I (as above), 72-90 m, dredge hauls 11-12, muddy sand and shell rubble, 15 June 1970; 3 specs. — Stn. AM II, Aru, Maikoor, approx. 8 miles (~ 13 km) SW. of Tg. Ratoe, 06°07′S 133°57′E, 63-54 m, dredge haul 3, sand and rubble, 18 June 1970; 2 specs. — Stn. TS I, Tanimbar, Selaru, approx. 5 miles (~ 8 km) N. of Labuan Olendir, 08°03′S 130°56′E, 50-57 m, dredge, sandy mud, 25 June 1970; 1 spec.

Remarks. — This species has been dealt with in detail previously (Griffin, 1973).

Distribution. — Widespread throughout the Indo-West Pacific.

Phalangipus longipes (Linnaeus, 1758)

Cancer longipes Linnaeus, 1758: 629; 1764: 446.
Phalangipus longipes. — Griffin, 1973: 182-186, figs. 1c, 3c,d, 6d, 7d, 8a,b.

Material examined. — 3 ♂♂, 2 ♀♀ (1 ovig.) 11-16.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 27 m, dive, 19 March 1914; 3 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AW I, Aru, W. Wokam, off W. coast of Wasir I., 05°30′S 134°12′E, 49-58 m, dredge hauls 3-4, sand and mud, 15 June 1970; 1 spec. — Stn. AW I (as above), 54-58 m, dredge haul 5, mud, 15 June 1970; 1 spec.

Remarks. — These specimens agree with those previously described (Griffin, 1973).

Distribution. — East coast of India, Sri Lanka, Andaman Sea, Gulf of Thailand, China Sea, Philippine Islands, Moluccas, Irian Jaya, Papua New Guinea, northwestern and northeastern Australia.

Pisoides H. Milne Edwards & Lucas, 1843

Type species. — *Pisoides tuberculatus* H. Milne Edwards & Lucas, 1843 = *Hyas edwardsi* Bell, 1835, by monotypy.

Remarks. — This genus at present contains three species — *Pisoides edwardsi*, the type species, from the southern East Pacific (off Chile) and *P. ortmanni* (Balss) and *P. bidentatus* (A. Milne Edwards) both from the northern West Pacific (Japan). The first pleopod of the male is scyriform in the two Japanese species but in the type species it is simple and produced to a narrow apex laterally. Two distinct genera may be warranted for these three species.

Distribution. — East and West Pacific.

Rochinia A. Milne Edwards, 1875

Type species. — *Rochinia gracilipes* A. Milne Edwards, 1875, by monotypy.

Description. — Carapace pyriform to elongate triangular, surface with tubercles, spines and/or flattened plates. Rostrum varying in length, rarely single, usually of two distinct spines, sometimes contiguous. Orbit above comprising an eave and postorbital lobe separated by a U-shaped hiatus (rarely adjacent). Supraorbital eave weakly expanded with a preorbital spine or a flattened plate, no antorbital lobe. Postorbital lobe hardly excavate, sometimes with a flattened plate which is adjacent or fused to another flattened plate on hepatic region. Eyestalk short, eyes retractile against postorbital lobe. Basal antennal article narrow to moderately broad, distally truncate or with a small anterolateral tooth, lateral margin otherwise entire; article separated from postorbital lobe by a narrow U-shaped hiatus. Cheliped of adult male usually enlarged, palm compressed, merus sometimes carinate. First pair of ambulatory legs longest. Abdomen of seven distinct segments in both sexes. First pleopod of male pisiform.

Remarks. — The genus *Sphenocarcinus* A. Milne Edwards, 1875 (type species: *Sphenocarcinus corrosus* A. Milne Edwards, 1875, by monotypy) is here regarded as synonymous with *Rochinia*. Alcock (1895) placed the genus *Sphenocarcinus* in the subfamily Acanthonychinae (now Epialtinae) and the genus *Scyramathia* (subsequently a synonym of *Rochinia*) in the subfamily Pisinae and this gross separation has been maintained.

Garth (1958) has given a detailed synonymy and diagnosis of both genera. The characters, of *Rochinia* s.l. and *Sphenocarcinus* respectively, which have been used to distinguish the genera are —

1) rostral spines distinct or contiguous;
2) preorbital angle produced or not;
3) flagellum of antenna visible from above or concealed;
4) male cheliped palm enlarged and compressed or small and slender.

These characters are not correlated with one another in many of the presently known species. In several Indo-West Pacific species of *Sphenocarcinus* the rostral spines are distinct, the cheliped of the adult male is enlarged and the palm compressed. In some of these species the preorbital angle is weakly produced — in others there is a flattened plate; in some species the flagellum of the antenna is concealed under the rostrum while in others it is visible from above. Also, some species of *Rochinia* s.l. have flattened plates while some species of *Sphenocarcinus* have no plates, and we do not find it possible to divide the species into two or more distinct groups on the basis of carapace shape.

We see no reason to retain these species in two distinct genera. The first pleopod of the male is pisiform in all the species of both genera (except *R. vesicularis*) we have examined or in which it has been described. *R. vesicularis*, which has a scyriform pleopod in the male, does not belong in this group, as Garth has suggested, and a new genus is required: its composition has yet to be determined. We do not know the form of the male pleopod of four species (*R. crassa*, *R. hystrix*, *R. umbonata*, *R. tanneri*) from the Atlantic nor of seven species (*R. aurita* *R. bidens*, *R. crosnieri*, *R. cuneata*, *R. debilis*, *R. makassar*, *R. natalensis*) from the Indo-West Pacific.

Doclea profunda Rathbun is here shown to be synonymous with *Pugettia mosaica* Whitelegge and, on the basis of the apically truncate first pleopod of the male, included in *Rochinia*. *Pugettia brevirostris* (Doflein) and *Pugettia sagamiensis* Gordon with similar male pleopods are now included in *Rochinia* also. A species from Ile de la Réunion, reported and figured by Crosnier as *Hyastenus* sp., is here described as a new species of *Rochinia* and five other new species are also described. This genus as redefined now contains 29 known species. The following species, included in the key, were considered only from the literature — *R. bidens* (Sakai, 1969), *R. coralliophilus* (Takeda, 1980), *R. strangeri* Serène & Lohavanijaya, 1973, and *R. natalensis* Kensley, 1977.

Distribution. — Atlantic Ocean, Indo-West Pacific and East Pacific.

KEY TO INDO-WEST PACIFIC SPECIES OF *ROCHINIA*

1 Preorbital angle of eave not produced; carapace with plates which are usually large and dominate the surface, a plate on the hepatic margin 2
— Preorbital angle of eave weakly to strongly produced; carapace surface and/or margins sometimes with plates but not dominated by them 9

2(1) Rostrum of two spines distinct from close to base 3
— Rostrum single or, if double, spines fused in basal half, contiguous in distal half 7
3(2) Branchial region with one or two large plates 4
— Branchial region with three small plates 5
4(3) Branchial region with only one large plate which extends laterally over epibranchial region; meri of ambulatory legs carinate ..... *R stimpsoni*
— Branchial region with two plates; meri of ambulatory legs lacking a carina ..... *R. luzonica*
5(3) Hepatic plate produced laterally and slightly upward as an acuminate spine ..... *R. coralliophilus*[28])
— Hepatic plate smooth, without a spine 6
6(5) Epibranchial plate projecting obliquely; cardiac plate pyriform, narrow posteriorly ..... *R. bidens*[28])
— Epibranchial plate convex not projecting outwards, rounded anteriorly; cardiac plate globular ..... *R carbuncula*
7(2) Rostrum of two lobes fused in proximal half, separated only by a slit distally, tip convex; cardiac and intestinal lobes fused into an inverted anchor shape ..... *R. aurita*
— Rostrum single, tip concave; cardiac and intestinal plates separate 8
8(7) Rostrum one-third postrostral carapace length; cardiac plate hardly wider than long ..... *R aurorae*
— Rostrum equal to postrostral carapace length; cardiac plate about three times as wide as long ..... *R. cuneata*
9(1) Hepatic margin with an oval or globular island or flattened plate or ear-like lobe 10
— Hepatic margin with a broad triangular or a conical lobe laterally directed or else a narrow spine 18
10(9) Branchial regions somewhat swollen, closely approximated in the midline; carapace margin without hepatic or branchial plates ..... *R. beauchampi*
— Branchial regions not swollen, not approximated medially; carapace margin with an hepatic and/or a branchial plate 11
11(10) Anterolateral margin of branchial region with a flattened plate; cardiac region with a tubercle or low, flat islet 12
— Anterolateral margin of branchial region without a flattened plate; cardiac region smooth or with a spine or flat elevated plate 15
12(11) Hepatic margin with an upturned flattened plate, apically subacute; epibranchial region with a pointed lobe or spine 13
— Hepatic and epibranchial margins surmounted by globular lobes 14
13(12) Hepatic plate globular ventrally; epibranchial spine slender, straight; intestinal region smooth except for a central tubercle ..... *R. globulifera*
— Hepatic plate flat throughout, margin thin; epibranchial spine stout, arched; intestinal region with a strong ridge parallel to posterior carapace margin on either side of medial tubercle ..... *R. velutina*
14(12) Carapace with three flattened islets in midline in posterior half of carapace — mesogastric, cardiac and intestinal; ambulatory meri each with a dorsal carina (fig. 56b) ..... *R. carinata*
— Carapace with tubercles in midline; ambulatory meri cylindrical, lacking carinae ..... *R. nodosa*
15(11) Epibranchial and cardiac regions each bearing a spine 16
— Epibranchial and cardiac regions smooth or each with a flattened plate 17
16(15) Epibranchial spine long to extremely long (0.4 to 0.8cw.); protogastric region with a single spine or tubercle on each side ..... *R. riversandersoni*
— Epibranchial spine of only moderate length (0.15 to 0.25cw.); protogastric region with two spines on each side ..... *R. strangeri*[28])
17(15) Carapace with eight small flattened plates dorsally; hepatic and postorbital lobes confluent ..... *R. hertwigi*
— Carapace smooth dorsally; hepatic and postorbital lobes separate (fig. 61b) ..... *R. tomentosa*
18(9) Epibranchial region with an apically pointed plate, directed laterally; cardiac and intestinal regions each with a flat plate ..... *R. sphenocarcinoides*

[28]) From the literature

— Epibranchial, cardiac and intestinal regions smooth or with tubercles or spines but not with flattened plates 19
19(18) Epibranchial region with a cylindrical spine, usually long; intestinal region with a spine 20
— Epibranchial region smooth or with a small tubercle or a blunt or broad conical lobe; intestinal region smooth or with a tubercle 24
20(19) Midline of carapace with four spines including posterior intestinal; protogastric and dorsal branchial regions with spines 21
— Midline of carapace with no more than two spines and a tubercle, including posterior intestinal; protogastric and dorsal branchial region with tubercles but no spines 22
21(20) Preorbital lobe upright; hepatic spine long, upright; one tubercle on branchial submargin ..... *R. pulchra*
— Preorbital lobe short, anterolaterally directed; hepatic spine short, conical, laterally directed; three tubercles on branchial submargin anterolaterally ..... *R. natalensis*[28])
22(20) Mesogastric region smooth; cardiac region with a tubercle; intestinal region with a short spine ..... *R. debilis*
— Mesogastric region with a tubercle; cardiac and intestinal region each with a prominent spine 23
23(22) Postorbital lobe laterally flattened; meri of ambulatory legs with dorsal carinae, at least in distal half ..... *R. mosaica*
— Postorbital lobe laterally convex; meri of ambulatory legs without any carinae ..... *R. fultoni*
24(19) Hepatic lobe with broad obtuse base and subacute to rounded apically (fig. 57c) 25
— Hepatic lobe narrow concial, acute or subacute apically (fig. 57a) 26
25(24) Postorbital and hepatic lobes separated by a broad concavity; branchial region with a high compound tubercle near anteromedial angle; anterior dorsolateral margin of branchial region not produced laterally; merus and propod of first ambulatory leg cylindrical ..... *R. brevirostris*
— Margin between postorbital and hepatic lobes nearly straight; branchial region lacking a high tubercle near anteromedial angle; anterior dorsolateral margin of branchial region produced laterally; merus of first ambulatory leg trigonal, propod compressed ..... *R. sagamiensis*
26(24) Hepatic lobe longer than postorbital lobe; cardiac region elevated, dorsally flat, a similar but lower elevation on anterior half of branchial region 27
— Hepatic lobe subequal to postorbital lobe; cardiac region with a conical elevation, anterior half of branchial region not elevated, smooth 28
27(26) Preorbital angle of eave weakly produced, blunt (fig. 57e); epibranchial angle with a distinct tubercle directed outwards... *R. makassar*
— Preorbital angle of eave strongly produced, acute (fig. 57a); epibranchial angle smooth (or with a small, low tubercle) ..... *R. crosnieri*
28(26) Postorbital lobe with a lateral keel which is confluent with anterior margin of hepatic lobe; cheliped merus lacking a terminal spine distinct from carina (fig. 59d) ..... *R. moluccensis*
— Postorbital lobe laterally flat, separate from hepatic lobe; cheliped merus with a distinct terminal spine (fig. 60c) ..... *R. suluensis*

Rochinia aurorae (Alcock, 1899) new combination

Sphenocarcinus aurorae Alcock, 1899: 84. — Kemp & Sewell, 1912: 30, pl.1 fig. 10.

Material examined. — 1 ♂, 7.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S. Africa Expedition: Stn. 3, Bali Sea, 07°42′S 114°E 450 m, Sigsbee trawl, mud with corals, 4 April 1929; 1 spec.

Remarks. — This species has been recorded previously only from the south-west coast of India. It is only distinguished from *R. cuneata* (Wood-Mason) by the shorter rostrum which is a third postrostral carapace length.

The carapace of this specimen closely resembles that of *R. stimpsoni* but comparison with the series of *R. stimpsoni* collected in the Kai Islands shows that the cardiac plate in that species is always strongly elongate transversely and not triangular as in *R. aurorae.*

There have been no previous records from the Indonesian area or Pacific Ocean of *Rochinia* species with fused rostral spines and, though the rostrum of this specimen is damaged, it is clearly different from that of *R. stimpsoni* which has the rostral spines separate from the base, and which is known from Japan to north Australia and also from Sri Lanka.

Distribution. — Southwest coast of India, Bali Sea.

Rochinia brevirostris (Doflein, 1904) new combination (Figs. 57c,d, 62c,d)

Hyastenus brevirostris Doflein, 1904: 85-86, pl. 27 figs. 13, 14.
Pugettia brevirostris. — Gordon, 1931: 557-558 (in discussion), text fig. 36a,b.
(Not *Pugettia brevirostris* Parisi, 1915 = *P. sagamiensis* Gordon, 1931.)

Material examined. — 1♂, cl. 22.5 mm.

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA

'Investigator' Expedition: Stn. 280, Bay of Bengal, 11°29′45″N 80°02′30″E, 803 m, Agassiz trawl, mud, sand, 19 March 1901; 1 spec. (ZSC 4047/10).

Remarks. — This specimen agrees with the holotype of *H. brevirostris* (ovig. ♀, 25.3 mm, SW. of Sumatra, 614 m, ZMB 13647), examined by Griffin (1970), in having a blunt, conical hepatic lobe directed laterally and connected to the postorbital lobe; a large blunt, conical epibranchial lobe directed laterally; two mesogastric tubercles; and a large anterior dorsal branchial tubercle.

This specimen differs from the holotype in having the preorbital lobe broadly rounded, upturned and subequal with the broad, laterally flat, postorbital lobe.

In this specimen there is an elongate mesogastric tubercle at the level of the hepatic spine and a small protogastric tubercle just lateral to it posteriorly; there is a high posterior mesogastric tubercle and behind it a small metagastric tubercle. The high tubercle near the anterior margin of the branchial region is trilobed; the medial margin of the branchial region is elevated and slightly produced over the urogastric region; the cardiac tubercle and the intestinal tubercle are conical. On the branchial submargin there is a ridge of four tubercles (second and fourth small) anteriorly, almost in line with the tubercles on the pterygostomian margin.

The merus of the cheliped of this male is carinate ventrally on the inner face, with a distinct angle dorsally and ventrally on the outer face but not carinate; a blunt terminal tubercle; carpus with two sharp ridges, an outer ridge dorsally and a ridge ventrally on the inner face; the palm is dorsally sharp and ventrally blunt, less than twice as long (1.8) as high and

[28]) From the literature.

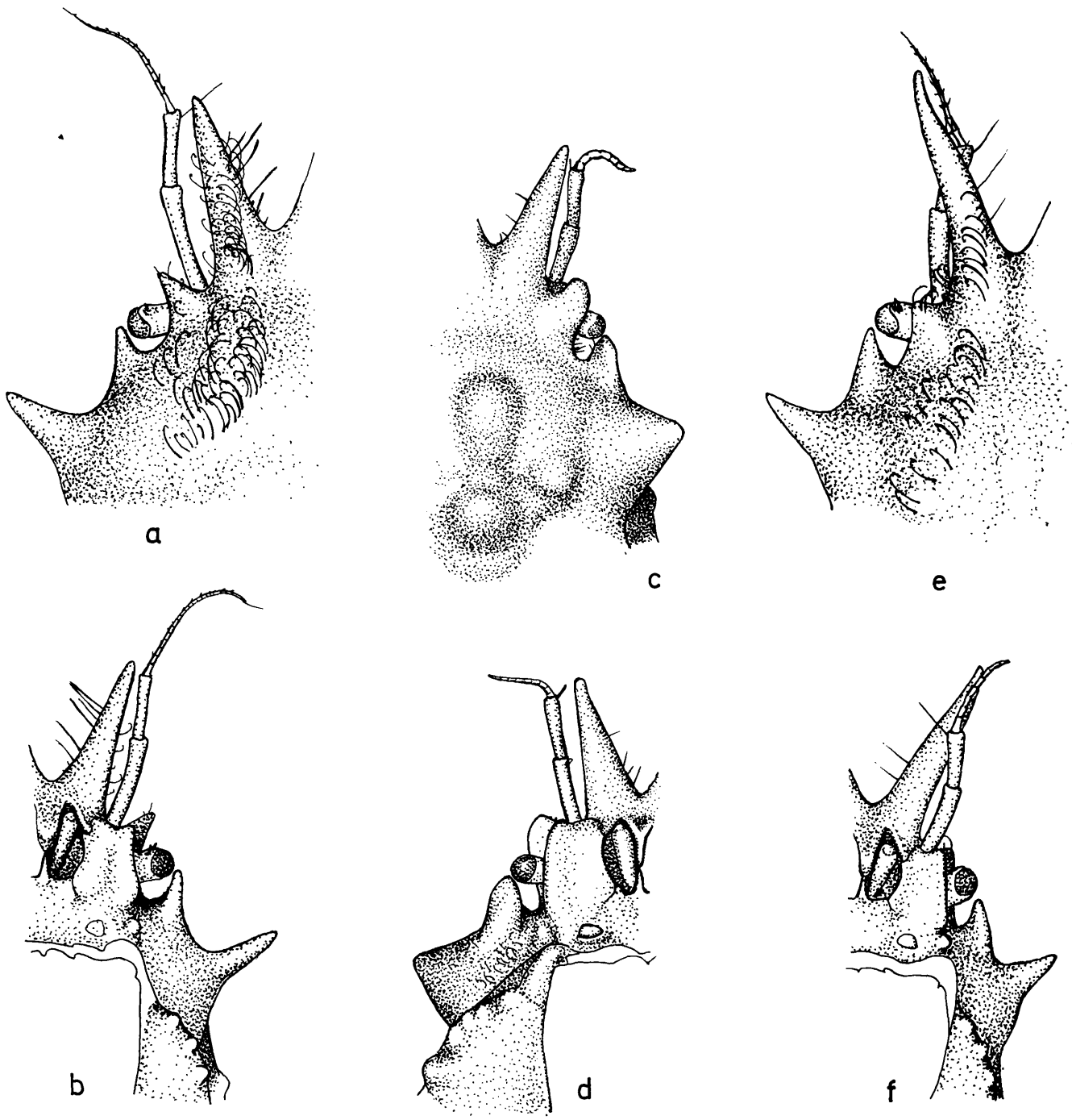


Fig. 57. *Rochinia crosnieri* (holotype) (a) left orbit, dorsal view, (b) ventral view of same; *R. brevirostris* (male, 22.5 mm, ZSC 4047/10) (c) right orbit, dorsal view; (d) ventral view of same; *R. makassar* (holotype) (e) left orbit, dorsal view, (f) ventral view of same.

there is a narrow gape between the fingers in the proximal half.

The ambulatory legs are smooth, tomentose with longitudinal rows of longer setae; cylindrical, as noted in the holotype by Gordon (1931), not prismatic as described by Doflein. The first leg is slightly longer (1.2) than the postrostral carapace length, the merus has a blunt terminal tubercle; the fourth leg is not much shorter (0.86) than the first leg.

The sternum of this male is smooth with shallow intersegmental grooves. The abdomen is smooth except for a medial anterior tubercle in segments three to six, the sixth segment is more than one and a half (1.7) times as wide as long; the seventh segment is as wide as long. The first pleopod of the male is straight, broad, narrowing slightly just before expanding to a truncate apex; lateral angle acute, produced laterally; medial angle blunt, produced slightly forward; the aperture is just below the anterior margin, laterally on the sternal surface.

R. brevirostris is distinguished from the other known species of *Rochinia* (except *R. sagamiensis* and *R. beauchampi*) by the broad concial lobe, directed laterally, on the hepatic margin.

It is distinguished from *R. sagamiensis* by having the postorbital and hepatic lobes separated by a broad concavity while in *R. sagamiensis* the margin between the two lobes is nearly straight, forming a large wing-like lobe. *R. brevirostris* is distinguished from *R. beauchampi* by not having the branchial regions strongly elevated and adjacent on the midline as they are in that species.

Distribution. — Eastern Indian Ocean: Bay of Bengal and SW. of Sumatra.

Rochinia carinata new species
(Figs. 56, 64 e,f, Pl. 12)

Material examined. — 4 ♂♂, 6 ♀♀ (3 ovig.) 13.5-25.5 mm, smallest ovig. ♀, 19 mm.
Holotype. — Male, cl. 25.5 mm, Kai Islands, 05°29′S 132°37′E, 290 m, trawl, mud, 12 May 1922; Danish Kei Islands Expedition, Stn. 58; Zoological Museum, University of Copenhagen.
Paratypes. As listed below:

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 251, Kai Is., 05°28.4′S 132°00.2′E, 204 m, trawl, hard coral sand, 8 December 1899; 1 spec. — Stn. 253, Kai Is., 05°48.2′S 132°13′E, 304 m, trawl, grey clay, hard and crumbly, 10 December 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 12, Kai Is., 05°30′S 132°35′E, 325 m, trawl, sand, shells, corals, 9 April 1922; 1 spec. — Stn. 50, Kai Is., 05°34′S 132°25′40″E, 233 m, trawl, sand, 4 May 1922; 2 specs. — Stn. 58, data as for holotype; 4 specs.

Description. — Carapace broad, greatest width about 0.8 postrostral carapace length, surface covered by a fine tomentum and with seven large, flattened, circular or subcircular islets.

Rostral spines short, straight, tapering to a sharp apex, length about one quarter postrostral carapace length. Eyestalks short, covered with tomentum, cornea terminal.

Orbital eave moderately expanded, preorbital angle produced forward into a blunt spine, antorbital angle indistinct; postorbital lobe short, broad, separated from eave by a narrow U-shaped hiatus, lateral margin basally adjacent to, but distinct from, anterior edge of large hepatic islet.

Hepatic margin with a large, broadly oval islet. Branchial margin with a narrow suboval plate anteriorly, just above carapace margin, anterior and dorsal edges of plate carinate; a large circular islet, posterolaterally.

Mesogastric region with a large circular islet posteriorly and a small tubercle in front of it (centrally); a protogastric tubercle just lateral to anterior margin of large mesogastric islet.

Cardiac region with a large subcircular islet, a tubercle just lateral to posterior margin of cardiac islet. Intestinal region with a large, circular islet, extending almost to posterior carapace margin. Branchial region anteriorly with a group of one large and two small tubercles near medial angle.

Basal antennal article flat, tomentose; anterolateral angle blunt, not produced, lateral margin weakly convex with a small basal tubercle; article separated from postorbital lobe by a narrow U-shaped hiatus.

Pterygostomian region smooth, margin carinate or with three to four compressed tubercles.

Third maxilliped smooth, anterolateral angle of merus only moderately produced and rounded.

Merus of cheliped of adult male with two carinate ridges, one dorsally and one ventrally on inner face (ventral margin of outer face blunt); a short, acute terminal spine distinct from dorsal ridge; carpus with two very low smooth ridges dorsally and a convex, carinate lobe ventrally on inner face. Palm dorsally sharp in proximal half, ventral surface commencing with a short right-angled carina; palm one and a half times as long as high; fingers more than 3/4 length of palm (0.8) with a moderate gape for proximal two thirds; dactyl with a large low tubercle in gape, fixed finger with a few small irregular teeth in gape.

Meri of first three pairs of ambulatory legs dorsally carinate, carina extending along proximal two thirds of first pair and confined to central third of second and third pairs; no terminal spine. First ambulatory leg about one and a half (1.6) times postrostral carapace length, fourth leg about 0.62 length of first.

Male sternum smooth, low ridges on anterior and lateral edges of first sternite.

Male abdomen of seven segments, smooth, third segment twice as wide as sixth segment, sixth segment about one and a half (1.4) times as wide as long, seventh segment about two thirds (0.7) as wide as long. Female abdomen of seven segments, smooth.

First pleopod of male straight, broad, narrowing at about distal sixth, and widening again to truncate apex.

Female gonopore a simple circular aperture, opening ventrally.

Remarks. — The first pleopod of the male of this species is similar to that of other species of *Rochinia*. This species is similar to *R. nodosa* (Rathbun) in having a broad carapace, short, stout rostral spines, a distinct preorbital spine and islets on the carapace that are nearly circular. However, this species is distinguished from *R. nodosa* by having well developed islets in the midline (mesogastric, cardiac, and intestinal) which are represented by broad, blunt tubercles in *R. nodosa*; by the presence of a small central mesogastric tubercle, absent in *R. nodosa*; and by the dorsally carinate meri of the ambulatory legs and the cheliped of the male.

This species is distinguished from *R. carbuncula* (Rathbun) and *R. bidens* (Sakai) by having only one branchial islet, rather than three as in the other two species, and by the presence of a distinct preorbital spine which is absent in *R. carbuncula* and *R. bidens*.

Distribution. — Only known from the Kai Islands.

Rochinia crosnieri new species
(Fig. 57a,b)

Hyastenus sp., Crosnier, 1976: 242, pl. 2 figs. 1, 2.

Holotype. — Female, ovigerous, cl. 24 mm, Ile de la Réunion, St. Paul, 580-680 m, trap, coll. Gueze, March 1973. Muséum National d'Histoire Naturelle, Paris.

Description. — Carapace pyriform, width three quarters (0.75) postrostral carapace length; carapace covered with a short, thick tomentum, regions not strongly defined; surface beneath tomentum smooth with broad, low elevations.

Rostral spines, slender, straight, weakly divergent, apically blunt; fused for less than proximal third (0.3), length more than a quarter (0.28) postrostral carapace length.

Orbital eave moderately expanded; preorbital spine short, about as large as postorbital lobe, directed upwards, outwards and slightly forwards, lateral edge concave, no antorbital angle; postorbital lobe separated from eave by a very broad U-shaped hiatus; postorbital lobe narrow, laterally flattened and smooth, length in lateral view about twice basal width, apex blunt. Eyestalks slender, short; cornea terminal.

Hepatic margin with a conical elevation surmounted by a large, blunt, cylindrical spine directed obliquely outwards and forwards; a low ridge connecting base of hepatic spine to base of postorbital lobe.

Branchial submargin anteriorly with a row of three tubercles, anterior largest; a small low epibranchial tubercle.

Gastric regions elevated, a very broad, low posterior mesogastric elevation and a small, rounded protogastric tubercle. Urogastric region weakly elevated.

Cardiac region with a smooth, broad elevation. Intestinal region smooth, weakly elevated medially near posterior carapace margin and with a low ridge laterally, parallel to margin.

Branchial region anteriorly with a broad, low subcircular elevation near medial angle.

Basal antennal article smooth, with a shallow longitudinal groove centrally; anterolateral angle produced into a small, blunt lobe; lateral margin weakly sinuous, concave in distal half and convex at proximal angle; medial margin of basal antennal article produced as a thin 'ledge' over antennal fossa. A small tubercle lateral to green gland.

Pterygostomian region smooth, margin with three small, well separated tubercles.

Third maxilliped smooth, covered with tomentum; anterolateral angle of merus moderately produced and rounded.

Cheliped of ovigerous female about equal (1.1) postrostral carapace length; merus smooth, subcylindrical, with a low terminal tubercle; carpus smooth; merus, carpus and outer face of palm covered in tomentum; length of palm about twice height, fingers about two thirds length of palm, each with about ten low teeth along cutting edge.

First ambulatory legs missing from specimen; merus of second ambulatory leg cylindrical, smooth, no terminal tubercle, all leg segments covered in tomentum; dactyl of fourth leg with minute spines ventrally along its length; length of second leg about one and a half times postrostral carapace length; fourth leg about equal to postrostral carapace length and about three fifths (0.6) of second leg.

Female abdomen of seven segments, smooth with a low medial ridge. Female gonopore a subtriangular aperture, opening ventrally.

The male of this species is unknown.

Remarks. — Crosnier (1976) distinguished this species from the specimen described as *Hyastenus brevirostris* by Doflein (1904) (now *Rochinia brevirostris*) by the presence in that species of a large conical epibranchial tubercle, whereas in *R. crosnieri* there is only a very small epibranchial tubercle. One of us (D.J.G.G.) has examined the holotype of *R. brevirostris* (ovig. ♀, 25.3 mm, SW. of Sumatra, 614 m, ZMB 13647) and *R. crosnieri* can be distinguished from it by the following additional points:

1) the hepatic spine is cylindrical in this species; it is broad and conical in *R. brevirostris*;
2) the postorbital lobe is separated from the eave by a very broad U-shaped hiatus; the hiatus is narrow and U-shaped in *R. brevirostris*.
3) there is only a low posterior mesogastric elevation; two distinct mesogastric tubercles in *R. brevirostris*;
4) the lateral edge of the basal antennal article is concave distally; the lateral edge is convex in *R. brevirostris*;
5) the merus of the cheliped is subcylindrical; it is trigonal (prismatic) in *R. brevirostris*.

This species is distinguished from *R. makassar* n.sp. by the presence of a preorbital spine, absent in *R. makassar*; and by the weakly elevated cardiac and anteromedial branchial regions which are distinct, and strongly elevated in *R. makassar*.

Distribution. — Known only from the type locality, Ile de la Réunion, St. Paul.

Rochinia globulifera (Wood-Mason, 1891)
(Fig. 62a, b)

Pugettia globulifera Wood-Mason, *in* Wood-Mason & Alcock, 1891: 260-261.
Scyramathia globulifera. — Alcock, 1895: 205-206. — Alcock & Anderson, 1896: pl. 20 figs. 3, 3a. — Doflein, 1904: 85.
Rochinia globulifera. — Serène & Lohavanijaya, 1973: 56 (in key).

Material examined. — 2 ♂♂, 10.0, 11.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S.Africa Expedition: Stn. 7, Bali Sea, 08°29'S 114°40'E, 200 m, small fish trawl, mud, 5 April 1929; 2 specs.

Remarks. — These specimens agree well with that figured by Alcock & Anderson (1896). On the gastric region there is a posterior medial tubercle with a smaller more anterior tubercle on either side. There is a flat, oval plate laterally on the branchial submargin and the epibranchial spines are acuminate. This species is distinguished from other known

species of *Rochinia* by the distinct, smooth, rounded elevation at the base of the flattened hepatic spine.

This species has previously been recorded only from the Indian Ocean.

Distribution. — Andaman Sea, Nicobar Islands, Bali.

Rochinia hertwigi (Doflein, 1900)

Scyramathia Hertwigi Doflein *in* Chun, 1900: 497 (fig.). — Doflein, 1904: 81-84, pl. 27 figs. 1-7, pl. 28 fig. 1.
Scyramathia hertwigi. — Stebbing, 1902: 7-8, pl. 6. — Barnard, 1950: 50-51, figs. 11b, c.
Rochinia hertwigi — Serène & Lohavanijaya, 1973: 56 (in key).

Material examined. — 4 ♂♂, 25.5-57.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S.Africa Expedition: Stn. 57, South Africa, 34°21′S 17°57′E, off Cape Town, ca. 356 m, trawl, mud, 18 December 1929; 3 specs. — 34°21′S 17°7′E, off Cape Town, 350 m, 18 December 1929; 1 spec.

Remarks. — These specimens agree well with those previously described by other authors. This large species (up to 60 mm, cl.) has eight flattened islets well separated on the carapace as well as a flat islet on the hepatic margin. The hepatic islet is produced dorsally as a broad spine and is confluent anteriorly with the postorbital lobe. The cheliped of the adult male is long, about three and a half times the postrostral carapace length.

R. hertwigi is distinguished from other Indo-West Pacific species of *Rochinia* which have many flat islets, by the islets being more widely separated and by the presence of a sharp preorbital spine lacking in the other species.

The similarity between this species and *R. carpenteri* Norman from the North Atlantic has been noted by Barnard (1950).

Distribution. — Southern coast of South Africa.

Rochinia luzonica (Rathbun, 1916) new combination (Fig. 63c,d)

Sphenocarcinus luzonicus Rathbun, 1916: 539-540. — Griffin, 1976: 211-213, fig. 11a.

Material examined. — 6 ♂♂, 6 ♀♀ (2 ovig.), 10-37 mm, smaller ovig. ♀, 22 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 95, Sulu Archipelago, 05°43.5′N 119°40′E, 522 m, dredge, stony bottom, 26 June 1899; 1 spec. — Stn. 251, Kai Is., 05°28.4′S 132°0.2′E, 204 m, trawl, hard coral sand, 8 December 1899; 1 spec. — Stn. 254, Kai Is., 05°40′S 132°26′E, 310 m, trawl, fine grey mud, 10 December 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 12, Kai Is., 05°30′S 132°35′E, 325 m, trawl, sand, shells, corals, 9 April 1922; 1 spec. — Stn. 49, Kai Is., 05°37′10″S 132°23′E, 245 m, trawl, sand, 3 May 1922; 1 spec. — Stn. 59, Kai Is., 05°28′S 132°36′E, 385 m, trawl, corals, sponges, 12 May 1922; 4 specs.

Mortensen Java-S.Africa Expedition: Stn. 15, Bali, off Boeleleng, 07°29′S 114°49′E, ca. 240 m, Sigsbee trawl, sand and mud with concretions, 10 April 1929; 2 specs.

Sulawesi, off Manado, 01°31′N 124°47′E, 450 m, coll. Capt. Christiansen, 12 March 1913; 1 spec.

Remarks. — The rostral spines are straight and weakly divergent in all specimens except two adult males; in one specimen from the Kai Islands ('Siboga' Stn. 254) the rostrum is sinuous and in the other from Sulawesi the tips are upturned.

There is a small tubercle on either side of the gastric islet; this islet has a more rounded outline in younger animals than in the adult. The anterior branchial islet is only a round tubercle in young specimens, becoming more elongate and laterally pointed in adults, but in several specimens it is notched on either the anterior or posterior margin. On the posterior margin of the carapace in one ovigerous female, the central triangular part of the islet is clearly separated from the slender lateral parts, instead of being fused to them as it is in other specimens. The dorsal islets of younger animals are smaller and flatter, while in the adults the islets are more convex and constricted below so that they stand out from the carapace surface; the gastric and cardiac islets have a central tubercle. The meri of the ambulatory legs are not carinate.

R. luzonica is one of the four species of *Rochinia* with large islets and separate rostral spines. It is distinguished from *R. bidens* and *R. carbuncula* by the presence of a transversely elongate intestinal islet just above the posterior carapace margin and from *R. stimpsoni* by the presence of two islets rather than one on the dorsal branchial region.

Distribution. — Indonesia, Philippine Islands; previously known only from the Philippine Islands.

Rochinia makassar new species (Fig. 57e,f)

Material examined. — 2 ♀♀, 11.0, 16.5 mm.

Holotype. — Female, immature, cl. 16.5 mm, Makassar Strait, 00°32′S 119°39.8′E, 655 m, trawl, fine grey mud, 19 June 1899, 'Siboga' Expedition, Stn. 87; Zoological Museum, Amsterdam.
Paratype. Female, immature, cl. 11 mm, Ceram Sea, 03°27′S 131°0.5′E, 567 m, deep sea trawl, fine, yellow grey mud, 28 August 1899, 'Siboga' Expedition, Stn. 173; Zoological Museum, Amsterdam.

Description. — Carapace pyrifrom, width three quarters (0.75) postrostral carapace length; carapace covered with a short tomentum; surface smooth with a few broad elevations.

Rostral spines slender, apically sharp and weakly incurved; fused for about proximal fifth; length about a third (0.36) postrostral carapace length.

Orbital eave moderately expanded, preorbital angle only very weakly produced and rounded; no antorbital angle;

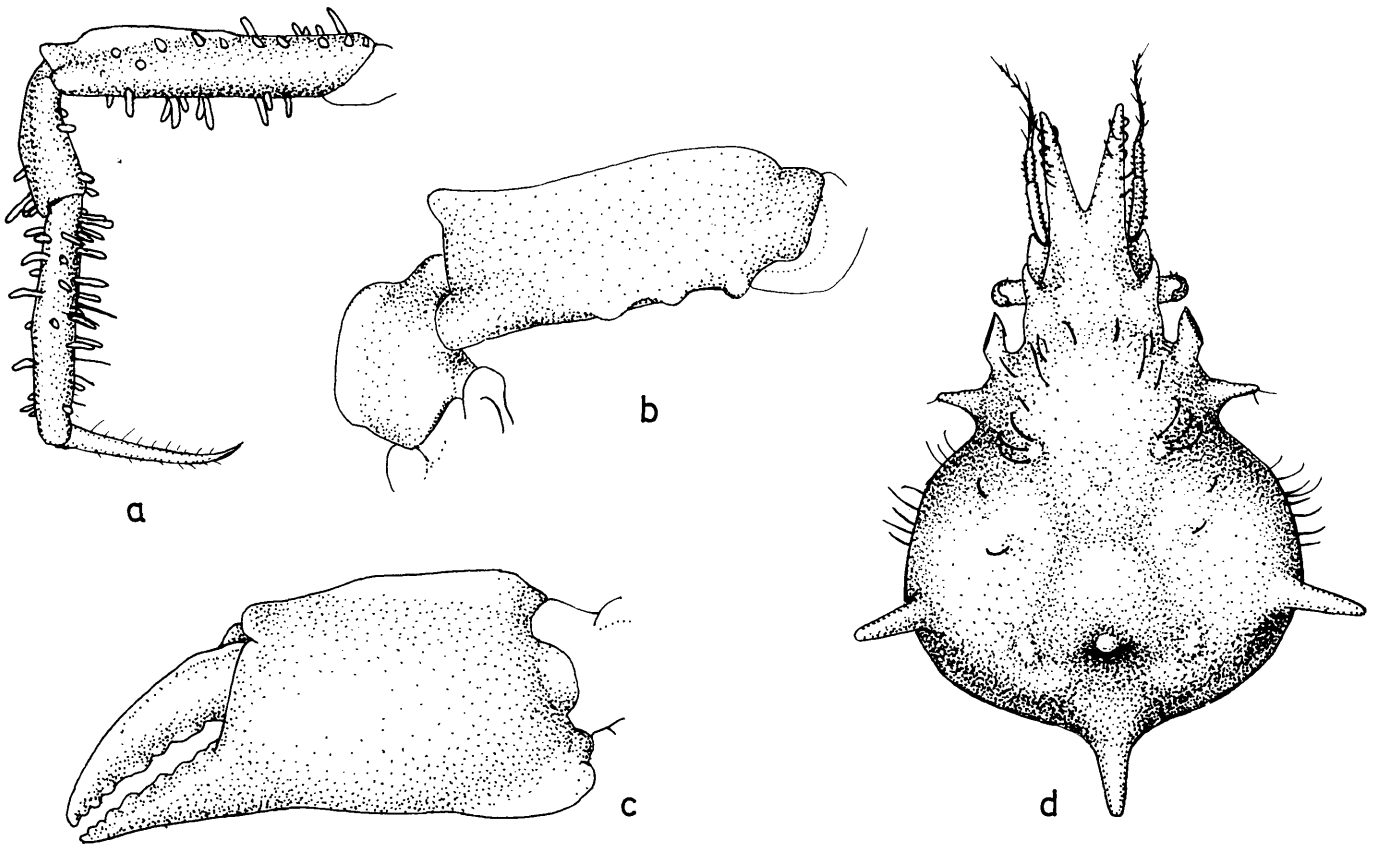


Fig. 58. *Rochinia mosaica* (male, 13 mm, AM P.11743) (a) left first ambulatory leg; (b) left cheliped, merus and carpus; (c) left chela; (d) carapace, dorsal view.

postorbital lobe separated from eave by a U-shaped hiatus; postorbital lobe narrow, laterally flattened but tomentose, length in lateral view about one and a half times basal width, apex blunt. Eyestalks slender, short; cornea terminal.

Hepatic margin with a small conical elevation surmounted by a cylindrical spine directed laterally and slightly forwards; base of hepatic spine connected with base of postorbital lobe by a low ridge.

Anterior branchial submargin with two small tubercles, anterior larger; a conical epibranchial tubercle directed laterally.

Gastric regions elevated, a small anterior mesogastric tubercle level with hepatic spine, a much larger posterior mesogastric tubercle and behind it, on posterior slope, a round tubercle; a very small posterior protogastric tubercle.

Cardiac region strongly elevated, smooth. A large circular tubercle on anterior border of the branchial region near medial angle; a small tubercle just lateral to cardiac region.

Intestinal region with a blunt tubercle centrally, carapace almost vertical below tubercle to posterior carapace margin; a low lateral ridge just in front of and almost parallel to margin.

Basal antennal article smooth, flat, anterolateral angle not produced or produced only to a very small triangular tooth; lateral margin straight; medial margin produced slightly over antennal fossa; a small tubercle lateral to green gland.

Pterygostomian region smooth, margin with three low, broad tubercles.

Third maxilliped smooth, covered with tomentum, anterolateral angle of merus produced and rounded.

Cheliped of immature female about equal to postrostral carapace length; merus smooth with a low terminal tubercle; carpus smooth; merus, carpus and palm covered with tomentum; length of palm about one and a half times height; fingers about four fifths (0.8) length of palm, a very narrow proximal unarmed gape between fingers, remainder of cutting edge of both fingers with low teeth.

Ambulatory legs smooth, merus of first leg with a small terminal tubercle; all segments of legs covered with tomentum; first leg about one and a half times (1.6) postrostral carapace length, fourth leg about two thirds length of first.

The male of this species is unknown.

Remarks. — The absence of a well developed preorbital spine distinguishes this species from *R. brevirostris* Doflein and *R. crosnieri.* This species is similar to *R. crosnieri* in having a slender hepatic spine which is the longest carapace spine, but it is distinguished from that species by the strongly elevated cardiac and anterior branchial regions which are low and broad in *R. crosnieri.*

R. sagamiensis (Gordon) also lacks a well developed preorbital spine, but in that species the postorbital and hepatic lobes are connected by a wing-like ridge just below the apex.

Distribution. — Makassar Strait, Ceram Sea.

Rochinia moluccensis new species
(Figs. 59, 64c,d)

Material examined. — 1♂, postrostral cl. 10.5 mm; 1 ♀, cl. 16.5 mm.

Holotype. — Female, adult, cl. 16.5 mm, Java Sea, 07°35′S 114°42′E, ca. 200 m, Sigsbee trawl, mud without concretions, 10 April 1929, Mortensen Java-S.Africa Expedition; Stn. 16, Zoological Museum, University of Copenhagen.
Paratype. Male, postrostral cl. 10. 5 mm, Straat Bougainville, W. of Waigeo I., 00°29.2′S 130°5.3′E, 469 m, dredge, coarse sand and broken shells, 15 August 1899, 'Siboga' Expedition, Stn. 156; Zoological Museum, Amsterdam.

Description. — Carapace pyriform, width about two thirds (0.66-0.68) postrostral carapace length; surface smooth with a few low tubercles.

Rostral spines slender, straight, divergent; length about one third (0.36) postrostral carapace length, fused for about proximal quarter.

Orbital eave moderately expanded; a broad, subacute preorbital spine directed obliquely forwards and slightly upwards; a small convexity on edge of eave at antorbital level; postorbital lobe separated from eave by a narrow U-shaped hiatus; postorbital lobe short, laterally keeled, keel extending posteriorly to meet hepatic spine. Eyestalks short, slender; cornea terminal.

Hepatic margin elevated, a short spine dorsally on elevation directed outward and slightly upward, anterior margin of spine produced forward as a sharp keel to be continuous with keel of postorbital lobe.

Branchial submargin smooth or with a very small tubercle; a small epibranchial tubercle in the female, a smaller, almost indistinguishable tubercle in the male.

Gastric regions elevated, a small posterior mesogastric tubercle; a low posterior protogastric tubercle.

Cardiac region with a large conical tubercle; branchial region elevated near anterior border, smooth.

Intestinal region with a very low medial tubercle near posterior carapace margin; laterally a low ridge just in front of and parallel to carapace margin.

Basal antennal article smooth, a longitudinal groove centrally; anterolateral angle produced forward into a short, blunt, triangular spine; lateral margin almost straight, weakly concave midway along; medial edge concave, produced slightly over antennal fossa; a small tubercle lateral to green gland.

Pterygostomian region smooth, margin with four broad tubercles, united (in male) to form a tuberculate ridge.

Third maxilliped smooth, anterolateral angle of merus moderately produced and rounded.

Cheliped of male about one and a quarter (1.23) times postrostral carapace length; merus smooth, carinate on dorsal and inner ventral edges, outer ventral edge rounded, terminal spine not separate from carina; carpus smooth with two carinate ridges, one dorsally and one ventrally on inner face; palm about twice as long as high, dorsal and ventral margins carinate; fingers about two thirds (0.69) palm, weakly gaping proximally, low teeth along cutting edge of both fingers.

Ambulatory legs smooth, slender, merus of first leg with a small terminal tubercle; dactyl of fourth leg with about four very small teeth ventrally along its length; first leg about one and a half times (1.42) postrostral carapace length; fourth leg less than two thirds (0.6) first leg.

Male sternum smooth, first sternite with a shallow depression on either side of a narrow ridge in front of abdominal fossa; shallow intersegmental grooves between remaining segments.

Male abdomen smooth, third segment less than twice (1.8) width of sixth segment; sixth segment one and a half times as wide as long; seventh segment as wide as long.

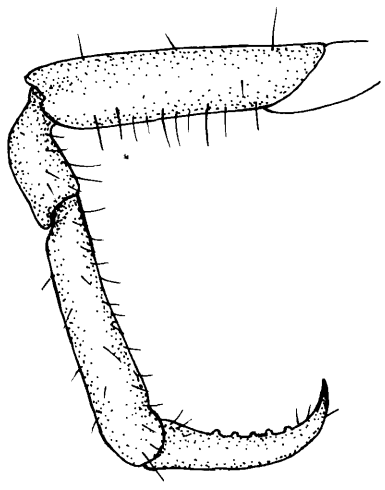
Female abdomen of seven segments, smooth except for a low medial ridge.

First pleopod of male straight, broad, twisted through 90° at about the distal quarter so that lateral margin becomes ventral; apical margin truncate; pleopod divided into two terminally separate lobes on rounded medial-ventral angle of apex; abdominal (inner) surface recurved along anterior border and its medial-ventral angle is a broad, rounded lobe; sternal (outer) surface is simply rounded on medialventral angle; central anterior margin curved in towards abdominal surface; aperture terminal between lobes.

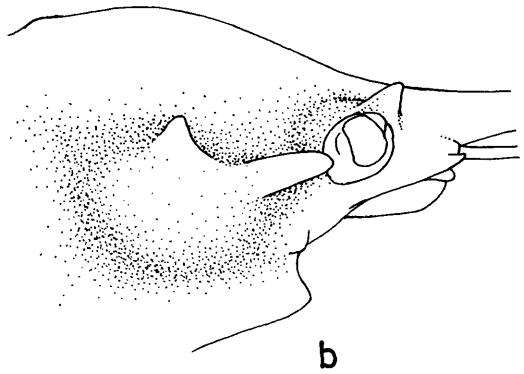
Female gonopore a simple subcircular aperture opening ventrally.

Remarks. — The presence of only a small epibranchial tubercle rather than a lobe, spine or prominent tubercle distinguishes *R. moluccensis* from most other species of *Rochinia.* Of the few species similarly lacking a strong epibranchial spine or lobe, *R. moluccensis* is distinguished from *R. crosnieri* and *R. makassar* by the hepatic spine which is short and directed upwards (long and directed laterally in *R. crosnieri* and *R. makassar*); from *R. suluensis* by the postorbital lobe which is keeled and confluent with the hepatic spine (laterally flat and separate from the hepatic spine in *R. suluensis*); and from *R. tomentosa* by the conical cardiac tubercle (cardiac region smooth in *R. tomentosa*). In *R. moluccensis* the subhepatic region is roundly elevated, but the elevation is not glabrous nor part of a hepatic plate as it is in *R. globulifera* and that species also has flattened plate laterally on the branchial submargin which is lacking in *R. moluccensis.*

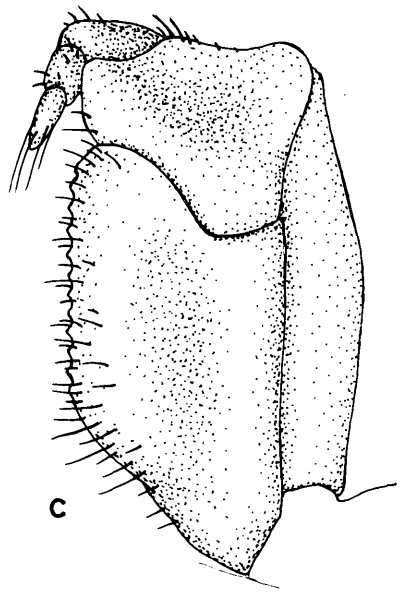
Distribution. — Moluccas, Java Sea.



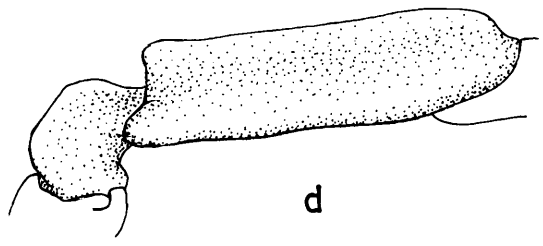
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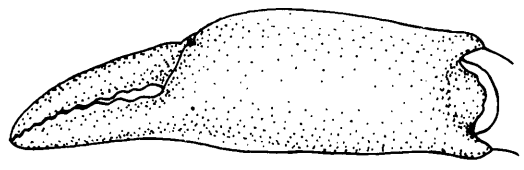
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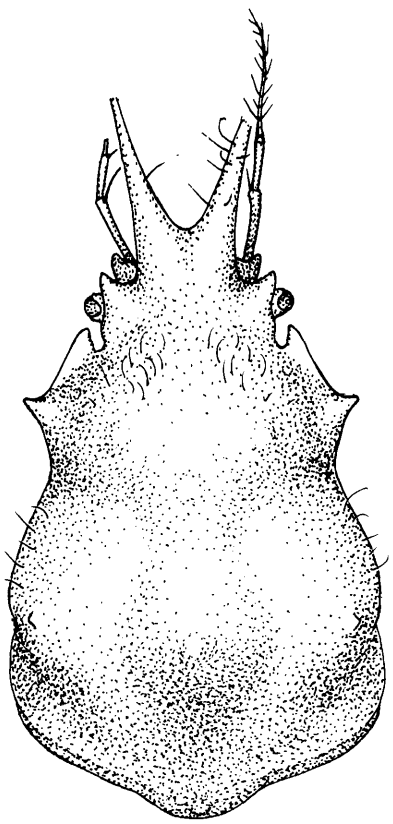
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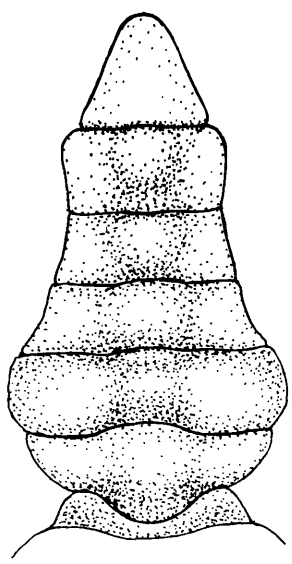
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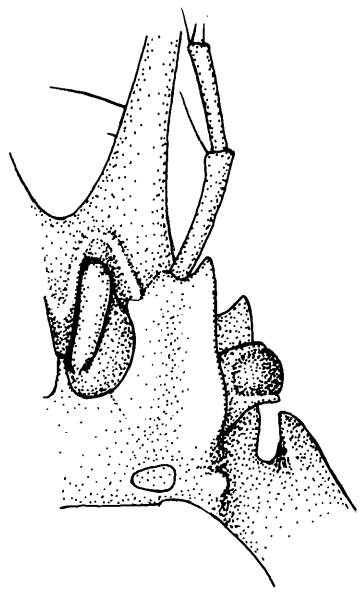
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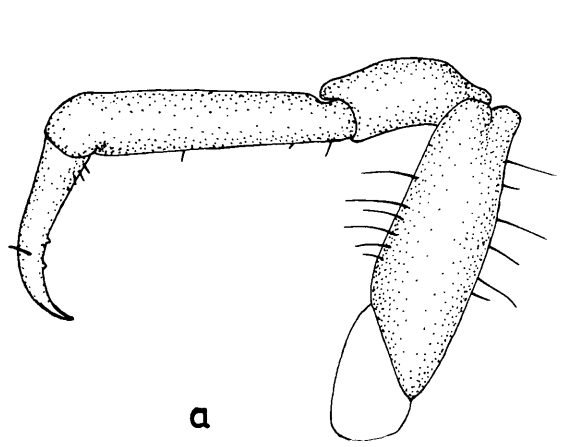


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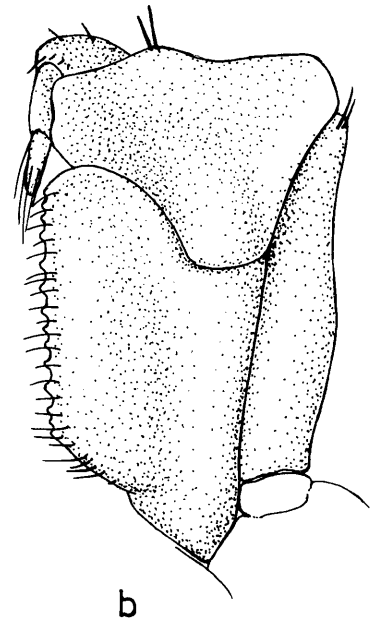


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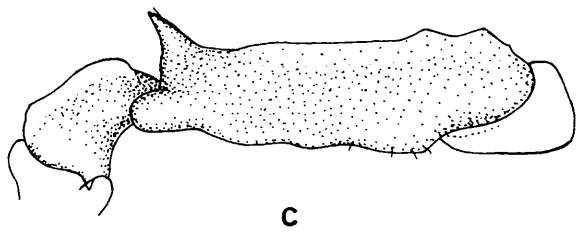
Fig. 59. *Rochinia moluccensis* (holotype, female) (a) left fourth ambulatory leg; (b) anterior region, lateral view (c) left third maxilliped; (paratype, male) (d) left cheliped, merus and carpus; (e) left chela; (holotype) (f) carapace, dorsal view; (paratype, male) (g) male abdomen; (holotype) (h) left orbit, ventral view.



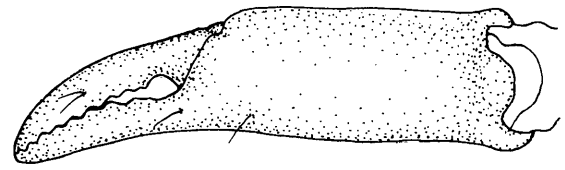
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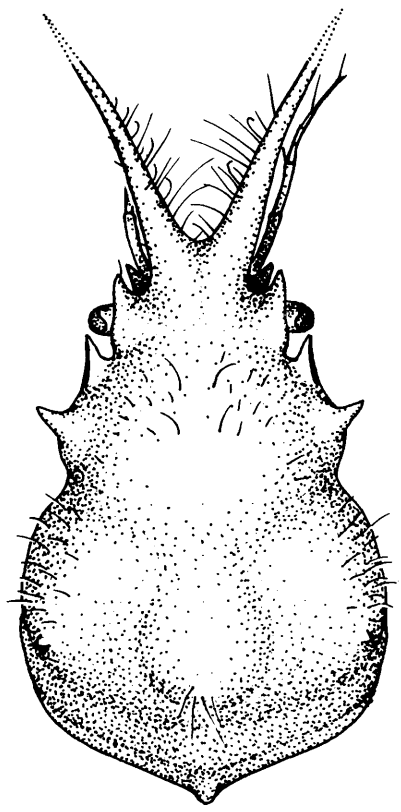
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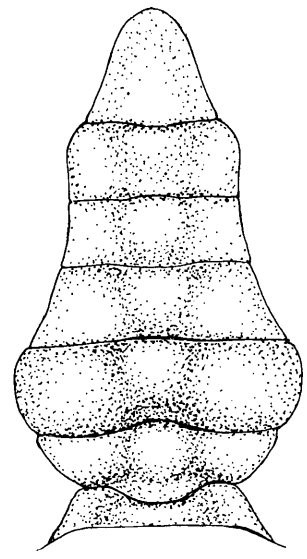
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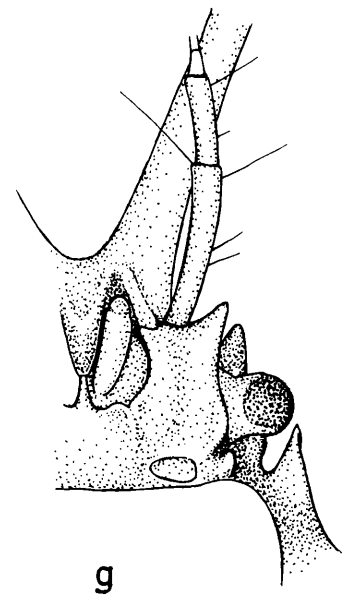
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Fig. 60. *Rochinia suluensis* (female, 11.5 mm, Bougainville Strait, ZMA) (a) left fourth ambulatory leg; (holotype) (b) left third maxilliped; (c) left cheliped, merus and carpus; (d) left chela; (e) carapace, dorsal view; (f) male abdomen; (g) left orbit, ventral view.

Rochinia mosaica (Whitelegge, 1900) new combination (Figs. 58, 62 e,f)

Pugettia mosaica Whitelegge, 1900: 141-142, pl. 35 figs. 5, 6, 7. — Griffin, 1972: 70-71.
Doclea profunda Rathbun, 1918: 16-17, pl. 7 figs. 1, 2. — Hale, 1927: 134 fig. 134; new synonymy.

Material examined. — 3 ♂♂, 5 ♀♀(4 ovig.), 7.5-11.0 mm, smallest ovig. ♀, 9 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

New South Wales: E. of Sydney, 33°46′S 151°43′E, 173 m, dredge, F. R.V. Kapala, 5 December 1977; 5 specs. (AM P.32091). — 2.3 km E. of Malabar, 33°59′27″S 150°16′48″E, dredge, 24 May 1973; 1 spec. (AM P 20740). — E. of Cronulla, 34°05′S 151°19′E 1° to 34°11′S, 151°14′E, 130 m, demersal fish trawl, F. R. V. Kapala, 22 April 1975; 2 specs. (AM P.20600).

Material previously examined and discussed (Griffin, 1972). — 54 ♂♂, 58 ♀♀, cl. 4.5-14.3 mm, from 13 localities between Cape Moreton, Queensland and Cape Everard, Victoria.

Remarks. — *Doclea profunda* Rathbun is synonymous with *Pugettia mosaica* Whitelegge. We have examined a large series of specimens identified as *Pugettia mosaica* and the type material of both species. The type material of *Pugettia mosaica* consisting of a lectotype (male, 14.4 mm, AM P. 15175) and paralectotypes (14 males, 28 females, AM G. 2331 to G. 2336 inclusive, G. 2342, P. 1400) has been discussed previously (Griffin, 1972). *Doclea profunda* is known only from the holotype (ovig. female, 10.7 mm, Great Australian Bight, S. of Eucla, 450-810 m, AM E. 6279). The type material of the two species agrees in the laterally flattened and smooth postorbital lobe; the separate, laterally directed hepatic spine; the large epibranchial, cardiac and intestinal spines; the longitudinally grooved, subrectangular basal antennal article; and the fused fifth and sixth segments of the female abdomen.

Rathbun described several small tubercles on the carapace of *Doclea profunda*: a posterior protogastric, and dorsally on the branchial region a group of tubercles anteromedially and a tubercle posterolateral to the cardiac spine. These tubercles are usually covered by a thick tomentum, described by Whitelegge as 'bead-like granules', and their presence is only indicated by a group of curled hairs or long setae. This tomentum is absent from the greater part of the carapace of the holotype of *D. profunda*, though the bases of hairs can be seen.

In all the specimens the postorbital lobe is separated from the orbital eave by a narrow U-shaped hiatus; ventrally there is a small tubercle lateral to the green gland and on the pterygostomian margin there are two tubercles, the anterior one at least twice the size of the other.

The first pleopod of the male is straight, broad, only narrowing slightly before expanding again apically; the apex is truncate, medially rounded, laterally subacute; the aperture appears to be terminal. This pleopod differs from the scyriform pleopod of most Japanese species of *Pugettia* but is similar to that of Indo-west Pacific species of *Rochinia*.

Brief notes found with some specimens of this species collected (1930-1937) by Melbourne Ward indicate that he thought then that *Doclea profunda* probably was synonymous with *Pugettia mosaica* although he never included this in any of his published work.

Distribution. — South-eastern and southern Australia from Cape Moreton (Queensland) to Great Australian Bight (South Australia).

Rochinia nodosa (Rathbun, 1916) new combination (Fig. 63g,h)

Sphenocarcinus nodosus Rathbun, 1916: 541-542. — Griffin, 1976: 213, fig. 10a. — Sakai, 1976: 204-205, pl. 72 fig. 2.

Material examined. — 1 ♂, 20 mm, 1 ♀ (ovig.), 20.5 mm.

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Mortensen Pacific Expedition: Japan, 21 miles (~ 33.5 km) W½S. of Bonomisaki, 440 m, trawl no. 3, 13 May 1914; 2 specs.

Remarks. — These specimens agree closely with specimens from the Philippine Islands reported on previously (Griffin, 1976).

Sakai (1976) suggests, but without discussion, that *Scyra tuberculata* Yokoya, 1933 may be a synonym of this species. Nothing in Yokoya's description and figure contradicts such a proposal, in our view, and we do not treat Yokoya's species as a separate taxon.

Distribution. — Philippine Islands and Japan.

Rochinia pulchra (Miers, 1886)

Anamathia pulchra Miers, 1886: 26-27, pl. 4 figs. 1, 1a-c.
Scyramathia pulchra. — Alcock, 1895: 202-203. — Doflein, 1904: 84, pl. 27 fig. 12.
Rochinia pulchra. — Sakai, 1938: 278-279, fig. 35, pl. 37 fig. 4; 1976: 223-224, pl. 79 fig. 1. — Serène & Lohavanijaya, 1973: 56-57, figs. 119-122, pl. 11A. — Takeda, 1975: 144-145, fig. 4a,b. — Griffin, 1976: 210.

Material examined. — 3 ♂♂, 3 ♀♀, 12.5-31.0 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 256, Kai Is., 05°26.6′S 132°32.5′E, 397 m, greyish green mud, 11 December 1899; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 52, Kai Is., 05°46′S 132°49′35″E, 352 m, trawl, mud, 7 May 1922; 1 spec.

Mortensen Java-S.Africa Expedition: Stn. 15, Bali, off Boeleleng, 07°29′S 114°49′E, ca. 240 m, Sigsbee trawl, sand and mud with concretions, 10 April 1929; 1 spec. — Stn. 16, off Bali, 07°35′S 114°42′E, ca. 200 m, Sigsbee trawl, mud without concretions, 10 April 1929; 2 specs.

Remarks. — The spines on the carapace of these specimens are all of a relatively similar length, except that the anterior protogastric spine is always slightly shorter than the posterior protogastric spine. Three of the specimens have two small additional spines between the mesogastric and metagastric spines, whereas the other three specimens have only two very

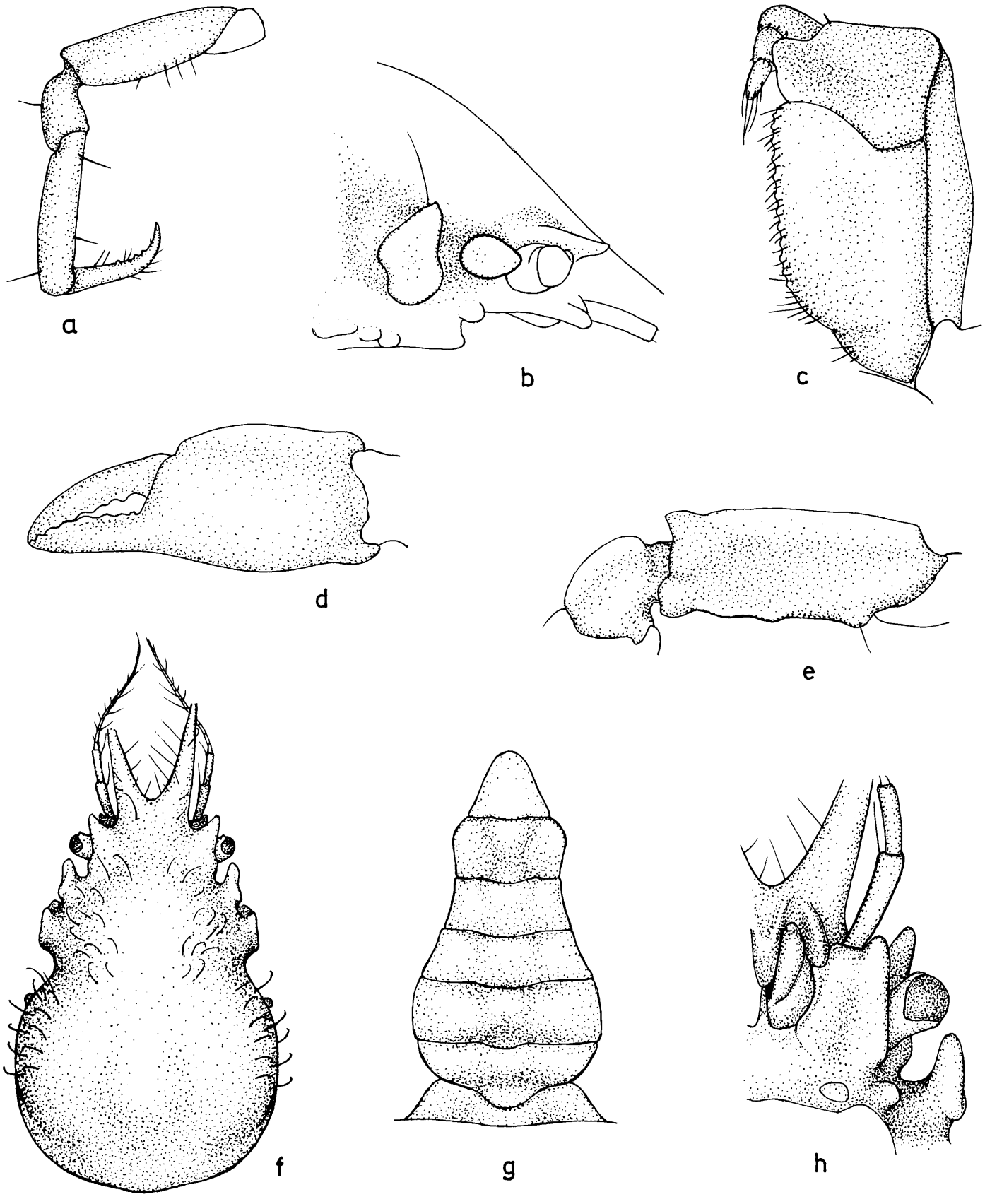


Fig. 61. *Rochinia tomentosa* (holotype) (a) left third ambulatory leg; (b) anterior region, lateral view; (c) left third maxilliped; (d) left chela; (e) left cheliped, merus and carpus; (f) carapace, dorsal view; (g) male abdomen; (h) left orbit, ventral view.

small tubercles. In some specimens the cardiac spine and some of the branchial spines are curved forward at the tip.

We have also examined a specimen (imm. ♀, cl. 42 mm, 540 m, FRV. 'Kapala', AM P. 32090) collected from off Point Danger, northern New South Wales, which is similar to *R. pulchra* in having many long carapace spines. As in *R. pulchra* the supraorbital spine, hepatic spine and protogastric spine are all long, slender and upright. However, this specimen differs from *R. pulchra* in having fewer carapace spines, there is only one protogastric spine on each side, not two; there is only one mesogastric spine; and one spine on the branchial margin, posterolaterally. While these differences are sufficient to justify considering this specimen a distinct species, we feel a detailed description should wait until more material is available.

Distribution. — Indo-West Pacific: East Africa to the Philippine Islands and Japan.

Rochinia riversandersoni (Alcock, 1895)

Scyramathia riversandersoni Alcock, 1895: 203-204. — Alcock & Anderson, 1896: pl. 22 figs. 2, 4, 4a. — Doflein, 1904: 84-85, pl. 27 figs. 8-11.
Rochinia riversandersoni. — Serène & Lohavanijaya, 1973: 58, figs. 129-132, pl. 12A. — Yaldwyn & Dawson, 1976: 98-101, figs. 6-9. — Griffin, 1976: 211.

Material examined. — 2♀♀ (1 ovig.), postrostral cl. 8.5 mm, ovig. ♀, postrostral cl. 11 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 170, Ceram, 03°37.7′S 131°26.4′E, 924 m, deep sea trawl, fine grey mud, 26 August 1899; 2 specs.

Remarks. — In these specimens the epibranchial spine is long and slender (equal to 7/8 carapace width) but on either side of the cardiac spine there are two tubercles, not two spines as in the specimens figured by other authors, or in the specimens examined from the Philippine Islands (Griffin, 1976).

The postorbital lobe is continuous with the hepatic spine; there is a medial metagastric tubercle rather than a spine, and on either side of it a smaller protogastric tubercle. The preorbital spine is apically blunt.

It is possible that all the specimens which have been reported by various authors under this name are not conspecific and that these specimens too may represent a new species.

Distribution. — East Africa, India, Ceram, South China Sea, Philippine Islands, Kermadec Islands, New Zealand.

Rochinia sagamiensis (Gordon, 1931) new combination (Fig. 62g,h)

Pugettia brevirostris. — Parisi, 1915: 287-289, text fig. 2, pl. 7 fig. 1. (Not *Hyastenus brevirostris* Doflein, 1904 = *Rochinia brevirostris* (Doflein).)
Pugettia sagamiensis Gordon, 1931: 557-558, figs. 35, 36c. — Sakai, 1938: 253-254, pl. 25 fig. 3; 1965a: 73-74, pl. 33 fig. 2; 1976: 195, pl. 69 fig. 2.

Material examined. — 1♂, 16.5 mm.

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Mortensen Pacific Expedition: Japan, Sagami Sea, 720 m, 1-4 June 1914; 1 spec.

Remarks. — Parisi (1915) considered a specimen of this species from Sagami Bay to be the same as *Hyastenus brevirostris* Doflein but placed it in *Pugettia*. In 1931 Gordon named the species and distinguished it from *Pugettia brevirostris*. Both species differ from most species of *Pugettia* in having large conical elevations on the carapace. The first pleopod of the male has not previously been described: it is not of the scyriform type present in species of *Pugettia*—the apex is truncate, laterally subacute and medially rounded without any medial lobes. There is a similar kind of pleopod in species of *Rochinia* and we have therefore removed this species from *Pugettia* and included it with other species having a similar pleopod in the pisine genus *Rochinia*.

This specimen agrees well with those previously described, but it is not as large as those recorded by Parisi or Sakai. The cheliped palm is not enlarged and the carapace tubercles are not so strongly developed.

This species is similar to *R. brevirostris*, *R. crosnieri* and *R. makassar*, but is distinguished from them by the merus of the first ambulatory leg which is trigonal rather than cylindrical and by the postorbital and hepatic lobes which are connected to form a single wing-like lobe, while in the other three species the postorbital and hepatic lobes are only connected basally and in *R. crosnieri* and *R. makassar* the hepatic lobe is narrow. It is further distinguished from *R. crosnieri* and *R. makassar* by the epibranchial angle having a broad conical lobe rather than being smooth or having a tubercle.

Distribution. — Endemic to Japan.

Rochinia stimpsoni (Miers, 1886) new combination (Fig. 63a,b)

Oxypleurodon stimpsoni Miers, 1886: 38-39, pl. 6 figs. 1, 1a-c.
Sphenocarcinus stimpsoni. — Sakai, 1938: 286-287, pl. 29 fig. 3; 1976: 203, pl. 72 fig. 1, pl. 73 fig. 1. — Griffin, 1976: 215.

Material examined. — 8♂♂, 11♀♀ (5 ovig.), 1 juv., 6.5-22.5 mm, smallest ovig. ♀, 15 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Mindanao, 07°30′N 123°30′E, 3 miles (~ 5 km) SW. of Tucaran, ca. 600 m, Sigsbee trawl, sand, 10 March 1914; 6 specs.

Danish Kei Islands Expedition: Stn. 4, Kai Is., 05°31′40″S 132°26′E, 250 m, trawl, sand, 3 April 1922; 1 spec. — Stn. 32, Kai Is., 05°32′20″S 132°34′E, 260 m, trawl, sand, 22 April 1922; 1 spec. — Stn. 45, Kai Is., 05°48′30″S 132°14′E, 300 m, trawl, sand, 1 May 1922; 1 spec. — Stn. 46, Kai Is., 05°47′20″S 132°13′E, 300 m, trawl, clay, mud, 2 May 1922; 3 specs — Stn. 49, Kai Is., 05°37′10″S 132°23′E, 245 m, trawl, sand, 3 May 1922; 2 specs. — Stn. 62, Kai Is., 05°29′25″S 132°50′E, 290 m, trawl, sand shells and concretions, 15 May 1922; 1 spec.

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Queensland, 1.6-3.2 km WNW. of Raine I., 250 m, prawn trawl, coll. J. Paxton, 12 February 1979; 5 specs. (AM P.29928).

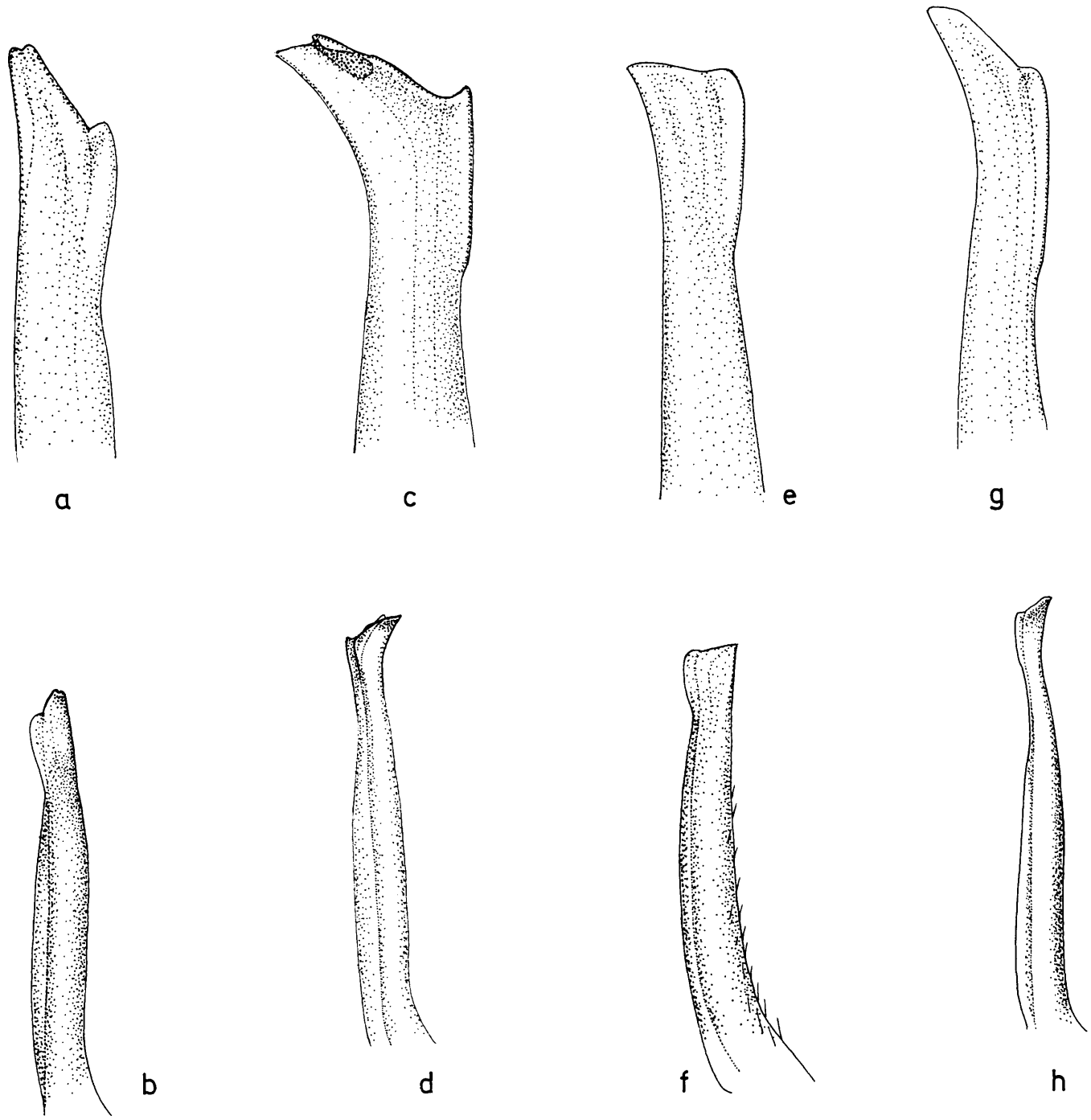


Fig. 62. Left first pleopod of male of *Rochinia globulifera* (11.5 mm, Java, ZMC) (a) sternal tip of pleopod, (b) abdominal view of same; *R. brevirostris* (22.5 mm, ZSC 4047/10) (c) sternal tip of pleopod, (d) abdominal view of same; *R. mosaica* (13 mm, AM P. 11743) (e) sternal tip of pleopod, (f) abdominal view of same; *R. sagamiensis* (16.5 mm, Sagami Sea, ZMC) (g) sternal tip of pleopod, (h) abdominal view of same.

Remarks. — In this series the rostral spines vary from barely half to nearly two thirds postrostral carapace length and are weakly divergent or subparallel; only in four specimens are they curved outwards as strongly as shown by Miers (1886).

The surface of the islets is granular; the elongate gastric islet reaches anteriorly to level with the postorbital lobe or may extend to the front of the eyestalk. The hepatic islet is not always confluent with the postorbital lobe even in adults. In juvenile specimens the islets are more widely separated but they are the same shape and are just as clearly distinguished as in the adults.

The meri of the ambulatory legs are carinate as in *R. aurorae*, *R. cuneata* (Wood-Mason) and *R. carinata*. The carpus has two dorsal ridges the medial being the larger.

R. stimpsoni is distinguished from other species of *Rochinia* with large islets on the carapace by having the rostral spines separate and only one large islet on the dorsal branchial region. The rostrum is fused for the basal half or only apically

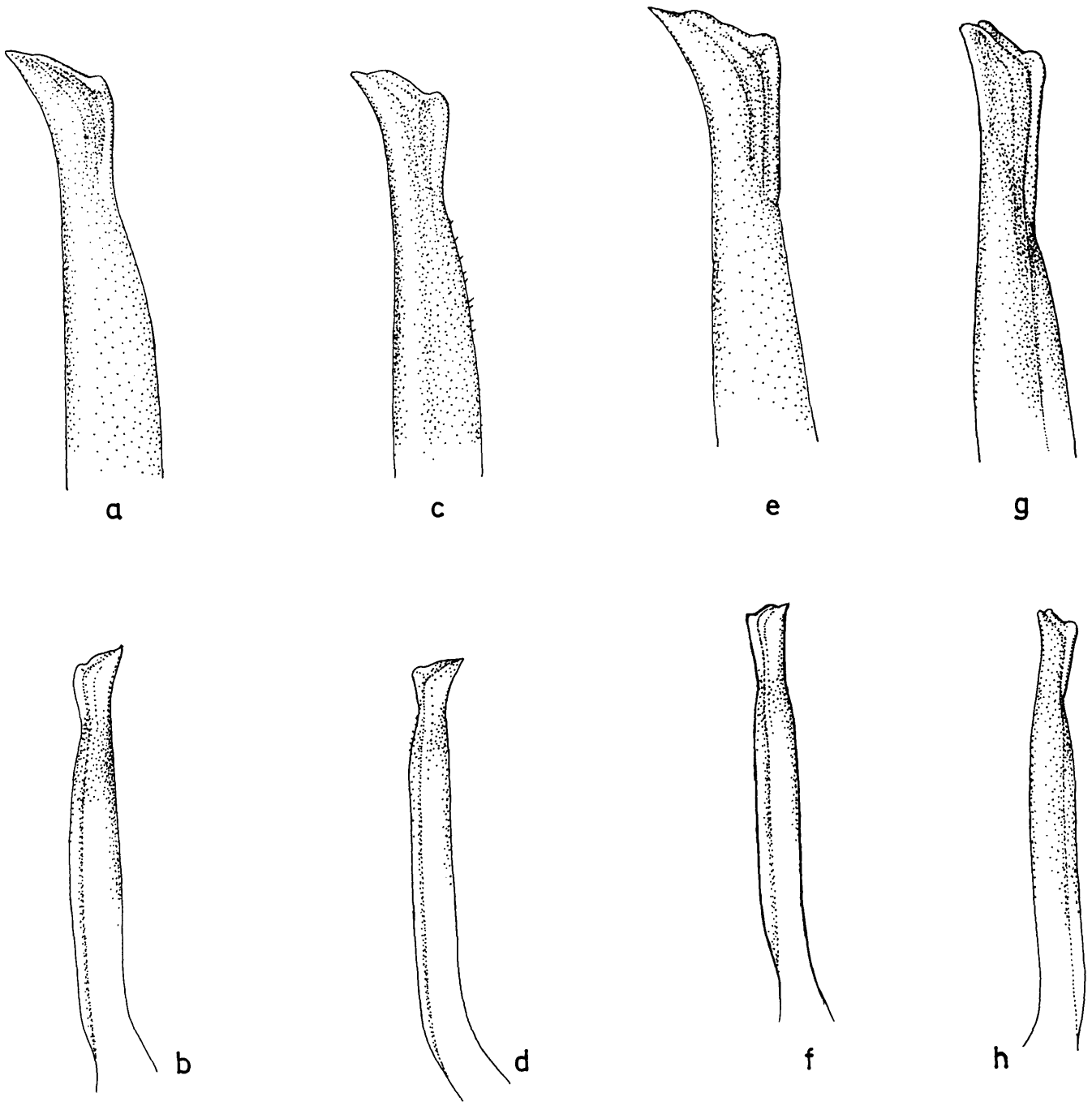


Fig. 63. First pleopod of male of *Rochinia stimpsoni* (21 mm, Kai Is., ZMC) (a) sternal tip of left pleopod, (b) abdominal view of same; *R. luzonica* (37 mm, off Manado, ZMC) (c) sternal tip of left pleopod, (d) abdominal view of same; *R. velutina* (22 mm, Kai Is., ZMC) (e) sternal view of left pleopod, (f) abdominal view of same; *R. nodosa* (20 mm, Japan, ZMC) (g) abdominal tip of right pleopod, (h) abdominal view of same.

bifid in the three other species with a single dorsal branchial islet (*R. aurorae*, *R. aurita* and *R. cuneata*) and in the three species with separate rostral spines (*R. bidens*, *R. carbuncula* and *R. luzonica*) there are at least two islets on the dorsal branchial region.

This is the first record of this species from Australian waters.

Distribution. — Sri Lanka, N. Australia, Kai Islands, Philippine Islands and Japan.

Rochinia suluensis new species
(Figs. 60, 64a,b)

Material examined. — 2 ♂♂, 1 ♀, 10.5-11.5 mm.

Holotype. — Male, cl. 11 mm, Bougainville Strait, W. of Waigeo I., 00°29.2′S 130°5.3′E, 469 m, dredge, coarse sand and broken shells, 15 August 1899; 'Siboga' Expedition, Stn. 156; Zoological Museum, Amsterdam.
Paratypes as follows:

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'Siboga' Expedition: Stn. 105, Sulu Archipelago, 06°8′N 121°19′E, 275 m, dredge, coral bottom, 4 July 1899; 1 spec. — Stn. 156, data as for holotype; 1 spec.

Description. — Carapace pyriform, carapace width about three quarters (0.7-0.75) postrostral carapace length, surface smooth with a fine tomentum.

Rostral spines slender, divergent, length about half postrostral carapace length.

Orbital eave moderately expanded, preorbital angle produced forward into a subacute spine; lateral margin of eave nearly straight; a small weak antorbital angle; postorbital lobe narrow in lateral view (length about twice basal width), laterally flattened, separated from eave by a U-shaped hiatus. Eyestalks short; cornea terminal.

Hepatic margin elevated, adjacent to base of postorbital lobe anteriorly and surmounted dorsally by a sharp spine (largest carapace spine) directed outwards and slightly upwards. Branchial margin with a minute tubercle anteriorly, just above carapace margin, and a small epibranchial tubercle.

Gastric regions elevated, smooth. Cardiac region elevated but without a tubercle or spine. Dorsal branchial regions smooth. Intestinal region with a medial, backwardly produced tubercle on posterior carapace margin.

Basal antennal article smooth, surface with a shallow, central longitudinal groove; anterolateral angle produced obliquely forward as a sharp spine; lateral margin weakly concave, proximal angle rounded; a tubercle lateral to green gland.

Pterygostomian region smooth, margin with three or four blunt, compressed tubercles; anterolateral angle of mouthfield produced and rounded.

Third maxilliped smooth, anteromedial angle of ischium slightly overlapping posteromedial angle of merus; anterolateral angle of merus produced and rounded.

Cheliped merus of male trigonal; a strong sharp, terminal spine dorsally, separate from carina; carpus with two sharp ridges, one dorsally and one ventrally on inner face; palm dorsally sharp in proximal half, length two and a half times height; fingers slender, more than half (0.6) length of palm; a small proximal gape without teeth, then gape narrowing with a few irregular teeth on both fingers.

Ambulatory legs smooth, merus of first leg with a small acute terminal spine, merus of fourth leg with a blunt terminal tubercle; dactyl of fourth leg with two very small ventral teeth distally; first leg about one and a half times (1.4) postrostral carapace length, fourth leg less than three quarters (0.7) of first.

Male sternum smooth, a shallow depression on each side in front of abdominal fossa; shallow intersegmental grooves between remaining segments.

Male abdomen of seven segments, smooth, third segment about one and a half times as wide as sixth segment; sixth segment twice as wide as long; seventh segment as wide as long.

Female abdomen of seven segments, smooth.

First pleopod of male straight, broad, narrowing only slightly before widening to a truncate apex; apex medially rounded, laterally subacute; aperture terminal.

Female gonopore a simple circular aperture opening ventrally.

Remarks. — In the male from the Sulu Archipelago the hepatic margin below the spine is not so strongly elevated as in the holotype; there is a short epibranchial spine rather than a tubercle; and on the cheliped carpus there are two compressed tubercles on the inner side of the dorsal ridge.

This species is similar to *R. moluccensis* and both are distinguished from other species of *Rochinia* (except *R. tomentosa*) by the presence of a small hepatic spine and a small epibranchial tubercle. *R. suluensis* is distinguished from *R. moluccensis* by the postorbital lobe which is laterally flat and separate from the hepatic spine while in *R. moluccensis* the postorbital lobe is laterally keeled and confluent with the hepatic spine. *R. suluensis* is distinguished from *R. tomentosa* by the presence of a conical spine on the hepatic margin, rather than a flat, glabrous islet as in *R. tomentosa*..

Distribution. — Halmahera Sea (Bougainville Strait) and Sulu Archipelago.

Rochinia tomentosa new species
(Figs. 61, 64g,h)

Material examined. — 1♂, 9 mm, 1♀, 7.5 mm.

Holotype. — Male, cl. 9 mm, Bougainville Strait, W. of Waigeo I., 00°29.2′S 130°5.3′E, 469 m, dredge, coarse sand and broken shells, 15 August 1899, 'Siboga' Expedition, Stn. 156; Zoological Museum, Amsterdam.
Paratype. Female, adult, cl. 7.5 mm, N. Makassar Strait, Pulu Kaniungan Ketjil, 11 m, shore exploration, coral, 21 June 1899, 'Siboga' Expedition, Stn. 89; Zoological Museum, Amsterdam.

Description. — Carapace pyriform, width about three quarters (0.7-0.8) postrostral carapace length; surface covered with a short dense tomentum of clubbed setae; surface beneath tomentum smooth, regions only weakly defined.

Rostral spines slender, weakly divergent, apically sharp, length about a quarter (0.28) postrostral carapace length.

Orbital eave moderately expanded; preorbital spine sharp, directed obliquely forwards; margin of eave weakly concave with a slight convexity at the antorbital level; postorbital lobe separated from eave by a U-shaped hiatus; postorbital lobe laterally flat, smooth, glabrous, Eyestalks short, slender, cornea terminal.

Hepatic margin with a smooth, glabrous 'islet' quite separate from postorbital lobe; 'islet' laterally flat or centrally depressed, ventral edge rounded, dorsal edge produced upward as a spine.

Branchial submargin with one or two small, glabrous tubercles anteriorly; no epibranchial tubercle.

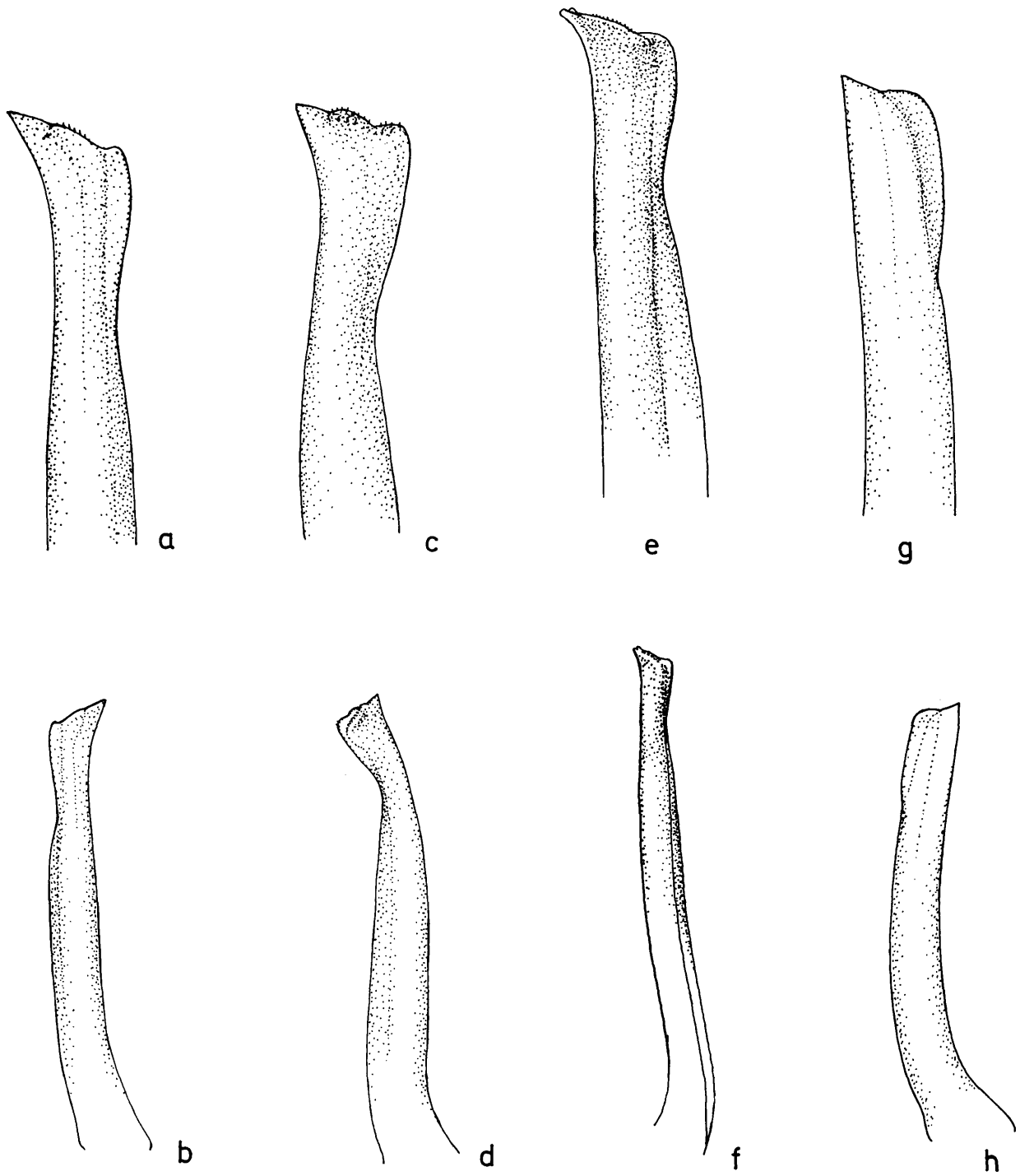


Fig. 64. First pleopod of male of *Rochinia suluensis* (holotype) (a) sternal tip of left pleopod, (b) abdominal view of same; *R. moluccensis* (paratype) (c) sternal tip of left pleopod, (d) abdominal view of same; *R. carinata* (holotype) (e) abdominal tip of right pleopod, (f) abdominal view of same; *R. tomentosa* (holotype) (g) sternal tip of left pleopod, (h) abdominal view of same.

Gastric regions elevated, smooth, only a weak cervical groove laterally. Cardiac region smooth, not elevated, weakly defined; dorsal branchial region and intestinal region smooth.

Basal antennal article smooth, a shallow longitudinal groove centrally; anterolateral angle produced forward as a short blunt (holotype) or sharp (paratype) spine; lateral margin straight, faintly crenulate, proximal angle rounded; medial margin produced slightly over antennal fossa; a blunt tubercle just lateral to green gland.

Pterygostomian region smooth, margin with three glabrous, blunt, compressed tubercles.

Third maxilliped smooth; anterolateral angle of merus only moderately produced and rounded.

Cheliped of male only slightly longer (1.2) than postrostral carapace length; merus with dorsal and ventral inner edges carinate, ventral outer edge sharp in distal third, a compressed tubercle at proximal third and at distal third; no terminal spine distinct from carina; carpus with two carinate ridges, an

outer dorsal ridge and a ventral ridge on inner face. Palm about one and a third (1.35) as long as high, dorsal margin carinate in proximal half, blunt distally, ventral margin rounded; fingers about two thirds (0.65) length of palm, a moderate gape between fingers in proximal half, two or three low teeth on both fingers in gape, and similar teeth on both fingers distally. Cheliped of adult female with merus dorsally blunt and a sharp terminal spine; inner ventral edge sharp, outer ventral edge blunt with two small tubercles.

Ambulatory legs slender, smooth, merus of first leg with a terminal tubercle surmounted by a spine; dactyl of third leg with two or three very small ventral teeth distally; first leg of male nearly one and a half (1.4) times postrostral carapace length, third leg about two thirds (0.6) length of first.

Sternum of male smooth, a shallow depression on either side of a narrow ridge in front of abdominal fossa.

Male abdomen of seven segments, smooth; third segment less than twice (1.8) as wide as sixth segment; sixth segment twice as wide as long; seventh segment as wide as long.

Female abdomen of seven segments, smooth.

First pleopod of male broad, straight, apically truncate; medial angle of anterior margin rounded, lateral angle subacute and produced slightly forward; aperture appears to be terminal.

Female gonopore a simple, circular aperture, opening ventrally.

Remarks. — This species is distinguished from all other known species of *Rochinia* by its smooth carapace with the regions only weakly defined. The gastric, cardiac and intestinal regions are smooth and there is no epibranchial spine or tubercle.

Distribution. — Halmahera Sea (Bougainville Strait), Makassar Strait.

Rochinia velutina (Miers, 1886)
(Fig. 63e,f)

Pugettia velutina Miers, 1886: 41-42, pl. 6 figs. 2, 2a,b.
Pugettia veltima (sic). — Yokoya, 1933: 153.
Rochinia velutina. — Serène & Lohavanijaya, 1973: 58-59, figs. 133-137, pl. 12 B,C.
Sphenocarcinus velutinus. — Griffin, 1976: 215.

Material examined. — 1♂, 1 ovig. ♀, 2 juv., 5.5-22.0 mm, ovig. ♀, 15.5 mm.

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Danish Kei Islands Expedition: Stn. 4, Kai Is., 05°31′40″S 132°26′E, 250 m, trawl, sand, 3 April 1922; 3 specs. — Stn. 50, Kai Is., 05°34′S 132°25′40″E, 233 m, trawl, sand, 4 May 1922; 1 spec.

Remarks. — These specimens agree closely with Miers' figure of *Pugettia velutina*. The hepatic lobe is flattened, with a dorsally directed point and there is a flattened lobe on the subbranchial region. The epibranchial spine is strong, directed outwards and covered with short hair. The dorsal protuberances are in the form of tubercles not 'islets' The first pleopod of the male is of the same type as in other species of *Rochinia.*

Distribution. — Kai Islands, Philippine Islands, South China Sea, Japan.

Scyra Dana, 1851

Type species. — *Scyra acutifrons* Dana, 1851, by monotypy.

Remarks. — This genus contains two species — one, the type, from the East Pacific (Alaska to Mexico) and the other, *S. compressipes* Stimpson from the western Pacific (Japan). In these two species the rostral spines are broad and taper to a point. There is a preorbital spine on the eave and the eave is separated from the postorbital lobe by a narrow slit. The basal antennal article is moderately broad, subrectangular and separated by a broad hiatus from the postorbital lobe. The cheliped merus of the male differs in the two species — in *S. acutifrons* the merus is subcylindrical and tuberculate while in *S. compressipes* it is prismatic with cristate margins.

The first pleopod of the male of *S. acutifrons* is scyriform and has been figured by Garth (1958) but the pleopod of *S. compressipes* hasn't been figured or described.

Distribution. — Northern Pacific.

Thusaenys new genus

Type species. — *Hyastenus calvarius* Alcock, 1895, by present designation.

Description. — Carapace pyriform, surface only sparsely tuberculate. Rostrum of two short spines generally less than one third length of carapace. Orbit comprising above an eave separated by a narrow hiatus from postorbital lobe; no intercalated spine. Supraorbital eave strongly produced, preorbital lobe a broad blunt lobe; antorbital lobe weakly produced, rounded. Postorbital lobe at least moderately produced, posterior margin lobed or keeled, anterior margin with a lobe proximally. Basal antennal article moderately broad, bearing a strong acute anterolateral spine, separated by a notch from anteromedial base bearing peduncle of antenna; lateral margin of article variously produced or lobed, lobe sometimes extending dorsally; article broadly separated from postorbital lobe. Abdomen of seven segments in male.

First pleopod of male simple, twisted distally and (except in *T. irami*) narrowing abruptly at about distal sixth, long setae on at least distal portion.

Remarks. — This genus contains five species: *T. calvarius* (Alcock), *T. irami* (Laurie), *T. minimus* (Rathbun), *T. orbis* (Rathbun) and *T. pehlevi* (Laurie), previously included in

Hyastenus. The strongly produced basal antennal article with anterior notch and the broad but weakly lobed supraorbital eave distinguish the species of this new genus from others of the '*Hyastenus*' group.

Thusaenys species are distributed through Indonesia and the Philippines extending south to northern Australia and west to Sri Lanka and the Gulf of Manaar; one species is known from Fiji in the Pacific.

The name of the new genus is derived, by rearrangement of the letters, from *Hyastenus*; the gender is masculine as is *Hyastenus*.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *THUSAENYS*

1 Anterior margin of postorbital lobe with a prominent proximal lobe; rostrum length at least 1/3 postrostral carapace length 2
— Anterior margin of postorbital lobe sinuous; rostrum length 1/4 to 1/3 postrostral carapace length 4
2(1) Margin of supraorbital eave strongly bilobed; lateral margin of basal antennal article concave or notched behind anterolateral lobe; carapace with many low tubercles ..... *T. pehlevi*
— Margin of supraorbital eave straight or weakly concave; lateral margin of basal antennal article straight or convex behind anterolateral lobe; carapace smooth or with a few low tubercles... 3
3(2) Lateral margin of basal antennal article strongly produced, convex; intestinal region with a short but strong medial spine... *T. calvarius*
— Lateral margin of basal antennal article straight or weakly convex; intestinal region with a low tubercle ..... *T. irami*
4(1) Lateral edge of basal antennal article straight behind anterolateral spine; anterolateral angle of mouthfield oblique; two compressed lobes on pterygostomian margin ..... *T. orbis*
— Lateral edge of basal antennal article concave or notched behind anterolateral spine; anterolateral angle of mouthfield rounded; two blunt conical tubercles on pterygostomian margin..... *T. minimus*

Thusaenys calvarius (Alcock, 1895), new combination (Figs. 65d, 66a,b)

Hyastenus calvarius Alcock, 1895: 213. — Alcock & Anderson, 1896: pl. 21 fig. 2. — Balss, 1938: 23.

Material examined. — 1♂, 5♀♀ (1 ovig.), 11-17.5 mm, ovig. ♀, 14 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: ?Haingsisi; 1 spec.
North coast of Sumatra, K. S. Cableship Telegraaf; 1 spec. (ZMA De. 100.802 (in part), det. Ihle as *Hyastenus* sp.).

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Danish Kei Islands Expedition: Stn. 16, Kai Is., 05°32′20″S 132°37′E, 50 m, dredge, sand with *Lithothamnion*, 12 April 1922; 1 spec. — Off Neira Banda, ca. 100-120 m, dredge, sand, stones, 5 June 1922; 1 spec. — Stn. 67, Java Sea, 05°48′S 106°12′E, 38 m, trawl, sand, 27 July 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 36-47 m, dredge hauls 7-9, coral, sponge, coarse sand, *Lithothamnion* and rubble, 1-2 June 1970; 1 spec.

Remarks. — This species is distinguished by the broad basal antennal article, the prominent lobe on the anterior margin of the postorbital lobe and the strong upright spine on the intestinal region.

The rostral spines are divergent and range from about half the postrostral carapace length to 2/3 the postrostral carapace length in an adult male (16.5 mm).

The supraorbital eave is relatively short and the preorbital angle is produced laterally and slightly upturned. The anterior border of the postorbital lobe has a very strong lobe proximally.

The gastric region is elevated. There are no mesogastric tubercles but there is sometimes a low rounded protogastric tubercle. On the branchial region there is only a very small epibranchial spine.

On the intestinal region, near the posterior margin, there is a strong upright spine curved forwards at the tip.

The basal antennal article is very broad for a species in this subfamily, its greatest width exceeding the length. The curved spine on the anterolateral angle of the article is separated by a shallow hiatus from the base of the first free segment of the flagellum; the lateral margin is produced to form a broad rounded lobe immediately posterior to the spine. The suborbital tooth is compressed laterally and the orbit is completely open below. There is a slender curved ridge extending on to the epistome from the base of the antennal fossa.

The anterolateral angle of the merus of the third maxilliped is quite strongly produced and rounded.

The palm of the chela of the adult male (16.5 mm) is twice as long as high with a tubercle at the base of the dactyl. The fingers gape moderately and there is a large tooth on the dactyl in the gape.

The dactyls of the ambulatory legs are slender and armed ventrally with small spines increasing in size distally.

The first pleopod of the male tapers abruptly at about the distal sixth and curves slightly outwards. Below this narrow tip there are long setae on the medial edge, and the most distal of these setae are as long as the narrow pleopod tip.

Distribution. — Fiji, Kai Is., Banda, Ceram, Java Sea, Andaman and Maldive Islands.

Thusaenys irami (Laurie, 1906), new combination (Fig. 66c,d)

Halimus irami Laurie, 1906: 379-380, pl. 1 figs 4, 4a.
Hyastenus irami. — Rathbun, 1924: 5.

Material examined. — 3♂♂, 4♀♀, 8-15 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 299, S. Timor, SE. of Roti I., 10°52.4′S 123°01.1′E, 34 m, dredge, reef exploration and diving, mud, coral and *Lithothamnion*, 27/29 January 1900; 1 spec. — Stn. 315, Flores Sea, Paternoster Is., anchorage E. of Sailus Besar, up to 36 m, dredge, coral and *Lithothamnion*, 17/18 February 1900; 2 specs.

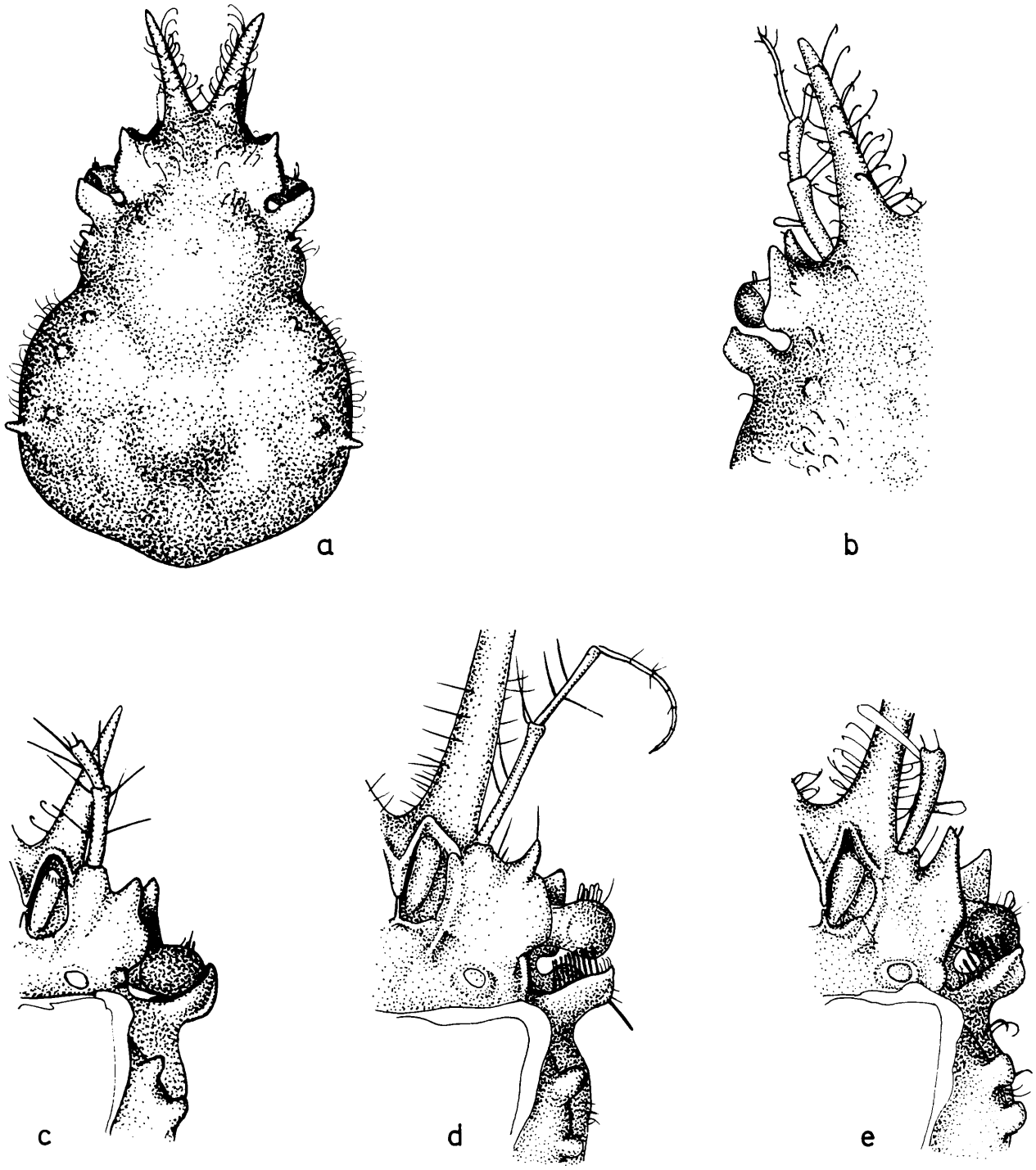


Fig. 65. *Thusaenys minimus* (female, 7.5 mm, AM P.29895) (a) carapace, dorsal view; *T. orbis* (male, 10 mm, Sulu Archipelago, ZMC) (b) left orbit, dorsal view; *T. minimus* (as above) (c) left orbit, ventral view; *T. calvarius* (male, 16.5 mm, Banda, ZMC) (d) left orbit, ventral view; *T. orbis* (as above) (e) left orbit, ventral view.

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia: north W. A., Broome, coll. B. Bardwell; 1 spec. (AM P.29899, dry, det. M. Ward). — Ninety Mile Beach, 25 m, from pearl shells, coll. B. Bardwell; 1 spec. (AM P. 29897, dry).

Queensland: Lizard I., Watsons Beach, under rocks below low tide, coll. H. Tranter, 3 May 1977; 1 spec. (AM P.29896).

Papua New Guinea: Port Moresby, 16/17 October 1932; 1 spec. (AM P.29898, dry, det. M. Ward).

Remarks. — This species is close to *T. pehlevi* and *T. orbis* in general appearance and the shape of the basal antennal article, but those two species hava a tuberculate carapace, while that of *T. irami* is smooth. Also the first pleopod of the male of *T, irami* does not taper distally as it does in the other two species.

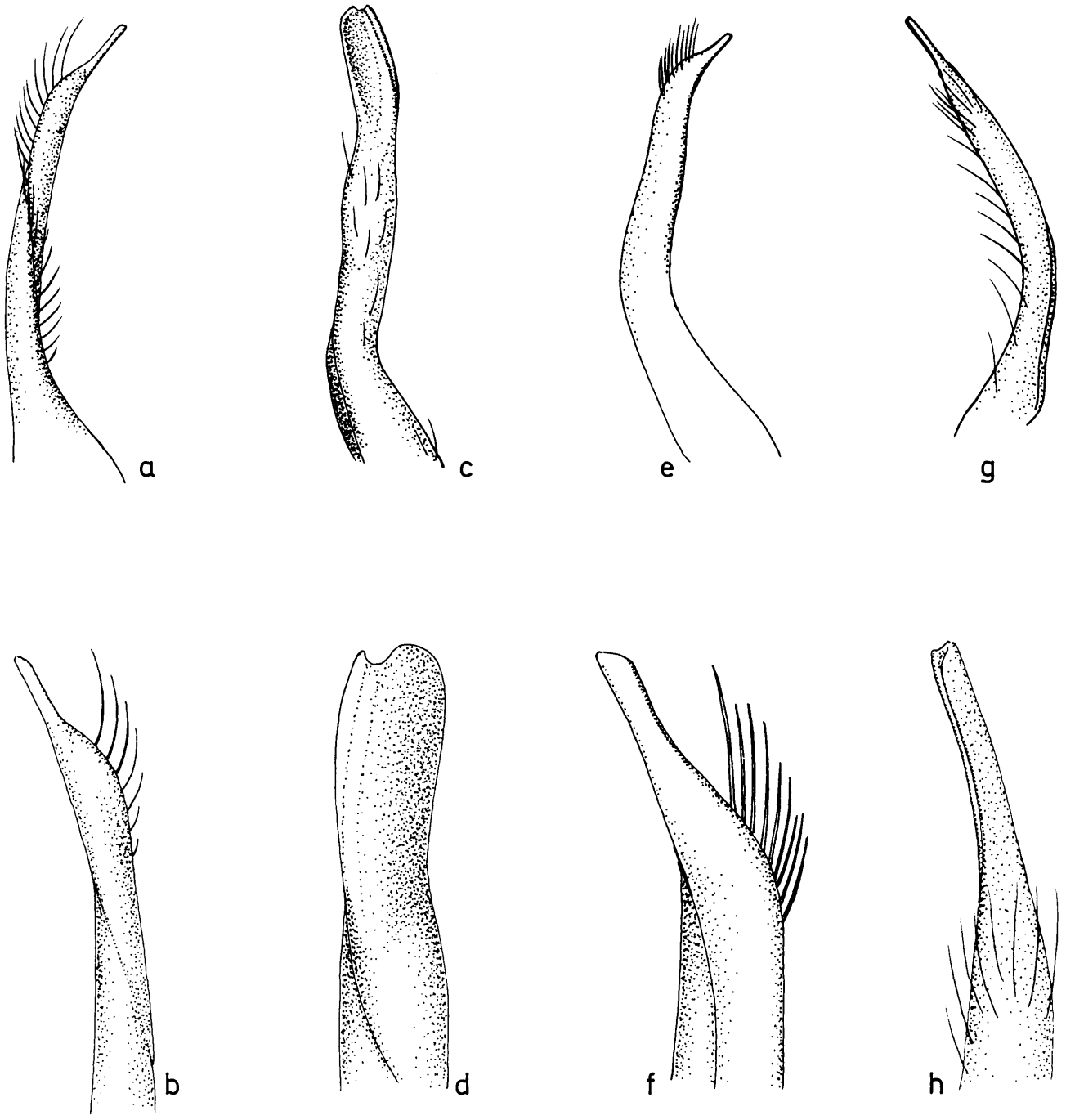


Fig. 66. First pleopod of male of *Thusaenys calvarius* (16.5 mm, Banda, ZMC) (a) abdominal view of left pleopod, (b) sternal tip of same; *T. irami* (13.5 mm, S. Timor, ZMA) (c) abdominal view of left pleopod, (d) sternal tip of same; *T. orbis* (10 mm, Sulu Archipelago, ZMC) (e) abdominal view of left pleopod, (f) sternal tip of same; *T. pehlevi* (11 mm, Sri Lanka, ZSC) (g) abdominal view of right pleopod, (h) abdominal tip of same.

The small tooth or lobe, on the posterior margin of the upper orbit hiatus, seems to be, as Rathbun indicated, a part of the postorbital lobe, and not an intercalated spine as Laurie suggested. In the small immature female (8.0 mm) the antorbital lobe is barely produced, and this small tooth is more separate from the postorbital lobe than it is in the larger specimens.

There is a very small epibranchial spine which may be concealed in the tomentum and a low tubercle on the intestinal region.

The basal antennal article is very broad, and the anterolateral angle is produced into a strong, straight spine; the lateral margin is convex (as figured by Laurie, pl. 1 fig. 4a) in three specimens, but much straighter in the other four.

The palm of the cheliped of the largest male has a tubercle midway along its dorsal margin, the fixed finger is slightly excavate and there is a large proximal tooth on the dactyl.

The first pleopod of the male expands slightly at the rounded tip, and the groove lies near the lateral margin on the abdominal surface.

Distribution. — Northeast and northwest Australia, Papua New Guinea, Timor, Sumbawa, Sri Lanka (Ceylon).

Thusaenys minimus (Rathbun, 1924), new combination (Fig. 65a,c)

Hyastenus minimus Rathbun, 1924: 4-5, fig. 1. — Griffin, 1966b: 281 (in key).

Material examined. — 2♀♀, 7.0, 7.5 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia: Ninety Mile Beach, 25 m, from pearl shells, coll. B. Bardwell; 2 specs. (AM P. 29895, dry).

Remarks. — These specimens agree well with the description given by Rathbun and with type material (USNM 56391, ♂, 4.4 mm; USNM 56392, ovig. ♀ 7.0 mm; Cape Jaubert, W. A.) examined by one of us (D.J.G.G.).

This species is similar in general appearance to *T. orbis* (Rathbun) but is distinguished from that species by the lateral edge of the basal antennal article which is concave behind the anterolateral spine (straight in *T. orbis*); the anterolateral angle of the mouthfield is rounded (oblique in *T. orbis*); the tubercles on the pterygostomian margin are cylindrical and blunt (compressed lobes in *T. orbis*); and the mesogastric region is smooth except for one low anterior tubercle (three mesogastric tubercles in *T. orbis*).

Distribution. — Known only from northern Western Australia.

Thusaenys orbis (Rathbun, 1916), new combination (Figs. 65b,e, 66e,f)

Hyastenus orbis Rathbun, 1916: 544-545. — Griffin, 1976: 192-194, fig. 4(a).

Material examined. — 3♂♂, 4♀♀, 6-10 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 109, Sulu Archipelago, anchorage off Pulu Tongkil (06°02′N 121°51′E), 13 m, dredge, townet, *Lithothamnion*, 5/6 July 1899; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, ca. 36 m, dredge, *Lithothamnion*, 17 March 1914; 2 specs. — Sulu Archipelago, off Jolo, off Marungas, 36-54 m, dredge, sand, coral, 19 March 1914; 3 specs.

Remarks. — These specimens agree well with the holotype (USNM 48216, ovig. ♀, 10.2 mm). The preorbital angle of the supraorbital eave is acute and produced forward and upward. On the gastric regions, the three mesogastric and transverse row of four protogastric tubercles are distinct, but the pair of tubercles at the base of the rostrum are less developed in some of the specimens. The cardiac region is elevated and conical but unarmed. On the branchial margin there is an arc of three tubercles and a short epibranchial spine.

The basal antennal article is broad, there is a broad acute spine directed forward on the anterolateral angle, and the lateral edge is weakly convex.

There are two flat spines on the pterygostomian margin and a similar spine in line with them on the anterior branchial submargin.

This is the first record of a male of this species. The palm of the chela is somewhat inflated, about twice as long as high, and there is a distal tubercle near the insertion of the dactyl. There is a small proximal gape between the fingers.

The first pleopod of the male is narrowed distally, the tip being about half as wide as the rest of the pleopod. At the base of the tip on the medial edge, there are long setae which reach or exceed the apex.

Distribution. — Known only from the Sulu Archipelago, Philippine Islands.

Thusaenys pehlevi (Laurie, 1906), new combination (Fig. 66g,h)

Halimus pehlevi Laurie, 1906: 378-379, pl. 1 figs. 3, 3a.

Material examined. — 1♂, 11 mm.

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA

Sri Lanka, Pearl Banks, coll. T. Southwell, 1911; 1 spec.

Remarks. — This species is distinguished by the supraorbital eave, which is divided into two lobes, and by the deep notch on the anterior border of the postorbital lobe. The eave is also divided in *Giranauria verrucosipes*, but in that species there is an intestinal spine, a large cardiac spine and two strong spines on the branchial region. In *T. pehlevi* there are only low tubercles on the carapace. This species resembles *T. calvarius* in the shape of the postorbital lobe, but in that species the supraorbital eave is only lightly notched and the carapace is smooth.

Our single specimen agrees well with that described and figured by Laurie. The basal antennal article is slightly wider than shown in Laurie's figure, but the lateral margin is the same shape. The compressed suborbital tooth lies close to the base of the basal antennal article.

The first pleopod of the male narrows slightly in the distal quarter and the apex is rounded. In *T. calvarius* and *T. orbis* the pleopod also narrows distally, but in those species there is a group of long setae on the medial edge at the base of the tip which is lightly curved outwards.

Distribution. — Sri Lanka (Pearl Banks) and Gulf of Manaar.

Tylocarcinus Miers, 1879

Type species. — *Cancer styx* Herbst, 1803, by original designation.

Remarks. — The upper orbit in species of this genus comprises an adjacent supraorbital eave, intercalated spine and postorbital lobe. The proximal part of the basal antennal article is adjacent to the postorbital lobe. The first pleopod of males of species of *Tylocarcinus* is straight with a large triangular lobe on the medial edge at the apex.

T. gracilis Miers is here shown to be a synonym of *Chorinus dumerilii* H. Milne Edwards. In 1978 Dai et al. described *T. sinensis* which we know only from the literature.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *TYLOCARCINUS*

1 Merus of first ambulatory leg of adult male with four to five small tubercles dorsally behind the terminal spine and two tubercles proximally on outer face; merus of fourth ambulatory leg smooth ..... *T. sinensis*[28a])

— Merus of first ambulatory leg of adult male with three or more dorsal spines as well as the terminal spine and two to four tubercles along the length of outer face; merus of fourth ambulatory leg with two tubercles on outer face 2

2(1) Rostral spines fused basally, then separated by a V-shaped hiatus, length from anterior margin of antennal fossa to apex of the hiatus at least as long as $^3/_4$ basal width of rostrum; basal part of rostrum with a well developed medial groove ventrally ..... *T. styx*

— Rostral spines separated from the base by a U-shaped hiatus, length from anterior margin of antennal fossa to apex of the hiatus less than $^1/_2$ the basal width of the rostrum; basal part of rostrum ventrally flat, lacking a medial groove ..... *T. dumerilii*

Tylocarcinus dumerilii (H. Milne Edwards, 1834) new combination

(Fig. 67a,b)

Chorinus dumerilii H. Milne Edwards, 1834: 316.
Tylocarcinus gracilis Miers, 1879a: 15. — Nobili, 1907: 382. — Calman, 1909; 712-713. — Balss, 1938: 22; new synonymy.
?*Hyastenus macrospinosus* Ward, 1934: 6-7, pl. 1 fig. 4, 4a. (Not *Hyastenus macrospinosus*. — Buitendijk, 1939: 242-244.)

Material examined. — 3 ♂♂, 3 ♀♀(1 ovig.), 7.5-15.5 mm, ovig. ♀, 13 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Dana' Expedition: Stn. 3742, N. Sulawesi (Kepulaun Sangi), Biaro, 02°08.6'N 125°21.7'E, 11 m, 6 July 1929; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Coral Sea, Herald Group, North East Cay: coral rock washings, coll. D. F. McMichael and J. C. Yaldwyn, 6 November 1964; 1 spec. (AM P. 17002). — Coral rock washings, coll. D. F. McMichael and J. C. Yaldwyn, 9 November 1964; 1 spec. (AM P. 17003). — From coral heads taken on outer reef at low tide, coll. D. F. McMichael and J. C. Yaldwyn, December 1964; 1 spec. (AM P. 17227).

Cook Islands, Raratonga, coll. M. Ward; 1 spec. (AM P. 29922, dry). — New Britain, Reef at Kokopo, near Rabaul, coll. M. Ward; 1 spec. (AM P. 29921, dry).

Remarks. — As well as *T. gracilis* described by Miers (1879a: 15), two animals apparently very closely related to it have been described by other authors. These are *Chorinus dumerilii* H. Milne Edwards (1834: 316) and *Hyastenus macrospinosus* Ward (1934: 6-7, pl. 1 fig. 4, 4a). All are distinguished from *T. styx* by a less distinctly tuberculate carapace and rostral spines divergent from the base. One of us (D.J.G.G.) has examined the syntypes of *T. gracilis* (2 ♂♂, 4 ♀♀, 10.6-16.3 mm, 'Eastern Seas', BMNH 62.35) and the holotype of *Chorinus dumerilii* (♀, adult, 14.3 mm, Vanikora, Santa Cruz, Paris Museum). However, we have been unable to locate in the Ward collection the specimen of *Hyastenus macrospinosus* referred to by Ward as "One female measuring 10 mm retained in the Ward collection, Sydney."

Our series of specimens agree in many features with the type material of *Chorinus dumerilii* and *Tylocarcinus gracilis* and with *Hyastenus macrospinosus* as described and figured by Ward.

The rostral spines in our specimens are about half (0.45-0.6) postrostral carapace length; they are slender, divergent from the base and separated by a U-shaped hiatus; the distance from the apex of the hiatus to the anterior margin of the antennal fossa is less than half the basal width of the rostrum; there is no medial, ventral groove. In *T. styx* the rostral spines are fused basally and separated by a V-shaped hiatus; the distance from the apex of the hiatus to the anterior margin of the antennal fossa ranges between three quarters and the full basal width of the rostrum; there is a well developed medial, ventral groove.

The intercalated spine is more distinct in this series than in *T. styx*; it is more strongly convex distally (nearly straight in *T. styx*); and separated from the postorbital lobe by a narrow slit, at least in the distal half (contiguous throughout its length in *T. styx*). Ward describes his specimens as having the intercalated spine fused with the postorbital lobe, but it seems possible, from the figure, that there may be a small distal slit. The specimen recorded by Buitendijk (1939: 242-244) as *H. macrospinosus* has no intercalated spine and so cannot be synonymous with our material.

Within this series the number of distinct protogastric tubercles varies but in all except the two smallest specimens (7.5, 11.0 mm) there is an anterior, medial, mesogastric tubercle. This tubercle is present also in the type material of *Chorinus dumerilii* and *T. gracilis* but not in the holotype of *Hyastenus macrospinosus* (10 mm) as figured by Ward. There is no anterior medial mesogastric tubercle in *T. styx*.

Ward has described his specimens as having some "short, stiff, black bristles, the tips of which are slightly curved", and on three of our specimens (♂, 12 mm, N. Sulawesi; ovig. ♀, 13 mm, Coral Sea; ad. ♀, 15.5 mm, Rabaul) there are bristles like this in a distinct area on the branchial margin.

On the cheliped merus of our largest male (15.5 mm) there are two long suberect spines — a subterminal and a terminal spine; on the carpus there are about six short spines. In *T. styx* there is a short terminal but no subterminal spine on the merus and only a few low tubercles on the carpus. In our four largest specimens (12-15.5 mm) of *T. dumerilii* there are

[28a]) from the literature (Dai et al., 1978).

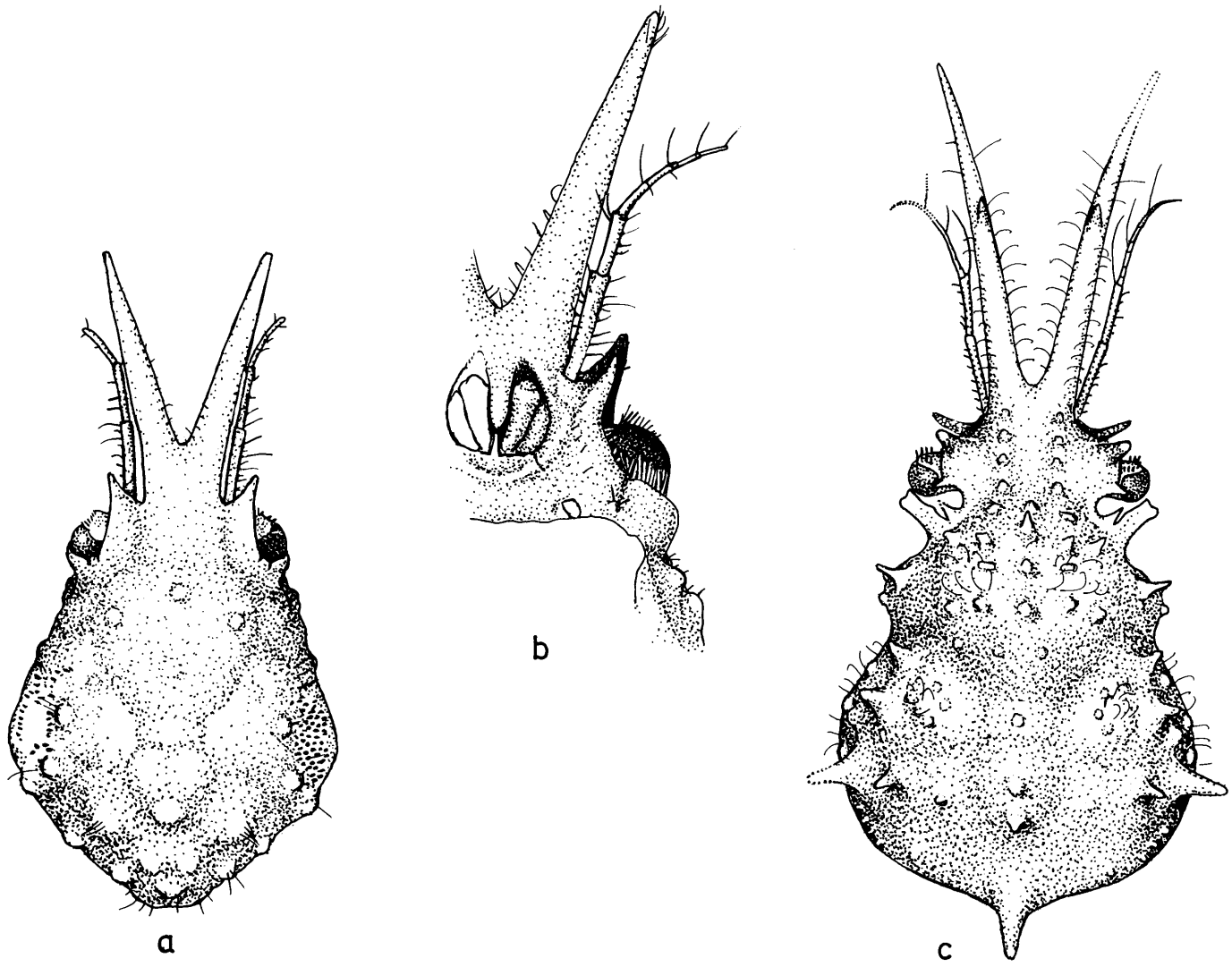


Fig. 67. *Tylocarcinus dumerilii* (male, 12 mm, N. Sulawesi, ZMC) (a) carapace, dorsal view, (b) left orbit, ventral view; *Naxioides carnarvon* (holotype, female, imm.) (c) carapace, dorsal view.

one to three small, proximal tubercles dorsally on the palm, as in the type material of *T. gracilis*. In our largest male the palm is about twice as long as high, there is a moderate gape between the fingers with one large and one small tooth on the dactyl in the gape and a few small teeth on the fixed finger, this specimen is probably subadult.

On the first ambulatory leg, in our specimens, there are four spines on the carpus — two on the anterior edge, one dorsally and one midway on the posterior edge; there are one to three proximal spines on the anterior edge of the propod and sometimes one or two small dorsal spines. In *T. styx* there is only one spine anteriorly on the carpus of the first leg and no spines on the propod. (The carpus of *H. macrospinosus*, as described and figured by Ward, has only one spine and there are no spines described or shown for the propod.)

The first movable segment of the second antenna is more slender in our specimens (l = 5 to 7.5 × w) than that in *T. styx* (l = 2.5 to 3.5 × w).

The specimens from Christmas I. described by Calman (1909) as *T. gracilis* seem quite clearly to be conspecific with our series. However, while it is probable that *H. macrospinosus* from Christmas I. is also conspecific, we cannot be completely certain from the description and figures given by Ward.

The first pleopod of the males agrees with that of the syntypes of *T. gracilis*, and is similar to that of *T. styx*.

Distribution. — Pacific Ocean: Paumotu Is., Cook Is., Tuvalu, Kiribati, Santa Cruz Is., Herald Group (Coral Sea), New Britain, Biaro (N. Sulawesi). Indian Ocean: Christmas I.

Tylocarcinus styx (Herbst, 1803)

Cancer Styx Herbst, 1803: 53-54, pl. 58 fig. 6.
Microphrys styx. — Paul' son, 1875: 11-12, pl. 1 fig. 1a-f.
Tylocarcinus styx. — Sakai, 1938: 271-272, pl. 36 fig. 5; 1976: 221, pl. 76 fig. 2. — Guinot, 1962b: 242, fig. 17a,b. — Griffin & Tranter, 1974: 186.

Material examined. — 14 ♂♂, 19 ♀♀, (14 ovig.), 6.5-23.5 mm, smallest ovig. ♀, 15.0 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 79b, Makassar Strait, Borneo - bank, Pulu Kabala-dua, 22 m, shore exploration, coral sand, 12/13 June 1899; 7 specs. (ZMA De. 100.789, det. Ihle). — Stn. 91, E. coast of Borneo, Moearas reef, inner side, up to 54 m, trawl and dredge, hard coral sand and coral, 22 June 1899; 4 specs. (ZMA De. 100.697, det. Ihle). — Stn. 220, Banda Sea, W. coast Binongko I., anchorage off Pasir Pandjang, to 278 m, townet, reef exploration, dredge, coral sand, 1/3 November 1899; 1 spec. (ZMA De. 100.813, det. Ihle).

Solomon Islands, Florida Group, Nggela, coll. M. J. A. de Koster, 1967; 3 specs.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Netherlands New Guinea Expedition: Irian Jaya, Biak, W. of Sorido, reef by naval barracks, February 1955; 1 spec. — Stn. 683A, Irian Jaya, Biak, W. of Sorido, reef in front of naval barracks, among *Pocillopora* spec., 22/23 March 1955; 1 spec. — Irian Jaya, Biak I., W. of Sorido village, naval barracks, on coral reef off the shore, coll. L. D. Brongersma and W. J. Roosdorp, 28 April 1952; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Dana' Expedition: Stn. 3594, Fiji, Suva, triangle dredge 19 November 1928; 1 spec.

Mortensen Java - S.Africa Expedition: Mauritius, Flat I., 17 October 1929; 7 specs.

Fiji Islands: Viti Levu, 14 May 1934; 1 spec. — Suva Harbour, 18°9′S 178°24′E, reef flat at low tide, living corals, coll. T. Wolff, 17 May 1965; 1 spec.

MUSÉUM NATIONAL D'HISTOIRE NATURELLE, PARIS

'Calypso' Red Sea Expedition: Orfèvre Sud Abulat, corals, 1952; 4 specs. (provisionally det. D. Guinot).

Remarks. — This species has been adequately described by several authors; the differences which distinguish it from *T. dumerilii* (H. Milne Edwards) are discussed under that species.

In this species the rostral spines are fused for about the basal half but this can vary from 0.4 to 0.6. The distance between the tips of the rostral spines can vary from slightly less than the basal width to one and a third times the basal width. None of the specimens in this series has the meri of the ambulatory legs as weakly tuberculate as those figured by Dai et. al. (1978) for *T. sinensis*. On the merus of the first ambulatory leg there are at least three spines behind the terminal spine and there are usually more than two tubercles on the outer face of the merus. The merus of the fourth ambulatory leg is smooth only in some small specimens.

In the collections at the Australian Museum there is a specimen of *T. styx* (♀, imm., cl. 11.5 mm, Port Moresby, AM P.32089, in part) with a double rostrum, i.e. four rostral spines fused basally. The two pairs of spines diverge at an angle of about 60° and each pair, as in a normal specimen, is fused in the basal half. As a result of this deformity the specimen has no interantennular partition and on the anterior margin of the orbit the basal antennal article is incompletely fused to the front.

Distribution. — Indo-West Pacific: Red Sea and Mauritius to Fiji and Japan.

SUBFAMILY MAJINAE

Maiinae Alcock, 1895: 161, 166, 236 (in part: the Maioida).
Majinae, sensu restr., Balss, 1929: 16, 20. — Garth, 1958: 340-341. — Griffin, 1966b: 261, 264.

Orbit formed (1) by a supraocular hood, the posteroexternal angle of which is often produced as a spine, (2) by a sharp postocular tooth, and (3) by a spine intercalated between the two. Basal antennal (article) broad, but not specially produced to form a floor to the orbit; usually armed at both its anterior angles with a strong spine. (Alcock, as quoted by Garth.)

Pleopod 1 slender, weakly curved, aperture usually subterminal and usually protected by lobes or flaps, apex usually slender and simple.

Of the changes proposed in this report to the classification of the family the most drastic are wrought upon the Majinae. The subfamily is now regarded as comprising species without an intercalated spine as well as with one, species are accommodated which have a broad, well developed orbit and cupped postorbital lobe as well as ones with only moderately developed orbit and spine-like postorbital lobe.

However these genera have in common, in the male, an abdomen which is nearly uniform in width rather than triangular, the third segment only slightly wider than the sixth and the last segment broad. In most genera the basal antennal article possesses both anteromedial and anterolateral spines or lobes. Also the first pleopod of the male has prominent lobes or flaps adjacent to the aperture. These lobes may be longitudinal, strongly projecting or folded and may be accompanied by tubercles, long setae or a spine.

The subfamily is greatly enlarged to accommodate genera from the Inachinae (*Anacinetops*, *Microhalimus* and *Naxia*), Tychinae (*Pseudomicippe*, including *Zewa* species), Pisinae (*Eurynome*-which is subdivided- and *Choniognathus*) and the Mithracinae (*Jaquinotia*, *Entomonyx*, *Tumulosternum* — which is enlarged — and *Pippacirama* — a new genus including '*Paramicippa*' *tuberculosa*). *Chlorinoides* is reduced to synonymy with *Naxioides* of the Pisinae. The species it contained, which until the 1960's were in the genus *Acanthophrys*, are now placed in a new genus *Thacanophrys*. A new genus *Seiitaoides*, is proposed for some species previously placed in *Eurynome*, *Teratomaia* is proposed for *Leptomithrax richardsoni* and *Ageitomaia* for the east Pacific *Paramithrax baeckstroemi* formerly included in *Notomithrax*, a genus now regarded as confined to the southwest Pacific. A new genus *Kimbla*, is proposed for a new species *K. neocaledonica*, from near New Caledonia.

The great diversity of this subfamily in the Indo-west Pacific is shown by the presence of more than 20 genera and 70 species in contrast to the presence of two monotypic genera (*Maiopsis*, *Ageitomaia*) in the east Pacific, one genus (*Temnonotus*) in the west Atlantic and two genera (*Maja*, *Eurynome*) each with only a few, similar, species in the east Atlantic.

KEY TO INDO-WEST PACIFIC GENERA OF MAJINAE

1 Eyestalks long, dorsally flattened with a lobe on both anterior and posterior margins in distal half; supraorbital eave only weakly expanded, barely covering bulbous base of eyestalk and curved over it; carapace surface covered with numerous blunt compound tubercles; second movable segment of antennal peduncle at right angles to first segment and directed laterally ..... *Pippacirama*

— Eyestalks of variable length but not dorsally flattened or lobed; supraorbital eave longer than basal width of eyestalk and not closely curved over it; carapace surface smooth or with spines, simple or boletate tubercles or tubercles fused to form flat plates; second movable segment of antennal peduncle in the same line as first segment and usually directed forward 2

2(1) Eyestalks long, more than two thirds of length exposed in dorsal view 3

— Eyestalks short or at least not more than half length exposed in dorsal view 4

3(2) Postorbital lobe narrow, apex often subacute, intercalated spine absent; carapace with at least a few dorsal tubercles ..... *Pseudomicippe*

— Postorbital lobe and intercalated spine subequal, both broad and blunt; carapace without dorsal tubercles ..... *Anacinetops*

4(2) Flagellum of antenna arising from within orbit..... 5

— Flagellum of antenna excluded from orbit by a process of the basal antennal article..... 9

5(4) Intercalated spine short (nearly obsolete) or closely approximated to eave and postorbital lobe; branchial margin with blunt or boletate tubercles or large plates but without acuminate spines ... 6

— Intercalated spine well developed, well separated from eave and postorbital lobe; branchial margin usually with spines..... 8

6(5) Tubercles of carapace fused into about ten to twelve large tuberculated or spinulated plates, small tubercles over surface; lateral margin of supraorbital eave spinulous..... *Seiitaoides*

— Tubercles of carapace numerous and distinct, very few fused to form larger plates; lateral margin of supraorbital eave smooth or with a few tubercles..... 7

7(6) Carapace tubercles boletate with crenulate edges, sometimes fused into plates; hepatic margin with a flat triangular plate or with a large scutellate or boletate tubercle; first pleopod of male with one or two recurved lobes near distal end and long setae ..... *Eurynome*

— Carapace tubercles blunt, flat, or if boletate with edges entire, never fused into plates; hepatic margin with a broad blunt tuberculate lobe or one to two sharp processes; first pleopod of male without recurved lobes or long setae, aperture simple and subterminal ..... *Choniognathus*

8(5) Rostral spines without any accessory spines; carpus and propod of male cheliped smooth; supraorbital eave smooth in front of antorbital spine..... *Maja*

— Rostral spines with one to three small accessory spines on lateral margin; carpus and propod of male cheliped spinulous; supraorbital eave spinulous in front of antorbital spine ..... *Majella*[29])

9(4) Orbit open ventrally, basal antennal article widely separated from postorbital lobe 10

— Orbit closed ventrally, basal antennal article in broad contact with postorbital lobe 22

10(9) Postorbital lobe a conical to acuminate spine, not 'cupped', cornea of retracted eye not protected on either dorsal or ventral surfaces 11

— Postorbital lobe excavate or 'cupped' anteriorly, the cornea of retracted eye protected on dorsal and ventral surfaces or sometimes only on dorsal surface..... 15

11(10) Gastric, cardiac and intestinal regions of carapace smooth; basal antennal article narrowing slightly distally and notched before anterolateral angle which is produced as a short, rounded crenulate tooth..... *Paramithrax*

— Gastric, cardiac and intestinal region of carapace with tubercles and/or short spines; lateral angle of basal antennal article unnotched, anterolateral angle produced as a sharp spine 12

12(11) Preorbital angle of eave with a well developed spine, apically sharp; male cheliped merus with a dorsal crest of about six flat spines and outer ventral margin with five spines; first pleopod of male with aperture protected by a distally directed flap..... *Ageitomaia*[29])[30])

— Preorbital angle of eave without a spine or sometimes with a blunt spine; male cheliped merus with dorsal ridge entire or with two to five spines on dorsal margin and outer ventral margin entire or with tubercles only; first pleopod of male with margins of aperture expanded as lobes 13

13(12) Basal antennal article narrow with one anterior spine; movable segments of antennal peduncle slender, first segment longer than wide (fig. 74) 14

— Basal antennal article broad with two anterior spines; movable segments of antennal peduncle stout, first segment about as wide as long ..... *Notomithrax*

14(13) Propodi of ambulatory legs weakly or strongly expanded ventrally near distal margin; dorsal surface of carapace with at least one mesogastric tubercle, surface bare or with a few small hairs between groups of strong curled hairs; orbit with an intercalated spine present (almost fused to eave in *N. tumida*, fig. 74g)..... *Naxia*

— Propodi of ambulatory legs cylindrical, not expanded ventrally; dorsal surface of carapace without a mesogastric tubercle, surface covered by a tomentum as well as a few groups of strong curled hairs; orbit lacking an intercalated spine..... *Microhalimus*

15(10) Preorbital angle of eave smooth, rounded, not produced as a spine or tubercle 16

— Preorbital angle of eave prominently produced as a spine or a tubercle 19

16(15) Rostral spines with one or two lateral accessory spines .. *Schizophrys*

— Rostral spines without a lateral accessory spine..... 17

17(16) Carapace densely spinose or tuberculate dorsally; large species (usually longer than 40 mm, sometimes up to 110 mm) ..... *Leptomithrax*

— Carapace with a few blunt tubercles but no spines dorsally; small species (usually less than 30 mm in length) 18

18(17) Basal antennal article narrow with two slender anterior spines; intercalated spine larger than antorbital spine, not excluded from margin of orbit; carapace hardly broadened posteriorly ..... *Schizophroida*

— Basal antennal article moderately broad with two short, blunt, anterior spines; intercalated spine much smaller than antorbital spine or else obsolete, or excluded from margin of orbit; carapace broadened posteriorly ..... *Tumulosternum*

19(15) Preorbital angle of eave armed with a blunt tubercle; carapace suborbicular; rostrum exceedingly short, an eighth to a twentieth postrostral carapace length; postorbital lobe with a prominent accessory spine on upper anterior edge near base..... *Cyclax*

— Preorbital angle of eave armed with a spine; carapace narrowly pyriform to pyriform; rostrum of at least moderate length; postorbital lobe sometimes with lobes or tubercles on posterior edge but not on anterior edge..... 20

20(19) Hepatic and branchial margins with tubercles but no spines or lobes; carapace surface with many small, rounded tubercles but no spines..... *Kimbla*

— Hepatic and branchial margins with spines or lobes; carapace with spines at least in the midline..... 21

21(20) Rostral spines no more than a fifth postrostral carapace length; branchial margin with four to six smooth acuminate spines (the last subdorsal), never with lamellate lobes; male chela long and slender (palm about four times as long as high); cheliped merus and carpus with spinous tubercles on all surfaces ..... *Teratomaia*

— Rostral spines usually longer than a third postrostral carapace length; branchial margin with one to three acuminate or knobbed spines (the last subdorsal), sometimes a lamellate lobe anteriorly; male chela short and stout (palm about one and a half times as long as high); cheliped merus and carpus usually with longitudinal ridges or crests..... *Thacanophrys*

22(9) Supraorbital eave strongly expanded to form a tubular orbit; branchial margin with at least two long spines; rostral spines narrow, separate, a fifth to a quarter postrostral carapace length . *Entomonyx*

— Supraorbital eave only moderately expanded; branchial margin with tubercles only; rostral lobes very short (a twelfth postrostral carapace length), broad, fused for almost their entire length ..... *Jaquinotia*

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[29]) from the literature (see genus accounts)

[30]) separate genus containing *A. baeckstroemi* (Balss) and restricted to SE. Pacific.

Ageitomaia new genus

Type species. — *Paramithrax baeckstroemi* Balss, 1924, by monotypy.

We have not been able to examine this species. The generic description is based on the literature (Rathbun, 1925; Garth, 1958).

Description. — Carapace pyriform, surface granulate, margin and midline with a few spines. Rostrum of two divergent spines separate from their base. Orbit comprising a broad supraorbital eave with a preorbital and antorbital spine; an intercalated spine, and a long postorbital spine remote from orbit; eave, intercalated spine and postorbital spine separated by wide, deep fissures. Eyestalks slender, rather long. Basal antennal article broad, subrectangular, of even width throughout, lateral edge not notched, anterolateral and anteromedial angles each produced into a well developed spine, flagellum excluded from orbit by a narrow process of article. Merus of third maxillipeds subquadrate, with inner distal angle deeply notched. Merus and carpus of chelipeds ornamented with flat lobes or teeth, on carpus forming two crests. First pleopod of male curved outwards distally and tapering, tip pointed, aperture subterminal, lateral, covered by a broad lateral flap.

Remarks. — This species from Chile has been included in the genus *Notomithrax* until now, but it differs from other species of *Notomithrax* in having a preorbital spine and the first pleopod of the male (Garth, 1958: pl. U fig. 2) shows significant similarities with the pleopods of some species of *Thacanophrys* and differs from those of *Notomithrax* species.

There are similarities between *A. baeckstroemi* and *Teratomaia richardsoni* (Dell) in the slender rostral spines, the preorbital spine, the basal antennal article with a strong anterolateral spine, the male abdomen and pleopod. However, there are marked differences in carapace spination and in shape and ornamentation of the cheliped. Both species appear to have very restricted distributions and to consider them congeneric would imply a zoogeographic relationship which cannot be justified at present.

The new name is derived from *ageiton* (Gk.), alone, separated, and *maia* (Gk.) a crab, in reference to the great geographic separation of *A. baeckstroemi* from similar majines.

Distribution. — East Pacific, Juan Fernandez Islands.

Anacinetops Miers, 1879

Type species. — *Anacinetops stimpsoni* Miers, 1879, by monotypy.

Remarks. — The one contained species has previously been placed in the Inachinae because of the long unprotected eyestalks and its similarity to *Camposcia*. However, *A. stimpsoni* shows more similarity to *Paramithrax barbicornis* than to *Camposcia* in the form of the rostrum, upper orbit, third maxilliped and male abdomen. The distal margin of the basal antennal article is fused to the carapace. The intercalated spine is the same shape as the postorbital spine and only slightly smaller.

The first pleopod of the male, figured here, while being of a general majine type does not resemble that of any other genus in the subfamily.

Distribution. — Australia, Timor, Kai Islands.

Anacinetops stimpsoni Miers, 1879
(Fig. 68a,b)

Anacinetops stimpsoni Miers, 1879a: 3. — Ortmann, 1894: 38, pl. 3 figs. 2, 2a. — Buitendijk, 1939: 232. — Griffin, 1972: 70.
Paramicippa hispida Baker, 1905: 126-127, pl. 24 figs. 6, 6a.
Eruma hispidum. — McCulloch, 1913: 336-337, figs. 47, 48.

Material examined. — 5 ♂♂, 6 ♀♀ (2 ovig.) 17-25.5 mm, smaller ovig ♀ 22.5 mm.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. KR VI, Kai Is., N. of Du Rowa I., N. of Nuhu Rowa, 05°32′S 132°41′E, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Torres Strait, Albany Passage, 16-22 m, dredge, coll. M. Ward, September 1926; 1 spec. (AM P.29814, dry). — N. Western Australia, Broome, coll. B. E. Bardwell; 9 specs. (AM P.29815, dry).

Remarks. — On the basal antennal article of our specimens the anterolateral angle is produced laterally and on the anteromedial angle there is a ventrally directed tubercle. The first pleopod of the male of *A. stimpsoni* has not previously been described or figured. The pleopod is apically subacute and curved strongly outward from just behind the aperture; there is a broad abdominal lobe which arches over the aperture and a low ridge sternal to the aperture.

Distribution. — Timor, Kai Is., NW., N., NE., and S. Australia.

Choniognathus Rathbun, 1932

Type species. — *Eurynome reini* Balss, 1924, by monotypy.

Description. — Carapace pyriform to subovate, constricted behind hepatic regions; surface with many small tubercles. Rostrum of two spines separated by a wide U-shaped hiatus. Supraorbital margin without a preorbital spine, comprised of eave, intercalated spine and postorbital lobe. Basal antennal article broad basally, narrow distally, antenna not excluded from orbit. Lower margin of orbit with prominent suborbital lobe. Third maxilliped smooth or with tubercles, anterolateral angle of merus moderately or strongly produced, merus and ischium fused or separate. Cheliped as long or much longer

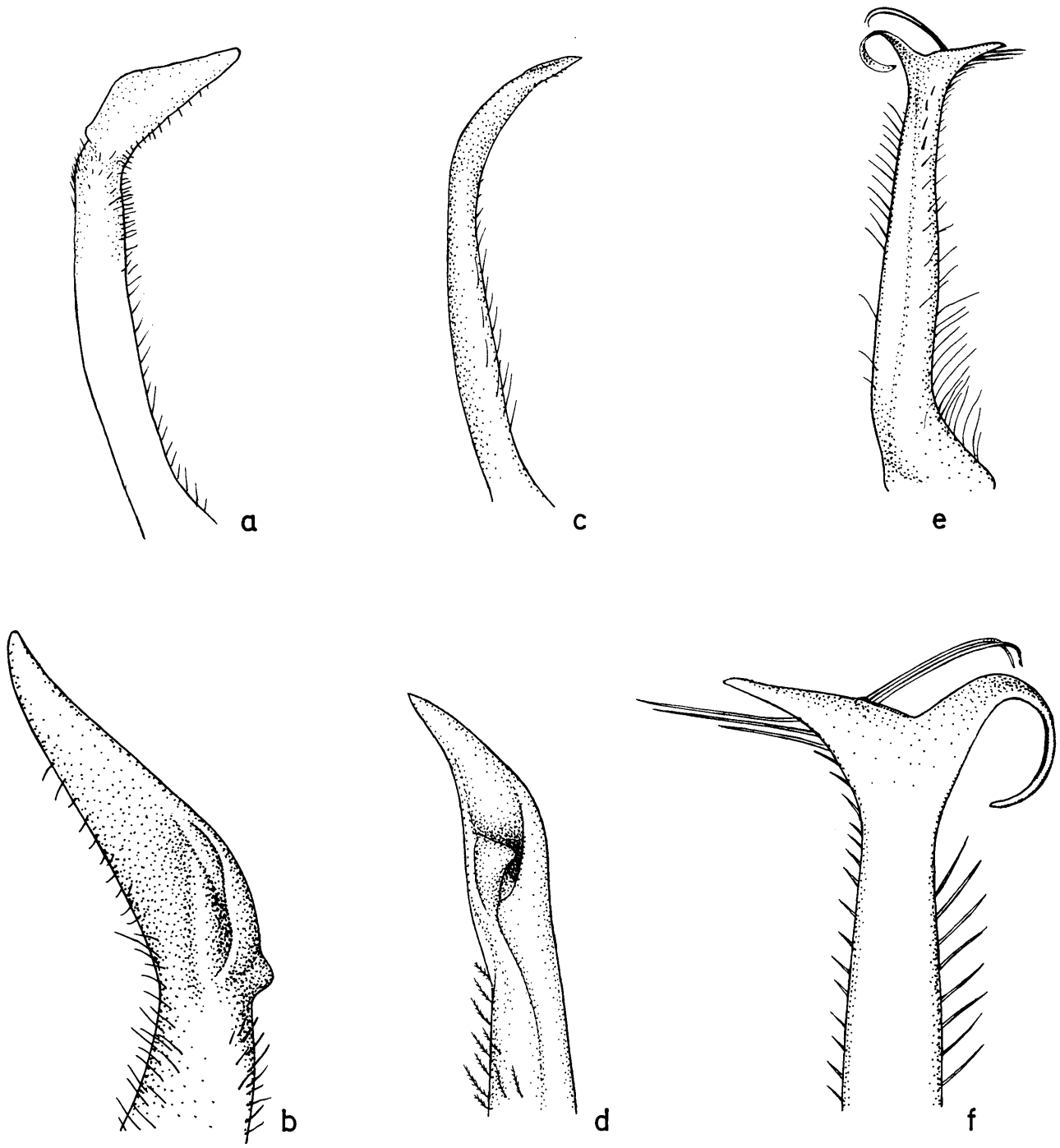


Fig. 68. Left first pleopod of male of *Anacinetops stimpsoni* (22.5 mm, Kai Is., NIO Jakarta) (a) abdominal view of pleopod, (b) sternal tip of same; *Schizophroida hilensis* (33.5 mm, AM P.19606) (c) abdominal view of pleopod, (d) sternal tip of same; *Pippacirama tuberculosa* (15.5 mm, AM P. 14006) (e) abdominal view of pleopod, (f) sternal tip of same.

than ambulatory legs, smooth or spinous; fingers short, bent on an angle towards fixed finger. Ambulatory legs short. Abdomen of seven free segments in both sexes; abdomen of adult female covering sternum. (Rathbun, modified.)

Remarks. — Rathbun (1932) described this genus for the species *Choniognathus koreensis*. Sakai (1938) declared that *C. koreensis* was a synonym of *Eurynome reini* Balss but maintained the separate genus. This genus has remained monotypic because of the apparently unique (among majids) lateral fusion of the ischium and merus of the third maxilliped. However, weighing this unusual feature against the very close resemblance of *C. reini* to *Eurynome granulosa* Baker (Griffin, 1965) in which the maxilliped is not fused, it is our opinion that these two species are congeneric. This has required the modification of the original description of *Choniognathus* given by Rathbun. Other species without a fused maxilliped may also be included in this genus. We have

removed *E. elegans* Stebbing and *E. verhoeffi* Balss to *Choniognathus* on the basis of the type of carapace tubercles, the form of the basal antennal article and the first pleopod of the male. The pleopod of *C. granulosa* is unknown. In the other three species, although there is some variation, the pleopod has a simple subterminal opening without lobes or long setae.

Distribution. — Indo-West Pacific: south east Africa, Red Sea, Gulf of Oman, south and west Australia, Japan.

KEY TO SPECIES OF *CHONIOGNATHUS*

1	Third maxilliped with merus and ischium fused ..... *C. reini*
—	Third maxilliped with merus and ischium free 2
2(1)	Carapace tubercles flat-topped (boletate); interantennular spine apically bifid..... *C. verhoeffi*
—	Carapace tubercles not flat-topped; interantennular spine simple 3
3(2)	Hepatic margin laterally extended as a flattened lobe; basal antennal article subrectangular, bilobate anteriorly, lateral lobe rounded ..... *C. granulosa*
—	Hepatic margin with acuminate spine; basal antennal article broad basally, narrow anteriorly, very small anterolateral spine *C. elegans*

Choniognathus reini Balss, 1924
(Fig. 69c,d)

Eurynome reini Balss, 1924: 31, pl. 1 fig. 3. — Yokoya, 1933: 158-159, text-fig. 57.
Choniognathus koreensis Rathbun, 1932: 33.
Choniognathus reini. — Sakai, 1938: 273-274, text-fig. 34, pl. 27 fig. 2; 1976: 222-223, text-fig. 120a,b, pl. 78 fig. 2. — Takeda & Miyake, 1969: 511-512.

Material examined. — 1 ♂, 7.5 mm

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Okinose, 540 m, 26 June 1914; 1 spec.

Remarks. — This specimen agrees well with specimens described by Balss and Sakai and with type material (2 ovig, ♀♀, 9.1,9.4 mm, Misaki; ZSM) examined by one of us (D.J.G.G.). The first pleopod of the male of *C. reini* has not previously been described. It is broad, straight and distally it is curved strongly ventrally and slightly outwards; apex blunt with long setae on the medial margin and a blunt subterminal lobe on the lateral margin; aperture is a narrow slit-like opening on the sternal surface of this subterminal lobe.

C. reini is unusual in the Majidae in having the ischium and merus of the third maxilliped fused in the lateral half.

This species resembles known species of *Eurynome* in the shape of the supraorbital eave, the presence of a well developed suborbital lobe and the sternum of the adult female completely covered by the abdomen.

As noted previously, *C. reini* is very similar to *C. granulosa* (Baker), redescribed by Griffin (1965), in the ornamentation and tomentum of the carapace; detail of the orbit and the smooth cheliped and ambulatory legs. However, in that species the ischium and the merus of the third maxilliped are not fused. The first pleopod of the male of *C. granulosa* is unknown.

Distribution. — This species is known only from Japan.

Cyclax Dana, 1851

Type species. — *Cyclax perryi* Dana, 1851, by monotypy.

Remarks. — Forest & Guinot (1961) have discussed this genus in detail and listed the synonymies of the two species *C. spinicinctus* Heller and *C. suborbicularis* (Stimpson); several specimens previously identified as *C. spiniger* (White) have been reidentified by them as one or other of these two species (discussed under *Schizophrys*). Forest & Guinot also commented that while *C. perryi* and *C. spinicinctus* are possibly synonymous further research would be needed to confirm this. (*C. perryi* is not included as a distinct species in the key below.)

Distribution. — Widespread throughout the Indo-West Pacific.

KEY TO SPECIES OF *CYCLAX*

1	Intercalated spine distally with three subequal spinules; basal antennal article with a strong accessory spine between anterolateral and anteromedial spines; marginal spines of carapace granular almost to tip ..... *C. suborbicularis*
—	Intercalated spine triangular, granulate basally only; basal antennal article lacking an accessory spine between main anterior spines; marginal spines of carapace granular only at their bases .... *C. spinicinctus*

Cyclax suborbicularis (Stimpson, 1907)

Mithrax suborbicularis Stimpson, 1907: 18-19, pl. 4 fig. 1.
Cyclax suborbicularis. — Forest & Guinot, 1961: 15-24, figs. 5, 6, 8 bis, 10, pl. 6 figs. 1, 2.

Material examined. — 1 ♀, 24 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S.Africa Expedition: Mauritius, Flat Island, 17 October 1929; 1 spec.

Remarks. — This specimen agrees well with that figured by Forest & Guinot, which also came from Mauritius.

Distribution. — Indo-West Pacific: Mauritius and Seychelles, Sri Lanka, New Caledonia, Samoa, Fiji and Tahiti.

Entomonyx Miers, 1884

Type species. — *Entomonyx spinosus* Miers, 1884, by monotypy.

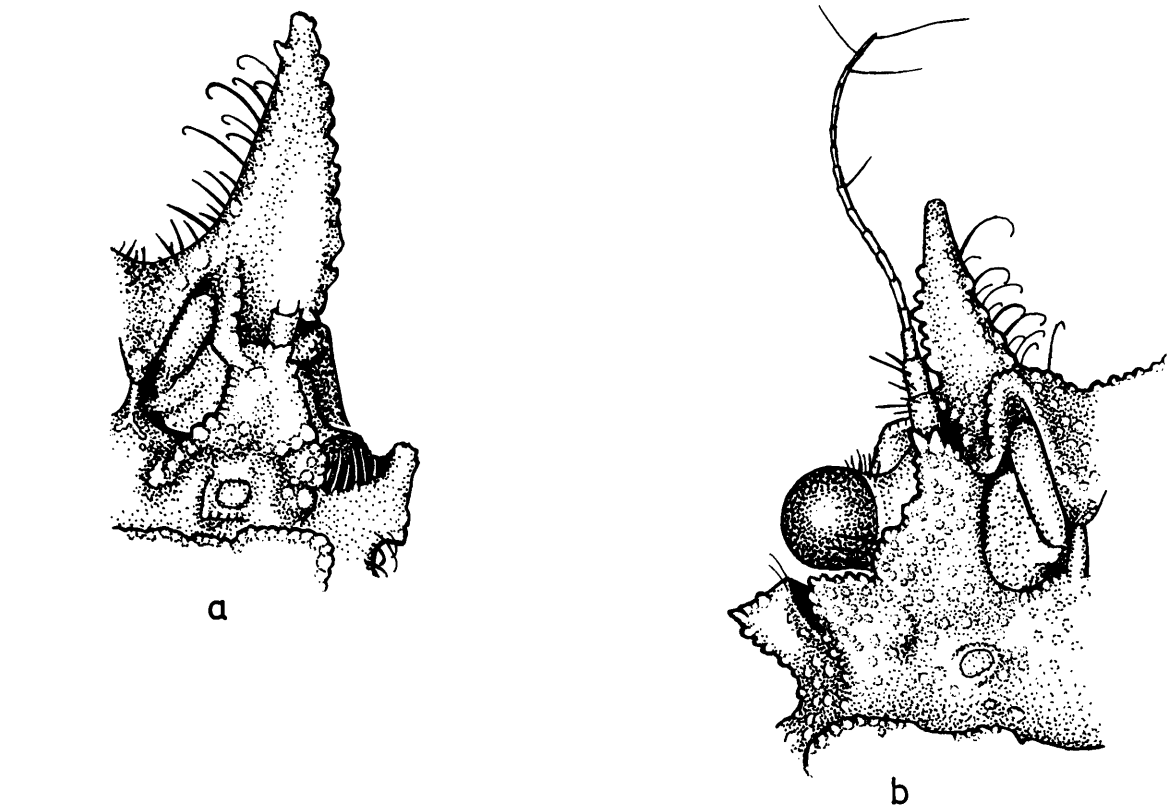


Fig. 69. *Eurynome erosa* (male, 8.5 mm, Cape of Good Hope, ZMC) (a) left orbit, ventral view; *Seiitaoides orientalis* (male, 6.5 mm, Kai Is., ZMC) (b) right orbit, ventral view; *Choniognathus reini* (male, 7.5 mm, Japan, ZMC) (c) abdominal-lateral view of left first pleopod, (d) sternal tip of same; *Seiitaoides orientalis* (male, 6.5 mm, Lesser Sunda Is., ZMA) (e) sternal tip of left first pleopod, (f) abdominal view of same.

Remarks. — The history of this genus has been discussed in detail previously (Griffin, 1966a). Balss (1929) and Sakai (1938, 1965a) considered that the single species then known belonged to the genus *Acanthophrys*. However, the broad eave and basal antennal article which form an almost tubular orbit, set it apart and justify its position as a separate genus. Sakai has added another species, *E. depressus*, which we know only from the literature (Sakai, 1976).

The form of the orbit suggests that *Entomonyx* belongs in the subfamily Mithracinae but examination of the first pleopod of the male of *E. spinosus* shows its basic similarity to the *Thacanophrys* type of pleopod. The pleopod has no similarities to that of any mithracine and as considerable weight must be given to pleopod structure in showing subfamily relationships this genus is more appropriately included in the Majinae.

Distribution. — Widespread throughout the Indo-West Pacific.

KEY TO SPECIES OF *ENTOMONYX*

1 Branchial margin with four spines; posterior carapace margin with two submedial spines ..... *E. depressus*
— Branchial margin with two spines; posterior carapace margin with a single medial spine ..... *E. spinosus*

Entomonyx spinosus Miers, 1884

Entomonyx spinosus Miers, 1884: 526, pl. 47 fig. B. — Takeda & Miyake, 1969: 515-516, fig. 12d-f. — Griffin, 1974: 11. — Sakai, 1976: 253, pl. 87 fig. 2.

Material examined. — 1 ovig. ♀, 13 mm.

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia, W. of Shoal Point, 27°59'S 113°21'E, 108 m, trawl, sponge and Bryozoa, 'Diamantina' Stn. 78, coll. B. Wilson, 5 December 1970; 1 spec. (WAM 82-71).

Remarks. — In Australia this species has been recorded only from Dampier I. northern Western Australia.

Sakai in 1974 added a new species to this previously monotypic genus. *E. depressus* Sakai differs from *E. spinosus* in lacking a preorbital spine, in having a wider postorbital lobe and in having more spines on the branchial region (four) and the intestinal region (two). Similar kinds of differences separate the species of *Thacanophrys*.

This species has been considered by Balss (1929) and Sakai (1938, 1965a) as belonging to *Acanthophrys*. Extensive synonymies are given by Takeda & Miyake (1969) and by Sakai (1976).

Distribution. — Widespread throughout the Indo-West Pacific.

Eurynome Leach, 1814

Type species. — *Cancer asper* Pennant, 1777, by monotypy.

Description. — As given by Griffin, 1966d: 42 (modified from Hartnoll, 1961).

Remarks. — The ten species which have been placed in this genus previously, have in common a number of striking features:

1. a strongly ornamented carapace;
2. a ledge-like supraorbital eave without a preorbital spine;
3. the fingers of the chela much shorter than the palm and inflected;
4. a well developed suborbital lobe;
5. the abdomen of the adult female covering the whole sternum.

However, there are differences in the first pleopod of the male, in details of the orbit and in ornamentation of the carapace which, in our opinion, justify separating the species into three distinct genera. In the genus *Eurynome* we have retained those species in which the male has a pleopod with a long, recurved, hook-like lobe just behind a pointed apex and with long, robust setae between the lobe and the apex. These species are *Eurynome aspera* (Pennant) *E. spinosa* Hailstone, *E. parvirostris* Forest & Guinot from the east Atlantic and *E. erosa* A. Milne Edwards and *E. bituberculata* Griffin from the Indo-West Pacific. In the last species there is a second recurved lobe on the sternal surface of the pleopod. These five species all have in common broadened rostral spines, boletate carapace tubercles and several prominent, flattened, triangular plates on the branchial margin.

The species *E. granulosa* Baker, *E. verhoeffi* Balss and *E. elegans* Stebbing we have removed to the genus *Choniognathus*. In that genus, the carapace tubercles are never fused into plates, they are blunt, flat or if they are boletate the edges of the tubercles are entire, not crenulate and the first pleopod of the male (unknown in *E. granulosa*) has a simple subterminal aperture.

For *E. stimpsoni* Miers and *E. orientalis* Sakai we have established the new genus *Seiitaoides*. In those two species there are a few large plates, rather than many tubercles, on the carapace and the first pleopod of the male, in *S. orientalis* anyway, is straight, with a simple apical aperture.

Distribution. — East Atlantic. Indo-West Pacific: South Africa, Samoa, New Zealand.

KEY TO SPECIES OF *EURYNOME*

1 Rostral spines truncate at tips, less than one sixth postrostral carapace length; a double row of distinct tubercles or spines dorsally on ambulatory meri 2
— Rostral spines acuminate, to subacute, at least one sixth postrostral carapace length; meri of ambulatory legs dorsally cristate..... 3
2(1) Proximal medial margin of rostral spines smooth, proximal lateral margins expanded, smooth, distal margins sometimes tuberculate beyond expansion; supraorbital eave narrow, margin smooth; a flattened triangular lobe on hepatic margin..... *E. bituberculata*
— Proximal margins of rostral spines with tubercles laterally and small spines medially, lateral margins not expanded; supraorbital eave broad, margin tuberculate; a large boletate spine on hepatic margin ..... *E. parvirostris*[31])
3(1) Hepatic margin with flattened triangular plate fused to postorbital lobe; anterolateral branchial margin with three similar blunt capitate or boletate tubercles ..... *E. spinosa*[32])
— Hepatic margin with scutellate tubercle separate from postorbital lobe; anterolateral branchial margin with two boletate or capitate tubercles followed by a granular conical lobe or tubercle 4
4(3) Posterior gastric tubercles fused into a single U-shaped plate; several intestinal tubercles also fused; a large scutellate branchial plate anterolaterally just above margin ..... *E. aspera*
— Posterior gastric tubercles and intestinal tubercles discrete; two or three discrete branchial plates anterolaterally..... *E. erosa*

Eurynome bituberculata Griffin, 1964

Eurynome bituberculata Griffin, 1964: 197-203, figs. 1-11; 1966d: 43-45, figs. 6, 7, 20.

Material examined. — 1 ♀ (ovig.), 10 mm.

[31]) From the literature (Forest & Guinot, 1966).
[32]) From the literature (Hartnoll, 1961)

NATIONAL MUSEUM OF NEW ZEALAND, WELLINGTON

New Zealand Oceanographic Institute Stn. F932, New Zealand, off North Cape, 34°26.7′S 173°07.5′E, 113-115 m, 15 October 1968; 1 spec.

Remarks. — This single specimen agrees closely with the type material. The tubercles of the carapace are slightly larger and the spaces between them narrower than in the type material and the rostral lobes are tuberculate distally beyond the proximal lateral expansions; in the type material the margins of the rostral lobes are generally smooth.

Distribuiton. — Restricted to New Zealand.

Eurynome erosa A. Milne Edwards, 1873
(Fig. 69a)

Eurynome erosa A. Milne Edwards, 1873: 254, pl. 12 fig. 1.

Material examined. — 1♂, 8.5 mm, 1♀, 11 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Cap. 5.5.1875, Corneliussen'; 2 specs.

Remarks. — These two specimens agree closely with the holotype, an ovigerous female in the collection of the Zoologisch Museum, Hamburg registered as K344; A. Milne Edwards' figure is accurate.

The species is very similar to *E. aspera*, *E. spinosa*, *E. parvirostris* and *E. bituberculata* in general arrangement of tubercles on the carapace i.e. boletate tubercles in groups on the gastric, cardiac, intestinal and branchial regions; form of the basal antennal article, i.e. truncate triangular with a medial sulcus; and in a number of other features.

The male in this series is the first known; the first pleopod is scyriform with two distal lobes and is very similar indeed to that of the four species mentioned above.

The principal difference between the five species concerns the ornamentation of the legs and the small or obsolete intercalated spine in the upper orbit of *E. erosa.*

Although the present series clarifies the characteristics of this species the geographic distribution appears disjunct. We asked Dr. Torben Wolff (Zoological Museum, University of Copenhagen) for an interpretation of the label with the specimens 'Cap. 5.5.1875, Corneliussen' and he has replied as follows: ''Corneliussen was one of several captains of the Danish merchant navy who were asked by Professor Japetus Steenstrup to provide mainly marine animals from all parts of the world. Cap. is no doubt Cape of Good Hope. In the museum's Accessory Journal under the date of 5 May 1875 are listed many animals, including fishes, molluscs, crustaceans and echinoderms, several of which are stated to be from Cap. or Kap. (Danish spelling). We have checked some of the identified echinoderms under that entry, labelled Cap. (and one labelled False Bay). At least two of the species occur only in that area which should be indicative of the correctness of this reference.''

Distribution. — Samoa, Cape of Good Hope.

Jacquinotia Rathbun, 1915

Type species. — *Prionorhynchus edwardsii* Jacquinot, 1853, by monotypy.

Remarks. — This monotypic genus and the synonymous genus *Campbellia* have been discussed in detail by Griffin (1963a, 1966d). This genus was, in the past, included in the Mithracinae on the basis of its similarities to the American genus *Mithrax*. However, there are some characters which indicate that *Jacquinotia* more properly belongs in the Majinae. The third segment of the male abdomen is only slightly wider that the sixth segment, a character typical of many Majinae, and also the first pleopod of the male basically resembles the *Thacanophrys* type of pleopod and does not resemble any of the pleopods found among the Mithracinae.

Distribution. — Confined to the New Zealand subantarctic.

Kimbla new genus

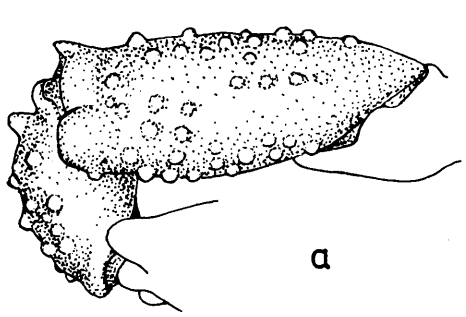
Type species. — *Kimbla neocaledonica* new species.

Description. — Carapace suboval, hardly expanded posteriorly; surface tuberculate, regions weakly defined. Rostrum of two short divergent spines. Orbit above comprising eave with a preorbital and an antorbital spine, intercalated spine and postorbital lobe, the last three closely approximated; postorbital lobe excavated anteriorly. Eyestalk short, cornea large. Orbit open below, basal antennal article moderately broad, subrectangular, anterior angles toothed, flagellum excluded from orbit. Merus of third maxilliped with shallow notch at anterolateral angle, a small spine on anterior margin of notch. Merus and carpus of cheliped with tubercles but not with spines or crests. Male abdomen of seven distinct segments. First pleopod of male curved outwards distally and tapering, tip pointed, aperture subterminal, lateral, covered by a broad lateral flap, a few large hairs abdominally on lateral edge.

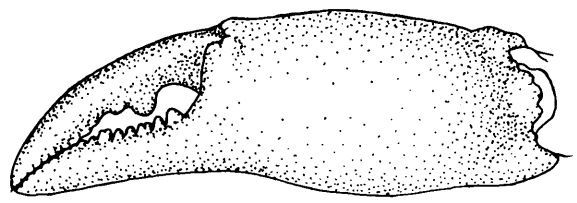
Remarks. — Whilst the new species described here basically possesses orbital features similar to a number of other majines, especially *Leptomithrax* species, absence of marginal spines from the carapace posteriorly, its tuberculate appearance and possession of a pleopod in the male more similar to that of *Thacanophrys* species than to pleopods of other genera make it extremely difficult to place it within another genus.

K. neocaledonica is similar to *Teratomaia richardsoni* in having a well developed lobe on the posterior margin of the postorbital lobe, a tuberculate merus of the cheliped and in *T. richardsoni* there is often a tubercle midway along the supraorbital eave. The fairly short, stout eyestalk of the single contained species of this genus is not present in any *Thacanophrys* species.

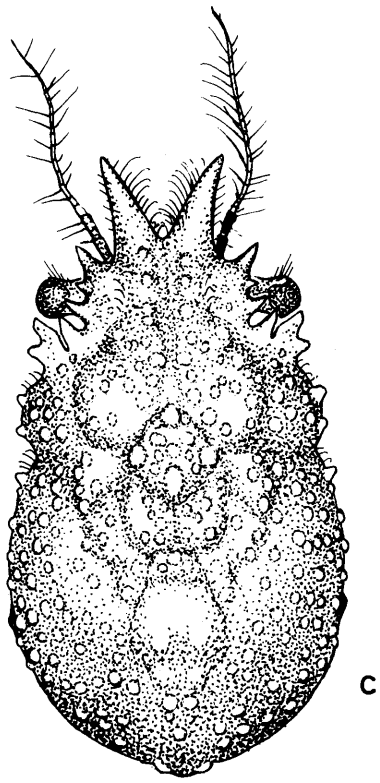
The new genus is named for the Australian naval vessel. HMAS 'Kimbla' which in recent years, despite its age and



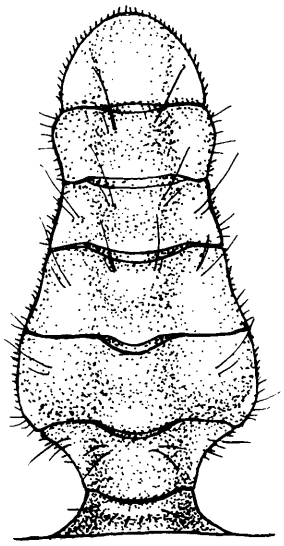
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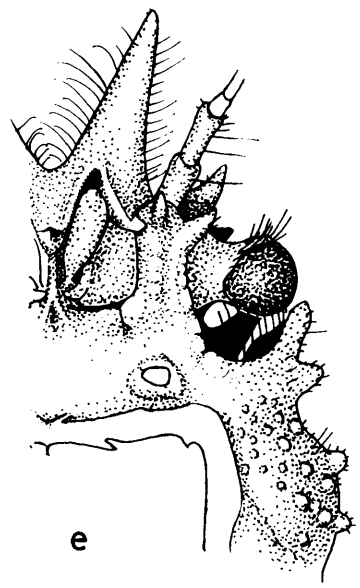
b



c



d



e

Fig. 70. *Kimbla neocaledonica* (holotype) (a) left cheliped, merus and carpus; (b) left chela; (c) carapace, dorsal view; (d) male abdomen; (e) left orbit, ventral view.

slow speed, has made no small contribution to marine science in eastern Australia.

Distribution. — Presently known only from near New Caledonia.

Kimbla neocaledonica new species
(Figs. 70, 93f-h)

Material examined. — 1♂, 19 mm.
Holotype. — Male, cl. 19 mm, off New Caledonia, 22°48.5′S 167°36.5′E, 85-100 m, large bottom dredge, coll. J. Paxton and P. Colman, 'Kimbla' Stn. K4-71-4, 8 May 1971. The Australian Museum, AM P.29841.

Description. — Carapace hardly widened posteriorly, carapace width less than 2/3 postrostral carapace length; regions very weakly elevated and defined; surface with numerous small, nearly uniform rounded tubercles but no spines.

Rostral spines short, about 1/5 post rostral carapace length, horizontal, divergent, tapering from a broad base to a sharp apex; rostral ridges each with three tubercles.

Orbital eave moderately expanded, preorbital angle produced into a sharp spine directed upwards and slightly outwards; a small erect spine midway along eave; antorbital angle produced laterally as a narrow triangular spine, tip upcurved; intercalated spine slightly larger than antorbital spine, separated from it by a narrow U-shaped hiatus, apices of both spines at same level; postorbital lobe basally broad, apically narrow, blunt, separated from intercalated spine by a narrow slit, anterior margin with an obtuse angle, posterior margin with a proximal accessory tubercle.

Hepatic margin with two tubercles, anterior one larger; surface of region dorsally tuberculate; subhepatic region tuberculate.

Branchial margin with only one sharp tubercle anteriorly.

Mesogastric region with a longitudinal row of about four tubercles on either side of midline; protogastric region tuberculate with two slightly larger tubercles one behind other anteriorly. A broad diamond-shaped metagastric region with slightly larger tubercles at each angle; urogastric region with many small tubercles.

Cardiac region only weakly elevated, a slightly larger submedial pair of tubercles at summit, smaller tubercles on anterior and posterior slopes.

Intestinal region with a pair of submedial tubercles anteriorly, a central tubercle and a pair of submedial tubercles on posterior margin of carapace.

Branchial region with small even sized rounded tubercles.

Basal antennal article with small tubercles along medial and lateral edges, a shallow longitudinal groove centrally; two spines anteriorly, a small, acute, anteromedial spine directed ventrally and forward, and a larger, acute anterolateral spine directed laterally; proximal margin of basal antennal article marked by a slit in suborbital border; no suborbital tubercle. Orbit open below.

Pterygostomian region smooth, two rows of granules and small tubercles along margin.

Third maxilliped smooth, ischium with about six large teeth on medial edge; merus with anterolateral angle moderately produced and rounded, a small spine in front of notch, medial edge behind notch convex with spinules on proximal part.

Cheliped merus of male with many small sharp tubercles, four or five along dorsal margin and a small sharp terminal spine; carpus also with many sharp tubercles but no ridges; palm smooth, length about twice height, fingers 2/3 length of palm and separated by a moderate gape in proximal half, dactyl with a large tooth midway in gape, fixed finger with small teeth along length of gape; both fingers with very small teeth uniformly along cutting edge in distal half.

(There are no ambulatory legs with the specimen.)

Sternum smooth except for a tubercle on edge of abdominal fossa in third segment and a tuberculate ridge in a similar position on fourth segment.

Abdomen smooth, third segment one and a half times as wide as sixth segment, sixth segment more than twice (2.3) as wide as long, seventh segment one and a half times as wide as long, anterior margin broadly convex.

First pleopod of male similar to that of *Thacanophrys goldsboroughi*, curved outwards distally and tapering, tip pointed, aperture subterminal, lateral, covered by a broad lateral flap, a few large hairs abdominally on lateral edge.

Remarks. — This species is clearly distinguished from those of the related genera *Thacanophrys* and *Teratomaia* by the narrow carapace which is evenly tuberculate but without spines.

The species name refers to the type locality.

Distribution. — Known only from the type locality off New Caledonia.

Leptomithrax Miers, 1876

Type species. — *Paramithrax* (*Leptomithrax*) *longimanus* Miers, 1876, by subsequent designation of Miers (1879).

Remarks. — This genus was discussed in detail by Griffin (1966d), and it was suggested then that *L. richardsoni* Dell with a preorbital spine, *L. parvispinosus* Ward with few tubercles and *L. bifidus* Ortmann with long rostral spines were on the borderline of this genus. Consideration of the male pleopods of these three species suggests that the first two species should be removed from *Leptomithrax* and the third species should be retained in the genus. *L. richardsoni* has been removed to the new genus *Teratomaia* and *L. parvispinosus* is now placed in *Tumulosternum*. We take the view that *Paramithrax* (*Leptomithrax*) *compressipes* Miers 1879 is most appropriately placed in *Maja*.

The first pleopod of the male of species of *Leptomithrax* is apically narrow, the aperture is subterminal, a longitudinal slit usually with narrow abdominal and sternal flaps.

L. sinensis Rathbun from off China is known only from the holotype.

Distribution. — Western Pacific: Australia, New Zealand and Japan.

KEY TO SPECIES OF *LEPTOMITHRAX*

1	Intercalated spine almost excluded from outer rim of supraorbital margin; sternum and/or abdomen in male excavated as pits	2
—	Intercalated spine not excluded from outer rim of supraorbital margin; sternum and abdomen of male without pits	6
2(1)	Postorbital lobe simple, without a subapical spine or lobe	3
—	Postorbital lobe truncate apically, an enlarged subapical lobe	5
3(2)	Third maxillipeds swollen at junction of ischium and merus	4
—	Third maxillipeds not swollen, at most weakly elevated at junction of ischium and merus	*L. tuberculatus*[33])
4(3)	Rostral spines subtriangular no more than 1/10 postrostral carapace length; pits of sternum and abdomen in male rimmed	*L. longipes*
—	Rostral spines acuminate, at least 1/6 postrostral carapace length; sternum in male with unrimmed pits, abdomen lacking pits	*L. edwardsi*
5(2)	Three marginal branchial spines; pits of sternum in male rimmed.	*L. sternocostulatus*
—	Four marginal branchial spines; pits of sternum unrimmed	*L. bifidus*
6(1)	Postorbital lobe truncate	*L. sinensis*[34])
—	Postorbital lobe sometimes with spines or tubercles but not truncate	7
7(6)	Postorbital lobe bearing spinules or tubercles on posterior edge; third maxillipeds elevated at junction of ischium and merus	8

[33]) both subspecies, see Griffin 1966d.

[34]) from the literature (Rathbun, 1916; Sakai, 1969).

— Postorbital lobe lacking spinules or tubercles on posterior edge; third maxillipeds not elevated at junction of ischium and merus. 10

8(7) Carapace narrowly pyriform; rostral spines slender; postorbital lobe with tip acuminate, adjacent spinule on posterior edge small in both juvenile and adult, posterior edge of lobe bearing a few small tubercles at base, otherwise unarmed; third maxillipeds with merus only swollen ..... *L. globifer*

— Carapace broadly pyriform; rostral spines stout; postorbital lobe with adjacent spinule on posterior edge subequal with tip, at least in juvenile, a second tubercle midway along posterior edge, lobe otherwise smooth; third maxillipeds with ischium at least weakly swollen 9

9(8) Postorbital lobe with adjacent spinule large in juvenile, small in adult, tip acuminate; mid-dorsal regions of carapace thickly covered by both spines and tubercles ..... *L. gaimardii*

— Postorbital lobe markedly bifid distally, adjacent spinule on posterior edge subequal with tip in both juvenile and adult; mid-dorsal regions of carapace smooth except for a few prominent spines ..... *L. waitei*

10(7) Postorbital lobe generally with prominent spine or tubercle on upper anterior edge; carapace covered by short spines and tubercles 11

— Postorbital lobe without spine on anterior edge; carapace dorsal surface with closely spaced tubercles or spinules 12

11(10) Carapace in both male and female covered by a few spines; merus and carpus of cheliped bearing numerous spines on all surfaces; postorbital lobe with a small tubercle on upper anterior edge about one-third from base, a larger additional spinule seldom present ..... *L. garricki*

— Carapace in male densely covered by spines, in female by numerous tubercles; merus and carpus of cheliped in male with spines restricted to upper and outer surfaces, lower surface smooth; postorbital lobe with a strong spinule on upper anterior edge about midway along, a small tubercle basal to spinule sometimes present ..... *L. australis*

12(10) Rostral spines more than half postrostral carapace length; postorbital spine prominent, acuminate; chela sometimes with nodules ..... *L. kiiensis*[34])

— Rostral spines less than 1/3 postrostral carapace length; postorbital spine broad, triangular; chela without nodules ..... *L. longimanus*

Leptomithrax australis (Jaquinot, 1853) (Pl. 13a,b)

Paramithrax (*Leptomithrax*) *brevirostris* Miers, 1879a: 8-9; new synonymy.
Leptomithrax australis. — Griffin, 1966d: 66-69, figs. 13, 14, 22.

Material examined. — No new material.

Remarks. — We have examined the type (the only reported specimen) of *L. brevirostris* Miers (1879a) (female, imm., postrostral cl. 34 mm, no locality, BM(NH) 1939.5.8.18) which Miers distinguished by its very short triangular rostral spines. Examination of the specimen shows that the rostral spines and all but one of the anterior spines of the two basal antennal articles are deformed. The rostral spines are less than a tenth (0.09) postrostral carapace length and are not identical in shape. On the basal antennal article on the right hand side of the specimen the anterolateral spine appears normal but the medial spine on that article and the two anterior spines on the left hand article are each of a different length but all are shorter than the apparently normal spine. Also the two peduncle segments of the antenna on the left hand side are about half the size of those on the right hand side. We have compared the specimen of *L. brevirostris* with immature females of a similar size in a series of *L. australis* (15 ♂♂, 10 ♀♀, cl. 21.5-74.5 mm, Campbell I., New Zealand, coll. J. Lowry, AM P.32092 — P.32107) and except in the characters mentioned above, it agrees with them in all respects. The immature females of *L. australis* differ from the adults in having shorter spines on the carapace margins and the cheliped has tubercles rather than short spines dorsally on the merus and carpus.

We see no good reason for regarding Miers' *L. brevirostris* as a distinct species and we now add it to the synonymy of *L. australis*. No locality was given by Miers in his original description. However, Miers' report was based on material in the British Museum Collections and deals with species from several localities including Australia and the Pacific. We draw the conclusion we have despite the fact that Miers (1876) recorded *L. australis* from New Zealand and referred to an adult female of this species in the British Museum Collection. Miers may have been confused by the deformed rostrum of his *L. brevirostris* as the rostrum of an adult female of *L. australis* is about a sixth of the postrostral carapace length.

Distribution. — Restricted to southern New Zealand.

Leptomithrax bifidus Ortmann, 1893

Paramithrax (*Leptomithrax*) *bifidus* Ortmann, 1893: 52-53, pl. 3 fig. 6. — Parisi, 1915: 290, pl. 7 fig. 2. — Yokoya, 1933: 161.
Leptomithrax bifidus. — Sakai, 1934: 298; 1938: 303-304, pl. 31 fig. 1; 1965a: 86, pl. 39 fig. 1; 1976: 243, pl. 87 fig. 1. — Takeda, 1973b: 43. — Takeda & Kurata, 1976: 25-27, fig. 3B-D.

Material examined. — 8 ♂♂, 9 ♀♀, 15-50 mm.

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Mortensen Pacific Expedition: Japan: 33°41′N 128°50′E, 135 m, trawl, sand, 17 May 1914; 2 specs. — 34°20′N 130°10′E, 108 m, dredge, sand, 18 May 1914; 3 specs. — Off Suno-Saki, 36-144 m, dredge, 12 June 1914; 1 spec. — Sagami Sea, Okinose, 180 m, 23 June 1914; 2 specs. — Sagami Bay, 540 m, 28 June 1914; 5 specs. — Sagami Bay, 540 m, 29 June 1914; 3 specs.

Japan, near Nagasaki, 32°59′15″N 129°23′50″E, 40 m, 'Store Nordiske', 6 August 1933; 1 spec.

Remarks. — In this species the postorbital spine is bifid at the tip and a lobe on the anterior edge meets the intercalated spine half way along its length, closing the sinus between the two. Ventrally there is a short U-shaped sinus between the basal antennal article and the postorbital spine. Sakai (1965a) uses this last character to distinguish *L. sinensis* from *L. bifidus*, but perhaps his remarks should read.. "in *L. sinensis* no such sinus may be found". On a young male specimen (15 mm) the postorbital spine is completely separate from the intercalated spine and the orbit is much more open ventrally.

The cheliped is as described by Ortmann (1893): the merus and carpus are armed dorsally with sharp tubercles and some spines, while the palm is smooth. (In Sakai, 1938: 303, one should perhaps read "carpus" for "palm".)

The first sternite of the male is excavate but without pits and there are intersegmental, unrimmed pits on the following segments.

The first pleopod of the male has been figured by Takeda & Kurata (1976).

This species is similar to *L. sternocostulatus* (H. Milne Edwards) from Australia in the truncate, distally bifid, postorbital spine and the pitted male sternum, but in *L. sternocostulatus* there are three spines, not four, on the branchial margin and the pits on the sternum are rimmed and deeper. The first pleopod of the male of *L. sternocostulatus* is distally less narrow and only weakly outcurved; there is a compact group of setae on the lateral edge near the opening, but none between them and the apex.

Distribution. — Japan.

Leptomithrax edwardsi (De Haan, 1839)

Maja (*Paramithrax*) *edwardsii* De Haan, 1839: 92-93.
Maja (*Paramithrax*) *Peronii*. — De Haan, 1839: pl. 21 fig. 2. (Not *Paramithrax peronii* H. Milne Edwards, 1834.)
Paramithrax edwardsii. — Adams & White, 1848: 14.
Paramithrax (*Leptomithrax*) *edwardsi*. — Ortmann, 1893: 52. — Parisi, 1915: 289-290. — Yokoya, 1933: 160-161.
Leptomithrax edwardsi. — Sakai, 1938: 302-303, pl. 30 fig. 4; 1965a: 86-87, pl. 39 figs. 2, 3; 1976: 242-243, pl. 86. — Takeda & Miyake, 1969: 513-514, figs. 12a-c; 1972a: 77. — Takeda, 1973b: 43.

Material examined. — 1♂, 2♀♀ (ovig.), 53.5 — postrostral cl. 59 mm, smaller ovig. ♀, 57.5 mm.

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Japan, Nagasaki, coll. James Jordan, 1911: 3 specs.

Remarks. — In this species the basal antennal article has s smooth surface and two strong anterior spines. The third maxilliped has a prominent, rounded swelling at the junction of the ischium and merus; the anterolateral angle of the ischium is produced laterally to a sharp spine.

There are two pairs of pits on the first sternite of the male and unrimmed intersegmental pits on the following segments. The first pleopod of the male has been figured by Takeda & Miyake (1969: fig. 12).

Distribution. — Restricted to Japan.

Maja Lamarck, 1801

Type species. — *Cancer squinado* Herbst, 1788, by subsequent designation (see Manning & Holthuis, 1981).

Remarks. — With the two new species described here, the number of species assigned to *Maja* is brought to 16. Of these 13 occur in the Indo-West Pacific and three in the east Atlantic and Mediterranean, seven species occur in Japan and four in the Philippines. There is one *Maja* species in Australia.

There is still some confusion about the identity of a few species. *M. linapacanensis* is known only from a single carapace and *M. kominatoensis* may be a synonym of *M. gibba* Alcock. *Leptomithrax compressipes* Miers is here considered to be a *Maja*.

Species of *Maja* are characterised by the generally spiny appearance, a ventrally open orbit, a basal antennal article spined both anteromedially and anterolaterally and a male abdomen which is about as broad distally as at the third segment and is sometimes straight sided.

The first pleopod of the male typically opens subterminally but in some is partly protected by a flap and in some the distal part bears long hairs as in *Thacanophrys* and *Eurynome*.

Distribution. — East Atlantic, Indo-West Pacific.

KEY TO INDO-WEST PACIFIC SPECIES OF *MAJA*

1		Carpus of first pair of ambulatory legs broad triangular, distal margin about three times basal width, distal margin of carpi of second and third pairs of ambulatory legs more than one and a half times basal width ..... *M. compressipes*
—		Carpi of first three pairs of ambulatory legs subcylindrical, distal margin less than one and a half times basal width 2
2(	1)	Carapace with spines in midline and on margins 3
—		Carapace without spines in midline, margins of carapace with at most sharp tubercles 10
3(	2)	Basal antennal article with spine on lateral edge at base; branchial region with two dorsal spines; hepatic spine long, equal and parallel to postorbital spine ..... *M. spinigera*[35])
—		Basal antennal article without spine on lateral edge at base; branchial region with one dorsal spine or without any spine; hepatic spine shorter than postorbital spine and usually not parallel to it . 4
4(	3)	Rostral spines usually projecting obliquely upwards; basal antennal article broad (l about $1^1/_2$ w) or with 'teeth' on medial border, anterior spines long 5
—		Rostral spines horizontal; basal antennal article narrow (l about 2 × w), surface with small tubercles, anterior spines short 7
5(	4)	Four long marginal branchial spines including one subdorsal posteriorly; medial edge of basal antennal article with tubercles or lobes but not spines 6
—		Six irregularly sized marginal branchial spines including one subdorsal posteriorly; medial edge of basal antennal article with one long spine and four shorter spines or 'teeth' .... *M. linapacanensis*[36])
6(	5)	Antorbital spine curved forward distally; anteromedial spine of basal antennal article acuminate, directed ventrally and curved forwards ..... *M. suluensis*
—		Antorbital spine straight, parallel to postorbital spine; anteromedial spine of basal antennal article, blunt, straight ..... *M. miersii*
7(	4)	One hepatic and four marginal branchial spines, all subequal, long; two obvious dorsal spines on branchial regions ..... *M. nagashimaensis*
—		One hepatic and a varying number of marginal branchial spines, two or three branchial spines markedly longer than others; no dorsal branchial spines 8
8(	7)	Intestinal region with one medial spine followed by a submedial pair on posterior margin; rostral spines a third postrostral carapace length ..... *M. africana*
—		Intestinal region without spines, sometimes with tubercles and enlarged granules; rostral spines no more than a quarter postrostral carapace length 9
9(	8)	Carapace elongate pyriform; tip of first male pleopod ovate and fringed with hairs ..... *M. sakaii*
—		Carapace broader than in *M. sakaii*; tip of first male pleopod pointed with an ovate slit ..... *M. japonica*

[35]) From the literature (Sakai, 1938; 1976).
[36]) Known from carapace only, possibly a synonym of *M. compressipes*.

10(2) Postorbital lobe with a prominent tubercle on anterior margin at base; basal antennal article lacking tubercles or spines on lateral edge and surface ..... *M. bisarmata*
— Postorbital lobe without accessory tubercles or spines; basal antennal article with tubercles on lateral edge and surface 11
11(10) Carapace tubercles granular, small tubercles among the larger tubercles; midline with six medial spines and two to three pairs of submedial tubercles ..... *M. confragosa*
— Carapace tubercles smooth, surface between tubercles smooth .. 12
12(11) Carapace uniformly covered with studded tubercles ..... *M. gibba*
— Carapace covered with large wart-like tubercles ..... *M. kominatoensis*[35])[37])

Maja africana new species
(Figs. 71a-e; 73c,d, Pl.14)

Material examined. — 1♂, cl. 24 mm.

Holotype. — Male, cl. 24 mm, South Africa, off Durban, 21°54′25″S 31°09′45″E, ca. 122 m, dredge, sand, gravel, 29 August 1929; Mortensen Java-S.Africa Expedition, Stn. 31; Zoological Museum, University of Copenhagen.

Description. — Carapace pyriform, width equal to 0.8 postrostral carapace length; surface with many small even tubercles and a few short spines, margin with a few long spines.

Rostrum of two straight slender spines, one third postrostral carapace length, weakly divergent.

Orbit consisting above of a moderately expanded eave; rounded anteriorly, no preorbital spine; antorbital spine narrowly triangular, directed outward and slightly forward, surface granular; intercalated spine narrowly triangular, extending as far laterally as antorbital spine, surface and edges with granules; postorbital spine triangular, twice as long as intercalated spine, proximally excavate, extending laterally and anteriorly beyond apex of antorbital spine, granules proximally, without a lobe on anterior margin.

Eyestalks with two or three granules midway on dorsal surface, cornea large, mainly ventral.

Hepatic margin with single very short spine, one sixth postorbital spine, hepatic region moderately swollen.

Branchial margin with four spines, last more dorsally placed, anterior two very short, posterior two longer, about equal to intestinal spine.

Mesogastric region with three medial spines, anterior two very short, barely higher than carapace tubercles, posterior spine about twice height of anterior spines. Protogastric region with a compound tubercle lateral to anterior mesogastric spine.

Cardiac region weakly elevated with a short central spine. Intestinal region with a long (about a quarter length of rostral spines) acuminate anterior spine; posterior margin of carapace with two long acuminate submedial spines, at least half length of rostral spines (tips broken).

Branchial region with an anterior and posterior compound tubercle dorsally.

Basal antennal article narrow, anteromedial and anterolateral spines short, acute; surface with tubercles mainly in two longitudinal rows, one on lateral edge and one just inside medial edge, medial edge almost smooth. Suborbital border tuberculate, a very fine fissure between basal antennal article and suborbital lobe, no fissure between suborbital and postorbital lobe.

Third maxilliped ischium with a shallow, central, longitudinal groove, ridge lateral to groove granular; merus with granules midway along posteromedial border, a few centrally; anterolateral angle moderately expanded, rounded; exognath with granules on medial edge.

Pterygostomian region smooth with a few small tubercles laterally, margin with about five tubercles.

Male sternum densely tuberculate on posterior quarter of first segment and all remaining segments, anterior three quarters of first segment smooth.

Cheliped smooth, slender, merus with a minute acute terminal spine, fingers with minute proximal teeth. Ambulatory legs cylindrical, slender, meri without terminal spine; first pair of legs nearly one and a half times postrostral carapace length; all segments with long setae; fringe of shorter setae dorsally on dactyl.

Abdomen of male with third segment only slightly wider (1.2) than sixth segment, both sixth and seventh segment wider (2.1, 1.7) than long; second segment with a pair of submedial tubercles and a lateral tubercle; third segment granular and remaining segments with a few granules.

First pleopod of male is curved laterally and only tapers just before acute apex; a large group of setae just behind apex on medial edge, another group a little further back near lateral edge anterior to opening; opening is subcircular on abdominal surface.

Remarks. — This species is similar to *M. japonica* and *M. sakaii*, but can be distinguished from them by the longer rostral spines which are a third rather than a quarter or a fifth postrostral carapace length; by the longer intercalated spine which is subequal to, not shorter than, the antorbital spine; by the longer postorbital spine which exceeds the apex of the antorbital spine; and by the two very long submedial spines on the posterior margin of the carapace. The first pleopod of the male is similar to that of *M. japonica* but the setae on the lateral edge are in a distinct group, not scattered as in that species.

The specific name refers to the type locality of the new species.

Distribution. — Known only from the type locality, off Durban, South Africa.

Maja compressipes (Miers, 1879) new combination
(Pl. 15a,b)

Paramithrax (*Leptomithrax*) *compressipes* Miers, 1879a: 8.

Material examined. — No new material.

[37]) These are the characters used by Sakai (1976); we do not consider that these reliably distinguish the two species from each other.

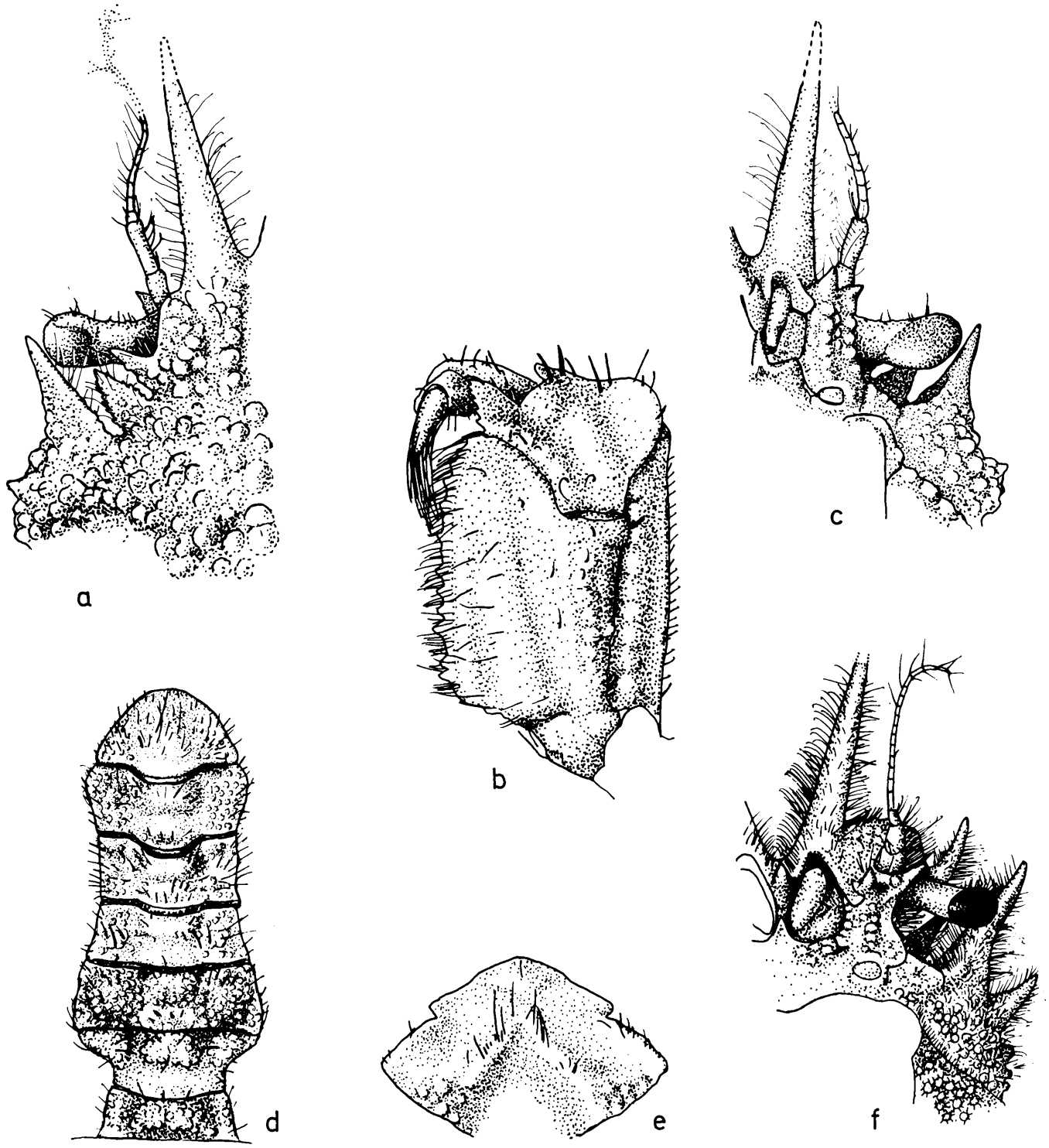


Fig. 71. *Maja africana* (holotype) (a) left orbit, dorsal view; (b) left third maxilliped; (c) left orbit, ventral view; (d) male abdomen; (e) male sternum; *M. suluensis* (female, 51.5 mm, N. of Jolo, ZMC) (f) left orbit, ventral view.

Remarks. — We have examined the type of this species (female, adult, postrostral cl. 51.6 mm, Canton, BMNH 1860.15). The flagellum of the antenna is included within the orbit and the chelipeds are smooth, indicating, with other characters, that this species is more correctly placed in *Maja* than in *Leptomithrax*. It is distinguished from all other known species of *Maja* by the carpi of the first three pairs of ambulatory legs which are dorsoventrally flattened and widened distally. This feature is particularly marked in the first ambulatory leg where the distal margin of the carpus is three times as wide as the proximal margin and only slightly less (0.9) than the carpus length.

The basal antennal article is moderately broad; there is a triangular, laterally directed anterolateral spine and a blunt anteromedial spine directed ventrally. There are two to three small tubercles on the anterior margin of the anterolateral

spine and the lateral margin of the article behind the spine is concave and finely crenulate. On the anterior face of the anteromedial spine, near the base, there is a large granular tubercle and just posterior to the spine, on the medial margin of the article there is a similarly-sized spine with tubercles at its base. At the base of the article, on the margin of the antennular fossa, there is a medially directed granular lobe with its blunt apex adjacent to the granular tubercle on the epistome. There is a tubercle midway along the medial margin of the article on the left hand side but not on the right hand side.

The carapace is covered with small close-set blunt tubercles and lacks a strong ridge on the midline. There is a small mesogastric spine and a small spine (broken) on the cardiac region. There is also the base of a short dorsal spine on the branchial region, level with the cardiac spine. On the hepatic margin there are three to four spines; the anterior is largest, about quarter the length of the postorbital lobe and at right angles to it. There are four to five short spines on the anterolateral margin of the branchial region.

The intercalated spine is shorter than either the postorbital or antorbital lobes but is not excluded from the lateral margin of the orbit. The rostral spines are weakly divergent (but the tips are broken).

Rathbun (1916) remarked that her specimen (an incomplete carapace) of *Maja linapacanensis* was similar to this species although it was then placed in a different genus. However, Miers' specimen is, in our view, properly considered a *Maja* and there is a dorsal branchial spine in this species as Rathbun described for *M. linapacanensis*. There appear to be differences between the basal antennal article of this species and that of *M. linapacanensis* described by Rathbun, even allowing for the variation in the number of small tubercles shown in this specimen. The two species appear to be generally similar but it would require the examination of not only the types of the two species but also of some more complete material to decide whether they are the same species or not.

Distribution. — Known only from Canton, China.

Maja confragosa new species
(Figs. 72, 73a,b; Pl. 16)

Material examined. — 1♂, cl. 39 mm.

Holotype. — Male, cl. 39 mm, Kai Islands, 05°39′S 132°26′E, 300 m, Sigsbee Trawl, mud bottom, 5 April 1922; Danish Kei Islands Expedition, Stn. 8, Zoological Museum, University of Copenhagen.

Description. — Carapace broad, width almost 0.9 times postrostral carapace length, surface densely covered with irregularly sized tubercles; dorsal midline weakly elevated with six low spines anteriorly and two or three pairs of submedial tubercles posteriorly.

Rostrum of two slender spines just over a third postrostral carapace length, parallel basally and divergent in distal half. (There is a spinule at distal third on left hand spine.)

Orbit consisting above of an expanded eave, rounded anteriorly, no preorbital spine; antorbital spine long, acute, directed outward and slightly forward; intercalated spine narrowly triangular, shorter than antorbital spine, sharp with granules on both edges; postorbital lobe reaching slightly further forward than antorbital spine, twice as long as intercalated spine, broad basally, excavate, narrow and acute distally, directed forward and slightly outward, small granular lobe proximally on anterior edge (on right hand side).

Eyestalks narrow, granules anteriorly on distal half, cornea large and mostly ventral.

Hepatic margin with a short spine, less than half postorbital spine and separate from it, basally granular; hepatic region behind spine swollen with two large tubercles. Branchial margin with four sharp spines on margin, last more dorsal on carapace.

Mesogastric region with four short blunt medial spines, first smaller than rest, urogastric region with one short medial spine. Cardiac region with two short medial spines, one anteriorly and one centrally, and a pair of submedial tubercles posteriorly.

Intestinal region with a pair of larger anterior submedial tubercles, and a pair of sharp submedial spines on posterior margin of carapace.

Branchial region dorsally with one short central spine, just lateral to central cardiac spine.

Basal antennal article narrow with an anteromedial and anterolateral spine, each with spinules, medial spine directed ventrally and forward, lateral spine directed outward and forward; two or three tubercles on lateral edge and close to medial edge, medial edge smooth. Suborbital lobe indistinctly separated from basal antennal article, no fissure marking separation from postorbital lobe. Epistome smooth.

Third maxilliped ischium with shallow, central longitudinal groove and granules on ridge lateral to groove; merus with granules midway along posteromedial border, anterolateral angle moderately produced, edge crenate; exognath with granules on medial edge.

Pterygostomian region smooth, margin with about five large and several small tubercles.

Sternal segments with small tubercles and granules on medial half adjacent to abdominal fossa, first segment smooth except for posterior edge, segments two to four each with one or two tubercles laterally.

Cheliped slender, smooth, small acute terminal spine on merus; chela slender, palm more than three times as long as high; fingers unarmed, one third length of palm.

Ambulatory legs slender, cylindrical, unarmed, all segments with long setae.

Male abdomen granulate, third segment only slightly wider (1.1) than sixth segment, sixth segment about twice as wide as

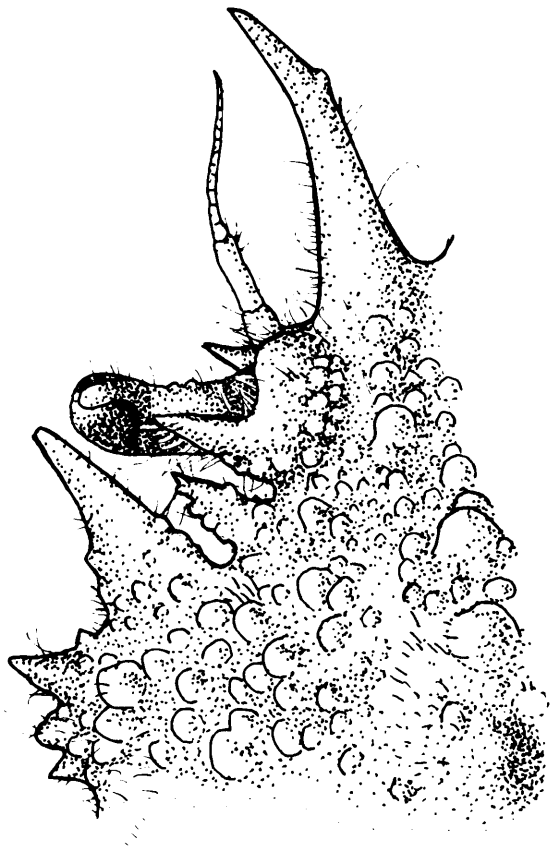


Fig. 72. *Maja confragosa* (holotype) (a) left orbit, dorsal view; (b) male abdomen; (c) third maxilliped; (d) left orbit, ventral view.

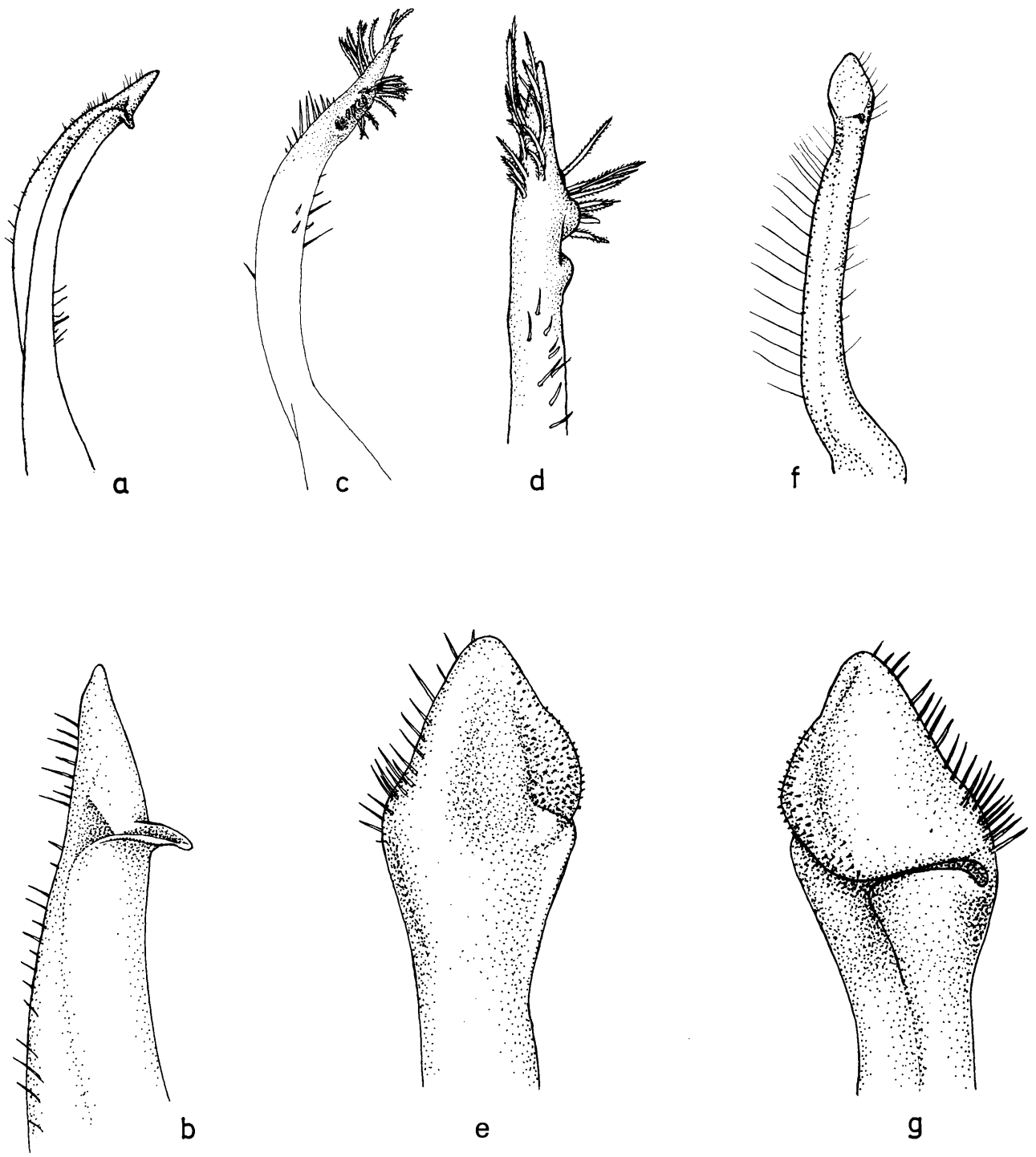


Fig. 73. Left first pleopod of male of *Maja confragosa* (holotype) (a) abdominal view of pleopod, (b) abdominal tip of same; *M. africana* (holotype) (c) abdominal view of pleopod, (d) sternal tip of same; *Notomithrax spinosus* (male, 12.5 mm, Kermadec Is., ZMC) (e) sternal tip of pleopod, (f) abdominal view of pleopod, (g) abdominal tip of same.

long, seventh segment about one and a half times as wide as long.

First pleopod of the male similar to that of *M. nagashimaensis* Sakai: distally curved slightly outwards and tapering only at apex; opening below apex on medial edge; ventral edge of opening with a short, narrow, acute lobe produced across abdominal surface.

Remarks. — This species can be distinguished from *M. miersii*, *M. suluensis* and *M. spinigera* by the absence of long dorsal spines. The first pleopod of the male is similar to that of *M. nagashimaensis* but this new species is distinguished from that species and the other small species, *M. japonica*, *M. sakaii* and *M. africana*, by having large coarse tubercles, not fine granules, on the carapace surface, and a ridge of stout spines rather than a few slender spines in the midline. It is distinguished from *M. bisarmata* by the presence in that species of two cardiac spines and the smooth carapace surface

between the more scattered tubercles and spines. This species is similar to *M. gibba* in the convex carapace and coarse tubercles which are enlarged along the midline, but in *M. confragosa* the carapace tubercles are granular with many small tubercles and granules between them, not smooth, rounded, with the surface between them smooth as in *M. gibba*, and there are six distinct tubercles on the midline. *M. confragosa* can be distinguished from a young *M. gibba* of the same size by the three longer spines anteriorly on the branchial margin and the presence of a fourth spine more dorsally placed (absent in *M. gibba*); by the postorbital spine which is longer and more slender distally than in *M. gibba*; and by the rostral spines which are longer (0.36 rather than 0.17 postrostral cl.) and horizontal, not declivous as in *M. gibba*.

M. confragosa is similar to the Atlantic species *M. squinado* (Herbst) in the convex, generally tuberculate carapace and the ridge of short subequal spines on the midline. The first pleopod of the male in *M. squinado* is similarly broad and tapers near the apex, but it lacks the small process on the abdominal surface. The basal antennal article in *M. squinado* is much broader than in *M. confragosa* or any of the Indo-west Pacific species of *Maja*.

The specific name refers to the rough appearance of the new species.

Distribution. — Known only from the type locality, Kai Islands.

Maja gibba Alcock, 1895

Maia gibba Alcock, 1895: 239-240, pl. 4 fig. 5, 5a. — Kemp & Sewell, 1912 31.

Maja gibba. — Serène & Lohavanijaya, 1973: 50 (in key), pl. 9 B. — Griffin, 1976: 200. — Sakai, 1976: 239-240, fig. 127a,b, pl. 84 fig. 1.

Material examined. — 4 ♂♂, 3 ♀♀ (1 ovig.) 35-85 mm, ovig. ♀, 76.5 mm.

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Mortensen Pacific Expedition: East China Sea, 32°17′N 128°11′E, 198 m, trawl, sand, 14 May 1914; 4 specs.

Mortensen Java — S. Africa Expedition: Stn. 15, Bali Sea, 07°29′S 114°29.7′E, ca. 240 m, trawl, sand and mud with concretions, 10 April 1929; 2 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

South China Sea, 16°09.4′N 114°31.6′E to 16°11′N, 114°29.7′E, 266-295 m, Granton trawl, white muddy sand, Fisheries Research Station, Hong Kong, 12 June 1964; 1 spec. (AM P.20323).

Remarks. — The smaller specimens in this series (less than 57 mm cl.) agree with *M. gibba* as figured by Alcock (1895): the tubercles are rather sharp, a few are low spines in the mid-dorsal line, and there are three to four short spines on the branchial margin. In the larger specimens the tubercles are blunt even in the mid-dorsal line and there is only a sharp tubercle on the branchial margin representing the first marginal spine of the juvenile. This difference between the young and adult specimens of *M. gibba* has been reported also by Sakai (1976).

The larger specimens of *M. gibba* are very similar to *M. kominatoensis* (Kubo) (Kubo, 1936: 361-364, figs. 1, 2; Miyake, 1936: 418-419, pl. 28 figs. 1, 2) and in the descriptions of these two species by previous authors there seems to be no character which distinguishes clearly between them; the size and bluntness of the carapace tubercles is not a reliable character because it varies with age. Sakai has not reported on the differences if any, between the young specimens of *M. kominatoensis* and those of *M. gibba.* Until a detailed published description or an examination of specimens proves otherwise, we feel that it is probable that *M. kominatoensis* is conspecific with *M. gibba.*

In the specimens of *M. gibba* that we have examined the basal antennal article has a short spine at both the medial and lateral angles anteriorly, there is a tubercle on the medial edge and two tubercles on the lateral edge. The first sternite of the male is smooth except for a group of tubercles on the posteromedial angle; on sternal segments two to four there are tubercles near the abdominal fossa. The merus of the adult male cheliped is broadened distally with a very small acute terminal spine, the carpus bears two longitudinal ridges of which the outer is more tuberculate, the palm is expanded and flattened and subquadrate and about one and a half times as long as high; the fingers are nearly as long as the palm, slender, unarmed, with a moderate gape between them proximally. The ambulatory legs of the adult males have a fringing row of setae on the distal half of the dactyl, but few other hairs; in the ovigerous female, however, all the legs have a distinct covering of hair (this character is not a reliable distinction between the two species as may perhaps have been inferred by comparing the two figures given by Sakai (1976: pl. 84)). The first pleopod of the male is like that figured as *M. gibba* by Sakai (1976) and as *M. kominatoensis* by Kubo (1936). The gonopore of the female opens anteromedially and the lateral edge of the opening is thickened.

Distribution. — Andaman Sea, Java, Philippine Islands, South China Sea, East China Sea, Japan.

Maja japonica Rathbun, 1932

Maja japonica Rathbun, 1932: 33. — Sakai, 1965a: 83, pl. 37 fig. 1; 1976: 238-239, fig. 126a,b, pl. 82 fig. 1 — Takeda & Miyake, 1969: 512-513 (in discussion), pl. 17 figs. A, B. — Takeda, 1973b: 42. — Serène & Lohavanijaya, 1973: 50-51, figs. 93-97, pl. 9 fig. A. (Not *Maja japonica* Sakai, 1934; 1938 = *M. sakaii* Takeda & Miyake, 1969.)

Material examined. — 3 ♂♂, 6 ♀♀ (2 ovig.), 15-26 mm, smaller ovig. ♀, 16.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Sagami Bay, Misaki, off the station, 144-216 m, 10 June 1914; 1 spec. — Okinose, Sagami Sea, 180 m, 15 June 1914; 1 spec. — Off Misaki, 144-180 m, 19 June 1914; 1 spec. — Okinose, Sagami Sea, 180 m, 23 June 1914; 1 spec. — Okinose, Sagami Sea, 540 m, 29 June 1914; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

South China Sea, 17°42.2′N 107°33.2′E to 17°42.8′N 107°29.2′E, 68 m, Granton trawl, mud bottom, Fisheries Research Station, Hong Kong, 6 October 1963; 4 specs. (AM P.20324).

Remarks. — The specimens from the Sagami Sea agree well with *M. japonica* Rathbun as described and figured. On the branchial margin anteriorly there is a short spine with two or three sharp tubercles behind it, and posteriorly there are two spines (one more dorsally placed) and a few sharp tubercles ventrally. The male in our Japanese series is infected with a bopyrid parasite and has only one sharp tubercle (not a spine) on the anterior and one spine (dorsal) on the posterior branchial margin.

Our specimens from the South China Sea are like that figured by Serène & Lohavanijaya (1973); on the branchial margin there are three short spines or sharp tubercles anteriorly and two posterior spines (one dorsal), with only one or two sharp tubercles ventral to them. The intercalated spine in the specimens from the South China Sea is slightly broader in the larger adult specimens, its margins are more granular and in the males it lies closer to the postorbital spine.

There is an anterior intestinal spine; the armament of the posterior margin of the carapace is variable and consists of two to four tubercles or enlarged granules.

The postorbital spine is directed forward with its apex about level with that of the antorbital spine; in *M. sakaii* the postorbital spine is shorter and more oblique.

The basal antennal article in this species is narrow with two short anterior spines, as it is in *M. sakaii*, but both edges and the surface are tuberculate, whereas in *M. sakaii* the tubercles are mainly along the edges.

The male of this species may be distinguished from that of *M. sakaii* by the form of the first pleopod (Sakai, 1976: fig. 126a). The gonopore of the female is a slit, opening anteromedially, with the lateral margin slightly thickened. (In *M. sakaii* it is a simple, round, opening.)

Distribution. — Japan, Tsushima Islands, South China Sea.

Maja miersii Walker, 1887

Maia Miersii Walker, 1887: 113-114, pl. 6 figs. 1-3.
Maja miersii. — Rathbun, 1924: 6. — Sakai, 1938: 298-299, pl. 38 fig. 2.; 1976: 237, pl. 82 fig. 3. — Griffin, 1966b: 284 (in key).

Material examined. — 2 ♂♂, 1 ♀ (ovig.), 22-51 mm, ovig. ♀, 51 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Singapore, 1 September 1908; 1 spec. — Singapore, trawl, 1903-1907; 2 specs.

Remarks. — This species is similar to *M. suluensis* Rathbun, and the characters that distinguish it are discussed under that species.

In our specimens the hepatic region behind the spine is distinctly swollen with several large tubercles, but there is no small secondary spine. This secondary spine was described and figured by Walker for the holotype, but not noted by Sakai (1938: 1976) for the Japanese specimens; it is absent from the specimen from Western Australia identified as *M. miersii* by Rathbun (1924).

Distribution. — Japan, Singapore, Western Australia.

Maja nagashimaensis Sakai, 1969

Maja nagashimaensis Sakai, 1969: 256-257, fig. 5b,b¹, pl. 1 fig. 2; 1976: 241-242, fig. 129, pl. 85 fig. 1.

Material examined. — 2 ♂♂, 16, 19 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 105, Sulu Archipelago, 06°08′N 121°19′E, 275 m, dredge, coral bottom, 4 July 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Japan, Misaki, 360 m, 30 June 1914; 1 spec.

Remarks. — The hepatic spine in this species is directed obliquely backwards and fused basally with the postorbital spine. There are four strong marginal branchial spines. On the midline there is a low spine or tubercle between the mesogastric and cardiac spines. There is no intestinal spine but there are two small submedial spines on the posterior margin of the carapace.

The first pleopod of our male specimen shows no differences from that figured by Sakai (1969: 1976).

This is the first record of this species outside Japan.

Distribution. — Japan; Sulu Archipelago.

Maja sakaii Takeda & Miyake, 1969

Maja japonica. — Sakai, 1934: 297, figs. 10, 11a; 1938: 229, pl. 30 fig. 2. (Not *Maja japonica* Rathbun, 1932.)
Maja sakaii Takeda & Miyake, 1969: 512-513, pl. 17 fig. C. — Sakai, 1976: 237-238, figs. 125a,b, pl. 85 fig. 2.

Material examined. — 8 ♂♂, 7 ♀♀ (4 ovig.), 9-15.5 mm, smallest ovig. ♀, 12.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Islands, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. — Stn. 260, Kai Is., 2.3 miles (~ 3.7 km) N63°W. from N. point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, Blake dredge, sand, coral and shells, 16/18 December 1899; 3 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Ambon I., Ambon Bay, 126 m, stones, 23 February 1922; 1 spec. — Ambon I., Ambon Bay, 126 m, stones, 25 February 1922; 3 specs. — Ambon, 90 m, stones, 2 March 1922; 1 spec.

Mortensen Java-S. Africa Expedition: Stn. 18, Bali Sea, 07°15′S 114°45′E, ca. 100 m, trawl, 11 April 1929; 1 spec. — Stn. 22, Java Sea, 07°31′S 113°8′E, ca. 35 m, Sigsbee trawl, mud and sand, 12 April 1929; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AH I, E. of Ambon, near Tg. Bt. Kapal, Haruku I., 03°36′S 128°24′E, 108-113 m, dredge haul 4, shell and rubble, 31 May 1970; 4 specs.

Remarks. — These specimens from Indonesia agree well with *M. sakaii* from Japan as described and figured under the name *Maja japonica* by Sakai (1934; 1938) and as *M. sakaii* by Takeda & Miyake (1969) and Sakai (1976).

The spines of the upper orbital border are well separated from each other. The postorbital spine is directed obliquely forwards, its apex does not reach as far forward as the apex of the antorbital spine and it has only a small lobe on the anterior border. (In *M. japonica* the postorbital spine is longer and less oblique.)

The carapace is slender and on the gastric region there are two mesogastric spines of which the anterior is either much shorter (two thirds of the specimens) or absent. There is a medial spine on the carapace region, one on the anterior intestinal region and one on the posterior margin of the carapace; in some specimens there are tubercles on either side of this last spine.

On the branchial margin there is a short spine anteriorly followed in some specimens by one or two tubercles; posteriorly there are two long spines, the more posterior situated more dorsally on the carapace.

The basal antennal article is narrow, there are two short anterior spines, tubercles on the lateral and medial margins and sometimes tubercles on the surface.

The males of this species may be distinguished from the similar species *M. japonica* by the form of the first pleopod (Sakai, 1976: fig. 125b). The gonopore of the female is a simple, round opening. (In *M. japonica* it is a slit, opening anteromedially.)

This species has not been recorded previously from Indonesia.

Distribution. — Indonesia: Java to Kai Islands; East China Sea, Japan.

Maja suluensis Rathbun, 1916
(Fig. 71f)

Maja suluensis Rathbun, 1916: 552-553. — Griffin, 1976: 300, fig. 7a.

Material examined. — 2♀♀, postrostral cl. 38 mm, cl. 51.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Sulu Archipelago, N. of Jolo, ca. 36 m, dredge, *Lithothamnion*, 18 March 1914; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. KN II, Kai Is., off Elat Bay, W. coast Nuhu Tjut, 05°40′S 132°59′E, 48-54 m, dredge haul 6, rubble, algae and sand, 13 June 1970; 1 spec.

Remarks. — This species is similar to *M. miersii* Walker. Rathbun distinguished it by the presence of two gastric spines (not one), and the absence of a secondary spine on the hepatic region. Our specimen from the Sulu Archipelago agrees with the type series of *M. suluensis* from the same locality described by Rathbun (1♂, 3♀♀, 14.5-50.5 mm, USNM 48224 (holotype), 48507, 49697) which one of us (D.J.G.G.) has subsequently examined: they all have two gastric spines. Our specimen from the Kai Islands, however, while being similar to these specimens in most characters, has only one gastric spine. In all these specimens the hepatic region behind the marginal spine is only weakly swollen and bears small tubercles. The holotype of *M. miersii*, according to the figures, has a secondary spine on the hepatic region but on the specimens described by later authors (Rathbun, 1924; Sakai, 1938, 1976) and those we have examined there is a group of large tubercles rather than a spine.

While we consider that *M. suluensis* and *M. miersii* are two valid species it seems that the characters which Rathbun used to diagnose *M. suluensis* are not reliable. The following characters appear to be more suitable in distinguishing the two species. In *M. suluensis* the antorbital spine is curved forward distally (straight, and parallel to the postorbital spine in *M. miersii*); on the basal antennal article the acute anteromedial spine is directed ventrally and curved forward distally as is the interantennular spine (blunt and straight in *M. miersii*); the anterolateral spine of the basal antennal article is directed outwards and slightly forwards (directed straight outwards in *M. miersii*) and the lateral edge is moderately concave and the proximal lobe moderately produced (strongly concave and strongly produced in *M. miersii*).

It is possible that the first pleopod of the adult males of these two species would provide additional distinguishing features, but they have not yet been figured and we have not had an opportunity to examine them.

This is the first record of this species outside the Sulu Archipelago.

Distribution. — Sulu Archipelago, Kai Islands.

Majella Ortmann, 1893

Type species. — *Majella brevipes* Ortmann, 1893, by monotypy.

Remarks. — This genus contains only a single species which appears to be confined to Sagami Bay, Japan; it has been discussed recently by Sakai (1965a: 84-85, text fig. 12, pl. 37 fig. 4). Dorsally the orbit comprises a spinulous eave, a sharp antorbital spine, an intercalated spine and a postorbital lobe; ventrally there is a suborbital lobe. The antenna is not excluded from the orbit. Sakai remarks that the chelipeds are like those of *Eurynome*, though not longer than the ambulatory legs, and the fingers are slightly bent toward the fixed finger. The first pleopod of the male, figured by Sakai, is straight, it

appears to have a terminal or subterminal aperture and a group of long setae on the lateral margin of the apex.

Distribution. — Restricted to Japan.

Microhalimus Haswell, 1880 new status
(Fig. 86g,h)

Type species. — *Halimus* (*Microhalimus*) *deflexifrons* Haswell, 1880, by monotypy.

Remarks. — The status of *Microhalimus* has been uncertain for some time (Griffin, 1966b, 1966d). It was originally described by Haswell as a subgenus of *Halimus*; Miers (1884) remarked on its similarity to *Pseudomicippe*; McCulloch (1913) included it as a subgenus of *Naxia*, the genus in which he placed other species of *Halimus*. It is here given status as a distinct monotypic genus and included in the Majinae. In *Microhalimus* as in *Naxia* and *Pseudomicippe* the postorbital spine is remote from the eye and serves no protective function. (McCulloch regarded the two spines behind the orbit as hepatic spines; we consider the first spine to be postorbital and the second hepatic.) Both *Microhalimus* and *Pseudomicippe* lack the intercalated spine present in *Naxia*.

The first pleopod of the male of *M. deflexifrons* (fig. 86) has an aperture similar to that found in species of *Naxia* but the tip beyond the aperture, is much more elongate, the apex is acute, and there are longer setae on the abdominal surface. In species of *Pseudomicippe* there is usually a spine, a flap and a tubercle near the aperture of the male pleopod, none of which are found on the pleopod of *M. deflexifrons*.

M. deflexifrons also differs from species of *Naxia* in having more slender eyestalks; a small tubercle on the anterior margin of the postorbital spine; the carapace tomentose rather than smooth between the groups of curled hairs and the seventh segment of the male abdomen twice as wide as long, not as wide as long.

Distribution. — Southeast Australia.

Naxia Latreille, 1825
(Figs. 74, 75)

Type species. — *Pisa aurita* Latreille, 1825, by monotypy.

Remarks. — The history of the generic name *Naxia* was dealt with in detail previously (Griffin, 1966d: 29-30). It seems that this genus has been included in the Inachinae on the basis of the incomplete orbit and slender eyestalk. However, the first pleopod of the male of four of the species of *Naxia* — *N. aries* (Guérin), *N. aurita* (Latreille), *N. spinosa* (Hess), *N. tumida* (Dana) — is similar to that of some Majinae, the aperture being slit-like with a rounded lobe and expanded margins. As well, in these four species, there is a developed, though not strongly broadened, eave; a broadened basal antennal article, fused distally so that the antenna is excluded from the orbit; and the merus of the third maxilliped is broad. Further, the two conical spines behind the eave are part of the orbit, the more anterior being an intercalated spine as is typical of the Majinae. In *N. tumida* the intercalated spine is separated from the eave by only a small notch.

The fifth species *Naxia huttoni* (A. Milne Edwards) differs from the four species above in the male pleopod, orbital structure, third maxilliped and male abdomen. It is our opinion that this species should remain in the Inachinae and revert to the monotypic genus *Trichoplatus*. It is discussed under that genus.

Haswell's subgenus *Microhalimus* was included as a subgenus of *Naxia* by McCulloch (1913). *Microhalimus* is here given separate generic status within the Majinae.

Distribution. — Confined to the Australian littoral except for one species *N. spinosa* which also occurs in the Kermadec Islands (recorded by Miers, 1879a, as *Halimus truncatipes*).

KEY TO SPECIES OF *NAXIA*

1 Anterolateral spine of basal antennal article with accessory spinules; intercalated spine separated from supraorbital eave only by a notch (or fused to it) (Fig. 74g); hepatic spine short and blunt ..... *N. tumida*
— Anterolateral spine of basal antennal article unarmed; intercalated spine well separated from supraorbital eave; hepatic spine acuminate 2
2(1) Rostral spines slender, strongly curved outwards distally; neither preorbital nor antorbital angles of eave produced as spines; postorbital and hepatic spines close at base; basal antennal article very slender ..... *N. aries*
— Rostral spines stout, straight, divergent; both preorbital and antorbital spines present; postorbital and hepatic spines well separated at base; basal antennal article moderately broad 3
3(2) Preorbital and antorbital spines both broad and triangular; intercalated spine directed laterally; propod of ambulatory leg not strongly expanded near distal margin ..... *N. aurita*
— Preorbital spine broad, blunt, upturned, antorbital spine slender, acuminate; intercalated spine directed obliquely forwards; propod of ambulatory leg strongly expanded near distal margin. *N. spinosa*

Notomithrax Griffin, 1963

Type species. — *Paramithrax peronii* H. Milne Edwards, 1834, by original designation.

Remarks. — This genus was discussed in detail by Griffin (1963b; 1966d). In the first pleopod of the male of *N. peronii*, *N. minor* (Filhol) and *N. ursus* (Herbst) the aperture is transverse and the basal and distal edges are expanded to varying degrees; beyond the aperture the pleopod is slender with a finely pointed tip. The pleopod of *N. spinosus* (Miers) is much braoder and quite blunt apically, it lacks the slender distal process of the other species and the edges of the aperture are not expanded.

Notomithrax baeckstroemi (Balss) from Juan Fernandez Islands, Chile has been included in this genus until now, but

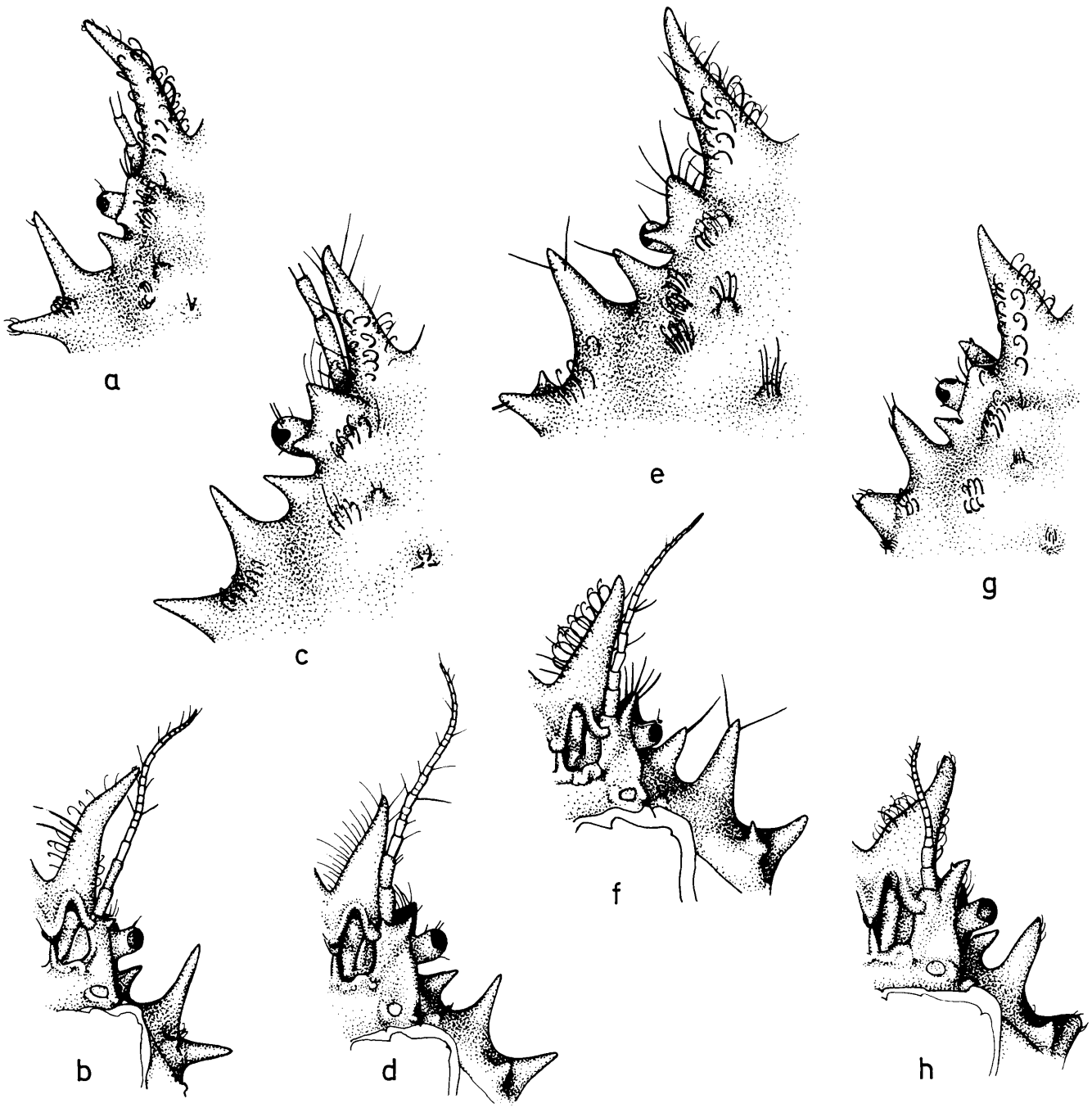


Fig. 74. Left orbit of *Naxia aries* (male, 39 mm, AM P.15992) (a) dorsal view, (b) ventral view; *N. aurita* (male, 62 mm, AM P.26918) (c) dorsal view, (d) ventral view; *N. spinosa* (male, 63 mm, AM P.12341) (e) dorsal view, (f) ventral view; *N. tumida* (male, 28 mm, AM P.10383) (g) dorsal view, (h) ventral view.

it differs from other species of *Notomithrax* in having a preorbital spine and the first pleopod of the male (Garth, 1958; pl. U fig. 2) shows more affinities with the pleopods of some species of *Thacanophrys* than with those of *Notomithrax* species. For these reasons we have removed *N. baeckstroemi* from *Notomithrax* to the new genus *Ageitomaia.*

Distribution. — South West Pacific; restricted to Australia, New Zealand and adjacent islands.

KEY TO SPECIES OF *NOTOMITHRAX*

1 Carapace with spines in the dorsal midline as well as tubercles; five to seven marginal branchial spines 2
— Carapace with tubercles in the dorsal midline; rarely short spines; two to four marginal branchial spines 3
2(1) Protogastric regions smooth or only faintly tuberculate ; seven marginal branchial spines; merus of cheliped smooth dorsally, carpus with dorsal ridge poorly developed, tuberculate, lateral ridge well developed, sharp, entire ..... *N. minor*
— Entire surface of carapace covered by tubercles and spines leaving no smooth areas; five marginal branchial spines; merus of cheliped

with a few spines and tubercles dorsally; carpus with dorsal ridge entire, blunt, lateral ridge well developed, blunt, entire.. *N. peronii*

3(1) Three marginal hepatic spines and three marginal branchial spines forward of widest part of carapace; intercalated spine acuminate, postorbital lobe slender; carpus of cheliped with serrate crests..... ..... *N. ursus*

— One marginal hepatic spine and four (sometimes two) marginal branchial spines, the last behind widest part of carapace; intercalated spine blunt, postorbital lobe broad; carpus of cheliped with sharp tubercles ..... *N. spinosus*

Notomithrax spinosus (Miers, 1879) (Figs. 73e-g, 76)

Paramithrax (*Paramithrax*) *spinosus* Miers, 1879a: 9, pl. 4 fig. 5.
Notomithrax spinosus. — Griffin, 1963b: 232 (in key).

Material examined. — 1♂, 12.5 mm, 1♀ (ovig.), 9.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Galathea' Expedition: Stn. 674, Kermadec Islands, Raoul Islet, 29°13′S 177°57′W, 75-85 m, dredge, gravel and stones, 3 March 1952; 1 spec. — Stn. 675, Kermadec Islands, Raoul Islet, 29°13′S 177°57′W, 60 m, trawl, stones, 3 March 1952; 1 spec.

Remarks. — These specimens agree with the holotype described by Miers in the small size, granulated carapace surface and blunt supraorbital spines.

These specimens differ from the description and figure given by Miers in the following points:

1. the spines on the gastric region, intestinal region and posterior margin of the carapace in the holotype, are represented only by tubercles;
2. there are four small spines (not two) on the branchial region;
3. the carpus of the cheliped is armed with sharp tubercles rather than a dentate crest;
4. as well as an anterolateral spine there is a small anteromedial spine on the basal antennal article;
5. the rostral spines are broader.

In general these differences are of the kind encompassed by intraspecific variation in other species of *Notomithrax*.

The first pleopod of the male is apically more blunt than that of other species of *Notomithrax* (see Griffin, 1966d: fig. 21).

Distribution. — South Western Pacific: Norfolk I., Kermadec Is.

Paramithrax H. Milne Edwards, 1834

Type species. — *Pisa barbicornis* Latreille, 1825 by subsequent designation of Desmarest (1858).

Remarks. — This genus and its type species have been dealt with in detail previously (Griffin, 1963b, 1963c, 1966d).

The first pleopod of the male of *P. barbicornis* is apically truncate, but in fact examination shows that it is similar in its basic structure to the first pleopods of males of *Thacanophrys* species. In *P. barbicornis* the part of the pleopod beyond the aperture is greatly reduced so that the aperture is terminal. A similar reduction in the tip of the pleopod occurs in *Tumulosternum parvispinosus* (Ward).

This genus is set apart from other genera with a *Thacanophrys* type of pleopod by the carapace ornamentation (weakly tuberculate and weakly spinous) but more importantly by the structure of the orbit. Dorsally the postorbital lobe is remote from the orbit and ventrally the broad basal antennal article has a notch on the lateral margin just before the anterolateral angle, giving the article a peculiar appearance.

Distribution. — Restricted to southern Australia (southwest, south, southeast).

Pippacirama new genus

Type species. — *Paramicippe tuberculosa* H. Milne Edwards, 1834.

Description. — Carapace pyriform with tubercles and spines. Rostrum of two spines fused basally, separate in distal half, deflexed. Orbit above comprising an eave and postorbital lobe; eave with a small posterior lobe. Postorbital lobe lamellate not excavate, a lobe on anterior margin. Eyestalks long, slender, not retractile against postorbital lobe, orbit open below. First free segment of antenna flattened and dilated. Third maxilliped with merus wider than ischium, anterolateral angle produced. Chelipeds of male tuberculate. Ambulatory meri tuberculate. Abdomen of seven segments in both sexes. First pleopod of male with two well developed apical lobes.

Remarks. — It has been explained previously (Griffin, 1966b: 268) that because *Paramicippa* was not a valid genus for *P. tuberculosa* this species has been included until now in the genus *Micippa*. However, it differs from all other species of *Micippa* in several important characters. The upper orbit lacks an intercalated spine and is open while in species of *Micippa* there is an intercalated spine and the orbit is closed; the lower orbit is also open and the basal antennal article is widely separated from the postorbital lobe, while in species of *Micippa* the basal antennal article is broad and there is a suborbital lobe adjacent to both it and the postorbital lobe; there are two well developed apical lobes on the first pleopod of the male, while in *Micippa* species the first pleopod is apically simple. In addition the rostral spines are separate in the distal half and the anterolateral angle of the merus of the third maxilliped is strongly produced and rounded, features not found in *Micippa*. The open orbit of *Pippacirama* makes it entirely inappropriate to place it in the Mithracinae.
The new name is an anagram of Paramicippa.

Distribution. — Southeastern and southern Australia.

Pippacirama tuberculosa (H. Milne Edwards, 1834), new combination (Figs. 68e,f, 77, Pl. 21b)

Paramicippe tuberculosa H. Milne Edwards, 1834: 333.
Micippe parvirostris Miers, 1879a: 13-14, pl. 4 fig. 9.

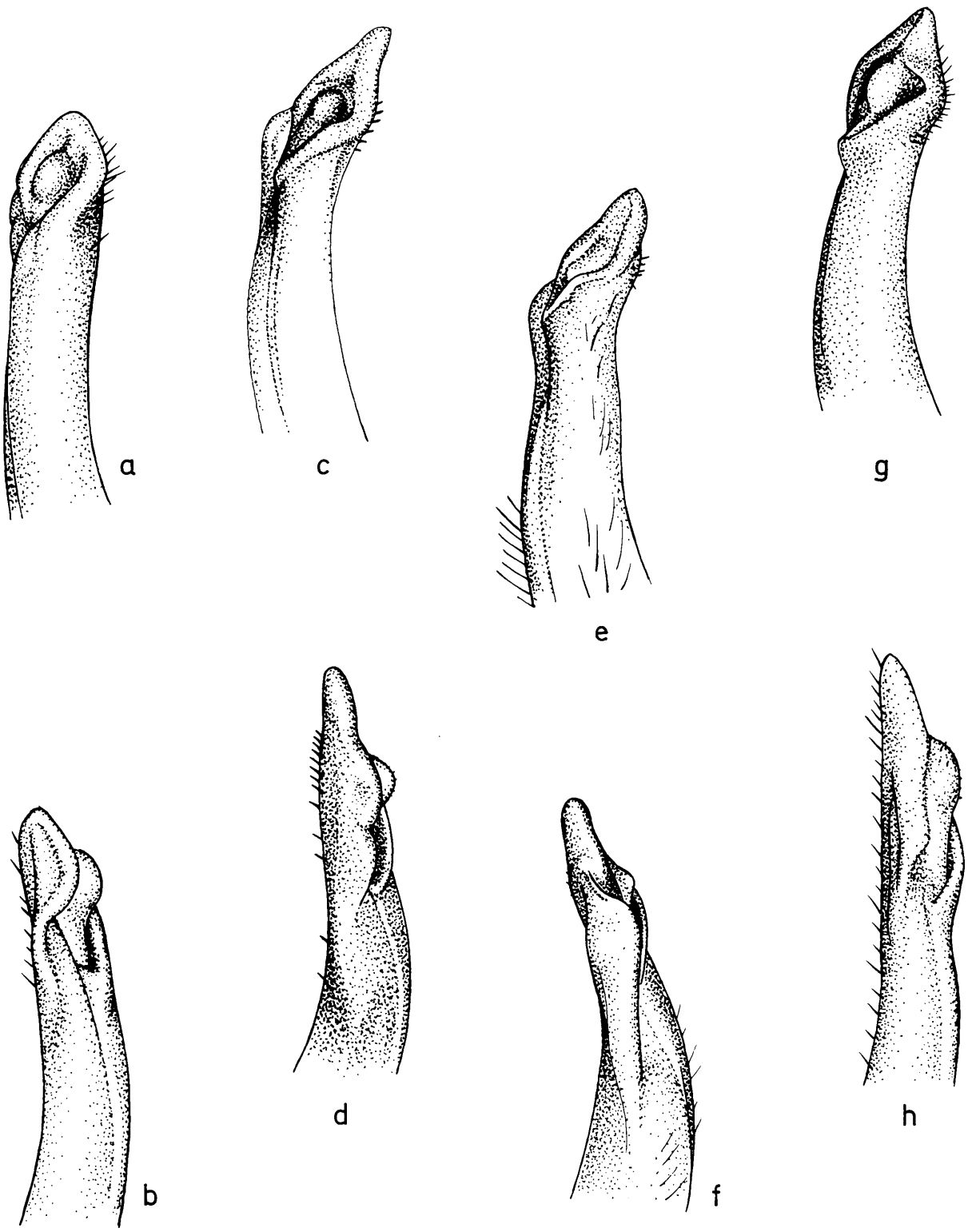


Fig. 75. Left first pleopod of male of *Naxia aries* (39 mm, AM P.15992) (a) abdominal tip of pleopod, (b) sternal tip of same; *N. aurita* (62 mm, AM P.26918) (c) abdominal tip of pleopod, (d) sternal tip of same; *N. spinosa* (63 mm, AM P.12341) (e) abdominal tip of pleopod, (f) sternal tip of same; *N. tumida* (28 mm, AM P.10383) (g) abdominal tip of pleopod, (h) sternal tip of same.

Paramicippa tuberculosa. — Miers, 1885: 12-13, pl. 1 fig. 1, 1a-c. — Hale, 1927: 140, fig. 142.
Micippa tuberculosa. — Griffin, 1966b: 268, 287; 1972: 73.

Material examined. — 5 ♂♂, 11 ♀ ♀ (7 ovig.) 10-20 mm, smallest ovig. ♀, 10 mm.

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New South Wales: Collaroy, Long Reef; 1 spec. (AM P. 8707). — Port Jackson; 2 specs. (AM P. 165); 1 spec. (AM P.29840). — Port Jackson, Bottle and Glass rocks, intertidal, 27 May 1926; 1 spec. (AM P. 9225); 1 spec. (AM P. 8619). — Port Jackson, Sow and Pigs Reef, about 5 m, coll. F. A. McNeill, November 1926; 2 specs. (AM P. 8714). — Port Jackson,

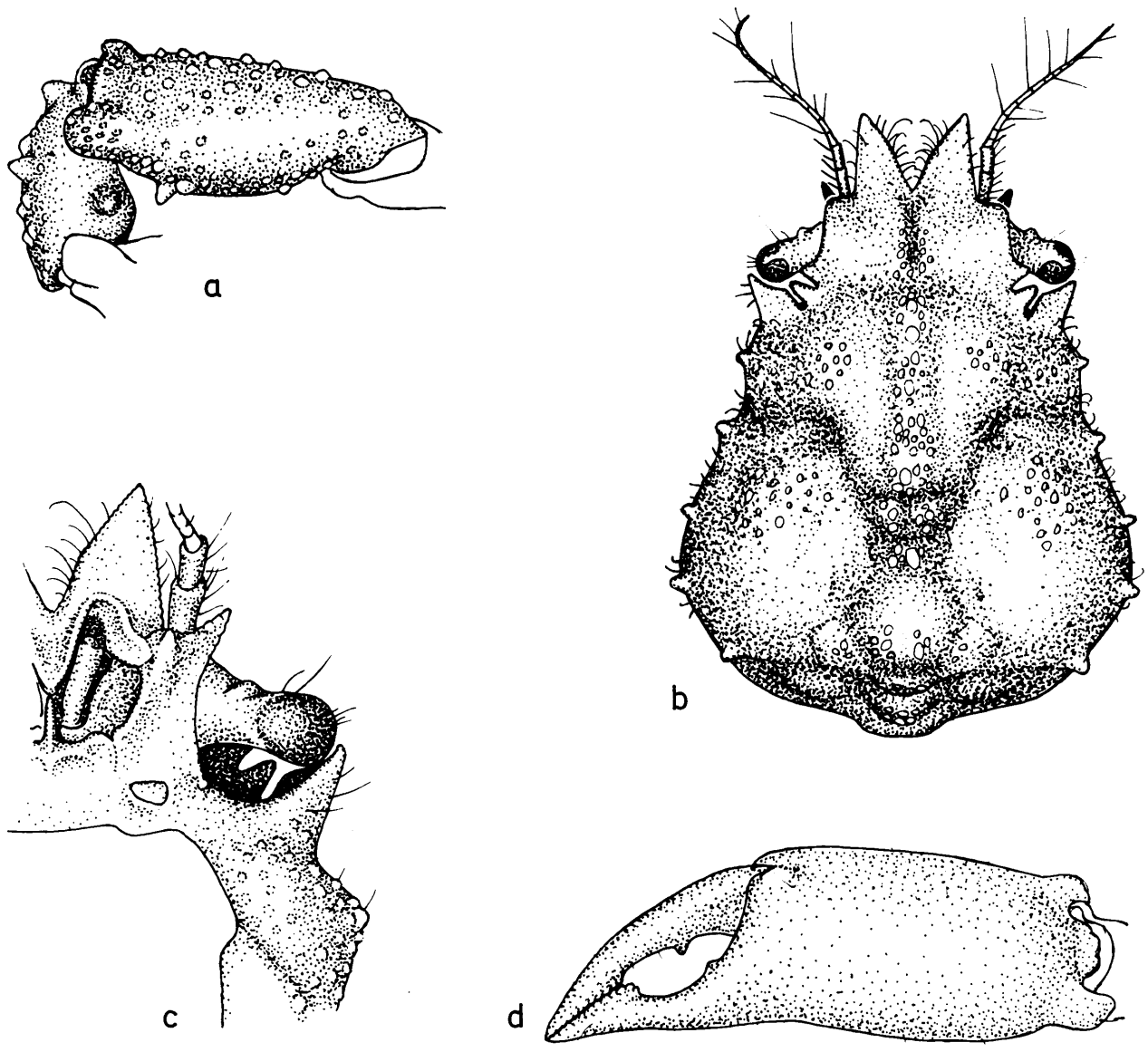


Fig. 76. *Notomithrax spinosus* (male, 12.5 mm, Kermadec Is., ZMC) (a) left cheliped, merus and carpus; (b) carapace, dorsal view; (c) left orbit, ventral view; (d) left chela.

vicinity of Sow and Pigs Reef, about 7 m, dredged, 16 January 1928; 1 spec. (AM P. 9049). — Botany Bay, Kurnell, coll. F. A. McNeill, December 1927; 1 spec. (AM P. 8941).

Victoria: Port Phillip; 2 specs. (AM G. 620); 1 spec. (AM G. 5936).

South Australia: 1 spec. (AM P.2350); 1 spec. (AM P. 3096).

Western Australia: near Albany, King George Sound, dredged, June 1948; 1 spec. (AM P. 14006).

Remarks. — This series of specimens comes from four discrete areas of Australia and shows geographic variation in several characters. In the specimens from New South Wales the margin of the supraorbital eave is smooth with a row of tubercles parallel to it; in specimens from Victoria and South Australia there is a continuous row of large tubercles on the margin; and in the specimen from Western Australia there are about six small, separate tubercles on the margin of the eave.

The postorbital lobe in the New South Wales specimens is blunt with a rounded accessory lobe on the anterior margin and tubercles principally on the margins of the lobe; in the Victorian and South Australian specimens the lobe is also blunt with a rounded accessory lobe but there are many rounded tubercles on the surface of the lobe; in the Western Australian specimen the postorbital lobe and the accessory lobe are both apically pointed and there are only a few basal tubercles on the lobe.

There is a large compound tubercle or groups of compound tubercles dorsally on the hepatic region in the New South Wales specimens. In these specimens the gastric region is also more strongly and narrowly elevated than in the specimens from other areas and there are three tuberculate mesogastric spines rather than three large mesogastric tubercles. On the cardiac region there are similar variations in the degree of elevation, density of tubercles and height of the two spines.

In the males of the series as a whole, the merus and carpus of the male cheliped are tuberculate dorsally and on the outer

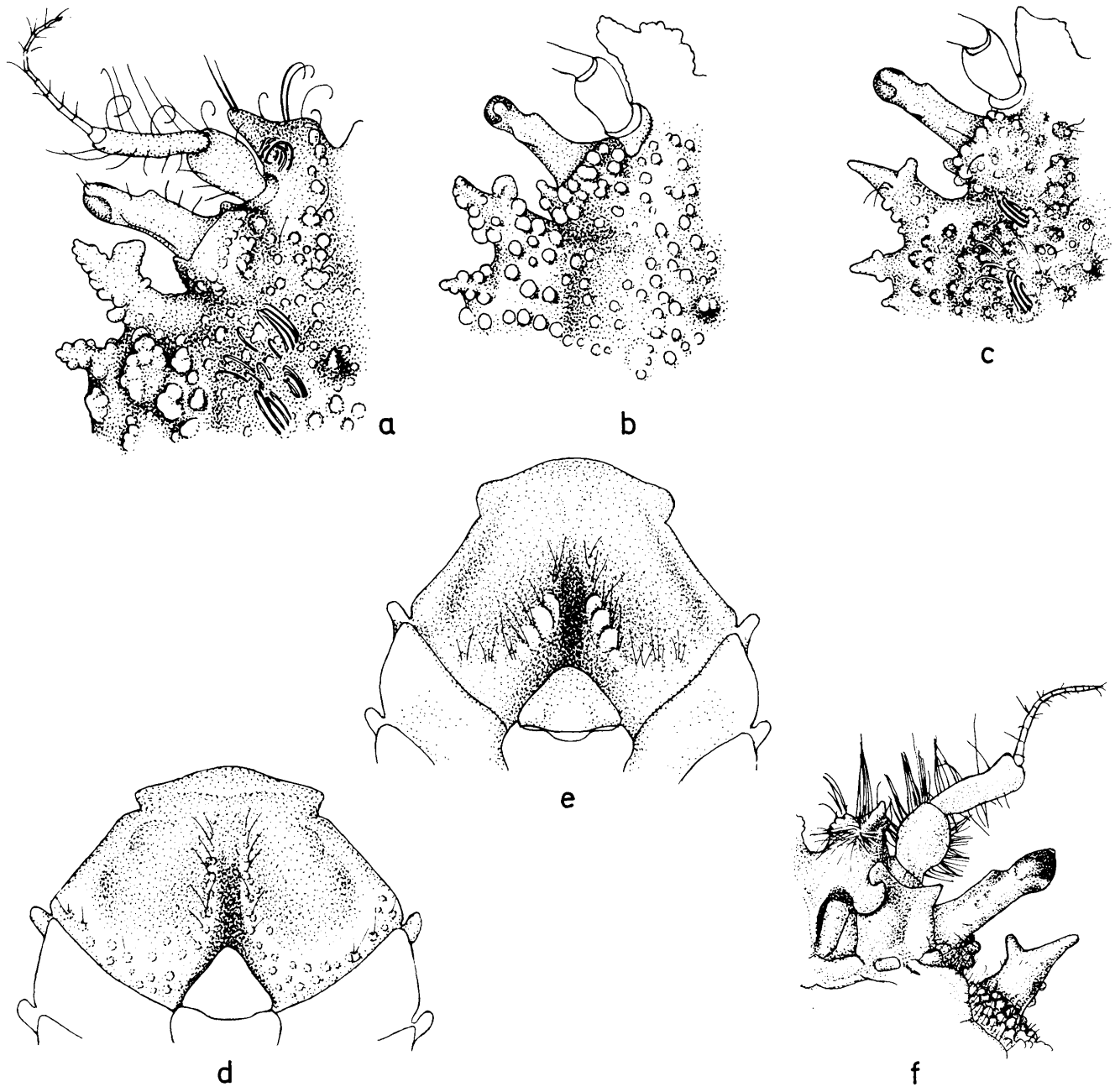


Fig. 77. *Pippacirama tuberculosa* (female, 14 mm, Port Jackson, AM P.8714 (a) left orbit, dorsal view; (male, 17.5 mm, S. Aust., AM P.3096) (b) left orbit, dorsal view; (male, 15.5 mm, W. Aust., AM P.14006) (c) left orbit, dorsal view; (male, 13.5 mm, Port Jackson, AM P.29840) (d) first sternite; (AM P.14006) (e) first sternite; (f) left orbit, ventral view.

face, but smooth on the inner face; there is a terminal spine on the merus. The palm is short, the length subequal to or only slightly longer (1.2) than the height; there are a few granules dorsally and about three small tubercles proximally on the dorsal margin; there is a proximal tubercle midway on the outer face. There is a large gape between the fingers and several small teeth on both fingers. In the Western Australian specimen there are fewer tubercles on the merus and carpus and only one or two granules on the palm.

Again, in all males of the series there is a groove on the first sternite, anterior to the abdominal fossa; in the New South Wales specimens the groove is bordered by many small tubercles, but in the Victorian and Western Australian specimens there are four or five large tubercles and in the South Australian specimens there are about eight moderate sized tubercles.

We have figured the first pleopod of the male which has not been described previously. There is no difference in the first pleopod of the male in specimens from different areas. The pleopod is straight and broad with two apical lobes — a narrow triangular lateral lobe directed outwards and a curved, slender medial lobe; there are two long setae on the anterior margin of the lateral lobe.

There is no evidence of gradation of characters from east

to west. The variations in the smoothness of the eave do not occur in conjunction with particular characters of the sternum or cheliped: it is not possible to separate the specimens into four valid species on the basis of the several characters described. We regard these specimens as belonging to a single variable species.

Distribution. — South eastern and southern Australia from Port Jackson (N.S.W.) through Victoria and South Australia to King George Sound (W.A.).

Pseudomicippe Heller, 1861; emended

Type species. — *Pseudomicippe nodosa* Heller, 1861, by monotypy.

Description. — Carapace pyriform, variously tuberculate, with a few small spines. Rostrum of two spines of moderate length, sometimes fused for up to basal third, sometimes deflexed. Orbit above comprising an eave expanded anteriorly and a postorbital spine separated by a narrow hiatus. Basal antennal article quadrate, not especially broad, with a prominent anterolateral spine or lobe; orbit open below. Eyestalks slender, long, extending beyond margin of carapace. Third maxilliped with merus as wide as ischium and expanded anterolaterally. Cheliped and ambulatory legs of moderate length. Abdomen of seven segments in both sexes.

Remarks. — Up till now most small tuberculate spider crabs previously in the subfamily Tychinae have been regarded as belonging to one of two genera: *Pseudomicippe* Heller, 1861 (based on *P. nodosa* Heller) or *Zewa* McCulloch, 1913 (based on *Z. banfieldi* McCulloch). A distinction between the genera has been made on the basis of the prominence of the preorbital lobe and of the antorbital lobe (''antero-superior lobe'' and ''hinder angle'' of orbit in McCulloch's terminology), *Zewa* species having an antorbital spine but not a preorbital lobe.

At present *Pseudomicippe* (including *P. nodosa* and *P. tenuipes* A. Milne Edwards) is known from the western Indian Ocean and Indonesia and *Zewa* (including *Z. banfieldi* McCulloch, *Z. varians* Miers (originally described as a *Pseudomicippe* species), *Z. nipponica* Sakai and *Z. okamotoi* Sakai) is known from the western Pacific (Japan, Indonesia, Australia) and the Indian Ocean (Western Australia). *Pseudomicippe incerta* Balss, 1938, from the Pacific is here shown to be a species related to *Lahaina ovata* one of the *Hyastenus* group of genera and is discussed under *Lahaina*.

It is extremely difficult, on the basis of one or two characters of the orbit to distribute the six previously known species and the five new species before us between two distinct genera. There are differences in the spininess, tuberculation, length and form of the rostrum (horizontal or deflexed), form of the basal antennal article and length of legs, differences which do not necessarily complement differences in the orbit. The preorbital area itself varies in prominence. All that remains to support such a division in a not untidy geographic separation.

This confusion is further exacerbated by examination of the first pleopods of the males, that of *P. tenuipes* being similar to that of *P. banfieldi* but significantly different from that of *P. nodosa*. In summary, examination of the first pleopod of the males shows the existence of four groups as listed below. The addition of five new species to the previously described species of *Pseudomicippe* and *Zewa* assists the confusion.

Group 1	*Group 2*	*Group 3*	*Group 4*
P. philippinensis n.sp.	*P. tenuipes*	*P. indonesica* n.sp.	*P. nodosa*
P. maccullochi n.sp.	*P. varians*		*P. eldredgei* n.sp.
P. banfieldi	*P. nipponica*		*P. maldivensis* n.sp.
	(? *P. okamotoi*) pl. 1, unseen		

There are only minor differences between the male pleopod of the first group and that of the second group, there is one major difference between the pleopod of these groups and that of the third group, and the male pleopod of the fourth group is even more distinct from that of the first three groups.

The principal feature of the first pleopod of males of these 11 species is the presence of three lobes near the tip. In most the distal lobe is spiniform, one of the other lobes (generally on or towards the medial surface) is a flap or process and the other (usually on or towards the lateral surface, and sometimes absent) is a tubercle or rarely a small flap. Most often the more distal lobe or spine is on the abdominal surface between the medial lobe and the lateral tubercle. In the fourth group (containing *P. nodosa*, *P. maldivensis* and *P. eldredgei*), however, these three lobes or processes occur on the sternal, not abdominal surface, the tip being rotated around 180° approximately as shown by the path of the groove leading to the aperture which is at or near the base of the more distal lobe or spine. In the third group (comprising only *P. indonesica* from Java) two of the three lobes are on the medial surface and the distal portion of the pleopod is extremely long and slender.

It would be possible on the basis of these features to assign members of the fourth group to the genus *Pseudomicippe* and the remaining species to *Zewa*, *P. indonesica* possibly being placed in a distinct genus. Both *P. maldivensis* and *P. eldredgei* possess rather prominent submarginal spines on the branchial region and, as in *P. nodosa*, the basal antennal article is expanded and 'petaloid' anterolaterally. (In other species the anterolateral angle of the basal antennal article is produced but is not 'petaloid'.) *P. nodosa*, however, does not have spines on the carapace. The preorbital area is strongly expanded in *P. nodosa* and *P. maldivensis* but in *P. eldredgei* is no more prominent than in *P. maccullochi* or *P. banfieldi*. Having regard to the many other similarities of the species of each group to species of other groups and the lack of support for such a division from geographic distributions we come to the conclusion that the eleven species represent one single genus *Pseudomicippe*.

We have taken the view that *Pseudomicippe* most appropriately belongs in the Majinae. Although the eyestalks are extremely long, the orbit is in general better developed than in any of the Inachinae but the eave is not expanded in the manner seen in the Tychinae. The third maxilliped and male abdomen are most similar to species of the Majinae in which the orbit is typically moderately developed with the postorbital lobe a spine rather than a strongly excavate lobe concealing the retracted eye as in pisines and mithracines. There is no intercalated spine in the upper orbit, a feature which is now recognised as varying within other genera and even species such as the pisine *Hyastenus*-like groups.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *PSEUDOMICIPPE*

1 Rostral spines directed anteriorly, at most only weakly deflexed 2
— Rostral spines strongly deflexed 5
2(1) Anterolateral angle of basal antennal article strongly expanded, petaloid; posterior margin of carapace with a medial spine ..... *P. maldivensis*
— Anterolateral angle of basal antennal article a simple spine or small lobe; posterior margin of carapace without a spine 3
3(2) Postorbital lobe with a distinct tubercle on posterior edge; branchial margin with four prominent tubercles; anterolateral angle of basal antennal article a slender spine ..... *P. okamotoi*[38])
— Postorbital lobe slender, without a tubercle on posterior edge; branchial region with groups of tubercles but not high marginal tubercles; anterolateral angle of basal antennal article a small triangular lobe 4
4(3) Mesogastric region with six tubercles in midline; protogastric regions with five pairs of submedial tubercles, second and third pairs large ..... *P. indonesica*
— Mesogastric region with four tubercles in midline; protogastric regions with two submedial tubercles ..... *P. banfieldi*
5(1) Basal antennal article bearing a broad flattened lobe anterolaterally 6
— Basal antennal article bearing a spine or a very small truncate lobe at anterolateral angle 7
6(5) Supraorbital eave strongly produced anteriorly; postorbital lobe broad, blunt, without a tubercle on anterior edge; anterolateral lobe of basal antennal article, lateral margin concave ..... *P. nodosa*
— Supraorbital eave with preorbital angle only slightly exceeding antorbital spine; postorbital lobe slender, with a prominent tubercle on anterior edge; anterolateral lobe of basal antennal article petaloid, lateral margin straight or convex ..... *P. eldredgei*
7(5) Basal antennal article with small truncate lobe at anterolateral angle; carapace almost smooth, branchial regions with only small tubercles; three mesogastric tubercles ..... *P. philippinensis*
— Basal antennal article with a slender spine at anterolateral angle; carapace with at least some prominent tubercles, especially on branchial regions; four or five mesogastric tubercles 8
8(7) Supraorbital eave prominently expanded anteriorly, more massive than antorbital spine ..... *P. varians*
— Supraorbital eave no more prominent anteriorly than at antorbital angle 9
9(8) Lateral margins of branchial regions only moderately tuberculate; intestinal region with one or three tubercles, sometimes more near posterior margin ..... *P. tenuipes*
— Lateral margins of branchial regions with prominent tubercles or short spines on margin and several submarginal tubercles; intestinal region with five tubercles including a pair of submedials near posterior margin 10
10(9) Preorbital angle of eave not produced at all; lateral margin of basal antennal article behind anterolateral spine straight; four tubercles on segments 2-4 of sternum in male ..... *P. nipponica*
— Preorbital angle of eave produced upwards to a small lobe; lateral margin of basal antennal article behind anterolateral spine concave; one tubercle on segment 3 and one on segment 4 of sternum in male ..... *P. maccullochi*

[38]) From the literature (Sakai, 1938).

Pseudomicippe banfieldi (McCulloch, 1913) new combination (Figs. 84c, 85a,b)

Zewa banfieldi McCulloch, 1913: 332-333, pl. 10 figs. 5-6. — Griffin, 1966b: 277 (in key).
Zewa varians. — McCulloch, 1913: 334 (larger spec. only).
Pseudomicippe varians. — Calman, 1900: 39, pl. 2 figs. 25, 26. (Not *Pseudomicippe varians* Miers, 1879a.)

Material examined. — 9 ♂♂, 22 ♀ ♀ (9 ovig.), 13-29 mm, smallest ovig. ♀, 13.5 mm.

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Queensland: Thursday I.; 1 spec. (AM P. 3018). — Cape York, Possession I., 6 m, dredge, coll. M. Ward, 30 August 1928; 1 spec. (AM P. 13970). — Albany Passage, 16-22 m, dredge, coll. M. Ward, September 1928; 2 specs (AM P.29861, dry). — Dunk I.; 1 spec. (AM P. 2562, holotype) — Dunk I.; 1 spec. (AM P. 4474). — Dunk I.; 1 spec. (AM P. 4144). — Port Denison, 9 m; 1 spec. (AM P. 29862). — Whitsunday Group, Black I., near Langford Reef, shallow water, coll. N. Coleman, November 1969; 1 spec. (AM P. 19541). — Lindeman I., reefs below low tide, amongst thick sargassum, coll. M. Ward, 1934-35; 5 specs. (AM P.29860, dry). — Swain Reefs, off Gillett Cay, 63-72 m, dredge, October 1962; 1 spec. (AM P.14023). — Capricorn Group, North West Islet, ca. 16 m, coll. A. A. Livingstone and W. Boardman, December 1930 — January 1931; 1 spec. (AM P. 10053).

Northern Territory: Port Darwin; 1 spec. (AM P.9473).

Western Australia: Broome, off Gantheaume Point, 7 m, dredge, coll. A. A. Livingstone, August 1929; 2 specs (AM P.13974). — Broome, entrance to Roebuck Bay, 16 m, coll. A. A. Livingstone, 15 August 1929; 1 spec. (AM P. 13972). — Broome, off Gantheaume Point, dredge, coll. A. A. Livingstone, 30 August 1929; 2 specs. (AM P.13971). — Broome, near entrance Roebuck Bay, 9-14 m, dredge, coll. A. A. Livingstone, 26 September 1929; 3 specs. (AM P. 13973). — Broome, coll. B. E. Bardwell; 3 specs. (AM P.29859, dry). — 2 miles (~ 3 km) off Carnarvon, 8 m, algae beds, coll. N. Coleman, 17 June 1972; 1 spec. (AM P.20322).

MUSEUM AND ART GALLERIES OF THE NORTHERN TERRITORY

Near Darwin, Lea Point, in mid littoral rock pools, coll. A. J. Dartnall, 12 July 1975; 2 specs.

Remarks. — This species is superficially very similar to *P. varians* Miers and occurs over a similar geographic range: the differences which distinguish the two are discussed under *P. varians*.

On the first pleopod of the male in *P. banfieldi*, at about the distal fifth, there is a rounded flap on the medial edge adjacent to a spine and a small tubercle on the abdominal surface; the tip of the pleopod beyond the flap is curved laterally to become sternally directed apically.

Distribution. — Australia: northern Western Australia, Northern Territory and Queensland.

Pseudomicippe eldredgei new species (Figs. 78, 86c,d)

Material examined. — 2 ♂♂, cl. 12, 18.5 mm.

Holotype. — Male, cl. 18.5 mm, Guam, Agana Bay, 27 April 1967, Allan Hancock Foundation, University of Southern California.
Paratype. Male, cl. 12 mm, data as for holotype.

Description. — Carapace pyriform, widened posteriorly, width about 0.7 postrostral carapace length; surface smooth with scattered low tubercles, each surmounted by a group of curled hairs; gastric region elevated.

Rostrum of two divergent, deflexed spines, in length about 0.2 to 0.25 postrostral carapace length, tapering from a broad base to a sharp apex and separated by a wide V-shaped hiatus.

Orbit above comprising a moderately broad eave and a postorbital lobe; preorbital angle produced outward into a blunt lobe; slightly exceeding small, acute antorbital spine; two rows of curled hairs on eave parallel to edge, eave with no large tubercle; postorbital lobe narrow, directed forward and slightly outward with a proximal lobe on anterior margin, no lobe proximally on posterior edge. Eyestalks long and slender, cornea small and terminal.

Hepatic region rounded with one large subhepatic tubercle.

Branchial margin with an arc of three high tubercles close together near broadest part of carapace, last in from margin.

Mesogastric region with a pair of very small submedial tubercles anteriorly and two medial tubercles posteriorly. Two groups of curled hairs on low tubercles, one behind other, on either side of mesogastric tubercles. Protogastric region with a pair of small submedial tubercles anteriorly between orbits. Urogastric region smooth.

Cardiac region weakly elevated with three small tubercles, two in front and one behind.

Intestinal region with a pair of very small anterior submedial tubercles, a central medial tubercle and a medial tubercle on posterior margin of carapace.

Branchial region with a small tubercle anteriorly just above carapace margin; a central group of curled hairs dorsally and another medially on anterior margin; other small groups of curled hairs scattered over region.

Basal antennal article smooth, distal half of lateral margin produced anterolaterally in a broad, blunt, ''petaloid'' lobe widest at about proximal third and apically truncate. A small tubercle near external angle of buccal cavity.

Pterygostomian margin with a large posterior tubercle, visible dorsally, and a small tubercle just in front of it.

Third maxilliped merus with anterolateral angle only slightly produced, crenate, posterior half of medial margin with a thick ridge.

Cheliped merus of large male with a low terminal spine; carpus with two strong dorsal ridges, lateral one smooth, medial one with four or five tubercles, one or two tubercles on inner face; chela smooth, length of palm about one and a half times height, fingers slightly exceeding half length of palm, gape small, both fingers with uniform small teeth along their length.

Ambulatory legs not elongate, length of first leg just exceeding postrostral carapace length; fourth leg about 0.75 of first leg; surface smooth with longitudinal rows of long setae and a dorsal row of groups of curled hairs; fourth dactyl with two rows of about seven small teeth ventrally along its length.

Male sternum first segment with a pronounced channel, smooth except for a pair of submedial tubercles on anterior edge and a tubercle on posteromedial angle; remaining segments also channelled, each with a smooth lateral ridge and tuberculate medial ridge along edge of abdominal fossa; segments separated by narrow intersegmental ridges.

Male abdomen of seven segments each with a medial tubercle situated anteriorly in segments one to six and posteriorly in segment seven, third segment with a rounded lateral tubercle and convex lateral margins; both sixth and seventh segments about twice as wide as long.

First pleopod of male broad, curving outwards distally and tapering abruptly to an acute apex; a broad flap on lateral edge of the sternal surface, at about distal fifth, curving ventrally around lateral edge of pleopod; a short spine in front of flap is directed medially across opening.

Remarks. — This species is similar to *P. nodosa* and *P. maldivensis* in the presence on the mesogastric region of only two medial tubercles; the rounded hepatic region with a single large tubercle ventrally; and the first pleopod of the male with a sternal spine and a broad flap behind it on the lateral edge, rather than an abdominal spine and medial flap as in other species. It resembles *P. maldivensis* but not *P. nodosa* in having three tubercles, two anteriorly and one behind, on the cardiac region. It can be distinguished from *P. nodosa* by its much smaller preorbital spine; by the longer and distally narrower postorbital lobe; and by the lobe on the anterolateral angle of the basal antennal article which, while broad as in *P. nodosa*, is quite different in shape.

This species differs from other *Pseudomicippe* species in having two mesogastric tubercles (three to five in other species), three cardiac tubercles (two pairs of submedial tubercles in other species) and only one hepatic tubercle (several small tubercles in other species).

The new species is named in honour of Professor Lucius G. Eldredge, of the Marine Station at Guam.

Distribution. — Western Pacific: known only from Guam.

Pseudomicippe indonesica new species
(Figs. 79, 85g,h)

Material examined. — 1♂, cl. 20.5 mm.

Holotype. — Male, cl. 20.5 mm, Java Sea, 1925, S. S. Radja, coll. G. J. Terwiel, Zoological Museum, Amsterdam.

Description. — Carapace narrowly pyriform, only slightly widened posteriorly, width about 0.6 postrostral carapace length; surface with scattered tubercles each surmounted by either one or two straight hairs or a group of curled hairs; gastric regions elevated.

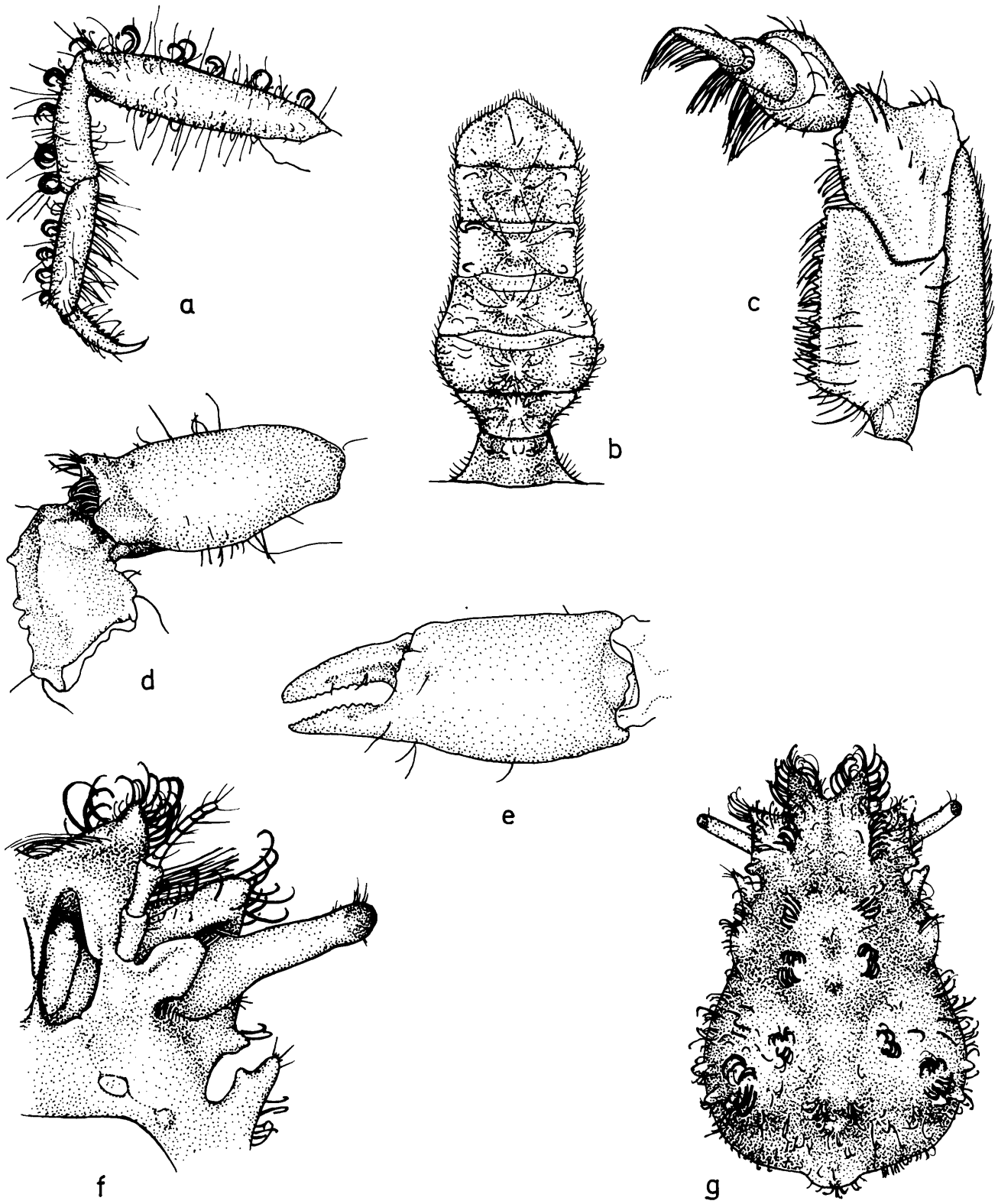


Fig. 78. *Pseudomicippe eldredgei* (holotype) (a) left first ambulatory leg; (b) male abdomen; (c) left third maxilliped; (d) left cheliped, merus and carpus; (e) left chela; (f) left orbit, ventral view; (g) carapace, dorsal view.

Rostrum of two weakly deflexed divergent spines, length about one third postrostral carapace length, cylindrical, each spine of almost uniform width, blunt apically.

Orbit above comprising a moderately expanded eave and a postorbital spine; preorbital angle only weakly produced, rounded; antorbital spine short, acute, triangular, more prominent than preorbital lobe; postorbital spine narrow, a lobe midway along anterior edge and a small tubercle midway along posterior edge. A separate tubercle on carapace just behind postorbital spine. A large, nearly conical tubercle on

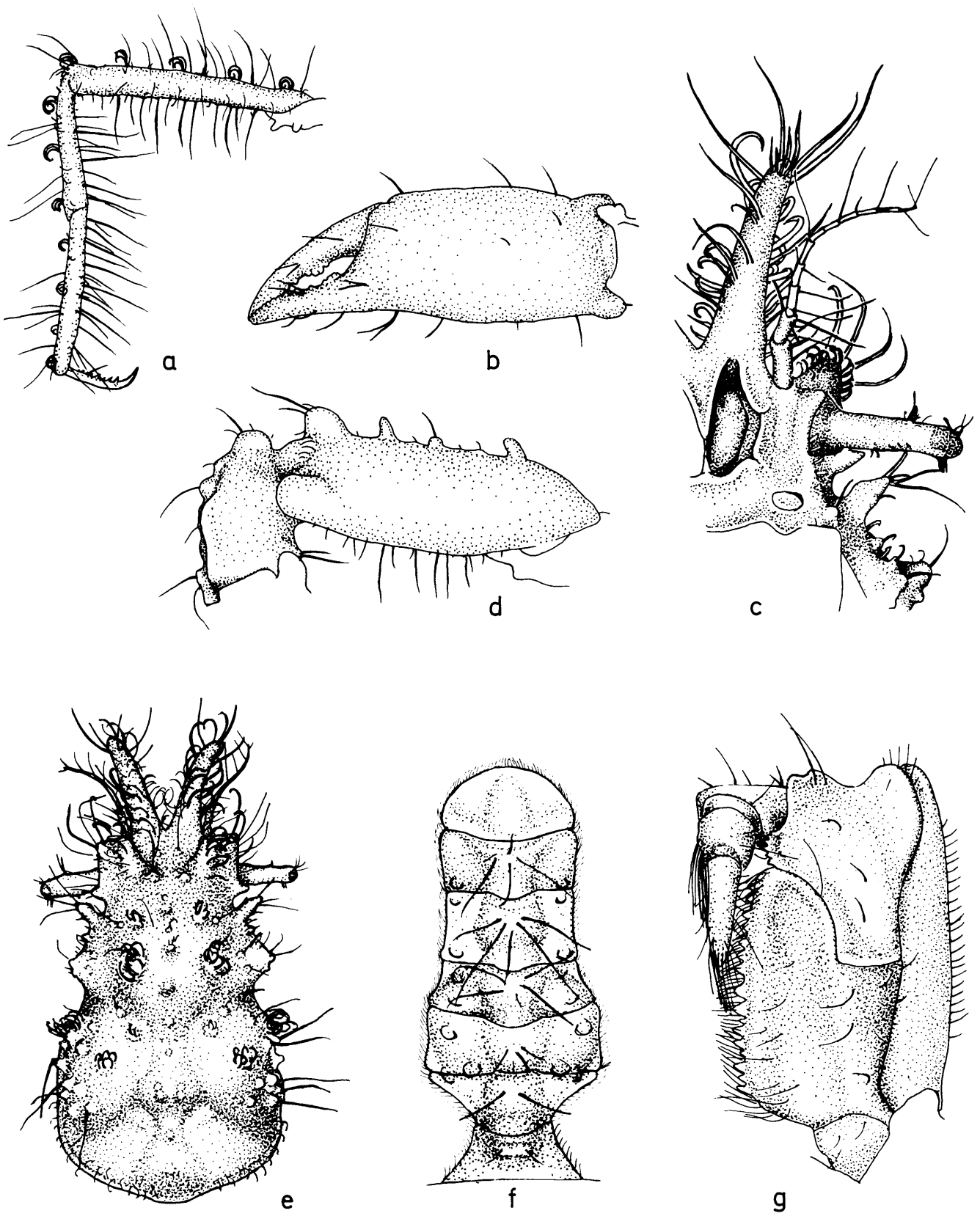


Fig. 79. *Pseudomicippe indonesica* (holotype) (a) left first ambulatory leg; (b) left chela; (c) left orbit, ventral view; (d) left cheliped, merus and carpus; (e) carapace, dorsal view; (f) male abdomen; (g) left third maxilliped.

eave, just inside edge, directed forward and surmounted by a large group of curled hairs.

Eyestalks slender, long, with three small tubercles anteriorly, posteriorly and ventrally, cornea small and terminal.

Hepatic margin with three tubercles; region swollen with group of three tubercles on dorsal surface; subhepatic region with a group of three tubercles and another of two small tubercles medially.

Branchial margin with a row of four tubercles dorsally, a pair of tubercles below the posterior two of this row and below these again a row of four small tubercles just above carapace margin; a bilobed tubercle anteriorly just above articulation of cheliped.

Mesogastric region with six medial tubercles, first, third and sixth smaller than others. Protogastric region with a pair of submedial tubercles anteriorly between orbits; posteriorly two large tubercles, one in front of the other, on either side of mesogastric tubercles and just lateral to anterior of these two, a much smaller tubercle with a similar tubercle behind it. Urogastric region with a medial tubercle.

Cardiac region with a pair of bilobed submedial tubercles. A medial tubercle at junction of cardiac and intestinal regions; central intestinal region weakly elevated with a tubercle at summit; posterior margin of carapace smooth.

Branchial region with three small tubercles anteriorly; close to medial margin, a low tubercle with curled hairs behind medial and lateral tubercles.

Basal antennal article moderately broad, smooth, anterolateral angle produced to a strong subtruncate spine; lateral edge weakly concave. A sharp tubercle near external angle of buccal cavity.

Pterygostomian region smooth, margin with two or three small tubercles posteriorly.

Third maxilliped smooth, anterolateral angle of merus unarmed, produced into a rounded lobe; medial edge of merus with four to five spinules midway along.

Cheliped merus with three dorsal tubercles and a blunt, laterally compressed terminal lobe; carpus with two blunt dorsal ridges, medial one uneven; palm smooth, length about 1.7 times height; fingers about three quarters length of palm, gaping moderately for proximal two thirds, a large, lobed tooth midway along dactyl in gape and a similar tooth proximally on fixed finger.

Ambulatory legs long, first leg about one and a half times postrostral carapace length, surface smooth, very slender; propod length about ten times width; dorsal surface with groups of curled hairs and longitudinal rows of long straight hairs; dactyls of ambulatory legs with two rows each of about ten small teeth ventrally along length.

Male sternum first segment with a shallow depression on either side of midline, smooth except for a tubercle on posteromedial angle; segments two to four each with two to four tubercles along border of abdominal fossa.

Male abdomen of seven segments, smooth except for anterior medial tubercles, anterolateral angle of sixth segment convex, both sixth and seventh segments about twice as wide as long. Third segment about one and a third (1.37) times as wide as sixth segment, lateral margins straight or weakly concave.

First pleopod of male with a very slender distal process which curves first ventrally and then forward and outward; at base of process two small hooks on medial edge and a rounded tubercle on abdominal surface.

Remarks. — The holotype of this species is similar to the ovigerous female figured as *Pseudomicippe tenuipes* by Buitendijk (1939: pl. 8 fig. 3) but lacks the third (most posterior) pair of tubercles on the gastric region and there are two medial tubercles on the intestinal region (not a medial and lateral); also in that specimen the postorbital spine is directed almost straight forward and the rostral spines are broader basally and tapering.

This species is similar to *P. varians* Miers and *P. banfieldi* (McCulloch) in the tuberculation of the carapace and the slender, elongate ambulatory legs. In *P. varians* the rostral spines are strongly tapered and in *P. banfieldi* the anterolateral angle of the basal antennal article is more weakly produced. This species is similar to *P. maccullochi* and *P. varians* in having the lateral margins of the third segment of the male abdomen straight or weakly concave rather than convex as in other species. The first pleopod of the male, however, distinguishes this species from all other known species of *Pseudomicippe*: in no other species is the distal part of the pleopod so slender.

Distribution. — Known only from the type locality, Java Sea.

Pseudomicippe maccullochi new species
(Figs. 80, 85c,d, Pl.17)

Material examined. — 6 ♂♂, 5 ♀♀(2 ovig.), 8-24 mm, smaller ovig. ♀, 16 mm.

Holotype. — Male, 23.5 mm, Tasman Sea, Lord Howe I., southern end of lagoon, coll. J. Booth, May 1962; The Australian Museum (AM P. 20326). Paratypes. As listed below.

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Lord Howe Island: south end of lagoon, 18 September 1962, coll. J. Booth; 1 spec. (AM P.29866). — Sylph's Hole, old settlement, in dead coral, coll. J. Booth, October 1962; 1 spec. (AM P.29867). — lagoon, sand and dead coral, 'El Torito', Stn. LHI. 73-78, 23 February 1973; 1 spec. (AM P. 20325). — 2 specs. (AM P. 29865, dry). — lagoon, boat ramp rocks, 2 m, coll. N. Coleman, 26 November 1979; 1 spec. (AM P. 30995).

Norfolk Island: Slaughter Bay, coll. P. and R. Southwell, 31 March 1969; 1 spec. (AM P. 17286). — Slaughter Bay, coll. I. Milton, June 1969; 1 spec. (AM P. 17396).

Queensland: Swain Reefs, Capri Cay, 22°09′S 152°46′E, Swain Reefs Exped. Stn. 8, 1962; 1 spec. (AM P. 17015).

MUSEUM OF VICTORIA, MELBOURNE

Victoria: Shoreham, 10 November 1902; 1 spec. (J 1460).

Description. — Carapace pyriform, width equal to about 0.7 postrostral carapace length; surface with numerous distinct tubercles; gastric regions elevated behind orbits.

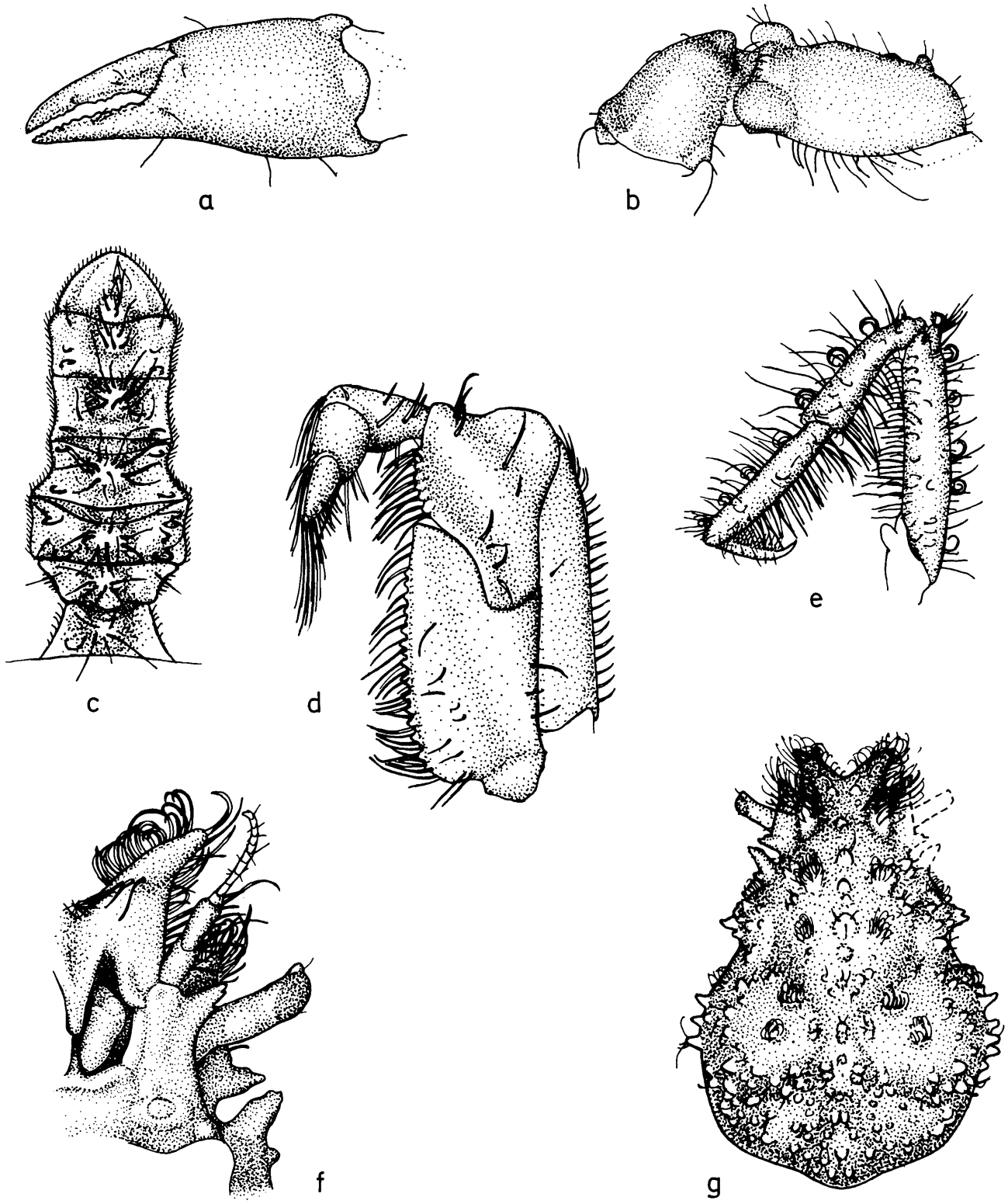


Fig. 80. *Pseudomicippe maccullochi* (male, 13.5 mm, AM P.17286) (a) left chela; (b) left cheliped, merus and carpus; (holotype) (c) male abdomen; (d) left third maxilliped; (e) left first ambulatory leg; (f) left orbit, ventral view; (g) carapace, dorsal view.

Rostrum of two short divergent spines, deflexed, wide basally and tapering distally; length equal to about one fifth (0.2) postrostral carapace length. (Two specimens with submedial tubercles on rostral ridges in front of orbits.)

Orbit above comprising a weakly expanded eave and a postorbital lobe; preorbital angle rounded, weakly produced; antorbital spine small, acute, subtriangular, directed outwards; postorbital spine narrow, tapering slightly to a blunt apex, anterior edge sometimes convex, but without a lobe, a granule or small tubercle at base posteriorly; a broad smooth tubercle surmounted by curled hairs on eave just in from edge. Eyestalks long and slender, cornea small and terminal.

Hepatic margin rounded, bearing two or three sharp tubercles, three small tubercles on dorsal surface of region; subhepatic region with two or three sharp tubercles.

Branchial margin with a row of three to four tubercles of unequal size, a row above them of about four short tubercles, and below anteriorly, a small tubercle just above base of cheliped.

Mesogastric region with five medial tubercles, last on posterior slope, second and fifth tubercles sometimes with small adjacent tubercles. Protogastric region with a medial tubercle or group of tubercles at level of antorbital spine; posteriorly two large tubercles, one in front of other, on either side of mesogastric tubercles and just lateral to anterior of these two, one or two small tubercles with another one or two tubercles behind.

Cardiac region weakly elevated with a pair of submedial tubercles, rounded or weakly bilobed, a small medial tubercle between them on anterior slope.

Intestinal region with a pair of small submedial tubercles anteriorly and behind them a second pair more widely separated; a central medial tubercle and a pair of submedial tubercles just in front of posterior margin of carapace; scattered small tubercles or granules laterally on intestinal region.

Branchial region with three tubercles in an oblique row on anteromedial border, a broad central tubercle surmounted by curled hairs and a few small dorsal tubercles.

Basal antennal article smooth, anterolateral angle with a sharp, narrow, spinulate spine; a sharp tubercle in front of external angle of buccal cavity.

Third maxilliped smooth; merus with anterolateral angle produced and rounded, with small spinules on edge; medial edge crenulate from midway along to posterior margin; exognath with lateral fringing setae.

Pterygostomian region smooth, margin with one posterior tubercle. Male sternal segments smooth except for two tubercles on edge of abdominal fossa, one midway on third segment and one posteriorly on fourth segment.

Cheliped merus of male (not adult) with a proximal tubercle and a sharp, laterally compressed, terminal spine; carpus without ridges; fingers of chela with small teeth along their length. (Our adult male specimen lacks chelipeds, so it is possible that this species, like *P. varians*, may develop ridges on the carpus in the adult.)

Ambulatory legs smooth, not elongate, length of first leg just exceeding carapace length, propod length about three times its width; fourth leg more than three quarters length of first leg, dactyl with two rows, each of about ten small teeth, ventrally along its length.

Male abdomen of seven segments, third segment about one and a quarter times as wide as sixth segment, lateral margins straight or weakly concave; sixth and seventh segments both about twice as wide as long; medial tubercle anteriorly on segments 1-6. Female abdomen of seven segments, surface setae each with a basal granule.

First pleopod of male with a broad medial lobe at about distal fifth; tapering only beyond lobe to acute apex; a spine on abdominal surface adjacent to anterior edge of lobe, and a rounded tubercle lateral to spine; opening abdominal, just behind spine and ventral to lobe.

Gonopore of female a narrow slit opening anteriorly.

Remarks. — Within our series of specimens there is a marked variation in the size of the carapace tubercles. In the adult male holotype and the larger ovigerous female (24 mm) there are distinct tubercles on the rostral ridges and additional small tubercles on the gastric regions and intestinal region. In some of the other specimens, especially females, several of the carapace tubercles are very low and their position is marked only by a group of hairs.

This species is very similar to *P. varians* Miers which also has a well developed process on the anterolateral angle of the basal antennal article and rostral spines which are broadened basally and deflexed. In *P. varians* however, there is a pair of submedial protogastric tubercles, not one medial tubercle on the level of the antorbital spine; the propod of the ambulatory legs is elongate and cylindrical; segments one and two of the male sternum have tubercles, not smooth; and the flap on the medial margin of the first pleopod is hook shaped rather than broad and flat.

The first pleopod of this species is similar to that of *P. banfieldi* but in that species the rostral spines are horizontal, not deflexed, and not broadened basally; the anterolateral angle of the basal antennal article is only weakly produced to a broad triangle; there is no medial protogastric tubercle at the level of the antorbital spines; and there is no medial tubercle on the urogastric region.

The ambulatory legs are similar to those of *Microhalimus deflexifrons* Haswell but in that species there is a long, narrow, forwardly directed process on the anterolateral angle of the basal antennal article and the first pleopod of the male lacks both a flap and a spine.

The new species is named for Alan R. McCulloch (1885-1925) who contributed significantly to our knowledge of Australian Crustacea and who was associated also with the early study of Lord Howe Island.

Distribution. — Norfolk I.; Lord Howe I.; Swain Reefs, Queensland; Shoreham, Victoria.

Pseudomicippe maldivensis new species
(Figs. 81, 82, 86e,f)

Material examined. — 1 ♂, 1 ovig. ♀, cl. 6.5, 12 mm.

Holotype. — Male, cl. 12 mm, Maldive Islands, Male Atoll, Dunidu I., on rocky reef, collected J. S. Garth, 18 March 1964. Allan Hancock Foundation, University of Southern California.
Paratype. Female, ovigerous, cl. 6.5 mm, Maldive Islands, Addu Atoll, Gan I., on *Acropora*, collected G. Beardsley, 30 April 1964. Allan Hancock Foundation, University of Southern California.

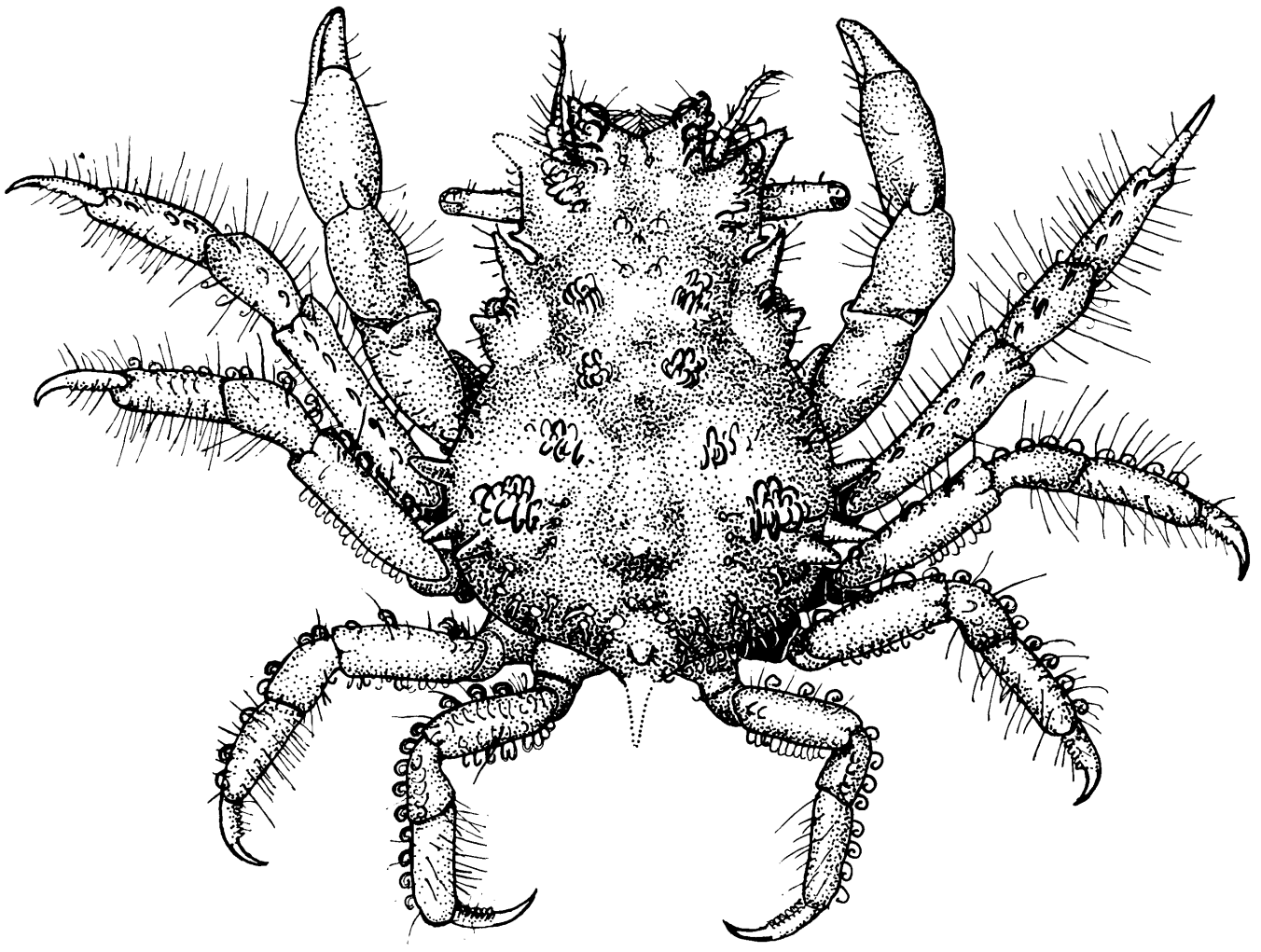


Fig. 81. *Pseudomicippe maldivensis* (holotype) whole animal, dorsal view.

Description. — Carapace pyriform, width about 0.8 postrostral carapace length; surface smooth between low tubercles which are each surmounted by a group of curled hairs; gastric regions elevated.

Rostrum of two divergent, deflexed spines, length about a quarter (male) or an eighth (female) postrostral carapace length; each spine tapering from a broad base to a narrow apex.

Orbit above comprising a moderately broad eave and a postorbital lobe; preorbital angle produced into a spine directed forwards; antorbital spine very small, acute; two rows of curled hairs on eave parallel to edge, no large tubercle; postorbital lobe narrow, directed obliquely forward, distally sharp, proximally with a small anterior and a weak posterior lobe. Eyestalks long and slender, cornea small and terminal.

Hepatic margin rounded with a short spine or tubercle and a tubercle below it.

Branchial margin with an arc of three adjacent spines at widest part of carapace, last in from margin.

Mesogastric region with a pair of very small submedial tubercles anteriorly and two medial tubercles posteriorly (very low in female). Protogastric region with a pair of submedial tubercles anteriorly between orbits, two groups of curled hairs (not on tubercles), one behind other, on either side of mesogastric tubercles. Urogastric region smooth.

Cardiac region weakly elevated with three tubercles, two in front and one behind. Intestinal region with a pair of small submedial tubercles anteriorly, a short central spine and a longer medial spine on posterior margin (damaged in holotype).

Branchial region dorsally with large, rounded, central tubercle and a smaller one near anteromedial border each surmounted by a group of curled hairs.

Basal antennal article with lateral margin distally produced obliquely forwards in a large acute, triangular "petaloid" lobe. A small tubercle near external angle of buccal cavity.

Pterygostomian margin with a large posterior tubercle and a much smaller tubercle just in front of it.

Third maxilliped merus with anterolateral angle only slightly produced, rounded; medial margin with about four very small teeth in male.

Cheliped merus of large male smooth except for a low dorsal ridge, a blunt proximal tubercle and a small blunt ter-

minal spine; carpus with two low dorsal ridges, medial ridge uneven; palm smooth, length equal to one and a quarter times height; fingers three quarters length of palm, weakly gaping, both fingers with uniform small teeth along their length.

Ambulatory legs not elongate, first leg about equal to postrostral carapace length and fourth leg about two thirds length of first leg, surfaces smooth with longitudinal rows of long setae and a dorsal row of groups of curled hairs; dactyl of fourth leg with two rows of about six small teeth ventrally along length.

Male sternum first segment smooth with a ridge along anterior edge of abdominal fossa; segments 2-4 smooth except for a low medial, tuberculate ridge along margin of fossa.

Male abdomen of seven segments, third segment only slightly wider (1.1) than sixth segment, lateral margins weakly convex; both sixth and seventh segments about twice as broad as long, seventh segment subrectangular, anterior margin very weakly convex.

Female abdomen of seven segments, smooth.

First pleopod of male broad, hardly tapering, curving laterally in distal third, apex blunt; a spine and a flap on lateral edge of sternal surface proximal to tip, spine directed medially across sternal surface, broad flap behind it curved ventrally around lateral edge and visible in abdominal view.

Female gonopore oval, opening anteriorly and slightly medially.

Remarks. — This species is similar to *P. nodosa* and *P. eldredgei* in the presence of only two medial mesogastric tubercles instead of 3-5 as in other species and in the basal antennal article being produced anterolaterally into a broad "petaloid" lobe. It is similar to *P. nodosa* (but not *P. eldredgei*) in having a well developed preorbital spine and to *P. eldredgei* (but not *P. nodosa*) in having three tubercles in an inverted triangle on the cardiac region. It differs from *P. nodosa* in the shape of the anterolateral lobe on the basal antennal article and from all other species of *Pseudomicippe* in the presence of a strong medial spine on the posterior carapace margin.

In this species as in *P. eldredgei* and *P. nodosa* the first pleopod of the male is twisted so that there is a sternal spine and a lateral flap rather than an abdominal spine and a medial flap as in other species.

Distribution. — Indian Ocean: known only from the Maldive Islands.

Pseudomicippe nipponica (Sakai, 1938) new combination
(Fig. 87b)

Pseudomicippe tenuipes. — Balss, 1924: 35-36, pl. 1 fig. 6. (Not *P. tenuipes* A. Milne Edwards.)

Zewa nipponica Sakai, 1938: 244-246, figs. 22a-d, pl. 25 fig. 1; 1976: 188-189, figs. 99, 100a.

Material examined. — 1 ♂, cl. 25.5 mm.

ZOOLOGISCHE STAATSSAMMLUNG, MÜNCHEN

Japan, Kachiyama, east shore of the Uragu Canals, coll. L. Doflein, determined *P. tenuipes* by Balss.

Remarks. — This specimen agrees well with *Pseudomicippe nipponica* (Sakai). In our specimen there are five medial tubercles on the gastric region as described by Sakai (1938), not four as described by Balss (1924); there is a distinct tubercle basally on the posterior margin of the postorbital spine (as figured by Balss, but not clear in Sakai's figure); there is a small accessory spinule on the posterior margin of the antorbital spine; the anterolateral spine on the basal antennal article has two small accessory spinules on the posterior margin and the lateral margin of the basal antennal article is straight and oblique, not curved. There are three or four tubercles on each of sternal segments two to four. We have figured the first pleopod of the male. There is a large flap, curved sternally, and immediately ahead of it is a small spine directed abdominally; on the abdominal surface there is a broad flap, directed laterally, across the opening.

The third segment of the male abdomen is only slightly wider than the sixth segment, the lateral margins are nearly straight but the segment widens slightly posteriorly. The lateral margins of the fourth segment are oblique, not curved abruptly as in *P. maccullochi*.

This species is similar to *P. maccullochi* in the deflexed rostral spines, the tubercular carapace with high marginal tubercles and the shape of the basal antennal article. It is distinguished from *P. maccullochi* by 1) the preorbital angle of the eave which is not produced at all (weakly produced in *P. maccullochi*); 2) the lateral margin of the basal antennal article is straight and oblique behind the anterolateral spine (concave in *P. maccullochi*); 3) there are three or four tubercles on segments 2-4 of the male sternum (only one tubercle on segments 3 and 4 in *P. maccullochi*). In addition the first pleopod of the male of *P. nipponica* has a much more elongate apex that that in *P. macullochi* with longer setae on the lateral edge and there are differences in the shape and position of the flap and the lobe.

P. nipponica is distinguished from *P. tenuipes* by the much more tuberculate carapace; the preorbital angle which is not even weakly produced as it is in *P. tenuipes* and the first pleopod of the male which lacks the two long medial processes present on the pleopod of *P. tenuipes*.

Distribution. — Japan.

Pseudomicippe philippinensis new species
(Figs. 83, 85f)

Material examined. — 1 ♂, cl. 8 mm.

Holotype. — Male, cl. 8 mm, Sulu Archipelago, anchorage off North Ubian, 06°07.5′N 120°26′E, 16-23 m, dredge townet, *Lithothamnion*, 28-30 June 1899, 'Siboga' Expedition. Stn. 99, Zoological Museum, Amsterdam.

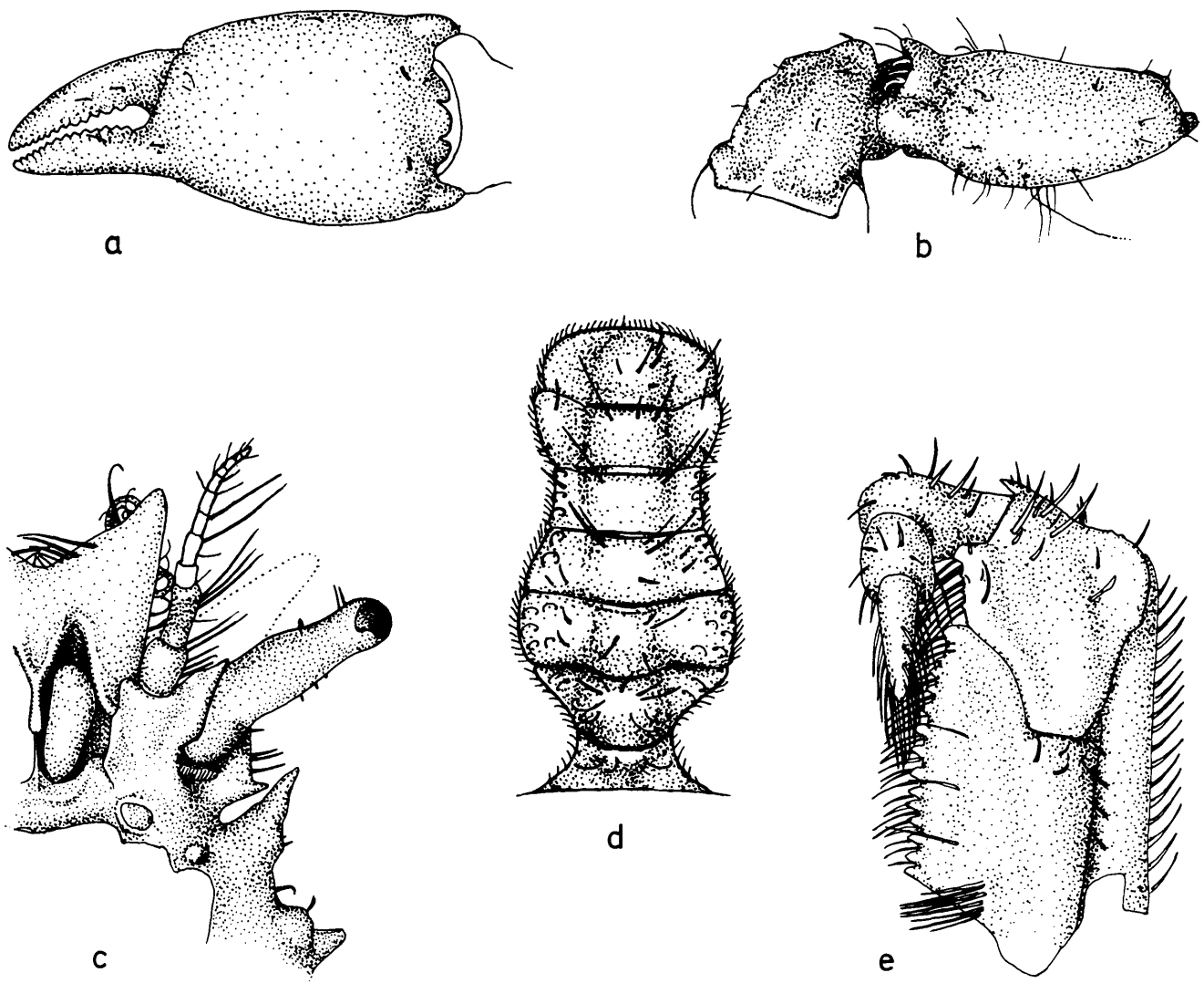


Fig. 82. *Pseudomicippe maldivensis* (holotype) (a) left chela; (b) left cheliped, merus and carpus; (c) left orbit, ventral view; (d) male abdomen; (e) left third maxilliped.

Description. — Carapace narrow pyriform, hardly widened posteriorly, width about 0.6 postrostral carapace length; surface generally smooth with a few small scattered tubercles surmounted either by long straight hairs or groups of curled hairs; gastric regions elevated.

Rostrum of two divergent spines about 0.2 postrostral carapace length, deflexed, each tapering from base.

Orbit above comprising a moderately broad eave and postorbital lobe; preorbital angle only slightly produced and rounded, not exceeding short, acute, triangular antorbital spine; postorbital spine slender, narrowing distally, apex blunt, a rounded lobe midway along anterior margin, a small tubercle at base posteriorly; a large tubercle on eave just inside edge. Eyestalks long, slender, with two small tubercles, one ventral and one posterior; cornea small and terminal, a small tubercle above cornea.

Hepatic margin rounded with two small tubercles and a small subhepatic tubercle. Branchial margin unarmed.

Mesogastric region with three medial tubercles. Protogastric region with two pairs of submedial tubercles anteriorly between orbits, posteriorly two tubercles, one behind other, on either side of mesogastric tubercles. Urogastric region smooth.

Cardiac region with a pair of low submedial tubercles. Intestinal region smooth except for an indistinct medial tubercle just in front of posterior margin.

Branchial region with three dorsal groups of curled hairs anteriorly, one medially and one laterally on anterior margin, a third group behind and between them; an arc of three small tubercles behind and below groups of curled hairs, two more small tubercles just above lateral margin.

Basal antennal article with anterolateral angle produced laterally into a short truncate lobe with distal spinules. A tubercle at external angle of buccal cavity.

Pterygostomian region smooth, a small posterior tubercle on margin. Third maxilliped smooth, merus with anterolateral angle moderately produced, edge spinulate; posterior medial edge of merus with spinules.

Cheliped merus with two dorsal tubercles and a terminal spine; carpus smooth; chela slender, palm about twice as long

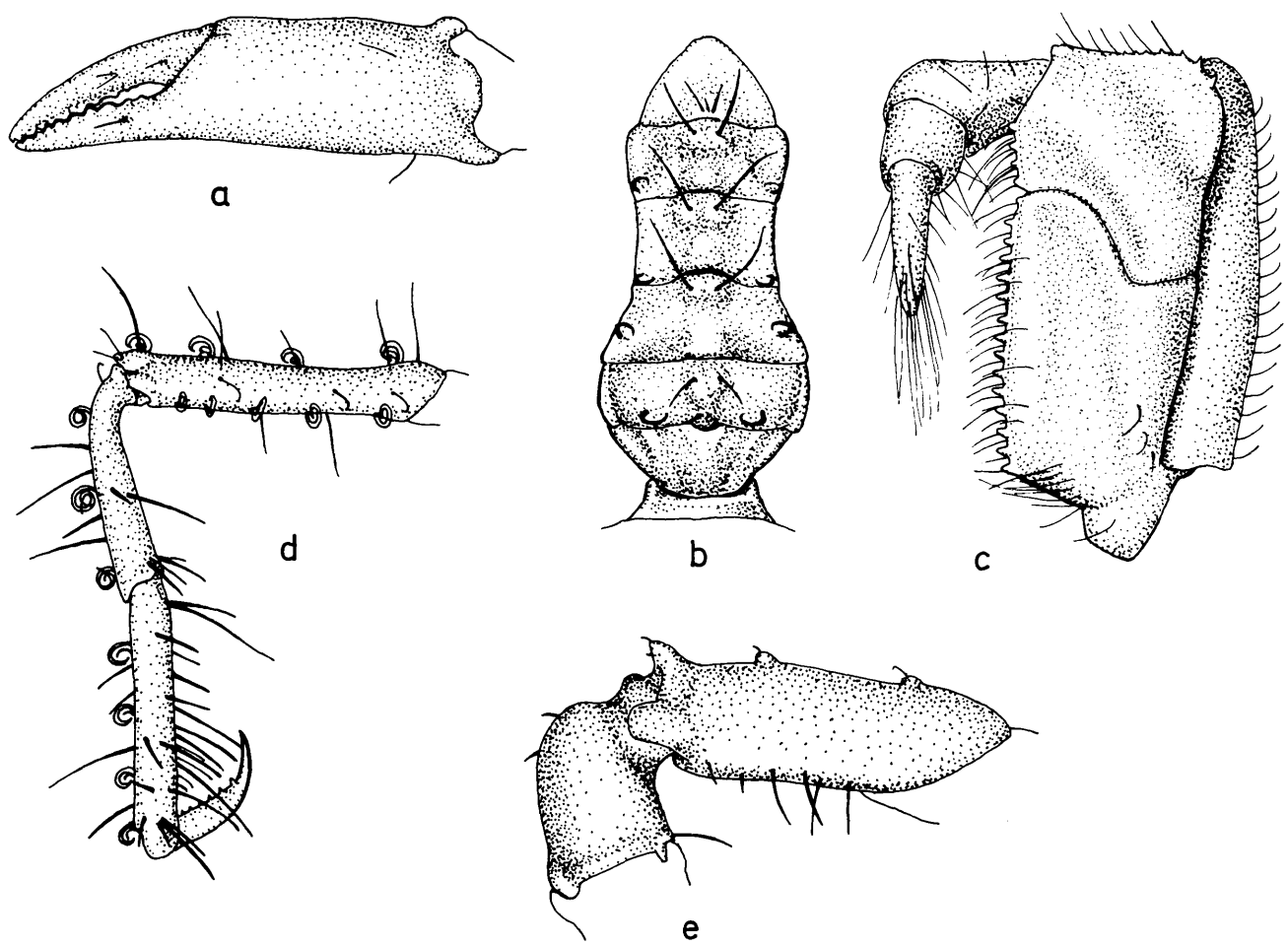


Fig. 83. *Pseudomicippe philippinensis* (holotype) (a) left chela; (b) male abdomen; (c) left third maxilliped; (d) left first ambulatory leg; (e) left cheliped, merus and carpus; (f) left orbit, ventral view; (g) carapace, dorsal view.

as high and slightly longer (1.25 times) than fingers; both fingers hardly gaping, with uniform, small teeth along their length.

Ambulatory legs slender, smooth, propod length about six times width, dorsal groups of curled hairs and longitudinal rows of straight hairs; dactyl with two rows each of about five small teeth ventrally along length.

Male sternum first segment smooth with shallow depressions; second segment with one lateral and two medial tubercles, third and fourth segments each with one lateral and one medial tubercle.

Male abdomen of seven segments, smooth except for an anterior tubercle on medial ridge of segments 3-6; third segment one and a quarter times as wide as sixth segment, lateral margins convex; sixth segment one and a half times as wide as long, anterolateral angles convex; seventh segment about as wide as long, blunt triangular.

First pleopod of male narrowing at about distal fifth, widening beyond, a spine and a lobe on medial edge, then tapering distally to acute apex; a tubercle on abdominal surface near spine and lobe.

Remarks. — This immature male is distinguished from other species of *Pseudomicippe* by the shape of the first pleopod. It is distinguished from *P. okamotoi* (Sakai) (pleopod not described) by the small, truncate lobe on the anterolateral angle of the basal antennal article; in *P. okamotoi* there is a slender spine on the anterolateral angle. *P. indonesica* and *P. banfieldi* resemble *P. philippinensis* in having a small anterolateral lobe on the basal antennal article and slender legs, but in both *P. indonesica* and *P. banfieldi* there are more tubercles on the branchial region and margin than in *P. philippinensis* and the rostral spines are longer and either horizontal or only weakly deflexed.

Distribution. — Known only from the type locality Sulu Archipelago.

Pseudomicippe tenuipes A. Milne Edwards, 1865
(Fig. 87c,d,g, Pl. 18)

Pseudomicippe tenuipes A. Milne Edwards, 1865: 139, pl. 5 figs. 2, 2a. — Buitendijk, 1939: 235, pl. 8 figs. 3, 4. — Sankarankutty, 1962: 160-161, figs. 17-23.

Material examined. — 2 ♂♂, 2 ♀ ♀, 7.5-11.5 mm.

ZOOLOGISCHE STAATSSAMMLUNG, MUNCHEN

Madagascar, Nosy Bé, Nosy Komba; 1 spec. (ZSM 7929, previously det. *Pseudomicippe nodosa*).

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, Wakde I., Tsoemoar, coll. L. D. Brongersma, 7 July 1952; 1 spec.

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Western Australia, Warroora, low tide, in algae, coll. N. Coleman, 28 June 1972; 2 specs. (AM P. 19139).

Remarks. — In these specimens the rostral spines are short, basally broad, and distally strongly divergent and deflexed, they all have a rounded preorbital lobe which is no more prominent than the short, acute antorbital lobe and the basal antennal article has a broad triangular tooth, directed outwards, at the anterolateral angle.

The pattern of tubercles on the carapace in our series agrees quite well with that figured by A. Milne Edwards (1865). On the mesogastric region there are four tubercles in the midline and two lateral pairs of tubercles. There is sometimes a low medial tubercle on the urogastric region. The cardiac region is slightly elevated with two pairs of very low tubercles. On the branchial region there are three or four small tubercles laterally. There is a central medial tubercle on the intestinal region and sometimes two small submedial tubercles anterior to it.

There is considerable variation among the specimens in the size of the tubercles and the degree of separation of the regions of the carapace. (Both female specimens are immature.) The specimen from Western Australia has an almost smooth carapace, only the gastric region being elevated, and the tubercles being low and rounded; that from Nosy Bé has many small distinct tubercles and the branchial and cardiac regions are also separated. In both male specimens the carapace regions are clearly separated, the tubercles on the branchial regions are small and acute and those on the gastric and cardiac regions large and rounded.

The first pleopod of the male is as figured by Sankarankutty (1962: figs. 22-23) but the two curved spine-like processes on the medial edge just below the tip are long and subequal.

Distribution. — Indian Ocean: Madagascar, Nicobar Islands, Western Australia; Irian Jaya.

Pseudomicippe varians Miers, 1879
(Figs. 84a,b,d,e, 87a,e,f)

Pseudomicippe? varians Miers, 1879a: 12-13, pl. 4 fig. 8; 1884: 197-198.
Zewa varians. — McCulloch, 1913: 334 (smaller spec. only). — Griffin, 1966b: 277 (in key).

Material examined. — 27 ♂♂, 25 ♀ ♀ (14 ovig.), 6-23.5 mm, smallest ovig. ♀, 14.5 mm.

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Queensland: Dunk I.; 1 spec. (AM P.2561). — Port Denison, intertidal among stones and dead coral; 1 spec. (AM P. 6955). — Lindeman I., reefs below low tide, amongst thick sargassum, coll. M. Ward, 1934-35; 46 specs., dry (AM P. 29864). — Port Curtis, Black Head; 1 spec. (AM P. 10379).

Remarks. *Pseudomicippe varians* Miers and *Pseudomicippe banfieldi* (McCulloch) are very similar species which often occur at the same locality and as a result of the brief original description and inadequate figure of *P. varians* given by Miers (1879a) have sometimes been confused by subsequent workers. We have examined series of specimens of both species including the holotype of *P. banfieldi* (♂, 29 mm,

Dunk I., Q'ld, AM P. 2562): we conclude that these species can be distinguished from each other by differences in the rostral spines, basal antennal article, arrangement of carapace tubercles, chela of adult male and female and first pleopod of the male as listed in the following table.

	P. varians	*P. banfieldi*
Rostral spines	broad basally, tapering distally, apex sharp, spines deflexed.	width almost uniform throughout length, apex blunt, spines nearly horizontal, curved downwards distally.
Rostral length / postrostral cl.	0.2-0.29 ♂ 0.16-0.26 ♀	0.36-0.44 ♂ 0.25-0.33 ♀
Basal antennal article, anterolateral angle	strongly produced, a narrow spine, often spinulate	weakly produced, a short bunt lobe
Anterior protogastric region	a pair of moderately large submedial tubercles	no submedial tubercles, or very low in adults
Urogastric region	a medial tubercle	no medial tubercle (or very small in adults).
First pleopod of male	distally a very small hook-like flap on the medial edge	distally a large rounded flap on the medial edge
Chela of adult male, gape between fingers	both fingers with a few small teeth	dactyl with large double tooth midway, fixed finger with smaller proximal tooth
Palm of adult female chela	dorsal and ventral margins converging, distal ht about $^3/_4$ proximal ht	dorsal and ventral margins parallel, distal ht equal to proximal ht

The type locality of *P. varians* is Shark Bay, Western Australia and our specimens of this species are from Dunk I., Port Denison, Lindeman I. and Port Curtis in Queensland. Our specimens of *P. banfieldi* are from Shark Bay, Carnarvon and Broome in Western Australia, through Darwin and Torres Straits to Port Curtis in Queensland, including the type locality Dunk I. (We have specimens of *P. banfieldi* from all the localities from which we have *P. varians*.)

Of the specimens, apart from the holotypes, described in the literature it seems certain that the specimen (♀, 19.5 mm) from Torres Straits described by Miers (1886) with 'rostral spines strongly deflexed' and 'distinct spine at anterolateral angle of basal antennal joint' is *P. varians* as identified by Miers. On the other hand, the specimen from Torres Straits figured by Calman (1900) as *Pseudomicippe varians* appears to be *P. banfieldi*: the anterolateral angle of the basal antennal article is only weakly produced into a short truncate tooth, and in the description Calman refers to 'rostral spines not perceptibly deflexed' and 'tapering only very slightly to the bluntly rounded tip'.

McCulloch (1913: 334) referred to two specimens of *P. varians* he had examined. We have reexamined these specimens and find that the female (18 mm, AM P. 3018) from Thursday I. is *P. banfieldi* while the smaller specimen from Dunk I. (10 mm, AM P. 2561) is *P. varians* and is an immature female not a male. The larger specimen from Thursday I. is damaged, there is only one rostral spine, which is detached, but it does not taper and the apex is blunt; the anterolateral angle of the basal antennal article is only weakly produced to a blunt lobe. In the smaller specimen the rostral spines are deflexed and taper distally to a sharp apex, the anterolateral angle of the basal antennal article is strongly produced laterally.

In *P. varians* as in *P. maccullochi* and *P. indonesica* the lateral margins of the third segment of the male abdomen are straight, not convex as in *P. banfieldi.*

On the first pleopod of the male of *P. varians* at about the distal fifth there is a small hook-like flap on the medial edge adjacent to a spine and small tubercle on the abdominal surface; the tip of the pleopod beyond the flap is straight, and the apex acute. (The first pleopod of *P. nipponica* (Sakai) also has a medial hook but in that species there is only a small blunt spine on the abdominal surface.) In *P. banfieldi* there is a rounded flap not a hook on the medial edge and the tip of the pleopod beyond the flap is more elongate, curved laterally and, at the apex, sternally. In *P. maccullochi* there is a round flap on the medial edge of the pleopod but the tip beyond the flap is short and abruptly tapered to an acute apex. Other differences which distinguish *P. varians* from *P. maccullochi* are discussed under that species.

Distribution. — Western Australia (Shark Bay), northern Queensland.

Schizophroida Sakai, 1933

Type species. — *Schizophrys hilensis* Rathbun, 1906, by present designation.

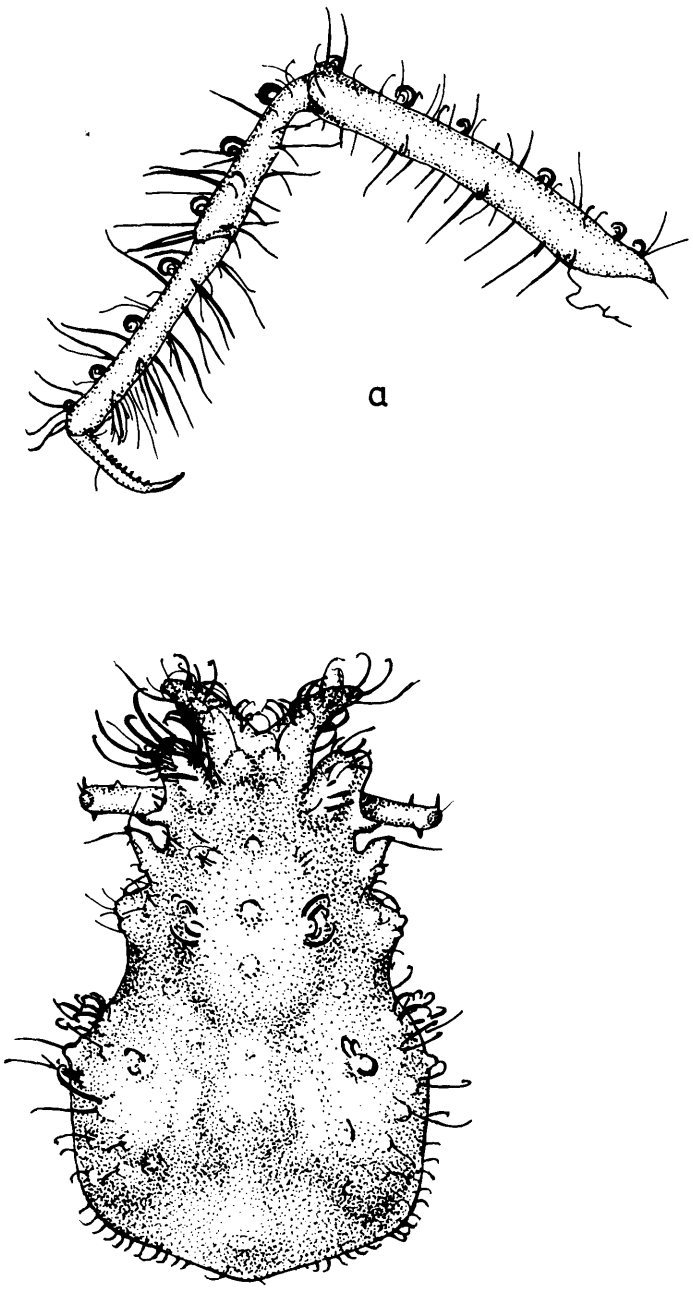
Remarks. — Neither Sakai nor Buitendijk designated a type for this genus so we have chosen as type the species described first. There are three described species in the genus. The differences which distinguish *S. hilensis* and *S. manazuruana* Sakai are not clear and it is possible that they are conspecific. *S. simodaensis* Sakai appears to be restricted to Japan. We have not provided a key to the three species as the status of them still seems uncertain; the differences which may serve to distinguish the species are discussed under *S. hilensis*. We have not examined the two Japanese species described by Sakai. *S. hilensis*, as understood here, shows variability in size at sexual maturity in populations from different localities just as do species of *Leptomithrax* and *Notomithrax.*

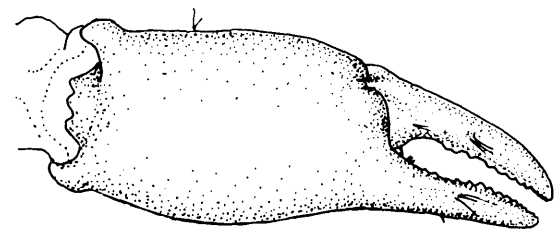
This genus is distinguished from *Schizophrys* White by the absence of both a lateral accessory spine on the rostral spine and an anterior accessory spine on the postorbital lobe.

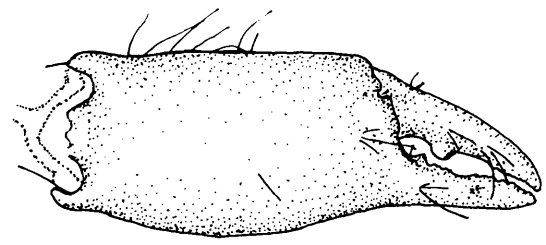
Distribution. — Western Pacific: Hawaii, Kermadec Islands, Lord Howe I., Japan.

Schizophroida hilensis (Rathbun, 1906)
(Fig. 68c,d, Pl. 19)

Schizophrys hilensis Rathbun, 1906: 882, fig. 38. — Chilton, 1911: 562-563.
Schizophroida hilensis. — Sakai, 1933: 138 (in key).







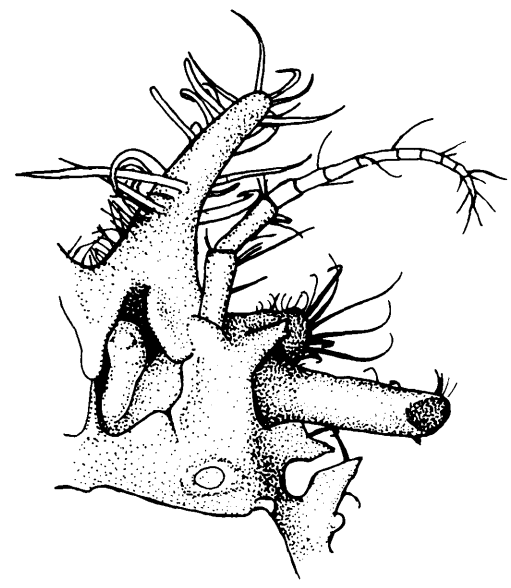


Fig. 84. *Pseudomicippe varians* (male, 22 mm, AM P.6955) (a) left first ambulatory leg; (b) right chela of adult male; *P. banfieldi* (male, 17 mm, AM P. 19541) (c) right chela of adult male; *P. varians* (as above) (d) carapace, dorsal view; (e) left orbit, ventral view.

Schizophroida manazuruana Sakai, 1933: 140, fig. 1; 1976: 245-246, pl. 89 fig. 2. — Buitendijk, 1939: 251.

Material examined. — 19 ♂♂, 18 ♀♀ (5 ovig.) 8.5-33.5 mm, smallest ovig. ♀, 12.5 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Hawaii, Hilo, 7 April 1915; 1 spec.

BRITISH MUSEUM (NATURAL HISTORY), LONDON

Kermadec Islands, coll. W. R. B. Oliver, 1908; 3 specs.

NATIONAL MUSEUM OF NEW ZEALAND, WELLINGTON

Kermadec Islands: Sunday I., R. S. Bell, 1909-1910, W. R. B. Oliver Collection; 1 spec. — Sunday I., R. S. Bell, 1909-1910, W. R. B. Oliver Collection; 7 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Hawaii: Reef at Waikiki, under stones near shore, coll. M. Ward, 24-30 August 1927; 7 specs. (AM P. 29816, det. M. Ward). — Reef at Waikiki, under surface of dead coral blocks; 2 specs. (AM P. 29822, dry). — Waikiki, taken from blocks of coral brought up from below low tide; 2 specs. (AM P. 29823, dry).

Lord Howe I.: coll. A. R. McCulloch; 2 specs. (AM P. 5288). — coll. Lyman Clark, April 1932; 2 specs. (AM P. 29821, dry). — Reef, coll. A. A.

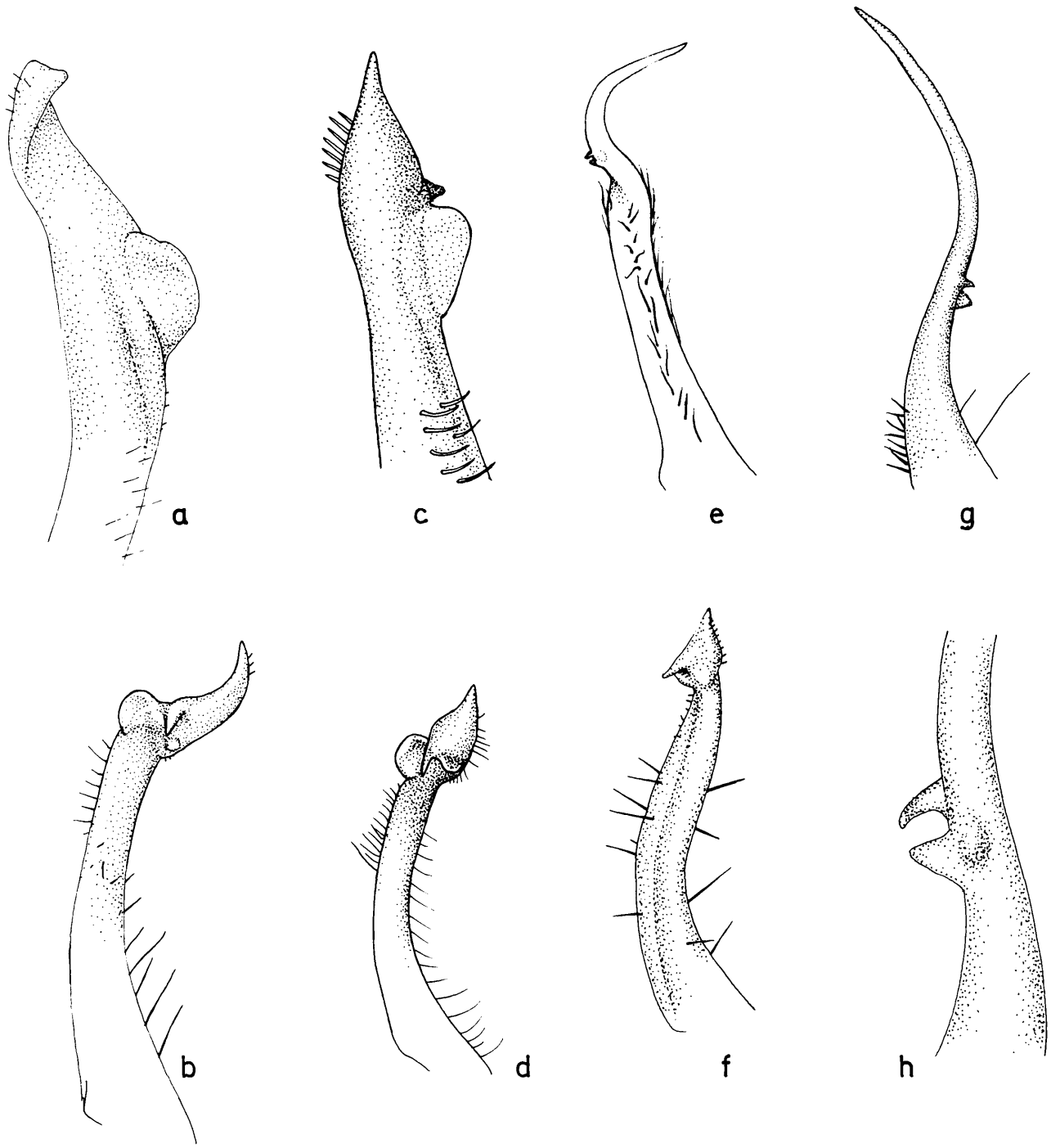


Fig. 85. Left first pleopod of male of *Pseudomicippe banfieldi* (17 mm, AM P.19541) (a) sternal tip of pleopod, (b) abdominal view of same; *P. maccullochi* (holotype) (c) sternal tip of pleopod, (d) abdominal view of same; *P. indonesica* (holotype) (e) abdominal view of pleopod; *P. philippinensis* (holotype) (f) abdominal view of pleopod; *P. indonesica* (holotype) (g) sternal tip of pleopod, (h) detail of abdominal aperture.

Livingstone, April 1933; 2 specs. (AM P. 10301). — Neds Beach, coll. I. Bennett, May 1964; 1 spec. (AM P. 19606). — Flat Rock, 25 m, coll. N. Coleman, 22 February 1979; 2 specs. (AM P. 29818). — Erscott's Hole, 3 m, coll. N. Coleman, 15 February 1979; 1 spec. (AM P. 29819). — Ball's Pyramid, 10 m, coll. N. Coleman, 24 February 1979; 1 spec. (AM P. 29820). — Deakon's Reef, 22 m, coll. N. Coleman, 30 November 1979; 2 specs. (AM P. 30996).

New Caledonia: 22°48.5′S 167°36.5′E, 85-100 m, large bottom dredge, 'Kimbla' Stn K4/71/4, coll. J. Paxton and P. Colman, 8 May 1971; 1 spec. (AM P. 29817).

Remarks. — There is considerable variation in this species, which has already led to Japanese specimens being considered as belonging to a species distinct from that described from Hawaii by Rathbun. There has been only one previous record of the species from the southwest Pacific (Chilton, 1911 — Kermadecs). The detailed remarks below set out these variations and our reasons for regarding southwest Pacific specimens as conspecific with those from Hawaii. Certain

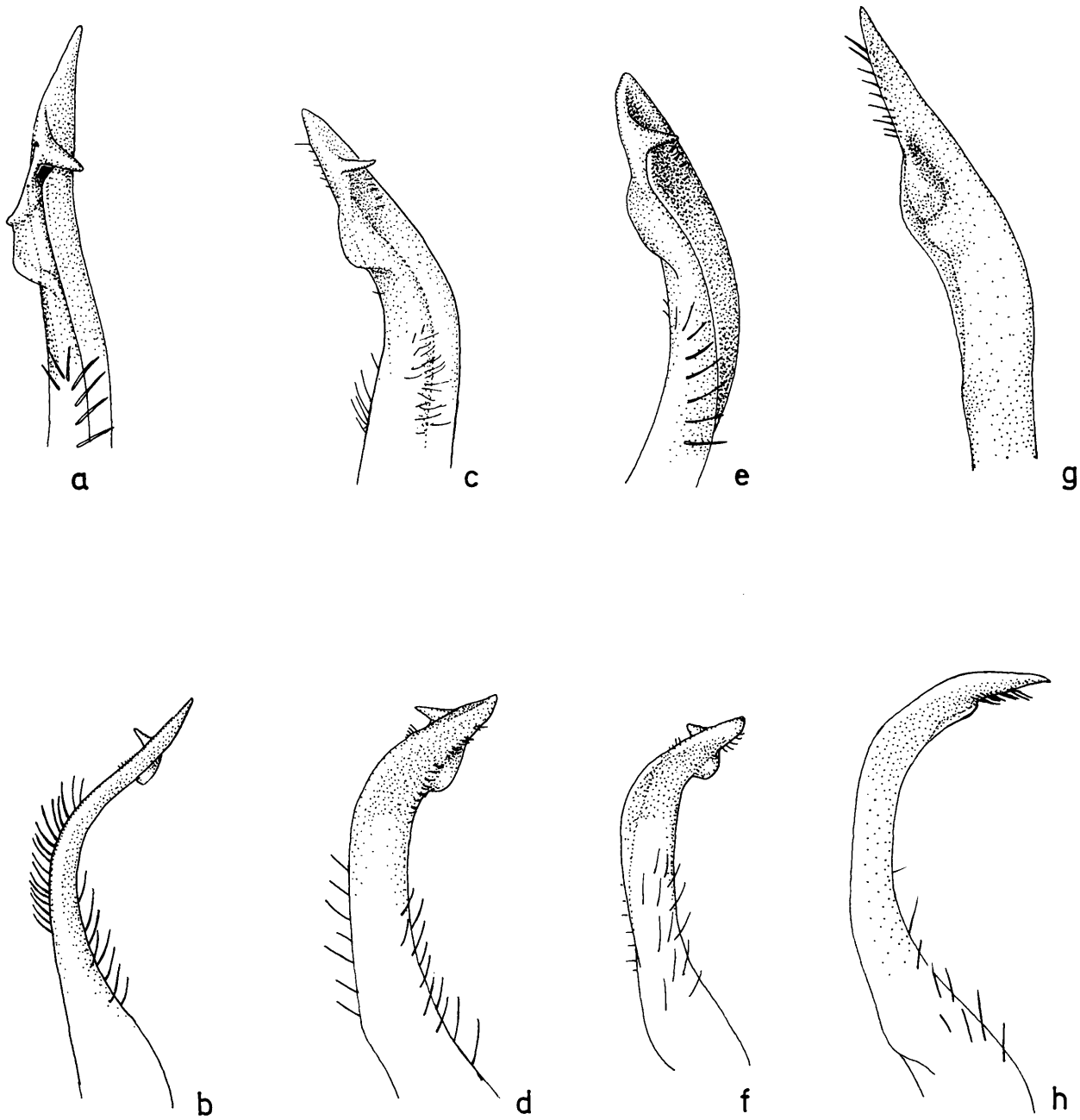


Fig. 86. Left first pleopod of male of *Pseudomicippe nodosa* (25 mm, Somalia, ZMF) (a) sternal tip of pleopod, (b) abdominal view of same; *P. eldredgei* (holotype) (c) sternal tip of pleopod, (d) abdominal view of same; *P. maldivensis* (holotype) (e) sternal tip of pleopod, (f) abdominal view of same; *Microhalimus deflexifrons* (14.5 mm, AM P.9047) (g) sternal tip of pleopod, (h) abdominal view of same.

characters, such as tuberculation, which would be considered normally to distinguish species from each other, appear to vary within the one species, perhaps in relation to age.

We have compared our series of twelve specimens (6 ♂♂, 6 ♀♀ (1 ovig.), 9.5-19.5 mm, ovig. ♀, 19.5 mm) from Hawaii with the description and figure given by Rathbun (1906). Our series agrees with the description in having five spines behind the postorbital spine, the first being the hepatic, and having a branchial spinule on either side of the intestinal spine. (This spinule is usually very small and is absent in the smallest specimen.) However, instead of a spinule, Rathbun's figure (fig. 38) shows an apparent sixth marginal spine lateral, and clearly anterior to the intestinal spine.

In our Hawaiian specimens the spines on the branchial margin and the posterior carapace margin are similar in length to the hepatic spine, but in those of our specimens not from Hawaii these spines are much shorter than the hepatic spine. The spinule on either side of the intestinal spine is absent in nearly all the specimens from the Kermadec Islands and in two of the smaller specimens from Lord Howe I.

In only eight of our Hawaiian specimens (and in none less than cl. 13.5 mm) are there any gastric tubercles. Of these

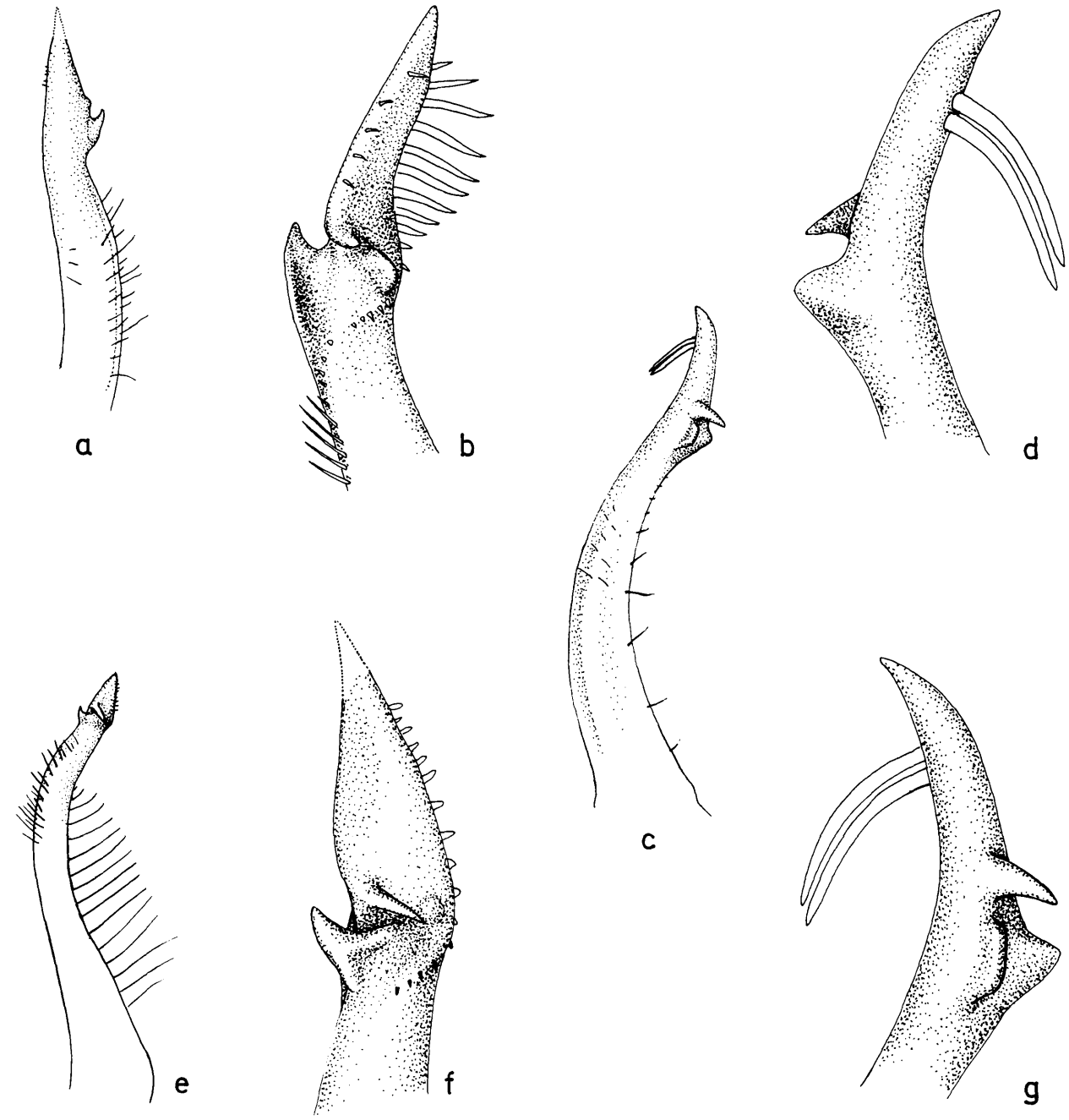


Fig. 87. Left first pleopod of male of *Pseudomicippe varians* (22 mm, AM P.6955) (a) sternal tip of pleopod; *P. nipponica* (25.5 mm, Japan, ZSM) (b) abdominal tip of pleopod; *P. tenuipes* (10.5 mm, AM P.19139) (c) abdominal view of pleopod, (d) sternal tip of same; *P. varians* (as above) (e) abdominal view of pleopod; (f) abdominal tip of same; *P. tenuipes* (as above) (g) abdominal tip of pleopod.

eight specimens one male and an ovigerous female have a distinct posterior mesogastric tubercle and two very small anterior protogastric tubercles, two other males have only a mesogastric tubercle and four other specimens have a very small or indistinct mesogastric tubercle. In the other 24 specimens in this series from Kermadec Islands (11 specimens), Lord Howe I. (13 specimens) and off New Caledonia (1 specimen) about half, i.e. 13 (and none of those less than cl. 13.5 mm) have tubercles on the gastric region; of these, three specimens from the Kermadec Islands and the specimen from off New Caledonia have only two small anterior protogastric tubercles; four of the specimens from Lord Howe I. have a transverse row of four protogastric tubercles; three of the specimens from Lord Howe I. and one specimen from the Kermadec Islands have a mesogastric tubercle as well as a transverse row of four protogastric tuberlces.

The rostral spines in this series vary in length from a fifth to about a quarter postrostral carapace length (Hawaii specimens 0.21-0.26; Kermadec specimens 0.19-0.25; Lord Howe I. specimens 0.19-0.27; New Caledonia specimen 0.3). The two anterior spines on the basal antennal article are

usually subequal in our Hawaiian specimens but in our other specimens the medial spine may be up to twice as long as the lateral spine.

Of the nineteen males in this series six have tubercles on the carpus of the cheliped. There are about eight tubercles — one central proximal tubercle, three or four in a row on either side dorsally and one or two about midway along the inner face. Of these six specimens, three are from Lord Howe I. (cl. 18; 18.5; 33.5 mm), two are from the Kermadec Islands (cl. 13.5, 14.0 mm) and one is from Hawaii (cl. 16 mm). Although there are differences in the chelae of the larger specimen from Lord Howe I. and the smaller ones and those from the Kermadec Islands they all have a distinct gape between the fingers and a large tooth on the dactyl in the gape. The male from Hawaii is less distinctly adult, there is only a narrow gape between the fingers and a few small teeth on both fingers in the gape; the palm is 3.5 times as long as high, while in other males from Hawaii without tubercles on the carpus the palm is four times as long as high. The chelipeds of the adult males from Lord Howe I. and Kermadec Islands are one and a half times postrostral carapace length, but in the Hawaiian specimen only 1.2 times postrostral carapace length. The chela of the adult males from Lord Howe I. is more elongate (palm length = 2.8 to 3.6 × height) than is that of the adult males from the Kermadec Islands (palm length = 2.2 × height) and in the largest male the tubercles on the carpus are smaller and confined to the proximal half, whereas in the smaller males and in the Kermadec males the tubercles are high and occur along the whole length of the carpus.

The first pleopods of the males from Hawaii, Kermadec Islands and Lord Howe I. are all very similar. At about the distal third the pleopod is curved strongly outwards and tapers to a sharp apex. The aperture is subterminal midway along the outwardly curved part and on the sternal surface; there is a triangular lobe on the lateral edge of the aperture.

Some female specimens from Lord Howe I. and off New Caledonia are larger at sexual maturity than our specimens from the Kermadec Islands or Hawaii. Ovigerous and adult females are in the size range 15-19.5 mm from Hawaii; 12.5-14.5 mm from the Kermadec Islands and the one ovigerous female from Lord Howe I. is 16 mm, but four females in the size range 16.5-25 mm from Lord Howe I. and off New Caledonia are still immature.

Our specimens from the Kermadec Islands, Lord Howe I. and off New Caledonia differ from our Hawaiian specimens in development of gastric tubercles, the size of the carapace spines, form of cheliped of the adult male and in the relative lengths of the anterior spines of the basal antennal article. As well there are differences in size at sexual maturity and in the cheliped of the adult male between our specimens from the Kermadec Islands and those from Lord Howe I. and off New Caledonia. There is, however, among these specimens a strong similarity to Hawaiian material in the first pleopod of the male, in the form of the orbit and position of the carapace spines. This series shows that the presence or absence of the gastric tubercles and the tubercles on the cheliped carpus is related to the size or age of the animal, and that the difference in relative length of the anterior spines on the basal antennal article is not necessarily a reliable character. Differences of size at sexual maturity in populations from different localities is often found in species of *Schizophrys*, *Notomithrax* and *Leptomithrax*. Therefore we do not feel that there is sufficient justification for recognising the south-western Pacific specimens as representing a new species.

Sakai (1933: 140), in his original description, distinguished *S. manazuruana* from *S. hilensis* by its smooth gastric region. (*S. hilensis* is described by Rathbun as having three spinules arranged in a triangle on the gastric region.) Later, Sakai (1938: 305) suggests that the two species are probably identical but "in the Japanese species the gastric region is smooth and not armed".

Buitendijk (1939: 251) identified her specimens from the Philippine Islands as *S. manazuruana* apparently because the gastric region is smooth, and suggests that the specimens of *S. hilensis*, from the Kermadec Is., described by Chilton are probably conspecific. Our specimens from the Kermadec Islands are those collected by W. R. B. Oliver and examined by Chilton.

Sakai (1976: 246) includes the Kermadec Islands in the distribution of *S. manazuruana* thus regarding Chilton's specimens as synonymous with his species.

We have not examined specimens from Japan identified as *S. manazuruana* but it is probable that that species is conspecific with *S. hilensis*. (The carapace length given by Sakai, 1976, for *S. manazuruana* is 14 mm.)

From the description of *S. simodaensis* Sakai 1938 (:304-305) it appears to be distinguished from *S. hilensis* by the presence of a larger number of spines (12-13) on the cheliped carpus and longer (1/3 postrostral carapace length), narrower rostral spines. There are about eight spines on the cheliped carpus in some specimens of *S. hilensis*, but the presence or absence of such spines appears to distinguish adults from juveniles in *S. hilensis*. The presence of a large tooth on the cheliped dactyl, the presence of only one (rather than three) gastric tubercles or the absence of a branchial spine near the intestinal spine are no longer valid characters to distinguish *S. simodaensis*.

Distribution. — Central and southwestern Pacific: Hawaii, Kermadec Islands, Lord Howe I., New Caledonia.

Schizophrys White, 1848

Type species. — *Mithrax aspera* H. Milne Edwards, 1834 by designation of Miers, 1879.

Remarks. — This genus contains four closely related species including two new species added here, both with restricted distributions; *S. dahlak* from Dahlak Archipelago in the Red Sea and *S. rufescens* from the southern coasts of Australia.

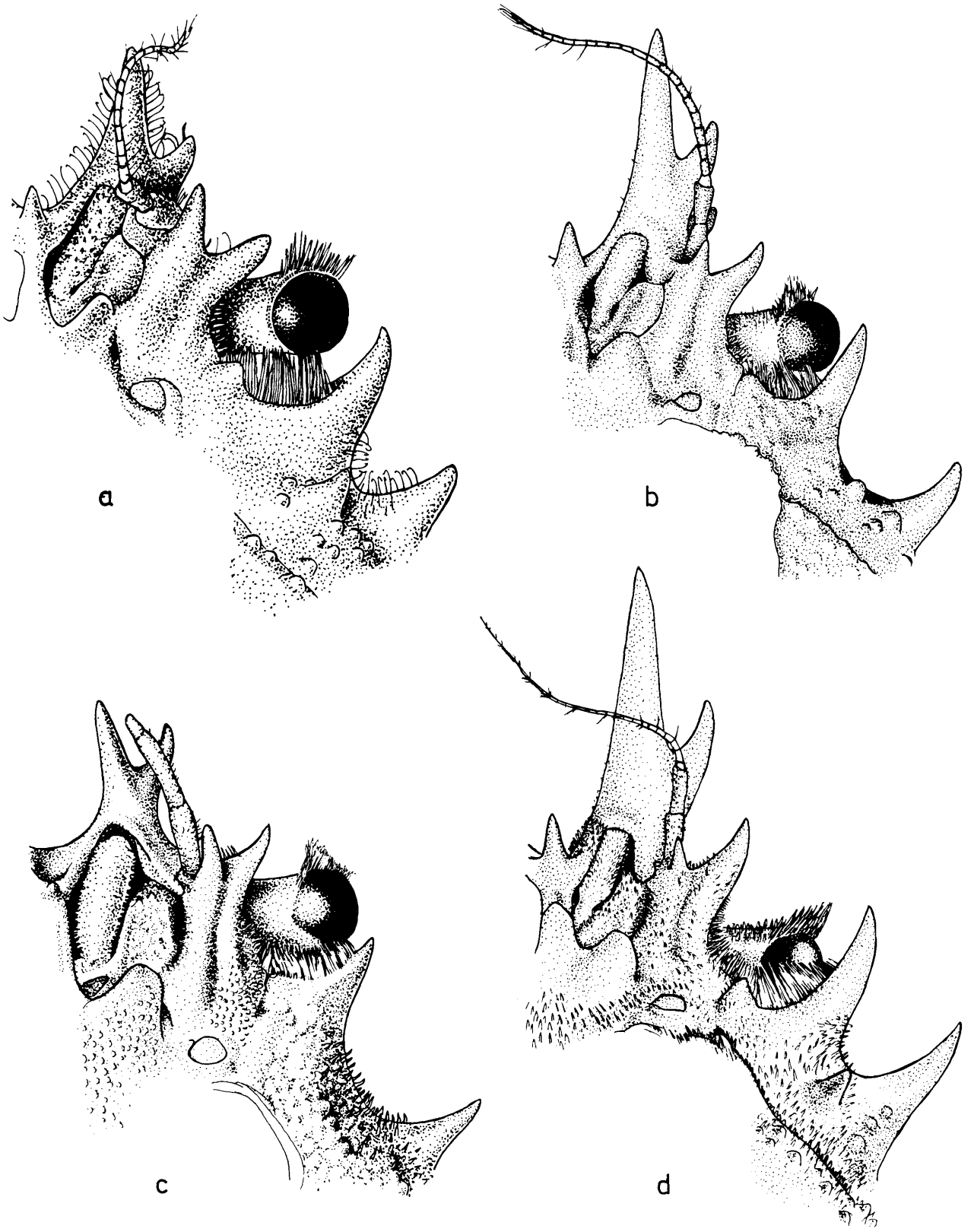


Fig. 88. *Schizophrys aspera* (male, 30.5 mm, AM P.17837) (a) left orbit, ventral view; *S. dama* (male, 59 mm, AM P. 13916) (b) left orbit, ventral view; *S. rufescens* (holotype) (c) left orbit, ventral view; *S. dahlak* (holotype) (d) left orbit, ventral view.

S. serratus White is considered to be a synonym of *S. aspera.* The orginal description of *S. spiniger* White (smooth chelipeds, two hepatic spines united at the base) appears to place it in the genus *Cyclax* rather than *Schizophrys*, and several specimens identified as *Cyclax spiniger* have been reidentified by Forest & Guinot (1961) as either *C. spinicinctus* or *C. suborbicularis. S. dichotomus* H. Milne Edwards from the 'Belearic Islands' has been figured and discussed in detail by Bouvier

(1940); we have seen no specimens that agree with this description and can say nothing about its status; its differences from *S. rufescens* are discussed under that species.

The first pleopod of the male in *Schizophrys* species is slender, curved outward distally, with a simple subterminal opening.

Distribution. — Widespread throughout the Indo-West Pacific.

KEY TO SPECIES OF *SCHIZOPHRYS*

1	Rostral spines each with two lateral accessory spines	*S. dama*
—	Rostral spines each with one lateral accessory spine	2
2(1)	Gastric region with a transverse row of four tubercles or spines	*S. aspera*
—	Gastric region granular, without tubercles or spines	3
3(2)	Rostral spines approx. 1/4 postrostral carapace length; first marginal branchial spine approx. one fifth carapace width; lower margin of orbit with a strong tooth	*S. dahlak*
—	Rostral spines approx. one sixth postrostral carapace length; first marginal branchial spine less than one tenth carapace width; lower margin of orbit without a tooth.....	*S. rufescens*

Schizophrys aspera (H. Milne Edwards, 1834) (Figs. 88a, 91g,h)

Mithrax asper H. Milne Edwards, 1834: 320.
Schizophrys aspera. — A. Milne Edwards, 1872: 231-234, pl. 10 fig. 1, 1a-f. — Alcock, 1895: 243-244. — Sankarankutty, 1962: 159-160, figs. 15-16. — Sakai, 1965a: 89, pl. 41 fig. 2; 1976: 246, pl. 89 fig. 3. — Griffin, 1966b: 286, pl. 16; 1966c: 312-313. — Takeda, 1973a: 109 — Griffin & Tranter, 1974: 181-182.
Schizophrys spiniger. — Ward, 1941: 1. (Not *Schizophrys spiniger* White, 1848.)
Schizophrys serratus. — Ward, 1942: 74.

Material examined. — 33 ♂♂,25 ♀♀ (9 ovig.), 5 juvs., 8-45 mm, smallest ovig. ♀, 21 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Is., Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. (ZMA De. 100.886, det.Ihle). — Stn. 78, Borneo Bank, Lumu-Lumu shoal, reef, 34 m, shore exploration, coral and coral sand, 10/11 June 1899; 2 specs. (ZMA De. 100.887, det.Ihle). — Stn. 79b, Borneo Bank, Pulu Kabala-dua, 22 m, shore exploration, coral sand, 12/13 June 1899; 2 specs. (ZMA De.100.888, det.Ihle). — Stn. 89, Sulawesi, Pulu Kaniungan ketjil, 11 m, shore exploration, coral, 21 June 1899; 1 spec. (ZMA De.100.889, det.Ihle). — Stn. 152, NW. coast of Waigeo I., Wunoh Bay, 00°12.6′S 129°48′E, 32 m, dredge, townet and reef exploration, *Lithothamnion*, 12/13 August 1899; 1 spec. (ZMA De.100.890, det.Ihle). — Stn. 174, N. coast of Ceram, 18 m, dredge, townet and reef exploration, mud, 28/29 August 1899; 2 specs. — Stn. 193, Moluccas, E. coast of Sula Besi, Sanana Bay, 22 m, reef exploration, mud, 13/14 September 1899; 1 spec. (ZMA De.100.896, det. Ihle). — Stn. 206, Buton Strait, 04°58′S 122°41′E, 51 m, trawl, fine green mud, 21 September 1899; 1 spec. (ZMA De.100.893, det.Ihle). — Stn. 248, Ceram Sea, N. point of Tioor I., anchorage off Rumah Lusi, to 54 m, reef exploration. 4/5 December 1899; 2 specs. — Timor, E. coast of Roti I., Pepela Bay, 10°38′S 123°25.2′E, 22 m, reef exploration, 30 January 1900; 2 specs. (ZMA De.100.699, det.Ihle). — Banda Reef; 1 spec. (ZMA De.100.711, det.Ihle). — Savu Sea, Haingsisi Reef; 3 specs. (ZMA De.100.895, det.Ihle).

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA

Sri Lanka, Pearl Banks, coll. T. Southwell, 1911; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Philippine Is., Mindoro, Puerto Galero, February 1914; 1 spec. — Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 2 specs. — Sulu Archipelago, off Jolo, coral reef, 20 March 1914; 1 spec.

Mortensen Java — S. Africa Expedition: Java I., coral reef, April 1929; 3 specs. — Mauritius, Cannonier's Point, coral reef, 17 September 1929; 2 specs. — Mauritius, Flat I., 17 October 1929; 3 specs.

Danish Kei Islands Expedition: Ambon, 12 February 1922; 1 spec. — off Neira Banda, 13 m, dive, sand, coral, 12 June 1922; 1 spec. — Stn. 72, Java Sea, 05°41′S 105°57′E, 35 m, stones, 28 July 1922; 2 specs.

'Galathea' Expedition: Stn. 226, Madagascar, Bay at Cape Diego (Diego Suarez), 6 m, trawl, corals, mud, 3 March 1951; 1 spec. — Papua New Guinea, Port Moresby, 1 m, *Zostera*, October 1951; 1 spec. — Stn. 682, Tonga Makaha'a at Nukualofa, 21°07′S 175°10′W, 0.5-1 m, coral reef, 8 March 1952; 1 spec.

Singapore, low water, 20 April 1906; 1 spec.

'Dana' Expedition: Stn. 3760, Irian Jaya, Manokwari, 16 July 1929; 1 spec.

Vanuatu (New Hebrides), 10 July 1934; 1 spec.

Fiji, Suva Harbour, 18°09′S 178°24′E, reef flat at low tide, living corals, coll. T. Wolff, 17 May 1965; 2 specs.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Fiji, Storm I., near Mbenggo, coll. H. Boschma, 5 March 1949; 2 specs.

MUSÉUM NATIONAL D'HISTOIRE NATURELLE, PARIS

'Calypso' Expedition to Red Sea: Abulat, corals, 1952; 1 spec. — Mersa bella, 1952; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. HP I. Moluccas, Halmahera, Teluk Pajahi, 00°19′N 127°37′E, 9 m, diving, coral bank, 21 May 1970; 1 spec. — Stn. KL III, Moluccas, between Laluin and Kajoa Is., 0°02′S 127°26′E, sand flats with marginal coral and patches of seagrass, 22 May 1970; 1 spec. — Stn. CP I, Ceram, Piru Bay, off Tg Tutuhuhur, 03°15′S 128°08′E, 36-43 m, dredge haul 7, coral, sponge and rubble, 1 June 1970; 2 specs. — Stn. AT I, N. of Aru, N. shore of Toba I., 05°21′S 134°27′E, shallow, coral reef and sand, 14 June 1970; 2 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Keppel Islands, Humpy I., coll. McGonigal and Kirkwood, 16 September 1970; 2 specs. (AM P. 17837). — Capricorn Group, Heron I., 7.5 m, channel in cave, January 1975; 3 specs. (AM P. 20627).

Western Australia: Warroora, 3 m, main outer reef, coll. N. Coleman, 30 June 1972; 1 spec. (AM P. 19431).

WESTERN AUSTRALIAN MUSEUM, PERTH

Indian Ocean, Christmas I., coll. D. Powell, October-November 1961; 3 specs. (WAM 315-73).

Remarks. — This species is distinguished from *S. dama*, *S. rufescens* and *S. dahlak* by the presence on the granular carapace of several distinct short spines or large tubercles. There is a transverse row of four tubercles and a posterior medial tubercle on the gastric regions and tubercles or spines anteriorly and posteriorly on the dorsal branchial region. In the other three species the carapace is covered in low granules, with either small posterior branchial tubercles only (*S. dahlak*) or with no tubercles (*S. dama* and *S. rufescens*). There is a tooth on the suborbital border and the carapace behind it is smooth. There is a single lateral accessory spine at the base of the rostrum and in most specimens there are distinct tubercles on the rostral ridges. Sometimes (about a

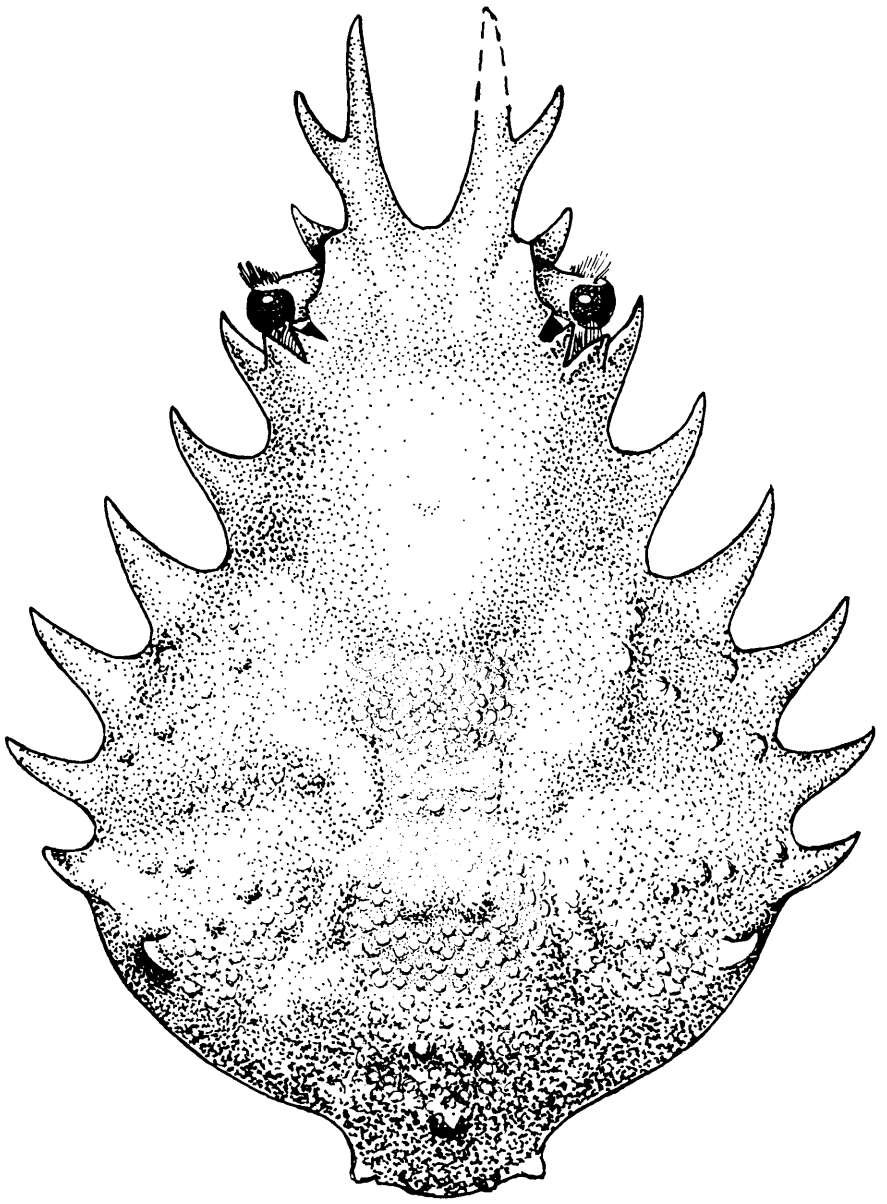


Fig. 89. *Schizophrys dahlak* (holotype) carapace, dorsal view.

third of our specimens) there is also a medial accessory spine or tubercle on the rostrum. There is a short acute terminal spine on the merus of the ambulatory legs. The first pleopod of the male is curved outward in the distal fifth with the opening on the sternal surface about midway between the curve and the apex (not subterminally as in the other species). In the female there is a strongly swollen area anterolateral to the narrow oval gonopore which opens posteromedially.

We have examined three specimens (1 ♂, 13 mm, 2 ♀ ♀, 16.5 21.5 mm, AM unregistered) from the Gulf of Davao, Philippine Islands, identified by Ward (1941) as *Schizophrys spiniger* White and they are *S. aspera.*

They differ from the brief description given by White (1847d: 223) in having small spines on the cheliped merus, and the two lateral carapace spines behind the postorbital spine are not united at the base. (From the original description *S. spiniger* White would appear to be a species of *Cyclax.*)

We have also examined three specimens (1 ♂, 57.5 mm, 2 ♀ ♀, 49.5, 50.5 mm, AM unregistered) from Mauritius identified by Ward as *Schizophrys serratus* White (Ward, 1942) and they are also conspecific with our specimens of *S. aspera.* There are tubercles on the gastric region, sharp tubercles anteriorly and posteriorly on the dorsal branchial region and a triangular tooth on the suborbital border.

Distribution. — Widespread Indo-West Pacific from East Africa and the Red Sea to Japan, Australia, Fiji and Hawaii.

Schizophrys dahlak new species
(Figs. 88d, 89, 90a,b,d,e, 91c,d)

Material examined. — 8 ♂♂, 3 ♀ ♀ (1 ovig.), 33-72 mm, ovig. ♀, 64.5 mm.

Holotype. — Male, cl. 63.5 mm, Red Sea, 3 m, in large coral head, coll. J. Forest, 'Calypso', 1952, Muséum National d'Histoire Naturelle, Paris. Paratypes. As listed below:

MUSÉUM NATIONAL D'HISTOIRE NATURELLE, PARIS

Red Sea, 3 m, in large coral head, coll. J. Forest, 'Calypso', 1952; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Red Sea, Dahlak Archipelago: March-April 1962; 3 specs. (ISRSE 62/4240). — Umm Aabak I., 0-2 m, 5 April 1962; 1 spec. (ISRSE 62/2705). — 15°37'N 40°43'E, 27 m, hard bottom, 'Negus Solomon', 23 October 1965; 1 spec. (ISRSE 65/1900).

ZOOLOGICAL MUSEUM, TEL AVIV UNIVERSITY

Red Sea, Dahlak Archipelago: N. of Nocra I., Umm Aabak I., 0-2 m, low tide, among and under corals, 5-6 April 1962; 1 spec. (ISRSE 62/1447). — Umm Aabak I., (close to a hot spring), 1962; 1 spec. (ISRSE 62/2097). — Museri I., Mangrove Bay, 0.5-1.5 m, low tide, about 100 m offshore, corals and sand, fishing with pro-noxfish, 13 October 1965; 1 spec. (ISRSE 65/1051).

MUSEO CIVICO DI STORIA NATURALE, MILAN

Red Sea, Massawa; 1 spec.

Description. — Carapace broad, width, about four fifths (0.8) postrostral carapace length, surface covered with low granules, regions barely elevated.

Rostrum of two slender, cylindrical spines, in length about a quarter postrostral carapace length; spines apically sharp, only weakly divergent; a slender, lateral accessory spine at about proximal third; main spine equal to two to three times accessory spine and about twice basal width of rostral spine.

Orbit above consisting of an expanded eave, no preorbital spine, antorbital angle produced to a broad triangle; intercalated spine triangular, length about one and a half times basal width; postorbital spine slender, sharp, curved forwards, tip reaching almost to preorbital angle, anterior edge with a short accessory spine whose apex barely exceeds intercalated spine; no tubercles between orbits.

Hepatic margin with a spine equal to postorbital spine; a small, sharp subhepatic spine.

Branchial margin with five sharp lateral spines, first about 0.17 cw., last smallest and more dorsally placed.

Gastric regions smooth, very weakly elevated, a few larger granules but no tubercles or spines.

Cardiac region not elevated, smooth. Intestinal region with a pair of low, anterior, submedial tubercles; a central medial tubercle; a pair of curved submedial spines on posterior margin with four tubercles between them.

Branchial region with about six tubercles posterodorsally; remainder of region smooth (in one specimen a lateral spine is bifid).

Basal antennal article slender, longitudinally grooved, two sharp anterior spines, lateral two to three times longer than medial; suborbital border with a triangular tooth and area near its base smooth (not tuberculate as in *S. dama* and *S. rufescens*); no tubercle lateral to green gland. Third maxilliped smooth.

Pterygostomian region mainly smooth with a few lateral tubercles and about two rows of tubercles on margin.

Male cheliped merus with tubercles and spines; two or more sharp, curved spines distally on medial edge (one on distal margin); at least two other curved spines on distal margin; carpus with sharp tubercles; palm smooth with a proximal dorsal tubercle; length about three times height; a moderate gape between fingers with a large tooth on dactyl in gape.

Ambulatory legs smooth except for a slender terminal spine on merus.

Sternum smooth.

Male abdomen of seven segments; last segment slightly wider (1.2) than long. First pleopod of male straight, curved laterally at tip (distal 1/8), with elongate, subterminal, sternal opening.

Remarks. — This species is similar to *S. aspera* in having one lateral accessory spine and a tooth on the suborbital border; it differs from that species in 1) having no gastric tubercles; 2) tubercles only on the posterior part of the branchial region; 3) the lateral spine much longer than the medial on the basal antennal article; and 4) the opening on the first pleopod of the male much nearer the apex. The characters which distinguish this species from *S. rufescens* are the longer more slender rostral and carapace spines; the presence of a tooth on the suborbital border; the anteromedial spine of the basal antennal article much shorter than the anterolateral; and the presence of tubercles on the posterior part of the branchial region. The characters which distinguish this species from *S. dama* are dealt with under that species.

The specific name refers to the type locality of the new species.

Distribution. — This species is known only from the southern Red Sea.

Schizophrys dama (Herbst, 1804)
(Figs. 88b, 91e,f)

Cancer Dama Herbst, 1804: 5-6, pl. 59 fig. 5.
Schizophrys dama. — Alcock, 1895: 245. — Alcock & Anderson, 1898: pl. 35 figs. 2, 2a. — Balss, 1935a: 124. — Buitendijk, 1950: 67-68. — Yaldwyn, 1964: 362, fig. — Griffin, 1966b: 286 (key).

Material examined. — 7 ♂♂, 6 ♀♀ (1 ovig.), 7.5-59 mm, ovig. ♀, 58.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 164, off W. point of Irian Jaya, 01°42.5'S 130°47.5'E, 32 m, dredge, sand, small stones and shells, 20 August 1899; 2 specs. — Stn. 273, E. coast Aru I., anchorage off Pulu Jedan, 13 m, trawl, dredge and divers, sand and shells, 23/26 December 1899; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Ambon, ca. 126 m, dredge, stones, sand, 22 February 1922; 1 spec.

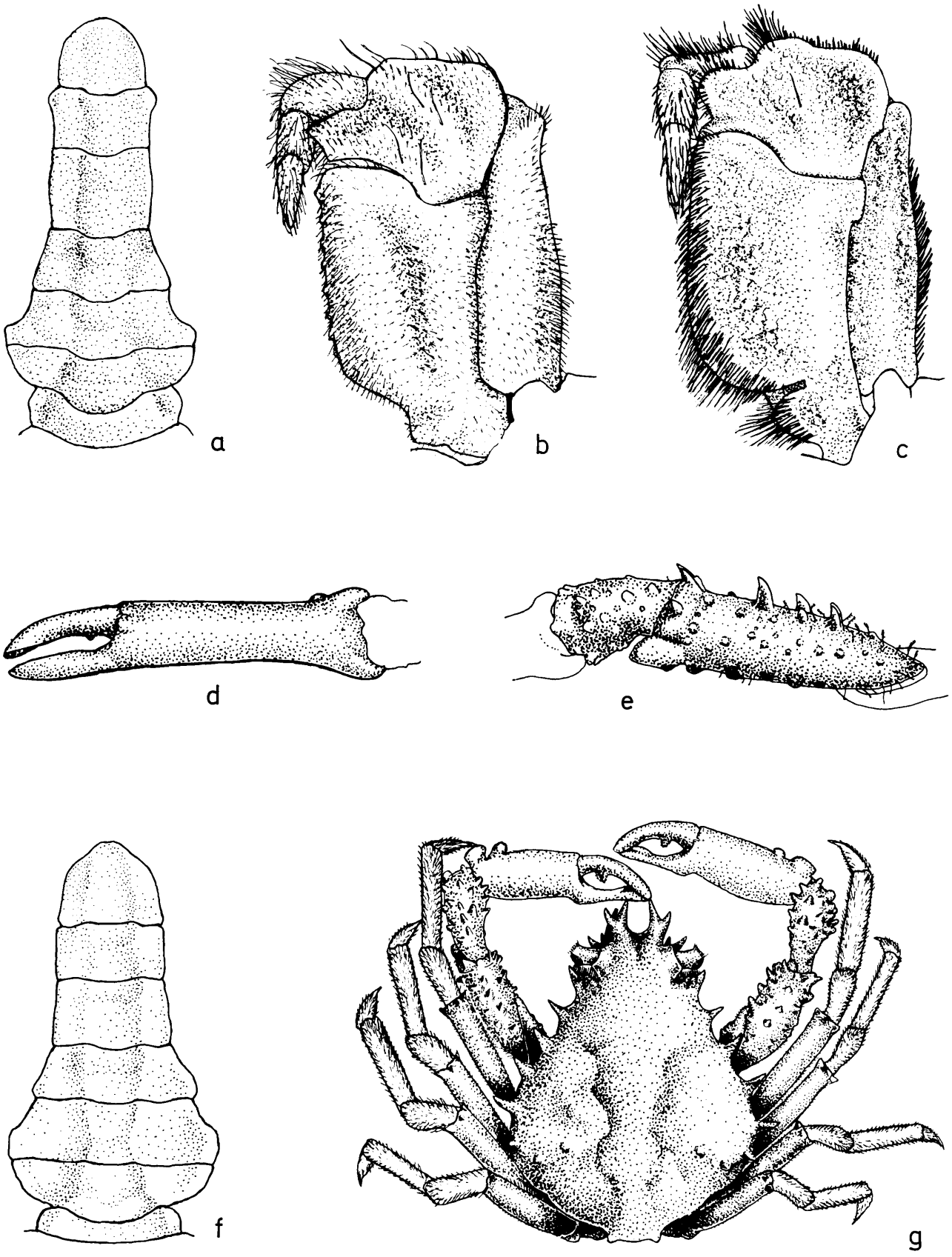


Fig. 90. *Schizophrys dahlak* (holotype) (a) male abdomen; (b) left third maxilliped; *S. rufescens* (holotype) (c) left third maxilliped; *S. dahlak* (holotype) (d) left chela; (e) left cheliped, merus and carpus; *S. rufescens* (holotype) (f) male abdomen; (g) whole animal, dorsal view.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, S. of Merauke, 'De Goede Hoop', March-April 1955; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AN I, Aru, S. Trangan I., SW. of Tg. Ngabordamlu, centred near 06°58′S 134°5′E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Northern Territory: N. Darwin, on buoys and beacons near lighthouse, coll. R. Kersting, 12 October 1963; 2 specs. (WAM 62-77).

SOUTH AUSTRALIAN MUSEUM, ADELAIDE

Great Australian Bight, coll. E. H. Howard, 1888; 1 spec. (SAM C1145).

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia; Between Cape Bossut and Broome, dredge, coll. A. A. Livingstone, 10 September 1929; 1 spec. (AM P.13916).

'Alpha Helix' Expedition 1975: Stn. 4, Arafura Sea, Torres Strait, 10°44.4′S 140°07.3′E, 48 m, coll. E. Ball and J. R. Paxton, 16 March 1975; 1 spec. (AM P.25071). — Stn. 7, Arafura Sea, 10°40.2′S 139°19.2′E, 48 m, small rocks, coll. E. Ball and J. R. Paxton, 16 March 1975; 1 spec. (AM P.25069).

Remarks. — *Schizophrys dama* is distinguished from the other two smooth species *S. rufescens* and *S. dahlak* by the presence of two lateral accessory spines (not one) on the rostrum; the much coarser granules on the carapace; and the narrower seventh segment of the male abdomen (as long as wide, not wider than long). In *S. dama* the rostral spines (0.2 postrostral cl.) and the marginal branchial spines (0.1 cw.) are shorter than in *S. dahlak* but longer than in *S. rufescens*. Both *S. dama* and *S. rufescens* are distinguished from *S. aspera* and *S. dahlak* by the absence of any dorsal branchial tubercles; by the absence of a tooth on the suborbital border; and by the region just below the suborbital border being tuberculate, not smooth.

On the rostrum one of the lateral spines is proximal and the other is at the distal half; it is this more distal spine which is present in those occasional specimens, mostly juveniles, which have only one spine. On the intestinal region there is a low central medial tubercle and on the posterior carapace margin two submedial tubercles, with four to six small tubercles between them.

The merus of the ambulatory legs is armed with only a sharp terminal tubercle, not a spine as in the other three species. The cheliped merus of the male is armed with tubercles and short spines including three short spines on the medial edge; the carpus has tubercles and short spines; the palm is smooth with a dorsal proximal tubercle. In the largest male in the series (57 mm) there is a small gape between the fingers and a large tooth on the dactyl.

The first pleopod of the male is similar to that of *S. rufescens*, straight, with a short laterally curved tip and a round subterminal sternal opening. In the female there is a swollen area lateral to the oval gonopore which opens medially.

This species has not been recorded from the east coast of Australia nor south of approximately 20°S on the west coast. However there is one specimen from the Great Australian Bight (♂, 39.5 mm, SAM C1145) which we have examined and the identification of which we have confirmed: the source of the record is reliable, so that the occurrence of *S. dama* in this southerly area must be regarded as rare.

Distribution. — Straits of Malacca; Indonesia; north Australia from Torres Straits to Port Hedland, Western Australia; Great Australian Bight.

Schizophrys rufescens new species
(Figs. 88c, 90c,f,g, 91a,b)

Schizophrys aspera. — Rathbun, 1918: 25. — Hale, 1927: 138-139 (in part: 'smooth and robust form' from South Australian 'Gulfs'). (Not *Mithrax asper* H. Milne Edwards, 1834.)

Material examined. — 21 ♂♂, 30 ♀♀ (5 ovig.), 14-58 mm, smallest ovig. ♀, 25.5 mm.

Holotype. — Male, cl. 52 mm, South Australia, west coast, Whittlebee Point, coll. W. Zeidler, 28 February 1975, SAM C.3875, South Australian Museum, Adelaide.

Paratypes. As listed below:

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: southern Queensland; 1 spec. (AM P.3534, det. M. Rathbun as *S. aspera*).

South Australia: 'South Australia'; 3 specs. (AM P.2338-40). — Spencer Gulf, 36 m; 2 specs. (AM E.830, AM P.2319, det. M. Rathbun as *S. aspera*). — Spencer Gulf, coll. H. Hale; 2 specs. (AM P.7484-5). — Spencer Gulf, Port Hughes, Tiparra Reef, 6-7 m, under rock, coll. N. Coleman, 25 November 1970; 1 spec. (AM P.19533). — Gulf St. Vincent, N. of Aldinga, on small tidal reef, coll. W. Ponder, 11 January 1971; 2 specs. (AM P.17838). — Kangaroo I., Kingscote, 35°40′S 137°37′E, 3-5 m, under Kingscote Jetty, coll. B. Russell, 9 March 1978; 1 spec. (AM P.29825). — Kangaroo I., American River, 2 m, on wharf piles, coll. N. Coleman, 10 March 1978; 1 spec. (AM P.29824).

Western Australia: Perth, Cockburn Sound, 2.5 m, under rock, coll. N. Coleman, 11/12 January 1972; 2 specs. (AM P.19444, AM P.19599). — Fremantle, Woodman's Point, 2 m, under rock, coll. N. Coleman, 4 March 1972; 1 spec. (AM P.19432).

SOUTH AUSTRALIAN MUSEUM, ADELAIDE

South Australia: Nuyts Archipelago, 5-7 m, 2 specs. (SAM C.232). — Pt Willunga, coll. H. M. Hale; 4 specs. (SAM C.1142). — Investigator Straits; 4 specs. (SAM C.1143). — Gulf St. Vincent; 3 specs. (SAM C.1144, dry). — Gulf St. Vincent, coll. W. H. Baker; 6 specs. (SAM C.1147, dry). — Whittlebee Point, coll. W. Zeidler, 28 February 1975; 4 specs. (SAM C.3876). — Reef, 3 miles (~ 5 km) S. of Port Vincent, coll. M. Tilbrook, 15 February 1972; 1 spec. (SAM C.3879).

Western Australia: Fremantle, Woodman's Point, 1927; 1 spec. (SAM C.1801).

Northern Territory: Gulf of Carpentaria, Groote Eyelandt, east coast, coll. N. B. Tindale, August 1921; 1 spec. (SAM C.162, dry).

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia: 10 miles (16 km) E. of Hopetoun, coll. R. W. George, 10 January 1959; 1 spec. (WAM 63-77). — Cheyne Beach, E. of Albany, sublittoral, rocky headland, 3 December 1968; 1 spec. (WAM 307-73). — Point Peron, 2 m, coll. H. W. Butler, 26 June 1960; 1 spec. (WAM 301-73 in part). — Point Peron, at National Fitness Camp, coll. R. W. George, 1 December 1961; 1 spec. (WAM 297-73). — Fremantle, Owen anchorage at power house, trawl, coll. R. W. George, 'Lancelin', 16 December 1959; 1 spec. (WAM 296-73). — Cockburn Sound, Woodman's Point, coll. B. R. Wilson, 13 February 1972; 1 spec. (WAM 295-73). — Jervoise Groyne, 6 m, on large black sponge, coll. B. R. Wilson, 22 April 1963; 2 specs. (WAM 66-77).

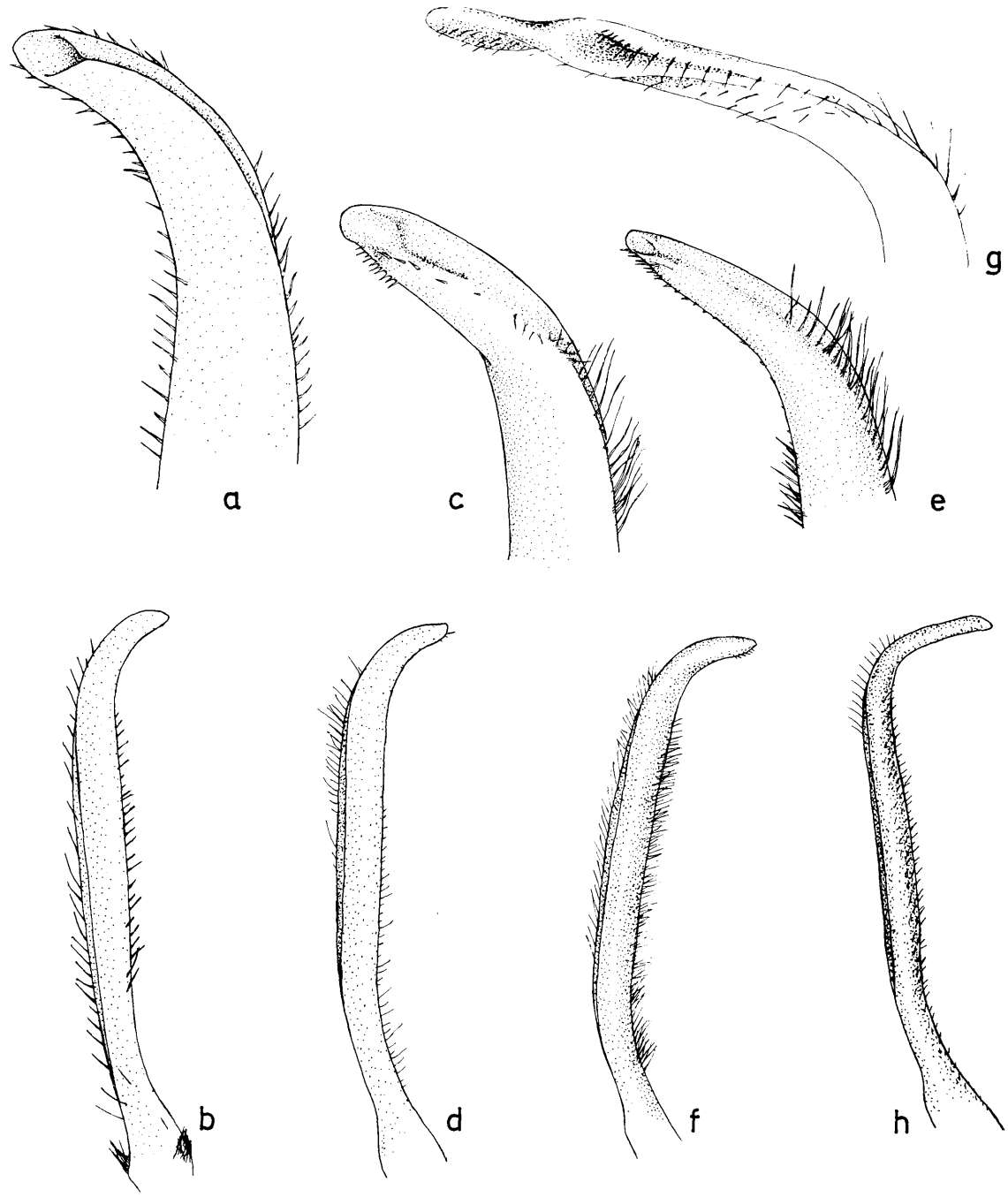


Fig. 91. Left first pleopod of male of *Schizophrys rufescens* (holotype) (a) sternal tip of pleopod, (b) abdominal view of pleopod; *S. dahlak* (holotype) (c) sternal tip of pleopod, (d) abdominal view of pleopod; *S. dama* (59 mm, AM P.13916) (e) sternal tip of pleopod, (f) abdominal view of pleopod; *S. aspera* (45 mm, AM P.20627) (g) sternal tip of pleopod, (h) abdominal view of pleopod.

Description. — Carapace broad, width five sixths (0.83) postrostral carapace length, surface covered with fine granules, mesogastric region weakly elevated.

Rostrum of two short spines, less than one sixth (0.15) postrostral carapace length; basal half broad and armed with one short, lateral accessory spine, distal half narrow; length of each rostral spine beyond accessory spine about half rostral length, one and a half times to twice length of accessory spine and less than (0.8) basal width of rostral spine.

Orbit above consisting of moderately expanded eave; no preorbital spine; antorbital angle produced to a short triangle. Intercalated spine triangular, length subequal to basal width; postorbital spine short, acute, apex reaching to about antorbital angle, armed anteriorly with a short accessory spine, apex of which slightly exceeds intercalated spine.

Hepatic margin with a spine equal to or smaller than postorbital spine; subhepatic region with several sharp tubercles. Branchial margin with five short spines (first spine

at most one fourteenth (0.07) carapace width), last spine much smaller and more dorsally placed.

Mesogastric region smooth, weakly elevated (more strongly elevated than in *S. aspera*), a larger central granule but no tubercles or spines. Protogastric region lacking tubercles between orbits.

Cardiac region very weakly elevated, with two larger granules in some specimens. Intestinal region with a central medial tubercle, two submedial tubercles on posterior margin but very small or no tubercles between them.

Branchial region without tubercles or spines.

Basal antennal article slender with a deep longitudinal groove, anterior medial spine equal to or slightly smaller than anterolateral spine. No tooth on lower edge of orbit adjacent to posterolateral angle of basal antennal article (present in *S. aspera*), carapace below border tuberculate (not smooth). Orbit open below. No suborbital tubercle lateral to green gland.

Pterygostomian region smooth with two rows of small tubercles on margin.

Male cheliped merus with short spines; dorsal spines sharp, including two on distal border; medial and ventral spines blunt; carpus with sharp tubercles or short spines; palm smooth with a proximal dorsal tubercle; adult male with a well developed gape between fingers and a large tooth on dactyl in gape.

Ambulatory legs armed with a short acute terminal spine on merus of first three pairs.

Male sternum smooth.

Male abdomen of seven segments; seventh segment wider (1.3) than long.

First pleopod of male straight, with a short laterally curved tip, opening round, sternal and subterminal.

Gonopore of female pear-shaped, opening posteromedially, a swollen area anterolateral to it.

Remarks. — Specimens of *S. rufescens* have previously been identified as *S. aspera* on the basis of the single lateral accessory spine. There are however, a number of characters which distinguish this species from *S. aspera*. There are no tubercles or spines on the gastric or branchial regions other than the marginal spines; the suborbital border lacks a tooth but the area between it and the anterolateral angle of the mouthfield is tuberculate (not smooth as in *S. aspera*); the first pleopod of the male has a short curved tip and a subterminal opening while in *S. aspera* there is a long curved tip and the opening is midway along it.

The characters which distinguish this species from *S. dama* and *S. dahlak* are dealt with under those species.

This species occurs from Gulf St Vincent, South Australia along the coast of the Great Australian Bight to Perth, Western Australia, but there are also two records, one from southern Queensland and one from the Gulf of Carpentaria; the specimens have been seen by us and we can confirm that they are *S. rufescens*. Other collections from southern Queensland and the Gulf of Carpentaria do not contain specimens of this species and the regular occurrence in those areas therefore is not confirmed although the sources for the two records are highly reliable.

S. dichotomus H. Milne Edwards from the 'Belearic Islands' figured by H. Milne Edwards (1934: pl. 15 figs. 1-4) and by Bouvier (1940: fig. 198, pl. 13 fig. 2) is similar to *S. rufescens* in the short rostral spines, in the absence of a tooth on the inferior border of the orbit and in the carapace which is without tubercles or spines except on the margins. However, both drawings show the postorbital lobe directed almost straight forward, not obliquely forward as in *S. rufescens* and in Bouvier's figure there are two spinules or tubercles on the posterior slope of the hepatic spine which is always smooth in *S. rufescens*. We do not know the status of *S. dichotomus*.

The specific name refers to the reddish colour of this new *Schizophrys*.

Distribution. — South Queensland, South Australia, southwestern Australia, Gulf of Carpentaria.

Seiitaoides new genus

Type species. — *Eurynome orientalis* Sakai, 1961.

Description. — Carapace pyriform to subpyriform, ornamented with a few large plates and some sharp tubercles. Rostrum of two distinct spines separated by a U-shaped hiatus. Supraorbital margin comprising eave, intercalated spine and postorbital lobe. Basal antennal article broad basally, narrow in distal half, antenna not excluded from orbit. Lower margin of orbit with a broad suborbital lobe. Ischium and merus of third maxilliped spinulated; anterolateral angle of merus produced. Cheliped of male spinous, longer than ambulatory legs; chela palm spinous, fingers short, bent on an angle towards fixed finger. Ambulatory legs short, with spinules. Abdomen of seven free segments in both sexes; abdomen of adult females covering sternum.

Remarks. — The very simple form of the male pleopod and the characteristic ornamentation of the carapace with a few large plates, rather than many tubercles, distinguish the species of this genus from those of *Eurynome* and *Choniognathus*. The first pleopod of the male of *Seiitaoides orientalis* (Sakai) is almost straight and the aperture is at the apex; the pleopod of the other species placed in the genus, *S. stimpsoni* (Miers), is unknown.

The name of the new genus is derived from the Japanese *Sei-ita* and refers to the armoured appearance of the carapace. *Sei-ita* is an extra back plate closing the opening in a *Harimake-do*, a type of Japanese armour opening down the back.[39])

[39]) Stone, G. C., 1961. A Glossary of the Construction, Decoration and Use of Arms and Armor. J. Brussel, New York.

Distribution. — Indo-West Pacific: Red Sea, Providence Reef, Western Australia, Indonesia, Japan.

KEY TO SPECIES OF *SEIITAOIDES*

1 Epibranchial plate subpyriform, laterally acute; surface of plates spiny, carapace surface between plates with 'star-shaped' tubercles; intercalated spine separated by fissures from supraorbital eave and postorbital lobe ..... *S. orientalis*

— Epibranchial plate subcircular; surface of plates tuberculate, carapace surface between plates with simple tubercles; intercalated spine contiguous with supraorbital eave and postorbital spine ..... *S. stimpsoni*

Seiitaoides orientalis (Sakai, 1961) new combination
(Fig. 69b,e,f)

Eurynome orientalis Sakai, 1961: 140-141, text fig. 1c,d, pl. 4 fig. 2; 1965a: 79-80, pl. 37 fig. 5; 1976: 221-222, text fig. 119, pl. 76 fig. 1. — Griffin, 1970b: 7-8, fig. 1.

Material examined. — 5 ♂♂, 4 ♀ ♀ (2 ovig.), 4-7 mm, smaller ovig. ♀, 6.5 mm (and 1 spec. in fragments).

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Is, Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. — Stn. 51, Lesser Sunda Is., Madura Bay and other locations in S. part of Molo Strait, 69-91 m, dredge, trawl and shore exploration, fine grey sand, coarse sand with shells and stones, 19 April 1899; 1 spec. — Stn. 260, Kai Is., 2.3 miles (~ 4 km) N.63°W. from N. point of Nuhu Jaan, 05°36.5′S 132°55.2′E, 90 m, Blake dredge, sand, coral and shells, 16/18 December 1899; 3 specs.

'Ihle collection', no locality data; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 3, Kai Is., 05°32′S 132°36′E, 245 m,trawl, sand, 31 March 1922; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AH I, near Tg. Bt. Kapal, Haruku I., (E. of Ambon), 03°36′S 128°24′E, 108-113 m, dredge haul 4, shell, sand and rubble, 31 May 1970; 1 spec. (prev. det. R. Serène). — Stn. AW IV, Aru, Wokam, off W. end Udjir I., 05°37′S 134°10′E, 68-94 m, dredge hauls 4-7, mud and rubble, 16 June 1970; 1 spec. (prev. det. R. Serène). — Stn. AM II, Aru, Maikoor, approx. 8 miles (~ 13 km) SW. Tg. Ratoe, centred on 06°7′S 133°57′E, 45 m, dredge hauls 4-5, sand and rubble, 18 June 1970; 1 spec. (damaged),(prev. det. R. Serène).

Remarks. — This species is distinguished by the subpyriform, laterally acute hepatic and epibranchial plates. Like *S. stimpsoni* it possesses a large cardiac plate and a slightly smaller mesogastric plate. However, in *S. orientalis* the surfaces of the plates are spiny and the surface of the carapace between the plates bears small "star-shaped" tubercles. In *S. stimpsoni* on the other hand, the surface of the plates are tuberculate, and the surface of the carapace between the plates bears simple tubercles. *S. orientalis* also differs in a generally more spiny appearance and in having more slender chelae on the male.

The rostral spines are generally slender and of moderate length. The hepatic plate is sometimes incised midway along its anterior border but in one specimen there is a small but distinct, laterally acute hepatic plate and medial to this a small oval plate. The epibranchial plate is usually distinct from any of the nearby plates but in one specimen the plate on the posterolateral border is fused with the epibranchial plate. The basal antennal article of these specimens is as described by Griffin (1970b).

In one small specimen, cl. 4 mm, the plates of the carapace are small and more distinct from each other than in large specimens.

Distribution. — Japan - Sagami Bay; Kai Is., Aru, Ambon, Lesser Sunda Is.; off Western Australia between Carnarvon and North West Cape.

Teratomaia new genus

Type species. — *Leptomithrax richardsoni*, Dell, 1960, by monotypy.

Description. — Carapace pyriform, surface tuberculate with moderately long spines. Rostrum of two slender, divergent spines separate from their base. Orbit comprising a broad supraorbital eave with a preorbital and antorbital spine; an intercalated spine and a postorbital lobe excavated anteriorly; eave, intercalated spine and postorbital lobe closely approximated. Eyestalk short, slender, cornea large, terminal. Basal antennal article moderately broad, sub-rectangular, anteromedial and anterolateral angles toothed, flagellum excluded from orbit. Merus of third maxilliped subquadrate with a deep anteromedial notch. Ambulatory legs of moderate length, cylindrical. Abdomen of seven segments in both sexes. Male first pleopod outwardly curved distally and tapering, tip pointed, aperture subterminal, lateral, surface below aperture expanded as a thin flap.

Remarks. — It was suggested by Griffin (1966d) that *Leptomithrax richardsoni* with its strong preorbital spine may not be congeneric with other species of *Leptomithrax*. In fact the first pleopod of the male shows more similarity to the pleopods of species of *Thacanophrys* than to species of *Leptomithrax*. However, there are many differences in the carapace and chelipeds which set it apart from *Thacanophrys*. There are similarities in pleopods and preorbital spine with *Ageitomaia baeckstroemi* (Balss) but differences between the two species in male chelipeds and postorbital lobes. The reasons for not considering these two species congeneric are discussed under *Ageitomaia*. We consider, therefore, that this species should be placed in a new, presently monotypic, genus.

The name is derived from the Greek *teras*,-*atos*, monster; *Teratomaia richardsoni* is a relatively recently described large spiny spider crab from the deep sea.

Distribution. — New Zealand and southeastern Australia.

Teratomaia richardsoni (Dell, 1960) new combination

Leptomithrax richardsoni Dell, 1960: 2-4, fig. 3, pl. 2. — Griffin, 1966d: 79-81, figs. 16, 23, pls. 3,4. — Griffin & Brown, 1976: 253.

Material examined. — 18 ♂♂, 11 ♀ ♀ (8 ovig.), 24-102 mm, smallest ovig. ♀, 63 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

New South Wales: NE. of Sydney, 33°40′S 151°45′E, to 33°45′S 151°51′E, 540 m, trawl, F.R.V. Kapala, 4 May 1976; 2 specs. (AM P. 24181-2). — E. of Sydney, 540 m,,trawl, F.R.V. Kapala, 6 September 1978; 1 spec. (AM P.29947). — E. of Brush I., 35°35′S 150°47′E to 35°29′S 150°44′E, 504-576 m, trawl, F.R.V. Kapala, 9 June 1976; 10 specs. (AM P.24392, P. 24394). — E. of Brush I., 35°44′S 150°38′E to 35°41′S 150°40′E, 540 m, trawl, F.R.V. Kapala, 10 November 1976; 2 specs. (AM P.25039). — E. of Brush I., 35°36′S 150°44′E to 35°34′S 150°46′E, 594 m, trawl, F.R.V. Kapala, 1 December 1976; 2 specs. (AM P.25044). — E. of Twofold Bay, 37°12′S 150°22′E, 378 m, F.R.V. Kapala, 12 October 1977; 1 spec. (AM P.27026).

Victoria: SE. of Gabo I., 37°45′S 150°12′E to 37°38′S 150°16′E, 396-432 m, trawl, F.R.V. Kapala, 10 July 1975; 4 specs. (AM P.20808, P. 21579). — SE. of Gabo I., 37°36′S 150°17′E to 37°43′S 150°15′E, 540 m, trawl, F.R.V. Kapala, 11 July 1975; 7 specs. (AM P.20803).

Remarks. — This additional material agrees with that reported previously from Australia.

Distribution. — New Zealand and southeastern Australia.

Thacanophrys new genus

Type species. — *Chorinus aculeata* H. Milne Edwards, 1834.

Description. — Carapace subpyriform, with spines or lamellate lobes or both. Rostrum of two spines distinct from base. Orbit above comprising eave, intercalated spine and postorbital lobe; eave generally with two spines or lobes; postorbital lobe lamellate, excavate anteriorly. Eyestalk retractile to postorbital lobe. Basal antennal article not especially broad, distant from postorbital lobe, orbit open below. Third maxillipeds with merus as broad as ischium. Chelipeds of male generally distinctly ridged. Ambulatory meri usually spined. Abdomen of seven segments in both sexes. First pleopod of male with a flap protecting subapical aperture.

Remarks. — It was strenuously argued previously (Griffin, 1966a) that the species until 1966 most commonly included in *Acanthophrys* (a genus now considered to be close to the pisine *Hyastenus*), but less often referred to as *Chlorinoides* or *Paramithrax* (*Chlorinoides*), were conspecific with *Chlorinoides tenuirostris* Haswell. However, examination of the first pleopod of the males of all species and further consideration of other features convinces us that *C. tenuirostris* differs significantly from all other species and in respect of the first pleopod of the male, the structure of the orbit and so on *C. tenuirostris* has a much closer relationship with *Naxioides* species than with the species which it was previously grouped with: this is discussed further under *Naxioides*. It is thus necessary, yet again, to reallocate those species other than *C. tenuirostris* which were included previously in *Chlorinoides* or *Acanthophrys* and to establish a new genus for them! We have chosen the name *Thacanophrys* and the species (wrongly) assumed by Bouvier (1906b) to be the type species of *Acanthophrys* is chosen as the type species of the new genus.

Since 1966 three new species have been described. *Chlorinoides barunai* Serène (1969) is now regarded as a synonym of *Thacanophrys albanyensis* (Ward). *Chlorinoides tosaensis* Sakai (1969) is a species close to *T. acanthonotus* (Adams) and is known now from the western Indian Ocean. *Chlorinoides occidentalis* Griffin (1970a), the eastern Indian Ocean counterpart of the Pacific *T. goldsboroughi* (Rathbun) resembles the Japanese *T. brevispinosus* (Yokoya). *Acanthophrys germaini* (Bouvier, 1906b) is now regarded as a synonym of *T. halimoides* (Miers). Thus, *Thacanophrys* is presently considered to contain twelve species.

Other genera of the Majinae in which the pleopod has a form similar to that of *Thacanophrys* species are *Entomonyx*, *Jacquinotia*, *Kimbla* and *Teratomaia* and, in a modified, form, *Tumulosternum*.

Distribution. — Throughout the Indo-West Pacific.

KEY TO SPECIES OF *THACANOPHRYS*

1		Preorbital and antorbital lobes developed as spines, not lamellate 2
—		Preorbital or antorbital lobe or both, lamellate 10
2(	1)	Preorbital spine upwardly directed, more than three times antorbital spine in length 3
—		Preorbital spine outwardly directed, not greatly exceeding antorbital spine 4
3(	2)	Preorbital spine bifid, intestinal region with two spines fused at the base, one spine directed forward, one backward..... *T. acanthonotus*
—		Preorbital spine simple, intestinal region with two distinct spines, both directed backwards ..... *T. tosaensis*
4(	2)	First marginal branchial lobe a flattened lamella, two or three spines behind it on margin 5
—		Branchial margin with one or two spines midway along, but no lamella anteriorly 7
5(	4)	One mesogastric spine; branchial margin behind anterior lamella with three spines ..... *T. brevispinosus*[40])
—		Two mesogastric spines in midline; branchial margin behind anterior lamella with one lamella and two spines or two spines only 6
6(	5)	Rostral spines one half postrostral carapace length, distance between tips two and a half times basal width; tips of preorbital and antorbital spines turned forwards ..... *T. occidentalis*
—		Rostral spines no more than one third postrostral carapace length, distance between tips one and a quarter times basal width; preorbital and antorbital spines directed obliquely forwards .... *T. goldsboroughi*
7(	4)	Rostral spines widely divergent distally, distance between tips at least more than two and a half times basal width; two branchial spines 8
—		Rostral spines moderately divergent, distance between tips no more than basal width; one branchial spine 9
8(	7)	A single cardiac spine; ambulatory meri with two long spines on distal margin ..... *T. aculeatus*
—		A pair of submedial cardiac spines; ambulatory meri with one moderately long spine and sometimes a shorter spine on distal margin..... *T. longispinus*
9(	7)	Cardiac region with a single spine; postorbital lobe a wide lamella ..... *T. halimoides*
—		Cardiac region with a pair of submedial spines; postorbital lobe narrowly triangular..... *T. harmandi*
10(	1)	Posterior intestinal margin with an acuminate spine; ambulatory legs trigonal ..... *T. albanyensis*
—		Posterior intestinal margin with a prominent lamellate lobe; ambulatory legs cylindrical 11

[40]) From the literature (Sakai, 1976).

11(10) Preorbital lobe lamellate, wide, apex truncate or concave, antorbital lobe a short spine; medial margins of rostrum armed with several short spines; posterior intestinal lobe widest midway from base, summit rounded..... *T. spatulifer*

— Preorbital lobe slender, spinous, acuminate, antorbital lobe lamellate, distally expanded and anteriorly directed; medial margins of rostrum lacking spines; posterior intestinal lobe widest at base, summit truncate to concave..... *T. filholi*

Thacanophrys acanthonotus (Adams, 1847) new combination (Figs. 92a,b,d, 93 a-c, Pls. 20,21a)

Chorinus acanthonotus Adams, *in* White, 1847c: 119-120. — Adams & White, 1848: 11-12, pl. 1 figs. 1, 1a-c.
Chlorinoides acanthonotus. — Griffin, 1966a: 4, 12.

Material examined. — 1♂, 20 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 320, Java Sea, 06°5′S 114°7′E, 82 m, trawl, fine grey mud, 23 February 1900; 1 spec. (ZMA De. 100.837, det. Ihle as *Paramithrax*).

Remarks. — This specimen agrees well with holotype (♀ ca. 27.3 mm, Borneo, BMNH 47.21).

On the hepatic region there are two or three tubercles ventral to the long hepatic spine which points obliquely backwards.

The basal antennal article is armed anteriorly with two long spines, that on the anterolateral angle pointing directly outwards and the medial spine pointing ventrally forwards; there is a short triangular spine on the proximal lateral angle.

The pterygostomian region is smooth with a short flattened spine in the middle of the border. The sternum of the male is smooth; the anterior margin of the abdominal fossa is carinate and there are a few granules on the lateral margins.

The merus of the cheliped is armed with three teeth ventrally and four dorsally, the terminal being the largest; the carpus has one proximal tooth and there are two on each of the dorsal ridges. The palm is not inflated, the dorsal length equals three times height and there are two low dorsal teeth.

The first pleopod of the male is similar to that of some other *Thacanophrys* species but the tip is produced into a narrow curving ridge on the sternal surface.

This is only the second record of this species and the first male known.

This species is very similar to *C. tosaensis* Sakai from Japan (Sakai, 1969: 254-255, pl. 1 fig. 3, text figs. 4c, 5a) and from off the eastern coast of Africa (Griffin, 1974: 7, 9, figs. 2, 3 f). In that species the preorbital spine is arched and simple, not straight and bifid, and on the intestinal region there are one or two separate spines pointing obliquely backwards instead of two spines in the midline, clearly united at the base, one directed anteriorly and the other posteriorly.

T. tosaensis from Japan has in common with *T. acanthonotus* a very long hepatic spine and a long postorbital spine. These spines are shorter in the specimens from the western Indian Ocean, and the anterolateral spine of the basal antennal article and the first free segments of the antenna are broader than in *T. acanthonotus.*

Distribution. — Borneo, Java Sea.

Thacanophrys aculeatus (H. Milne Edwards, 1834) new combination (Fig. 93 d,e)

Chorinus aculeata H. Milne Edwards, 1834: 316.
Chlorinoides aculeatus. — Griffin, 1966a: 4, 11, 13; 1974: 7; 1976: 186.

Material examined. — 2♂♂, 7♀♀(4 ovig.), 16-54 mm, smallest ovig. ♀, 26 mm.

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Singapore, trawl, 1903-1907; 1 spec.

Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36-54 m, dredge, sand, coral, 19 March 1914; 1 spec.

Danish Kei Islands Expedition: Ambon, ca. 1 m, 28 February 1922; 1 spec. — Stn. 72, Kai Is., 05°41′S 105°57′E, 35 m, trawl, stones, 28 July 1922; 1 spec.

Mortensen Java-S.Africa Expedition: Stn. 90, Sunda Strait, 05°55′S 105°30′E, 36 m, hard bottom, 1 August 1929; 1 spec.

5 Thai Danish Expedition: West Malay Peninsula, 06°43′N 99°34′E, 17-18 m, 23 January 1966; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, Padaido Is., Ex. Natural Science Foundation, January-February 1956; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition - Moluccas: Stn. AN I, Aru Is., SW of Tg. Ngabordamlu, S. Trangan I., centred near 06°58′S 134°5′E, 26-29 m, dredge haul 1, coral and sponge, 20 June 1970; 2 specs.

Remarks. — The single preorbital spine is upcurved in all except one specimen. In all these specimens there is a single cardiac spine and two long spines on the intestinal region, one anteriorly and one on the posterior margin of the carapace. There are two spines at the distal end of the merus of each ambulatory leg.

Distribution. — Indo-West Pacific from Bay of Bengal to Japan and north Australia.

Thacanophrys albanyensis (Ward, 1933) new combination

Prismatopus albanyensis Ward, 1933: 391-392, pl. 23 fig. 3.
Chlorinoides albanyensis. — Griffin, 1966a: 4, 10, 13.
Chlorinoides barunai Serène, 1969: 285-288, figs. 1, 4, 6, 11, 12, pl. 1 figs. A-C; new synonymy.

Material examined. — 1♂, 1♀, 25.5, 30.5 mm.

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'Siboga' Expedition: Stn. 274, Aru Is., 05°28.2′S 134°53.9′E, 57 m, dredge, sand and shells, stones, 26 December 1899; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AN I, Aru Is., S. Trangan I., SW. of Tg. Ngabordamlu, centred near 06°58′S 134°5′E,

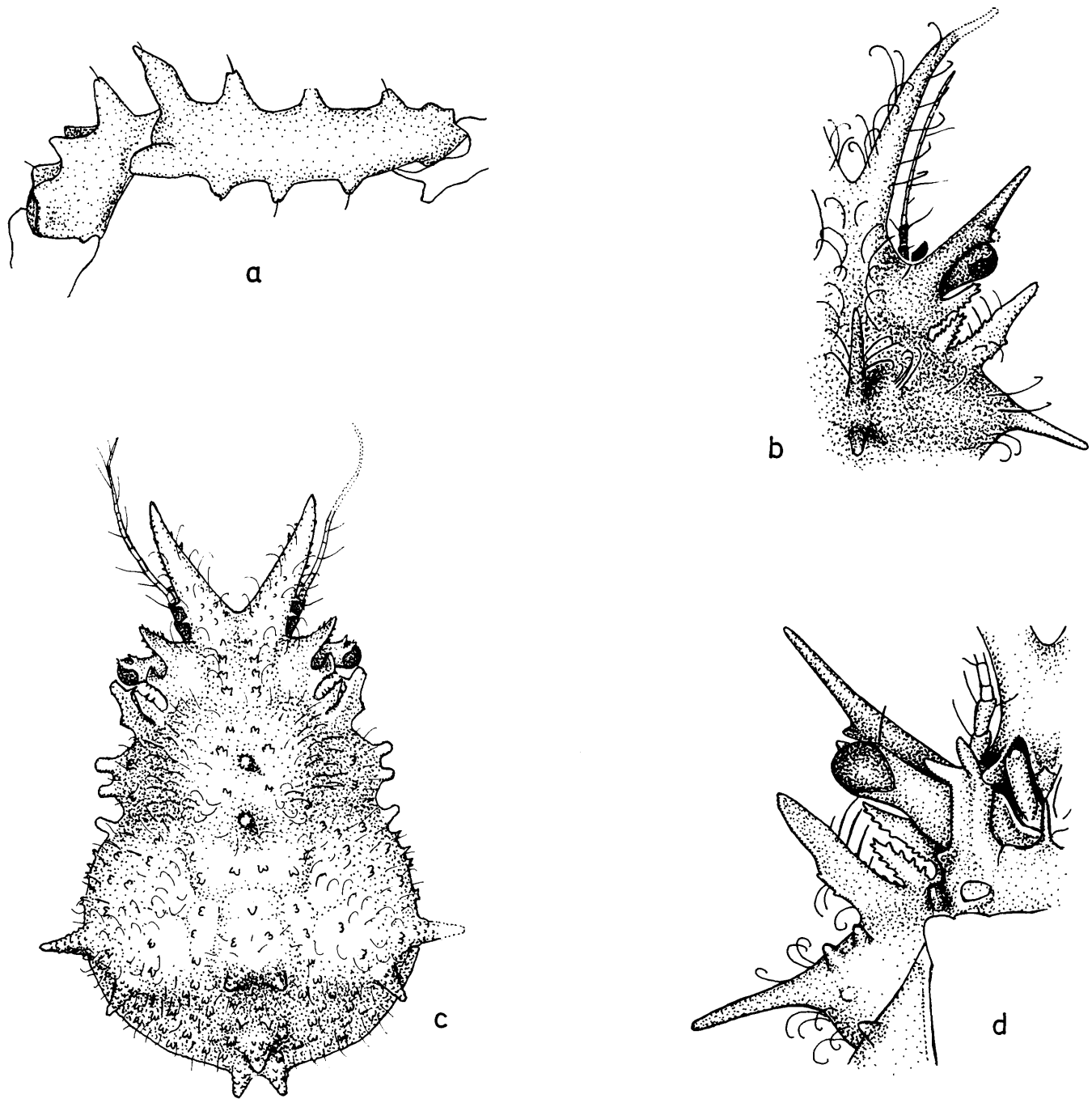


Fig. 92. *Thacanophrys acanthonotus* (male, 20 mm, Java Sea, ZMA De. 100.837) (a) left cheliped, merus and carpus; (b) right orbit, dorsal view; *T. goldsboroughi* (female, ovig., 16.5 mm, Kermadec Is., ZMC) (c) carapace, dorsal view; *T. acanthonotus* (as above) (d) right orbit, ventral view.

25-27 m, dredge haul 3, broken shell and coral, sponge and mud, 20 June 1970; 1 spec.

Remarks. — These specimens have been compared with type material of *T. albanyensis* (Ward) (3 ♀ ♀, 15, 19 (holotype), 24 mm, Albany Passage, N.Q'ld, AM P. 10639, P. 13942). They also agree well with *T. barunai* (Serène) (Serène, 1969). All the specimens have a long, single, upcurved preorbital spine. The antorbital spine is lamellate and concave on the anterior edge. The two cardiac spines are united basally and there is a single intestinal spine just above the posterior margin of the carapace.

The merus of the ambulatory legs is trigonal, there is a lamellate spine ventrally on the ischium, two distal spines dorsally on the merus and one on the carpus.

The palm of the cheliped of the large male is broader than that figured by Serène, the dorsal length being approximately 1½ times the greatest height.

The first pleopod of the male from Aru and of another from Broome, W.A. (11.5 mm, AM P. 13943) are extremely similar to that figured for *T. barunai* by Serène (1969: figs. 11, 12).

It is clear that *T. barunai* is conspecific with *T. albanyensis*.

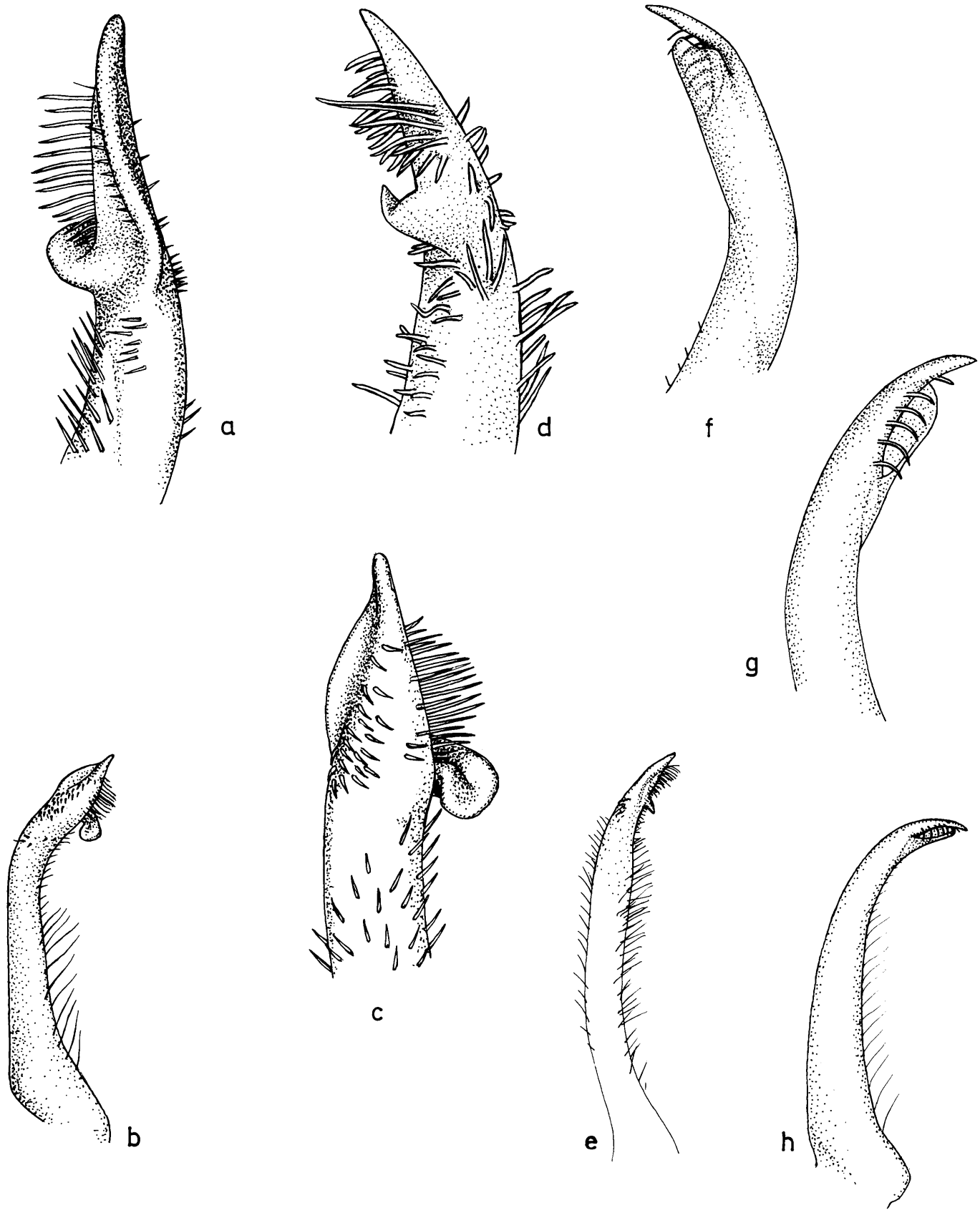


Fig. 93. Left first pleopod of male of *Thacanophrys acanthonotus* (20 mm, Java Sea, ZMA De. 100.837) (a) sternal tip of pleopod, (b) abdominal view of pleopod, (c) abdominal tip of same; *T. aculeatus* (39 mm, Aru Is., NIO Jakarta) (d) sternal tip of pleopod, (e) abdominal view of pleopod; *Kimbla neocaledonica* (holotype) (f) sternal tip of pleopod, (g) abdominal tip of same, (h) abdominal view of pleopod.

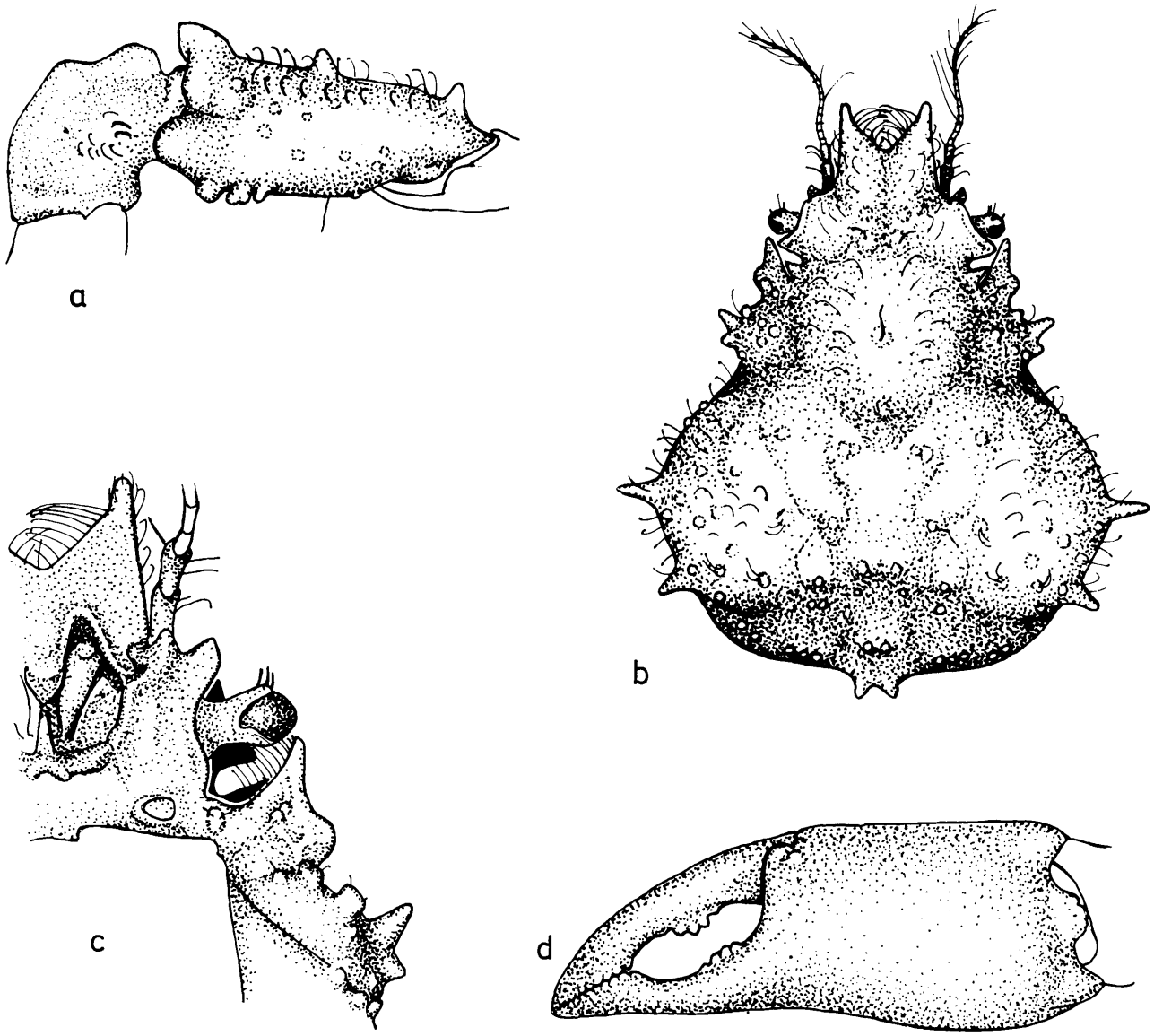


Fig. 94. *Tumulosternum parvispinosus* (male, 21 mm, AM P.29830) (a) left cheliped, merus and carpus; (b) carapace, dorsal view; (c) left orbit, ventral view; (d) left chela.

Distribution. — NE. Australia through the Arafura Sea to NW. Australia.

Thacanophrys goldsboroughi (Rathbun, 1906) new combination (Fig. 92c)

Chlorinoides goldsboroughi Rathbun, 1906: 881-882, pl. 14 fig. 7. — Griffin, 1970a: 67-70, figs. 1a, 2, 4b,c,f. — Griffin & Brown, 1976: 252.

Material examined. — 4 ♂♂, 3 (ovig.) ♀♀, 5.5-16.5 mm, smallest ovig. ♀, 14.0 mm.

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'Galathea' Expedition: Stn. 674, Kermadec Islands, Raoul Islet, 75-85 m, dredge, gravel and stones, 3 March 1952; 2 specs. — Stn. 675, Kermadec Islands, Raoul Islet, 29°13′S 177°57′W, 60 m, trawl, stones, 3 March 1952; 4 specs. — Stn. 676, Kermadec Islands, Raoul Islet, 29°13′S 177°37′W, 83-95 m, trawl, stones, 3 March 1952; 1 spec.

Remarks. — These seven specimens collected from between 60 m and 95 m in the Kermadec Islands are similar to *T. goldsboroughi* in most characters including general shape, length of rostral and carapace spines and the granular carapace surface. However, they differ from *T. goldsboroughi* in having two large spines on the posterior carapace margin and the merus of the third maxilliped is not so distinctly subcircular in shape as previously noted for *T. goldsboroughi*. These differences also distinguish *T. occidentalis* (Griffin) from *T. goldsboroughi* but that species differs from these specimens in having longer, more slender rostral and carapace spines and a smooth carapace surface between the spines.

In this series there are small tubercles on the urogastric region (urogastric region smooth in *T. occidentalis*); there is a compressed, blunt terminal spine on the cheliped merus (a weakly compressed terminal spine in other *T. goldsboroughi*

specimens, a slender, sharp terminal spine in *T. occidentalis*); the carpus of the adult male cheliped has a large lateral crest (similar to that in *T. occidentalis*); the first sternite of the male is broad anteriorly (as in *T. goldsboroughi*, narrow in *T. occidentalis*); many of the sharp granules on the carapace surface have two points; the first pleopod is of the same type as in both *T. goldsboroughi* and *T. occidentalis*.

T. goldsboroughi is a widespread species occuring in Hawaii and off eastern Australia, so these differences may represent geographical variation, though it is possible that these few specimens may prove to be a new species.

The specimen of *T. goldsboroughi* (♂, 19 mm, AM P. 19643) reported previously (Griffin & Brown, 1976) from off Gabo I., also differs from those figured (Griffin, 1970a). On the branchial region of that specimen there is a small, slender, anterior spine and a large, robust, posterior spine; there is an equally large medial spine on the posterior carapace margin; the small spines anteriorly on the branchial margin and on the hepatic region are sharp rather than lamellate and the merus of the third maxilliped is not subcircular. Although an immature male the first pleopod of the Gabo I. male is similar to those of other *T. goldsboroughi* and *T. occidentalis*.

Another similar species is *T. brevispinosus* (Yokoya) from Japan: the differences which distinguish it from *T. goldsboroughi* have been discussed by Griffin (1970a) and by Sakai (1976: 251-252, fig. 134), but the first pleopod of the male has not been figured. The different number of mesogastric spines and different configuration of spines and lamellae on the branchial margin in the two species lead us to maintain the view that *T. brevispinosus* and *T. goldsboroughi* are valid, distinct species.

Distribution. — Hawaii, Kermadec Islands, southeastern Australia.

Thacanophrys halimoides (Miers, 1879) new combination

Paramithrax halimoides Miers, 1879a: 10.
Acanthophrys germaini Bouvier, 1906b: 487-488.
Chlorinoides halimoides. — Griffin, 1966a: 13 (in key).
Chlorinoides germaini. — Serène, 1969: 282-284, figs. 2, 5, 7-10, pl. 2 A, B, C; new synonymy.

Material examined. — 1♂, 14.5 mm.

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Singapore, 27 November 1907; 1 spec.

Remarks. — This specimen agrees well with the type of *Paramithrax halimoides* (♂, 22 mm, 'Eastern Seas', BMNH 47.21) which one of us (D.J.G.G., 1970) has examined, and both the type and our specimen agree with the specimens figured and described as *C. germaini* (Bouvier) by Serène (1969). In our specimen the single cardiac spine has a terminal knob; the spine on the posterior margin of the carapace is flat and evenly tapering from the base. and the meri of the ambulatory legs are trigonal in section.

The six apparent differences between *T. halimoides* and *C. germaini* which Bouvier (1906b) noted in describing his new species, are the result of Miers' inadequate description and are clarified below —

1) the rostral spines are strongly divergent (not weakly so, as stated by Miers);
2) the spine on the posterior carapace margin is dorsoventrally flattened (not mentioned by Miers);
3) the anterior spines on the basal antennal article are not spiniform but lamellate (Miers says the anteroexternal angle is prominent);
4) the preorbital and antorbital spines arise from a strongly expanded eave (Bouvier refers to this as the preorbital spine which is divided distally, and Miers mentions the single preorbital but not the antorbital spine);
5) the preorbital lobe is narrow basally and broad distally (Miers simply says it is large and lamellate);
6) the carapace of the type of *T. halimoides*, although it is a smaller specimen, has the same proportions as the specimen (postrostral cl. 37 mm) described by Bouvier (it seems Bouvier misunderstood Miers' description "scarcely narrowing anteriorly").

It is clear therefore that *C. germaini* is conspecific with *T. halimoides*.

Distribution. — Singapore, Vietnam.

Thacanophrys harmandi (Bouvier, 1906) new combination

Acanthophrys harmandi Bouvier, 1906a: 484-485; 1906b: 487 (in key).
Acanthophrys harmandi. — Sakai, 1938: 307-308, text-fig. 42; 1965a: 87, pl. 40 fig. 3.
Chlorinoides harmandi. — Griffin, 1966a: 4, 13. — Takeda & Miyake, 1969: 514-515; 1972a: 76-77. — Sakai, 1976: 248-249, text-fig. 132, pl. 88 fig. 2.

Material examined. — 1♂, 1♀, 23.5, 15.5 mm.

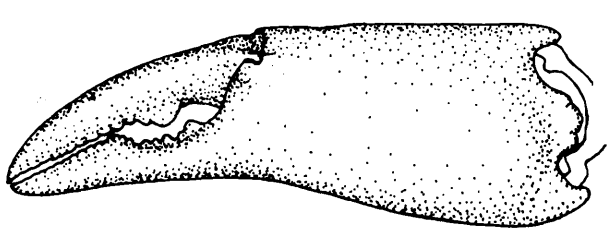
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Mortensen Pacific Expedition: Sagami Bay, Okinose, 108 m, 11 June 1914; 1 spec. — Sagami Bay, Okinose, 540 m, 29 June 1914; 1 spec.

Remarks. — This species can be distinguished from all its congeners by the apically bifid preorbital spine, the pair of submedial tubercles between the posterior mesogastric spine and the cardiac spines and the presence of a single spine on the branchial region. There are two spines on the intestinal region, one anteriorly and one just above the posterior margin of the carapace. On the basal antennal article there are, in addition to the two anterior spines, two short spines on the middle of the medial border and one basally on the lateral border. The postorbital spine of these immature specimens is narrow.

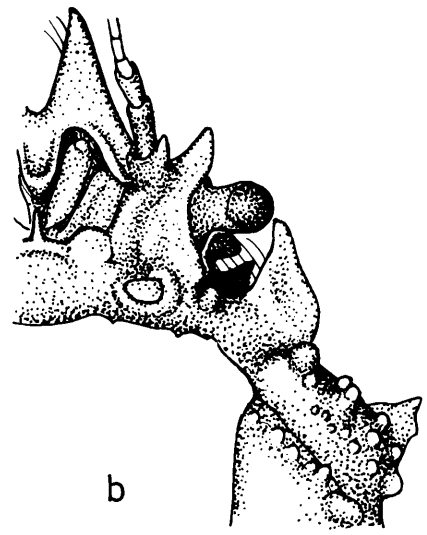
Distribution. — Japan: Sagami Bay, Kii Peninsula and East China Sea.

Thacanophrys longispinus (De Haan, 1839) new combination

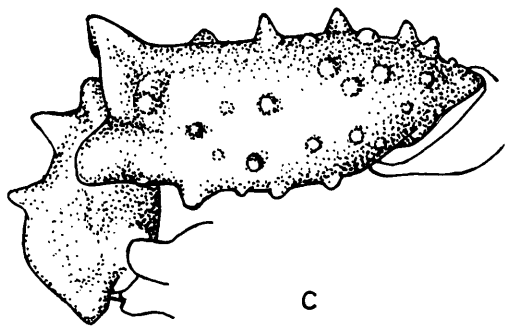
Maja (*Chorinus*) *longispina* De Haan, 1839: 94-95.
Maja (*Chorinus*) *aculeata.* — De Haan, 1839: pl. 23 figs. 2, 2a,b. (Not *Chorinus aculeata* H. Milne Edwards, 1834 = *Thacanophrys aculeatus*.)



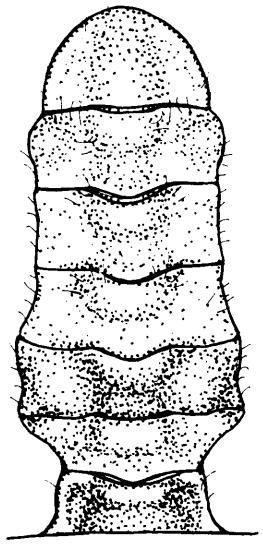
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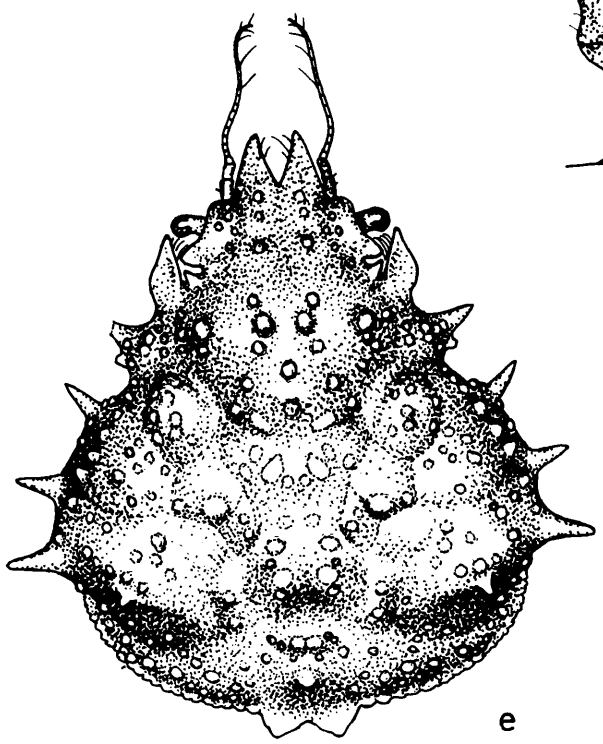
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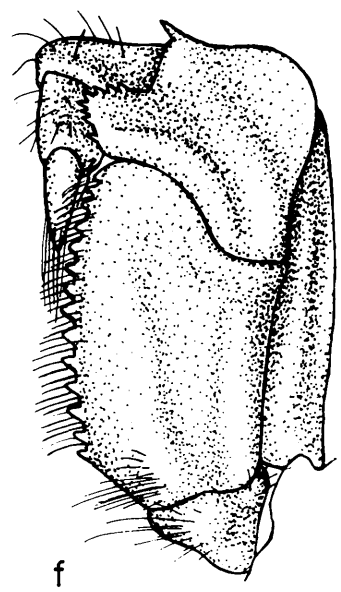
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d



e



f

Fig. 95. *Tumulosternum wardi* (male, 20 mm, AM P.29839) (a) left chela; (holotype) (b) left orbit, ventral view; (AM P.29839) (c) left cheliped, merus and carpus; (male, 20.5 mm, AM P.29836) (d) male abdomen; (holotype) (e) carapace, dorsal view; (f) left third maxilliped.

Chlorinoides longispinus. — Griffin, 1966a: 4, 11, 13; 1976: 186. — Serène, 1969: 286-288, figs. 3, 13-15, pl. 3 figs. A, B. — Campbell & Stephenson, 1970: 262-263.

Material examined. — 13 ♂♂, 9 ♀♀ (5 ovig.), 9.5-30.5 mm, smallest ovig. ♀, 14 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 109, Sulu Archipelago, anchorage off Pulu Tongkil, 13 m, dredge, townet, *Lithothamnion* bottom, 5/6 July 1899; 1 spec. (ZMA De. 100.701, det. Ihle). — Stn. 164, N. Ceram Sea, 01°42.5′S 130°47.5′E, 32 m, dredge, sand, small stones and shells, 20 August 1899; 2 specs. (ZMA De. 100.900, det. Ihle and unreg.).

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Mortensen Pacific Expedition: Sulu Archipelago, off Jolo, 36 m, dredge, *Lithothamnion*, 17 March 1914; 1 spec. — Sulu Archipelago, off Jolo, 54 m, sand, coral, 19 March 1914; 5 specs.

Mortensen Java-S.Africa Expedition: Stn. 9, Java, 08°30′-08°35′S 114°28′E, ca. 70-150 m, dredge, hard bottom, 6 April 1929; 1 spec.

Danish Kei Islands Expedition: Stn. 31, Kai Is., Doe Roa Bassin, 50 m, sand, 18 April 1922; 1 spec. — Stn. 53, Kai Is., 05°36′S 132°55′E, 85 m, trawl, sand, 9 May 1922; 1 spec. — Stn. 82, Sunda Strait, 06°38′S 105°21′E, 35 m, trawl, sandy mud, 30 July 1922; 1 spec. — Stn. 103, Sunda Strait, 06°05′S 105°42′E, 52 m, sand, shells, 4 August 1922; 2 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg. Tutuhuhur, 03°15′S 128°8′E, 54 m, dredge haul 15, grey sand, fine with shelly grit, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N. of Du Rowa I., N. of Nuhu Rowa, 05°32′S 132°41′E, 32-36 m, dredge haul 1, sand, 10 June 1970; 1 spec. — Stn. KR VII, Kai Is., between Du Rowa and Kai Dulah Is., 05°32′S 132°46′E, 32-36 m, dredge hauls 1-8, muddy sand and sponge, 11 June 1970; 2 specs. — Stn. KN II, Kai Is., off Elat Bay, W. coast Nuhu Tjut, 05°40′S 132°59′E, 48-54 m, dredge, rubble, algae and sand, 13 June 1970; 2 specs. — Stn. AW II, Aru, W. Wokam, NW. corner of Wasir I., 05°30′S 134°14′E, snorkel and shore collecting, 15 June 1970; 1 spec.

Remarks. — In this species there is considerable variation, especially in the form of the spines above the orbit (Griffin, 1976: 186). This series of specimens includes some with two upcurved preorbital spines, two hepatic spines and cardiac spines proximally united and others with a single upcurved preorbital spine, a single hepatic spine and the cardiac spines separated at the base. The specimens figured by De Haan (1839: pl. 23 figs. 2, 2a, 2b) have two preorbital spines as have those originally described as *Paramithrax coppingeri* by Haswell (1882) from northeast Australia and *Paramithrax* (*Chlorinoides*) *longispinus* var. *bituberculatus* by Miers (1884) from Providence I.; De Haan's material possessed two hepatic spines and proximally united cardiac spines. On the other hand the specimens figured by Alcock & Anderson (1898: pl. 34, figs. 4, 4a, 4b), from Sri Lanka and the Bay of Bengal, Laurie's (1906) *Paramithrax* (*Chlorinoides*) *longispinus* var. *bispinosus* from Sri Lanka and Bouvier's (1906b) *Acanthophrys longispinus* var. *spinosissima* from Mozambique have only one preorbital spine; the Alcock & Anderson specimens have only a single hepatic spine and the cardiac spines are separate at the base.

Seven of the specimens (three from the Kai Islands, one from the north Ceram Sea, four from the Sulu Archipelago) have a single preorbital spine which even in the adults is subequal to the antorbital spine and horizontal. In these seven specimens there is a strong tubercle on the anterolateral spine of the basal antennal article and there are three to four short, separate spines ventrally on the hepatic margin. On the intestinal region there is at most a low tubercle anteriorly and there is short spine (3 specimens) or no spine at all on the posterior margin of the carapace. As well as the usual curled hairs there are 'plumed' hairs on the rostrum, sternum and ambulatory legs.

In this series all these variations of the orbit were found among specimens from the Kai Islands.

Distribution. — Widespread Indo-West Pacific from east Africa to Japan and Australia.

Thacanophrys occidentalis (Griffin, 1970) new combination

Chlorinoides occidentalis Griffin, 1970a: 70-74, figs. 1b, 3, 4a, d,e.

Material examined. — 1♂, 1♀', 12.5, 14 mm.

WESTERN AUSTRALIAN MUSEUM, PERTH

Western Australia, NW. of Rottnest I., 144 m, sand and Bryozoa, 'Bluefin', 15 September 1965; 1 spec. (WAM 93-71, in part). — Western Australia, W. of west end of Rottnest I., 144 m, 'Bluefin', 16 September 1965; 1 spec. (WAM 77-71).

Remarks. — These specimens are very similar to those previously described.

Distribution. — Southwestern Australia.

Tumulosternum McCulloch, 1913

Type species. — *Micippoides longimanus* Haswell, 1880, by designation of McCulloch (1913).

Description. — Carapace broad, pyriform, with tubercles and short spines; regions fairly well delimited; hepatic margin with a strong spine or flat topped tubercle. Rostrum of two short, broad spines. Orbit above comprising an eave with antorbital angle produced outwards; a small intercalated spine (which is sometimes absent) and a stout, angular, postorbital lobe; eyestalk short, retractile against postorbital lobe which is somewhat excavate to receive it. Basal antennal article broad, bilobed anteriorly, orbit open below. Third maxillipeds with merus as wide as ischium and with a broadly rounded external angle, palp articulated at notch on anteromedial angle. Chelipeds large in adult males, merus tuberculate, palm smooth, compressed; ambulatory legs short. Abdomen consisting of seven free segments in both sexes. (McCulloch -modified.)

Remarks. — The unusual form of the first pleopod of the male *T. longimanus* can be related to the *Thacanophrys* type of pleopod. There is a basal flap near the aperture but the distal portion of the pleopod is bent back on itself. *T. wardi* n.sp. has a similar pleopod although the basal flap is smaller. It has

been noted before (Griffin, 1966d) that *Leptomithrax parvispinosus* Ward differs in several features from other known species of *Leptomithrax* and examination of the pleopod confirms this. In fact, detailed examination shows that the pleopod is modified from the *Thacanophrys* type, the distal portion beyond the flap being very much reduced, while the flap is larger and more robust than usual. This similarity in the male pleopods is supported by similarities in the orbit and therefore we consider these three species to be congeneric. The accommodation of the two other species in the genus has required the modification of the generic description given by McCulloch.

On the basis of the form of the pleopod, and also of the orbit, this genus is now regarded as belonging to the Majinae. *Tumulosternum* was placed by Balss (1957) in the Majinae near *Tiarinia* and on that basis included in the Mithracinae by Griffin (1966b).

Distribution. — Southwest Pacific: apparently restricted to the east coast of Australia.

KEY TO SPECIES OF *TUMULOSTERNUM*

1 Carapace without lateral branchial spines; subhepatic region with a subcircular flattened plate, similar plates elsewhere on lower surface and margins of carapace ..... *T. longimanus*
— Carapace with two or more lateral branchial spines; carapace without flattened plates 2
2(1) Branchial margin with two spines; anterolateral spine of basal antennal article as wide as long; rostral spines fused for basal third, then each tapering abruptly to a narrow apex ..... *T. parvispinosus*
— Branchial margin with four spines; anterolateral spine of basal antennal article longer than wide; rostral spines triangular, tapering evenly from base ..... *T. wardi*

Tumulosternum longimanus (Haswell, 1880) (Fig. 96a,b)

Micippoides longimanus Haswell, 1880b: 444-445, pl. 26 fig. 5.
Tumulosternum longimanus. — McCulloch, 1913: 334-335, fig. 45. — Griffin, 1966b: 288 (in key).

Material examined. — 7 ♂♂, 6 ♀♀ (4 ovig.), 8.5-18.5 mm, smallest ovig. ♂, 13,5 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

New South Wales: mouth of Clarence River, Iluka, Woody Head, coll. A. A. Cameron, 3 September 1960; 1 spec. (AM P. 13486). — Collaroy, Long Reef, intertidal, sandy beach, under stones, 5 April 1924; 1 spec. (AM P. 7189). — Collaroy, Long Reef, coll. E. Pope, 9 December 1946; 1 spec. (AM P. 13166). — Port Jackson, Sow and Pigs Reef and Shark I., 9-12 m, dredged, coll. F. A. McNeill, 16 May 1923; 1 spec. (AM P. 6505). — Port Jackson, Sow and Pigs Rocks, about 5 m, dredged, coll. F. A. McNeill, 26 October 1926; 1 spec. (AM P.8715). — Vicinity Sow and Pigs Shoal, about 7 m, dredged, coll. F. A. McNeill and M. Ward, January 1930; 1 spec. (AM P. 9436). — Coogee, August 1920; 1 spec. (AM P.4935). — Coogee, intertidal, coll. F. A. McNeill and A. A. Livingstone, 15 December 1921; 1 spec. (AM P.6087). — Botany Bay, Kurnell, reef between tides, 22 January 1928; 1 spec. (AM P.9057). — Botany Bay, Kurnell, low tide on reef, February 1947; 1 spec. (AM P.11728). — Shellharbour; 1 spec. (AM P.6303); 1 spec. (AM P.6611); 1 spec. (AM P. 6845); 1 spec. (AM P.8434).

Remarks. — These specimens agree well with the syntypes (1♂, 20 mm, 1 ad. ♀, 18.5 mm, Port Jackson, AM G.5124). However, in these specimens and in the syntypes there is a small spine in the hiatus of the upper orbit. In three specimens the spine is very small and in two specimens it is only present in one orbit.

We have figured the first pleopod of the male which has not previously been described. The pleopod is broad and straight, curving outwards only in the distal fifth, with a long, slender, curved medial process at the apex. There is a short, narrow lobe just lateral to the subterminal aperture on the abdominal surface.

The specimen from Madagascar described and figured as *Tumulosternum longimanus* by Peyrot-Clausade & Serène (1976: 1350-1351, pl. 1A) is not this species. The rostral spines in *T. longimanus* are weakly deflexed but even in the male are always visible dorsally; there is no preorbital spine in this species; and the eyestalks are much shorter, not exceeding the postorbital lobe. The specimen figured by Peyrot-Clausade & Serene is probably *Pseudomicippe nodosa.*

T. longimanus is distinguished from *T. parvispinosus* and *T. wardi* by the absence of any spines on the lateral carapace margin and the presence of two flattened plates, one subhepatic and one anterior branchial, just above the carapace margin.

Distribution. — Southeast Australia.

Tumulosternum parvispinosus (Ward, 1933) new combination (Figs. 94, 96f-h)

Paramithrax parvispinosus Ward, 1933: 392, pl. 23 fig. 4.
Leptomithrax parvispinosus. — Griffin, 1963b: 234-235; 1966b: 284 (in key).

Material examined. — 8 ♂♂, 16 ♀♀ (8 ovig.), 11.5-22.5 mm (holotype, postrostral cl. 9.0 mm), smallest ovig. ♀, 14.0 mm.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Little Lindeman I., under coral masses, coll. M. Ward; 3 specs. (AM P. 29833, dry). — Capricorn Group, North West Islet, coll. M. Ward, May 1930; 1 spec. (AM P.10640, holotype). — Capricorn Group, North West Islet, January 1929; 4 specs. (AM P.29832, dry).

New South Wales: Yamba, Angourie Point, coll. A. A. Cameron, January 1939; 1 spec. (AM P.11024). — Woody Head, near mouth of Clarence River, coll. A. A. Cameron, 15 June 1962; 1 spec. (AM P. 29826). — Woody Head, intertidal, coll. A. A. Cameron, August 1962; 1 spec. (AM P.29827). — Angourie, Green Point, intertidal, coll. A. A. Cameron, 19 December 1964; 1 spec. (AM P.29828). — Woody Head, below low tide, A. A. Cameron, 1 March 1965; 1 spec. (AM P. 17895). — Woody Head, intertidal rocks, coll. A. A. Cameron, 1 May 1965; 1 spec. (AM P. 15284). — Clarence River mouth, Iluka Bluff, intertidal, coll. A. A. Cameron, 11 September 1965; 1 spec. (AM P.29829). — Clarence River mouth, Woody Head, intertidal, coll. A. A. Cameron, January 1966; 1 spec. (AM P.29830). — Woody Head, coll. A. A. Cameron, 1966; 2 specs. (AM P. 16858). — Near Woody Head, Shark Bay reef, coll. A. A. Cameron, May 1969; 1 spec. (AM P.17353). — Near Grafton, Minnie Waters, intertidal rock platform, coll. J. C. Yaldwyn, 15 February 1965; 1 spec. (AM P. 15995). — Nambucca Heads, 14-24 September 1937; 2 specs. (AM P.29834, dry). — Near Sydney, Pittwater, dredged off Mackerel Point, January 1932; 2 specs. (AM P.29831, dry).

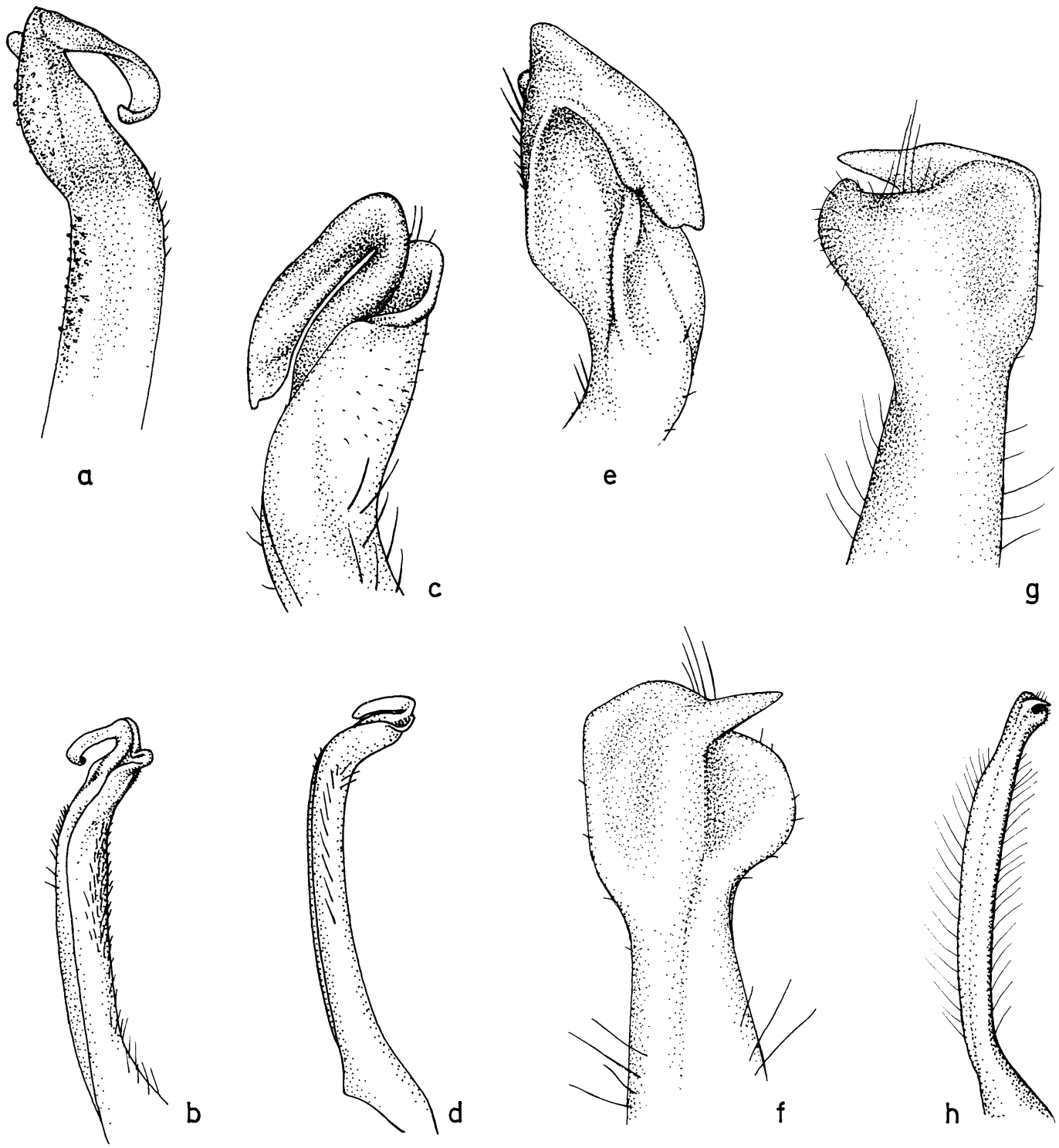


Fig. 96. Left first pleopod of male of *Tumulosternum longimanus* (17.5 mm, AM P.8715) (a) sternal tip of pleopod, (b) abdominal view of pleopod; *T. wardi* (20.5 mm, AM P.29836) (c) abdominal tip of pleopod, (d) abdominal view of pleopod, (e) sternal tip of same; *T. parvispinosus* (21 mm, AM P.29830) (f) abdominal tip of pleopod, (g) sternal tip of same, (h) abdominal view of pleopod.

Remarks. — These specimens agree well with the holotype (AM P.10640) and are clearly conspecific. However, the holotype has the rostral spines broken off and although Ward mentions them in the description they are not apparent in the photograph (pl. 23 fig. 4). In our series the rostral spines are fused in the proximal third and the lateral edges are parallel, they are separated in the distal two thirds by a broad V-shaped hiatus and are apically narrow; in length they are only one tenth (0.18 to 0.22) of the postrostral carapace length.

The intercalated spine is a short, narrow triangle the apex of which does not reach the apex of the antorbital spine and so

is excluded from the orbit. As stated by Ward the tubercles on the carapace are mostly small and few in number. There are two tubercles on each rostral ridge.

There are two mesogastric tubercles, one central and one posterior; there is a low transverse ridge anteriorly on the urogastric region with usually two and sometimes four small tubercles; on the cardiac region there is a pair of submedial tubercles at the summit and a pair of smaller tubercles on the posterior slope; there is a pair of submedial tubercles anteriorly on the intestinal region in all but three specimens which have only a single tubercle; on the posterior carapace margin there are two triangular spines directed obliquely upwards. There are two strong spines on the branchial margin, one dorsally on the posterolateral angle, the other in front of it, more ventrally and above the base of the first walking leg.

The broad anterolateral spine of the basal antennal article is weakly bilobed or truncate; there is a short blunt spine on the anteromedial angle; the lateral margin is concave. The merus of the third maxilliped has only a low, narrow ridge on the posterior margin at the junction with the ischium.

The male was not described by Ward. The merus of the cheliped of the adult male has a few small tubercles on the outer face, dorsally there is a large proximal tubercle, a similar tubercle midway along the dorsal edge and a large blunt, compressed terminal spine; there are three larger tubercles on the ventral margin in the distal half and a row of small tubercles ventrally on the inner face. The carpus has dorsally a large carinate outer ridge and a very low tuberculate inner ridge. The palm is smooth, about one and a half times as long as high; the fingers are about three quarters the length of the palm with a large gape between them in the proximal two thirds, the dactyl has a large three lobed tooth midway in the gape, the fixed finger has a similar tooth slightly more proximally and distally both fingers have small uniform teeth along the cutting edge.

The meri of the ambulatory legs is dorsally smooth with a sharp terminal spine, a thick fringe of hairs on the anterior and posterior borders, and a few ventral tubercles; the first ambulatory leg is about equal in length to the postrostral carapace length, the fourth leg is about three quarters the length of the first.

The sternum of the male is smooth, a narrow ridge running along the edge of the abdominal fossa on the third and fourth segments. The abdomen of the male hardly narrows distally (sixth segment 0.8 width of third segment), the sixth segment being more than twice (2.3) as wide as long, the seventh segment about one and a half times as wide as long.

The first pleopod of the male is nearly straight, curved slightly outwards, tapering a little before widening again at the tip; the tip consists of two broad lobes, an abdominal and a sternal lobe separated terminally, laterally and, somewhat less distinctly, on the medial edge; the abdominal lobe is produced as a spine like process on the anterolateral angle and curves dorsally across the broad, roundly produced, lateral edge of the sternal lobe.

The pleopod, although at first sight appearing extremely unusual, in fact, has the same basic structure as do the pleopods of the other two species of *Tumulosternum* and which are modified forms of the type of pleopod found in species of *Thacanophrys* (discussed in notes on genus).

This species is similar to *T. wardi* n.sp. in general carapace shape and in having the small intercalated spine excluded from the orbit. This species is distinguished from *T. wardi* by the form of the male pleopod, by the fewer spines on the branchial region, by the broad spine on the basal antennal article and by the shape of the rostral spines. These differences are discussed in more detail under *T. wardi*.

Distribution. — East coast of Australia: (Queensland) Lindeman I., Capricorn Group; (New South Wales) Woody Head, Angourie Point, Nambucca Heads, Pittwater.

Tumulosternum wardi new species
(Figs. 95, 96c-e)

Material examined. — 20 ♂♂, 15 ♀♀ (3 ovig.), 9.5-26 mm, smallest ovig. ♀, 16.5 mm.
Holotype. — Female (adult), cl. 26 mm, New South Wales, Collaroy, Long Reef, below low tide level, coll. M. Ward, 1932/1937; The Australian Museum, Sydney, AM P.29835.
Paratypes. As listed below:

THE AUSTRALIAN MUSEUM, SYDNEY

New South Wales: Collaroy, data as for holotype; 1 spec. (AM P.29836). — Collaroy, Long Reef, below low tide mark, 17 December 1937; 31 specs. (AM P.29839, dry). — Collaroy, Long Reef; 1 spec. (AM P.29837, dry). — Collaroy, Long Reef; 1 spec. (AM P.29838, dry).

Description. — Carapace broadly pyriform, broad posteriorly, greatest width about 0.8 postrostral carapace length; surface with scattered granules, tubercles and a few spines.

Rostral spines very short, broad at base and each tapering to a sharp apex, subparallel, about one tenth postrostral carapace length, three tubercles on each rostral ridge, posterior the largest.

Orbital eave strongly expanded, dorsally tuberculate, preorbital angle rounded, not produced, antorbital angle produced in a broad, blunt triangle; intercalated spine triangular, short, acute apex not reaching apex of antorbital spine; postorbital lobe basally broad, apically narrow, directed forward, anterior margin straight, posterior margin proximally convex but without any accessory spine or lobe.

Hepatic margin with a strong laterally directed spine, a few small tubercles dorsally above spine; subhepatic region tuberculate. Branchial margin with four strong spines, the fourth smallest and more dorsally placed.

Gastric regions elevated. Mesogastric region with two tubercles posteriorly. Protogastric region with four tubercles in a transverse row anteriorly and behind them a similar row of smaller tubercles; several small protogastric tubercles on either side of mesogastric tubercles. Urogastric region with a pair of submedial tubercles.

Cardiac region weakly elevated with a pair of submedial tubercles at summit, submedial pairs of smaller tubercles on anterior and posterior slopes.

Intestinal region with two medial tubercles, the anterior often transversely widened (or two submedial tubercles anteriorly); posterior carapace margin with a pair of broad, compressed, triangular spines, directed slightly upward.

Branchial region with an oblique row of five or six tubercles just dorsal to two anterior marginal spines and a similar row of about four tubercles in front of fourth marginal spine; a group of small tubercles at anteromedial angle and a large tubercle on medial edge midway between urogastric and cardiac tubercles, several small scattered tubercles dorsally.

Basal antennal article moderately broad, smooth, with a shallow longitudinal groove centrally; anterolateral angle produced forward as a broad curved spine, anteromedial angle with a slightly smaller cylindrical spine directed more ventrally than other spine; lateral border concave. Orbit open below. A small tubercle lateral to green gland.

Third maxilliped smooth, ischium with a well marked longitudinal depression; merus with a narrow ridge on posterior margin, medial edge with a spinulous lobe behind notch and a small, sharp spine in front of it.

Pterygostomian region smooth, margin with a row of four or five small tubercles and a large posterior tubercle.

Male sternum smooth, a lateral depression and a broad medial ridge anterior to abdominal fossa, third and fourth segments with a ridge on edge of abdominal fossa.

Merus of adult male cheliped tuberculate, with four or five sharp tubercles dorsally larger than others, and a strong, broad terminal spine; carpus with a proximal spine and two dorsal ridges, outer ridge carinate, inner ridge comprising three broad, compressed spines; palm highest proximally, tapering slightly distally, length of palm about one and a half times height; fingers nearly as long as palm with a moderate gape in proximal half, dactyl with a large tubercle midway in gape, fixed finger with a smaller proximal tubercle, distal half of both fingers with small uniform teeth along cutting edge.

Ambulatory legs short, first leg slightly longer (1.15) than, and fourth leg equal to postrostral carapace length, merus of first ambulatory leg with a short, acute terminal spine, a row of tubercles dorsally and ventrally and a row of smaller tubercles midway on outer face; posterior legs with fewer tubercles.

Male abdomen of seven segments, smooth, width of sixth segment about twice length, width of seventh segment about one and a half times length.

First pleopod of male curved laterally at about distal fifth, slightly flattened apex abruptly recurved medially and lying against preceding part of pleopod, just below where apex recurves, lateral edge formed into a flap on abdominal surface.

Female abdomen of seven segments, smooth.

Female gonopore opening posteromedially from a small rounded swelling.

Remarks. — This species is similar to *T. parvispinosus* (Ward) in general carapace shape and in having the small intercalated spine excluded from the orbit. This species can be distinguished from *T. parvispinosus* by the strongly elevated branchial region with four marginal spines (two spines in *T. parvispinosus*); the anterolateral spine on the basal antennal article longer than wide and apically subacute (in *T. parvispinosus* the spine is as wide as long, truncate or weakly bilobed); the male first pleopod has a long recurved terminal lobe (*T. parvispinosus* pleopod with a short spine like terminal process); the rostral spines taper gradually from the base (in *T. parvispinosus* the rostral spines are fused for the basal third then taper abruptly to a narrow apex); the carapace is also more tuberculate than in *T. parvispinosus*.

In 1965 J. C. Yaldwyn compared the specimen now designated as the holotype of *T. wardi* with the type of *Leptomithrax parvispinosus* and noted that they were not conspecific.

Distribution. — Presently known only from Collaroy, near Sydney, New South Wales.

SUBFAMILY MITHRACINAE

Maiinae Alcock, 1895: 161, 236 (in part: the Periceroida).
Mithracinae Balss + Macrocoelominae Balss, 1929: 16, 20.
Mithracinae. — Garth, 1958: 346. — Griffin, 1966b: 264.

Carapace broadened anteriorly by the outstanding, often tubular, orbits; the orbits formed (1) by an arched supraocular hood, or semi-tubular horn, (2) by a hollowed postocular process, and (3) by a remarkable broadening, or by a prolongation, of the anterior part of the basal antennal article, affording complete concealment to the retracted eye. Rostrum often more or less deflexed. (Alcock, as quoted by Garth.)

Pleopod 1 usually slender, straight or weakly curved, aperture terminal, apex simple or curved or expanded into two or three processes.

The mithracines, broadly speaking, must be regarded as more than majids with tubular orbits related in some way to, perhaps as a continuation of the evolutionary trends shown in, the Majinae. The first pleopod of the males resembles that of various pisines rather than species of any other group. We agree with Garth that there appear to be different groups presently contained within this subfamily. Thus males of some American species of the genera *Mithrax*, *Ala*, *Microphrys* and so on possess a first pleopod expanded apically and lobate or with 'flanges'. Other American species — of the genera *Macrocoeloma*, *Stenocionops*, *Libinia* (currently classed as a pisine) and *Coeloceros* — possess an apically expanded pleopod with a prominent medial lobe. In all Indo west Pacific species, on the other hand, the males possess first pleopods which are hardly expanded apically: they are at most truncate and possess no lobes or flanges.

It is possible then, that the subfamily, as presently envisaged, comprises three evolutionary lines distinct from early geological time. No mithracines occur in the east Atlantic.

We have included in this subfamily *Cylclocoeloma* from the Tychinae and *Cyphocarcinus* from the Epialtinae. On the other hand we have removed *Jaquinotia*, *Entomonyx* and *Tumulosternum*, all with male first pleopods similar to *Thacanophrys*, to the Majinae. '*Paramicippa*' *tuberculosa* has also been transferred to the Majinae as the new genus *Pippacirama*. '*Tiarinia*' *elegans* has been transferred to the Pisinae as representing the new genus *Lyramaia*.

The Mithracinae in the Indo west Pacific are thus represented by only two main genera, *Micippa* and *Tiarinia*, a great contrast with the diverse American fauna of tubular-orbitted majids.

KEY TO INDO-WEST PACIFIC GENERA OF MITHRACINAE

1		Rostral spines broad, flattened, fused for at least proximal two thirds; intercalated spine present in upper orbit ..... *Micippa*
—		Rostral spines slender, cylindrical, separate from base although sometimes contiguous; intercalated spine absent, orbit comprising only eave and postorbital lobe 2
2(	1)	Rostral spines with a single accessory spine apically or dorsally in distal half 3
—		Rostral spines unarmed or with two to four lateral spines proximally 4
3(	2)	Carapace narrow, width half postrostral carapace length, branchial region scarcely wider than hepatic region; preorbital spine small; small species (cl. less than 25 mm) ..... *Cyphocarcinus*
—		Carapace widened posteriorly, width at least two thirds postrostral carapace length, branchial region one and a half times as wide as hepatic region; preorbital spine large, acute; large species (cl. more than 50 mm) ..... *Paranaxia*
4(	2)	Orbits greatly expanded laterally, tubular; preorbital part of eave an upturned obtuse lobe extending almost to level of apex of very short rostral spines ..... *Cyclocoeloma*
—		Orbits expanded laterally but not tubular, closed above and below; preorbital angle blunt, acute or produced but not exceeding proximal third of rostral spines 5
5(	4)	Carapace anteriorly narrowed, interorbital width less than half width of carapace ..... *Tiarinia*
—		Carapace not noticeably narrowed anteriorly, interorbital width more than half width of carapace ..... *Leptopisa*

Cyclocoeloma Miers, 1880

Type species. — *Cyclocoeloma tuberculata* Miers, 1880, by monotypy.

Remarks. — This distinctive monotypic genus has been moved from the Tychinae to the 'mithracine' group because of the nature of the orbit which resembles that of *Tiarinia* species. The tubular orbit is closed above and below but has no intercalated spine or suborbital lobe.

Distribution. — Known only from the western Pacific.

Cyclocoeloma tuberculata Miers, 1880
(Fig. 102g,h)

Cyclocoeloma tuberculatum Miers, 1880: 229-230, pl. 13 figs. 1,2.
Cyclocoeloma tuberculata. — Buitendijk, 1939: 236. — Sakai, 1967: 76-77, frontispiece fig. 3.

Material examined. — 1 ♀, 36.5 mm, 1 ovig. ♀, 42 mm.

WESTERN AUSTRALIAN MUSEUM, PERTH

Sulu Archipelago, near Siasi I., north of Laminusa I., coll. B. R. Wilson, 'Pele', 17 February 1964; 1 spec. (WAM 40-67).

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland, Townsville, Wheeler Reef, 12 m, under plate coral, camouflaged with anemones, coll. I. Loch, 31 August 1975; 1 spec. (AM P.23824).

Remarks. — Our specimens agree well with those figured by Miers and by Sakai. The palm of the chela of the adult male is $1^1/_2$ times as long as high; there is a large gape proximally between the fingers and a small proximal tooth on the dactyl.

Segments four to six of the female abdomen are fused.

The first pleopod of the male is slightly narrowed distally and has a subterminal, medial opening.

Distribution. — Western Pacific: Japan, Sulu Archipelago, Ambon, Timor, northeast Australia.

Cyphocarcinus A. Milne Edwards, 1868

Type species. — *Cyphocarcinus minutus* A. Milne Edwards, 1868, by monotypy.

Remarks. — These small crabs have, like species of *Huenia*, been considered almost infinitely variable and great confusion has surrounded the use of specific names. This study recognises five species of which two are described as new. *C. capreolus* (Paul'son) and *C. suspensus* (Gravier) are recognised as separate species distinct from *C. minutus*. The species are distinguished without great difficulty on the basis of rostrum and basal antennal article. The broad orbit almost concealing the eye from view leads us to the view that *Cyphocarcinus* is appropriately placed near 'mithracine' genera like *Tiarinia*, not amongst the Epialtinae. The first pleopod of the male is very similar in each of the four species from which it is known.

Distribution. — Indian Ocean, one species occuring only in the Red Sea and Iranian Gulf.

KEY TO SPECIES OF *CYPHOCARCINUS*

1		First movable segment of antenna with a prominent lateral lobe .. 2
—		First movable segment of antenna cylindrical 3
2(	1)	First movable segment of antenna subtriangular, apically acute; lateral margin of basal antennal article produced into a prominent acute lobe extending anteriorly beyond anterior edge of article; rostral spines weakly divergent beyond small accessory spines ..... *C. rathbunae*
—		First movable segment of antenna produced as a blunt distal lobe; lateral edge of basal antennal article produced as a blunt lobe, no longer than, and not extending anteriorly beyond, anterolateral lobe; rostral spines strongly divergent beyond dorsal accessory spines ..... *C. alcocki*
3(	1)	Anterolateral angle of basal antennal article with a prominent rounded lobe larger than and extending laterally just beyond proximal lobe of lateral edge of article; rostrum deflexed ..... *C. minutus*
—		Anterolateral angle of basal antennal article with small lobe, no larger than lobe on lateral edge of article and not laterally produced as far as lateral margin; rostrum almost horizontal 4

4(3) Gastric region weakly elevated in male, moderately elevated in female, summit with a medial tubercle and two lateral tubercles, without ridges; intestinal region posteriorly without medial tubercle ..... *C. suspensus*

— Gastric region moderately elevated in male, strongly elevated in female, summit lacking a tubercle, one tubercle laterally, two submedial ridges; intestinal region posteriorly with a medial tubercle..... *C. capreolus*

Cyphocarcinus alcocki new species
(Figs. 97a-e, h,i, 98d,i, 99d)

? *Cyphocarcinus minutus* Alcock, 1895: 254.
Cyphocarcinus minutus. — Rathbun, 1911: 255 (part-male only). (Not *Cyphocarcinus minutus* A. Milne Edwards, 1868.)

Material examined. — 1♂, 2♀♀ (ovig.) 7-10.5 mm.
Holotype. — Male, cl. 7.0 mm, Amirante, 45-144 m, 11 October 1905, 'Sealark' Expedition, Stn. E11, Smithsonian Institution USNM 41430 (det. Rathbun, 1911, as *C. minutus*).
Paratypes. Female, ovig., cl. 8.5 mm, Andaman Is., Port Blair Harbour, coral reefs, Zoological Survey Calcutta 3853/9. — Female, ovig., cl. 10.5 mm, Sri Lanka, Pedro Shoal, Zoological Survey Calcutta 8887/6. (both det. Alcock, 1895, as *C. minutus*).

Description. — Carapace slender, length approximately 2 1/2 times width. (In this series of specimens the carapace of the male (Amirante) is more tuberculate than that of the female from the Andaman Islands. The female from Pedro Shoal has a large part of the carapace covered with encrusting growth and, where this has been removed, is smoother than either of the other two specimens.)

Rostral spines slender, short (approx. 1/4 postrostral carapace length) and strongly divergent beyond dorsal accessory spine.

Orbit above with a small acute preorbital spine directed laterally or obliquely forward, a tubercle on supraorbital eave and a pronounced postorbital lobe.

Hepatic region with one tubercle.

Gastric regions strongly elevated, more so in females than male, greatest height above orbit (female) or above hepatic region (male); two medial tubercles on anterior slope with a pair of small submedial tubercles between them and in male two small lateral tubercles in line with posterior tubercle forming a row of five tubercles, two or three small tubercles just medial to, and in front of preorbital spine.

Cardiac region weakly elevated with a broad medial tubercle and two small submedial tubercles on the anterior slope.

Dorsal ridge above lateral margin clearly defined and armed with four tubercles, the anterior being broad but low, the posterolateral being smaller but more acute. (In the female from the Andaman Islands the tubercles opposite the cardiac region are indistinct.)

Intestinal region with one lateral and three medial tubercles. In male but not female, a medial tubercle just in front of posterior margin and one between it and posterolateral tubercle; broad medial lobe on posterior margin deflexed.

Basal antennal article broad with a blunt lateral lobe at base of the first movable segment and a blunt subequal anterolateral lobe separated from it by a hiatus. Antenna with an obtuse distal lobe on lateral margin of first movable segment; lobe truncate (male and female from Pedro Shoal) to rounded (female from the Amdaman Is.).

Male cheliped merus with six dorsal and four ventral tubercles and a terminal spine; male chela slightly enlarged, gape between fingers small, one tooth on each finger in gape.

Ambulatory leg merus somewhat flattened dorsally with a row of thick hairs on each margin. Dactyl of fourth leg armed with one large subterminal spine and four smaller teeth.

Male abdomen with sixth segment broader than long, lateral margins convex, seventh segment longer than broad. Female abdomen slender, greatest width equal to half total length, last segment very short, broadly obtuse.

First pleopod of male straight, apex truncate, distal quarter tapering, flattened and twisted so as to lie in a dorsoventral plane. (This is similar to that of *C. minutus*.)

Remarks. — This species is distinguished from all other known species of *Cyphocarcinus* by the presence of an obtuse (truncate to rounded) distal lobe on the lateral margin of the first movable segment of the second antenna. In *C. rathbunae* this segment has an acute lobe and in the other three species the segment is slender and parallel-sided, without a distal lobe.

This new species is named in honour of A. Alcock whose studies of the Indian Ocean Crustacea still stand amongst the most notable contributions made to carcinology.

Distribution. — Amirante, Sri Lanka, Andaman Islands.

Cyphocarcinus capreolus (Paul'son, 1875)
(Figs. 98a,f, 99a)

Ixion capreolus Paul'son, 1875: 13, pl. 2 figs. 1a-f.
Cyphocarcinus minutus. — Nobili, 1906: 109 (not seen). — Stephensen, 1945: 108-109, fig. 21A,B. — Griffin & Tranter, 1974: 166.

Material examined. — 3♂♂, 6♀♀(4 ovig.), 11-21 mm, smallest ovig. ♀, 11 mm.

MUSEÚM NATIONAL D'HISTOIRE NATURELLE, PARIS

'Calypso' Expedition to Red Sea: Red Sea, Abulat, 26 December 1951; 1 spec. (prev. det. D. Guinot as *C. minutus*).

SMITHSONIAN INSTITUTION, WASHINGTON

Saudi Arabia, Iranian Gulf, Tarut Bay, coll D. S. Erdman, 18 May 1948; 3 specs. (USNM 89885, det. F. A. Chace Jr. as *C. minutus*).

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Expedition to Iran: Iranian Gulf Stn. 2, coral reef, 6 nautical miles S. of Bushire, 22-24 February 1937; 1 spec. — Iranian Gulf Stn. 49D, 2 1/2 nautical miles E.S.E. of Bustani, 5-6 m, algae, sand, coll. G. Thorson, 6 April 1937; 4 specs. (all det. K. Stephensen as *C. minutus*).

Remarks. — Balss (1929) considered the specimens he examined from the Red Sea and those described by Gravier from Madagascar to be two distinct species, *C. minutus* A.

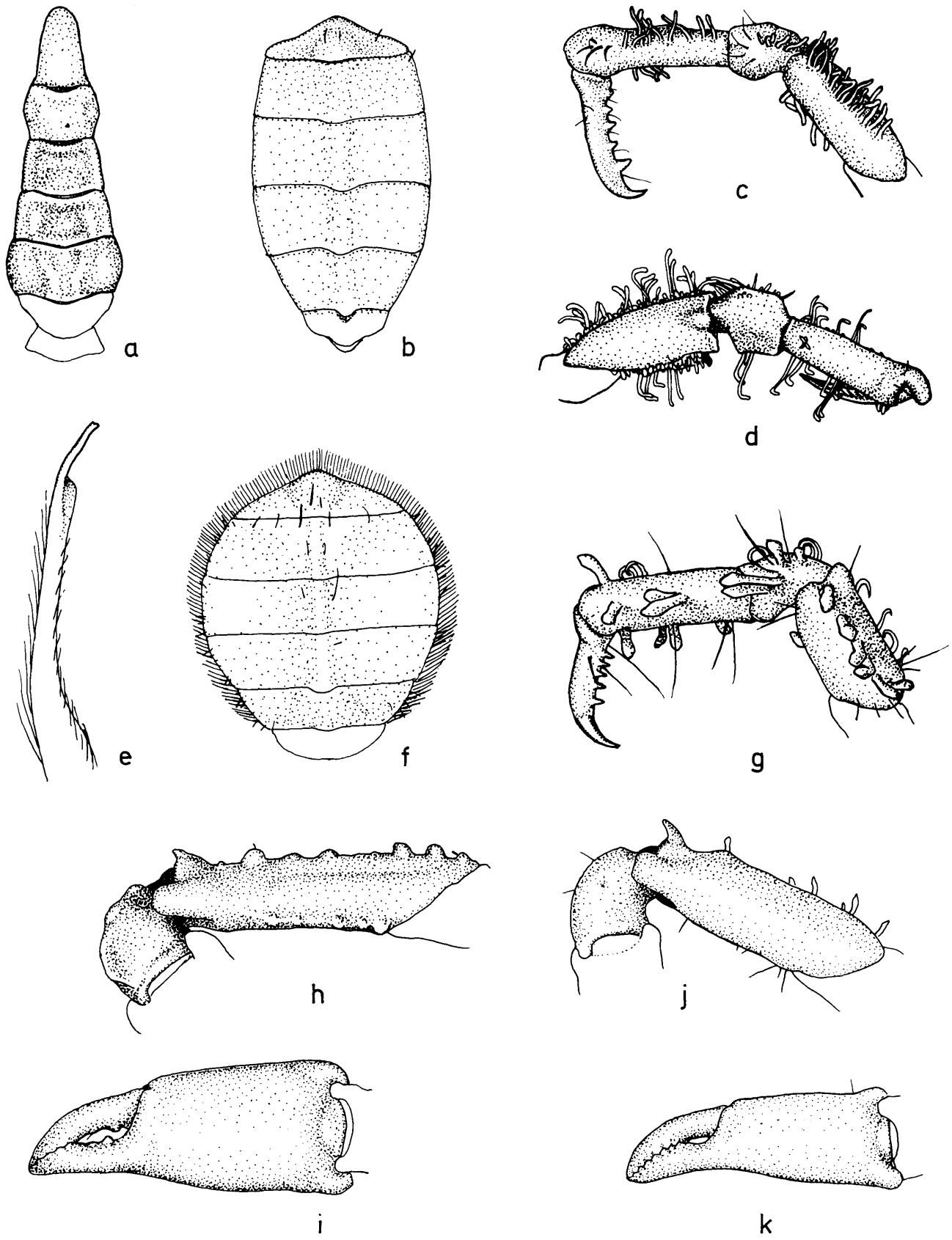


Fig. 97. *Cyphocarcinus alcocki* (holotype) (a) male abdomen; (female, ovig., 10.5 mm, Sri Lanka, ZSC 8887/6) (b) female abdomen; (holotype) (c) left fourth ambulatory leg (posterior); (d) left fourth ambulatory leg (dorsal); (e) left first pleopod, abdominal view; *C. rathbunae* (holotype) (f) female abdomen; (g) left fourth ambulatory leg; *C. alcocki* (holotype) (h) left cheliped, merus and carpus; (i) left chela; *C. rathbunae* (holotype) (j) left cheliped, merus and carpus; (k) left chela.

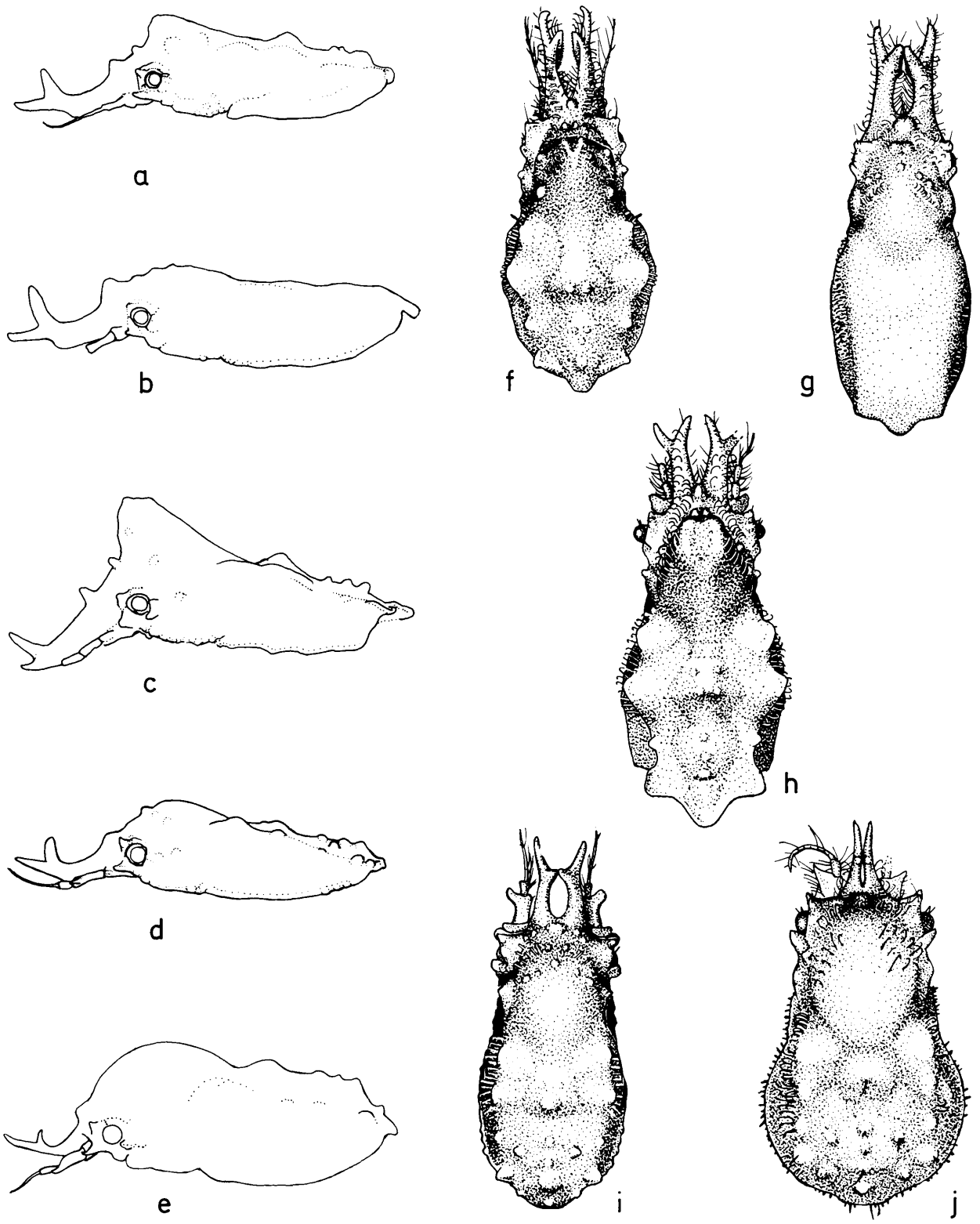


Fig. 98. *Cyphocarcinus capreolus* (male, 18.5 mm, Gulf of Iran, ZMC) (a) carapace, lateral view; *C. suspensus* (male, 15 mm, Delagoa Bay SAM A.10900) (b) carapace, lateral view; *C. minutus* (male, 11.5 mm, Mombasa, ZMC) (c) carapace, lateral view; *C. alcocki* (holotype) (d) carapace, lateral view; *C. rathbunae* (holotype, female) (e) carapace, lateral view; *C. capreolus* (as above) (f) carapace, dorsal view; *C. suspensus* (as above) (g) carapace, dorsal view; *C. minutus* (as above) (h) carapace, dorsal view; *C. alcocki* (holotype) (i) carapace, dorsal view; *C. rathbunae* (holotype, female) (j) carapace, dorsal view.

Milne Edwards and *C. suspensus* (Gravier) respectively, *Ixion capreolus* Paul'son being considered a synonym of *C. minutus*. Barnard (1955) retained the name *C. minutus* for the tuberculate Red Sea specimens, but regarded *C. suspensus* as a synonym of Paul'son's species. Since the time of the original description of *C. minutus*, no specimens agreeing with that description have been recorded until now, and the name has come to be used for the species more commonly found in the Red Sea. Peyrot-Clausade & Serène (1976) have examined the types of *C. minutus* and *C. suspensus* as well as specimens from the Red Sea reported on by Nobili (1906) as *C. minutus* and have shown that the first is a distinct species from the last two — *C. suspensus* and "*C. minutus*" of Nobili — which they regard as conspecific and to which they applied the name *C. capreolus*. We have not seen the specimens reported by Nobili from the Red Sea and Iranian Gulf but it is probable that they are conspecific with our material from this area. The two males which we have examined (see under *C. minutus*) also confirm the validity of A. Milne Edwards' species. We have examined specimens from the Red Sea and compared them with the specimens from Inhaca I. described by Barnard and they are not conspecific with each other. Therefore, we consider the species name *capreolus* to be validly applied to the distinct species from the Red Sea and the Iranian Gulf and the species name *suspensus* to be validly applied to the less tuberculate species described by Gravier (1923) and by Barnard.

We have examined the specimens described as *C. minutus* from Ceylon by Alcock (1895) and from the Seychelles by Rathbun (1911) and consider them to be not conspecific with any of the above three species (*C. capreolus*, *C. minutus* and *C. suspensus*). In those three species the first movable segment of the second antenna is slender and its sides parallel, while in Alcock's and Rathbun's specimens the disterolateral margin of the first movable segment of the second antenna is strongly produced. We have therefore designated them as new species, *C. alcocki* and *C. rathbunae* and they are discussed elsewhere.

As well as the Red Sea specimen from the 'Calypso', the three specimens from the Iranian Gulf in the USNM and the material from the Red Sea previously discussed as *C. minutus* by Griffin & Tranter (1974), we have examined specimens from the Iranian Gulf (3 ♂♂, 2 ♀♀ 13.5-21 mm) described by Stephensen (1945) as *C. minutus* and consider that they are all properly identifiable as *C. capreolus*. There is some variation among the specimens in the size of the tubercles on the dorsal ridge above the lateral margin of the carapace and in the degree of elevation of the gastric region within each sex (apart from the higher gastric elevation in the female due to sexual dimorphism). However, all these specimens agree with each other in several characters which distinguish them from *C. suspensus*.

On the summit of the gastric region of *C. capreolus* there are two low ridges anteriorly and a lateral tubercle. Anteriorly, there is a medial tubercle near the base of the rostral spines and behind it another medial tubercle (or two submedial tubercles). The anterior tubercle is at most twice as large (male) or the same size (female) as the tubercle behind it. In *C. suspensus* there is a third medial tubercle near the summit of the gastric region, and in line with it are two lateral tubercles, forming a transverse row of five tubercles; there are no ridges on the summit and the anterior tubercle (near the rostrum) is often the largest carapace tubercle, being about four times (male) or twice (female) as large as the tubercle behind it.

In *C. capreolus* there is a hiatus on the anterior edge of the basal antennal article. The medial edge of the hiatus, at the base of the flagellum, is weakly produced and rounded while the lateral edge is produced forward into a much larger rounded lobe. In *C. suspensus* the medial lobe of the hiatus is more strongly produced and the lateral lobe is subequal to it.

In *C. capreolus* there is a strong medial tubercle on the posterior margin of the carapace and a tubercle on the posterolateral angle. In *C. suspensus* (and *C. minutus*) there is no medial tubercle on the posterior margin, and at the most a very weak tubercle posterolaterally.

The abdomen of the adult female in both *C. capreolus* and *C. suspensus* is elongate oval in shape. In *C. capreolus* the lateral margin of the abdomen is curved towards the abdominal cavity and the length of segments three to seven is about one and a half times (1.4-1.6) the greatest width. In *C. suspensus* the lateral margin of the abdomen is flat and the length of segments three to seven is about one and three quarters times (1.7-1.8) the greatest width. The female gonopore is a slit-like aperture opening medially.

The characters which distinguish *C. capreolus* from *C. minutus* A. Milne Edwards are discussed under that species.

Distribution. — Red Sea, Iranian Gulf.

Cyphocarcinus minutus A. Milne Edwards, 1868
(Figs. 98c,h, 99c)

Cyphocarcinus minutus A. Milne Edwards, 1868: 73-76, pl. 19 figs. 7-12.
Cyphocarcinus capreolus. — Barnard, 1955: 15-18, fig. 4 (part-1 male). (Not *Ixion capreolus* Paul'son, 1875.)

Material examined. — 3 ♂♂, 1 ovig. ♀, 10-11.5 mm, and postrostral cl. 11 mm, ovig. ♀, 10 mm.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Galathea' Expedition: Stn. 256, Mombasa, 04°05'S 39°41'E, 1-2 m, dredge, corals, 22 March 1951; 1 spec.

SOUTH AFRICAN MUSEUM, CAPE TOWN

Delagoa Bay, Inhaca I.; 1 spec. (SAM, Cape Town, A.16212, ? det. K. H. Barnard as *C. capreolus*).

MUSEO ZOOLOGICO, UNIVERSITY OF FLORENCE

Somalia, Sar Uanle, 20 km S. of Chisimaio, coll. M. Vanini, 1976; 2 specs.

Remarks. — We have examined the specimens reported on by Alcock (1895) and by Rathbun (1911) as *C. minutus* and

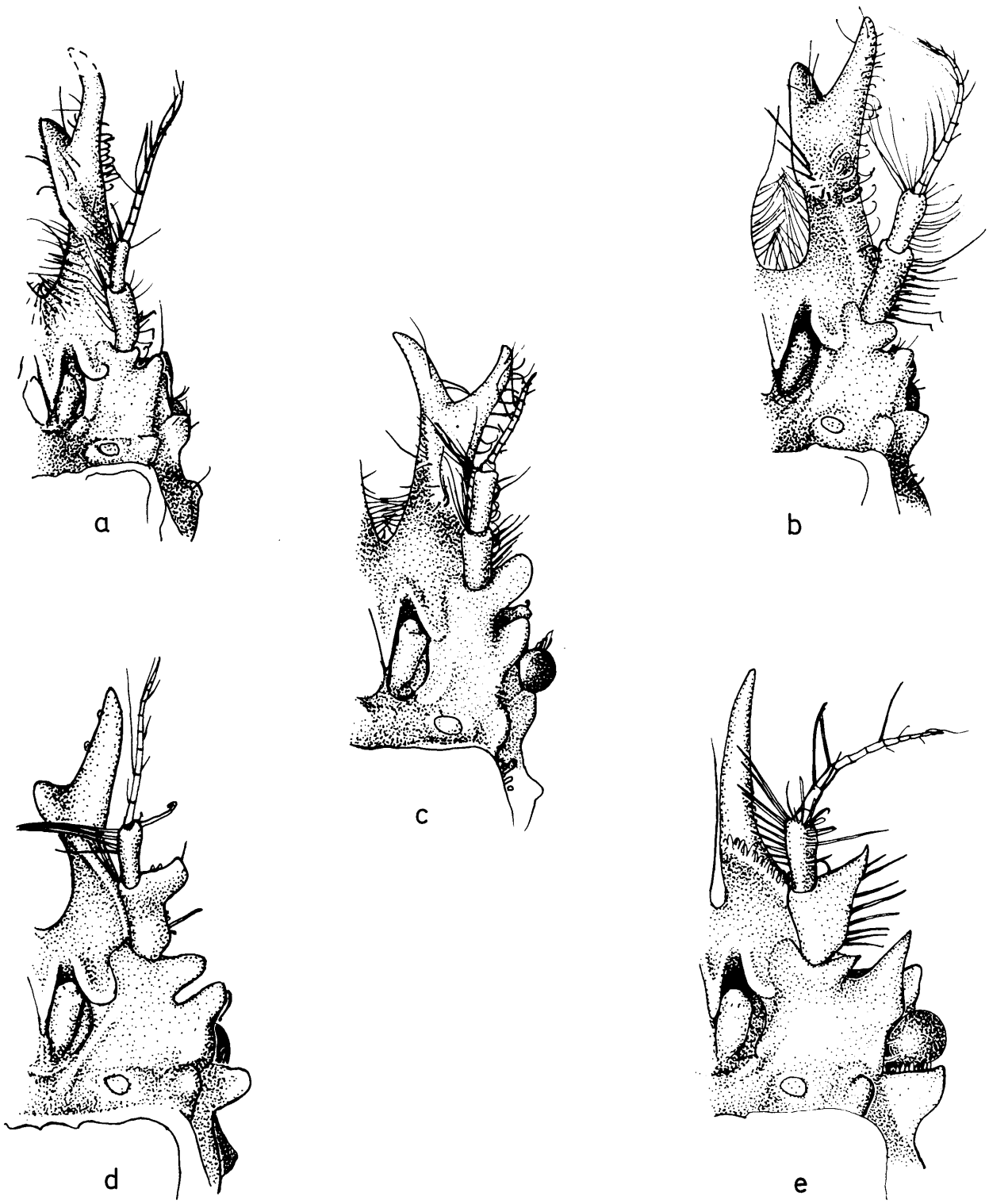


Fig. 99. *Cyphocarcinus capreolus* (male, 18.5 mm, Gulf of Iran, ZMC) (a) left orbit, ventral view; *C. suspensus* (male, 15 mm, Delagoa Bay, SAM A.10900) (b) left orbit, ventral view; *C. minutus* (male, 11.5 mm, Mombasa, ZMC) (c) left orbit, ventral view; *C. alcocki* (holotype) (d) left orbit, ventral view; *C. rathbunae* (holotype, female) (e) left orbit, ventral view.

they are not conspecific with our specimens. We have placed Alcock's specimens and one of Rathbun's specimens (a male) in one new species *C. alcocki*, and the other of Rathbun's specimens (a female) in another new species *C. rathbunae* (see under those species).

We have examined the specimens determined as *C. minutus* by Stephensen (1945) and they are conspecific with other material from the Red Sea and Iranian Gulf now known as *C. capreolus* (see under that species).

The specimen from Mombasa collected by the Galathea expedition agrees well with the holotype of *C. minutus* from Madagascar (female, 10.5 mm, Museúm National d'Histoire

Naturelle, Paris) figured by A. Milne Edwards, particularly in the shape of the basal antennal article.

We have examined four specimens (2 ♂♂, 2 ♀ ♀, Inhaca I., Delagoa Bay SAM, Cape Town. A.10900) apparently determined as *C. capreolus* by Barnard (1955). Although one male and the two females are clearly those described by Barnard (now considered to be *C. suspensus*), the other male (now SAM, Cape Town. A.16212) is conspecific with our specimen of *C. minutus* from Mombasa.

In these two males — the Mombasa specimen and the one male from Delagoa Bay — the gastric region is strongly elevated (though not as strongly as in the female holotype), vertical anteriorly, with the highest point above the orbit. The rostrum is less than half (0.4) postrostral carapace length (holotype rostrum about 1/4 postrostral carapace length). In the male and ovigerous female from Sar Uanle, Somalia, collected by Vannini, the rostral spines are very short, less than 1/4 and about 1/6 postrostral carapace length respectively. The spines are contiguous in the basal half and barely visible in dorsal view as in the holotype figured by A. Milne Edwards.

There are two low submedial ridges anteriorly on the summit and a lateral tubercle above the orbit. There is a medial tubercle near the base of the rostral spines and two submedial tubercles behind it. The dorsal ridge above the margin is well developed, the largest tubercle is level with the cardiac region. The posterolateral angle is produced but not tuberculate and there is a flat smooth medial lobe produced posteriorly and horizontally over the abdomen in the males and weakly deflexed in the female. There are two or four cardiac tubercles and a medial intestinal ridge or a row of three tubercles; the carapace surface is smooth between the tubercles.

There is only a small preorbital tubercle and the postorbital lobe is only weakly produced laterally. The basal antennal article is as figured for the holotype; the medial edge of the hiatus, at the base of the flagellum, is produced into a large blunt lobe directed obliquely forwards; the lateral lobe is smaller and posterior to it. (In the specimens from Sar Uanle the lateral lobe is much smaller than the anterior.) The margins of the first movable segment of the antenna are parallel: there is no lobe.

The palm of the chela of the adult male is compressed and there is a well developed gape, each finger being armed with a single tooth in the gape. The cheliped merus is armed with six dorsal and four ventral tubercles and a blunt terminal spine. The dactyls of the last three pairs of walking legs have a subterminal pair of teeth larger than the other teeth.

The first pleopod of the male is similar to that of *C. capreolus* (figured by Stephensen) and *C. suspensus* (figured by Barnard) but the truncate apex is terminally straight, not angled, and the flattened distal fifth of the pleopod, which *appears* to narrow suddenly, is twisted to lie in a dorsoventral plane. The first pleopod of *C. alcocki* is similarly flattened and twisted in the distal quarter.

The abdomen of the ovigerous female is about twice as long as wide.

This species is distinguished from the four other known species of *Cyphocarcinus* by the shape of the basal antennal article (see above). Further it is distinguished from *C. suspensus* (Gravier) by the more strongly elevated gastric region, with only one, not two, lateral tubercles; from *C. capreolus* (Paul'son) by the absence of the medial tubercle on the posterior margin of the carapace present in that species; and from *C. alcocki* and *C. rathbunae* by the more strongly elevated gastric region and the absence of a strong anterolateral lobe on the first movable segment of the antenna.

Distribution. — Madagascar, Delagoa Bay, Mombasa, Sar Uanle (Somalia); previously known only from Madagascar.

Cyphocarcinus rathbunae new species
(Figs. 97f,g,j,k, 98e,j, 99e)

Cyphocarcinus minutus. — Rathbun, 1911: 255 (part-female only). (Not *Cyphocarcinus minutus* A. Milne Edwards, 1868.)

Material examined. — 1 ♀ (ovig.), cl. 7.5 mm.
Holotype. — Female, ovigerous, cl. 7.5 mm, Seychelles, Coetivy, 1905. Smithsonian Institution USNM 41431 (det. Rathbun, 1911 as *C. minutus*).

Description. — Carapace pyriform, width approximately half postrostral length; margin and tubercles with large setae.

Rostral spines short (approx. 1/4 postrostral carapace length) with a short accessory spine; slender, subparallel, almost contiguous, separated by a proximal slit and weakly divergent distally.

Orbit above with a very small, sharp preorbital spine directed forward and upward; supraorbital eave without a tubercle; a distinct postorbital lobe present.

Hepatic region rounded with a low ventral tubercle.

Gastric regions moderately elevated, broadly rounded, smooth, greatest height above hepatic region; a low medial tubercle halfway down anterior slope and a slightly smaller lateral tubercle between this and preorbital spine. Urogastric region with a low conical tubercle. Dorsal ridge above lateral margin not so distinctly marked as in other species, with five low tubercles, the fifth close to intestinal region. Cardiac region with three medial tubercles and one tubercle laterally. Intestinal region depressed posteriorly, with one medial tubercle.

Basal antennal article broad with a very small sharp lobe at base of first movable segment of antenna and, separated from it by a hiatus, a large acute anterolateral lobe. Anterolateral angle of first movable segment similarly produced into a large acute lobe.

Cheliped merus with a terminal spine but no distinct tubercles, chela slender.

Merus of ambulatory legs with thick fringing hairs. Dactyl of fourth leg with a long curved terminal tooth and four very small teeth, other dactyls similarly armed.

Female abdomen broad, width subequal to length.

Remarks. — Rathbun (1911) commented briefly on this specimen. This species is distinguished from all other known species of *Cyphocarcinus* by the acute anterolateral lobe on the basal antennal article and on the first movable segment of the antenna. The gastric elevation is more broadly rounded and the dorsolateral margin less distinctly marked than in the other known species. Also the carapace is broader, as noted by Rathbun (l = w; other species l = $1^1/_2$ or 2 × w); the rostral spines are almost contiguous and the terminal tooth on the dactyls of the ambulatory legs is much longer in relation to the other teeth on the dactyl then in the other species.

This species is named for Mary Jane Rathbun (1860-1943) whose unmatched contributions to the study of Brachyura of the world extended over forty years.

Distribution. — Known only from the type locality: Coetivy, Seychelles.

Cyphocarcinus suspensus (Gravier, 1923)
(Figs. 98b,g, 99b)

Stenocarabus suspensus Gravier, 1923: 214-218, figs. 1-3.
Cyphocarcinus suspensus. — Balss, 1929: 23.
Cyphocarcinus capreolus. — Barnard, 1955: 15-18, fig. 4 (part-1♂, 2♀♀). (Not *Ixion capreolus* Paul'son, 1875.)

Material examined. — 1♂, 2♀♀ (1 ovig.), 13.5-15 mm, ovig. ♀, 13.5 mm.

SOUTH AFRICAN MUSEUM, CAPE TOWN

Delagoa Bay, Inhaca I.; 3 specs. (SAM, Cape Town. A. 10900, det. K. H. Barnard as *C. capreolus*).

Remarks. — We consider that this species should retain its status as a species distinct from *C. capreolus* (Paul'son) despite the views of Peyrot-Clausade & Serène (1976) who consider that these two species are synonymous and that the differences in tuberculation of the carapace are only minor. We have found consistent differences between the specimens from Inhaca I., described by Barnard and those examined from the Red Sea. In the former the lobes on the basal antennal article are subequal (not one twice as large as the other) and the hiatus between them is directed obliquely, not straight forward; there is one more tubercle on both the anterior and lateral slopes of the gastric elevation; and there is no medial tubercle on the posterior carapace margin. We discuss these differences in more detail under *C. capreolus*. In *C. suspensus* the gastric region is less strongly elevated than in either *C. capreolus* or *C. minutus* and the highest point, in both males and females, is level with the hepatic region.

Distribution. — Tuléar, Madagascar and Inhaca I., Delagoa Bay.

Leptopisa Stimpson, 1871

Type species. — *Tiarinia setirostris* Stimpson, 1871, by monotypy.

Remarks. — This genus has an unusual disjunct distribution. The type species occurs in the west Atlantic (Florida to Brazil) and the other two species are from the west Pacific. The first pleopod of the male of *L. australis* is here figured but the pleopod of *L. setrirostris* has not been described and only females are known of *L. nipponensis* Sakai (Sakai, 1976).

Distribution. — West Atlantic and West Pacific.

KEY TO SPECIES OF *LEPTOPISA*

(Only one species — *L. australis* — has been seen, information on the rest taken from the literature.)

1		Rostral spines long, about half postrostral carapace length; basal antennal article with two distal spines ..... *L. setirostris*
—		Rostral spines short, not more than a third postrostral carapace length; basal antennal article with only an anterolateral spine..... 2
2(	1)	Epibranchial spine short, acute; chelipeds and ambulatory legs unarmed..... *L. nipponensis*
—		Epibranchial tubercle small; chelipeds and ambulatory legs with tubercles ..... *L. australis*

Leptopisa australis new species
(Figs. 100, 107e, 112g,h)

Material examined. — 3♂♂, 8♀♀ (3 ovig.), 5.5-15.5 mm, smallest ovig. ♀, 11 mm.
Holotype. — Male, cl. 15.5 mm, Flores Sea, Postillon Is. (Liukang Tenggaja Kep.), 06°45′S 118°50′E, anchorage off Pulu Sarassa, up to 36 m, dredge, coral, 4/5 April 1899, Siboga Expedition, Stn. 43, ZMA De. 100.735 (in part), det. Ihle as *Tiarinia cornigera*.
Paratypes. As listed below.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn.43, as for holotype; 4 females (ZMA De 100.735, in part, det.Ihle as *T. cornigera*). — Stn. 66, S. Sulawesi, S. of Salajar, bank between Bahuluwang I. and Tambolungan I., 8-10 m, dredge, dead coral, *Halimeda*, *Lithothamnion*, 7/8 May 1899; 1 female. — Stn. 96, Sulu Archipelago, SE. side of Pearl Bank, 15 m, dredge, townet, *Lithothamnion* bottom, 27 June 1899; 2 females. — Stn. 315, Flores Sea, Paternoster Is. (Tengah Kep.), 07°30′S 117°30′E, anchorage E. of Sailus Besar, up to 36 m, dredge, coral and *Lithothamnion* 17/18 February 1900; 2 males, 1 female.
(Also examined: ZMA, 2♂♂, 9.5, 15.5 mm, 1♀, 12.0 mm, no data.)

Description. — Carapace about 0.7 postrostral carapace length, weakly tuberculate, tubercles mostly low and broad but some small and distinct; weak ridge just above posterior margin; scattered fine hairs (not plumose as in *Tiarinia* species).

Rostrum of two slender contiguous spines, length in male less than a third, in female a fifth to a quarter, postrostral carapace length, slightly upturned apically.

Orbit consisting above of a broad eave, preorbital spine small, upcurved; lateral edge of eave weakly concave; antorbital lobe hardly expanded; postorbital lobe adjacent to antorbital angle so as to close the orbit above, anterior margin weakly bilobed in most specimens. Eyestalks stout, short smooth, cornea large.

Hepatic region with three small tubercles. Branchial margin with a distinct epibranchial tubercle and two low tubercles anterior to it.

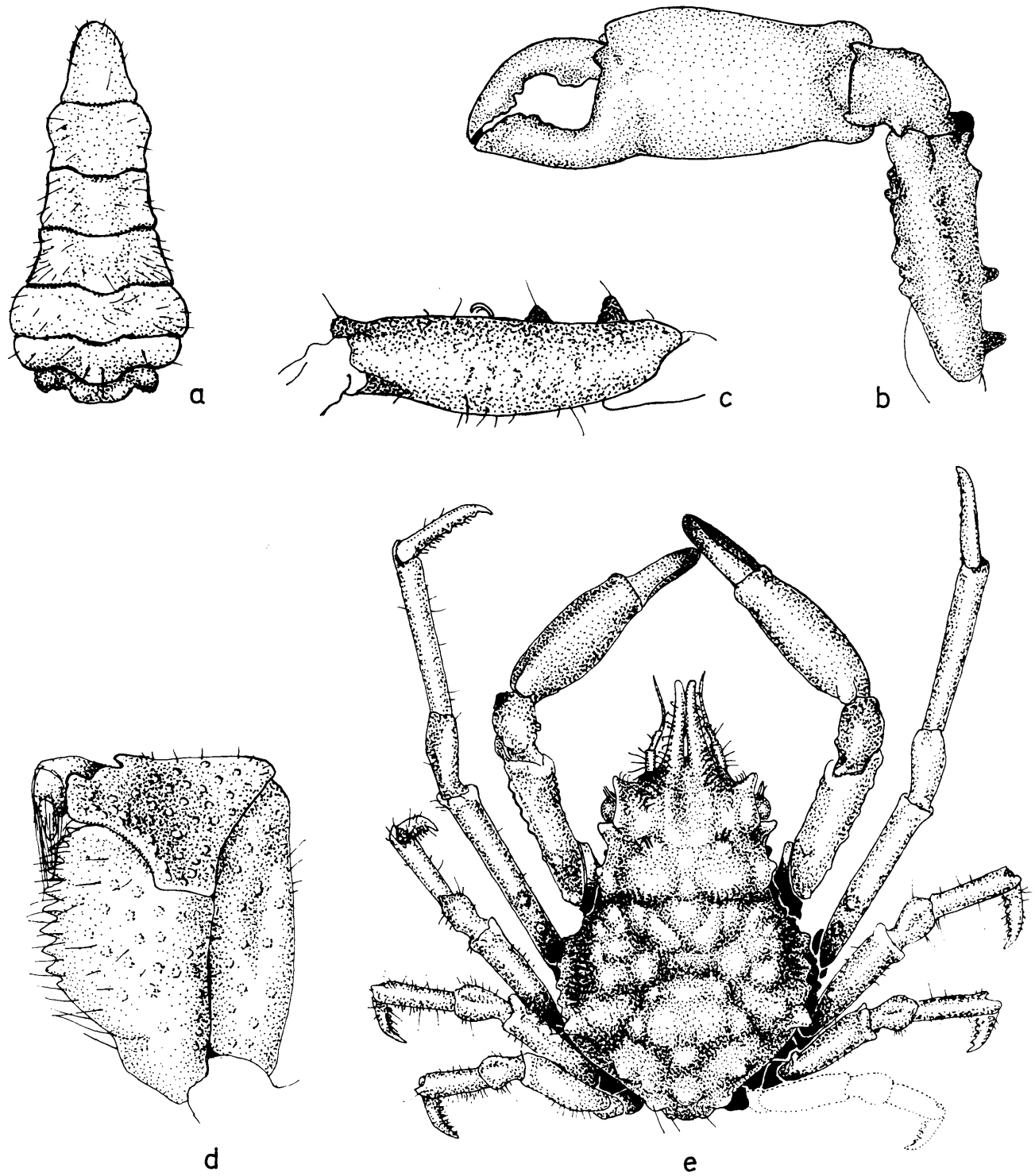


Fig. 100. *Leptopisa australis* (holotype) (a) male abdomen; (b) left cheliped; (c) merus of left second ambulatory leg; (d) left third maxilliped; (e) whole animal, dorsal view.

Gastric regions weakly elevated, surface indistinctly tuberculate, tubercles low and rounded. Urogastric region depressed with one low rounded tubercle.

Cardiac region with three extremely low rounded tubercles, two in front and one behind. Intestinal region with a central tubercle and behind it a pair of submedial tubercles which form medial points of a narrow unarmed ridge parallel to posterior carapace margin; posterior margin with three or four tubercles near midline.

Branchial region anteriorly with five low tubercles in two oblique rows; an irregular row of four to six small distinct tubercles above lateral carapace margin; and a metabranchial tubercle just posterolateral to cardiac region.

Basal antennal article broad, subquadrate, surface with a

shallow, longitudinal groove centrally, otherwise smooth; anterolateral angle with only a short spine, lateral margin entire. A small suborbital tubercle adjacent to green gland.

Pterygostomian region with two to three tubercles near margin.

Third maxilliped with anterolateral angle of merus moderately produced; notch of merus shallow, medial edge a broad rounded lobe. Male sternum smooth.

Cheliped merus of adult male with one distal and two proximal tubercles dorsally and a small terminal spine, a row of small tubercles ventrally and midway along outer face, a few tubercles on medial surface; carpus with four to five small tubercles on dorsal and medial surfaces; palm compressed, smooth, length about 1.75 times height, fingers gaping widely, fixed finger excavate, dactyl with a large tooth in gape proximally.

Ambulatory legs with merus cylindrical, two or three proximal tubercles dorsally but no terminal spine; dactyl of fourth leg with about six small teeth ventrally along its length. First ambulatory leg one and a half times longer than second leg in adult male.

Male abdomen of seven segments, smooth, sixth segment wider (1.5) than long, seventh segment as wide as long. Female abdomen of seven segments, smooth.

First pleopod of male straight, apex truncate, weakly produced at lateral angle, opening terminal.

Female gonopore a simple opening, wider laterally.

Remarks. — This species differs from *Leptopisa setirostris* (Stimpson) (as described by Rathbun, 1925: 375) in having shorter spines (a fifth to a quarter (female) or less than a third (male), rather than half postrostral carapace length); the basal antennal article is not armed with a spine midway along the anterior margin or at the base of the first free segment and the epibranchial spine is sometimes represented only by a tubercle.

This species is similar to *Leptopisa nipponensis* Sakai in general appearance but differs in having a less pronounced epibranchial spine and the cheliped and ambulatory legs armed, not smooth, as in that species; there are at least four small distinct tubercles laterally on the branchial region, just above the carapace margin, apparently not present in *L. nipponensis*; the anterolateral angle of the merus of the third maxilliped is not extremely produced as in *L. nipponensis* (but is produced more laterally than in *L. setirostris*) and the medial border is also different in the two species; in the ovigerous female the first ambulatory leg is only slightly longer than the second leg (as in *L. nipponensis*) but in the adult male it is one and a half times as long.

The specific name refers to the fact that this species is the southernmost western Pacific species of the genus.

Distribution. — Flores Sea, South Sulawesi, Sulu Archipelago.

Micippa Leach, 1817

Type species. — *Cancer cristata* Linnaeus, 1758, by monotypy.

Remarks. — With *Tiarinia*, *Micippa* represents one of the most speciose mithracines of the Indo-Pacific. Within the genus principal confusion has concerned the relationship of *Paramicippa tuberculosa* H. Milne Edwards to other *Micippa* species and the distinctness of *M. philyra* and *M. platipes*. As previously stated (Griffin, 1966b), Miers (1879c) confused the situation by designating *Micippa platipes* Rüppell as the type species of *Paramicippa* but later including only *P. tuberculosa* in his revision (Miers, 1885). *P. tuberculosa* is here transferred to a new genus and by Miers' action *Paramicippa* is reduced to synonymy with *Micippa*. The distinctness of *M. platipes* and *M. philyra* was clarified by Buitendijk (1939). *Lophomicippa* Rathbun, 1907 (type species *L. limbata* Rathbun by monotypy = *Micippa parca* Alcock) is reduced to synonymy with *Micippa*.

Distribution. — Indo-West Pacific.

KEY TO SPECIES OF *MICIPPA*

1 Rostrum divided for distal quarter or more 2
— Rostral spines fused for almost entire length, only a notch in the midline apically 6
2(1) Rostrum bearing a short, broad, recurved spine on each side 3
— Rostrum with many lateral spines or lacking spines altogether 4
3(2) Basal antennal article smooth, orbit usually open below with a hiatus between basal antennal article and postorbital lobe; anterolateral borders of carapace with eight to ten spines..... *M. platipes*
— Basal antennal article tuberculate, orbit closed below, basal antennal article in broad contact with postorbital lobe; anterolateral borders of carapace with three to six spines..... *M. philyra*
4(2) Orbit closed below, basal antennal article adjacent to postorbital lobe; lateral margin of rostrum with numerous spines ... *M. cristata*
— Orbit open below, a wide hiatus between basal antennal article and postorbital lobe; rostrum without lateral spines 5
5(4) Postorbital lobe with a large lobe on posterior margin basally; anterior lateral margin of carapace without spines; basal antennal article smooth, anteromedial angle produced ..... *M. xishaensis*[41])
— Postorbital lobe with no lobe on posterior margin; anterior lateral margin of carapace with at least four spines; basal antennal article with tubercles on anterior and lateral margins, a small tubercle at anteromedial angle..... *M. thalia*
6(1) Carapace with three spines along dorsal midline; intercalated spine separated from postorbital lobe by a narrow fissure ..... *M. spinosa*
— Carapace without spines in dorsal midline; intercalated spine adjacent to postorbital lobe 7
7(6) Posterior margin of carapace with rounded 'bosses'; rostrum straight distally 8
— Posterior margin of carapace unarmed or granular; rostrum inflexed distally 9
8(7) Posterior margin of carapace with one medial and a lateral 'boss' on each side ..... *M. margaritifera*
— Posterior margin of carapace with one medial spine, a submedial spine and a lateral 'boss' on each side ..... *M. parca*
9(7) Hepatic margin without tubercles or spines; posterior carapace margin with small spines; basal antennal article with a central, tuberculate ridge ..... *M. curtispina*
— Hepatic margin with two tubercles; posterior carapace margin without spines; basal antennal article granular distally otherwise smooth..... *M. excavata*

[41]) From the literature (Chen, 1980).

Micippa cristata (Linnaeus, 1758)

Cancer cristata Linnaeus, 1758: 629.
Micippe cristata. — H. Milne Edwards, 1834: 330.
Micippa cristata. — Adams & White, 1848: 16. — Buitendijk, 1939: 252, fig. 20. — Takeda, 1973a: 110-111, fig. 4E, pl. 3 fig. D. — Griffin, 1976: 202.

Micippa cristata granulipes. — Sakai, 1976: 255-256, figs. 136, 137a.

Material examined. — 21 ♂♂, 18 ♀♀ (6 ovig.) 13.5-58 mm, smallest ovig. ♀, 32 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Sulu Archipelago, Tawi Tawi Is, Sanguisiapo, 1899; 3 specs. (ZMA De. 100.586, det. Ihle). — Stn. 172, Ceram Sea, anchorage between Geser and Seram Laut, 18 m, townet, reef exploration, coral and lithothamnion, 26/28 August 1899; 9 specs. (ZMA De. 100.719, De. 100.799, det. Ihle). — Ambon, 1899; 1 spec. (ZMA De. 100.860, det. Ihle). — Kai Is., Ellat Reef, December 1899; 1 spec. (ZMA De. 100.702, det. Ihle). — Aru, Dobo Reef, December 1899; 1 spec. (ZMA De. 100.817, det. Ihle). — S. of Timor, Haingsisi Reef; 1 spec. (ZMA De.100.816, det. Ihle). — Stn. 313, N. coast of Sumbawa, Saleh Bay, anchorage east of Dangar Besar, reef exploration, 14/16 February 1900; 1 spec. (ZMA De.100.861, det. Ihle as *M. cristata* var. *granulipes*).

Lesser Sunda Is., Sumba, on shore, coll. Laurense, 5 January 1909; 2 specs. (ZMA De.100.818, det. Ihle). — S. of Timor, Haingsisi Reef, on falling tide, coll. Laurense, 2 November 1909; 1 spec. (ZMA De.100.820, det. Ihle). — SW. Irian Jaya, Kaimana Reef, 03°41′S 133°44′E, 28 August 1910; 3 specs. (ZMA De.100.819, det. Ihle). — South Bali, Den Pasar; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Ambon I., Ambon Bay, 13-18 m, sand, 28 Febraury 1922; 1 spec. — Near Ambon, Saparua Bay, on beach, 12 March 1922; 1 spec. — Banda Sea, Banda, 7 June 1922; 8 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn.KL I, Moluccas, S. end of Kajoa I., 00°05′S 127°27′E, coarse sand cay with marginal corals, 0-3 m, 21 May 1970; 4 specs. — Stn.TS IV, Kai Is., Tanimbar, Selaru, N. side of Labuan Olendir, 08°07′S 130°59′E, 3 m, dredge, sand, 26 June 1970; 1 spec.

Remarks. — Takeda (1973a) has given a detailed description of this species, figured the first pleopod of the male and summarised the distribution and status of Zehntner's "subspecies". Zehntner's (1894) "varieties" *laevimana* and *granulipes* were based on differences in granulation of the chelipeds. Buitendijk (1939) noted the variation of cheliped granules with age and sex and Takeda suggested that *laevimana* represents the females and young males and *granulipes* the older males. This is confirmed by our material in which the chelipeds of large males (cl. greater than about 30 mm) have all segments granulate; all adult and ovigerous females have very weak granulations on the merus and carpus and the chela smooth; and immature females and smaller males have all cheliped segments completely smooth. Sakai (1976) continues to use the subspecies name *granulipes* without commenting on whether the two females he examined had granular or smooth chelipeds. We do not consider however, that the two subspecies are valid.

This species is easily distinguished from all other *Micippa* species by the laterally multispinate rostrum the strong anterior spine above the eye, strong spines on the carapace, and the meri of the ambulatory legs which are cylindrical and granular with few hairs.

Distribution. — West Pacific from Indonesia to Japan.

Micippa curtispina Haswell, 1880

Micippa curtispina Haswell, 1880b: 446-447, pl. 25 fig. 1, 1a. — Lanchester, 1900: 725. — Griffin, 1966b: 288 (in key).

Remarks. — No new material has been examined. There are two specimens of *M. curtispina* in the collections of the Australian Museum. In 1905, a specimen was registered as G.5136: the locality is stated as Port Denison and it was identified in the register as type at the same time as it was registered. Subsequently, in 1941, a second specimen was relocated and registered as P. 11385; it appears that at that time the existence of the previously registered specimen was unknown since (in McNeill's handwriting) there is a note on the catalogue card and in the register stating that "a specimen in the collection labelled type discovered since this was written". The specimen registered as P.11385 also has the locality 'Port Denison, Q'ld'; and a note in the round, glass-topped container in which it sits states in McNeill's handwriting, "labelled on base of box in Prof. Haswell's handwriting." Haswell stated that his specimen was 5 lines in length (i.e. 10.5 mm); the sex of the specimen was not stated although the figure shows an animal with very slender chelae (which suggests either a female or a juvenile male). Of the two specimens, that registered as P.11385 is a male with very slender chelae and is 9.5 mm long; all legs are detached as is also the abdomen. The other specimen (G. 5136) is 13 mm long, the chelae are folded under the body. In both cases, specimens of other Crustacea registered at the same time came from the 'Old Collection'.

In fact since both specimens are identified by us as *Micippa curtispina* determination of which is in fact the holotype doesn't affect the nomenclature. However, we consider the specimen registered as P.11385 as most probably the holotype because its size more nearly approaches that given by Haswell.

This species is similar to *M. excavata* but is distinguished from it by:

1) anterolateral margin of rostrum convex (*M. excavata* anterolateral margin of rostrum oblique);
2) hepatic margin granular without tubercles or spines (*M. excavata* with two distinct granular tubercles);
3) posterior carapace margin with 3-5 spines on each side of midline (*M. excavata* with granules, no spines, on posterior margin);
4) basal antennal article has a tuberculate ridge from the base of the first movable segment and is tuberculate laterally (*M. excavata* smooth near base of first movable segment and granular laterally);
5) cheliped merus with two dorsal spines in distal half (*M. excavata* cheliped merus with high undivided carina in distal half).

The specimens from Torres Strait reported by Miers (1884, 1885) in which the anterolateral angles of the rostrum are 'ob-

nion bottom, 29 June 1899; 4 specs. — Stn. 109, Sulu Archipelago, anchorage off Pulu Tongkil, 13 m, dredge and townet, *Lithothamnion*, 5/6 July 1899; 1 spec.

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Sri Lanka, Trincomali, 11 m; 1 spec. — Mauritius; 1 spec.

ZOOLOGICAL SURVEY, CALCUTTA

Sri Lanka, Pearl Banks, coll. T. Southwell, 1911; 1 spec.

Remarks. — This species is distinguished by the presence on the posterior margin of the carapace of three shiny 'bosses', one in the midline and one on each side. The lateral margins of the rostrum are parallel in these specimens, not sloping inwards as figured by Henderson (1893). On the anterior edge of the basal antennal article there are tubercles and a spine as well as a spine at the anterolateral angle. The first pleopod of the male is curved strongly outwards distally.

Distribution. — Indo-West Pacific: Mauritius, Seychelles, Sri Lanka, Gulf of Martaban, Maldive Islands, Sulu Archipelago, Japan.

Micippa parca Alcock, 1895
(Fig. 102a)

Micippa margaritifera var. *parca* Alcock, 1895: 253. — Alcock & Anderson, 1898: pl. 35 fig. 4, 4a.
Micippa parca. — Edmondson, 1951: 213, fig. 17a-c. — Holthuis, 1953: 5.
Lophomicippa limbata Rathbun, 1907: 65-66, pl. 5 fig. 3, pl. 6 fig. 1-1g; 1911: 255 (in discussion); new synonymy.

Material examined. — 6 ♂♂, 6 ♀ ♀ (4 ovig.), 7.5-13.5 mm, smallest ovig. ♀, 7.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 96, Sulu Archipelago, SE side of Pearl Bank, 15 m, dredge and townet, *Lithothamnion*, 27 June 1899; 1 spec. — Stn. 99, anchorage to W. of North Ubian, 06°07.5′N 120°26′E, 16-23 m, dredge and townet, *Lithothamnion*, 29 June 1899; 3 specs. — Stn. 109 Sulu Archipelago, anchorage off Pulu Tongkil, 13 m, dredge and townet, *Lithothamnion*, 5/6 July 1899; 1 spec. — Stn. 144, Moluccas, anchorage north of Damar I., 45 m, dredge, townet and reef exploration, coral and *Lithothamnion*, 7/9 August 1899; 2 specs. — Stn. 282, anchorage between Nusa Besi and NE.point of Timor, 08°25.2′S 127°18.4′E, 27-50 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Honolulu, 18-72 m, coral, 5 May 1915; 3 specs.

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Mariel King Memorial Expedition — Moluccas: Stn. AW II, Aru, W. Wokam, NW. corner of Wasir I., 05°30′S 134°14′E, snorkel and shore collecting, 15 June 1970; 1 spec.

Remarks. — This species can be clearly distinguished by the presence on the posterior margin of two round shiny 'bosses', one on each side of a medial group of three to seven spines.

There is a strong anterolateral spine on the basal antennal article; behind it there is another smaller spine or in some specimens only a strongly convex lateral edge.

On our male specimen from Honolulu, as in that figured by Edmondson (1951), there are about five flattened spines on the anterior lateral margin of the carapace. On the other specimens from the Philippine Islands and Indonesia, as in that figured by Alcock & Anderson (1898), the anterior lateral margin bears one tubercle or is quite unarmed.

The specimen (ovig. ♀, cl. 9.2 mm, Makemo, Paumotus, USNM 32856) described by Rathbun (1907) as *Lophomicippa limbata* is clearly conspecific with *M. parca.* Rathbun (1911) explained, "in describing *Lophomicippa limbata*, its relationship to *M. parca* Alcock was overlooked. The principal difference lies in the absence from the carapace of *M. limbata* of the coarse granulation plainly visible in *M. parca*; instead there are numerous punctae not visible to the naked eye. It is possible that the single punctate specimen from the reef at Makemo is really *M. parca* with the granules entirely worn off". We confirm Rathbun's later view now. In our specimens the carapace granules vary from very fine over the whole surface to coarse with larger granules on the protogastric, branchial and intestinal regions.

The first pleopod of the male is similar to that of *M. platipes*: lightly curved outwards in the distal half and tapering towards the tip.

This species is clearly distinct from *M. margaritifera* Henderson which possesses three shiny 'bosses' on the posterior margin of the carapace but no spines.

Distribution. — Andaman Islands, Indonesia, Sulu Archipelago, Honolulu.

Micippa philyra (Herbst, 1803)

Cancer philyra Herbst, 1803: 51-52, pl. 58 fig. 4.
Micippa philyra. — Buitendijk, 1939: 253-254, 255-256, fig. 21, pl. 10 figs. 1, 3. — Sakai, 1965a: 90, pl. 42 fig. 1; 1976: 257, figs. 138a,a', pl. 90 fig. 3. — Griffin, 1976: 202.

Material examined. — 18 ♂♂, 16 ♀ ♀ (7 ovig.), 7.5-23 mm, smallest ovig. ♀, 11.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 47, Lesser Sunda Is., Bay of Bima, near south fort, beach, mud with patches of fine coral sand, 8-12 April 1899; 1 spec. — Stn. 99, Sulu Archipelago, anchorage to W. of North Ubian, 06°07.5′N 120°26′E, 16-23 m, dredge and townet, *Lithothamnion* bottom, 29 June 1899; 1 spec. — Stn. 127, N. Sulawesi, Great Sangir I., Taruna Bay, 45 m, trawl and reef exploration, fine, dark coloured sand, 20-21 July 1899; 1 spec. (ZMA De. 100.721, det. Ihle). — Stn. 129, Celebes Sea, Karkaralong Group, anchorage off Kawio and Kamboling Is., 29-31 m, reef exploration, dredge and townet, sand, 22-23 July 1899; 1 spec. (ZMA De. 100.722, det. Ihle). — Stn. 258, Kai Is., Tual anchorage, 22 m, reef exploration and dredge, *Lithothamnion* sand and coral, 12-16 December 1899; 4 specs. (ZMA De.100.862, det. Ihle). — Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, trawl, dredge and reef exploration, sand, coral and *Lithothamnion*, 15-17 January 1900; 2 specs. (ZMA De.100.723, det. Ihle and unreg.). — Banda Sea, Banda, 5-20 m; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERISTY OF COPENHAGEN

Mortensen Siam Expedition: Gulf of Thailand, Koh Kahdat, 1.8 m, sandy bottom, sponges, dead corals, 11 January 1900; 1 spec. — Gulf of

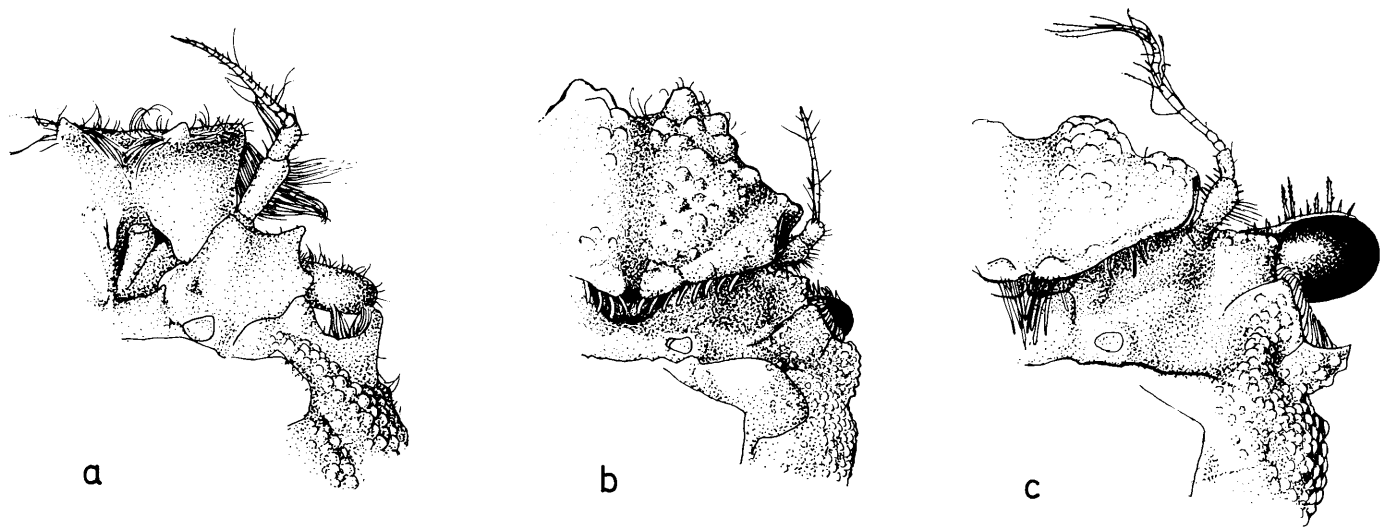


Fig. 101. *Micippa spinosa* (male, 18.5 mm, AM P. 180, in part) (a) left orbit, ventral view; *M. excavata* (male, 19 mm, Broome, AM P.13982) (b) left orbit, ventral view; *M. excavata* (female, ovig., 12 mm, Java, ZMC) (c) left orbit, ventral view.

solete' and the carina on the cheliped merus 'entire' may be *M. excavata* but are not *M. curtispina.*

Distribution. — Singapore, northeast Australia.

Micippa excavata Lanchester, 1900
(Figs. 101b,c, 102c,d, Pl. 22)

Micippa excavata Lanchester, 1900: 725-726, pl. 44 fig. 1a-c. — Buitendijk, 1950: 68.

Material examined. — 3 ♂♂, 5 ♀♀ (2 ovig.), 7.0-19 mm, smaller ovig. ♀, 12 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Is., Sapeh Strait, 08°23.5′S 119°04.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Danish Kei Islands Expedition: Stn. 64, Java I., 05°51′S 106°22′E, 35 m, trawl, sandy mud, shells, 26 July 1922; 1 spec. — Stn. 71, Java Sea, 05°40′S 106°08′E, 54 m, trawl, sand and stones, 28 July 1922; 1 spec. — Stn. 106, Java Sea, 05°50′S 106°16′E, 32 m, trawl, sand, 5 August, 1922; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Torres Strait, north end of Albany Passage, coll. M. Ward, 1928; 1 spec. (AM P.13981). — Albany Passage, 16-22 m, dredge, 1928; 1 spec. (AM P.29883, dry).

Western Australia: Broome, Roebuck Bay, near entrance, 104 m, *Lithothamnion* reef bottom, coll. A. A. Livingstone, 26 September 1929; 1 spec. (AM P. 13982). — Broome; 1 spec. (AM P.29884, dry).

Remarks. — This species can be distinguished from the very similar *M. curtispina* by the presence of two tubercles on the hepatic margin, uniform granules, not spines, on the posterior carapace margin, and a high undivided carina, not spines, on the distal half of the cheliped merus. The differences between these two species are discussed more fully under *M. curtispina.*

The palm of the adult male cheliped is smooth, twice as long as high; the fingers are slightly more than half as long as the palm and gape strongly in the proximal two thirds, bearing very small teeth distally in the gape. The sternum of the male has tubercles posteriorly on the first segment and on the second, third and fourth segments. The male abdomen is narrow, the segments smooth except for a transverse medial ridge anteriorly; the sixth segment is twice as wide as long; the seventh segment is one and a half times as wide as long, the anterior margin straight or weakly concave.

The first pleopod of the male is broad, weakly curved outwards, tapers slightly to the tip, and the medial edge of the apex is produced into a short, narrow lobe.

In the specimens from Indonesia there is a depression on the proximal part of the basal antennal article separated by a ridge on the suborbital lobe from another more lateral depression. In the Australian specimens the ridge and the depressions are not so pronounced.

Only three specimens of this species, all from Singapore, have been recorded previously.

Distribution. — Singapore, Indonesia, northwest and north Australia.

Micippa margaritifera Henderson, 1893
(Fig. 102b)

Micippa margaritifera Henderson, 1893: 348-349, pl. 36 figs. 5-7 — Alcock, 1895: 253. — Alcock & Anderson, 1898: pl. 35 fig. 3, 3a. — Rathbun, 1911: 255. — Sakai, 1938: 317, pl. 32 fig. 1; 1976: 259, pl. 90 fig. 4. — Buitendijk, 1939: 252-253.

Material examined. — 2 ♂♂, 6 ♀♀ (5 ovig.) 4.5-15 mm, smallest ovig. ♀, 9 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 99, Sulu Archipelago, anchorage to W. of North Ubian, 06°7.5′N 120°26′E, 16-23 m, dredge and townet, *Lithotham-*

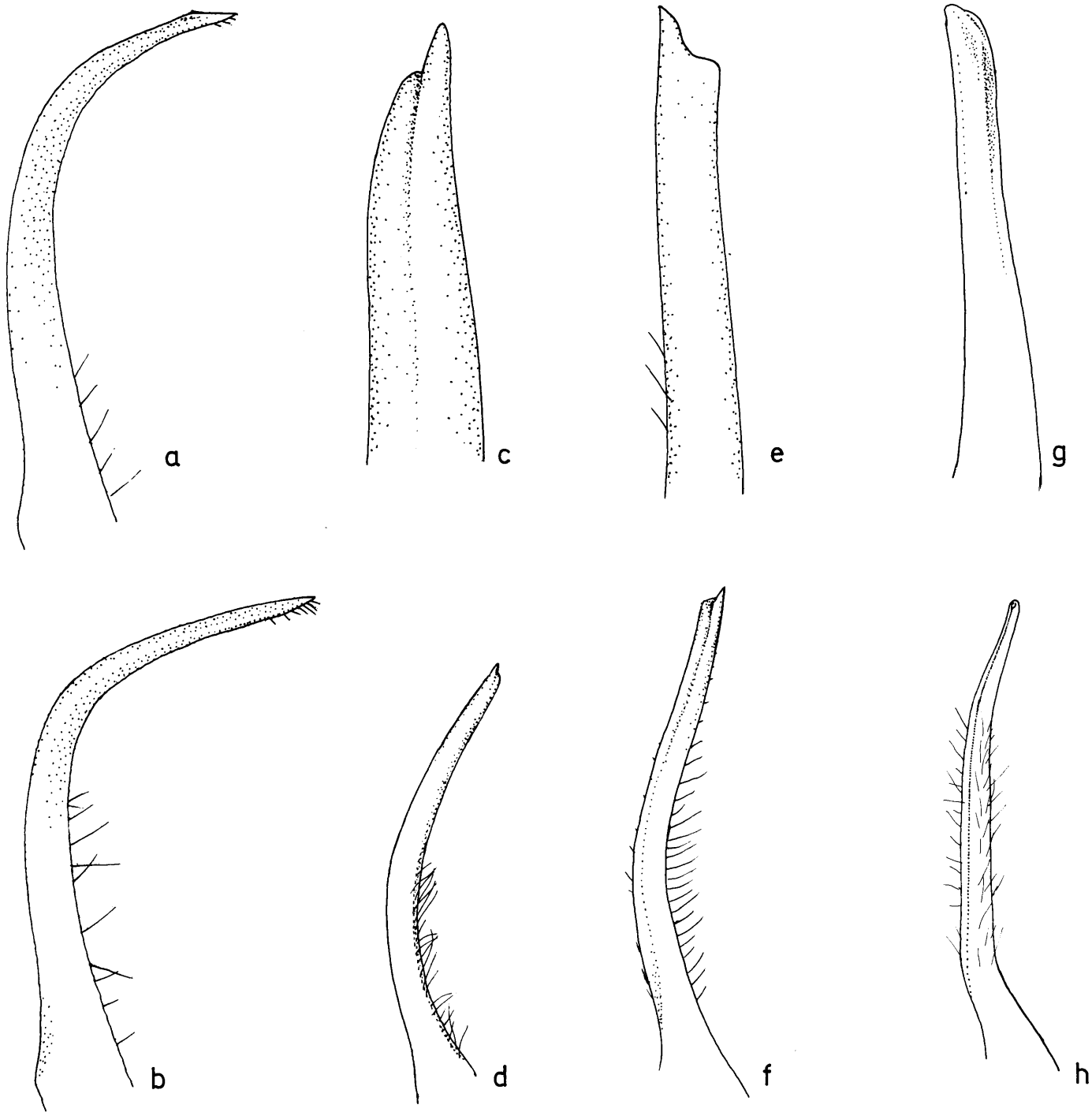


Fig. 102. Left first pleopod of male of *Micippa parca* (12 mm, Sulu Archipelago, ZMA) (a) abdominal view of pleopod; *M. margaritifera* (12 mm, Sulu Archipelago, ZMA) (b) abdominal view of pleopod; *M. excavata* (AM P.13982) (c) sternal tip of pleopod, (d) abdominal view of pleopod; *M. spinosa* (AM P.180) (e) sternal tip of pleopod, (f) abdominal view of pleopod; *Cyclocoeloma tuberculata* (36.5 mm, AM P.23824); (g) sternal tip of pleopod, (h) abdominal view of pleopod.

Thailand, Koh Kahdat, 7-9 m, sand, stones and coral, 15-18 February 1900; 1 spec. — Gulf of Thailand, S. of Koh Mak, 9-11 m, dredge, 17 February 1900; 3 specs.

Mortensen Pacific Expedition: Sulu Archipelago, off Marongas, 36-54 m, dredge, sand, coral, 19 March 1914; 2 specs.

Danish Kei Islands Expedition: Stn. 30, Kai Is., between Doe Roa and Kai Doelah, 40 m, trawl, sand, shells, 18 April 1922; 3 specs. — Off Neira Banda, ca. 20 m, dive, sand, 1 June 1922; 1 spec. — Banda, off Kombir, ca. 70-90 m, sand, 7 June 1922; 1 spec. — Stn. 67, Java Sea, 05°48′S 106°12′E, 38 m, sand, 27 July 1922; 1 spec.

Snellius Expedition: Moluccas, Morotai, 3-10 June 1930; 1 spec.

Danish Expedition to Iran: Stn. 39D, Iranian Gulf, 12 nautical miles ENE. of the lightship at Bahrein, 23 m, shell gravel, coll. G. Thorson, 27 March 1937; 1 spec. (ZMC unreg. det. K. Stephensen as *M. philyra* var. *mascarenica*).

5 Thai-Danish Expedition: Stn. 1154, West Malay Peninsula, 09°11′N 98°13′E, 20 m, coarse 'Amphioxus' sand, 5 March 1966; 1 spec.

Sumatra: 1917; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. CP I, Ceram, Piru Bay, off Tg.Tutuhuhur, 03°15′S 128°8′E, 54 m, dredge haul 15, grey

sand, fine with shelly grit, 2 June 1970; 1 spec. — Stn. KR VI, Kai Is., N. of Du Rowa I., N. of Nuhu Rowa, 05°32′S 132°41′E, 32-36 m, dredge haul 2, *Lithothamnion* rubble and sand, 10 June 1970; 1 spec. — Stn. KR VI, as above, 27-36 m, dredge hauls 3-10, sand and rubble, 11 June 1970; 3 specs. — Stn. KN II, Kai Is., off Elat Bay, W. coast of Nuhu Tjut, 05°40′S 132°59′E, 48-54 m, dredge haul 6, rubble, algae and sand, 13 June 1970; 1 spec.

Remarks. — Buitendijk has adequately distinguished this species from *M. platipes* and given a complete bibliography of both species. In addition to the differences listed by Buitendijk we also note the following: in the upper orbital border of *M. philyra* the antorbital and intercalated spines are adjacent only in the basal half or two thirds and are distally separated by a wide V-shaped hiatus whereas in *M. platipes* these two spines are adjacent for their whole length; in *M. platipes* the postorbital spine has a flattened lobe on the posterior margin which is not present in *M. philyra*.

The holotype of *Cancer philyra* Herbst (ZM Berlin 77, ♀ cl. 22.1 mm) and the syntypes of *Paramicippa asperimanus* Miers (BMNH 82.24, 2♂♂, 5♀♀ (1 ovig.) 8.5-17.4 mm), considered a synonym since Miers (1885), have been examined.

Distribution. — Indo-West Pacific from east Africa to Japan and Australia.

Micippa platipes Rüppell, 1830

Micippe platipes Rüppell, 1830: 8-10, pl. 1 fig. 4.
Micippa platipes. — Buitendijk, 1939: 254-256, pl. 10 figs. 2, 4, text fig. 22. — Takeda, 1973a: 113, fig. 4G. — Griffin & Tranter, 1974: 176.
Micippa bicarinata. — Ward, 1941: 1 (in list).

Material examined. — 10♂♂, 20♀♀ (5 ovig.), 7.5-36 mm, smallest ovig. ovig. ♀, 10 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 16, Java Sea, S coast of Kangeang, Bay of Kankamaraan, 06°59′S 115°24.7′E, to 22 m, shore exploration, Hensen net, mud, 15-16 March 1899; 1 spec. — Stn. 127, Celebes Sea, Great Sangir I., Taruna Bay, 45 m, trawl, fine dark coloured sand, 20-21 July 1899; 1 spec. — Stn. 162, Irian Jaya, between Loslos and Broken Is., W. coast of Saluwati, 18 m, dredge, coarse and fine sand with clay and shells, 18 August 1899; 1 spec. (ZMA De.100.814, det. Ihle). — Stn. 193, Moluccas, E. coast of Sula Besi, Sanana Bay, 22 m, reef exploration, mud 13-14 September 1899; 1 spec. (ZMA De.100.815, det. Ihle). — Ambon, Ambon Reef; 3 specs. (ZMA.De 100.703, det. Ihle as *M. philyra*). — Ambon, Ambon Reef; 2 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Java-S.Africa Expedition: Mauritius, Cannonier's Point, coral reef, 17 September 1929; 1 spec. — Mauritius, Ilot Marianee, coral reef, November 1929; 1 spec.

'Galathea' Expedition (1846): Nicobars, Pulo Milu, coll. Reinhardt, ? 1846; 1 spec.

Sri Lanka: Krusadai, coll. H. Lemche (Stn. 27), 15 October 1951; 1 spec. — Galle, coll. H. Lemche, 19 October 1951; 1 spec.

'Te Vega' Expedition: North Tonga, Niuatobutabu, 15°58′S 173°48′W, tidal flat with coral mud, coll. T. Wolff, 1 June 1965; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Netherlands New Guinea Expedition: Stn. N628, Irian Jaya, N. of Jayapura, Pacific Ocean coast, beach (at Base G), slow spider crabs from among corals fished up from reef and broken up on shore, coll. L. B. Holthuis, 12 November 1954; 2 specs. — Stn. W636, Irian Jaya, N. of Jayapura, reef (by Base G), crabs among coral, coll. L. B. Holthuis, 27 November 1954; 3 specs. — Stn. 683, Biak, W. of Sorido, reef in front of naval barracks, in coral, January 1955; 2 specs. — Stn. 722, Irian Jaya, shore of Manokwari Bay, near town, under coral on shore and in living coral in the sea, 14 March 1955; 1 spec.

Kenya, Tiwi Beach, 10 miles (16 km) S. of Mombasa, 0-0.5 m, coll. L. B. Holthuis, 25 November 1969; 4 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. TJ II, Kai Is., Tanimbar, W. side of Namwaan I., NW. Jamdena, 07°07′S 131°26′E, 0-3 m, snorkel collecting, coral reef, muddy stones close to shore 23 June 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Philippine Islands, Mindanao, Davao Gulf, Padado Beach, coll. G. R. Oesch, 14-16-19 March 1936; 2 specs. (det. M. Ward as *M. bicarinata*).

Remarks. — This species was adequately distinguished from *M. philyra* by Buitendijk (1939) and a full bibliography given. Additional differences are discussed here under *M. philyra*.

We have examined two specimens from the Davao Gulf, Philippine Islands identified by Ward (1941) as *M. bicarinata* Adams & White: we consider them to be *M. platipes*.

Distribution. — Widespread throughout the Indo-West Pacific.

Micippa spinosa Stimpson, 1857
(Figs. 101a, 102e,f)

Micippa spinosa Stimpson, 1857: 218; 1907: 14-15, pl. 1 fig. 2. — Miers, 1885: 8-9. — Griffin, 1966b: 288 (in key); 1972: 73.
Paramicippe affinis Miers, 1879a: 13.
Paramicippa spinosa. — Hale, 1927: 140-141, fig. 143.

Remarks. — No new material has been examined. This species has been adequately described previously and there are also recent additional notes (Griffin, 1972). However, neither the ventral orbit nor the first pleopod of the male has been figured before. We therefore take the opportunity to do so now. The adult male (cl. 21 mm) figured was selected from a series (AM P.180) of 35 males and 39 females from Port Jackson. The first pleopod of the male is broad, weakly curved outwards, hardly tapering, the lateral edge of the apex with a small sharp lobe projecting beyond the aperture which is subterminal and situated on the abdominal surface.

Distribution. — South-eastern Australia from Port Stephens (N.S.W.) to Bass Strait and eastern South Australia.

Micippa thalia (Herbst, 1803)

Cancer thalia Herbst, 1803: 50-51, pl. 58 fig. 3.
Micippa thalia. — A. Milne Edwards, 1872: 238-239, pl. 11 figs. 1, 1a-b. — Alcock, 1895: 251-252. — Sakai, 1965a: 90, pl. 42 fig. 3; 1976: 256-257, fig. 137b, pl. 90 fig. 1. — Takeda, 1973a: fig. 4F. — Griffin, 1974: 21. — Griffin & Tranter, 1974: 177.

Material examined. — 7♂♂, 3♀♀, 1 juv., 6-26 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 164, Ceram Sea, 01°42.5'S 130°47'E, 32 m, dredge, sand, small stones and shells, 20 August 1899; 2 specs. — Sulawesi, Makassar, 27-32 m; 1 spec.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Siam Expedition: between Koh Kut and Koh Kahdat, 18 m, dredge, shell bottom, 10 January 1900; 1 spec. — Off Koh Sakait, 9-11 m, dredge, hard bottom, 23 February 1900; 1 spec.

Mortensen Pacific Expedition: Sulu Archipelago, off Marongas, 36-45 m, dredge, sand, coral, 19 March 1914; 1 spec.

Danish Kei Islands Expedition: Stn. 72, Java Sea, 05°41'S 105°57'E, trawl, stones, 28 July 1922; 1 spec.

Sri Lanka, Trincomali, 11 m; 2 specs. — Japan, Nagasaki, coll. James Jordan, 1909; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AN I, Aru, S. Trangan I., SW. of Tg. Ngabordamlu, centred near 06°58'S 134°5'E, 25-27 m, dredge haul 3, broken shell and coral, sponge and mud, 20 June 1970; 1 spec.

Remarks. — In this species the orbit is incomplete below, the suborbital lobe is small and separate from the basal antennal article. Dorsally the antorbital lobe, the intercalated spine and the postorbital lobe are separate.

On all these specimens there are two mesogastric spines and one dorsal branchial spine. There is a spine or tubercle on the supraorbital eave in all except in one specimen from Sri Lanka.

The first pleopod of the male has been figured by Takeda (1973a).

Distribution. — Indo-West Pacific from Africa to Japan and Australia.

Paranaxia Rathbun, 1924

Type species. — *Pisa serpulifera* Guérin, 1829 , by designation of Rathbun, 1924.

Remarks. — The single distinctive species of this genus is unusual in that the young develop directly to juvenile crabs (Rathbun, 1914).

The orbit is closed above and below but there is no intercalated spine or suborbital lobe.

Distribution. — Western and northern Australia.

Paranaxia serpulifera (Guérin, 1829) (Fig. 103)

Pisa serpulifera Guérin, 1829, pl. 8 figs. 2-2d.
Naxia serpulifera. — H. Milne Edwards, 1834: 313-314.
Naxioides serpulifera. — Rathbun, 1914: 661-662, pl. 2 figs 9, 10.
Paranaxia serpulifera. — Rathbun, 1924: 7. — Griffin, 1966b: 266, 288 (in key), pl. 17 fig. a. — Sakai, 1976: 264-265, text fig. 143.

Remarks. — No new material has been examined. In the male both the abdomen and the sternum are excavated, the pits being distinctly rimmed. The first pleopod of the male curves outwards distally and the opening is subterminal and abdominal.

Until further specimens confirm the presence of this species in Japan we consider its distribution limited to western and northern Australia and the carapace recorded from the Kii Peninsula by Sakai (1976) as probably a specimen brought back to Japan from northern Australian waters by a fishing boat.

Distribution. — Western and northern Australia.

Tiarinia Dana, 1851

Type species. — *Pisa cornigera* Latreille, 1825, by subsequent designation of Miers, 1879.

Remarks. — *Tiarinia* is a predominantly West Pacific genus, only three of the eleven species occurring in the Indian Ocean. The present study recognises five new species. One species, *Tiarinia elegans* Haswell has been removed to a new genus in the Pisinae.

Distribution. — Indo-West Pacific.

KEY TO THE SPECIES OF *TIARINIA*

1	Rostrum with lateral accessory spines	2
—	Rostrum without lateral accessory spines	4
2(1)	Sixth segment of abdomen in male twice as wide as long, wider than fifth segment; gonopore of female ovate	*T. takedai*
—	Sixth segment of abdomen in male hardly wider than long, fifth segment wider than sixth; gonopore of female more or less abruptly narrowed medially, 'keyhole' — shaped	3
3(2)	First pleopod of male curving outwards at apex which is simple and only slightly narrowed, opening apical; medial portion of gonopore of female reduced to a slit	*T. alidae*
—	First pleopod of male straight distally, apex truncate with a broad rounded medial subapical lobe, opening subterminal; medial portion of gonopore of female narrower than lateral portion but not a slit	*T. angusta*
4(1)	Branchial region with a well developed epibranchial spine	5
—	Branchial region tuberculate but without a well developed epibranchial spine	6
5(4)	Two prominent subdorsal spines behind epibranchial spine; rostrum 1/4 postrostral carapace length	*T. spinigera*
—	No branchial spines behind epibranchial spine; rostrum 1/3 postrostral carapace length	*T. tiarata*
6(4)	Basal antennal article with a strong anterolateral spine	7
—	Basal antennal article with anterolateral angle acute or right angled but without a spine	9
7(6)	Posterior margin of carapace smooth	*T. macrospinosa*
—	Posterior margin of carapace tuberculate	8
8(7)	Large tubercles on midline of carapace more pronounced than lateral branchial tubercles; ambulatory legs tuberculate	*T. cornigera*
—	Tubercles on midline of carapace low, less pronounced than large lateral branchial tubercles; ambulatory legs smooth or with indistinct tubercles	*T. gracilis*
9(6)	Carapace with a few large 'islet-like' tubercles; surface beneath tomentum otherwise smooth	*T. garthi*
—	Carapace weakly or evenly tuberculate without any 'islet-like' tubercles	10
10(9)	Rostral spines about 1/4 postrostral carapace length, strongly tapering from base to narrow apex; anteromedial branchial region weakly tuberculate	*T. mooloolah*

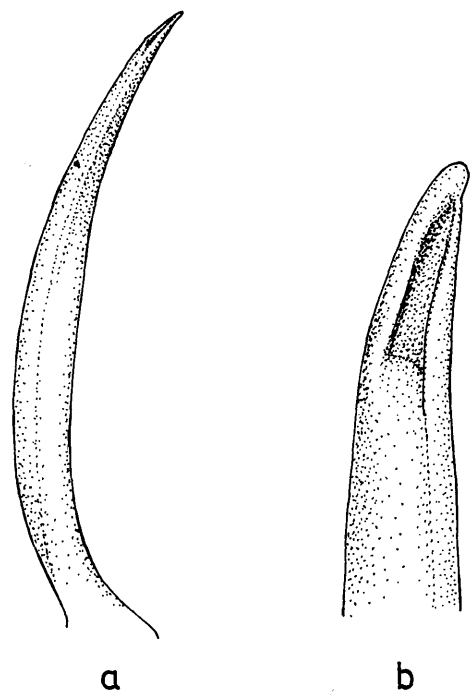


Fig. 103. Left first pleopod of male *Paranaxia serpulifera* (110 mm, AM P.13871) (a) abdominal view of pleopod, (b) abdominal-medial tip of same.

— Rostral spines more than 1/3 postrostral carapace length, weakly tapering from base to blunt apex; anteromedial angle of branchial region with a group of large rounded tubercles ..... *T. dana*

Tiarinia alidae new species

(Figs. 104, 105b, 111a,d,e)

Tiarinia angusta. — Buitendijk, 1939: in part, fig. 24. (Not *Tiarinia angusta* Dana, 1852.)

Material examined. — 2 ♂♂, 6 ♀♀ (4 ovig.), 20-39.5 mm, smallest ovig. ♀, 31.5 mm.
Holotype. — Female (ovigerous), cl. 39.5 mm. Philippine Islands, Sulu Archipelago, Tawi Tawi Group, 18 m, coral sand, 21 February 1908, 'Albatross' Philippine Expedition 1907-8, Stn. 5159, Smithsonian Institution USNM 49695 (in part), det. M. Rathbun as *Tiarinia angusta.*
Paratypes. As listed below.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Is., Sapeh Strait, 08°23.5′S 119°4.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. (ZMA De. 100.726, det. Ihle as *T. angusta*). — Stn. 169, W. coast of Irian Jaya, anchorage off Atjatuning, 57 m, trawl, dredge, townet, reef exploration, mud, 23/25 August 1899; 1 spec. — S. Sulawesi, Salajar; 1 spec. (ZMA De. 100.644, det. Ihle as *T. angusta*). — no locality; 2 specs. (ZMA De. 100.848, in part, det. Ihle as *T. angusta*).

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' Philippine Expedition: Stn. 5159, (data as for holotype); 1 spec (USNM 49695, in part). — Stn. 5160, Sulu Archipelago, Tawi Tawi Group, 22 m, sand, 22 February 1908; 1 spec. (USNM 47374). — S. Sulawesi, Great Tobea I., Buton Strait, tide pool, 15 December 1909; 1 spec. (USNM 49560). (All det. M. Rathbun as *T. angusta.*)

Description. — Carapace width about two thirds postrostral carapace length, surface tuberculate.

Rostrum of two contiguous spines from 0.37 to 0.5 postrostral carapace length, separated at apex (sometimes divergent), with two or three lateral accessory spines on proximal half. Rostral ridges tuberculate.

Orbit above consisting of a strongly expanded eave; preorbital spine directed obliquely forward; supraorbital eave with a tubercle midway along; antorbital angle adjacent to postorbital lobe distally, but basally separated by a small slit; postorbital lobe with a tubercle on antero-external angle.

Hepatic and subhepatic regions tuberculate. Branchial region tuberculate with a large sharp epibranchial tubercle on lateral margin.

Mesogastric region with three medial groups of tubercles anteriorly and posteriorly two submedial pairs of groups of tubercles; protogastric region with an anterior and posterior group of tubercles. Urogastric region with a medial group of tubercles. Cardiac region with three large tubercles in form of a triangle, base forwards, and several small tubercles. Intestinal region tuberculate with three large tubercles in a triangle anteriorly, a large lateral tubercle just behind this group and two to four large tubercles along posterior margin.

Basal antennal article broad, a shallow longitudinal groove centrally, anterolateral angle produced to a spine, lateral edge sinuous, base adjacent to postorbital lobe.

Merus of third maxilliped with anterolateral angle strongly produced and rounded.

Pterygostomian region smooth except for two small tubercles, margin with two large blunt tubercles, posterior one more dorsal.

Sternum of male smooth, lateral lobes rounded, broad.

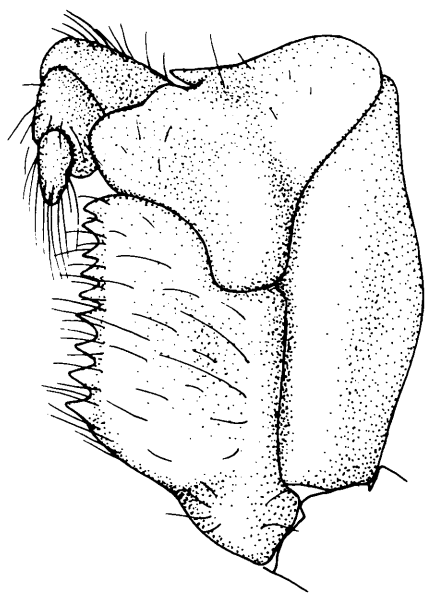
(We have not been able to examine an adult male so the description of the cheliped is based on an immature male and an adult female.) Merus with four dorsal tubercles, three large and one small and a sharp terminal spine curved somewhat forwards; ventrally one tubercle on inner edge and two tubercles on outer edge. Carpus smooth, sometimes with a low dorsal tubercle. Chela not enlarged on larger male (26.5 mm), length of palm more than two and a half times height, no gape between fingers.

Merus of first ambulatory leg with a row of four to five dorsal tubercles and on posterior slope three small tubercles, one distal and two proximally; no terminal spine; carpus flattened dorsally with a broad blunt tubercle at anterodistal angle. Dactyl with six to nine small teeth ventrally.

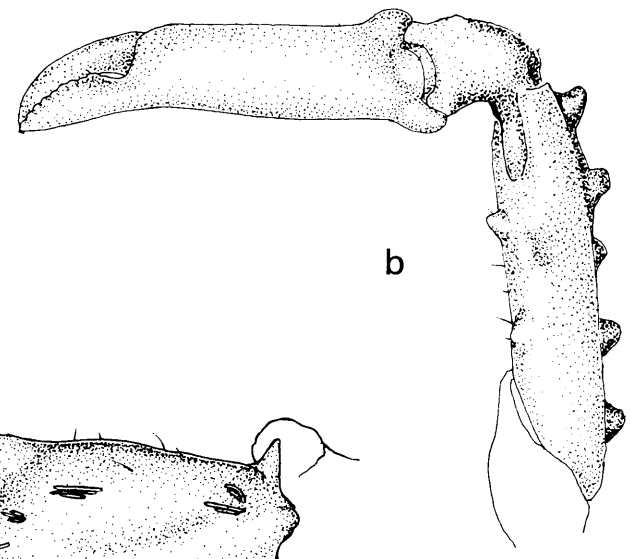
Male abdomen with fourth segment narrowing distally, basal width more than twice length; fifth and sixth segments slightly wider (1.3) than long; seventh segment slightly longer (1.3) than wide.

First pleopod of male (figured by Buitendijk, 1939) curving outwards at apex which is simple and only slightly narrowed, opening apical.

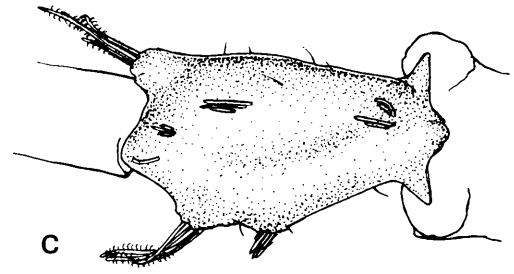
Gonopore of female opening ventrally, laterally rounded but in medial third opening reduced to a 'keyhole' by anterior and posterior lobes.



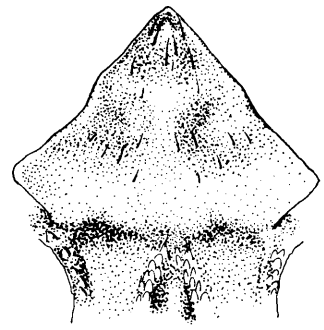
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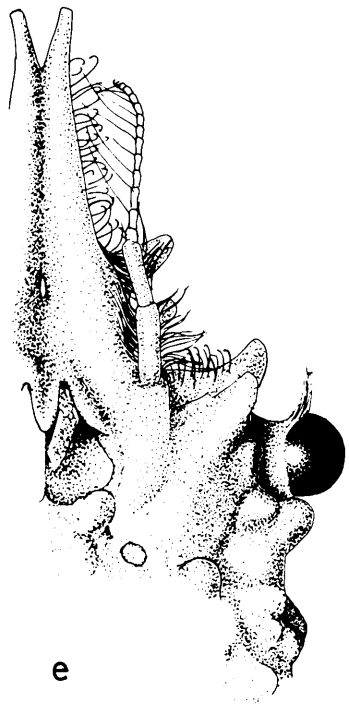
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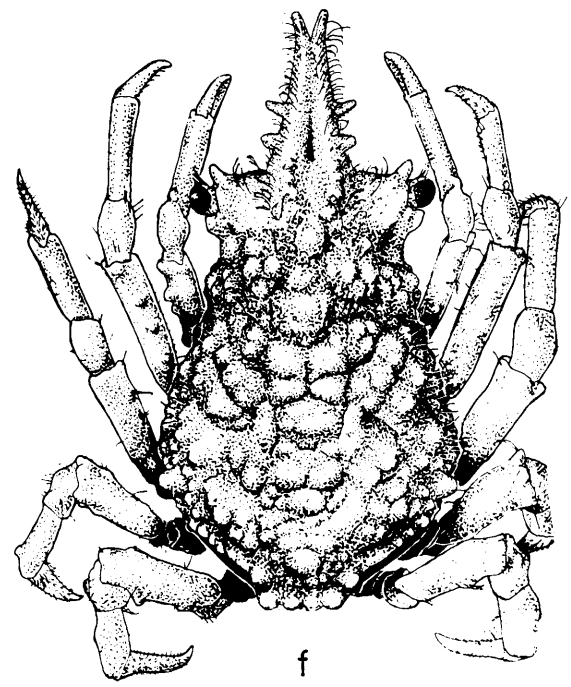
c



d



e



f

Fig. 104. *Tiarinia alidae* (female, 39.5 mm, USNM 49695, in part) (a) left third maxilliped; (b) left cheliped; (c) carpus of left first ambulatory leg, dorsal view; (male, 27 mm, ZMA De. 100.848) (d) male sternum; (holotype) (e) left orbit, ventral view; (f) whole animal, dorsal view.

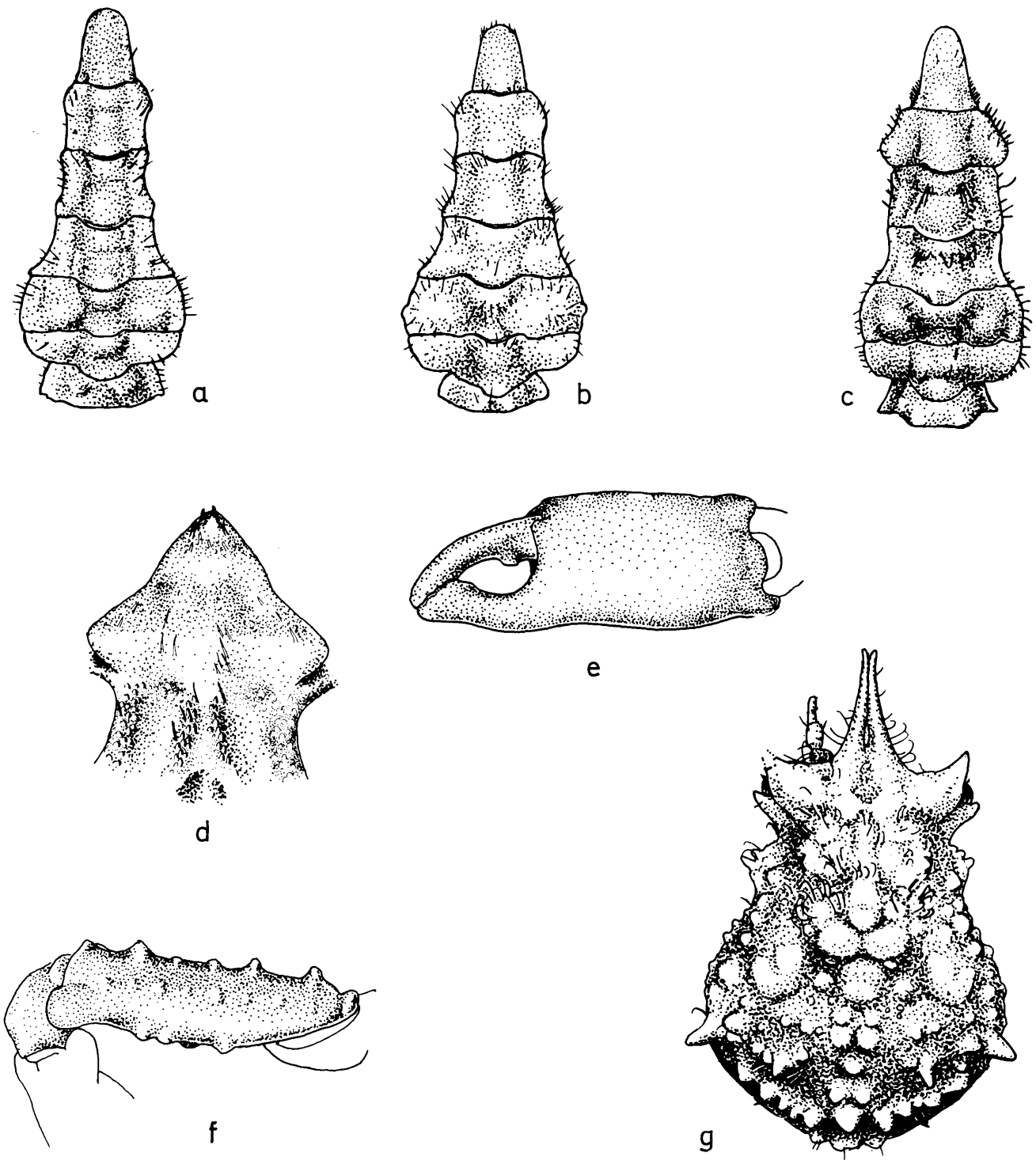


Fig. 105. *Tiarinia angusta* (neotype) (a) male abdomen; *T. alidae* (male, 27 mm, ZMA De.100.848) (b) male abdomen; *T. takedai* (holotype) (c) male abdomen; *T. angusta* (neotype) (d) male sternum; (e) left chela; (f) left cheliped, merus and carpus; *T. spinigera* (female, ovig., 19.5 mm, ZMA De. 100.853, in part) (g) carapace, dorsal view.

Remarks. — The basis of the decision to separate this series as a new species and the status of *T. angusta* are discussed under that species.

This species is very similar to *T. angusta* and *T. takedai* and is distinguished from them by the shape of the first pleopod of the male and the presence of two medial lobes on the female gonopore. In addition, the lateral lobes of the sternum are broader at their apex than in *T. takedai* but not as broad as in *T. angusta*; the terminal spine on the merus of the cheliped is more pronounced than in either of the two similar species; the carpus of the first ambulatory leg is slightly narrower (l = 1.5-1.8 w) than in *T. angusta* (l = 1.3-1.6 w); and the fifth and sixth segments of the male abdomen are narrower (l = $^3/_4$ w) than in *T. takedai* (l = $^1/_2$ w).

Buitendijk (1939) figured the first pleopod of a male from Sapoeka Besar, Postillon Is, Flores Sea, under the name

T. angusta. Unfortunately the only two males in our series (Siboga Exped., ZMA De. 100.484 (in part) det. Ihle as *T. angusta*) have no locality data. Because of the variation in the number of accessory spines on the rostrum in these very similar species it is not possible to say how many of the other specimens listed by Buitendijk are conspecific with the male figured by her. In our series of this species there were either two or three, but not four, accessory spines on each rostral spine.

The new species is named in honour of Alida Buitendijk, Dutch carcinologist, whose account of the collections of the Snellius expedition significantly advanced knowledge of tropical Indo-Pacific spider crabs.

Distribution. — Sulu Archipelago, Sulawesi, Flores Sea, Irian Jaya.

Tiarinia angusta Dana, 1852
(Figs. 105a,d-f, 111c,g,h)

Tiarinia angusta Dana, 1852: 113; 1855: pl. 3 fig. 7a,b. — Dai et al., 1978: 228, fig. 4a,b, pl. 1 fig. 4. — Chen, 1980: 131-132, fig. 14, pl. 3, fig. 1.
Tiarinia spinosirostris Haswell, 1882: 28.

Material examined. — *Neotype.* Male, cl. 38.5 mm, Philippine Islands, Sulu Archipelago, Marongas I., shore, coral head, 10 February 1908, 'Albatross' Philippine Expedition 1907-8, Smithsonian Institution USNM 47373 (in part), det. M. Rathbun as *Tiarinia angusta.*

In addition, 32 ♂♂, 35 ♀♀ (24 ovig.), 1 juv., 8.9-50 mm, smallest ovig. ♀, 25 mm, as follows:

SMITHSONIAN INSTITUTION, WASHINGTON

'Albatross' Philippine Expedition: Sulu Archipelago, as for neotype; 5 specs. (USNM 47373, in part, 1♂, 3 imm. ♀♀, 1 juv., det. M. Rathbun as *T. angusta*).

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 79b, Makassar Strait, Borneo Bank, Pulu Kabala-dua, 22 m, shore exploration, coral sand, 12/13 June 1899; 7 specs (ZMA De.100.660). — Stn. 89, N. Makassar Strait, Pulu Kaniungan Ketjil, 11 m, shore exploration, coral, 21 June 1899; 1 spec. (ZMA De. 100.847). — Stn. 91, E. coast of Borneo, Karong Lintang and Pulu Palabangan I., shore exploration, 22 June 1899; 4 specs. (ZMA De. 100.806). — Stn. 144, Moluccas, anchorage N. of Damar I., 45 m, dredge, townet and reef exploration, coral and *Lithothamnion*, 7/9 August 1899; 1 spec. (ZMA De.100.641). — Stn. 301, E. coast of Roti I., Pepela Bay, 10°38′S 123°25.2′E, 22 m, reef exploration, 30 January 1900; 1 spec. (ZMA De.100.642). — Kai Is., Kur I.; 1 spec. (ZMA De. 100.846). (All det. Ihle as *T. angusta.*)

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

'Galathea' Expedition: Nicobar I., Sambelong, coll. Reinhardt; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, Biak I., coll. L. D. Brongersma, February-May 1952; 1 spec. — Netherlands New Guinea Expedition: Irian Jaya, Biak I., W. of Sorido village, reef near naval barracks, February 1955; 2 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. AT I, N. of Aru, N. shore of Toba I., 05°21′S 134°27′E, snorkel, shallow coral reef and sand, 14 June 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Western Australia: Broome, Entrance Point, between tides on rocky shore, August 1929; 2 specs. (AM P. 13962). — Cape Leveque, intertidal, 20 August 1929; 9 specs. (AM P.13961).

Northern Territory: Darwin, Dudley Reef, coll. E. Pope, 13 October 1965; 2 specs. (AM P.15217); 24/25 October 1965; 1 spec. (AM P.15219). — Port Darwin, East Point, shore, 9 December 1934; 1 spec. (AM P.10584).

Queensland: Torres Strait, Murray I., August-October 1907; 1 spec. (AM P. 2871); 1 spec. (AM P. 2878); 1 spec. (AM P. 2879). — Murray I.; 9 specs. (AM P. 13960). — Green I.; 1 spec. (AM G. 3276); 1 spec. (AM P. 1283). — Hope I.; 1 spec. (AM P.3777); 1 spec. (AM P. 3778).

Papua New Guinea: Samarai, 16 February 1933; 1 spec. (AM P. 29881, dry).

Solomon Islands: Ysabel, Tunabuli Harbour, reef at Government Station, August-September 1924; 6 specs. (AM P.7639-7644); 1 spec. (AM P.7649). — Malaita, Bita'ama, coll. W. Dawbin, August 1966; 1 spec. (AM P. 15638).

Vanuatu: December 1888; 1 spec. (AM P.772). — Erakot Reef, 4 miles (~ 6.4 km) from Vila, coll. P. Homes, April-May 1974; 1 spec. (AM P.27155).

Philippines: Mindanao, Davao Gulf, Padado Beach, 6-19 July 1936; 1 spec. (AM P.29882, dry, det. M. Ward as *T. angusta*).

Remarks. — This species has been reported on by a number of authors (see synonymy given by Takeda, 1973a: 113) and the whole animal has been figured by Dana (1855), De Man (1895) and Sakai (1936; 1938; 1976). The first pleopod of the male was figured by Buitendijk (1939) and Takeda (1973a): comparing these two figures it is clear they are from different species. In the examination of this rather large series of specimens we have males (agreeing with the general description of *T. angusta*) with three quite distinct types of first pleopod, and females with gonopores of three distinct types. We consider that those specimens previously all described as *T. angusta* belong in fact to three species — *T. angusta*, *T. takedai* n.sp. and *T. alidae* n.sp. These three species, although very similar can be distinguished principally by sexual characters in the adults (see below). By detailed examination of this series it has been possible to determine which adult males and females are conspecific. We have less confidence in identifying immature females, especially those of less than 20 mm carapace length. At present it is not possible from the description and figure of the immature holotype (♂, 12.5 mm, no longer in existence) to assign it to one of these three species. In this series two of the three species are represented in the collection from the type locality (Sulu Archipelago) and we have decided to consider the most widely distributed of these two species as *T. angusta.* (Although *T. alidae* has a longer rostrum without lateral spines on the distal half, as shown in Dana's figure, this is also often true of young forms (< 16 mm) of the other two species.)

Clearly, it is necessary to fix the identity of *T. angusta* and to effect this we have selected as the neotype of this species an adult male from Marongas Island, Sulu Archipelago (38.5 mm, USNM 47373 (in part), det. M. Rathbun as *T. angusta*). There is no adult female of *T. angusta* from Sulu Archipelago in our series. However, from the same locality as the neotype, and collected with it, there are three immature females (cl. 23-25 mm) which, while they cannot be positively

identified as *T. angusta* by the form of the gonopore margin, agree well in other characters with this species, viz. there are four lateral accessory spines on each rostral spine, the lateral lobes of the sternum are broadly rounded and the carpus of the first ambulatory leg is only slightly longer (1.3-1.45 times) than wide. There are both male and female specimens of *T. angusta* from several other localities — NW. Australia, Torres Strait, NE. Australia, Solomon Is, Vanuatu, N. Irian Jaya and Makassar Strait. A juvenile (9.5 mm) collected with the neotype resembles the small male holotype of *T. angusta* (as figured) in having only three small accessory spines on the proximal half of each slender rostral spine. The holotype of *T. spinosirostris* Haswell, is also a small immature male (12.5 mm, AM G. 5139) with three accessory spines on the proximal half of each rostral spine: we see no reason to change the status of *T. spinosirostris* as a synonym of *T. angusta* (see Griffin, 1966b).

Also from the Sulu Archipelago in this series there are three ovigerous females (USNM 47374, 38.5 mm; USNM 49695, 37.0, 39.5 mm, det. M. Rathbun as *T. angusta*) which we have determined as *T. alidae* because on the marginal ridge of the gonopore there are two medial lobes which are lacking in *T. angusta* (discussed further under *T. alidae*).

This species as now understood is distinguished from *T. takedai* and *T. alidae* by the shape of the first pleopod of the male and the lack of any marginal ridge around the female gonopore. The male pleopod is straight and the apex truncate with a broad rounded medial lobe just below the apex, the opening is sternal and subterminal.

The rostrum varies from 0.3-0.47 of the postrostral carapace length, there are three or four lateral spines of which the most distal pair is usually on the distal half. The lateral lobes of the sternum are broader and more rounded than in either *T. takedai* or *T. alidae*.

The terminal spine on the cheliped is low, and blunt, especially in adults. In the largest males (cl. 40-50 mm) the chela is enlarged (l < 2 w), there is a large gape between the fingers and a large tooth on the dactyl in the gape. On the merus of the first ambulatory leg there is a row of four or five tubercles dorsally and one proximal and two or three distal tubercles on outer (posterior) face. The carpus is slightly broader (l = 1.3-1.6 w) and the anterodistal tubercle narrower and more acute than in *T. takedai* or *T. alidae*. The dactyl is armed with three to six small teeth.

This species appears to be more widely distributed than either *T. takedai* or *T. alidae*.

Distribution. — Nicobar I., Makassar Strait, S. Philippine Is., Moluccas, China, Timor, Irian Jaya, Papua New Guinea, Solomon Is., Vanuatu and N. Australian coast from Broome (W.A.) across to Moreton Bay, (Queensland).

Tiarinia cornigera (Latreille, 1825)

Pisa cornigera Latreille, 1825: 141.
Pericera cornigera. — Adams & White, 1848: 18.
Tiarinia cornigera. — Buitendijk, 1939: 259; pl. 11 fig. 1, text fig. 25. — Griffin, 1976: 216. — Sakai, 1976: 259-260, pl. 91 fig. 1.

Material examined. — 21 ♂♂, 49 ♀♀, (30 ovig.) 9.5-32 mm, smallest ovig. ♀, 13.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 49a, Lesser Sunda Islands, Sapeh Strait, 08°23.5′S 119°04.6′E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. (ZMA De. 100.736, det Ihle). — Stn. 60, Timor, Samau I., Haingsisi, 23 m, shore exploration, reef, *Lithothamnion* in 3 m and less, 27/28 April 1899; 2 specs. (ZMA De. 100.737, det. Ihle). — Stn. 81, Makassar Strait (Borneo Bank), Pulu Sebangkatan, 34 m, dredge and shore exploration, coral and *Lithothamnion*, 14 June 1899; 2 specs. (ZMA. De.100.728, det. Ihle as *T. gracilis*). — Stn. 93, Sulu Archipelago, Tawi Tawi Is., Pulu Sanguisiapo, 12 m, dredge, townet and reef exploration, *Lithothamnion*, sand and coral, 24/25 June 1899; 4 specs. — Stn. 133, N. Sulawesi, Salibabu I., anchorage off Lirung, up to 36 m, trawl, dredge and reef exploration, mud and hard sand, 25/27 July 1899; 1 spec. (ZMA De.100.729, det. Ihle as *T. gracilis*). — Stn. 193, Moluccas, Sanana Bay, east coast of Sula Besi I., 22 m, reef exploration, mud, 13/14 September 1899; 10 specs. (ZMA De.100.851 (in part), det. Ihle). — Stn. 220, Banda Sea, west coast of Binongka, anchorage off Pasir Pandjang, reef exploration, 1/3 November 1899; 1 spec. (ZMA De.100.739, det. Ihle). — Stn. 225, Banda Sea, south of Lucipara I., 894 m, horizontal cylinder, coral and shells, 8 November 1899; 1 spec. (ZMA De.100.645 (in part), det. Ihle as *T. gracilis*). — Stn. 282, anchorage between Nusa Besi and NE. point of Timor, 08°25.2′S 127°18.4′E, 27-54 m, reef exploration, sand, coral and *Lithothamnion*, 15/17 January 1900; 1 spec. (ZMA De.100.892, det. Ihle as *Schizophrys aspera*). — Stn. 299, south coast of Roti I., Boeka or Cyrus Bay, 10°52.4′S 123°01.1′E, reef exploration, 27/29 January 1900; 1 spec. (ZMA De.100.850, det. Ihle). — Ambon Reef; 2 specs. (ZMA De.100.849, det. Ihle). — Ambon Reef; 1 spec. — Kai Is., Kur I., reef; 1 spec. (ZMA De.100.732 (in part), det. Ihle as *T. gracilis*).

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Philippine Is, Zamboanga, Little St. Cruz I., coral reef, 28 February 1914; 1 spec. — Japan, Misaki, under stones, 28 April 1914; 4 specs. — Japan, Misaki, under stones, 28 June 1914; 1 spec. — Japan, (?) Nagasaki, coll. James Jordan; 2 specs.

Danish Kei Islands Expedition: Kai Is, Toeal, 0-1 m, 20/21 March 1922; 1 spec.

'Galathea' Expedition: Stn. 415, Philippine Is., Dinagat, Tubajon Bay, 10°20′N 125°32′E, coral reef, tidal zone, 18 July 1951; 4 specs.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, Pasir Poetih, near Manokwari, coll. J. C. Bauwens, received 1952; 1 spec.

Netherlands New Guinea Expedition, 1954-55: Stn. N 628, Irian Jaya, Pacific Coast, N. of Jayapura, beach (at base G), coll. L. B. Holthuis, 12 November 1954; 4 specs. — Stn. W 636, Irian Jaya, N. of Jayapura, reef (by Base G), crabs among coral, coll. L. B. Holthuis, 27 November 1954; 5 specs. — Stn. 683, Biak I., W. of Sorido village, reef in front of naval barracks, in coral, January 1955; 3 specs. — Biak I., W. of Sorido village, reef near naval barracks, February 1955; 3 specs. — Stn. 683F, Biak I., W. of Sorido, reef near naval barracks, among *Montipora* spec., 23 March 1955; 1 spec. — Biak I., W. of Sorido, reef near naval barracks, 2 May 1955; 7 specs.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition — Moluccas: Stn. KL I, Moluccas, S. end of Kajoa I., 00°5′S 127°27′E, to 3 m, snorkeling, coarse sand cay with marginal corals, 21 May 1970; 1 spec. — Stn. OG I, Moluccas, S. coast of Gomumu I., S. of Obi I., 01°52′S 127°36′E, snorkeling, 23 May 1970; 1 spec. — Stn. KR I, Kai Is., W. of Tonguin I., W. side of Nuhu Rowa, 05°48′S 132°30′E, 9 June 1970; 1 spec. — Stn. TS IV, Tanimbar, Selaru, N. side of Labuan Olendir, 08°07′S 13°59′E, 26 June 1970, 1 spec.

WESTERN AUSTRALIAN MUSEUM, PERTH

Philippine Islands, Sulu Archipelago, near Siasi I., N. of Laminusa I., sponge and coral, coll. B. R. Wilson, 'Pele', 17 February 1964; 1 spec. (WAM 40-67).

Remarks. — This species is similar to *T. gracilis* and the characters which distinguish it from that species have been listed by Buitendijk (i.e. first pleopod of male wider distally, merus of first ambulatory leg more tubercular, tubercles in midline of carapace larger). In addition, we find that on the basal antennal article of *T. cornigera* there is a ridge running obliquely backwards from the anterolateral spine and separated from the swollen area at the base of the free segments by a pronounced groove whereas in *T. gracilis* there is no such strongly marked ridge and groove on the basal antennal article. The specimens from Japan (ZMC) are larger at maturity than those from the Philippines and Indonesia, and the carapace tubercles especially on the gastric region, are sharper.

This species is distinguished from *T. spinigera* by the absence of the three strong branchial spines present in that species, by having the outer margin of the supraorbital eave concave (it is straight in *T. spinigera*) and by the broader apex of the first male pleopod.

Distribution. — Indo-West Pacific: Japan through Philippines to Australia and to the Andaman Sea.

Tiarinia dana new species
(Figs. 106, 107c, 112e,f)

Material examined. — 3♂♂, 2♀♀ (1 ovig.), 6.5-21.5 mm, ovig. ♀, 19 mm.

Holotype. — Male, cl. 21.5 mm, Moluccas, Biaro Island, 0-0.5 m, 6 July 1929, 'Dana' Stn. 3743; Zoological Museum, University of Copenhagen.

Paratypes. As listed below:

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 172, Ceram Sea, anchorage between Geser and Seram Laut, 18 m, reef exploration, coral and *Lithothamnion* bottom, 26/28 August 1899; 1 spec. (ZMA De. 100.738, det. Ihle as *T. cornigera*).

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Netherlands New Guinea Expedition 1954-55: Stn. 683, Irian Jaya, Biak I., W. of Sorido village, reef in front of naval barracks, January 1955; 2 specs. — Irian Jaya, Biak I., W. of Sorido village, near naval barracks, April 1955; 1 spec.

Description. — Carapace width 3/4 postrostral length, surface tuberculate, covered by a low tomentum with longer hairs on tubercles.

Rostrum of two slender, contiguous, scarcely tapering spines, weakly upcurved distally, length equal to 1/3 — 1/2 postrostral carapace length; surface with rows of curled hairs.

Orbit above consisting of a strongly expanded eave and broad preorbital spine directed forward but not upward. Anterior margin of postorbital lobe convex, tip truncate. Antorbital angle adjacent to anteromedial angle of postorbital lobe in adult male, almost reaching it in female, so as to close orbit above; separation greater in young female and male. Eyestalk smooth, almost covered by orbital eave, cornea terminal, ventral.

Hepatic region rounded with many small tubercles.

Mesogastric region not greatly elevated; most anterior tubercle forms with two pairs of protogastric tubercles an anteriorly convex row of five tubercles, behind that, two medial tubercles and posteriorly a pair of submedial tubercles. Three pairs of small protogastric tubercles laterally, close to orbit and a posterior pair of larger submedial tubercles, other tubercles laterally. A single urogastric tubercle.

Cardiac region with a pair of submedial tubercles and a medial tubercle behind them. Intestinal region with one medial tubercle, and one small lateral tubercle; a weak ridge above posterior margin; posterior margin without tubercles but with a few long hairs.

Branchial region fairly evenly tuberculate, a group of large rounded tubercles anteriorly (in female two posterior tubercles are sharper); one submarginal tubercle, anteriorly, in line with those on pterygostomian margin.

Basal antennal article extremely broad, a shallow, longitudinal groove centrally, surface otherwise smooth; anterolateral angle almost a right angle, not produced as a spine. Edge of postorbital lobe slightly overlapping basal antennal article only in adult male.

Pterygostomian region with tubercles in two irregular parallel rows, one on margin.

Third maxilliped merus with anterolateral angle produced into a rounded lobe.

Male sternum with low ridges but no tubercles.

Cheliped merus with three dorsal tubercles and a terminal tubercle (or spine in female and young male), a few ventral tubercles; carpus with a few scattered tubercles; chela of large male with fingers only slightly gaping, both dactyl and fixed finger with small teeth in gape.

Ambulatory legs slender, smooth, merus cylindrical with groups of curled hairs dorsally in a central row and scattered plumose setae. Dactyl of fourth leg with five to seven small teeth ventrally along its length.

Male abdomen with sixth segment broader (1.5) than long; seventh segment longer (in holotype twice, in small male 1.5 times) than broad. Female abdomen smooth.

First pleopod of male straight, narrowing slightly before widening at apex (shaft with setae in large male).

Gonopore of female a simple, oval, anterior opening.

Remarks. — This species resembles *T. macrospinosa* in the large preorbital spine, the absence of tubercles on the posterior margin of the carapace and the smooth, cylindrical ambulatory legs. It can be distinguished from *T. macrospinosa* by the preorbital spine which is directed forward (not anterolaterally); the anterior edge of the postorbital lobe which is convex (not concave); the presence of only one tuber-

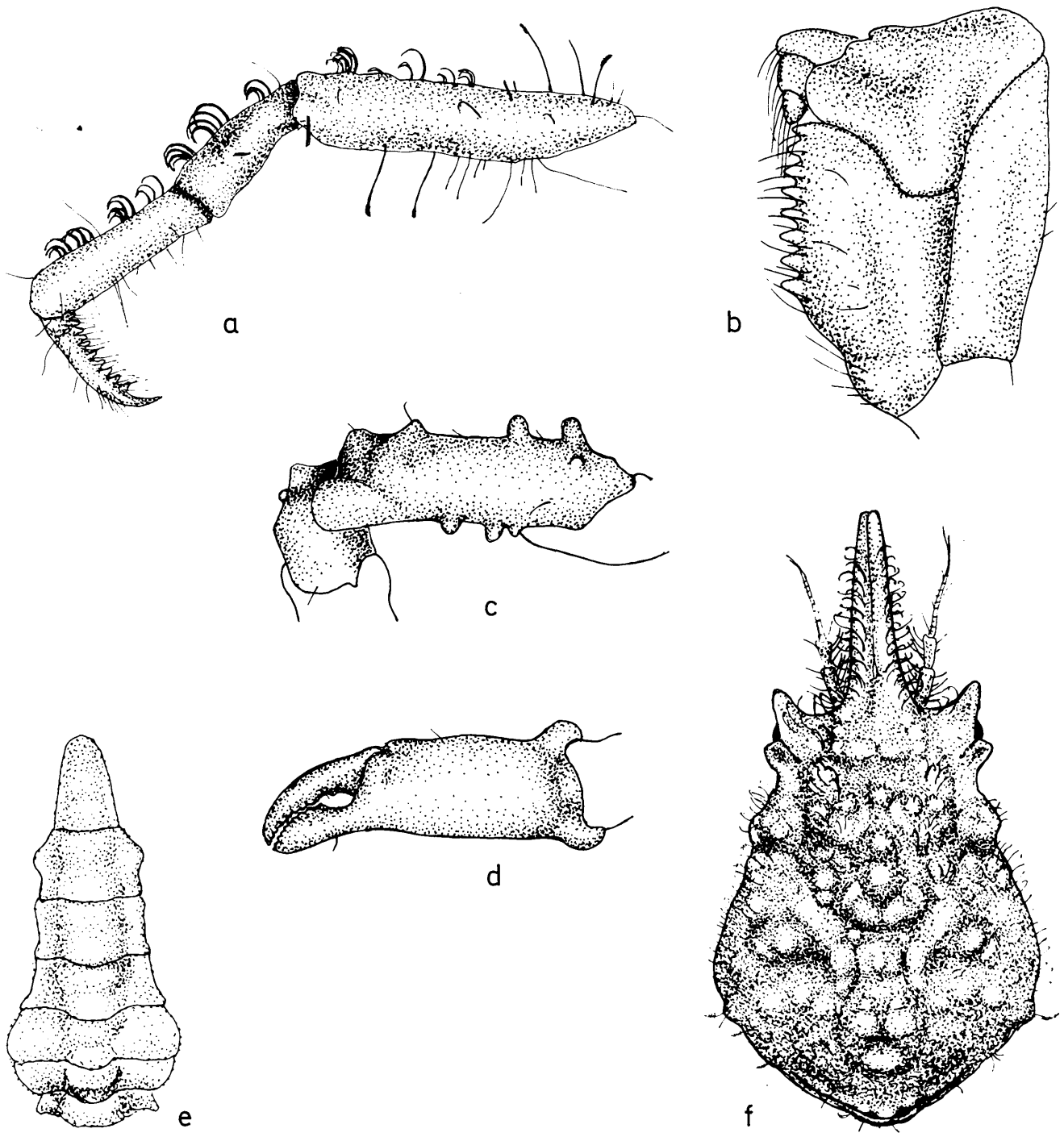


Fig. 106. *Tiarinia dana* (female, ovig., 19 mm, Biak I., RMNH) (a) left first ambulatory leg; (holotype, male) (b) left third maxilliped; (c) left cheliped, merus and carpus; (d) left chela; (e) male abdomen; (f) carapace, dorsal view.

cle (not five) on the branchial region just above the lateral carapace margin; the absence of an anterolateral spine on the basal antennal article; the presence of tubercles on the carpus of the cheliped (not smooth); the sixth segment of the male abdomen being wider than long (not longer than wide).

The new species is named for the Danish research vessel, Dana, which through its visit to the Moluccas in 1929 allowed this species to be collected.

Distribution. — Moluccas, N. Irian Jaya.

Tiarinia garthi new species
(Figs. 107a, 108, 112c,d)

Material examined. — 2♂♂, 3♀♀ (1 ovig.), 10-22 mm, ovig. ♀, 18.5 mm.

Holotype. — Male, cl. 22 mm, Western Australia, Broome, Entrance Point, intertidal, rocky reef shore, coll. A. A. Livingstone, August 1929. The Australian Museum, AM P. 13969.

Paratypes. Data as for holotype, 3 females, cl. 16.5 18.5 (ovig.), 19 mm (AM P.29877); 1 male, cl. 10 mm (AM P.24834).

Description. — Carapace broad, about three quarter to seven eighths postrostral carapace length, covered with a dense

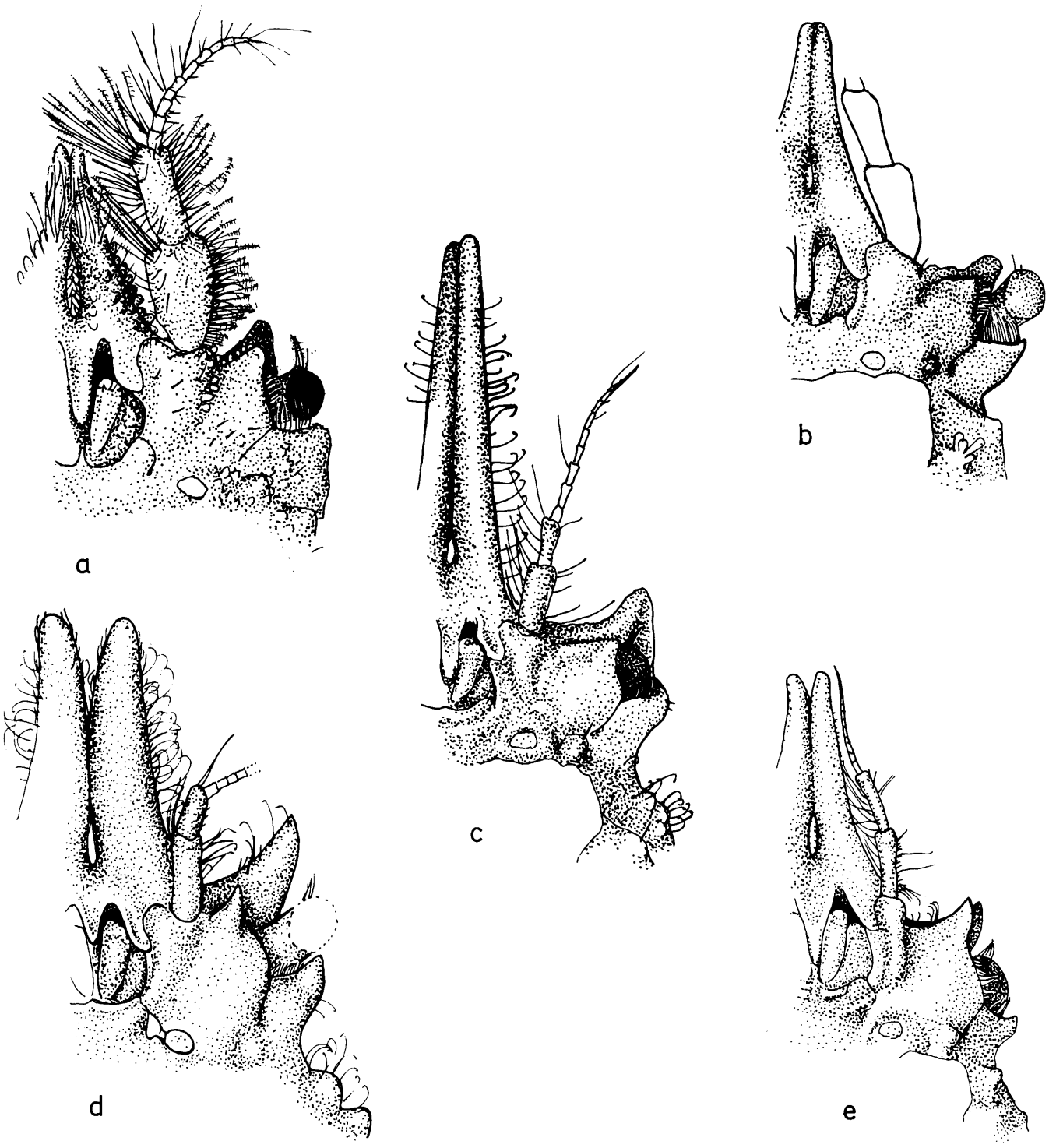


Fig. 107. *Tiarinia garthi* (holotype) (a) left orbit, ventral view; *T. mooloolah* (holotype) (b) left orbit, ventral view; *T. dana* (holotype) (c) left orbit, ventral view; *T. macrospinosa* (male, 23 mm, ZMA De.100.731) (d) left orbit, ventral view; *Leptopisa australis* (holotype) (e) left orbit, ventral view.

tomentum, with a few very distinct large elevated islet-like tubercles. (Holotype and one female paratype are infected with bopyrid parasites.)

Rostrum of two contiguous spines, one fifth (male) or one seventh (female) postrostral carapace length, strongly tapering, dorsal surface with rows of curled hairs.

Orbit above consisting of a moderately expanded eave, a blunt preorbital spine directed forward and weakly upward, and adjacent to eave a broad weakly flattened postorbital lobe.

Hepatic region with two low dorsal islets.

Mesogastric region with low, very broad tubercles, indistinct in smallest specimen; posteriorly two adjacent medial tubercles followed by a pair of submedial tubercles. Pro-

togastric region with two pairs of tubercles (islets) lying just behind most anterior mesogastric tubercle (islet) and forming with it a transverse row of five tubercles. Urogastric region depressed with an indistinct tubercle.

Cardiac region with three large adjacent tubercles (islets), two in front and one behind, giving appearance of one large three lobed tubercle (islet). Intestinal region with a transversely elongate medial tubercle (islet) and a smaller lateral tubercle on each side. Posterior margin with two groups of plumose setae.

Branchial region with an arc of three adjacent elevated tubercles (islets) anteriorly; two separate larger tubercles (islets) on posterior branchial region, lateral one with blunt pointed apex, directed obliquely posteriorly.

Basal antennal article very broad, a short groove between anterolateral angle and base of first free segment, surface otherwise smooth; anterolateral angle produced to a sharp point rather than a spine.

Third maxilliped moderately produced anterolaterally, a small notch on anterolateral angle.

Pterygostomian margin with two small tubercles.

Male sternum smooth, third and fourth segments with elevated ridges on margin of abdominal fossa (as in *T. gracilis*).

Cheliped merus with three or four dorsal tubercles and a short terminal spine; a group of small tubercles (in adult male) along a ventromedial ridge; male chela with a moderate gape between fingers, fixed finger excavate in proximal half, dactyl with a large tooth in gape.

Ambulatory leg meri smooth, heavily fringed with plumose setae along dorsal and ventral edges; other segments fringed with hairs; dactyl of fourth leg with only minute teeth ventrally along its length.

Male abdomen of seven segments, sixth and seventh segments about as long as wide. Female abdomen of seven segments, surface smooth.

First pleopod of male weakly curved outwards with medial edge of tip truncate.

Gonopore of female a simple slit, opening anteriorly.

Remarks. — The presence of prominent islet-like tubercles gives this species a superficial resemblance to a *Rochinia* but it can be distinguished from that genus by the broad supraorbital eave and basal antennal article which close the orbit above and below. This species is similar to *T. gracilis* in the flat basal antennal article and in the shape of the apex of the first pleopod of the male. However, the large tubercles are fewer in number and more elevated than in *T. gracilis*, and the carapace surface between them is quite smooth beneath the tomentum.

The new species is named in honour of John S. Garth, formerly of the Allan Hancock Foundation, University of Southern California, who has made so may notable contributions to our knowledge of majid spider crabs.

Distribution. — Known only from the type locality, Broome, Western Australia.

Tiarinia gracilis Dana, 1852

Tiarinia gracilis Dana, 1852: 111-112; 1855; pl. 3 figs. 6a-d, — Buitendijk, 1939: 259-264, text fig. 26, pl. 11 fig. 2. — Griffin, 1976: 216-217. — Takeda & Nunomura, 1976: 67.

Material examined. — 16 ♂♂, 26 ♀♀ (13 ovig.), 8.5-27 mm, smallest ovig. ♀, 16.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 7, Java, near reef at Batjulmati, 07°55.5'S 114°26'E, 15 m and more, dredge and shore exploration, coral and stones, 11 March 1899; 1 spec. — Stn. 34, Lombok, anchorage off Labuan Pandan, 18 m, shore exploration, coral reef, 27 March 1899; 1 spec. — Stn. 49a, Lesser Sunda Is., Sapeh Strait, 08°23.5'S 119°04.6'E, 69 m, dredge, coral and shells, 14 April 1899; 1 spec. (ZMA De.100.727, det. Ihle). — Savu Sea, Sawu, Seba, reef, 24/25 April 1899; 1 spec. (ZMA De.100.734, det. Ihle). — Stn. 162, W. coast of Salawatti, between Loslos and Broken Is, South Island Reef, 18 m, dredge, coarse and fine sand with clay and shells, 18 August 1899; 1 spec. — Stn. 169, W. coast of New Guinea, anchorage off Atjatuning, 57 m, reef exploration, mud, 23/25 August 1899; 2 specs. (ZMA De.100.852, det. Ihle). — Stn. 193, Moluccas, E. coast of Sula Besi I., Sanana Bay, 22 m, reef exploration, mud, 13/14 September 1899; 3 specs. (ZMA De.100.851 (in part), det. Ihle as *T. cornigera*; ZMA De.100.853 (in part), det. Ihle). — Stn. 220, Banda Sea, W. coast of Binongka, anchorage off Pasir Pandjang, reef exploration, 1/3 November 1899; 1 spec. (ZMA De.100.730, det. Ihle). — Stn. 225, Banda Sea, S. of Lucipara I., 894 m, horizontal cylinder, coral and shells, 8 November 1899; 14 specs. (ZMA De.100.645 (in part), det. Ihle). — Stn. 285, anchorage, S. coast of Timor, 08°39.1'S 127°4.4'E, 34 m, dredge, on the limit between mud and coral, *Lithothamnion*, 18 January 1900; 1 spec. — Ambon reef; 1 spec. (ZMA De.100.733, det. Ihle). — Ambon reef; 1 spec. — Kai Is., Kur I., reef; 2 specs. (ZMA De. 100.732 (in part), det. Ihle). — Lombok, Pidjot Bay, 9-22m; 4 specs.

ZOOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Mortensen Pacific Expedition: Philippine Is., Zamboanga 25 February 1914; 3 specs.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Irian Jaya, near Manokwari, Pasir Poetih, coll. J. C. Bauwens, received 1952; 1 spec.

Netherlands New Guinea Expedition: Stn. 709, Irian Jaya, Japen I., W. of Serui, seashore near Sarawandori, under rocks on the seashore, 24 February 1955; 2 specs. — Stn. 722, Irian Jaya, shore of Manokwari Bay, near town, under coral on shore and in living coral in the sea, 14 March 1955; 2 specs.

Remarks. — These specimens agree well with those described and figured as *T. gracilis* by Buitendijk. This species is distinguished from *T. cornigera* by the characters listed by Buitendijk and also by the absence of an oblique ridge on the basal antennal article (present in *T. cornigera* — see remarks under that species). In *T. gracilis* the third and fourth sternal segments of the male have a strong ridge on the margin of the abdominal fossa, while the corresponding segments are not ridged in *T. cornigera*.

This species is obviously very close to *T. depressa* Stimpson as described and figured by Sakai (1938; 1976) and regarded as endemic to Japan. *T. gracilis* has not been recorded north

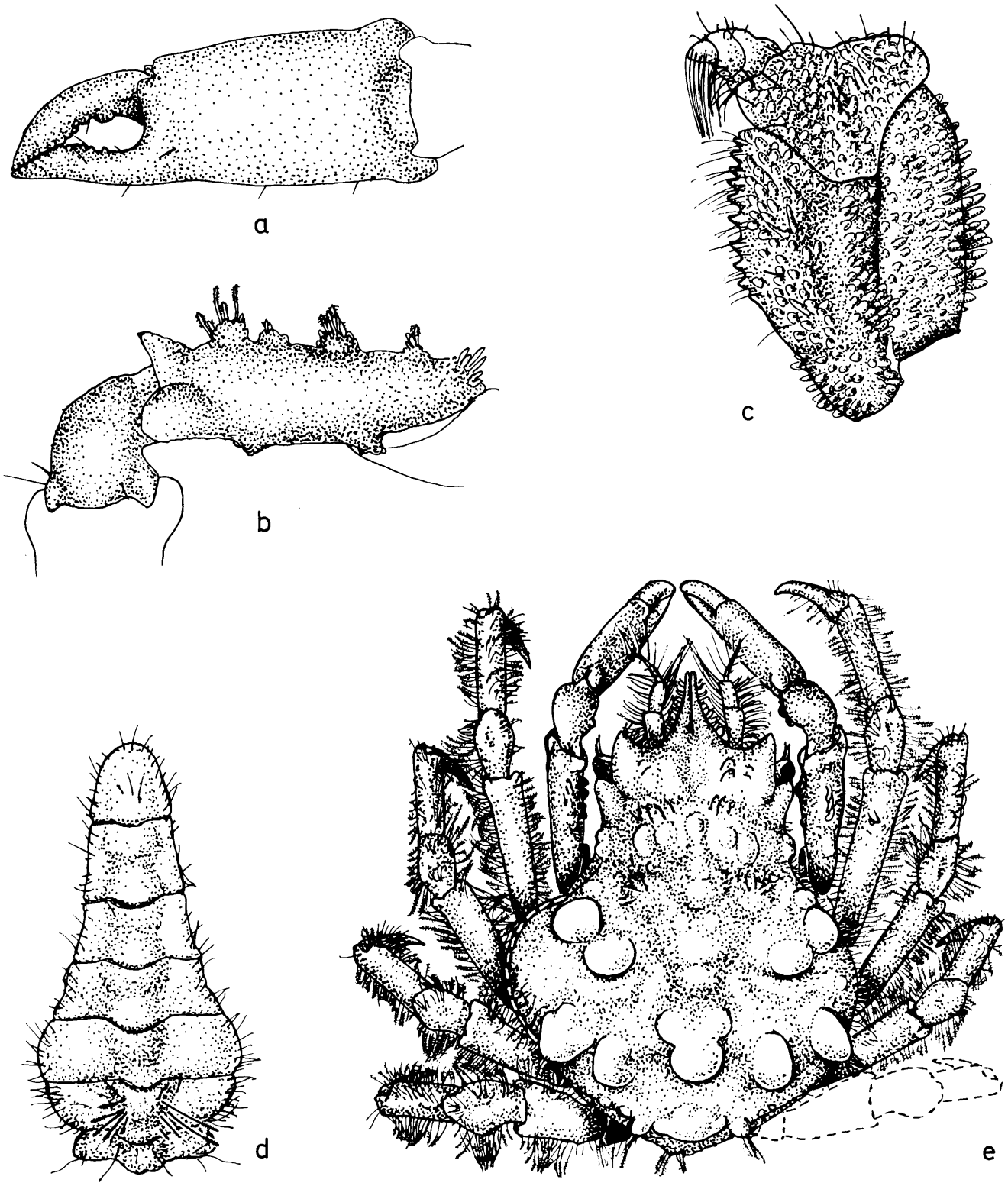


Fig. 108. *Tiarinia garthi* (holotype) (a) left chela; (b) left cheliped, merus and carpus; (c) left third maxilliped; (d) male abdomen; (e) whole animal, dorsal view (note expansion, indicated by dotted line, of left branchial region due to bopyrid parasite).

of the central Philippine Islands. In both species the branchial and intestinal tubercles are similarly flattened, the first pleopod of the male is similar in shape and the merus of the ambulatory legs is flattened, weakly tuberculate and fringed with haris. It is not possible without examining specimens from both regions to say what characters distinguish *T. gracilis* from *T. depressa* or if they are in fact conspecific. Takeda & Nunomura (1976) suggest that it is quite probable that the two species are synonymous.

Distribution. — West Pacific: central Philippine Islands to New Caledonia, north Australia and Singapore.

Tiarinia macrospinosa Buitendijk, 1939
(Fig. 107d)

Tiarinia macrospinosa Buitendijk, 1939: 264-265, pl. 10 fig. 5.

Material examined. — 1♂, 23 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 296, south coast of Timor, anchorage off Noimini, 10°14′S 124°5.5′E, 8-36 m, reef exploration, sandy mud, 24/26 January 1900; 1 spec. (ZMA De.100.731, det. Ihle as *T. gracilis*).

Remarks. — This immature male is about half the size of the holotype (ovig. ♀, cl. 42 mm) described by Buitendijk, but agrees well with it. As in Buitendijk's type specimen there is a slender preorbital spine directed anterolaterally, the anterior margin of the postorbital lobe is concave, there is a spine on the anterolateral angle of the basal antennal article, there are five tubercles on the branchial submargin just above the lateral carapace margin, there is a central intestinal tubercle and two submedial tubercles just anterior to it, the posterior margin is smooth and above it there is a smooth, narrow ridge on each side and there is a well developed tomentum.

In our specimen the rostral spines are 1/3 postrostral carapace length, slightly longer than in the type. There are four dorsal tubercles (one terminal) on the cheliped merus and the carpus is smooth. The dactyl of the fourth ambulatory leg possesses about eight close-set spines along the ventral surface. The abdomen is detached in our specimen, both the sixth and seventh segments are longer than wide (1 1/4 times and 1 1/2 times respectively). The first pleopod of the male is straight with a simple tip but this is an immature animal and the pleopod of the adult may be somewhat different.

This species resembles *T. dana* and the characters which distinguish it are dealt with under that species.

This is the first male and the second record for this species.

Distribution. — Known only from Timor.

Tiarinia mooloolah new species
(Figs. 107b, 109, 112a,b)

Material examined. — 16♂♂, 20♀♀ (6 ovig.), 4.5-17 mm, smallest ovig. ♀, 8 mm.

Holotype. — Male, cl. 11.5 mm, Queensland, Point Cartwright, 26°41′S 153°08′E, coll. A. A. Livingstone, 2 August 1922; Australian Museum, AM P. 6377. (Holotype with both chelipeds and left second and third ambulatory legs; three other ambulatory legs loose with the specimen.)

Paratypes. As listed below:

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 301, Timor Sea, E. coast of Roti I., Pepela Bay, 10°38′S 123°25.2′E, 22 m, dredge and reef exploration, mud, coral and *Lithothamnion*, 30 January 1900; 1 spec.

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Netherlands New Guinea Expedition 1954-55: Stn. N628, Irian Jaya, Pacific Ocean coast, N. of Jayapura, beach (at Base G), slow spider crabs from reef corals carried to shore to be broken up, coll. L. B. Holthuis, 12 November 1954; 1 spec. — Stn. W636, Irian Jaya, N. of Jayapura, reef (by base G), crabs among corals, coll. L. B. Holthuis, 27 November 1954: 3 specs.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Heron I., reef, from dead coral growths, coll. W. K. Patton, December 1957; 1 spec. (AM P.13191). — Heron I., reef; 1 spec. (AM P.13193). — Heron I., under nigger head coral, 12 August 1960; 2 specs. (AM P.29873). — Masthead I.; 1 spec. (AM P.2573). — North West Islet, reef; 1 spec. (AM P.8673, det. Rathbun as *T. gracilis*). — North West Islet; 1 spec. (AM P.10365). — North West Islet, February 1929, M. Ward Collection; 3 specs. (dry) (AM P.29871). — North West Islet, July 1929, M. Ward Collection; 1 spec. (dry) (AM P.29869). — Gladstone (Port Curtis), Seal Rocks; 1 spec. (AM P.12192). — Tannum Sands, coll. J. S. Garth, 29 May 1973; 1 spec.

New South Wales: Woody Head, mouth of Clarence River, intertidal, coll. A. A. Cameron, 28 August 1965; 1 spec. (AM P.29875). — Woody Head, near mouth of Clarence River, coll. A. A. Cameron, 20 September 1966; 1 spec. (AM P.29876). — S. of Tweed Heads, Hastings Point, 1.5-3 m, on sublittoral algae, low tide, coll. J. Laxton, 12 June 1971; 1 spec. (AM P.29874). — Nambucca Heads, M. Ward Collection; 13 specs. (dry) (AM P.29870). — Nambucca Heads, 14-24 September 1937; 1 spec. (AM P.29872, dry).

Description. — Carapace width three quarters postrostral carapace length, surface almost smooth with only a few low tubercles, gastric region elevated.

Rostrum of two contiguous, strongly tapering spines, equal to one quarter to one third postrostral carapace length, dorsal surface with rows of curled hairs.

Orbit above consisiting of an expanded eave with a straight lateral edge and a short, blunt preorbital spine directed forward and weakly upward. Anterior margin of postorbital lobe straight, oblique or at right angles to edge of eave.

Hepatic margin rounded, without spines or tubercles; one or two ventral tubercles on region. Branchial margin with an epibranchial tubercle or small spine.

Gastric regions distinctly elevated with low rounded tubercles. Mesogastric region with an anterior tubercle and two medial tubercles behind, and in some specimens, a posterior pair of submedial tubercles. Two pairs of protogastric tubercles lying just behind most anterior mesogastric tubercle and with it forming a transverse row of five tubercles. Urogastric region depressed, smooth or with a low posterior tubercle.

Cardiac region elevated with three broad adjacent tubercles, a submedial pair anteriorly and one behind. Intestinal region with a medial tubercle and a small lateral tubercle; a very weak ridge or none at all above posterior margin (ridge stronger in three females from N. Irian Jaya and Timor Sea); no tubercles or up to three small tubercles on posterior margin.

Branchial region only weakly tuberculate, low tubercles anterior and medial to epibranchial tubercle; a tubercle or ridge near cardiac region; a tubercle anteriorly on dorsal margin but none on anteromedial border of branchial region which is depressed, smooth or bears two low ridges.

Basal antennal article very broad, a shallow, central, longitudinal groove anteriorly, surface otherwise smooth, anterolateral angle almost a right angle, weakly produced to a sharp point or small spine in some specimens. (In some specimens edge of postorbital lobe overlaps basal antennal article.)

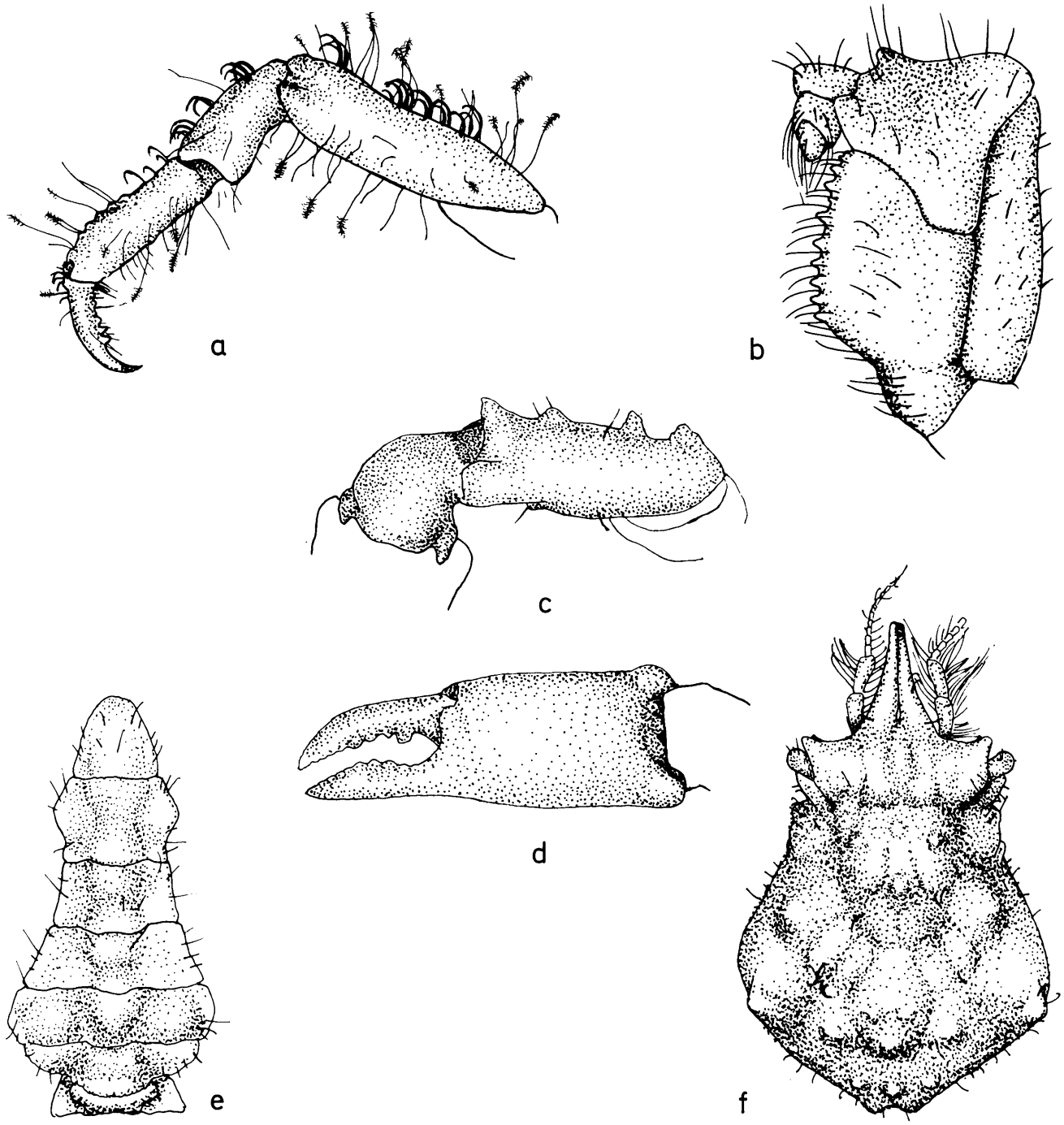


Fig. 109. *Tiarinia mooloolah* (female, 10.5 mm, AM P.12192) (a) left first ambulatory leg; (holotype, male) (b) left third maxilliped; (c) left cheliped, merus and carpus; (d) left chela; (e) male abdomen; (f) carapace, dorsal view.

Pterygostomian region smooth with two small tubercles on margin.

Third maxilliped merus only weakly produced at anterolateral angle. Male sternum smooth.

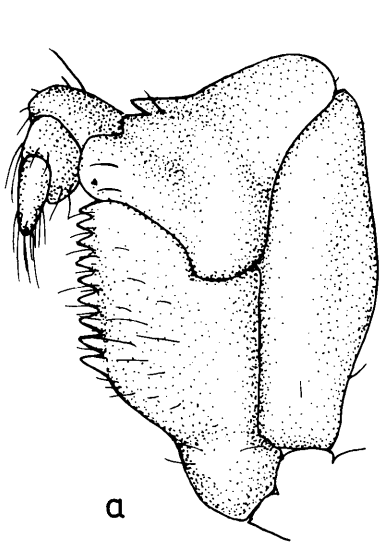
Cheliped merus with two dorsal tubercles, a low distal ridge and a short terminal spine. In adult male, merus with tubercles on medial face; palm of chela one a half times as long as high and one and a half times length of fingers; fingers coarsely toothed proximally, weakly gaping, dactyl with a large tooth in gape.

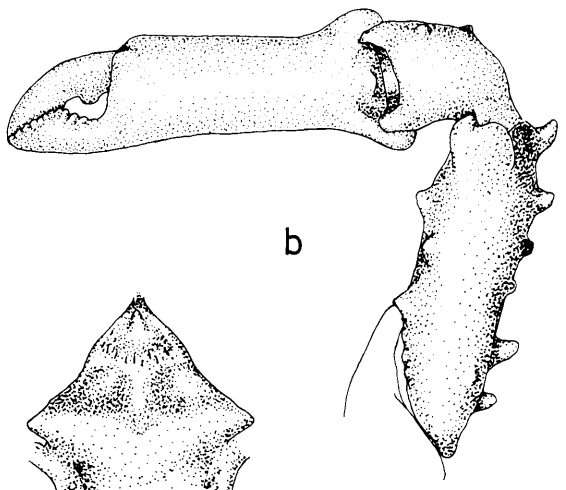
Ambulatory leg meri cylindrical, smooth, dorsal surface with a row of groups of curled hairs and scattered plumose setae. Dactyl of fourth leg armed ventrally with six small teeth along its length.

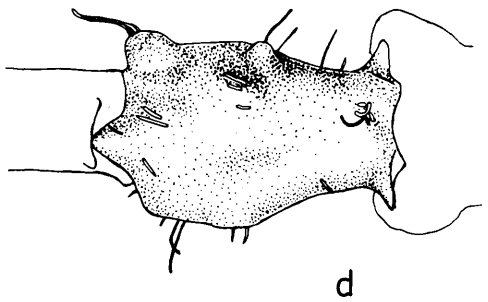
Male abdomen with sixth segment broader (1.5) than long and seventh segment about as long as broad. Female abdomen of seven segments, smooth.

First pleopod of male straight, narrowing slightly just before truncate apex, opening terminal.

Gonopore of female a simple, round, ventral opening.









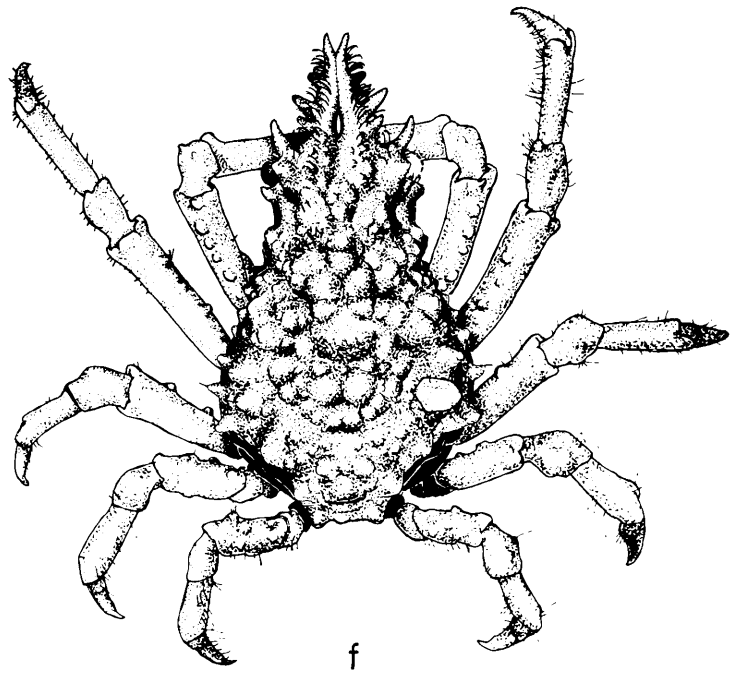


Fig. 110. *Tiarinia takedai* (holotype) (a) left third maxilliped; (b) left cheliped; (c) male sternum; (d) carpus of left first ambulatory leg, dorsal view; (e) left orbit, ventral view; (f) whole animal, dorsal view (barnacle on right hand side).

Remarks. — This species is distinguished from *T. gracilis* and *T. cornigera* by the straight (not concave) edge of the supraorbital eave; the much less tuberculate carapace and the shape of the first pleopod of the male.

T. mooloolah resembles *T. spinigera* in the shape of the upper orbit (upcurved preorbital spine, straight lateral edge of the eave, slender postorbital spine) but is distinguished from it by its less tuberculate carapace and absence of spines. In the

specimens of *T. mooloolah* from N. Irian Jaya in which the ridge above the carapace margin is distinct, it is smooth (not made up of sharp tubercles), there are three posterior branchial tubercles (not spines) and the carapace between them is smooth (not tuberculate).

T. mooloolah is similar to the larger species *T. macrospinosa* and *T. dana* in the absence of strong tubercles on the posterior margin of the carapace, but it is distinguished from them by the shorter rostral spines which are broader at the base and more strongly tapering; the more slender preorbital spine; and the much less tuberculate branchial region, especially the absence of large tubercles on the anteromedial border of the branchial region.

The new species is named for the town of Mooloolah near Point Cartwright, the type locality of this new *Tiarinia*.

Distribution. — Irian Jaya, Timor Sea, east coast of Australia from Capricorn Group (Great Barrier Reef) to Nambucca Heads, New South Wales.

Tiarinia spinigera Stimpson, 1907
(Fig. 105g)

Tiarinia spinigera Stimpson, 1907: 13-14, pl. 3 fig. 3. — Sakai, 1976: 260-261, text fig. 139, pl. 91 fig. 3.

Material examined. — 1 ovig. ♀, 19.5 mm.

ZOOLOGICAL MUSEUM, AMSTERDAM

'Siboga' Expedition: Stn. 193, Moluccas, Sanana Bay, E. coast of Sula Besi I., 22 m, reef exploration, mud, 13/14 September 1899; 1 spec. (ZMA De.100.853, det. Ihle as *T. gracilis*).

Remarks. — This specimen agrees well with that described and figured by Stimpson as *T. spinigera*. There are three sharp erect spines on the branchial region and the preorbital spine is long, sharp and upcurved. The ridge on the upper intestinal region is made up of five lateral tubercles and one larger central tubercle; there are four tubercles on the posterior margin.

In this specimen the rostrum is greater than 1/4 postrostral carapace length; the postorbital lobe is more slender and produced further laterally than in *T. cornigera*; the basal antennal article is nearly flat, and the anterolateral angle is produced into only a small spine. The gonopore is a simple round ventral opening while in *T. cornigera* it is an anteromedial slit.

This species has not previously been recorded outside Japan.

Previous descriptions and illustrations of *T. spinigera* generally agree with each other. However, the figure provided by Sakai (1938: fig. 48), differs from others in the preorbital lobe being shorter, the epibranchial spine shorter and the other branchial spines much shorter. In this respect also two figures of Sakai's of *T. tiarata* differ from the figure and description given by Balss (1929: 20-21, fig. 9). Sakai (1938: pl. 38 fig. 7; 1976: fig. 141) shows the preorbital lobe and the epibranchial spine as less prominent than does Balss. Since *T. spinigera* is quite similar to *T. tiarata* but differs from *T. tiarata* most obviously in possessing two prominent spines medial to the epibranchial spine and a shorter rostrum, it is clear that reliance on Sakai's figures could lead to a confusion of the two species.

Distribution. — Japan, Moluccas.

Tiarinia takedai new species
(Figs. 105c, 110, 111b,f)

Tiarinia angusta. — Takeda, 1973a: fig. 4H. (Not *Tiarinia angusta* Dana, 1852.)

Material examined. — 23 ♂♂, 13 ♀♀ (11 ovig.), 15.5-39 mm, smallest ovig. ♀, 22 mm.
Holotype. — Male, cl. 37.5 mm, North Queensland, Albany Passage, collected M. Ward, August-September 1928; Australian Museum, AM P.15235.
Paratypes. As listed below:

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE, LEIDEN

Netherlands New Guinea Expedition: Stn. 646, Irian Jaya, Biak I., W. of Sorido, reef near naval barracks, 6 December 1954; 1 spec. — Stn. 683, Biak, I., W. of Sorido, reef in front of naval barracks, in coral, January 1955; 2 specs. — Biak I., W. of Sorido, reef near naval barracks, February 1955; 10 specs. — Biak I., W. of Sorido, reef near naval barracks, March 1955; 1 spec. — Stn. 683A, Biak I., W. of Sorido, reef in front of naval barracks, among *Pocillopora*, 22/23 March 1955; 1 spec.

NATIONAL INSTITUTE OF OCEANOLOGY, JAKARTA

Mariel King Memorial Expedition-Moluccas: Stn. KL II, Moluccas, S. end of Labuin I., SW. of Kajoea I., 00°05'S 127°26'E, 0-4.5 m, marginal coral reef, 22 May 1970; 1 spec.

THE AUSTRALIAN MUSEUM, SYDNEY

Queensland: Torres Strait, Albany Passage, coll. M. Ward, August-September 1928; 1 spec. (AM P.29879). — Torres Strait, Murray I.; 1 spec. (AM P.29878). — Ellison Reef, outer Barrier, 14.5 m, 1924; 3 specs. (AM P.8021). — Lindeman I., reefs, diving, 1934-35; 13 specs. (AM P.29880, dry). — Swain Reef, NW. end of Gillett Cay, intertidal, October 1962; 1 spec. (AM P.14020).

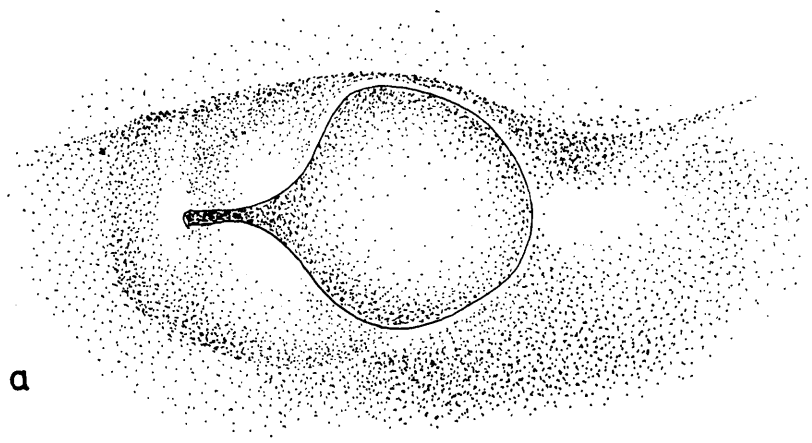
Description. — Carapace width two thirds postrostral carapace length, surface tuberculate.

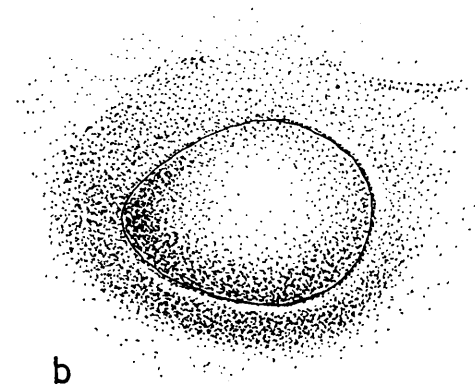
Rostrum of two contiguous spines of moderate length, from 0.3 to 0.45 postrostral carapace length, separated at the apex, each with three lateral accessory spines. Rostral ridges tuberculate.

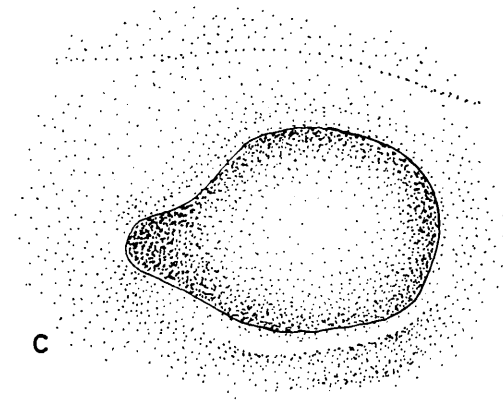
Orbit above consisting of a strongly expanded eave; preorbital spine directed obliquely forward; supraorbital eave with a tubercle midway along; antorbital angle adjacent to postorbital lobe distally, but basally separated by a small slit; postorbital lobe with a tubercle on anteroexternal angle.

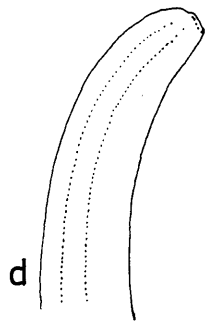
Hepatic and subhepatic regions tuberculate.

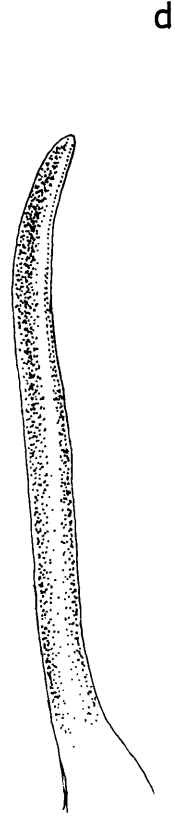
Mesogastric region with an anterior group of tubercles in the midline followed by two large medial tubercles or groups of tubercles and posteriorly by a submedial pair of tubercles or groups of tubercles. Protogastric region with an anterior and posterior group of tubercles. Urogastric region with a pair of small, anterior submedial tubercles and a large medial tubercle or group of tubercles.

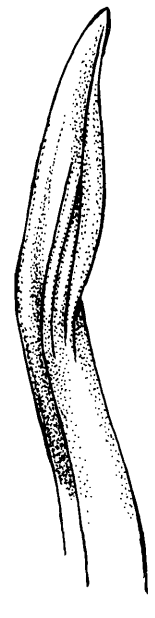


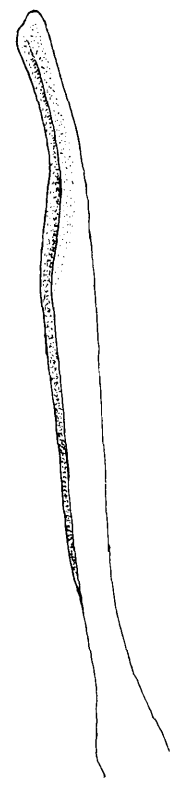












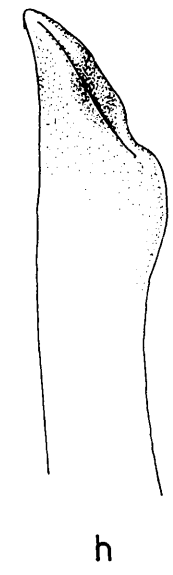


Fig. 111. Female of *Tiarinia alidae* (holotype) (a) left gonopore; *T. takedai* (ovig., 32 mm, AM P.29879) (b) left gonopore; *T. angusta* (adult, 34.5 mm, ZMA De.100.660) (c) left gonopore. Left first pleopod of male of *T. alidae* (27 mm, ZMA De.100.848) (d) sternal tip of pleopod, (e) abdominal view of pleopod; *T. takedai* (holotype) (f) abdominal tip of pleopod; *T. angusta* (neotype) (g) abdominal view of pleopod, (h) sternal tip of same.

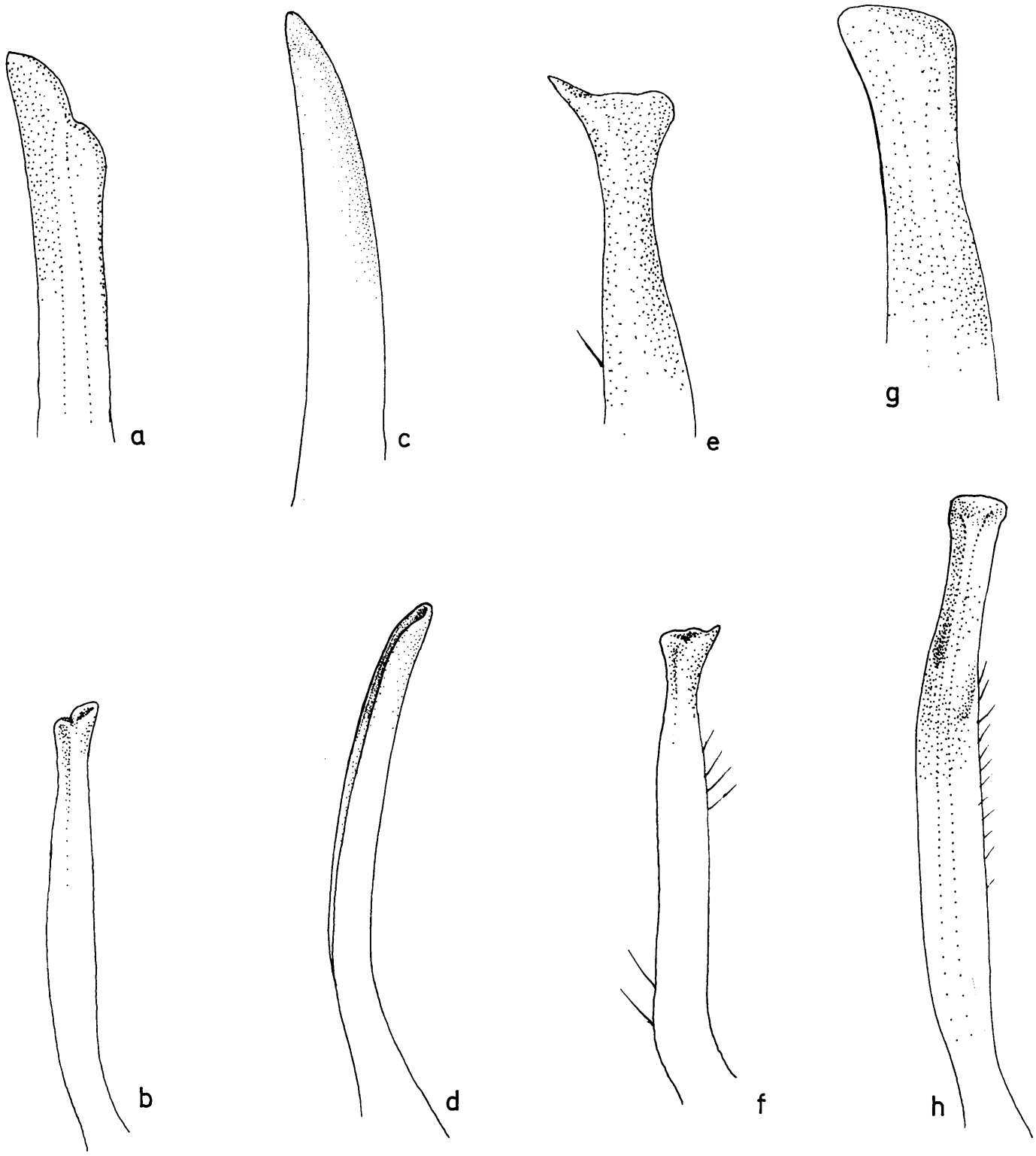


Fig. 112. Left first pleopod of male of *Tiarinia mooloolah* (holotype) (a) sternal tip of pleopod, (b) abdominal view of pleopod; *T. garthi* (holotype) (c) sternal tip of pleopod, (d) abdominal view of pleopod; *T. dana* (holotype) (e) sternal tip of pleopod, (f) abdominal view of pleopod; *Leptopisa australis* (holotype) (g) sternal tip of pleopod, (h) abdominal view of pleopod.

Cardiac region with three large tubercles in a triangle, base forwards, and several small tubercles. Intestinal region tuberculate with three large tubercles in a triangle anteriorly, a large lateral tubercle just behind this group and two to four large tubercles on posterior margin.

Branchial region tuberculate with four to five larger sharp tubercles just above lateral margin, a row below of smaller tubercles.

Basal antennal article broad, a shallow longitudinal groove centrally, anterolateral angle produced to a spine, lateral edge sinuous with a low tubercle midway along.

Merus of third maxilliped with anterolateral angle strongly produced and rounded.

Pterygostomian region smooth except for two small tubercles, margin with two large blunt tubercles.

Sternum smooth, lateral lobes triangular with a blunt apex.

Merus of cheliped of adult male with four short spines and a tubercle dorsally (often only three tubercles in females), and a small, sharp terminal spine; ventral surface with five scattered tubercles. Carpus with two small tubercles dorsally and one on inner (anterior) edge. Chela slender, not inflated even in largest male (cl. 37.5 mm, holotype), length of palm two and a half times height; a small gape between fingers, dactyl with a tooth in gape.

Merus of first ambulatory leg with a row of four short spines (or tubercles) dorsally and a low proximal and a low distal tubercle on outer (posterior) face, no terminal spine; carpus dorsally flat with a blunt tubercle at anterodistal angle. Dactyl armed with five to six small teeth along ventral edge.

Male abdomen with segments four to six broad, length only half width; segment four hardly narrowing distally; seventh segment longer (1.3) than wide.

First pleopod of male (figured by Takeda, 1973a) curving toward midline at distal third, straight in distal quarter, slightly oblique, with narrow lateral and medial lobes, tapering to a point; opening abdominal, about halfway along lobed section.

Gonopore of female a simple ventral opening, rounded laterally and pointed medially and with a marginal ridge of uniform height.

Remarks. — The basis of the decision to separate this series as a new species and the status of *T. angusta* are discussed under that species. This species is very similar to *T. angusta* and *T. alidae* and is distinguished from them by the apically narrower first pleopod of the male; the wider abdomen of the male (segments 5 and 6 twice as wide as long); and the presence around the female gonopore of an unlobed uniform ridge. The lateral lobes of the sternum are narrower at their apex than they are in either *T. angusta* or *T. alidae*. The terminal spine on the merus of the cheliped is sharper than in *T. angusta* but not as pronounced nor as forwardly curved as in *T. alidae*. The carpus of the first ambulatory leg is slightly more slender (l = 1.5-1.7 w) than in *T. angusta* (l = 1.3-1.6 w) and the anterodistal tubercle is slightly broader and blunter than in that species.

The number of lateral accessory spines on the rostral spine is not a reliable character to distinguish these three species, but in this species we have found none with only two spines as found in some specimens of *T. alidae* or with four spines as in some specimens of *T. angusta*.

In this series the specimens from Albany Passage, Lindeman Island and Biak include both male and female of this species.

The new species is named for Masatsune Takeda, now of the National Science Museum, Tokyo, in recognition of his contribution to our knowledge of spider crabs including the genus *Tiarinia*.

Distribution. — North Queensland, Torres Strait, Irian Jaya, Moluccas, Palau.

DISCUSSION

In this study 46 new species of majids have been described and the known range of many species has been extended. There are now 73 species in 28 genera recorded from the Kai and Aru Islands where collections were made by three of the major expeditions from which we received material.

The status of some subspecies has been changed and some known species placed in new genera. The more appropriate alignment of genera in subfamilies has resulted in a rearrangement in which the Tychinae now contains only nine species in three genera while the Majinae, in particular, has been expanded and now includes 87 species in 22 genera.

The following is a summary of the distribution of the genera and species in the Indo-West Pacific. We have omitted *Cyclonyx frontalis* and *Doclea rissonii* (location unknown); *Lambrachaeus ramifer* and *Planotergum mirabile* (not majids) and *Pyromaia tuberculata* which is a recent introduction from the East Pacific. Allowance should be made for the uncertain number of valid species in some genera eg. *Paratymolus* and for a number of older, unconfirmed records of species reported only once. We have taken the Indian Ocean to include Australian waters as far east as Torres Straits in the north and Kangaroo Island in the south.

The majority of genera (61% or 50) are represented in both the Indian Ocean and the west Pacific, nearly a third (30% or 25) are restricted to the West Pacific and only 9% (7) are restricted to the Indian Ocean. At the species level just over half of the species (46% or 176) are known only from the West Pacific, about a third (32% or 125) occur in both the Indian Ocean and the West Pacific while about a fifth (22% or 83) are restricted to the Indian Ocean. A similar pattern of species distribution is found at the subfamily level in the Inachinae and Mithracinae. However, in the Majinae 60% of the species are restricted to the West Pacific and only 10% to the Indian Ocean while in the Epialtinae there are equal numbers of species (about 40%) with a distribution restricted to either the West Pacific or the Indian Ocean. The Pisinae has the largest percentage of species (40%) occurring in both the Indian Ocean and West Pacific and a similar number of species (43%) known only from the West Pacific.

Distribution of majid genera in the Indo-West Pacific by subfamily

Subfamily	genera in subfamily	Indian O. only	Indo-West Pacific	W. Pacific only
Inachinae	22	5 (23%)	12 (57%)	5 (23%)
Tychinae	3	—	2 (66%)	1 (33%)
Epialtinae	10	—	8 (80%)	2 (20%)
Pisinae	19	—	12 (63%)	7 (27%)

Majinae	22	—	14 (63%)	8 (27%)
Mithracinae	6	2 (33%)	2 (33%)	2 (33%)
	82	7 (9%)	50 (61%)	25 (30%)

Distribution of majid species in the Indo-West Pacific by subfamily

Subfamily	species in subfamily	Indian O. only	Indo-West Pacific	W. Pacific only
Inachinae	86	19 (22%)	29 (34%)	38 (44%)
Tychinae	9	6 (66%)	2 (22%)	1 (11%)
Epialtinae	56	22 (39%)	12 (21%)	22 (39%)
Pisinae	117	20 (17%)	47 (40%)	50 (43%)
Majinae	86	9 (10%)	25 (29%)	52 (60%)
Mithracinae	30	7 (23%)	10 (33%)	13 (43%)
	385	83 (22%)	125 (32%)	176 (46%)

There are 13 species in eight genera which occur in both the Indian Ocean and the West Pacific and which appear to be restricted to Australian waters. There are now 124 species (in 57 genera) recorded from Australia (32% of the total Indo-West Pacific species) and 36 of the species (in 24 genera) are endemic. Eleven species are restricted to New Zealand and 37 species are restricted to Japan. There are 10 species in seven genera restricted to the Red Sea.

The relatively large number of new species described and the many extensions of range shown by this study suggest that the record of majid species and their distribution in the Indo-West Pacific is still incomplete.

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Plate 1. *Cyrtomaia goodridgei* (female, ovig., 38 mm, E. of Zamboanga, ZMC) (a) dorsal view, (b) ventral view.

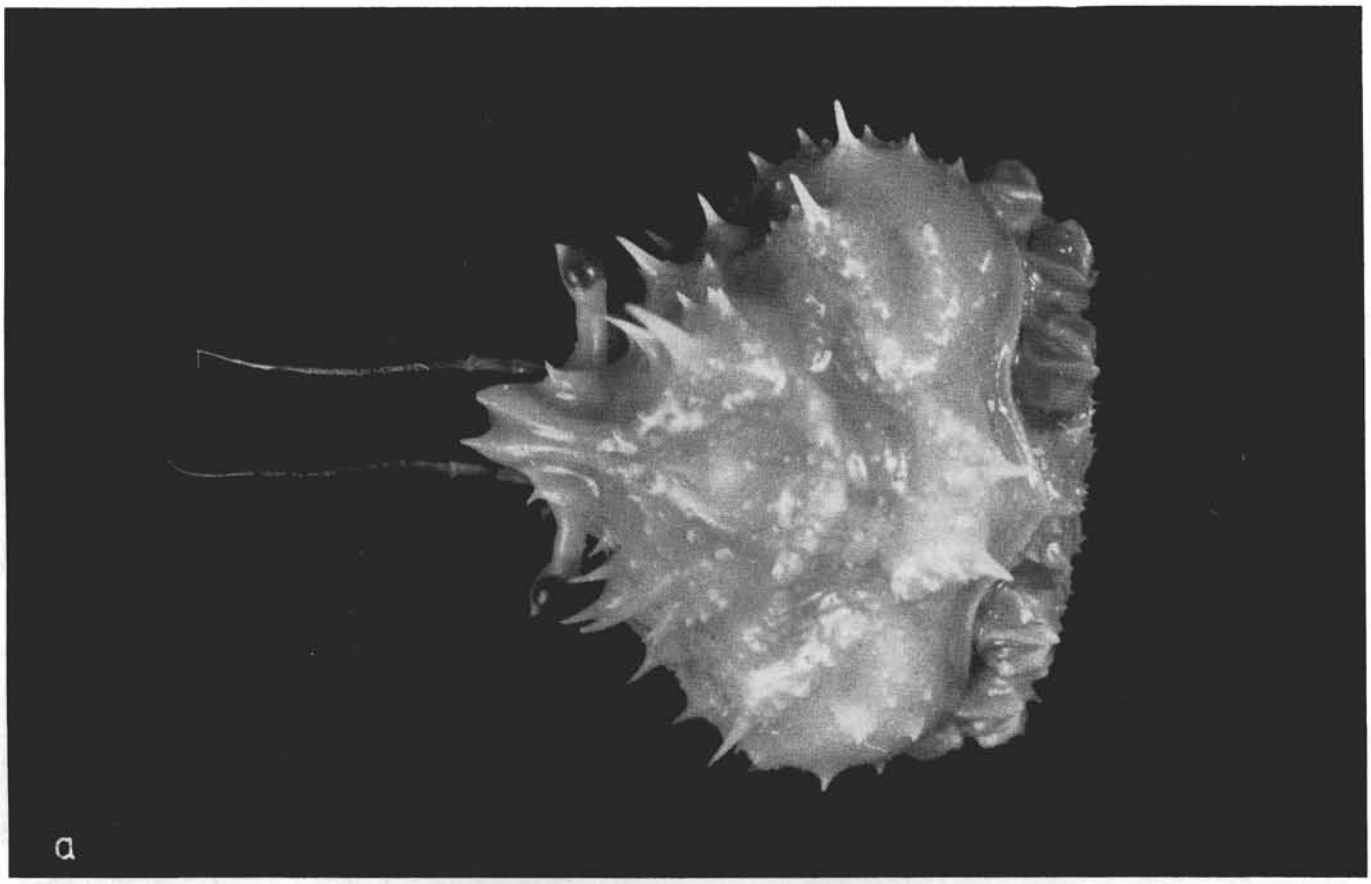




Plate 2. *Cyrtomaia murrayi* (male, 13 mm, Western Australia, WAM 13-67) (a) dorsal view, (b) ventral view.

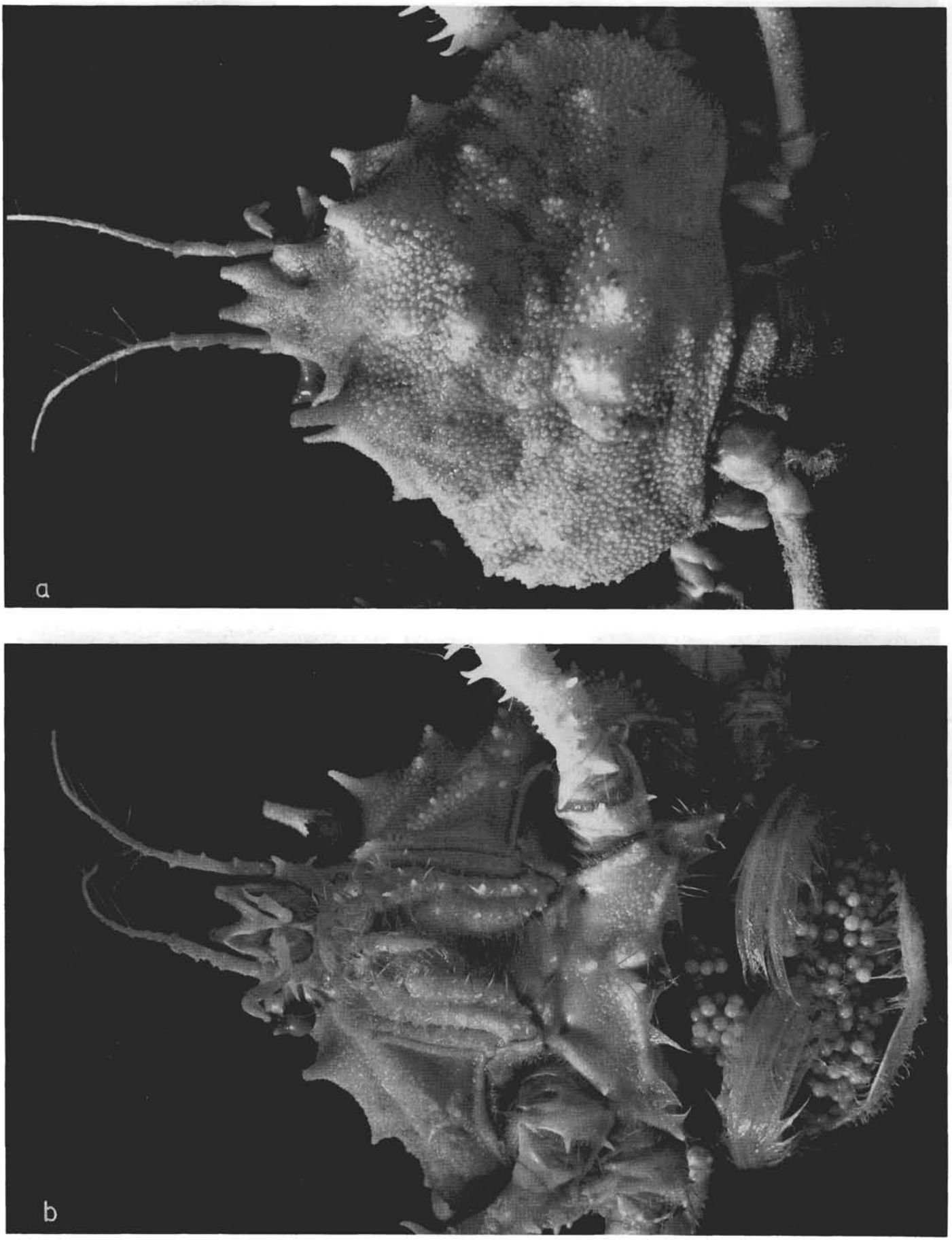
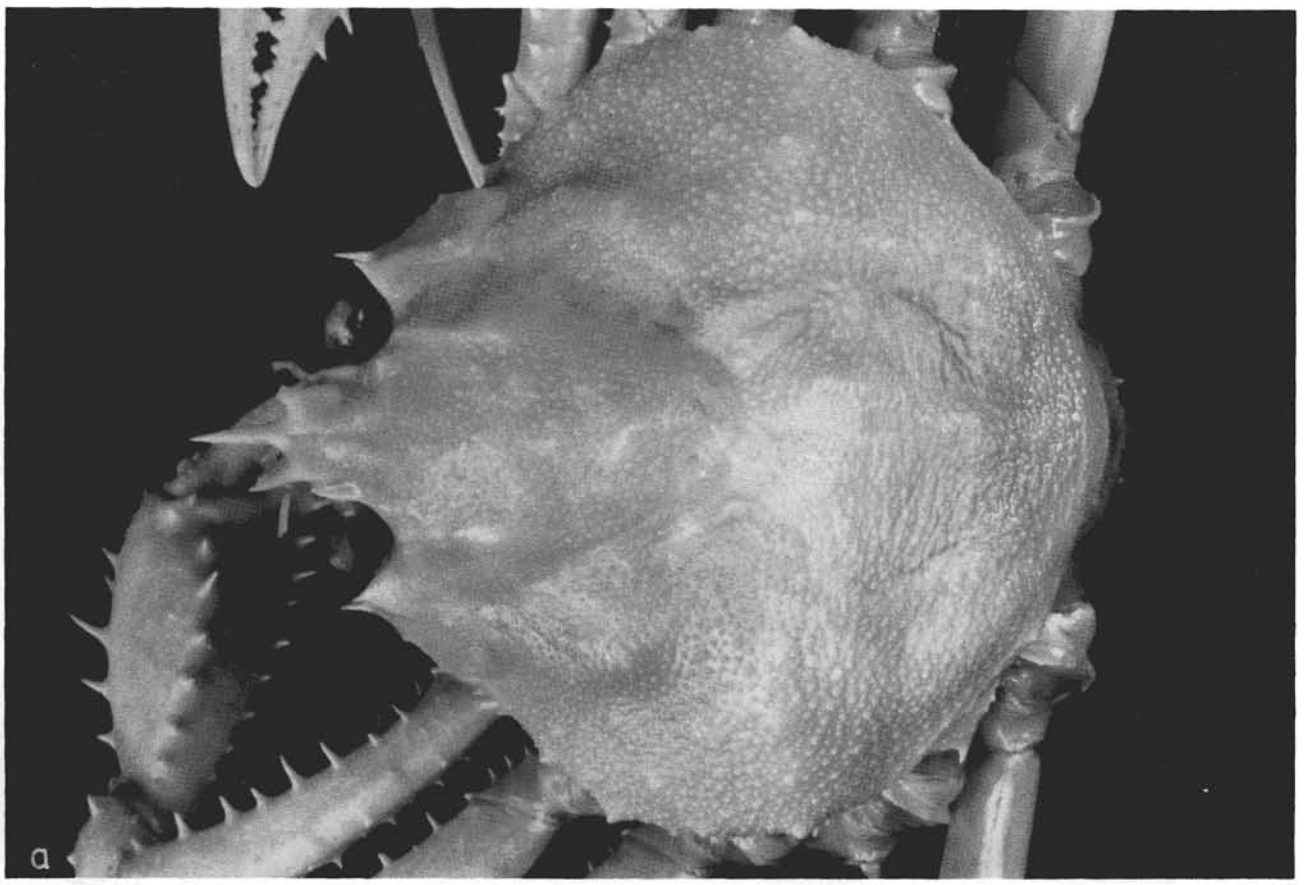


Plate 3. *Cyrtomaia bicornis* (female, ovig., 26 mm, Java Sea, ZMC) (a) dorsal view, (b) ventral view.



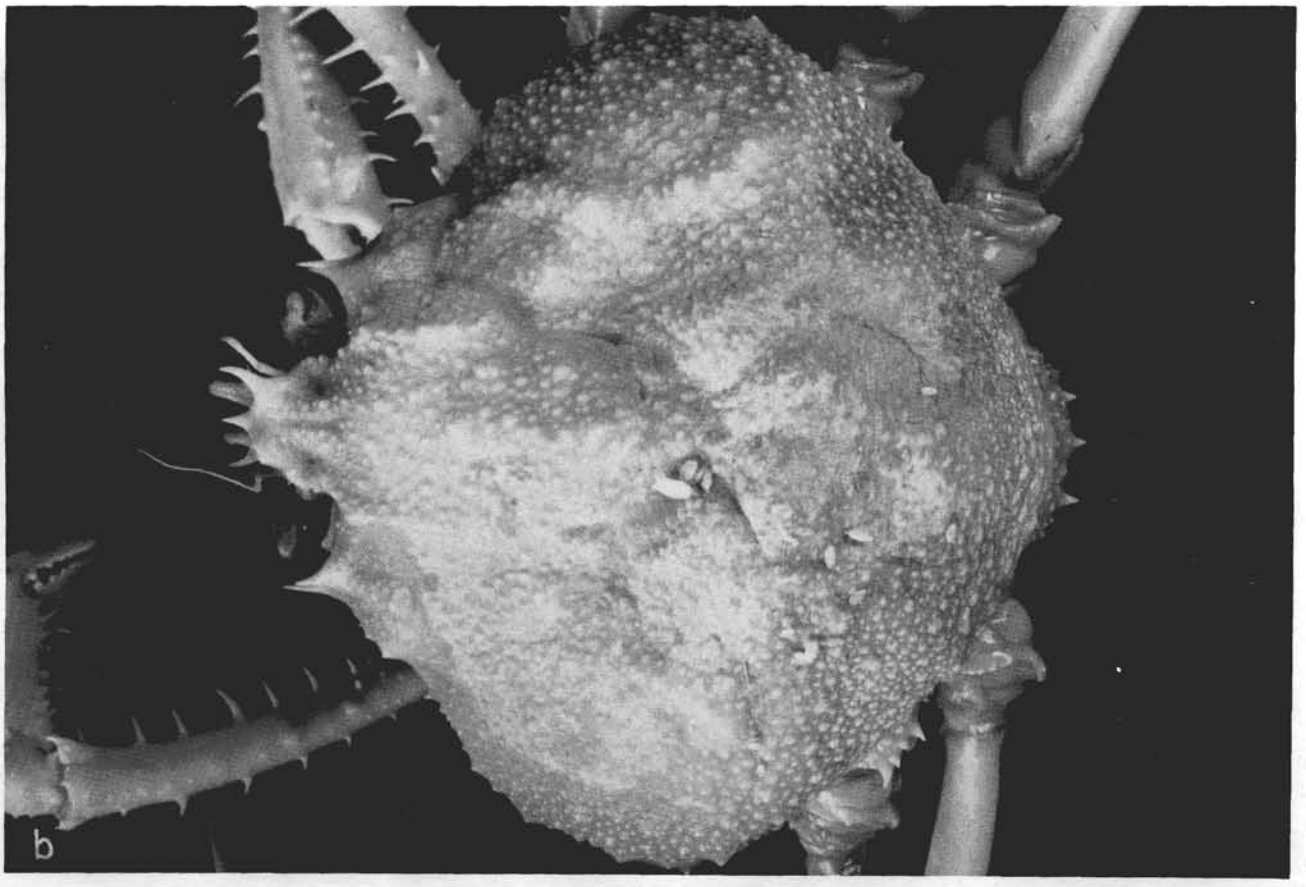


Plate 4. *Platymaia bartschi* (male, 59.5 mm, S. China Sea, AM P.20246) (a) dorsal view; *P. alcocki* (male, 62.5 mm, E. of Mombasa, AM P.17794) (b) dorsal view.

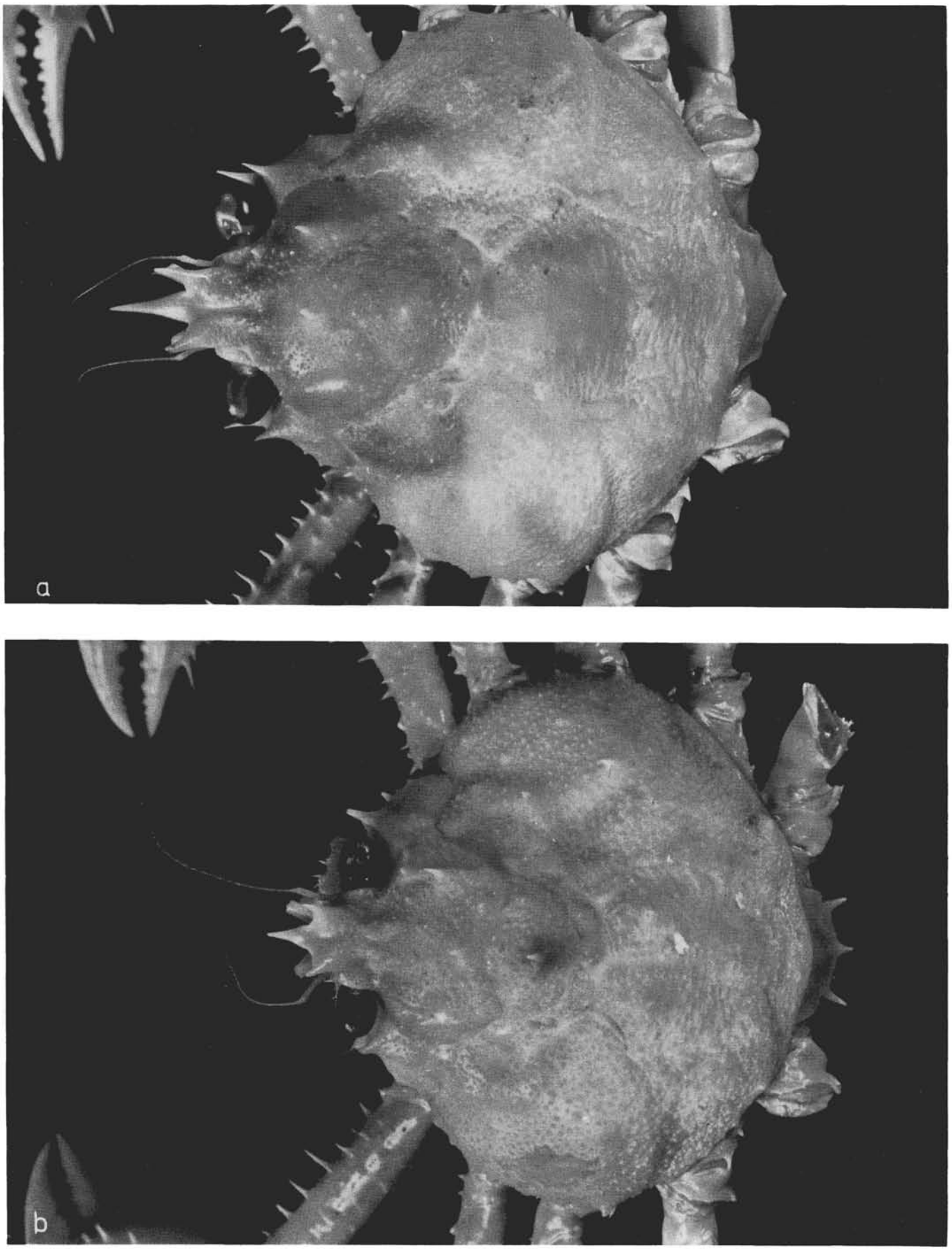


Plate 5. *Platymaia maoria* (male, 59.5 mm, off New South Wales, AM P. 29944) (a) dorsal view; *P. wyvillethomsoni* (male, 35 mm, off New South Wales, AM P.20744) (b) dorsal view.

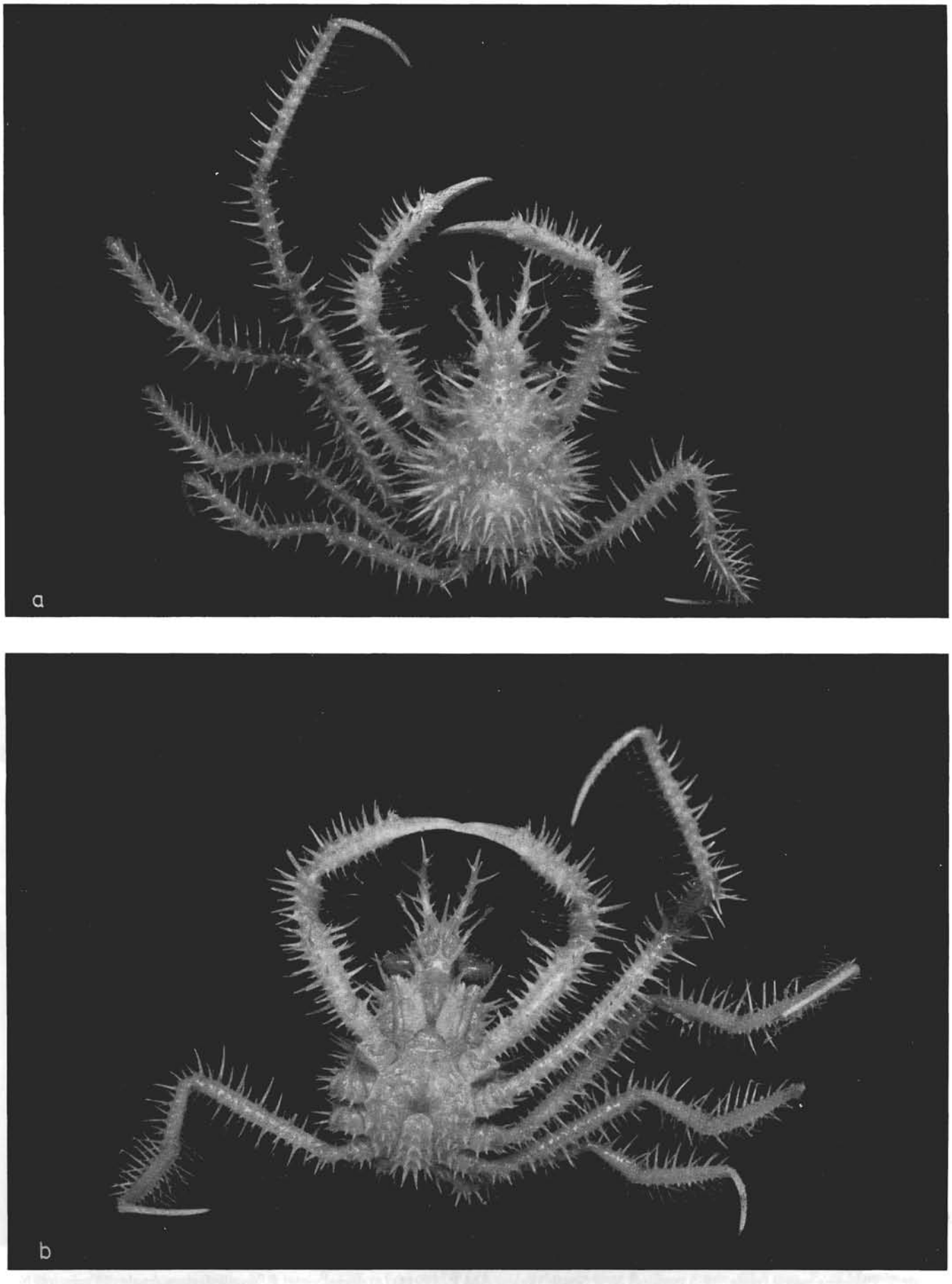
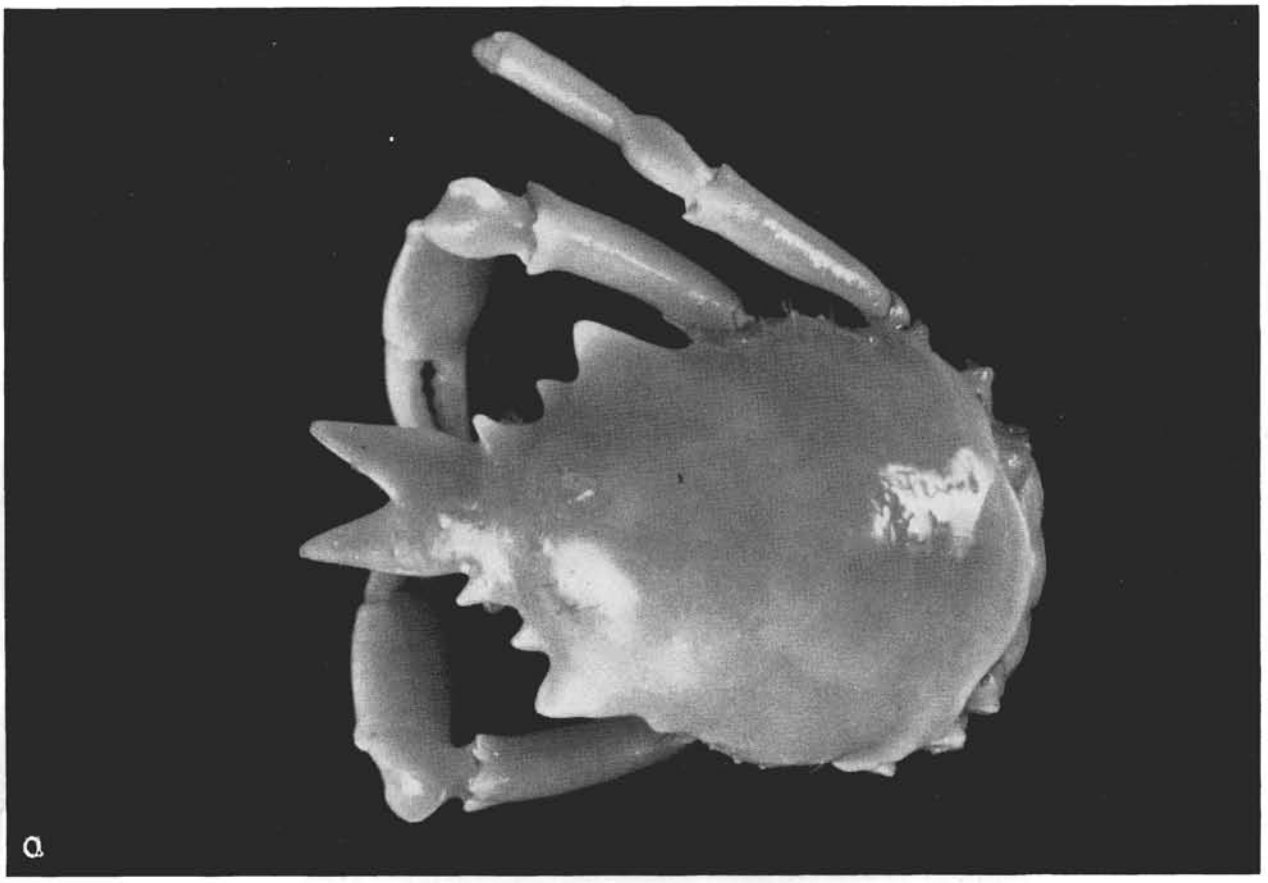


Plate 6. *Pleistacantha cervicornis* (male, 25 mm, New Caledonia, ZMC) (a) dorsal view, (b) ventral view.



Plate 7. *Acanthonyx euryseroche* (holotype) (a) dorsal view, (b) ventral view.



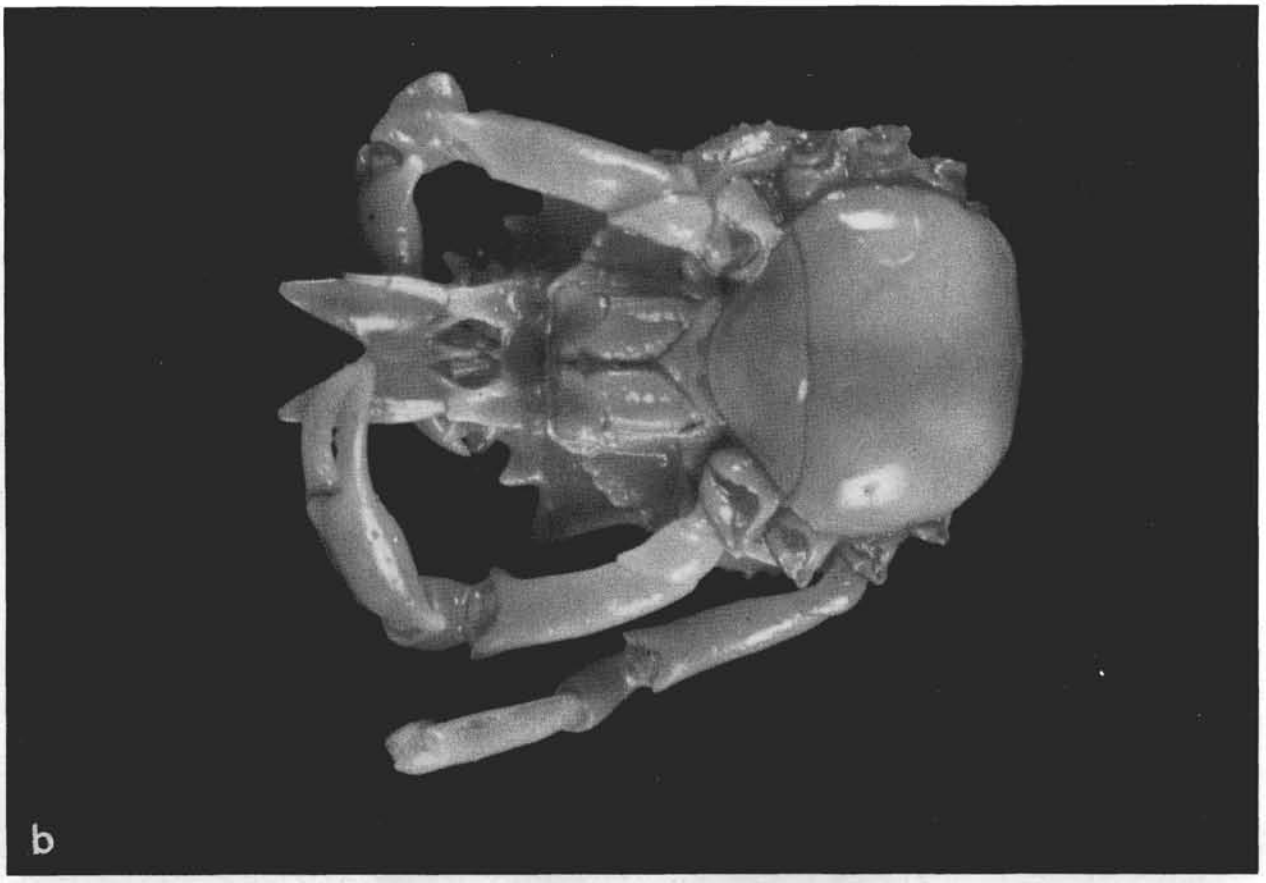
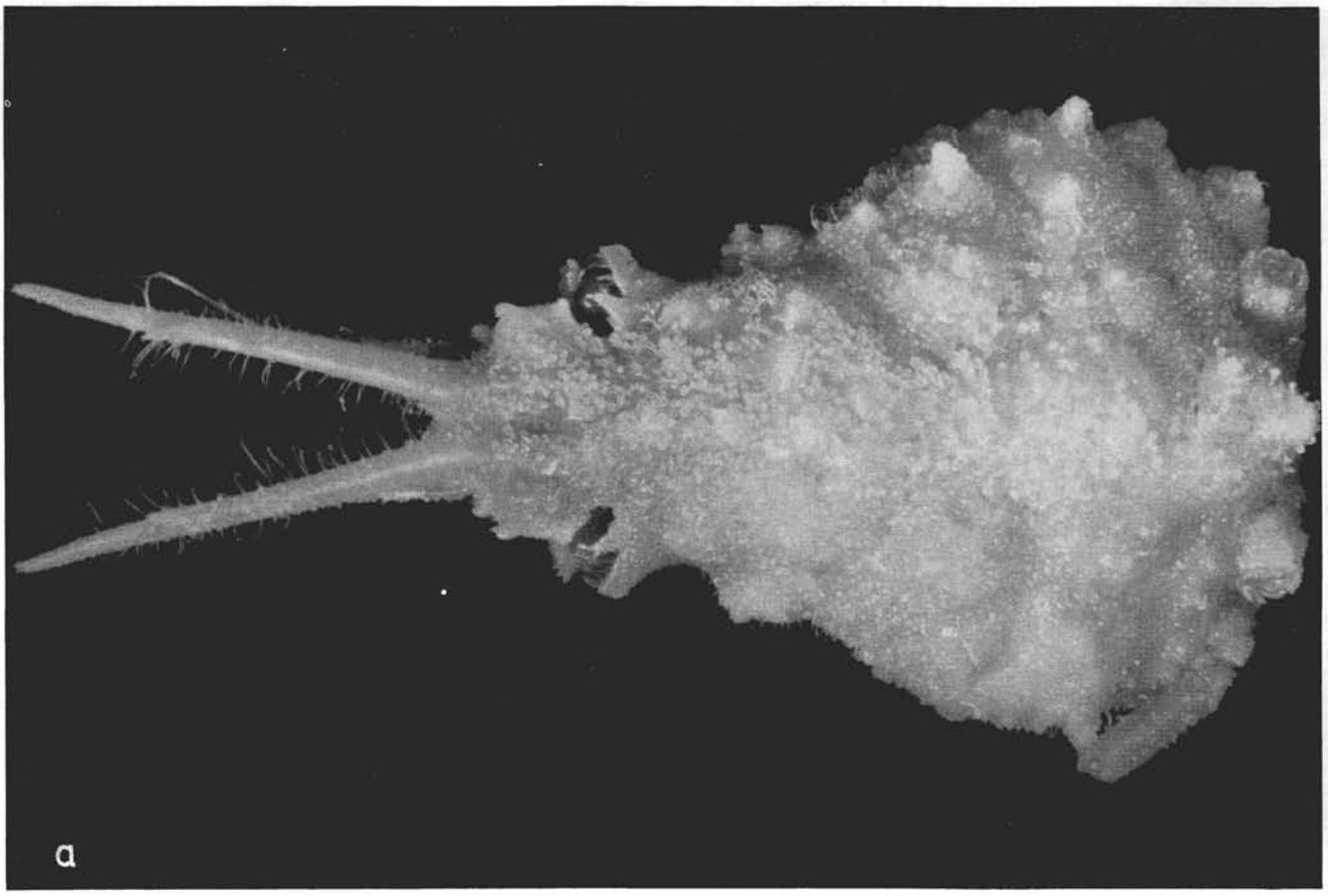


Plate 8. *Antilibinia polita* (holotype) (a) dorsal view, (b) ventral view.





Plate 9. *Doclea japonica* (male, 64 mm, China USNM 58743) (a) dorsal view, (b) ventral view.



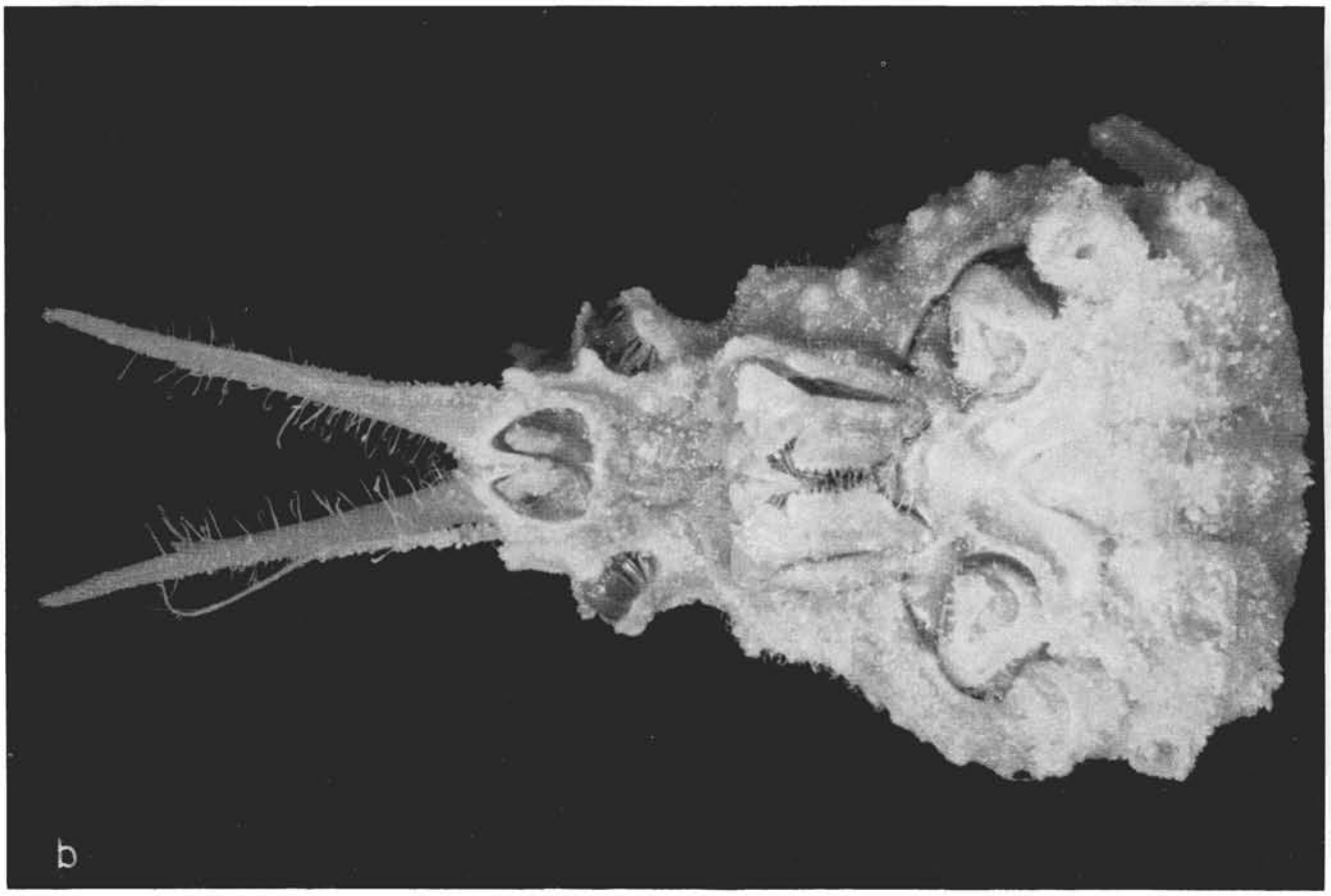
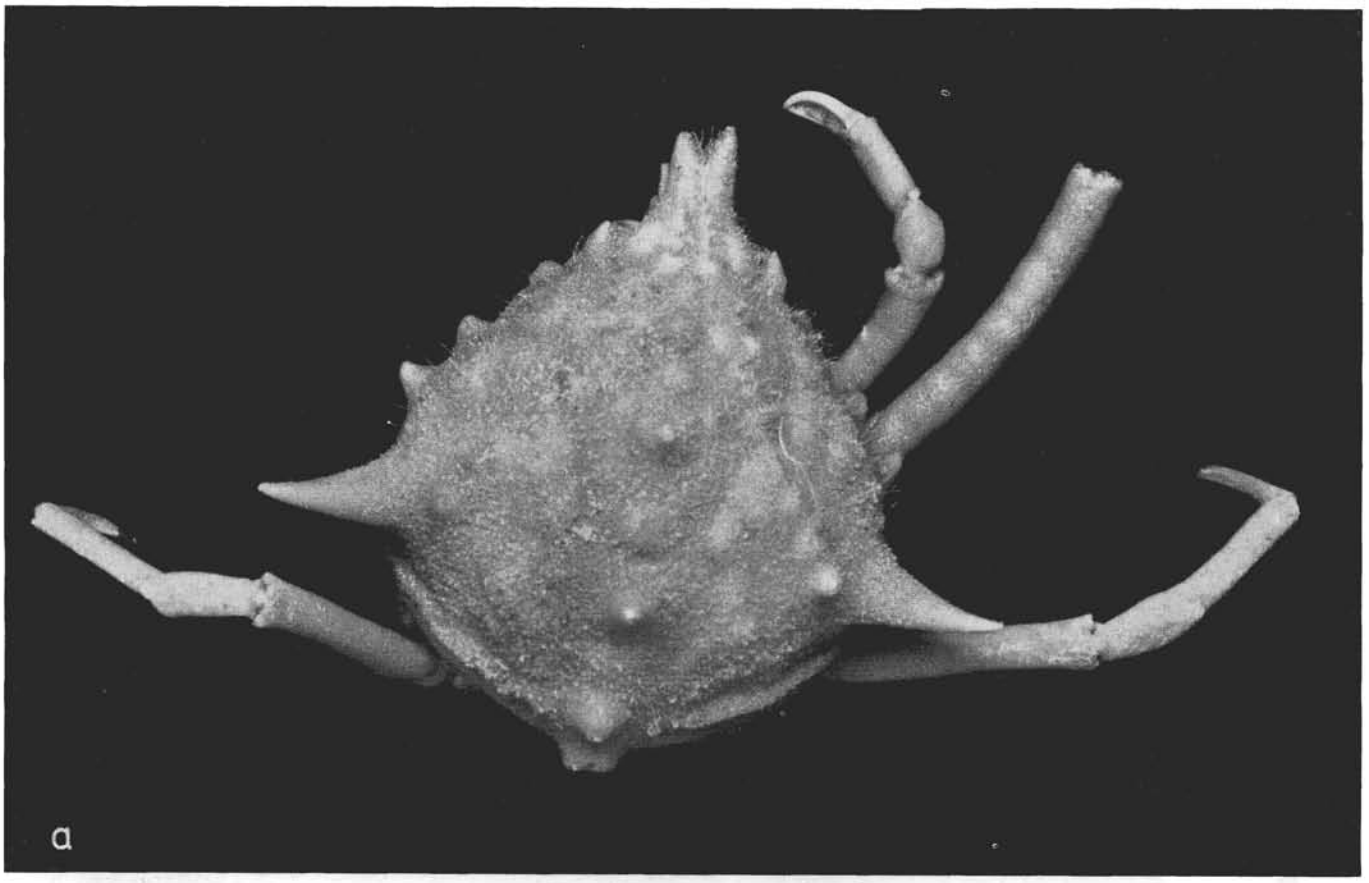


Plate 11. *Naxioides taurus* (male, 25.5 mm, Sulu Archipelago, ZMC) (a) dorsal view, (b) ventral view.



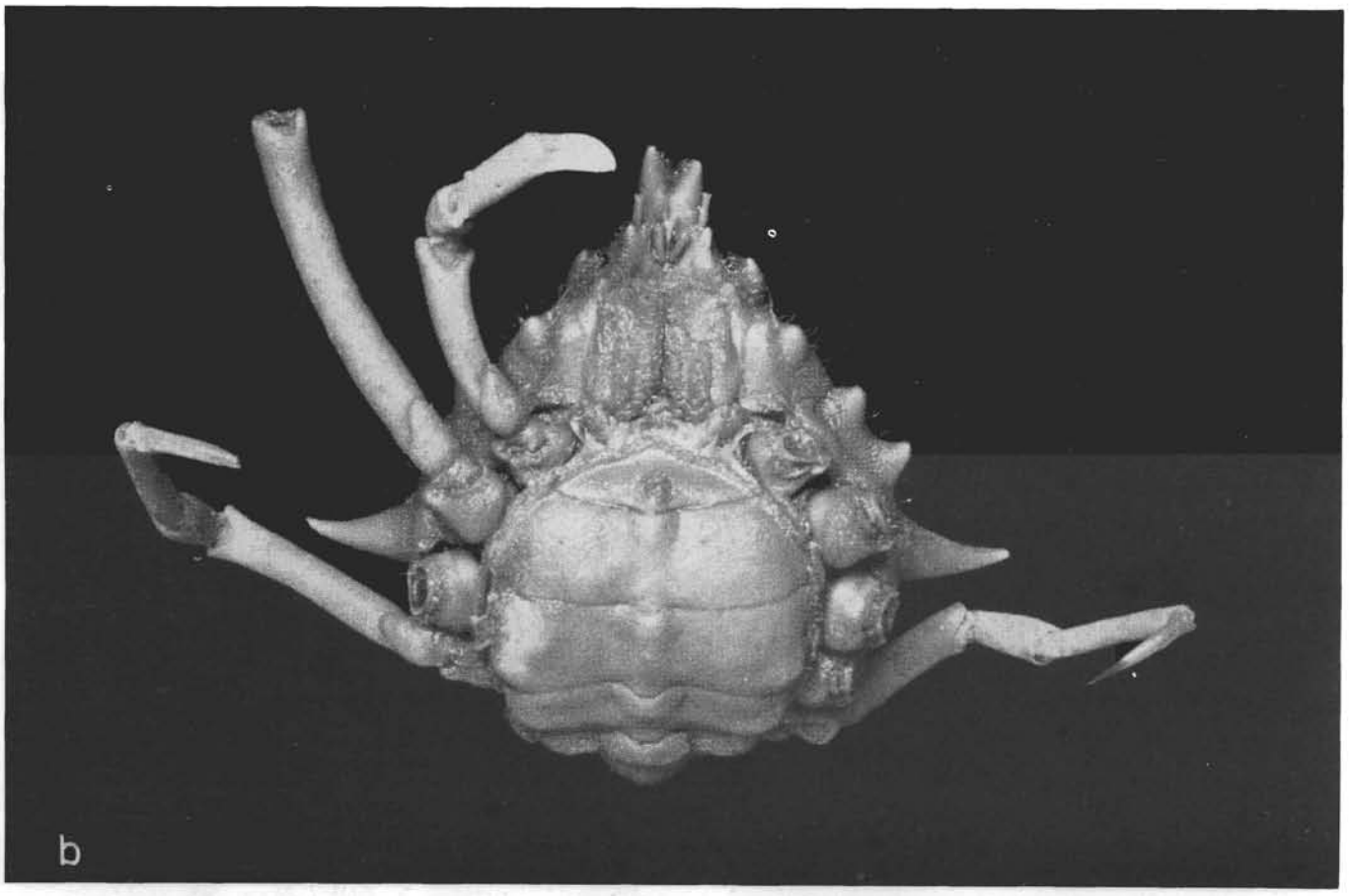
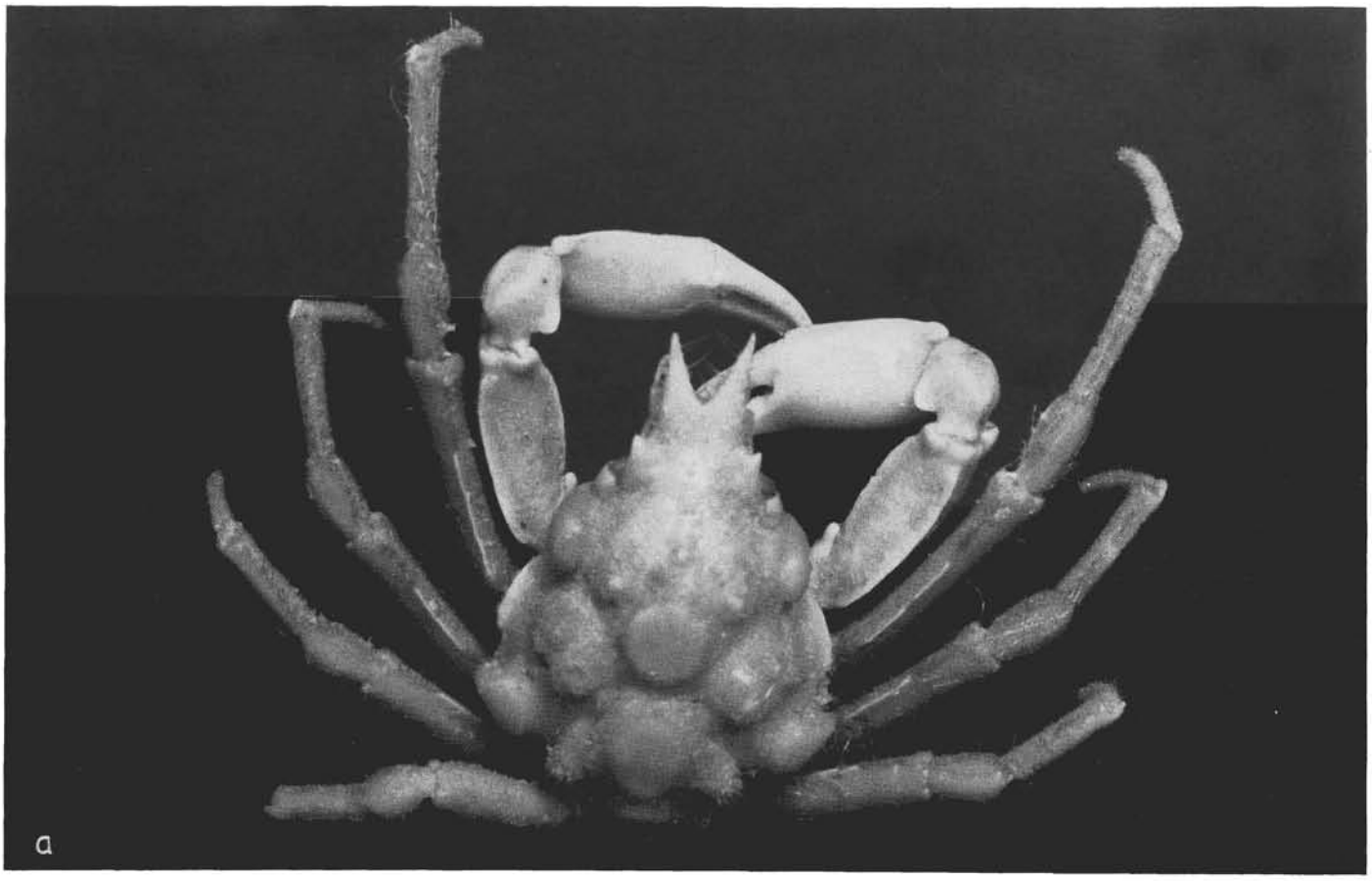


Plate 10. *Doclea simeti* (holotype) (a) dorsal view, (b) ventral view (large intestinal spine broken).



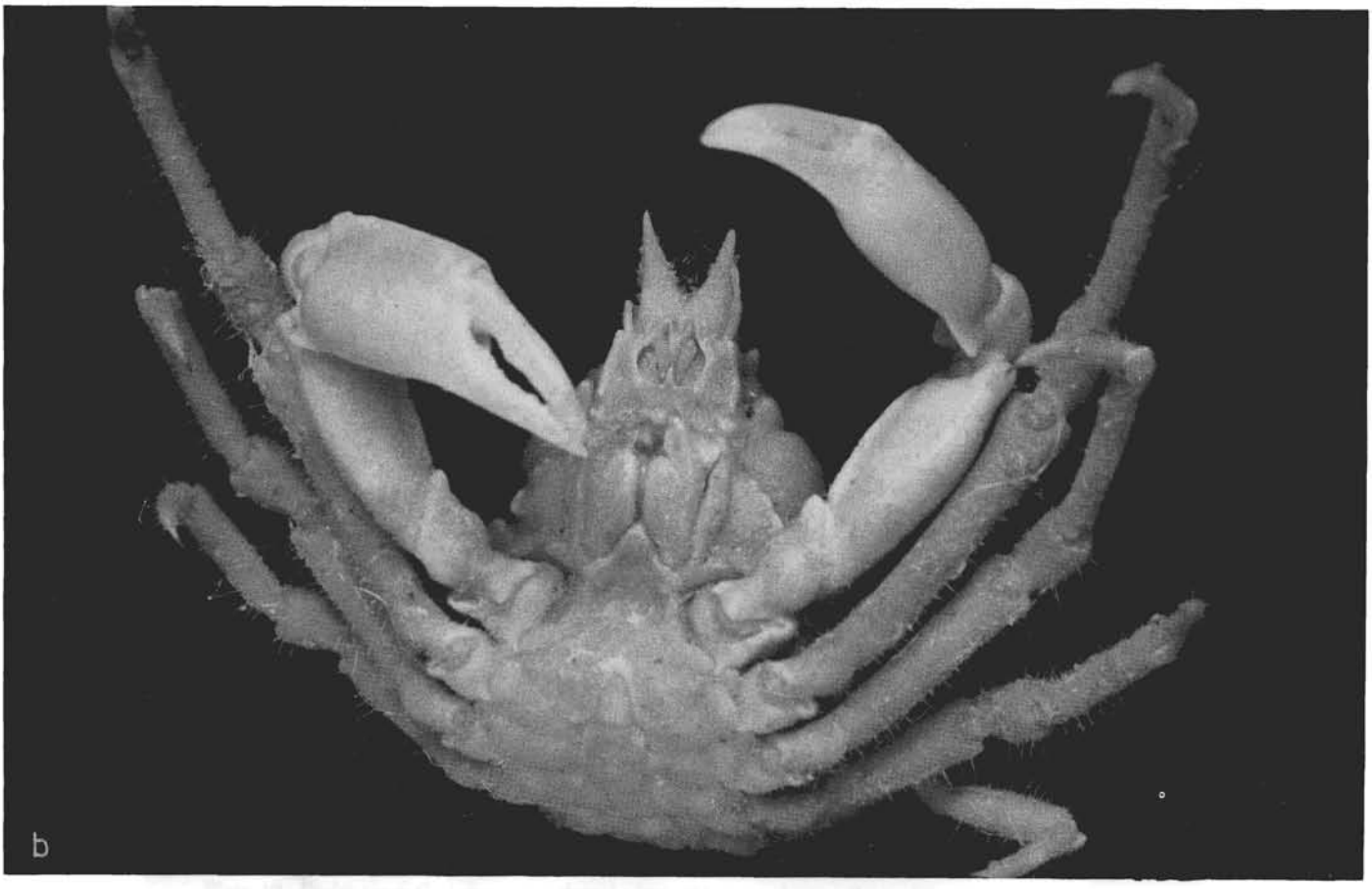


Plate 12. *Rochinia carinata* (holotype) (a) dorsal view, (b) ventral view.

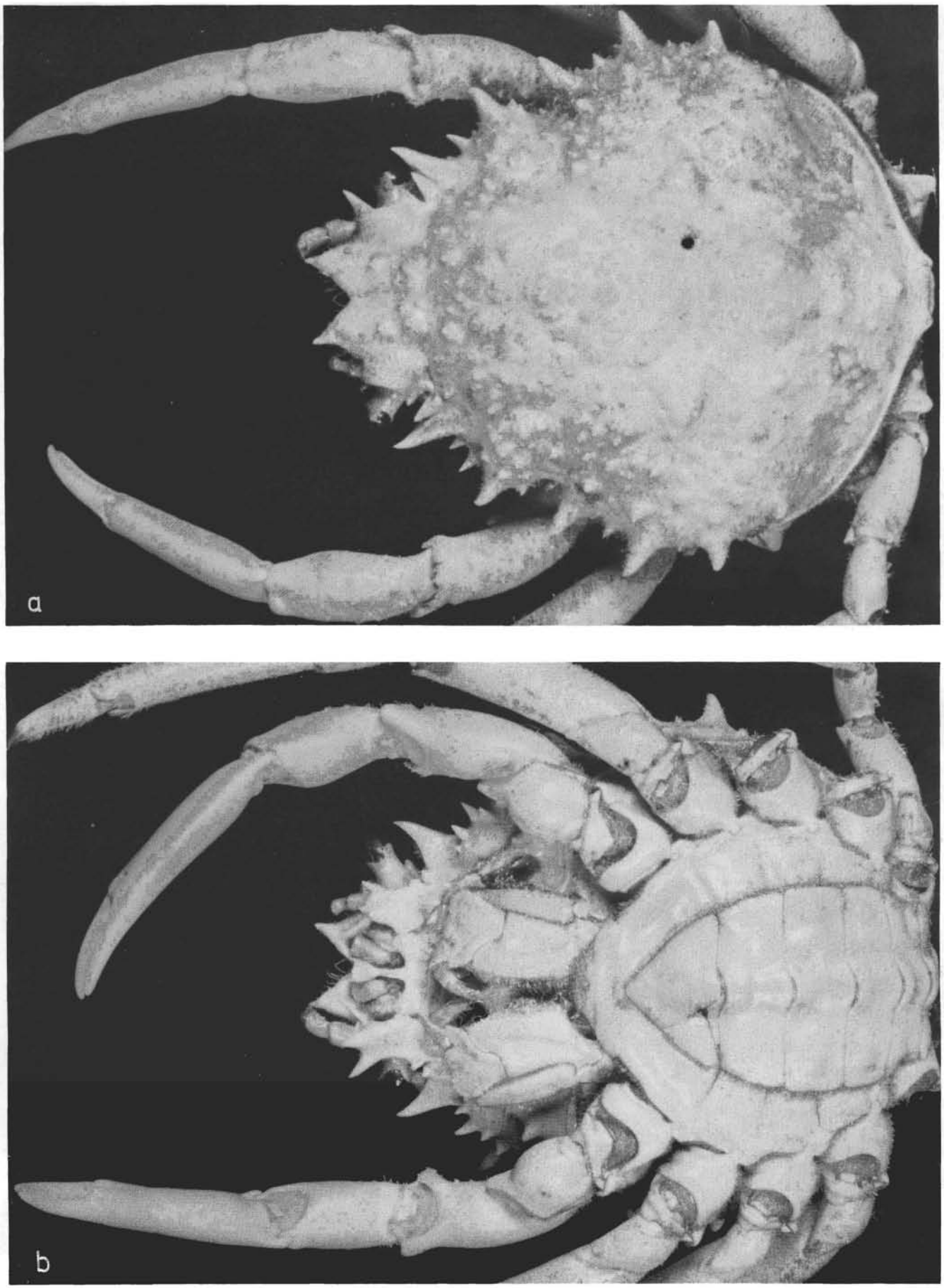


Plate 13. *Leptomithrax australis* (holotype of *L. brevirostris* Miers) (a) dorsal view, (b) ventral view.





Plate 14. *Maja africana* (holotype) (a) dorsal view, (b) ventral view.

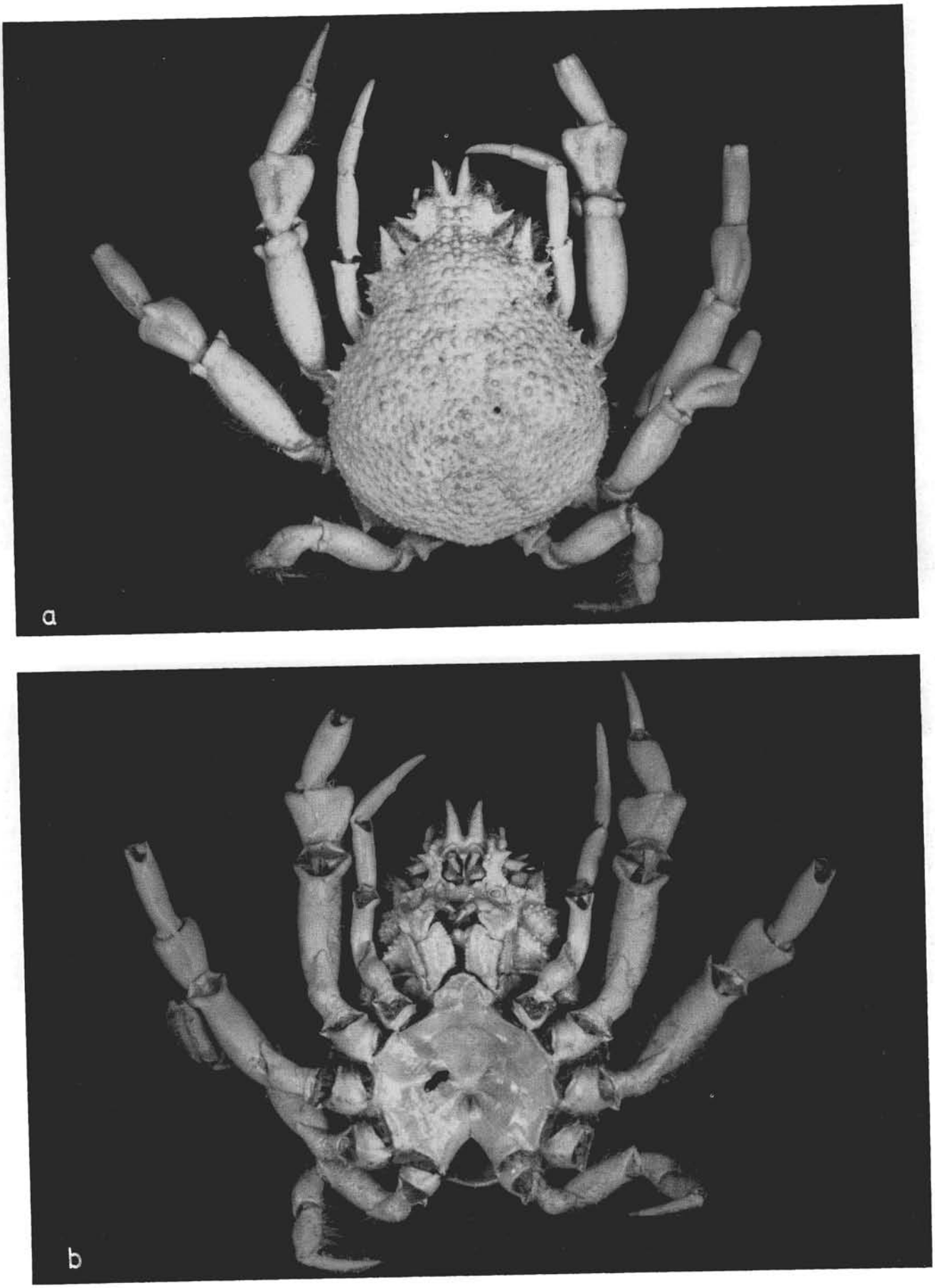


Plate 15. *Maja compressipes* (holotype) (a) dorsal view, (b) ventral view.





Plate 16. *Maja confragosa* (holotype) (a) dorsal view, (b) ventral view.

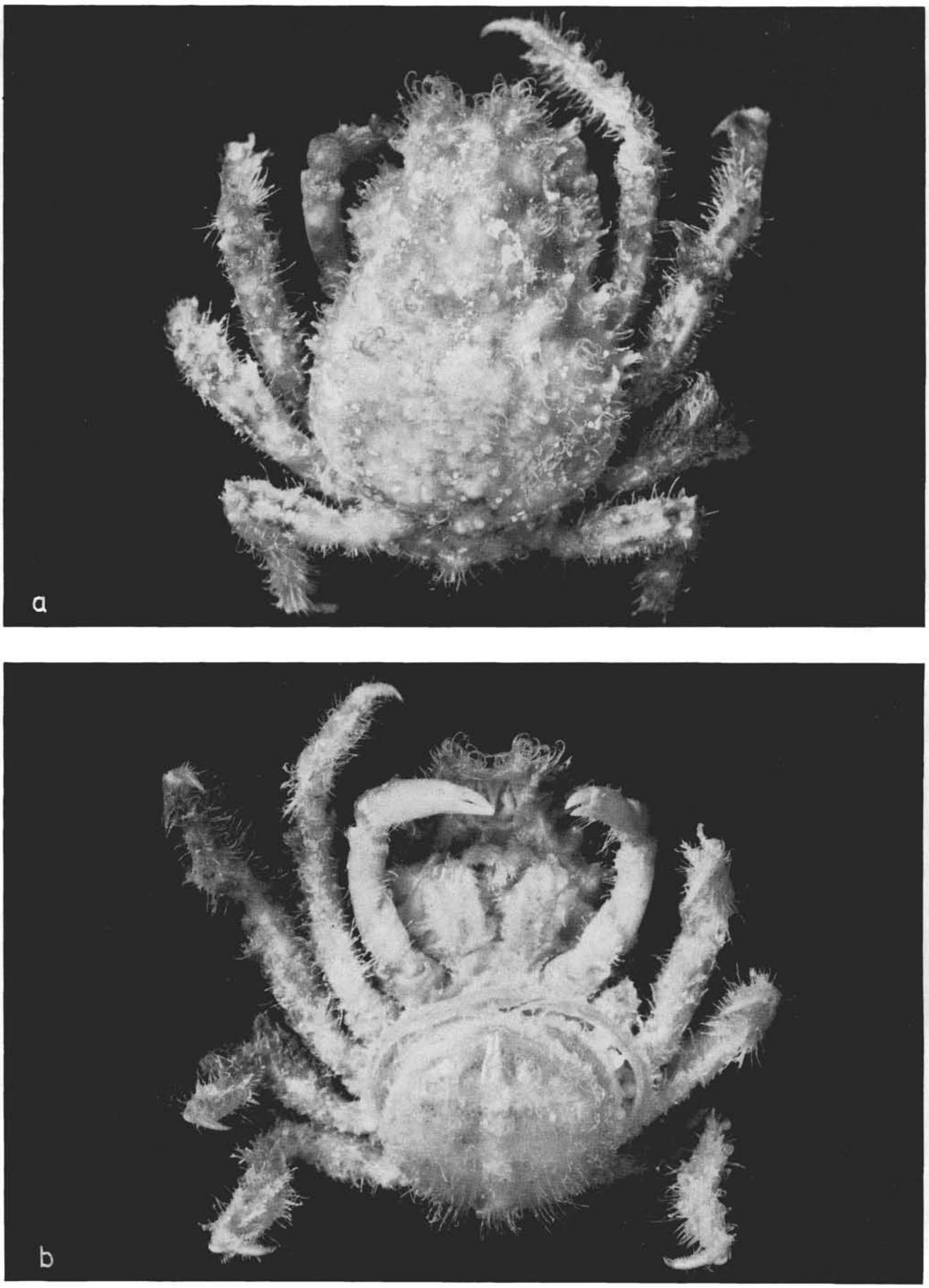


Plate 17. *Pseudomicippe maccullochi* (female, ovig., 24 mm, Lord Howe I., AM P. 30995) (a) dorsal view, (b) ventral view.

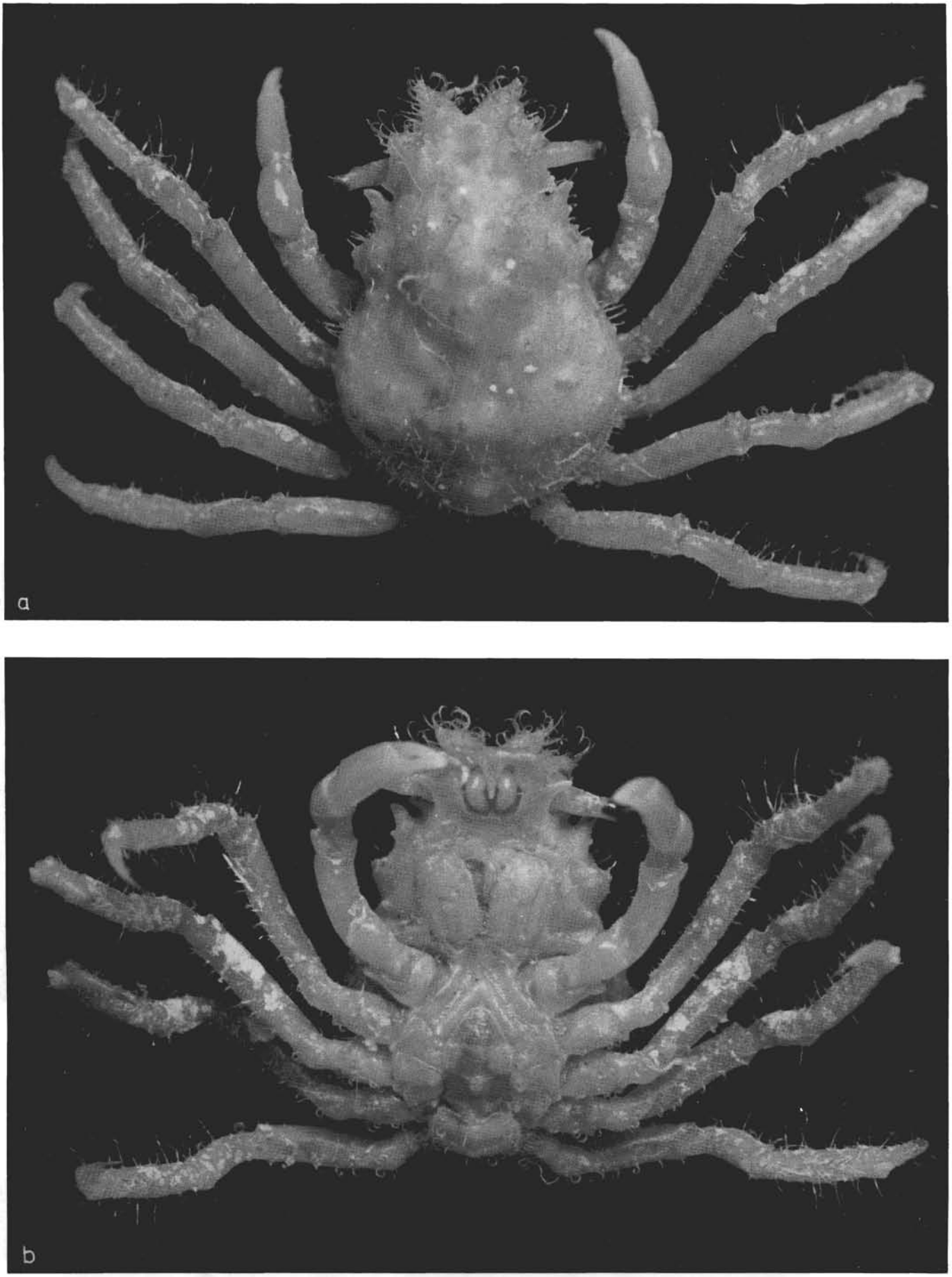


Plate 18. *Pseudomicippe tenuipes* (male, 10.5 mm, Western Australia, AM P.19139) (a) dorsal view, (b) ventral view.

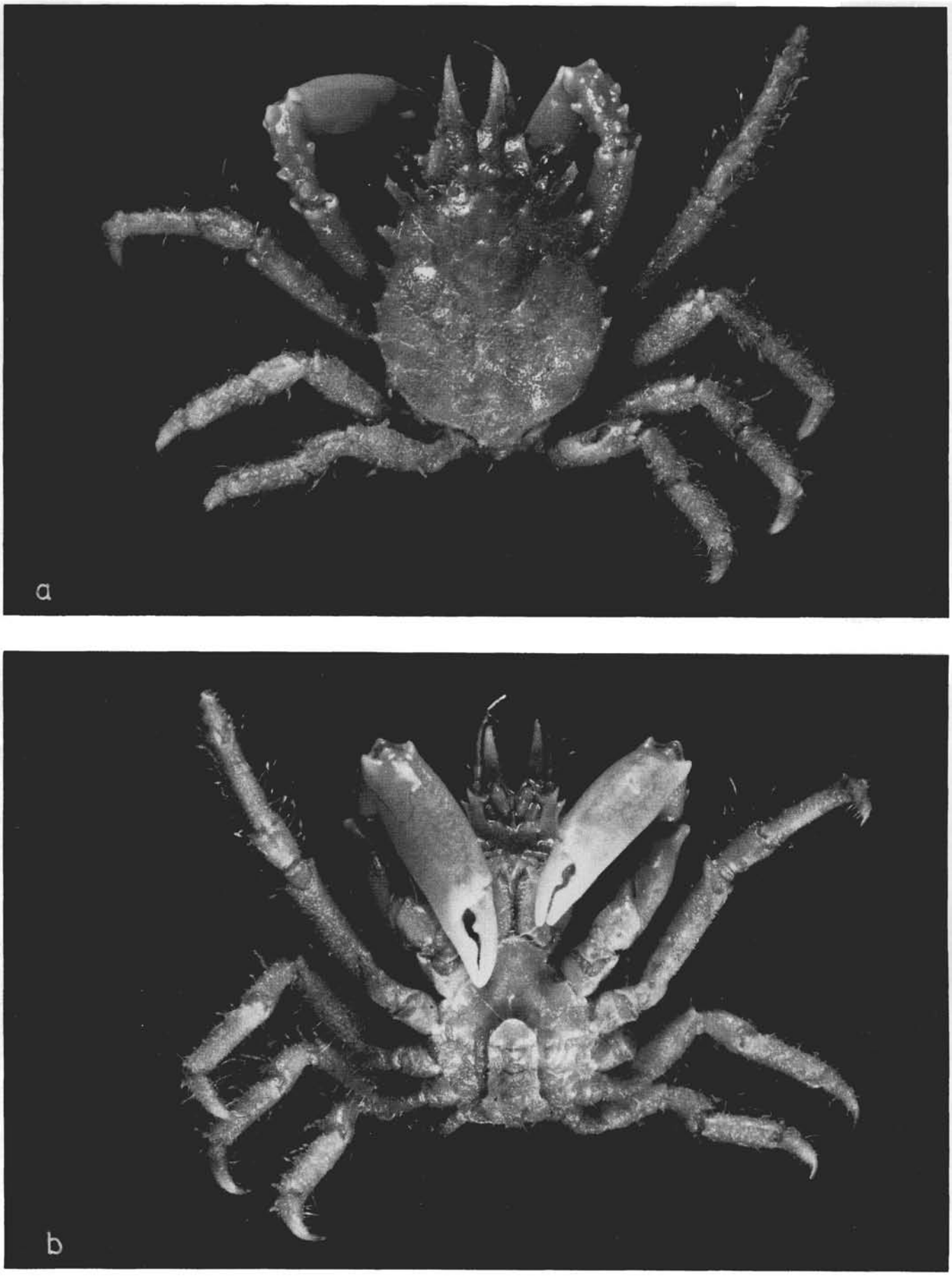


Plate 19. *Schizophroida hilensis* (male, 13.5 mm, Kermadecs, National Museum of New Zealand, Wellington) (a) dorsal view, (b) ventral view.

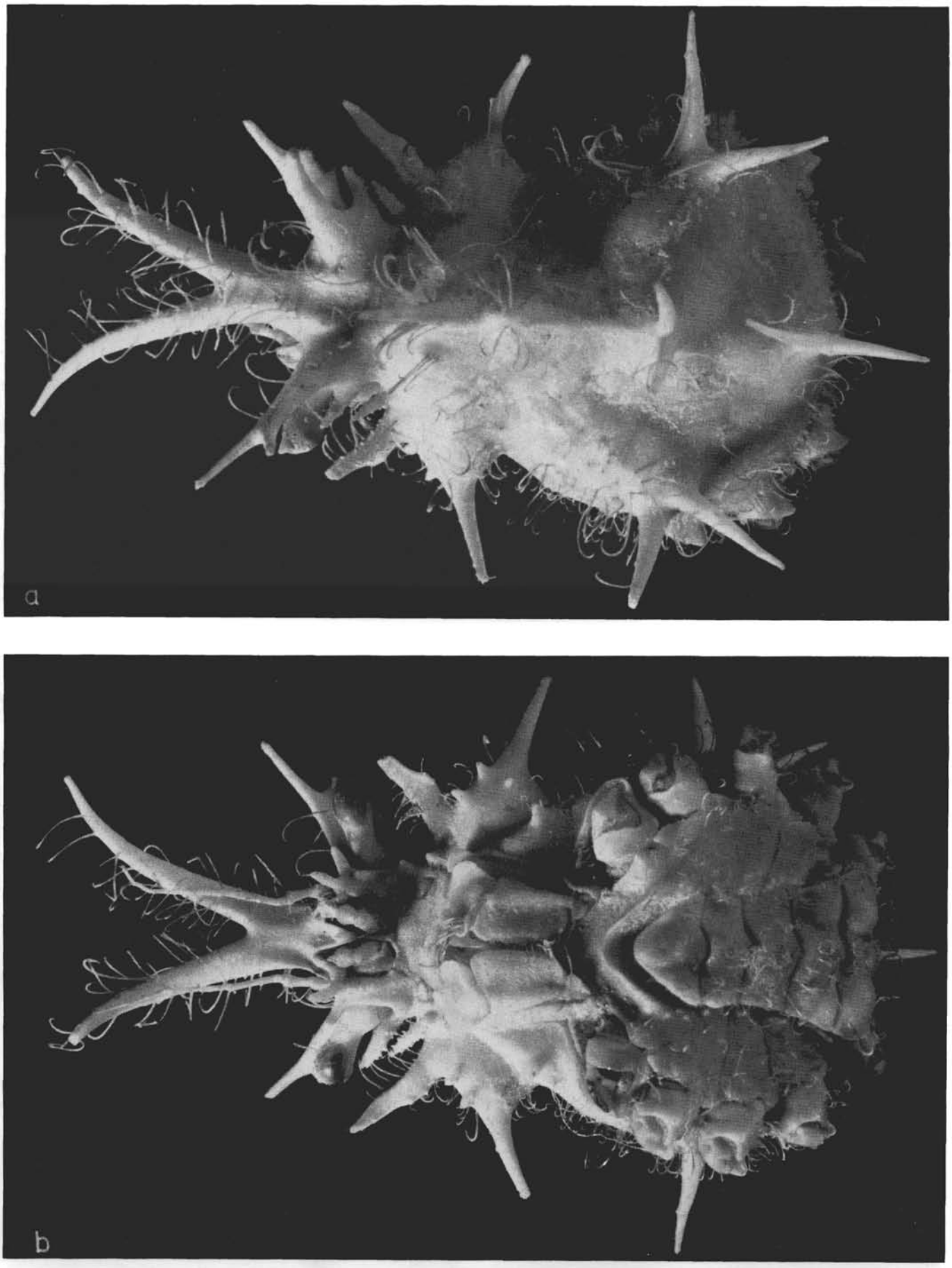


Plate 20. *Thacanophrys acanthonotus* (male, 20 mm, Java Sea, ZMA De.100.837) (a) dorsal view, (b) ventral view.

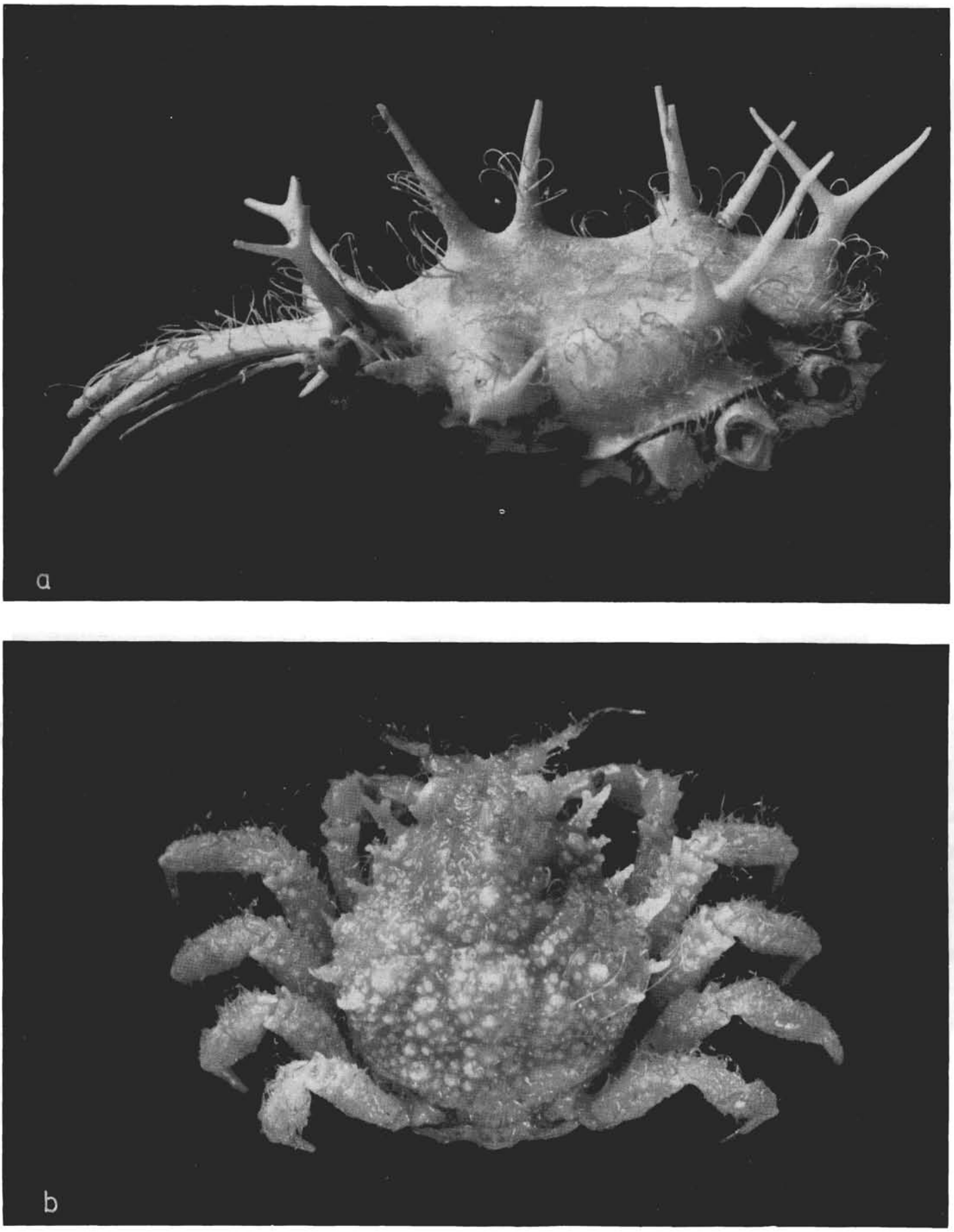


Plate 21. *Thacanophrys acanthonotus* (male, 20 mm, Java Sea, ZMA De.100.837) (a) lateral view. *Pippacirama tuberculosa* (female, ovig., 10.5 mm, New South Wales, AM P.8707) (b) dorsal view.



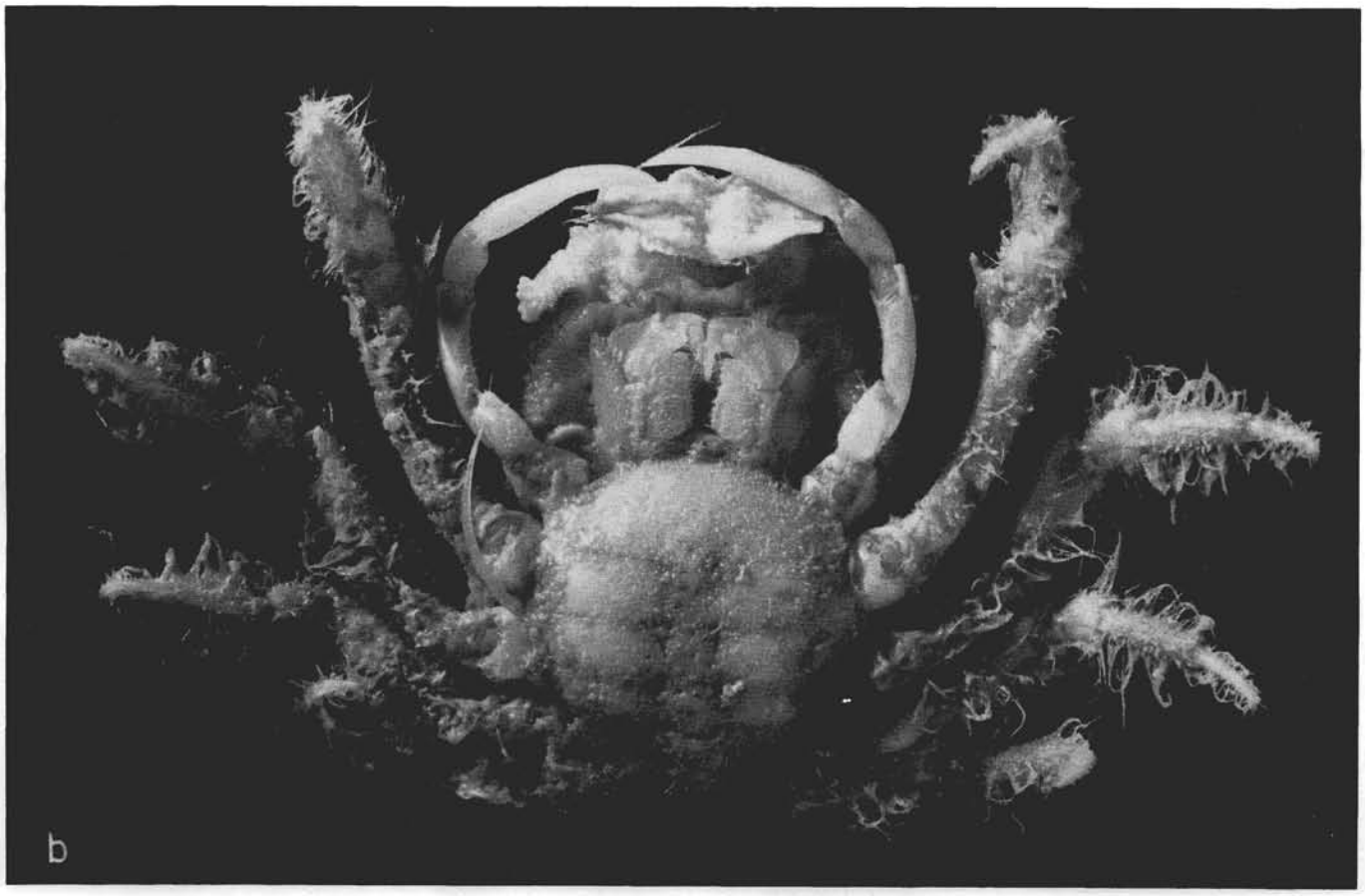


Plate 22. *Micippa excavata* (female, 15.5 mm, Java Sea, ZMC) (a) dorsal view, (b) ventral view.

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APPENDIX

Representative specimens of many species were donated to the Australian Museum by the Zoological Museum, Amsterdam and the Zoological Museum, University of Copenhagen at the conclusion of the study but these are still included under ZMA or ZMC in the lists of 'Material examined'. The Australian Museum registration numbers of these specimens are listed below.

Achaeus akanensis
(ZMC) 1 spec. (AM P. 34532).
Achaeus brevifalcatus
(ZMA) 1 spec. (AM P. 34533). — (ZMC) 1 spec. (AM P. 34534).
Achaeus brevirostris
(ZMC) 2 specs (AM P. 34535); 2 specs (AM P. 34536); 1 spec. (AM P. 34538); 1 spec. (AM P. 34537).
Achaeus curvirostris
(ZMA) 1 spec. (AM P. 34539).
Achaeus japonicus
(ZMC) 1 spec. (AM P. 34540).
Achaeus lacertosus
(ZMC) 6 specs (AM P. 34541).
Achaeus paradicei
(ZMC) 2 specs (AM P. 34542).
Achaeus pugnax
(ZMC) 1 spec. (AM P. 34543); 1 spec. (AM P. 34544).
Achaeus robustus
(ZMA) 2 specs (AM P. 34545).
Achaeus serenei
(ZMC) 1 spec. (AM P. 34547); 1 spec. (AM P. 34548).
Achaeus superciliaris
(ZMC) 10 specs (AM P. 34549).
Achaeus tuberculatus
(ZMC) 3 specs (AM P. 34550).
Achaeus villosus
(ZMA) 1 spec. (AM P. 34551).
Achaeopsis thomsoni
(ZMC) 8 specs (AM P. 34552).
Cyrtomaia horrida
(ZMC) 1 spec. (AM P. 34553).
Cyrtomaia lamellata
(ZMC) 1 spec. (AM P. 34554).
Cyrtomaia owstoni
(ZMC) 1 spec. (AM P. 34555).
Oncinopus angustifrons
(ZMC) 1 spec. (AM P. 34556).
Oncinopus aranea
(ZMA) 1 spec. (AM P. 34557); 1 spec. (AM P. 34558). — (ZMC) 1 spec. (AM P. 34559).
Oncinopus neptunus
(ZMC) 2 specs (AM P. 34560); 1 spec. (AM P. 34561); 1 spec. (AM P. 34562).
Oncinopus postillonensis
(ZMA) 1 spec. (AM P. 34563).
Paratymolus pubescens
(ZMA) 1 spec. (AM P. 34564); 1 spec. (AM P. 34565). — (ZMC) 1 spec. (AM P. 34566); 1 spec. (AM P. 34567); 1 spec. (AM P. 34568).
Physachaeus ctenurus
(ZMC) 1 spec. (AM P. 34569).
Platymaia fimbriata
(ZMA) 1 spec. (AM P. 34570).
Pleistacantha oryx
(ZMC) 4 specs (AM P. 34571).
Pleistacantha sanctijohannis
(ZMC) 3 specs (AM P. 34572); 3 specs (AM P. 34573).
Pleistacantha simplex
(ZMA) 1 spec. (AM P. 34574). — (ZMC) 2 specs (AM P. 34575); 1 spec. (AM P. 34576).
Prosphorachaeus multispina
(ZMA) 1 spec. (AM P. 34578); 1 spec. (AM P. 34577).
Prosphorachaeus suluensis
(ZMC) 1 spec. (AM P. 34579).
Sunipea indicus
(ZMA) 4 specs (AM P. 34581).
Criocarcinus superciliosus
(ZMA) 1 spec. (AM P. 34582); 1 spec. (AM P. 34583).
Antilibinia polita
(ZMC) 1 spec. (AM P. 34584).
Huenia grandidierii
(ZMC) 2 specs (AM P. 34585).
Huenia pacifica
(ZMA) 4 specs (AM P. 34586).
Menaethiops xiphias
(ZMA) 1 spec. (AM P. 34587).
Menaethius monoceros
(ZMA) 2 specs (AM P. 34588). — (ZMC) 2 specs (AM P. 34589); 1 spec. (AM P. 34590).
Menaethius orientalis
(ZMA) 1 spec. (AM P. 34591).
Perinia tumida
(ZMC) 2 specs (AM P. 34592).
Pugettia incisa
(ZMC) 1 spec. (AM P. 34593).
Pugettia intermedia
(ZMC) 1 spec. (AM P. 34594).

Pugettia marissinica
(ZMC) 1 spec. (AM P. 34595).
Pugettia minor
(ZMC) 2 specs (AM P. 34596); 2 specs (AM P. 34597).
Pugettia nipponensis
(ZMC) 1 spec. (AM P. 34598).
Simocarcinus simplex
(ZMC) 1 spec. (AM P. 34599).
Xenocarcinus conicus
(ZMC) 1 spec. (AM P. 34600); 1 spec. (AM P. 34601).
Austrolibinia andamanica
(ZMC) 1 spec. (AM P. 34602).
Doclea calcitrapa
(ZMC) 2 specs (AM P. 34603).
Doclea gracilipes
(ZMC) 4 specs (AM P. 34604).
Giranauria tinaktensis
(ZMA) 1 spec. (AM P. 34605). — (ZMC) 1 spec. (AM P. 34606).
Giranauria verrucosipes
(ZMC) 2 specs (AM P. 34608); 1 spec. (AM P. 34607).
Hyastenus ambonensis
(ZMC) 1 spec. (AM P. 34609).
Hyastenus aries
(ZMC) 4 specs (AM P. 34610); 3 specs (AM P. 34611).
Hyastenus auctus
(ZMC) 2 specs (AM P. 34612).
Hyastenus biformis
(ZMA) 2 specs (AM P. 34613).
Hyastenus bispinosus
(ZMA) 1 spec. (AM P. 34615).
Hyastenus brockii
(ZMA) 1 spec. (AM P. 34616); 1 spec. (AM P. 34617). — (ZMC) 1 spec. (AM P. 34618).
Hyastenus convexus
(ZMC) 1 spec. (AM P. 34619); 1 spec. (AM P. 34620); 3 specs (AM P. 34621).
Hyastenus cracentis
(ZMA) 1 spec. (AM P. 34622).
Hyastenus diacanthus
(ZMC) 2 specs (AM P. 34623); 3 specs (AM P. 34624).
Hyastenus elongatus
(ZMC) 1 spec. (AM P. 34625); 1 spec. (AM P. 34626).
Hyastenus fraterculus
(ZMC) 1 spec. (AM P. 34627).
Hyastenus hilgendorfi
(ZMA) 2 specs (AM P. 34628). — (ZMC) 1 spec. (AM P. 34629); 3 specs (AM P. 34630).
Hyastenus mindoro
(ZMA) 1 spec. (AM P. 34631); 1 spec. (AM P. 34632). — (ZMC) 2 specs (AM P. 34633).
Hyastenus planasius
(ZMA) 2 specs (AM P. 34634). — (ZMC) 3 specs (AM P. 34635).
Hyastenus scrobiculatus
(ZMC) 2 specs (AM P. 34636).
Hyastenus sebae
(ZMC) 4 specs (AM P. 34637); 4 specs (AM P. 34638).
Hyastenus trispinosus
(ZMA) 2 specs (AM P. 34639).
Hyastenus uncifer
(ZMC) 1 spec. (AM P. 34640).
Hyastenus whitei
(ZMA) 2 specs (AM P. 34641). — (ZMC) 3 specs (AM P. 34642).
Lahaina agassizii
(ZMA) 2 specs (AM P. 34643).
Lahaina mauritiana
(ZMC) 2 specs (AM P. 34644).
Lahaina ovata
(ZMC) 6 specs (AM P. 34645).
Naxioides taurus
(ZMC) 2 specs (AM P. 34646).
Phalangipus longipes
(ZMC) 1 spec. (AM P. 34648).
Rochinia carinata
(ZMC) 2 specs (AM P. 34651).
Rochinia globulifera
(ZMC) 1 spec. (AM P. 34652).
Rochinia hertwigi
(ZMC) 1 spec. (AM P. 34653).
Rochinia luzonica
(ZMC) 1 spec. (AM P. 34654); 1 spec. (AM P. 34655).
Rochinia makassar
(ZMA) 1 spec. (AM P. 34656).
Rochinia pulchra
(ZMC) 1 spec. (AM P. 34657).
Rochinia stimpsoni
(ZMC) 1 spec. (AM P. 34658).
Rochinia suluensis
(ZMA) 1 spec. (AM P. 34659).
Rochinia velutina
(ZMC) 1 spec. (AM P. 34661).
Thusaenys calvarius
(ZMC) 1 spec. (AM P. 34662).
Thusaenys irami
(ZMA) 1 spec. (AM P. 34663).
Thusaenys orbis
(ZMC) 1 spec. (AM P. 34664).
Tylocarcinus styx
(ZMC) 2 specs (AM P. 34665).
Eurynome erosa
(ZMC) 1 spec. (AM P. 34666).
Leptomithrax bifidus
(ZMC) 3 specs (AM P. 34667).
Leptomithrax edwardsi
(ZMC) 1 spec. (AM P. 34668).
Maja gibba
(ZMC) 1 spec. (AM P. 34669).

Maja japonica
(ZMC) 1 spec. (AM P. 34670).
Maja miersii
(ZMC) 1 spec. (AM P. 34671).
Maja sakaii
(ZMC) 2 specs (AM P. 34672).
Schizophrys aspera
(ZMC) 1 spec. (AM P. 34673); 1 spec. (AM P. 34674); 1 spec. (AM P. 34675).
Seiitaoides orientalis
(ZMA) 2 specs (AM P. 34676).
Thacanophrys aculeatus
(ZMC) 1 spec. (AM P. 34677).
Thacanophrys longispinus
(ZMC) 2 specs (AM P. 34678); 1 spec. (AM P. 34679).
Cyphocarcinus capreolus
(ZMC) 2 specs (AM P. 34680).
Leptopisa australis
(ZMA) 1 spec. (AM P. 34681); 2 specs (AM P. 34682).
Micippa cristata
(ZMA) 1 spec. (AM P. 34683); 1 spec. (AM P. 34684). — (ZMC) 2 specs (AM P. 34685).
Micippa excavata
(ZMC) 1 spec. (AM P. 34686).
Micippa margaritifera
(ZMA) 1 spec. (AM P. 34687).
Micippa parca
(ZMA) 2 specs (AM P. 34688).
Micippa philyra
(ZMC) 2 specs (AM P. 34690).
Micippa thalia
(ZMC) 1 spec. (AM P. 34691).
Tiarinia alidae
(ZMA) 1 spec. (AM P. 34692); 1 spec. (AM P. 34693).
Tiarinia angusta
(ZMA) 1 spec. (AM P. 34694).
Tiarinia cornigera
(ZMA) 2 spec. (AM P. 34695). — (ZMC) 2 specs (AM P. 34696).
Tiarinia gracilis
(ZMA) 2 specs (AM P. 34697).

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