

**A REVISION OF *CERATOCARCINUS* WHITE, 1847, AND
HARROVIA ADAMS & WHITE, 1849 (CRUSTACEA: DECAPODA:
BRACHYURA: EUMEDONIDAE), TWO GENERA OF CRABS
SYMBIOTIC WITH CRINOIDS**

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ABSTRACT. - The crabs of the genera *Ceratocarcinus* White, 1847, and *Harrovia* Adams & White, 1849, are revised. Members of both genera are obligate symbionts of crinoids. *Ceratocarcinus* White, 1847, now contains three species: *C. longimanus* White, 1847, *C. frontodentata* (Shen, Dai & Chen 1982), and *C. trilobatus* (Sakai, 1938). One species, *Ceratocarcinus spinosus* Miers, 1879, is referred to a new genus, *Tiaramedon*. *Harrovia* is redefined and now contains seven species: *H. albolineata* Adams & White, 1849, *H. cognata*, new species, *H. elegans* De Man, 1887, *H. japonica* Balss, 1921, *H. longipes* Lanchester, 1900, *H. ngi* Chen & Xu, 1992, and *H. tuberculata* Haswell, 1880. *Harrovia purpureus* Gordon, 1934, and *Harrovia egeriae* Gordon, 1947, are referred to two new genera, *Permanotus* and *Tauropus* respectively.

KEYWORDS. - Revision, Eumedonidae, crinoid symbionts, *Ceratocarcinus*, *Harrovia*, new genera, new species.

INTRODUCTION

The family Eumedonidae Dana, 1853, consists a group of marine crabs, all of which are symbiotic with echinoderms. Four genera are known obligate symbionts of featherstars (crinoids), viz. *Ceratocarcinus* White, 1847, *Harrovia* Adams & White, 1849, and *Rhabdonotus* A. Milne Edwards, 1879. Ng & Chia (1995) revised the genus *Rhabdonotus* and added two new species to the previously monotypic genus. Serène et al. (1958) had briefly discussed the taxonomy of some species of *Ceratocarcinus* and *Harrovia* but left many questions (especially the definition and composition of the two genera) open. More recently, Chia et al. (1993) dealt with the taxonomy of *Harrovia longipes* and *H. albolineata*, while Castro et al. (1995) clarified the identity of *Ceratocarcinus longimanus*.

The present paper revises the taxonomy of *Ceratocarcinus* and *Harrovia*. As a result, three species of *Ceratocarcinus* are now regarded as valid, viz. *C. longimanus* White, 1847, *C. frontodentata* (Shen, Dai & Chen 1982), and *C. trilobatus* (Sakai, 1938). One species, *Ceratocarcinus spinosus* Miers, 1879, is also transferred to a new genus, *Tiaramedon*. Seven species of *Harrovia* are here recognised, viz. *H. albolineata* Adams & White, 1849, *H. cognata*, new species, *H. elegans* De Man, 1887, *H. japonica* Balss, 1921, *H. longipes* Lanchester, 1900, *H. ngi* Chen & Xu, 1992, and *H. tuberculata* Haswell, 1880. *Harrovia japonica* had previously been regarded as a junior synonym of *H. elegans*. Two species previously assigned to *Harrovia* are transferred to new genera. *Harrovia purpureus* Gordon, 1934, is transferred to *Permanotus*, new genus, while *Harrovia egeriae* Gordon, 1947, is referred to *Tauropus*, new genus.

The term inner supraorbital tooth is equivalent to the lateral rostral lobule used by some workers. The abbreviations G1 and G2 are for the first and second male pleopods respectively. Measurements provided are of the carapace length and width respectively. carapace length (cl) was measured from the tip of the rostrum to the posterior margin of the carapace; carapace width (cb) from one antero-posterior angle to the other. A full description is only provided for the type species of each genus. Diagnoses are provided for the other species. The type species of each genus is discussed first and rest are treated alphabetically.

Specimens examined are deposited in: AM - Australian Museum, Sydney, Australia; BMNH - Natural History Museum (former British Museum (Natural History)), London, United Kingdom; BPBM - Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.; IOAS - Institute of Oceanology, Academia Sinica, Qingdao, China; MNHN - Muséum National d'Histoire Naturelle, Paris, France; NMW - Naturhistorisches Museum, Vienna, Austria; NRS - Naturhistoriska Riksmuseet, Stockholm, Sweden; QM - Queensland Museum, Brisbane, Australia; IRSNB - Institut Royal des Sciences Naturelles de Belgique/Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels, Belgium; RMNH - Nationaal Natuurhistorisches Museum (former Rijksmuseum van Natuurlijke Histoire), Leiden, Netherlands; SMF - Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt-am-Main, Germany; TMCD - Taiwan Museum (Crustacea Department), Taipei, Taiwan; USNM - United States National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.; WAM - Western Australian Museum, Perth, Australia; ZMUC - Zoological Museum, University of Copenhagen, Denmark; ZRC - Zoological Reference Collection, Department of Biological Sciences, National University of Singapore.

DESCRIPTIVE PART

GENUS *CERATOCARCINUS* WHITE, 1847

Ceratocarcinus White, 1847a: 125 [nomen nudum].

Ceratocarcinus White, 1847b: 57; White, 1847c: 61 [text identical to White, 1847b]; Adams & White, 1848-1849: 33; Neumann, 1878: 17; Miers, 1879a: 670; Miers, 1886: 104; Alcock, 1895: 286 [in key], 288; Flipse, 1930: 18, 20 [in key]; Gordon, 1934: 65, 67; Balss, 1957: 1631; Serène et al., 1958: 137, 168, 175, 231, 233; Sakai, 1976: 294 [in key], 300 [English text], 181 [Japanese text]; Takeda, 1979a: 69, 71; Wu, 1983: 65 [name in Chinese]; Stevcic et al., 1988: 1308, 1318; Dai et al., 1986: 162 [key only] [Chinese text], Dai & Yang, 1991: 179 [key only] [English text].

Harrovia - Stimpson, 1858: 221 (part); 1907: 32 (part); Balss, 1922: 136 (part); Sakai, 1938b: 329 [in key], 350 (part) [not *Harrovia* Adams & White, 1849].

Type species. - *Ceratocarcinus longimanus* White, 1847, by monotypy.

Etymology. - The name was derived from the Greek 'keratos' and 'carcinus' for 'horned crab'. Gender masculine.

Diagnosis. - Carapace pentagonal to quadrate, dorsal surfaces not distinctly convex; regions well defined; inner supraorbital teeth well developed, protruding well beyond frontal margin. Anterolateral and posterolateral margins clearly demarcated by angle; anterolateral margin usually lamelliform, with four teeth (including external orbital angle), first three teeth truncate, separated by deep, broad or narrow fissures or clefts, sometimes tightly adjoining each other and appearing fused, last anterolateral tooth always strong. Infraorbital and subhepatic teeth well developed. Antennules folding obliquely at about 45° from the horizontal. Second antennal segment elongate, length to width ratio of second antennal segment 4.2-5.7. Chelipeds granular to rugose; carpus usually with spine or distinct tubercle on inner angle; chelae elongated, length ca. 4 times length of fingers, height 4-5 times height of fingers; fingers not carinate, pollex not distinctly bent downwards. Dactylus of first ambulatory leg elongated, other segments subcylindrical, not cristate.

Remarks. - Stimpson (1858, 1907) synonymised *Harrovia* under *Ceratocarcinus*, noting that there were no clear characters separating them. This was followed by many subsequent workers like Balss (1922) and Sakai (1938) who followed Stimpson (1858, 1907). Serène et al. (1958) recognised both genera, distinguishing them almost entirely by the length of the inner supraorbital teeth, which in *Ceratocarcinus*, are very long, while in *Harrovia*, they are relatively short. Their decision was followed by workers such as Sakai (1976), Dai et al. (1986) and Dai & Yang (1991). Stevcic et al. (1988) recognised six species in the genus, viz. *C. dilatatus* A. Milne Edwards, 1872, *C. intermedius* Zehntner, 1894, *C. longimanus* White, 1847, *C. speciosus* Dana, 1851, *C. spinosus* Miers, 1879, and *C. trilobatus* Sakai, 1938.

The length of the inner supraorbital teeth, frontal lobes, as well as the shape of the carapace and structure of the anterolateral teeth, however, while sometimes useful in separating species, do not reliably distinguish the two genera. In fact, the carapace and rostral features of some species (e.g. *H. cognata*, new species, and *H. ngi*) are intermediate.

Serène et al. (1958) discussed the possible value of the length of the basal and second antennal segments in separating *Harrovia* and *Ceratocarcinus*, but did not use this character eventually. In *Harrovia*, the second antennal segment is always short (length to width ratio of second antennal segment 2.0-3.4, see Table 1) whereas in almost all *Ceratocarcinus* species, the second antennal segment is distinctly elongate and proportionately longer (length to width ratio of second antennal segment 4.2-5.7). Serène et al. (1958) commented, that while *C. spinosus* Miers, 1879, has a short second antennal segment (like *Harrovia*), its long inner supraorbital teeth and carapace features were clearly those of *Ceratocarcinus*. Serène et al. (1958) also felt that *Harrovia purpurea* Gordon, 1934, was clearly a species of *Harrovia* with an unusually short second antennal segment. This apparent inconsistency made Serène et al. (1958) decide against using this character.

The excellent series of specimens of *Ceratocarcinus* and *Harrovia* species examined in this study, however, show that the relative length of the second antennal segments is a reliable generic character that can be used to distinguish the two genera. With the present transfer of *Ceratocarcinus spinosus* and *Harrovia purpurea* to their own respective genera, the range of the length of second antennal segment does not overlap for all adult specimens of

Table 1. Ratio of length over breadth of second antennal segment of species of *Ceratocarcinus* White, 1847, *Harrovia* Adams & White, 1849, *Permanotus*, new genus, *Tauropus*, new genus, and *Tiaramedon*, new genus.

Species	Adults		Juveniles
	Range (n = sample size)	Mean	Range (n = sample size)
<i>Ceratocarcinus longimanus</i>	4.5-5.7 (n = 10)	4.9	3.5, 4.1 (n = 2)
<i>Ceratocarcinus frontodentata</i>	4.2-4.6 (n = 3)	4.3	—
<i>Ceratocarcinus trilobatus</i>	4.4-4.7 (n = 3)	4.6	3.4 (n = 1)
<i>Harrovia albolineata</i>	2.4-3.2 (n = 10)	3.0	2.2, 2.7 (n = 2)
<i>Harrovia cognata</i>	2.2-3.4 (n = 10)	2.6	2.3 (n = 1)
<i>Harrovia elegans</i>	2.3-3.1 (n = 10)	2.4	2.1 (n = 1)
<i>Harrovia japonica</i>	2.3-3.1 (n = 10)	2.6	2.0, 3.0 (n = 2)
<i>Harrovia longipes</i>	2.3-3.0 (n = 20)	2.7	1.9-2.6 (n = 5)
<i>Harrovia ngi</i>	2.0 (n = 1)	2.0	—
<i>Harrovia tuberculata</i>	2.7 (n = 1)	2.7	—
<i>Permanotus purpureus</i>	1.4-2.0 (n = 10)	1.7	1.9 (n = 1)
<i>Tauropus egeriae</i>	1.4 (n = 1)	1.4	—
<i>Tiaramedon spinosum</i>	1.3-2.0 (n = 10)	1.5	1.5 (n = 1)

Ceratocarcinus s. str. and *Harrovia* s. str. examined (Table 1). *Harrovia frontodentata* Shen, Dai & Chen, 1982, is not a *Harrovia* species as presently defined, and should be referred to as *Ceratocarcinus* instead (see below). Juveniles of *Ceratocarcinus* and *Harrovia* species do have slightly proportionately shorter second antennal segments although this is not always the case (Table 1). The character is certainly reliable for adults.

Ceratocarcinus spinosus, with a length to width ratio of the second antennal segment at 1.3-2.0 and its many other peculiar features, should not be included in either *Ceratocarcinus* or *Harrovia*. It is here transferred to a new genus, *Tiaramedon* (see Remarks for *Tiaramedon*). *Harrovia purpurea*, with its folded frontal margin and inner supraorbital teeth, fused anterolateral lobes, almost straight G1 and short second antennal segment (length to width ratio 1.4-2.0) is also transferred to a new genus, *Permanotus* (see Remarks for *Permanotus*).

Using the character of the second antennal segment, some species, namely *H. ngi* Chen & Xu, 1992, and *H. cognata*, new species, although having carapace shapes similar to those of *Ceratocarcinus* species, are now placed in *Harrovia*. Similarly, we refer *Harrovia frontodentata* to *Ceratocarcinus*. This species has a carapace which resembles those of typical *Harrovia* species but the structure of its antennal segment argues for its inclusion in *Ceratocarcinus* instead. The present revision restricts *Ceratocarcinus* to only three species, *C. longimanus* White, 1847, *C. frontodentata* (Shen, Dai & Chen, 1982), and *C. trilobatus* Sakai, 1938. *Ceratocarcinus dilatatus*, *C. intermedius* and *C. speciosus* have been shown to be junior synonyms of *C. longimanus* (see Castro et al., 1995).

KEY TO THE SPECIES OF *CERATOCARCINUS*

1. Inner supraorbital teeth broader than long; anterolateral lobes not fused or callositised; no large tubercles on protogastric, metagastric, branchial and cardiac regions of carapace *C. frontodentata* (Shen, Dai & Chen, 1982), new combination

- Inner supraorbital teeth as long as broad or longer than broad; anterolateral lobes might be fused, tuberculated or callose; very large tubercles on protogastric, metagastric, branchial and cardiac regions of carapace 2
- 2. Inner supraorbital teeth almost as long as broad; very large tubercles on protogastric, metagastric, branchial and cardiac regions of carapace; anterolateral lobe 1-3 truncate, lobe 1 free, 2 and 3 always fused and lightly callositised, lower part of lobe 3 laterally directed, lobe 4 very prominent, laterally directed, lower part expanded, abrupt, plate-like; distinct angle between anterolateral and posterolateral margins; all surfaces heavily tuberculated.....
..... *C. trilobatus* (Sakai, 1938)
- Inner supraorbital teeth longer than broad; large tubercles on protogastric, metagastric, branchial and cardiac regions of carapace; anterolateral lobe 1-3 truncate, seldom fused with callosities, lower part of lobe three not often expanded to direct laterally except in very large specimens, lobe 4 very prominent, laterally directed; angle between anterolateral and posterolateral margins not as distinct; surfaces not as strongly tuberculated..... *C. longimanus* White, 1847

***Ceratocarcinus longimanus* White, 1847**

(Figs. 1, 2)

Ceratocarcinus longimanus White, 1847a: 125 [nomen nudum] (type locality 'Eastern Seas (Balambangan)' = Borneo: Sabah, Malaysia).

Ceratocarcinus longimanus White, 1847b: 57 (type locality 'northcoast of Borneo (Balambangan)' = Borneo: Sabah, Malaysia); White, 1847c: 62 (text identical to White, 1847b); Adams & White, 1848-1849: 34, pl. 6: Figs. 6, 6a [colour plate] (Sabah, Malaysia); Miers, 1886: 105 (Aru Islands, Indonesia); Alcock, 1895: 288 (Straits of Malacca); Balss, 1922: 136 (list only); Flipse, 1930: 76, 77, 80, 90 (list only); Roxas, 1930: 18 (Mindoro island, Philippines); Gordon, 1934: 69, Fig. 33a (Borneo, holotype re-examined; Banda Islands, Moluccas = Maluku Islands, Indonesia); Estampador, 1937: 559 (list only); Serène et al., 1958: 175 [in key], 184, 232 [as *G. longimanus*], 233, Figs. 4A, 4B, 6, pl. 4: Fig. B (on unidentified comatulid crinoid; Nhatrang, Vietnam); Estampador, 1959: 121 (list only); Serène & Romimohtarto, 1963: 5, Figs. 1B, 3 [male first pleopod]; pl. 1: Fig. C (Nusalenga, Moluccas = Maluku Islands, Indonesia); Serène, 1968: 63 (list only); Monod & Serène, 1976: 27 (on unidentified comatulid crinoids; list only); Serène et al., 1976: 16 (Moluccas = Maluku Islands, Indonesia); Yang, 1979: 11 (Mindoro island, Philippines); Stevcic et al. 1988: 1308 (on unidentified comatulid crinoid; Townsville, Queensland, Australia); Takeda, 1989: 150, Fig. 9B (on unidentified comatulid crinoid; Oshima Passage, Amami Islands, Nansei (Ryukyu) islands, Japan); Fabricius & Dale, 1993: 43, 45 (on *Comanthus gisleni* Rowe et al., *C. parvicirrus* (Müller) & *Comatula purpurea* (Müller)), central Great Barrier Reef, Queensland, Australia); Castro et al., 1995: 239, Fig. 1 (India, Malaysia, Indonesia, Papua New Guinea, Australia, New Caledonia, Solomon Islands, Fiji, Palau, Philippines, Japan; on comatulids, zygometrids and himerometrids).

Ceratocarcinus speciosus Dana, 1851: 274 (type locality 'Archipelago Vitiensis' = Viti Levu island, Fiji; on unidentified comatulid crinoid); Dana, 1852: 139, pl. 6: Fig. 8 (no new record); Miers, 1886: 105 (list only); Balss, 1922: 136 (list only); Flipse, 1930: 80, 90 (list only); Balss, 1938: 25 (Viti Levu island, Fiji); Serène et al., 1958: 175 [in key], 234, Fig. 4F (list only); Serène, 1968: 63 (list only); Stevcic et al., 1988: 1308 (list only).

Ceratocarcinus dilatatus A. Milne Edwards, 1872: 256, pl. 14: Figs. 2, 2a, 2b (type locality New Caledonia); Miers, 1886: 105 (list only); Walker, 1887: 109 (Singapore); De Man, 1887-1888: 230, 585 (Ambon, Moluccas = Maluku Islands, Indonesia); McCulloch, 1913: 338 (Murray Island, Torres Strait, Queensland, Australia); Rathbun, 1918: 29 (Double Island Point, Queensland, Australia); Hale, 1927: 143, Fig. 146 (Great Australian Bight, South Australia); Flipse, 1930: 71, 76, 77, 80, 90, Figs. 5, 6 (Postillon Island = Sabalana Island, Indonesia); Balss, 1957: Fig. 1189 (list only); Serène et al., 1958: 175 [in key], 233, Fig. 4C (list only); Griffin & Yaldwyn, 1968: 171 (list only); McNeill, 1968: 9, 49 (off Lookout Point, Queensland, Australia); Serène, 1968: 63 (list only); Stevcic et al., 1988: 1308 (on *Zygometa* sp., Roebuck Bay, Western Australia).

Ceratocarcinus intermedius Zehntner, 1894: 141, pl. 7: Figs. 1, 1a, 1b (type locality Ambon, Moluccas = Maluku Islands, Indonesia); Balss, 1922: 136 (list only); Flipse, 1930: 76, 77, 80, 90 (list only); Serène et al., 1958: 175 [in key], 233, Fig. 4D (list only); Serène, 1968: 63 (list only); Stevcic et al., 1988: 1308 (list only).

Ceratocarcinus sp. - Mather & Bennet, 1984: 66 (Heron Island, Queensland, Australia).

Material examined. - **Indonesia:** 1 female (20.0 by 14.3 mm) (MGE), Amboina, coll. Voyage Bedot Picket (holotype of *C. intermedius* Zehntner, 1894). **Vanuatu:** 1 female (MNHN B25594), Station CP1131, 15°38.41'S, 167°03.52'E, coll. MUSORSTOM 8, N/O 'Alis', 11 Oct. 1994. - 1 male (MNHN B25595), Station DW976, 19°25.22'S, 169°26.73'E, coll. MUSORSTOM 8, N/O 'Alis', 22 Sep. 1994. **Philippines:** 1 female (USNM 50879), station 5142, Jolo Island, vicinity of Jolo, 21 fms, coll. ALBATROSS Philippine Expedition, 15 Feb. 1908. - 1 male, 1 female (USNM 50880), Marengas Island, vicinity of Jolo, coll. ALBATROSS Philippine Expedition, 10 Feb. 1908. **Palau (= Belau):** 1 male, 1 female (USNM 134387), from green and yellow crinoid, Caroline Islands, coll. F. M. Bayer, 22 Oct. 1955. **Unknown locality:** 1 male (ZRC 1989.2050), from crinoid in aquarium at Singapore aquarium, possibly from Philippines, coll. P. K. L. Ng, May 1986. (For types of *C. longimanus* White, 1847, *C. speciosus* Dana, 1851, *C. dilatatus* A. Milne Edwards, 1872, and additional material from India, Singapore, Malaysia, Indonesia, Papua New Guinea, Australia, New Caledonia, Solomon Islands, Fiji, Palau, Philippines and Japan, see Castro et al., 1995).

Description. - Carapace quadrate, distinctly broader than long in all except juveniles; frontal margin short, distinctly deflexed downwards; inner supraorbital teeth well developed, longer than broad, produced well beyond edge of frontal margin; regions well defined, protogastric, metagastric, branchial and cardiac regions with well developed tubercles of varying degrees, more prominent in adults, tubercles covered with callosities in large individuals; surfaces of carapace relatively smooth, covered with scattered small granules coarser in larger adults; dorsal surface of carapace usually covered with very thin pubescence, with longer setae on protogastric tubercles. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin lamelliform, with four lobes (including external orbital angle), first three lobes (especially the third) truncate, usually well defined, separated by narrow fissures, tightly adjoining each other, sometimes appearing fused, lower part of third lobe might be laterally directed, fourth lobe especially well developed, long, sharp, laterally directed. Antennules folding obliquely, ca. 45° from horizontal; antennular fossae oblique. Antenna free, does not fill orbital hiatus, reaching into orbit; antennal basal segment rectangular; length to width ratio of second antennal segment 4.5-5.7. Eyes well developed, filling orbit; cornea distinct, pigmented; infraorbital teeth very large. Anterior surface of epistome depressed; posterior margin appears entire because of 2 fused truncate median lobes. Pterygostomial, subhepatic, suborbital regions mildly granulated. Third maxilliped quadrate; ischium rectangular, median oblique sulcus shallow; merus squarish; exopod just reaches antero-external edge of merus. Sutures between thoracic sternite segments 1 and 2 indistinct, 2 and 3 distinct, shallow; between 3 and 4 interrupted medially; lateral clefts small. Abdomen 7 segmented, sutures for all segments visible. Chelipeds elongate, cylindrical; surfaces granular; carpus with sharp spine or low, rounded tubercle on inner distal angle; chelae elongated, length ca. 4 times length of fingers, height ca. 4-5 times of height of fingers; fingers not carinate, pollex does not bend downwards. Dactylus of first ambulatory leg elongated, other segments subcylindrical, not cristate; anterior margin of ambulatory meri sometimes tuberculated. G1 long, slender, distal part lined with short spines, tip bends at approximately 90°. G2 relatively short, distal segment short.

Sexual dimorphism. - Males have disproportionally larger and stouter chelipeds when compared to females.

Remarks. - After examining a large series of specimens, Castro et al. (1995) showed that *C. dilatatus* A. Milne Edwards, 1872, *C. intermedius* Zehntner, 1894, and *C. speciosus* Dana, 1851, are junior synonyms of *C. longimanus* White, 1847. Castro et al. (1995) have already discussed in detail the synonymy and variation of the species. Castro et al. (1995) could not

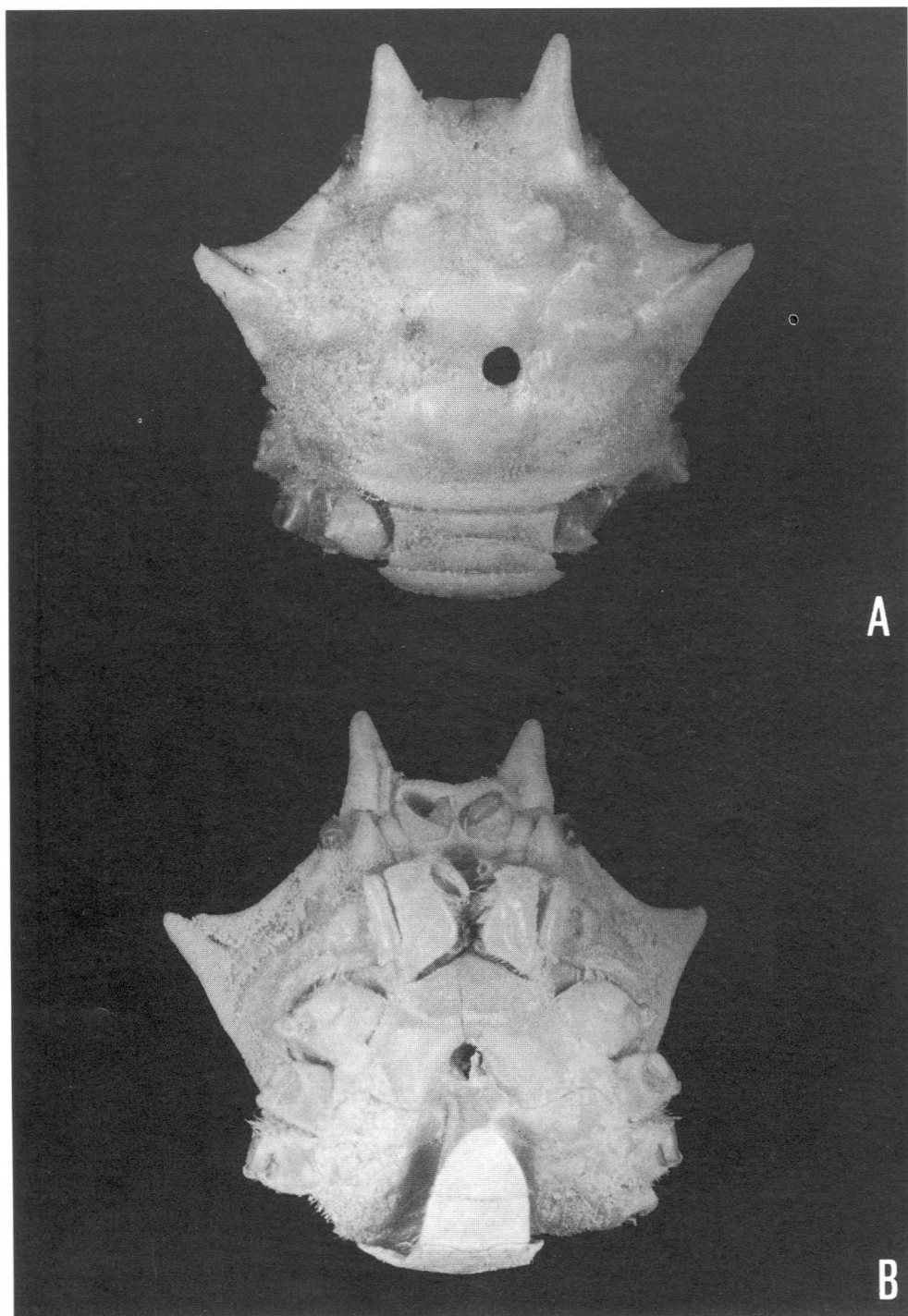


Fig. 1. *Ceratocarcinus longimanus* White, 1847. Holotype male, 8.0 by 6.6 mm (BMNH 1939.9.20.7). A, dorsal view; B, ventral view (circle indicate ex-position of pin).

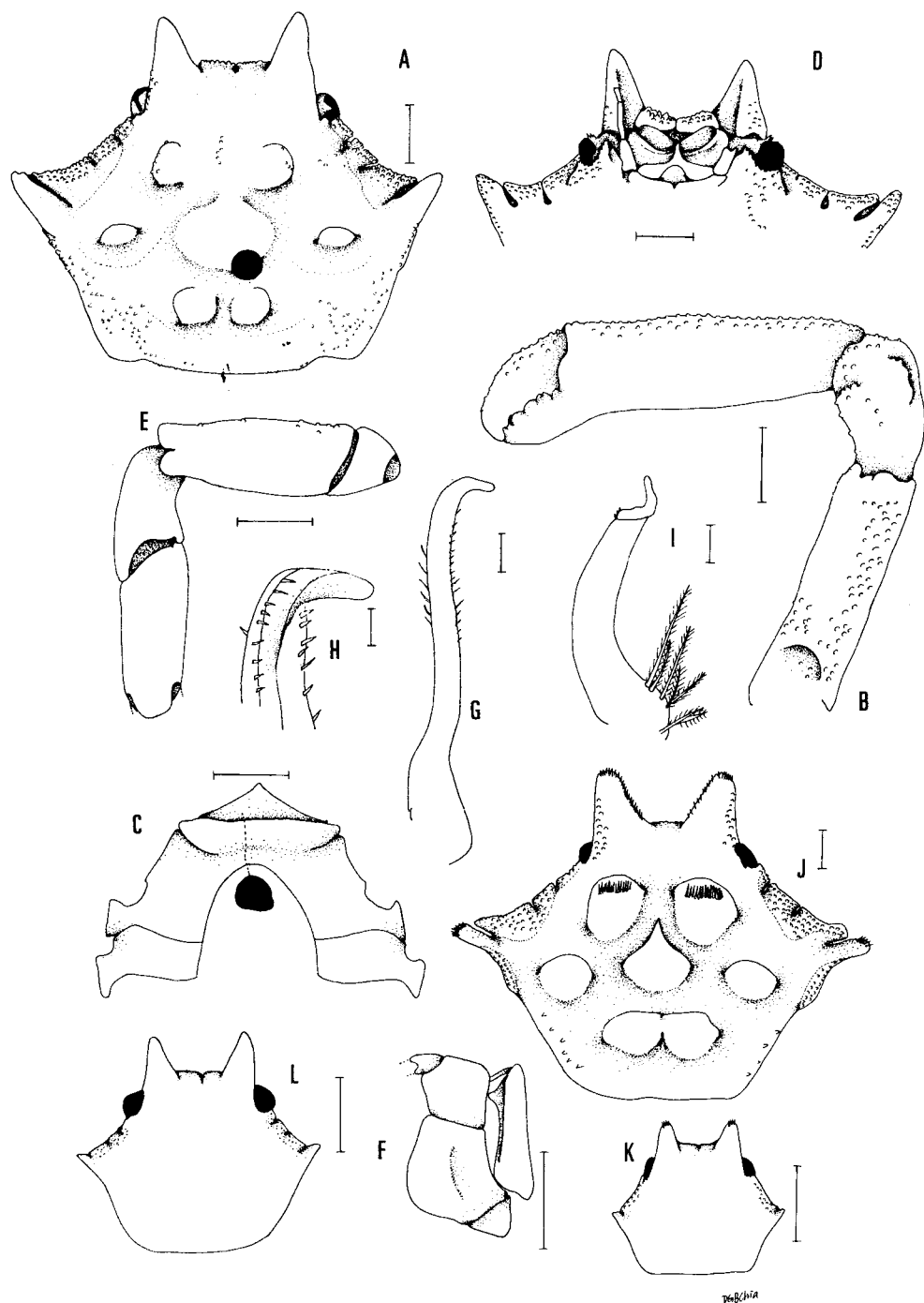


Fig. 2. *Ceratocarcinus longimanus* White, 1847. A-I, holotype male, 8.0 by 6.6 mm (BMNH 1939.9.20.7); J, female, 7.8 by 12.0 mm (MNHN B24738a); K, juvenile male, 2.0 by 2.5 mm, (MNHN B24738d); L, juvenile male, 3.4 by 3.6 mm (NRS 14396). A, dorsal view of carapace (solid circle indicates ex-position of pin); B, postero-dorsal view of right cheliped; C, thoracic sternum (solid circle indicates ex-position of pin; dotted line indicates a crack); D, face of carapace; E, fourth left ambulatory leg; F, left third maxilliped; G, left G1; H, distal tip of left G1; I, left G2. Scales: A-G, J-L = 1.0 mm; H-I = 0.1 mm (fide Castro et al., 1995)

examine the type of *C. intermedius* Zehntner, 1894, but argued that from the description and figures, it was clearly a synonym of *C. longimanus*. We have since managed to obtain the type on loan. The holotype is a large female 20.0 by 14.3 mm in excellent condition and agrees very well with the descriptions of *C. longimanus* by Castro et al. (1995). Most of the dorsal surface of the carapace of this specimen is distinctly pubescent except for the more glabrous anterolateral and highest parts of the regions. The swollen gastric regions have tufts of longer, coarser setae.

Larvae. - The first zoeae have been obtained by P. Castro (pers. comm.) and will be described at a later date.

Host records. - The ecology of this species has been reviewed by Castro et al. (1995).

Distribution. - *Ceratocarcinus longimanus* has been recorded from the Ryukyu Islands, southern Japan to as far west as the Nicobar Islands in the Andaman Sea and as far east as Fiji. Two specimens presumably from South Australia (Hale, 1927) represent the only record (indeed of any eumedonid) collected from outside the Indo-West Pacific region.

***Ceratocarcinus frontodentata* (Shen, Dai & Chen, 1982), new combination**
(Figs. 3, 4)

Harrovia frontodentata Shen, Dai & Chen, 1982: 146 [Chinese text], 149 [English text], Figs. 5-12 5-14, pl. 3: Fig. 13 [type locality Haimen, Guandong Province, China]; Dai et al., 1986: 165, Fig. 97, pl. 22: Fig. 5 [list only]; Stevcic et al., 1988: 1312; Dai & Yang, 1991: 183, Fig. 97, pl. 22: Fig. 5 [list only].

Material examined. - Holotype: male (6.9 by 8.8 mm) (IOCAS C901), Haimen, Guandong Province, coll. 7 May 1957.

Paratype: Male (6.0 by 7.1 mm) (IOCAS C902), same data as holotype.

Others: **China:** 1 female (7.7 by 9.4 mm) (BMNH), Foochow (= Fuzhou), coll. Ms. Clark, presented by Dr. Cheng, Fujian University.

Diagnosis. - Carapace quadrate, broader than long; rostrum short, slightly deflexed downwards; inner supraorbital teeth developed, broader than long, produced slightly beyond edge of frontal margin; regions well defined; surfaces of carapace relatively smooth, covered with scattered small granules; dorsal surface of carapace usually covered with very thin pubescence; protogastric, metagastric, branchial and cardiac regions mildly raised. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin lamelliform, with four lobes (including external orbital angle), first three lobes truncate, separated by gaps, mildly tuberculated, fourth lobe conical; posterolateral margin lined with many minute spines. Pterygostomial region granulated, subhepatic and suborbital regions not as granulated. Chelipeds elongate; surfaces very granular; carpus without tubercle on inner distal angle; fingers not carinate, pollex does not bend downwards. G1 slender, long.

Sexual dimorphism. - Not known.

Remarks. - This is a poorly known species, known only from southern China. First described by Shen et al. (1982) on the basis of two males as a *Harrovia*, it is transferred to *Ceratocarcinus* in the present study on the basis of its long second antennal segment (Table

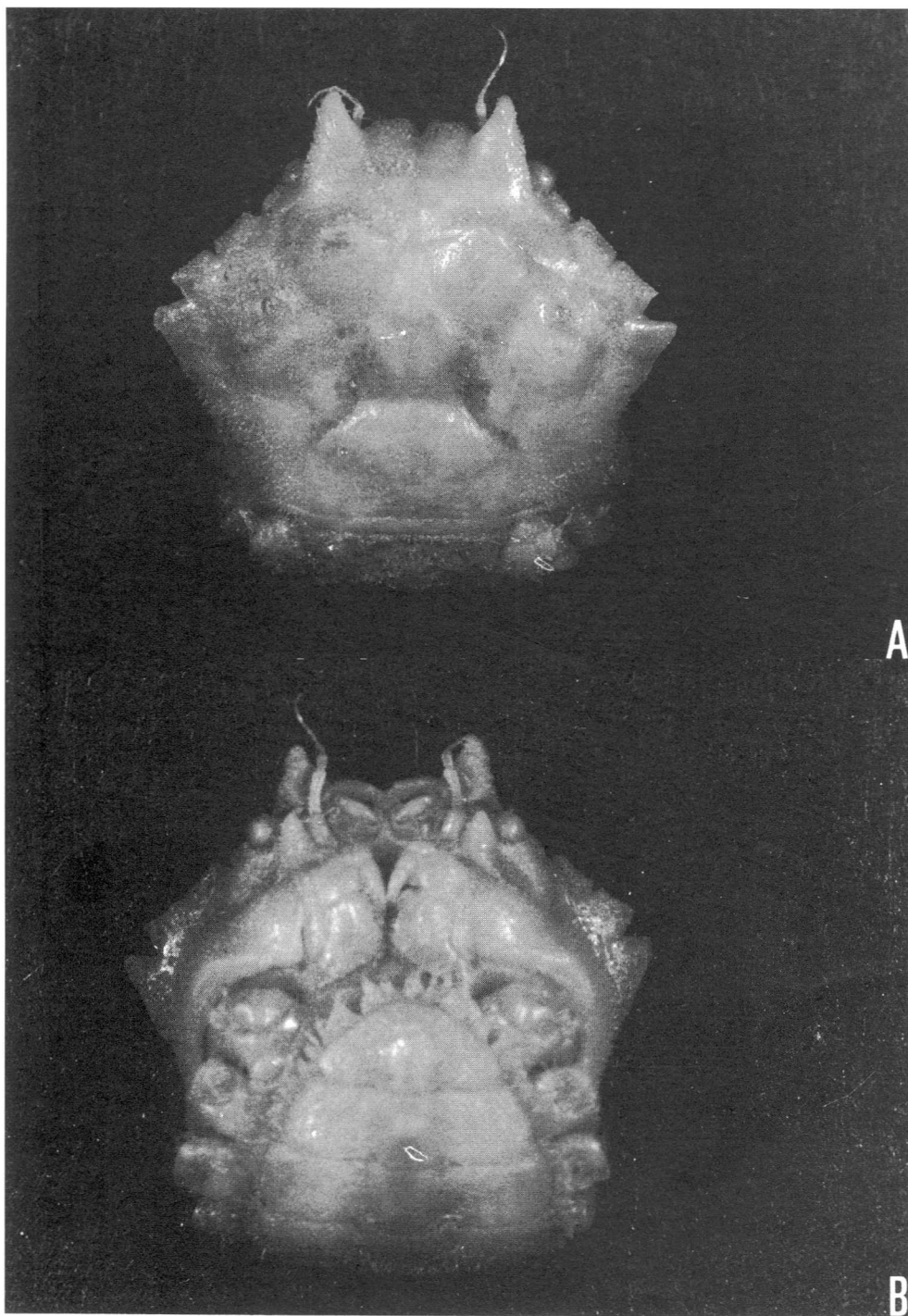


Fig. 3. *Ceratocarcinus frontodentata* (Shen, Dai & Chen, 1982), new combination. Female, 7.7 by 9.4 mm (BMNH): A, dorsal view; B, ventral view.

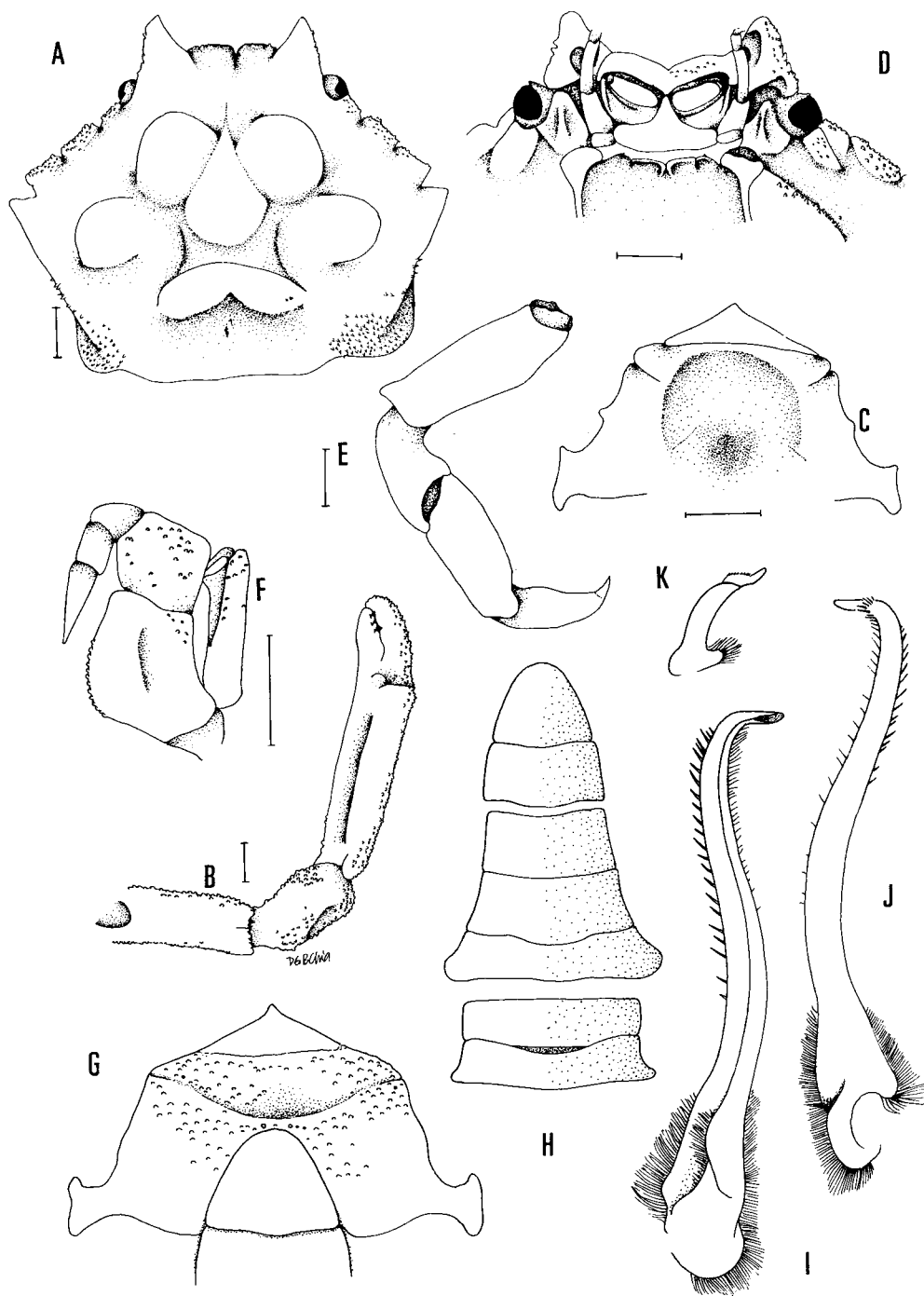


Fig. 4. *Ceratocarcinus frontodentata* (Shen, Dai & Chen, 1982), new combination. A-F, female, 7.7 by 9.4 mm (BMNH); G-J, holotype male, 6.9 by 8.8 mm (IOCAS C901): A, dorsal view of carapace; B, postero-dorsal view of right cheliped; C, thoracic sternum; D, face of carapace; E, only ambulatory leg (number cannot be determined); F, left third maxilliped; G, anterior thoracic sternites; H, abdomen; I, J, left G1. Scales = 1.0 mm.

1). The authorship for the species has been cited as Chen & Dai, in Shen, Dai & Chen, 1982, by some workers but the publication (Shen et al., 1982) was in actual fact a joint publication between Shen, Dai and Chen. The correct authorship for the species should thus be Shen, Dai & Chen (see Ng, 1994).

Although *C. frontodentata* has a relatively long second antennal segment, the carapace closely resembles those of *Harrovia* species with regards to the carapace proportions (almost as broad as long), broader than long inner supraorbital teeth and a less ornamented carapace.

The two type specimens agree with each other in all major aspects. The BMNH specimen is relatively soft and seems to have moulted just before it was collected. Therefore, some regions of the carapace which are not yet fully inflated (e.g. the left four anterolateral lobe and the sternum) which may be due to this. However, it agrees well with the types in almost all aspects.

Distribution. - Southern China only. Two species of *Ceratocarcinus* have been found so far in the southern waters of China, i.e. *C. trilobatus* and *C. frontodentata*.

***Ceratocarcinus trilobatus* (Sakai, 1938)**

(Figs. 5, 6)

Harrovia trilobata Sakai, 1938b: 351, 360, text-Fig. 55 [type locality Simoda (= Shimoda), Izu Peninsula, Honshu island, Japan]; Sakai, 1940: 56 [list only]; Sakai, 1956: 26 [appendix list; list only]; 1957: 698, Fig. 2018 [list only].

Ceratocarcinus trilobata - Serène et al., 1958: 172, 174, 175 [in key], 234; Sakai, 1965: 101, pl. 46: Fig. 1 [English text], 42 [Japanese text] [Honshu island, Japan].

Ceratocarcinus trilobatus - Serène, 1968: 63 [list only]; Nishimura & Suzuki, 1971: 112, pl. 39: Fig. 4 [list only]; Takeda, 1975: 130 [colour photograph, list only]; Sakai, 1976: 300 [in key], 301, text-Fig. 169 [English text], 181, 182 [Japanese text]; pl. 100: Fig. 2 [Honshu island, Japan]; Takeda, 1982: 137, Fig. 405 [list only]; Miyake, 1983: 212 [list only]; Wu, 1983: 65 [name in Chinese]; Dai et al., 1986: 164, Fig. 96, pl. 22: Fig. 4 [Fujian Province, southern China]; Masuda et al., 1986: 141 [colour photograph; list only]; Nishimura & Ito, 1987: 137 [colour photograph; list only]; Stevcic et al., 1988: 1309 [list only]; ?Morton, 1989: 20, 118, pl. 2 [Hong Kong]; Dai & Yang, 1991: 182, Fig. 96, pl. 22: Fig. 4 [list only].

Material examined. - **Japan:** 1 male (10.2 by 13.4 mm) (USNM 50888), Hirado, Hizen, coll. Y. Hirare. - 1 young female (ZRC 1997.150), Kushimoto, 10 m, with *Comanthus* sp., coll. S. Nagai, Feb. 1988. - 1 female (SMF TS00062), Nagai, Hayama, Kanagawa, coll. T. Sakai. - 1 male (7.9 by 9.7 mm) (SMF ZMGTS00405), Izu, Ohshima, Habu Minata, coll. T. Sakai.

Diagnosis. - Carapace quadrate, distinctly broader than long; rostrum short, distinctly deflexed downwards; inner supraorbital teeth developed, as long as broad, produced beyond edge of frontal margin; regions well defined; surfaces of carapace relatively smooth, covered with scattered small granules; dorsal surface of carapace usually covered with very thin pubescence; protogastric, metagastric, branchial and cardiac regions with well-developed tubercles of varying degree. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin lamelliform, with four lobes (including external orbital angle), first three lobes truncate, lobe one and two separated by a gap, second and third lobes appearing fused and more tightly adjoined, lower part of third lobe elongated and laterally directed, fourth lobe especially well developed, long, sharp, laterally directed, lower part expanded, abrupt, plate-like; posterolateral margin lined with numerous small spines. Pterygostomial, subhepatic, suborbital regions highly granulated. Chelipeds elongate; surfaces very granular, rugose;

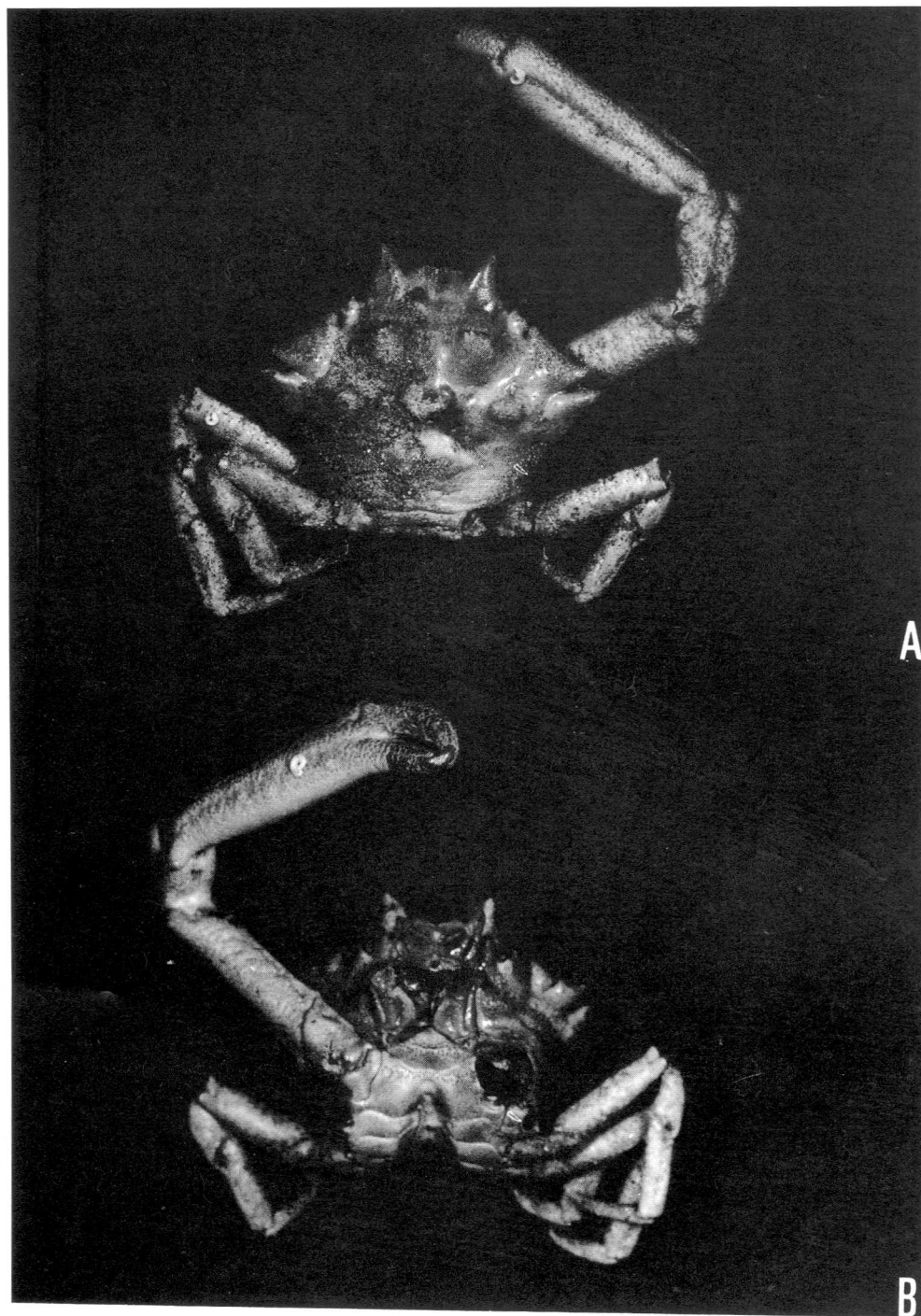


Fig. 5. *Ceratocarcinus trilobatus* (Sakai, 1938). Male, 10.2 by 13.4 mm (USNM 50888). A, dorsal view; B, ventral view.

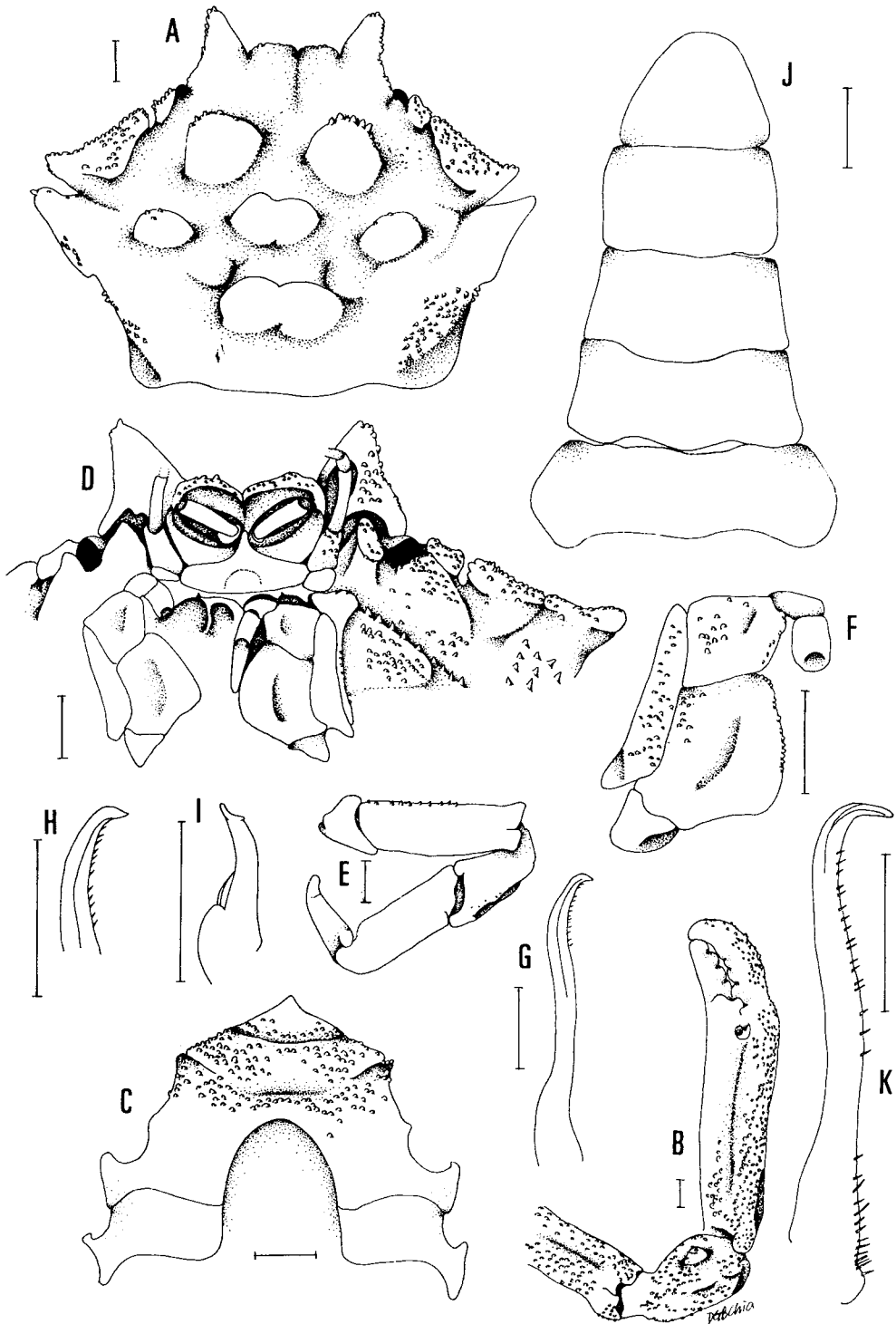


Fig. 6. *Ceratocarcinus trilobatus* (Sakai, 1938). A-J, Male, 10.2 by 13.4 mm (USNM 50888); K, male, 7.9 by 9.7 mm (SMF ZMGTS00405). A, dorsal view of carapace; B, postero-dorsal view of right cheliped; C, thoracic sternum; D, face of carapace; E, fourth right ambulatory leg; F, right third maxilliped; G, left G1; H, distal tip of left G1; I, left G2; J, abdomen (segment 3-7). Scales: A-G, I-K = 1.0 mm; H = 0.1 mm.

carpus with low, rounded tubercle on inner distal angle; fingers not carinate, pollex does not bend downwards. G1 long, slender.

Sexual dimorphism. - Males have disproportionally larger and stouter chelipeds as compared to females.

Remarks. - This is an uncommon species, known only from Japan and the southern coast of China. First described by Sakai (1938) in *Harrovia*, it was subsequently transferred to *Ceratocarcinus* by Serène et al. (1938: 172, 174-5) on the basis of its long inner supraorbital teeth and carapace proportions. Morton's (1989) figure is viewed with some doubt due to it being too schematic and having a seemingly highly inflated carapace. Thus its identity cannot be verified. With a record from Fujian, southern China (Dai et al., 1986), it is, however, not surprising that *C. trilobatus* can be found in Hong Kong as well.

The present study agrees with the prognosis of Serène et al. (1938: 172, 174-5) that this species belongs to *Ceratocarcinus* on the basis of its long second antennal segment and carapace proportions. *Ceratocarcinus trilobatus*, however, does closely resemble some larger specimens of *C. longimanus* (e.g. SMF ZMG685). However, in *C. trilobatus*, the inner supraorbital teeth are never as long as those of *C. longimanus*, its anterolateral lobes two and three are always fused even in juveniles and the lower part of lobe three is always laterally directed and reaching laterally as far as lobe four which is conical in shape.

Host records. - *Ceratocarcinus trilobatus* has always been collected from comasterids, although there is a questionable reference to its presence on *Dendronephthya*, a soft coral (Sakai, 1938; (Dai & Yang, 1991).

Distribution. - *Ceratocarcinus trilobatus* has only been recorded from Japan and southern China. There seems to be no overlap in the distribution of the *C. longimanus* and *C. trilobatus*. The former has never been reported from China and in Japan, being known only from the Ryukyu Islands (Takeda, 1989). As for *C. trilobatus*, it has been reported from China, southern Honshu and Kyushu (Japan) but not from the Ryukyus as yet.

TIARAMEDON, NEW GENUS

Ceratocarcinus Miers, 1879a: 670; Miers, 1886: 104; Alcock, 1895: 286 [in key], 288; Flipse, 1930: 18, 20 [in key]; Gordon, 1934: 65, 67; Balss, 1957: 1631; Serène et al., 1958: 137, 168, 175, 231, 233; Sakai, 1976: 294 [in key], 300 [English text], 181 [Japanese text]; Takeda, 1979a: 69, 71; Wu, 1983: 65 [name in Chinese]; Stevcic et al., 1988: 1308, 1318; Dai et al., 1984: 162 [key only] [Chinese text]; Dai & Yang, 1991: 179 [English text] [not *Ceratocarcinus* White, 1847].

Harrovia - Stimpson, 1858: 221 (part); Stimpson, 1907: 32 (part); Balss, 1922: 136 (part); Sakai, 1938b: 329 [in key], 350 (part) [not *Harrovia* Adams & White, 1849].

Type species. - *Ceratocarcinus spinosus* Miers, 1879, by present designation. Gender of genus is masculine.

Etymology. - The name is derived from 'Eumedon', and alludes to the tiara-like appearance of the type species. Gender neuter.

Diagnosis. - Regions of carapace well defined, protogastric, metagastric, branchial and cardiac regions strongly produced into dorsally directed spines, length of spines varies, protogastric spines always longest. Frontal lobes triangular, very narrow, small, strongly deflexed, beak-

like from dorsal view, appearing fused at times with visible suture. Inner supraorbital teeth very well developed, produced well beyond frontal margin, almost 1.5 times longer than broad, obscuring most of frontal margin. Anterolateral and posterolateral margins clearly demarcated, anterolateral margin sublamelliform, entire, without trace of teeth or lobes; lateral carapace tooth strong, sharp and long. Antennules folding obliquely, ca. 45° from horizontal. Length to width ratio of second antennal segment 1.3-2.0. Chelipedal merus and basis-ischium unarmed; carpus with sharp spine on inner distal angle and distinct tooth on outer distal angle; distal dorsal margin of palm with distinct elongate tooth. Meri of all ambulatory legs with strong tooth on subdistal dorsal margin; merus of first ambulatory leg more slender than that of others, unarmed, not cristate; first ambulatory dactylus more elongate and slender, ca. 1.3 times that on other legs.

Remarks. - Serène et al. (1958), while noting that *C. spinosus* had an antenna very different from that of typical *Ceratocarcinus* species, commented that it was in all other respects, a species of *Ceratocarcinus*. In the long inner supraorbital teeth, well developed lateral tooth and ornamented carapace, *C. spinosus* indeed resembles *Ceratocarcinus*. But in the form of the antenna (with the very short second segment), extreme elongation of the protogastric teeth into long spines (vs. swollen tubercles, never spiniform in *Ceratocarcinus*), the triangular frontal lobes, shape of the male abdomen (proportionately broader) as well as the shorter, stouter and more sinuous G1, *C. spinosus* is clearly not congeneric with *C. longimanus*, the type species of *Ceratocarcinus*. A new genus, *Tiaramedon* has therefore been established for *C. spinosus* (Miers, 1879).

***Tiaramedon spinosum* (Miers, 1879), new combination**
(Figs. 7, 8)

Ceratocarcinus spinosus Miers, 1879b: 2, 27, pl. 5: Fig. 11 [type locality 'Eastern Seas']; Balss, 1922: 136 [list only]; Balss, 1924: 2 [Red Sea]; Balss, 1929: 25 [list only]; Flipse, 1930: 72, 76, 77, 80, 90 [Paternoster = Sabalana Island, Flores Sea, Indonesia]; Gordon, 1934: 65, 66, Figs. 33b, b1 [holotype re-examined; Red Sea]; Sakai, 1938a: 54, Fig. 1 [Honshu island, Japan]; Balss, 1940: Fig. 42 [list only]; Sakai, 1953: 74 [Hachijo Island, Japan]; Sakai, 1956: 26 [appendix list], fig 68 [list only]; Serène et al., 1958: 175 [in key], 176, 234, Figs. 4E, 5, pl. 5 [Spratly Islands, South China Sea]; Guinot, 1966: 299, 312 [list only]; Suzuki & Kurata, 1967: 97, pl. 8: Fig. 4 [Oshima Island, Japan]; Serène, 1968: 63 [list only]; Fishelson, 1973: 467, Fig. 4b [Red Sea]; Fishelson, 1974: 188, Fig. 10 [specimens of Fishelson, 1973]; Sakai, 1976: 300 [in key], text-Fig. 168 [English text], 181 [Japanese text] [Honshu island, Japan]; Serène et al., 1976: 16 [Moluccas = Maluku Islands, Indonesia]; Monod & Serène, 1976: 27 [list only]; Hwang & Yu, 1980: 153, pl. 4: Fig. 3 [Taiwan]; Miyake, 1983: 56, 212, pl. 19: Fig. 6 [list only]; Wu, 1983: 65 [name in Chinese]; Stevcic et al., 1988: 1309 [list only].

Material examined. - Holotype: juvenile (3.6 by 4.0 mm) (BMNH 62.53), Australia sea, coll. H.M.S. Herald.

Others: **Red Sea:** 1 male (NMW 1820), Pola expedition, coll. Museum Vindobonensis. - 1 female (BMNH 1928.6.7.3), coll. Meinertzhagen. **Israel:** 2 juveniles (RMNH 26997), Eilat, Gulf of Akaba, coll. L. Fishelson, 20 Feb. 1966. - 1 male (RMNH 19938) (heavily damaged by fungus), Eilat, Gulf of Akaba, on *Lamprometra klunzingeri*, coll. L. Fishelson, 23 Mar. 1964. **Indian Ocean:** 1 male (AM P21801), Christmas Island, 10°30'S, 105°40'E, coll. Slack-Smith & Paterson, Sep. 1969. **East Malaysia:** 1 juvenile (ZRC 1997.202), Hanging Gardens, Sipadan, Sabah, on *Comanthus parvicirra*, coll. D. Lane, 25 May 1992. **Indonesia:** 1 juvenile male, 1 female (MNHN B24767), Siladen, Manado, Indonesia, 10-12 m, on crinoid, coll. P. Castro, 20 Sep. 1992. - 1 female (RMNH), lagoon, Bay of Sanggar, north of Sumbawa Island, Snellius II station 4.114, 8°19.2'S 118°14.4'E, scuba diving/snorkeling, side of barrier reef, 21/22 Sep. 1984. - 1 female (RMNH), NE Cape, Komodo Island, Snellius II station 4.096, 30 m, scuba diving/snorkeling, edge of narrow coastal reef, sloping down

to sandy bottom, 8°29'S 119°34.1'E, 19 Sep. 1984. **Papua New Guinea:** 1 male (ZRC 1997.203), Reef crest, Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, on *Clarkcomanthus littoralis*, coll. P. Castro, 16 Dec. 1993. - 1 female (ZRC 1997.204), Reef crest, Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, on *Comanthus suavia*, coll. P. Castro, 18 Dec. 1993. - 1 male (MNHN B24748), Wongad Island, Madang, 3-6 m, on *Clarkcomanthus littoralis*, coll. P. Castro, 16 Dec. 1993. **Australia:** 1 male (WAM 108-93), Sandy Island, East of Gun Island, Pelsart Gr., Abrolhos Islands, Western Australia, coll. L. Marsh, F. Wells & C. Bryce, 4 Apr. 1976. - 1 male (9.9 by 9.9 mm) (WAM 105-93), east of North Scott Reef, Western Australia, coll. L. Marsh, 14 Sep. 1984. - 1 male (8.0 by 8.6 mm) (WAM 98-93), west side of Clarke Reef, Rocky Shoals, Western Australia, on crinoid reef flat, coll. WAM Party, Jul. 1982. **New Caledonia:** 1 male (MNHN B25649), 23°24.86's, 168°05.72'E, SMIB8, DW186, 57 m, coll. MUSORSTOM, 31 Jan. 1993. **Niue:** 1 male (BPBM), site HNIUE-13, on crinoid. **Unknown locality:** 1 male, 1 female (USNM 359474), no other data.

Description. - Carapace squarish, slightly broader than long; regions well defined, protogastric, metagastric, branchial and cardiac regions strongly produced into dorsally directed spines, length of spines varies, protogastric spines always longest; surfaces of carapace smooth, densely covered with short, stiff setae in a systematic fashion. Frontal lobes, triangular, very short, narrow, strongly deflexed downwards, appears beak-like from dorsal view. Inner supraorbital teeth well developed, long, almost 1.5 times longer than broad, produced well beyond and obscuring most of frontal margin. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin sublamelliform, entire, without trace of teeth or lobes; lateral carapace teeth strong, sharp. Antennules folding bliquely, ca. 45° from horizontal, covered with setae; antennular fossae oblique. Surfaces of antenna covered with short stiff setae; antennal free, free, does not fill orbital hiatus, reaching into orbit; antennal basal segment rectangular; length to width ratio of second antennal segment 1.3-1.8. Eyes well developed, filling orbit; cornea distinct, pigmented; infraorbital tooth distinct, subhepatic tooth distinct. Anterior surface of epistome depressed; posterior margin appears entire because of 2 fused truncate median lobes. Pterygostomial, subhepatic, suborbital regions smooth with occasional scattered, minute granules beneath a dense layer of stiff short setae. Third maxilliped quadrate, surfaces covered with short, stiff setae; ischium rectangular, inner margin mildly granulated, median oblique sulcus shallow; merus squarish; exopod just reaches antero-external edge of merus. Thoracic sternum covered with setae; sutures between sternite segments 1 and 2, 2 and 3 distinct, shallow; between 3 and 4 interrupted medially; lateral clefts indistinct. Abdomen 7 segmented, sutures for all segments visible, all surfaces covered with setae. Chelipeds smooth, densely covered with short, stiff setae; merus and basis-ischium unarmed; carpus with sharp spine on inner distal angle and distinct tooth on outer distal angle; chela stout, length 3 times length of fingers, height ca. 2-3 times height of fingers, distal dorsal margin with distinct elongate tooth; fingers not carinate, pollex not bent downwards. Ambulatory legs unarmed, densely covered with short, stiff setae; meri of all ambulatory legs with strong tooth on subdistal dorsal margin; merus of first ambulatory leg more slender than that of others, unarmed, not cristate; first ambulatory dactylus more elongate and more slender, ca. 1.3 times that on other legs. G1 long, sinuous, tip bends at approximately 90°. G2 relatively short, distal segment short.

Remarks. - The label on the type specimen (BMNH 62.53) states that the collection site was in 'Australian seas', not 'Eastern seas' as originally reported by Miers (1879). Although the precise type locality is uncertain, *T. spinosum*, being a widely distributed species, is indeed present in Australia as well (Western Australia, present record). The distribution of this species also reaches the vicinity of northeastern Australia, i.e. Papua New Guinea and New Caledonia. Although the holotype is a juvenile and its exact type locality is uncertain, from the current range of specimens examined there is little doubt that all the present specimens belong to this species, with relatively limited variation. It is a very distinctive species

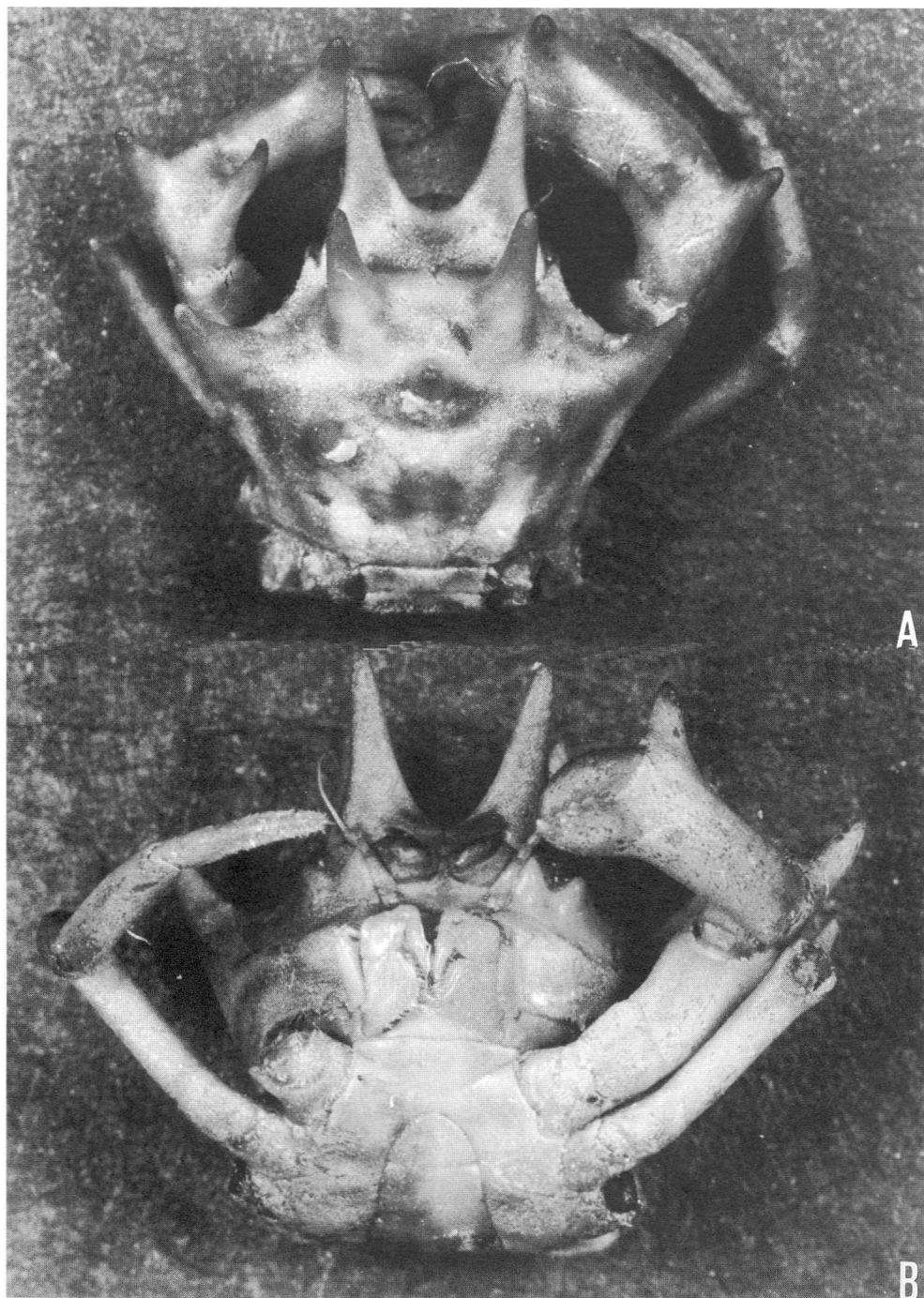


Fig. 7. *Tiarmedon spinosum* (Miers, 1879), new combination. Male, 8.0 by 8.6 mm (WAM 98-93). A, dorsal view; B, ventral view.

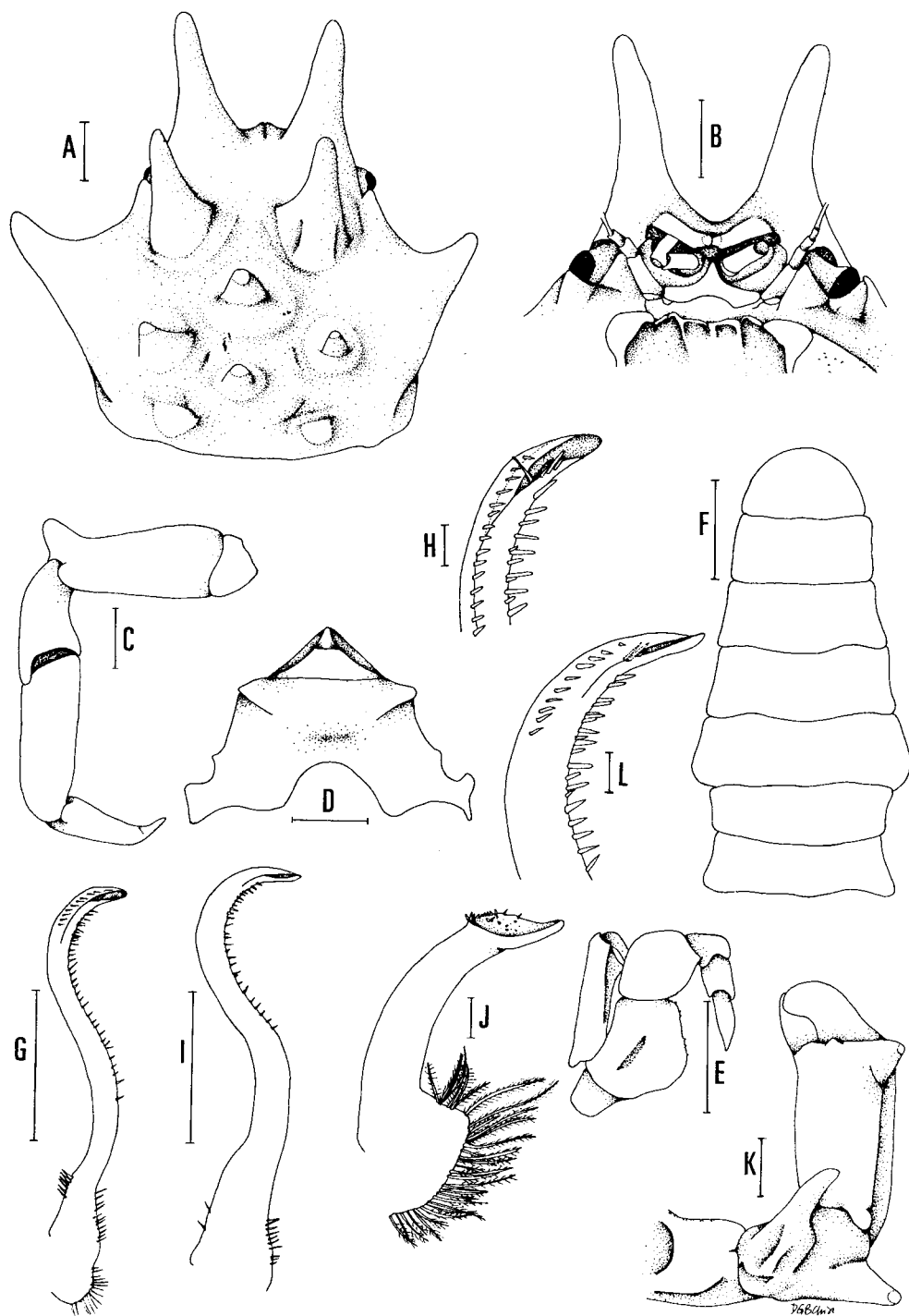


Fig. 8. *Tiaramedon spinosum* (Miers, 1879), new combination. A-H, J, K, male, 8.0 by 8.6 mm (WAM 98-93); I, L, male, 9.9 by 9.9 mm (WAM 105-93). A, dorsal view of carapace; B, face of carapace; C, fourth left ambulatory leg; D, thoracic sternum; E, right third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, left G1; J, left G2; K, postero-dorsal view of right cheliped; L, distal tip of left G1. Scales: A-G, I, K = 1.0 mm; H, J, L = 0.1 mm.

characterised by a very spiniform carapace. Figured here is an adult specimen from Western Australia (Figs. 8A-H, J-K).

From the description and figures by Balss (1924, 1940), Flipse (1930), Gordon, (1934), Sakai (1938a, 1953, 1976), Serène et al. (1958), Suzuki & Kurata (1967), Fishelson (1973, 1974), Serène et al. (1976), Hwang & Yu (1980) and Miyake (1983), their specimens clearly fit the current description of *T. spinosum*.

The carapace of *T. spinosum* is ornamented with very long spines. The length of the spines varies among specimens, but in almost all cases, the protogastric spines are the longest, even in juveniles. The juveniles are generally less spiny when compared to the adults. The frontal margins appear to be fused at all ages. The distal tip of the G1 can be very sharp and pointed (Figs. 8I) or slightly blunt (Fig. 8G). There seems to be two morphs of colour variation, a light yellow form and a brown form, both of which can be found in the same locality.

Larvae. - Not known.

Host records. - Collected from comatulid hosts such as *Clarkcomanthus littoralis*, *Comanthus parvicirra*, *C. suavia* and *Lamprometra klunzingeri*.

Distribution. - This is a widely distributed species, occurring from the Sunda Shelf (continental Southeast Asia) to the Sahul Shelf (continental northern Australia), including Japan, Taiwan, and New Caledonia.

GENUS HARROVIA ADAMS & WHITE, 1849

Harrovia White 1847a: 51 [nomen nudum].

Harrovia Adams & White, 1849: 55; Miers, 1879a: 671; Flipse, 1930: 18, 20 [in key]; Gordon, 1934: 65, 67; 1947: 113; Balss, 1957: 1631; Serène et al., 1958: 139 [in key], 172, 194, 199, 231, 238. Sakai, 1976: 294 [in key], 298 [English text], 180 [Japanese text]; Takeda, 1979a: 70; Wu, 1983: 165 [name in Chinese]; Stevcic & Ng, 1988: 4; Stevcic et al., 1988: 1311, 1318; Tirmizi & Kazmi, 1988: 190 [in key], 193.

Ceratocarcinus - Stimpson, 1858: 221 (part); 1907: 32 (part); Balss, 1922: 136 (part); Sakai, 1938b: 329 [in key], 350 (part) [not *Ceratocarcinus* White, 1847].

Type species. - *Harrovia albolineata* Adams & White, 1849, by monotypy.

Etymology. - The origins of the name are uncertain. Gender is feminine by inference from the type species name 'albolineata'

Diagnosis. - Carapace quadrate, usually broader than long; frontal margin short, not as strongly deflexed downwards; inner supraorbital teeth prominent, but short, usually level with or slightly projecting beyond frontal margin; regions not as well defined, protogastric and branchial regions more distinct, usually swollen; surfaces of carapace relatively smooth or covered with scattered small granules; dorsal surface of carapace usually covered with very thin pubescence, with longer setae on protogastric regions. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin usually lamelliform, with four teeth (including external orbital angle), first three teeth sharp to truncate, separated by deep, broad or narrow fissures or clefts, sometimes tightly adjoining each other and appearing fused, last tooth well developed, sharp, laterally directed. Infraorbital and subhepatic teeth developed.

Antennules folding obliquely, ca. 45° from horizontal. Second antennal segment short, length to width ratio of second antennal segment 2.0-3.4. Chelipeds granular to rugose; carpus usually without spine or distinct tubercle on inner angle; chelae elongated, length ca. 4 times length of fingers, height ca. 4-5 times height of fingers; fingers not carinate, pollex not distinctly bent downwards. Dactylus of first ambulatory leg elongated, very slender, ca. 2 times length of that on other legs; dorsal margin of merus lined with granules or spinules, not cristate. G1 long, slender.

Sexual dimorphism. - Males usually have disproportionately larger and stouter chelipeds.

Remarks. - The redefined genus *Harrovia* is the largest known eumedonid genus, with seven species: *H. albolineata* Adams & White, 1849, *H. cognata*, new species, *H. elegans* De Man, 1887, *H. japonica* Balss, 1921, *H. longipes* Lanchester, 1900, *H. ngi* Chen & Xu, 1992, and *H. tuberculata* Haswell, 1880. Two other species, *H. purpurea* Gordon, 1934, and *H. egeriae* Gordon, 1947, have been transferred to two new genera respectively on the basis of their carapace structures and extremely short second antennal segments. *Harrovia frontodentata* Shen, Dai & Chen, 1982, is transferred to *Ceratocarcinus*. *Harrovia plana* Ward, 1936, is synonymised under *H. longipes* Lanchester, 1900, after examining a large series of specimens.

Table 2. Ratio of fourth ambulatory merus in seven species of *Harrovia*

Species	Sample size	Adults (range)	Adults (mean)
<i>H. albolineata</i>	21	2.2-3.1	2.6
<i>H. cognata</i>	4	3.1-3.6	3.4
<i>H. elegans</i>	6	2.7-3.6	3.3
<i>H. japonica</i>	11	2.6-3.4	3.0
<i>H. longipes</i>	23	3.0-4.3	3.6
<i>H. ngi</i>	1	3.1	3.1
<i>H. tuberculata</i>	2	2.7, 2.9	2.8

KEY TO THE SPECIES OF *HARROVIA*

1. Merus of fourth ambulatory leg long, length 3.0-4.3 times width (see Table 2) *H. longipes* Lanchester, 1900
- Merus of fourth ambulatory leg short, length 2.2-3.1 times width (see Table 2) 2
2. A tubercle either strong, developed into a large spine or low and blunt, on distal inner margin of the cheliped carpus 3
- No strong tubercle on distal inner margin of the cheliped carpus 4
3. 1-2 strong spinules on anterior margin of all ambulatory meri; anterolateral lobes 1 and 2 low and subtruncate, anterolateral lobe 3 lobate, lobe 4 dentiform, both 3 & 4 directing anteriorly; cheliped appears eroded and sculptured, high ridge on median dorsal surface of carpus, strong tubercles along the inner and outer proximal margins of merus; regions of carapace usually more distinct, protogastric, epibranchial, gastric and cardiac regions inflated due to presence of very large tubercles *H. tuberculata* Haswell, 1880
- Anterior margin of all ambulatory meri smooth or lined with blunt and small tubercles; anterolateral lobe 1 low, subtruncate, anterolateral lobe 2 low, blunt, anterolateral lobe 3 subtruncate, lobe 4 large, dentiform, developed, anterolateral lobe 3 smaller than 4, rarely equal in size; cheliped not eroded with high ridges; regions of carapace not as well defined and inflated *H. albolineata* Adams & White, 1849

4. Anterolateral lobe 1 and 2 truncate, raised, margins lined with tubercles, anterolateral lobe 3 and 4 distinctly dentiform, subequal in size 5
- Anterolateral lobe 1, 2 and 3 truncate, raised, margins lined with tubercles, anterolateral lobe 1-3 separated by narrow fissures, margin of anterolateral lobe 1 and 2 straight, anterolateral lobe 3 concave, lower edge of anterolateral lobe 3 unequally spiniform, directing slightly anteriorly, anterolateral lobe 4 distinctly dentiform, separated from anterolateral lobe 1-3 by a wide cleft, posterior margin of anterolateral lobe 4 forms an expanded structure which joins at a right angle with posterolateral margin 6
5. Anterolateral lobe 1 and 2 truncate, raised, margins concave, thickly lined with large tubercles, either separated by narrow fissure or fused into one structure, edges of anterolateral lobe strongly spiniform; anterolateral lobe 3 and 4 very large, distinctly dentiform, acute, directing obliquely-anteriorly, subequal in size. Infraorbital and subhepatic teeth very strong. Anterior margin of ambulatory merus lined with strong spinules *H. japonica* Balss, 1921
- Anterolateral lobe 1 and 2 truncate, lower, margins straight, lined with small tubercles, separated by a wide cleft, edges of anterolateral lobe are not spiniform; anterolateral lobe 3 and 4 dentiform though weaker and less acute, directing obliquely outwards. Infraorbital and subhepatic teeth weak. Anterior margin of ambulatory merus lined with weak spinules *H. elegans* De Man 1887
6. Frontal margin lined with many small tubercles; anterolateral lobe 3 highly concave, lower part of anterolateral lobe 3 strongly spiniform, directing slightly forward, margins of anterolateral lobes 1-3 heavily tuberculated, lower part of anterolateral lobe 4 lined with many tubercles; posterolateral margin lined with several spinules; G1 thickens medially thus appearing straighter *H. cognata*, new species
- Frontal margin smooth; anterolateral lobe 3 weakly concave, lower part of anterolateral lobe 3 directs slightly forward, margins of anterolateral lobes 1-3 lined with occasional small tubercles, margins appearing smooth, no tubercles on posterior margin of anterolateral lobe 4 and posterolateral margin; G1 appearing more slender medially, thus more sinuous in appearance *H. ngi* Chen & Xu, 1992

***Harrovia albolineata* Adams & White, 1849**

(Figs. 9-11)

Harrovia albo-lineata White, 1847a: 51 [nomen nudum; type locality 'Cageyan, Philippines'].

Harrovia albo-lineata Adams & White, 1848-1849: 56, pl. 12: Figs. 5, 5a, 5b [type locality Borneo and Philippine islands]; Estampador, 1937: 559 [list only]; Estampador, 1959: 121 [list only].

Harrovia albolineata - Miers, 1879a: 671, plate 13: Fig. 11 [list only]; Lanchester, 1900: 728 [Singapore]; Balss, 1922: 136 [list only]; Gee, 1925: 166 [Hong Kong]; Flipse, 1930: 76, 77, 80, 90 [list only]; Gordon, 1934: 63, Fig. 33c [type re-examined]; Buitendijk, 1950: 70 [Straits of Malacca]; Serène et al., 1958: 199 [in key], 200, 232, 239, Fig. 7E [Vietnam] (part); Serène, 1968: 63 [list only] (part); Wu, 1983: 165 [name in Chinese]; Stevcic et al., 1988: 1311 [list only] (part); 151, 177, Fig. 9A [Ryukyu islands, Japan]; Chia et al., 1993: 261, pl. 1A, figs 1A, 2, 4A, C, 5A, B, E, F, 6A, C, 7A-J, 8B-K [Singapore, Malaysia, Vietnam].

Harrovia elegans - Lin, 1949: 17 [Taiwan]; Wang & Chen, 1981: 152 [list only] [not *Harrovia elegans* De Man, 1887].

Harrovia tuberculata - Lanchester, 1900: 729 [Singapore]; Chen & Xu, 1991: 85, Figs. 29-1 - 29-4 [Nansha = Spratly Islands, South China Sea] [not *Harrovia tuberculata* Haswell, 1880].

Harrovia sp. - Buitendijk, 1950: 71 [Singapore]; Johnson, 1962: 288 [Singapore] (part).

Ceratocarcinus albolineatus - Stimpson, 1858: 221 [Hong Kong]; Stimpson, 1907: 33 [list only]; Shen, 1940: 218 [list only].

Ceratocarcinus sp. - Johnson, 1962: 288 [Singapore and Peninsular Malaysia] (part).

Material examined. - **Singapore:** 1 male (ZRC 1997.172), Johore Shoal, 17.6 m, coll. D. Chia et al., 12 Sep. 1994. - 1 male, 1 juvenile female (ZRC 1997.173-174), Johore Shoal, 17.6 m, coll. D. Chia et al., 12 Sep. 1994. - 1 female (ZRC 1985.1434), Singapore Straits, south of Singapore, B58, 59 m, sand, stone substratum, coll. SRFRS (Singapore Regional Fisheries Research Station), 6 Jan. 1955. **Vietnam, Gulf of Tonkin:** 1 female (MNH B21547), Ozlik, Station 19, 17°47'5N, 111°53'0E, 106

m, coll. Zarenkov, 23 Apr. 1960. - 3 females (IOAS K284 B-31), 21st Voyage, Station 6223, 25 m, sand substratum, coll. Shen, 23 Oct. 1960. **Philippines:** 1 male (NMW), Bohol. - 1 juvenile female (WAM 103-73), southwest Malanipa Island, Basilan Straits, Sulu Archipelago, 48-51 m, sand, coral, rubble substratum, coll. B.R. Wilson, R.V. 'Pele', 12 Feb. 1964. - 1 female (MNHN B25631), 14°15.0'N, 120°31.2'E, Station 73, 76-70 m, coll. MUSORSTOM, 28 Mar. 1976. - 1 female (MNHN B25632), 13°53.1'N, 120°08.9'E, Station 56, 129-134 m, coll. MUSORSTOM, 26 Mar. 1976. - 1 female (MNHN B25633), Station CP134, 12°01'N, 121°57'E, 92-95 m, coll. MUSORSTOM, R.V. Coriolis, 5 Jun. 1985. - 15 males (6.7 by 8.5 mm), 13 females (SMF ZMG684), northeast Lanpinin, Bohol, 11-28 m, coll. Semper, 1863-4. - 1 male (USNM), Marengas Island, coll. ALBATROSS Philippine Expedition. - 1 male, 1 female (USNM 50897), Jolo Lt., vicinity of Jolo Island, coll. ALBATROSS Philippine Expedition, 14 Feb. 1908. - 1 male (USNM 5098), station 5174, Jolo Lt., vicinity of Jolo, 20 fms, coll. ALBATROSS Philippine Expedition, 5 Mar. 1908. - 1 female (USNM 50896), station 4929, northeast point, Yaku Shima, in Colnett or Vincennes Strait, 84 fms, coll. 1906. **Taiwan:** 1 male (7.0 by 9.9 mm) (NMW), coll. Novarra. - 1 female (7.3 by 10.1 mm) (TMCD 263), Heng Chun, south Taiwan, coll. J. Y. Wei, 25 Aug. 1955. - 1 female (TMCD Cr 475), Tainan Fish Port, southeast Taiwan, Feb. 1971. **Papua New Guinea:** 1 male (7.3 by 10.6 mm) (IRSNB I.G. n°26.253), southeast Duangit, muddy substratum, 53-54 m, coll. J. Pierret, 14 Sep. 1980. **Indonesia:** 1 female (MNHN B25634), Corindon, Makassar Straits, Station DR 293, 2°38'S, 117°49'E, 45 m, Moluccas, coll. MUSORSTOM. - 1 male (7.9 by 10.3 mm) (ZMUC), Station 38, 35 m, trawl, sand and substratum, coll. Danish Expedition, 24 Apr. 1922. - 1 female (ZMUC), Doe Roa, Station 31, 50 m, sand substratum, coll. Danish Expedition, 18 Apr. 1922. - 1 female (ZMUC), Jolo, 20-30 m, sand, coral substratum, coll. Dr T. Mortensen, 19 Mar. 1914. - 1 female (ZMUC), south of Doe Roa, Station 14, 40 m, sand substratum, coll. Danish Expedition, 10 Apr. 1922. - 1 male (ZMUC), Ambon, Moluccas, coll. Danish Expedition, 2 Mar. 1922. (For types and material from Singapore, Malaysia and China, see Chia et al., 1993).

Description. - Carapace quadrate, slightly broader than long; frontal margin with small median fissure, not as strongly deflexed, appearing straight from dorsal view; inner supraorbital teeth prominent; regions not as well-defined, usually with two tubercles on protogastric and two tubercles on branchial regions, but sometimes absent; surface usually pubescent. Anterolateral margins separated into four teeth; separated by shallow (sometimes deep, in larger specimens), narrow fissures, the first low, subtruncate, second low, blunt, third and fourth large, third subtruncate (rarely dentiform), fourth distinctly dentiform, strongly developed, third slightly smaller than fourth, rarely equal in size. Antennules folding obliquely, ca. 45° from horizontal; antennular fossae oblique. Antenna free, does not fill orbital hiatus, reaching into orbit; antennal basal segment rectangular; length to width ratio of second antennal segment 2.4-3.2. Eyes well developed, filling orbit; cornea distinct, pigmented; infraorbital teeth distinct. Anterior surface of epistome depressed; posterior margin appears entire because of 2 fused truncate median lobes. Pterygostomial, subhepatic, suborbital regions smooth with scattered tubercles. Third maxilliped quadrate; ischium rectangular, median oblique sulcus shallow; merus squarish; exopod just reaches antero-external edge of merus. Sutures between thoracic sternite segments 1 and 2 indistinct, 2 and 3 distinct, shallow; between 3 and 4 interrupted medially; lateral clefts small. Abdomen 7 segmented, sutures for all segments visible. Chelipeds elongate, cylindrical, surfaces granular; carpus with sharp spine or low, rounded tubercle on inner distal angle; several tubercles on the inner and outer proximal margin of merus; chelae elongated, length ca. 3 times length of fingers, height ca. 2 times height of fingers; fingers not carinate, pollex does not bend downwards. Dactylus of first ambulatory leg elongated, other segments subcylindrical, not cristate; ambulatory legs short and stout, ratio of length to width of fourth ambulatory merus 2.2-3.1, anterior margin of ambulatory merus smooth or lined with blunt and small tubercles. G1 long, slender, distal part lined with short spines, tip bends at approximately, 45°, 90° or at about 110°. G2 relatively short, distal segment short.

Remarks. - For a detail discussion of this species, see Chia et al. (1993).

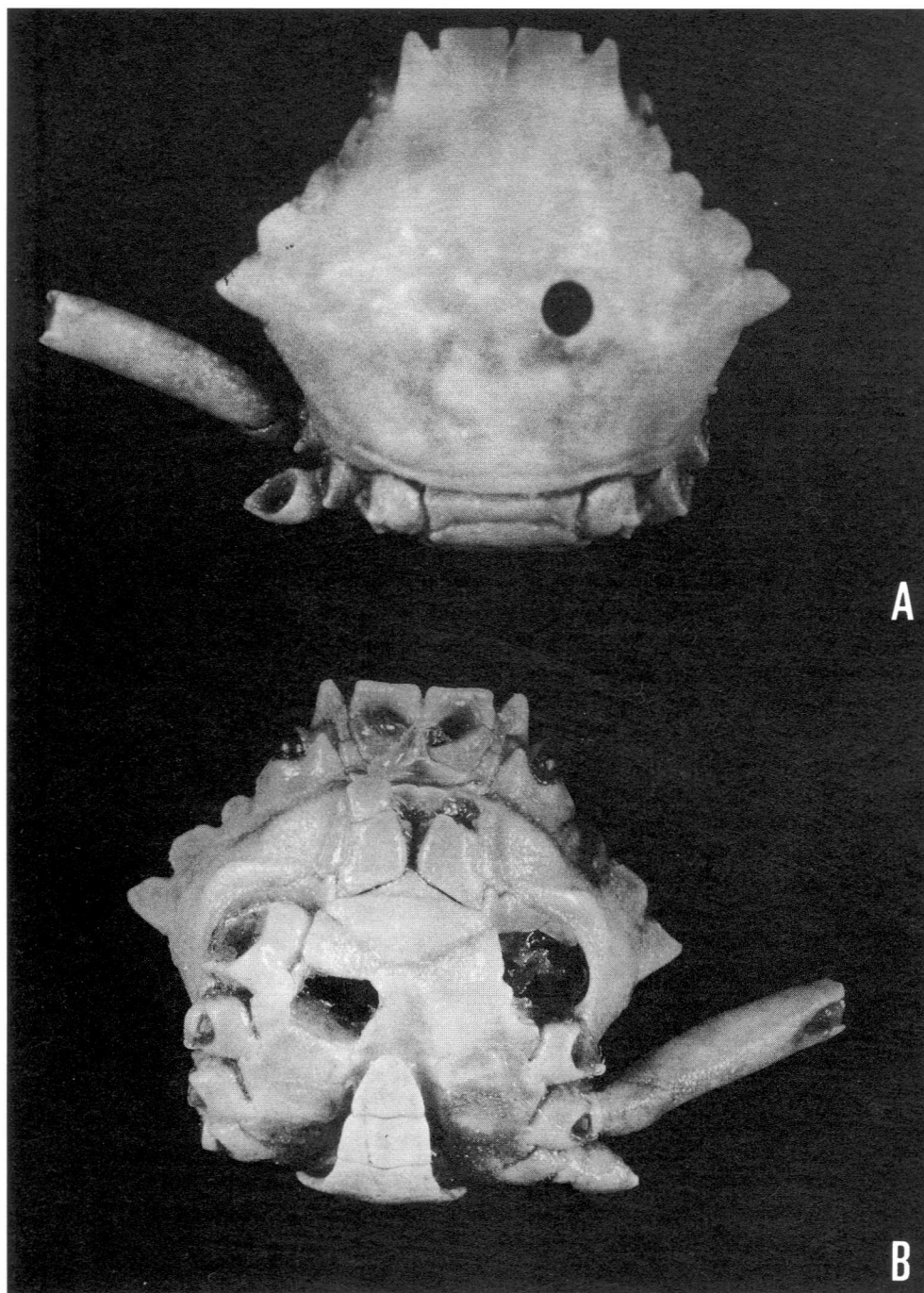


Fig. 9. *Harrovia albolineata* Adams & White, 1849. Lectotype male, 7.0 by 8.9 mm (BMNH 43.6). A, dorsal view; B, ventral view (hole indicates ex-position of pin).

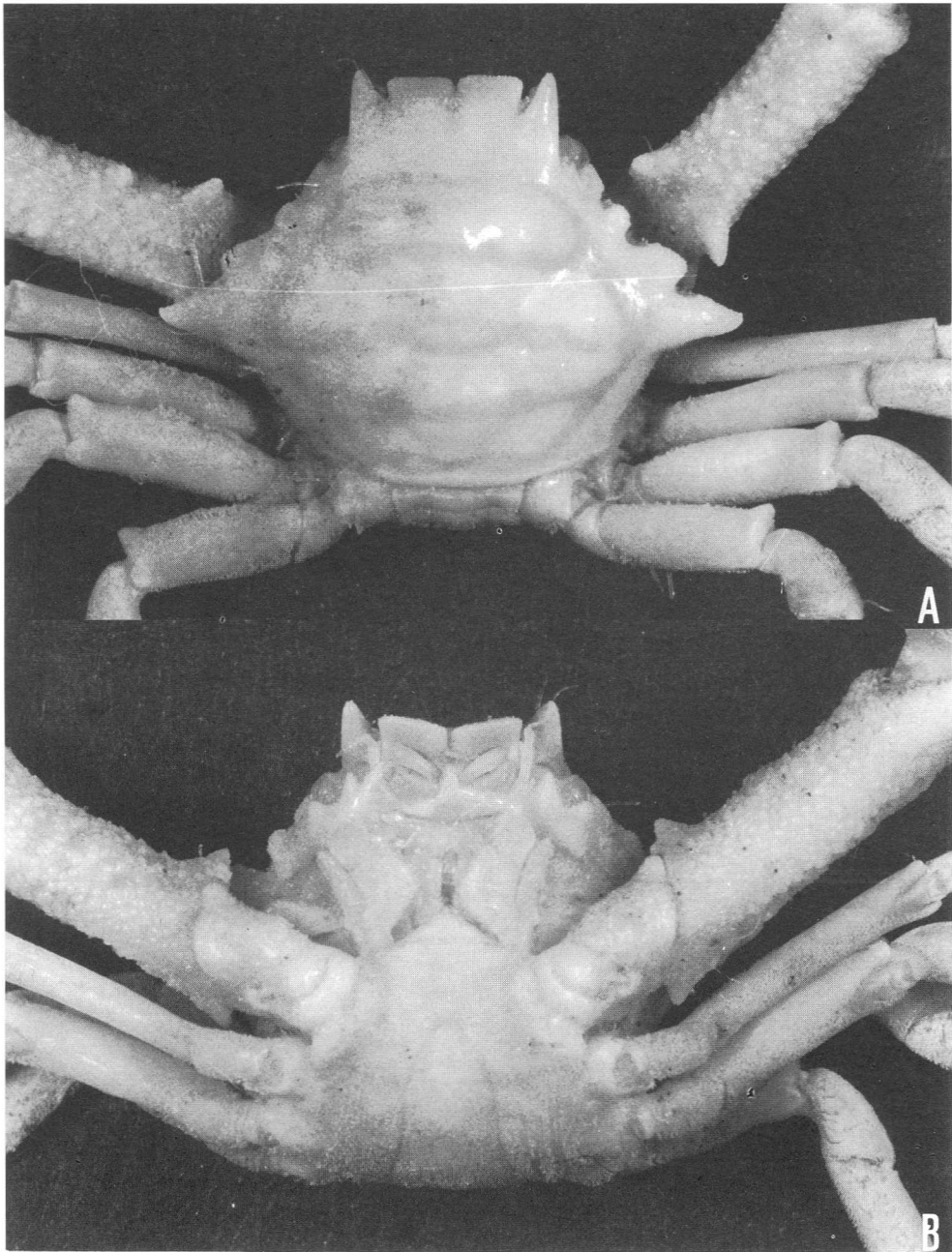


Fig. 10. *Harrovia albolineata* Adams & White, 1849. Male, 7.3 by 10.6 mm (IRSNB I.G. no 26.253). A, dorsal view; B, ventral view.

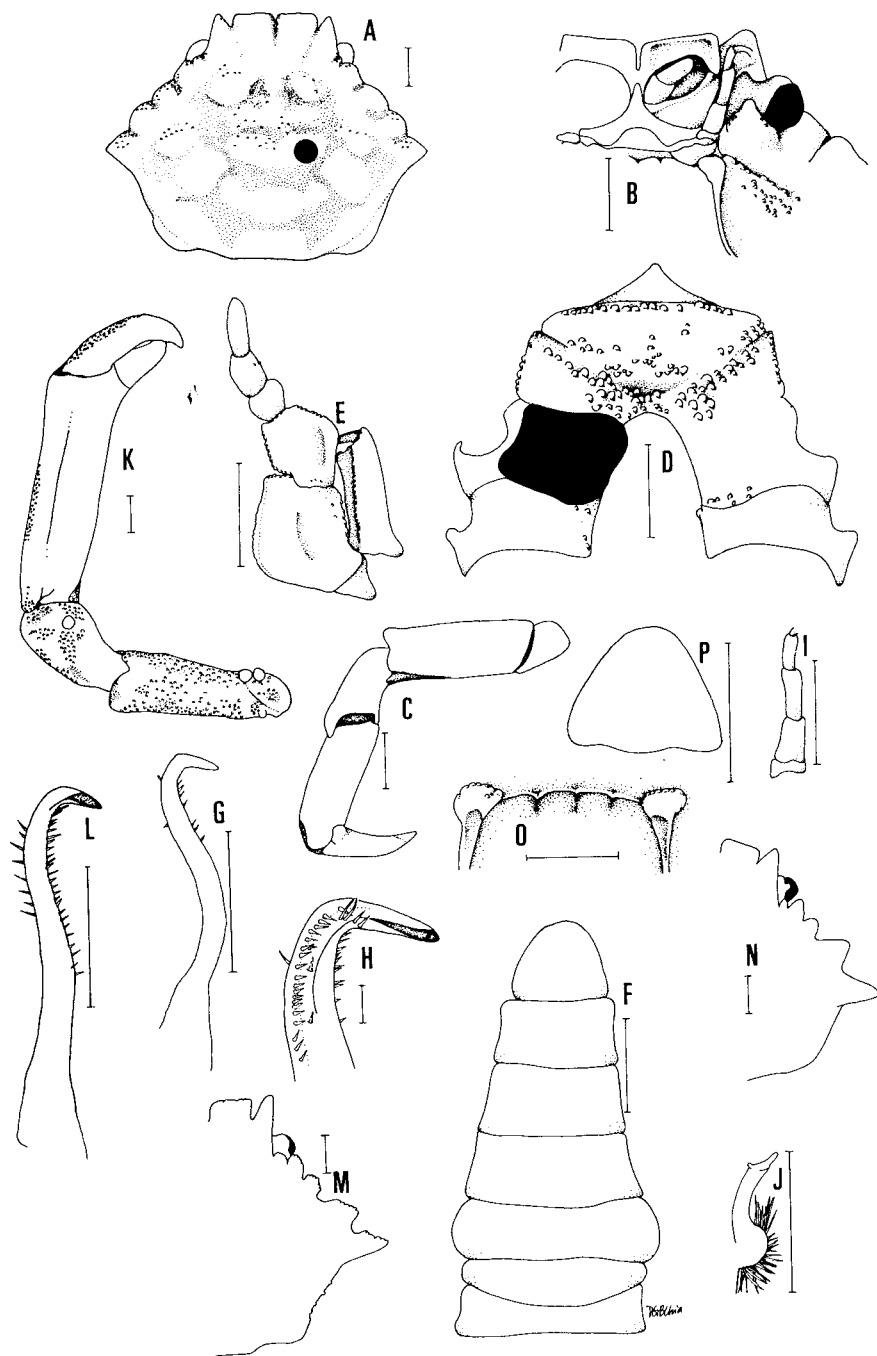


Fig. 11. *Harrovia albolineata* Adams & White, 1849. A-E, G-I, K, O-P, lectotype male, 7.0 by 8.9 mm (BMNH 43.6); F, J, male, 6.7 by 8.5 mm (SMF ZMG 684a); L-M, male, 7.3 by 10.6 mm (IRSNB I.G. n_26.253); N, male, 7.0 by 9.9 mm (NMW), dorsal view of carapace (schematic). A, dorsal view of carapace (solid circle indicates ex-position of pin); B, face of carapace; C, fourth left ambulatory leg; D, thoracic sternum (solid circle indicates ex-position of pin); E, left third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, antenna; J, left G2; K, postero-dorsal view of left cheliped; L, left G1; M, dorsal view of carapace (schematic); O, endostome; P, 7th abdominal segment. Scales: A-G, I-P = 1.0 mm; H = 0.1 mm.

The specimen, reported by Wang & Chen (1981: 152) as *Harrovia elegans* has been examined and re-identified as *H. albolineata*.

Amongst the present lot of specimens examined, the large male specimen (7.3 by 10.6 mm) from Papua New Guinea (IRSNB I.G. n°26.253), seems to have unusually incised anterolateral lobes and a rather long and laterally directed fourth lobe (Figs. 10A, 11M). The surfaces of the chelipeds of this individual are rather tuberculated, the dorsal margins of all its ambulatory legs end in a triangular lobe and its infraorbital and subhepatic teeth are rather strong (Figs. 10A, B). The length to width ratio of its last ambulatory leg reaches 3.1, thus stretching the maximum range of this species. With only one specimen on hand, these observed differences seem to represent the extreme variation of the species when measuring large specimens (as compared to some larger males of SMF ZMG684). The third lobe of a male specimen from Taiwan (7.0 by 9.9 mm, NMW) appears to be more lobate than truncate and directed forwards (Fig. 11N). In other aspects, viz. the distinctive chelipedal carpus spine and rather smooth ambulatory legs, this specimen agrees with the current definition of the species. Hence, the differences observed in these specimens are hereby regarded as infraspecific variation. A female specimen (7.5 by 10.6 mm, MNHN), collected from the Philippines, has one to two spines present on the right second and third ambulatory legs but none on the left ambulatory legs. This specimen thus represents the extreme spinose condition of the species.

Harrovia albolineata is close to a poorly known species, *H. tuberculata*. Differences are as follow, in *H. albolineata*: the protogastric, metagastric, branchial and cardiac tubercles of the carapace are less prominent and sometimes absent; the third anterolateral lobe varies from truncate to dentiform (Chia et al., 1993); the anterior margin of the ambulatory meri are not spiny, being at most tuberculated (Chia et al., 1993); the chelipeds are not as highly eroded and sculptured, and there is no high median ridge on the carpus or strong tubercles along the margins of the merus. In *H. tuberculata*, however, the protogastric, metagastric, branchial and cardiac regions of carapace are prominent; the third anterolateral lobe is lobate and anteriorly directed; chelipeds are highly rugose and sculptured with a high median ridge on the carpus and several strong tubercles along the inner and outer proximal margins of the merus; and there are one to two strong spines present on each of the ambulatory meri. These characters work for the series of specimens examined. As previously mentioned, *H. tuberculata* is a poorly known species and more specimens need to be obtained to better define it.

Larvae. - The first zoea has been described by Chia et al. (1993).

Host records. - Found only on crinoids.

Distribution. - Sunda Shelf (continental Southeast Asia) and with present record extending to the Sahul Shelf (continental Australia and Papua New Guinea). It is often found in deeper water (10-140m) than many other species of *Harrovia*

***Harrovia cognata*, new species**

(Figs. 12, 13)

Material examined. - Holotype: male (6.5 by 9.1) (QM W18689) (left G1 is missing, right G1 is broken), Northwest Shelf, Western Australia, Australia, Station 03D03BT, 19°59.0'S, 117°50.7'E, 41-42 m, trawled, marine, sublittoral, coll. CSIRO (Commonwealth Scientific and Industrial Research Organisation), R.V. 'Soela', 26 Jun. 1983.

Paratypes: 1 male (5.6 by 7.9 mm) (QM W18690), Northwest Shelf, Western Australia, Australia, Station 02B05S, 19°05.2'S, 118°51.3'E, 83 m, epibenthic sledge, marine, sublittoral, coll. CSIRO, R.V. 'Soela', 27 Apr. 1983. - 2 males (3.7 by 5.0 mm, 4.5 by 6.0 mm) (QM W18692), Northwest Shelf, Western Australia, Australia, Station 05B07BT, 19°30.9'S, 118°49.2'E, 38-39 m, trawled, marine, sublittoral, coll. CSIRO, R.V. 'Soela', 25 Oct. 1983. - 1 male, 2 females (5.7 by 7.2 mm, 4.4 by 5.7 mm, 4.5 by 6.0 mm) (QM W18691), Northwest Shelf, Western Australia, Australia, Station 02B07BT, 19°30.9'S, 118°48.7'E, 39-40 m, trawled, marine, sublittoral, coll. CSIRO, R.V. 'Soela', 26 Apr. 1983. - 2 males, 1 female (5.4 by 7.3 mm, 4.3 by 5.7 mm, 4.6 by 5.5 mm) (QM W18693), Northwest Shelf, Western Australia, Australia, Station 05B09BT, 19°28.2'S, 118°55.4'E, 35-37 m, trawled, marine, sublittoral, coll. CSIRO, R.V. 'Soela', 25 Oct. 1983. Others: **Australia:** 1 juvenile female (3.2 by 4.7 mm) (QM W18654), Northwest Shelf, Western Australia, Australia, Station 03D01BT, 19°59.1'S, 117°49.0'E, 43 m, trawled, marine, sublittoral, coll. CSIRO, R.V. 'Soela', 25 Jun. 1983. - 1 juvenile male (3.1 by 3.9 mm) (WAM 107-93), 41 miles north of Port Hedlang, Northwest Shelf, Western Australia, Australia, 19°38'S, 118°30'E, trawled, marine, sublittoral, coll. LMM or Solla, 17 Apr. 1982. ¶

Etymology. - The name is derived from the Latin "cognatus" for kindred, alluding to the close affinities of this species with *H. ngi*.

Diagnosis. - Carapace hexagonal, regions well-defined, with tubercles on protogastric and cardiac regions; surface covered with thin pubescence. Anterolateral margins separated into four lobes, margins of lobes tuberculated; separated by deep, narrow fissures, the first, second and third lobes generally lobiform, subtruncate, the margins usually straight or slightly concave, heavily tuberculated; lower part of the third lobe, strongly dentiform, directs slightly forward; fourth lobe distinctly dentiform, lower part expanded, abrupt, plate-like, lined with many tubercles. Frontal margin with small median fissure, slightly deflexed, appearing straight from dorsal view, shallow median cleft, lined with many tubercles. Posterolateral margin with large spines. Surface of third maxilliped highly tuberculated. Chelipeds cylindrical, carpus without large tubercle or spine on distal inner margin of carpus, surface of chelipeds lined with numerous small tubercles. Ambulatory legs long and slender, ratio of length to width of fourth ambulatory merus 3.1-3.6, anterior margin of the ambulatory merus lined with small spinules. Distal part of G1 bends approximately 90°, median part straight.

Sexual dimorphism. - Chelipeds of male specimens are stouter and longer in proportion to the body size.

Remarks. - *Harrovia cognata* is closest to *H. ngi* but the two species can be separated by several distinct characters. The median part of the G1 of *H. ngi* is more sinuous (Fig. 25G), the frontal margin of *H. ngi* is not lined with strong tubercles, the outer margin of the inner supraorbital teeth of *H. ngi* is not lined with strong tubercles, the margins of the anterolateral lobes are rather smooth in *H. ngi*, the lower part of the third anterolateral lobe of *H. ngi* is less spiniform, the lower part of the fourth anterolateral lobe of *H. ngi* is smooth (Fig. 25A), the surface of the third maxilliped is quite smooth in *H. ngi* (Fig. 25E), the posterolateral margin of *H. ngi* is smooth (Fig. 25A) and the second antennal segment is proportionately shorter, the ratio of length to width being 2.0 (vs. 2.6 in *H. cognata*).

The main difference between *H. cognata* and *H. ngi* lies in the extent of tuberculation on the carapace and the length of the second antennal segment. In *H. cognata*, the carapace is always heavily tuberculated, especially along the frontal margin, inner supraorbital teeth, margins of anterolateral lobes and posterolateral margins (Fig. 13A). This is true even of juveniles (Fig. 13N). The median part of the G1 of *H. cognata* is also almost straight (Figs. 13L, M) (vs. sinuous in *H. ngi*). The characters discussed are constant for the series of specimens of

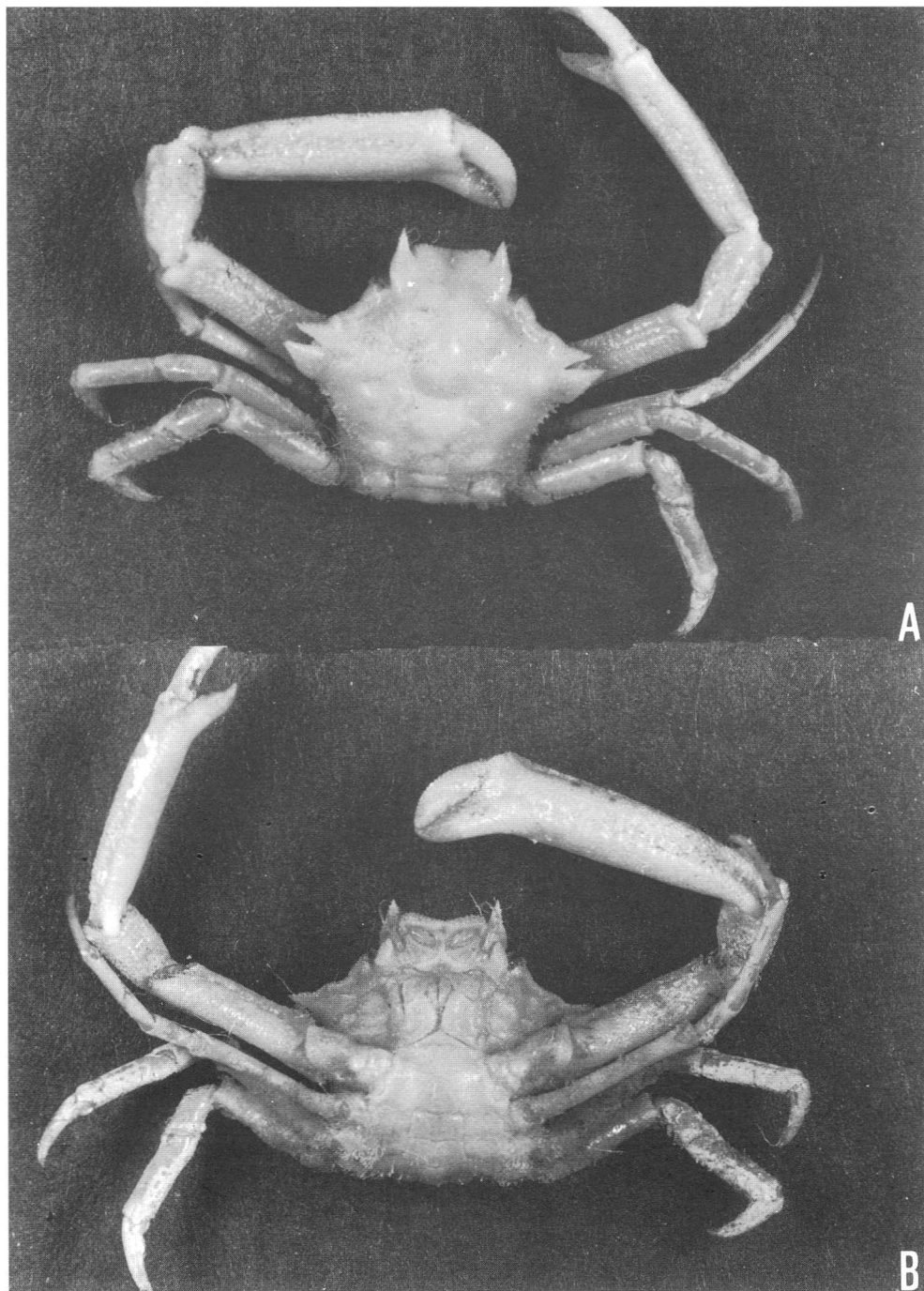


Fig. 12. *Harrovia cognata*, new species. Holotype male, 6.5 by 9.1 mm (QM W18689). A, dorsal view; B, ventral view.

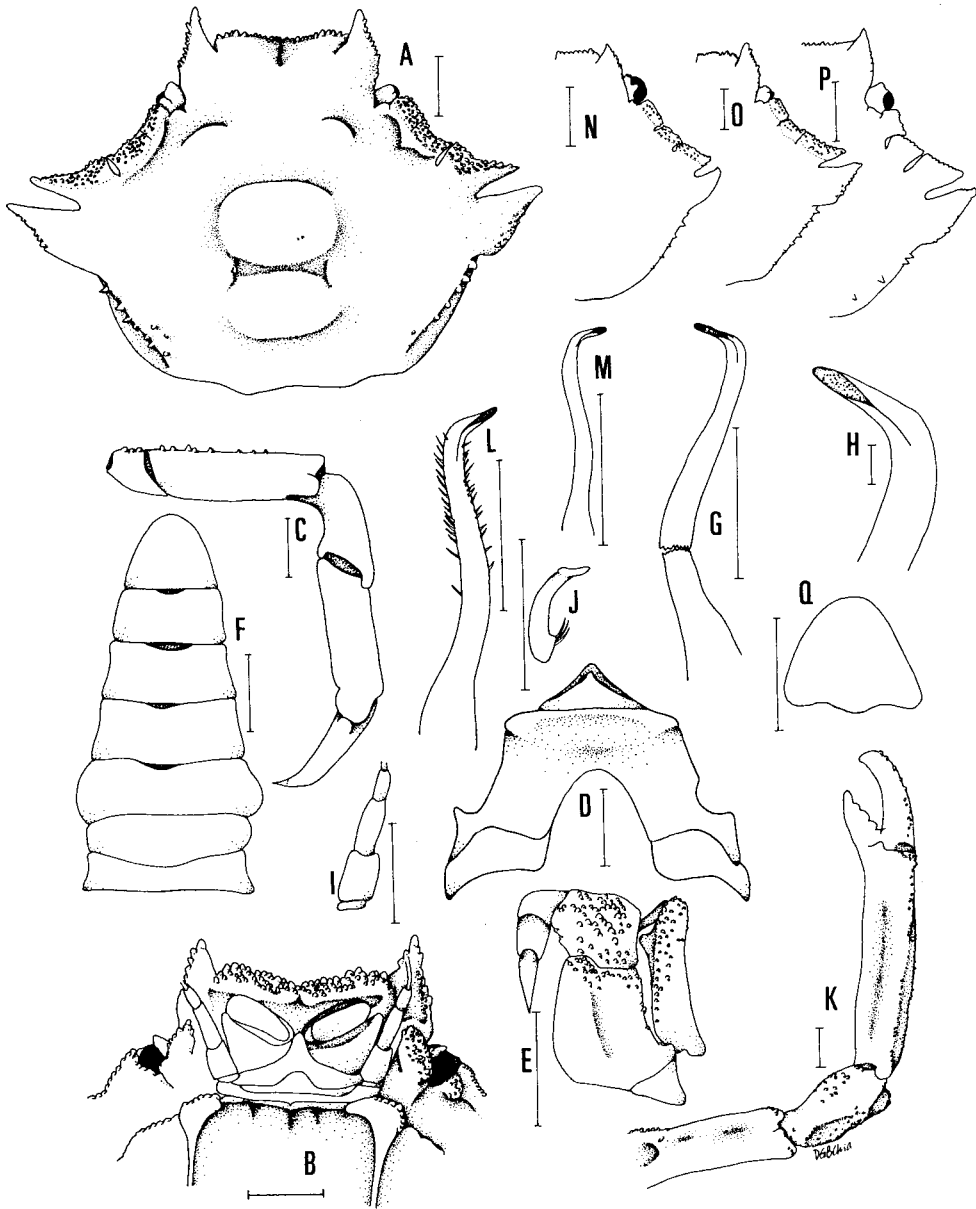


Fig. 13. *Harrovia cognata*, new species. A-K, O, Q, holotype male, 6.5 by 9.1 mm (QM W18689); L, male, 5.6 by 7.9 mm (QM W18690); M, male, 3.7 by 5.0 mm (QM W18692); N, male, 3.2 by 4.7 mm (QM W18694); P, male, 5.4 by 7.3 mm (QM W18693). A, dorsal view of carapace; B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, right G1; H, distal tip of right G1; I, antenna; J, left G2; K, postero-dorsal view of right cheliped; L, M, left G1; N-P, dorsal view of carapace (schematic); Q, 7th abdominal segment. Scales: A-G, I-Q = 1.0 mm; H = 0.1 mm.

H. cognata examined here. But the understanding of *H. ngi* is poor due to the limited number of specimens, thus making comparison between the two species difficult. As mentioned, the diagnostic characters of *H. cognata* are constant with little variation.

One slight variation observed in *H. cognata* is that the anterolateral lobes can be tightly joined, being fused with deep, narrow fissures (Fig. 13N) or separated by gaps but are fused only at the anterolateral margin (Fig. 13P).

***Harrovia elegans* De Man, 1887**

(Figs. 14, 15)

Harrovia elegans De Man, 1887-1888: 5, 21, pl. 1: Figs. 5, 6 [type locality Elphinestone Island (= Thayawthadangi Kyun), Mergui Archipelago, Burma (= Myanmar)]; De Man, 1902: 473, 682 [Ternate, Moluccas = Maluku Islands, Indonesia]; Balss, 1922: 136 [list only]; Flipse, 1930: 76, 77, 80, 90 [list only]; Serène et al., 1958: 196-198, 199 [in key], 239, Fig. 12A [type drawing refigured] [list only] (part); Garth, 1964: 140 [Enewetak Atoll, Marshall Islands, central Pacific Ocean; Serène, 1968: 63 [list only] (part); Kim, 1970: 26, pl. 5: Fig. 4 [Chuja Island, South Korea]; Kim & Rho, 1972: 86, 100, Fig. 5 [Chuja Island, South Korea]; Kim, 1973: 558, 586, 670, Fig. 265, pl. 112: Fig. 213 [list only]; Serène & Vadon, 1981: 124 [north of Lubang Island, Philippines]; Tirmizi & Kazmi, 1982: 308, Fig. 1 [Mekran coast, Pakistan]; Tirmizi & Kazmi, 1983: 369, 379 [list only]; Wu, 1983: 165 [name in Chinese]; Garth et al., 1987: 236, 242, 256 [list only]; Stevcic et al., 1988: 1311 [list only] (part); Tirmizi & Kazmi, 1988: 194, Fig. 60 [Mekran coast, Pakistan]; Castro, 1989: 97 [Sar Vanle, Somalia; Thailand, Andaman Sea; Kwajalein Atoll, Marshall Islands, central Pacific Ocean]; Chia et al., 1993: 266 [note only].

Harrovia albolineata - Laurie, 1906: 393 [Gulf of Manaar, southeast India]; Jones & Sankarankutty, 1961: 194, pl.1, fig1-4 [Gulf of Manaar, southeast India]; Serène et al., 1958: pl. 7, Figs. C, D, text Figs. 13A, B [Vietnam] (part); Sankarankutty, 1966: 350, 354 [Gulf of Manaar, southeast India] [not *Harrovia albolineata* Adams & White, 1849].

Material examined. - Neotype: male (7.2 by 9.3 mm) (BMNH 1907.5.22.194), South of Manaar, Sri Lanka, coll. Herdman, no other data. Others: **Somalia:** 1 female (7.0 by 9.4 mm), (RMNH D42944), east Africa, Sar Unale, 20 km south of Kisimayo, open coast with tidepools, coll. M. Vannini, Nov. 1971. **Sri Lanka (= Ceylon):** 1 female (7.1 by 9.2 mm) (BMNH 1907.5.22.195), South of Manaar, coll. Herdman, no other data. - 1 female (BMNH 1934.1.16.68), Gulf of Manaar, coral reef, coll. Herdman, no other data. **Thailand:** 1 male (7.5 by 9.3 mm), 3 females (8.0 by 10.3 mm) (ZRC 1997.320-323), Andaman Sea, coast of Thailand, Tevega Expedition, coll. J.L. & J.P. Christofferson, 29 Oct. 1953. **Peninsular Malaysia:** 3 males (5.5 by 7.0 mm, 4.3 by 5.2 mm, 4.9 by 6.0 mm), 1 female (ZRC 1985.1427-30), Sembilan Isles, 46-82 m, shell gravel, coral substratum, coll. D. S. Johnson, 29 Oct. 1953. **South China Sea:** 1 female (6.6 by 8.2 mm) (BMNH 92.8.28.342), Macclesfield Bank, R.V. 'Penguin', no other data. **Philippines:** 1 female (7.8 by 10.1 mm) (MNHN B25635), Station CP8, 85-90 m, 13°55'N, 120°20'E, MUSORSTOM 2 expedition, coll. MUSORSTOM. **Indonesia:** 1 female (6.1 by 7.6 mm) (SMF ZMG7077), Ternate, Moluccas, Kükenthal expedition, no other data. - 1 female (7.9 by 10.1 mm) (ZMUC), Kei Islands, Station 20, circa 50 m, sand and gravel substratum, trawl, Danish expedition, 14 Apr. 1922.

Diagnosis. - Carapace hexagonal, regions not well defined, usually with two tubercles on protogastric regions, but sometimes absent; surface usually thinly pubescent. Anterolateral margins separated into four lobes; the first and second generally lobiform, very low, subtruncate, the margins usually straight, separated by wide cleft, not fused, lobe two might be elongate and appears dentiform; third and four lobes distinctly dentiform, directed obliquely outwards. Posterolateral margin mildly tuberculated. Frontal margin with small median fissure, slightly deflexed, appearing straight from dorsal view, shallow median cleft. Infraorbital and subhepatic teeth not as strong. Merus of third maxilliped tuberculated. Surfaces of sternum highly tuberculated. Chelipeds cylindrical, surfaces highly tuberculated, carpus without large tubercle or spine on distal inner margin of carpus. Ambulatory legs short and stout, ratio of length to width of fourth ambulatory merus 2.7-3.6, anterior margin

of the ambulatory merus lined with strong spinules; distal part of G1 bends approximately 45°, sometimes 90°.

Remarks. - The holotype of *H. elegans* cannot be located. It is not in the BMNH or any of the museums where de Man could have retained his material. Considering the problems with *H. elegans*, we feel that it is best to designate a neotype to stabilise the taxonomy of this and allied species. Although it would be ideal to designate specimens from near the type locality (i.e. Andaman Islands), in this case, the only specimen available is from Sri Lanka (BMNH 1907.5.22.194). Decision was made against selecting the specimen (SMF ZMG7077) examined by De Man (1902) since it was collected from the Moluccas, which is even more distant from the type locality.

Specimens reported by Garth (1964), Kim (1970), Kim & Rho (1972), Kim (1973), Serène & Vadon (1981), Tirmizi & Kazmi (1982, 1988) and Castro (1989) seem to fit into the current concept of the species. The record by Huang (1989: 346, Fig. 316) from Zhejiang Province in China cannot be ascertained as his figure is too schematic.

Specimens reported by Laurie (1906) as *Harrovia albolineata* are examined and are re-determined as *H. elegans*. From the figures and descriptions provided by Jones & Sankarankutty (1961) and Sankarankutty (1966), their specimens are also referable to *H. elegans*. As reported in Chia et al. (1993: 267), Serène et al.'s (1958) specimens from Vietnam consisted a mixture of three species, which can be identified as *H. albolineata*, *H. elegans* and *H. longipes*. The specimens which appear on plate 7, figures. C, D and on text figures 13A, B are probably referable to *H. elegans*.

The series of specimens examined here shows a certain degree of variation. All of them seems have the form of anterolateral lobes as defined here for *H. elegans*, with minor variations. In the Somalia specimen (RMNH D42944), the second anterolateral lobe seems to be somewhat elongate and almost tooth-like (Fig. 15R). This is rather unusual and is not observed in any other specimens. In the Philippine specimen (7.8 by 10.1 mm, MNHN AC63) (Fig. 15V), the second anterolateral lobe appears to smaller than usual, and more interestingly, the ambulatory legs of this specimens are somewhat longer and thinner (length to width ratio = 3.6). The posterolateral margin of a specimen (6.6 by 8.2 mm, BMNH 92.8.28.342) is slightly more tuberculated than others (Fig. 15U).

There is also a variation in the distal part of G1. Two forms were observed amongst the lot of specimens from Sembilan (Malaysia): 1), the majority of specimens have the distal part bending at 45° (Figs. 15L, M), and 2), in some specimens, the distal part bending at 90° (Fig. 15N). Despite this variation, the anterolateral lobes, seem to agree well with the other specimens which were collected near the type locality.

Harrovia elegans is very close to *H. japonica*, the main difference being in the form of the anterolateral teeth (see *Remarks* for *H. japonica*). *Harrovia elegans* is also smaller in size when compared to *H. japonica*. As with other species of *Harrovia*, the carapace of large females appears to be bulbous, inflated and highly convex (Fig. 15S). This is particularly obvious in the female specimens (ZRC 1997.320-323) from Thailand.

Distribution. - Stretches from the Indian Ocean to the Pacific Ocean and as far south to Indonesia.

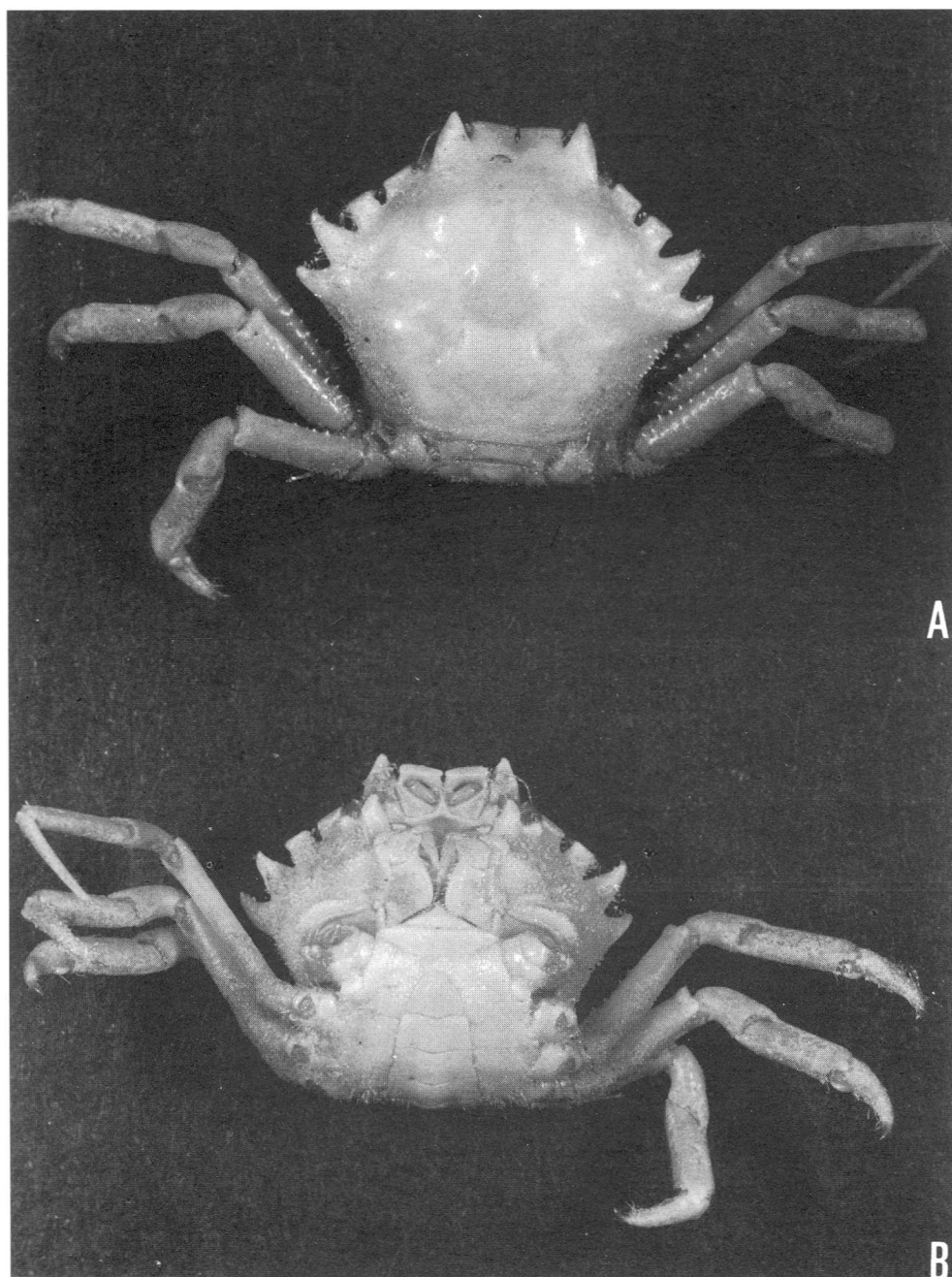
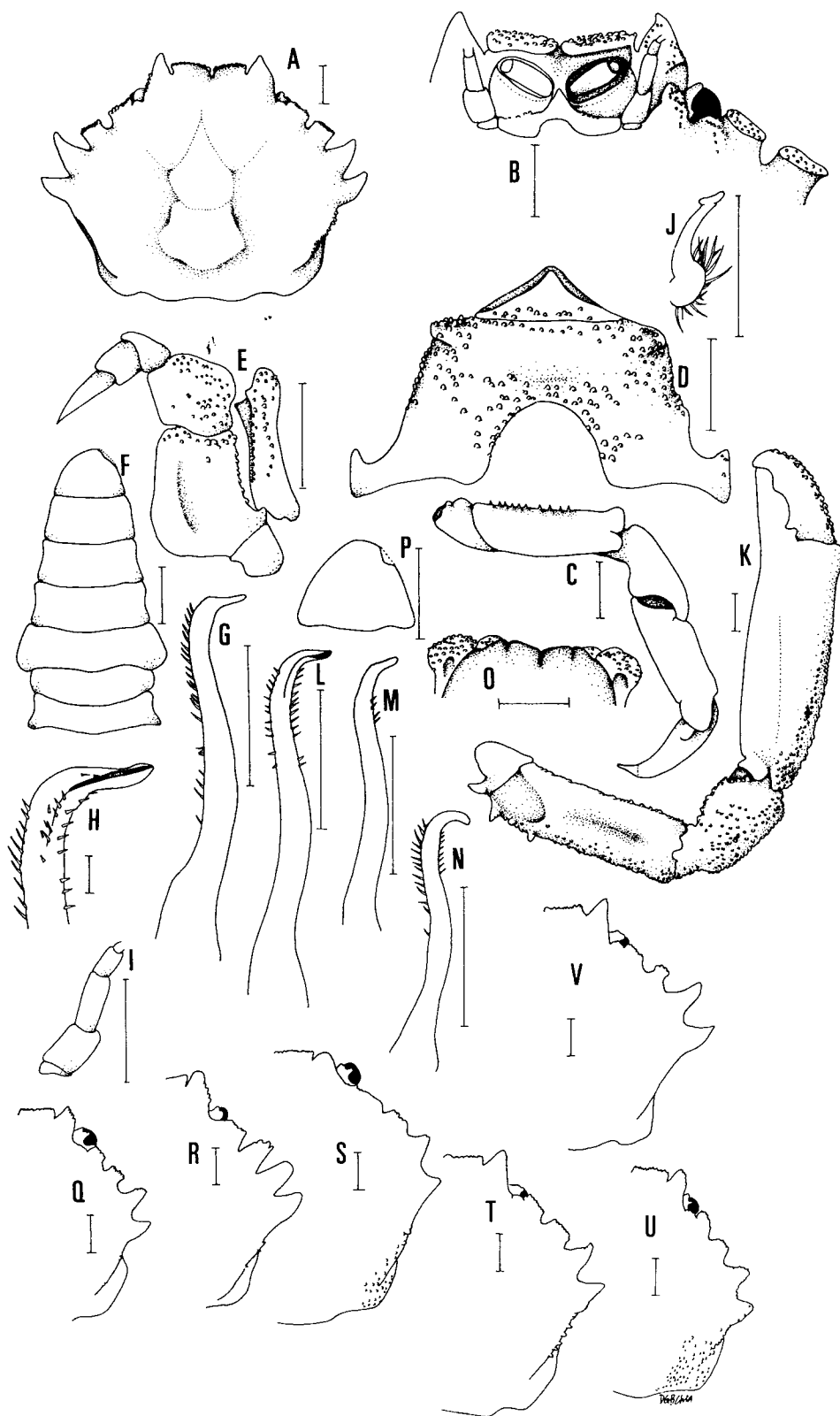


Fig. 14. *Harrovia elegans* De Man, 1887. Neotype male, 7.2 by 9.3 mm (BMNH 1907.5.22.194). A, dorsal view; B, ventral view.



Harrovia japonica Balss, 1921

(Figs. 16-18)

Harrovia japonica Balss, 1921: 177 [type locality Sagami Bay, Honshu island, Japan]; Balss, 1922: 136, Figs. 8,9 [Sagami Bay, Honshu island, Japan]. Chia et al. 1993: 266 [note only].
Harrovia elegans - Urita, 1918: 164 [Kagoshima, Japan]; Urita, 1926: ii, 30 [off Ibusuki, Kyushu island, Japan]; Sakai, 1932: 42, 54, pl. 2, Fig. 2 [Tateyama and Sagami bays, Izu Peninsula, Honshu island, Japan]; Sakai, 1934: 300, Fig. 13 [Nagasaki, Kyushu island, Japan]; Yokoya, 1936: 142, Fig. 8 [Sagami Bay, Honshu island, Japan]; Sakai, 1936: 18, 114, Fig. 54, pl. 30: Fig. 3 [colour plate] [list only]; Sakai, 1938a: 53 [Izu Islands, Japan]; Sakai, 1938b: 350, pl. 33: Fig. 1 [colour plate] [Tateyama and Sagami bays, Izu and Kii peninsulas, Honshu island; Nagasaki, Kyushu island, Japan]; Sakai, 1940: 37 [list only]; Sakai, 1956: 26 [appendix list] [list only]; Sakai, 1957: 699, Fig. 2019 [list only]; Serène et al., 1958: 240, Figs. 12B, 12D [list only]; Sakai, 1960: 53, pl. 26: Fig. 5 [colour plate] [list only]; Miyake, 1961: 17 [Amakusa Island, Japan]; Sakai, 1961: colour plate on unnumbered page [list only]; Miyake et al., 1962: 128 [list only]; Ozaki, 1964: 43 [Kii Peninsula, Honshu island, Japan]; Sakai, 1965: 101, pl. 46: Figs. 2, 5 [colour plate] [English text], 42 [Japanese text] [Sagami Bay, Honshu island, Japan]; Suzuki & Kurata, 1967: 97 [Izu Islands, Japan]; Serène, 1968: 63 [list only] (part); Utinomi, 1969: 80, pl. 40: Fig. 8 [colour plate] [list only]; Nishimura & Suzuki, 1971: 112, pl. 39: Fig. 3 [colour plate] [list only]; Watabe, 1974: 139 [Sagami Bay, Honshu Island, Japan]; Takeda, 1975: 23, 130 [colour photograph] [list only]; Sakai, 1976: 298 [in key], 299, Fig. 166d [volume in English], 180 [volume in Japanese], pl. 100: Fig. 3 [colour plate] [Tateyama and Sagami bays, Izu and Kii peninsulas, Honshu island; Nagasaki, Kyushu island, Japan] - Yamaguchi et al., 1976: 36 [Amakusa Islands, Japan]; Kim, 1977: 208 [Cheju Island, South Korea]; Miyake & Takeda, 1978: 37 [Amakusa Islands, Japan]; Takeda, 1979b: 155 [Cape Shimonoseki, Honshu island, Japan]; Takeda, 1982: 137, Fig. 404 [colour plate] [list only]; Kim & Kim, 1982: 154 [list only]; Imanaka et al., 1983: 63 [Kominato, Honshu island, Japan]; Miyake, 1983: 56, 212 pl. 19, Fig. 5 [colour photograph] [list only]; Kikuchi, 1985: 84 [Amakusa Islands, Japan]; Masuda et al., 1986: 141 [colour photograph] [list only]; Yamaguchi et al., 1987: 17, pl. 7: Fig. 2 [Amakusa Islands, Japan]; Stevcic et al., 1988: 1311 [list only] (part); Anon, 1992: 8 (colour photograph) [Japan]; Takeda, 1994: 246 [Japan] [not *Harrovia elegans* De Man, 1887].

Material examined. - Lectotype: 1 female (10.3 by 14.4 mm) (BMNH 1934.4.6.1, exchange with Munich Museum), Sagami Bay, Japan.

Others: **Japan:** 1 male (9.5 by 14.0 mm), 1 female (11.3 by 16.8 mm) (RMNH 32040), Wagu, Kii, Mie Prefecture, coll. N. Yamashita, 1978-79. - 1 young female (4.7 by 6.6 mm) (ZMUC), Misaki, on *Actinometra*, coll. Dr Th. Mortensen, 6 May 1914. - 1 male, 3 females (BMNH 1967.6.5.132-4), Tosa Bay, commensal on *Comanthus japonicus*, coll. T. Sakai, Apr. 1961. - 2 males, 2 females (ZMG TS00063), Tsuji-Shima, Amakusa, Kumamoto Prefecture, Japan. coll. T. Sakai, 25 Apr. 1963. - 1 female (ZMG), Habu-minato, Oshima, Izu, coll. T. Sakai, 10 May 1963. - 1 male, 1 female (ZMG), coll. T. Sakai, no other data. - 1 male, 1 female (13.3 by 19.2 mm) (ZRC 1997.175-176), Shirahama Bay, found live at Seto Aquarium, on *Comanthus japonicus*, coll. P. Castro, Aug. 1993. - 1 male, 1 female (ZRC 1997.177-178), Fuku-ura, Manazuru, Honshu, 35°09'N, 139°08'E, 4.5m, on *Comanthus japonicus*, coll. P. Castro, 5 Oct. 1993. - 1 juvenile female (ZRC 1997.179), Tomioka Bay, Amakusa-Shimo-Shima Island, Amakusa Islands, 5 m, coll. P. Castro, 25 Aug. 1993. - 1 female (ZRC 1997.183), Kushimoto, 10 m, on *Comanthus* sp., coll. S. Nagai, Sep. 1990. - 1 male (BPBM), Simoda Biological

(See opposite page) Fig. 15. *Harrovia elegans* De Man, 1887. A-K, O, P, neotype male, 7.2 by 9.3 mm (BMNH 1907.5.22.194); L, male, 7.5 by 9.3 mm (ZRC 1997.320-323); M, male, 5.5 by 7.0 mm (ZRC 1985.1427-30); N, male, 4.6 by 6.0 mm (ZRC 1985.1427-30); Q, female, 6.1 by 7.6 mm (SMF ZMG7077); R, female, 7.0 by 9.4 mm (RMNH D42944); S, female, 8.0 by 10.3 mm (ZRC 1997.320-323); T, female, 7.9 by 10.1 mm (ZMUC); U, female, 6.6 by 8.2 mm (BMNH 92.8.28.342); V, female, 7.8 by 10.1 mm (MNHN AC63). A, dorsal view of carapace; B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, antenna; J, left G2; K, postero-dorsal view of right cheliped; L-N, left G1; O, endostome; P, 7th abdominal segment; Q-V, dorsal views of carapaces (schematic). Scales: A-G, I-V = 1.0 mm; H = 0.1 mm.

Station, Simoda, 27 Jan. 1936, no other data. - 1 male (9.2 by 12.9 mm) (ZRC 1997.180), off Akasaki, Matsu-Shima Island, on comatulid crinoid, coll. T. Yamaguchi, Aug. 1993. - 1 male, 1 juvenile female (ZRC 1997.181-182), Tomioka Bay, Amakusa-Shimo-Shima Island, coll. K. Yamahira, 24 Aug. 1993. - 1 female (USNM 50895), station 3729, Omai Zaki Lt., 34 fms, off Honshu, coll. ALBATROSS Philippine Expedition. - 1 female (USNM 72504), off Honshu Island, 34 fms, coll. ALBATROSS Philippine Expedition, 15 May 1900. 1 female (dried) (USNM 22862), Japan, don. Reverend H. Loomir. - 1 female (USNM 48457), Tara, Ibusuki, in net used for *Penaeus* fishing, coll. T. Urita, no date. **Southern China:** 1 male (8.8 by 12.8 mm) (ZMUC), Cape Christiansen, 23°15'N, 117°40'E, SL Nordiske, 26 Jan. 1912.

Diagnosis. - Carapace hexagonal, regions not well defined, usually with two strong tubercles on protogastric regions, but sometimes absent; surface covered with thick pubescent. Anterolateral margins separated into four lobes; the first and second generally truncate, separated by narrow fissures, usually appearing fused, margins usually straight or distinctly concave, lined with many tubercles, often callositised, edge of lobes highly spiniform; third and four lobes distinctly dentiform, almost equal, directed strongly forward, margin of third lobe might be covered with some tubercles thus appearing straight. Posterolateral margin mildly tuberculated, sometimes absent. Frontal margin with small median fissure, slightly deflexed, appearing straight from dorsal view, shallow median cleft, covered with many tubercles. Strong infraorbital and subhepatic teeth which are often covered with callosities. Merus of third maxilliped tuberculated. Chelipeds cylindrical, carpus without large tubercle or spine on distal inner margin of carpus. Ambulatory legs short and stout, ratio of length to width of fourth ambulatory merus 2.6-3.4, anterior margin of the ambulatory merus lined with very strong spinules. Distal part of G1 bends approximately 90° or very slightly downwards.

Remarks. - This species was described by Balss (1921) but was later synonymised under *H. elegans* by Sakai (1932). Most subsequent workers have followed this action (e.g. Serène et al., 1958). Not much justification was provided for the synonymy. Sakai (1932) regarded De Man's (1887) type specimen of *H. elegans* as a juvenile (6.6 by 9.25 mm) when compared to his specimen measuring 12.5 by 15 mm. Chia et al. (1993: 266) suggested that *H. japonica* should be regarded as a distinct taxon from *H. elegans*.

Undoubtedly, these two species are very close. However, there are consistent differences in the form of their anterolateral lobes. The margins of the first and second anterolateral lobes in *H. japonica* are concave and the edges of the lobes are strongly spiniform, apposing each other and appearing fused, whilst the third and fourth anterolateral lobes are highly spiniform, acute and distinctly curving forward. This condition is evident even in small specimens (Figs. 18A, M). In *H. elegans*, the margins of the first and second anterolateral teeth are straight or subtruncate, the edges are not spiniform, and are separated by a wide gap; the third and fourth anterolateral teeth are less acute, weaker and directed obliquely outwards (Fig. 15A). Other differences include the stronger infraorbital and subhepatic teeth in *H. japonica*, stronger spinules on the anterior margins of the ambulatory meri in *H. japonica*, and the more tuberculate surfaces of the third maxillipeds and thoracic sternum in *H. elegans*. Known *H. japonica* specimens in general are also larger in size (width of adult carapace is usually above 10 mm as compared to less than 10 mm in *H. elegans*).

Variations observed within the species include a more dentiform third anterolateral lobe the but margin of which may be tuberculated, appearing slightly truncate (Fig. 18N), highly or mildly tuberculated surfaces of the chelipeds, the number of spines on the anterior margins of the ambulatory meri vary from two to 10, the posterolateral margin of the carapace is

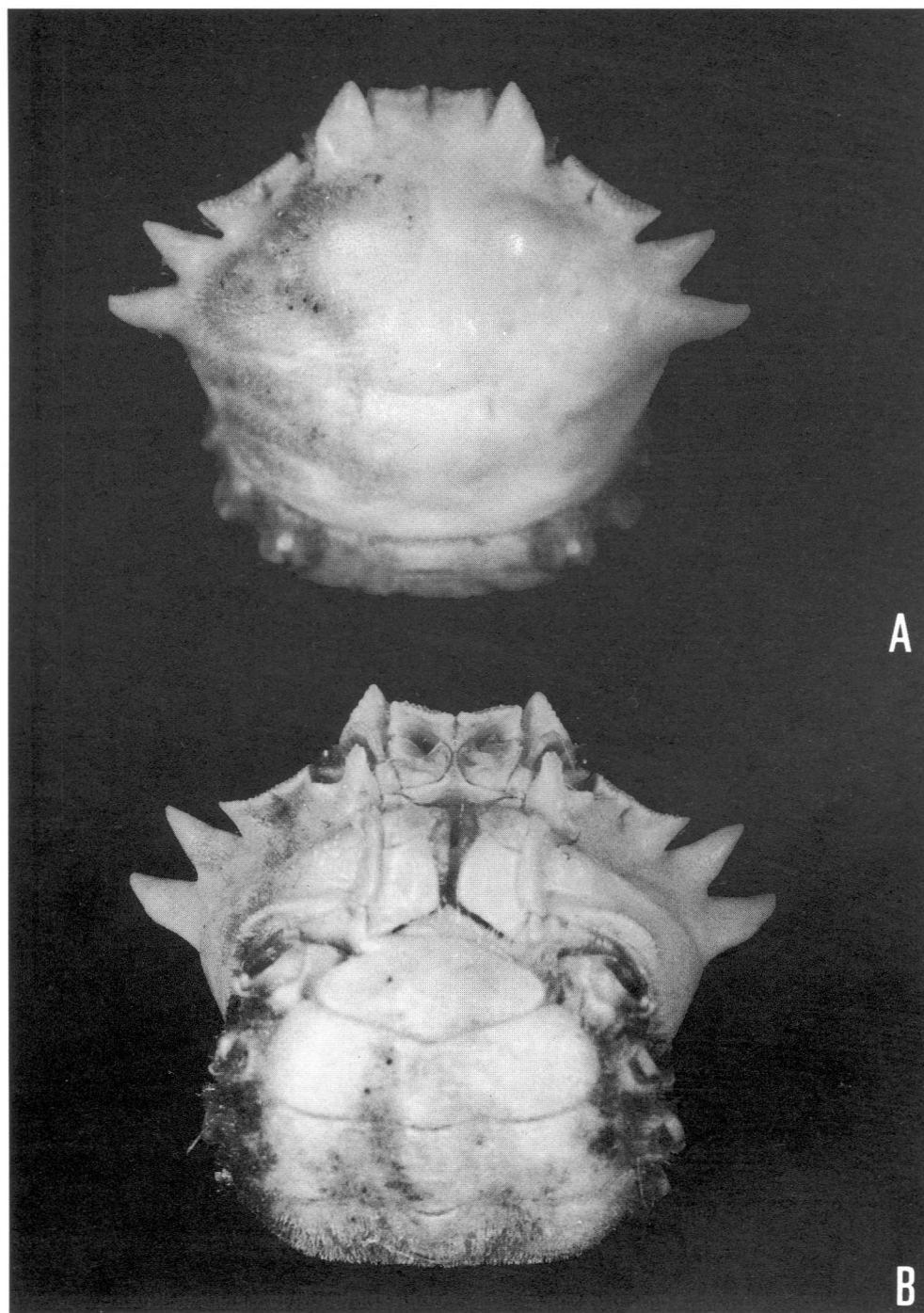


Fig. 16. *Harrovia japonica* Balss, 1921. Lectotype female, 10.3 by 14.4 mm (BMNH 1934.4.6.1). A, dorsal view; B, ventral view.



Fig. 17. *Harrovia japonica* Balss, 1921. Male, 9.5 by 14.0 mm (RMNH 32040). A, dorsal view; B, ventral view.

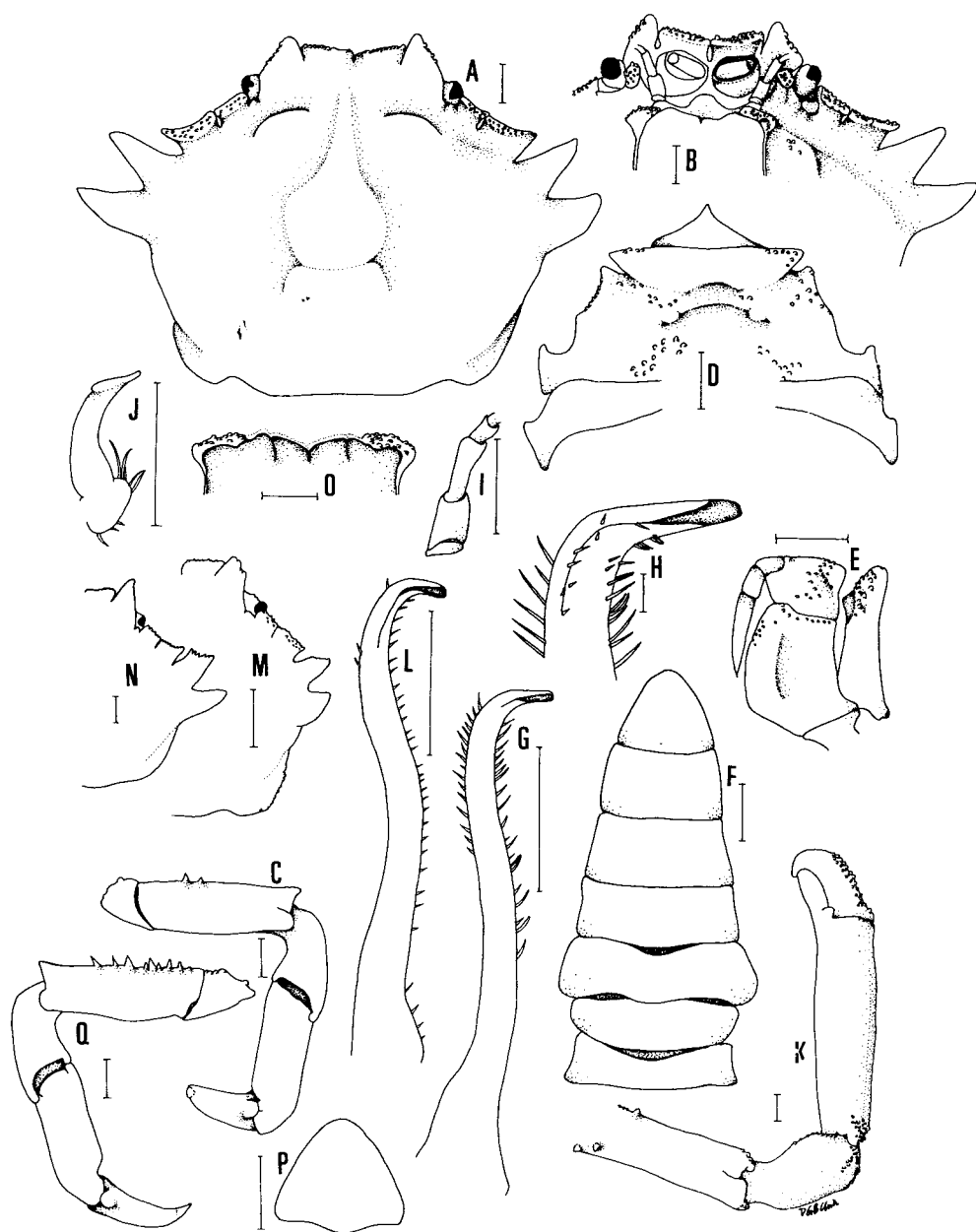


Fig. 18. *Harrovia japonica* Balss, 1921. A-E, I, O, Lectotype female, 10.3 by 14.4 mm (BMNH 1934.4.6.1); F-H, J-K, P, male, 9.5 by 14.0 mm (RMNH 32040); L, male, 8.8 by 12.8 mm (ZMUC); M, juvenile female, 4.7 by 6.6 mm (ZMUC); N, male, 9.2 by 12.9 mm (ZRC 1997.180); Q, female, 11.3 by 16.8 mm (RMNH 32040). A, dorsal view of carapace; B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, antenna; J, left G2; K, postero-dorsal view of right cheliped; L, left G1; M, N, dorsal view of carapace (schematic); O, endostome; P, 7th abdominal segment; Q, fourth left ambulatory leg. Scales: A-G, I-Q = 1.0 mm; H = 0.1 mm.

smooth to mildly tuberculated, the distal part of the G1 bends at 90° (Fig. 18G) or slightly inwards (Fig. 18L), and the right first and second anterolateral lobe of a female specimen (ZRC, 13.3 by 19.2 mm) are separated by a narrow gap but the left lobes are fused.

The syntype deposited in the BMNH is hereby designated as the lectotype for the species.

A specimen from southern China was examined and it fits well into the current definition of *H. japonica*. This record thus extends the range of the species further south.

Host records. - Often found on *Comanthus japonicus*.

Distribution. - Occurs in Japan and southern China. In Japan, it has been often found together with *C. trilobatus* on comatulid crinoids. In southern China, two other crinoid dwelling species, *C. frontodentata*, *C. longimanus* and *Rhabdonotus pictus* are present as well.

***Harrovia longipes* Lanchester, 1900**

(Figs. 19-23)

Harrovia albolineata var. *longipes* Lanchester, 1900: 729, pl. 44: Fig. 3 [type locality Singapore]; Flipse, 1930: 76, 77, 80, 90 [list only]; Serène et al., 1958: 239 [list only].

Harrovia albolineata - Serène et al., 1958: 200, 239, Figs. 7G, 8, 9, 13C 13 [broken-line drawing], pls. 4C, 6, 7: Figs. A, B [Vietnam] (part); Serène, 1968: 63 [list only] (part); Lim & Ng, 1988: 217, Fig. 1 [Singapore; larvae]; Stevcic et al, 1988: 1311 [list only] (part); Ng & Lim, 1990: 257 [Singapore] [not *Harrovia albolineata* Adams & White, 1849].

Harrovia longipes - Chia et al., 1993: 274, plate 1B, Figs. 1B, 3, 4, 5C, D, 6B, D, 7K-N, 8A [Singapore, Malaysia].

Harrovia plana Ward, 1936: 10, pl. 3: Figs. 7, 8 [type locality Lindeman Island, Whitsunday Passage, Queensland, Australia]; Serène et al., 1958: 198, 240 [list only]; Serène, 1968: 63 [list only]; Stevcic et al., 1988: 1312 [list only].

Material examined. - **Singapore:** 1 female (ZRC 1997.184), Raffles Lighthouse, coll. J. Christophe, Apr. 1993. **Peninsular Malaysia:** 2 males (6.0 by 8.2 mm) (ZRC 1997.185-186), Pulau Gelok, coll. D. Chia & C. P. How, 27 Jun. 1993. **Vietnam, Gulf of Tonkin:** 1 female, (6.4 by 8.9 mm) (IOAS), Yezhu Island, Yolong Bay, 6-9 m, from crinoid, leg. Neumann, 23 Nov. 1990. **Philippines:** 1 male (4.0 by 4.5 mm) (MNHN B25636), coll. MUSORSTOM 3, R.V. 'Coriolis', no other data. **Australia:** 1 male (5.5 by 6.6 mm) (QM W741, holotype of *H. plana*), Lindeman Island, Whitsunday Passage, Australia, M.E.Q. - 1 female (QM W16275), Flinders reef, off Cape Moreton, SE Queensland, 26°59'S, 153°29'E, 6-20 m, coll. P. Davie, J. Short & P. Lawless, 10 Mar. 1989. - 1 female (QM W15970), Davies reef lagoon, northeast Queensland, A.I.M.S., 18°50'S, 147°39'E, 7 m, coll. K. Fabricius, 24 Oct. 1988. - 1 juvenile male (2.7 by 2.7 mm) (MNHN B24737), Lizard Island, Queensland, 15 m, on *Lamprometra palmatagyes*, coll. P. Castro, 8 Aug. 1992. - 3 males (5.0 by 5.9 mm), 5 females, 6 juveniles (MNHN B25637), Great Barrier Reef, Queensland, Australia, coll. K. Fabricius. - 1 male (4.6 by 5.4 mm) (AM P17857), off Heron Island, Queensland, Australia, 23°27'S, 151°55'E, coll. K. Gillett, 6 Jan. 1969. **New Caledonia:** 1 male (4.8 by 5.8 mm) (MNHN B21548), coll. 1903. - 1 male (5.8 by 7.2 mm) (MNHN B25638), Lagon East, Station 0692, 21°31'S, 166°12.3'W, 44-48 m, coll. 9 Aug. 1986. - 1 female (MNHN B25639), Lagon East, Station 0710, 21°24'S, 166°02'E, 30-31 m, coll. 10 Aug. 1986. - 1 female (MNHN B25640), Iles des Pins, Station 586, 22°48'S, 167°35'E, 57 m, coll. 18 Jul. 1985. - 1 male (5.2 by 6.0 mm), 1 female (MNHN B25641), Lagon East, Station 0686, 21°34.3'S, 166°15.8'E, 33-35 m, coll. 9 Aug. 1986. - 1 male (MNHN B25642), Lagon East, Station 0736, 22°06.7'S, 166°58.4'E, 44-45 m, coll. 12 Aug. 1986. - 1 male (5.5 by 6.7 mm), 1 female (MNHN B25643), Lagon East, Station. 0723, 21°21.6'S, 165°56.7'E, 45 m, coll. 12 Aug. 1986. - 1 male, 1 female (MNHN B25644), east coast Touho, Ti°, 5-7 m, coll. no other data. - 2 males (badly damaged) (7.1 by 8.2 mm, 7.1 by 9.5 mm) (MNHN B25645), Touho, Ti° shoal, 5-7 m, coll. 9 Sep. 93. - 1 male (6.8 by 8.4 mm), 1 female (MNHN B25646), Bathust Cruise, Station DW 1236, 21°18.13'S, 165°53.68'E, coll. R.V. 'Alis', 13 Mar. 1993. - 1 female (MNHN B25647), east coast of Touho,

20°44.20'S, 165°14'E, 51-59 m, Montrouzier expedition, coll. 15 Sep. 1993. **Papua New Guinea:** 1 male (8.0 by 10.1 mm), 1 female (MNHN B24750), Wongad Island, Madang, 3-6 m, on *Comaster* sp., coll. P. Castro, 19 Aug. 1992. - 1 female (MNHN B24752), Tab Island, Madang, 1-6 m, on *Comaster* sp., coll. P. Castro, 18 Aug. 1992. - 1 female (MNHN B24751), Rasch Passage, Madang, 14 m, on *Comissia* sp., coll. P. Castro, 19 Aug. 1992. - 1 female (MNHN B24753), Wongad Island, Madang, 10 m, on *Comaster gracillis*, coll. P. Castro, 21 Aug. 1992. - 1 female (MNHN B24754), Madang, on *Comaster* sp., coll. P. Castro, no other data. - 1 female (IRSNB I.G n° 26.227), NE Duangit, dredged in Hansa Bay, 50 m, sand, *Halimeda* substratum, coll. J. Pierret, 9 Dec. 1980. - 1 male (IRSNB), Lahaye, on *Comaster multibrachiatus*, Nov. 1990, no other data. - 1 male (IRSNB sample no. 212), east side of Miller slope, on *Comaster schoenovi*, 42 m, no other data. - 1 male (IRSNB sample no. 252), on *Comaster multifidus*, no other data. - 1 female, 2 juveniles (ZRC 1997.187-189), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comaster multifidus* (3 separate crinoids), reef crest, coll. P. Castro, 21 Dec. 1993. - 1 male, 2 females (ZRC 1997.190-192), north Tab Island, Madang, 5°10'S, 145°50'E, 5 m, on *Comaster multifidus* (3 separate crinoids), reef crest of barrier reef, coll. P. Castro, 20 Dec. 1993. - 2 males (ZRC 1997.193-194), Wongad Natun reef, Madang, 5°08.31'S, 145°49.36'E, 4 m, on *Comaster multifidus*, reef crest, coll. P. Castro, 29 Dec. 1993. - 2 males, 1 female (ZRC 1997.195-197), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comaster multifidus*, reef crest, coll. P. Castro, 19 Dec. 1993. - 1 female (ZRC 1997.198), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, on *Comaster multifidus*, reef crest, coll. P. Castro, 17 Dec. 1993. - 1 male (ZRC 1997.199), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 1 m, on *Comaster multifidus*, reef crest, coll. P. Castro, 27 Dec. 1993. - 1 male (ZRC 1997.200), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comaster multifidus*, reef crest, coll. P. Castro, 26 Dec. 1993. - 1 male (ZRC 1997.208), Matazeng Reef, Madang, 3 m, on *Comaster multifidus*, reef crest, coll. P. Castro, 27 Dec. 1993. **Indonesia:** 2 males, 2 females (8.8 by 11.3 mm) (MNHN B24764), Siladen, Sulawesi, 10-12 m, on crinoid, coll. P. Castro, 20 Sep. 1992. - 2 females (11.2 by 14.9 mm) (MNHN B24765a-b), Bunaken, Sulawesi, 10-15 m, on crinoid, coll. P. Castro, 20 Sep. 1992. 1 male (7.5 by 10.0 mm), 1 female (MNHN B24763a-b), Mantehage, Sulawesi, 18 m, on crinoid, coll. P. Castro, 19 Sep. 1992. - 1 female (MNHN B24761), Samalona Island, Sulawesi, 4 m, on crinoid, coll. P. Castro, 13 Sep. 1992. - 1 juvenile female (MNHN B24762), Nain Island, Sulawesi, on crinoid, coll. P. Castro, 19 Sep. 1992. - 1 female (MNHN B24770), Amed, Bali, Lesser Sunda Islands, 3-5 m, on crinoid, coll. P. Castro, 3 Oct. 1992. - 5 males (4.0 by 4.5 mm), 5 females (9.3 by 11.6 mm, 9.0 by 11.5 mm, 6.7 by 8.3 mm) (MNHN B24768a-j), Saparna Island, Moluccas, 10-15 m, on crinoid, coll. P. Castro, 24 Sep. 1992. (For type and materials from Malaysia and Singapore, see Chia et al., 1993).

Diagnosis. - Carapace hexagonal, regions not well defined, usually with two tubercles on protogastric regions, but sometimes absent; surface usually thinly pubescent. Anterolateral margins separated into four lobes; separated by shallow, narrow fissures, the first and second lobes generally lobiform, very low, subtruncate, the margins usually straight or slightly concave; third lobe varies, either subtruncate or dentiform or lower part of the third lobe becomes dentiform whereas upper part remains subtruncate; fourth lobe distinctly dentiform. Frontal margin with small median fissure, slightly deflexed, appearing straight from dorsal view, shallow median cleft. Chelipeds cylindrical, carpus without large tubercle or spine on distal inner margin of carpus, several tubercles on the inner and outer proximal margin of merus. Ambulatory legs long, slender, ratio of length to width of fourth ambulatory merus 3.0-4.3, anterior margin of the ambulatory merus lined with strong spinules. Distal part of G1 bends at approximately 45°, sometimes 90°.

Sexual dimorphism. - Males have disproportionately larger and stouter chelipeds as compared to the females.

Remarks. - Chia et al. (1993) have clarified to a large extent the taxonomy and status of *H. longipes* occupying the Sunda Shelf (continental Southeast Asia). However, re-examination of the extant type specimens and extensive preserved and live materials from other regions has shown that the poorly known species, *H. plana* Ward, 1936, is actually a junior synonym of *H. longipes* Lanchester, 1900.

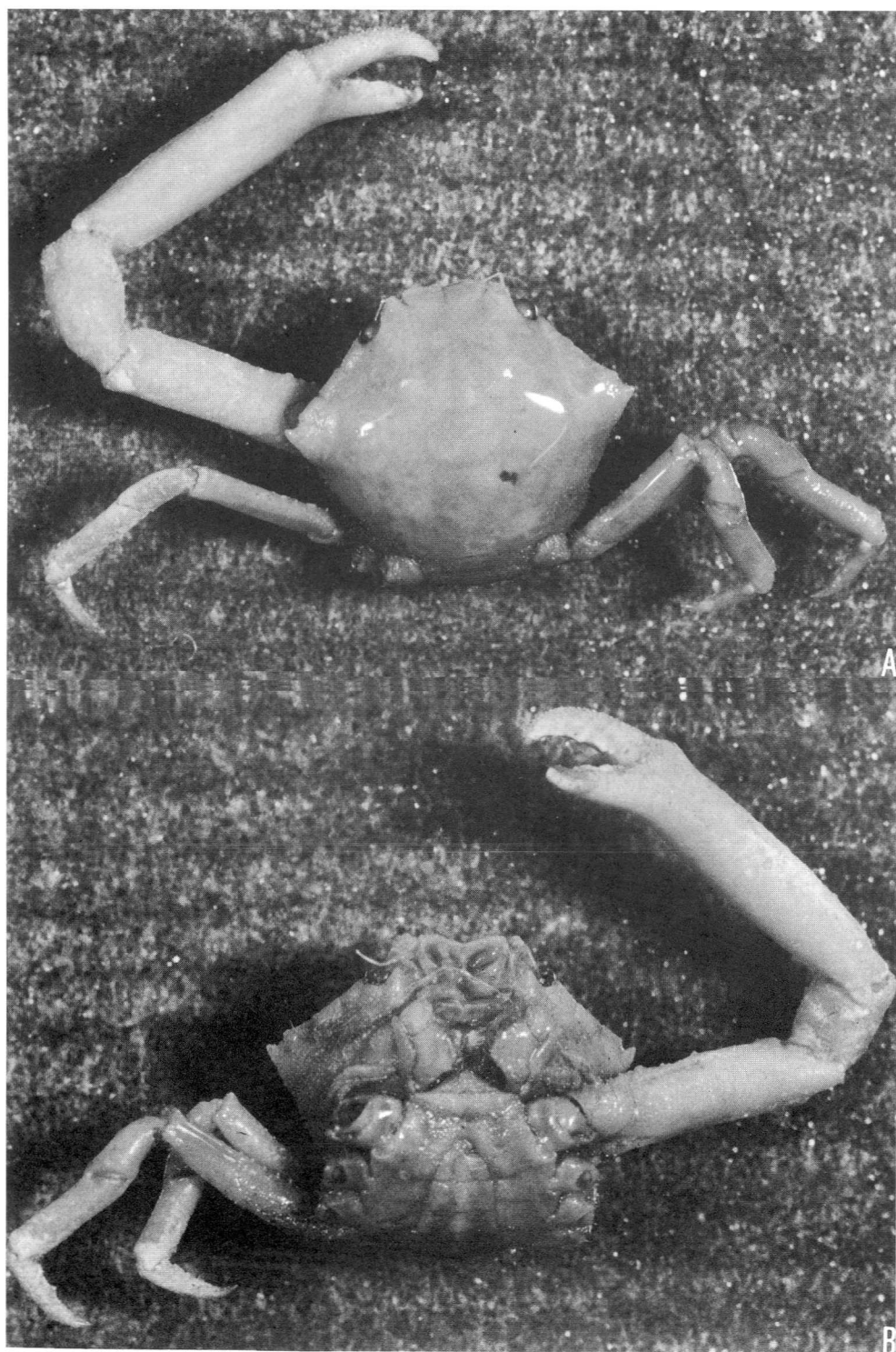


Fig. 19. *Harrovia longipes* Lanchester, 1900. Holotype male, 6.4 by 8.3 mm (BMNH 1900.10.22.42). A, dorsal view; B, ventral view.

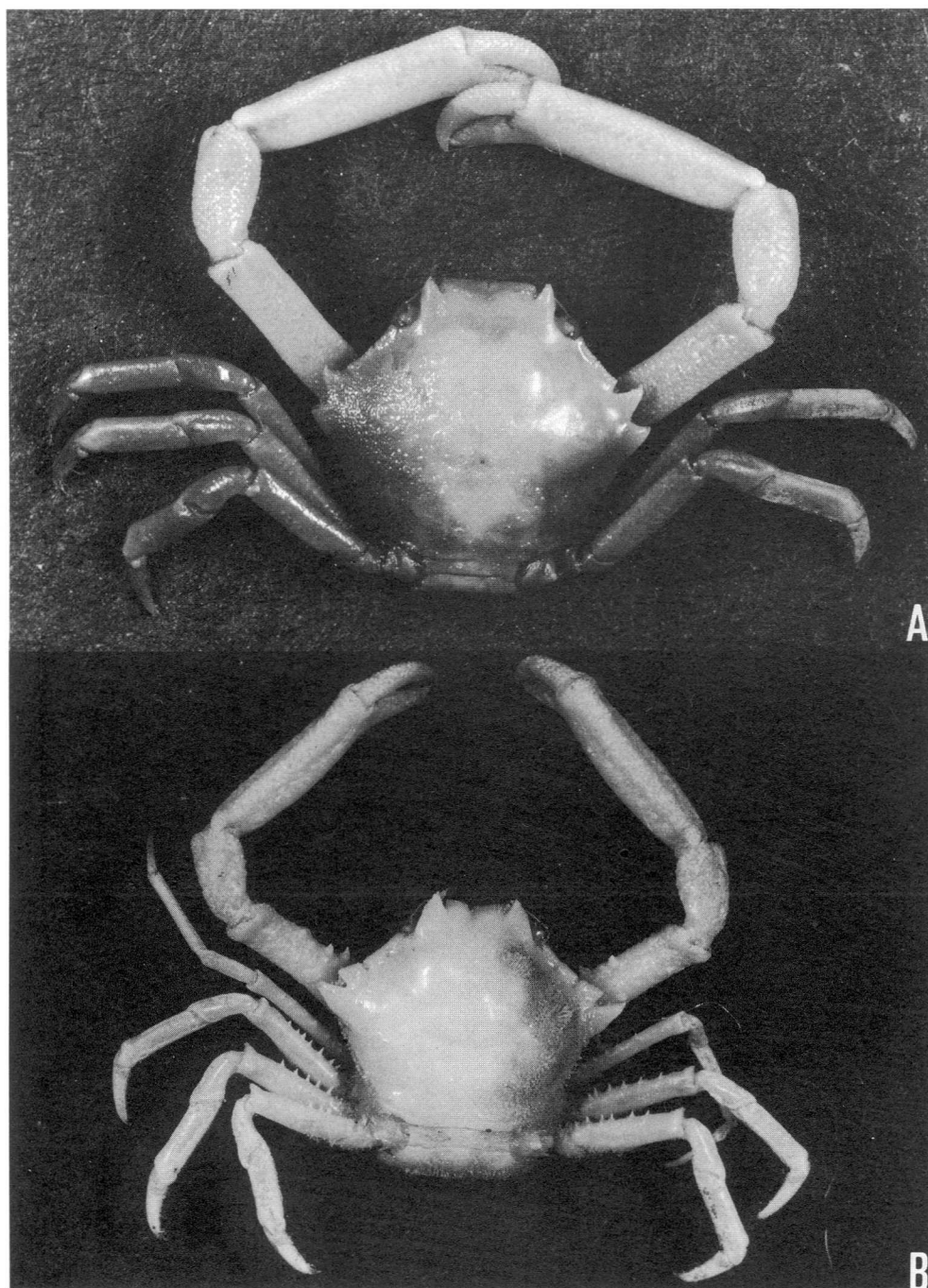


Fig. 20. *Harrovia longipes* Lanchester, 1900. A, holotype male of *H. plana* Ward, 1936, 5.5 by 6.6 mm (QM W741). B, female, 6.4 by 8.9 mm (IOAS).

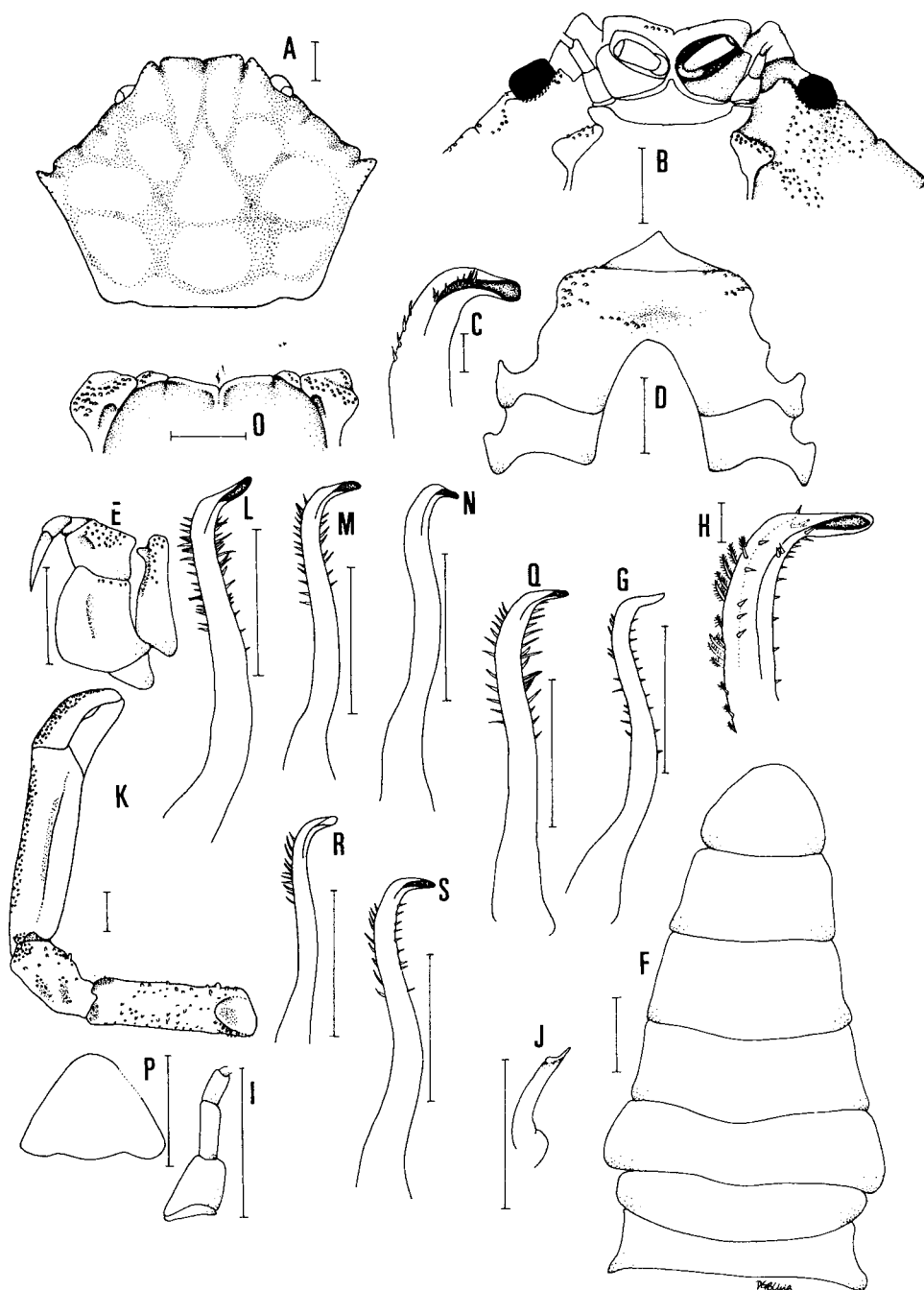


Fig. 21. *Harrovia longipes* Lanchester, 1900. A, B, D, E, G-K, P, holotype male, 6.4 by 8.3 mm (BMNH 1900.10.22.42); C, N, holotype male of *H. plana*, 5.5 by 6.6 mm (QM W741); F, O, male, 9.1 by 11.8 mm (ZRC 1992.9525); L, male, 8.0 by 10.1 mm (MNHN B24750); M, male, 5.2 by 6.0 mm (MNHN AC82-83); Q, male, 6.0 by 8.2 mm (ZRC 1997.185-186); R, male, 4.6 by 5.4 mm (AM P17857); S, male, 5.8 by 7.2 mm (MNHN AC79). A, dorsal view of carapace; B, face of carapace; C, distal tip of left G1; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, antenna; J, left G2; K, postero-dorsal view of left cheliped; L, M, left G1; N, left G1; O, endostome; P, 7th abdominal segment; Q-S, left G1. Scales: A-B, D-G, I-S = 1.0 mm; C, H = 0.1 mm.

The only difference between *H. longipes* and *H. plana* seems to lie in the form of the anterolateral lobes. *Harrovia longipes* usually has anterolateral lobes one, two and three subtruncate, follow by a dentiform fourth anterolateral lobe (Fig. 23A). In *H. plana*, anterolateral lobes one and two are subtruncate and tuberculated, but anterolateral lobes three and four are distinctly dentiform and acute (Fig. 23J). This character proves to be highly unsatisfactory when it comes to identifying specimens from New Caledonia, Papua New Guinea, Moluccas and Sulawesi (especially in the latter two localities). There seems to be an intermediate form existing in the Sulawesi. In these areas, the third anterolateral lobe of some specimens seem to be half truncate and half dentiform (Figs. 23E, F). The upper part of the third anterolateral appears to be subtruncate and lined with tubercles whereas the lower part is dentiform. Other than the intermediates, there is also a mixture of specimens examined from these regions, some resembling *H. longipes* (Fig. 23D), others resembling

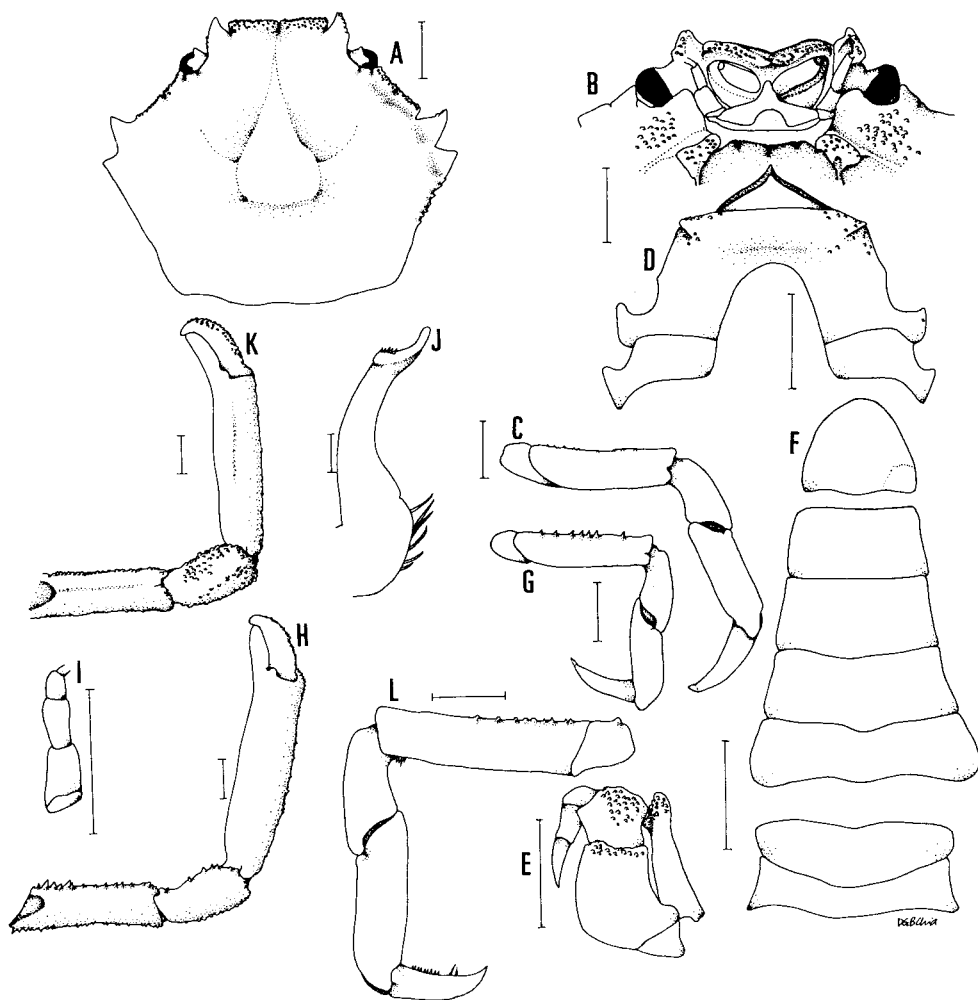


Fig. 22. *Harrovia longipes* Lanchester, 1900. A-F, I-K, holotype male (of *H. plana* Ward, 1936), 5.5 by 6.6 mm (QM W741); G, H, male, 5.8 by 7.2 mm (MNH AC79); L, holotype male of *H. longipes*, 6.4 by 8.3 mm (BMNH 1900.10.22.42). A, dorsal view of carapace; B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, fourth right ambulatory leg; H, postero-dorsal view of right cheliped; I, antenna; J, left G2; K, postero-dorsal view of right cheliped; L, fourth left ambulatory leg. Scales: A-I, K-L = 1.0 mm; J = 0.1 mm.

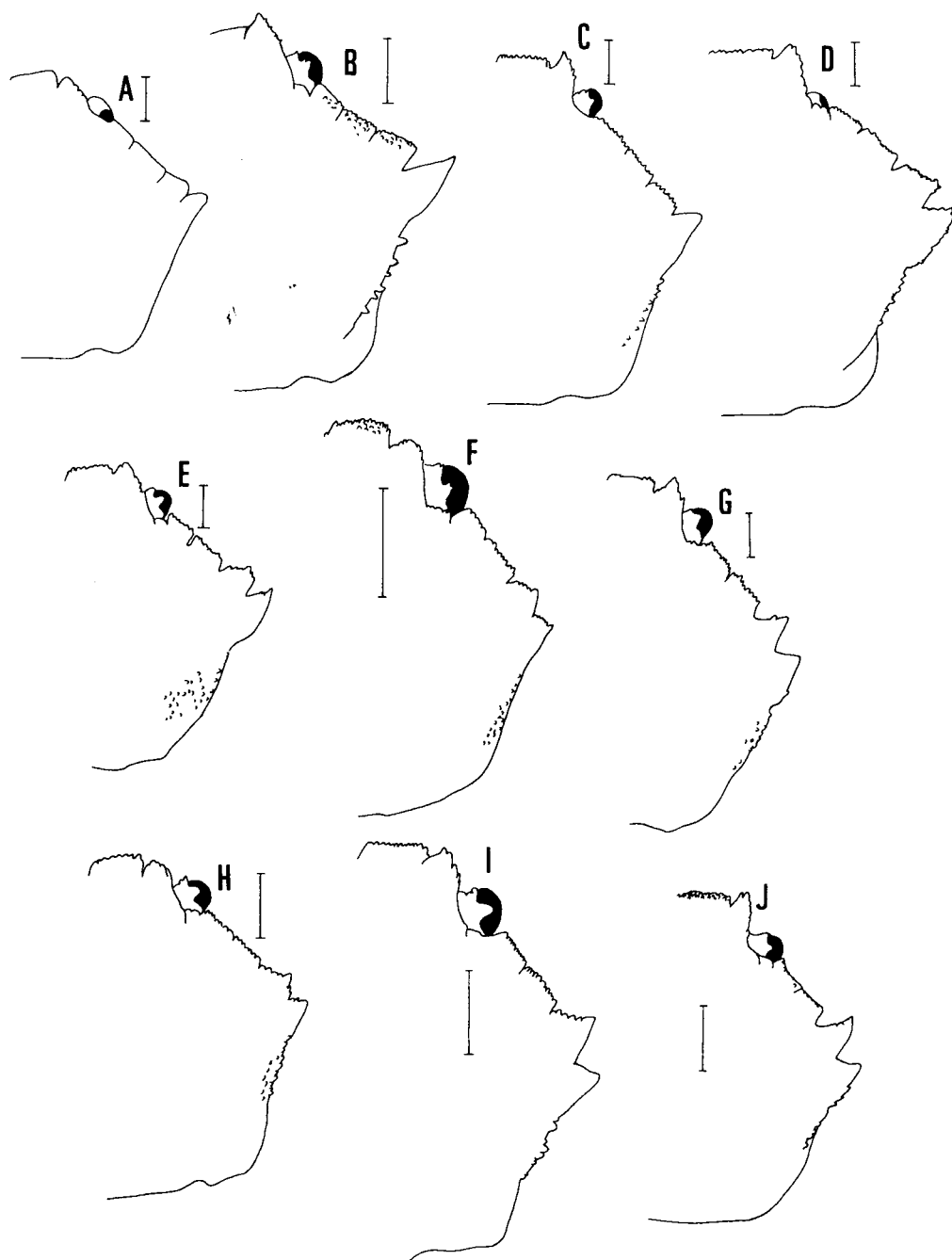


Fig. 23. *Harrovia longipes* Lanchester, 1900. Anterolateral lobes (schematic): A, holotype male, 6.4 by 8.3 mm (BMNH 1900.10.22.42); B, female, 6.4 by 8.9 mm (IOAS); C, male, 8.8 by 11.3 mm (MNHN B24764); D, female, 11.2 by 14.9 mm (MNHN B24765); E, male, 7.5 by 10.0 mm (MNHN B24763a); F, male, 4.0 by 4.5 mm (MNHN B24768a); G, female, 9.0 by 11.5 mm (MNHN B24768c); H, male, 5.5 by 6.7 mm (MNHN AC85); I, male, 5.2 by 6.0 mm (MNHN AC82-83); J, holotype male of *H. plana* Ward, 1936, 5.5 by 6.6 mm (QM W741). Scales = 1.0 mm.

H. plana (Fig. 23G). Most of the specimens from Sulawesi approach *H. longipes*, while specimens from Moluccas, Papua New Guinea, New Caledonia and Australia seem to have specimens that match *H. plana*. There seems to be a gradual trend for the third anterolateral lobe to transform from truncate to dentiform when moving eastward (i.e. from Southeast Asia to Australasia). But one cannot overlook the fact that when specimens from the Sunda and Sahul Shelves are compared, the difference in the third anterolateral lobe seems to be rather obvious. Since there is evidence of a cline, in the present revision, *H. plana* Ward, 1936, is regarded as a junior synonym of *H. longipes* Lanchester, 1900.

There are two morphological variants regarding the distal part of the G1, some bending at 110° (Figs. 21L-M) and others at 90° (Figs. 21G, Q, S), both of which can be found in the same locality. The distal part of the G1 of the type of *H. plana* (QM W741) seems to turn slightly more downwards (Fig. 21N) but this is not observed in the other specimens from the Great Barrier Reef, Australia (Fig. 21R). Hence this character is regarded as part of the normal variation of the species. The surfaces of the chelipeds appear as spiny to tuberculated. The anterior margin of the ambulatory legs are lined with low to high spinules (Figs. 22C, G, L).

A female collected from the Gulf of Tonkin (6.4 by 8.9 mm, IOAS) has unusually incised anterolateral lobes and the inner supraorbital teeth appear to be rather broad (Fig. 23B). In other aspects (the form of the anterolateral lobes (three subtruncate and one dentiform), strongly spiniform ambulatory legs and chelipedal meri), it belongs to *H. longipes*. A small male (4.0 by 4.5 mm, MNHN AC64) from the Philippines was examined and tentatively identified as *H. longipes*, albeit doubt. Its identity is difficult to ascertain due to its small size. The anterolateral lobes one and two of this specimen are truncate, the third lobe is subtruncate and subdentiform, and the fourth lobe is dentiform, all of which seems to fit into the present definition of *H. longipes*.

Larvae. - The first zoea was described by Lim & Ng (1988) as *H. albolineata* but its identity as *H. longipes* was determined by Chia et al. (1993).

Host records. - Mostly found on comasterids.

Distribution. - This shallow water, coral reef species occurs from the Sunda Shelf (continental Southeast Asia) to the Sahul Shelf (continental Australia) and reaching as far north to the Philippines.

Harrovia ngi Chen & Xu, 1992

(Figs. 24, 25)

Harrovia longipes - Chen & Xu, 1991: 87 [Chinese text], 105 [English text], Fig. 30 [type locality Nansha Islands, 6°30'N, 108°17'E, South China Sea] [not *Harrovia longipes* Lanchester, 1900].
Harrovia ngi Chen & Xu, 1992: 265 [replacement name].

Material examined. - Holotype: male (3.4 by 5.1 mm) (IOCAS SSB III 17-20), Nansha Islands (= Spratly Islands), Station 10, 6°30'N, 108°17'E, 94 m, sandy substratum, 7 May 1986.

Diagnosis. - Carapace hexagonal, regions well defined, with tubercles on protogastric, metagastric, branchial, cardiac and metabranchial regions; surface very smooth, with few occasional low, scattered tubercles. Anterolateral margins separated into four lobes, margins

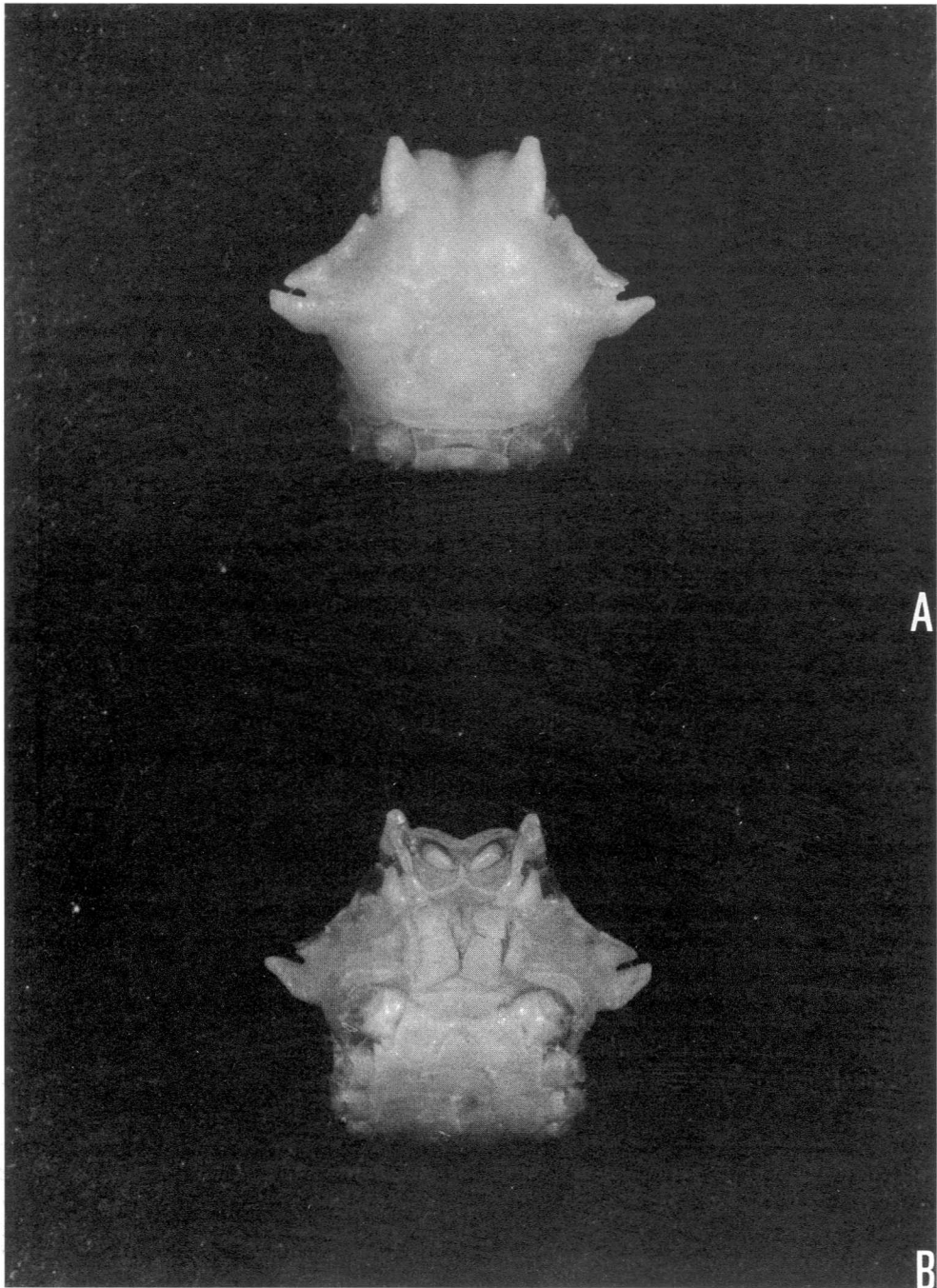


Fig. 24. *Harrovia ngi* Chen & Xu, 1992. Holotype male, 3.4 by 5.1 mm (IOAS SSB III 17-20). A, dorsal view; B, ventral view.

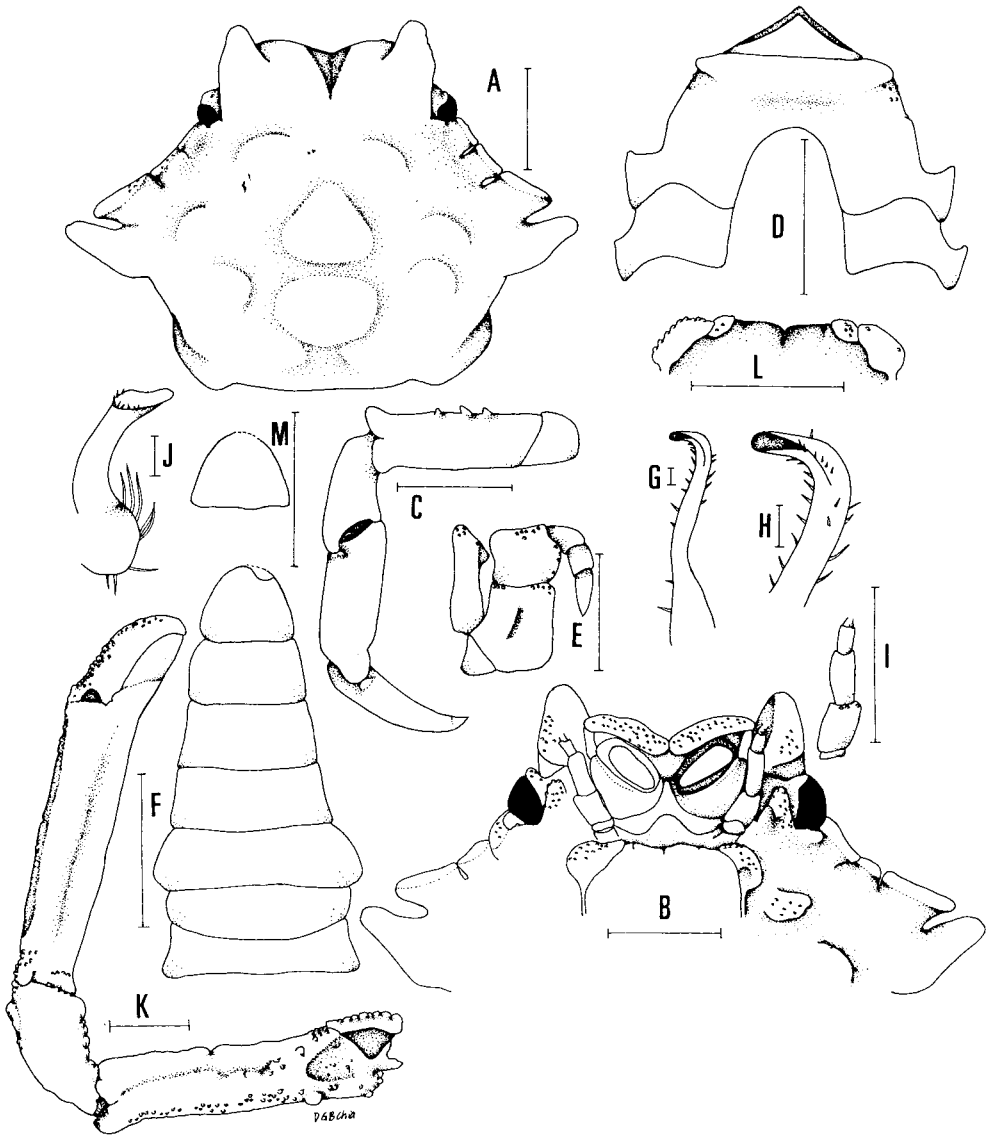


Fig. 25. *Harrovia ngi* Chen & Xu, 1992. Holotype male, 3.4 by 5.1 mm (IOAS SSB III 17-20). A, dorsal view of carapace; B, face of carapace; C, fourth left ambulatory leg; D, thoracic sternum; E, right third maxilliped; F, abdomen; G, right G1; H, distal tip of right G1; I, antenna; J, left G2; K, postero-dorsal view of left cheliped; L, endostome; M, 7th abdominal segment. Scales: A-F, I, K-M = 1.0 mm; G-H, J = 0.1 mm.

of lobes with few tubercles; separated by deep, narrow fissures, the first, second and third lobes generally lobiform, very low, subtruncate, the margins usually straight or slightly concave; lower part of the third lobe, slightly dentiform, directed slightly forward, surface smooth; fourth lobe distinctly dentiform, lower part expanded, abrupt, plate-like. Frontal margin with small median fissure, slightly deflexed, appearing straight from dorsal view, shallow median cleft, margin smooth. Posterolateral margin smooth. Surface of third maxilliped smooth. Chelipeds cylindrical, carpus without large tubercle or spine on distal inner margin of carpus, surface of chelipeds lined with numerous small tubercles, no large tubercles along margins. Ambulatory legs long and slender, ratio of length to width of fourth ambulatory merus 3.1, anterior margin of the ambulatory merus lined with small spinules. Distal part of G1 bends approximately 90°, median part sinuous.

Sexual dimorphism. ¹ Not known.

Remarks. - This species was first described by Chen & Xu (1991) as *H. longipes*. As this name is preoccupied by *H. longipes* Lanchester, 1900, a replacement name was given by the same authors in 1992.

The holotype was re-examined in the present study. It seems to be the only specimen of the species. In terms of the carapace proportions and the form of the anterolateral lobes, *H. ngi* and *H. cognata* are very similar in appearance to *C. trilobatus*. However, the ratio of the length versus width of the second antennal segment for *H. ngi* is 2.0 and 2.6 for *H. cognata* (vs. 4.4-4.7 for *C. trilobatus*), thus establishing them as members of *Harrovia*. The close proximity of *H. ngi* with *H. cognata*, has been discussed earlier.

Distribution. - Known only from the Spratly Islands

***Harrovia tuberculata* Haswell, 1880**

(Figs. 26-28)

Harrovia tuberculata Haswell, 1880: 455, pl. 27: Fig. 4 [type locality Darnley Island, Torres Strait, Queensland, Australia]; 1882: 39 [list only]; Balss, 1922: 136 [list only]; Flipse, 1930: 76, 77, 80, 90 [list only]; Serène et al., 1958: 197, 199 [in key], 240, Fig. 7D [list only]; Serène, 1968: 63 [list only]; Wu, 1983: 165 [name in Chinese]; Stevcic et al., 1988: 1312 [list only]; Chen & Xu, 1991: Figs. 29-5 - 29-7 [holotype re-figured].

Material examined. - Holotype: male (6.0 by 8.2 mm) (AM P40853), Darnley Island, Torres Strait, 09°35'S, 143°46'E, coll. Chevert Expedition. Others: **Australia:** 1 male, 1 female (4.4 by 5.5 mm, 6.0 by 7.5 mm) (QM W18657), Northwest Shelf, Western Australia, Australia, 19°05.4S, 118°53.3'E, 02B04S, 82 m, epibenthic sledge, sublittoral, coll. CSIRO (Commonwealth Scientific and Industrial Research Organisation), R.V. 'Soela', 27 Apr. 1983.

Diagnosis. - Carapace hexagonal, regions well-defined, with very strong tubercles on protogastric, metagastric, cardiac and branchial regions, surface usually pubescent; anterolateral margins separated into four teeth, separated by deep, narrow fissures; the first tooth low, subtruncate, second low, blunt, third and fourth large, distinctly dentiform, strongly developed, third more lobate, can be smaller than fourth. Frontal margin with small median fissure, not strongly deflexed, appearing straight from dorsal view. Chelipeds cylindrical, surfaces very eroded, sculptured and tuberculated; high ridge on median dorsal surface of carpus, one large tubercle or spine on distal inner margin of carpus; several strong tubercles along the inner and outer proximal margin of merus. Ambulatory legs short and stout; ratio



Fig. 26. *Harrovia tuberculata* Haswell, 1880. Holotype male, 6.0 by 8.2 mm (AM P40853). A, dorsal view; B, ventral view. (Photograph courtesy of AM)

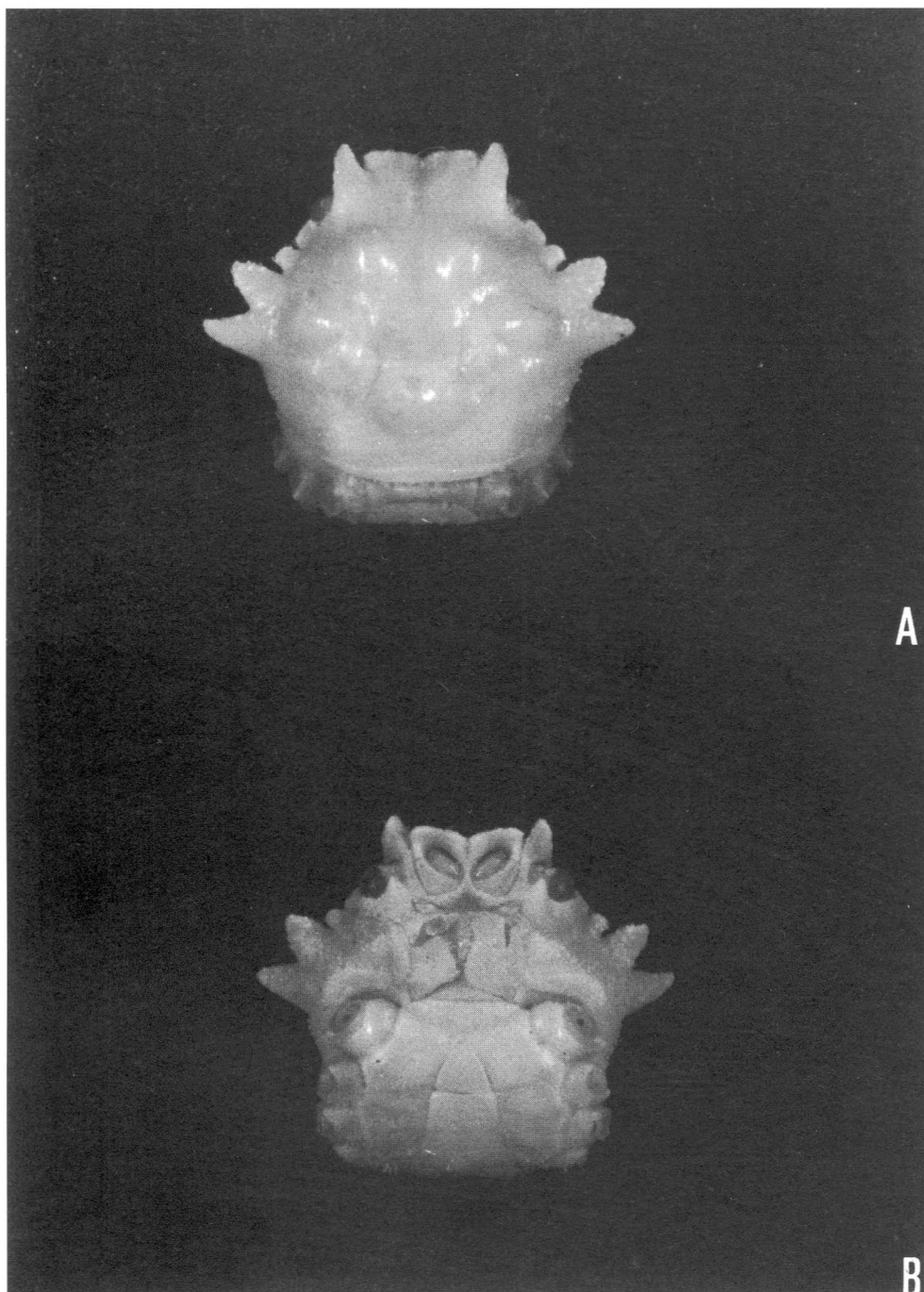


Fig. 27. *Harrovia tuberculata* Haswell, 1880. Male, 4.4 by 5.5 mm (QM W18657). A, dorsal view; B, ventral view.

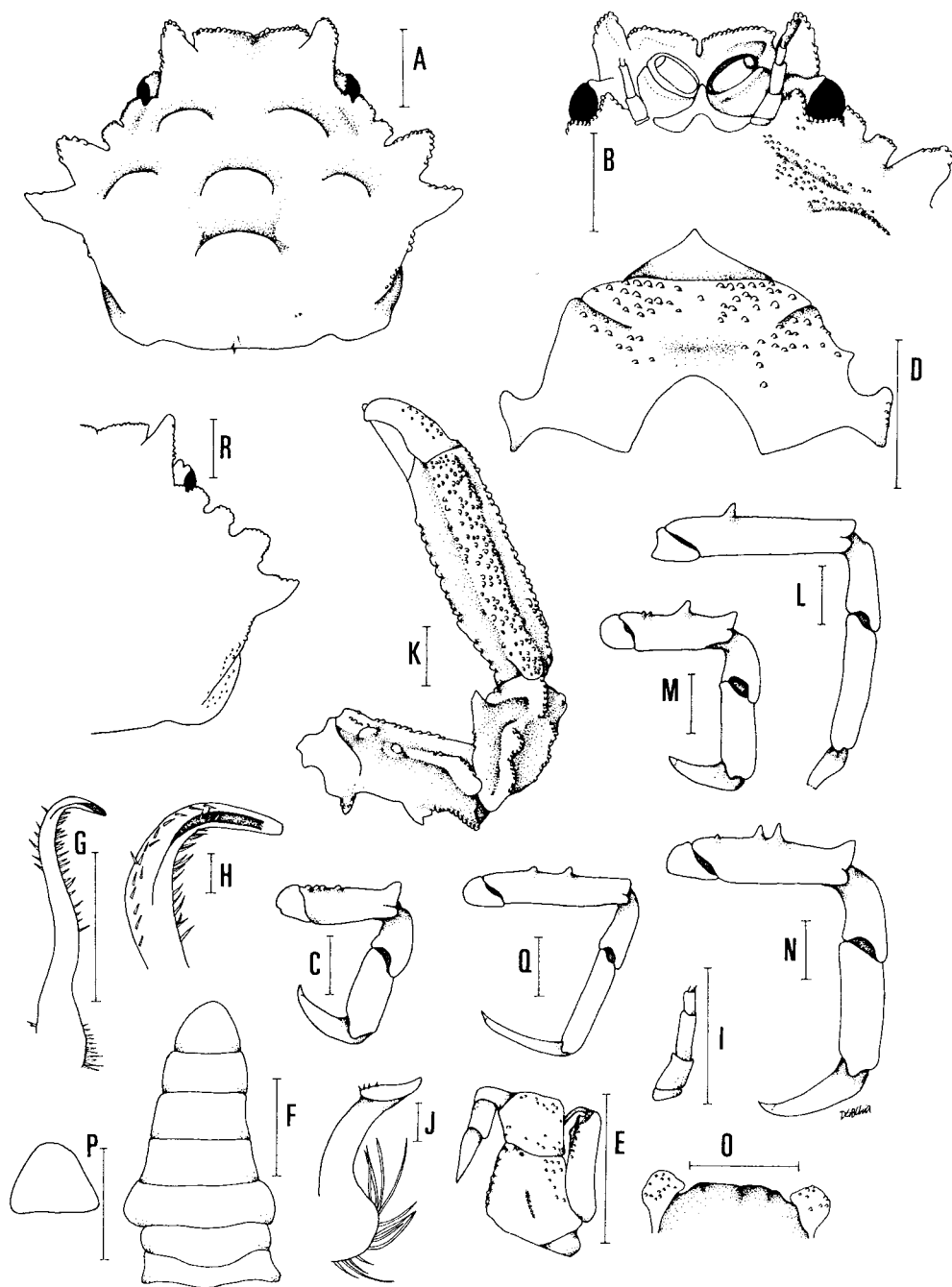


Fig. 28. *Harrovia tuberculata* Haswell, 1880. A-K, O-Q, male, 4.4 by 5.5 mm (QM W18657); L-M, R, female, 6.0 by 7.5 mm (QM W18657). A, dorsal view of carapace; B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, antenna; J, left G2; K, postero-dorsal view of right cheliped; L, first right ambulatory leg; M, fourth right ambulatory leg; N, second or third right ambulatory leg, sex indetermined; O, endostome; P, 7th abdominal segment; Q, first right ambulatory leg; R, dorsal view of carapace (schematic). Scales: A-G, I, K-R = 1.0 mm; H, J = 0.1 mm.

of length to width of fourth ambulatory merus 2.7-2.9; anterior margin of all ambulatory meri lined with 1-2 strong, acute spines. Distal part of G1 bends at approximately at about 110°.

Sexual dimorphism. - Males have disproportionally large chelipeds.

Remarks. - Haswell's illustration (1880: pl. 27: Fig. 4) of the holotype is small and inadequate. Subsequent figures by Chen & Xu (1991: Figs. 29-5, 29-7) provided a clearer depiction of the holotype. The present specimens examined here agree well with the holotype. This is particularly in the aspects of the highly tuberculated carapace, lobate third anterolateral lobe (Fig. 28A), spiny ambulatory meri (Figs. 28C, L, M, N, Q) and highly eroded chelipeds (Fig. 28K). There a consistent presence of one or two strong spinules on the anterior margins on the ambulatory meri which is distinctive for *H. tuberculata*. These characters are also distinguish this species from *H. albolineata* (see *Remarks* under *H. albolineata*).

PERMANOTUS, NEW GENUS

Harrovia - Gordon, 1934: 67 (part); Serène et al., 1958: 139 [in key], 172, 194, 199, 231, 238 (part); Dai et al., 1986: 162 [in key], 165 (part); Stevcic et al., 1988: 1311, 1318 (part); Dai & Yang, 1991: 179 [in key], 183 (part) [not *Harrovia* Adams & White, 1849].

Type species. - *Harrovia purpurea* Gordon, 1934, by present designation. Gender of genus masculine.

Etymology. - The new generic name is derived from the Greek for 'shield' in arbitrary combination with the name 'Eumedonus'. Gender masculine.

Diagnosis. - Carapace distinctly broader than long; rostrum short, distinctly deflexed downwards; inner supraorbital teeth distinct but very small, separated from frontal margin by longitudinal groove, folded downwards; frontal margin appearing entire from dorsal view but separated by distinct longitudinal groove; regions well defined, gastric and protogastric regions distinct, cardiac region mildly swollen; hepatic regions slightly depressed; surfaces of carapace relatively smooth to covered with scattered small granules; dorsal surface of carapace usually covered with very thin pubescence. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin rounded, not lamelliform, with four lobes (including external orbital angle), first three lobes truncate, lined with small granules, separated by narrow fissures, tightly adjoining each other, appearing fused, sometimes forming a structure, last tooth confluent with first three teeth but more developed, sharper, laterally directed. Antennules folding obliquely, ca. 45° from horizontal. Second antennal segment short, length to width ratio of second antennal segment 1.4-2.0. Chelipeds smooth or slightly granulated, surface pitted; carpus without spine or tubercle on inner angle; chelae elongated and slender, length ca. 3-4 times length of fingers, height ca. 2 times height of fingers; fingers not carinate, pollex not distinctly bent downwards. Merus of first ambulatory leg more slender than others, dactylus elongated, slender, ca. 2 times length of that on other legs; dorsal margin of merus smooth, not cristate. G1 long, slender.

Remarks. - The new genus, *Permanotus*, described here, has very a short second antennal segment (length to width ratio = 1.4-2.0) compared to those of *Harrovia* which varies from 2.0 to 3.4 (Table 1). Although there seems to be a slight overlap in the range of the ratio, the

mean is distinct and separate for both genera, i.e. *Permanotus* at 1.7 and *Harrovia* at 2.6. Also in *Permanotus*, the forms of the carapace structure, inner supraorbital teeth, frontal and anterolateral margins are very different compared to *Harrovia* s. str. In *Permanotus*, the carapace is flattened with distinctly depressed hepatic regions and the frontal, inner supraorbital teeth and anterolateral margins are very rounded and fold downwards. In *Harrovia*, the carapace does not have distinctly depressed regions and the frontal, inner supraorbital teeth and anterolateral margins are lamelliform and planar. The two genera are nevertheless closely related, sharing similar features (i.e. the colour pattern, form of chelipeds and ambulatory legs) and habits (both are crinoid symbionts).

Permanotus contains only one species, *P. purpurea* (Gordon, 1934).

***Permanotus purpureus* (Gordon, 1934), new combination**
(Figs. 29-31)

Harrovia purpurea Gordon, 1934: 67, Figs. 33d, 34, 35 [type locality Sorong, western New Guinea = Irian Jaya, Indonesia]; Buitendijk, 1939: 266 [Obilatu Island, Moluccas = Maluku Islands, Indonesia]; Holthuis, 1953: 6 [Kwajalein Atoll, Marshall Islands, central Pacific Ocean]; Serène et al., 1958: 198, 199 [in key], 240, Figs. 7C, 14 [list only]; Serène, 1968: 63 [list only]; Wu, 1983: 165 [name in Chinese]; Nagai & Nomura, 1988: 221 [colour photograph; Okinawa, Ryukyu Islands, Japan]; Stevcic et al., 1988: 1312 [list only]; Castro, 1989: 98 [Koror, Palau Island; Guam, Mariana Islands; Kwajalein Atoll, Marshall Islands, central Pacific Ocean]; Takeda & Marumura, 1994: 26, Fig. 2 (colour) [Kii Peninsula, Japan].

Harrovia bituberculata Shen, Dai & Chen, 1982: 146 [Chinese text], 149 [English text], Fig. 4-9 - 4-11, pl. 2: Fig. 12 [type locality Xincun, Hainan Island, China]; Dai et al., 1986: 165 [in key], 166, Fig. 98, pl. 22: Fig. 6 [list only]; Stevcic et al., 1988: 1311 [list only]; Dai & Yang, 1991: 183 [in key], 184, Fig. 98, pl. 22: Fig. 6 [list only].

Material examined. - Holotype: male (3.6 by 4.9 mm) (IRSNB IG9223), Sorong door, western New Guinea (= Irian Jaya), Indonesia, 2 Mar. 1929.

Others: **Malaysia:** 1 female (ZRC 1997.201), Barracuda Point, Sipadan Island, East Malaysia, coll. D. Lane, 21 May 1992. **Indonesia:** 8 males (4.1 by 5.6 mm, 4.8 by 6.4 mm), 4 females (6.6 by 8.3 mm) (MNHN B24760), Bunaken, Sulawesi, 10-15 m, on crinoid, coll. P. Castro, 20 Sep. 1992. - 7 males, 1 female (MNHN B24759), Bunaken, Sulawesi, 2-3 m, on crinoid, coll. P. Castro, 20 Sep. 1992. - 4 males, 6 females (MNHN B24758), Siladen, Sulawesi, 10-12 m, on crinoid, coll. P. Castro, 20 Sep. 1992. - 7 males, 1 female (MNHN B24769), Amed, north Bali, 3-5 m, on crinoid, coll. P. Castro, 3 Oct. 1992. - 1 male (MNHN B24755), Samalona Island, northwest of Ujung Pandang, 5°08'S, 119°26'E, 4 m, fringing reef, coll. P. Castro, 13 Sep. 1992. - 1 male, 1 female (MNHN B24756), Bunaken Island, off Manado, north of Sulawesi, 1°37'N, 124°46'E, 24 m, on crinoid, coll. P. Castro, 18 Sep. 1992. - 1 male, 1 female (MNHN B24757), northwest Mantehage Island, off Manado, north Sulawesi, 124°45'E, 1°46'N, 5 m, on *Comanthus parvicirrus*, reef slope, coll. P. Castro, 19 Sep. 1992. - 1 female (5.3 by 7.6 mm) (RMNH 4467), Station Obi Patoe, Snellius Expedition, 23-27 Apr. 1930. **Papua New Guinea:** 1 male, 3 females, 1 juvenile (MNHN B24740), Tab Island, Madang, 1-6 m, on *Clarkcomanthus littoralis* & *Comanthus parvicirrus*, coll. P. Castro, 18 Aug. 1992. - 1 female (CSPU 1), Southern Pass, Tab. Island, Madang, 5°10'S, 145°50'E, 1-4 m, on *Comatella stelligera*, reef crest, coll. P. Castro, 29 Dec. 1993. - 1 male (CSPU 2), Southern Pass, Tab. Island, Madang, 5°10'S, 145°50'E, 1-4 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 29 Dec. 1993. - 1 male (5.3 by 7.5 mm), 1 female (MNHN B24745), Wongad Island, Madang, on *Comatella stilligera*, coll. P. Castro, 21 Aug. 1992. - 1 male, 1 female (MNHN B24742), Wongad Island, Madang, 3-5 m, on *Clarkcomanthus littoralis*, coll. P. Castro, 22 Aug. 1992. - 6 males (4.2 by 5.5 mm), 4 females (MNHN B24741), Wongad Island, Madang, 3-6 m, on 4 species of crinoids, coll. P. Castro, 19 Aug. 1992. - 2 females (MNHN B24743), Wongad Island, Madang, on *Clarkcomanthus littoralis*, coll. P. Castro, 19 Aug. 1992. - 1 male, 1 female (MNHN B24747), Wongad Island, 3 m, on *Clarkcomanthus littoralis*, lagoon side, coll. P. Castro, 21 Aug. 1992. - 2 females (CSPU 3), Wongad Natun Reef, Madang, 5°08.31'S, 145°49.36'E, 4 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 29

Dec. 1993. - 1 female (ZRC), Matazeng Reef, Madang, 2-3 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 27 Dec. 1993. - 2 females (ZRC), Matazeng Reef, Madang, 2-3 m, on *Comanthina schlegelii*, reef crest, coll. P. Castro, 27 Dec. 1993. - 1 male (ZRC), Matazeng Reef, Madang, 3 m, on *Comanthina schlegelii*, reef crest, coll. P. Castro, 27 Dec. 1993. - 2 males, 3 females (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 27 Dec. 1993. - 1 female (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comanthina schlegelii*, coll. P. Castro, 21 Dec. 1993. - 1 male, 1 female (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comanthina schlegelii*, reef crest, coll. P. Castro, 27 Dec. 1993. - 1 female (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 16 Dec. 1993. - 1 juvenile female (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 26 Dec. 1993. - 1 male, 2 females (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comanthina schlegelii*, reef crest, coll. P. Castro, 19 Dec. 1993. - 1 male, 1 female (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 4 m, on *Comatella stelligera*, reef crest, coll. P. Castro, 15 Dec. 1993. - 1 male (ZRC), Padoz Tinan Reef, Madang, 3 m, on *Comanthus parvicirrus*, reef crest, coll. P. Castro, 15 Dec. 1993. - 1 female (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 3 m, on *Comanthina schlegelii*, reef crest, coll. P. Castro, 15 Dec. 1993. - 3 males, 5 females (ZRC), Padoz Tinan Reef, Madang, 5°09.53'S, 145°48.88'E, 2-3 m, on *Comanthina schlegelii* & *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 23 Dec. 1993. - 1 male, 1 female (ZRC), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 2 m, on *Comatella stelligera*, reef crest, coll. P. Castro, 27 Dec. 1993. - 1 male (ZRC), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 1-2 m, on *Comanthus parvicirrus*, reef crest, coll. P. Castro, 22 Dec. 1993. - 1 male (ZRC), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 2 m, coll. P. Castro, 17 Dec. 1993. - 1 juvenile female (ZRC), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 2 m, on *Comanthina schlegelii*, reef flat, coll. P. Castro, 27 Dec. 1993. - 1 female (ZRC), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 2 m, on *Comanthina schlegelii*, coll. P. Castro, 13 Dec. 1993. - 1 male (ZRC), Padoz Natun Reef, Madang, 5°09.60'S, 145°48.77'E, 3 m, on *Clarkcomanthus littoralis*, coll. P. Castro, 14 Dec. 1993. - 1 male (IRSNB IG n°26.253), Madang, Bunu, N°17, Capcrosille, 25 m, coll. V. C. Brakman, 19 Sep. 1980. - 1 female (IRSNB), Madang, on crinoid, coll. D. Vandenspiegel, no other data. - 2 males, 3 females (ZRC), Madang, coll. P. Castro, Dec. 1993. - 1 male, 1 female (dismembered) (ZRC), patch reef adjacent to Christiansen Research Institute, Nagada Harbour, Madang, 6 m, on *Comanthus mirabilis*, coll. C. G. Messing, Jul. 1991. - 1 male, 1 female (ZRC), AWAR wreck, coll. D. Vandenspiegel, Aug. 1992. - 1 female (MNHN B24744), Planet Rock (pinnacle), on *Oxycomanthus bennetti*, 8 m, coll. P. Castro, 20 Aug. 1992. - 1 male (MNHN B24746), Rasch Passage, 3-4 m, on *Clarkcomanthus littoralis*, reef crest, coll. P. Castro, 19 Aug. 1992. **Australia:** 1 male (5.8 by 6.9 mm.), 1 female (QM W17512), Cartier Reef, Timor Sea, 12°32.2'S, 123°31.9'E, marine, reef slope symbiotic with crinoid, western side of reef, coll. J. Short, 4 May 1992. - 1 male, 1 juvenile female (AM P39255), west of 'Yoshin Maru Iwaki' wreck, Elizabeth Reef, Tasman Sea, Station 30, 29°57.2S, 159°01.2'E, coll. P. Davie & J. Short, 10 Dec. 1987. **Pacific Ocean:** 1 male (MNHN B25648), Banc Waterwit, southwest Pacific, Station DW 536, 12°31'S, 176°41'W, 27-37 m, coll. MUSORSTOM 7, R.V. 'Alis', 16 May 1992. - 1 female (ZRC), Koror Island, Palau, lagoon along southern tip of island, coll. P. Castro, Jul. 1974. - 1 male (ZRC), Agat Bay, Guam, coll. P. Castro, 1974. - 1 female (6.2 by 9.2 mm) (RMNH 9736), Kwadak, Kwajalein Atoll, Marshall Islands, 5.5-7 m, in *Comanthus bennettii*, coll. P. E. Cloud, 1 Jul. 1951. - 3 males, 1 female (USNM 93855), Kwadak, Kwajalein Atoll, Marshall Islands, 5.5-7 m, in *Comanthus bennettii* (Clark i.d.), coll. P. E. Cloud, 7 Sep. 1951. - 1 female (USNM 359474), Anatahan, Marshall Islands, southwest shore, at base of volcanic cliffs, consolidated substrate, 30-35 feet water, coll. R. Kropp, 7 Jan. 1975.

Description. - Carapace distinctly broader than long; rostrum short, distinctly deflexed downwards; inner supraorbital teeth distinct but very small, separated from frontal margin by longitudinal groove, folded downwards; frontal margin appearing entire from dorsal view but separated by distinct longitudinal groove, numerous flat tubercles along the frontal margin; regions well defined, gastric and protogastric regions distinct, slightly swollen with tubercles, cardiac region mildly swollen; hepatic regions depressed; surfaces of carapace relatively smooth to covered with scattered small granules; dorsal surface of carapace usually covered with very thin pubescence. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin rounded, not lamelliform, with four lobes (including external orbital angle), first three lobes truncate, lined with small granules, separated by narrow fissures,

tightly adjoining each other, appearing fused, sometimes forming a structure, last tooth confluent with first three teeth but more developed, sharp, laterally directed. Antennules folding obliquely, ca. 45° from horizontal; antennular fossae oblique. Antenna free, does not fill orbital hiatus, reaching into orbit; antennal basal segment rectangular; length to width ratio of second antennal segment 1.4-2.0. Eyes well developed, filling orbit; cornea distinct, pigmented; infraorbital teeth small. Anterior surface of epistome depressed; posterior margin appears entire because of 2 fused truncate median lobes. Pterygostomial regions mildly granulated. Third maxilliped quadrate; ischium rectangular, median oblique sulcus deep; merus squarish; exopod just reaches antero-external edge of merus. Sutures between sternite segments 1 and 2 indistinct, 2 and 3 distinct, shallow; between 3 and 4 interrupted medially; lateral clefts indistinct. Abdomen 7 segmented, sutures for all segments visible. Chelipeds smooth or slightly granular; carpus without spine or tubercle on inner angle; chelae elongated and slender, length ca. 3-4 times length of fingers, height ca. 2 times height of fingers; fingers not carinate, pollex not distinctly bent downwards. Merus of first ambulatory leg more slender than others, dactylus elongated, slender, ca. 2 times length of that on other legs, other segments subcylindrical; anterior margin of merus smooth, not cristate, but may have some very small tubercles at proximal end. G1 long, slender, distal part lined with short spines, tip bends at approximately 90° or 110° . G2 relatively short, distal segment short.

Sexual dimorphism. - Males have disproportionately larger chelipeds compared to females. The carapaces of large females are swollen and bulbous.

Remarks. - *Permanotus purpureus* new combination, is a very distinct species. The colour photograph provided by Nagai & Nomura (1988) clearly shows the species. Holthuis (1953) reported it from the Marshall Islands. Castro (1989) reported specimens from Palau, Guam and Marshall Island. Specimens from all these localities were re-examined and their identities confirmed.

Harrovia bituberculata Shen, Dai & Chen, 1982, was established on the basis of following characters: 1, presence of tubercles on the gastric region of carapace, 2, length of the basal antennal segment not reaching the infraorbital tooth, 3, absence of spines along the posterior margins of all the ambulatory segments, and 4, relatively broad third ambulatory propodus. Examining the present large series of specimens, it is found that the above characters can vary within the species. The swollen gastric region of carapace is evident in almost all specimens. The length of the basal antennal segment varies, sometimes reaching or exceeding the infraorbital tooth. There is no spine along the posterior margin of all ambulatory segments. Gordon (1934: 67) stated (for the holotype of *P. purpureus*) '... the distal half of the propodi and dactyli also bear several rows of what appear to be short spines...' and figure 34c was referred to. On closer examination, the spines that Gordon mentioned are stiff setae resembling spines. In fact, the ambulatory legs of this species are very smooth except for a few very small tubercles which may be present at the proximal anterior margin of the ambulatory meri. As for the relative broadness (measured at length versus width) of the third ambulatory propodus, it varies from 2.8-3.2 (mean 3.1). Indeed, the third ambulatory propodus of the holotype of *P. purpureus* (at 3.6) seems to be more slender, and appears to represent the extreme range of the species. In any case, *H. bituberculata* whose propodal measurement is 3.1, fits into the present concept of the species. Thus, on the basis of what is known, it is clear that *Harrovia bituberculata* Shen, Dai & Chen, 1982, is a junior synonym of *Permanotus purpureus*.

The present series of specimens examined agrees well with the holotype. Although the species

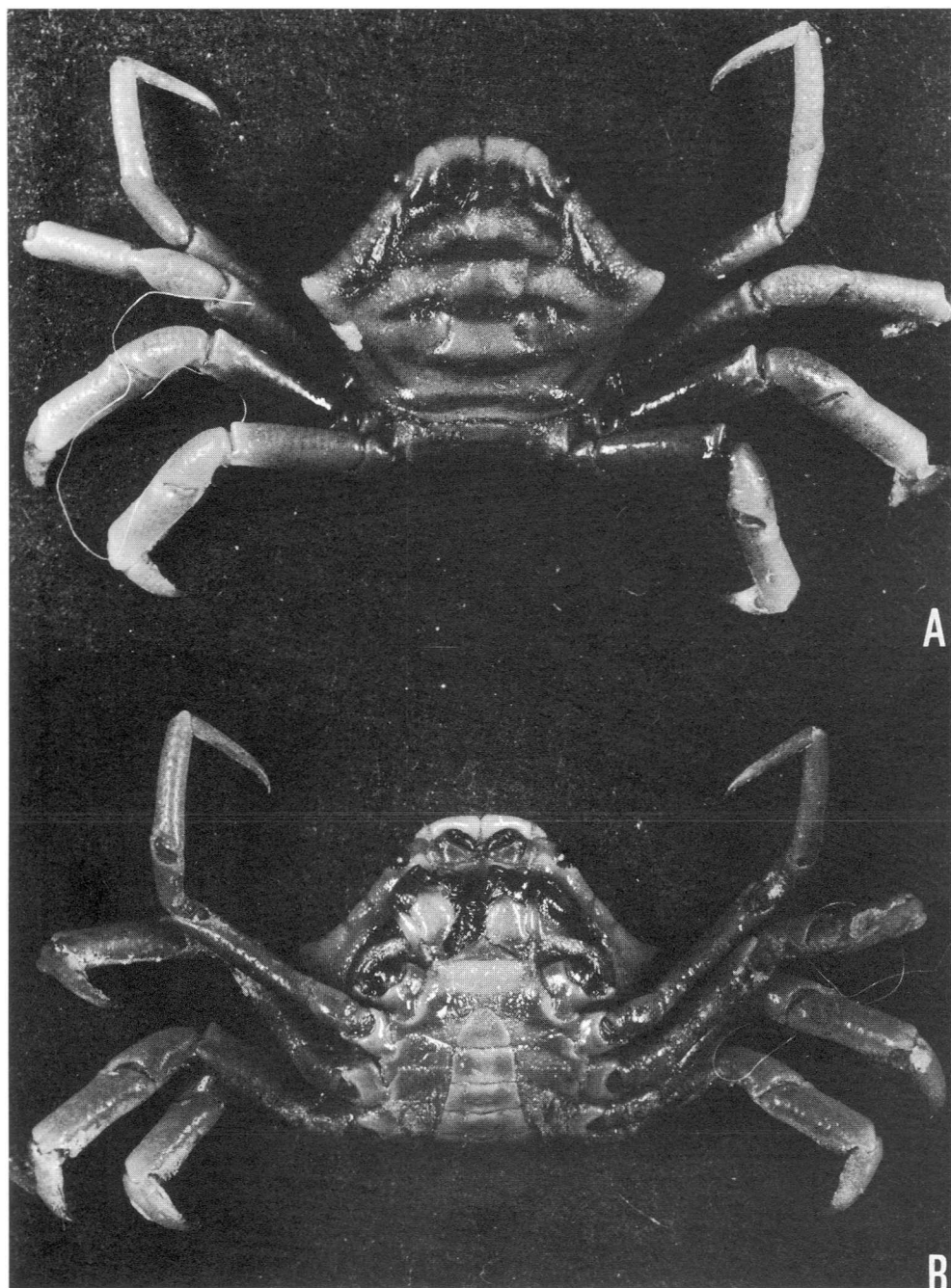


Fig. 29. *Permantotus purpureus* (Gordon, 1934), new combination. Male, 5.8 by 6.9 mm (QM W17512). A, dorsal view; B, ventral view.

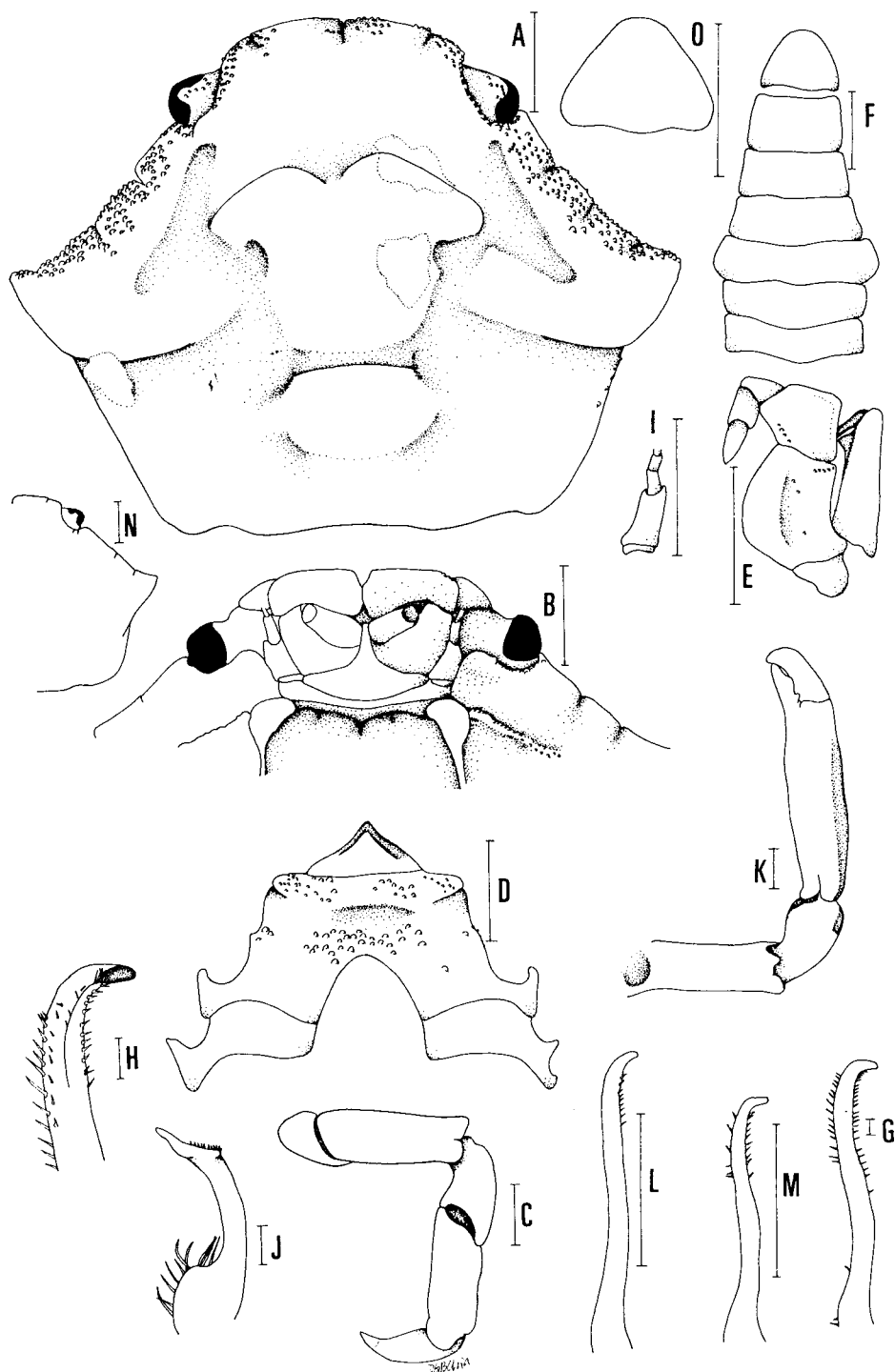


Fig. 30. *Permanotus purpureus* (Gordon, 1934), new combination. A-K, O, male, 5.8 by 6.9 mm (QM W17512); L, N, male, 5.3 by 7.5 mm (MNHN B24745); male, 4.2 by 5.5 mm (MNHN B24741). A, dorsal view of carapace; B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, abdomen; G, left G1; H, distal tip of left G1; I, antenna; J, right G2; K, postero-dorsal view of right cheliped; L, left G1; O, 7th abdominal segment; M, left G1; N, dorsal view of carapace (schematic). Scales: A-G, I, K-O = 1.0 mm; H, J = 0.1 mm.

is widely distributed, it is relatively stable with little morphological variation. There seems to be two forms of distal part of G1, bending at either 90° (Fig. 30G, M) or 110° (Fig. 30L), occurring within the same population. All other features of the specimens agree well with the current understanding of the species. Also, the juveniles tend to have small spinules along the anterior margin of ambulatory meri and along the proximal inner and outer margins of the chelipedal meri.

There seems to be three colour morphs, all of which can be found within the same population (e.g. in Sulawesi). The first morph is dominated by dark orange with cream-coloured transverse bands (Fig. 31A). The second morph is dominated by cream colour with dark transverse orange bands (Fig. 31B) and the third morph which is an intermediate between the first two morphs, with equal amount of orange and cream colour (Fig. 31C). Of the three morphs, the first morph (i.e. dominated by dark orange) seems to be the most common whereas the second morph (i.e. dominated by cream colour) appears to be the rarest.

Larvae. - The first zoeae of this species has been obtained by P. Castro. They will be described later in another paper.

Host records. - Found mainly in shallow water, found together with comasterids.

Distribution. - A widely distributed species. Previous records of the species stretched from Irian Jaya (type locality), eastward to central Pacific and northward reaching Japan. Current

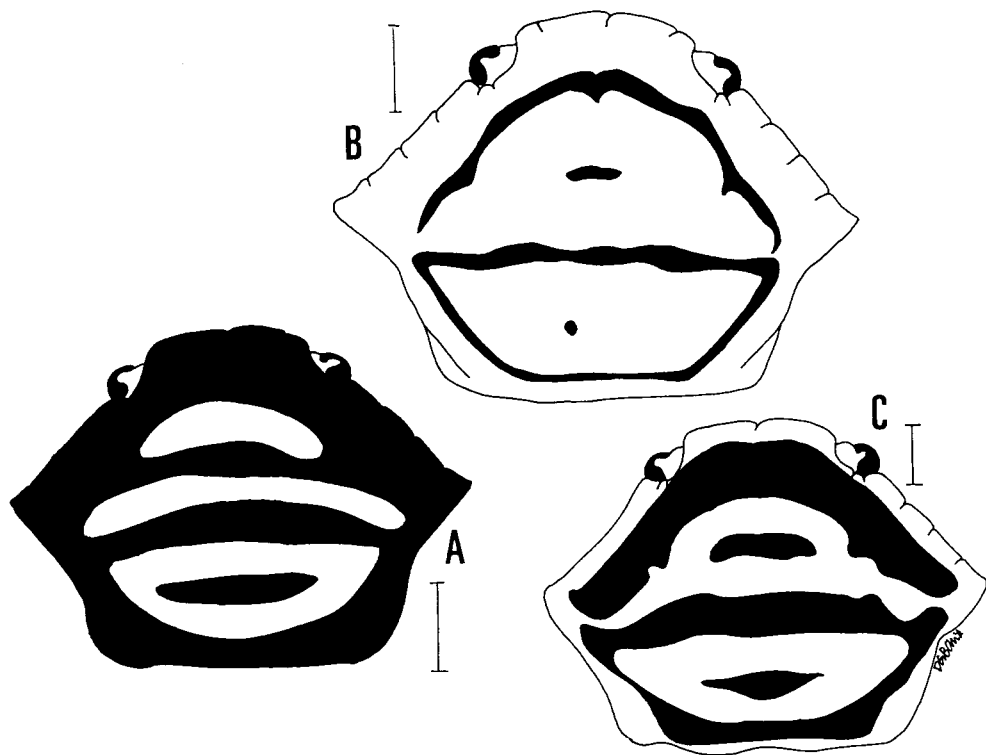


Fig. 31. *Permanotus purpureus* (Gordon, 1934), new combination. Colour morphs (schematic): A, male, 4.1 by 5.6 mm (MNHN B24760a); B, male, 4.8 by 6.4 mm (MNHN B24760b); C, female, 6.6 by 8.3 mm (MNHN B24760c). Portion painted in black ink indicates orange colour in live and unpainted portion indicates cream colour in live specimens. Scale = 1.0 mm.

records include the southwest Pacific, Sulawesi, Papua New Guinea, Australia and East Malaysia. The Tasman sea (Australia) specimens are the southernmost specimens ever recorded. The distribution seems to be disjunct in Australia, this species is found along the northern (Timor Sea) and southeastern coasts (Tasman Sea) but so far not the northeastern (Coral Sea) or western coasts (Indian Ocean).

TAUROPUS, NEW GENUS

Harrovia - Gordon, 1947: 111 (part); Serène et al., 1958: 139 [in key], 172, 194, 199, 231, 238 (part); Stevcic et al., 1988: 1311, 1318 (part) [not *Harrovia* Adams & White, 1849].

Type species. - *Harrovia egeriae* Gordon, 1947, by present designation. Gender of genus masculine.

Etymology. - The name is derived from the Greek for 'bull', alluding to the shape of the carapace of the type species. Gender masculine.

Diagnosis. - Carapace distinctly broader than long; rostrum short, distinctly deflexed downwards; inner supraorbital teeth low but distinct, posterior to frontal margin, folded downwards; regions defined; surfaces of carapace covered with scattered small granules. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin rounded, not lamelliform, with four lobes (including external orbital angle), first three lobes truncate, lined with small granules, separated by narrow fissures, tightly adjoining each other, appearing fused, lobe three very large, lower part expanded laterally, last tooth small, obscured by lobe three, confluent with first three teeth but developed, sharp, laterally directed. Antennules folding obliquely, ca. 45° from horizontal. Second antennal segment short, length to width ratio of second antennal segment 1.4. Surface of chelipeds granular; carpus with strong sharp tooth on inner distal angle; merus and basis-ischium unarmed; chela stocky, stout, length 2 times length of fingers, height ca. 2-3 times height of fingers; fingers not carinate, pollex not bent downwards. Merus of first ambulatory leg as slender as others. G1 not known.

Remarks. - This genus is established for a remarkable species which was described from only one specimen. In the general carapace morphology (i.e. having four distinct anterolateral lobes), it bears some resemblance to the genus *Harrovia*. In the form of the folded and rounded anterolateral lobes and inner supraorbital teeth, it resembles *Permanotus*, but in the form of its very stout and stocky ambulatory legs and chelipeds, it is closer to *Eumedonus* and *Gonatonotus* instead. It thus seems to be an intermediate genus between *Harrovia*, *Permanotus* and *Eumedonus*.

This unusual genus has very large, expanded third anterolateral lobe and small, inconspicuous fourth lobe, a character which is not observed in any other eumedonid genus. The other unusual feature is the very short second antennal segment, the length to width ratio being only 1.4.

The new genus contains only one species, *T. egeriae* (Gordon, 1947).

***Tauropus egeriae* (Gordon, 1947), new combination**

(Figs. 32, 33)

Harrovia egeriae Gordon, 1947: 111, Fig. 1 [type locality Macclesfield Bank, South China Sea]; Serène et al., 1958: 198, 199 [in key], 239 [list only]; Serène, 1968: 63 [list only]; Stevcic et al., 1988: 1311 [list only]; Takeda & Marumura, 1995: 5, Fig. 5 (colour) [Kii Peninsula, Japan].

Material examined. - Holotype: female (11.2 by 16.6 mm) (BMNH 93.11.3.79), Macclesfield Bank, 82 m, coll. Bassett Smith, H.M.S. Egeria.

Description. - Carapace distinctly broader than long; rostrum short, distinctly deflexed downwards; inner supraorbital teeth low but distinct, posterior to frontal margin, folded downwards; regions defined; surfaces of carapace covered with scattered small granules. Anterolateral and posterolateral margins clearly demarcated; anterolateral margin rounded, not lamelliform, with four lobes (including external orbital angle), first three lobes truncate, lined with small granules, separated by narrow fissures, tightly adjoining each other, appearing fused, lobe three very large, lower part expanded laterally, last tooth small, obscured by lobe three, confluent with first three teeth but developed, sharp, laterally directed. Antennules folding obliquely, ca. 45° from horizontal; antennular fossae oblique. Antenna free, does not fill orbital hiatus, reaching into orbit; antennal basal segment rectangular; second antennal segment short, length to width ratio of second antennal segment 1.4. Eyes well developed, filling orbit; cornea distinct, pigmented; infraorbital teeth small. Anterior surface of epistome depressed; posterior margin appears entire because of 2 fused truncate median lobes. Pterygostomial, infraorbital and subhepatic regions heavily tuberculated. Third maxilliped quadrate; ischium rectangular, median oblique sulcus shallow; merus squarish; exopod just reaches antero-external edge of merus. Sutures between sternite segments 1 and 2 indistinct, 2 and 3 distinct, shallow; between 3 and 4 interrupted medially; lateral clefts indistinct. Surface of chelipeds granular; carpus with strong sharp tooth on inner distal angle; merus and basis-ischium unarmed; chela stocky, stout, length 2 times length of fingers, height ca. 2-3 times height of fingers; fingers not carinate, pollex not bent downwards. Merus of first ambulatory leg not more slender than that of others; other segments subcylindrical; anterior margin of ambulatory meri smooth, not cristate, ends in a distinct tooth (except for the last meri). G1 not known.

Sexual dimorphism. - Not known.

Remarks. - The holotype is an ovigerous female. Takeda & Marumara (1995) subsequently reported a second specimen (also a female) from Kii in Japan.

Larvae. - Not known.

Host records. - Not known.

Distribution. - Only known in Macclesfield Banks (South China Sea) and southern Japan.

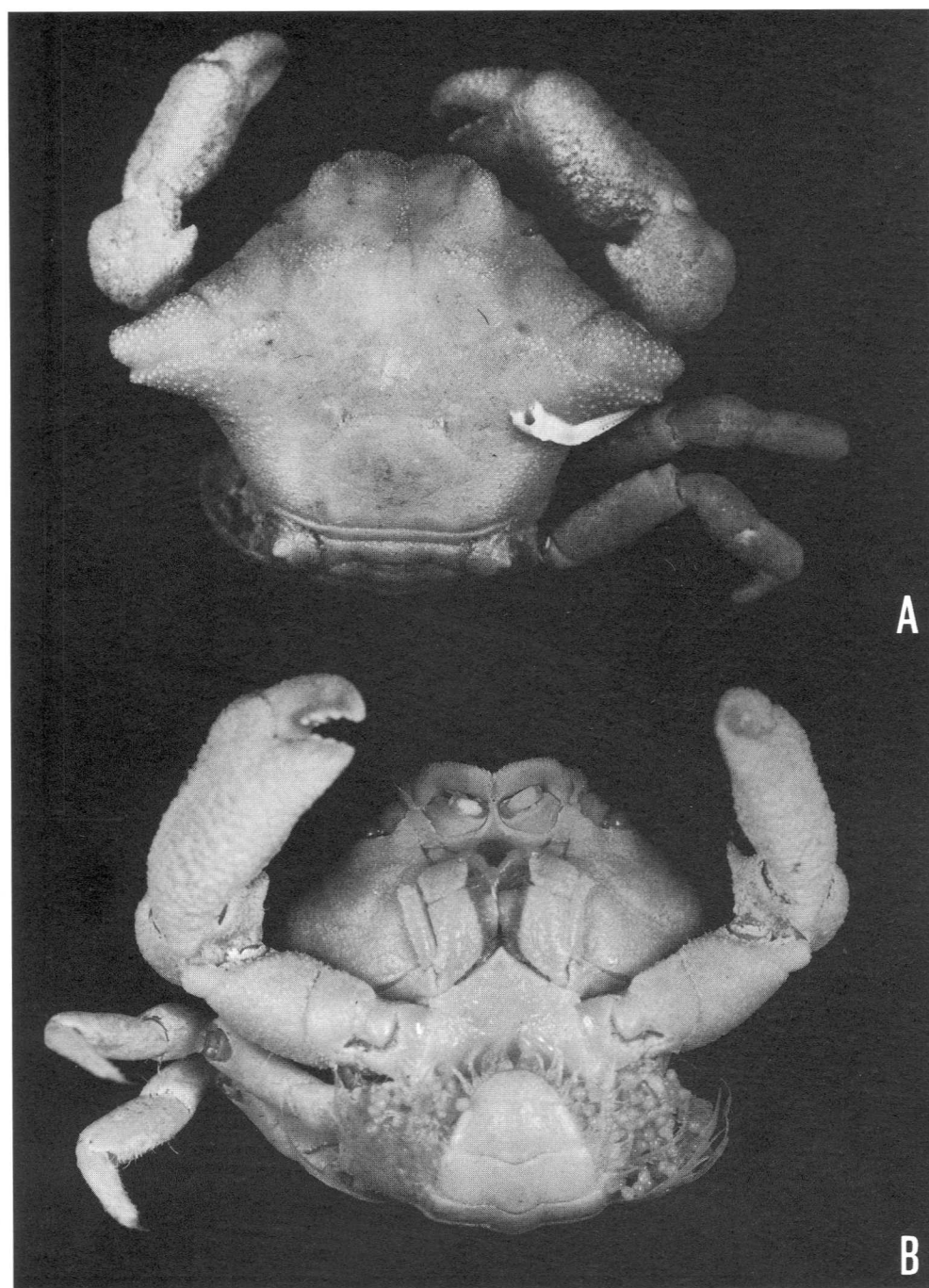


Fig. 32. *Tauropus egeriae* (Gordon, 1947), new combination. Holotype female, 11.2 by 16.6 mm (BMNH 93.11.3.79). A, dorsal view; B, ventral view.

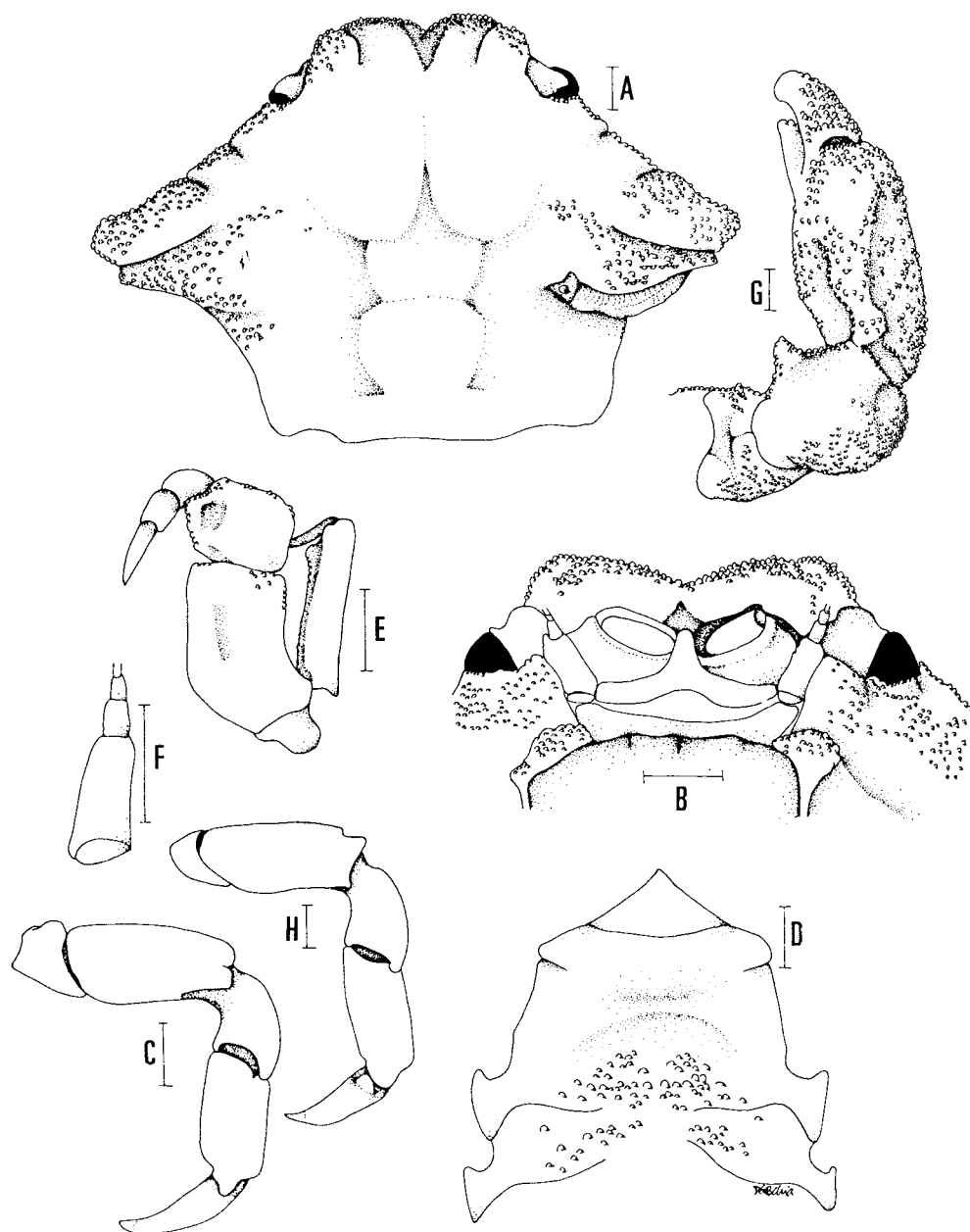


Fig. 33. *Tauropus egeriae* (Gordon, 1947), new combination. Holotype female, 11.2 by 16.6 mm (BMNH 93.11.3.79). A, dorsal view of carapace (with worm tube on right side); B, face of carapace; C, fourth right ambulatory leg; D, thoracic sternum; E, left third maxilliped; F, antenna; G, postero-dorsal view of right cheliped; H, third right ambulatory leg. Scales = 1.0 mm

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