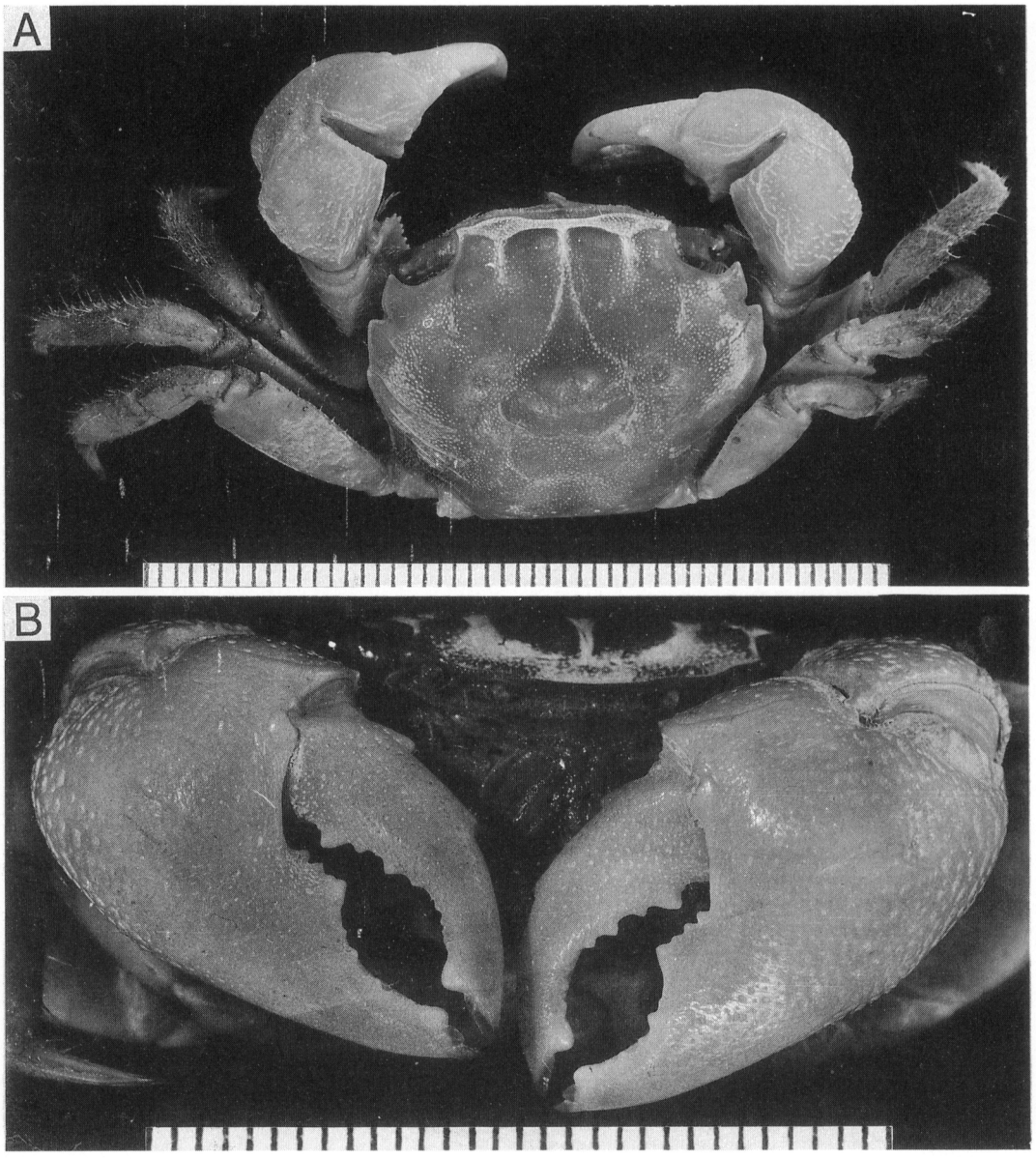

FIG. 9. *Neosarmatium malabaricum* (Henderson, 1893), ♂ syntype, BMNH1892.7.15.242-5. A, dorsal view; B, frontal view. Scale line in mm.

Serène (1975). Type locality: Cochin, Malabar Coast of India.

MATERIAL EXAMINED

MNHN-B10461, 1♂ (22.5 x 19.0mm), mangrove near Pegasus Reef Hotel, Colombo, Sri Lanka, R. Serène, 11.10.1972; MNHN unreg., 6 ♂ (21.5 x 18.1; 22.7 x 18.8; 23.8 x 19.3; 26.2 x 21.5; 29.7 x 24.3; 30.9 x 24.3mm), ♀ (26.7 x 22.0mm), Colombo, Sri Lanka, R. Serène, 12.10.1972.

DESCRIPTION

Carapace. c.1.2 times broader than long. Fronto-orbital width c.1.1 times carapace length. Depth c.0.75 times carapace width. Cardiac region distinct; Lateral margins subparallel;

slightly concave. Exorbital angle triangular and sharp. First anterolateral tooth triangular and blunt; similar in size to exorbital angle. Second anterolateral tooth an angular projection only. Front c.0.6 times fronto-orbital width; strongly vertically deflexed, not visible from above; with shallow median emargination; lateral angles bluntly acute; slight pre-orbital concavity; lateral margins concave. Post-frontal lobes without clumps of setae. Epi-branchial ridges run inwards from each anterolateral tooth; short ridge medially on first epibranchial tooth. Branchial ridges prominent; first follows from posterior edge of last epibranchial tooth; relatively short; others arise just inside lateral margin; a strong ridge curving over base of last leg. Posterior margin c.0.45 times carapace width. Carapace surface smooth, shining, punctate. Setae arranged sparsely on branchial lines. Upper orbital border smooth to microscopically granular. Lower orbital border straight; evenly granular. Inter-antennular septum c.0.36 times width of front.

Third maxilliped. Suture between merus and ischium horizontal. Ischium inner margin smooth. Exopod narrow, not much visible in frontal view; 0.4-0.5 times width of ischium.

Chelipeds. Merus with posterior border with minute granular striations; lower border granulate; anterior border convex coarsely granulate; carpus with inner angle granular; inner margin unarmed; a secondary ventral granular ridge bearing a short row of long setae proximally; tubercles present on inner face of carpus just below inner angle; outer margin striated. Upper surface of palm defined anteriorly by a swollen longitudinal ridge; posteriorly by uneven granular rim with some larger granules distally. Outer surface of palm naked, punctate proximoventrally, with short oblique granular striations; with indistinct median longitudinal row. Inner surface of palm sparsely granular; with a strongly raised granular vertical crest, and a secondary, lower, oblique granular crest running onto base of fixed finger. Immovable finger rounded on outer surface; moderately long, length cutting edge c.0.47 times length propodus. Ventral border of chela straight below fixed finger. Dorsal surface of dactyl bearing 2 large, acute, chitinous tipped tubercles on superior inner margin, similar size and shape, one medial, one proximal. Fingers pointed, lower finger with tip notched, such that dactyl is intermeshing; curved slightly inwards; a wide gape between cutting margins.

Walking legs. First three pairs all of similar length, second slightly the longer, c.1.6 times maximum carapace width. Merus of third leg c.2.1 times as long as wide. Carpus c.2.1 times as long as wide. Propodus c.1.7 times as long as wide. Dactyli about equal to length of propodi, or slightly longer than propodi. Carpi and propodi bear a short felt of setae on both dorsal and ventral surfaces of legs 1-3, above the accessory carinae on the carpi and almost encircling the propodi distally; this felt only on dorsal surface of fourth leg; felt continues in thin rows onto the dactyli.

Male abdomen. Width segment 3 c.4 times length. Segment 6 slightly elongated, c.1.6 times wider than long. Telson subequal to segment 6, both longer than preceding segments; c.1.1 times longer than wide; evenly rounded.

Gonopods. G1 relatively slender. Inner-dorsal margin distally curved inward. Dorsal surface of stem flattened; completely calcified. Palp poorly developed, not separated from stem, large, narrow, rounded, calcified. Outer dorsal margin of stem straight. Distal part of the stem narrow. Apical process corneous, strongly produced, straight. Gonopore terminal. Setae long, simple, lie along apical process and on palp obscuring structural detail. G2 short; evenly curved, twisted.

Colour

'Live specimens are dark brown with a violet tinge, especially on the carapace' (Pillai, 1951: 37).

Remarks

The present specimen was compared with photographs of the holotype in the British Museum. They are identical. See remarks under *N. indicum* for discussion of points of separation from that species and from *N. punctatum*.

Habitat

Serène (1975) noted that in Sri Lanka it is similar to *N. meinerti* in that it lives in the rearward mangrove zone around the houses, and in the grass platform around the coconut trees; also they dig deep holes but do not construct mounds. Pinto (1984) observed that it was crepuscular, colonised the drier soils, and made T-shaped burrows which bifurcate shortly after their origin. Around the Vembanad Lake, in Southern India, Pillai (1951, as *Sesarma punctatum*) said that it shows a preference for muddy regions where it burrows in loose dark mud close to the waterline.

Distribution

Cochin, Malabar Coast, India (type locality);

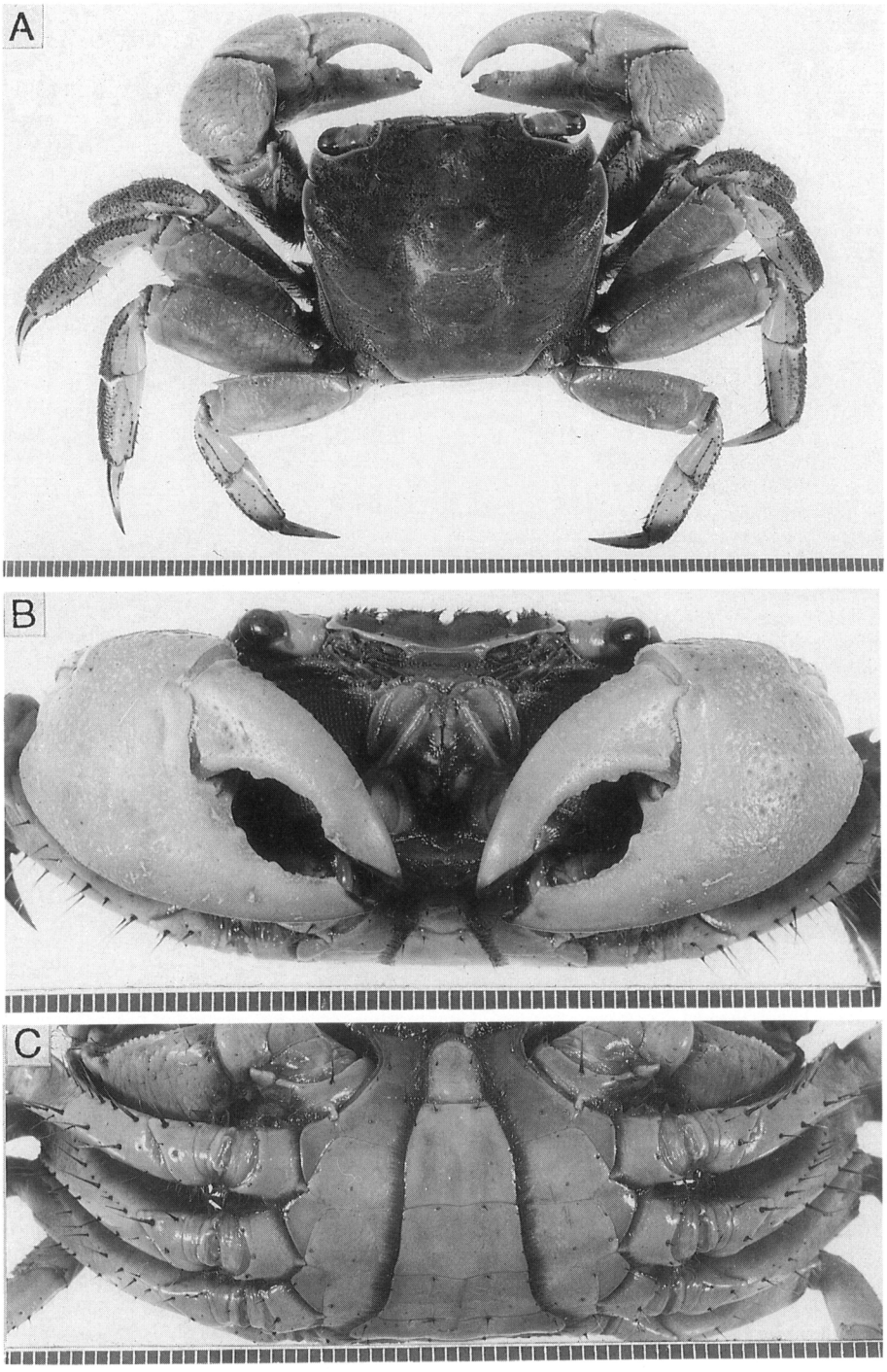

FIG. 10. *Neosarmatium meinerti* (De Man, 1887), ♂, AMP11213. A, dorsal view; B, frontal view; C, ventral view of abdomen and sternum. Scale line in mm.

Ceylon (Serène 1975; and present record). Also almost certainly from the Vembanad Lake, Southern India (Pillai, 1951); Seychelles (Nobili, 1903); Nicobars (Heller, 1865).

Neosarmatium meinerti (De Man, 1887) (Figs 2E-G; 10; 16)

Sesarma tetragona: H. Milne Edwards, 1837: 73; 1853: 184-185; Krauss, 1843: 44; Hilgendorf, 1869: 90, pl. 3, fig. 3d; 1879: 809; A. Milne Edwards, 1868a: 71; Hoffmann, 1874: 23; Lenz & Richters, 1881: 425; Henderson, 1893: 392 [not *Cancer tetragona* Fabricius, 1798: 341].

Sesarma africana?: Bianconi, 1869: 341 [fide Hilgendorf, 1879: 809; Tesch, 1917: 171].

Sesarma tetragonum: Miers, 1879: 490; Stebbing, 1910: 321; 1917a: 438; 1917b: 10.

Sesarma rotundifrons: De Man, 1880: 24 [not *Sesarma rotundifrons* A. Milne Edwards, 1869].

Sesarma meinerti De Man, 1887: 648, 668-69; Pfeffer, 1889: 31; Bürger, 1893: 617; Ortmann, 1894a: 720; 1894b: 56; Alcock, 1900: 417; Doflein, 1904: 130; Lenz, 1905: 372; Gravier, 1920: 472; Cott, 1930: 679-92, pl. 1; Horikawa, 1940: 30; Lin, 1949: 30; Fourmanoir, 1953: 89; 1954: 5; Haig, 1984: 127.

Sesarma (*Sesarma*) *meinerti*: Tesch, 1917: 171-174, 246; Chace, 1942: 201; 1953: 441; Miyake, 1938: 108; Barnard, 1950: 125-26, fig. 25e-f; Crosnier, 1965: 61, figs 81, 90, 91, 96, 103.

Sesarma (*Episesarma*) *meinerti*: De Man, 1895: 166.

Sesarma (*Sarmatium*) *meinerti*: De Man, 1929, fig. 4 (in part).

Neosarmatium meinerti: Serène & Soh, 1970: 398, 406 (in list); Serène, 1973: 127-129, pl. 4 A-C; 1977a: 51; Dai et al., 1986: 496, fig. 280, pl. 70(3); Dai & Yang, 1991: 543-44, fig. 280, pl. 70(3).

TYPE INFORMATION

Holotype unidentifiable (see Remarks). Type locality: Isle de France (= Mauritius).

MATERIAL EXAMINED

SOUTH AFRICA: QMW8835, 3♂ (41.3 x 35.7; 42.2 x 36.2; 45.7 x 39.0mm), 1♀ (30.5 x 25.6mm), 7.5.1964, W. Macnae; QMW8877, 2♂ (46.7 x 38.1; 37.5 x 32.7mm), 7.8.1964, W. Macnae; QMW8878, 5 ♂, 3 ♀ (27.0 x 22.2 - 42.3 x 35.7mm), South Africa, 7.8.1964, W. Macnae. MADAGASCAR: MNHN-B16735, 2♂ (42.8 x 34.8; 40.2 x 33.4mm), 3 ovig. ♀ (34.4 x 28.9; 37.9 x 31.4; 38.9 x 32.3mm), Nosy-Be, A. Crosnier. MAURITIUS: NNM17503, ♂ (27.1 x 22.4mm), Fort Barkly, Port Louis, Mauritius, C. Michel, Feb. 1960. AUSTRALIA: ZMH Unreg., 2♂ (35.0 x 29.0; 39.5 x 33.3mm), Crab Creek, 14 miles east of Broome, W. Australia, G. Hartman, 11.9.1975; AMP11213, ♂ (38.2 x 32.7mm), ♀ (40.2 x 33.2mm), Melville Bay and Cape Arnhem area, NT, no date or collector information; QMW9077, ♂ (46.2 x 37.9mm), Nungbalgarri Ck., 10 km upstream Rolling Bay, NT, 11°59'S, 133°59'E, Aug. 1975, D. Grace, *Ceriops* forest, mudfloor, caught in pipe trap; QMW9076, ♂ (45.2 x 38.5mm), Ngandauda Ck., Boucaut Bay, NT, 12°05'S, 134°43'E, 8.9.1975, D. Grace, 20.5 kms upstream, west bank, *Avicennia* forest, mudfloor, burrows; QMW9074, ♂ (42.9 x 36.1mm), Hutchinson Strait, Buckingham Bay, NT, 12°15'S, 135°19'E, 24.Sep.1975, D. Grace, upper reaches Ck. A., *Ceriops* thicket, burrows; QMW9075, 2♀ (47.5 x 39.6; 39.8 x 33.3mm), Glyde R., Buckingham Bay, NT, 12°17'S, 135°02'E, 14.9.1975, D. Grace, 5 kms upstream, east bank *Avicennia/Ceriops* mudfloor, burrows; QMW9072, 2♂ (43.0 x 37.2; 44.0 x 37.0mm), Glyde River, Buckingham Bay, NT, 12°S, 135°E, 12.9.1975, D. Grace, 15 kms upstream, west bank, *Avicennia/Ceriops* mudfloor, burrows; QMW9073, ♀ (43.3 x 35.5mm), Glyde River, Buckingham Bay, NT, 12°21'S, 135°02'E, 14.9.1975, D. Grace, 30 km upstream, east bank, *Brugiera/Ceriops* forest, burrows; QMW8837, ♂ (48.4 x 41.6mm), Buckingham River, NT, 12°31'S, 135°43'E, 29.9.1975, burrow in mudbank below *Ceriops*; QMW8836, ♂ (44.9 x 38.4mm), Mornington Island, NT, 16°36'S, 139°21'E, Dec. 1976, J. Covacevich; NTM Unreg., ♂ (38.4mm c.b.), Stn HC/4, MacArthur R., Gulf of Carpentaria, R. Hanley; NTM Cr Unreg., ♀ (40.0mm c.b.), Stn PC/T5, MacArthur R., Gulf of Carpentaria, R. Hanley.

DIAGNOSIS

Carapace smooth, shining, punctate, bearing short setae in tufts; c.1.2 (1.5-1.23) times broader than long. Lateral margins slightly convergent posteriorly; a single prominent epibranchial tooth, second tooth present but reduced to a trace; greatest carapace width between middle of first epibranchial teeth. Frontal border slightly sinuous with a shallow median concavity, approximately half carapace width; postfrontal lobes strongly indicated. Posterior border straight; width variable, usually less than frontal width in males, but may be subequal or wider in females. Merus of cheliped without subdistal tooth developed on posterior margin. Inner surface of palm of male cheliped with a vertical crest consisting of a single row of large tubercles; outer surface without sub-median, horizontal crest; outer edge of upper border of palm without obvious longitudinal rim; ventral border of chela broadly convex; superior margin of dactyl with a single row of uniform sized, evenly spaced,

chitinous tubercles; a broad gape between fingers of mature males. Meri of walking legs broad (merus of third pair c.2.5 times longer than wide), anterior borders slightly convex, with acute subdistal spine, dorsal face with short transverse striae; carpi and propodi with dense covering of short setae around superior margin. Male abdomen narrow; telson slightly longer than broad at base; segment 6 elongated, c.1.6 times longer than telson, and c.1.1 times broader (at base) than long.

COLOUR

'*S. meinerti* is an extremely handsome beast. Above, the carapace is dark purple anteriorly, passing into a beautiful deep violet posteriorly, and having the anterior and lateral margins narrowly bordered with orange; the under surfaces are mauve and ochre. The walking legs are purple dorsally, with an orange spot around the hinge-like articulations between the joints, and pale yellow beneath. ... The proximal joints [of the chelipeds] are pale yellow, the merus bright orange, the wide and conspicuous carpus and the proximal region of the propodus and dactylus being a brilliant red, intermediate in tone between vermilion and orange. Beneath the chelipeds are yellow' (Cott, 1930: 682-83).

It appears that the intensity and predominant colour of this species changes through its range. In the Northern Territory, Australia, I have found two colour morphs living sympatrically. The 'orange form' has predominantly orange chelipeds, with the palm being orange over the proximal half, fading to yellow distally, the fingers being mainly yellow; the carapace has a reddish-orange undertone, and reddish-orange anterolateral margins. The 'yellow form' has the chelipeds a uniform dirty pale yellow; the carapace is steel-gray but with a yellowish undertone, the yellow being predominant on the anterolateral margin.

REMARKS

De Man named this species without seeing specimens. He realised that the record of *Sesarma tetragona* of H. Milne Edwards (1853) from Isle de France, was wrongly identified and represented an undescribed taxon. Unfortunately there is now no indication in the collections of the MNHN, Paris, which specimens had been examined by H. Milne Edwards, or even if they still exist (D. Guinot, in litt.). One bottle containing three females (MNHN-B10887) is labelled 'Sesarma Meinerti de Man vu par M. de Man, 10 juin 1890 Ile de France'; but this is after De Man had published his new name, and there is no other indication that this was the H. Milne Edwards' material. I have considered designating a neotype, however there is currently no confusion over the identity of *N. meinerti*, and the stability of nomenclature is not threatened. Under these circumstances according to Article 75(b) of the *International Code of Zoological Nomenclature* (Third Edition, 1985) the designation of a neotype would be invalid.

This is probably the best known and best studied of the *Neosarmatium* species, and along with *N. smithi*, the most widely distributed. Early reports recorded this species from the south-western Pacific, from eastern Australia and New Caledonia, but Serène (1973) realised that these specimens differed in a number of consistent features from typical *N. meinerti* and described a new species *N. fourmanoiri* to accept them. The characters that separate these two species are given under 'Remarks' for *N. fourmanoiri*.

HABITAT AND BIOLOGY

Cott (1930) and Hogue & Bright (1971) have written accounts of the ecology and natural history of *N. meinerti* in South Africa and Kenya respectively. 'Lives on the higher and drier ground adjoining the mangrove ditches ... a low lying area covered with coarse grass and intersected by tidal mangrove creeks, and being about 6-8 feet above the mud level of the ditches' (Cott, 1930: 680). Bright & Hogue (1972: 7) record 'Sandy-clay areas and higher, drier, muddy banks associated with estuaries and mangroves'. In the Northern Territory it lives in the rearward-most mangrove zone, a very dry area, inundated by high spring tides only.

'Burrows are well developed and most common in areas where there is dry, relatively hard mud. The burrows are deep and usually extend to the water table. Often the mouth of the burrow has a hood built of mud excavated while enlarging the tunnel or cleaning out. These crabs are retiring, remaining at the mouth of the burrow, and only leave to forage at night. They apparently feed primarily on plant material, but also act as scavengers where they occur in high density. There is no indication of colonialism in areas of high density' (Bright & Hogue, 1972: 7-8).

Larval stages have been described by Pereyra Lago (1989). There are five larval stages and development takes an average of 25 days at 25°C and in 35 ppt. salinity.

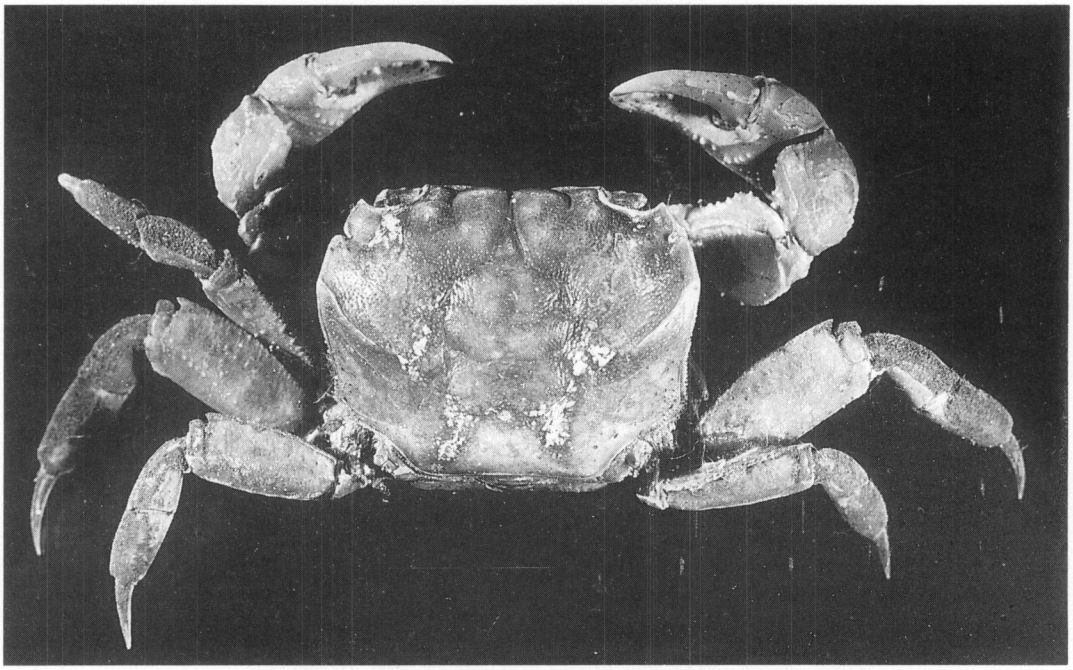

FIG. 11. *Neosarmatium punctatum* (A. Milne Edwards, 1873). Dorsal view of ♂ holotype.

DISTRIBUTION

Only key references given. Mauritius (type locality, H. Milne Edwards, 1853); Madagascar (Crosnier, 1965); South Africa (Barnard, 1955); Aldabra (Haig, 1984); Seychelles (Serène, 1977a); East Africa (A. Milne Edwards, 1868; Ortmann, 1894); India (Alcock, 1900); Andamans (Alcock, 1900); Indonesia (De Man, 1895); northwestern Australia, and the Gulf of Carpentaria (present records); Philippines (Bürger, 1893); Saipan, Marianas, Micronesia (Miyake, 1938); Taiwan (Horikawa, 1940; Lin, 1949; Dai & Yang, 1991).

Neosarmatium punctatum (A. Milne Edwards, 1873) (Figs 11; 17)

Metagrapsus punctatus A. Milne Edwards, 1873: 308, pl. 17, fig. 2.

Sarmatium punctatum: De Man, 1887: 660 (no new specimens).

? *Sarmatium punctatum*: Urita, 1926: 20; Sakai, 1934: 325 [? = *N. indicum*].

TYPE INFORMATION

Lectotype (here designated), ♂ (31.0 x 24.6 mm), MNHN-B3630. Type locality: New Caledonia.

MATERIAL EXAMINED

SYNTYPES: MNHN-B3630, 1♀ (30.8 x 23.0mm) 2♂ (31.0 x 24.6; 35.4 x 26.3mm), New Caledonia, M. Balansa, no date.

OTHER MATERIAL: QMW19897, ♂ (28.9 x 22.6mm), in garden at Anse Vata, Noumea, C. Henin, Feb. 1993.

DESCRIPTION

Carapace. c.1.25-1.35 times broader than long. Fronto-orbital width c.1.05-1.1 times carapace length. Depth c.0.7 times carapace width. Cardiac region distinct. Lateral margins slightly convergent posteriorly; sinuous. Anterolateral margins with single, forwardly directed, epibranchial tooth, triangular and blunt; similar in size to exorbital angle; with second small epibranchial projection. Exorbital angle triangular and sharp. Front c.0.5 times carapace width; c.0.6 times fronto-orbital width; lateral angles bluntly acute; small pre-orbital concavity present; lateral margins concave. Lateral post-frontal lobes distinctly but narrowly separated from orbital margin. Post-frontal lobes without clumps of setae. Single sharp lateral ridge running from obliquely behind last anterolateral tooth to outer edge of posterior

margin; first branchial ridge follows from posterior edge of epibranchial projection, relatively long; second arising from just short of lateral margin; third arising from lateral margin. Posterior margin c.0.5 times carapace width. Carapace surface smooth and shining, punctate; wrinkled posteriorly; without obvious setation. Upper orbital border smooth, but minutely granular laterally. Lower orbital border straight; evenly granular. Basal segment of antennal peduncle with outer tongue short, bearing thick fringe of setae on ventral edge. Inter-antennular septum c.0.4 times width of front.

Third maxilliped. Suture between merus and ischium sloping slightly obliquely inward. Exopod narrow, not obvious in frontal view, reaches slightly less than half length of merus.

Chelipeds. Merus with posterior border minutely granulate; with blunt projection; lower border granulate; anterior border tuberculate mesially and proximally, convex; carpus with inner angle granular; inner margin granular, with secondary ventral, microscopically granular ridge bearing tuft of long setae proximally; granules present on inner face of carpus just below inner angle; outer margin striated. Upper surface of palm defined anteriorly by an indistinct longitudinal ridge. Outer surface of palm naked, punctate, granular medio-ventrally; with median longitudinal row. Inner surface of palm mainly smooth; with strongly raised granular vertical crest and with short row of 3-4 large granules obliquely at base of fixed finger. Immovable finger slightly flattened on outer surface; moderately long. Length cutting edge c.0.45 times length propodus. Ventral border of chela convex. Dorsal surface of dactyl smooth, rounded, but bearing 2 strong blunt spines on inner margin, proximal one smaller, c.one-fifth length from base, distal one larger and placed just short of halfway; tipped with chitin; female chela with spines less prominent. Fingers pointed, but with narrow spooning; curved inwards; a wide gape between cutting margins.

Walking legs. Third pair slightly the longest, c.1.4 times maximum carapace width. Merus of third leg c.2.2 times as long as wide. Carpus c.2.1-2.3 times as long as wide. Propodus c.1.9-2 times as long as wide. Dactyli c.0.9-1.0 times length of propodus. Dactyli stout and slightly recurved. Carpi and propodi bear a short felt of setae on both dorsal and ventral surfaces of legs 1-3, above the accessory carinae on the carpi, and almost encircling the propodi distally; only on dorsal surface of 4th leg; felt continues in thick rows onto the dactyli; also present on extreme distal end of upper margin of meri of legs 1-4 and on sub-distal spine.

Male abdomen. Male abdomen moderately broad; segment 1 the widest (segments 1-3 subequal). Segment 1 covers entire width of sternum between 4th pereiopods; narrow. Segments 3-5 tapering (tapering strongly from 3-4, then moderately). Width segment 3 c.4.4 times length. Segment 6 elongated (moderately); 1.6 times wider than long. Telson not longer than preceding segments (sub-equal to segment 6); 1.1 times longer than wide; evenly rounded.

Gonopods. Could not be extracted from dry type specimens, and abdomen and gonopods missing from spirit specimen.

COLOUR

'Sa couleur est d'un violet fonce devenant rougeatre sur les pattes' (A. Milne Edwards, 1873: 309).

REMARKS

All three type specimens must be considered syntypes, but as the smaller male, 31.0 x 24.6mm, corresponds to the size of the only specimen mentioned by A. Milne Edwards (1873) it is here designated as the lectotype; the other two specimens become paralectotypes.

The only records for this species which can be relied on at this time are those of the type series and one recent specimen from New Caledonia. Otherwise the records must be considered to be confused between *N. punctatum* and its very closely related sister-species *N. malabaricum* from the eastern Indian Ocean. Henderson (1893) erected *Sarmatium malabaricum* as a subspecies of *N. indicum* after being told by A. Milne Edwards that his specimens were referable to *S. indicum* not *S. punctatum* as Henderson had at first supposed. It is clear that while Milne Edwards was correct in realising that Henderson's specimens were not *S. punctatum*, he erred in thinking they were like *S. indicum*. The present examination of the type material of *N. punctatum* with specimens of *N. malabaricum* from Ceylon, and photographs of the lectotype (designated by Serène, 1975), reveal that the species are extremely close. They can only be separated by: 1, on *malabaricum* the distal tooth on the upper surface of the dactyl of the cheliped is placed very close to the middle; while on *N. punctatum* it is clearly less than half way to the tip; 2, the upper surface of the palm of the cheliped has a very strong longitudinal rim marking its outer edge on