ON THE „RADJUNGANS" OF THE BAY OF BATAVIA.

By

DR. H. C. DELSMAN (BATAVIA)

and

DR. J. G. DE MAN (OERSEKE, HOLLAND)

EXTRAIT DE TREUBIA VOL. VI
LIVR. 3/4. DÉCEMBRE 1925.

LANDSDRUKKERIJ — BATAVIA — 1925.

With the compliments of

Dr. J. G. de MAN.

Ierseke, Zeeland, Holland.

ON THE "RADJUNGANS" OF THE BAY OF BATAVIA.

By

Dr. H. C. DELSMAN (Batavia)

and

Dr. J. G. DE MAN (Ierseke, Holland).

with 6 plates and 8 figures.

The best-known edible crab of Java is the "kepiting", *Scylla serrata* (Forskål), which is caught quite near the coast in very shallow water and in the salt-water fish-ponds along the coast, where it lives in holes. It is the "mangrove-crab" of Australia where it occurs especially along the northern coasts (Plate X, a).

Another swimming crab is landed almost daily in considerable quantity at the fish-market of Batavia and meets with a ready demand by the native consumers. It is known by the Malayan name "radjungan", and is identical with the "blue swimming crab" of the Australians: *Neptunus pelagicus* (Linné). Especially the males are beautifully coloured and form a true ornament in our newly opened seawater aquarium. The females are of much duller colour and would not themselves deserve the name "blue" swimming crabs. Moreover they are smaller than the males and have relatively smaller chelipeds.

That this species plays an important role also in Australia is evident from what STEAD (1) writes on it:

"*N. pelagicus* is the most common of our pelagic Brachyura, being the principal edible crab of the Sidney Fish Markets. Incidentally I might mention that great numbers of these are sold every morning in these markets, with an occasional sprinkling of four other species, viz. *Nept. sanguinolentus*, *Scylla serrata*, *Charybdis cruciatus* and *Platyonychus bipustulatus*".

Along the Atlantic coasts of America a similar role is played by the kindred "blue crab", *Callinectes sapidus*, whose life history has been studied

(1) D. G. STEAD. 1898, Contribution to a knowledge of the Australian Crustacean Fauna, I, Observations on the Genus *Neptunus*, in: Proc. Linnean Society of N. S. Wales, Vol. XXIII.

in detail by HAY (1) and CHURCHILL (2). In some places it has even given rise to an important industry (3). The crabs are cooked, the meat is picked out with a sharp-pointed knife and packed in tin cans which are packed again in barrels with ice. The waste remnants of shell are sold to fertilizer-factories.

Although the common radjungan strongly prevails among the catches landed at the fish-market of Batavia, yet we sometimes find a number of other species among them too, though never in any considerable quantity. Gradually I have gathered some nine of these species, known among the natives as radjungan, radjungan bintang (bintang = star), r. karang (karang = coral), r. batu (batu = stone), r. hidjau (hidjau = green), r. batik (batik = the native way of applying coloured ornaments on cotton, as a rule brown and blue) and r. angin (angin = air, wind). They were all sent to Holland for examination and identification, the results of which are found below.

1. **Neptunus pelagicus** (Linné), radjungan (Plate X b and XI).

Pagurus Rediungan, G. E. RUMPHIUS, D'Amboinsche Rariteitkamer, Amsterdam, 1705, 1st book, p. 11 and plate VII, R. (RUMPHIUS Gedenkboek, edited by the Koloniaal Museum, at Haarlem, 1902, p. 103).

Cancer pelagicus, LINNÉ, Museum Ludovicae Ulricae Reginae, Holmiae, 1764, p. 434.

Lupea pelagica, H. MILNE EDWARDS, Hist. Nat. des Crust. I, 1834, p. 450.

Portunus (Neptunus) pelagicus, W. DE HAAN, Fauna Japonica, Crustacea, 1835, p. 37, Tab. IX ♀, Tab. X ♂.

Neptunus pelagicus, A. MILNE EDWARDS, Archives du Muséum, X. 1861, p. 320.

Neptunus pelagicus, A. ALCOCK, Materials for a Carcinological Fauna of India, Nr. 4. The Brachyura Cyclometopa, Part II. The Families Portunidae, Cancridae and Corystidae. Calcutta, 1899, p. 34 (in: Journal Asiatic Soc. of Bengal, vol. LXVIII, part. II, nr. 1, 1899).

Distribution: Red Sea (Suez), Mediterranean (Port Said), Indian Ocean (Natal, Zanzibar, Mozambique, Madagascar, Coasts of India), Persian Gulf, Mergui Archipelago, Singapore, Indian Archipelago, Philippines, coasts of Australia (Port Jackson, Swan River, Shark Bay, Western Australia), New Zealand, New Caledonia, Tahiti, China Sea, Japan.

---

(1) HAY, W. P., 1905, The Life History of the Blue Crab, in: Report U. S. Bureau of Fisheries, 1904.

(2) CHURCHILL, E. P., 1919, Life History of the Blue Crab, in: Bulletin Bureau of Fisheries, Vol. 36, p. 95.

(3) ROBERTS, W. A., 1905, The Crab Industry of Maryland, in: Report Bureau of Fisheries, 1904, p. 423.

CHURCHILL, E. P., 1919, Crab Industry of Chesapeake Bay, ibid. 1918, appendix IV.

RUMPHIUS (l.c.) already says that this is the most common of edible crabs, but he reckons among this species also the *Neptunus sanguinolentus* (Herbst) which in the Bay of Batavia is much less common. He says further that the Malayans call it Reidjungan, Reidjucan and Rindu Rindu, also Cattam (ketam) bulan (which means "moon-crab"). The Amboinese call it "Leytim Yatallan" after the resemblance to the out-spread wings of the bird Tallan, i.e. the "shear-bird" *(Fregata)*.

Among the species of swimming crabs mentioned in this article this is the one in which the sexual dimorphism is most strongly pronounced, the males being larger and having more elongated limbs than the females, and showing a fine blue colour which is missing in the latter. H. MUNRO FOX (cf. Nature, 1924, p. 714) has traced the migration of this species through the Suez Canal into the Mediterranean since 1889. It is found now along the Mediterranean coast from Alexandria to Haifa.

2. **Neptunus sanguinolentus** (Herbst), radjungan bintang (Plate XII a).

Cancer sanguinolentus, J. F. W. HERBST, Versuch einer Naturgeschichte der Krabben und Krebse, Berlin, 1790, Bd. I, p. 161, Tab. VIII, figs. 56, 57.

Lupea sanguinolenta, H. MILNE EDWARDS, Hist. Nat. des Crustacés, Paris, 1834, I, p. 451.

Neptunus sanguinolentus, A. MILNE EDWARDS, Études zoologiques sur les Crustacés récents de la famille des Portuniens, in: Archives du Muséum, X, 1858—1861, p. 319.

Neptunus sanguinolentus, A. ALCOCK, Materials for a Carcinological Fauna of India, Nr. 4. The Brachyura Cyclometopa, Part II, The Families Portunidae, Cancridae and Corystidae, Calcutta, 1899, p. 32 (in: Journal Asiatic Society of Bengal, Vol. LXVIII, Part II, nr. I, 1899).

Distribution: Red Sea (Coast of Erythraea), Natal, Cape of Good Hope, Indian Ocean, Indian Archipelago, China Sea, Japan, Hawaiian Islands, East- and South-Australia.

No such marked sexual dimorphism as in *Neptunus pelagicus* occurs in the present species, males as well as females having the general appearance and colour of the female of the foregoing species, without, however, quite attaining the size of the latter.

As to their occurrence round the Hawaiian Islands HENSHAW (1) remarks: "The common bay crab, numbers of which are brought in every time the fishermen draw their nets" *(Neptunus pelagicus* is not mentioned for the Hawaiian Islands).

(1) cf. MARY J. RATHBUN, The Brachyura and Macrura of the Hawaiian Islands, in: Bulletin of the U. S. Fish Commission, Vol. XXIII, part III, 1906.

3. **Charybdis (Goniosoma) erythrodactyla** (Lamarck) (Plate XV a).

Thalamita erythro-dactyla, H. MILNE EDWARDS, Hist. nat. Crust. I, 1834, p. 464.
Goniosoma erythrodactylum, A. MILNE EDWARDS, in: Archives du Muséum, T X, 1861, p. 369.
Goniosoma erythrodactylum, J. G. DE MAN, Ueber einige neue oder seltene indopacifische Brachyuren, in: Zool. Jahrb. Abt. Systematik, Bd. IV, 1889, p. 424.
Charybdis erythrodactyla, G. NOBILI, Bull. scientifique France et Belgique, XL, 1906, p. 118, fig. 3.
Charybdis (Goniosoma) erythrodactyla, G. NOBILI, Faune Carcinologique de la Mer Rouge. Décapodes et Stomatopodes, in: Annales Sc. Nat. 9e série, Zool. T. IV, 1906, p. 194.

Distribution: Red Sea (Djeddah), Amirante Islands, Ceylon, Mauritius, Moluccas, Flores, Tahiti, Marquesas and Hawaiian Islands.

The only sample ever brought to us from the Bay of Batavia, a male, is figured here. The upper surface of the carapace is covered with short felt, with the exception of the teeth, of the border and of the granular transverse ridges shown in the figure. Colour dark olive-green with a large, round, red blot on the branchial regions. Fore-legs pale flesh-coloured, fingers at the proximal half purple-red, the distal half and the teeth black; spines red at the base. Walking and swimming legs reddish, covered with red dots.

4. **Charybdis (Goniosoma) cruciata** (Herbst), radjungan karang (Plate XII b).

G. E. RUMPHIUS, D'Amboinsche Rariteitkamer, 1705, 1st book, p. 11, and plate VI, letter R.
(RUMPHIUS Gedenkboek, 1902, p. 102, under the name: *Goniosoma cruciferum* (Fabr.) A. M. Edw.).
Cancer cruciatus, J. F. W. HERBST, l.c. Bd. II, Heft 5, 1794, p. 155, Tab. 38, fig. 1.
Portunus crucifer, FABRICIUS, Supplementum Entom. Syst. 1798, p. 364.
Thalamita crucifera, H. MILNE EDWARDS, l.c. 1834, p. 462.
Goniosoma cruciferum, A. MILNE EDWARDS, l.c. 1861, p. 371.
Charybdis (Goniosoma) crucifera, A. ALCOCK, l.c. 1899, p. 51.
Charybdis cruciata, M. J. RATHBUN, The Danish Expedition to Siam 1899—1900, V, Brachyura. Copenhague, 1910, p. 363 (in: Kgl. Danske Vidensk. Selsk. Skrifter, 7. Raekke, Naturvidensk. og. Mathem., section V. 4).

Distribution: Indian Ocean, South Africa (Port Alfred), Indian Archipelago, China Sea, Japan, Australia.

This species is fairly often met with at the Pasar ikan. Although the malayan name seems to imply that it is found especially on the karang (coral-reefs), yet there seems to be no question of a preference of the animal to the latter. It is found on muddy ground and in the sero's as well.

Rev. STEBBING (A history of Crustacea, London, 1893) writes: "It is perhaps this species that suggested the story found in the old writers that on one occasion, to calm the sea, Xavier threw a crucifix into it, and that this was afterwards restored to him by a crab."

The fine brown and crême colours make this species one of the most beautiful swimming crabs.

5. **Charybdis (Goniosoma) natator** (Herbst) H. M. Edw., radjungan batik (Plate XIII a).

Cancer natator, J. F. W. HERBST, Naturgeschichte der Krabben und Krebse II, 1796, p. 156, Pl. XL, fig. 1.

Thalamita natator, H. M. EDWARDS, Histoire naturelle des Crustacés, I, 1834, p. 463, Pl. 17, figs 13 and 14.

Portunus (Charybdis) granulatus, W. DE HAAN, Fauna Japonica, Crustacea, 1835, p. 42, Pl. I, fig. 1 .

Goniosoma natator, A. MILNE EDWARDS, Archives du Muséum X, 1861, p. 370, 385.

Charybdis (Goniosoma) natator, A. ALCOCK, Materials for a carcinological Fauna of India, Nr. 4, Part II. Calcutta 1899, p. 61.

Distribution: Red Sea, Mozambique, Natal, Mayotte, Amirante Islands, Ceylon, Madras, Pondicherry, Singapore, Phillippines, Penang, Celebes, Amboina, Shanghai, Japan.

This species shows a very wide distribution but I suppose it is nowhere very common: Professor ALCOCK (l.c.) says that only 10 samples are present in the Indian Museum at Calcutta, from Ceylon, Madras and Pondicherry, and one from Singapore, and in all my (DE MAN's) publications it is mentioned only twice. Neither does it occur often in the remaining literature.

The best figure is that given by DE HAAN (l.c.), where, however, the anterior one of the six lateral teeth of the carapace appears not sufficiently truncate. DE HAAN himself, however, already remarks in his description "Dentes laterales supremi truncati (obtusiores quam in figura laudata)". One may recognize *Charybdis natator* (Herbst) easily by the reddish colour of the lateral and frontal teeth, by a number of transverse and finely granulous ridges on the carapace and by the numerous spines and knobs on the fore-legs which, moreover, show a blue tint on the inner side of the base of the fingers of the chela.

6. Charybdis (Goniosoma) lucifera (Fabr.), radjungan batu (Plate XIII b).

Portunus lucifer, FABRICIUS, Supplem. Entom. Syst., 1798, p. 364.
Goniosoma quadrimaculatum, A. MILNE EDWARDS, l.c. 1861, p. 375, plate XXXIV, fig. 3.
Goniosoma luciferum, J. G. DE MAN, Report on the Podophthalmous Crustacea of the Mergui Archipelago, London 1888, p. 83 (foot-note), in: Journ. Linn. Society, Zoology, Vol. XXII.
Charybdis (Goniosoma) quadrimaculata, A. ALCOCK,l. c. 1899, p. 54.
Charybdis lucifera, M. J. RATHBUN, l.c. 1910, p. 364, plate II, fig. 10.

Distribution: Coasts of the British-Indian Peninsula, Malabar, Siam, Java (Batavia, miss RATHBUN).

7. Thalamita crenata Ltr., radjungan hidjau I (Plate XIV a).

Portunus crenatus, LATREILLE, Collection du Muséum.
Thalamita crenata, E. RÜPPELL, Beschreibung und Abbildung von 24 Arten kurzschwänziger Krabben. Frankfurt a.M. 1830, p. 6, plate 1, fig. 2.
Thalamita crenata, H. MILNE EDWARDS, Hist. Nat. des Crustacés, I, 1834, p. 461.
Thalamita crenata, F. KRAUSS. Die Südafrikanischen Crustaceen. Stuttgart, 1843, p. 25.
Thalamita crenata, A. MILNE EDWARDS, Archives du Muséum, X, 1861, p. 365, 367.
Thalamita prymna, R. KOSSMANN, Zool. Ergebnisse einer Reise in die Küstengebiete des Rothen Meeres, Leipzig, 1877, III, Malacostraca, p. 47.
Thalamita crenata, J. G. DE MAN, in Journ. Linn. Soc. London, Zoology, vol. XXII, 1888, p. 79, and in: Abhandl. Senckenb. Naturf. Gesellschaft, Frankfurt a.M. Bd. XXV, 1902, p. 644.
Thalamita crenata, A. ALCOCK, l.c. p. 76.
Distribution: Red Sea (Suez), Indian Ocean (coast of Natal, Mozambique, Madagascar, Bombay, Persian Gulf, Mergui Archipelago, Andamans, Penang, Singapore), Indian Archipelago, Cape York, New Caledonia, Samoa, Fiji, Marquesas and Society Islands, Carolines, Liu-kiu-Islands, coasts of China.

KOSSMANN (l.c.) and ALCOCK (l.c.) are inclined to consider as belonging to one all the species of the genus *Thalamita* in which, as in *Thalamita prymna* (Herbst), eight frontal teeth are present and the basal joint of the outer antennae is much broadened, this one species then being *Thal. prymna* (Herbst). The species mentioned are: *Thalamita crenata* Latr., *coeruleipes* Jacquinot and Lucas, *crassimana* Dana, *spinimana* Dana, *picta* Stimpson, *Danae* Stimpson, and *Stimpsonii* A. M. — Edw. ALCOCK (l.c. p. 76), however, says: "But

as it is only occasionally that one encounters specimens that show a combination or confusion of characters I prefer, for convenience, to consider the usually accepted species as distinct". With which opinion I agree (DE MAN).

M. WEBER (Zoöl. Ergebnisse einer Reise in Nederl. Ost-Indien, II, p. 285) collected a few more species of this genus near the isle of Enkhuizen in the Bay of Batavia. These are: *Thalamita prymna* and *Admete* Herbst, besides *Th. Danae* Stimpson.

8. **Thalamita Danae** Stimpson, radjungan hidjau II (Plate XIV b).

Thalamita crenata, J. D. DANA, U. S. Explor. Exped. Crustacea, Pt. I. p. 282, plate XVII, figs. 7 a—b.

Thalamita Danae, W. STIMPSON, in: Proc. Acad. Nat. Sciences of Philadelphia, March 1858, p. 37.

Thalamita Danae, A. MILNE EDWARDS, Archives du Muséum, X, 1861, p. 366, plate XXXVI, figs. 1—1 e.

Thalamita Danae, J. G. DE MAN, in: Journal Linn. Soc. London, vol. XXII, 1888, p. 78, plate IV, figs 8 and 9, and in: Notes from the Leyden Museum, vol. XV, 1893, p. 285, and in: Abhandl. Senckenb. Naturf. Gesellsch., Frankfurt a.M., Bd. XXV, 1902, p. 644, plate XXI, fig. 28.

Thalamita Danae, A. ALCOCK, l.c. p. 77.

Distribution: Red Sea (Obock), Mozambique, Mergui Archipelago, Andaman-Islands, Indian Archipelago (Padang, Java, Amboina, Ternate, Timor, Ceram), Hongkong, Auckland.

p. 78 In his article (l.c. ~~188~~) on the Crustacea Podophthalma of the Mergui-Archipelago DE MAN has suggested that *Thalamita Stimpsoni* A. M. EDW. (l.c. 1861, p. 362, Pl. XXXV, fig. 4) must be considered as a variety of *Thal. Danae.* If, however, one compares the full-grown samples of *Thal. Danae* and *Thal. crenata* with each other, the differences are so great that it seems almost impossible that these two species should be identical.

9. **Podophthalmus vigil** (Fabr.), radjungan angin (Plate XV b and c).

Portunus vigil, J. C. FABRICIUS, Supplementum Entomol. Syst. 1798, p. 363, nr. 1.

Podophthalmus spinosus, J. B. P. A. DE LAMARCK, Hist. Nat. des Animaux sans Vertèbres, V. p. 157.

Podophthalmus spinosus, A. G. DESMAREST, Considérations Générales sur la Classe des Crustacés etc., Paris, 1825, p. 100, plate 6, fig. 1.

Podophthalmus vigil, H. MILNE EDWARDS, Histoire naturelle des Crustacés, I, 1834, p. 467, and in: Règne Animal de Cuvier, Atlas, plate IX, fig. 1

Portunus (Podophthalmus) vigil, W. DE HAAN, Fauna Japonica, Crustacea, 1835, p. 44.

Podophthalmus vigil, A. MILNE EDWARDS, in: Archives du Muséum, X, 1861, p. 420.

Podophthalmus vigil, E. J. MIERS, Report on the Challenger Brachyura, London, 1886, p. 207.

Podophthalmus vigil, J. G. DE MAN, in: Sammlungen des Geologischen Reichs-Museums in Leiden, Ser. I, Bd. VII, Leiden, 1904, p. 274.

Distribution: Red Sea, Indian Ocean, coasts of Siam, Japan, Hawaiian Islands.

This species, distinguished from all other indopacific swimming crabs by its enormously elongated eye-stalks which occupy together the whole breadth of the carapace, was thus far missing in all the Decapoda-collections identified by me (DE MAN). All these collections, however, belonged to the litoral fauna, not to the deeper water. The Batavian fishermen bring it up from a depth of about 15 fathoms, while fishing there for "peperrek" (small fishes belonging to the genera *Equula* and *Gazza*).

In this species also the sexual dimorphism is very evident, the males being here, as in *Neptunus pelagicus*, larger and having more elongated limbs than the females.

Good figures of this species are to be found in the above mentioned work of DESMAREST and in CUVIER'S Règne animal. Professor ALCOCK, curiously enough, does not mention it in his "Materials" of which the part on Portunidae appeared in 1899. He, however, describes a second species of this genus under the name of *Podophthalmus nacreus* A. ALCOCK; this species, living in the Gulf of Martaban and on the coasts of the Andaman Islands, shows a quite different carapace which is less strongly broadened, whereas the eye-stalks reach to beyond the large lateral tooth of the cephalothorax. The *Pod. nacreus*, the second species known of this genus, approaches in its characters and external appearance the genus *Euphylax* described in 1862 by STIMPSON and comprising the swimming crabs of the West-Indies.

In 1904 I wrote (l.c.) on some ten samples of *Podophthalmus vigil* from post-tertiary layers of the Minahassa, Celebes.

For the sake of easy determination Dr. DE MAN has made the following dichotomous table.

Table for the determination of the Batavian radjungans.

I. Eye-stalks of moderate length, the latter being always considerably less than the breadth of the front, i.e. the part situated between the two eye-holes. Front directed horizontally forwards, not bending downwards. Outer border of the eye-holes reaching laterally less far than the next following part of the carapace which bears a series of teeth of which the hindmost reaches furthest outwards.

A. Lateral border of the carapace with n i n e teeth (1), including the

(1) To this group belongs also the common "kepiting" (*Scylla serrata*).

tooth on the outside of the eye-hole. The hindmost of these teeth terminating into a fairly long spine.

1. A sharp spine at the end of the hind border of the arm of the forelegs. Posterior half of the carapace without three large red round spots.

Neptunus pelagicus Linné.

2. Hind border of the arm of the fore-legs without spine at the extremity. Three large red roundish spots on the posterior half of the carapace.

Neptunus sanguinolentus (Herbst).

B. Lateral border of the carapace with six or seven teeth, including the tooth on the outside of the eye-hole.

1. Lateral border of the carapace with seven teeth, the second and the fourth one being rudimentary.

Charybdis (Goniosoma) erythrodactyla (Lamarck).

2. Lateral border with six teeth of equal size.

a. The first or anterior one of these six teeth, which forms the outer border of the eye-hole, is truncate or even slightly concave.

aa. The whole animal looks smooth, hairless. No transverse finely granulous ridges occur on the posterior half of the carapace, behind the finely granulous and slightly curved line which unites the hindmost lateral teeth. First or anterior lateral tooth generally slightly concave. Fore-legs smooth, with spines but not granulous. On the middle of the carapace a pale figure in the shape of a cross, and on both sides two pale bands uniting anteriorly and ending on the outside of the eye-holes.

Charybdis (Goniosoma) cruciata (Herbst).

bb. The whole animal covered with a very short, grey, felt-like hair-coat which, however, leaves free the finely granulous ridges on the carapace, the margin of the lateral and frontal teeth, the spines and knobs of the fore-legs, these free parts all showing a bright red colour. On the posterior half of the carapace, behind the finely granulous transverse ridge joining the posterior lateral teeth, a few more finely granulous transverse ridges are found, viz. one, interrupted for a short distance in the middle, on the *regio cardiaca,* and on either side two shorter ones, one behind the other, on the *regio branchialis,* the anterior one of these being slightly broader than the posterior one. The first

or anterior one of the six lateral teeth truncate, but not concave. Fore-legs coarsely granulous.

Charybdis (Goniosoma) natator (Herbst). H. M. Edw.

b. The first or anterior one of these six teeth, which forms the outer border of the eye-hole, terminates in a pointed tip, in the same way as the other ones. On the posterior half of the carapace four large pale spots, two on either side, the median ones being larger than the outer ones.

Charybdis (Goniosoma) lucifera (Fabricius).

C. Lateral border of the carapace with five teeth, including the first or anterior tooth at the outer border of the eye-holes and sometimes with little denticles in the interdental spaces. The fourth lateral tooth has the same size as the fifth or posterior one, not much smaller.

a. Upper surface of the carapace smooth, the transverse lines on the anterior half very finely granulous, not very conspicuous. Chelae on the outer and the inner side, as well as the under surface, completely smooth.

Thalamita crenata Latr.

b. The granulous transverse lines on the upper surface of the carapace very conspicuous, the anterior four strongly developed. Chelae

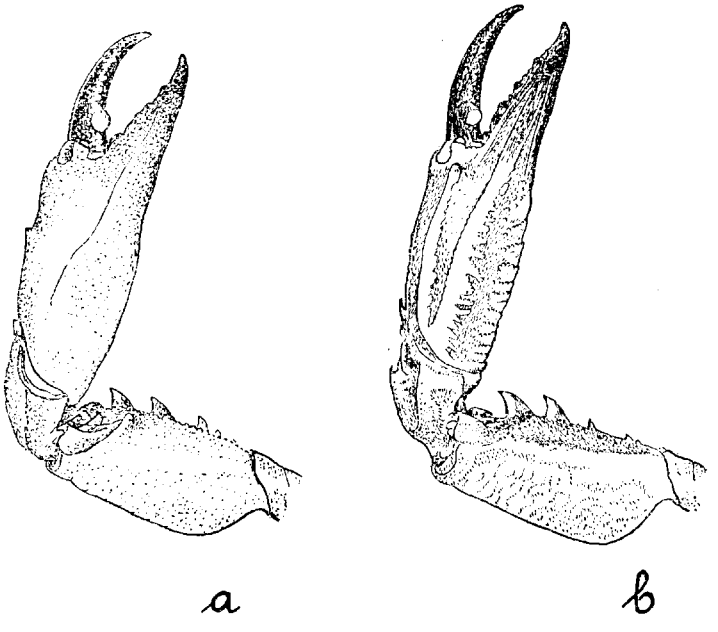


Fig. 1. Underside of the fore-leg of *a Thalamita crenata* Latr.
b „ *Danae* Stimpson.

on the outer and the inner side, as well as on the under surface, distinctly granulous; the ridge running — as in C *a* — on the outer side and reaching to the end of the unmovable finger, begins already at the articulation of the preceeding joint (the carpus) which is not the case in C *a*. Besides there is here a second, coarsely granular, ridge, missing in C *a*, and running on the outside of the chela between the first-mentioned ridge and the upper surface (cf. Fig. 1*b*). On the posterior half of the upper surface of the carapace a large reddish spot may be observed on either side.

Thalamita Danae Stimpson.

II. Eye-stalks extremely long, occupying together the whole breadth of the carapace and separated by a very narrow strip, directed obliquely downwards and terminating in a transverse narrow plate, the front proper. Outer corner of the eye-holes terminating into a very sharp and slightly forward-directed spine, behind which only one more small sharp tooth is found, the lateral border of the carapace running further obliquely inwards and backwards. Chelae elongate, with three spines of which one is situated on the inner side. On the middle of the outer side of the chela a longitudinal granulous and very conspicuous ridge.

Podophthalmus vigil (Fabricius).

With the exception of the radjungan angin (*Podophthalmus vigil*) and the radjungan hidjau I have kept alive in the aquarium all the species mentioned, often for a considerable time. They all behaved somewhat in the same manner.

Although the name "swimming crab" and the paddle-shaped hind-legs might suggest that their normal way of moving is swimming, yet this appears not to be the case. Only occasionally did they "take paddle", e.g. when a female was being pressed hard by a courting male. The swimming gives the impression of being a fairly strenuous occupation and soon they sink again to the bottom. According to the fishermen the radjungans are found a little distance above the bottom when the weather is rough. Evidently they are swimming then, perhaps the water is troubled near the bottom which is quite possible as the radjungans live in depths varying from two or three to ten fathoms only. Never did I observe radjungans swimming near the surface of the sea as is often the case with *Matuta* where all the legs are more or less swimming legs. For the rest one gets the impression that the hind-legs are used by the radjungans more when the crab buries itself backwards into the sand than for swimming. Never did the radjungans in the aquarium any harm to the living fishes but as soon as there were dead ones they were at them. As a rule we gave them "tri" (*Stolephorus* spp.) as food. They would take one with their chelae and bring it with one end to the mouth in the same way as we would do with a cigar. The maxillipeds then nibbled busily

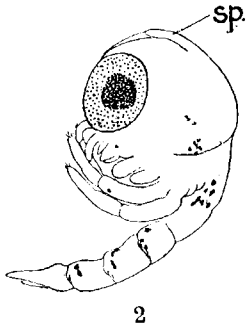
at this end of the fish and in this way the fish gradually disappeared. From time to time, however, the crab would pause a moment and withdraw the rest of the fish from its mouth, in the same way as a smoker does with his cigar.

Especially with animals newly brought into the aquarium I often observed the males paying their court to the females. He would approach high on his legs and with the chelae widely spread out, whereas she was trying to evade. If he succeeded in cornering her, then she would often have recourse to the swimming legs and thus succeed in escaping. The copulation was more than once observed. The female then lies on her back, quite passively, the chelae and most of the other legs drawn in. The male is standing over it, its pleon inserted under that of the female which is turned back.

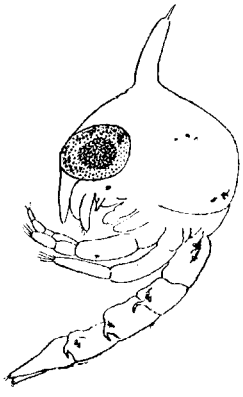
The eggs are attached in the usual way to the pleopods of the female. When newly laid they are yellow, in the course of the next days they gradually get darker until at last the egg-mass is nearly black. I cannot say, how many days the hatching takes, for although we got eggs more than once in the aquarium, we never saw them hatch. They always disappeared again after a few days, for which I know no other explanation than that they are eaten up by the mother, perhaps after she had noticed that the development did not proceed in the normal way.

According to STEAD (l.c. p. 748) the spawning season in Australia is about August, September, October and November. In Batavia no such definite spawning time could be observed, egg-bearing females occurring all the year round.

If we take a female radjungan from the fish-market bearing eggs of a very dark, nearly black colour, we find that these eggs contain young zoea-



2



3

Fig. 2. Embryo freed from the egg-membrane, × 45.
„ 3. Newly hatched larva, × 45. *sp* dorsal spine.

larvae, as shown in figs. 2 and 3. The latter of these figures represents the larva after the moult which accompanies the hatching. In fig. 2 the dorsal

spine on the cephalothorax, so characteristic in zoea-larvae of Brachyura, is still folded up in forward direction inside the cuticle which will burst soon. The same is the case with the lateral spines which we see in fig. 3 pointing backwards from the hindborder of the pleonsegments 2—4. In fig. 2 these spines are still folded up inside the cuticle and directed to the dorsal side, whereas in fig. 3 they have just become free. Besides the rudiments of the first and the second antennae and of the mandibles, those of the two pairs of maxillipedes may be discovered. Very constantly a black pigment spot is present on the mandible and one on the protopodite of the first maxilliped. Other pigment spots may be seen on the segments 2—4 of the pleon, where a group of them is found at the base of each of the spines. Finally we see groups of black pigment spots also in the more anterior segments.

In the surface plankton of the Bay of Batavia I have sometimes found large numbers of zoea- and megalopa-larvae, evidently all belonging to one species. The megalopa-larvae could be recognized as those of swimming-crabs, the posterior pair of perciopods showing already an evident flattening of the outer joints. The youngest zoea-larvae agreed very well with those freed from the eggs of the radjungan, although being larger and further advanced. Now taking into consideration that radjungans occur in great numbers at the bottom of the bay of Batavia and that other crabs are not nearly so common there, the conclusion lies at hand that we are dealing with the larvae of radjungans. And as we have seen, that all the species enumerated in this article may be called fairly rare as compared with the common radjungan, *Neptunus pelagicus*, we may safely conclude that by far the majority of the larvae, if not all, belong to the latter species.

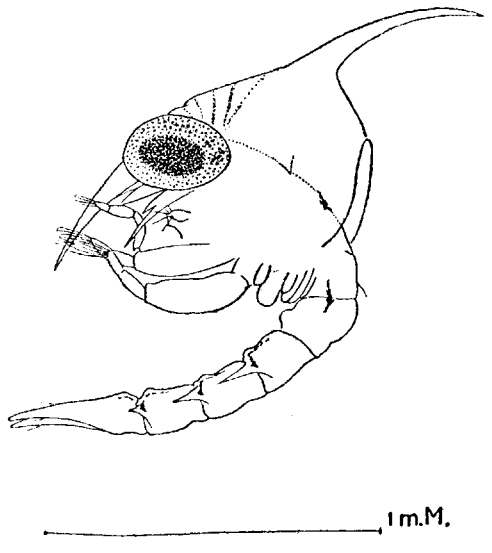


Fig. 4. Zoea-larva from the plankton, × 45.

Figs. 4, 5 and 6 represent three stages in the development of the pelagic zoea, evidently corresponding to three successive moults. Black pigment spots are to be found in the same places as with the larvae freed from the eggs, viz. at the base of the spines of the pleon-segments 2—4, a few also more anteriorly and one on the rudiment of the mandible. Only the pigment spot on the protopodite of the first maxillipede could not be found again in the pelagic larvae.

The two spines of the carapace, one directed forward and one backward,

are well developed now; there is also a smaller lateral spine on each side.

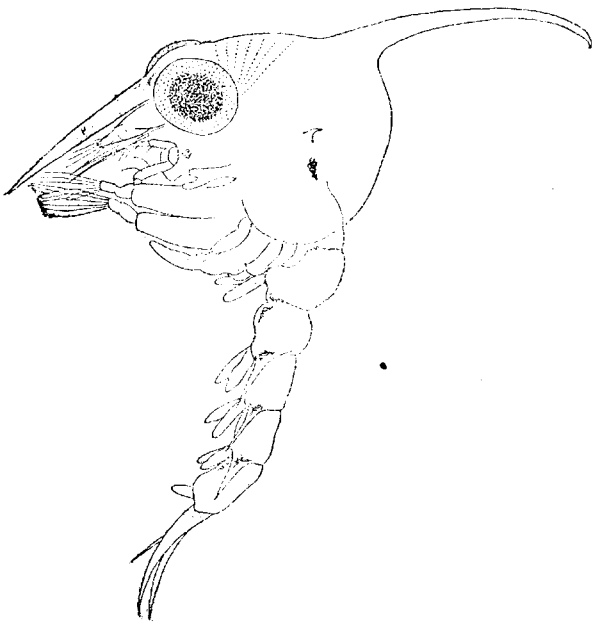


Fig. 5. Zoea-larva from the plankton, × 24,7.

The pleon consists of six joints, of which nrs 2—4 bear lateral spines, whereas in nrs 1 and 5 there may be discovered only a faint rudiment of such a spine in the corresponding place. All the segments develop a pair of pleopods, with the exception of the last one, while the rudiments of those of the 5th segment are smaller than those in the proximal ones.

Besides the pleopods we see, in comparing the three successives stages, also the

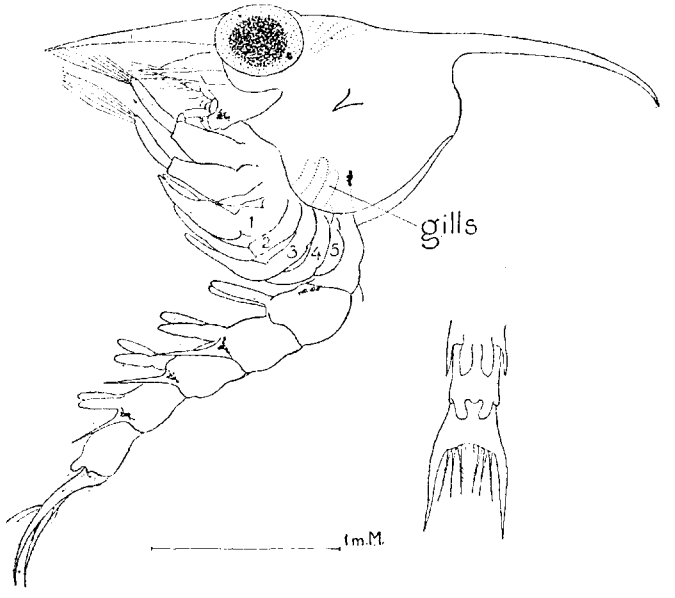


Fig. 6. Zoea-larva from the plankton, × 24,7.

pereiopods developing steadily, and in fig. 6 the rudiment of the gills may be observed through the transparent carapace.

The transition into the megalopa-stage seems to be a fairly sudden one; at least in a number of plankton samples in which zoea- and megalopa-larvae abounded, I did not meet with any intermediate stage between those of fig. 6 and of fig. 7.

All the pereiopods are well developed now and by the flattened terminal joint of the 5th pair (figs. 7 and 8) we recognize the swimming crab. The basal segment of this last pair of pereiopods bears a strong, backward directed spine which in both figures may be seen at the left and the right of the basal part of the pleon. Hairs have appeared on the surface of all the pereiopods. The lateral spines of the pleon-segments 2—4 have disappeared, with the exception of those of the 4th segment. In the stage of fig. 7 the segments 5 and 6 are already flexed forward (in the figure they have been pulled back) and in fig. 8 the segments 3 and 4 are bending round also.

It seems that at this stage the larvae disappear from the surface plankton; I did not find any further advanced stages.

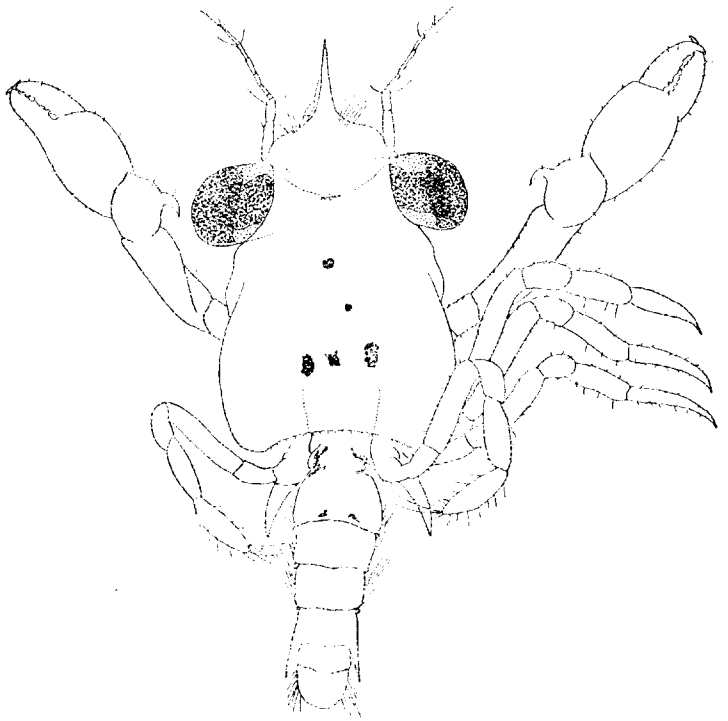


Fig. 7. Megalopa-larva from the plankton × 24,7.

The moulting of the adult radjungans was often observed in the aquarium, it wholly agrees with what we know of the moulting of crabs in general. The

perfect condition in which the exuvium is left behind causes surprise again and again. The crab leaves its old coat by a fissure dorsally at the limit of the cephalothorax and the first pleon-segment.

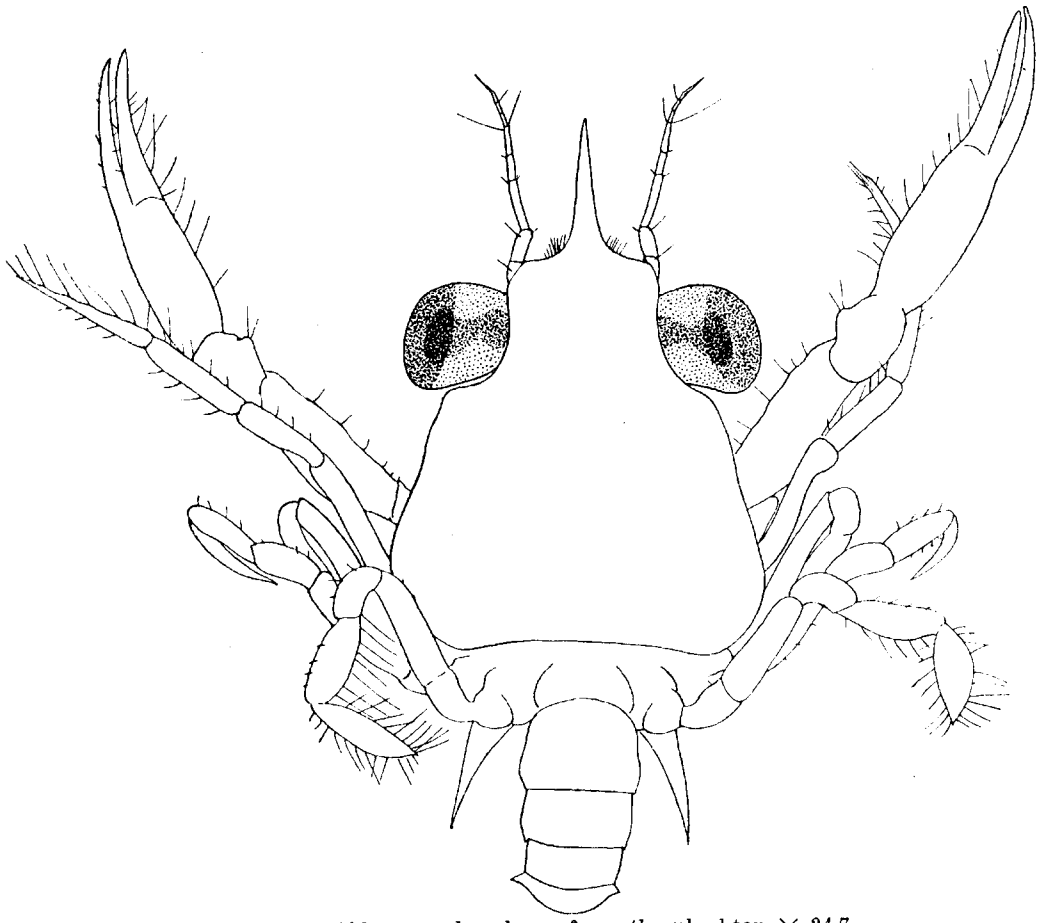
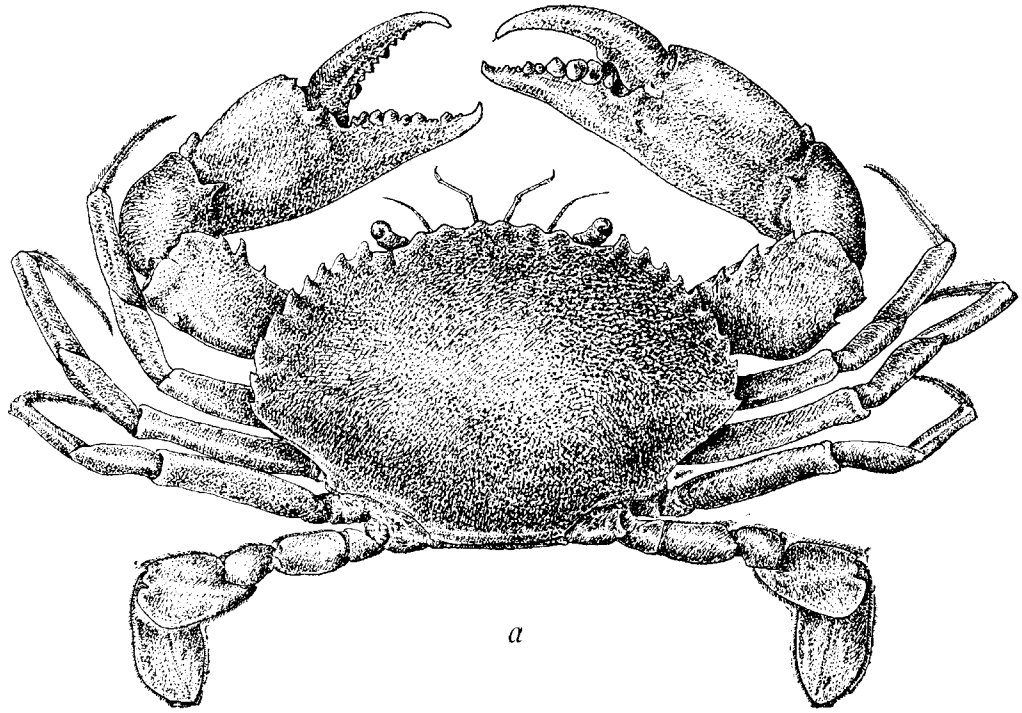
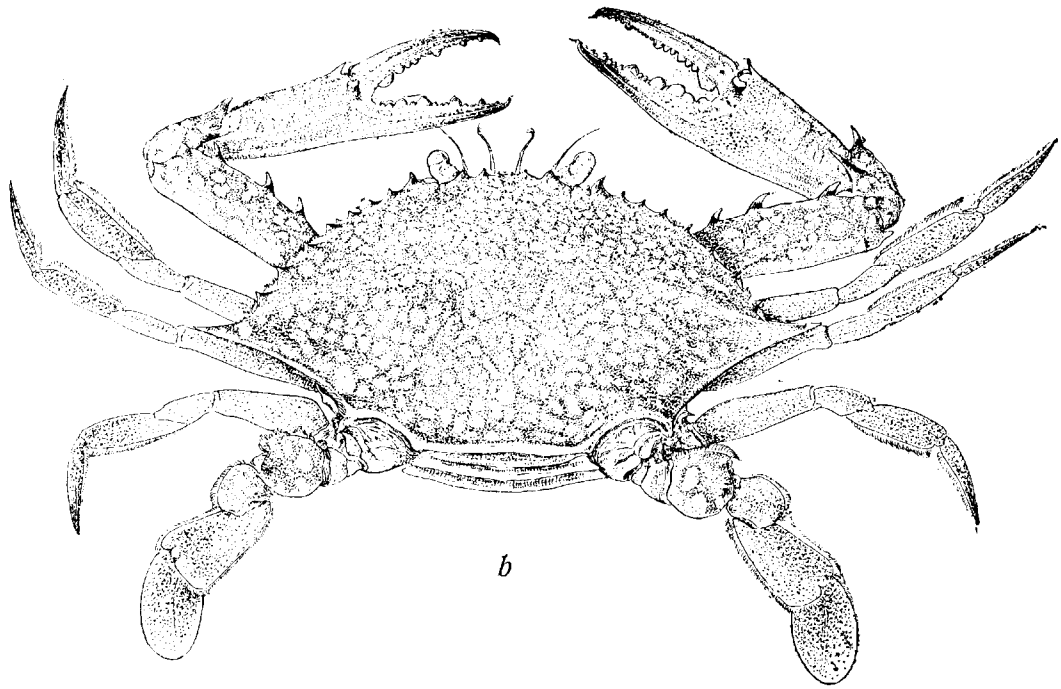


Fig. 8. Older megalopa-larva from the plankton × 24,7.

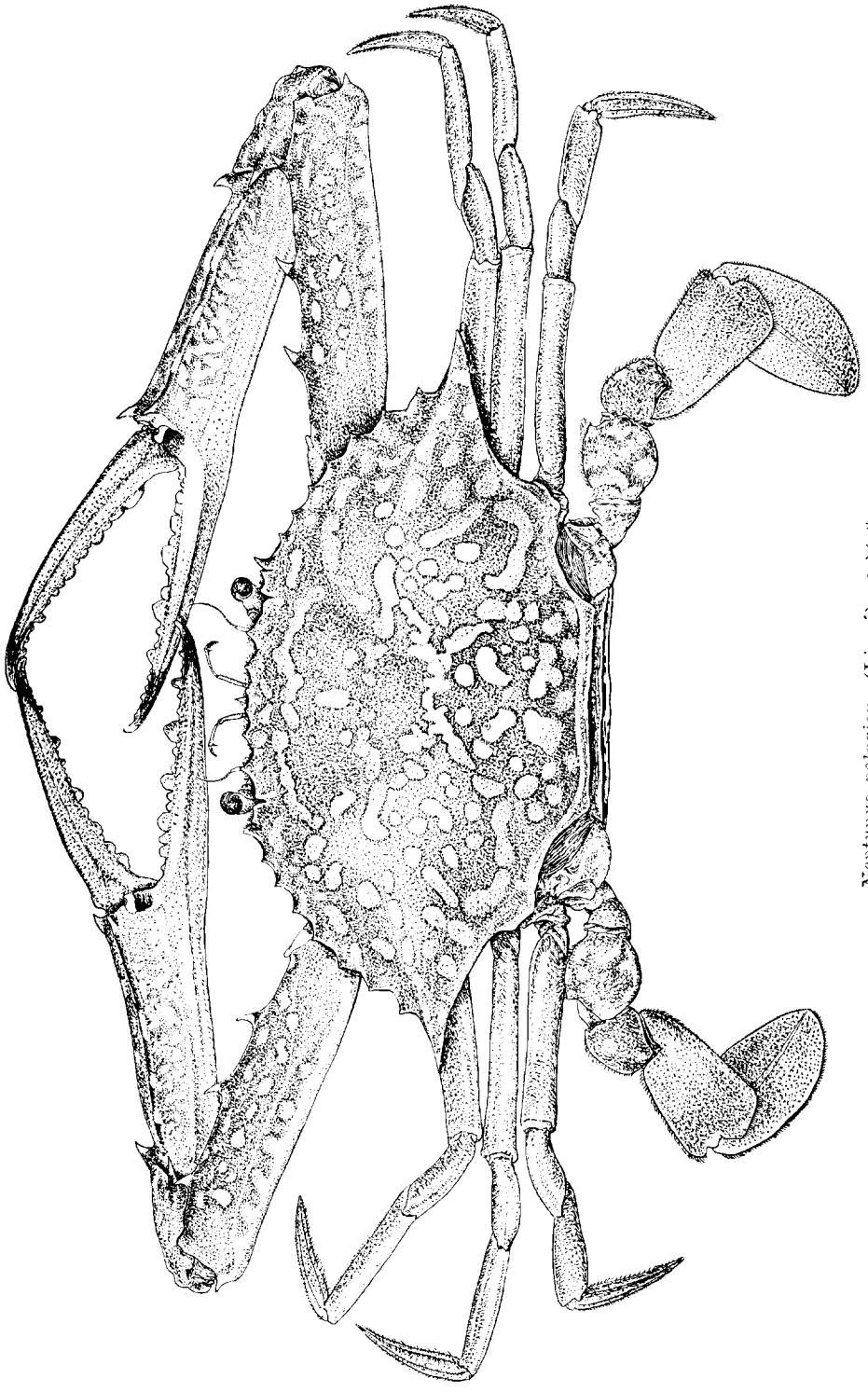


a

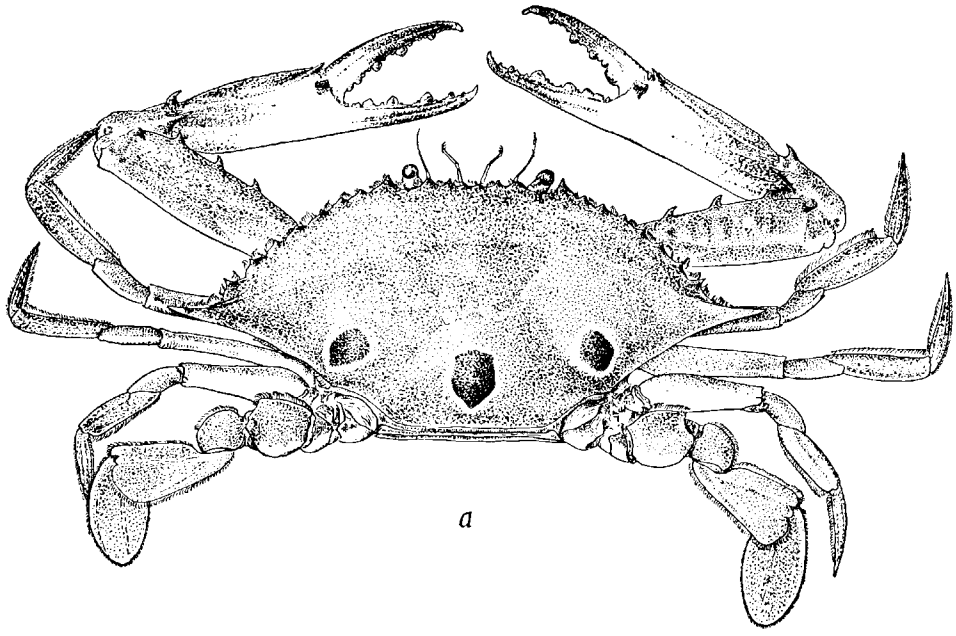


b

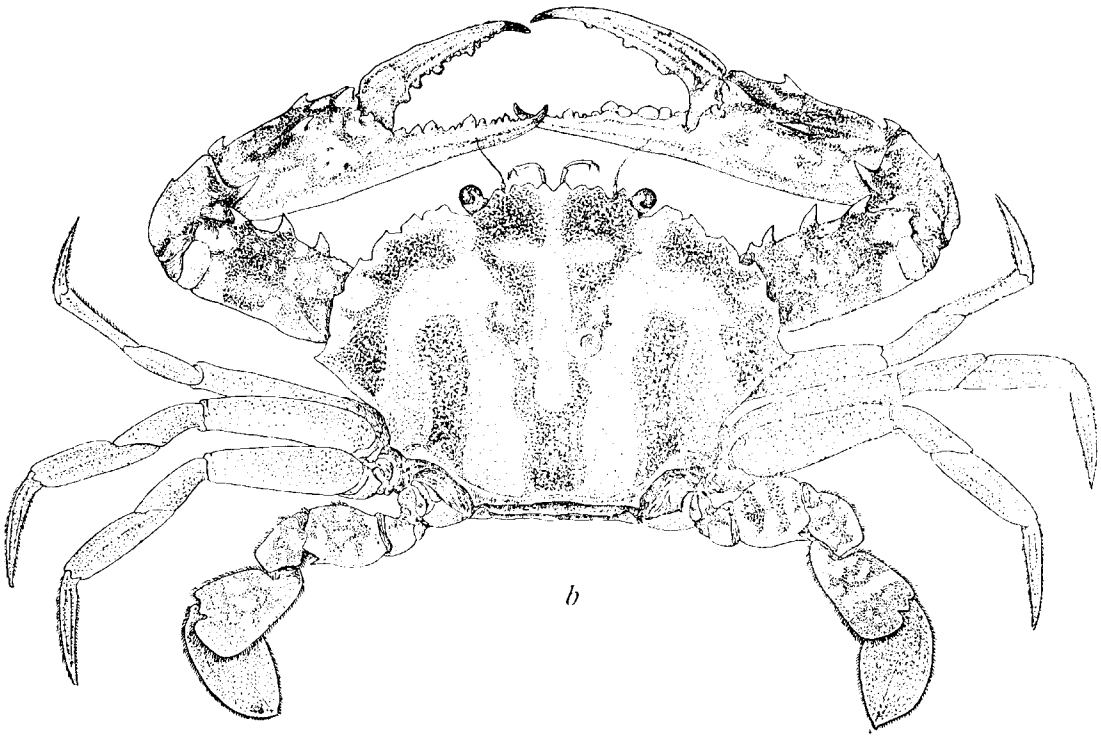
a. Scylla serrata (Forskål) ♂ × $^{1}/_{5}$.
b. Neptunus pelagicus (Linné), ♀ × $^{2}/_{3}$.



Neptunus pelagicus (Linné), ♂ × $\frac{2}{3}$

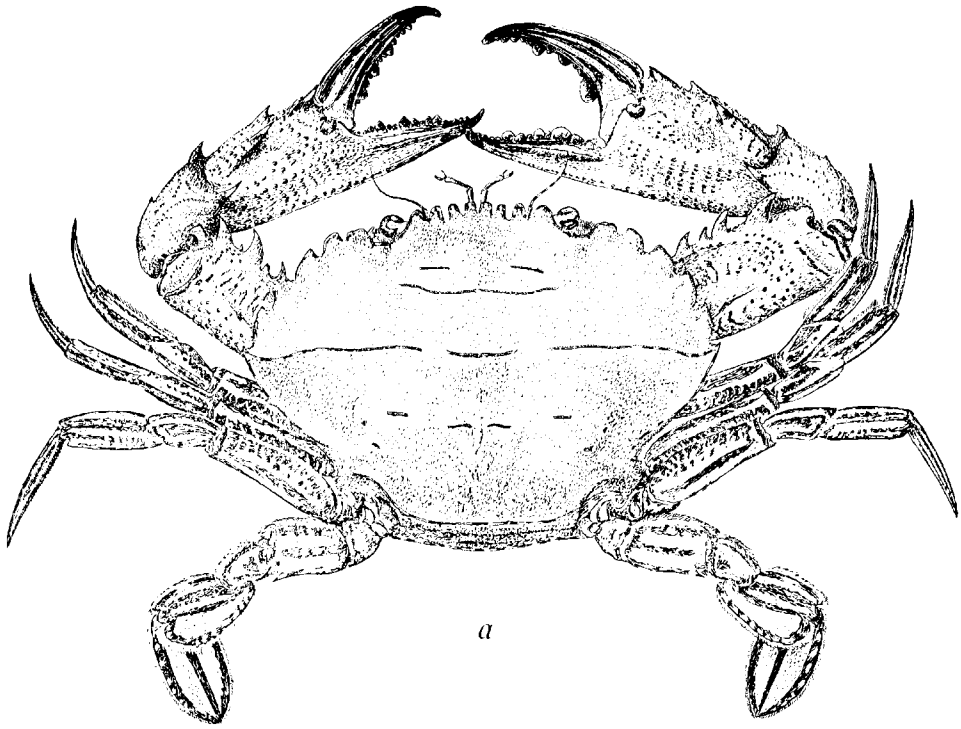


a

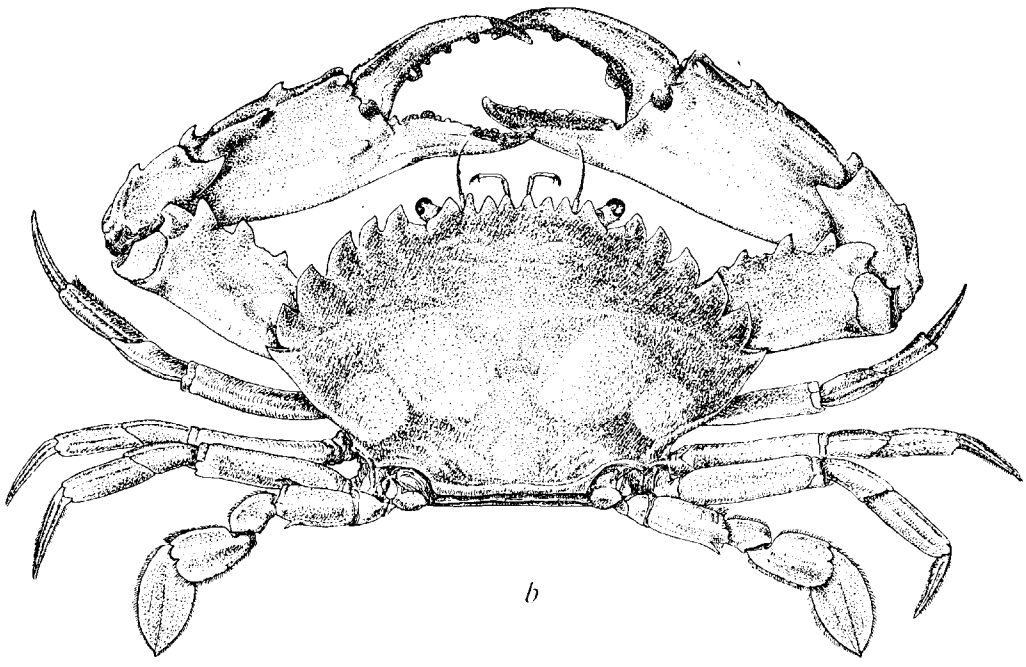


b

a. Neptunus sanguinolentus (Herbst), ♂ × ⅔.
b. Charybdis (Goniosoma) cruciata (Herbst), × ⅔.

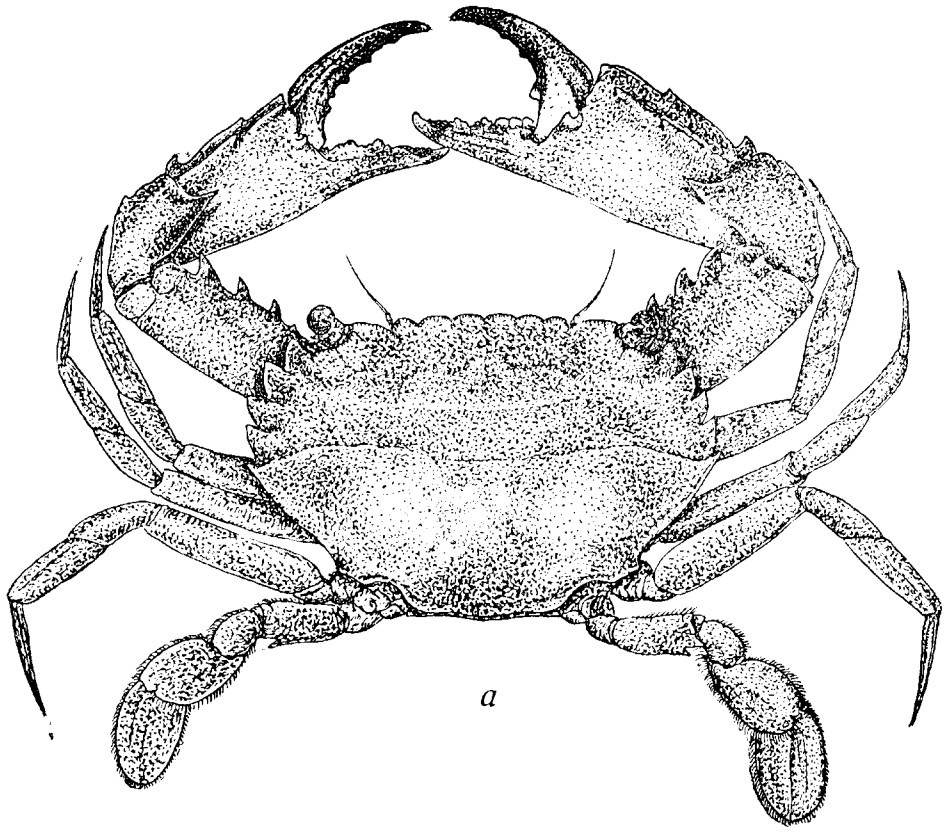


a

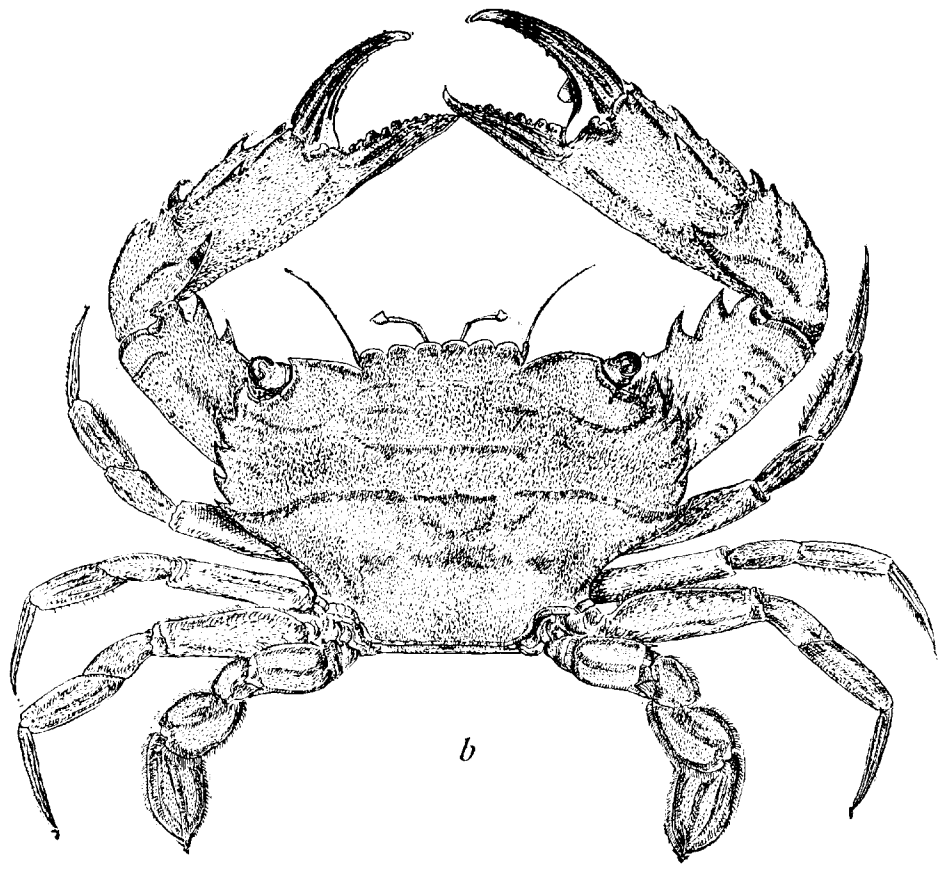


b

a. Charybdis (Goniosoma) natator (Herbst), ♀ × ⅔
b. „ „ *lucifera* (Fabr.), × ⅔.

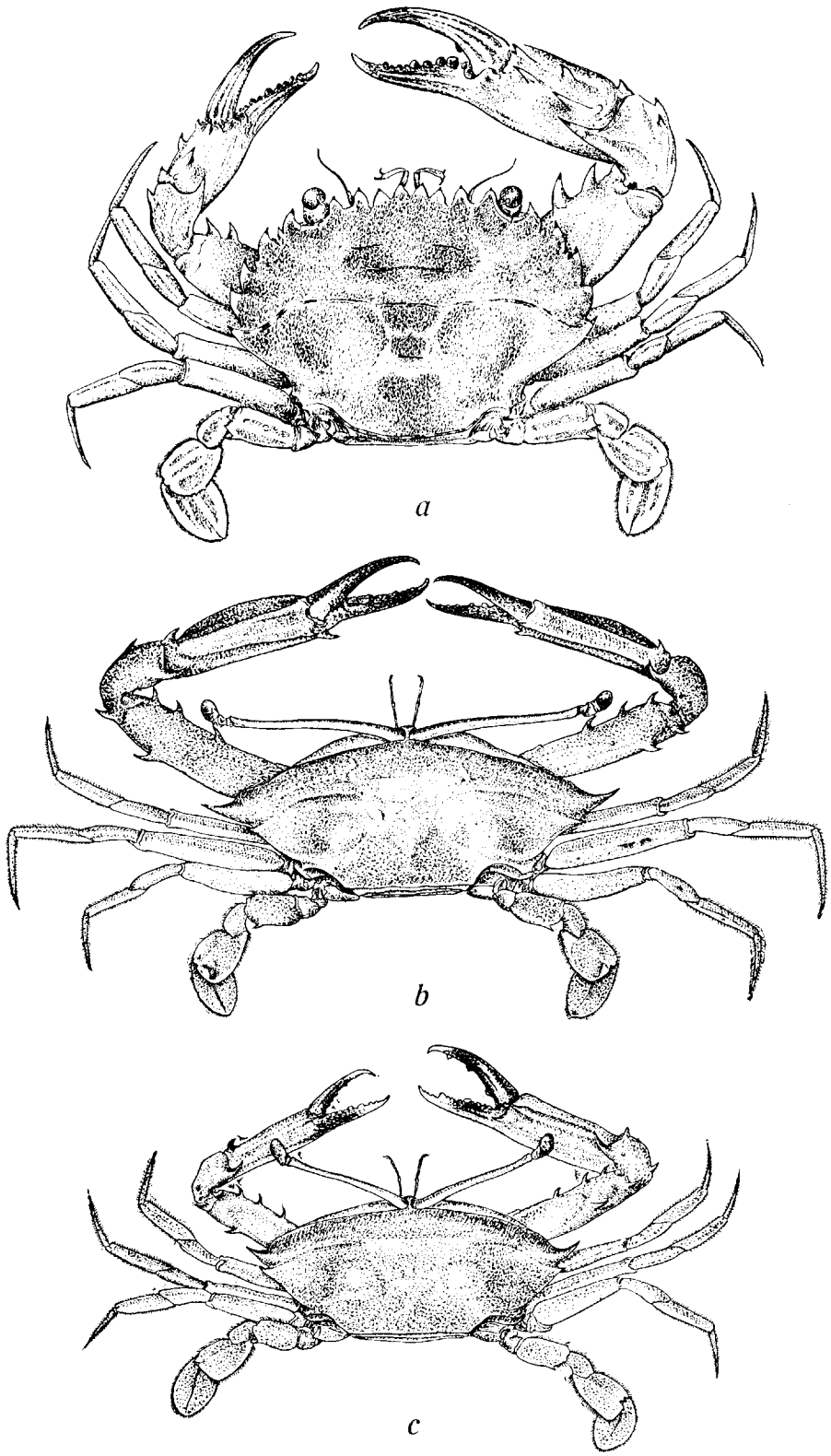


a



b

a. Thalamita crenata Latr. × 1.



a. Charybdis (Goniosoma) erythrodactyla (Lamarck), ♂ × ⅔.
b. Podophthalmus vigil (Fabr.), ♂ × ⅔.
c. " " ♀ × ⅔.