

**A REVISION OF THE FAMILY SCYLLARIDAE (CRUSTACEA
DECAPODA MACRURA). I. SUBFAMILY IBACINAE**

by

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Key words: Crustacea; Scyllaridae; key, subfamilies and genera; Ibacinæ; Arctidinae; Theninae; Scyllarinae; *Evibacus*; *Ibacus*; *Parribacus*.

General account of morphology and taxonomy of Scyllaridae with keys to subfamilies and genera. Establishment of subfamilies Ibacinæ, Arctidinae, Theninae and Scyllarinae. Monographic treatment of subfamily Ibacinæ and its genera *Evibacus* (one species), *Ibacus* (six species, one subspecies), and *Parribacus* (six species). No new species.

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INTRODUCTION

In 1960, at the invitation of the Smithsonian Institution, a study was undertaken of the rich Scyllarid collections of the United States National Museum, Washington, D.C. (USNM), with the object to revise this family of Crustacea. The studied material, in which most of the known species are represented, clearly showed the necessity of such a revision, and at the same time offered the materials for it. Later, the Scyllaridae of the Zoologisch Museum, Amsterdam (ZMA), the Universitetets Zoologiske Museum, Copenhagen (UZM), the Zoologisches Museum, Berlin (ZMB), the Zoologisches Museum, Hamburg (ZMH), the Bernice P. Bishop Museum, Honolulu (BPBM), the Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), the British Museum (Natural History) London (BM), the Allan Hancock Foundation, University of Southern California, Los Angeles (AHF), the Institute of Marine Science, Miami (IMS), the Zoological Museum of Moscow State University (ZMM), the Muséum d'Histoire Naturelle, Genève (MG), the Zoologisk Museum, Oslo (ZMO), the Muséum National d'Histoire Naturelle, Paris (MP), the Western Australian Museum, Perth (WAM), the Academy of Natural Sciences, Philadelphia (ANS), and the Australian Museum, Sydney (AM) were studied. The results of all these studies are incorporated in the present paper.

My visit to the U.S. National Museum was made possible by an O.N.R./A.E.C. grant to the Smithsonian Institution. I am most grateful to Dr. Fenner A. Chace, Jr., at that time Curator Division of Marine Invertebrates, for allowing me working space in his office and for his continuous help and advice. I also wish to express my sincere gratitude to the staff of the above-mentioned institutions for enabling me to study the material entrusted to their care. In the following text the various institutions are indicated with the initials given above in parentheses behind their names.

SCYLLARIDAE Latreille, 1825

- Macroura Divisio II Leach, 1815: 338.
- Sagaritides Billberg, 1820: 134.
- Laticornes Haworth, 1825: 184.
- Scyllarides Latreille, 1825: 278.
- Scyllariens H. Milne Edwards, 1837: 279.
- Scyllaroidea De Haan, 1841: 148, 149.
- Scyllaridae White, 1847: 67.
- Scyllariana Gibbes, 1850: 192.
- Scyllarina Bate, 1881: 228.
- Scillarini Riggio, 1885: 145.
- Scillariidae Gurjanova & Phuong, 1972: 158, 164.

Definition. — A family of Decapoda Macrura Reptantia belonging to the infraorder Palinura, which is distinguished from all other families of that infraorder (and in fact from all other families of Macrura Reptantia) by having the segments of the antennal peduncle wide and flat and by having the antennal flagellum transformed to a single broad and flat segment without a trace of articulations.

Description. — The carapace is often depressed, always with a distinct lateral margin. The rostrum is small and enclosed by the antennular somite. The eyes are placed within distinct orbits which lie at or near the anterior margin of the carapace. On the carapace several grooves, ridges, teeth and incisions may be present. Of the grooves the most important is the cervical groove which traverses the dorsal surface of the carapace from side to side, being curved posteriorly in the middle. The postcervical groove lies behind the cervical and, if present, is usually only visible for part of its length. A pair of branchiocardiac grooves runs in longitudinal direction between the branchial and cardiac regions; they usually connect the cervical with the postcervical grooves. The marginal groove is a deep groove which runs close to and parallel with the posterior margin of the carapace. In most Scyllaridae five longitudinal ridges run over the carapace: one postrostral ridge, two branchial and two lateral ridges. The postrostral ridge runs from the rostrum backward, the branchial ridge starts at the inner margin of the orbit and continues backward from there, while the lateral ridge forms the lateral margin of the carapace. The postrostral and branchial ridges may be divided into two parts by the cervical groove; these parts are here always indicated as the anterior and posterior. Sometimes the posterior postrostral ridge is cut in two by the postcervical groove, the posterior part then is called intestinal ridge. In *Scyllarus* a short longitudinal or oblique intercervical ridge is present between the cervical and postcervical grooves and between the branchial and lateral carinae. The lateral carina sometimes is divided in three parts by the cervical and postcervical grooves; these three parts are indicated here as anterior, intermediate and posterior. The orbital carina encircles the orbit. A postorbital ridge is sometimes found in *Scyllarus*. This is a short oblique ridge which begins at the confluence of the anterior branchial and the orbital ridges and is directed outward and posteriorly. In the same genus a postorbital tubercle may also be present behind the orbit. The anterior and posterior submedian ridges are longitudinal ridges placed at each side of and close to the anterior and posterior postrostral ridges respectively. The posterior carina is a transverse carina which runs just before the marginal groove. On the postrostral carina 6 teeth may be present, these are from before backwards: (1) the rostral tooth placed on the rostrum, (2) the pregastric tooth placed between the ros-

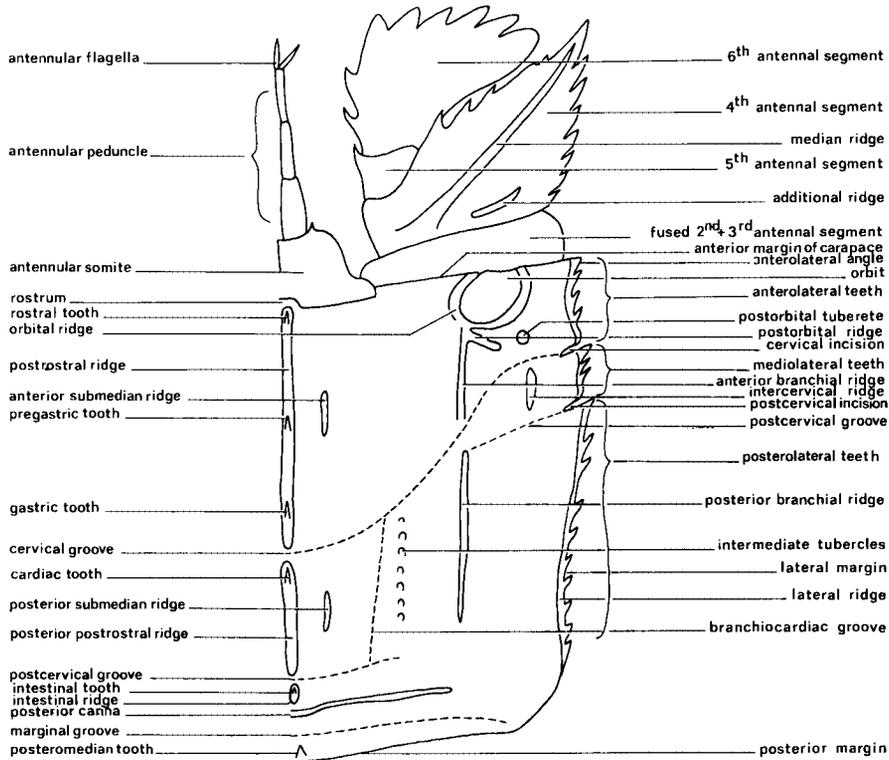


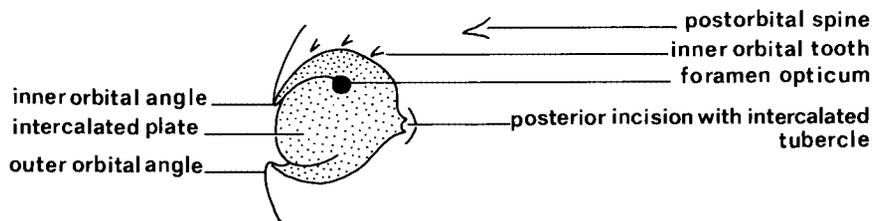
Fig. 1. Schematic dorsal view of right half of scyllarid carapace and cephalic appendages, showing various regions, spines, grooves, teeth, etc.

tral and gastric teeth, (3) the gastric tooth placed just before the cervical groove, (4) the cardiac tooth placed just behind the cervical groove, (5) the intestinal tooth placed just behind the postcervical groove, and (6) the posteromedian tooth placed between the posterior margin and the marginal groove. The anterolateral teeth are those of the lateral teeth that are placed before the cervical groove, the posterolateral teeth are those placed behind it. If, as in the genus *Scyllarus*, a postcervical incision is distinct, the name posterolateral teeth is confined to those teeth behind the postcervical incision, the lateral teeth between the two incisions are then named mediolateral teeth. A row of tubercles, the intermediate tubercles, may extend along the outer side of the branchiocardiac groove in *Scyllarus*. The lateral margin of the carapace may show incisions at the level of the cervical and postcervical grooves; these incisions are named the cervical and postcervical incisions respectively. The cervical incision is very distinct and usually very deep in *Evibacus*, *Ibacus*

and *Parribacus*; in *Scyllarus* and *Arctides* it is not deep but distinct, in *Scyllarides* it is absent, indistinct, or rather distinct. The postcervical incision is only found in the genus *Scyllarus*, and in one species of *Scyllarides* (*S. elisabethae*).

The first abdominal somite has very short pleura. The pleura of the second somite are largest, being longer and broader than those of the following somites in which they gradually diminish in size. The somites are divided in an anterior and a posterior half. The anterior half is that part of the somite which disappears under the previous somite when the abdomen is fully stretched and which is only visible in a curved abdomen. This anterior part is usually quite smooth, but may show occasional grooves or flat tubercles. The posterior part is often higher than the anterior and usually separated from it by a transverse groove. The surface of the posterior half is either similar to that of the carapace or it is intricately sculptured. The telson consists of two parts: the anterior part which is calcified and may show tubercles etc., and the posterior part which is membranaceous and longitudinally grooved.

The eyes are well-developed, though rather small. The basal segment generally is small except in *Thenus* where it is considerably elongated. The cornea may be broader, equal to, or narrower than the stalk. In most genera the orbit is formed by the carapace. It usually is a circular depression of the carapace at the anterior margin. Anteriorly it shows two angles, the inner and the outer orbital angles. The anterior margin of the carapace traverses the orbit: it runs from the inner orbital angle to the opening for the ophthalmic nerve and from there to the outer orbital angle. Between the ophthalmic opening and the outer angle it usually forms a lobe-like plate, the intercalated plate which grows out anteriorly and may even close the gap between the outer and inner orbital teeth, forming thereby part of the bottom of the orbit. Sometimes the orbit is open anteriorly and even ventrally. The inner orbital angle sometimes gives off a lobe which closes the orbit (e.g., in *Scyllarides squamosus*) or both orbi-



Figs. 2. Structure of a scyllarid orbit (schematic).

tal angles may overlap each other (e.g., in *Evibacus*). The genus *Scyllarus* is aberrant in that not the orbital angles or the intercalated plate close the orbit anteriorly, but the combined second and third antennal segments, which are immovably fused with the carapace. Aberrant also is *Thenus* in which the orbit is formed by a long and elongate horizontal depression at the anterior margin of the carapace, which extends from the submedian area of this margin to the anterolateral angle. The upper and lower margin are bent towards each other so that the lower covers the upper and they enclose a tube-like space. The orbit thereby becomes extremely elongate, which causes the basal segment of the eye to become very long, much longer than the distal segment which is of the normal shape.

The antennular somite usually is divided into two parts by a transverse groove. Behind the groove lies a usually narrow and transverse strip which is somewhat sunken into the anterior part of the carapace and encloses the base of the rostrum; sometimes it is divided in two halves by the rostrum. The anterior part is longer and divided in two halves by a longitudinal groove. In most genera it is longer than broad and ends in two strong teeth, which may be placed close together (*Parribacus*, *Scyllarides*, *Arctides*) or wider apart (*Thenus*, *Ibacus*); sometimes they end in blunt tops (*Evibacus*) or are wider than long with a distinct transverse anterior margin which may or may not bear teeth (*Scyllarus*).

The antennular peduncle consists of three slender, cylindrical segments which fold vertically in a zig-zag fashion. The two flagella are short.

The basal segment of the antennal peduncle is fused with the carapace; it is only visible ventrally. The second and third segments are fused to a single segment which is short and broad and may bear teeth on the anterior margin. In most genera this segment is free. In *Scyllarus*, however, it is immovably fused with the antennular somite and the carapace, thereby forming an integral part of the orbit. The fourth segment is large, broad and flat; it usually bears teeth on its margins. The fifth segment is narrow and small; it may bear teeth on the inner margin. The last segment of the antenna, which represents the flagellum, is very broad and flat, sometimes with teeth on the margin. This segment, together with the fourth, makes the antenna into a broad, shovel-like organ for which the vernacular names 'shovelnose shrimp' and 'bulldozer lobster' are given to species of this group.

The epistome may provide specific characters for the distinction of species; it may bear spines or teeth.

The mandible bears a palp (3-segmented in *Scyllarides* and *Arctides*; 2-segmented in *Parribacus*, 1-segmented in *Scyllarus*, *Thenus*, *Ibacus* and *Evibacus*). The maxillula has the laciniae elongate and bears a palp in

Scyllarides and *Arctides*. In the other genera this palp is absent. The maxilla consists of a large scaphognathite, a palp which ends in two lobes and also may show a longitudinal carina.

The first maxilliped possesses an exopod which in *Scyllarides*, *Arctides* and *Parribacus* bears a well-developed flagellum; in *Ibacus* and *Evibacus* the flagellum is short, in *Scyllarus* and *Thenus* no flagellum is present at all. The palp is present and the endites are usually bilobed. The second and third maxillipeds have a well-developed exopod with a multi-articulate flagellum in *Scyllarides*, *Arctides*, *Parribacus*, *Ibacus* and *Evibacus*; in *Thenus* and *Scyllarus* the flagellum of the second maxilliped is transformed to a broad and thin laminate segment, while in the third maxilliped it is entirely absent. The third maxilliped is slender and pediform. The branchial formula of all genera, with the exception of *Scyllarus*, is the following:

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	—	—	—	—	1	1	1	1
Arthrobranchs	—	1	2	2	2	2	2	—
Podobranchs	—	1	1	1	1	1	1	—
Epipods	1	1	1	1	1	1	1	—
Exopods	1	1	1	—	—	—	—	—

In *Scyllarus* the formula differs by that the second maxilliped does not have any branchiae.

The first four legs in both sexes and the fifth leg of the males end in simple dactyli and are not chelate. The females, except those of the genus *Thenus*, have the fifth legs chelate; in *Thenus* these legs are simple in both sexes.

The first abdominal somite bears no pleopods in either sex. A pair of pleopods is present on the second to fifth somites. The first pleopods of the male have the endo- and exopod well-developed, laminate, and of about equal shape, the endopod being somewhat longer than the exopod. The endopod may bear a stylamblys, but this may be indistinct or even absent. The following pleopods are smaller than the first, they become gradually smaller posteriorly; as a rule the endopod diminishes more strongly in size than the exopod. The first pleopods (i.e., the pleopods of the second abdominal somite) of the female have both endopod and exopod well developed, being of about equal size; they are much larger and broader than those of the male and also larger than those of the following pleopods; the endopod carries a very small stylamblys on the inner margin. In the following pleopods the propodite is strongly produced in the inner basal part, carrying the endopod at

the end of this prolongation. The endopod is much shorter than the exopod and carries near its top an elongate stylamblys which is far larger than that of the first pleopod. From the second to the fourth pleopods the exopod and endopod diminish in size, but the exopod more strongly so than the endopod.

Relationships. — The Scyllaridae form a sharply defined natural group, most closely related to the Palinuridae but quite distinct from that family. The short and flattened plate-like antennae of the Scyllaridae distinguish them immediately from the Palinuridae where the antennae are cylindrical with a long, stiff, multi-articulated flagellum.

Within the Scyllaridae four natural groupings can be recognized, which are here treated as subfamilies: the Ibacinae with the genera *Evibacus*, *Ibacus*, and *Parribacus*; the Arctidinae with the genera *Arctides* and *Scyllarides*; the Scyllarinae with the genus *Scyllarus*; and the Theninae with the genus *Thenus*. As two of these subfamilies are monotypic and the other two have only three and two genera respectively, I have hesitated rather long to elevate these groupings to the status of subfamilies. On the other hand, the differences separating the four are so important that the action seems fully justified.

History. — Aristotle in his *Historia Animalium* already mentioned a crustacean under the name 'arctus'; it is generally assumed that this is a Scyllarid, although the information offered by Aristotle is insufficient to prove this. In the oldest printed works dealing with marine animals (Belon, 1553; Rondelet, 1554) *Scyllarus arctus* and *Scyllarides latus* from the Mediterranean are well described and illustrated. In 1648 Marcgraf published the first account of an extra-european Scyllarid; he then namely described and figured a Brazilian specimen of *Parribacus antarcticus* which he indicated with the name Potiquixixé. The number of species to become known rapidly increased and when the 10th edition of Linnaeus's *Systema Naturae* appeared in 1758, the following species had been published upon: *Scyllarus arctus*, *Scyllarides aequinoctialis*, *S. latus*, *Parribacus antarcticus*, and *Thenus orientalis*. All these species were united by Linnaeus (1758) into a single one which he named *Cancer arctus*. In 1775 Fabricius erected the genus *Scyllarus*, splitting it off from Linnaeus's genus *Cancer*. The number of recognized species soon increased, so Lund (1793) described *S. antarcticus*, *S. orientalis* and *S. aequinoctialis*, Spengler (1799) introduced *S. guineensis* and Latreille (1803) *S. latus*. In 1815 Leach erected the new genera *Ibacus* and *Thenus*, and when H. Milne Edwards in 1837 revised the Crustacea, he recognized the three genera *Scyllarus*, *Thenus*, and *Ibacus*, placing 10 species in them. The genus *Scyllarus* was divided by H. Milne Edwards into two groups corresponding with the modern *Scyllarus* and *Scyllarides*. For his classification Milne Edwards relied largely on characters offered by the shape of the carapace. De Haan (1833-1850), bas-

ing himself almost exclusively on characters derived from the branchial arrangement and the mouthparts, distinguished five groups which correspond with the genera *Scyllarides*, *Parribacus*, *Ibacus*, *Thenus* and *Scyllarus*; at first (1841) De Haan considered these groups to be subgenera of the genus *Scyllarus*, later (1849) he treated them as full genera, reserving the name *Scyllarus* for *Scyllarides* and using that of *Arctus* for the true *Scyllarus*. *Parribacus* and *Ibacus* were indicated by him as *Ibacus* A and *Ibacus* B respectively. Dana (1852) adopted De Haan's classification and introduced the name *Parribacus* for *Ibacus* A. Evidently without knowledge of the existence of *Arctus* De Haan, Dana proposed the same generic name for the same genus. Later zoologists added new species to the genera *Scyllarides*, *Ibacus*, and especially *Scyllarus*, while the new genus *Evibacus* was erected in 1869 by S. I. Smith. Several of the post-larval stages were described as new genera (*Pseudibacus*, *Nisto*), which thanks to the work of Bouvier (1913-1917) were reduced to their proper place in synonymy. De Man (1916) gave an enumeration of all the species of the family known to him; he listed eight genera (including the larval genera *Nisto* and *Pseudibacus*), 45 species and three subspecies. Since that time a number of species and subspecies have been reduced to the synonymy of others and a number of new species were added. In the present paper seven genera are recognized in which more than 60 species are placed. The taxonomy of the family was placed on a solid basis by H. Milne Edwards (1837) and De Haan (1833-1850) and although some genera and numerous species have been discovered since, their arrangement can be adopted without major changes.

The seven genera that are recognized here, can be identified with the help of the following key:

1. Exopods of all maxillipeds with a multi-articulate flagellum 2
- Exopod of third and first maxilliped without a flagellum; the flagellum of the second maxilliped transformed to a single laminate segment 5
2. Carapace strongly depressed, with a deep cervical incision in the lateral margin. Mandible with a simple or two-segmented palp (subfamily *Ibacinae*) 3
- Carapace rather highly vaulted, with a small, shallow cervical incision, which may be lacking altogether. Mandible with a three-segmented palp (subfamily *Arctidinae*) 6
3. Orbits entirely closed, placed behind the anterior margin of the carapace. Cervical incision closed. Carapace with a posteromedian tooth. Fifth abdominal somite in the adults without posteromedian spine. Body smooth and tuberculate. East Pacific *Evibacus*

- Orbits anteriorly open, placed on the anterior margin of the carapace. Cervical incision usually open, at least at the base. Carapace without posteromedian tooth. Atlantic and Indo-West Pacific 4
- 4. Dorsal surface of the body smooth and punctate, not tuberculate, sometimes pubescent. Carapace with postrostral and branchial carinae distinct. Distance between the orbits as long as or shorter than the distance separating each orbit from the nearest anterolateral angle. Fifth abdominal somite with posteromedian spine. Mandibular palp consisting of a single segment *Ibacus*
- Dorsal surface of the body coarsely squamose-tuberculate, without postrostral or branchial ridges. Distance between the orbits more than twice as long as the distance between each orbit and the anterolateral angle of the carapace. Fifth abdominal somite without posteromedian spine. Mandibular palp two-segmented *Parribacus*
- 5. Orbits on the anterolateral angle of the carapace. Body strongly depressed. Lateral margin of the carapace with only the cervical incision. No teeth on the lateral margin of the carapace, apart from the anterolateral and postcervical. Fifth leg of female without a chela (subfamily Theninae) *Thenus*
- Orbits on the anterior margin of the carapace, some distance from the anterolateral angle. Body not depressed, but rather high and vaulted. Lateral margin of the carapace with both cervical and postcervical incisions, neither of which is very deep. Lateral margin of the carapace with numerous teeth or squamiform tubercles. Fifth leg of female with a chela (subfamily Scyllarinae) *Scyllarus*
- 6. First abdominal somite without a transverse groove dorsally; it is smooth there and shows a pattern of coloured spots. Orbits closed in the lower half of the anterior part, either by the intercalated plate or by a lobe from the inner orbital angle. Carapace without postorbital spine. Apart from a median ridge, the abdomen shows no dorsal sculpturation *Scyllarides*
- First abdominal somite with a distinct transverse groove dorsally. Orbits open anteriorly, intercalated plate very poorly developed or absent. Carapace with postorbital spine. Abdominal somites with a distinct sculpturation on either side of the median line *Arctides*

SUBFAMILY IBACINAE NOV.

Body flattened and strongly depressed. Eyes short, implanted in orbits on the anterior margin of the carapace at a considerable distance from the ante-

rolateral angle. Cervical incision very deep, no postcervical incision; lateral margin behind cervical incision with several distinct teeth. No postorbital spine on carapace. Mandible with a single or a two-segmented palp. Exopods of all maxillipeds with a multi-articulated flagellum. Fifth leg of female with a chela.

Apart from the type genus *Ibacus* Leach, the present new subfamily includes the genera *Evibacus* Smith and *Parribacus* Dana.

***Evibacus* Smith, 1869**

Evibacus Smith, 1869, Amer. Journ. Sci. (2) 48: 118. Type species by monotypy: *Evibacus princeps* Smith, 1869. Gender: masculine.

Evibaccus Nobili, 1901, Boll. Mus. Zool. Anat. comp. Torino 16(415): 8. Erroneous spelling of *Evibacus* Smith, 1869.

Diagnosis. — The carapace is flattened, with a deep, closed cervical incision in the anterior part of the lateral margin, but without postcervical incision. The orbits are closed, and lie behind the anterior margin of the carapace. The distance between the orbit and the nearest anterolateral angle of the carapace is somewhat more than half the distance between the two orbits. The lateral margin of the carapace is irregularly serrate, the teeth being small and shallow. The upper surface of the carapace is regularly tuberculate, the tubercles being low and rounded. A cervical groove is present, while behind and parallel to the cervical incision a postcervical groove is visible, often indistinctly so. The postrostral and branchial ridges of the carapace are present. The postrostral bears five large teeth (the rostral, pregastric, gastric, cardiac and posteromedian); in large specimens these ridges are indistinct but the teeth remain conspicuous.

The transverse groove on the first somite of the abdomen is only visible in its extreme lateral parts, the larger part of the somite is smooth. The second to fifth somites have a median carina. The fifth somite has no posteromedian spine in adults, but such a spine is shown in the juveniles. The pleura of the somites are elongate triangular.

The antennular somite is almost as long as broad and ends in two blunt points, which are placed close together near the median line. The last segment of the antennae bears some distinct teeth on the inner margin, the outer margin is crenulate or provided with small, shallow teeth.

The epistome bears no teeth or spines. It only shows three incisions, one median and one on each side near the base of the antenna.

The mouthparts are similar to those of *Ibacus*. The exopod of the third

maxilliped bears a flagellum. The merus of the maxilliped is swollen and shows deep incisions on the inner margin.

The branchial formula is normal.

Type species. — The type and only known species of *Evibacus* is *Evibacus princeps* Smith, which occurs on the west coast of America between Lower California and Peru.

Remarks. — Miers's (1882: 543) supposition that the present genus might be identical with *Pseudibacus* Guérin-Méneville, 1855, is not correct. The latter genus is based on juvenile stages of the genus *Scyllarides* Gill, 1898.

***Evibacus princeps* Smith, 1869**

(figs. 3, 4)

Evibacus princeps Smith, 1869: 119; Smith, 1869a: 229; Miers, 1882: 543; De Man, 1916: 66; Steinbeck & Ricketts, 1941: 449, pl. 21 fig. 1; Bott, 1955: 46, pl. 3 fig. 2; Lindsay, 1964: 223; Butler & Pease, 1965: 12, 13, 15, 18, 19, 24, figs. 15, 21, 30-32; Pease, 1965: 6, fig. 9; Johnson, 1968: 98, figs. 1-29; Robertson, 1969: 311; Robertson, 1969a: 581; Bayer, Voss & Robins, 1970: A98, A230; Johnson, 1971b: 1, 3, 14, fig. 7, chart 12; Bullis & Klima, 1972: 170; Del Solar, 1972: 11; Brusca, 1973: 220; Johnson, 1974: 639; Johnson, 1975: 143, figs. 9-13; Luke, 1977: 20; Brusca, 1980: 261; Van der Heiden & Hendrickx, 1982: 57; Manning, 1982: 362.

Type locality: 'La Paz, Lower California', Mexico.

Evibacus Ortmann, 1898: 1138.

Evibaccus princeps Nobili, 1901: 8; Festa, 1909: 381; Rathbun, 1910: 603.

Ibacus sp. Chirichigno Fonseca, 1970: 23, fig. 40.

Ibacus sp. Del Solar, Blancas & Mayta, 1970: 20.

Evibacus princoes Scelzo, 1974: 9.

not *Evibacus* sp. Prasad, Tampi & George, 1980: 96.

Vernacular names. — Langosta de arena (= Sand lobster) (México, also as Langosta de arena: Steinbeck & Ricketts, 1941; Brusca, 1973, 1980; field note on specimen from Pichilínque in USNM; Costa Rica, El Salvador, Guatemala: Manning, 1982), Zapatera (= shoemaker) (México: Steinbeck & Ricketts, 1941; Brusca, 1973, 1980), Flat lobster, Boot lobster, Slipper lobster (México: Brusca, 1973, 1980), Sand lobster (México, Panamá: Butler & Pease, 1965; Pease, 1965; Bullis & Klima, 1972; Brusca, 1973, 1980), Langosta china (Panamá: Manning, 1982), Chinese lobster (Panamá: Butler & Pease, 1965), Pacific sand lobster (Panamá: Butler & Pease, 1965; Pease, 1965), Langosta chata, Langosta filipina (Perú: Chirichigno, 1970; Manning, 1982). FAO names (Manning, 1982): Cigarro chato (Spanish), Cigale écusson (French), Shield slipper lobster (English). The names Rock lobster, Shovel lobster, Spanish lobster, and Bulldozer also mentioned by Butler & Pease (1965), evidently refer to *Scyllarids* in general.

Material examined. — México: West coast of México (received February 1887, 1 ♂, USNM); off Cape San Lucas, Baja California (6 August 1932, Templeton Crocker Expedition, 1 juvenile, USNM); Pichilínque, La Paz Bay, Baja California (26 May 1917, C. Nuñez, 1 ♂, USNM); Gulf of California (received November 1965, 1 ♀, RMNH); Bahía de San Jorge, Sonora, 31° 00'N 113° 12'W (from shrimp trawler, 27 May 1967, B. Burch, 2 ♀ (1 ovigerous), USNM); Tepoca Bay, Sonora (20-22 m, 4 February 1940, "Velero" Sta. 1078-40, 1 juv., AHF); off Punta Piaxtla, Sinaloa, 23°35.2'N 106° 53.5'W — 23°33.7'N 106°52.6'W (44-48 m, 13 May 1959, "Velero" Sta. B II-33, 1 juvenile, AHF); off San Blas, Navarit, 21°50'N 106°09.4'W — 21°

52.2°N 106° 12.12'W (55 m, 13 May 1959, "Velero" Sta. B II-39, 1 postlarva, AHF); Tenacatita Bay, Jalisco (night light, plankton, 9 December 1931, "Velero" Sta. 2-31, 2 postlarvae, AHF).

El Salvador: La Barra de Santiago, dept. Ahuachapán, 13°42.5'N 90°2'W (26 September 1979, El Salvador Peace Corps, Sta. KD 1952-2, 1 ♀, USNM); Los Blancos, 13°20'N 88°59'W (24 m, 4 September 1978, El Salvador Peace Corps, Cr. 45, 1 ♂, USNM).

Costa Rica: Salinas Bay, channel near island (15 m, mud, 2 February 1935, Allan Hancock Expedition Sta. 476-35, 1 juvenile, USNM); Puerto Culebra (5 March 1910, J. Oestmann, 1 ♂, 1 ♀, ZMH).

Panamá: near Parida Island, Chiriqui Gulf, 8°08'N 82°17'W (5-7 fathoms (= 9-13 m), 40' flat trawl, 22 and 23 March 1963, "Pelican" Sta. 616 and 633, 3 ♂, USNM); near Coiba Island, 7°18'N 81°48'W (1 fathom (= 1.8 m), in lobsterpots, 7-14 November 1962, "Pelican" Sta. 166, 1 ♂, USNM); west side of Gulf of Panamá, 20 miles east of Punta Mala (50 fathoms (= 91 m), 14 September 1972, trawler "Canopus" Sta. MACI/FAO 196, 1 ♀, RMNH); Farallon Beach near Rio Hato, 8°20'N 80°10'W (in gill net, 10 November 1968, L. G. Abele, 1 ♂, 3 ♀ (1 ovigerous), RMNH); Gulf of Panamá, 8°54'N 79° 33.5'W (6-8 fathoms (= 11-15 m), in lobster pots, 12-16 October 1962, "Pelican" Sta. 124, 1 ovigerous ♀, USNM); 8°21'N 78° 49.5'W (6-8 fathoms (= 11-15m), in lobster traps, 7 December 1962, "Pelican" Sta. 200, 1 ♂, RMNH); Taboga Island (4-5 fathoms (= 7-9 m), sand, stones, dredged, 8 February 1916, Th. Mortensen, 1 juv., UZM); fish market Panamá City (12 May 1967, "J. E. Pillsbury" Sta. 567, 1 ♂, IMS); Isla San José, Archipiélago de las Perlas, Gulf of Panamá (21 fathoms (= 38 m), 17 June 1964, L. G. Abele, 1 ♂, RMNH); Archipiélago de las Perlas, Gulf of Panamá (December 1969, L. G. Abele, 3 juv. ♂, RMNH); 7°33'N 78°11'15"W (22 m, 8 August 1967, Shimada, I. O. Canal Co., 2 ♂, USNM).

Perú: Mancora, S. of Tumbes, N. Perú (received 1956; W. K. Weyrauch, 1 ♀, RMNH).

Description. — The dorsal surface of the carapace of the adults is naked except in the grooves and along the anterior margin; in juveniles it may bear scattered hairs. The surface itself is covered with numerous rounded but flattened tubercles; in the early postlarvae the surface is smooth and shiny. The orbits are entire and fully enclosed in the adults, in the juveniles and postlarvae they are open anteriorly, the gap being closed by the second and third antennal segments. The outer orbital angle is rounded and touches the inner orbital margin. The anterior margin of the carapace to the sides of the orbits is slightly serrate. In large specimens the anterolateral angle of the carapace, which is directed obliquely forward, does not reach the general outline of the animal, in small specimens it may reach beyond the lateral margin. In the postlarvae the contour of the carapace and antennae is almost a perfect circle. The deep cervical incision is closed. In the adults the lower margin of the incision is much longer than the upper. The lateral margin of the carapace shows no larger teeth before the cervical incision, behind it is irregularly serrate; about 10 to 13 of the teeth of this serration are larger than the others. These larger teeth, though broad, still are very shallow; their tips are sharp and of a dark colour in the adults, uncoloured in the juveniles. The cervical groove is quite distinct, as are, to a lesser degree, the branchiocardiac grooves. Behind the cervical incision a faint indication of a postcervical groove is visible. There are the same dorsal carinae on the carapace as in *Ibacus*; they are very indis-

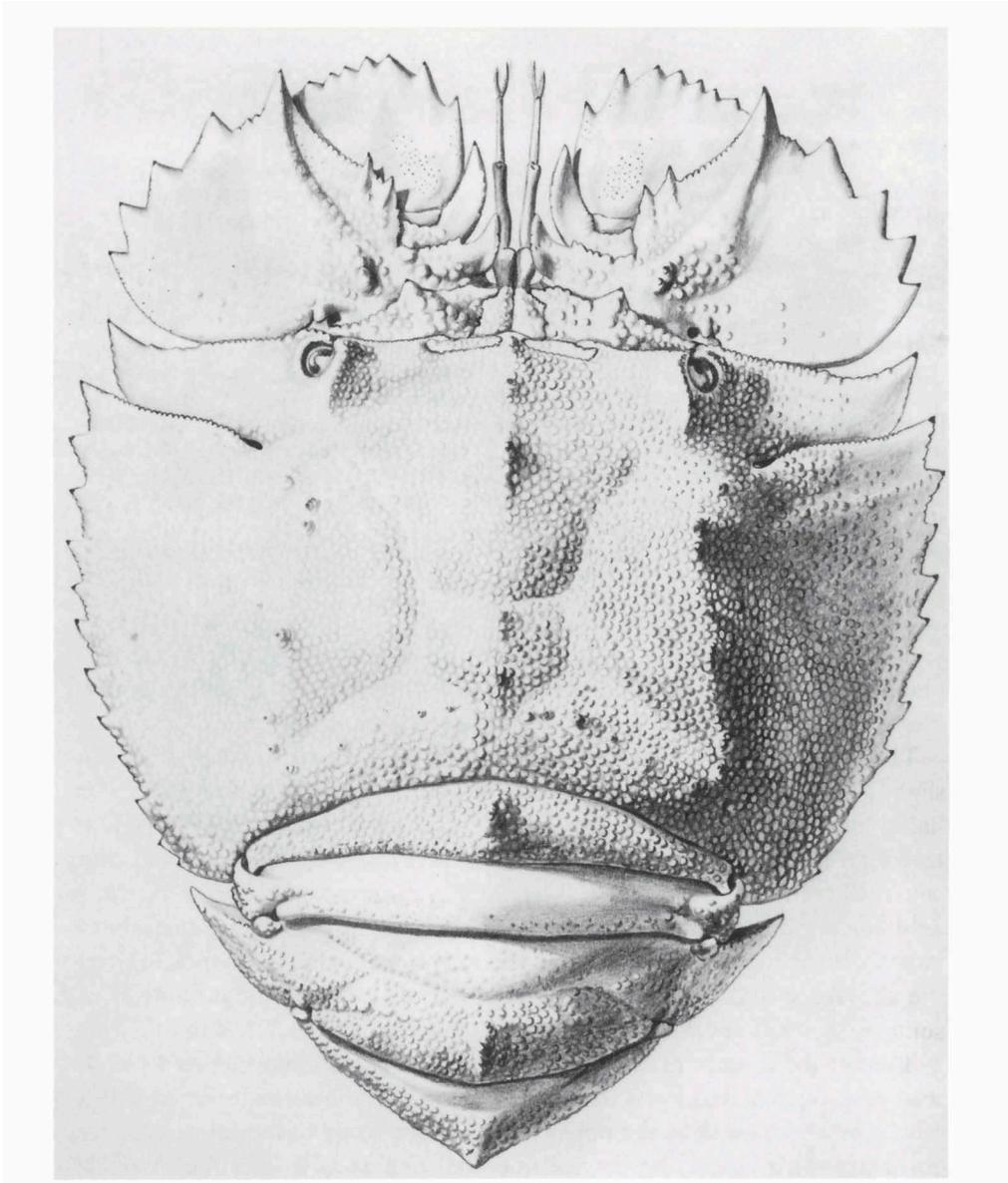


Fig. 3. *Evibacus princeps* Smith. Dorsal view of female from Mancora, Peru. $\times 0.9$.

tinct in the large specimens. The postrostral and branchial carinae each carry a row of dark-tipped tubercles. In juvenile specimens these tubercles have the shape of true teeth. The tubercles of the postrostral carina are five in number,

the rostral, pregastric, gastric, cardiac and posteromedian. In the postlarvae the pregastric tooth is obscure. On each posterior branchial ridge there is a row of three or four tubercles. Just before and parallel to the marginal groove there is a transverse row of tubercles.

The abdomen shows the same general tuberculation as the carapace. The tubercles on the median carina of the second to fourth somites are larger and higher than the other tubercles. In the large specimens the median carinae are extremely indistinct and the tubercles have dark-coloured apices. In young specimens the median carinae are quite distinct, while furthermore there are two oblique carinae extending from the base of the pleura inward and forward; these oblique carinae are not noticeable in the large specimens. The pleura are rather broad when compared to those of *Ibacus*, they are elongate triangular and end in a sharp point which in the adults is of a dark colour. The posterior margin of the pleuron is convex; the anterior is concave or straight in the second, practically straight in the third, and convex in the fourth and fifth somites. In the juveniles the pleura of the second and third somites have a low longitudinal tuberculated median carina, which is no longer visible in the large specimens, and also does not show in the early postlarvae. The sixth somite possesses no median carina. Its upper surface is evenly granular, the posterior margin bears several tubercles which, however, are not conspicuous.

The last (= sixth) segment of the antenna is about triangular. In adults it is slightly hairy dorsally and bears a conspicuous pubescent spot on the inner half of the lower surface. On its inner margin it bears two or three distinct teeth, the anterior margin is provided with five to seven broad, low teeth, which are rounded in the juvenile, pointed in the large specimens. The fifth segment is pubescent dorsally. The fourth segment ends in an anteriorly directed sharp point. The inner margin bears two spinous teeth in the basal part, the outer margin is provided with four teeth (the apex excluded); it bears some pubescence dorsally.

The epistome does not show any spines. It only bears three incisions, one median and one at each side near the base of the antenna.

The merus of the third maxilliped is broad and somewhat swollen. Its inner margin is divided into four broad, rounded lobes by three deep incisions, which reach almost to the middle of the segment. The outer margin bears four or five teeth, one or two of which may be very small. The inner margin of the ventral surface of the ischium is entire, the outer margin is provided with a few teeth. The anterolateral angle is pointed and reaches somewhat beyond the base of the merus. The basal segment of the exopod bears a few teeth on the lateral margin. A flagellum is present. In the postlarvae no incisions are visible in the third maxilliped.

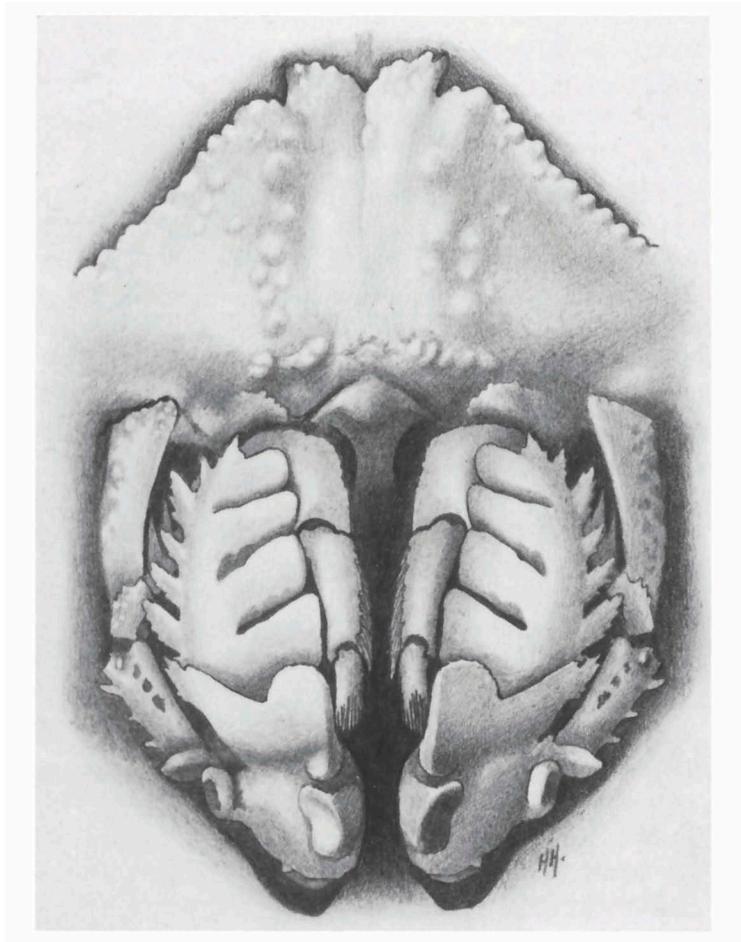


Fig. 4. *Evibacus princeps* Smith, female from Mancora, Peru. Oral field in ventral view. $\times 3.2$. H. Heijn del.

The pereiopods are rather short and heavy. The first is far more robust than the rest. The ischium shows no spines. The dactylus of the fourth and fifth pereiopods are strongly flattened dorsally; this is, though to a much lesser degree, also true for the third pereiopod. The propodus and carpus of the legs bear no carinae, but the carpus shows a faint longitudinal groove. The merus of the first leg possesses a high dorsal carina which ends in a sharp anterior tooth. The merus of the second leg has also a dorsal carina which ends rather abruptly at some distance before the anterior margin of the merus. In the third to fifth legs the merus bears no ridge.

The thoracic sternum is concave, it shows no median tubercles or spines,

but blunt knobs are present near the bases of the legs. The lateral margins of the second, third and fourth thoracic sternites show a blunt anterior lobe and a very slender posterior process. A pair of submedian spines is present on the last thoracic sternite of juvenile and postlarval specimens.

Colour. — In spirit specimens the colour has disappeared, but in the dry specimens from Pichilique (USNM) and the Gulf of California (RMNH), traces of the original pattern are still visible. The upper surface of the animal is pale reddish or greyish brown, becoming darker and of a more violet tinge on the antennae and the anterolateral region of the carapace. The teeth on the antennal segments and the lateral margin of the carapace and abdomen are strikingly pale with dark tips and dark bases. The legs, the underside of the antennae and that of the anterolateral angles of the carapace are pale with many rather large spots of the same colour as the upper surface of the antennae. Similar but far smaller spots are present on the rest of the lower surface of the thorax.

Size and weight. — The carapace length of the present specimens ranges between 10 and 125 mm. The ovigerous females examined have cl. 76, 85 and 125 mm. The carapace length of the postlarvae is 11 and 12 mm. In the literature specimens are reported with cl. 145 mm (the female holotype), 110 and 125 mm (Nobili's specimens), while Nobili (1901) mentioned a specimen of 230 mm total length (= cl. about 100 mm), which Ortmann had seen in the New York Museum. The specimen figured by Steinbeck & Ricketts (1941) (cl. ca. 32 mm) is evidently juvenile. Bott's (1955) specimens have cl. 52 and 80 mm. Butler & Pease (1965) reported their largest male to have cl. 108 mm, and the largest female had cl. 120 mm; they provided length and weight frequency curves of their material. Their largest male weighed 17 ounces, the largest female 25 ounces.

Distribution. — The species inhabits the west coast of America between Baja California, México and Perú. According to Nobili (1901: 8) Ortmann (1898: 1138) reported upon a specimen in the American Museum of Natural History in New York "proveniente dalla California". As, however, Ortmann (1898) actually gave as the locality of that specimen "Küste von Niedercalifornien", Nobili clearly made a mistake in writing California instead of Lower California (= Baja California, México), and consequently the species cannot be considered as part of the fauna of California proper. Steinbeck & Ricketts (1941: 449) mentioned the occurrence of the species in Perú; this evidently also is based on a mistake, as they cite Rathbun (1910) as their authority, while Rathbun did not include Perú in the range of the species. The reliable published locality records for the present species are: Baja California, México (Ortmann, 1898), La Paz, Baja California, S.W. coast of Gulf of California

(Smith, 1869), 400 miles N. of La Paz (Luke, 1977), Las Galeras, islets S.E. of Puerto Escondido, Baja California (Lindsay, 1964), Puerto Peñasco, Sonora, México, northern Gulf of California (Brusca, 1973, 1980), off Guaymas, Sonora (Steinbeck & Ricketts, 1941), southern Sinaloa, México (Van der Heiden & Hendrickx, 1982), Guatemala (Manning, 1982), El Salvador (Manning, 1982), La Libertad, El Salvador (Bott, 1955), Costa Rica (Manning, 1982), Panamá (Rathbun, 1910; Bayer, Voss & Robins, 1970; Manning, 1982), Gulf of Panamá (Butler & Pease, 1965; Pease, 1965; Bullis & Klima, 1972), Punta Santa Elena, Ecuador (Nobili, 1901), Perú (Manning, 1982), N. Perú (Chirichigno Fonseca, 1970), Caleta la Cruz, near Tumbes, Perú (Del Solar, Blancas & Mayta, 1970; Del Solar, 1972).

Habitat. — The species has been taken at depths between 2 and 90 m (= 1 to 50 fathoms); more than 2/3 of the records are from less than 25 m depth, the rest from between 38 and 90 m. The bottom from which the specimens were taken is variously described as mud, sand, sand and mud, sand and rocks, and rocks on silt bottom.

Biology. — A large female (cl. 115 mm) carried some five larger and smaller Balanids on the dorsal surface of the carapace, and a few small Lepadids on the legs and lower part of the thorax. Calcareous serpulid worms were found on the dorsal surface of the carapace of the two females (cl. 100 and 125 mm) from Bahía de San Jorge, México. A smaller male (cl. 47 mm) from Los Blancos, El Salvador, carried some hydroids dorsally on the carapace.

Development. — Johnson (1968, 1971b) described and figured the phyllosoma stages of the species, while the postlarva was described and figured by him later (Johnson, 1975). A larva from the Indian Ocean mentioned by Prasad, Tampi & George (1980) as *Evibacus* sp. most likely does not belong to the present genus, which has not been found outside the Eastern Pacific region.

Economic importance. — As the species is relatively large and of excellent taste, it is eaten, but its economic importance is small. It is consumed locally or offered for sale at local markets (e.g., in Panamá.). Exploratory trawling in the Gulf of Panamá showed the species to be present there in commercially interesting quantities (Butler & Pease, 1965; Pease, 1965; Bullis & Klima, 1972).

Ibacus Leach, 1815

- Ibacus* Leach, 1815 (1814-1817), Zool. Miscell. 2: 151. Type species, by monotypy: *Ibacus Peronii* Leach, 1815. Placed on the Official List of Generic Names in Zoology in Opinion 519 (Hemming, 1958, Opin. Decl. Int. Comm. zool. Nomencl. 19 (6): 136). Gender: masculine.
- Ibachus* H. Milne Edward 1837, 1840, Hist. nat. Crust. (atlas): 19 (1840), pl. 24 (1837). Erroneous spelling of *Ibacus* Leach, 1815.
- Ibaccus* Bate, 1888, Rep. Voy. Challenger, Zool. 24: ix, xi, xxi, xliv, liii, lviii, lxii, lxiii, lxxv, lxxxii, 56-58, 62-65, 72, 74, 98, 100, 101, 114, 934. Erroneous spelling of *Ibacus* Leach, 1815.
- Ibacus* Valdés Ragués, 1909, Mis Trabajos Acad.: 178. Erroneous spelling of *Ibacus* Leach, 1815.
- Ibbacus* Yoshida, 1941, Bull. Fish. Exper. Sta. Tyosen 7: pl. 9. Erroneous spelling of *Ibacus* Leach, 1815.
- Jabacus* Chekunova, 1971, Trudy VNIRO, Moscow 72: 82. Erroneous spelling of *Ibacus* Leach, 1815.
- Phacus* Anon., 1979, Zool. Record Crustacea 112 (10): 62. Erroneous spelling of *Ibacus* Leach, 1815.

Diagnosis. — The carapace is strongly dorso-ventrally flattened, with a deep, cervical incision in the anterior part of the lateral margin; this incision is usually open, only in *I. peronii* it is closed in its basal part. There is no postcervical incision. The orbits are open anteriorly and lie on the anterior margin of the carapace. The intercalated lobe is poorly developed. The distance between the orbits is as large as or smaller than the distance between the orbit and the anterolateral angle. The lateral margin of the carapace bears 6 to 19 posterolateral teeth. The upper surface of the carapace is pitted and not tuberculate; the postrostral and branchial carinae are distinct. The postrostral ridge may show pregastric, gastric, cardiac and intestinal teeth, but the rostral and posteromedian are absent in all species. The posterior branchial carinae are diverging posteriorly and start some distance behind the end of the anterior branchial carinae. The cervical groove is indistinct: from the end of the cervical incision it curves forward between the anterior and posterior branchial carinae and then again backward towards the postrostral carina. The postcervical groove is distinct in its posteromedian part, but is not visible behind the cervical incision. The branchiocardiac grooves are distinct. The anterior margin of the carapace and the anterior margin of the lateral teeth bear a fringe of long and soft setae.

The abdomen has a median carina on the second to fifth somites, that of the fifth ends in a spine. The pleura of these somites are elongate triangular and pointed. The transverse groove on the first abdominal somite is visible only in its extreme lateral parts, the larger part of the dorsal surface is smooth.

The antennular somite is slightly broader than long and ends in two strong teeth, which are distinctly separated. The last (= sixth) segment of the antenna bears teeth on the anterior margin, except in the males of some species (*I. ciliatus*, *I. brevipes*) where these teeth are reduced to shallow lobes.

The epistome bears two anterior submedian spines and usually one median spine or process.

The mandible bears a palp which consists of a single segment. No palp is present on the maxillula. In the first maxilliped the exopod bears a short multi-articulated flagellum. The exopod of the second and third maxillipeds is provided with a flagellum. The third maxilliped has the merus often swollen and deformed.

The branchial formula is normal, there are 21 branchia at each side.

The dactyli of the last three pairs of pereopods bear two rows of rather long hairs on the upper surface; such hairs are absent in the first two pairs. No carinae are present on the propodus or carpus of the legs, the carpus shows a longitudinal groove. The meri of the first two legs, but not those of the last three, have a dorsal carina. The propodus of the fifth pereopod of the female has a rather strong distoventral tooth, about half as long as the dactylus, which with the dactylus forms a chela.

The abdominal sternites do not have median spines. The pleopods of the second somite in the male have the endo- and exopod elongate ovate and of about the same size. The following pleopods diminish in size, the endopods more rapidly so than the exopods. In the females the pleopods are similar to those of females of *Parribacus*.

Remarks. — The genus contains six species, all of which occur in the Indo-West Pacific region; one of these species has also been reported from the Atlantic, but probably incorrectly so. Of one of the species two subspecies are recognized here.

KEY TO THE SPECIES OF THE GENUS *IBACUS*

1. Merus of third maxilliped swollen, often with a yellowish tinge, with deep incisions on the inner margin, several of which may reach beyond the middle of the merus 5
- Merus of the third maxilliped with the ventral surface slightly concave, not swollen, and not coloured differently from the other segments; inner margin sometimes crenulate but not with deep incisions 2
2. Anterior margin of the wide cervical incision of the carapace forming the posterior margin of the anterolateral angle of the carapace; the carapace shows no lateral margin between the anterolateral angle and the cervical incision. The carapace has seven to nine posterolateral teeth. Australia, New Zealand 3
- Anterior margin of the narrow cervical incision of the carapace reaching

- the lateral margin some distance behind the anterolateral angle. Part of the lateral margin of the carapace extends between the anterolateral angle and the cervical incision and bears some teeth there. The carapace bears 10 to 13 posterolateral teeth 4
3. Dorsal surface of the body with a short, woolly pubescence. Fourth segment of antenna slender, without lateral teeth, regularly narrowing from base to tip *I. alticrenatus*
- Dorsal surface of the body naked to the unaided eye, with microscopically small, scattered setae. Fourth segment of the antenna not slender, at first widening in a lateral direction before narrowing into the apex, with a distinct lateral margin that is provided with well-developed teeth *I. brucei*
4. Carapace of adult specimens naked. Lateral margin of carapace with 10 to 12, usually 11 posterolateral teeth *I. ciliatus ciliatus*
- Carapace of adult specimens with a thick cover of a velvety pubescence. Lateral margin of carapace with 11 to 13, usually 12 posterolateral teeth *I. ciliatus pubescens*
5. Lateral margin of carapace behind cervical incision with six to eight teeth. Merus of third maxilliped evenly swollen, most of the incisions of the inner margin reach beyond the middle of the segment; anterolateral angle of ischium reaching only slightly beyond the base of the merus ... 6
- Lateral margin of carapace behind cervical incision with 12 to 17 teeth. Merus of third maxilliped strongly swollen at the distal end, less so in the rest of its length; the incisions of the inner margin, though rather deep, not reaching the median line of the merus; anterolateral angle of ischium strongly produced, almost reaching halfway the length of the merus *I. brevipes*
6. Posterior branchial carinae of the carapace straight or only slightly convex, lying in one line with the anterior branchial carinae. Posterior incision of the orbit without an intercalated tubercle. Lateral margin of carapace with eight (rarely seven) posterolateral teeth. Anterior teeth of the epistome directed forwards *I. novemdentatus*
- Posterior branchial carinae of the carapace strongly convex, not lying in one line with the anterior branchial carinae. Posterior incision of the orbit with an intercalated tubercle. Lateral margin of carapace with six or seven, seldom eight, posterolateral teeth. Anterior teeth of epistome directed ventrally *I. peronii*

***Ibacus ciliatus ciliatus* (Von Siebold, 1824)**
(figs. 5-7)

Scyllarus Ciliatus Von Siebold, 1824: 15. Type locality: "Japonia", probably: Bay of Nagasaki, Japan. Lectotype (no. 969) in RMNH.

Scyllarus ciliatus Von Siebold, 1825: 87; Von Siebold, 1826: 19; De Haan, 1841: 153; De Haan, 1844: pls. J, L.

Ibacus ciliatus De Haan, 1841: pl. 36/37 fig. 2; White, 1847: 68; Von Siebold, 1850: xiii; Dana, 1852: 14; Dana, 1852a: 517; Whitelegge, 1890: 223; Ortman, 1891: 45; Bouvier, 1899: 175; Doflein, 1902: 643; Doflein, 1906: 197, 198, fig.; De Man, 1916: 65; Parisi, 1917: 12; Fisheries Society Japan, 1935: pl. 58 fig. 3; Holthuis, 1946: 101; Okada, 1951: 85; Kubo, 1954: 759, fig. 2189; Harada, 1958: 173, text-figs. 1, 2, pls. 9-11; Utinomi & Harada, 1958: 390; Estampador, 1959: 39; Yamaji, 1959: 23, fig.; Kubo, 1960: 98, pl. 49 fig. 8; Saisho & Nakahara, 1960: 84, fig. 1; Miyake, 1961: 9; Nishimura & Yamazaki, 1961: 281; Miyake, Sakai & Nishikawa, 1962: 124; Saisho, 1962: 174; Ikematsu, 1963: 10; Liu, 1963: 232; Shojima, 1963: 349, pl. 1; Bruce, 1965: 12; Chang, 1965: 45, fig.; Harada, 1965: 36, fig. 2a, b; Harada & Holthuis, 1965: 23, 25, text-fig. 2, pl. 7 figs. 3, 4; Kubo, 1965: 627, fig. 1021; Bruce, 1966: 163; Bruce, 1966a: 284; Dotsu, Seno & Inoue, 1966: 181, figs. 1-3, 5, 7, 10; Dotsu, Tanaka, Shojima & Seno, 1966: 195, text-figs. 1-3, 5-13, pl. 1, pl. 3 figs. 1-4; Saisho, 1966: 177, 194, fig. 2; Holthuis, 1967: 10, 16; Robertson, 1968a: 334; Holthuis & Sakai, 1970: 92, 98, 112, pl. 3; Nishimura & Suzuki, 1971: 89, pl. 30 fig. 1; Bardach, Ryther & McLarney, 1972: 647; Gurjanova, 1972: 76; Gurjanova & Phuong, 1972: 159; Kim & Park, 1972: 209; Motoh, 1972: 48, pl. 16 figs. 1, 2; Mistakidis, 1973: 19, 25; Shojima, 1973: 106, fig. 3; Burukovsky, 1974: 102; Motoh, 1974: 10, pl. 2 fig. 4; Miyake, 1975: 107, fig.; Polz, 1975: 42, figs. 2, 3; Kim, 1976: 147; Thampi, 1976: 560; Davidson, 1977: 141, 2 coloured figs. (one as unnumbered plate, the other on the dust cover); Kim, 1977: 333, 400, text-figs. 148, 149, pl. 35 fig. 73; Matsuzawa, 1977: pl. 75 figs. 2, 3; Kikuchi & Miyake, 1978: 25; Takahashi & Saisho, 1978: 305, text-figs. 1-12, pls. 1-3, pl. 6 fig. 3; Motoh & Kuronuma, 1980: 60, fig. 22; Phillips, Cobb & George, 1980: 62, 71; Van Olst, Carlberg & Hughes, 1980: 336; Phillips & Sastry, 1980: 29, 31, 39; Miyake, 1982: 86, pl. 29 fig. 4; Burukovsky, 1983: 143; Hwang & Yu, 1983: 262, fig. 1; Sakai & Nakano, 1983: 76.

Phyllosoma Guerini De Haan, 1849: 226, pl. 50 fig. 6; Herklots, 1861: 153; Bals, 1914: 80, fig. 44. Type locality: Japan, probably Bay of Nagasaki. Lectotype (no. 5588) in RMNH.

Scyllarus (Ibacus) Ciliatus Herklots, 1861: 142.

Ibacus pictus Vilanova y Pera, 1875: 380, fig. 306. Type locality: Japan.

Ibaccus ciliatus, Balss, 1914: 80, fig. 44; Maki & Tsuchiya, 1923: 89, pl. 8 fig. 1; Yosii, 1934: 168; Estampador, 1937: 495; Yoshida, 1941: 33, text-fig. 15, pl. 9 fig. 1; Okada, Taki, Sakai & Abe, 1958: 142, fig. 256.

Paribacus ciliatus Komai, Akatsuka & Ikari, 1927: 294; Komai & Ikari, 1929: 121.

Ibacus ciliata Yokoya, 1933: 48; Gurjanova & Phuong, 1972: 158.

Phyllosoma utivaebi Tokioka, 1954: 362, text-figs. 14, 15, pls. 41-43; Tokioka & Harada, 1963: 425, figs. 1-4. Type locality: shore near Seto Marine Laboratory, Seto near Tanabe, Japan.

"Crustaceans" Bartlett & Shohara, 1961: 422, fig. 128.

Ibacus ciliatus Holthuis, 1967: 7.

(Japanese name) Imajima, Umebayashi & Okutani, 1970: 29, fig.

Jabacus ciliatus Chekunova, 1971: 82.

not *Ibacus ciliatus* Guilding, 1825: 337 (= *Parribacus antarcticus*); Utinomi, 1956: 62, pl. 31 fig. 1 (= *Ibacus novemdeniatus*); Liu, 1976: 130, 131 (= *Thenus orientalis*, fide Phillips, Cobb & George, 1980: 62).

Vernacular names. — The official Japanese name for this species is "Utiwaebi" (see Fisheries Soc. Japan, 1935; Harada & Holthuis, 1965), also spelled "Uchiwa ebi" (Motoh, 1972). Already Von Siebold (1850: xiii) reported upon this name, which he spelled "Utsiwa jebi" and of which

he gave the Latin translation “*macrurus flabella*” (= fan lobster). Von Siebold (1850: xiii, xv) also mentioned the names “*Takuma jebi* (= *macrurus ursus major*)” and “*Kai rô* (= *senex maritimus*)”, meaning “big bear lobster” and “old man of the sea”, respectively. In Thailand the name “*Kong kradan deng*” is used (Davidson, 1977). In the Philippines the name “*Pitik-pitik*” is used in Ilongo and Cebuano, and that of “*Cupapa*” in Surigaonon (Motoh & Kuronuma, 1980). Vernacular names in non-latin characters are provided by Kim (1977: 333) for Korea, by Motoh (1974: 10) for Ishikawa prefecture, Japan, and by Chang (1965: 45) for Taiwan.

Material examined. — Japan, no further locality data: 1822-1824, P. F. von Siebold, 1 ♀ lectotype, 2 ♂, 3 ♀ (1 ovigerous) paralectotypes, RMNH, 1 ♀ paralectotype, USNM (all types of *Scyllarus ciliatus* Von Siebold); 1823-1834, P. F. von Siebold and H. Bürger, 2 ♂, 7 ♀, RMNH; 1825-1834, H. Bürger, 2 ♂, 7 ♀, RMNH; 1823-1834, P. F. von Siebold and H. Bürger, 1 lectotype, 3 paralectotypes of *Phyllosoma guerini* De Haan, RMNH: 1914. X.II.1-3, R. Gordon, 2 ♂, 1 ♀, BM; 94.7.8.3, 1 ♂, BM; 2 ♀, BM; received 19 December 1881, F. C. Dale, 1 ♀, USNM; 1 ♀, AM; 1898, leg. A. Boucard, 1 sp., MP; 1873-1876, F. Hilgendorf, 2 ♀, ZMB.

Japan, Honshu: Tokyo (as Jedo or Yedo, 1873-1874, F. Hilgendorf, 2 ♀ (1 ovigerous), ZMB); Sagami Bay (1911, A. Haberer, don. Mus. Munich, det. H. Balss, 1 ♂, UZM); Enoshima, W. of Kamakura, Sagami Bay (16 June 1906, H. Schoede, 3 juv., ZMB); Odawara, Atami District, Sagami Bay (April 1894, F. Sakamoto, 2 ♀, USNM); Kobe (1912, Gordon Smith, 1 ♀, ZMB).

Japan, Kyushu: Nagasaki (G. C. Berendt, 2 ♀, ZMB; June 1881, P. L. Jouy, 1 larva, USNM; James Jordan, rec. 1 July 1911, 1 juv. ♀, UZM; 1889, J. Böddinghaus, 2 ♂, 2 ♀, ZMH); Ozeaki Light, N 9°E 6.5 miles, Goto Islands, 32°30'10"N 128°34'40"E (139 fathoms (= 254 m), bottom gray sand and broken shells, 10 August 1906, “Albatross” Sta. D 4901, 1 ♀, USNM); Ozeaki Light N 27°E 6 miles, Goto Islands, 32°31'20"N 128°32'40"E (107 fathoms (= 196 m) bottom: fine gray sand and broken shells, 10 August 1906, “Albatross” Sta. D 4904, 1 juv. USNM); Chirin Shima beacon W. 2.3 miles, Kagoshima Gulf, 31°16'45"N 130°43'40"E (70 fathoms (= 128 m), 16 August 1906, “Albatross” Sta D 4938, 2 juv., USNM); Chirin Shima beacon S 27°W 2 miles, Kagoshima Gulf, 31°18'30"N 130°42'E (85 fathoms (= 155 m), 16 August 1906, “Albatross” Sta. D 4939, 5 juv. USNM, RMNH); Yamakawa, Kagoshima Gulf (14 June 1903, H. M. Smith, 1 juv. USNM).

China: without further locality indication (F. E. Guérin coll., don. T. B. Wilson, 1 ♀, ANS); Ningpo, Chekiang (1924, A. de C. Sowerby, 1 ♂, USNM); Canton (November 1873, leg. Dabry, 1 ♀, MP).

South China Sea: E. of Hongkong, 21°41'N 116°46'E (122 fathoms (= 223 m), sand and broken shells, 5 November 1908, “Albatross” Sta. D 5314, 1 ovigerous ♀, USNM); E. of Hongkong, 21°40'N 116°58'E (148 fathoms (= 271 m), bottom sand and shells, 5 November 1908, “Albatross” Sta. D 5315, 1 ♂, USNM); S. of Hongkong, 21°13.3'N 116°60.0'E – 21°16.2'N 116°01'E (132-150 fathoms (= 242-274 m), 2 August 1963, “Cape St. Mary” Cr. 2/63, St. 32, T. 14, A. J. Bruce, 1 juv., RMNH); East of Hainan, 19°35.0'N 112° 12.0'E (98-102 fathoms (= 179-187 m), 21 May 1961, S. C. Tung, 2 ♂, BM); E. of Hainan, 19°09'N 112°31'E (102-108 fathoms (= 187-198 m), prawn trawl, 22 July 1957, A. J. Bruce, 1 ♂ RMNH); S. of Hainan, 17°43.0'N 110°12.0'E-17°31.8'N 110°11.0'E (114-120 fathoms (= 209-220 m), bottom clay, 9 March 1965, “Cape St. Mary” Cr. 4/65, St. 49(12), T. 340, A. J. Bruce, 1 juv., RMNH); W. of Borneo, 2°51.5'N 110°16.8'E-2°51.0'N 110°17.0'E (26-27 fathoms (48-49 m), sandy mud, 16 November 1964, “Cape St. Mary” Cr. 7/64, St. 86, T. 267, A. J. Bruce, 1 juv., RMNH).

Philippines: Legaspi Light S 58° W 4.5 miles, S. E. Luzon, 13°12'N 123°49'18"E (146 fathoms (= 267 m), 7 June 1909, “Albatross” Sta. D 5453, 1 ♂, USNM); Dumalag Island S 65°W 4.5 miles, Gulf of Davao, Mindanao, 7°03'N 125°39'E (100 fathoms (= 183 m), bottom soft mud, 18 May 1908, “Albatross” Sta. D5255, 1 juvenile, USNM); Dumalag Island S 78°W 3.8 miles, Gulf of Davao, 7°02'N 125°38'45"E (135 fathoms (= 247 m), bottom mud, 18 May 1908, “Albatross” Sta. D 5247, 1 ♂, 1 ♀, USNM).

Description. — The carapace is naked and has the surface coarsely pitted.

In adult specimens no hairs are visible on the dorsal surface, but in juveniles the carapace may be pubescent (e.g. in the specimens from "Albatross" Sta. 4938 and 4939). The orbits have two sharp teeth on the inner angle and one on the outer; no other teeth are present. The outer tooth is curved inwards and bears no denticles on the anterior margin. The posterior part of the orbital margin shows a broad, quadrangular incision, in which there is no tubercle. Between the orbit and the anterolateral angle the anterior margin of the carapace is provided with a number (about ten) distinct teeth. On the lateral margin of the carapace there are two to five, usually four, seldom one or six smallish anterolateral teeth. Usually the toothed anterolateral margin is clearly set off from the cervical incision. There are as a rule eleven posterolateral teeth (in the specimens examined there were ten posterolateral teeth in eight cases, 11 in 37 cases, 12 in five cases, and 18 in one case).

The postrostral carina of the carapace is so obscure as to be practically non-existent. In its anterior part it shows very faint indications of pregastric, gastric, cardiac and intestinal teeth, but these are mere elevations, usually hardly set off from the carina, the gastric tooth being faintest of all. The anterior branchial carinae gradually fade away posteriorly and disappear at the cervical groove. The posterior branchial carinae are straight or slightly concave, they diverge posteriorly and lie in one line with the short anterior branchial carinae. Between the postrostral and the branchial carinae the carapace is slightly concave, and there is a faint branchiocardiac groove.

The abdominal somites are punctate, in the adults they are naked. The median carinae of the third to fifth somites are low, that of the second somite is more strongly set off. The posterior margin of the pleuron of the fourth and sometimes also that of the third somite bears one or more teeth. The pleuron of the fifth somite is broader, the posterior margin is convex and provided with many distinct teeth. The posterior margins of both the fifth and sixth somites bear teeth. The upper surface of the sixth somite is smooth or bears a few inconspicuous tubercles which may be arranged in a transverse median row.

The last segment of the antenna has the upper surface pubescent, very strongly so in the male. Its anterior margin bears eight to eleven, usually nine, teeth, five to seven (usually six) are large, two to six (usually three) are much smaller. In the very large males the teeth are short, broad and blunt, so that the anterior margin of the segment forms an undulating line; the inner teeth are the last to become blunt. This change of the dentition takes place in males with the carapace more than 50 mm long. The fourth segment of the antenna has the anterior margin with a number of teeth (about ten). The lateral margin of this segment bears four to six, rarely three and usually four, teeth, two

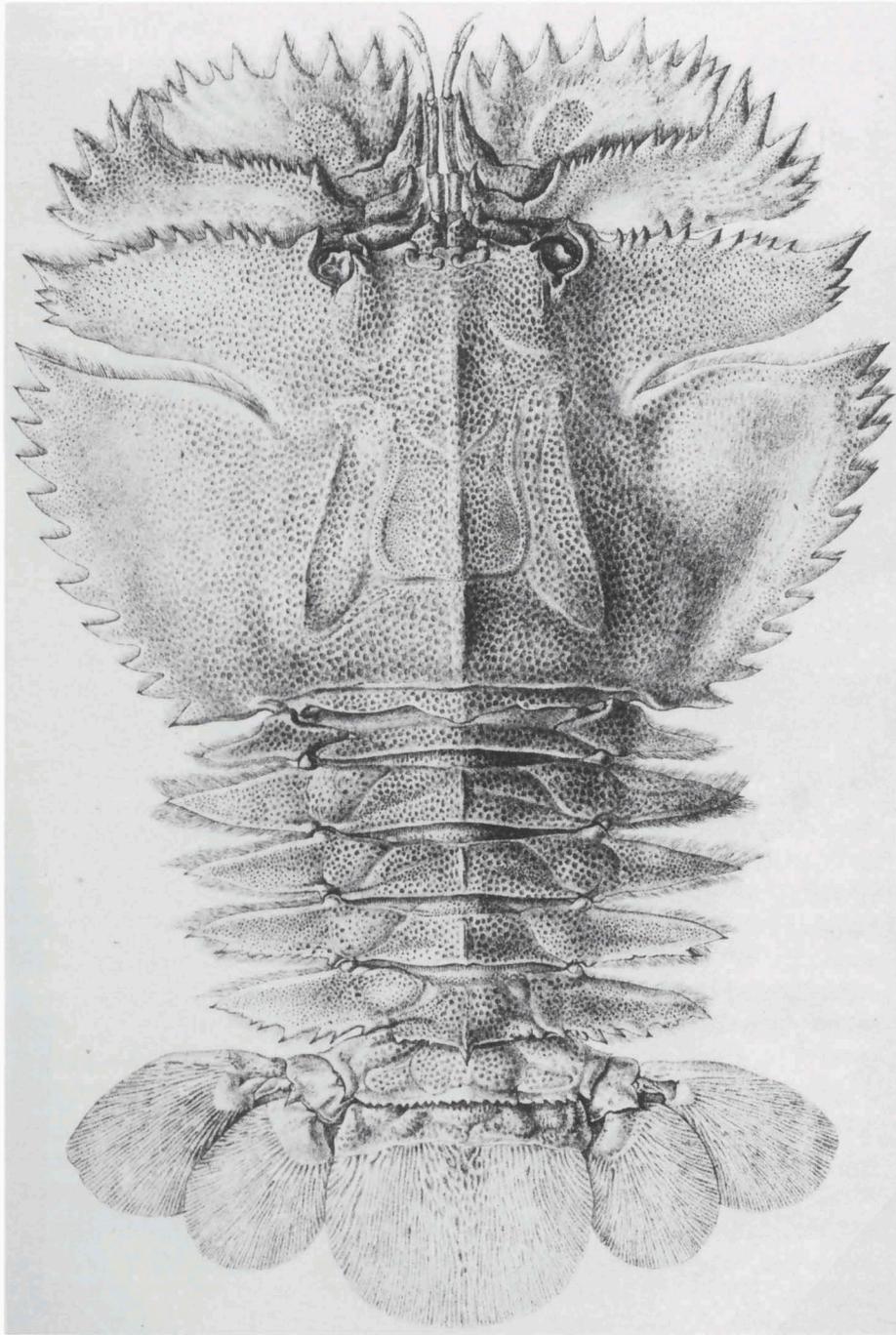


Fig. 5. *Ibacus c. ciliatus* (Von Siebold). Male from Japan, in dorsal view. After De Haan, 1841.

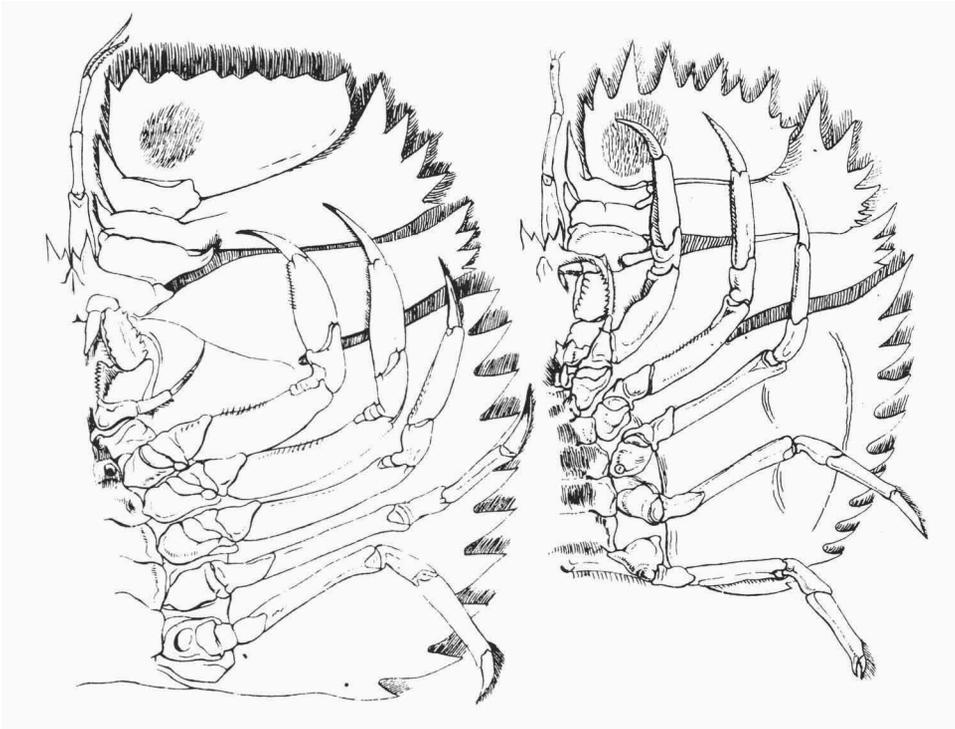


Fig. 6. *Ibacus c. ciliatus* (Von Siebold), left half of thorax in ventral view, specimens from Japan. Left, male; right, female. After De Haan, 1841.

to four (rarely five, usually three) of which are large, one to three (usually one) being smaller.

The epistome ends in two triangular, sharp teeth which are directed forward and diverge; the inner side of the base of each of these teeth is usually provided with a small additional tooth. The teeth lie in the same plane as the ventral surface of the epistome. Slightly behind these teeth the epistome shows a strongly elevated, short, longitudinal ridge which has a semicircular outline or ends in an anteriorly directed spine.

The merus of the third maxilliped has the ventral surface flattened or somewhat concave, it is not swollen. The inner margin is crenulate but shows no deep incisions, the outer margin is denticulate and winged. The outer and inner margins of the ischium show some faint, shallow teeth or lobes. The outer margin is winged and projects beyond the outer margin of the merus. The anterolateral angle of the ischium is broadly rounded and only slightly overreaches the base of the merus. A row of slender spinules is present on the outer margin of the basal segment of the exopod.

The pereiopods are slender. The inner margin of the segments bear stiff hairs. The ischium bears no spines or teeth.

Colour. — The colour of the species was described by De Haan (1841: 154) as follows: “color in vivis purpureo-rubens, punctis minimis caeruleis, pagina inferiore alba, appendicibus caudalibus pedibusque rubellis”. This description is clearly based on a coloured figure and a colour description of the species which were sent by H. Bürger to De Haan. Bürger’s coloured plate, which was painted by Kawahara Keiga, has been published by Holthuis & Sakai (1970: pl. 3); these two authors also cited verbatim Bürger’s Dutch colour description, of which they provided an English translation. Bürger’s manuscript and paintings at present are in the Rijksmuseum van Natuurlijke Historie, Leiden. Vilanova y Piera (1875) gave the colour as: “rojo, moteado de azul”,

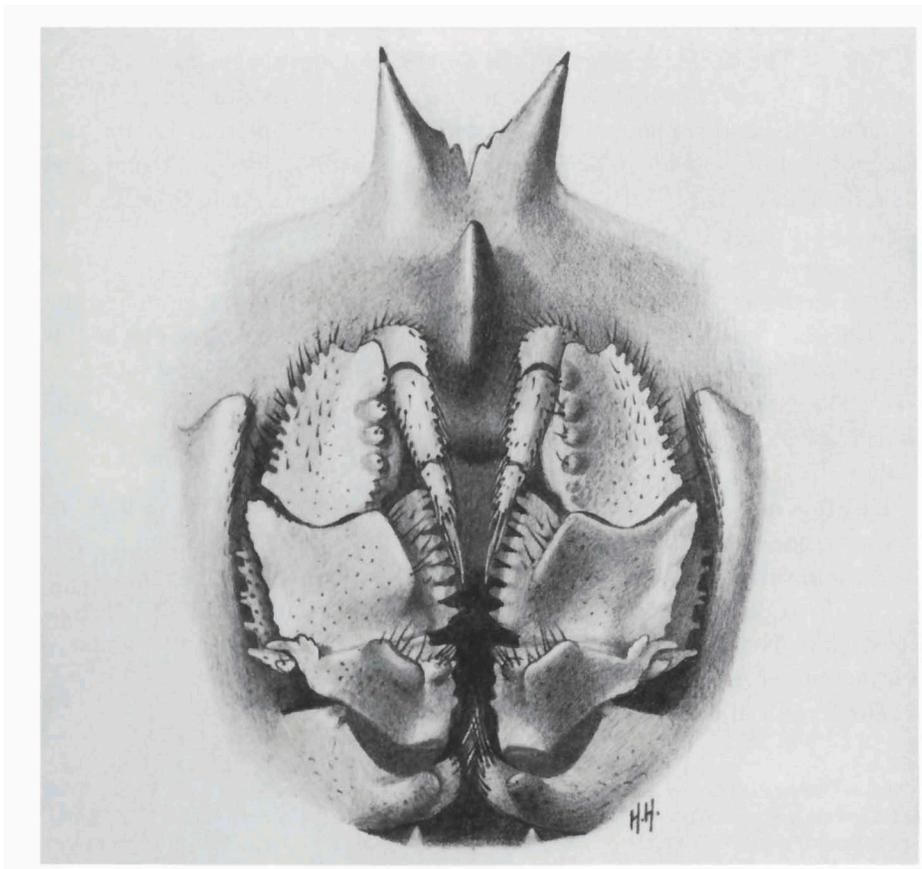


Fig. 7. *Ibacus c. ciliatus* (Von Siebold), specimen from Japan. Oral field in ventral view. H. Heijn del.

while Fisher. Soc. Japan (1935) described it as "faintly reddish". Chang (1965) gave the colour as "dark brown". Harada & Holthuis (1965) stated the living animals to be "generally toned with reddish pink". while Motoh & Kuronuma (1980) described them as "toned with reddish brown". Coloured illustrations of the species have been published by Fisher. Soc. Japan (1935: pl. 58), Okada, Taki, Sakai & Abe (1958: fig. 256), Kubo (1960: pl. 49 fig. 8), Holthuis & Sakai (1970: pl. 3), Nishimura & Suzuki (1971: pl. 30 fig. 1), Miyake (1975: 107), Davidson (1977: unnumbered pl., and front of dust cover), Kim (1977: pl. 35), Matsuzawa (1977: pl. 75 fig. 2), Motoh & Kuronuma (1980: pl. 22) and Miyake (1982: pl. 29 fig. 4); these figures show the dorsal surface of the body of a rather uniformly reddish colour with the tailfan more yellowish or brownish. The red colour can be pink, brick red, purplish red to almost purple, brownish red to pale brownish, sometimes with minute lighter, often bluish, spots.

Size. — The carapace length in the examined males ranges from 43 to 76 mm, in the females from 42 to 80 mm; two ovigerous females had cl. 60 and 80 mm. The carapace length in the juveniles ranged from 16 to 33 mm. Harada & Holthuis (1965) reported upon males with cl. 45 to 62 mm, and females with cl. 47 to 57 mm; Hwang & Yu (1983) had a male from Taiwan with cl. 40 mm, tl. 115 mm.

The size of the first stage phyllosoma is about 3 mm (Saisho, 1966), in the fourth stage the body length has already doubled. The later stages are often indicated as "giant phyllosomas" measuring up to 37.5 mm. Tokioka & Harada (1963) reported upon larvae up to 33 mm long. The type of *Phyllosoma guerini* was said by De Haan (1849) to measure 1½ inch, about 37.5 mm, which checks well with the largest extant type specimen, which reaches a length of 36 mm.

Distribution. — In Japan the species reaches the northern limit of its known range of distribution, namely at Tokyo Bay (about 35.5°N) on the east coast, and Niigata (about 38°N) on the west coast. On the continent it is known from the south coast of Korea (Korea Strait) south along the Chinese coast from Ningpo to Hainan, from the South China Sea and Thailand. Furthermore from Taiwan and the east coast of the Philippines.

The records in the literature are the following:

Japan (Von Siebold, 1824, 1825, 1826; De Haan, 1841-1849; White, 1847; Herklots, 1861; Vilanova y Piera, 1875; Bouvier, 1899; Fisher. Soc. Japan, 1935; Holthuis, 1946; Kubo, 1954; Okada, Taki, Sakai & Abe, 1958; Kubo, 1960; Harada, 1965; Harada & Holthuis, 1965; Kubo, 1965; Saisho, 1966; Nishimura & Suzuki, 1971; Miyake, 1975, 1982); Japan Sea off Niigata, west coast of Honshu (Nishimura & Yamazaki, 1961; Miyake, Sakai & Nishikawa, 1962); Toyama, west coast of Honshu (Miyake, Sakai & Nishikawa, 1962); Toyama Bay, Ishikawa-ken (Motoh, 1972); Tokyo Bay, Honshu (Ortmann, 1891; Doflein, 1902); Yokohama and Negishi, Tokyo Bay

(Parisi, 1917); Sagami Bay, Honshu (Doflein, 1902, 1906; Parisi, 1917); Misaki, Sagami Bay (Balss, 1914; Parisi, 1917; Yosii, 1934); Enoshima, Sagami Bay (Parisi, 1917); mouth of Fujikawa River, Suruga Bay, Honshu (Parisi, 1917); south of Maisaka near Shimizu, Sizuoka-ken, Suruga Bay (Yokoya, 1933); Mie-ken, Honshu (Okada, 1951; Sakai & Nagano, 1983); near Owase, Mie-ken (Yokoya, 1933); off Minabe, Wakayama-ken, Honshu (Harada & Holthuis, 1965); near Seto near Tanabe, Wakayama-ken (Komai, Akatsuka & Ikari, 1927; Komai & Ikari, 1929; Tokioka, 1954; Harada, 1958; Tokioka & Harada, 1963); off Kii Peninsula, Wakayama-ken, 33°40.0'N 135° 12.2'E, 33°41.1'N 135° 10.2'E, and 33°39.7'N 135° 9.7' E (Utinomi & Harada, 1958; Harada, 1965); Muroto, Shikoku (Matsuzawa, 1977); S. of Kochi, Shikoku (Yokoya, 1933); west of Kagoshima-ken, Kyushu (Yokoya, 1933); Amakusa, Kumamoto-ken, Kyushu (Miyake, 1961; Miyake, Sakai & Nishikawa, 1962; Ikematsu, 1963; Kikuchi & Miyake, 1978); Bay of Nagasaki, Kyushu (Shojima, 1963); Nagasaki harbour (Dotsu, Tanaka, Shojima & Seno, 1966); Tsuyazaki, Fukuoka-ken, N. W. Kyushu (Dotsu, Tanaka, Shojima & Seno, 1966); south-west coast of Japan (Holthuis & Sakai, 1970); southern Japan (Saisho, 1962); "western sea of Kyushu and Eastern China Sea" (Dotsu, Seno & Inoue, 1966), Shojima (1973, fig. 3) in a chart indicated numerous (almost 50) localities for the species in the Korea Strait and S.W. of Kyushu between 28°20' and 34°20'N and 126° to 130° 10'E.

Korea: Busan fishmarket, Korea (Yoshida, 1941; Kim & Park, 1972; Kim, 1977); Haeundae, Gyeongsang-nam-do province, Korea Strait (Kim, 1976, 1977); near Chuja Island, Jeju-do province, Korea Strait (Kim, 1977); Hanrim, Jeju Island, Korea Strait (Harada & Holthuis, 1965).

China and South China Sea: China (White, 1847; Liu, 1963; Harada & Holthuis, 1965); Hong Kong (Mistakidis, 1973); off Hainan (Harada & Holthuis, 1965; Mistakidis, 1973); mouth of Gulf of Tonkin, south of Hainan (Gurjanova, 1972; Gurjanova & Phuong, 1972); off east coast of Vietnam (Mistakidis, 1973); South China Sea, 19°40.0'N 113° 41.0'E - 19°39.5'N 113°36.0'E (Bruce, 1965); South China Sea, 15°55.7'N 109°28.5'E - 15°57.9'N 109°31.5'E (Bruce, 1966, 1966a).

Taiwan (= Formosa) (Maki & Tsuchiya, 1923; Yokoya, 1933); Ta-chi, I-Lan, N. E. Taiwan (Hwang & Yu, 1983); Chilung and Suao in N.E. Taiwan, and Anping, Kaohsiung, and Tungkang in S. W. Taiwan (Chang, 1965).

Thailand (Davidson, 1977).

Philippines (Harada & Holthuis, 1965; Motoh & Kuronoma, 1980); Manila Bay (Estampador, 1937); "commonly sold in the market of Manila and also in Iloilo", Panay (Estampador, 1959); Mindanao (Harada & Holthuis, 1965). Some of the material reported from the Philippines could belong to the subspecies *pubescens* (see there). Whitelegge (1890: 223) remarked of *I. ciliatus*: "There are two examples of this species in the Australian Museum labelled P. J."; P. J. stands for Port Jackson, New South Wales. As in the same paper Whitelegge dealt also with *Ibacus peronii*, no confusion with that species was evidently made. It remains possible that the specimens were incorrectly labelled, as the occurrence of *I. c. ciliatus* in Australian waters has so far not been confirmed. At present there are only two dry specimens of *I. ciliatus* in the collection of the Australian Museum; their label states them to be from Japan. If these indeed are Whitelegge's specimens, their label must have been corrected since, and the correctness of Whitelegge's record thereby becomes still more unlikely.

Habitat and biology. — The depths in which the full-grown specimens of this species have been found range between 48 and 270 m in the present material, and between 91 and 189-252 m in Yokoya's (1933) report. Utinomi & Harada (1958) found the species in depths between 120 and 140 m, while Harada & Holthuis (1965) reported it from about 100 m. Bruce (1965) took it from a depth of 314-332 m, Bruce (1966, 1966a) from 259-314 m, Gurjanova & Phuong (1970) from 100-160 m. The total range thus is 48 to 314 m.

The specimens of the examined material were found on bottoms of (a) fine gray sand and broken shells, (b) sand and broken shells, (c) sand and shells, (d) mud, (e) soft mud, (f) sandy mud, and (g) clay. In the literature it is reported from coarse sand (Bruce, 1965), sand and fine sand (Utinomi & Harada, 1958), and from sandy mud (Harada & Holthuis, 1965). It is evident that the species prefers a sandy substratum, pure or mixed with mud or shell fragments.

The phyllosoma stages were encountered in surface plankton and also found washed ashore.

Shojima (1963, 1973) reported upon the phenomenon that phyllosomas of this species are sometimes found clinging to the umbrella of jellyfish; a similar observation was made by Thomas (1963: 208) for phyllosomas of *Ibacus* (possibly *I. peronii*) in Australian waters. Shojima (1973) suggested that the phyllosomas may feed on the medusae.

Development. — Harada & Holthuis (1965) stated ovigerous females to occur in Japanese waters between December and March, while in captivity they were even observed as late as June. The present material from the South China Sea contains an ovigerous female collected early November. Spawning is known to take place from April to the early part of the summer (Tokioka & Harada, 1963).

Phyllosoma larvae of the present species were first described and figured by De Haan (1849) as a separate species *Phyllosoma guerini*. Balss (1914) gave an additional figure of the cephalothorax of this larva and correctly synonymized *Phyllosoma guerini* with *Ibacus ciliatus*. In 1954 Tokioka described and figured a new species of *Phyllosoma* which he named *P. utivaebi*. Utiwa-ebi being the Japanese name of *Ibacus ciliatus*, Tokioka used this specific name to indicate that he thought that his new species might be the larva of *Ibacus ciliatus*. He mentioned a few differences between *Phyllosoma utivaebi* and *P. guerini* namely: (1) the antenna of *P. guerini* was shown in De Haan's figure with five instead of four free segments, (2) the three distal segments of the antennal peduncle in De Haan's pl. 50 fig. 6b are shown with the inner margin produced into a tooth-like process (in *P. utivaebi* only the last two of these segments have such teeth), while (3) the propodi of the pereopods are longitudinally grooved, which they are not in *P. utivaebi*. Tokioka suggested the possibility that these differences are artificial and remarked that a final decision can be made only by examination of the types. The three type specimens of *Phyllosoma guerini* are still extant and preserved dry (as they were in De Haan's time). Two of them, even after more than 150 years, are remarkably complete. An examination of these types proved them to agree completely with Tokioka's description of *Phyllosoma utivaebi*; the first two of the dif-

ferences mentioned above are due to inaccuracies of De Haan's artist (in De Haan's pl. 50 fig. 6a the inner margin of the antenna is shown correctly, it is only in 6b that too many teeth are shown), while the third, as already suggested by Tokioka, is due to the fact that the types of *P.guerini* are dried and somewhat shrivelled. Until 1958 the phyllosomas of *I. ciliatus* reported upon represented the large later stages, but Harada (1958) described and figured the first phyllosoma stage and mentioned the naupliosoma. Saisho & Nakahara (1960), Saisho (1966) and Dotsu, Seno & Inoue (1966) succeeded in raising the larvae up to the fourth phyllosoma stage, all these stages being dealt with by them. Tokioka & Harada (1963) gave additional information on the later phyllosomas, while Dotsu, Tanaka, Shojima & Seno (1966) described the metamorphosis of the last phyllosoma into the *Pseudibacus* stage. Finally, Takahashi & Saisho (1978) described the complete larval development of the species. These authors, as well as Dotsu, Tanaka et al. (1966) and Dotsu, Seno et al. (1966) compared the various stages of the present species with those of *I. novemdentatus* Gibbes.

Economic importance. — Bürger, in a manuscript dating from around 1830, mentioned that on the S.W. coast of Japan *Ibacus ciliatus* is frequently caught in the outer bays, especially in the spring, and that the species can be found every day on the fish markets of the region (Holthuis & Sakai, 1970: 112). Yoshida (1941) and Kim (1977) reported the species from the fish market of Busan, Korea. Mistakidis (1973), in his report on the Crustacea in South China Sea fisheries, mentioned that good concentrations are present off Vietnam and Hainan. In Taiwan (Chang, 1965) and in the Philippines (Motoh & Kuronuma, 1980) the species is trawled and often found on the fish markets, together with *Thenus orientalis* (Lund); the two species fetch there the same prices (in 1965 the price in Taiwan was 3 to 8 NT \$ per kilogram, and in the Philippines in 1980 it was P 15 per kg). Also Estampador (1959) reported the species from the markets of the Philippines (Manila and Iloilo).

Remarks. — Bartlett & Shohara (1961: 422) reproduced a well recognizable figure of this species in both dorsal and ventral views. This figure had been published first in 1758 by Matsuoka Gantatsu.

***Ibacus ciliatus pubescens* Holthuis, 1960**

(fig. 8)

Ibacus ciliatus pubescens Holthuis, 1960: 147; Phillips, Cobb & George, 1980: 71. Type locality: Off Panálangan Point, Talajit Island, Philippines, 12°00'30" N 124°05'36"E, 153 fathoms, green mud. Holotype in USNM.

Material examined. — Off Luzon, Philippines: 14°02.7'N 120°20.3'E — 14°02.0'N 120°18.0'E (191-200 m, 22 March 1976, Musorstom I Sta. 25, 1 ♂, MP); 14°01.8'N 120°17.2'E — 14°01.2'N 120°19.0'E (182-194 m, 19 March 1976, Musorstom I Sta. 4, 1 ♀, MP); 14°00.8'N 120°20.5' E — 14°00.5'N 120°17.2'E (187-210 m, 20 March 1976, Musorstom I St. 12, 3 ♂, MP); 14°00.5'N 120°16.3'E — 13°59.5'N 120°18.6' E (194-195 m, 27 March 1976, Musorstom I Sta. 64, 1 ♂, MP); 14°00.0'N 120°19.2'E — 14°00.8'N 120°16.2'E (194-202 m, 27 March 1976, Musorstom I Sta. 65, 2 ♂, MP); Corregidor Light N 26° E 25.50 miles, 14°N 120°22'30"E (118 fathoms (= 216 m), mud, shells, coral sand, 14 July 1908, "Albatross" Sta. D 5272, 1 ♂, USNM); Tayabas Light (outer) N 43°W 6 miles, Tayabas Bay, 13°49'40"N 121°40'15"E (83 fathoms (= 152 m), green mud, 24 February 1909, "Albatross" Sta. D 5371, 1 ♀, 4 juv., USNM); Tayabas Light (outer) N 3°W 4.5 miles, 13°49'12"N 121°36'09"E (150 fathoms (= 274 m); green mud, 24 February 1909, "Albatross" Sta. D 5372, 1 juv., USNM); Tayabas Light (outer) N 50°W 8.8 miles, 13°48'N 121°43'E (106 fathoms (= 194 m), black sand, 24 February 1909, "Albatross" Sta. D 5369, 1 ♂, 1 juv., USNM); Tayabas Light (outer) N 49°W 18.2 miles, 13°42'15"N 121°50'15"E (107 fathoms (= 196 m), green mud, 2 March 1909, "Albatross" Sta. D 5375, 6 ♂, 2 ♀, USNM, RMNH).

Off Verde Island, Philippines: Sombrero Island S 17°E 10.80 miles, Verde Island Passage, 13°52'22"N 120°46'22"E (118 fathoms (= 216 m), 21 January 1908, "Albatross" Sta. D 5117, 3 ♂, 2 ♀ USNM, RMNH).

Off Mindoro, Philippines: Malabrigo Light N 14°W 9 miles, 13°27'20"N 121°17'45"E (108 fathoms (= 198 m), dark green mud, 2 February 1908, "Albatross" Sta. D 5121, 1 ♂, USNM); Balanja Point 80°W 6 miles, 12°30'55"N 121°34'24"E (145 fathoms (= 265 m), sand and mud, 4 June 1908, "Albatross" Sta. D 5261, 1 juv., USNM).

Between Samar and Masbate, Philippines: Panalangan Point, Talajit Island S 59°E 14.8 miles, 12°03'30"N 124°03'36"E (136 fathoms (= 249 m), hard sand, 13 March 1909, "Albatros" Sta. D 5393, 1 ♀, USNM); Panalangan Point, Talajit Island S 68°E 8.1 miles, 12°00'30"N 124°05'36"E (153 fathoms (= 280 m), green mud, 13 March 1909, "Albatross" Sta. D 5394, 1 ♂ holotype, USNM).

Between Masbate and Cebu, 11° 38'N 123°52'38"E (90 m, otter trawl, 5 June 1978, "Sting Ray", sta. T 7, SIPhilExp. 78, 1 ♀, 2 juv., (USNM).

Between Panay and Negros, Philippines: Lusaran Light S 29°E 4 miles, 10°32'48"N 122°26'E (96 fathoms (= 176 m), soft green mud, 30 March 1908, "Albatross" Sta. D 5183, 1 ♂, USNM).

Off Mindanao, Philippines: Point Tagolo Light, S 80°W 9.7 miles, 8°46'N 123°32'30"E (175 fathoms (= 320 m), globigerina mud, 9 August 1909, "Albatross" Sta. D 5516, 1 ♂, USNM); Point Tagolo Light S 83°W 10.5 miles, 8°45'30"N 123°33'45"E (169 fathoms (= 309 m), globigerina mud, 9 August 1909, "Albatross" Sta. D 5517, 1 ♀, USNM); Macabalan Point Light S 35°E 8.2 miles, 8°37'37"N 124°35'E (214 fathoms (= 392 m), fine sand and grey mud, 4 August 1909, "Albatross" Sta. D 5501, 1 ♀, USNM).

Philippines: "Albatross" Philippine Expedition 1907-1909 (1 ♀, USNM).

Western Australia: W.of Broome, 16°50'S 121°05'E (80-120 fathoms (= 146-220 m), F. V. "Courageous", 26 June 1978, 1 ♂, WAM).

Description. — In the collections made by the "Albatross" and "Musortom I" expeditions in the Philippine Islands a form of *Ibacus* is represented which doubtless belongs to *Ibacus ciliatus* (Von Siebold). However, it shows some differences from Japanese and Chinese material and from specimens from the eastcoast of the Philippines. These differences apparently are of a subspecific nature. For this reason the material is assigned to a separate subspecies of *I. ciliatus*, *I. c. pubescens*.

The most striking difference between the two subspecies is that in subsp. *ciliatus*, though the juveniles may be pubescent, the adults have the dorsal

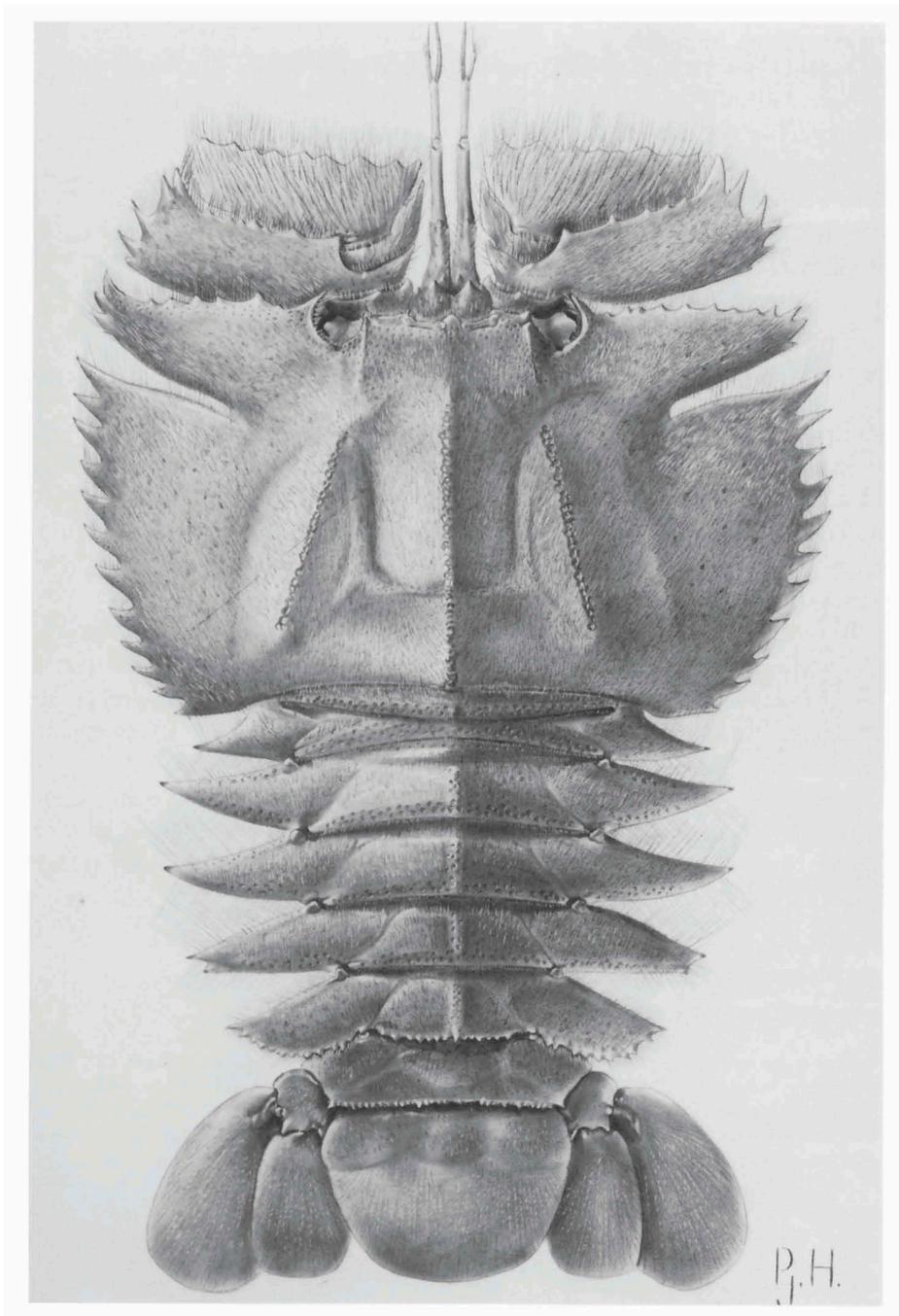


Fig. 8. *Ibacus ciliatus pubescens* Holthuis. Male holotype in dorsal view. Mrs. P. Hogue del.

surface of the carapace and abdomen naked, while in subsp. *pubescens* the dense short pubescence of the juvenile persists in the adults.

A second difference is shown by the denticulation of the lateral margin of the carapace posterior to the cervical incision. In the pubescent form, namely, the number of posterolateral teeth varies between 11 and 14, being mostly 12 (in 17 cases the number was 11, in 34 it was 12, in nine it was 13, and in two (the Australian specimen) it was 14). In *Ibacus c. ciliatus* the number of teeth varies between 10 and 12, being mostly 11.

In almost all other characters the two forms resemble each other closely.

Size. — The specimens examined have the carapace between 18 and 78 mm long. No ovigerous females were found.

Distribution. — All the known specimens but one have been found in the Philippine Islands, on the west coast as well as among the islands, All *Ibacus* specimens found on the east coast proved to belong to *I. c. ciliatus*. It is possible that (part of) the specimens reported upon in the literature from the Philippines as *Ibacus ciliatus* (see there) belong to the present subspecies; such records are by Estampador (1937, 1959), Harada & Holthuis (1965) and Motoh & Kuronuma (1980).

Recently the subspecies also has been found off Western Australia. The single specimen, which was kindly placed at my disposal by Dr. R. W. George of the Western Australian Museum in Perth, agrees well with the Philippine specimens, and even has more (14) lateral teeth on the carapace behind the cervical incision.

Habitat. — The depth at which the subsp. *pubescens* has been found varies between 152 and 391 m. It is found on bottoms of mud (often green mud or globigerina mud; sometimes mixed with shells or coral sand) or sand (black sand, hard sand, sometimes mixed with mud).

***Ibacus alticrenatus* Bate, 1888**

(fig. 9)

Ibacus alticrenatus Bate, 1888: 63, pl.9 fig. 2; Young, 1929: 154; Powell, 1947: 37, fig. 184. Type locality: west of New Zealand, 39°32'S 171°48'E, 150 fathoms, blue mud. Syntypes in BM.

Ibacus alticrenatus Hutton, 1904: 253; Chilton, 1911: 304; De Man, 1916: 65; Dell, 1956: 148; Yaldwyn, 1961: 3; Burukovsky, 1974: 102; Lesser, 1974: 262, 269, 273, 275, figs. 2, 9; Coleman, 1977: 132, fig.; Philipps, Cobb & George, 1980: 71; Atkinson & Boustead, 1982: 275, figs. 1-8; Burukovsky, 1983: 143.

Ibacus alticrenatus septemdentatus Grant, 1905: 322, pl. 11 fig. 1. Type locality: "About 28 miles east from Port Jackson Heads" near Sydney, New S. Wales, Australia; "250-300 fathoms". Syntypes in AM.

Ibacus alticrenatus septemdentata De Man, 1916: 65.

Ibacus alticrenatus George & Griffin, 1972: 228.

Vernacular names: Prawn killer (Powell, 1947), Deepwater bug, Sandy bug (Coleman, 1977).

Material examined. — New South Wales, Australia: Off Broken Bay, N. of Sydney (45-75 fathoms (= 82-137 m), 31 August 1959, M. V. "Challenge", 3 juv., AM); bought at market, Sydney (May 1980, M. de Saint Laurent, 1 ♂, 1 ovigerous ♀, MP); off Eden, 37°04'S (trawled, 23 May 1961, 1 ♂, AM). Furthermore in the Australian Museum, not seen by me, but identified by Mr. F. A. McNeill: off Burrawarra Head, near Bateman's Bay (50 fathoms (= 91 m), trawled, 1929, K. Möller, 1 specimen); 24 miles N.N.E. of Montague Island (90 fathoms (= 165 m), trawler "Gunner", September 1926, W. Boardman, 6 specimens); 28 miles E. of Port Jackson (250 fathoms (= 457 m), W. F. Petterd, 2 syntypes of *Ibacus alticrenatus septemdentatus* Grant, no. G. 5424).

N.E. Victoria, Australia: off Gabo Island (M. Ward, 1 ♀, BM, 80-100 fathoms (= 146-183 m), "Endeavour" no. 4782, 4783; 2 ♂, 2 ♀, RMNH, USNM); off Cape Everard (70-75 fathoms (= 128-137 m), trawled, June 1929, S. Kellner, 1 ♂, 1 ovigerous ♀, USNM); 30 miles S. of Mt. Cann (71 fathoms (= 130 m), "Endeavour" no. E 6097, 1 ♂, USNM); 38°15'S 149°20'E (150-260 fathoms (= 274-476 m), soft bottom, trawl, 19 September 1914, "Endeavour", leg. T. Mortensen, 1 ♂, UZM); 38°15'-38°25'S 148°20'-148°43'E (70-120 fathoms (= 128-220 m), sand, trawl, 8-9 September 1919, "Endeavour", leg. T. Mortensen, 3 ♂, 1 ♀, UZM).

Tasmania, Australia: East of Babel Island near Flinders Island, Bass Strait (about 70 fathoms (= 128 m), "Endeavour" no. E 5198, 1 ♂, RMNH); east coast of Flinders Island ("Endeavour" no. E 437, P. 2226, P. 2228, 4 ♀ RMNH, USNM; 1912, 1 ovigerous ♀, BM 1912.11.22.141; received April 1910, 1 ovigerous ♀, WAM); east of Flinders Island (Commonwealth Fishery Bureau, no. 2224, 1 ♀, AM).

South Australia, Australia: Great Australian Bight (80-120 fathoms (= 146-220 m), "Endeavour" no. E 3697, 1 ♂, USNM); S.E. of Eucla, 131°E (200-250 fathoms (= 366-457 m), "Endeavour" no. E 3695, 1 ♂, USNM).

Off New Zealand, 39°32'S 171°48'E (150 fathoms (= 274 m), blue mud, 24 June 1874, "Challenger" Sta. 167, 2 ♂, 2 ovigerous ♀, syntypes of *Ibacus alticrenatus* Bate, BM); 37°35' - 37°37'S 178°46' - 178°47'W (128-146 m deep, 28 May 1966, "Eltanin" Cr. no. 23 Sta. 1716, 1 ♂, 1 ovigerous ♀, 2 juv., USNM).

Description. — The carapace is covered by a very short, velvety pubescence which only leaves the carinae exposed. After removal of the hairs the carapace shows many very fine and some slightly coarser pits. The inner angle of the orbit is provided with two distal teeth, the posterior of which is far larger and sharper than the anterior. The outer angle of the orbit forms a large inward-curved tooth which bears no denticles on the anterior margin. The posterior margin of the orbit shows a rather broad quadrangular incision which carries no tubercle. There is a distinct tooth on the orbital margin between the posterior notch and the outer angle; further, a few denticles may be observed near the notch. Between the orbit and the anterolateral tooth the anterior margin of the carapace bears about six small blunt teeth, the toothed part as a rule being separated from both the orbit and the anterolateral angle by an unarmed interval. The cervical incision of the carapace is very wide. The anterior margin of the incision forms the posterior margin of the slender anterolateral angle, there being no lateral margin of the carapace left between the cervical incision and the anterolateral angle. Behind the cervical incision the lateral margin of the carapace bears seven to nine, usually eight, seldom 11, sharp, posterolateral teeth, the anterior of which is largest and the last very

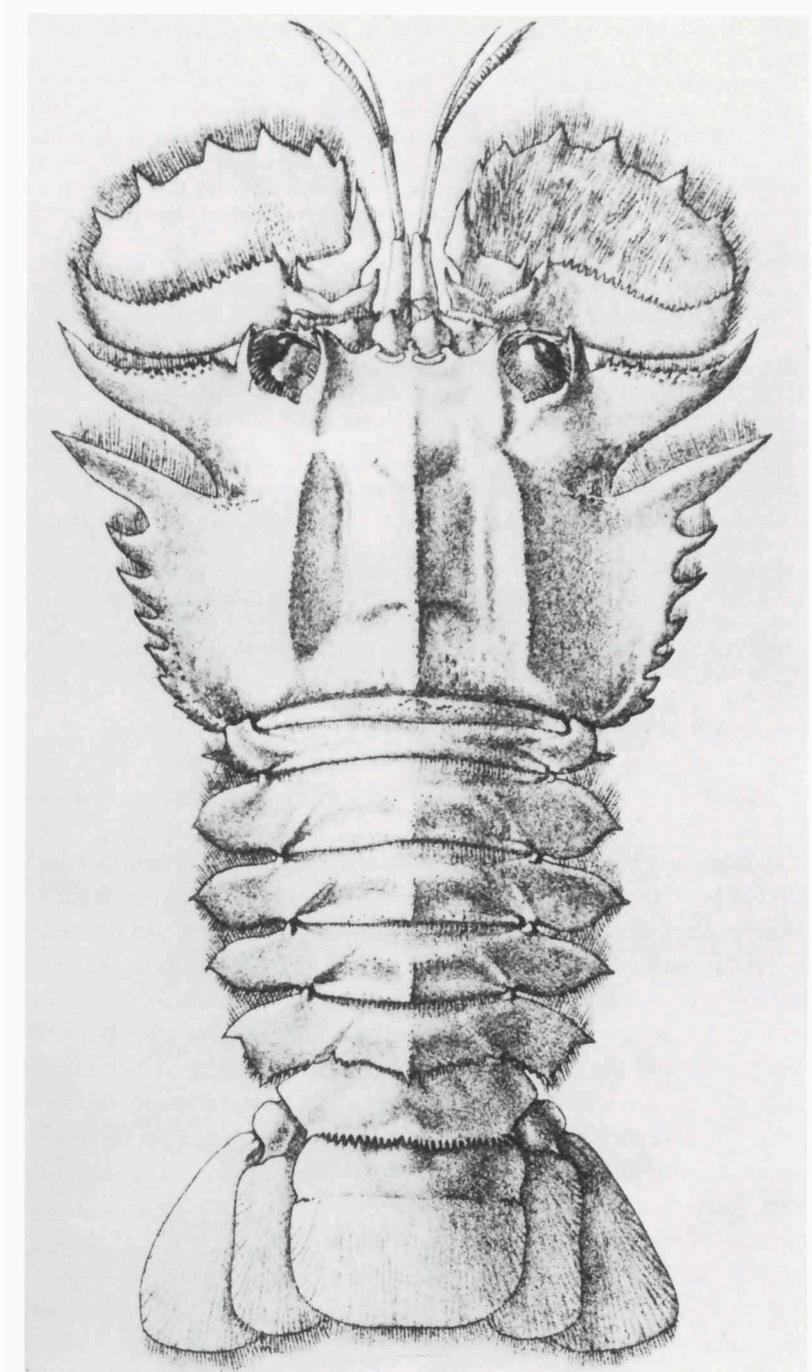


Fig. 9. *Ibacus alticrenatus* Bate. Dorsal view of female syntype from west of New Zealand. After Bate, 1888. $\times 1.65$.

small. In 31 cases examined five had seven teeth, 18 had eight, seven had nine and one had 11 teeth.

The anterior branchial carinae are short and diverge somewhat posteriorly. The posterior branchial carinae are placed at an angle with the anterior and are somewhat convex. The postrostral carina is vaguely visible in the anterior part, the pregastric, cardiac and intestinal teeth are low but far more distinct than in *I. ciliatus*, the gastric tooth is extremely vague. The region between the postrostral and branchial ridges is somewhat concave with the indication of a shallow branchiocardiac groove.

The abdominal somites show a velvety pubescence on the upper surface. This pubescence does not cover the carinae which thereby become very conspicuous. Apart from the longitudinal median carina on the second to fifth somites, there are raised carinae along the anterior and posterior margin of the somites and the pleura, as well as an oblique carina which extends from the posterior basal point of each pleuron anteriorly and inward. The pleura are elongate and end in a sharp point which usually is directed posteriorly. The pleuron of the fourth somite shows small, that of the fifth larger teeth on the posterior margin. Of the latter, one sometimes is much larger than the others. The posterior margin of the fifth and sixth somites are denticulate, though in the fifth this denticulation is less distinct than in the sixth. There are no tubercles on the dorsal surface of the sixth somite.

The antennal segments have the upper surface velvety pubescent. In large males this pubescence may become rather long and shaggy. The anterior margin of the sixth segment bears five to eight fairly large teeth. The fourth segment of the antenna is very short and broad. Its anterior margin bears some very small denticles. The lateral margin is short and unarmed, its ends in a large, sharp, anteriorly directed terminal tooth.

The epistome ends anteriorly in two short and broad submedian processes which lie close together and each of which ends in two (seldom three) short teeth. A short distance behind these submedian processes there is a short, highly elevated median ridge which sometimes ends in a sharp, obliquely anteriorly directed tooth.

The merus of the third maxilliped has the ventral surface flattened and even somewhat concave. The inner margin is crenulate, but shows no deep incisions. The outer margin shows about eight or nine small denticles, the anterior of which may be larger than the rest. The ischium has both inner and outer margin of the ventral surface without teeth. The anterolateral angle is bluntly rounded and only slightly produced beyond the base of the merus. The basal segment of the exopod bears several distinct teeth.

The pereopods are slender. The ischium bears no spines.

Colour. — Powell (1947) described the colour as “dull salmon”. Coleman (1977: 132) published a coloured photograph showing the animal to be light orange-yellow with darker orange-red spots and marblings.

Size. — The carapace length of the present specimens varies between 15 and 63 mm. In the ovigerous females it is 32 to 43 mm. Bate's male types have the carapace 28 and 29 mm long, those of the female types are 30 mm.

Distribution. — The species occurs in New Zealand waters as well as in the seas off East and South Australia. The records in the literature are the following:

Australia. Common off New South Wales (Coleman, 1977), between Newcastle, New S. Wales, and Bass Strait (George & Griffin, 1972); about 28 miles east of Port Jackson, Sydney, New South Wales (Grant, 1905); Tasman Sea (Phillips, Cobb & George, 1980).

New Zealand. Off Cape Maria van Diemen, north point of North Island (Powell, 1947; Atkinson & Boustead, 1982); W. of Cape Egmont, 39°32'S 171°48'E (Bate, 1888); Bay of Islands (larvae: Atkinson & Boustead, 1982); Bay of Plenty, N.E. North Island (Powell, 1947; larvae: Atkinson & Boustead, 1982); 12 miles W.S.W. of Cape Runaway (Chilton, 1911); off East Cape: 37°34'S 178°42'E, 37°48'S 178°41'E, 37°53'S 178°34'E (larvae: Atkinson & Boustead, 1982); off Napier, east coast of North Island (Dell, 1956); 12 miles N.E. of Cape Kidnappers (Chilton, 1911); off Cape Kidnappers, 39°36'S 177°24'E (larvae: Atkinson & Boustead, 1982); off Castlepoint (Dell, 1956; Lesser, 1974; larvae: Atkinson & Boustead, 1982); between Hawke Bay and Cape Palliser, east coast of North Island (Lesser, 1974); 7 miles off the east coast of North Island (Dell, 1956).

Off west coast of South Island (larvae: Atkinson & Boustead, 1982); off Cape Campbell, N.E. South Island (Dell, 1956); 18 miles E.N.E. of Oamaru, east coast of South Island (Chilton, 1911; Atkinson & Boustead, 1982); Chatham Islands (Chilton, 1911; Young, 1929; Atkinson & Boustead, 1982).

Habitat. — The present material was collected at depths between 82 and 455 m (the certain range being between 136 and 360 m). The depth records in the literature vary between 20 and 546 m (certain range being 20 to 455 m). The species was found on soft, muddy bottoms (soft mud, blue mud, ooze, and sand, shells and mud). The larvae were taken at depths between 5 and 100 m, but by far the most at depths of less than 50 m (Atkinson & Boustead, 1982).

Biology. — Coleman (1977) described the habits of this species as follows: “This species generally spends much of its time buried beneath the sand with just tips of its antennae and eyes showing. When swimming, it flaps its tail vigorously to propel itself along backwards for a metre or so at a time. The large head section tends to droop downwards during swimming and may drag along the bottom, as this species rarely swims at a height of more than a quarter of a metre above the bottom”.

Development. — Ovigerous females were taken in May and June (present material; Bate, 1888), August (Lesser, 1974) and October (Dell, 1956). Lesser (1974) described and figured the naupliosoma and the first stage larva, which

were raised from the egg. Atkinson & Boustead (1982) succeeded in describing and figuring the complete larval development of the species, partly from larvae hatched in the laboratory, partly from specimens taken in the plankton.

Economics. — According to Lesser (1974: 260), *Ibacus alticrenatus* is of no commercial importance in New Zealand. But Coleman (1977: 132) stated that in New S. Wales “commercial quantities of *Ibacus alticrenatus* are still taken by trawlers working off the continental shelf by day and by night”. As shown by the examined material, the species is sold on the Sydney market.

Predators. — Chilton (1911: 304) mentioned an adult specimen taken from the stomach of a specimen of *Zeus*. Atkinson & Boustead (1982: 276) reported upon late phyllosoma stages taken from the stomach of an albacore *Thunnus alalunga* (Gmelin).

Remarks. — Bate’s original figure excellently depicts the present species, only the pubescence of the dorsal surface is hardly indicated; also his description gives most of the important characters.

Grant’s (1905) *Ibacus alticrenatus* var. *septemdentatus* cannot be considered distinct from the typical form. The differences in the dentition as given by Grant fall within the range of variation of *Ibacus alticrenatus*, as has already been pointed out by Chilton (1911) and Dell (1956).

***Ibacus brucei* Holthuis, 1977**

(figs. 10-12)

Ibacus brucei Holthuis, 1977: 191, pls. 1, 2; Phillips, Cobb & George, 1980: 71. Type locality: “Due east of Point Lookout, North Stradbroke Island, Queensland; 86 fathoms (= 157 m)”. Male holotype in RMNH (Crust. no. D. 24744).

Material examined. — Queensland, Australia: due east of Point Lookout, North Stradbroke Island (86 fathoms (= 157 m), otter trawl, 1 August 1967, commercial vessel “Sadie III”, don. A. J. Bruce, 1 ♂ holotype, RMNH); off southern Queensland, 26°31’S 153°43’E (100-102 fathoms (= 183-187 m), 20 July 1968, “Nimbus” Sta. 11, don. A. J. Bruce, 1 ♂ paratype, RMNH).

Kermadec Islands, New Zealand: off Raoul Island, 29°13’S 177°57’W (83-90 m, bottom with stones, trawled, 3 March 1952, “Galathea” Sta. 676, 1 ♂ paratype, UZM); off Raoul Island, between meteorological station and Hutchinson Bluff (60-66 fathoms (= 110-121 m), 4 April 1973, R. V. “Acheron”, 1 ♀, National Museum, Wellington, New Zealand).

Additional material. — Dr. D. J. G. Griffin, Director, Australian Museum, Sydney, provided me with information and photographs of the following specimens in the collection of his Museum:

Queensland, Australia: east of Moreton Bay (162 m, July 1972, leg. N. Ruello, 2 ♂ paratypes, AM).

Central New South Wales, Australia: south-east of Broken Bay, 33° 40’S 151°46’E – 33°35’S 151°52’E (edge of shelf, 167-172m deep, 2 November 1976, 1 ♂ paratype, AM).

Description. — The carapace is minutely pitted, with a very short hair in each pit. The hairs are so small and inconspicuous that to the naked eye the carapace gives the impression of being naked. The inner angle of the orbit bears two sharp distal teeth which are of about equal size. The outer angle is a strong tooth which is minutely denticulate on the anterior margin. The posterior margin of the orbit shows a rather broad quadrangular incision which carries no tubercle. The orbital margin bears no teeth or denticles apart from the above mentioned ones. Between the orbit and the anterolateral tooth the anterior margin of the carapace bears about 12 to 14 small blunt teeth, of which the inner six to ten are distinct. The cervical incision of the carapace is deep and wide. The anterior margin of the incision forms the posterior margin of the slender anterolateral tooth, it bears no teeth. There is no true lateral margin of the carapace left between the anterolateral angle and the cervical incision. Behind the incision there are seven or eight posterolateral teeth on the margin of the carapace; these teeth become smaller posteriorly. The anterior branchial carinae are short and indistinct, they diverge somewhat posteriorly. The posterior branchial carinae lie in the same line as the anterior and are straight, they diverge also. The postrostral carina is vaguely visible in the anterior part, being distinct more posteriorly. The pregastric, cardiac, and intestinal teeth are hardly noticeable, the pregastric being the most distinct. The area between the postrostral and branchial carinae is somewhat concave, with the branchiocardiac groove distinct, although shallow; the cervical and postcervical grooves are also vaguely visible.

The surface structure and setation of the abdomen is like that of the carapace. The second to fifth somites bear a longitudinal median carina which is not very high. An oblique groove extends from the posterior end of the base of the pleura of all somites mediad and forward; from the same point a transverse groove runs mediad. The pleura end in a strong and sharp point with an acute horny tip, which is directed outward or slightly forward, the tip sometimes being curved somewhat posteriorly. The anterior margin of the first pleuron bears a large and wide triangular tooth which shows a bluntly rounded lobe on its inner margin. The anterior margin of the second pleuron is slightly concave, that of the third and fourth is sinusoid, and of the fifth slightly convex; only that of the second shows some indistinct tubercles. The posterior margin of the second to fifth pleura is convex and tuberculate; in the fifth it shows in addition to the tubercles two strong, spine-tipped teeth. The dorsal surface of the sixth somite is tuberculate.

The surface of the antennal segments is similar to that of the carapace, only the hairs are somewhat longer. The anterior margin of the sixth segment bears six to nine teeth; the inner three of these teeth are large and very sharp. The

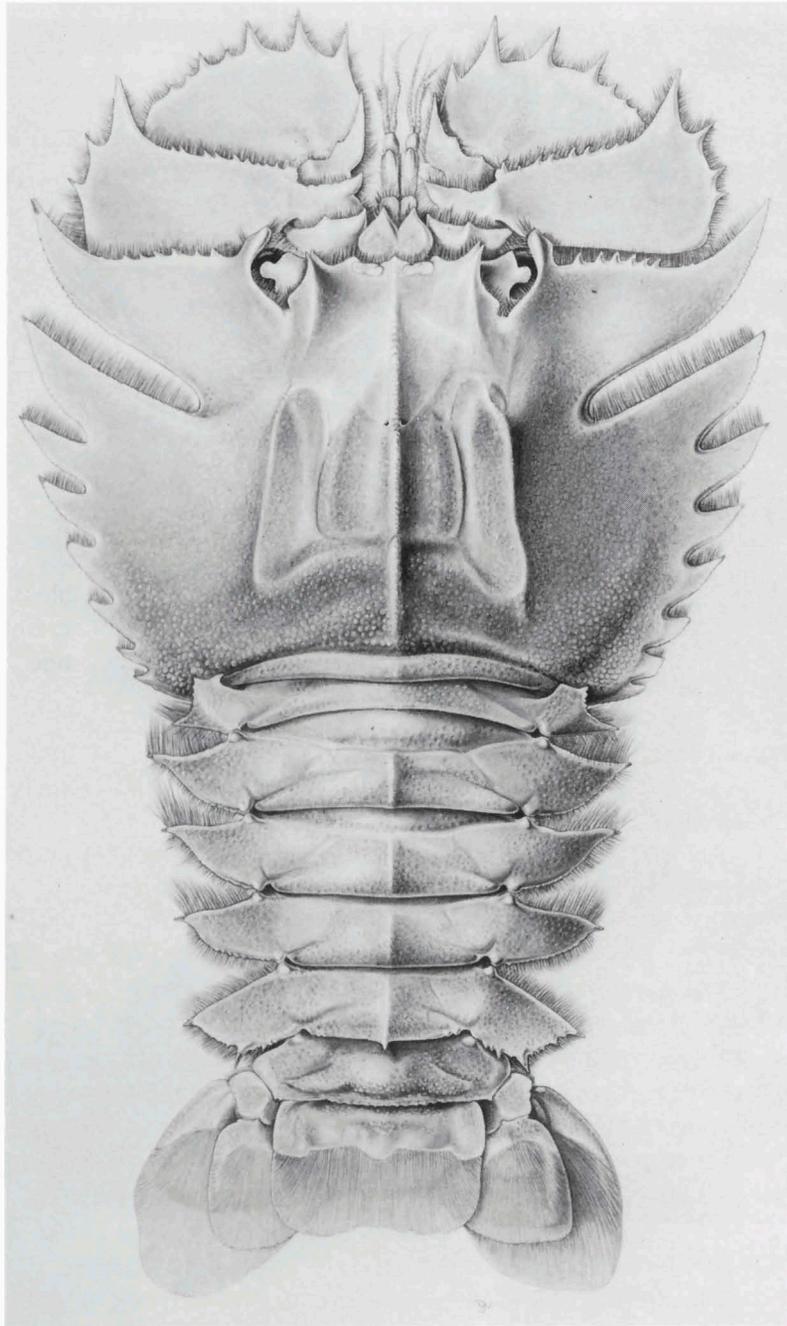


Fig. 10. *Ibacus brucei* Holthuis. Dorsal view of male holotype. $\times 1.9$. J. Wessendorp del.

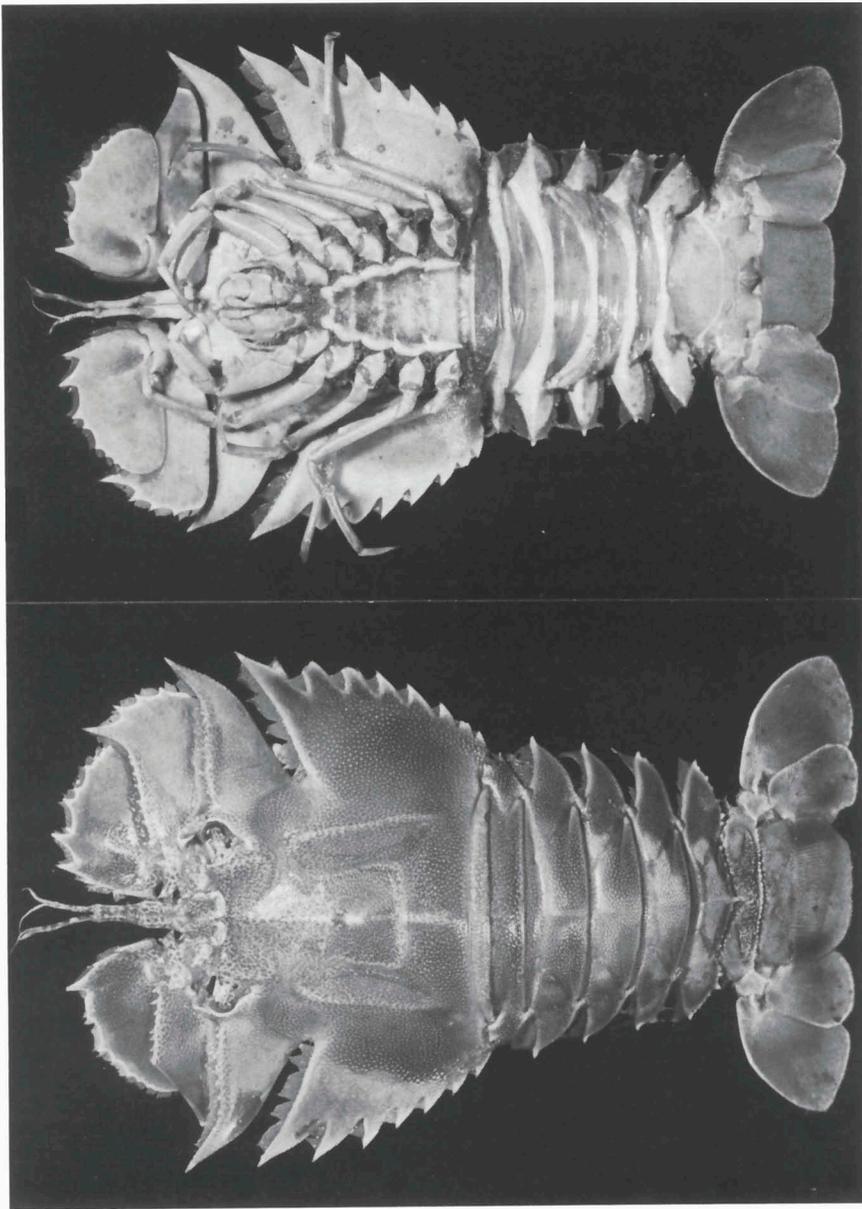


Fig. 11. *Ibacus brucei* Holthuis. Male paratype from Central New South Wales in dorsal (left) and ventral (right) view. Gregory Milten phot. Copyright Trustees Australian Museum.

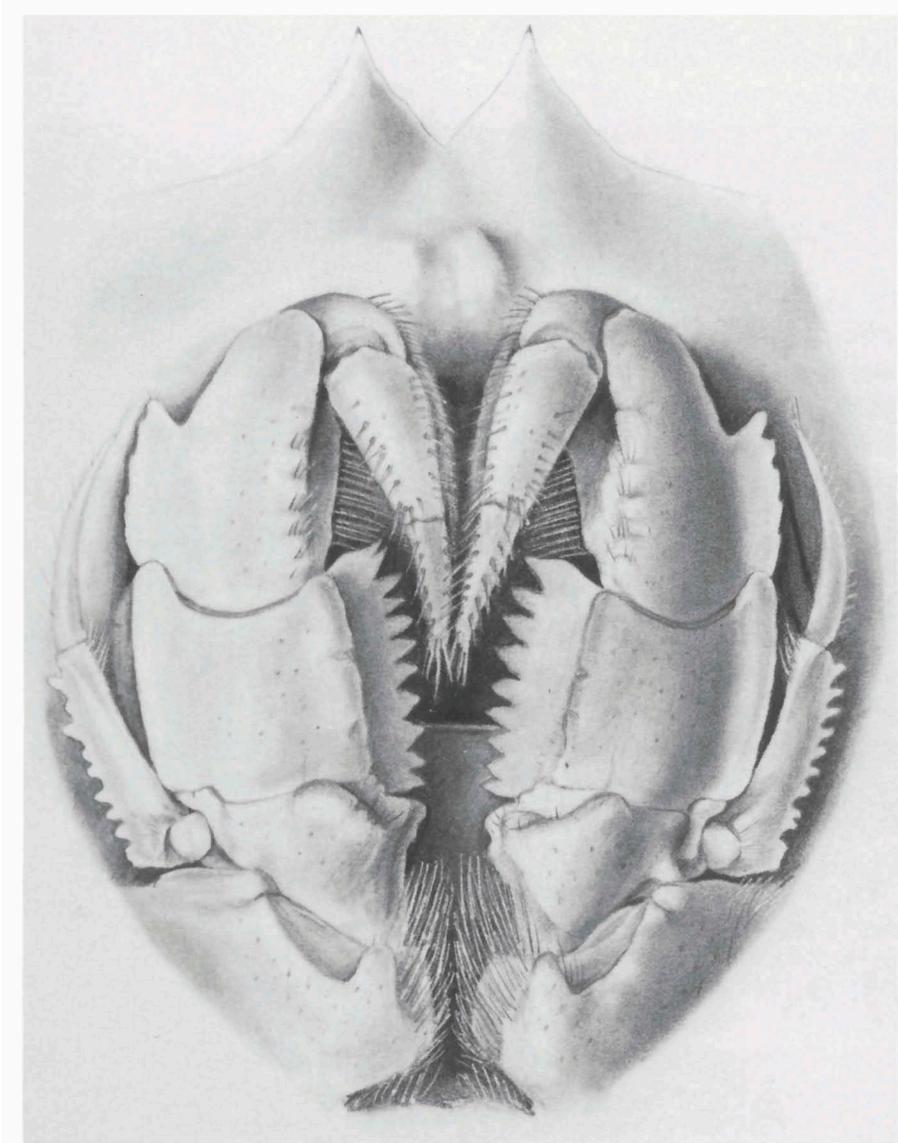


Fig. 12. *Ibacus brucei* Holthuis, male holotype. Oral field in ventral view. $\times 10$. J. J. M. Vreeburg del.

fifth segment ends in a strong, anteriorly directed, sharp tooth. The fourth is much longer than in *I. alticrenatus*. Its anterior margin bears about 10 to 14 small, sharp teeth, the anterolateral tooth is strong and directed forward; the

lateral margin is quite long and bears two or three distinct sharply topped teeth.

The epistome ends anteriorly in two triangular, sharply pointed or blunt teeth. Posteriorly the epistome ends in a blunt median, posteriorly directed tooth, before which there are two low, blunt submedian elevations.

The merus of the third maxilliped has the ventral surface slightly convex in the inner half, concave in the outer. The inner margin shows no incisions, but has in its basal part a few low tubercles with tufts of short hair. The outer margin has a high, wing-like keel in the basal half, this keel stops abruptly and ends in a blunt tooth; the upper margin of the keel is feebly serrate. The outer margin of the ischium is formed by a wing-like keel without teeth; the inner margin of the ventral surface is somewhat crenulate, the inner margin of the lower surface bears distinct teeth.

The pereopods are slender. There is no spine on the ischium.

Colour. — The dorsal surface of the body has a pale yellowish brown background colour, overlaid by brick-red. The median area of the carapace is covered by numerous brick-red spots which in the lateral areas merge to a solid brick-red colour, in which only the pits are somewhat lighter. The entire abdomen, both in the median and lateral regions, shows such a solid brick-red colour with lighter pits. In both the thorax and the abdomen the margins of the segments are slightly lighter than the rest, while the tips of the larger lateral teeth are white. Also the anterior margin of the distal segment of the antenna, and the lateral margin of the fourth segment are white, as is also the outer margin of the uropodal exopod.

The ophthalmic peduncles and the entire antennular peduncle are spotted with brick-red, as are also the basal and inner parts of the antennae. The greater part of the fourth and sixth segments of the antennae, however, are solid brick-red.

The entire ventral surface of the animal is whitish with a reddish tinge in the lateral parts. The basal two segments of the antennular peduncle have the ventral surface whitish, in the third this surface is spotted with red. The third maxilliped and the first pereopod are pale brownish in colour, in the more posterior legs the colour becomes more reddish. The pleopods are uncoloured. The soft parts of the uropods and telson are reddish brown ventrally, being only slightly paler than they are dorsally (after coloured photographs of the specimen from Broken Bay, New South Wales, two of which were published by Holthuis, 1977: pl. 2).

Size. — The holotype is an adult male with cl. 35 mm. The male paratypes have cl. 20 to 53 mm. The female specimen from the Kermadec Islands has cl. 57 mm.

Distribution. — The species is only known from the above-mentioned material. Its known range thus extends along the east coast of Australia from southern Queensland (26°31'S) to central New South Wales (33°40'S), and includes the Kermadec Islands (New Zealand).

Habitat. — On the Australian east coast the species was taken at depths between 157 and 183 (187) meters, in the Kermadec Islands between 83 and 121 m (certain range 90-110 m). Little is known about the bottom configuration where the species is found; it is likely a soft bottom as with most other species of the genus; this is the more likely as several of the specimens have been obtained in trawling. The only definite statement of the type of bottom is in one of the specimens from the Kermadec Islands, where it says that the bottom is with stones.

Remarks. — The shape of the third maxilliped of this species is similar to that of *Ibacus alticrenatus* and *I. ciliatus*, differing from the other three species by having the merus not swollen, without incisions on the inner margin and not coloured differently from the rest of the appendage. *I. brucei* resembles *I. alticrenatus* and differs from *I. ciliatus* (1) by that the anterior margin of the cervical incision merges gradually with the posterior margin of the anterolateral tooth of the carapace, so that there is no true lateral margin in front of the incision, and (2) by the small number of posterolateral teeth on the carapace margin. The species evidently is most close to *Ibacus alticrenatus*, in which, however, the upper surface is woolly pubescent, the orbital margin possesses a tooth on the outer half behind the two distal teeth, and the fourth segment of the antenna is very short and slender, showing no teeth on the lateral margin.

***Ibacus brevipes* Bate, 1888**

(figs. 13, 14)

Ibacus brevipes Bate, 1888: 62, pl. 9 fig. 1. Type locality: "lat. 5°49'15" S., long. 132°14'15"E.; off the Ki Islands [= Kai Islands, = Kepulauan Ewab, eastern Indonesia]; depth, 140 fathoms; blue mud." Holotype ♂ in BM.

Ibacus verdi Bate, 1888: 58, pl. 7 fig. 2, pl. 8; Estampador, 1937: 495. Type localities: "St. Vincent, Cape Verde Islands, July 1873, depth 7 to 20 fathoms" [probably an erroneous locality], and "off Zamboangan [= Zamboanga], Philippine Islands, . . . lat. 6°47' N., long. 122° 28'E.; depth, 250 fathoms; green mud". A specimen (cl. 43.5 mm) from "St. Vincent" is selected as the lectotype. Paralectotypes and lectotype in BM.

Ibacus verdi Stebbing, 1893: 193; De Man, 1916: 65; Estampador, 1959: 39; Burukovsky, 1974: 102; Burukovsky, 1983: 144.

Ibacus brevipes De Man, 1916: 65; Phillips, Cobb & George, 1980: 71.

not *Ibacus verdi* Stebbing, 1910: 373; Gilchrist, 1918: 53 [= *I. novemdentatus* Gibbs].

Material examined. — Atlantic Ocean: St. Vincent, Cape Verde Islands (7-20 fathoms (= 13-37 m), "Challenger" Expedition, July 1873, 4 ♂, 1 ♀, paralectotypes of *Ibacus verdi* Bate, BM).

South China Sea: near Macclesfield Bank, 16°09.4'N 114°31.6'E — 16°11.0'N 114°28.1'E (148-164 fathoms (= 271-300 m), fine white muddy sand, 12 June 1964, "Cape St. Mary" Cr. 3/64, Sta. 9, T. 147, A. J. Bruce, 2 ♀ RMNH; 1 ♂, 1 ♀, BM).

Philippines: S. W. of Luzon, 14°01.2'N 120°18.4'E — 13°59.4'N 120°18.4'E (183-190 m, beam trawl, 20 November 1980, Musorstom II, Sta. 4, 1 ♂, MP); 13°59.0'N 120°18.5'E — 14°08.0'N 120°16.5'E (186-187 m, beam trawl, 23 March 1976, Musorstom I, Sta. 35, 1 ♀, MP); Balanja Pt. N 80°W 6 miles, off S.E. Mindoro, 12°30'55"N 121°34'24"E (145 fathoms (= 265 m), sand and mud, 4 June 1908, "Albatross" Sta. D 5261, 1 ♂, USNM); off Zamboanga, 6°47'N 122°28'E (250 fathoms (= 457 m), green mud, 23 October 1874, "Challenger" Sta. 200, 1 ♀, paralectotype of *I. verdi* Bate, BM); Dammi Island (N) S 69°W 6 miles, between Jolo Island and Tawi Tawi, 5°51'42"N 120°30'30"E (243 fathoms (= 445 m), sand and pteropod shells, 21 September 1909, "Albatross" Sta. D 5565, 1 ♀, USNM).

Indonesia: off the Kai Islands, 5°49'15"S 132°14'15"E (140 fathoms (= 256 m), blue mud, 26 September 1874, "Challenger" Sta. 192, 1 juv. ♂, holotype of *Ibacus brevipes* Bate, BM).

New Caledonia: off the N.W. coast, 20°45'S 164°13'E (350 m, 26 November 1928, "Dana" Sta. 3609, 1 ♀, UZM); off Récif Tombo, S.W. coast, 22° 32.1'S 166°26.1'E (175-250 m, 6 June 1979, 16h05-16h45, Expédition ORSTOM à Nouvelle Calédonie, drague no. 7, 2 ♀, MP).

Description. — The carapace has the upper surface naked, or with a slight pubescence in the anteromedian region; as in *I. ciliatus*, it is pitted. The orbits have two teeth on the inner angle. The outer orbital angle is somewhat produced and tooth-like. The posterior margin of the orbit shows a rather broad, open incision which carries no tubercle; there are a few faint tubercles on the orbital margin laterally of the posterior incision, but no teeth are present there. The anterior margin of the carapace at either side bears 7 to 12 small teeth. The part of the lateral margin of the carapace before the cervical incision gradually tapers towards the anterolateral angle. One to six small incisions or small anterolateral teeth may be observed here behind the anterolateral angle. Behind the cervical incision the lateral margin of the Washington and Paris specimens bears 13 to 15 (in three cases 13, in two 14, in three 15) posterolateral teeth. Dr. Isabella Gordon who was so kind to examine Bate's (1888) type specimens of *I. brevipes* and *I. verdi* for me, found that the type of *I. brevipes* has 16 teeth behind the cervical incision, the Philippine specimen of *I. verdi* 12 and 13 teeth, and the six specimens from the Cape Verde Islands 13 to 17. The specimens from the South China Sea had 12, 13, 13 and 14 posterolateral teeth. The number of such teeth in this species thus ranges between 12 and 17.

As in *I. ciliatus*, the anterior and posterior branchial carinae lie in one line, the left and right diverge posteriorly.

The upper surface of the abdominal somites is naked but punctate. The median carinae are less distinct than in *I. ciliatus*. The posterior margin of the pleura of the second somite is more convex than in *I. ciliatus* and the pleuron thereby is wider. In other respects the abdomen strongly resembles that of *I.*

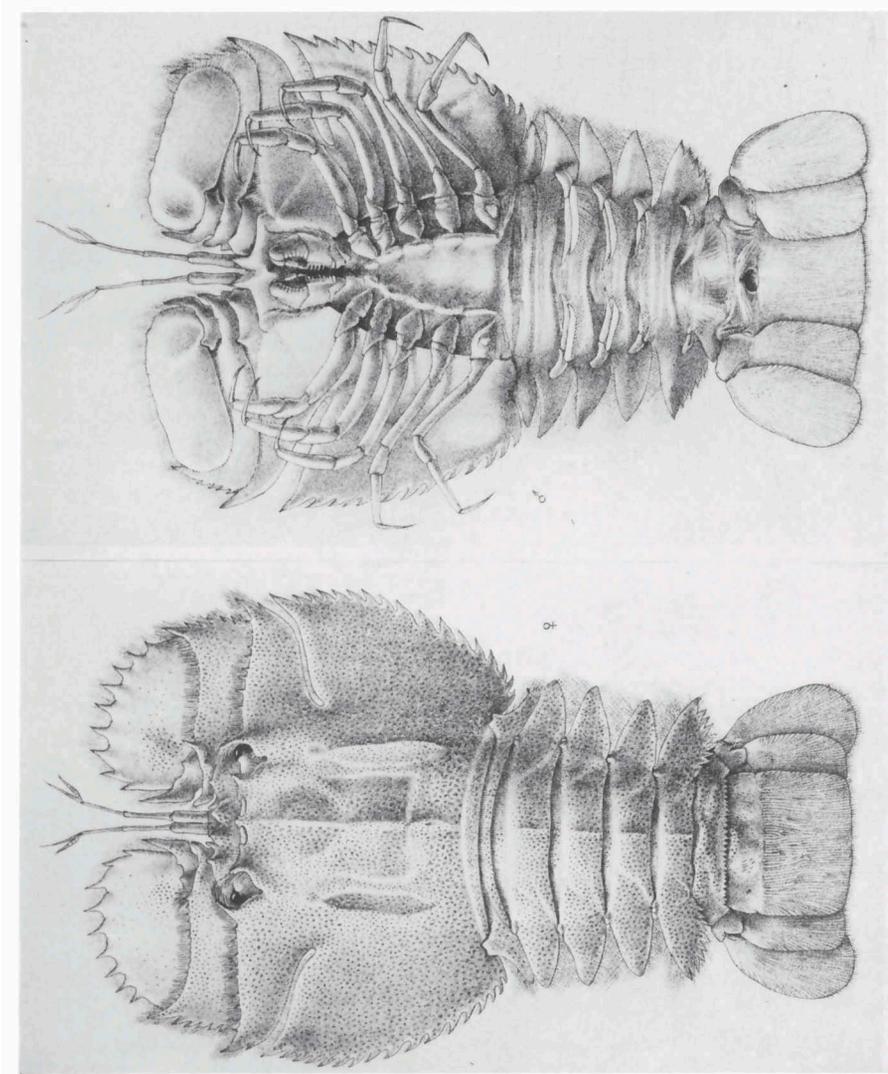


Fig. 13. *Ibacus brevipes* Bate. Left figure: dorsal view of female lectotype of *Ibacus verdi* Bate; right figure: ventral view of male paralectotype of *I. verdi*; both from "St. Vincent". $\times 0.8$. After Bate, 1888.

ciliatus. The sixth somite shows a few inconspicuous tubercles in the median area of the dorsal surface.

The sixth segment of the antenna is broad and in the Washington and Leiden specimens it bears 12 or 13 teeth on the anterior margin; in the specimen from New Caledonia 11 and 12 teeth of very different size are present there, some being extremely small. According to Bate, there are six to seven teeth there in the type, while he figured seven and eight respectively. In Bate's

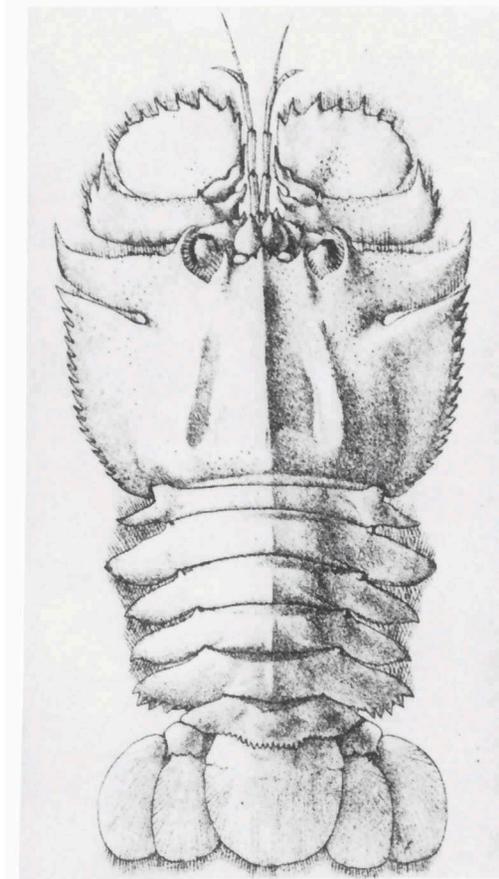


Fig. 14. *Ibacus brevipes* Bate. Dorsal view of male holotype. $\times 1.5$. After Bate, 1888.

figured male and in the "Challenger" male examined by me, the teeth are strongly reduced, the margin of the segment being undulate; this is also the case in the male of *Musorstom* II sta. 4. The fourth segment of the antenna has the anterior margin with 13 to 20 minute teeth. The outer margin of the segment bears five to eight teeth.

The epistome bears two strong submedian teeth on the anterior margin. These teeth are parallel or slightly diverging and lie in the same plane as the lower surface of the epistome or are slightly elevated. A third tooth which is curved forward and stands vertically on the epistome, is placed in the median line some distance behind the submedian teeth.

The third maxillipeds differ from those of *I. ciliatus* in that the merus is

swollen in the anterior part, showing a smooth, rounded knob there which bulges over the base of the carpus; the proximal half of the ventral surface of the merus is flat or slightly concave. The incisions in the inner margin are far deeper than in *I. ciliatus*; they form behind the terminal knob five to seven rounded lobules on the inner margin; the outer margin of the merus bears a short wing which is provided with some teeth. The ischium has the outer margin strongly winged and produced distinctly beyond the base of the merus; the anterior end of the wing is pointed and almost reaches to the middle of the merus. The basal segment of the exopod bears teeth on the outer margin.

The pereopods are somewhat more slender than in *I. ciliatus*.

Size. — In the present specimens the carapace length varies between 21 and 45 mm. The specimens with cl. 21 mm evidently are juveniles. In the holotype of *I. brevipes* the carapace length is 21 mm. In Bate's female type of *I. verdi* the carapace length is 43.5 mm, the male types have cl. 40 to 44 mm.

Distribution. — So far the species is only known with certainty from the South China Sea, the Philippines, the Moluccas and New Caledonia. The records in the literature are: off Zamboanga (= Samboangan), Phillipines, 6°47'N 122°28'E (Bate, 1888), off the Kai Islands, Moluccas, 5°49'15"S 132°14'15"E (Bate, 1888). It seems highly probable that the specimens reported by Bate (1888) from St. Vincent, Cape Verde Islands, have been incorrectly labelled as to the locality.

Habitat. — The species is known from depths between 186 and 457 m, and was taken from bottoms of fine sediment (green mud; blue mud; fine white muddy sand; sand and mud; sand and pteropod shells). The specimens which Bate (1888) reported from the Cape Verde Islands were said to be obtained from a depth between 7 and 20 fathoms, which is another argument to doubt the correctness of the label of that lot.

Remarks. — The type locality of the species is off the Kai Islands, Moluccas, 5°49'15"S 132°14'15"E, depth 140 fms. blue mud. The type specimen is preserved in the British Museum. The British Museum possesses also the six syntypes of *I. verdi* Bate. Of these, the female from "St. Vincent" figured by Bate (1888, pl. 8), a specimen with cl. 43.5 mm, is selected here to be the lectotype of the species.

Dr. Isabella Gordon who at my request examined the types of *I. verdi* and *I. brevipes*, wrote to me that after examination of the specimens and especially after comparing the third maxillipeds and the epistomes "I think all Bate's material is referable to one species". The only difference seems to be that in Bate's Zamboanga specimen the spines on the anterior margin of the epistome are directed somewhat more ventrally than those of the Atlantic speci-

mens. The curious shape of the third maxilliped which is not present in any other species of *Ibacus*, is shown by all of Bate's material of *I. verdi* and *I. brevipes*. Dr. Gordon was so kind as to send me one of the male paratypes of *I. verdi* from the Cape Verde Islands on loan for examination and comparison with the Philippine material of the U.S. National Museum. After comparison of the two forms I fully agree with Dr. Gordon that the two species are identical and should be synonymized.

The situation that a single species occurs near the Philippines, the Moluccas and New Caledonia on the one hand and near the Cape Verde Islands on the other is highly unusual and would cast doubt on the correct labelling of the so-called Cape Verde Islands material. Also suspicious is the fact that the Cape Verde Islands specimens were collected at less than twenty fathoms, while most species of the genus live at far greater depths. Furthermore these specimens are the only representatives of the genus ever to have been reported from the Atlantic; neither before nor after has the genus *Ibacus* been found in the Atlantic Ocean. The possibility that the so-called Cape Verde Islands specimens actually came from the Indo-West Pacific area but are incorrectly labelled, seems highly likely. For that reason the name *brevipes* is given here precedence over *verdi*.

***Ibacus novementatus* Gibbes, 1850**

(figs. 15-17)

Ibacus novementatus Gibbes, 1850: 19. Type locality unknown.

- Ibacus novementatus* Dana, 1852: 14; Dana, 1852a: 517; Stimpson, 1860: 23; De Man, 1916: 65; Gee, 1925: 159; Harada, 1965: 36, fig. 2c, d; Harada & Holthuis, 1965: 28, text figs. 1, 3, pl. 7 figs. 1, 2; Utinomi, 1965: 62, pl. 31 fig. 1; Dotsu, Seno & Inoue, 1966: 181, figs. 1, 2, 4, 6, 8, 9, 10; Dotsu, Tanaka, Shojima & Seno, 1966: 195, text figs. 1 F-J, 4, 12F, G, 14, 15, 16, pl. 2, pl. 3 figs. 5, 6; Robertson, 1968a: 334; Prasad & Tampi, 1969: 84; Johnson, 1971: 272, figs. 85-88 (provisional identification); Nishimura & Suzuki, 1971: 89, pl. 30 fig. 2; Bardach, Ryther & McLarny, 1972: 647; Kim & Park, 1972: 210, pl. 6 figs. 3, 4; Shojima, 1973: 105, text figs. 3, 4, pl. 1; Berry, 1974: 13, 16, fig. 37; Burukovsky, 1974: 102; Miyake, 1975: 107, fig.; Far Seas Fisheries Research Lab., 1976: 110, fig. E. Afr. 121; Kim, 1976: 147; Kim, 1977: 336, 400, text fig. 150, pl. 36 fig. 74; Matsuzawa, 1977: pl. 75 fig. 4; Kikuchi & Miyake, 1978: 26; Takahashi & Saisho, 1978: 305, text fig. 13, pls. 4, 5, pl. 6 figs. 1, 2, 4; Utinomi, 1978: 62, pl. 31 fig. 1; Ivanov & Krylov, 1980: 287; Phillips, Cobb & George, 1980: 71; Phillips & Sastry, 1980: 29, 39; Shirai, 1980: 411, fig.; Van Olst, Carlberg & Hughes, 1980: 336; Miyake, 1982: 86, pl. 29 fig. 5; Burukovsky, 1983: 144; Hwang & Yu, 1983: 262, fig. 2; Sakai & Nakano, 1983: 76.
- Ibacus verdi* Stebbing, 1910: 373; Gilchrist, 1918: 53 (not *I. verdi* Bate, 1888).
- Ibacus* Gilchrist, 1921: 57; Gilchrist, 1922: 26, 34; C. von Bonde, 1928: 16, 17, 20, 28, 29, 66.
- Ibacus peronii* Stebbing, 1923: 6, pl. 13; Barnard, 1926: 123; Tokioka & Harada, 1963: 433; Utinomi, 1965: 62, pl. 31 fig. 1 (not *I. peronii* Leach, 1815).
- Ibacus peroni* C. von Bonde, 1932: 62; C. von Bonde & Marchand, 1935: 7.
- Ibacus incisus* Ramadan, 1938: 128; Barnard, 1950: 563, fig. 104 c, d; Kubo, 1960: 98; Saisho, 1962: 174; Kensley, 1981: 30 (not *Scyllarus incisus* Leach, 1815).

Ibacus ciliatus Utinomi, 1956: 62, pl. 31 fig. 1 (not *Scyllarus ciliatus* Von Siebold, 1824).

Ibacus sp. Chang, 1965: 46, fig.

Phacus novementatus Anon., 1979: 62.

? *Ibacus* sp. a Phillips, Brown, Rimmer & Braine, 1981: 426, fig. 8.

Vernacular names. — The official Japanese name for the species is “Ohba-utiwaebi” (Harada & Holthuis, 1965: 28). In Shimane, Japan, the species is named “Kejirami-gani”. In South Africa the name “Digging lobster” is used (Von Bonde, 1932). Other vernacular names published for the species are “Sand lobster” and “Large toothed sand crayfish” (Far Seas Fisher. Research Lab., 1976), and “Flat lobster” (Ivanov & Krylov, 1980).

Material examined. — East Africa (1975-1976, R. V. “Prof. Mesyatsev”, FAO-VNIRO Indian Ocean Exped., 1 ♀, RMNH).

Off Zanzibar, Tanzania, 5°38'54"S 39°15'42"E — 5°40'18"S 39°17'36"E (Agassiz trawl, 212 m, 12 January 1934, “John Murray” Exped., Sta. 106, 1 ♀, BM).

Off Moçambique: 13°55.7'S 40°39.6'E (186 m, 14 January 1976, R. V. “Prof. Mesyatsev”, FAO-VNIRO Exped., Sta. 31, 1 ♂, 1 ♀, ZMM); 25°12'S 34°04'E (230-295 m, trawl, 9 September 1964, “Anton Bruun” IIO Exped., Cruise 8 Sta. 397A, Ru-52, 1 ♂, USNM); off Maputo (210 m, 13 February 1979, J. C. Miquel, 1 ♂, RMNH).

Off South Africa: 19 miles off the mouth of the Umvati River, N. of Durban, Natal (130 fathoms (= 238 m), H. W. Bell-Marley, 1 ♂, Stebbing coll., BM no. 1928, 12. 1.33); off Durban, Natal, 29°59'S 31°7'30"E (127 fathoms (= 232 m), sand, dredge, 27 August 1929, “Pickle”, leg. T. Mortensen, Sta. 27, 1 ♂, 2 ♀, UZM).

Off N.W. Madagascar: 12°43.0'S 48°15.5'E (290-295 m, 18 January 1972, A. Crosnier, P3, Chalut. 18, 1 ♂, 3 ♀, MP); 15°20.0'S 46°11.8'E (245-250 m, 7 November 1972, A. Crosnier, P4, Chalut. 47, 4 juv., MP).

Mauritius-Seychelles Ridge (1975-1976, R.V. “Prof. Mesyatsev”, FAO-VNIRO Indian Ocean Exped., 1 ♀, ZMM); 15°45.5'S 60°40.0'E (230-270 m, 6 April 1976, R. V. “Prof. Mesyatsev”, FAO-VNIRO Exped., Sta. 130, 2 ♂, 1 ♀, ZMM, 1 ♀, RMNH).

Japan. Honshu: Tokaido coast, Kururi District near Tokyo (March 1893, F. Sakamoto, 1 ♀, USNM); off Minabe, Wakayama-ken (trawled, January 1963, E. Harada, 1 ♀, RMNH); off Masuda, Yamaguchi-ken (trawled, 39 fathoms (= 71 m), sandy mud, 13 November 1962, E. Harada, 1 ♂, RMNH). Kyushu: Tomioka, Amakusa Islands (40 fathoms (= 73 m), in gill nets, 1 February 1966, 1 ♂, Amakusa Marine Biological Laboratory).

China (coll. F. E. Guérin-Méneville no. 273, don. T. B. Wilson, 1 juv., ANS; 3 ♂, BM; “Mers de Chine”, 2 sp., MP).

Taiwan: Chilung (18 January 1916, M. Ohshima, 1 ♂, USNM).

South China Sea: S.E. of Hongkong, 21°36'N 115°35'E — 21°33'N 115°31' E (60-62 fathoms (= 110-113 m), mud, “Cape St. Mary” Cr. 4/64 Sta. 48, Tr. 193, 12 August 1964, A. J. Bruce, 1 ♂, 1 ♀, BM); S.E. of Hongkong, 21°29.6'N 115°E — 21°26'N 115°E (50 fathoms (= 91 m), mud, Agassiz trawl, “Cape St. Mary” Cr. 4/64 Sta. 71, Tr. 201, 14 August 1964, A. J. Bruce, 2 ♀, BM); S.E. of Hongkong, 21°11'N 115°31'E — 21°8.4'N 115°30'E (Granton trawl, 66 fathoms (= 121 m), sandy mud, 13 August 1964, “Cape St. Mary” Cr. 4/64, Sta. 54, Tr. 195, A. J. Bruce, 1 ♀, 2 ♂, RMNH); 19°35.0'N 112°12.0'E (trawled, 98-102 fathoms (= 179-187 m), soft mud, 21 May 1961, S. C. Tung, 1 ovigerous ♀, RMNH).

Vietnam: Bay of Tam-Quan, about 15°N 109°E (“Lanessan” Entrée no. 7, 1930, A. Krempf, 1 ♂, MP).

Philippines: S.W. of Luzon (without more exact data, 18-28 March 1976, Musorstom I, 1 ♂, 1 ♀, MP); north of Lubang Island, 13°59.0'N 120°10.5' E — 13°59.0'N 120°12.3'E (150-164 m, ottertrawl, 20 March 1976, Musorstom I, Sta. 16, 2 ♂, 1 ♀, MP); 13°53.1'N 120°8.9'E — 13°53.3'N 120° 10.7'E (129-134 m, beam trawl, 26 March 1976, Musorstom I, Sta. 56, 1 postlarva, MP).

Western Australia: W. of Broome, 16°05'S 121°05'E (80-120 fathoms (= 146-220m), trawled, M. V. "Courageous", 26 June 1978, R. W. George, 2 ♀, WAM); N.W. of Cape Cuvier, 23°05'S 113°21'E (210 m, trawled, 10 April 1981, R. W. George, 3 ♂, WAM).

Without locality indication: 1864, coll. Biedermann, 2 specimens, MG.

Description. — The carapace is glabrous and coarsely pitted. The orbits have two sharp, short teeth on the inner angle. The posterior orbital margin shows a shallow and rather broad, more or less quadrangular incision which bears no tubercle. The outer angle of the orbit is somewhat produced, ends in a rather sharp tip, and carries a few teeth on the anterior margin. No incisions or teeth are visible on the orbital margin between the posterior notch and the outer angle. Between the orbit and the anterolateral angle the anterior margin of the carapace bears seven to ten small but distinct teeth. Before the cervical incision the lateral margin of the carapace curves regularly towards the slender and narrowly pointed anterolateral angle; it bears no teeth there, though sometimes some very small spinules may be visible. The lateral margin of the carapace shows eight (more rarely seven) rather broad but pointed postlateral teeth. The anterior and posterior branchial carinae of the upper surface of the carapace lie in a single line. The posterior are straight, becoming slightly convex posteriorly. The postrostral carina is visible over practically its entire length and bears four distinct, blunt teeth (the pregastric, gastric, cardiac and intestinal). Between the postrostral and branchial carinae the carapace shows a shallow branchiocardiac groove.

The abdominal somites have the dorsal surface coarsely punctate and naked. All the somites show a rather indistinct longitudinal dorsal carina which is clearest in the second somite. The pleura of the second to fourth abdominal somites are elongate and pointed; the tip of the second is directed slightly anteriorly. The posterior margins of those of the third to fifth somites bear denticles which are faintest in the third and most distinct in the fifth. The posterior margins of the fifth and sixth somites bear smaller denticles. In the fifth a strong median spine is present on the posterior margin. On the sixth somite there is a distinct transverse band of granules, the two to four median of these are largest and are pointed. The band is one, two or three granules wide.

The distal two segments of the antenna are hairy above in the male, naked in the female. The last segment bears seven or eight teeth on the anterior margin, three or four of which are large, the rest being far smaller. The fourth segment of the antennula bears about 9 to 13 small denticles on the anterior margin; there are three to six small and one to three large teeth on the lateral margin. The anterior tooth is largest and lies more to the interior than the other teeth.

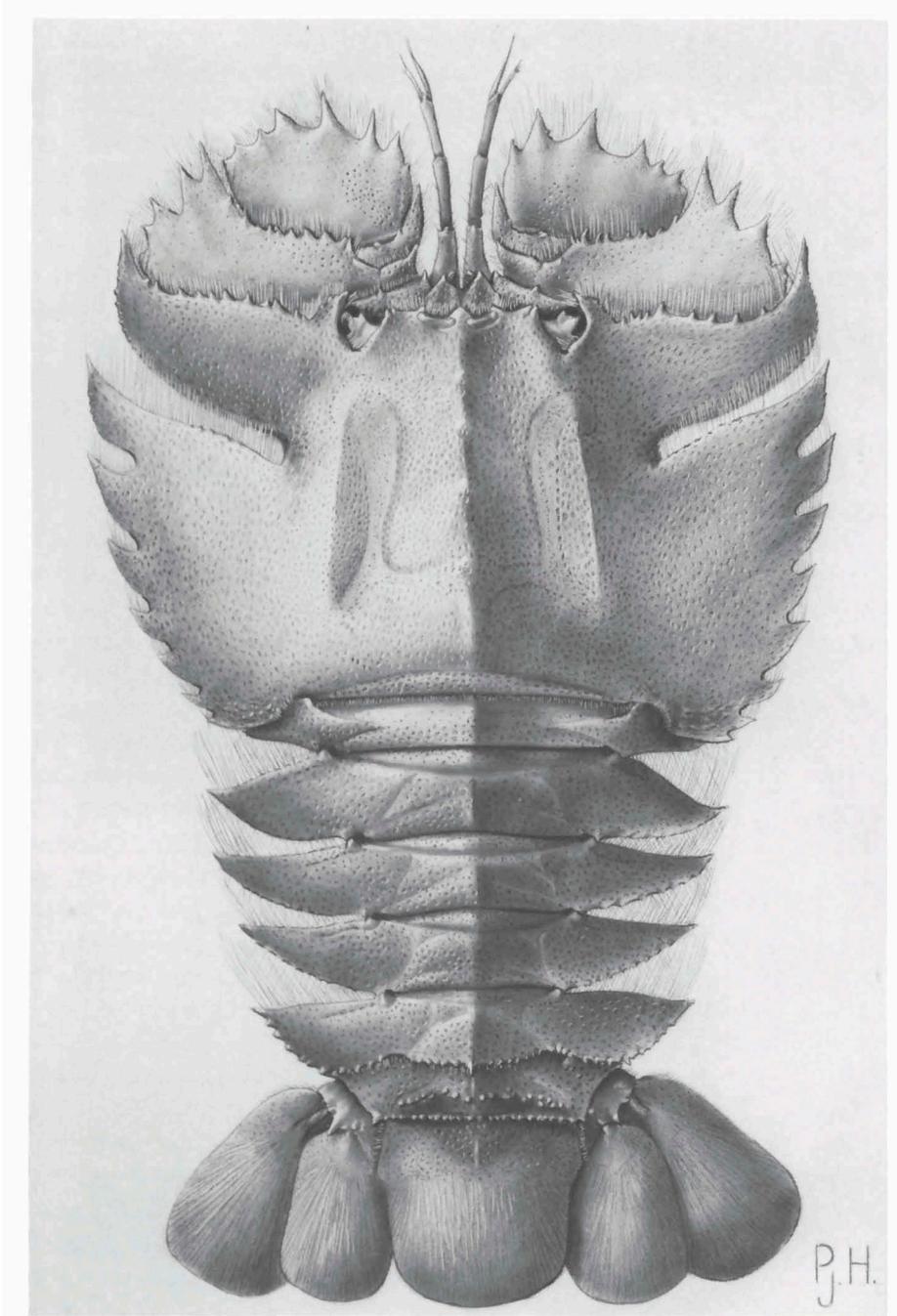


Fig. 15. *Ibacus novemdentatus* Gibbes. Dorsal view of female from Kururi District, Japan. Mrs. P. Hogue del.

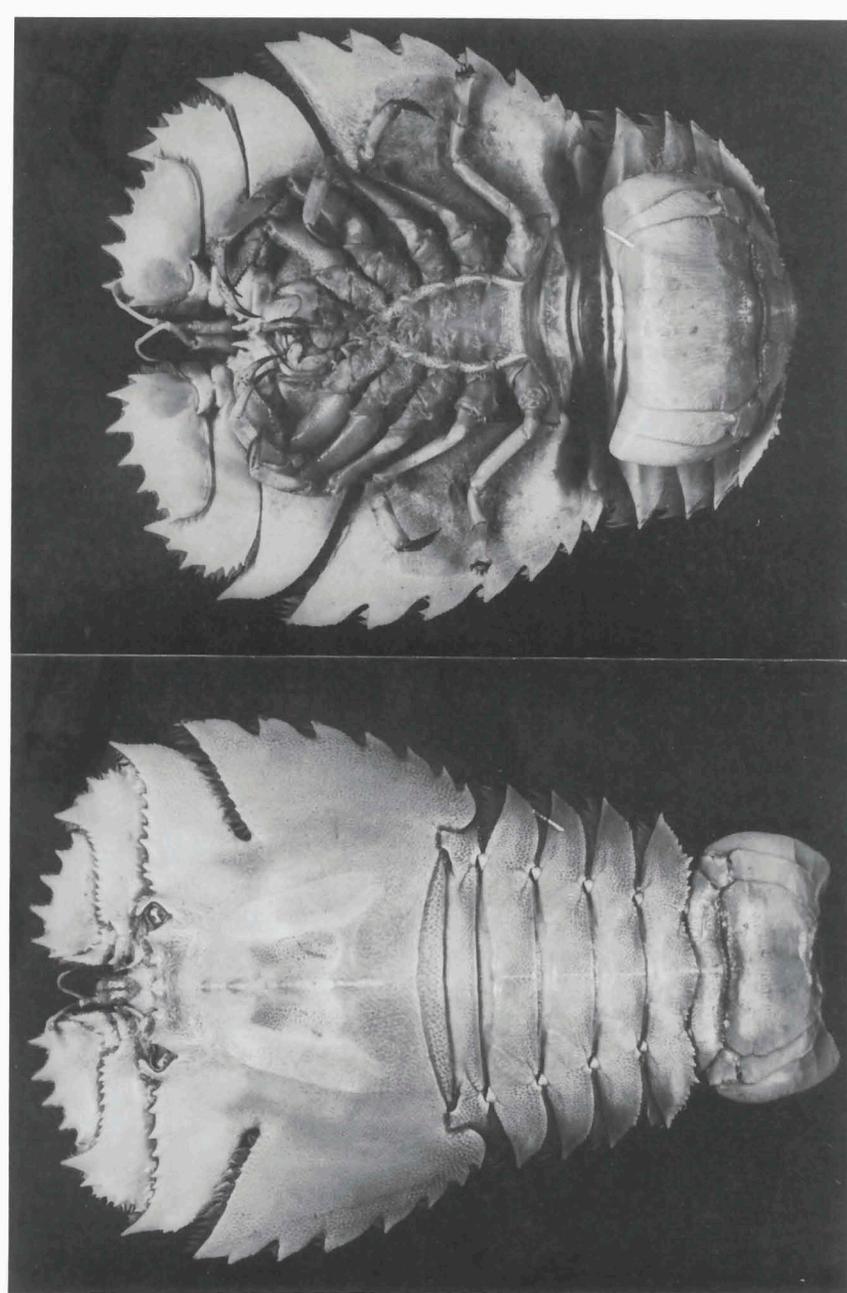


Fig. 16. *Ibacus novemdentatus* Gibbes. Dorsal (left) and ventral (right) view of female from off Zanzibar (John Murray Expedition). $\times 0.5$.

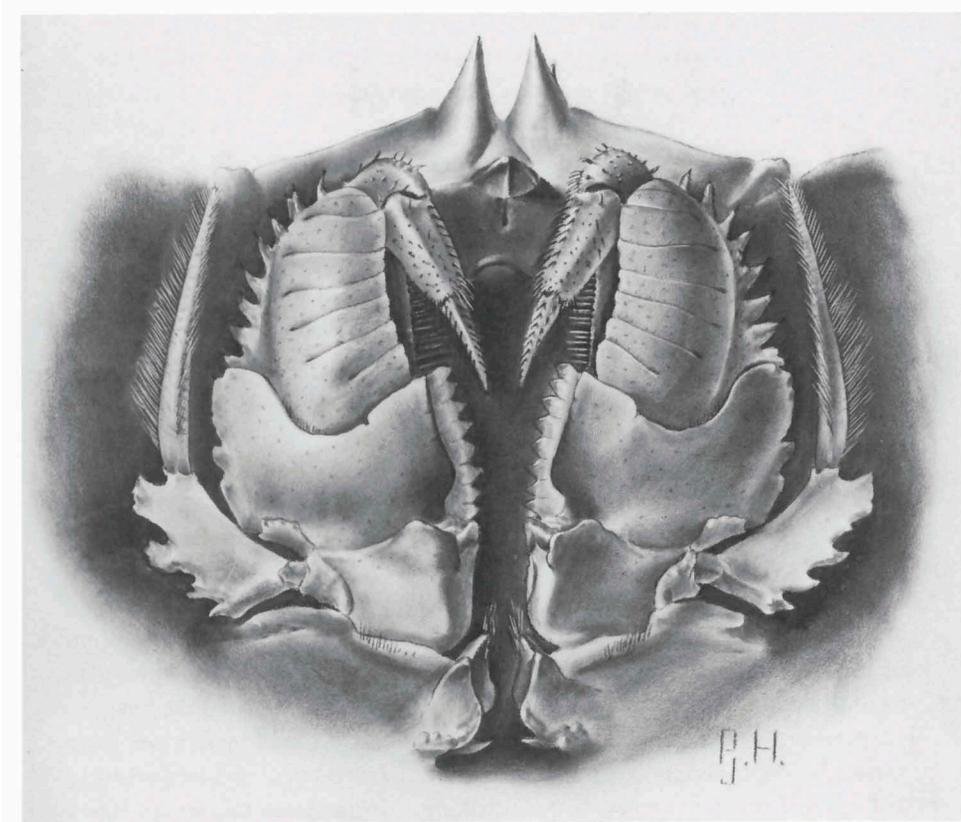


Fig. 17. *Ibacus novemdentatus* Gibbes, female from Kururi District, Japan. Ventral view of oral field. Mrs. P. Hogue del.

The epistome bears three sharp spines which are similar in shape. Two of these are submedian and placed on the anterior margin of the epistome; they are directed forwards. The third lies behind the two former, and is placed in the median line; it points ventrally.

The merus of the third maxillipeds is strongly broadened and swollen. On its inner margin it bears six to eight deep transverse incisions which for the larger part reach beyond the middle of the segment. The outer margin bears six to nine teeth which are placed closer together in the proximal than in the distal part. The ischium has the outer margin about entire or cut into three or four shallow lobes and teeth; the anterolateral angle is rounded and is only slightly produced forwards, it falls far short of the middle of the merus. The basal segment of the exopod bears several narrow spines or lobes on the outer margin. The legs are rather short and less slender than in *I. ciliatus*. The isch-

ium of the first to third pereopods shows an anterodistal spine which is strongest in the first and least conspicuous in the third legs. A second spine is visible behind the first; in the third leg this second spine is reduced to a blunt knob. In the first leg the anterior margin of the ischium is crenulate.

In part of its range *I. novemdentatus* is found together with *I. ciliatus*, a species which it resembles very much. It may immediately be distinguished from *I. ciliatus* by the smaller number of teeth on the lateral margin of the carapace, by the stronger teeth on the postrostral carina, the denticles on the anterior margin of the outer orbital angle, the shape of the epistome and that of the third maxilliped.

Gibbes's (1850) original description, though short and incomplete, mentions enough details to make certain that his species and the specimens here examined are specifically identical. Gibbes's account fortunately gives the most important details, like the number of lateral teeth of the carapace, the number of teeth on its anterior margin, and the shape of the third maxillipeds.

Colour. — "Live specimens are pale yellowish orange with scattered red stipples" (Harada & Holthuis, 1965). Utinomi (1956, 1965, 1978), Nishimura & Suzuki (1971), Miyake (1975, 1982), and Kim (1977) published coloured figures of the species. These figures show the dorsal surface with a ground colour of pale orange, sometimes more pink, sometimes more brownish. On this ground colour there are small spots and marblings of a darker red, covering the entire body, except the soft parts of the tail fan which are pale brownish, sometimes almost uncoloured. In the presence of the spots and marblings the present species differs strikingly from *I. ciliatus* which has a more uniform red or purplish colour. The teeth of the lateral margin of the body usually are pale, rarely with a darker tip. The small teeth on the anterior margin of the carapace and those on the anterior margin of the fourth antennal segment usually are red. The oblique grooves on the second to fourth abdominal somites are often pale. In some published coloured figures (Far Seas Fisheries Research Lab., 1976; Shirai, 1980) the colour seems to be less distinctly marbled.

Size. — The carapace length of the examined males varies between 31 and 72 mm, that of the females between 31 and 77 mm; the ovigerous female has cl. 57 mm. Juveniles with cl. 20 to 26 mm, and a postlarva with cl. 15 mm are present in the collections studied. Shojima (1973) observed a nisto stage with a total length of 30.4 mm, and found phyllosoma's of 2.8 to 28.0 mm long.

Distribution. — The species is now known from East Africa (Kenya to Cape Province), the western Indian Ocean (N.W. Madagascar, Mauritius-Seychelles Ridge), from Korea and Japan to Vietnam and the Philippines, and from Western Australia. The type locality is not known. The first definite

locality from which the species was reported is Hong Kong (Stimpson, 1860). Stimpson's statement that "Specimen nostrum dentes octo laterales habet" makes it practically certain that his identification is correct. Later authors like De Man (1916) and Gee (1925) only repeated Stimpson's locality, and had no new material. The specimens brought by Stebbing (1923) and Ramadan (1938) to *I. peronii* (which the latter author indicated with the name *I. incisus*) on examination showed to belong to *I. novemdentatus*. Stebbing (1923) already remarked on the close resemblance of his specimen to Gibbes's species, and even decided that the two species were synonymous. Also the *Ibacus* specimens from S. and S.E. African waters assigned by Gilchrist (1921, 1922), Von Bonde (1928, 1932), Barnard (1926, 1950), and Von Bonde & Marchand (1938) to *I. peronii* and those which Stebbing (1910) and Gilchrist (1918) thought to be *I. verdi*, all evidently belong here. In Japanese literature the species was first identified with *I. ciliatus* (Von Siebold); Utinomi (1956) gave a good coloured figure of *I. novemdentatus* under the former name. Later Japanese authors recognized the form to be distinct from Von Siebold's species and assigned it to *Ibacus peronii*, as was done by Tokioka & Harada (1964) and Utinomi (1964). Harada (1965) and Harada & Holthuis (1965) showed the second Japanese *Ibacus* to be *I. novemdentatus*, a species not uncommon in Japan, but generally overlooked. The records of the species in the literature are the following:

East Africa: off East Africa (Far Seas Fisheries Research Lab., 1976), "very common . . . on the shelf and in the upper part of the continental slope from Kenya to southern Mozambique and on the Mascarene Ridge banks" (Ivanov & Krylov, 1980); off Malindi, Kenya (Ivanov & Krylov, 1980); off Zanzibar, 5°38'54"S 39°15'42" E – 5°40'18"S 39°17'36"E (Ramadan, 1938); off Mozambique, 25°24'S 33°25'E and 26°3'S 33°4'E (Barnard, 1926, 1950); off Natal, South Africa, 28°53.6'S 32°08.9'E and 29°52'S 31°14.0'E (Berry, 1974); between the mouth of the Umvoti River and Durban (Gilchrist, 1918, 1921, 1922; Stebbing, 1923; Von Bonde, 1928, 1932; Barnard, 1950); off Nahoon Point, East London, Cape Province (Stebbing, 1910; Von Bonde & Marchand, 1935; Barnard, 1950).

Western Indian Ocean: Saya de Malha Bank, Mascarene Ridge banks (Ivanov & Krylov, 1980).

Japan (Utinomi, 1956, 1965, 1978; Kubo, 1960; Tokioka & Harada, 1963; Nishimura & Suzuki, 1971; Miyake, 1975, 1982); southern Japan (Saisho, 1962); off Masuda, Shimane-ken, west coast of Honshu (Harada & Holthuis, 1965); Tokaido, Kururi district, east coast of Honshu (Harada & Holthuis, 1965); Toba, Mie-ken (Sakai & Nakano, 1983); off Minabe, Wakayama-ken (Harada & Holthuis, 1965); Kii district, Wakayama-ken, Honshu (Harada, 1965); Muroto, Shikoku (Matsuzawa, 1977); off Hachinosubana, Uwajima, Ehime-ken, Shikoku (Harada & Holthuis, 1965); off Kamaye, Ohita-ken, Kyushu (Harada & Holthuis, 1965); Tsuyazaki, Fukuoka-ken (Dotsu, Tanaka, Shojima & Seno, 1966); Amakusa, Kumamoto-ken, Kyushu (Kikuchi & Miyake, 1978); Tsushima Island, W. of Kyushu (Harada & Holthuis, 1965); Korea Strait, off S.W. Kyushu, and E. China Sea (Shojima, 1973: distribution chart on fig. 3); "western sea of Kyushu and the Eastern China Sea" (Dotsu, Seno & Inoue, 1966); Ryukyu Islands (Shirai, 1980).

Jeju Island, Korea Strait, Korea, and Hanrim on Jeju Island (Kim, 1976, 1977); Seogwipo on Jeju Island (Kim & Park, 1972; Kim, 1977); Geo-mun Island, Korea Strait, Korea (Kim & Park, 1972; Kim, 1977).

China (Harada & Holthuis, 1965); near Hong Kong (Stimpson, 1860; Gee, 1925; Harada & Holthuis, 1965); Chilung (= Keelung), N. Taiwan (Harada & Holthuis, 1965; Chang, 1965; Hwang & Yu, 1983); Suao, N.E. Taiwan, and Anping and Tungkang, S.W. Taiwan (Chang, 1965); South China Sea (Johnson, 1971).

Western Australia: ? Phillips, Brown, Rimmer & Braine, 1981.

Habitat. — *I. novemdentatus* has been reported from depths between 37 and 400 m. The examined material came from depths of between 71 and 290 m. The depth records in the literature are as follows: "20 org." [= 37 m] (Stimpson, 1860), ca. 40-60, 60-130, ca. 70, ca. 100 m (Harada & Holthuis, 1965), 82 m (Stebbing, 1910; Barnard, 1950), 90-400 m (Kensley, 1981), 150-200 m (Ivanov & Krylov, 1980), 183-194 m (Ramadan, 1938), 100-200 fathoms [= 183-366 m] (Barnard, 1950), 130 fathoms [= 238 m] (Stebbing, 1923; Barnard, 1950), 132 fathoms [= 241 m] (Von Bonde, 1932), 290 and 310 m (Barnard, 1926). Like the other species of this genus *Ibacus novemdentatus* prefers a bottom of fine sediments ("fundo limoso", Stimpson, 1860; sand and shells, Gilchrist, 1921; mud and sand, and mud, Gilchrist, 1922; fine sand, and sand and mud, Barnard, 1926; sand, Von Bonde, 1932; mud, sandy mud, and muddy fine sand, Harada & Holthuis, 1965; sandy mud and soft mud, present material).

Biology. — Chang (1965) remarked that in Taiwan waters the species occurs throughout the year, but is most abundant from March to August. During night-lighting experiments in Nagasaki harbour, Shojima (1973: 114, pl. 1 figs. 1-3) observed "phyllosomas associated with medusae... Each phyllosoma accompanied one or two medusae (*Beroe cucumis?*, *Aequorea macrodactyla?*, pelagiidae and debris of medusa)". He suggested that the phyllosomas may feed on the medusae. Similar observations have been made for *I. ciliatus* and *I. peronii* (q.v.).

Development. — Harada & Holthuis (1965) reported that ovigerous females are found in March. Shojima (1973) found larvae of this species in the E. China Sea from May to September and drew the conclusion that the breeding season must be from March to August. The first four larval stages were described and figured by Dotsu, Seno & Inoue (1966), the last larval and the post-larval (Pseudibacus) stage by Dotsu, Tanaka, Shojima & Seno (1966). Johnson (1971) described and figured a late phyllosoma stage which he provisionally assigned to the present species. Berry (1974) described and figured phyllosoma material from off Natal, South Africa. Takahashi & Saisho (1978) managed to raise the larvae in the laboratory and dealt with the complete larval development.

Phillips, Brown, Rimmer & Braine (1981: 426, fig. 8) described and figured a phyllosoma taken off Western Australia, different from the phyllosoma of *Ibacus peronii* found commonly in the same general area. It is well possible that this phyllosoma of “*Ibacus* sp. a” belong to *I. novemdentatus*, the more so as that species has recently been found off Western Australia.

Economics. — In Korea the species is sold on the market of Busan (Kim, 1977). In Japan it is taken by trawlers and also obtained by long-line fishery (Harada & Holthuis, 1965). In Taiwan it is caught by trawlers and sold on the markets together with *Thenus orientalis* and *Ibacus ciliatus*; the retail prices in 1965 being NT\$ 3 to NT\$ 8 per kg (Chang, 1965). Ivanov & Krylov (1980) recorded maximum catches of 19.2 kg/hour at Saya de Malha Bank, and maximum catches of 22.6 kg/hour off Kenya.

***Ibacus peronii* Leach, 1815**
(figs. 18-20)

- Ibacus Peronii* Leach, 1815 (1814-1817): 152, pl. 119; Latreille, 1816: 32; Desmarest, 1823: 292, unnumbered pl. fig. 2; Schinz, 1823: 46; Desmarest, 1825: 183, pl. 31 fig. 2; Guérin, 1825: 416; Comte, 1832-1840: pl. 56; Griffith & Pidgeon, 1833: 183; H. Milne Edwards, 1837: 287; H. Milne Edwards, 1837a: 120; H. Milne Edwards, 1838: 168; Lucas, 1840: 167; White, 1847: 68; Dana, 1852: 14; Dana, 1852a: 517; Vilanova y Piera, 1875: 380; Haswell, 1879: 280; Pfeffer, 1881: 49; Haswell, 1882: 168; McCoy, 1890: 369, pl. 199; Whitelegge, 1890: 233; Stead, 1898: 208; Stead, 1900: 631; De Man, 1916: 65. Name placed on the Official List of Specific Names in Zoology as name no. 1537, by the International Commission on Zoological Nomenclature in Opinion 519 (Hemming, 1958, Opin. Decl. Int. Comm. zool. Nomencl., 19: 140). Type locality: “New Holland” (= Australia). Holotype in MP.
- Scyllarus incisus* Leach, 1815 (1814-1817): 152 (MS name by Péron, mentioned in synonymy); Lamarck, 1818: 213; Latreille, 1818: 5, pl. 320 fig. 1; Guérin, 1825: 416; H. Milne Edwards, 1837a: 376; H. Milne Edwards, 1839: 394.
- Ibacus peronii* Latreille, 1829: 80; Latreille, 1836: 182; ?Casto de Elera, 1895: 565; Steel, 1896: 550; ?Dakin & Colefax, 1940: 173, text fig. 262, pl. 2 fig. 2; Dakin, Bennett & Pope, 1952: 184, pl. 9 fig. 3, pl. 39 fig. 3; Holthuis, 1956: 113; Hemming, 1958: 136, 140; Healy & Yaldwyn, 1970: 58, text fig. 29, pl. 27; George & Griffin, 1972: 227, fig. 1; Ritz & Thomas, 1973: 5, text figs. 1-8, pl. 1; Burukovsky, 1974: 102; Phillips, Cobb & George, 1980: 71; Phillips & Sastry, 1980: 39; Phillips, Brown, Rimmer & Braine, 1981: 418, 425, fig. 12 c; Burukovsky, 1983: 144.
- ?*Phyllosoma Duperreyi* Guérin, 1829: unnumbered page, pl. 12; Guérin, 1830 (1829-1838): pl. 5 fig. 2; Lukis, 1835: 461; H. Milne Edwards, 1837: 485; Guérin, 1838: 46; Lucas, 1838: 447; Lucas, 1840: 217; Hess, 1865: 168; Richters, 1873: 637, pl. 33 fig. 3; Schmeltz, 1874: 78. Type locality: “Port Jackson”, Sydney, New South Wales, Australia.
- Ibacus Pronii* Latreille, 1831: 61; Latreille, 1834: 195.
- Astacus (Scyllarus) Peronii* Voigt, 1836: 163.
- Ibachus Peronii* H. Milne Edwards, 1840 (1834-1840): 19, pl. 24. fig. 10.
- Scyllarus (Ibacus) Peronii* Herklots, 1861: 142.
- ?*Phyllosoma Duperreyi* Schmeltz, 1866: 24.
- ?*Phyllosoma Duperreyi* Schmeltz, 1869: 61.
- Ibaccus incisus* Bate, 1888: 57, 58, 62, 64, 65; Stebbing, 1893: 193.
- Ibaccus peronii* Bate, 1888: 64 (in synonymy).

- Ibacus incisus* Stebbing, 1893: 194, fig. 16; Thompson, 1901: 18; Coulon, 1918: 18; McNeill, 1926: 327; Hale, 1927: 70, fig. 68; Guiler, 1952: 35; Guiler, 1956: 6; Dakin, Bennett & Pope, 1969: 184, pl. 9 fig. 3, pl. 39 fig. 3; Prasad & Tampi, 1969: 84.
- ?*Phyllosoma duperreyi* Stebbing, 1900: 606, 609; Chilton, 1911: 550.
- ?*Ibacus* Stead, 1935: 105; Thomas, 1963: 208; Bennett, 1967: 132, fig. 95b.
- ?*Ibacus*, species ? (possibly *peronii*) Dakin & Colefax, 1940: 173, fig. 262.
- Ibacus peroni* Holthuis, 1952: 80; Phillips, Cobb & George, 1980: 8.
- Ibacus* Grant, 1978: 685.
- not *Ibacus peronii* Stebbing, 1923: 6, pl. 13; Barnard, 1926: 123; C. von Bonde, 1932: 62; Tokioka & Harada, 1963: 433; Utinomi, 1965: 62, pl. 31 fig. 1; Kensley, 1981: 30 (= *Ibacus novemdentatus* Gibbes).
- not *Ibacus peroni* C. von Bonde, 1932: 62; C. von Bonde & Marchand, 1935: 7 (= *Ibacus novemdentatus* Gibbes).
- not *Ibacus incisus* Ramadan, 1938: 128; Barnard, 1950: 563, fig. 104c, d; Kubo, 1960: 98; Saisho, 1962: 174; Kensley, 1981: 30 (= *Ibacus novemdentatus* Gibbes).

Vernacular names. — “Balmain Bug”, E. Australia (Dakin, Bennett & Pope, 1952, 1969; Healy & Yaldwyn, 1970; George & Griffin, 1972; Grant, 1978; Phillips, Cobb & George, 1980), “Prawn-killer”, New South Wales and South Australia (McNeill, 1926; Hale, 1927; George & Griffin, 1972), “Flapjack”, E. Australia (Dakin, 1952; Dakin, Bennett & Pope, 1969), “Squagga”, South Australia (Hale, 1927), “Sand crayfish” and “Sand lobster” (Healy & Yaldwyn, 1970), “Butterfly lobster” (George & Griffin, 1972), “Southern shovel-nosed lobster” (Phillips, Cobb & George, 1980), “Péron’s *Ibacus* crab” (McCoy, 1890). The first four names are those used by fishermen and local people; the last two evidently are thought up by scientists and are not in common use.

Material examined. — Australia: “Nouvelle Hollande” (1801-1803, F. Péron, 1 holotype, dry, MP); “New Holland” (capt. G. Grey, 1 dry sp., no. 757, BM); no other data (4 dry sp., BM); “Australien”, leg. Blandoncker, 1 juv. (ZMB).

Queensland: Southport, S.E. Queensland (28 fathoms (= 51 m), soft sand, trawled, 5 February 1963, vessel “Dorothea”, W. Goode, 2 juv., WAM).

New S. Wales: no other data (M. Ward, 1 ♀, USNM); S.E. of Ballina (27-28 fathoms (= 49-51 m), “Endeavour” Sta. E 2025-2027, 4 ♂♂, 2 ♀♀, RMNH, USNM); Port Stephens (139-140 fathoms (= 254-256), don. Australian Museum, no. 1912.11.12, 1 ♂, 1 ♀, BM); between Port Stephens and Newcastle (22-60 fathoms (= 40-110 m), “Endeavour” Sta. E 2, 1 ♀, USNM); Port Jackson (1 dry ♂, AM; 1 ♀, MP); off Tathra Head, about 36°43’S (70 fathoms (= 128 m), “Endeavour” Sta. E 6083, 6084, 1 ♂, 1 ♀, USNM); off Twofold Bay (40 fathoms (= 73 m), “Endeavour” Sta. E 6074, 1 ♂, USNM); N. of Twofold Bay, 37°05’S 150°05’E (30-50 fathoms (= 55-91 m), trawl, 30 September 1914, “Endeavour”, leg. T. Mortensen, 2 ♀, UZM).

Victoria: no other data (1 dry ♂, BM); S.E. of Mt. Cana (70 fathoms (= 128 m), “Endeavour” Sta. E 6073, 1 ♀, USNM); S. of Mt. Cana (50-70 fathoms (= 91-128 m), “Endeavour” Sta. E 6075, 1 ♂, RMNH); Melbourne (Baron F. J. H. von Müller, 1895, 1 juv. ♂, MP). In Australian Museum, det. F. A. McNeill, not seen by me: Port Phillip, dredged.

Tasmania: no other data (H. W. Parritt, don. Museum Sydney, 1 ♀, USNM; 1 dry sp., BM); Bass Strait (1 dry sp., BM); E. of Flinders Island, Bass Strait (“Endeavour” Sta. E 492, 1 ♀, USNM); east coast of Flinders Island (“Endeavour” Sta. E 5669, 1 ♂, USNM).

South Australia: no other data (1 dry ♂, AM); 40 miles W. of Kingston (30 fathoms (= 55 m), “Endeavour” Sta. E. 731, P. 2305, P. 2306, 6 ♂♂, 4 ♀♀, RMNH, USNM); St. Vincent Gulf (W. T. Bednall, 1 ♂, ANS); S.W. of Kangaroo Island, 36°13’S 136°10’E (104-110 m, Blake trawl, 30 July 1968, USARP Cruise 34 Sta. 2249, 1 ♀, USNM); Cape Willoughby, Kangaroo Island (January 1950, S. Mansell, don. S. Australian Museum, 1 ovigerous ♀, RMNH); Marsden Point, Kangaroo Island (“Endeavour”, rec’d April 1910, no. 3957, 1 ♂, WAM); S.E. of Kangaroo Island, 36°18’S 138°29’E (60 m, sand, 6 December 1951, “Galathea” Sta. 564, 2 ♂♂, UZM); 36°00’S 138°21’E (64 m, sand, 6 December 1951, “Galathea” Sta. 563, 1 ♀, UZM).

Western Australia: 33°06.5'S 127°16.8'E (107-108 m, 25 September 1973, R. V. "Lira" Sta. 312, leg. O. Petrov, TINRO Exped., 1973, 2 juv., ZMM); Esperance (washed up on the beach, F. J. Daw, 1 dry ♀, AM); Albany (4 June 1921, Inspector of Fisheries, 1 ♀, WAM); 16 miles west of Busselton (5 March 1963, K. King, 1 ♂ WAM); Bunbury (black beach, September 1932, 1 ♀, WAM); near Fremantle (1 ♀, AM); South Fremantle (7 December 1963, G. Staton, don. Western Australian Museum, 1 dry ♀, RMNH); North Fremantle (July 1940, I. Kirkwood, don. Western Australian Museum, 1 dry ♂, RMNH); Swan River (F. Castelnau, 4 ♂, 4 ♀, MP).

"Chile": "Valparaiso" (1 ♂, ZMH no. K7780).

Description. — The carapace is almost naked and coarsely pitted. Very small, stiff hairs are implanted in the pits, but as a rule they do not detract from the impression that the animal is glabrous; the old specimens are more hairy than the young. The orbits have two blunt tubercles in the distal part of the inner margin; the outer angle is produced forward and inward and has a blunt top, its anterior margin bears some tubercles. The posterior margin of the orbit bears an incision in which a tubercle is placed. The orbital margin between the posterior incision and the external angle is uninterrupted, though granules may be present outside of the margin. Between the orbit and the anterolateral angle the anterior margin of the carapace bears about 12 irregular, blunt denticles. The anterior margin of the deep cervical incision of the carapace curves forward and ends in the rather sharply pointed anterolateral tooth. There are no distinct teeth on this part of the margin which may, however, be slightly serrate or crenulate. Behind the lateral incision, the lateral margin bears six to eight rather broad posterolateral teeth (usually six or seven, seldom eight; of the 61 cases examined, 30 showed six teeth, 26 showed seven teeth and only three abnormal specimens showed eight). The anterior branchial carinae are short and straight; the posterior are well pronounced, and markedly convex, bulging outward, they do not lie in one line with the anterior. The postrostral carina is distinct almost throughout its length; it bears four blunt teeth: the pregastric, gastric, cardiac and intestinal, the gastric usually being inconspicuous. These teeth are more distinct in juveniles than in adults. A distinct branchiocardiac groove is present on the carapace.

The abdominal somites are coarsely punctate. The longitudinal median ridge is distinct on the second to fifth somites and is well set off from the rest of the surface; on the fifth somite it ends in a posterior spine. The pleura are elongate, but broader than in *I. ciliatus*. The pleura of the second segment are directed somewhat anteriorly. The posterior margins of the abdominal pleura bear denticles which are largest on that of the fifth somite. The dorsal surface of the sixth somite shows an X-shaped figure of tubercles, most of which are prominent and end in a spine, the submedian being most distinct. The posterior margin of both the fifth and sixth somites bear pointed granules which are lacking in the other somites.

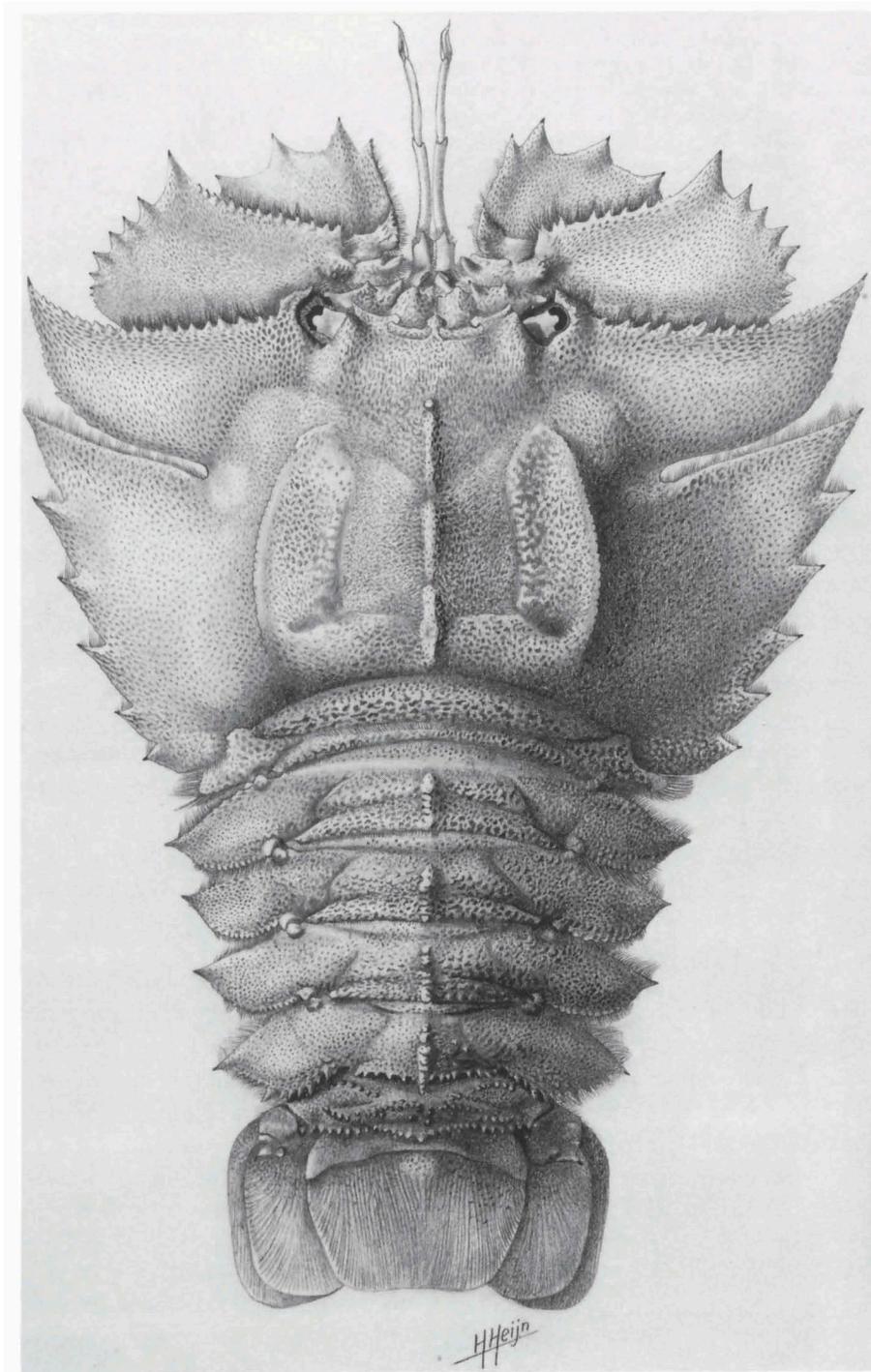


Fig. 18. *Ibacus peronii* Leach. Dorsal view of male from S.E. of Ballina, New S. Wales. Natural size. H. Heijn del.

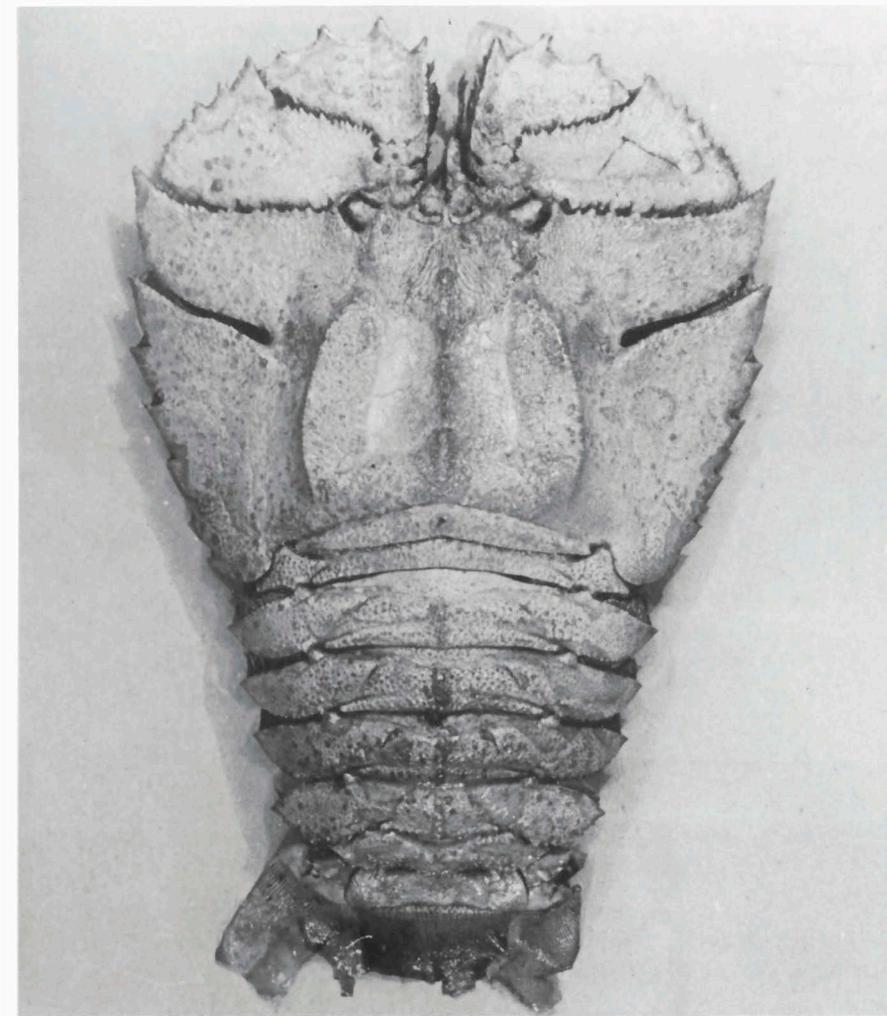


Fig. 19. *Ibacus peronii* Leach. Holotype in dorsal view. Phot. Mus. Paris.

The dorsal surface of the sixth segment of the antenna bears some hairs in adult specimens; these hairs are not more numerous in the males than in the females. The anterior margin bears four to seven teeth, three or four of these are large, the other are low, blunt and small. The fourth segment has about ten very small, blunt, irregular denticles on the anterior margin. The outer margin bears about four to nine teeth, about two to four of which usually are rather large; they are relatively short and broad. The distal is largest and lies closer to the median line of the body than the others.

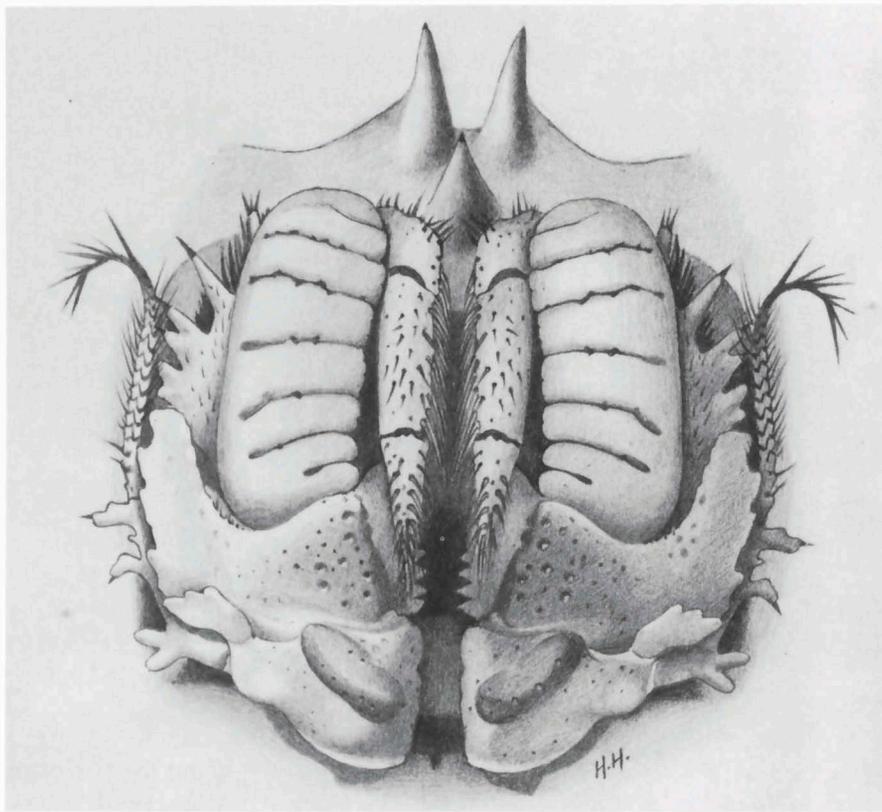


Fig. 20. *Ibacus peronii* Leach, male from S.E. of Ballina, New S. Wales. Oral field in ventral view. H. Heijn del.

The epistome bears three spines of equal size: two submedian in the anterior part and one median more posteriorly; all of these spines are directed obliquely ventrally.

The merus of the third maxilliped is swollen and of a yellowish tinge. On the inner margin it bears seven or eight deep incisions. The outer margin carries about seven slender teeth. The inner margin of the ventral surface of the ischium is entire, the outer is either entire or shows some teeth which usually are inconspicuous; the anterolateral angle is produced into a sharp point and reaches about one third of the length of the merus. The basal segment of the exopods shows some spines on the outer margin. The legs are more heavy than in *I. ciliatus*. The ischium of the first leg shows a blunt tubercle at the distal end of the inner margin, while a second tubercle is placed further back. Traces of this second but not of the first tubercle are visible in the following legs.

Colour. — Various authors described the colour of the living animal: “Reddish, dull cinnamon-brown on upper surface, sides of carapace and outer antennae spotted with round, darker, unequal clouds of same colour, and a few irregular marks of dark Vandyke brown on telson and lateral tail flaps; underside of abdomen pale yellowish; underside of carapace cinnamon-brown, with blackish-brown on basal portions of outer antennae and anterior spine of carapace, behind bases of legs and on swimmerets” (McCoy, 1890: 370). “They are of a beautiful salmon-colour” (Stead, 1898: 208). “The body is dull salmon-red; the carapace is faintly marked with darker spots, and the posterior four-fifths of the telson and the branches of the uropods are yellowish” (Hale, 1927: 70, 71). Excellent coloured illustrations have been published by McCoy (1890: pl. 199) and Healy & Yaldwyn (1970: pl. 27), the former a drawing, the latter a photograph. Ritz & Thomas (1973: 15) described the first postlarval stage as having “a hard calcified shell, creamy white in colour with little pigmentation”, while “after the next moult . . . the animal developed dull orange-red pigment over the dorsal surface”; and “pigment was well developed” in the third stage.

Size. — The examined specimens have the carapace length varying between 19 and 79 mm. The largest specimen reported upon in the literature (namely one mentioned by McCoy, 1890) had a total length of 9 inches, which would correspond with a carapace length of about 80 mm. The usual carapace length, according to McCoy, is about 40 mm, which is about the size of the type specimen which, according to H. Milne Edwards (1837), measures “environ 5 pouces” in total length. The size of the various larval and post-larval stages has been discussed by Ritz & Thomas (1973).

Distribution. — The species is known with certainty only from S.E., S., and S.W. Australia, from Newcastle (N.S.W.) to Geraldton (W.A.); there are records from Chile and the Philippines which need confirmation. The published records are the following:

Australia (= New Holland, = Nouvelle Hollande), without further details (Leach, 1815; Latreille, 1817, 1818, 1829, 1831, 1834, 1836; Lamarck, 1818; Desmarest, 1823, 1825; Guérin, 1825; Voigt, 1836; H. Milne Edwards, 1837a, 1838, 1839; White, 1847), Australasian seas (Leach, 1815; H. Milne Edwards, 1837a, 1838a; Lucas, 1840; Vilanova y Piera, 1875; De Man, 1916 (as “southern seas”)), off the coast of New South Wales (McNeill, 1926; Dakin & Colefax, 1940), Ballina, N.S.W. (Larva: Thomas, 1963), Newcastle (George & Griffin, 1972), estuary of Hawkesbury River, N. of Sydney (Larva: Thomas, 1963), Sydney (Haswell, 1882; De Man, 1916; Stead, 1935. Larva: Thomas, 1963), Pyrmont, Sydney (Steel, 1896), Port Jackson, Sydney (Haswell, 1879; Whitelegge, 1890; Stead, 1898, 1900. Larva: Guérin, 1830, 1833, 1838; Lukis, 1835; Lucas, 1838, 1840; Hess, 1865), Cape Three Points, New South Wales (Coulon, 1918), Philip Island, Victoria (McCoy, 1890), shores outside Port Philip (McCoy, 1890), Hobson’s Bay, Melbourne, Victoria (McCoy, 1890), Tasmania (Ritz & Thomas, 1973), D’Entrecasteaux Chan-

nel, Tasmania (Guiler, 1952), E. Devonport, Tasmania (Guiler, 1956), South Australia (Hale, 1927), St. Vincent Gulf (Hale, 1927; Ritz & Thomas, 1973), Spencer Gulf (Ritz & Thomas, 1973), Port Lincoln harbour, South Australia (Late phyllosoma: Ritz & Thomas, 1973), Fremantle, Western Australia (Ritz & Thomas, 1973), Western Australia south of 31°30'S (Ritz & Thomas, 1973), Geraldton, Western Australia (George & Griffin, 1972). Ritz & Thomas (1973) reported larvae off Western Australia between 25°S and 34°S, up to 350 miles offshore. The specimen reported from Samar Island, Philippines by Casto de Elera (1895) almost certainly does not belong to the present species, it might be *I. novemdentatus* or even *I. ciliatus* or *I. brevipes*; as Casto de Elera gave no details about his material, its identity will remain uncertain. Pfeffer (1881) reported the species from Valparaiso, Chile, but Holthuis (1952) pointed out that this record must be considered dubious. An examination of Pfeffer's specimen, a juvenile male with cl. 25 mm which is preserved in the collection of the Hamburg Museum (reg. no. K 7780), unmistakably showed it to be *I. peronii*; it is likely therefore that the locality label "Valparaiso" is incorrect. Haswell (1879) probably is correct that the larvae mentioned as *Phyllosoma duperreyi* Guérin from Port Jackson belong to the present species. It seems less likely, however, that those from Milne Bay, New Guinea and Denham Bay Beach, Sunday Island, Kermadec Archipelago, reported by Stebbing (1900) and Chilton (1911) as *Phyllosoma duperreyi*, belong here. Schmeltz (1866, 1869, 1874) identified Lot 388 of the Museum Godeffroy as *Phyllosoma duperreyi*. In 1866 he stated that the material came from the South Seas, but later (1869, 1874) he changed the locality to Atlantic Ocean. As both the identity and the locality of this material are doubtful and as no details of it are provided, these records be best ignored. Our knowledge of the phyllosoma larvae is still too insufficient to assign with confidence most of the old larval records to their proper species.

Stebbing's (1923: 7) supposition that *I. novemdentatus* Gibbes is synonymous with the present species, on examination of material of both proves to be incorrect. Gibbes's species is quite distinct.

Habitat. — The species, like the other members of the genus, seems to prefer a substratum of fine to rather coarse sediment. The only records of the bottom in the material examined speak of "sand" and "soft sand". Also Phillips, Cobb & George (1980: 71) speak of "soft substrates". George & Griffin (1972: 228) describe it as "a coarse, muddy, sand bottom". Adults have been obtained in depths between 40 and 250 m; sometimes specimens were found washed ashore. The phyllosoma larvae have been obtained in surface plankton, and also in hauls down to 120-200 m (Ritz & Thomas, 1973: 14).

Development. — As already suggested by Haswell (1879), *Phyllosoma duperreyi* Guérin probably is the larva of the present species. Guérin (1830, 1833, 1838) gave reasonably good descriptions and figures of it. Later authors (Lukis, 1835; H. Milne Edwards, 1837; Lucas 1838, 1840; Hess, 1865) did not add anything to our knowledge of the species. Richters (1873) provided some additional details about what he thought to be the same species, but of which he did not indicate the locality. Haswell (1879) described a late phyllosoma stage from Port Jackson, which he considered to belong to the present species and to represent a later stage than the type of *P. duperreyi*. The larvae mentioned by Stebbing (1900) and Chilton (1911) as *P. duperreyi* from New Guinea and the Kermadec Islands probably are species different from the

present. As pointed out before, the larvae from the "South Seas" or "Atlantic Ocean" brought by Schmeltz (1866, 1869, 1874) to the same species are of very dubious identity. Dakin & Colefax (1940) dealt with *Ibacus* phyllosomas from New S. Wales waters, which very probably belong to the present species. Finally, the complete larval development of the species was described by Ritz & Thomas (1973).

Thomas (1963) discussed the association between phyllosomas of an Australian species of *Ibacus*, most likely the present, with medusae: the phyllosomas attach themselves to the umbrella of the medusae. A similar observation for phyllosomas of the Japanese *Ibacus ciliatus* was published the same year by Shojima (1963), who later (Shojima, 1973) made the same observation for *Ibacus novemdentatus*. Shojima suggested that the phyllosomas feed on the medusae.

Economics. — The species, living on soft bottoms, is occasionally taken by trawlers. According to Healy & Yaldwyn (1970: 58), it is sold. Dakin, Bennett & Pope (1969: 184) state that "it has quite a good flavour when cooked", but according to Grant (1978: 685), its flesh "sometimes tastes and smells strongly of garlic" and therefore is much less esteemed than *Thenus*. The very scant information on this subject seems to indicate that the species is not of great economic importance.

Parribacus Dana, 1852

- Parribacus* Dana, 1852, Proc. Acad. nat. Sci. Philadelphia, 6: 14. Type species selected by Ward (1942, Mauritius Inst. Bull. 2(2): 61): *Scyllarus antarcticus* Lund, 1793. Placed on the Official List of Generic Names in Zoology in Opinion 519 (Hemming, 1958, Opin. Decl. Int. Comm. zool. Nomencl. 19(6): 137). Gender masculine.
- Parribachus* Boas, 1880, K. Danske Vidensk. Selsk. Skr. (6) 1 (2): 87, 88, 89, 181, 182. Erroneous spelling of *Parribacus* Dana, 1852.
- Paribacus* Pfeffer, 1881, Verh. naturwiss. Ver. Hamburg (2) 5: 49. Erroneous spelling of *Parribacus* Dana, 1852.
- Paribaccus* Nobili, 1899, Ann. Mus. Stor. nat. Genova 40: 243. Erroneous spelling of *Parribacus* Dana, 1852.
- Paribaeus* Bergroth, 1905, Zoologist, London (4)9: 65. Erroneous spelling of *Parribacus* Dana, 1852.
- Parabacus* Edmondson, 1923, Bull. Bishop Mus. Honolulu 5: 28. Erroneous spelling of *Parribacus* Dana, 1852.
- Parabaccus* Banner & Randall, 1952, Atoll Res. Bull. 13: 30. Erroneous spelling of *Parribacus* Dana, 1852.
- Parribucus* Aikawa & Isobe, 1955, Rec. oceanogr. Works Japan 2(2): 113. Erroneous spelling of *Parribacus* Dana, 1852.
- Parribaccus* Schroeder, 1964, Nat. Geogr. Mag. 125(1): 134. Erroneous spelling of *Parribacus* Dana, 1852.

Diagnosis. — The carapace is dorso-ventrally flattened, with a deep cervical incision in the anterior part of the lateral margin. This incision is open. The orbits lie on the anterior margin of the carapace; the inner and outer orbital angle do not meet, an intercalated plate is present. The orbital margin is regularly dentate or crenulate. The distance between the two orbits is twice or more than twice the distance between the orbit and the nearest anterolateral angle of the carapace. The lateral margin of the carapace is provided over its whole length with large, sharply pointed teeth of about equal size. The upper surface of the carapace is covered by small squamiform tubercles which show a fringe of stiff, short hairs along their anterior margin. This gives the animals a woolly appearance that made already Rumphius (1705: 3) compare them to “wolle wanten” (woollen mittens). The carapace bears no carinae; only some tubercles in the median line may be larger and more prominent than the others. The cervical, postcervical and branchial grooves are very obscure or absent.

The transverse groove of the first abdominal somite is only visible in its extreme lateral part; it is entirely absent in the greater part of the width of the somite. The upper surface of the posterior half of the following somites bears coarse tubercles which are surrounded by a fringe of short, stiff hairs. A more or less elevated median carina is present on the second to fifth somites, while on the posterior half of each of these somites there is a transverse groove. The fifth somite carries no posteromedian spine. The pleura end in anteriorly directed points.

The antennular somite is almost as long as broad; it is about triangular and ends in two teeth which are placed on either side of the median line, and the tips of which come together. The last (= sixth) and fourth segments of the antenna have large and sharp teeth, placed on their anterior and outer margins.

The epistome is broad and is serrate or crenulate on the anterior margin; the ventral surface of the epistome is devoid of teeth, spines or tubercles.

The mandibular palp is two-segmented. The maxillula has no palp. The exopods of the maxillipeds all are provided with a well-developed flagellum. The third maxilliped has none of its segments swollen.

The normal number of 21 pairs of branchiae is present.

The pereopods are slender. They bear no carinae. The meri show two longitudinal, rather broad, hairy grooves, one on the lower and one on the posterior surface. The carpus has similar grooves which are most distinct in the posterior, least in the anterior legs. The dactyli have no lines of long hairs on the upper surface and are not flattened there. The propodus of the fifth leg of the female has a ventrodiscal tooth which forms a distinct chela with the dactylus.

In the males this ventrodiscal tooth is extremely small and hardly noticeable, so that the leg has an unchelate appearance. The propodus of the legs has a hairy groove on the posterior surface.

The sternum is rather narrow in the large specimens, broader in the younger. The second and third segment have a median posterior tubercle, while in the fifth segment there are usually two submedian tubercles or ridges.

The second to fifth abdominal somites of the male bear pleopods which consist of a protopod with an exo- and endopod. The exopod is leaf-shaped and triangularly broadens towards the apex where it reaches its greatest width. The endopod is similar in shape and size to the exopod. The pleopods diminish in size posteriorly, the endopod more rapidly so than the exopod. The spermatophores are placed on the sternite of the first abdominal somite of the female where they are visible as a narrow, dark-coloured mass.

Remarks. — Of this genus six species are at present known. One of these has a wide distribution, occurring throughout the Indo-West Pacific region and also in the West Indies. The other five species all are Indo-West Pacific and have restricted ranges which do not overlap.

The derivation of the name *Parribacus* is not, as often supposed, from the words “para” and “Ibacus”, but in all probability from “Parra”, the name of the 18th century author Don Antonio Parra who in 1787 described and figured *Parribacus antarcticus* from Cuba.

KEY TO THE SPECIES OF *PARRIBACUS*

1. The transverse groove which separates the anterior from the posterior part of the abdominal somites and which in the fully stretched animal forms the anteriormost part of the visible portion of the somites, is wide and naked, bearing at most a few hairs and tubercles in the median area. The anterior part of the second to third abdominal somites, situated before the just-mentioned groove, bears distinct tubercles. The median carinae of the second and third abdominal somites are elevated. The lateral margin of the fourth segment of the antenna as a rule bears six teeth (exclusive of the apical tooth). The two lateral teeth before the cervical incision are of almost equal size. Indo-West Pacific and West Indian regions *antarcticus*
- The transverse groove which separates the two parts of the abdominal somites is narrower and filled with many short hairs. The median carinae of the second and third abdominal somites are usually almost level with the surface of the somites. The posterior of the two lateral teeth of the

- carapace before the cervical incision is always smaller than the first.
Indo-West Pacific 2
2. The anterior part of the second to fifth abdominal somites, which disappears under the previous somite when the abdomen is fully stretched, carries distinct tubercles. Fourth segment of antenna with six or seven teeth on the outer margin (apical tooth not included). Legs short and robust 3
- The anterior part of the second to fifth abdominal somites smooth or with a reticular pattern of shallow and narrow grooves. Fourth segment of antenna as a rule with five or six teeth on the outer margin. Legs more slender 4
3. Fourth segment of antenna with seven teeth on the outer margin (apical tooth not included). Squamiform tubercles on upper surface of carapace blunt and appressed. Queensland, New Caledonia, Loyalty Islands, New Hebrides and Fiji *caledonicus*
- Fourth segment of antenna with six teeth on the outer margin (apical tooth not included). Squamiform tubercles on upper surface of carapace pointed and not appressed. Easter Island *perlatus*
4. Distance between the orbit and the anterolateral angle of the carapace more than $\frac{2}{5}$ of the distance between the two orbits; outer margin of second segment of antenna as a rule with five teeth. The posterior of the two lateral teeth of the carapace before the cervical incision much smaller than the first. First abdominal somite with five red, sharply defined spots on the posterior margin, and a row of smaller spots which is placed more anteriorly *holthuisi*
- Distance between the orbit and the anterolateral angle of the carapace $\frac{2}{5}$ or less than $\frac{2}{5}$ of the distance between the two orbits. The posterior of the two lateral teeth of the carapace before the cervical incision smaller, but not very much smaller than the anterior. The first abdominal somite with three or five not very sharply defined spots on the posterior margin: no second row of spots is present 4
5. Rostrum with a dorsal rostral tooth. Outer margin of second segment of antenna as a rule with six teeth *scarlatinus*
- Rostrum without a dorsal rostral tooth. Outer margin of second segment of antenna as a rule with five teeth *japonicus*

Parribacus antarcticus (Lund, 1793)

(figs. 21, 25A)

- “Potiquiyixxe” Marcgrave, 1648: 186, fig.; Marcgrave, 1942: 185, fig.; Sawaya, 1942: 186, lxiii, fig.
- “Potiquiuijixxe” Jonstonus, 1650: pl. 9 fig. 14; Jonstonus, 1767: pl. 9 fig. 14.
- “Potiquiunijxe” Jonstonus, 1657: pl. 9 fig. 14; Jonston, 1660: pl. 9 fig. 14; Jonstonus, 1665: pl. 9 fig. 14; Ruysch, 1718: pl. 9 fig. 14.
- “Squilla Brasilian. Potiquiyixxe” Sachs, 1665: 93, pl. 3.
- “Ursa-Cancer” Rumphius, 1705: 3, pl. 2 fig. C; Rumphius 1711: 1, pl. 2 fig. C; Rumphius 1739: 1, pl. 2 fig. C; Rumphius, 1741: 3, pl. 2 fig. C; Seba, 1759: 50, pl. 20 fig. 1.
- “Squilla lata Mas” Petiver, 1713: 1, pl. 2 fig. 12.
- “Tafel-Kreeft” Renard, 1718, pt. 2: pl. 47 fig. 195; Renard, 1754, pt. 2: pl. 47 fig. 195.
- “Potiquiyixxe” Sloane, 1725: 271.
- “Oedang Pasir Laoet” Valentijn, 1726: 423, fig. 255.
- Cancer Arctus* Herbst, 1786: pl. 364.
- “Langostino” Parra, 1787: 150, pl. 54 fig. 2.
- Scyllarus antarcticus* Lund, 1793: 22; Weber, 1795: 94; Latreille, 1802: 181; Lamarck, 1818: 212; Guérin, 1827 (1827-1831): pl. 20 fig. 1; Guérin, 1828 (1827-1831): 4; Latreille, 1829: 80; Desmarest, 1830: 53; Latreille, 1831: 61; Henschel, 1833: 203; Latreille, 1834: 195; H. Milne Edwards, 1837a: 375; H. Milne Edwards, 1839: 394; Owen, 1839: 86; H. Milne Edwards, 1841 (1836-1844): 120, pl. 45 fig. 3; Holthuis, 1956: 114; Hemming, 1958: 137. Type localities: Amboina and Brazil, restricted to Amboina by the lectotype selection by Holthuis (1956: 111), who as such selected the specimen figured by Rumphius (1705) as Ursa-Cancer. Name placed on the Official List of Specific Names in Zoology as Name no. 1527, in Opinion 519 (Hemming, 1958, Opin. Decl. Int. Comm. zool. Nomencl., 19(6): 138).
- Cancer (Astacus) ursus major* Herbst, 1793 (1791-1796): 82, pl. 30 fig. 2. Type localities: Japan and Amboina: restricted to Amboina by the lectotype selection by Holthuis (1956: 111), who as such selected the specimen figured by Rumphius (1705) as Ursa-Cancer. Name placed on the Official Index of Rejected and Invalid Specific Names in Zoology, as Name no. 534, in Opinion 519 (Hemming, 1958, Opin. Decl. Int. Comm. zool. Nomencl., 19(6): 144).
- Scyllarus antarcticus* Fabricius, 1798: 399.
- Scyllarus antarcticus* Lamarck, 1801: 157; Bosc, 1801-1802: 19.
- Scyllarus Antarteticus* Leach, 1814: 397.
- Cancer ursus major* Latreille, 1816: 32.
- ?*Scyllarus carinatus* Guilding, 1825: 336; Holthuis, 1946: 89. Type locality: “in mari Caribeo”, probably near St. Vincent, West Indies.
- Ibacus ciliatus* Guilding, 1825: 337. Type locality: “in Caribeo mari”, probably near St. Vincent, West Indies.
- “Scyllare antarctique” Latreille, 1825: 416.
- Scyllarus Antarteticus* Comte, 1832-1840: pl. 56.
- Ibacus antarcticus* H. Milne Edwards, 1837: 287.
- Ibacus antarcticus* H. Milne Edwards, 1838: 168; H. Milne Edwards, 1839 (1836-1844): pl. 45 fig. 3; Bleeker, 1845: 504; White, 1847: 68; Gibbes, 1850: 193; Dana, 1852: 14; Dana, 1852a: 517; A. Milne Edwards, 1862: 14; A. Milne Edwards, 1863: 14; Schmeltz, 1866: v, 24; Von Martens, 1872: 124; Hoffmann, 1874: 42; Brocchi, 1875: 14; Neumann, 1878: 34; Richters, 1880: 161; Haswell, 1882: 169; Mocquard, 1883: 147; Whitelegge, 1897: 146; Anon., 1899: 518; Thompson, 1901: 18; Coulon, 1907: 179; Torralbas, 1917: 69, fig. 45.
- Ibacus Parrae* H. Milne Edwards, 1837: 288; Guérin, 1856: xvii; Guérin, 1857: xlii; Dana, 1852: 14; Dana, 1852a: 517. Type locality: “les Antilles”, here restricted to Cuba.
- Ibacus parrae* Gibbes, 1850: 193.
- Ibachus antarcticus* Gibbes, 1850a: 25, 28.
- Ibachus Parrae* Gibbes, 1850a: 28.

- Parribacis antarcticus* Dana, 1852: 14; Dana, 1852a: 517; Dana, 1852b: 124; Dana, 1855: 11, pl. 32 fig. 6; Miers, 1877: 138; Miers, 1880: 378; Rathbun, 1897: 43; Rathbun, 1906: 896; Nutting, 1919: 72; Pesta, 1933: 280; Seurat, 1934: 60; Holthuis, 1946: 102 (p.p.); Poisson, 1947: 15, 63, pl. 7; Holthuis, 1953: 50 (p.p.); Forest, 1954: 345, fig. 26A; Hiatt, 1954: 30; Matthews, 1954: 28, figs. 1-11; Matthews, 1954a: 205, figs. 1, 2A, 3A, 6-10; Holthuis & Zaneveld, 1958: 15, not pl. 1 (= *P. caledonicus*); Holthuis, 1959: 99, pl. 7 fig. 1; Holthuis, 1959a: 129; Chuang, 1961: 182, 210, pl. 84 centre fig.; Green, 1961: 70; ? Saisho, 1962: 174, figs. 1, 2; Harada, 1965: 37; Tinker, 1965: 48, pl. 12; Fausto Filho, Matthews & Holanda Lima, 1966: 127; ? Saisho, 1966: 177, 196, fig. 3; Robertson, 1968: 93, 95, figs. 1-7; Robertson, 1968a: 334; Sims, 1968: 261, 262; Sims & Brown, 1968: 80; Chevalier, Denizot, Mougou, Plessis & Salvat, 1969: 137; Prasad & Tampi, 1969: 84; Robertson, 1969: 311; Robertson, 1969a: 565, 578, 579, 581, 583; Johnson, 1970: 19; Hazlett, 1971: 5, 6, 7, 8; Johnson, 1971: 88, figs. 42-71; Johnson, 1971a: 273, figs. 89-92; Johnson, 1971b: 15; Michel, 1971: 472; Bardach, Ryther & McLarney, 1972: 647; Coelho & Ramos, 1972: 159; Opresko, Opresko, Thomas, Voss & Bayer, 1973: 7, 30, text fig. 14, pl. 10; Berry, 1974: 13, 17, 18, figs. 60-66; Burukovsky, 1974: 102; Johnson, 1974: 643; Farrugio, 1975: 3, 4, 8, fig. 7; Farrugio & St. Felix, 1975: 17; Thampi, 1976: 561; Colin, 1978: 355; Manning, 1978: Scyll Par 1, fig.; Cervigon & Fischer, 1979: 239; George & George, 1979: 77; Phillips, Cobb & George, 1980: 53, 71; Prasad, Tampi & George, 1980: 99, fig. 16; ? Shirai, 1980: 411, fig.; Van Olst, Carlberg & Hughes, 1980: 336; Ingle, 1982: 456, upper fig.; Burukovsky, 1983: 144; Hwang & Yu, 1983: 263, fig. 3; Meiyappan & Kathirvel, 1983: 117, fig. 1; Prasad, 1983: 144, fig. 3d.
- Parribacis Parrae* Dana, 1852: 14; Dana, 1852a: 517; Dana, 1852b: 124; De Man, 1916: 66.
- Scyllarus (Ibacus) Parrae* Herklots, 1861: 142.
- Ibacus (Paribacis) antarcticus* Schmeltz, 1869: 61; Schmeltz, 1874: 78.
- Parribacis* Boas, 1880: 87, 88, 89, 181, 182.
- Paribacis antarcticus* Pfeffer, 1881: 49; Ortmann, 1891: 45; Thallwitz, 1892: 50; Borradaile, 1899: 1014; Borradaile, 1899a: 419; Lenz, 1901: 441; De Man, 1902: 101; Andrews, 1912: 182, text figs. C-G, pl. 6 fig. 2; Demandt, 1913: 108; Demandt, 1914: 110; Estampador, 1959: 39.
- Paribacis antarcticus carinatus* Pfeffer, 1881: 49. Type locality: "Südsee". Holotype in ZMH.
- Paribacis antarcticus* Nobili, 1899: 243; Balss, 1914: 81; Edmondson, 1933: 223, fig. 133; Edmondson, 1946: 258, fig. 157; Smith, 1948: 97; Wiersma, 1951: 137; Wiersma & Ripley, 1952: 395, 397.
- Ibacus parrae* Young, 1900: 430, fig.
- Parribacis papyraceus* Rathbun, 1906: 897, pl. 18 fig. 5; Dawydoff, 1952: 137. Type localities: "Hilo, Hawaii" and "South coast of Molokai Island", Hawaiian Archipelago. As lectotype is chosen the male from the latter locality (USNM, cat. no. 30265). Both types in USNM.
- Scyllarus Latus* Valdés Ragués, 1909: 178 (not *Scyllarus latus* Latreille, 1802).
- Paribacis parra* Balss, 1914: 81.
- Parribacis ursus* Stebbing, 1915: 63.
- Parribacis ursus major* De Man, 1916: 66, 93; De Man, 1924: 57; Edmondson, 1925: 18; Petit, 1930: 122; Ward, 1942: 61; Poisson, 1947: 15; Barnard, 1950: 565; Dawydoff, 1952: 137; Fourmanoir, 1955: 28; Michel, 1974: 256; Kensley, 1981: 30.
- Parribacis ursus major carinata* De Man, 1916: 66.
- Paribacis ursus major* Parisi, 1917: 13 (p.p.?), not fig. 3.
- Parabacis antarcticus* Edmondson, 1923: 28.
- Paribacis ursus-major* Matthews, 1926: 8, 17.
- Parribacis ursus-major* Boone, 1935: 54, pl. 13; Oo-U-Kijo, 1937: 30, figs. 1, 2.
- Parribacis antarticus* Nutting, 1936: 81; Chabouis & Chabouis, 1954: 89, fig.; Bonnelly de Calventi, 1974: 19; Bagnis & Christian, 1977, 1980, 1983: 40; Rodriguez, 1980: 195.
- Cancer barffi* Curtiss, 1938: 164. Type locality: "On the barrier reef, at Tautira", Tahiti.
- Phyllosoma* Johnson, 1951: 274, pls. 1, 2.
- Parabacis antarcticus* Banner & Randall, 1952: 30.
- ?*Parribacis ursus-major* Aikawa & Isobe, 1955: 113, fig. 1.
- Jasus lalandii* Prasad & Tampi, 1960: 163, fig. 18.

- Parribacis antacticus* Lemos de Castro, 1962: 41, 48, pl. 3 figs. 22, 23.
Parribacis antarcticus Schroeder, 1964: 134, fig. on p. 145.
Parribacis antharticus Chevalier, Denizot, Mougins, Plessis & Salvat, 1969: 92.
 ?*Scyllarus* spec. Berry, 1974: 17, figs. 60-66.
Syelarides neocaledonicus Brower, 1974: 145, fig. (not *Parribacis caledonicus* Holthuis, 1960).
 "Antarctic Slipper Lobster" DeLuca & DeLuca, 1976: 48.
Parribacis caledonicus Faulkner & Fell, 1976: 189, pl. 131 (not *P. c.* Holthuis, 1960).
Scyllarus Hamelin-Vivien & Pétron, 1981: 50, 100, fig. 59.
 not *Scyllarus (Ibacus) antarcticus* De Haan, 1841: 153, pls. J, L; Herklots, 1861: 142 (= *P. japonicus* Holthuis).
 not *Parribacis antarcticus* Stimpson, 1860: 23; Nobili, 1907: 366; Morrison, 1954: 16; Wiens, 1962: 258 (= *P. holthuisi* Forest).
 not *Parribacis ursus-major* Kubo, 1954: 759, fig. 2188 (= *P. japonicus* Holthuis).
 not *Parribacis antarcticus* Utinomi, 1956: 62, pl. 31 fig. 2; Kubo, 1960: 98, pl. 49 fig. 7; Kubo, 1965: 627, fig. 1022; Utinomi, 1965: 62, pl. 31 fig. 2; Holthuis & Sakai, 1970: 92, 290; Nishimura & Suzuki, 1971: 89, pl. 30 fig. 3; Miyake, 1975: 107, fig.; Matsuzawa, 1977: pl. 75 fig. 5; Utinomi, 1978: 62, pl. 31 fig. 2 (= *P. japonicus* Holthuis).
 not *Parribacis* Sims, 1964: 265, figs. 1-4; Sims, 1965: 142, figs. 1-13; Sims, 1968: 259, 261, 263 (= *Scyllarides* sp.).

Vernacular names. — Atlantic: "Langostino", Cuba (Parra, 1787), "Sea cockroach", Jamaica (Andrews, 1912), "Savate", "Maman homard", "Marie-carogne", Martinique (Farrugio, 1975), "Horseshoe crab", Barbados (Young, 1900), "Chineza", Brazil (Cervigon & Fischer, 1979), "Potiquiyixé", near Recife, Brazil (Marcgrave, 1648).

Indo-West Pacific: "Cigale de Mer", "Taille de boeuf", Réunion (Hamelin-Vivien & Pétron, 1981), "Udang laut lebar" (= flat sea shrimp), Malaysia (Chuang, 1961), "Oedang [= Udang] lawut [= laut] lebar", Java (Bleeker, 1845), "Udang laut lebar", "Cattam [= ketam (= crab)] gonosso, Amboina (Rumphius, 1705), "Oedang [= Udang] pasir laut" (= sea sand shrimp), Amboina (Valentijn, 1726), "Uhut", "Miju uhut", Amboina (Rumphius 1705), "Braber", Palau (Brower, 1974), "Tapatapa", Kapingamarangi (Smith, 1948), "Allpap", Kusaie, Caroline Islands (Smith, 1948), "Uraber", Jaluit and Ailinglapalap, Marshall Islands (Smith, 1948), "Jipukpuk", Majuro, Marshall Islands (Smith, 1948), "Te Mnawa", Onotoa, Gilbert Islands (Banner & Randall, 1952), "Tappa tappa", Funafuti, Ellice Islands (Whitelegge, 1897), "Papata", Samoa (Demandt, 1913), "Tianée", Tahiti (Curtiss, 1938; Chabouis & Chabouis, 1954; Bagnis & Christian, 1980), "Kopapa", Mangareva (Seurat, 1934), "Ula-papapa", Hawaiian Islands (Tinker, 1965; Dr. Lutz, ZMH, on field label), "Sand lobster" (Smith, 1948; Banner & Randall, 1952), "Langouste de sable", "Cigale de mer" (Chabouis & Chabouis, 1954), "Spanish lobster", "Shovel-nosed lobster", "Antarctic slipper lobster" (Tinker, 1965). The FAO names are: "Sculptured slipper lobster" (English), "Cigale savate" (French), "Cigarro chino" (Spanish).

Material examined.

Atlantic

West Indies: West Indies (1 specimen, BM); Antilles (1 ♂, ZMA); Caribbean Islands (1888, Dahl, 1 ♀, ZMO).

Greater Antilles: Cuba (J. Gundlach, 1 ♀, ZMB); Havana, Cuba (1 ♂, UZM); Arroyo Bermejo, Jibacoa, between Havana and Matanzas, Cuba (Gorgonaria stand among Madrepোরিয়া, 5 m, 16 June 1967, H.-E. Gruner, 1 ♂, ZMB); Jamaica (1 ♂, USNM); Montego Bay, Jamaica (caught in fish pot in shallow water, 1910, C. B. Wilson, 1 ♂, USNM).

Lesser Antilles, Eagle Shoal, St. John, Virgin Islands (1 February 1961, J. Randall, 1 ♂, IMS); St. Croix, Virgin Islands (40 feet (= 12 m), coral and sand, February 1961, D. Wolfferts, 1 ♂, IMS); Roseau, Dominica (A. H. Verrill, 1 ♀, USNM); Martinique (1859, Bellanger, 1 ♀, MP); outer Piscadera Bay near Willemstad, Curaçao, Netherlands Antilles (11 and 27 June 1958,

J. S. Zaneveld, 1 ♂, 2 ♀, RMNH); Lac, Bonaire (in fish trap, 1 m, 3 August 1982, M. van der Knaap, 1 ♂, RMNH); Klein Bonaire, near Bonaire, Netherlands Antilles (washed ashore on western shore, 25 March 1955, J. S. Zaneveld and P. Wagenaar Hummelinck, 1 carapace, RMNH).

Florida: Florida Keys (shallow water, N. C. Hulings, 1 ♂, coll. Texas Christian University, Fort Worth, Texas, U.S.A.); off Key Biscayne, Miami (about halfway between shore and edge of drop-off, 1962, J. de Joco, 1 ♀, IMS); 1/3 mile SSW of Alligator Light, near Lower Matecumbe Key, Florida Keys (20 feet (= 6 m), inside ledge, 5 January 1963, W. A. Starck and R. E. Schroeder, 1 ♂, IMS).

Caribbean Sea off Nicaragua, 14°21'N 81° 55'W (10' try net, 192-263 m, 31 January 1971, R. V. "Pillsbury" Sta. 1354, 1 *Pseudibaculus* stage RMNH).

British Honduras: Half Moon Cay (May 1948, Walters, 1 ♀, IMS).

Guianas: Georgetown, Guyana (in fish pot, 2½ fathoms (= 4.6 m), 12 May 1938, Oxford University Cayman Expedition, 1 ♀, BM); Suriname (1 ♀, ZMH; W. V. Brehn, 1 ♀, ZMH).

Brazil: Recife (= Pernambuco), Brazil (1875, R. Rathbun, 1 postlarva, USNM), Bahia (1 ♀, ZMH; 25 August 1863, A. F. Andréa, 1 ovigerous ♀, UZM).

Indo-West Pacific

East Africa: East Africa (R. H. P. Carcasson, 1961, don. Coryndon Museum Nairobi, 1 ♀, BM; L. S. B. Leakey, 1951, 1 ♂, BM); reef off Mombasa (1959, L. S. B. Leakey, 1 ♂, BM); Mombasa, Kenya (fish market, 1974, A. J. Bruce, 1 ♂, RMNH); Bagamoyo, Tanzania (1960, H. W. P. van Barneveld, 1 ♂, RMNH).

Western Indian Ocean: Baie d'Ambanoro, Nosy Bé, N. W. Madagascar (in front of ORSTOM station, trammel net, 1979, 1 ♀, MP); Mauritius (R. E. Griffiths, 1 ♀, ANS; 1 ♀, BM; 3 *Pseudibaculus* stages, syntypes of *Pseudibaculus pfefferi* Miers, BM; L. W. Schaufuss, 4 *Pseudibaculus* stages, ZMB); Pointe des Galets, Réunion (trammel net, P. Guézé, 1 ♂, MP); near Pointe Marianne, ocean side of Diego Garcia, Chagos Archipelago (15 April 1972, Y. Miski and L. Lambert, 1 ♂, USNM); Ceylon (1963, G. H. P. de Bruin, 1 ♀, RMNH); Christmas Island (October-November 1961, D. Powell, 1 ♂, 3 ♀ ♀, WAM).

Taiwan: Near Ch'u'an-Fah-Shi, 21°55.8'N 120°49'E (rocky shore, 0-1 m, 7 May 1968, V. G. Springer no. 68-21, 1 juv., USNM).

Philippines: Cuyo Islands, 10°55'05"N 121°02'03"E (0-4 m, poison station, 22 May 1978, V. G. Springer, SIPhilExp. 78-18, 1 ♂, USNM); Guimaras Island, near Panay (1 specimen, BM); Port Siyt, S. Negros oriental, 9°4'N 123° 10.8'E (0-31 m, poison station, 28 April 1979, SIPhilExp. 79, 1 ♂, USNM); Cebu Channel (J. B. Steere, 1 ♂, USNM); Lauang, Samar (reef, F. Jagor, 1 ♂, ZMB); Tubajon Bay, Dinagat Island (obtained from natives, remains of a meal, "Galathea" expedition Sta 415, 18 July 1951, 1 carapace, UZM).

Indonesia: Sumatra (1 specimen, BM); Sabang Bay, N. Sumatra (G. Hermans, 1 ♂, ZMA); North Celebes (A. B. Meyer, 1 ♀, ZMB); Beo, Karakelong, Talaud Islands (13 m, mud and sand, 24/25 July 1899, "Siboga" Exped. Sta. 131, 1 juv. ♂, ZMA); Kisar near Timor (1898, K. Schädler, 1 ♂, RMNH); see also under New Guinea.

New Guinea: New Guinea (E. Gerrard, Jr., 1 ♂, 1 ♀, BM; O. G. J. Mohnicke, 1 sp., ZMB); Korido, Soepiori (= Soweik) Island, Schouten Islands, West New Guinea (12 March-3 April 1869, C. B. H. von Rosenberg, 1 ♀, RMNH); Sorido, south coast of Biak Island, West New Guinea (shore, obtained from natives, February 1955, B. Pluymers, 1 carapace, RMNH); Inserom near Sorido (reef, 8 March 1955, L. B. Holthuis, 1 ♀, RMNH); Base G, Pacific coast N. of Hollandia, West New Guinea (reef, April 1955, G. van Hout and G. F. Haneveld, 1 ♂, RMNH); Walis (= Valif) Island, north coast Papua New Guinea, 3°14'S 143°19'E (18 July 1912, Preussische Neuguinea Comp., 1 juv., ZMB); Hermit Island, 1°30.5'S 144°59.25'E (north side of W. entrance, 0-12 m, poison station, 4 November 1978, V. G. Springer no. 78-19, 1 ♀, USNM); Samarai (= Dinner) Island, S. E. Papua (1888, H. O. Forbes, 1 ♀, BM).

Australia: Australia (1 ♀, ZMA).

Polynesia: Polynesia (I. E. Thayer, 2 ♂, USNM); Southern Seas (Mus. Godeffroy, 1 ♂ holotype of *Parribacus antarcticus carinatus* Pfeffer, ZMH).

Melanesia: New Ireland (1 ♂, ZMA); Ralum, New Britain (coral reef, December 1896, F. Dahl, 1 ♀, ZMB); Gasmata, New Britain (1950, H. A. Ashton, 1 ♂, ANS); Duke of York Island (1877, G. Brown, 1 ♂, 1 ♀, BM); Puruata Island near Bougainville Island, Solomon Islands (14 August 1944, W. L. Necker, 1 ♂, USNM); Santa Ana Island, Solomon Islands (July 1933, Templeton Crocker Expedition, 1 ♀, USNM).

Micronesia: Ringatori, Kapingamarangi (algal mat and rill zone, 3 August 1954, C. Hand, 4 ♂, 2 ♀ (1 ovigerous), USNM); Caroline Islands (1898, F. W. Clouetair, 1 ♂, 1 ♀, BM); southern end of Falarik Island, and northern end of Falalap Island, Ifaluk Atoll, Caroline Islands (from seaward reef, collected with Coleman lamp, 11 October 1953, F. M. Bayer, 1 ♂, USNM); Enewetak Atoll (north end Runite (= Yvonne) Island, 11°33'N 162° 21.5'E, outer reef flats, 0-1 m, night collecting, 28 September 1969, 2 ♀, USNM; ocean reef flat of Medreu Island, in hollow on reef, low tide at night, 6 March 1976, leg. Medrano, 1 ♂, BPBM); Jaluit Atoll, Marshall Islands (Pazifik Expedition, O. Finsch, 1 ♂, 1 ♀, ZMB; shore, 13 January 1900, "Albatross" Expedition, 1 ♂, 2 ♀, USNM); Ebon Island, Marshall Islands (B. G. Snow, 1 ♂, USNM); Majuro Atoll, Marshall Islands (5 March 1958, A. F. Bartsch, 1 ♀, USNM); N. of Ine village, Arno Atoll, Marshall Islands (reef flat, lagoon, June-August 1950, J. W. Wells, 1 ♂, USNM); Onotoa Atoll, Gilbert Islands (7 August 1951, P. E. Cloud, 1 ♂, USNM; July 1954, A. H. Banner no. A-4, 1 ♂, USNM; 2 August 1954, A. H. Banner no. A-8, 1 ♀, USNM).

Hawaiian Islands: Hawaiian Islands (T. Nuttall & J. K. Townsend, 1 ♀, 1 juv., ANS; 1844, W. H. Pease, 1 specimen, BM; 1883, 2 ♂, 1 ♀, BM; Baillieu, 2 ♂, 3 ♀, MP; 1957, S. W. Tinker, 1 ♂, 1 ♀, AHF); Waimea, Kauai (V. Kundsens, 1 ♂, USNM); Honolulu, Oahu (13 May 1892, Dr. Lutz, 1 ♂, ZMH; 1896, 1 ♀, ZMO; 1901, U.S. Fish Commission, 1 ♀, USNM; market, "Albatross" Expedition, 1 ♀, USNM; coral reef, 28 March 1915, Th. Mortensen, 1 ♀, UZM; market, 1929, O. Degener, 1 ♂, 1 ♀, USNM); south coast of Molokai, Lae-o Ka Laau Light N.69°W 2.8' (surface, night anchorage, 31 March 1902, "Albatross" Expedition Sta. D 3821, 1 juv., holotype of *Parribacus papyraceus* Rathbun, USNM); Hilo, Hawaii (H. W. Henshaw, 1 ♀, 1 juv., paratype of *Parribacus papyraceus* Rathbun, USNM; U.S. Fish Commission, 2 ♂, USNM; 1901, U.S. Fish Commission, 2 ♂, 1 ♀, USNM).

Line Islands: Palmyra Island (August 1924, Whippoorwill Expedition, 1 specimen, BPBM).

Phoenix Islands: Enderbury Island, 3°08'29.7"S 171°05'34.4"W (collected by natives, 19 and 20 May 1939, L. P. Schultz, 4 ♂, USNM); Canton Island (20 July 1939, Lt. Miller, 1 ♀, USNM); Hull Island, 4°29'16"S 172°10'15"W (with flashlight, on reef, 14 July 1939, L. P. Schultz, 1 ♂, USNM).

Samoa Islands: Samoa Islands (Thilenius, 1 ♂, 2 ♀, ZMB); Savaii Island (coast, 1874, Rev. S. J. Whitmee, 1 ♀, BM); Upolu Island (U.S. Exploring Expedition, J. D. Dana, 1 ♂, 1 ♀, USNM); Apia, Upolu Island (July 1902, U.S. Fish Commission, 4 ♂, 1 ♀, USNM; 1910, E. Demandt, 2 ♂, 2 ♀, ZMH); Tafuna, Tutuila Island (coral reef, 10 March 1950, M. H. Powell, 1 ♂, USNM).

Society Islands: Tahiti (December 1846, "Galathea" Expedition, 2 juveniles, UZM; Mus. Godeffroy, 1 *Pseudibacus* stage, ZMH; 2 specimens, MP; 1900, de Beausacq, 1 ♂, MP; 1952, G. Ranson, 1 ♂, 2 ♀, MP); Maupiti Island, 16°27'S 152°15'W (1936, M. de Trois Rivières, 1 ♂, MP).

Tuamotu Islands: Takapoto Atoll, 14°38'S 145°12'W (outer slope, southwest side, collected at night, April 1983, P. Laboute, 1 ♂, MP); Anaa Atoll, 17°20'S 145°30'W (north east side, intertidal coral reef N. of landing, 28 October 1967, Marquesas Exped. 242-70, 1 juv. ♂, WAM).

Description. — The distance between the orbits is 2.5 to 3.2 times as great as the distance between the orbit and the nearest anterolateral angle of the carapace. The rostrum bears a rostral tooth on the dorsal margin some distance behind its tip. The two lateral teeth placed before the deep cervical inci-



Fig. 21. *Parribacus antarcticus* (Lund). Male from Bagamoyo, Tanzania, in dorsal view. $\times 0.9$.

sion are of about equal size, the posterior being only slightly smaller than the anterior. Behind the cervical incision there are constantly six teeth (only one of all the specimens examined, namely the specimens from Hull Island, had seven teeth there).

The first abdominal somite shows flattened tubercles over its entire width. In the second to fifth somites the anterior half which disappears under the previous somite if the body is stretched, is covered by conspicuous rounded tubercles which have a fringe of very short, stiff hairs along the posterior margin. The groove between the anterior and posterior part of the abdomen is wide, naked and smooth or shows a few minute tubercles in the middle. The posterior part of the somite bears a very distinct median carina, of which the anterior end is conspicuously elevated in the second and third somites, forming usually a tooth-like projection there; this tooth-like elevation is most distinct in small specimens. The tubercles on the posterior part of the second to sixth somites are large and surrounded by a fringe of very short, stiff hairs. The transverse groove in this part of the somite is not entirely closed over by hair, at least in the second and third somites. As a rule the individual tubercles are distinct. The smooth area along the posterior margin of the somites is rather narrow.

The distal segment of the antenna bears seven (seldom six or eight) large, pointed teeth on the anterior and one or two on the inner margin. The posterior margin shows some crenulations. The inner margin of the fifth segment bears two teeth, the posterior of which is small. The outer margin of the fourth segment is provided with six teeth, seldom seven or five (in the 62 cases examined, 55 had six teeth, six had seven teeth, one had five teeth), the distal tooth not included. The anterior margin bears two teeth (not included the distal).

The anterior margin of the epistome bears three to five pairs of teeth, the median and lateral of which are larger than the rest.

The pereopods are slender. Andrews (1912) extensively described the structure of the claw of the fifth pereopods in the female and the male.

Colour. — The general colour impression of freshly preserved specimens is a pale animal, extensively marbled with dark purplish grey. The dark colour often covers large parts of the dorsal surface of the animal. The orbits may be reddish. A broad, pale band extends over the median region of the abdomen. The lateral teeth of the carapace and antenna are dark purplish grey in the basal half, white in the distal half; small white spots are visible in the grey, a reddish or purplish ring is present in the middle of the white part. The underside is of a plain, pale yellowish brown colour. The live colour of the specimen from Half Moon Cay, British Honduras, was described on the field label as

follows: "central markings russet-brown, bristles yellow; nodules grey-green and russet brown". The field label of the specimen from Georgetown, British Guiana, bore the annotation: "pale fawn with blue spots". The earliest published colour description is by Guilding (1825): "nigro-flavescens purpureo varius". Dana (1852: 517) gave the colour of this species as: "yellow or smoky yellow, clouded with smoky brown and some spots of carmine; around the eye carmine. Last abdominal segment deep ochre-yellow". Nutting's (1919) description is: "The body is mottled dull brownish and yellowish". Curtiss (1938: 164) gave the following colour notes of this species: "The body is variegated above, black and pale greenish; except for the fins at the end of the tail, which are pale orange; these fins are pale orange on their under side too, but the rest of the body is, on the under side, variegated with pale orange, pale greenish, and whitish", the "four swimming feet under the abdomen are pale orange, inclining whitish, with the hindmost pair most whitish". The "five feet on each side of the thorax [are] pale greenish in color, with plain pale orange nails . . . The hindmost foot on each side has a pale green spine behind, at the base." Forest (1954: 351) described the colour as follows: "Les *P. antarcticus* au contraire ont une teinte beaucoup plus sombre [than *P. holthuisi*]: de larges taches d'un noir violacé couvrent une grande partie de la face supérieure du corps. Les spécimens de cette espèce, depuis longtemps dans l'alcool, prennent une teinte brun-roussâtre uniforme; quant à ceux qui sont conservés secs, ils gardent parfois des marques colorées qui ont passé du noir violacé au rouge". About the teeth of the lateral margin of the fourth antennal segment the same author stated: "il y a immédiatement en dessous de la pointe cornée une très courte zone claire, puis un anneau sombre situé au-dessus d'une tache arrondie claire qui reste visible chez des spécimens fortement décolorés". Tinker (1965: 48) described the species as of "a mottled reddish brown colour and resembles the rocks on which it lives". Rodriguez (1980: 196) described the colour of Venezuelan specimens as follows: "El primer somito abdominal tiene sobre la línea media y cerca del borde posterior una pequeña mancha oscura, una mancha más grande a cada lado de la central y una mancha irregular grande sobre los extremos que se prolonga hasta el borde anterior". The specimen from Minicoy reported upon by Meiyappan & Kathirvel (1983: 118) had its colour described as follows: "Colour of the specimen at the time of capture was bright yellow with a few scattered brownish blotches on carapace and abdomen; orange spots on the proximal and distal part of the spines of the antennae". Colour photographs of living specimens have been published by Schroeder (1964), Faulkner & Fell (1976), George & George (1979), Hamelin-Vivien & Pétron (1981), and Ingle (1982).

Size. — The carapace length of the examined males varied between 23 and

87 mm, that of the females between 23 and 92 mm. The *Pseudibacus* stages had the carapace length 7 to 22 mm. An ovigerous female with a total length of 147 mm (carapace length about 64 mm) was seen, while specimens with spermatophores had the carapace 61 to 69 mm long. The carapace length of the male from the Cuyo Islands, Philippines, in which the spermatophores protrude from the sexual openings, is 87 mm. In the literature total lengths of up to 180 mm are mentioned in specific cases, although in general statements the total length often is indicated as up to 200 mm (e.g., Farrugio, 1975; Manning, 1978; George & George, 1979; Rodriguez, 1980), or 8 inches (Edmondson, 1933, 1946). Carapace lengths of 92 mm (Rodriguez, 1980) and 92.2 mm (Bonnely de Calventi, 1974) have been reported.

Distribution. — The species is known both from the Western Atlantic (Florida to N.E. Brazil, including the West Indian Islands and the mainland coast of the Caribbean Sea), and from the Indo-West Pacific (E. and S.E. Africa to Formosa, perhaps to Japan, and to Polynesia). The records in the literature are the following:

Atlantic: Alligator Reef, Florida Keys, Florida, U.S.A. (Schroeder, 1964); West Indies (Guilding, 1825; Forest, 1954); Cuba (Parra, 1787; von Martens, 1872; Valdés Ragués, 1909; Torralbas, 1917); Jamaica (Sloane, 1725; Rathbun, 1897); Montego Bay, Jamaica (Andrews, 1912); La Cailleta, D. N., Dominican Republic (Bonnelly de Calventi, 1974); Virgin Islands (Thompson, 1901); Santa Cruz (= ? St. Croix) (Gibbes, 1850, 1850a); Martinique (Farrugio, 1975; Farrugio & St. Felix, 1975); S.E. of Loup-Garou, Martinique (Farrugio, 1975); Barbados (Young, 1900; Nutting, 1919, 1936); Islas Los Roques, Venezuela (Rodriguez, 1980); Chichirivichi, W. of Caracas, Venezuela (Rodriguez, 1980); Klein Bonaire near Bonaire, Netherlands Antilles (Holthuis & Zaneveld, 1958);? Surinam (Neumann, 1878; Holthuis, 1959a); Brazil (Marcgrave, 1648; Jonstonus, 1650, 1657, 1660, 1665, 1767; Sachs, 1665; Ruysch, 1718; Forest, 1954; Lemos de Castro, 1962); Praia de Mucuripe, Fortaleza, Ceará, Brazil (Lemos de Castro, 1962); Ceará (Fausto Filho, Matthews & Holanda Lima, 1966); Pernambuco, Brazil (Matthews, 1926; Coelho & Ramos, 1972).

Indo-West Pacific: Indian Ocean (Lamarck, 1818; H. Milne Edwards, 1837a, 1839; Ortmann, 1891); East Indies (Fabricius, 1798; Bosc, 1801-1802; Leach, 1814 (erroneously as India); Desmarest, 1830); East Indian Seas (Latreille, 1802, 1803); Eastern Seas (White, 1847; Haswell, 1882); Natal (Kensley, 1981); Ifafa Beach, Natal, S. Africa (Barnard, 1950); Anjouan, Comoro Islands (Fourmanoir, 1955); east coast Madagascar (Petit, 1930); Vohémar, N.E. Madagascar (Poisson, 1947); Tamatave, E. Madagascar (Poisson, 1947); Mauritius (White, 1847; Hoffmann, 1874; Petit, 1930; Michel, 1974); Fouquets, Mauritius (Richters, 1880); Reunion (A. Milne Edwards, 1862, 1863; Hoffmann, 1874; Petit, 1930); Salomon Island, Chagos Archipelago (Ward, 1942); Minicoy, India (Meiyappan & Kathirvel, 1983); Japan (?Herbst, 1793; ?Thompson, 1901; ?Parisi, 1917; ?Saisho, 1962; ?Harada, 1965; ?Saisho, 1966), ?Tokyo Bay, Japan (Ortmann, 1891), ?Negishi near Yokohama, Tokyo Bay (Parisi, 1917); ?Fukuura and Misaki, Sagami Bay (Bals, 1914); ?Maizuru, N.W. coast of Honshu (Ortmann, 1891); ?Goto Islands, Kyushu, S. Japan (Parisi, 1917); ?Ei-cho, Kagoshima prefecture (Saisho, 1962); ?Tomari Bay, Kagoshima prefecture, Kyushu (Aikawa & Isobe, 1955); ?Ryukyu Islands (Shirai, 1980); Taiwan (Oo-U-Kijo, 1937); Chilung (= Keelung), Taiwan (Hwang & Yu, 1983); southern Annam, Viet-Nam (Dawydoff, 1952); Malaya (Chuang, 1961); Guimaras Island, near Panay, Philippines (White, 1847; Estampador, 1959); Beo, Karakelang, Talaud Islands, Indonesia (De Man, 1916); Sabang Bay, Sumatra, (De Man, 1924; Holthuis, 1946); Jakarta (= Batavia), Java (Bleeker, 1845); Kisar, near

Timor (Holthuis, 1946); Amboina, Moluccas (Rumphius, 1705, 1711, 1739, 1741; Petiver, 1713; Renard, 1718, 1754; Valentijn, 1726; Seba, 1759; Henschel, 1833; Nobili, 1899; De Man, 1902; Holthuis, 1959); Ternate, Moluccas (Nobili, 1899); New Guinea (Miers, 1880); Korido, Supiori (= Soweik) peninsula, Schouten Islands, West New Guinea (Holthuis, 1946); Irubi (= Rubi), southern extremity of Geelvinck Bay, W. New Guinea, Indonesia (Thallwitz, 1892); Australia (Haswell, 1882); Pacific Ocean (= Südsee) (Schmeltz, 1874; Pfeffer, 1881; Ortmann, 1891; Thompson, 1901); Palau (= Belau) (Brower, 1974); Great Reef, Bailechesengel Island, Ngemelis Islands, Belau (Faulkner & Fell, 1974); Duke of York Island, New Britain, Bismarck Archipelago (Miers, 1877); ?New Caledonia (Mocquard, 1883); ?Natikitiwan, Lifu, Loyalty Islands (Borradaile, 1899a); Kapingamarangi (Smith, 1948); Kusaie, Caroline Islands (Smith, 1948); Ailinglapalap and Majuro, Marshall Islands (Smith, 1948); Jaluit Atoll, Marshall Islands (Balss, 1914; Smith, 1948); Ine village, Arno Atoll, Marshall Islands (Holthuis, 1953); Onotoa Atoll, Gilbert Islands (Banner & Randall, 1952; Holthuis, 1953); Funafuti Atoll, Ellice Islands (Whitelegge, 1897; Anon., 1899); Rotuma (Borradaile, 1899); Hawaiian [= Sandwich] Islands (Gibbes, 1850; Stimpson, 1860; Rathbun, 1906; Pesta, 1933; Edmondson, 1933, 1946; Wiersma, 1951; Wiersma & Ripley, 1952; Hiatt, 1954; Matthews, 1954, 1954a; Tinker, 1965; Hazlett, 1971); Laysan, Hawaiian Islands (Edmondson, 1925); French Frigate Shoals (Edmondson, 1925); Waiawa, Kauai (Rathbun, 1906); Oahu, Hawaiian Islands (Boas, 1880; Rathbun, 1906); Honolulu, Oahu (Lenz, 1901; Rathbun, 1906); south coast of Molokai, Hawaiian Islands (Rathbun, 1906); Hilo, Hawaiian Islands (Rathbun, 1906); Johnston Island (Edmondson, 1925); Palmyra, Line Islands (Edmondson, 1923); Samoa (= Navigator) Islands (Schmeltz, 1866, 1869; Thallwitz, 1892; Demandt, 1913, 1914; Parisi, 1917); Upolu, Samoa (Dana, 1852); French Oceania (Chabouis & Chabouis, 1954); Tahiti, Society Islands (Forest, 1954; Bagnis & Christian, 1977, 1980, 1983); Tautira, Tahiti (Curtiss, 1938); Papeete and Venus Point reef, Tahiti (Boone, 1935); ?Tureia (= Carysfort Island, = Papatena), Tuamotu Islands (Owen, 1839); Mururoa (Chevalier et al., 1969); Mangareva, Tuamotu Islands (Seurat, 1934). Coulon (1907) listed a specimen with the locality indication "Zélée (Leguillon)". A similarly labelled specimen was found by me in the collection of the Paris Museum. Zélée evidently is not a locality but the name of one of the two ships, the "Astrolabe" and "Zélée", which under the leadership of J. S. C. Dumont d'Urville made a scientific voyage around the world (1837-1840), during which the Pacific and Indian Oceans were extensively explored. The name "Leguillon" evidently stands, be it misspelled, for Elie Jean François le Guillou, "chirurgien-major" on board the "Zélée". The true locality of these specimens cannot be ascertained.

Habitat. — *Parribacus antarcticus* is an inhabitant of shallow tropical waters, preferably coral or stone reefs with a sandy bottom. It has been reported from "Riffspalten" (Demandt, 1913), an outer pool of a rocky reef (Matthews, 1926), "shallow water" (Edmondson, 1933, 1946), „inhabits the holes in the coral-reefs" (Curtiss, 1938), "windward reef" (Banner & Randall, 1952; Holthuis, 1953), "lagoon reef flat" (Holthuis, 1953), "sur les fonds de sable" (Chabouis, 1954), "dans le corail découvert en période de vive eau" (Fourmanoir, 1955), "arrecifes" (Coelho & Ramos, 1972), "moonlit reef" (Faulkner & Fell, 1974), "20 m sur fond algueux" (Farrugio, 1975), "on rocks and reefs" (George & George, 1979), "coral crevice in the lagoon at a depth of 3 m" (Meiyappan & Kathirvel, 1983). Of relatively few of the examined specimens the exact depth of collecting is known: 0-1 m, 0-4 m, 0-12 m, 0-31 m, 1m, 5m, 2½ fathoms, 20 feet, 40 feet (= 4.5, 6 and 12 m, respectively), and 13 m, also "intertidal reef". In the literature depths of 3 m (Meiyappan & Kathirvel,

1983), 13 m (De Man, 1916), 20 m (Farrugio, 1975), and 150 m (Balss, 1914) are mentioned. The latter depth seems rather unlikely as the species practically always is indicated as a form from shallow water (13 m and less); therefore also Manning's (1978) statement that the species is found "in water deeper than 10 m" should be considered with some reserve. The postlarvae were taken in surface plankton hauls; the specimen taken from "192-263 m" off Nicaragua by R. V. "Pillsbury" at Sta. 1354, may have entered the net when it was hauled in.

Biology. — Few data about the biology have been published. Tinker (1965) stated that it "is a somewhat gregarious species and often lives in small groups. Like the other slipper lobsters, it is nocturnal in its habits". The nocturnal habits are confirmed by other sources, so the species is usually hunted at night. Rumphius (1705: 4) remarked that "hij kruipt meest op den grond, met eenen langzamen gang" (it usually crawls over the bottom at a slow pace").

Physiology. — The species formed the subject of investigations on the innervation pattern of the nerves in the legs by Wiersma (1951) and Wiersma & Ripley (1952). Hazlett (1971) studied its antennule chemosensitivity.

Development. — Andrews (1912) and Matthews (1954, 1954a) gave a detailed account of the histology and formation of the spermatophores, which consist of two large, blackish, transversely elongate masses which the male deposits just behind the fifth thoracic sternite of the female. These two masses form a narrow, usually continuous band over almost the entire width of the ventral surface of the first abdominal somite. These spermatophore masses possibly fertilize more than one batch of eggs. An unusual situation was observed by me in a male specimen (cl. 71 mm) from Christmas Island (WAM). This male specimen was found in a lot with three females, all provided with spermatophores. The male showed two almost circular spermatophore masses on the telson just level with the male sexual openings if the abdomen is flexed under the thorax. These spermatophores are much smaller than in the females, they are rounded and anteriorly drawn out into a narrow point. Their diameter is about 10 mm and the distance between the two slightly more than that. Whether these spermatophores were deposited there by another male, or by the animal itself is difficult to decide. The animal itself could have achieved it only by rolling up the tailfan in such a way that its dorsal surface came in contact with the male openings of the fifth pereopods, and then slowly unroll them.

The male (cl. 87 mm) from Cuyo Islands, Philippines (USNM) shows two spermatophores that protrude as dark brown masses from the male sexual openings. On either side the exopod of the first pleopod (i.e. of the second

abdominal somite) is stuck to the spermatophoric mass while on the right side also the endopod of the second pleopod is attached to the mass, the endopods of the first pleopods being free.

The first phyllosoma larva, raised from the eggs of an ovigerous female, was described and figured by Aikawa & Isobe (1955). Saisho (1962, 1966) described the first three larval stages. It is not certain whether the species before these authors was really *P. antarcticus* or whether they had *P. japonicus*.

Sims (1964, 1965) dealt with phyllosoma larvae from the West Indian area (Florida and Yucatan Straits) which he assigned to *Parribacus* (as only one species of the genus is known from the Atlantic this, by inference, would be *P. antarcticus*). Later (Sims, 1968) he dealt with similar larvae from off the east American coast (North Carolina and New Jersey) and the Azores.

Due to incorrect interpretations by previous authors, confusion existed about the identity of phyllosoma larvae of the type dealt with by Sims. Such larvae were indicated by Johnson (1968) as Phyllosoma X. They were variously assigned to *Thenus*, *Parribacus* or *Arctides*. Johnson (1968, and later 1970) gave a good review of the problem, which proved to be caused by the incorrect assignment of some *Scyllarus* larvae to *Scyllarides*. Only when Robertson (1969) managed to rear the larvae of *Scyllarides aequinoctialis*, the problem was solved and it was shown that Phyllosoma X actually belongs to *Scyllarides*. Robertson (1969a) also showed that Sims' (1964, 1965 and 1968) phyllosomas belong in *Scyllarides*.

Sims & Brown (1968) described a giant phyllosoma (t.l. 69 mm) from Bermuda, and Robertson (1968) at the same time dealt with an equally large phyllosoma (t.l. 65 mm) from near the Cayman Islands (19°40-46'N 82° 58'-83°07'W), which possibly are *Parribacus antarcticus*. Robertson (1968) considered four smaller phyllosomas as possibly belonging to the same species (these originated from off Recife, Brazil, 8°7'S 33°0'W; Florida Strait, 25°35'N 79°25'W; and N. of Bahamas, 28°27'N 73°39' W). Johnson (1971) described and figured stages 1, 4, 5, 7-11 of *Parribacus antarcticus* after material from the Hawaii area (22°06'N 157°44'W, 22°15'N 157°43'W, 21°10'N 158°19'W, 21°08'N 158°25'W, 21°10'N 158°10'W, 21°24'N 158°23'W, 16 miles E. of Johnston Island, 200 miles N. of Johnston Island), mentioning also specimens from off Viet-Nam and the Philippine Sea (14°02'N 119°12'E), while also the giant specimen from the Marshall Islands (9°0' 168°E) previously reported by Johnson (1951) was assigned to the present species. Later Johnson (1971a) described and figured the seventh stage from the South China Sea off Viet-Nam (about 15°45'N 111°30'E and about 8°40'N 111°25'E). Berry (1974: 17, figs. 60-66) found phyllosomas off the Natal coast (29°40.5'S 31°53.0'E and 30°09.3'S 31°21.2'E), which agreed well with Johnson's description of stages 8

and 11 of the present species. Prasad, Tampi & George (1980) described and figured several stages which were obtained off East and South Africa, off Madagascar, off Sumatra, off Java and due south of India, but found the larvae to be not very common. They also remarked that the early larvae from the Laccadive Sea that they previously (Prasad & Tampi, 1960: 163, fig. 18) recorded as *Jasus lalandii* actually belong to the present species. Johnson (1974) reported two late *Parribacus* phyllosomas from the eastern part of the Central Pacific (about 2°N 118°W and 14°13.6'S 126°0'W) but was unable to assign them to a definite species. Also Michel (1971: 467) listed phyllosoma larvae of "*Parribacus* sp." from the areas of New Caledonia and the New Hebrides, the Gilbert Islands, the Tuamotu Archipelago and the Marquesas Islands. Prasad (1983) studied the growth of the larvae of *Parribacus antarcticus* and illustrated this in a curve. Several of the giant phyllosomas reported in the literature seem to belong to this species (Johnson, 1951, t.l. 70 mm; Sims & Brown, 1968, 69 mm; Robertson, 1968, 65 mm; Prasad, Tampi & George, 1980, 76, 77, 80 mm). Michel reported a *Parribacus* phyllosoma (species not known) of 83 mm.

The postlarvae of the present genus have been described by various authors (Guilding, 1825; Boas, 1880; Rathbun, 1906). Guilding (1825: 336) described his specimen as a new species, *Scyllarus carinatus* from the Caribbean (probably St. Vincent) where it was found after a very heavy storm. The description is very short: "S. rufescente-vitreus, lateribus obscure crenatis, testâ caudâque carinatis. *Habitat* in mari Caribeo: post procellam terribilem in littus ejectum marem pedibus duobus posticis simplicibus semel detexi. Longitudo corporis 2 un. Desc. *Testa* lata: *cauda* angusta". The size of the specimen (50 mm) and the fact that it is "vitreus" show that it evidently is an early postlarval stage. It is most likely, because of the size and shape, that Guilding's specimen belongs to *Parribacus* or *Scyllarides*. The size and also the fact that the carapace and abdomen are carinate agree well with *Parribacus*. The early postlarval stages of *Scyllarides* that I know are smaller (about 30 mm), while the carapace and abdomen are toothed. However, as so little is known about the early stages of the West Indian Scyllaridae, it is impossible to identify Guilding's species with certainty. Boas (1880: 88) described a transparent specimen with a total length of 50 mm from Oahu, Hawaii, which he recognized as a juvenile *Parribacus*. Rathbun (1906: 897, pl. 18 fig. 5) described under the name *Parribacus papyraceus* two specimens slightly larger (58.2 mm total length, 21.4 mm carapace length) than that of Boas, likewise originating from the Hawaiian Islands. As has been pointed out by several authors (Balss, 1914: 81; De Man, 1916: 66, 93, 94; Parisi, 1917: 13, etc.) and already suggested by Rathbun herself, this supposedly new species is nothing but a juvenile stage of

P. antarcticus; an examination of the material again confirmed this.

Economics. — The species seems to be of excellent taste and therefore eaten in many areas. Dawydoff (1952: 137) mentioned its fishery in South Annam. The material from Dinagat Island, Philippines, reported upon above, was stated on the field label to form the remains of a meal. Rumphius (1705) reported that the species is harpooned by the fishermen of Amboina, and that its meat is white, hard and sweet, of a better taste than that of the lobsters (palinurids). Banner & Randall (1952: 29, 30) mentioned it to be fished in Onotoa “by men and woman either during the day when the tide is out or over the reef surface at night, when torch fishing. Dipnets are used for its capture. It is boiled and the abdomen, portions of the cephalothorax and legs are eaten”. About the Hawaiian animals Tinker (1965) remarked that “although this lobster may appear to be of commercial value, it is too small and flat to make its use as food worth while”. Demandt (1913) stated that in Samoa it is “als Speise sehr beliebt”. For Tahiti Curtiss (1938) remarked that “it is good to eat”. Poisson (1947) listed the species among the edible Crustacea of Madagascar and Petit (1930) already mentioned it in his account of the fisheries on the east coast of Madagascar. Chabouis (1954) considered “la chair, très fine, est la meilleure de toutes celles des crustacés marines”; he reported that the animals are harpooned by the natives of French Oceania. Chevalier et al. (1969: 92) found it “très recherchée” at Mururoa. There is no organized fishery for the species, which is often caught incidentally during fisheries for spiny lobster; it is used fresh for local consumption (Manning, 1978; Cervigon & Fischer, 1979). DeLuca & DeLuca (1976) rate it as “too small to be economically valuable”.

Type. — Holthuis (1956, Bull. zool. Nomencl., 12: 111) selected as the lectotype of the present species the specimen figured in Rumphius' (1705) Amboinsche Rariteit-kamer, pl. 2 fig. C. The restricted type locality of the species thereby becomes Amboina, Moluccas. The type specimen itself is no longer extant. The original drawing of it is still preserved in the Koninklijke Bibliotheek (Royal Library), The Hague, Netherlands. As has already been pointed out by De Haan (1841: 153) and De Man (1902: 101; 1916: 94), Rumphius' figure is not very accurate as far as the serrations of the lateral margins of the carapace and antennae are concerned, but it is sufficiently characteristic to indicate the identity of the species.

Remarks. — The present species was first mentioned in the literature by Marcgrave (1648) who figured under the name Potiquiyixe the Atlantic form of this species, which he evidently observed near Recife, Brazil. Georg Marcgrave (born 10 September 1610 at Liebstadt, Germany, died July or August 1644 in Luanda, Angola), namely, was in Brazil from 1638 to 1644 as a

scientist at the court of Johan Maurits van Nassau, the governor of the Dutch possessions in Brazil. He was stationed at Recife and it is most likely that the larger part of the animals dealt with by him, including *Parribacus*, came from that region. The species was described for a second time by Rumphius (1705). Georg Everhard Rumphius (born in 1627 near Hanau, Germany, died 15 June 1702 at Amboina, Mollucas) lived from 1654 to 1702 at Amboina as a servant of the Dutch East India Company. His fundamental "Amboinsche Rariteit-kamer" contained excellent descriptions and figures of many marine animals of the Moluccas, among which the present species which Rumphius compared to woollen mittens. He gave the length of the animal as "een span", i.e., about 200 mm. That Rumphius' specimen was a female is clear from the following sentence of his description: "hy heeft geen scheeren, maar aan ieder zyde vyf pooten, dewelke eindigen in zwarte en spitze Vogelkluuwen, aan de vier voorste voeten enkel, aan de agterste dubbel, of in tweeën gespleeten, als een scheer" (it has no pincers, but on each side five legs, which end in black and sharp bird-claws, which are simple in the first four legs, double, or split up into two, like a pincer, in the last one). Also the maxillipeds were noticed by Rumphius: "benevens twee kleene voetjes aan den mond, die hem voor handen dienen" (furthermore two small feet next to the mouth, which serve it as hands). The movable broadened antennae and the narrow antennulae were likewise described by Rumphius, as also the position of the eyes. Linnaeus (1758) identified the species with *Cancer arctus*, but in 1793 it was recognized as an independant species by Lund, who named it *Scyllarus antarcticus*, and by Herbst, who used the name *Cancer (Astacus) ursus major*. As shown by Holthuis (1946), Lund's name has preference over that by Herbst, and it was placed on the Official List of Specific Names by the International Commission on Zoological Nomenclature in Opinion 519, while the name *ursusmajor* Herbst at the same occasion was placed on the Official Index.

Guilting (1825) described two new Scyllarids from the West Indies (evidently from St. Vincent, where he lived); one, *Scyllarus carinatus*, as already pointed out above under "Development", in all probability is a juvenile of the present species; the other, *Ibacus ciliatus*, is based on an adult specimen. The West Indian form was again described as new by H. Milne Edwards who named it *Ibacus parrae* and who thought it to differ from *I. antarcticus* by the absence of spines at the base of the last pair of pereopods. All subsequent authors found such spines to be present in West Indian *Parribacus* and it is assumed that H. Milne Edwards' specimen was damaged. So far, a comparison of West Indian and Indo-West Pacific specimens of this species failed to produce any characters that makes a specific or subspecific distinction of the two possible (see also Forest, 1954).

The holotype of *Parribacus antarcticus carinatus* Pfeffer, 1881, a juvenile male with cl. 27 mm from the "Südsee" (Pacific Ocean), is still preserved in the Hamburg Zoological Museum. The specimen is a typical *Parribacus antarcticus*. In his description Pfeffer emphasized the presence of strongly elevated median carinae which, however, is not at all an unusual feature in the young of this species.

Parribacus papyraceus Rathbun, as pointed out above (under "Development"), is based on a young postlarval stage of the present species.

Curtiss (1938) described from Tahiti a new crustacean which he named *Cancer barffi*. His description of the animal makes it clear that *P. antarcticus* is meant. The fourth segment of the antenna (indicated by Curtiss as the second) "on the outer side, has nine spines . . ."; this evidently are the outer and anterior teeth taken together. Also the description of the raised "bumps" on the second and third abdominal somite agree with what is found in the present species.

***Parribacus caledonicus* Holthuis, 1960**

(fig. 22)

?*Ibacus antarcticus* Mocquard, 1883: 147, fig. 150.

? *Parribacus antarcticus* Borradaile, 1899a: 419.

Parribacus antarcticus p.p. Holthuis, 1946: 102; p.p. Forest, 1954: 350; Holthuis & Zaneveld, 1958: pl. 1 middle figure (not text p. 15).

Parribacus caledonicus Holthuis, 1960: 147; Harada, 1961: 192, text fig. 2, pl. 6; Michel, 1971: 472; George, 1972: 2, fig. 8; George, 1972a: 5, 8, 25, 35; Burukovsky, 1974: 102; Laboute & Magnier, 1978: 42, 45, 115, fig. 119; Laboute & Magnier, 1979: 42, 44, 115, fig. 119; Phillips, Cobb & George, 1980: 71; Burukovsky, 1983: 144. Type locality: Ile des Pins, New Caledonia.

Parribacus neocaledonicus? George, 1971: 6.

Scyllarides neocaledonicus George, 1971: 4.

Scyllarides neocaledonicus George, 1971: 9.

Scyllarides caledonicus George, 1972a: 2.

not *Syellarides neocaledonicus* Brower, 1974: 145, fig. (= *P. antarcticus*).

not *Parribacus caledonicus* Faulkner & Fell, 1976: 189, pl. 131 (= *P. antarcticus*).

Vernacular names. — "Popinée", New Caledonia (Laboute & Magnier, 1978), "Butterfly lobster", Fiji (George, 1972a), "New Caledonian butterfly lobster" (George, 1972).

Material examined. — Eastern Seas (1 ♂, BM); Indian Ocean (1 ♀, BM).

Lady Elliot Island, Great Barrier Reef, Queensland, Australia (Mrs. C. Wright leg., 1 ♂, AM).

New Caledonia (G. A. Frank vend., 1 ♂ paratype, RMNH; 1880, don. A. Milne Edwards, 1 ♀ paratype, RMNH; don. A. Milne Edwards, 1 ♂, ZMB; 1934, A. M. Patch, about 30 paratypes, mostly in poor condition, USNM, RMNH; from old collection of Laboratoire des Pêches coloniales, 1 ♂, MP); near Nouméa (1983, Y. Magnier, 1 ♂, MP); Ile des Pins, New Caledonia (on reef, April-May 1960, leg. Yves Merlet, 2 ♂ paratypes, 1 ♀ holotype, 1 ♀ paratype, RMNH; 1 ♂, 1 ♀, 1 juv., BM); Récif de Bogota, Canala, east coast of New Caledonia (5 Janu-

ary 1962, Mission Singer-Polignac, B.Salvat, 1 ♂, MP).

New Hebrides (1 ♂, AM); Erromango, New Hebrides (1 ♂, BM).

Cap des Pins, Lifu, Loyalty Islands (coral reefs, 1950, Miss L. E. Cheesman, 1 ♂, 1 ♀, BM).

Fiji Islands (1 juv., AM); Maravu, Savu Savu, Vanua Levu, Fiji (January 1941, O. Degener, 1 ♀ paratype, USNM).

Isle of Ngoi (?) (1 ♂, 1 ♀, BM).

Japan (erroneous label) (1 ♂ paratype, RMNH).

Locality unknown (Mus. Godeffroy, 2 ♀ paratypes, RMNH; 1 ♂ paratype, RMNH; 1900, A. Milne Edwards, 1 ♂, 1 ♀, MP).

Description. — The distance between the two orbits is 2.4 to 2.9 times as great as the distance between each orbit and the nearest anterolateral angle of the carapace. The rostrum bears a blunt dorsal tooth at some distance behind the tip. The posterior of the lateral teeth placed before the cervical incision is distinctly smaller than the anterior. Behind the cervical incision there are six large teeth of equal size.

The first abdominal somite shows flattened tubercles over its entire breadth. In the second to fifth somites, the anterior half which disappears under the previous somite when the body is stretched, is covered with conspicuous rounded tubercles which have a fringe of stiff hairs along the posterior margin. The groove between the anterior and posterior parts of the second to sixth abdominal somites is rather narrow, filled with short hairs and tubercles. These grooves are conspicuously narrower than in *P. antarcticus*. The median carina of the second and third abdominal somites is distinctly elevated in juvenile and in medium-sized specimens, but is almost level with the upper surface of the somite in the very large specimens. In small specimens the ridge is anteriorly produced into a blunt tooth. The tubercles on the posterior part of the second to sixth abdominal somites are relatively larger than in *P. antarcticus* and the setae that fringe them are longer than in that species. The transverse groove in this part of the somites as a rule is closed by the hairs surrounding the neighbouring tubercles. The smooth area along the posterior margin of somites is narrow.

The distal segment of the antenna bears seven (seldom six or eight) teeth on the anterior margin and one or two on the inner margin. The posterior margin shows some crenulations. The fifth segment has two teeth on the inner margin, the posterior of which usually is indistinct. The outer margin of the fourth segment bears as a rule seven teeth (seldom six), the distal tooth not included. In the 43 cases examined, 37 had seven teeth there, only six had six. The anterior margin bears two teeth, not including the distal tooth.

The anterior margin of the epistome ends in two submedian and two lateral teeth, between which there may be one or two smaller pairs.

The pereopods, though of the same general shape, are decidedly less slender than those of *P. antarcticus*.

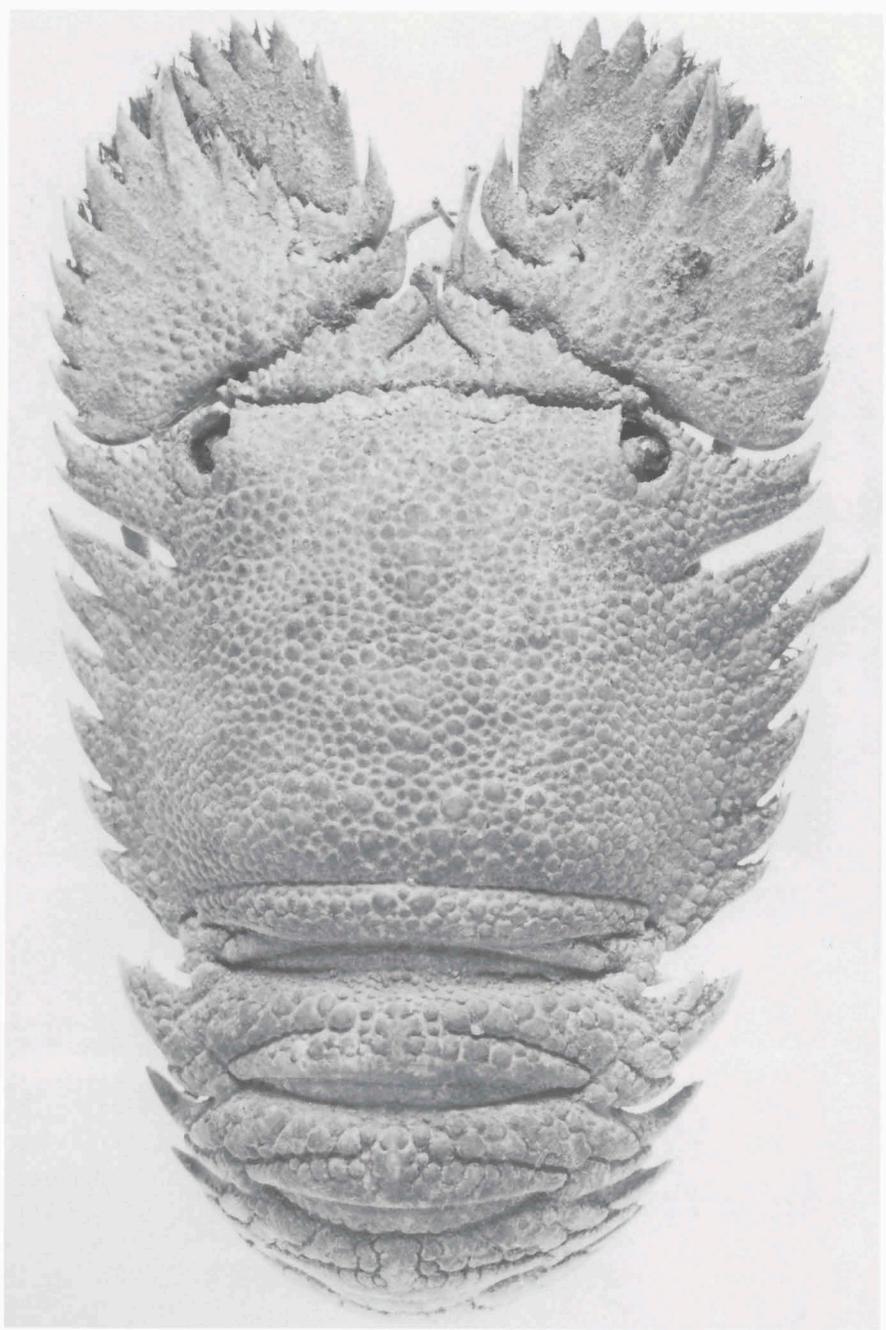


Fig. 22. *Parribacus caledonicus* Holthuis. Dorsal view of female paratype from New Caledonia (don. A. Milne Edwards). $\times 1.2$.

Colour. — Both the alcohol and the dry specimens are greyish with a dark reddish mottling over the body, which is especially distinct on the second to fifth abdominal somites which may be almost entirely red with a few greyish spots. The carapace of the dry specimen show a broad, pale longitudinal band over each of the lateral parts behind the cervical incisions. The teeth of the carapace and antenna have horny-yellow tips, below which there is a distinct white band. The teeth of the antenna are red with in the basal part a roundish or irregular silvery grey spot with a dark center. The legs of the dry and the fresh alcohol specimens have a broad, dark, bluish ring in the middle of the propodus, one in the middle or basal part of the carpus and one in the middle or distal part of the merus. The dactyli of the fresh specimen are purplish in the basal part, horny-coloured at the top. Harada (1961) remarked that the teeth of the antennal segments “are marked each with a round white spot on both dorsal and ventral sides. A dark blue band is found girding transversely each segment of the pereopods. Dark blue spots on the ventral surface of the carapace and thoracic and abdominal sternites are rather inconspicuous as compared with those found on *Parribacus japonicus* Holthuis”. George (1972: 2, fig. 8) published a coloured photograph of fresh animals and remarked: “It has distinctive rounded spots on each of the spines on the flattened shovel-like antennae”. Laboute & Magnier (1978, fig. 119) also published a coloured photograph of the species; they (p. 45) described the animals as follows: “petites cigales de mer constellées de petites taches vertes, bleues, mauves et rougâtres qui leur font un camouflage efficace”.

Size. — The carapace length of the holotype female is 72 mm. The other examined females had the carapace length varying from 45 to 78 mm; two specimens, both with cl. 65 mm, carried spermatophores. The carapace length of the males ranged from 41 to 68 mm.

Distribution. — The species is most frequently reported from New Caledonia, but its range extends to the west as far as the Great Barrier Reef, judging by the above-mentioned specimen from Lady Elliot Island. To the east of New Caledonia the range includes the Loyalty Islands, the New Hebrides, Fiji and Samoa. The first record of a *Parribacus* from this area is that by Mocquard (1883) who dealt with the gastric armature of a specimen of “*Ibacus antarcticus*” from New Caledonia. The fact that all the New Caledonia material of the genus *Parribacus* in the Paris Museum, and that donated by the Paris Museum to the Leiden Museum proved to be *P. caledonicus*, makes it highly likely that Mocquard’s specimen also belonged to the latter species, although he gave no details of the general morphology of his material. The New Caledonia specimens listed by Holthuis (1946) as *Parribacus antarcticus* on re-examination proved to belong to *P. caledonicus*.

Forest (1954) already pointed to the fact that in material from New Caledonia the number of teeth on the outer margin of the fourth antennal segment is eight (inclusive of the apical tooth). Holthuis & Zaneveld (1958) dealt with West Indian *Parribacus antarcticus*; their illustration, however, is that of *P. caledonicus*, namely a female specimen from an unknown locality, obtained by the Leiden Museum in the end of last century from the Museum God-effroy. A preliminary description of the present species was first published in 1960 (Holthuis, 1960: 147). One year later Harada (1961) provided a description of it, illustrated with excellent figures. The records in the literature are:

New Caledonia (Mocquard, 1883; Holthuis, 1946, 1960; Forest, 1954; Laboute & Magnier, 1978; Phillips, Cobb & George, 1980), Ile des Pins, New Caledonia (Holthuis, 1960; Harada, 1961), Ilot Maître, New Caledonia (Harada, 1961), throughout the New Hebrides (George, 1972a), Nukosoge Reef, Lau Group, Fiji Archipelago (George, 1971, 1972, 1972a), Apia, Western Samoa (George, 1971, 1972a). Borradaile (1899a) reported *Parribacus antarcticus* from Natikitiwan, Lifu, Loyalty Islands: he did not provide any description so that it cannot be ascertained whether his identification was correct, or whether his material belongs to the present species.

Habitat. — The species is found, like *P. antarcticus*, in shallow water on reefs. Harada (1961) reported it from the outer reef of Ile des Pins. Also Dr. Y. Merlet, who collected the holotype, indicated that the species is found in shallow water and is well known to the New Caledonia fishermen. According to George (1971, 1972, 1972a), the species usually is found in surge channels of the side of the reef exposed to the surf; it is found there together with *Panulirus penicillatus* (Olivier). Laboute & Magnier (1978: 42) report it likewise from “les récifs beaucoup plus battus”, and (p. 45) that the animals are found “sur le plafond des petites cavernes où elles se tiennent plaquées pendant la journée, dans les mêmes endroits, battus par la houle, que les langoustes vertes [= *Panulirus penicillatus* (Olivier)]”.

Economics. — The fishermen obtain the animals by jumping in the surge channels and grabbing them with gloved hands (George, 1971: 4; 1972a: 2). Laboute & Magnier (1978: 44) mentioned that in New Caledonia these lobsters are “consommés de façon fréquente”. According to George (1971: 6; 1972a: 5), *P. caledonicus* is commercially acceptable in Fiji. In Apia, W. Samoa, the species is found on the market, but is “not in demand by the hotel trade” (George, 1971: 9; 1972a: 8).

Type. — The largest female (cl. 72 mm) from Ile des Pins is the holotype; it is preserved in the collection of the Rijksmuseum van Natuurlijke Historie under reg. no. Crust. D. 14506. Paratypes are in USNM and RMNH.

Remarks. — The species is most closely related to *P. antarcticus*, but differs from it by the small second lateral tooth of the carapace, the narrow hairy

grooves of the abdomen, the greater number of teeth on the outer margin of the second antennal segment and the less slender pereopods.

***Parribacus perlatus* Holthuis, 1967**
(fig. 23)

"Languster" Heyerdahl, 1957: 272.

"Hummer" Heyerdahl, 1957: 276.

"Lobster" Heyerdahl, 1958: 270, 274.

Parribacus perlatus Holthuis, 1967a: 305; Holthuis, 1972: 44, pl. 1; Burukovsky, 1974: 102; Phillips, Cobb & George, 1980: 62, 71; Retamal, 1981: 16, fig. 43; Burukovsky, 1983: 144. Type locality: "Easter Island".

Vernacular names. — According to field notes made by Dr. I. E. Efford, the species is named "Rape Rape" in the Rapa Nui language of Easter Island. This term, however, clearly indicates Scyllaridae in general, as it is also given to *Scyllarides roggeveeni*. The Spanish name given to the species at Easter Island, according to Mr. Efford, is Lancotina, which possibly is derived from the Spanish Langostino, a word used by Spanish speaking people all over the world to indicate large macruran Crustacea, though it is given to different species in different areas: in Spain it is used for *Nephrops*, in Argentina for *Pleoticus*, in Chile for *Cervimunida*. Heyerdahl (in litt., 26 August 1965) stated that "the Easter Island lobster, frequently referred to as "crayfish" in English, and always as "langosta" in Spanish, is termed by the local natives as "ura raperape" or simply "ura".

Material examined. — Easter Island, Pacific Ocean (19 January 1965, I. E. Efford & J. A. Mathias, 1964-1965 Medical Expedition, Sta. F 90, 1 ♀ holotype, RMNH); La Perouse Bay, northeast coast of Easter Island (16 March 1956, 1955-1956 Thor Heyerdahl Expedition, 2 ♀ paratypes, ZMO), Anakena, north east coast of Easter Island (in sand among rocks, 30 December 1964, leg. Korike Pahte, 1964-1965 Medical Expedition, Sta. M7, 1 ♂ paratype, 1 ♀ paratype, RMNH).

Description. — The carapace is far rougher than in the closely related species *P. scarlatinus* Holthuis and *P. caledonicus* Holthuis. The squamiform tubercles on the dorsal surface of the carapace are not rounded and appressed, but are more pointed and more erect. The rostrum shows a very distinct sharp dorsal tooth. In the midline of the carapace behind the rostral tooth there are four more teeth before the cervical groove, the last three are placed rather close together. The cardiac tooth is distinct, erect and rather sharp; behind it there are four groups of two submedian teeth which are somewhat blunter and sometimes not very distinct. The teeth on the orbital margin are sharply pointed. The distance between the orbits is 2.4 to 2.5 times as great as the distance between each orbit and the nearest anterolateral angle of the carapace.

The posterior of the two lateral teeth of the carapace, which are placed before the cervical incision, is only slightly less strong than the anterior. Behind the cervical incision the lateral margin bears six large teeth.

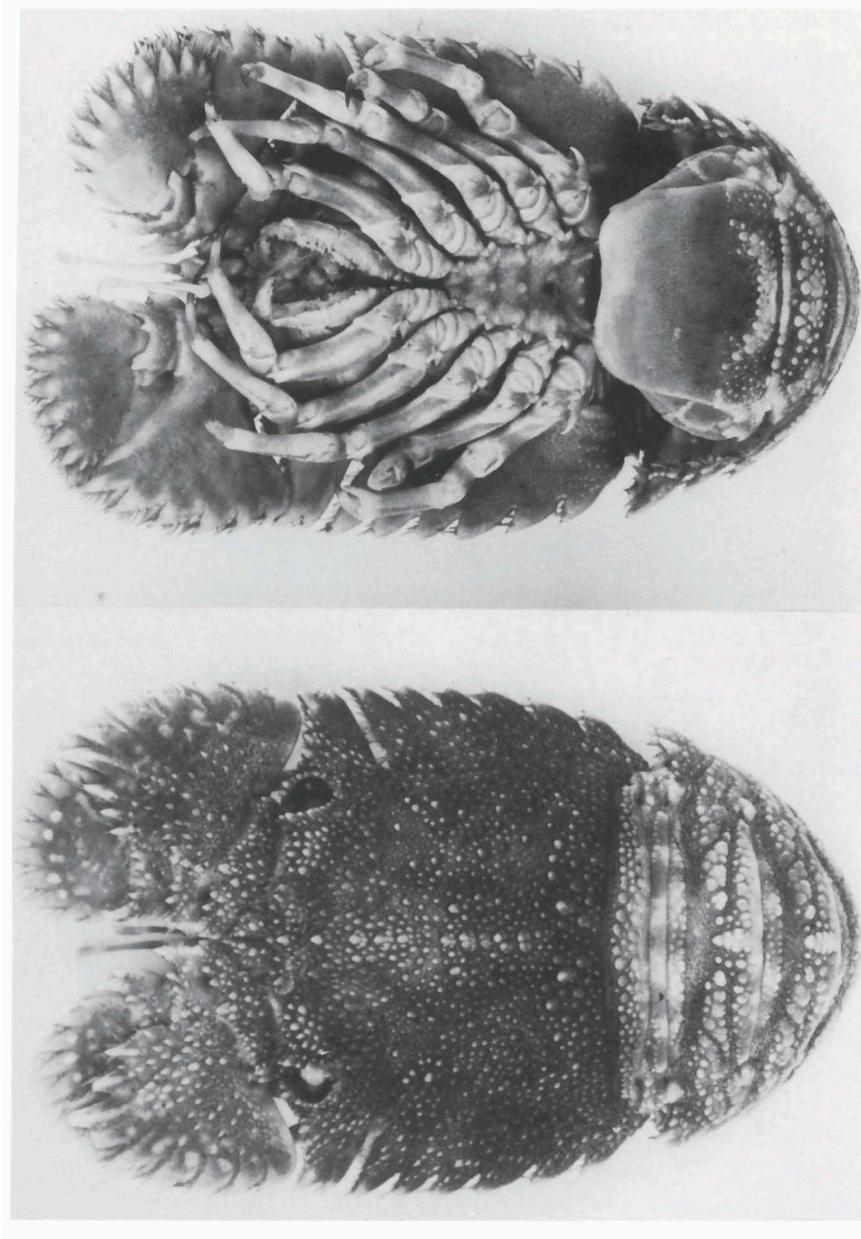


Fig. 23. *Parribacus perlatus* Holthuis, Dorsal (left) and ventral (right) view of female holotype from Easter Island. After Holthuis, 1972. Natural size.

The posterior marginal groove of the carapace is rather narrow, behind it there are numerous rounded squamae which are placed in two transverse rows of bigger ones, in between which smaller squames or tubercles are scattered. The smaller squames are more numerous and less different in size from the larger than in *P. scarlatinus*.

The first abdominal somite is smooth dorsally in the middle, with rather distinct semi-circular impressions, some of which even may carry fringes of short setae. Actual tubercles are present along the transverse groove in the lateral part of the segment. In the second to fifth somites, the anterior part which disappears under the previous somite when the body is fully stretched, bears several flattened tubercles. The posterior of these are largest and give the posterior margin of this part of the tergum a crenulated appearance. The anterior tubercles are much smaller; some have a fringe of short hairs. The groove between the anterior and the posterior parts of the second to fifth abdominal somites is narrow and entirely filled with short hairs and tubercles. The median carina of these somites is low and practically flush with the surface of the rest of the somite, only in somites 2 and 3 the anterior part of the carina is elevated and is acute in lateral view. The tubercles of the somite are as in *P. scarlatinus*, only the small tubercles are relatively more numerous and larger. The hairy fringes around the larger tubercles are rather long and they entirely cover the transverse grooves of the posterior part of the somites.

The distal segment of the antenna bears eight large, sharply pointed distal teeth and one inner tooth; at the outer margin three small teeth are present. The distal teeth are less slender than those of *P. scarlatinus*. The inner margin of the fifth segment of the antenna ends in two distinct teeth, the posterior of which is almost as strong as the anterior. The outer margin of the fourth segment bears six teeth (the anterolateral tip of the segment not included), while the anterior margin shows two or three teeth. The upper surface of this segment bears scattered flattened tubercles which anteriorly end in a sharp tip that is pointed obliquely upward.

The anterior margin of the epistome bears six to nine teeth, of which the median and external pairs are the largest.

The pereopods are definitely less slender than those of *P. scarlatinus* and resemble those of *P. caledonicus*.

The sternum shows at the posterior margin of the sternites of the second and third pereopods a very distinct median pearly tubercle which is sharply set off from the rest of the sternum. These tubercles are far more conspicuous than in the other species of the genus. Between the sternites of the fourth and fifth pereopods there is the usual deep pit. The sternite of the fifth pereopod is peculiar in that it shows two distinct submedian tubercles in the middle of

its length; these tubercles are much smaller than the median tubercles in the anterior part of the sternum. Furthermore there is one tubercle in each lateral part of the last thoracic sternite, which with the two submedian tubercles form a single transverse row; the lateral tubercles are often continued anteriorly as a short carina. The tubercles of the sternum are found both in the male and female. In the male the sternite of the fifth pereopod is narrower than that of the fourth, but the difference is less conspicuous than in *P. scarlatinus*.

The pleopods are of the normal type.

Colour. — All the specimens examined are preserved in alcohol. Though they have been preserved for periods of different length (since 1956 and 1965), the general impression of the colour is the same. The whole body has a brownish red to red colour with paler (yellowish white) spots. The carapace is more brownish red because of the brown pubescence. The tips of the lateral teeth of the carapace are whitish. On the carapace there are irregular pale areas in which, because of the pubescence, especially the tubercles that break through the pubescence are conspicuously whiter than the rest. The posterior area behind the marginal groove is red with a few whitish tubercles. The first abdominal somite shows five large reddish spots in the posterior half, touching the posterior margin. The anterior part of the segment bears about eight to ten smaller spots which are irregular and partly fused with each other and with the posterior spots. These spots are not sharply delimited and set off from each other as in *P. holthuisi* Forest. The following somites are red with whitish spots. About four not sharply defined pale spots are present in the anterior half of the somites, while five to eight small pale spots are to be found along the posterior margin of each tergite. The tips of the pleura are white. The distal segments of the antenna are red, also the teeth are red, although the tips are paler. A sharply defined whitish spot is present at the base of the inner five distal teeth of the last segment and of the distal five lateral teeth of the fourth segment. Irregular whitish spots are present on the rest of the upper surface of the fourth and sixth segments. The lower surface of the sixth segment shows a large pale spot in the inner part; small pale spots are present here also at the bases of the teeth of the fourth and sixth segments. The legs are banded. The dactylus has the base red, the tip horn-coloured, with a whitish band in between. The propodus has a basal red band which is inconspicuous or absent in the last legs, and a broad red band over the middle. The carpus has a broad red band and the merus has two, the distal of which is the more distinct. Heyerdahl (1958: 270) described the animals as "big red fellows".

Size. — The carapace length of the examined females ranged between 43 and 53 mm. The largest female is the holotype. The only male examined has cl. 40 mm.

Distribution. — So far the species is only known from Easter Island. The known precise localities (La Perouse Bay and Anakena) both lie in the north-eastern part of the island.

Habitat. — Of the three species of lobster known from Easter Island, *Parribacus perlatus* is the one which comes closest inshore and therefore is commonly caught by the natives. During the Medical Expedition of 1964-1965, *Panulirus pascuensis* Reed was caught with a gill net and *Scyllarides roggeveeni* Holthuis with a trap, while at least two of three *Parribacus* were caught by the Easter Islanders.

Biology. — The largest female (cl. 53 mm) is provided with a spermatophoric mass which covers practically the whole of the first abdominal sternite.

Economics. — The fishery for this species by the natives of Easter Island has been described by Heyerdahl (1958: 270) as follows: "Some of our men had been out by moonlight the night before with native girl friends catching rock lobsters. This was one of the islands' great delicacies: it is really a big lobster without claws. Our frogmen could often spear it in underwater caves, but the simplest way was to wade breast-high in the water along the shore at night with flaming torches. The native vahines (girls) were very skilful at this. They trod on the great creatures and held hem fast with their toes till they could plunge down to pick them up and put them in a sack. The evening the cook had twenty-one big red fellows in his pot . . ."

Dr. Heyerdahl (in litt., 26 August 1965) informed me that "The 'ura' was caught by the natives both at night and in plain sunlight, nearly always by the native stepping on the animal with one foot and then picking it up by grasping the body with his hand. Sometimes the 'ura' was caught in deep water by divers swimming along the cliffs grasping into the recesses in small submarine caves where they can be quite common. At night the 'ura' is caught with the aid of torches, and the native men or women then usually go together in pairs, one carrying the torch and stepping on the crayfish which is attracted by the light, while the other picks it up and puts it in his container, usually a sack. According to the natives the best time for catching crayfish is when the wind turns against the shore. If this is correct or merely superstition, I cannot say from my short experience".

Remarks. — The species differs from *P. scarlatinus* in the rough and spinulose carapace, the tubercular anterior half of the abdominal somites, the elevated anterior part of the median dorsal carinae of the second and third abdominal somites, in the less slender teeth of the distal segment of the antenna, in the less slender legs and in the ornamentation of the sternum. From *P. caledonicus* it likewise differs in the scabrous carapace and the carina of the

second and third abdominal somites, further by having only six lateral teeth on the fourth segment of the antenna, and by the shape of the sternum.

After a preliminary description of the species was published in 1967, a full account of it appeared five years later (Holthuis, 1972). No new finds were published since then, with the exception of the record by Retamal (1981) who mentioned the species as occurring at "Isla de Pacua" without further details, but he provided an original figure.

***Parribacus holthuisi* Forest, 1954**
(figs 24, 25B)

Parribacus antarcticus Stimpson, 1860: 23 (p.p.); Nobili, 1907: 366; Holthuis, 1953: 50 (p.p.); Morrison, 1954: 16; Wiens, 1962: 258 (not *Scyllarus antarcticus* Lund, 1793).

Parribacus holthuisi Forest, 1954: 346, figs. 25, 26B; Johnson, 1971: 15; Michel, 1971: 472; Burukovsky, 1974: 103; Phillips, Cobb & George, 1980: 71; Burukovsky, 1983: 144. Type localities: Hikueru and Hao, Tuamotu Islands. By present lectotype selection restricted to Hikueru.

Vernacular names. — „Tianee", Tahiti (Nobili, 1907), „Opapa", Mangareva (Nobili, 1907), "Akamaru", Gambier Islands (Nobili, 1907).

Material examined. — Tahiti (1853-1856, North Pacific Exploring Expedition, W. Stimpson, 1 ♀, USNM; (1 specimen, BM).

Hikueru, Tahiti (1952, G. Ranson, 6 ♂ paralectotypes and 6 ♀ paralectotypes, 1 ♀ lectotype, MP, 1 ♂ paralectotype, BM, 1 ♀ paralectotype, RMNH).

Hao, Tuamotu Islands (1905, L. G. Seurat, 2 ♀ paralectotypes, MP; reef flat, 23 December 1937, A. Samson and A. Seligman, 1 ♀, BM).

Ngumoroa Island, Raroia Atoll, Tuamotu Islands (near edge of outer reef, fishing at night, 22 July 1952, J. P. E. Morrison, loc. 1972, 2 ♀, USNM; south end of island, near edge of outer reef, a little behind the Lithothamnion ridge, fishing at night, 23 July 1952, J. P. E. Morrison, loc. 1979, 1 ♂, 1 ♀, USNM).

Mangareva, Gambier Islands (central lagoon, 12 m, collected at night, 1 ♂, MP; lagoon, 7 m, collected at night, 29 February 1984, P. Laboute, 1 juv., MP).

Description. — The distance between the orbits is 2.1. to 2.3 times as great as the distance between each orbit and the nearest anterolateral angle of the carapace. These values thus are conspicuously lower than those found for the other species. The rostrum shows a small sharp dorsal tooth just behind its tip. The posterior of the two lateral teeth placed before the cervical incision is very much smaller than the anterior. Behind the cervical incision there are six large teeth of equal size.

The first abdominal somite is smooth in the middle, showing a few tubercles near the transverse groove in the lateral part. In the second to fifth somites the anterior half which disappears under the previous somite when the body is stretched, is smooth, showing no tubercles at all. The groove between the anterior and posterior parts of the second to sixth abdominal somites is rather narrow and completely filled with numerous short hairs; it

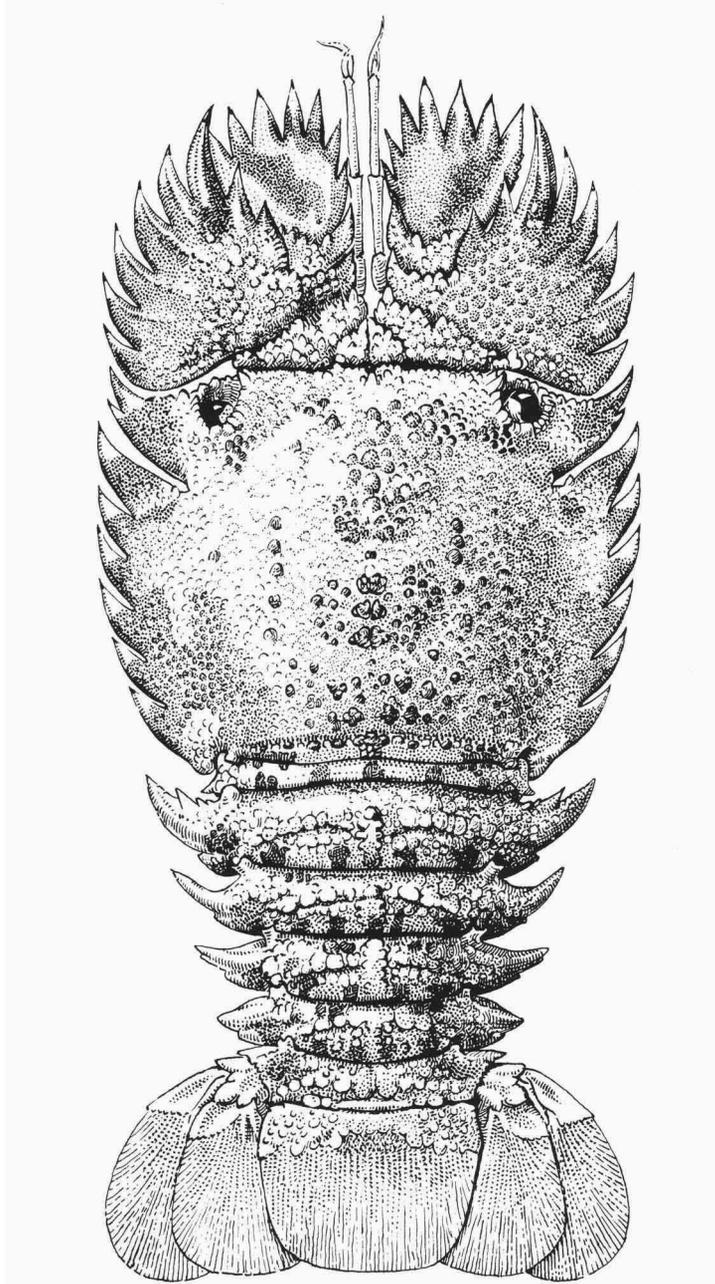


Fig. 24. *Parribacus holthuisi* Forest. Dorsal view of type. $\times 1$. M. Gaillard del. After Forest, 1954.

shows some tubercles. These grooves are far narrower than in *P. antarcticus*. The median carina of the second to fifth abdominal somites is hardly produced above the level of the dorsal surface of the somites, in the second and third somites the anterior part of the carina is slightly elevated. The tubercles of the abdominal somites are relatively larger than in *P. antarcticus* and their hairy fringe is longer. The transverse grooves on the posterior part of the somites are entirely closed over by the hairs of the tubercles. The smooth area along the posterior margin of the abdominal somites is relatively longer than in *P. antarcticus*.

The distal segment of the antenna bears six teeth on the anterior margin and one on the inner. The posterior margin is convex and shows some crenulations. The inner margin of the fifth segment bears two teeth, the posterior of which is far shorter than the anterior. The outer margin of the fourth segment bears five teeth (not included the distal) in all specimens. The anterior margin is provided with three teeth (including the distal).

The anterior margin of the epistome bears a number of teeth, the submedian and lateral pairs being the largest; between the two there are about two to four low teeth.

The pereopods are slender, resembling those of *P. antarcticus*.

Colour. — The carapace in fresh specimens is pale brownish yellow with numerous small, dark, irregularly arranged spots; larger dark spots are found at the bases of the lateral teeth. The spots are dark purple, only those in the posterior parts being more red; three rather large red spots are situated on the posterior margin of the carapace, one median and two laterals. The rim of the orbit is red for the larger part of the external half and for about half the internal half, these two red areas being separated by a short distance which is not coloured.

The first abdominal somite bears five red spots on the posterior margin, one median and two laterals which are rather regularly divided along the margin. Before these spots there is a transverse row of some 10 to 12 small red spots. Red spots are also found on the posterior margin of the second to fifth somites: there are five in the second, four in the other somites, while a red spot also may be present on the posterior basal angle of the abdominal pleura. Small red spots are present on the smooth part of the somites and on the anterior part of the tuberculated half. All the red spots of the carapace and abdomen are well defined and surrounded by a dark, purple ring.

The inner teeth of the antennae are either red or have a red spot on the base. A dark spot is present on the last segment of the antenna, near the base and along the bases of the external teeth of the second segment. Forest (1954: 351) described the colour of these external teeth as follows: "la région distale

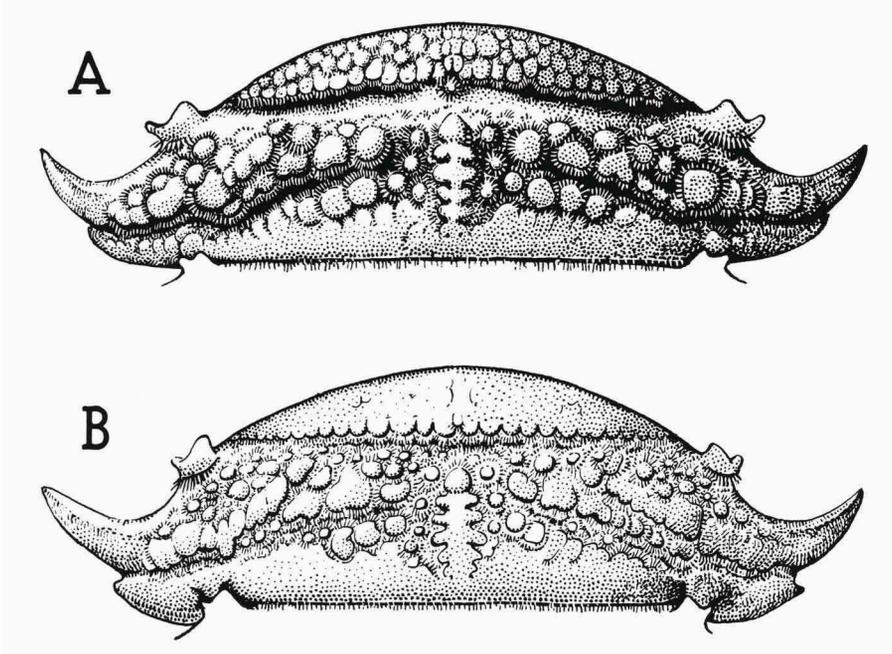


Fig. 25. Third abdominal somite in dorsal view. A, *Parribacus antarcticus* (Lund); B, *Parribacus holthuisi* Forest. M. Gaillard del. After Forest, 1954.

des dents . . . est jaunâtre, la région proximale rouge”, this coloration thus differing conspicuously from that in *P. antarcticus*.

In some specimens the legs are banded with a dark colour, being similar to those of *P. caledonicus*.

The lower surface of the body is not coloured, apart from some dark spots on the antenna.

The colour pattern is very persistent and the red spots on carapace, orbits and abdomen are still visible in Stimpson's specimen which has been preserved in alcohol for more than 100 years. In some of the other specimens the colour is still very fresh, in some, however, it is much vaguer and here the red of the orbit is practically entirely gone, although the rest of the pattern is still well visible.

The colour pattern seems to be quite constant and is one of the easiest characters for distinguishing the species.

Size. — The carapace length of the examined males varied from 43 to 58 mm, that of the females from 27 to 65 mm. A female with cl. 55 mm was provided with spermatophores.

Distribution. — The species is only known from the Society, Tuamotu and Gambier Islands in the southern Pacific. The records in the literature are:

Tahiti, Society Islands (Stimpson, 1860; Forest, 1954), Raroia Atoll, Tuamotu Islands (Morrison, 1954; Wiens, 1962), Ngumaroa Island, Raroia Atoll (Holthuis, 1953), Hikueru, Tuamotu Islands (Forest, 1954), Hao, Tuamotu Islands (Nobili, 1907; Forest, 1954), Rikitea, Mangareva Island, Gambier Islands (Nobili, 1907; Forest, 1954). Forest (1954: 351) also reported on a specimen of this species in the Paris Museum which was labelled "Viña del Mar, Chili"; it is possible that this label is not correct, which is the more likely as Viña del Mar lies in the southern (colder) half of the temperate Peruvian-North Chilean faunal province where one would hardly expect to find a tropical genus like *Parribacus*. Johnson (1971) reported on a larva from 14°13.6'S 126°00'W, which he thought might belong to the present species.

Habitat. — Like the other *Parribacus* species, *P. holthuisi* is found in shallow water on the sandy bottom of reefs.

Biology. — The lectotype female (cl. 55 mm) from Hikueru carried two spermatophores on the ventral surface of the first abdominal somite. Each spermatophore consists of dark, broad, transversely-oval mass which occupies almost the full length, but distinctly less than half the width of the sternite; the two masses are separated in the middle of the sternite by a distinct interspace.

On a specimen from Raroia Atoll commensal Lepadidae were observed on the mouthparts (Morrison, 1954; Wiens, 1962).

Economics. — Morrison (1954) indicated that the present species is used for food at Raroia, and that they are collected by the natives whenever the tide is out. "The edible species taken here by the natives, with the aid of torches in the early days, but now with the aid of kerosene or gasoline lanterns".

Types. — Syntypes from the series collected by Dr. G. Ranson at Hikueru are present in MP, BM and RMNH. The female with cl. 55 mm carrying spermatophores, and preserved in the Paris Museum, is herewith selected the lectotype.

Remarks. — Forest (1954) was the first to recognize that the genus *Parribacus* is not monotypic, as at that time was thought by all other authors. He indicated the differences between the present species and *P. antarcticus* and showed that the specimens which Nobili (1907) brought to the latter species in reality belong to the present. Examination of Stimpson's (1860) specimen from Tahiti which he identified as *P. antarcticus*, showed it to belong to the present species as well.

***Parribacus scarlatinus* Holthuis, 1960**

(fig. 26)

Parribacus scarlatinus Holthuis, 1960: 148; Michel, 1971: 472; Burukovsky, 1974: 102; Phillips, Cobb & George, 1980: 71; Burukovsky, 1983: 144. Type locality: Enderbury Island, Phoenix Archipelago, 3°08'29.7"S 171°05'34.4"W.

?*Parribacus* sp. George, 1972: 31.

Material examined. — Ringtoru Island, Kapingamarangi Atoll, Micronesia (algal mat and rill zone, 3 August 1954, C. Hand no. 523, 2 ♀ paratypes (1 ovigerous), USNM).

Jaluit Atoll, Marshall Islands (4 February 1880, O. Finsch, Pazifik Exped., no. 26, 1 ♂, 2 ♀ ♀, ZMB; outer reef, 12 July 1892, S. G. Steinbach, 1 ♂, 1 ♀, ZMB; shore, 13 January 1900, "Albatross" Expedition, 1 ♂ paratype, USNM).

Apaiang, Gilbert Islands (1859, A. Garrett, 2 ♂ paratypes, 2 ♀ paratypes, USNM, RMNH).

Canton Island, Phoenix Islands (20 July 1939, L. P. Schultz no. U 01104, 1 ♀ paratype, USNM).

Enderbury Island, Phoenix Islands, 3°08'29.7"S 171°05'34.4"W, 19 and 20 May 1939, L. P. Schultz no. U 39-362, -363, and -364, 1 ♂ holotype, USNM, 3 ♂ paratypes, USNM and RMNH).

Marquesas Islands (1968, A. Michel, 1 ♂, MP).

Description. — The distance between the orbits is 2.5 to 2.8 times as great as the distance between each orbit and the nearest anterolateral angle of the carapace. The rostrum shows a small, sharp dorsal tooth some distance behind the tip. The posterior of the two lateral teeth that are placed before the cervical incision is only slightly less strong than the anterior. Behind the cervical incision the carapace carries six large teeth.

The first abdominal somite is smooth dorsally with only at most a few short, curved grooves or faint traces of a reticular pattern of grooves which are made more conspicuous by that they are of a darker colour than the rest; a few actual tubercles are present near the transverse grooves of the upper surface. In the second to fifth somites the anterior part which disappears under the previous somite when the body is fully stretched, is practically smooth, but, like the first somite, has a reticular pattern of very faint grooves which are accentuated by a darker colour whereby this part seems to be tuberculate, but is not. The groove between the anterior and posterior halves of the abdominal somites is slightly wider than in *P. holthuisi*, and as in that species, is entirely filled with numerous hairs and tubercles. The median carina of the second to fifth somites is very low and is hardly produced above the level of the somite; the anterior part is not elevated. The tubercles of the somites are similar to those of *P. holthuisi*. The smooth area along the posterior margin of the somite is broader than in that species. The hairy fringes around the tubercles are rather long and they entirely cover the transverse grooves in the posterior part of the somites.

The distal segment of the antenna bears seven teeth on the distal and one on the inner margin. On the outer margin two small teeth are present. The inner margin of the fifth segment of the antenna bears two teeth, the posterior of which is often so small as to be hardly noticeable. The outer margin of the fourth segment bears six teeth, the apex not included (in twenty cases six, in two cases five teeth). The anterior margin bears two teeth (not including the apical).

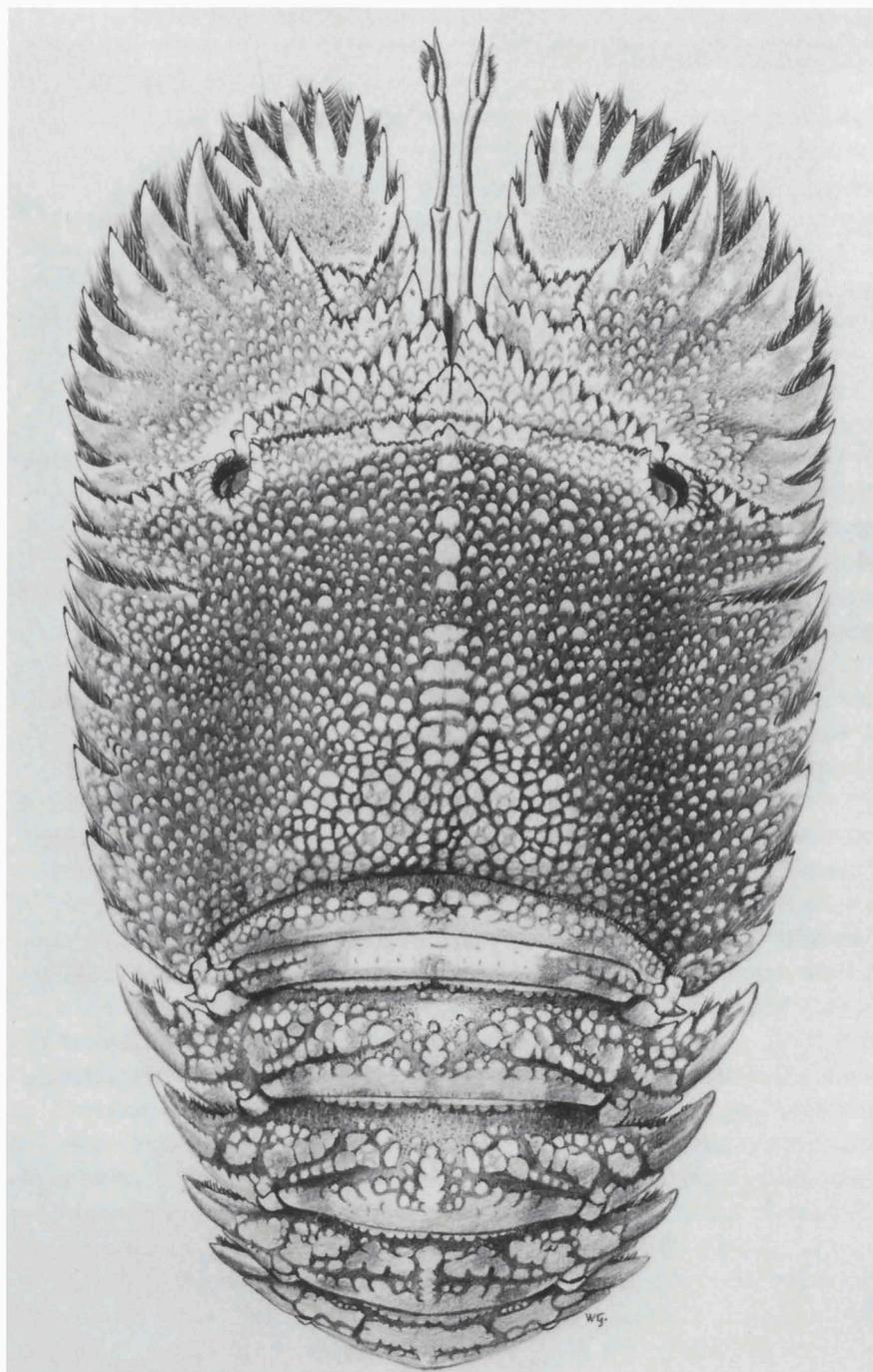


Fig. 26. *Parribacus scarlatinus* Holthuis. Dorsal view of male paratype from Apaiang, Gilbert Islands. $\times 12$. W. C. G. Gertenaar del.

The anterior margin of the epistome bears six to twelve (usually ten) small teeth, of which the median and external pair are largest.

The pereiopods are slender and resemble those of *P. holthuisi*.

Colour. — In preserved specimens the following colour pattern was observed. The orbital margins are red as are also the rostrum and the bases of the lateral teeth of the carapace. The teeth of the antennae are pale reddish with a yellowish tip. A large red spot is present in the outer part of the base of the fourth segment of the antenna. The posterior margin of the carapace shows three red spots: a small one in the middle and a large one on each side. Sometimes a large median red spot is visible in the posterior part of the carapace and a large irregular dark spot may occur in the posterior part of each half of the carapace; furthermore a dark band may be seen between the eyes.

A freshly collected male specimen from the Marquesas Islands was kindly placed at my disposal by Dr. J. Forest of the Paris Museum. It showed the following colour pattern: The carapace was mainly red in colour with the red spots mentioned in the above description very dark red, contrasting distinctly with the rest of the carapace. Furthermore there are irregular, pale brownish spots, one of these occurring just mediad of the eyes, one in the median area just behind the cervical groove, and a few, less distinct, around the pregastric tooth. Other such brown spots are found near the base of the cervical incision, one near the base of the second and one near that of the last posterolateral tooth, one at either side of the dark red median spot just before the posterior groove of the carapace. The median red spot on the posterior margin of the carapace has a distinct lighter area at each side.

The last segment of the antenna shows a large reddish spot near its base and along the proximal part of its inner margin. The fifth segment is entirely red. The fourth shows the large red spot in the outer half of its basal area and a small spot in the extreme inner part; the teeth of this segment are reddish except for their tips.

The first abdominal somite has a small posteromedian spot and two large lateral ones which sometimes are divided into two, so that the total number of spots is five. These spots are not so sharply demarcated as in *P. holthuisi*. The second and third somites each have a small anteromedian and a small posteromedian red spot; large irregular spots are visible on the lateral part of the tergum and on the pleura. The same pattern is found in the fourth and fifth somites, but the median spots are indistinct or absent. The sixth abdominal somite and the tailfan show only some colour in the extreme lateral parts.

The lower surface of the antennae is spotted with small red spots. The legs are banded with red: one band over the base of the merus, partly touching the ischium, one over the middle of the distal half of the merus, one over the car-

pus, one over the propodus, and one in the basal half of the dactylus.

Size. — The carapace length of the males varies between 58 and 66 mm, that of the females between 53 and 69 mm, while there is also a juvenile female with cl. 24 mm. The carapace length of the ovigerous female is 60 mm.

Distribution. — The species so far is known only from a rather restricted, narrow area extending over the Central Pacific from Kapingamaringi through the Marshall, Gilbert and Phoenix Islands to the Marquesas. The records in the literature are:

Kapingamaringi Atoll (Holthuis, 1960), Marshall, Gilbert and Phoenix Islands (Holthuis, 1960), Enderbury Island, Phoenix Archipelago, 3°08' 29.7"S 171°05'34.4"W (Holthuis, 1960), Marquesas Islands (Michel, 1971). See "Remarks" below for the possible occurrence of the species in the Cook Islands.

Habitat. — Very little is known about the habitat of this species. According to the field notes of the examined material, it came from "algal mat and rill zone", "outer reef", and "shore". It evidently lives in shallow water.

Type. — The holotype is the largest male (cl. 66 mm) from Enderbury Island, Phoenix Islands (USNM No. 100826). Paratypes are present in USNM and RMNH.

Remarks. — In the hairiness of the grooves of the abdomen and the low median ridges of the abdominal somites, the present species differs from *P. antarcticus* and resembles *P. holthuisi*. Furthermore it resembles the latter species in having the first abdominal somite and anterior part of the following somites not tuberculate, although the surface is not as smooth as in *P. holthuisi*. The differences from that species are mainly found in the colour which is strikingly different, and in the fact that the fourth segment of the antenna has usually six and not five outer teeth; also, the anterolateral tooth of the carapace is not strikingly larger than the tooth behind it.

George (1972: 31) mentioned three specimens of a "fawn coloured butterfly lobster *Parribacus* sp. with red blotch markings on antennae and body" that were "collected on the outer reef at Palmerston and Aitutaki" (Cook Islands). Judging by the colour description, these specimens could well belong to the present species.

***Parribacus japonicus* Holthuis, 1960**

(fig. 27)

?*Cancer (Astacus) ursus major* p.p. Herbst, 1793: 82, pl. 30 fig. 2.

Scyllarus (Ibacus) antarcticus De Haan, 1841: 153, pls. J, L (not *Scyllarus antarcticus* Lund, 1793).

Scyllarus (Ibacus) Antarcticus Herklots, 1861: 142 (not *Scyllarus antarcticus* Lund, 1793).

- ?*Paribacus antarcticus* p.p. Ortmann, 1891: 45.
 ?*Ibacus antarcticus* p.p. Thompson, 1901: 18.
 ?*Paribaccus antarcticus* p.p. Balss, 1914: 81.
Parribacus ursus major Parisi, 1917: 13 (p.p.), fig. 3.
Scyllarus haani Fisher. Soc. Japan, 1935: pl. 58 fig. 2 (not *Scyllarus haanii* De Haan, 1841).
Parribacus antarcticus Holthuis, 1946: 102 (p.p.); Utinomi, 1956: 62, pl. 31 fig. 2; Kubo, 1960: 98, pl. 49 fig. 7; ?Saisho, 1962: 174, figs. 1, 2; Kubo, 1965: 627, fig. 1022; Utinomi, 1965: 62, pl. 31 fig. 2; ? Saisho, 1966: 177, 196, fig. 3; Holthuis & Sakai, 1970: 92, 290; Nishimura & Suzuki, 1971: 89, pl. 30 fig. 3; Miyake, 1975: 107, fig.; Matsuzawa, 1977: pl. 75 fig. 5; Utinomi, 1978: 62, pl. 31 fig. 2; ? Shirai, 1980: 411, fig. (not *Scyllarus antarcticus* Lund, 1793).
Parribacus ursus-major Kubo, 1954: 759, fig. 2188.
 ?*Parribacus ursus-major* Aikawa & Isobe, 1955: 113, fig. 1.
Parribacus japonicus Holthuis, 1960: 148; Harada, 1961: 193; Harada, 1965: 37; Burukovsky, 1974: 103; Phillips, Cobb & George, 1980: 71; Miyake, 1982: 89, pl. 30 fig. 1; Sakai, 1982: 129; Burukovsky, 1983: 144; Sakai & Nakono, 1983: 76. Type locality: Kururi District, Tokyo Bay, Japan. Holotype in USNM (no. 18883).
 [Japanese name] Imajima, Umabayashi & Okutani, 1970: 29, fig.

Material examined. — Japan (1825-1835, H. Bürger, 2 ♂ paratypes, RMNH; 1 ♂ paratype, RMNH; 1 ♂, ZMA; 1876, F. Hilgendorf, 1 ♂, ZMB; E. Gordon Smith, 1 ♂, BM; 1894, 1 ♀, BM); Tokyo Bay, Honshu (1 ♀, AM); Tokyo (market, M. Sasaki, 1 ♀ paratype, USNM; as Yedo, 16-18 June 1876, F. Hilgendorf, 3 ♂, 2 ♀, ZMB); Kururi District, Tokyo Bay (March 1893, F. Sakamoto, 1 ♂ holotype, 1 ♂ paratype, USNM); Sagami Bay (A. Haberer, 1 ♂, 1 ♀, ZMB); Kobe, Honshu (3 June 1911, E. Gordon Smith, 1 ♀, ZMB); Takaoka, fishing port on east coast of tip of Muroto peninsula, Shikoku (20 m, from gill nets, 27 March 1984, K. Matsuzawa, 2 ♂, 1 ♀, RMNH); Uranouchi Inlet near Usa, Shikoku (20 July 1953, 1 ♀, Usa Marine Biological Laboratory); Nagasaki, Kyushu (1911, James Jordan, 1 ♂, 1 ♀, UZM); probably near Deshima, Nagasaki (K. N. Motosuke, 1 ♀, ZMA); Tomioka, Amakusa Islands, Kyushu (23 December 1932, Mr. Yamada, 1 ♂, Amakusa Marine Biological Laboratory).

Description. — The distance between the orbits is 2.6 to 2.7 times as great as the distance between each orbit and the nearest anterolateral angle of the carapace. The rostrum is smooth dorsally and shows no tooth there. The posterior of the two lateral teeth placed before the cervical incision is only slightly smaller than the anterior. Behind the cervical incision there are six lateral teeth of equal size.

The first abdominal somite is smooth in the middle, showing only a few shallow, short, curved grooves or faint traces of a reticular pattern of grooves which, as in *P. scarlatinus*, are made more conspicuous because they are of a darker colour than the rest of the surface. A few tubercles are present along the grooves in the lateral part of the somite. In the second to fifth somites the anterior part which disappears under the previous somite when the body is fully stretched, are practically smooth but, like the first somite, have a reticular pattern of very shallow grooves which often are accentuated, being of a darker colour. In some of these grooves there are rows of posteriorly directed hairs. This part of the somite at a first glance seems to be tuberculate. The groove between the anterior and posterior halves of the abdominal somites is

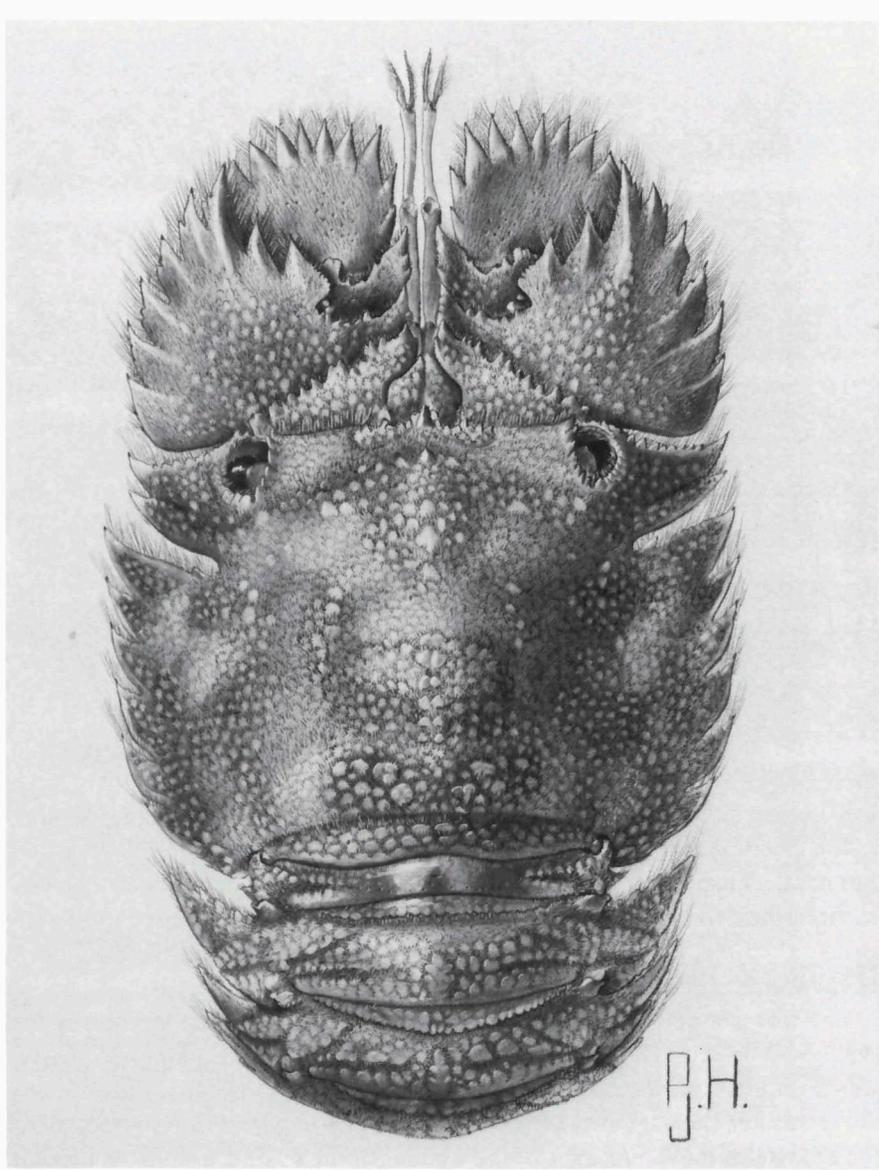


Fig. 27. *Parribacus japonicus* Holthuis. Dorsal view of male holotype from Kururi District, Japan. Mrs. P. Hogue del.

as in *P. scarlatinus*; it is entirely filled with numerous short hairs and tubercles. The median carina of the abdominal somites likewise is similar to that of *P. scarlatinus* in that it is low with the anterior end not elevated. The tubercles

of the abdominal somites and their hairy fringes are like those of *P. scarlatinus*. The smooth area along the posterior margin of the abdominal somite is slightly narrower than in *P. scarlatinus*.

The distal segment of the antenna bears seven or eight teeth on the anterior and one on the inner margin. The posterior of the two teeth on the inner margin of the fifth segment of the antenna is reduced to a small lobe at the base of the anterior tooth. The outer margin of the fourth segment bears five teeth (not including the apical tooth), the inner margin bears two teeth (not including the apical). In only one specimen examined by me there are six external teeth.

The epistome bears eight to ten small teeth of which the outer are largest and the median pair larger than the other two or three pairs.

The pereiopods are slender and resemble those of *P. scarlatinus*.

Colour. — Fresh specimens from Takaoka, Shikoku showed the following colour. The upper surface of the body is dark brownish through the presence of a cover of short, velvet-like brown hairs. The smaller tubercles are dark purple or almost brown; the large tubercles, especially those in the median line and along the posterior margin, are cherry-red. The tips of the lateral marginal teeth are horn-coloured with white along the base of the horn-coloured area, and the white followed by reddish. The segments of the antennae have the same colour as the dorsal surface of the carapace, except the last segment which is dark bluish with small white spots. The tips of the teeth of the antennal segments are likewise horn-coloured with a white base. The antennulae are dark brown with a white spot at the end of the peduncle and a pale longitudinal line on both the upper and lower surface of the last two peduncular segments.

The dorsal surface of the abdomen has the same colour as the carapace, brown, with the naked parts (tubercles and median lobed figure) deep red. The three spots on the first abdominal somite are deep dark purple; the surface lateral of the outer spots is slightly lighter purple. On either side of the median spot the surface is whitish with a few small, dark specks. The extreme tips of the pleura are white, but so small as to be hardly visible. The soft part of the tailfan is yellowish brown with numerous large, dark blue spots.

The lower surface of the entire body is pale yellowish brown, with numerous large, blue spots uniformly distributed behind the cervical groove; before the groove the area is unspotted and shows as a light region. The uropods and telson are also spotted with blue. The antennal segments are like the rest of the under surface, only slightly darker whereby the spots are less conspicuous; the last antennal segment, however, is evenly dark blue.

The legs are pale yellowish brown, distinctly ringed with blue. The dactylus

has a large basal ring, the propodus shows one in the middle, the carpus has one over the larger part of the surface; while the merus has a narrow complete ring at the base, a broad complete ring in the middle, an interrupted ring in between and another interrupted ring at the distal end.

The spermatophore carried by the female is black anteriorly, whitish posteriorly.

In only one of the preserved specimens traces of the original colour pattern are visible. The carapace is irregularly spotted with dark purplish brown, large spots being visible in the posterolateral and posteromedian areas and along the bases of the lateral teeth. The first abdominal segment has a small median and two large lateral spots. On the smooth anterior part of each of the following somites three dark spots are visible. The rest of the abdomen is pale reddish with whitish in the median area. Harada (1961: 193) stated that in the present species the dark blue spots on the ventral surface of the carapace and the thoracic and abdominal sternites are much more conspicuous than in *P. caledonicus*. Coloured figures of this species have been published by Fisher. Soc. Japan (1935), Utinomi (1956, 1965, 1978), Kubo (1960), Imajima, Umabayashi & Okutani (1970), Nishimura & Suzuki (1971), Miyake (1975, 1982), Matsuzawa (1977) and Shirai (1980). These coloured figures show the animals to have an overall brown tinge, sometimes more purplish or reddish, the carapace being sometimes uniform in colour, but more frequently marbled with darker markings. The last antennal segment is often shown darker, more greyish or bluish than the rest. The first abdominal somite shows five dark spots, reddish brown to almost black; the central one is isolated, on each side the two laterals may be more or less fused. The soft part of the tailfan is distinctly spotted with dark spots and is lighter, often more yellowish than the rest. The pereopods show striking dark bands.

Size. — The carapace length of the examined males varied from 42 to 67 mm, that of the females from 54 to 74 mm.

Distribution. — So far the species is only known from Japan where it replaces *P. antarcticus*, or possibly may occur together with that species. The records in the literature are the following:

Japan (? Herbst, 1793; De Haan, 1841; Herklots, 1861; ? Thompson, 1901; ? Parisi, 1917; Holthuis, 1946; Kubo, 1954, 1960, 1965; Utinomi, 1956, 1965, 1978; ? Saisho, 1966; Holthuis & Sakai, 1970; Nishimura & Suzuki, 1971; Miyake, 1975, 1982); Pacific coast of Japan (Fisher. Soc. Japan, 1935); ?Tokyo Bay, Honshu (Ortmann, 1891); Kururi District, Tokyo Bay (Holthuis, 1960); Negishi near Yokohama (Parisi, 1917); Sagami Bay (Parisi, 1917); ? Fukuura and Misaki, Sagami Bay (Balss, 1914); Kii District (Harada, 1965); Toba, Mie-ken (Sakai & Nakano, 1983); ? Maizuru, N.W. coast of Honshu (Ortmann, 1891); Kainancho-Asakawa, Kaifugun, Tokushima-ken, Shikoku (Sakai & Nagano, 1983); Muroto, Shikoku (Matsuzawa, 1977); Himejima, South-West Islands, Kochi Prefecture, Shikoku (Sakai, 1982); ? Goto Islands, Kyushu (Parisi, 1917); ?

Ei-cho, Kagoshima Prefecture (Saisho, 1962); ? Tomari Bay, Kagoshima Prefecture, Kyushu (Aikawa & Isobe, 1955); ?Ryukyu Islands (Shirai, 1980).

Habitat. — Saisho (1962: 174) reported what may have been this species from the “shore reef along the coast of southern Japan”. The specimens from Takaoka where taken with gill nets at a depth of 20 m.

Development. — Saisho (1962: 174) gave the spawning season of the Japanese *Parribacus* as from “late May to early August with its maximum activity in July”; berried females were collected in July. Aikawa & Isobe (1955) described the first, and Saisho (1962, 1966) the first three larval stages of Japanese *Parribacus*, probably the present species.

Types. — The holotype is the largest male from Kururi District (USNM reg. no. 18883); paratypes are both in USNM and RMNH. If Herbst's specimen, said to be from Japan, indeed belongs to the present species, *Cancer (Astacus) ursus major* is a composite species. The Japanese specimen then is a paralectotype of Herbst's species, since Rumphius' (1705) specimen figured by him on his pl. 2 fig. C was selected by Holthuis (1956: 111) to be the lectotype. This specimen, namely, having been referred to by Herbst in the original description of *Cancer (Astacus) ursus major*, is one of its syntypes.

Remarks. — Until 1960, when the present species was described for the first time as new, all Japanese *Parribacus* were referred to *P. antarcticus*. Some of these specimens, like the ones mentioned by De Haan and Herklots, could be examined and proved to be *P. japonicus*. Of others, too little information is given as to make their identity certain. So Herbst's (1793) figure is not sufficiently clear to enable the definite identification of the specimen. The juveniles from Sagami Bay that Parisi (1917) reported upon, are, as his figure shows, typical *P. japonicus*. The identity of Parisi's other material as well as of the Japanese specimens reported upon by Ortmann, Thompson and Balss is still uncertain.

The present species is closely related to *P. scarlatinus* and may eventually prove to be only a subspecies of it. Whether the differences found, viz., the smooth rostrum, the presence of only five teeth on the outer margin of the second segment of the antenna and the colour, are sufficiently constant to warrant the retention of the present form as a full species, can only be decided if more material becomes available.

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