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Biological Results of the Fishing Experiments
carried on by the F.I.S. "Endeavour" 1909-14

H. C. Dannevig
Commonwealth Director of Fisheries

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Report on the Crustacea Macrura (Families Peneidæ,
Campylonotidæ and Pandalidæ) Obtained by the
F.I.S. "Endeavour" in Australian Seas.

With notes on the species of "*Penaeus*" described by Haswell and
contained, in part, in the collections of the Macleay
Museum, at the University of Sydney.

BY

WALDO L. SCHMITT.
U.S. National Museum.

Plates Ivii.-lxviii. and one Map.



CORRIGENDA ET ADDENDA.

- p. 311, line 9.—for *Penæus* read *Peneus*.
- p. 320, line 3.—for *periopods* read *pereiopods*.
- p. 320, 2nd par., line 7.—for the *read* this.
- p. 320, 2nd par., line 11.—for *lère* read *lêre*.
- p. 324, 1st par.—*add* Though the single specimen of "*Parapeneus*" *rectacutus* in the U.S. National Museum collection (received from the Indian Museum) is in very poor condition, small scale-like exopodites certainly seem to be present on the thoracic legs; for this reason and because of the absence of sutures on the carapace this species is transferred to the genus *Penaeopsis*.
- p. 333, below *Penaeopsis macleayi* (Haswell) insert sub-heading.—"*Penæus macleayi*." (*Note*:—This is not a species collected by the F.I.S. "Endeavour," and should be sub-headed, like other such species in this report, under the original name given by Haswell.)
- p. 352, 2nd par.—*add* As in the preceding species, only the third legs are provided with epipodites.
- p. 352, footnote 40.—*add* Dr. Schmitt has since proved that minute spines are present on the telson in *T. granulatus*. An adult female "Endeavour" specimen (79.5 mm. long) from the collection of the United States National Museum was sent specially for our examination. This proved to possess two pairs of very minute spines on the telson in advance of the subterminals, which were almost lost to view among the fringes of hair adorning the edges of the telson. A further microscopic examination of the figured specimen in the collection of the Australian Museum verifies the previous statement, but with the assistance of the United States National Museum specimen there may be detected two pairs of most minute indentations on the edges of the telson above the subterminal spines, which mark the position where minute spines occurred. They have apparently become rubbed off, as suggested by Dr. Schmitt (*in lit.*).
- p. 352, last par., line 3.—for *does read* do.
- p. 356, line 9.—for *part read* par.
- p. 358, line 12.—*delete* possible.
- p. 358, 3rd par., last line.—for *Stimpson read* (Stimpson).
- p. 366, 8th par., line 1.—for *pestasma read* petasma.
- p. 369, 4th par., line 9.—*after* Bate *insert* ("Challenger" Rept. Zool., xxiv., Macrura, 1888, pl. xxxii., fig. 3).
- p. 372, line 5.—for *subtribe Hoplophorida read* superfamily Oplophoroida.
- p. 372, lines 12, 13 and 26.—for *Hoplophorida read* Oplophoroida.
- p. 372, line 18.—for *Hoplophoridæ read* Oplophoridæ.
- p. 372, line 37.—for *Anchistiella hani read* *Anchistiella hahni*.

- p. 373, line 15.—for Bright read Bight.
- p. 377, 3rd par., line 11.—for Hoplophoridæ read Oplophoridæ.
- p. 377, footnote 61.—add In working over a check-list of crustacean genera, I find that *Gonatonotus* M. Edw. is preoccupied by *Gonatonotus* Adams and White (in White, Proc. Zool. Soc., London, XV., 1847, p. 57). For *Gonatonotus* M. Edw., therefore, *Eugonatonotus* is proposed.
- p. 380, line 20.—for Baljan read Batjan.
- Plate lix., Explanation.—for *Panaeopsis endeavouri* read *Penaeopsis endeavouri*.
-

THIS first part of a report upon the Macrura and Anomura collected by the Australian Fisheries Investigation Steamer "Endeavour" covers the macruran families Peneidæ, Campylonotidæ and Pandalidæ. The first, and most important economically of these families comprises the bulk of the shrimps taken, both in point of numbers and species.

Three apparently new species are described for the first time: *Penæopsis endeavouri*, *Penæus maccullochi*, and *Campylonotus rathbunæ*. In all, thirteen species of Peneids, the one new Campylonotid, and two Pandalids, are represented. A complete list includes:

PENEIDÆ.		PAGE
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Through the kind offices of the authorities of the Australian Museum, Sydney, I have been enabled to examine co-types of most of the Peneids described by Haswell in his Catalogue of the Australian Crustacea,¹ and others which have been critically compared with the holotypes in the Macleay Museum at the University of Sydney. Thus it has been possible to determine the

¹The Australian Museum, Sydney, 1882, pp. I-XXIV., and 1-324, pls. I-IV.

rightful status of several of Haswell's species, which, for some time, have been considered of doubtful value, owing to the insufficiency of their original descriptions. It is also interesting to note that the true *Trachypeneus anchoralis* has been found for the first time since it was taken originally by the "Challenger" and described by Spence Bate.

An attempt at a complete key to the Australian and Indo-Pacific species of the genus *Peneus* has been introduced in connection with the systematic discussion of the "Endeavour" representatives of that group.

The principal synonymical references have been cited under each species dealt with in this paper and in addition to the local occurrence the general distribution is given. Re-descriptions of a few species have been deemed necessary, and in nearly all cases measurements and remarks considered pertinent have been added. The sections of the text dealing particularly with Haswell's specimens examined in connection with this report are subheaded by the names under which the species were described by Haswell. These are: *Penæus mastersii* [= *Penæopsis monoceros*] (p. 325); *Penæus* [= *Penæopsis*] *maclcayi* (p. 333); *Penæus* [= *Penæopsis*] *novæ-guinææ* (p. 338); and *Penæus palmensis* [= *Penæopsis novæ-guinææ*] (p. 338). Haswell's *Penæus granulosus* is *Trachypeneus granulosus* (p. 351).

My best thanks are due to Dr. Mary J. Rathbun for most helpful guidance in the preparation of this paper, and to the late Allan R. McCulloch for his kindness in furnishing me with notes upon Haswell's types. Also to the authorities of the Australian Museum and the United States National Museum, the former for the opportunity of studying the collection upon which this report is based, and the latter for the extensive use of its laboratory and research facilities.

The photographs were taken by Mr. Clarence R. Shoemaker, of the United States National Museum.¹

¹ Certain specimens in the Australian Museum collection which were not seen by Dr. Schmitt exhibit various features which have enabled Mr. F. A. McNeill to supplement in some small degree a few of the author's observations. These are recorded in their proper places as brief footnotes under Dr. Schmitt's observations upon the several species concerned.—EDITOR.

Order DECAPODA.

Suborder NATANTIA.

Tribe PENEIDES.

Family PENEIDÆ.

Subfamily ARISTEINÆ.

GENUS ARISTEOMORPHA, *Wood-Mason*.ARISTEOMORPHA FOLIACEA (*Risso*).²

(Plate Ivii., figs. 1-3.)

Pencus foliaceus, Risso, Hist. Nat. Europe Mérid., v., 1826, p. 69, pl. ii., fig. 6.

Aristeus ? foliaceus, Smith, Proc. U.S. Nat. Mus., viii., 1885, p. 188.

Aristæomorpha giglioliana, Wood-Mason, Ill. Zool. "Investigator," Crustacea, 1892, pl. ii., fig. 2.

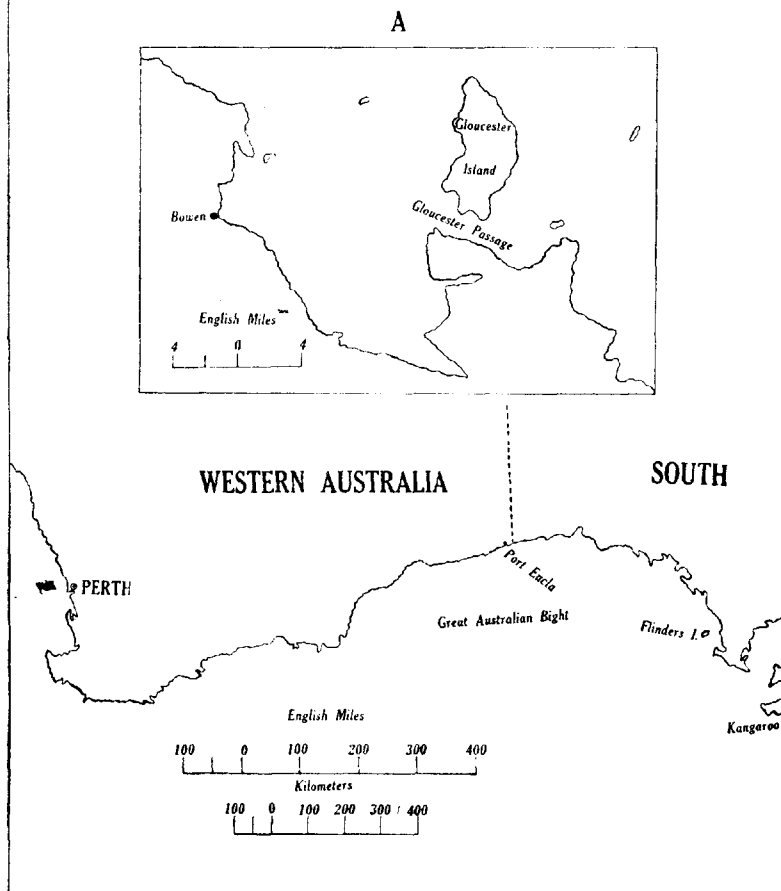
Aristæomorpha foliacea, Senna, Soc. Ent. Italiana, Bull., xxiv., 1902, p. 235, pls. iv.-xviii. Bouvier, Rés. Camp. Sci. Monaco, xxxiii., 1908, p. 53, pl. iii., fig. 1, pl. xi., figs. 1-5. Kemp and Sewell, Rec. Indian Mus., vii., 1912, pp. 18, 19, pl. i., fig. 5. Pesta, Archiv f. Naturg., 1915, Abt. A, Heft 1, p. 101.

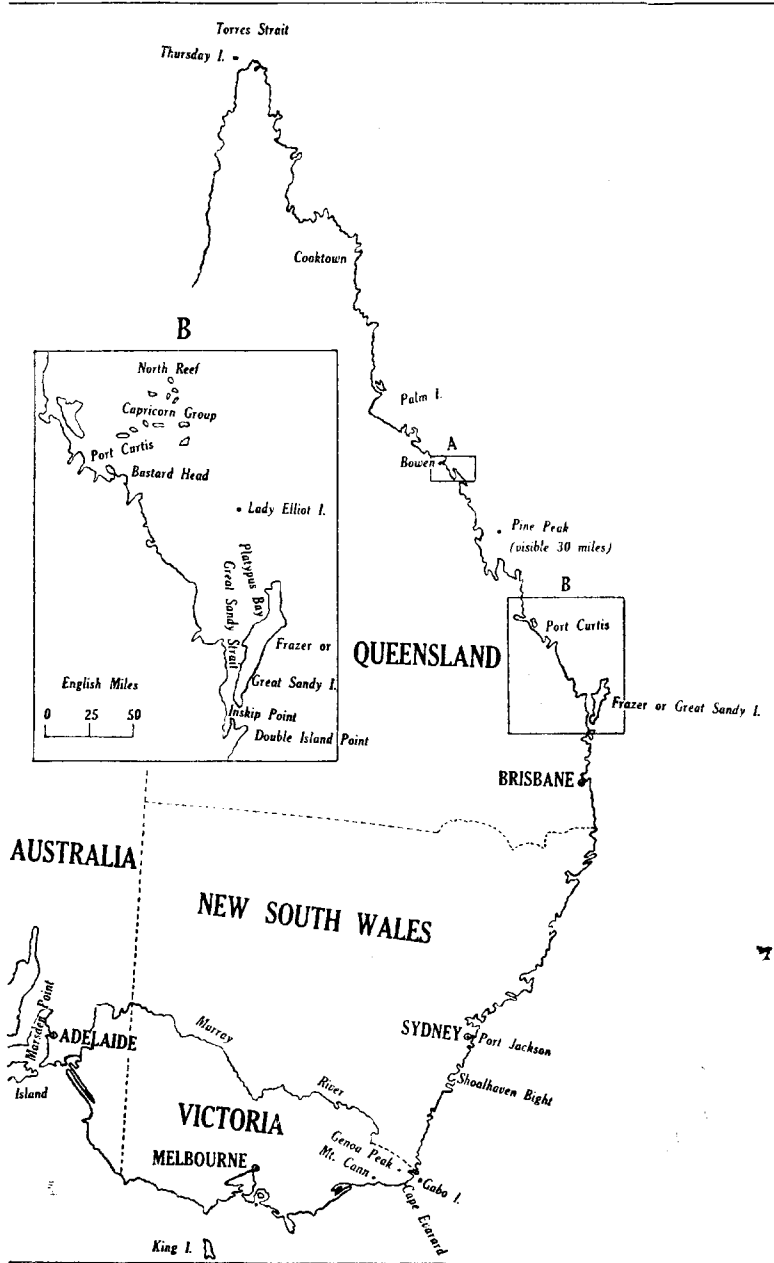
Occurrence.—Ten specimens of this species were taken: Off Gabo Island, Victoria, 200 fathoms; two males and five females (Reg. Nos. E. 6621, E. 6707, E. 6708 and E. 6709). 40 miles S.S.E. of Genoa Peak, Victoria, 200 fathoms; two males and one female (Reg. No. E. 6125).

Distribution.—Also known from the Mediterranean; East Atlantic.—Bay of Biscay and off the coast of

²The "Endeavour" specimens being damaged, the figure showing a lateral view of this species has been prepared from a perfect female specimen in the collection of the Australian Museum (Reg. No. P. 4695). It was trawled east of Sydney, New South Wales, May, 1920; 150 fathoms.

The figure of the rostrum is based upon an "Endeavour" specimen (Reg. No. E. 6621) from off Gabo Island, Victoria.—F. A. McNEILL.

MAP SHOWING LOCALITIES REFERRED
TO IN THIS REPORT



Morocco, 500-1,300 meters (Bouvier); and West Atlantic.—Gulf of Darien, 155 fathoms; "Albatross" Stn. 2143 (Smith).

Remarks.—The finer points of distinction elaborated by Kemp and Sewell, and upon which this species is separated from *A. rostridentata* hold good for the "Endeavour" specimens and distinguish them from that species. The latter, however, seems to be hardly more than a variety of the former, especially in view of any lack of differentiation in either petasma, thelycum, or oral appendages (*vide* Kemp and Sewell).

Smith's *Aristeus* ? *foliaceus*, a form somewhat intermediate between the two, is most like, and no doubt is a true *A. foliacea* (see lateral view photograph of Smith's specimen, a small male, on Plate lvii.). Its pterygostomian region is but 3.33 times as long as its greatest width, as compared with a length not exceeding 2.5 times for *A. rostridentata*, and more than 3.5 times in *A. foliacea* (*vide* Kemp and Sewell—the length of the pterygostomian region is "measured from the anterolateral margin of the carapace to the postero-dorsal end of the hepatic groove"). In the "Endeavour" specimens, the length of the pterygostomian region is from 3.5 to about 4 times its greatest width. The telson, like that of *A. foliacea*, falls about one-fifth of its length short of the tip of the inner uropod. The relation of the length of the dactyls of the last two pairs of legs to the length of the propodi, approaches that of *A. foliacea*, being less than one-half their length. The dactyls of these legs in Smith's specimen are now wanting, but fortunately his very complete measurements included their various lengths. In *A. rostridentata* they appear to measure more than half the length of their respective propodites. Unlike either of these species, Smith's specimen has a more slender sixth abdominal somite, which is a little more than 1.75 times as long as its greater depth. In both *A. rostridentata* and *A. foliacea* the length of the sixth abdominal somite varies from 1.5 to 1.66 times its greatest depth.

Measurements.—Of six of the "Endeavour" specimens enumerated above, and the one (Cat. No. 7264, U.S.N.M.) upon which Smith's description of *Aristeus* ? *foliaceus* was based; the measurements are in millimetres.

	Australian Museum, Reg. No. E. 6125.			Australian Museum, Reg. No. E. 6621, etc.			U.S. Nat. Mus., Cat. No. 7264.
	♂	♂	♀	♀	♀	♂	♂
Sex	♂	♂	♀	♀	♀	♂	♂
Total length	144	?	125	145	132 ¹	114 ¹	110
Length of rostrum	38	broken	34	42.5	38 ¹	31 ¹	31.3
Length of carapace	37	32	30	34	33.2	26.3	24.7
Length of pterygostomian region	15.5	14	13.2	15.5	15	11.1	10.2
Greatest breadth of pterygostomian region	4	4	3.4	4	3.5	3.2	3.1
Ratio of length to breadth of pterygostomian region	3.8	3.5	3.8	3.9	4.2	3.5	3.3
Length of sixth abdominal somite	15.5	14	13.8	15	14	12.5	13
Greatest depth of sixth abdominal somite	9.8	9	8	9	7	7.5	7
Ratio of length to depth of sixth abdominal somite	1.58	1.55	1.72	1.66	1.55	1.66	1.87
Rostral formula..	$\frac{9}{0}$	broken	$\frac{8}{0}$	$\frac{8}{0}$	$\frac{7}{0}$	$\frac{9}{0}$	$\frac{9}{0}$

¹ Estimated; tip of rostrum and telson broken off.

Sub-family PENEINÆ.

Genus HALIPORUS, *Bate*.

HALIPORUS SIBOGÆ, *de Man*.³

Haliporus sibogæ de Man, Notes Leyden Museum, xxix., 1907, p. 138; "Siboga" Exped., xxxixa, Decapoda, pt. i., Penæidæ, 1911 (plates, 1913), p. 38, pl. iii., figs. 10, 10a-10b, pl. iv., figs. 10c-q.

Occurrence.—Thirty-one specimens of this distinct and well-characterized form were taken by the "Endeavour" as follows:

³ Additional specimens of this species are in the Australian Museum from the following localities:

35 miles east of Sydney, 800 fathoms; seven males and eight females (Reg. No. G. 6049, Austr. Mus.).

East of Sydney, 150 fathoms; May, 1920; two females (Reg. Nos. P. 4696-7, Austr. Mus.).

Those from 800 fathoms were dredged during the Expedition of the "Woy Woy" in 1906, and are the specimens "reserved for further consideration" by McCulloch, Rec. Austr. Mus. vi. 5, 1907, p. 353. They range from 19-53½ mm. in length from the tip of the rostrum to the end of the carapace, and the largest female from 150 fathoms measures 52 mm.—F. A. MCNEILL.

South of Gabo Island, Victoria, 180-150 fathoms; seven females (Reg. No. E. 4393).

Off Gabo Island, 200 fathoms; five males and seven females (Reg. No. E. 4828).

30 miles south of Gabo Island, 200 fathoms; two males and three females (Reg. No. E. 6269).

From Gabo Island to Cape Everard grounds, Victoria, 200-250 fathoms; one male and two females (Reg. No. E. 6126).

40 miles S.S.E. of Genoa Peak, Victoria, 200 fathoms; two males and two females (Reg. No. E. 6124).

Distribution.—Also known from East Indian Archipelago: Flores Sea, Straits of Makassar, Banda Sea, and near Kei Islands, 397-521 metres (de Man).

Remarks.—The rostral formula for such of these specimens as have complete, or virtually complete, rostra, ranges from $\frac{7}{1}$ to $\frac{9}{2}$; but only one individual had the latter count, $\frac{8}{2}$ being the number of rostral teeth found in most of the specimens.

GENUS SOLENOCERA, Lucas.

SOLENOCERA MELANTHO, de Man.

Solenocera melantho, de Man, Notes Leyden Museum, xxix., 1907, p. 137; "Siboga" Exped., xxxixa, Decapoda, pt. i., Penæidæ, 1911 (plates, 1913), p. 48, pl. v., figs. 12-12i.

Occurrence.—12 miles N.N.E. of Bowen, Queensland, 19-25 fathoms; one male (Reg. No. E. 6617).

Distribution.—Otherwise known only from the East Indian Archipelago: near Rotti Island, Lobetobi Strait, Saleh-bay, north coast of Sumawa, 216-274 meters (de Man).

Remarks.—The single example is evidently this species, though the inner, anterior pair of lobes of the petasma are less truncated and more rounded than in the typical *S. melantho* figured by de Man. The rostrum has nine teeth on the upper margin, of which four are on the carapace and the fifth above the orbital margin. The carapace is much broken and the antennules are missing beyond the second joint of their peduncle. In general, however, this specimen agrees with de Man's description so closely that I have no doubt as to its identity.

Genus *PENÆOPSIS*, Bate.

Penæopsis (A. Milne Edwards, M.S.) Bate, Ann. Mag. Nat. Hist. (5), viii., 1881, p. 182 (*P. serratus* A. Milne Edwards, M.S.). *Id.* Kemp, Mem. Indian Museum, v., 3, 1915, p. 320. *Id.* A. Milne Edwards and Bouvier, Mem. Mus. Comp. Zool., xxvii., 3, 1909, p. 220.

? *Metapenæus* Wood-Mason, Ann. Mag. Nat. Hist. (6) viii., 1891, p. 271 (*Penæus affinis* H. Milne Edwards).

Though Bate's definition of *Penæopsis* (A. Milne Edwards, MS.) is worthless, as noted by Kemp (*loc. cit.*), his citation of an existing type "*P. serratus* (A. Milne Edwards, MS.), length about 4 inches,"⁴ together with Milne Edwards's and Bouvier's subsequent careful description of that type, must be accepted as validating the name. But I am not entirely satisfied that *Penæopsis* Bate and *Metapenæus* Wood-Mason, are synonymous as is stated by Kemp. There seems to be a small "*P. serratus*" group of species within the genus *Penæopsis* in its broader sense, having characters which, if constant, may separate them from the rest of the "Metapenei." These characters, as exhibited by various species, are discussed in the following pages.

As Milne Edwards and Bouvier believe *Parapenæus megalops* Smith⁵ to be the same as *Penæopsis serratus*, Smith's types have been carefully re-examined. Prof. Smith failed to mention the peculiar modification of the basal portion of the inner antennular flagellum of the male. This forms a flattened semicircular loop ending distally in a more or less backwardly directed blunt knob or tubercle, which is the butt of the straight, distal portion of the flagellum; this loop is about one-fourth or fifth of the total length of the flagellum. A very similar structural modification exists in *Parapenæus rectacutus* (Bate) as figured by Alcock,⁶ only Smith's species has the loop annulated like the rest of the flagellum, and not unsegmented as is shown in Alcock's figure.

⁴The type locality is wrongly given as "Gulf of Mexico," probably as a result of a misapprehension as to the scene of the "Blake's" operations.

⁵Proc. U.S. Nat. Mus., viii., 1885, p. 172.

⁶Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., pl. vi., fig. 19.

De Man,⁷ together with other significant observations on the species, has called attention to the fact, "that in *Parap. rectacutus* all the periopods are provided with very small exopods and that there is an epipod on the legs of the 3rd pair." *Parapenæus megalops*, Smith, also has small, inconspicuous scale-like exopodites on all of the thoracic legs and epipodites on the third and preceding, but not on the last two pairs of legs. As in *rectacutus*, there are no suture lines in evidence on the carapace. The telson is armed on either side with two movable spines in advance of an immovable one; this is one pair of movable spines less than Alcock assigns to his *rectacutus*, but corresponds to the number de Man (*op. cit.*, p. 82) observed on his "Siboga" specimen of that species.

The specimens identified as *Penæopsis serratus* by A. Milne Edwards and Bouvier from the "Blake" collections were all more or less mutilated and included but one male of the typical species, and one of a varietal form. If they were specifically identical with *megalops*, either the antennular flagella of these males were wanting, or the secondary male character was overlooked. All the specimens had small scale-like exopodites on the thoracic legs—"Tous ces appendices [pattes] sont munis de court . . . [exopodites] en forme d'écaillés qui se réduisent progressivement de la lère paire à la dernière paire" (*op. cit.* p. 223).

The branchial formula given for *P. serratus*, and said to be common to all representatives of the genus except as regards the number of exopodites, differs from that given by Alcock under "*Metapeneus*" in having one podobranch, one arthrobranch and one pleurobranch, instead of one podobranch and two arthrobranches on the second maxillipeds, and in omitting mention of the vestigial anterior arthrobranch found on the penultimate pair of legs of all the "*Metapenei*" examined by Alcock. It may not be easy to determine the exact attachment of the two gill plumes of the second maxillipeds, other than the podobranch, but from a close inspection of *P. megalops*, I should say that both were arthrobranches. There is no vestigial anterior arthrobranch on the penultimate pair of legs. The second maxilliped carries a rudimentary arthrobranch, as noted by Smith in the branchial

⁷ Siboga Exped., xxxix.a. Decapoda, pt. I., Penæidæ, 1911, p. 78.

formula he gives for "*Parapeneus*," and this branchial member is probably also to be found in *P. rectacutus*, even though Alcock grouped that species with forms lacking it.

In addition to a re-examination of some of the *Metapenei* examined by Alcock, and *Penaeopsis endeavouri* described below, a number of other species in the collection of the United States National Museum have been examined. These are *acclivis* (Rathbun), *akayebi* (Rathbun), *dalei* (Rathbun), *incisipes* (Bate), *intermedius* (Kishinouye), *goodei* (Smith), *mobilispinis* (Rathbun), *mogiensis* (Rathbun), *velutinus* (Dana) (Rathbun), and *lamellatus* (de Haan.). Only the latter appears to have no trace of the vestigial arthrobranch so easily made out on the penultimate pair of legs of all the other species, and which, but for the inclusion of this species, I should have regarded of great generic value. *P. lamellatus* has a very hairy lobule on the posterior border of the articulating membrane of each penultimate thoracic leg, but it is neither in the position of, nor of the same character as, the vestige found in the other species, and does not represent an anterior arthrobranch. I find no other characters to separate this species generically from its fellows.

In seeking other characters that might possibly differentiate *Penaeopsis* from *Metapeneus*, I noticed that *P. megalops* and *P. rectacutus* had antennular flagella as long as or longer than their peduncle, while all the other "*Metapenei*" except "*Metapeneus coniger*" and its variety "*andamanensis*" had quite short antennular flagella, noticeably shorter than their peduncles. These two exceptions, of which the United States National Museum fortunately possesses a male and female of the typical species, and a male of the varietal form, have antennular flagella which are about as long as their peduncle, and what is more remarkable, the males have the inner flagellum somewhat flattened proximally with "its inner border concave . . . up to a small conical denticle" (Alcock, *op. cit.* p. 25), being thus constituted strikingly like the corresponding flagella in *P. megalops* and *P. rectacutus*. Moreover, the exopodites of "*Metapeneus coniger*" are quite small, tending to approach the scale-like ones of *P. megalops* in their degree of reduction. They are quite incorrectly figured by Alcock (*op. cit.*,

pl. iv., fig. 12), who represents them as moderately long and flagelliform; this, however, is their appearance in the variety *coniger andamanensis*, in which their tips fall a little short of the middle of the ischial joints of the thoracic legs. In both of these forms the vestigial arthrobranch on the penultimate pair of legs is present as in all the other "metapenei" except *lamellatus*. The telson of each of the specimens of *coniger* at hand has three pairs of movable spines in advance of the fixed spines, as described and figured by Alcock (*op. cit.*, p. 25, pl. iv., fig. 12).

On the whole there seems to be a small "*Penæopsis serratus*" group within the genus in its broader sense, the members of which have the inner antennular flagellum of the male modified to form a more or less flattened loop proximally and terminated by a knob or conical denticle, which is situated at the base of the straight portion of the flagellum; the antennular flagella in both sexes are as long as or longer than their respective peduncles. The species of this group, *P. serratus*, Milne Edwards (= *megalops*, Smith), *rectacuius* (Bate), *coniger* and *coniger* var. *andamanensis*, Wood-Mason, have usually short, more or less scale-like exopodites on the thoracic legs (except in *P. coniger* var. *andamanensis*), epipodites on all the legs except the last two pairs, and no vestigial anterior arthrobranch on the penultimate pair (except in *P. coniger* and *coniger* var. *andamanensis*). The telson is laterally armed with two or three pairs of movable spines in addition to the distal, immovable pair. If Milne Edwards and Bouvier are correct in stating that *Penæopsis serratus* has an arthrobranch and one pleurobranch on the second maxillipeds instead of two arthrobranches, and if this character be present in the other members of this small group, it might prove a more valid feature to separate them from the rest of the "Metapenei" than any other here set forth.

SUBDIVISION OF THE GENUS *Penæopsis*.

The species of *Penæopsis* are usually subdivided into two groups on the basis of the absence or presence of lateral marginal spines on the telson.⁸ Of the first

⁸ Alcock, *Cat. Indian Decapod Crust.* 1906, pt. iii, fasc. i., p. 49. *Id.* De Man, "Siboga" Exped. xxxix.a, Decapoda, pt. i., Penæidac, 1911, pp. 8, 54. *Id.* Pesta, *Archiv f. Naturg.* 1915, Abt. A. Heft I., p. 103.

group, characterised by the absence of lateral marginal spines, all the species, so far as known, have the fifth pair of legs without exopodites, while the merus joint of the same legs in the male has a notch and a spine or tooth near its proximal end. A single exception is *P. deschampsii* Nobili⁹ from Pondicherry and Mahé, which species Alcock thinks "may possibly be the non-adult form of *M. monoceros*" (Alcock, *loc. cit.*, p. 49). This has no notch or spine on the merus of the fifth pair of legs. Of the species belonging to this first group, only *P. monoceros* appears among the "Endeavour" specimens.

The second group is represented by a new species, and the familiar *P. stridulans*, which proves to be the long neglected *P. nova-guineæ* of Haswell. *Penæopsis macleayi* Haswell¹⁰ also belongs here. Of this species I have been able to examine a cotype and several other specimens, male and female. It belongs to that section of this second group in which the males have the meri of the fifth legs notched, as they are in *P. monoceros*. The adult male of our new species possesses such a notch, while in *P. nova-guineæ* Haswell it is lacking.

NOTE ON SOME SPECIES OF *Parapenæus*, AND THE
CHARACTERS OF THE GENUS.

I take this opportunity of supplying a few brief comments upon some species of *Parapenæus* available to me in the United States National Museum. These were examined, both for the purpose of determining the correct generic position of the species assigned to *Parapenæus* by Smith, and to ascertain some information not hitherto published regarding them.¹¹

It would seem that the genus *Parapenæus* should be restricted to those forms possessing characteristic suture lines described by Alcock¹² as "*a longitudinal suture . . . on either side extending from the orbital to the posterior border of the carapace*, and also a vertical suture extending across the branchiostegite at

⁹ Boll. Mus. Torino, xviii., 1903, No. 452, p. 2, fig. 1.

¹⁰ Haswell, Proc. Linn. Soc. N.S.W., iv., 1, 1879, p. 40; Cat. Austral. Crust. 1882, p. 201.

¹¹ Cf. De Man, "Siboga" Exped. xxxix.a. Decapoda, pt. i., Penæidæ, 1911, p. 78.

¹² Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 30.

the level of the 2nd pair of chelipeds." There are no exopodites on any of the legs, the telson is without movable spines, and the branchial formula is as given by Alcock (*loc. cit.* p. 30), though his "somite VII (2nd maxillipeds)" should read somite VII (1st maxillipeds). Epipodites are on the first two or three pairs of the thoracic legs.

Parapenæus politus Smith¹³ is a characteristic representative of the genus. The diagnostic longitudinal and vertical suture lines are present on the carapace, the thoracic legs are without exopodites—there are epipodites on the third legs, however—and the telson is without movable spines. There is no rudimentary arthrobranch associated with the first maxilliped, as is the case with *Penæopsis*, nor is there any vestige of an anterior one on the penultimate pair of legs. In these several respects, the species is like *P. longirostris* Lucas¹⁴ from the Mediterranean. But I am unable to understand Bouvier's tabulation of the branchial formula of the first maxillipeds of *Parapenæus* as "0 (ou 2?)," unless the "2" be a misprint for "r" (= rudimentary). If this be so, I should say the rudiment was suggested only to enable him to accommodate doubtful or aberrant species of Parapenæids in the generic definition. Unfortunately, I have but a single specimen of *P. longirostris* at hand.

As noted by De Man (*op. cit.*, pp. 78-82), *P. fissurus* (Bate), *P. investigatoris* Alcock & Anderson, and *P. longipes* Alcock have the characteristic suture lines, no movable spines on the telson, no exopodites on the thoracic legs and no epipodites on the third or following pairs of legs. *P. americanus* Rathbun,¹⁵ from Porto Rico, exhibits the same features.

Parapenæus paradoxus (Bouvier)¹⁶ perhaps does not belong to this genus, as the description makes no mention of the vertical suture across the branchiostegite above the second pair of legs. If this is present, however, the species would certainly be a true *Parapenæus*, and the above suggested definition of the genus would have to be modified to include exopodites on the first

¹³ Proc. U.S. Nat. Mus. iii., 1881, p. 444 and v., 1885, p. 172.

¹⁴ Cf. Bouvier, Rés. Camp. Sci. Monaco xxxiii., 1908, p. 102.

¹⁵ Bull. U.S. Fish. Comm. for 1900, xx. (1901), pt. ii., p. 102, pl. ii.

¹⁶ Cf. Mem. Mus. Comp. Zool. xxvii., 1909, No. 3, p. 220.

legs. In *Parapenæus paradoxus*, also, the epipodites on the third legs may be well developed, or reduced, or absent. It may be recalled in this connection that Bouvier¹⁷ himself originally instituted a new genus, *Neopenæopsis*, for this species, but later referred it to *Parapenæus*.

The inclusion by De Man¹⁸ of such a peculiar form as his *Penæopsis challengeri* (nom. n. for *Penæus serratus* Bate) within that already rather heterogeneous assemblage of species, *Penæopsis (sensu lato)*, leads me to suggest the placing of this doubtful Parapenæid within that genus at least temporarily. *Parapenæus africanus* Balss,¹⁹ which not only lacks the very important suture lines on the carapace, but has exopodites on the first pair of legs, was made the type of a new genus, *Macropetasma*, by Stebbing,²⁰ on the basis of several males from Mossel Bay, Cape Colony. It is to be regretted that Stebbing did not verify the branchial formula given by Balss (*loc. cit.*), for if the species is definitely without podobranchs on the second pair of maxillipeds, it is most peculiar, in view of the forms to which it seems most nearly related.

PENÆOPSIS MONOCEROS (*Fabricius*).

(Plate lviii., figs. 1-2.)

- Penæus monoceros*, Fabricius, Entomol. Syst., Suppl., 1798, p. 409. *Id.* Haswell, Cat. Austr. Crust., 1882, p. 200.
- Penæus mastersii*, Haswell, Proc. Linn. Soc. N.S.W., iv. 1, 1879, p. 42; Cat. Austral. Crust., 1882, p. 203.
- Penæus* sp., Whitelegge, Proc. Roy. Soc. N. S. Wales, xxiii., 1890, p. 225; Whitelegge, in Ogilby, Ed. Fish and Crust. N. S. Wales, 1893, p. 203.
- Penæus incisipes*, Kishinouye, Jour. Fish. Bur. Tokyo, viii., 1900, p. 18, pl. iv., fig. 2, pl. vii., fig. 6.
- Metapenæus monoceros*, Alcock, Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 18, pl. iii., figs. 7-7c, and synonymy. *Id.* McCulloch, Rec. Austr. Mus., vii. 4, 1909, p. 313.

¹⁷ C. R. Acad. Sci. cxli., 1905, p. 747.

¹⁸ "Siboga" Exped. xxxix.a, Decapoda, pt. i., Penæidæ, 1911, p. 76.

¹⁹ In Schultze, Zool. Anthrop. Ergebn. Forschungsreise west. zent. Südafrika, 1903-1905, v., 1913, Lief. ii., p. 105, figs. 1-6.

²⁰ Ann. South African Mus. xv., 1914, p. 22, pl. lxxii.

Penaeopsis monoceros, De Man, "Siboga" Exped., xxxix.a, Decapoda, pt. i., Penaeidæ, 1911 (plates 1913), p. 55, pl. vi., figs. 14a-c. Pesta, Archiv f. Naturg., 1915, Abt. A, Heft I., p. 104. Stebbing, Ann. South African Mus., xv., 1915, p. 70. Kemp, Mem. Indian Mus., v., No. iii., 1915, p. 321; Mem. Asiatic Soc. Bengal, vi., 1918, p. 294. Balss, Abh. der K. Bayer. Akad. Wiss., II., Math.-phys. Klasse, Suppl., 9 Abh., 1919, p. 7.

Occurrence.—Sixteen specimens of this rather well-known and widely distributed species were taken off Southern Queensland (Reg. Nos. E.6612, 6614, 6616, and P.3584, 3586-8); seven males and eight females.

Seven miles N.N.E. of Bowen, Queensland, 16 fathoms (Reg. No. E.6620); one female.

Distribution.—According to Alcock, this is one of the commonest of the Indian prawns, and its distribution, as given by De Man, is: "Along the coasts of India from the Indus Delta to Hongkong (Alcock); East Indian Archipelago (Atjeh; Makassar; fresh water of the river at Maros; Pare-Pare; brackish water of the river Tjenrana at Palima, Celebes) (de Man); Philippine Islands (Spence Bate) and at the coasts of Japan (Kishinouye). Haswell records this species from the Endeavour River, Queensland, and, according to Hilgendorf, it should also occur at Quelimane [on the east coast of Africa]." Pesta extended its range southward along the East African coast as far as Delagoa Bay, whence he had a single female specimen, while Stebbing, in addition to two further specimens from the same locality, lists a third from even a little farther south, "off South Head of Tugela River, in depth between 12 and 14 fathoms." Kemp records *Penaeopsis monoceros* as very abundant in the Chilka Lake, Orissa Coast, Bengal, and numerous in the Tale Sap Lake on the east coast of peninsular Siam.

Remarks.—With this species I identify a cotype of Haswell's *P. mastersii* from the collection of the Macleay Museum; it is an immature male from Port Darwin. Also, three immature male and female specimens from Finche's Bay, Cooktown, Queensland, from the Australian Museum (Reg. No. P.4287); these were collected by the late Allan R. McCulloch and identified by him as *P. mastersii*.

"PENÆUS MASTERSII."

(Plate lviii., figs. 1-2.)

Alcock correctly inferred that this species probably belonged either to the *P. affinis* or *P. deschampsii* group; an examination of the cotype shows that it belongs to the former, or *P. monoceros* group, as it is sometimes also designated. Haswell's cotype is immature, the two halves of the petasma being separate, undeveloped and simple, but a faint notch and tubercle on the merus of the left fifth leg—the right is missing—gives unmistakable evidence as to its true position. The dactyl of this leg is missing, but apparently it would not have reached the tip of the antennal scale.

This cotype is 71 mm. long from the tip of the telson to the end of the damaged rostrum. The carapace, excluding the rostrum, is 16 mm. long, and the rostrum, from which the tip is gone, measures 10 mm. in length. The only feature in Haswell's description of *P. mastersii* which could differentiate that species from *P. monoceros* is the "smooth carapace" but on the carapace of this immature male, there are ample evidences or traces of tomentum, which seems to have been largely rubbed off. In some of the depressions on the abdomen also there are traces of former pubescence, particularly on the fifth and sixth somites. When wet, this rather scanty pubescence is not very noticeable, which evidently explains why the carapace was originally described as smooth.

The other three specimens from Finche's Bay, Cooktown (Reg. No. P.4287) are all small and more or less immature. The smallest, 47 mm. long, is a female, and its thelycum resembles that of an immature *P. monoceros*. The median anterior grooved "tongue" is rather wider posteriorly than anteriorly, which is the reverse of what is usual in larger specimens of *P. monoceros*; in a large female of 160 mm. from Mauritius, however, this "tongue" is widest at the middle of its length. The ear-like lobes bounding the postero-lateral angles of the thelycum are rather more medial than one would expect to find in a *monoceros*, but an examination of a series of females, the smallest of which is a specimen from Formosa about 62 mm. long, indicates that their position varies with growth. In the course of development or growth of the thelycum, the ear-like lobes change from a transverse medial position to an almost wholly lateral one; further,

from being more or less flattened out, the "salient free edge" becomes strongly incurved. The typical adult thelycum is better figured by de Man than by either Alcock or Kishinouye.

The fifth legs of this smallest "*mastersii*" female reach about four-ninths the length of the antennal scale, while the third maxillipeds fall just short of its proximal third. In this specimen any pubescence that may have been present seems to have become rubbed off.

The intermediate of the three Cooktown specimens is an immature male of 51 mm., and resembles the cotype in having the lobes of the petasma still rudimentary and entirely separate. The tips of its fifth legs reach a little beyond the middle of the antennal scale, and the third maxillipeds extend only as far as the proximal three-tenths of the length of the scale. On the abdomen there are very evident traces of pubescence.

The largest specimen, also a male, measures 74 mm. in length. The two halves of its petasma are considerably more developed than in the smaller specimen, and joined. Superficially, this petasma somewhat resembles that of *P. brevicornis*, as figured by Alcock, but the similarity seems to be due to the immaturity of the Cooktown specimen. The "gargoyles," as they are designated by Alcock, apparently have not attained their adult or mature condition. The median, dorsal lobes are prominent, and not hidden by the "gargoyles" as occurs in full grown specimens. The petasma of the adult of *P. monoceros* is rather better figured by de Man and Kishinouye than by Alcock. The relative length and the evident meral notch of the fifth legs, together with the shape and dentition of the rostrum, seem to definitely preclude any confusion as to the identity of this immature male.

The fifth legs of this specimen extend seven-eighths the length of the scale, and the third maxillipeds but four-elevenths of its length. There is even more pubescence on the abdomen than in the smaller male.

The rostrum of this large male from Finche's Bay is identical in proportion, general shape and trend with those of several specimens of *monoceros* 100 mm. long, from Formosa. The smaller male and the female have

slightly more curved rostra, but they are well within the limits of variation common to any fair series of the species. According to Alcock, the number of rostral teeth in *P. monoceros* varies from 9-12; Haswell counted 8-9 in his *mastersii*, but two of the Cooktown specimens have nine, and the third, the smaller male, has ten. As stated before, the rostrum of the cotype lacks its tip, and ends at about the middle of the second segment of the antennular peduncle. On it eight teeth are to be counted. Of the "Endeavour" specimens, eight have ten teeth above, four have nine, and one has eleven teeth; in the others the rostra are incomplete.

PENEOPSIS ENDEAVOURI, *new species*.

(Plate lix., figs. 1-3. Plate lxxviii., fig. 4.)

Occurrence.—11-14 miles N.W. of Pine Peak, Queensland, 24-26 fathoms; one female (Reg. No. E.6613).

Southern Queensland coast; nine males and four females (Reg. Nos. E.3198-9, E.6687-8, P.3583, P.3585, P.3589); E.3199 is the female holotype.

Description.—A very pubescent species, so closely related to *P. intermedius* (Kishinouye)²¹ that the two are difficult to differentiate without recourse to the shapes of the petasma and thelycum. There are also some differences in the arrangement of the pubescent areas on the body.

The lateral pubescent areas of the carapace are much larger in *P. endeavouri*, occupying the greater part of the branchial region, which is for the greater part bare in *P. intermedius*. Similarly, the roughly circular pubescent areas on all but the first of the abdominal epimera in *P. intermedius* are never more than half the width of the corresponding epimeron, and usually scarcely more than a third of its width; in *P. endeavouri* the similarly placed, irregularly triangular patches always occupy more than a half, and usually two-thirds of the epimera. The two pubescent patches on the epimeron of the first somite in *P. intermedius* are separated by an interval considerably wider than either patch, while in *P. endeavouri* each patch is more than twice as wide as the interval between them.

²¹ Kishinouye, Journ. Fish. Bur. Tokyo, viii., 1900, p. 21.

The only portion of the dorsum of the second abdominal somite of *P. endeavouri* which is not pubescent is a smooth and often rather narrow hastate area; this is perhaps the trace of an anterior extension of the prominent carina of the fourth, fifth and sixth somites, which also is apparently indicated along the median line of the dorsum of the third by a longitudinal non-pubescent area. In *P. intermedius* on the other hand the dorsum of the second abdominal somite is smooth and shining, except for two narrow transverse lines of pubescence, of which the posterior is indicated, laterally only being incomplete for quite a wide interval over the middle of the back; the smooth dorsum of the third somite extends on to the epimera, being interrupted laterally by only a few small pubescent patches on each side; the fourth somite is carinated only in its posterior half, while the fifth and sixth are much as in *P. endeavouri*. The carina of the sixth somite ends posteriorly in a tooth in both species.

The rostrum is distinctly ascending and extends as far as, or slightly beyond, the distal border of the second joint of the antennular peduncle, which in turn is as much exceeded by the spine of the antennal scale. Only in one specimen, a large female of 175 mm. in length, does it equal the peduncle in length. The rostrum is armed with ten to twelve teeth above; eleven are present in ten of the fourteen specimens. The post-rostral carina is distinct almost to the posterior margin of the carapace.

The third maxillipeds and the first legs both reach about as far forward as the end of the antennal peduncle, and the second legs exceed that point by the length of the hand. The third legs and fifth legs seem to be variable in length. In the figured female holotype the former reach to about the end of the spine of the antennal scale, as do also those of a male specimen taken with the holotype; in another male specimen from the same source the third legs reach to, or slightly exceed the tips of the scale. In another male specimen the fifth legs extend along five-sevenths of the length of the scale, while in the holotype they reach to about the middle of the scale. In another female in which they might have been lost and later regenerated, though there is no evidence that this is the case, they extend only to the end of the first third of the scale. The first legs, are bispinose beneath, the second and third pairs unispinose.

The petasma is symmetrical and, though relatively of a somewhat heavier build, is in general much like that of *P. intermedius*. As seen from below, the antero-lateral spine of the terminal portion of each moiety is quite strong and prominent, and considerably overreaches the rounded protuberance of the inner distal angle. The spine is as long as the anterior margin of the terminal piece. Adjacent to the spine on its inner side, is a smaller spine-like projection of which there is no counterpart in *P. intermedius*; in this latter species also the antero-lateral spine is subequal to, or a little shorter than the median protuberance. In *P. intermedius* there is an indication of a small point on the outer proximal margin, which is not found in *P. endeavouri*; on the other hand, the proximo-lateral angle of the terminal portion of *P. endeavouri* is prominently produced backward and outward in a slightly flattened, twisted lobe, while in *P. intermedius* the same angle is merely rounded off.

The thelycum lacks the posterior median point, or tubercle characteristic of *P. intermedius* which is so well shown by Balss,²² and the lateral plates are not bent to form a right angle about the middle of their length; nor do they form so sharp a ridge, being very blunt and more or less evenly rounded off in ventral aspect. They are also separated by a wider interval on the median line. Furthermore, the posterior extensions of the fourth pair of legs of *P. intermedius* not only overhang the lateral plates of the thelycum, but they much surpass them in prominence and conspicuousness. In *P. endeavouri* on the other hand, they are quite subordinate in size and position to the lateral plates. The median anterior plate of the thelycum, like that of *P. intermedius*, is labiate, but not so broadly so anteriorly, and, in direct contrast to that species, is slightly emarginate in the middle of the anterior margin. At this point in *P. intermedius* there is a small blunt tooth or prominence.

Size and Measurements.—This species appears to attain a larger size than *P. intermedius*. Of three specimens of the latter before me, two females measure 120 mm. in length and a male is 110 mm. long. Kishinouye's

²² Balss, Abh. der K. Bayer. Akad. Wiss., ii., Math.—phys. Klasse. Suppl., 9 Abh., 1914, p. 8, fig. 2.

only specimens of *P. intermedius* were both 120 mm. long. The largest female of *P. endeavouri* is 175 mm. long, and the largest male 140 mm.

The rostrum of the female holotype is 20.5 mm. long, the carapace 35.5, and the abdomen and telson together about 101 mm. long, making a total length of about 157 mm., though the extreme tip of the telson is lacking. The telson is about 21 mm. long, and the sixth abdominal somite 21 mm. to the tip of the posterior median spine. The height of this somite, measured at the middle of its length, is 17 mm., and its greatest width at the same point is 9.5 mm.

Remarks.—*P. endeavouri* belongs to that group of Penæopsi having lateral spines on the telson, symmetrical petasmas, and no exopodites on the last pair of legs, which in the adult male have a notch and a tooth or spine near the proximal end of their meral joints, such as is characteristic of *P. monoceros*.²³

To this group belong *P. ensis* (de Haan),²⁴ *P. intermedius* (Kishinouye),²⁵ *P. stebbingi* (Nobili),²⁶ *P. macleayi* (Haswell),²⁷ and doubtfully *P. cognatus* (Nobili),²⁸ the male of which is still unknown.

De Man²⁹ has recently given a few differential characters tending to separate *P. ensis* (de Haan) from *P. intermedius* (Kishinouye). "*Peneopsis ensis* (de Haan) from Japan differs from both the typical *Pen. intermedia* and the variety *anchista* by an obtuse crest which from the hepatic spine runs backward to the posterior margin of the carapace, and furthermore by the stronger carination of the abdomen; the posterior half of the 2nd tergum is crested, there is a distinct *flattened* keel on the 3rd, while the 4th to the 6th terga are sharply carinated. In *Pen. ensis* the rostrum is slightly turned upward, the two posterior spinules of the telson are rather long like

²³ Cf. Alcock, Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 50.

²⁴ Cf. De Man, Zool. Medd. Rijks. Mus. Nat. Hist. v., 1920, p. 104.

²⁵ Jour. Fish. Bur. Tokyo viii., 1900, p. 21.

²⁶ Bull. Mus. Hist. Nat., Paris, 1909, No. 5, p. 229; Ann. Sci. Nat. (9), Zool. iv., 1906, p. 15, pl. i., fig. 2. Tattersall, Jour. Linn. Soc. London, xxxiv., 1921, p. 365, pl. xxvii., figs. 7-10 and pl. xxviii., fig. 13.

²⁷ Proc. Linn. Soc. N.S.W. iv., 1, 1879, p. 40; Cat. Austral. Crust., 1882, p. 201.

²⁸ Bull. Mus. Hist. Nat., Paris, 1904, No. 5, p. 229; Ann. Sci. Nat. (9), Zool. iv., 1906, p. 14, pl. i., fig. 1.

²⁹ Zool. Medd. Rijks. Mus. Nat. Hist., v., 1920, p. 104.

in typical *intermedia*, but, like in the variety *anchista*, the anterior spinule is only half as long as the posterior. In *Pen. ensis*, finally, the peræopods of the 1st pair are also bispinose. (These characters of *Pen. ensis* were communicated to me by Dr. Horst of the Leiden Natural History Museum, who kindly did examine the only still existing type specimens of this species).” His *P. intermedia*, variety *anchista* I have not seen.

Though *P. endeavouri* has the pereopods of the first pair bispinose, and the rostrum a little more ascendant than *P. intermedius*, I am disinclined to identify it with *P. ensis* as characterized by de Man, without knowing more about the sexual organs of that species. I should hardly designate the central non-pubescent patch on the dorsum of the second abdominal somite as a crest, nor any of the bare intervals between the lateral pubescent areas of the carapace as an “obtuse crest which from the hepatic spine runs backward to the posterior margin of the carapace.”

P. cognatus, also a very pubescent species, differs in having all the abdominal segments carinated. Further, the postocular (orbital) tooth is an insignificant blunt angle in *P. endeavouri*, but is said to be spiniform in *P. cognatus*, and the antero-lateral angle of the carapace, which is sharp in the latter, is rounded in *P. endeavouri*. The thelycum, too, as described by Nobili, seems to have a different form.

Apart from the number of their rostral teeth, which in *P. stebbingi* is 8-10 and in *P. macleayi* 5-7, both these species differ from *P. endeavouri* in that the postrostral carina does not extend backward on to the posterior third of the carapace. Furthermore, both these species are much less pubescent than *P. endeavouri*.

PENÆOPSIS MACLEAYI (*Haswell*).

(Plate lx., figs. 1-5.)

Penæus macleayi Haswell, Proc. Linn. Soc. N. S. Wales iv., 1, 1879, p. 40, and Cat. Austr. Crust., 1882, p. 210.
Id. Ogilby, Ed. Fish. and Crust. N. S. Wales, 1893, p. 204. *Id.* Whitelegge, Mem. Austr. Mus. iv., 2, 1900, p. 197.

Metapenæus macleayi Alcock, Cat. Indian Decapod Crust., pt. iii., fasc. 1, 1906, p. 17.

Penæus macleayi Phillipps, Austr. Zool., iv., 1, 1925, p. 3, pl. ii., fig. 1.

Penæus haswelli Phillipps, *tom. cit.*, 1925, p. 3.³⁰

Through the kindness of the authorities of the Australian Museum, I am able to record here some notes upon a female cotype, and some other specimens of this species forwarded to me through Mr. Allan McCulloch.

The rostrum of the Port Jackson cotype is broken and shows but five teeth. Another female specimen in the Australian Museum from Port Jackson (Reg. No. P. 1438) has seven teeth above, as did apparently the specimens from Sydney, upon which de Man³¹ commented. Of three mature males before me, the largest, of about 101 mm. long over all, has six teeth above of which but one is on the carapace, just behind the orbital margin. The epigastric tooth, which ordinarily is situated almost over the hepatic spine, is completely wanting. The two smaller males have six and seven teeth respectively above, as have two immature males, in which the halves of the petasma are not yet united. Hence the number of dorsal rostral teeth becomes from 5-7, rather than from 5-6 as given by Haswell. As noted by de Man, the more or less styliform terminal portion is usually shorter than half the length of the free portion of the rostrum. In the Port Jackson female specimen with a complete rostrum, two teeth, counting the epigastric, are on the carapace, four on the basal half of the free portion of the rostrum, and one, the seventh, just before its middle. The rostrum is 20 mm. long and the tip of the last rostral tooth is 8.25 mm. from the tip of the rostrum. In the largest male specimen, the penultimate rostral tooth is at the middle of the free portion of the rostrum, as it also is in two

³⁰ In this paper Phillipps deals with the commercial aspect of New South Wales prawns imported into New Zealand. He found that the specimens he examined and identified as *Penæus macleayi* differed from Haswell's description of that species in the dentition of the rostrum, and proposed the provisional name "*Penæus haswelli*" in the event of the differences being substantiated.

The characters enlarged upon by Phillipps are negligible, as the question of the rostral variation of Haswell's *P. macleayi* has received detailed attention in the present report by Dr. Schmitt.

Unfortunately the editor of the "Australian Zoologist" has further complicated the nomenclature of *Penæopsis macleayi* by including some misleading statements in an *erratum* notice which appeared in the following issue of that journal (iv., pt. 2, 1925, p. 111). He states that the prawn belongs to the genus *Metapenæus*, and that the provisional name *haswelli* is preoccupied. Both these remarks are incorrect.—F. A. MCNEILL.

³¹ Notes Leyden Mus. xii., 1890, p. 124.

other male specimens, one mature and the other immature; in two other males, and an additional female, with unbroken rostra the last dorsal tooth is just about the middle of the free portion of the rostrum. As described by Haswell, the post-rostral carina is quite thick and low, and becomes broadened out and flattened behind, losing itself before reaching the posterior third of the carapace. It extends about as far behind the point where the continued cervical groove would cross the dorsum of the carapace as the first rostral (epigastric) tooth is in front of that point. At this point, moreover, the post-rostral carina is noticeably pinched in or narrowed, broadening out behind to form an elongate triangular area, and showing a more or less distinct longitudinal pit or depression, which is less marked in the male than in most female specimens. The grooves of the carapace carry more or less pubescence. The pubescence is thicker at the upper end of the cervical groove, and on either side of the narrowest part of the post-rostral carina, in the angle made by the ridge with the general surface of the carapace. Otherwise the carapace and abdomen are smooth and shining. The posterior orbital margin shows an orbital spine quite contrary to Haswell's statement "supra-orbital spine absent." De Man, whose specimens were a little over three inches (about 81 mm.) long, suggests that possibly the orbital spine disappeared in the adult. Though Haswell's cotype is only about 88 mm. (about 3.37 inches) long, the other specimen before me is 126 mm. (about 4.87 inches) long; in both specimens, the orbital spine is distinct. The orbital spine, here so called, is a produced sharp angle in the orbital margin, forming in lateral view an apparent flattened spine.

The legs of the cotype extend about as far forward as in de Man's specimens. The first and fifth legs are a little shorter, the former attaining but the proximal third of the terminal joint of the antennal peduncle, and the latter just about five-sevenths the length of the scale; the second legs exceed the antennal by a little more than the length of the fingers; the third pair is the longest, and "extends with the fingers beyond the antennal scale;" and the fourth pair only reaches the end of the antennal peduncle. The third maxillipeds exceed the antennal peduncle by the greater part of the length of their terminal joint.

In the other and larger female of *P. macleayi* (Reg. No. P.1438), the first, second, and fifth legs are proportionately about as long as in the cotype; the third legs are shorter, scarcely reaching the base of the notch between the spine and blade of the antennal scale, while the fourth legs instead of reaching only the end of the antennal peduncles, slightly exceed the second pair in length. The third maxillipeds extend beyond the antennal peduncle by one-half the length of their terminal joint.

The legs of the largest male are relatively not unlike those of the two preceding specimens; the first legs only reach one-third the length of the distal segment of the antennal peduncle, attaining thus about the middle of the penultimate joint of the third maxillipeds; the fifth pair five-sevenths the length of the scale; the second pair of legs is regenerating; the third legs about reach the tip of the spine of the antennal scale; the fourth scarcely to the end of the antennal peduncle. The third maxillipeds reach about half the length of the spine of the antennal scale, and exceed the peduncle by about the length of their terminal joint.

As in *P. monoceros*, the symmetrical petasma "consists of the two rigid segments tightly folded in all their length, interlocked all along their anterior margin, and in close apposition along the greater part of their posterior margin, so as to form a compressed tube. Distally the tube ends in a pair of large gargoyles, the posterior lips of which are convoluted like the mouth of a personate corolla." The softer, more or less, fleshy terminal flaps of the petasma forming the "gargoyles," represent, as it were, the produced inner margins of the basal elements, twisted forward and upward (from a ventral point of view), so that the produced horns of the externo-distal angles of the basal pieces are concealed except for their tips in ventral view. In *P. macleayi* these terminal flaps or "gargoyles" appear to represent the continued growth of the medial two-thirds of the anterior margin and the inner margin of the basal elements together, bent over to form domed, "billowed" caps or hoods over the extremities of the basal pieces, about meeting, but not obscuring the blunt, moderately produced externo-distal angles. In some respects the petasma is not unlike that of *P. affinis*, as figured by

Alcock, of which, unfortunately, I have no male specimen for comparison.

The thelycum is quite striking and characteristic. On either side of the anterior median plate, which is medially sulcate and anteriorly hastate, the coxæ of the fourth legs have developed prominent quadrangular plates, somewhat rolled or turned up on their inner edges. These coxal plates rather overshadow the median anterior plate of the thelycum. Posteriorly from the level of the hinder margin of each coxal plate, the somewhat curved flattened ear-like lateral plates with raised outer margins, extend inward toward the median line, where they are more or less separated from one another by a quite prominent median, and smoothly rounded tubercle. Just posterior to the inner posterior angle of each coxal plate of the fourth legs is situated a similar more prominent and conspicuous rounded tubercle, one in each anterolateral angle of the median depressed area of the thelycum enclosed by the lateral ear-like lobes. Behind these, in line with the coxæ of the fifth pair of legs, is a thickened, rounded, transverse bar, somewhat swollen on either side of the middle. Near either end the hinder margin of this bar is indented, or rather excavated to accommodate a large raised and rounded oblique lobe. The median anterior plate described as anteriorly hastate above, has a somewhat rounded posterior extension connected with it by a narrower portion of the same plate, in effect giving the plate in its entirety a somewhat "dumb-bell"-shaped outline. This posteriorly rounded portion of the plate is flush with the anterior slope of the depressed portion of the thelycum: the anterior more or less free end is narrower and more pointed than the posterior embedded portion, being as already described, hastate in outline.

The fourth abdominal somite is dorsally carinated for the posterior two-thirds of its length, but not so sharply as the fifth and sixth, which are carinated throughout their length. The telson has four pairs of lateral marginal spinules, including the subterminal pair. In the female cotype the carina on the fourth abdominal somite, though no longer, is sharper and more prominent than in the other female specimen from Port Jackson.

Distribution.—This species has so far been found only off the coast of New South Wales. I have seen

specimens from the collections of the Australian Museum collected at Fullerton Cove Bay, April 18, 1910; Hawkesbury River, September 29, 1923 (A. R. McCulloch, coll.); and Port Jackson (type locality).

Miers had a specimen from the Richmond River; de Man two from Sydney; Ogilby records it from the Sydney market; and Whitelegge examined two from off Shoalhaven Bight, in 15-18 fathoms ("Thetis" Sta. 50).

PENEOPSIS NOVE-GUINEÆ (*Haswell*).

(Plate lxi., figs. 1, 2*a-b*. Plate lxxviii., fig. 2*a-b*.)

Penæus Nova-Guineæ Haswell, Proc. Linn. Soc. N.S.W., iv., 1879 (1880), p. 43, and Cat. Austral. Crust., 1882, p. 203. *Id.* Alcock, Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 55. *Id.* de Man, "Siboga" Exped., xxxix.a, Decapoda, pt. i., Penæidæ, 1911, p. 11.

Penæus Palmensis Haswell, Proc. Linn. Soc. N.S.W., iv., 1879 (1880), p. 43, and Cat. Austral. Crust. 1882, p. 204.

Metapeneus palmensis Alcock, Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 51.

Metapeneus stridulans Alcock, Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 27, pl. v., figs. 14-14*d*.

Penæopsis palmensis de Man, "Siboga" Exped., xxxix.a, Decapoda, pt. i., Penæidæ, 1911, pp. 8, 55, 73.

Penæopsis stridulans de Man, "Siboga" Exped., xxxix.a, Decapoda, pt. i., Penæidæ, 1911 (plates, 1913), p. 65, pl. vii., figs. 20*a*, 20*b*. *Id.* Balss, Denkschrift., Math.-naturwissen. Klasse, K. Akad. Wissen., xci., 1915, pl. 10. *Id.* Pesta, Archiv f. Naturg., 1915, Abt. A., Heft 1, p. 104. *Id.* Tattersall, Jour. Linn. Soc. London, xxxiv., 1921, p. 366. *Id.* Balss, Kongl. Svenska Vetens. Handl., lxi., No. 10, 1921, p. 6.

Occurrence.—Great Sandy Strait, off Point Inskip, Queensland, 10 fathoms; one male and one female (Reg. No. E.3182).

Great Sandy Strait, Queensland; two females (Reg. No. P.3568).

Seven miles N.N.E. of Bowen, Queensland, 16 fathoms; one female (Reg. No. E.3102).

Distribution.—This species proves to be rather widely distributed. Heretofore it has been recorded from: Japan—Osima and Yokohama (Pesta); Hongkong (Alcock and Pesta); Dutch East Indies (Alcock); Australia—Cape Jaubert, West Australia (Balss), Sydney?, New South Wales (Pesta), and Palm Island, Queensland (Haswell); New Guinea—Katow (Haswell); Orissa coast, Andamans, Ganjam coast, Vizapatam coast, Madras coast, Palk Strait, Gulf of Martaban (Alcock); Red Sea, Suez, Shubuk and Kunfunda (Pesta, Tattersall, Balss).

Remarks.—At last it is possible to raise Haswell's *Penæus novæ-guinææ* from obscurity among "species the systematic position of which is doubtful" (de Man), and to restore it to the status of a good species. However, in so doing it is perhaps unfortunate that so well known a species as *Penæopsis stridulans* becomes relegated to the position of a synonym. Likewise the *Penæus palmensis* of Haswell becomes a synonym of *Penæopsis novæ-guinææ*.

I have been able to examine one male and three female Penæids from Gloucester Passage, Queensland (Reg. No. P.412, Austr. Mus.), which Mr. McCulloch identified with *novæ-guinææ* with this comment: "The male has been closely compared with the holotype of *P. novæ-guinææ*, which is of about the same size. The females exhibit some variation in the length of the rostrum and include characters of both *novæ-guinææ* and *palmensis*; the spines between the bases of the second chelipeds are always well developed in the females, but may be rudimentary in the males." Mr. McCulloch adds, "The unique holotype, a male from Katow, New Guinea, measures 17 mm. from the tip of the rostrum to end of carapace. It is in a bad state of preservation and its characters are difficult to observe even with a modern binocular microscope. It differs from Haswell's description in having the gastro-hepatic sulcus just as in *palmensis*; hepatic spines are present though imperfect. The palp of the external maxillipeds is similar to that of *palmensis*; the second joints of the second chelipeds bear spines similar to those of the first."

"A most careful comparison of the holotypes of *novæ-guinææ* and *palmensis* fails to reveal any differences between them other than the length and armature of the

rostrum, it being slightly longer and having fewer teeth in *novæ-guineæ*."

I have also been enabled to examine several specimens of Haswell's "*Penæus Palmensis*" from the Macleay Museum. Regarding these Mr. McCulloch wrote, "I identify as this species a large female 29 mm. long from tip of rostrum to end of carapace, together with two smaller females and two small males, all from Darnley Island, which are forwarded for examination. These were confused with *P. granulatus* by Haswell, and the notes upon the males at the end of his description of that species are based upon these specimens. I have critically compared one of the smaller females, 11.5 mm. long from tip of rostrum to end of carapace, with the holotype of *P. palmensis*, which is of about the same size, and find it agrees in all details."

In a brief key to the Peneids described by Haswell, which the late Allan R. McCulloch was kind enough to prepare for my convenience, he considered *palmensis* a variety of *novæ-guineæ*, but I feel certain that, together with *P. stridulans*, they represent but one species. The range of variation which was observed by de Man in his "Siboga" series of 23 males and 29 females is sufficient to include the differences Haswell detected between his *novæ-guineæ* and *palmensis*. In a survey of his material de Man remarked: "The examination of these numerous specimens, though mostly of young or of medium size, proved that *Penæopsis stridulans* (W.-Mas.) is a very variable species. At first, indeed, the specimens did appear to me to belong to two different species, but the existence of several transitional forms led me to the conclusion that all ought to be referred to one and the same species. The variability bears upon the tothing of the rostrum, the more or less distinct development of the branchiostegal spine, the form of the stridulating organ and the number of its ridges,³² the shape of the carina on the 3rd abdominal tergum, of the thelycum and of the thoracic legs, as also the length of the telson." The rostra of de Man's specimens carried from 5 or 6 to 8

³² For want, possibly, of sufficient specimens showing the short, straight, high placed stridulating organ, and the longer, curved, lower placed form, I have been unable to detect any noticeable or really appreciable differences in the epimera of the first abdominal somites, which play upon the several different types of stridulating organs in this species

teeth in addition to the epigastric; the stridulating organ was composed of from 11 to 20 ridges; and the thelycum varied between the form figured by Alcock (*l.c.*) and that figured by de Man (*l.c.*).

“PENÆUS NOVÆ-GUINÆÆ.”

(Plate lxi., fig. 2a-b. Plate lxxviii., fig. 2a-b.)

Of the four specimens of *P. novæ-guinææ* received from the Australian Museum (Reg. No. P.412), the largest is a female about 64 mm. long; its rostrum is about 8 mm. long, and reaches nearly to the middle of the third or terminal joint of the antennular peduncle. Including the epigastric tooth, which is not much in evidence on the badly broken carapace of this specimen, there are eight rostral teeth. The harshly tomentose carapace is about 16 mm. long and shows no post-rostral carina. The stridulating apparatus consists of nine ridges transversely placed on the naked curved band near the postero-lateral angle of the carapace; the antero-lateral angle is spined. The third maxillipeds of this specimen are nearly as long as the antennal scale, which is exceeded by the third chelipeds by the length of their fingers; the first legs exceed the antennal peduncle by the length of their fingers, and are exceeded by the second by the length of their hands; and these fall short of just reaching to the ends of the carpus of the third legs. The fourth legs are wanting, and the left fifth, its mate being lacking, reaches through five-eighths the length of the antennal scale.

There is no carina on the first abdominal somite. On the second, however, there is a faintly sulcate, blunt carina on the posterior two-thirds of the somite. Narrowing posteriorly and becoming more flattened, this carina merges with the narrow naked area paralleling and forming the posterior margin of the somite.

The third somite has likewise a low, blunt, faintly grooved carina, narrowest at a point a little in advance of the middle of its length. Posteriorly the carina is wider and more flattened, so that the rather broad sulcus appears to become obliterated. The carinæ of the fourth, fifth and sixth somites are high, narrow and prominent; the fifth somite is about one-half the length of the sixth, and the postero-lateral angle of the latter ends in a small

spine. The sixth somite is a little shorter than the telson, which is as long as the inner branch of the uropods.

The other females of this lot (Plate lxi., fig. 2*a-b*, Plate lxxiii., fig. 2*a-b*) are about of a size, being 49 and 50 mm. long respectively. The rostrum of the larger is 7 mm. long and runs to the end of the second segment of the antennular peduncle; it is armed with eight teeth, including the epigastric tooth on the carapace, which is as far from the second as the second is from the fourth; the second tooth is just in advance of the orbital margin; otherwise the rostral teeth are rather evenly spaced. The stridulating organ is much as in the preceding specimen and has but nine ridges. Behind the epigastric tooth the carapace is not carinated. The carination of the abdomen is as in the largest specimen; the inner branches of the uropods slightly exceed the tip of the telson.

The smaller of these two females, the one of 49 mm. length, exhibits some differences which seem to be of no great or specific importance. The chief reason for figuring these females (Plate lxxiii., fig. 2*a-b*) was to portray their rostral variation. In any good series of *P. stridulans*, or as we now know it, *P. nova-guinea*, the rostrum is somewhat variable, ranging from fairly slender, straight, and uptilted ones as in the larger of the two females described above, to those more or less sinuous in general outlines and of greater depth as shown in the smaller; in some specimens of "*stridulans*" the upper margin appears quite concave, as in a 71 mm. female from the Indian Museum.

The rostrum of the 49 mm. female has but seven teeth, of which the first, or epigastric tooth on the carapace is as far from the second as it is from the fourth, which in turn is farther from the third than this is from the second; as a result the teeth appear quite unequally spaced. The stridulating organ of this same specimen is placed much lower than in the other specimens, and is much less conspicuous; about eleven transverse ridges can be counted. The carina of the second abdominal somite shows no trace of a sulcus, and that of the third somite is only faintly grooved, and hardly that, for in its breadth dorsally it is just very slightly depressed medially for a small fraction of its length near the anterior end.

The thelycum in all of these specimens is much as that figured for the Darnley Island specimen of *P. palmensis* (= *novæ-guinæ*) below (Plate lxi., fig. 1), and seems to be intermediate between those figured by Alcock and de Man.

The male, and smallest specimen, is about 48 mm. long, of which length the carapace and rostrum together equal 17 mm. This is the identical length given by McCulloch for the holotype for the same interval (see previous pages). This, of course, indicates some error in Haswell's original measurement given as "2.5 inches," a length which would be some 15 mm. greater than the compared specimen before me "which," as Mr. McCulloch distinctly states above, "is of about the same size" as the holotype.

The rostrum has six teeth on its free portion, all before the orbital margin, not counting the epigastric tooth on the carapace, thus giving a total count of seven teeth, or one more than in the holotype. The first or epigastric tooth is about as far from the second as this is from the fourth; beginning with the second tooth, the interval between the successive teeth becomes greater until the sixth is reached. The distance from the sixth to the seventh is but half that between the fifth and sixth; the seventh is situated at three-fifths the distance from the sixth to the tip. The rostrum is 7.5 mm. long and reaches about two-thirds the length of the last segment of the antennular peduncle, which is about as long as the antennal scale. As in *P. stridulans* (= *P. novæ-guinæ*) there is an inconspicuous postocular notch, or denticle; a strong antennular spine, and a small but well-formed and distinct hepatic spine. In this particular, Haswell's holotype, as well as the foregoing specimens, are at variance with his description, which states that the hepatic spine is absent. The stridulating organ is quite inconspicuous, but plainly seen with a glass, and composed of 11 or 12 little quadrangular, tuberculiform ridges on a slightly raised, non-pubescent, curved band. The third maxillipeds extend nearly four-fifths the length of the antennal scale; the first pair of legs easily attain the end of the antennal peduncle, as do also the fourth legs; the second legs exceed the first by the length of their hands, and the third legs in turn exceed the second by their hands and

reach about as far forward as the third maxillipeds; the fifth legs are wanting, or broken. A further discrepancy in Haswell's description is also to be noted. He has it that the "under surfaces of the second and third pairs [of legs are] devoid of spines." This is true with respect to the third pair of legs, but the second pair in all of the specimens before me, as well as in the holotype, has the basis spined as in the first pair of legs, which in addition has the ischial joint spined as well.

As in the females, there is no indication of a carina on the first abdominal somite; that on the second is hardly more than a narrow, smooth, median area, scarcely raised above the general surface of the dorsum; just before the middle, the carina shows a small inconspicuous punctation. On the third somite, the carina is more prominent, dorsally flattened and without any noticeable trace of a groove; the carinae on the fourth, fifth and sixth somites are narrow and prominent. The sixth somite is very slightly more than twice as long as the fifth and subequal to the telson, which falls scarcely little more than a seventh of its length short of the tip of the inner branch of the uropod.

The petasma is in very close agreement with the one figured by Alcock for *P. stridulans*, for though the outer "lobule" of the left lobe lacks the so-called "crown of stiffish filaments," these are suggested by very slight crenulations of the tip of the "lobule."

"PENÆUS PALMENSIS."

(Plate lxi., fig. 1.)

The small female specimen which has been critically compared with the holotype of *palmensis* is certainly a small *Penæopsis novæ-guineæ*, as McCulloch supposed.

The tip of the rostrum attains the distal margin of the second segment of the antennular peduncle, and, counting the epigastric, carries ten teeth of which all but the epigastric are before the posterior orbital margin. The antennular peduncle reaches as far forward as the antennal scale. There is an obscure post-ocular tooth, and the antero-lateral angle of the carapace is dentiform. The stridulating organ has from 13 to 14 ridges. The third maxillipeds reach forward nine-tenths of the length of the antennal scale, the extremity of

which is about reached by the third pair of legs; the first legs exceed the antennal peduncle by one-half the length of the fingers; the second and fourth pairs are wanting; the left fifth leg just surpasses the point of articulation of the antennal scale; this is unusually short as compared with the other specimens in the same lot, as well as more typical specimens of *P. stridulans* (= *novæ-guinææ*). The carina on the second abdominal somite is rather small; that of the third somite is distinctly grooved. From the tip of the telson this specimen is about 32 mm. long, a little shorter than the holotype.

The large female is 80 mm. long from tip of rostrum to end of telson, the carapace and rostrum together are 29 mm. long, and the rostrum alone about 11.5 mm. long. The rostrum is distinctly upcurved, and extending nearly half the length of its free portion beyond the eyes, reaches well to the end of the second segment of the antennular peduncle. Post-ocular, antennal, and hepatic spines proportionately well developed, and antero-lateral angle of the right side of the carapace spined; on the left side, however, rounded. The stridulating organ of this specimen is placed much like the one figured by Alcock (*op. cit.*, 1906, pl. v., fig. 14b) and of the same shape; either organ has twenty-one or twenty-two transverse ridges. The third maxillipeds extend along nine-tenths of the antennal scale; the fifth legs are missing. As in typical *P. novæ-guinææ* the first and second legs are spined beneath. The carina on the second abdominal somite is very short and insignificant, on the third well developed and distinctly grooved.

The two small males, McCulloch informed me, are those which Haswell confused with "*Penæus granulatus*" and referred to at the end of his description of that species. The larger of these is about 50 mm. long. Its rostrum is straight and uptilted, and carries eight teeth including the epigastric, which is the only one situated on the carapace; there are eleven ridges to the stridulating organ; the antero-lateral angles are spiniform and the third maxillipeds reach not quite nine-tenths the length of the antennal scale.

The carina of the third abdominal somite is grooved for only the posterior half of its length. The petasma is like that of the male *novæ-guinææ* above in having the fringes on the "lobule" of the left lobe faintly indicated.

The smaller male has the carina on the third abdominal somite grooved throughout. Its external maxillipeds are comparatively as long as those of the larger male. If anything, the fringes on the petasma are more distinctly indicated in this specimen than in its fellow, or even the male of *nova-guinea* above.

The smallest female of this "*palmensis*" lot is something else. There is no stridulating organ present. The rostrum has eight teeth above, counting the epigastric, of which all but the latter are in front of the posterior margin of the orbit. The small carina on the second abdominal somite is blunt and ungrooved, as is also the carina on the third somite. The specimen has all the ear-marks of a true *P. mogiensis*. The thelycum is very close to, if not identical with, the one figured by de Man³³ as the *Penaeopsis* sp. for which he suggests the name *hilarulus*. Though I have not seen any *P. mogiensis* identified by Alcock, I am unwilling to concede the identity of de Man's specimen with Alcock's *mogiensis* to the exclusion of Miss Rathbun's species of that name. Alcock's description fits Miss Rathbun's species, and his figure of the thelycum is nearer the typical species than is the one given by de Man. Between the four pairs of legs, the median teeth, as Alcock calls them, might well be described as platelets. These usually diverge only at their tips, as is shown by Alcock, rarely so pronouncedly as in the case of Miss Rathbun's figured type from Mogi, Japan.³⁴ The more usual, and possibly less mature type, of a specimen 82 mm. long from Minato, Satsuma, Japan, is shown in fig. 4 of Plate lxi. The anterior of the two parallel transverse plates lying between the fifth legs are in both figures, Miss Rathbun's and Alcock's, cut into two laminæ, each of which may again be cut into two teeth. In the specimens in the collection of the U.S. National Museum, these teeth are more as delineated by Miss Rathbun, and not at all so sharply dentiform as Alcock has them in his figure, which I take to be a variational extreme. It is in the case of this very plate that de Man's³⁵ *Penaeopsis* sp. (or *P. hilarulus*) differs from both the *mogiensis* of Alcock and Rathbun, inasmuch as it is all in one piece

³³ "Siboga" Exped., xxxixa, Decapoda, pt. i., Penæidæ, 1911 (plates 1913), p. 70, pl. vii, figs. 22a-22d.

³⁴ Rathbun, Proc. U.S. Nat. Mus., xxvi, 1903, p. 40, fig. 8.

³⁵ "Siboga" Exped., xxxixa Decapoda, pt. i., Penæidæ, 1911 (plates. 1913), p. 70, pl. vii, figs. 22a-22d.

and raised into blunt teeth only at the outer angles. Such a specimen is this small Darnley Island, Torres Strait, female from the Macleay Museum, Sydney (see Plate lxi., fig. 3).

When it is borne in mind that Alcock in commenting on the pair of divergent median teeth between the fourth pair of legs, says: "In the young female the most conspicuous part of the thelycum is the last-mentioned pair of teeth," cannot it be that what on the whole seem to be minor differences between de Man's specimens and the typical species, are due to immaturity of the former? Though his largest females, of which the figured specimen is one, are of no mean size, 60 mm. long, de Man regrets that "the specimens collected by the 'Siboga' are unfortunately all young. . . ."

The Macleay Museum specimen is scarcely 33 mm. long, but closely approximates de Man's figure in the shape of the thelycum and its component plates. The spines between the second pair of legs are like those of typical *mogiensis*, and resemble de Man's representation of them, but differ slightly in being a little more slender and more widely spaced. The fifth legs of this specimen are broken, and the third maxillipeds are gone entirely. The right first leg exceeds the antennal peduncle by about the length of the fingers, the second exceeding the first by nearly the entire length of the hand; the third leg of the right side is longer than the antennal scale by about the length of the fingers, while the fourth legs reach about as far forward as the first.

All in all there hardly seems to be sufficient ground to justify the separation of either de Man's or Alcock's specimens from the true *P. mogiensis* of Miss Rathbun. I also find that this same opinion was expressed by Balss³⁶ in his "Ostasiatische Decapoden." De Man's male specimens, by the way, show no characters at all tending to separate them from the true *mogiensis* of Rathbun.

The juvenile thelycum figured by Balss³⁷ as that of *P. mogiensis* is surely not that species. It is not unlike Tattersall's³⁸ drawing of that organ of *P. stebbingi*. The

³⁶ Abh. der K. Bayer. Akad. Wissen., II., Math.-phys. Klasse, Suppl., 9. Abh., 1914, p. 9.

³⁷ Denkschr., math.-naturwissen. Klasse, K. Akad. Wissen., xci., 1915, text-fig. 6.

³⁸ Jour. Linn. Soc. London, Zool., xxxiv., 1921, pl. xxvii., fig. 9.

original description of the sternal armature, and the arrangement of the spines at the bases of the legs of *P. stebbingi* also fit Balss's figure very nicely. It is to be regretted that Balss did not otherwise characterise his juvenile *mogiensis* females.

Genus TRACHYPENEUS, *Alcock*.

TRACHYPENEUS ANCHORALIS (*Bate*).

(Plate lxii., figs. 1-3. Plate lxviii., fig. 3.)

Penaeus anchoralis, Bate, Ann. Mag. Nat. Hist. (5), viii., 1881, p. 181, and "Challenger" Rept. Zool. xxiv., Macrura, 1888, p. 258, pl. xxxv., fig. 1 (part: only female from the Arafura Sea). Not the *T. anchoralis* of other authors.

Occurrence.—7 miles N.N.E. of Bowen, Queensland, 16 fathoms; one male, one female (Reg. No. P.3528), and three females (Reg. No. E.6618).

12 miles N.N.E. of Bowen, Queensland, 19-25 fathoms; six females (Reg. Nos. E.6611 and E.6615).

Distribution.—Otherwise known only from the type locality: Arafura Sea, south of Papua, 28 fathoms ("Challenger" Sta. 188, lat. 9° 59' S., long. 139° 42' E.).

Description.—*Of female*: rostrum usually distinctly recurved or bent upward distally; occasionally, however, quite straight and tilted, but little above the line of the dorsum of the carapace; armed above with eight to nine teeth not counting the isolated epigastric tooth; post-rostral carina usually quite distinct, especially so in younger specimens, tending, however, in older specimens to become broader and less distinct toward the posterior margin of the carapace which it very nearly reaches.

Carapace otherwise very much as described by Alcock³⁹ for his *T. asper*, except that there is a faint indication of what appears to be the lower end of a short cervical groove on either side, and that the anterolateral angle is blunt, and not "distinctly dentiform." In fact, all the Pacific representatives of this genus,

³⁹ Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 43, pl. ix., fig. 28, 28a, b.

as regards abdomen, carapace, and in general, rostrum, are so very much alike within reasonable variational limits as to render detailed descriptions of their appearance rather superfluous.

The presence and absence of epipodites on the thoracic legs of some species is both significant and diagnostic, but the thelycum and petasma furnish, so far as I am aware, the best clues to the species. The relative lengths of the fifth pair of legs and the third maxillipeds as compared with the antennal scale are often helpful, though of somewhat doubtful value specifically.

The fifth pair of legs in this species exceeds the tip of the antennal scale by from one-third to one-half the length of the propodal joint, while the third maxillipeds reach to a third or a fourth of the length of the scale from its tip. A basal spine is present on the first two pairs of thoracic legs, and epipodites are present only on the third pair.

The thelycum is as figured by Bate, and except for the inclusion of the male of *curvirostris*, it is strange that his very distinctive figure should have been confused with other species. The transverse posterior plate is broadly U-shaped, and encloses a more or less circular depressed area. Anteriorly the circumference of this area is somewhat indented by the convex posterior margin of the median anterior plate, which is medially sulcate to the extent of rendering it a broad, very shallow V-shaped trough.

The fifth abdominal somite is about three-fourths the length of the sixth, which in turn is nine-tenths the length of the telson. On either side the telson has a small subterminal marginal spine, in advance of which on either margin there are one or two scarcely perceptible spinules. The second abdominal tergum, as seems common to all the members of the genus *Trachypeneus*, carries a median compressed tubercle. The third to sixth terga are sharply carinated.

The *single male* found in the same bottle with a female of this species from seven miles N.N.E. of Bowen, Queensland, in sixteen fathoms (P.3528 part), I am inclined to consider the male proper to the species. There

is, of course, the possibility that it might prove to be the male of *T. granulatus*, of which females in three instances were associated with females of *T. anchoralis* (Reg. Nos. E.6618, 6615 and 6611).

This lone male is approximately 54 mm. long, of which length the carapace and rostrum together represent 19.5 mm., and the rostrum alone 7 mm. It agrees in most particulars quite closely with the female. The rostrum is fairly straight, but no more than in some of the females. It is armed above with eight teeth exclusive of the epigastric. The post-rostral carina is evident nearly to the hinder margin of the carapace, though becoming broader and less distinct posteriorly. The antero-lateral angle is blunt and not produced.

Likewise the abdomen is much as in the female, the fifth somite being about three-fourths the length of the sixth. The telson is broken.

The petasma is of the same general type as that of *T. salaco*, symmetrical, and reaching as in that species the coxæ of the fourth legs; the lateral hooks with which it is provided, however, attain the coxæ of the preceding pair of legs. The two branches are united on their anterior or dorsal surface, but leave below or posteriorly a narrow fissure between them. Distally the petasma ends in two apparently truncated "horns." The truncation is produced by the upward-turned and forward-twisted, and in part outwardly rotated slender extremities of these "horns," which form the lateral hooks, so-called above. Just short of the rounded end of these slender processes or hooks there is an upward-cut notch, making the end of the hook resemble much the tip of a crochet needle. The transverse lamina on the anterior margin of each "horn" of *T. salaco* is represented in this species by a platelet placed just about as far laterally, as seen in ventral view, as is possible without touching the lateral hook of the corresponding horn. Medially there are two joined, ventrally curved lobes which have their counterparts in *T. salaco* and correspond to the submedian teeth in *T. curvirostris*. Much as in *T. salaco* also, there is developed on the posterior surface of the petasma, at the level of the middle of the laterally directed portions of the "horns," a suggestion of a tooth on either margin of the median fissure.

The specimen is somewhat longer than de Man's two largest males. As in that species, it has epipodites only on the third of the thoracic legs. Though the rostral tooth is the same, and the third maxillipeds and antennules are relatively the same length—the fifth legs are comparatively a little longer—the shape and direction of the hooked and twisted tips of the lateral horns of the petasma are so unlike *T. salaco* that this male cannot be identified with that species.

Measurements.—As stated above, the single male specimen is about 54 mm. long. The smallest of the eight females is possibly 67 mm. long and the largest about 84 mm. Three specimens better than average are 79, 80 and 81 mm. long respectively.

Remarks.—“Challenger” specimens from Japan (Yokohama) identified as *Penaeus anchoralis* by Bate and determined by Alcock as *T. curvirostris*, are referred to under the last-named species further on.

TRACHYPENAEUS GRANULOSUS (*Haswell*).

(Plate lxiii., figs. 1-2.)

Penaeus granulatus, Haswell, Proc. Linn. Soc. N.S.W., iv., 1879 (1880), p. 41, and Cat. Austral. Crust., 1882, p. 202 (part: female only). Not the *T. granulatus* of other authors.

Occurrence.—7 miles N.N.E. of Bowen, Queensland, 16 fathoms; three females (Reg. Nos. P.3521, P.3527 and E.6622).

12 miles N.N.E. of Bowen, Queensland, 19-25 fathoms; three females (Reg. Nos. P.3529 and E.3116).

Distribution.—Also known from Darnley Island, Torres Strait—the type locality.

Description of female.—Rostrum a little up-tilted and very slightly recurved, not quite reaching the distal extremity of the second segment of the antennular peduncle, armed above with from eight to ten teeth in addition to a small epigastric tooth situated at the anterior two-sevenths of the carapace. The rostrum is carried as a prominent, though blunt post-rostral carina quite to the posterior margin of the carapace. Orbital, antennal and hepatic spines as with the other members of the genus; antero-lateral border of the carapace

angled, but not acute or spined. The antennular flagella are about two-thirds to five-sevenths the length of their peduncle.

The fifth pair of thoracic legs extend about as far forward as the third pair and exceed the tip of the antennal scale by from one-fifth to nearly one-third the length of their propodal joints. There are spines at the bases of the first and second pair of legs.

The telson shows on each margin in advance of the readily discernible pair of subterminal spines, one or two pairs of minute, scarcely perceptible spines.⁴⁰

The thelycum has anteriorly the more or less cordiform plate seemingly typical of the females of this genus. In this particular species, however, this plate has a median posterior extension or tongue, which overlaps what ordinarily in most of the related species is a centrally depressed portion of the posterior plate, and fuses with the hinder margin of that plate, so as to form a pair of lateral depressions, one under each outer angle of the "cordiform" plate. Anteriorly this "cordiform" plate is itself medially slightly depressed or excavated; posteriorly its tongue-like extension rises to a bluntly indicated, transverse ridge about in line with the lateral pits or depressions of the posterior plate of the thelycum. Behind this prominence or swelling the "tongue" is posteriorly rounded off; before it the sloping portion of the "tongue" shows a faint median ridge which rapidly fades out on the "cordiform" plate before it reaches its depressed portion.

Measurements.—Of the "Endeavour" specimens listed above, the largest is 95 mm. long from tip of rostrum to end of telson, and the two smallest 82 mm. long; the three others are respectively 86, 89 and 89 mm. long.

Remarks.—The male of this species has not yet been seen. It is possible that it might prove to be the same as de Man's *salaco*, as there does not seem to be any exclusive characters. On the other hand, however, until more is known of both species, it seems better to consider them as distinct.

⁴⁰These spines have been carefully searched for by three members of the Australian Museum staff, but could not be distinguished. They are, therefore, not shown in the illustration on plate xlix., prepared at the Australian Museum.—F. A. McNEILL.

Through the Australian Museum I received for examination a paratype 72 mm. long, said to be of about the same size as the female holotype,⁴¹ and another smaller paratype 45 mm. long. Type locality—Darnley Island, Torres Strait. The carapace and rostrum of the larger paratype measure 28.5 mm. as compared with 31 mm. for the holotype. The rostrum alone is 9.5 mm. long and fails to reach the last segment of the antennular peduncle. Above, it is armed with eight teeth in addition to the epigastric spine, as is also the 6.3 mm. rostrum of the smaller specimen. The post-rostral carina is distinct practically to the posterior margin. The third maxillipeds reach to a point a little in advance of the middle of the antennal scale. The fifth legs are wanting in both specimens, and the telson of each appears to have two pairs of tiny marginal spinules in advance of the subterminal pair (see footnote⁴⁰).

TRACHYPENEUS CURVIROSTRIS (*Stimpson*).

(Plate lxiii., fig. 3.)

Penæus curvirostris, Stimpson, Proc. Acad. Nat. Sci. Phila., xii., 1860, p. 44 [113].

Penæus curvirostris, Miers, Proc. Zool. Soc. London, 1878, p. 307. *Id.* Ortmann, Zool. Jahrb. Syst., v., 1890, p. 451, pl. xxxvi., fig. 4 *a, b*. *Id.* Kishinouye, Jour. Fish. Bureau, Tokyo, viii., 1900, p. 23, pl. vi., fig. 4, pl. vii., fig. 10, 10 *a-c*. *Id.* Doflein, Abh. K. Bayer. Akad. Wissen., 1902, II. Klasse, xxi., Abt. iii., p. 631.

Penæus anchoralis, Bate, Ann. Mag. Nat. Hist. (5), viii., 1881, p. 181, and "Challenger" Rept. Zool., xxiv., Macrura, 1888, p. 258, pl. xxxv., fig. 1" (part: except female from the Arafura Sea).

Penæus granulatus, Miers, Zool. "Alert," 1884, p. 295.

Parapenæus curvirostris, Rathbun, Proc. U.S. Nat. Mus., xxvi., 1902, p. 38.

Trachypeneus curvirostris, Alcock, Ann. Mag. Nat. Hist. (7), xvi., 1905, p. 523.

Trachypeneus asper, Alcock, Ann. Mag. Nat. Hist. (7), xvi., 1905, p. 531, and Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 43, pl. ix., fig. 28, 28 *a, b*.

⁴¹ The late A. R. McCulloch, of the Australian Museum, examined Haswell's specimens of "*Penæus granulatus*" and selected a specimen with 10 teeth above the rostrum, which he regarded as the holotype of the species.—F. A. MCNEILL.

Metapenæus curvirostris (?), Nobili, Ann. Sci. Nat., Zool. (9), iv., 1906, p. 20.

Trachypenæus curvirostris, de Man, Trans. Linn. Soc. London, (2), Zool., ix., 1907, p. 436, pl. xxxiii., fig. 56-58. *Id.* Balss, Abh. der K. Bayer. Akad. Wiss., Math.-phys. Klasse, Suppl., 10 Abh., 1914, p. 11.

Trachypenæus anchoralis, de Man, "Siboga" Exped., xxxix.a, Decapoda, pt. 1, Penæidæ, 1911 (plates 1913), p. 88, pl. viii., fig. 28. *Id.* Tattersall, Jour. Linn. Soc. London, xxxiv., 1921, p. 367.

Trachypenæus asper, Balss, Denkschr. math.-naturwissen. Klasse k. Acad. Wissen., xci., 1915, p. 12.

Occurrence.—Off Frazer Island, Queensland, 32-33 fathoms; one male and two females (Reg. No. E.4472).

Distribution.—Previously known from:

Japan, Hakodate to Kagoshima and Nagasaki, to a depth of 150 m. (Stimpson, Ortmann, Rathbun, Doffein, Balss); Inland Sea (de Man); Formosa.

Dutch East Indies, Halmaheira Sea, off Salawatti Island, south of Timor, Molo Strait, 18 to 141 fathoms (de Man); Arafura Sea, south of Papua, 28 to 49 fathoms (Bate).

Australia, Port Darwin, North Australia, 12 fathoms (Miers); Cape Jaubert, West Australia, 51-140 feet (Balss); Thursday Island, Torres Strait, 4 to 6 fathoms (Miers).

Indian Ocean, Andaman Islands, 25 to 35 fathoms; Ganjam coast, Bay of Bengal, 20 to 35 fathoms (Alcock).

Persian Gulf (Alcock); ? Red Sea, Massaouah (Nobili).

Remarks.—Pesta in his revision of the "Penæidæ" of the Vienna Museum, separates his specimens of *Trachypenæus* into the two species, *asper* and *curvirostris*, on the basis of difference in direction and shape of the rostrum, and the distinctness of the post-rostral carina. The rostral distinctions he sets forth are entirely inadequate, being included in any good series of *T. curvirostris*; and, too, his second diagnostic character is subject to some variation.

In the three "Endeavour" specimens which are here assigned to *T. curvirostris*, as regards the indistinctness of the post-rostral carina and the tendency toward longer

legs, they approach the species designated as *T. asper* by Alcock; the thelycum, however, fits into the series of *T. curvirostris* before me, while the petasma of the single male specimen is like that figured by Bate for *anchoralis* and referred to by de Man under the same name. The fifth legs of the "Endeavour" specimens vary from one-third the length of the dactylus short of the tip of the antennal scale in the largest, to exceeding the scale by not quite one-third of the length of the dactylus in the smallest specimen of 37 mm. length.

The count of the rostral teeth in the lone male and the one female with a complete rostrum, totals seven, exclusive of the epigastric tooth, being thus coincident in number with the count, which was found to be remarkably constant for a series of more than thirty Japanese specimens of *T. curvirostris* in the collections of the U.S. National Museum. Among these there were but four deviations; other than the epigastric, one had eight teeth, one six teeth, another five, with, however, a blunt hump indicative of a possible former sixth tooth; and the fourth specimen with but three teeth, all confined to the basal half of the free portion of the rostrum and clearly an abnormality, possibly the result of regeneration, though not apparent as such on examination.

With respect to the rostral count and the length of the fifth pair of legs, de Man's specimens of *T. anchoralis* also approach Alcock's *T. asper*, but here again the thelycum stands within a *curvirostris* series, as does also the somewhat variable character and development of the post-rostral carina of his specimens. The rostrum of *T. asper* is dorsally armed with nine or ten teeth, not including the isolated epigastric tooth. In de Man's *T. anchoralis*, so-called, the rostral count of the three specimens for which it is given, not including the epigastric, is eight, nine and ten. Bate's *anchoralis* males, which surely are true *T. curvirostris*, had from six to eight rostral teeth in addition to the epigastric.

De Man's statement that his *anchoralis* differs from *T. curvirostris* by virtue of the non-projection of the submedian teeth of the petasma beyond the lateral lobes, is a distinction of very doubtful value. Even Kishinouye's three views of the same petasma are not wholly in agreement with regard to the relative length, or projection, of the submedian teeth beyond a line connecting the

distal margins of the lateral lobes. The size of these median teeth seems to vary with age, in young small specimens being possibly a little below the most distal points of the lateral lobes of the petasma; and in older, larger, more mature specimens, rising above or beyond that level. In a male 70 mm. long from Kagoshima, Japan, these teeth do project slightly; in two males from Aomori, Rikuoku, Japan, they are about on a part with the lateral lobes; while in the lone male taken by the "Endeavour," they are if anything possibly a little shorter. The lateral lobes of the petasma figured by Bate are represented as being much bowed up, and for that reason only may exceed the median teeth. The petasma portrayed by Alcock, I feel sure is a misrepresentation on the part of the artist; it is not unlike, in appearance, the sketch given by Ortmann. Unfortunately Alcock makes no written comment on either the petasma or his figure of it.

I believe that until more valid differences are brought forward to distinguish *T. asper* and de Man's *anchoralis* from *T. curvirostris*, they had better be united.

Though it might later appear that Alcock's specimens ranging in size up to 3.5 inches (nearly 90 mm.) in length, represent an Indian Ocean variety or subspecies—*asper*—with longer fifth legs, a much fainter post-rostral carina and sharper antero-lateral angles of the carapace, it should be borne in mind that de Man's comparatively immature specimens of 52 mm. and less, with legs and rostral teeth much as in *T. asper*, and quite distinct post-rostral carina nearly to the posterior margin of the carapace, have the thelycum and petasma much as in *T. curvirostris*; while the three "Endeavour" specimens, from 37 to about 50 mm. in length, which also exhibit a tendency toward comparatively longer legs, have straighter rostra, and have in the two specimens with complete rostra the exact number of rostral teeth of typical *T. curvirostris*, and though carinated for a longer or shorter distance following the tip of the epigastric tooth, in none of the three specimens does the carina run on to, if as far as, the posterior half of the carapace.

Otherwise, the only *small* specimens of *T. curvirostris* I have seen are two females from northern Japan 33 and 41 mm. long. They have the fifth legs longer than

usual for other and larger specimens of the species from that region, reaching nearly to the tip of the spine of the antennal scale. The rostral count of these specimens is typical, and the post-rostral carina can be traced to near the posterior margin of the carapace.

Of the species here grouped together as *T. curvirostris*, the comparative length of the antennular flagella likewise seems to be too variable to have any value as a diagnostic character. The antennular flagella of de Man's *anchoralis* range in length from three-fourths the length of their peduncle in the largest female, of 64 mm., to "but little shorter than it" in two other much younger specimens. Of his two *curvirostris* females from the Inland Sea of Japan, the antennular flagella are "only one-third shorter than their peduncle," which is just about the length given by Alcock in describing the female of *T. asper*—"the antennular flagella [are] . . . about two-thirds the length of their peduncle." The length of the antennular flagella of about twelve females of the U.S. National Museum series of *T. curvirostris* from Japan, varies from four-fifths, and nine-tenths, to nearly as long as the peduncle. In the larger of the two females taken by the "Endeavour" the antennular flagella are ten-elevenths the length of the peduncle and in the smaller of 47 mm. they are just about as long as the peduncle. The single 37 mm. male has the flagella one-sixteenth longer than the peduncle.

The telson of these three "Endeavour" specimens is spined as in *curvirostris*, the spining of which has been set forth in detail by de Man. The several spines, however, are relatively somewhat longer and more slender than is usual with most representatives of *T. curvirostris*, a possible indication of youth or immaturity, except the third, or pair immediately adjacent to the fourth or subterminal pair of spinules. This third pair of spinules is very small, inconspicuous and hard to see, but when quite dry plainly shows on the right side of the detached telson of the smaller female. On the left side the former presence of the corresponding spine is indicated by a tiny pit or punctation. In the other two specimens the evidence is less conclusive. The larger female has a similar pit discernible on the left side of the telson close upon the base of the subterminal spine; on the right side both the third and fourth spines are wanting. The position

of each is indicated by a blunt hump as though the spine had been accidentally destroyed at some time during the life of the individual, and the injury subsequently overcome without regenerating the spines. The telson of the male specimen is somewhat damaged. Alcock speaks of but three pairs of very small, obscure and hardly perceptible spinules. In *T. curvirostris* too, all the spines are fairly small. There always has been much confusion regarding the number of marginal spinules in the several species of *Trachypneus* as described (cf. Bate, Ortmann, Haswell). Therefore is it not possible that Alcock may have overlooked a possible tiny pair close upon the bases of the subterminal pair?

Further, de Man's intermediates, if you will, have the antero-lateral angles of the carapace "rather obtuse," on the basis of which they tend to stand nearer true *curvirostris* than *asper* as described by Alcock. Alcock has remarked that among other features, *T. asper* differs from *T. curvirostris* in that "the antero-inferior angles are sharper," but in occasional specimens of *T. curvirostris* the anterior-inferior angles of the carapace appear quite as prominent and sharp as shown in Alcock's figure, even though they could not be described as what he designates in *asper*, "distinctly dentiform."

The specimens which Miers listed as *T. granulatus* in his "Alert" report are said by Alcock to be the same as *anchoralis* Bate. Consequently on the basis of what that species was heretofore supposed to be, such an identity would render them synonymous with *T. curvirostris* Stimpson.

Balss has more recently listed *T. asper* from Western Australia, 45-46 miles W.S.W. of Cape Jaubert, 50-140 feet. From his citations I take it he follows Pesta in the separation of his material from *T. curvirostris*. It seems, therefore, as regards the post-rostral carina that his specimens are much like those taken by the "Endeavour." But in all this discussion even though these "Endeavour" specimens might some time be determined as a distinct species, the fact should not be overlooked that Alcock described the post-rostral carina of his species as "low, broad and faint; nearly reaching the posterior border of the carapace." The several specimens Pesta determined as *asper* are, by the way, listed as juvenile by him.

Genus PENEUS, Weber, Alcock.

Key to the Species of *Peneus* (s.s.) known from Australia and the Indo-Pacific.

1. Lateral grooves on the carapace extending practically the entire length of the carapace, rostrum with only one tooth on inferior margin.
 - A. Telson with three pairs of lateral spines.
 1. Lateral grooves on carapace paralleling medially sulcate post-rostral carina to posterior margin of carapace.
 - a. Rostrum without a secondary or accessory pair of lateral rostral sulci.
 - i. Thelycum tubular (oval in cross-section), the two lateral plates being indistinguishably united on the median line to form a single large plate. Petasma with submedian teeth or "horns" bent over, so as to overhang the distal margin of the side plates of the petasma.

japonicus. Bate.
 - ii. Thelycum composed of two distinct plates, juxtaposed, but not united on the median line. Petasma with submedian teeth or protuberances but slightly bent over, and not overhanging the distal margin of the side plates of the petasma.

latisulcatus, Kishinouye (p. 365).
 - b. Rostrum with a secondary pair of lateral carinae subtending an accessory pair of lateral sulci on the sides of the upper blade of the rostrum, not extending backward behind the last rostral (gastric) tooth. Thelycum and petasma much as in *P. latisulcatus*.

plebejus, Hess (p. 367).
 2. Lateral grooves on carapace posteriorly confluent, uniting behind the sulcated post-rostral carina and crossing over to form an X-shaped depression.

maccullochi, new species (p. 370).
 - B. Telson laterally unarmed.

canaliculatus (Olivier).
- II. Lateral grooves on the carapace not extending posterior to the last rostral (gastric) tooth; rostrum with two to five teeth on inferior margin. Telson laterally unarmed.
 - A. Carapace with a more or less prominent subhepatic crest.
 1. No exopodites on the fifth pair of legs; subhepatic crest a prominent longitudinal ridge extending posteriorly for about one-third its length behind the angle formed below the hepatic spine by the meeting of the antennal sulcus with the ridge which terminates anteriorly in the antennal spine. Post-rostral carina usually more or less sulcate.

carinatus, Dana.
 2. Fifth pair of legs with small but well-formed exopodites.
 - a. Post-rostral carina sulcate; subhepatic crest formed by the lower margin of an oblique "incision"

beginning a little behind and above the angle formed below the hepatic spine by the meeting of the antennal sulcus with the ridge which terminates in the antennal spine, and extending forward and downward to an angle of about 30° to the longitudinal axis of the carapace toward its antero-lateral angle.

semisulcatus, de Haan.

- b. Post-rostral carina not sulcate or grooved.
 - i. Subhepatic crest formed by the lower margin of a straight, longitudinal "incision" extending posteriorly scarcely as far as the angle formed below the hepatic spine by the meeting of the antennal sulcus with the ridge which terminates anteriorly in the antennal spine; rostrum with five to seven, usually six teeth above, and most often three, rarely four teeth below.

esculentus, Haswell (p. 362).
 - ii. Subhepatic crest longitudinal and arcuate; extending for some distance behind the angle formed below the hepatic spine by the meeting of the antennal sulcus with the ridge which terminates anteriorly in the antennal spine; rostrum with nine teeth above and two below.

gracilirostris, Thallwitz.

B. Carapace without a subhepatic crest.

- 1. Rostrum exceeding the antennal scale by one-third to two-fifths the length of its free portion.
 - a. Last or anterior dorsal rostral tooth at most placed over the last or terminal segment of the antennular peduncle, often not so far forward.

indicus var. *longirostris*, de Man
(adult and juvenile).
 - b. Last, or anterior dorsal rostral tooth invariably placed in advance of the last, or terminal segment of the antennular peduncle.

merguiensis, de Man (juvenile).
- 2. Rostrum about as long as antennal scale, rarely and then only slightly exceeding it; often shorter than the antennal scale.
 - a. Dactyl of third or external maxillipeds of adult male about as long as or markedly shorter than propodus.
 - i. Dactyl of third maxilliped of adult male about as long as propodus. Rostral crest, in both sexes, only of moderate height.

indicus, M. Edw.
 - ii. Dactyl of third maxilliped of adult male, scarcely half as long as propodus. Rostral crest proximally conspicuously high and of broad triangular form in both sexes.

merguiensis, de Man (adult).

- b. Dactyl of third or external maxilliped of adult male from one and one-half to two and three-fourth times the length of the propodus. Rostral crest high but not forming a decided triangle.

indicus var. *penicillatus*, Alcock.

The distinction of true *Peneus indicus* from its near relatives and varietal forms is by no means satisfactory. De Man,⁴² in saying that "in young individuals both of *P. indicus* [*longirostris*]⁴³ and of *P. merguensis* the rostrum projects beyond the antennal scales and is more or less conspicuously curved upward, in many cases these young specimens may, however, be distinguished by the teeth of the upper margin, which in *P. merguensis* usually occur till near the tip, while in *P. indicus* [*longirostris*] the foremost tooth is situated opposite the terminal joint of the antennular peduncle, so that the distal unarmed part of the upper border appears comparatively longer," seems to leave the typical form of *P. indicus* without its younger stages, especially as he cites both Alcock's figure⁴⁴ of the juvenile and his own⁴⁵ in illustration of his remarks. Can it be that Alcock had no young forms of typical *P. indicus*, and that the lone specimen which Pesta⁴⁶ had with an *indicus*-like rostrum, but short, is the true young of *P. indicus*? Nevertheless one feels that Kemp⁴⁷ is nearer the correct solution of the difficulty when he says "the variety *longirostris* described by de Man, is based entirely on the length of the rostrum and the great degree of variation that Indian specimens exhibit in this respect leads me to believe that the varietal name cannot be retained." Stebbing,⁴⁸ however, more recently, in spite of admitting, in connection with the possible relation of the species to "*Palaeomon longicornis*," Olivier,⁴⁹ that "Its great variability, explained by Alcock and de Man, makes the study of it rather perplexing. Especially the elongation and slenderness of the rostrum in the younger and smaller specimens give them a very different appearance from

⁴² "Siboga" Exped., xxxix, Decapoda, pt. i, Penaeidae, 1911, p. 195.

⁴³ De Man, though he does not use the varietal name *longirostris* in the immediate quotation given here, has reference only to the variety, as is shown by the citation in his "Siboga" Report; cf. footnote above.

⁴⁴ Cat. Indian Decapod Crust., 1906, pt. iii, fasc. i, pl. i, fig. 3a.

⁴⁵ In Max Weber's Zool. Ergebn., ii, 1892, pl. xxix, fig. 53.

⁴⁶ Archiv f. Naturg., 1915, Abt. A., Heft 1, p. 117.

⁴⁷ Mem. Indian Mus., v., 1915, No. iii, p. 319.

⁴⁸ Ann. Durban Mus., i, 1917, pt. v., p. 413.

⁴⁹ Encycl. Méth., viii, 1811, p. 662.

that of the large forms," still lists the var. *longirostris* as distinguishable from the species proper.

PENEUS ESCULENTUS, *Haswell*.

(Plate lxiv., figs. 1-4.)

Penæus esculentus, Haswell, Proc. Linn. Soc. N.S.W., iv., 1879 (1880), p. 38, and Cat. Austral. Crust., 1882, p. 200.

Penæus monodon, Whitelegge, Jour. Roy. Soc. N.S.W., xxviii., 1889, p. 224. *Id.* Ogilby, Edible Crust. N.S.W., 1893, p. 203, not including synonymy.

Penæus esculentus, de Man, "Siboga" Exped., xxxix.a, Decapoda, pt. I., Penæidæ, 1911, p. 96.

Occurrence.—Port Curtis, Queensland, 14-16 fathoms; one female (Reg. No. P.2399). Bustard Bay, Queensland, 11-16 fathoms; one male and one female (Reg. Nos. P.2400 and P.2401).

4-5 miles S.W. of Bustard Head Light, Queensland, 11-16 fathoms; four males and two females (Reg. No. E.2054).

Platypus Bay, Queensland, 7-9 fathoms; two females (Reg. No. E.3162).

Platypus Bay, Queensland, No. 1, haul 2, 28.7.10; one male and one female (Reg. Nos. P.3550 and P.3551).

11-14 miles N.W. of Pine Peak, Queensland, 24-26 fathoms; three males and fourteen females (Reg. Nos. E.3200, E.3202, E.3204, E.3205 and E.3206).

S. 29° E. Pine Peak, Queensland; three males and three females (Reg. Nos. P.3590, P.3591, P.3592, P.3593, P.3594 and P.3595).

Southern Queensland; five males and seven females (Reg. Nos. P.3596, P.3597, P.3598, P.3599, P.3600, P.3601, P.3602, P.3603, P.3604, P.3605, P.3606 and P.3607).

11-14 miles N.W. of Pine Peak, Queensland, 24-26 fathoms; two males and six females (Reg. Nos. E.3201 and E.3203).

Distribution.—Apparently found only off the northern and eastern coasts of Australia: other than the localities enumerated above, known from the type locality, Port Jackson, New South Wales, and Port Darwin, Northern Territory of South Australia (Haswell). Ogilby states that: "This is the 'Tiger Prawn' of the Sydney fishermen. . . . This species is

at times common in the Sydney market, but is irregular in its appearance; during the summer and autumn of 1891-92 it was exceptionally plentiful, since which time but few specimens have been observed; Dr. Haswell is mistaken in saying that this species is 'the common edible Prawn of Sydney, Newcastle, etc.'

"This is a marine species and is taken principally, if not entirely, on clean, sandy beaches. It does not mix with other Prawns, but from its preference for the same class of ground sometimes occurs in company with *P. canaliculatus* [= *P. plebejus*]."

Remarks.—De Man takes this species "to be closely related to *P. carinatus* (as described by him, *loc. cit.*, 1911, p. 101), but to differ by its very short antennular flagella." However, just as he notes an apparent discrepancy in the length of the antennular flagella between Dana's description of *P. carinatus*, and the specimen he takes to be that species, so I find a similar difference between Haswell's description of *P. esculentus* and the "Endeavour" specimens before me. In a co-type from Port Jackson, which I have been enabled to examine through the courtesy of the Australian Museum, but one of the four antennular flagella are present, the right outer one, and of this but its basal portion, which, lacking the slender, thread-like terminal filament, is just as long as the last two joints of its peduncle. In fact, in none of the species of *Peneus* (*sensu strictu*) which I have examined in connection with this paper are the antennular flagella shorter than the last two segments of their peduncle.

Aside from the presence of a small but well-developed exopodite on the fifth pair of legs, there are other more or less striking differences, though possibly of less diagnostic value, separating *P. esculentus* from *P. carinatus*.⁵⁰ (1) The midrib of the rostrum in the former is quite straight throughout its length except for a slight upturning of the tip; in the latter there is an evident rise in the midrib just before reaching, and above, the orbit, which with its ascending extremity gives the rostrum its "distinct double curve" (described by Alcock⁵¹ for his *P. semisulcatus*, = *P. carinatus*); (2) as a result of

⁵⁰ De Man, *loc. cit.*, 1911, p. 101.

⁵¹ Cat. Indian Decapod Crust., 1906, pt. iii., fasc. i., p. 10, pl. i., fig. 2.

this convexity above the orbit, the upper blade of the rostrum of *P. carinatus* is quite narrow, only about half the width of that of specimens of *P. esculentus* of the same size; (3) also in specimens of the same size, the carapace of *P. esculentus* is shorter and much stouter than in *P. carinatus*; (4) the cervical groove of *P. carinatus* is quite short (much as in Alcock's figure), being often more or less obscure, or even obsolescent at times; likewise the antennal sulcus is very short anteriorly, both of these grooves being only a third as long, relatively, as they are in *P. esculentus*; (5) a further difference between the two species is to be found in the prominence, position and length of the subhepatic crest or ridge; in fact all the species of *Peneus* having subhepatic ridges, three or more teeth on the lower border of the rostrum and no lateral spinules on the telson, differ with respect to this character: (a) in *P. esculentus* it is more the slightly turned-up or bent outward lower margin of a straight, longitudinal incision which extends posteriorly scarcely as far as the angle formed by the meeting of the antennal sulcus with the ridge which terminates anteriorly in the antennal spine, situated below the hepatic spine; (b) in *P. carinatus* it is a strongly raised, prominent, longitudinal ridge extending posteriorly for about one-third its length behind the angle corresponding to the one defined above; (c) in *P. semisulcatus* (de Man, *loc. cit.*, 1911, p. 99) the crest is formed much in the same manner as that in *P. esculentus*; or, as de Man states: "The subhepatic 'crest' appears as a narrow, linear groove and hardly may be described as a crest," but in contrast to the subhepatic crest in *P. esculentus* it is oblique, and at an angle of nearly 30 degrees to the longitudinal axis of the carapace, beginning behind and a little above the antennal sulcus-ridge angle, below the hepatic spine, and running downward toward the antero-lateral angle of the carapace.

The petasma in the male is anteriorly (distally) much as in *P. latisulcatus*, but posteriorly (proximally) has no lobes forming a bifurcation below, being evenly rounded on each side of a median notch.

The thelycum of *P. esculentus* has the medial margins of the lateral plates very prominent, raised as high as half the width of the remaining portion of either lateral plate. These raised margins are juxtaposed and

distinctly crenulated, the crenulations being the continuations of ridges on their opposed surfaces. The concave median plate of the thelycum ends anteriorly in two more or less contiguous though laterally placed knobs, with a median knob lying between and behind these two in the notch formed by the incurving of the anterior margins of the lateral plates toward the median line.

In the Macleay Museum co-type received through the Australian Museum, the anterior median plate of the thelycum is but little more than a slightly concave surface with raised edges, which though approximating, do not at all attain the prominence and thickening necessary to quite warrant designating the anterior extremities of these edges as "knobs."

This specimen is about 190 mm. in length; carapace and rostrum together, 70 mm. over all. The 26 mm. rostrum has six teeth above and three below. The subhepatic ridge distinctly fails to reach the angle formed below the hepatic spine by the meeting of the antennal sulcus with the ridge which terminates anteriorly in the antennal spine.

From the specimens at hand it appears that, above, the rostral teeth may vary from five to seven, and below, from three to four. Of the specimens with complete rostra, forty had $\frac{6}{3}$; seven, $\frac{7}{3}$; two, $\frac{6}{4}$; one, $\frac{7}{3}$; one, $\frac{5}{3}$; one specimen with an obviously regenerated rostrum had but four teeth above and one below. The typical count given by Haswell was six above and three or four below.

Size.—The late Allan R. McCulloch wrote me that this species "occasionally reaches a large size. Our largest specimen measures 12.25 inches (about 310 mm.) from tip of rostrum to end of telson, and comes from Port Jackson," the same locality as that of the 190 mm. co-type mentioned above. The length of the greater number of specimens ranges between 150 and 206 mm. Most of the specimens, however, are about the size of the co-type.

PENEUS LATISULCATUS, Kishinouye.

Penaeus latisulcatus, Kishinouye, Jour. Fish. Bureau, Tokyo, viii., 1900, p. 12, pl. ii., fig. 2, pl. vii., fig. 2.
Id. Rathbun, Proc. U.S. Nat. Mus., 1902, xxvi., p. 27.

Penæus latisulcatus, de Man, "Siboga" Exped., xxxixa, 1911 (plates, 1913), Decapoda, pt. i., Penæidæ, p. 108, pl. ix., figs. 35a-b, and synonymy. *Id.* Balss, Abh. der K. Bayer. Akad. Wiss., II., Math.-phys. Klasse, Suppl., 10 Abh., 1914, p. 13. Pesta, Archiv f. Naturg., 1915, Abt. A., Heft 1, p. 111, fig. 3.

Occurrence.—12 miles N.N.E. of Bowen, Queensland, 19-25 fathoms; one male (Reg. No. E.3157).

Off Marsden Point, Kangaroo Island, South Australia, 17 fathoms: two males and three females (Reg. Nos. E.797, E.798, E.4501, E.4502 and P.2308).

South Australia: four males and twenty-three females (Reg. Nos. E.3196, E.3197, P.3575, P.3576, P.3577, P.3578, P.3579, P.3580, P.3581, P.3582, P.3608, P.3609, P.3610, P.3611, P.3612, P.3613).

Distribution.—Previously known from Japan, Nagasaki to Yokohama (Kishinouye, Rathbun, Balss); Pescadores Islands, Formosa, Sandakan Bay, Borneo, Dutch East Indies, Batjan, Ceram, Nusa Sant, Tiur and Saleyer Islands (de Man), Straits Settlements, Penang (Lanchester), Red Sea (de Man).

Remarks.—The teeth on the upper margin of the rostrum vary from 8-11 in number, but usually the number is 9 or 10. In this species the post-rostral carina, inclusive of the median sulcus which it bears, generally appears to be narrower than the width of the lateral grooves, while in the related *P. japonicus* of Bate it seems wider than the lateral grooves. However, the form of the thelycum and petasma will always separate the two.

The thelycum in *P. latisulcatus* is composed of two plates separated from one another on the median line by a narrow fissure: in *P. japonicus* the two plates composing the thelycum are indistinguishably fused on the median line to form a single large plate.

The pestasma has two very short submedian teeth or "horns," hardly more than mere protuberances. These are but slightly bent over and do not tend to overhang the distal margin of the side plates of the organ.

In *P. japonicus* (*cf.* Pesta, *op. cit.*, figs. 1-2) the similarly placed protuberances or "horns" are bent over,

overhanging "cap-like" almost the whole distal margin of the side plates of the petasma.

Size.—The "Endeavour" specimens of this species range from 120 to about 190 mm. in length, thus exceeding in maximum size the largest hitherto recorded, so far as I am aware, Kishinouye's of 150 mm.

PENEUS PLEBEJUS, Hess.

(Plate lxxv., figs. 1-4. Plate lxxviii., fig. 1.)

Penæus plebejus, Hess, Archiv f. Naturg., 1865, i., p. 168, pl. vii., fig. 19.

Penæus canaliculatus, Haswell, Proc. Linn. Soc. N.S.W., iv., 1879 (1880), p. 38, and Cat. Austral. Crust., 1882, not including synonymy.

Penæus canaliculatus, var. *australiensis*, Bate, "Challenger" Rept., Zool., xxiv., Macrura, 1888, p. 248, pl. xxxiii., fig. 3.

Penæus canaliculatus, Ogilby, Edible Crust. N.S.W., 1893, p. 202, not including synonymy. *Id.*, Stead, Zoologist (4), ii., London, 1898, p. 209.⁵² *Id.*, Whitelegge, Mem. Austral. Mus., iv., 1900, pt. 2, p. 197.

Penæus plebejus, de Man, "Siboga" Exped., xxxix, Decapoda, pt. i., Penæidæ, 1911 (plates, 1913), pp. 96 and 108-111, pl. ix., fig. 36a; and references there given. *Id.*, Pesta, Archiv f. Naturg., 1915, Abt. A., Heft 1, p. 112; text-figs. 4, 5.

Occurrence.—13 miles N.E. of North Reef, Queensland, 70-74 fathoms; one male and one female (Reg. Nos. P.3614 and E.3208).

18 miles S. by W. of Lady Elliott Island, Queensland, 18 fathoms; six females (Reg. No. E.2056).

18 miles S.W. by S. of Lady Elliott Island, Queensland, 18 fathoms; three males (Reg. Nos. P.2403, P.2404 and P.2405).

9 miles E. of Frazer Island, Southern Queensland, 24-26 fathoms; eight females (Reg. Nos. P.2402, P.3615, P.3616, P.3617 and E.2055).

⁵²The three following localities were given by Stead: Port Jackson; Botany Bay; Japan. Specimens from the two former were the basis of his identification. The "Japan" locality, like other extra-Australian localities in the same paper, were taken from literature.—F. A. McNEILL.

11-14 miles N.W. of Pine Peak, Queensland, 24-26 fathoms; four males (Reg. No. E.3207).

13 miles N. by W. of Double Island Point, Queensland, 25-26 fathoms; one male and four females (Reg. No. E.2057).

Distribution.—Otherwise *P. plebejus* is known from the type locality, Sydney (Hess and Pesta), and Port Jackson, Australia, 2-10 fathoms (Bate); also Auckland, New Zealand (Pesta). Ogilby gives the common name of "Sand Prawn" to this shrimp and says: "This Prawn is taken in large numbers by small-meshed nets on sandy beaches near the mouths of our [Australian] rivers, the principal supply coming from George's and Cook's Rivers.

"They are delicious food, and grow to five inches in length."

Remarks.—This species can readily be distinguished from other related species, bearing three pairs of lateral spinules on the telson, and but one spine on the lower border of the rostrum, by the presence "at either side of the rostrum, about midway between the lateral rostral carinæ and the tips of the teeth, another carina that commences near the base of the first rostral tooth and that, gradually narrowing, is continued to the foremost tooth where it passes into the upper margin of the rostrum. This second carina is wanting in *P. latissulcatus*" (de Man, *op. cit.*, p. 110). These secondary, lateral, rostral carinæ subtend or rather define distinct secondary, lateral, rostral sulci easily seen in the dorsal view.

Concerning the type specimen of *P. canaliculatus*, var. *australiensis* Bate, which de Man refers to as *P. plebejus*, Dr. Calman wrote de Man (*op. cit.*, p. 111): ". . . . The accessory carinæ are present just as you describe them in *P. plebejus*, but the groove which defines each on the inner side of the rostral teeth becomes distinct in front of the fourth tooth, so that, on the rostrum itself, the accessory ridges are only a little better defined than the slight ridges occupying the same position in *P. canaliculatus*. Posteriorly, however, the accessory ridges are quite distinct and end just behind the first tooth. . . ."

As first called to our attention by de Man (*loc. cit.*) and later figured by Pesta (*loc. cit.*), "there are

two loops, instead of one [as in *P. latisulcatus* and *P. japonicus*], between the posterior part of the post-ocular ridge and the rostral crest; of the two loops that are separated from one another, from the rostral crest and the post-ocular ridge, by deep, though narrow sulci, the inner is a little shorter than the outer."

The rostrum in thirteen of the "Endeavour" specimens of *P. plebejus* was armed, as in Hess's type, with ten teeth above, and one below, while eleven others were provided with a further or eleventh tooth above.

The males are much like those of *P. latisulcatus*, though of relatively frailer build. The petasma, of which Pesta gives a sketch in lateral view, is not unlike the figure given for Kishinouye for *P. latisulcatus*, the protuberances at the end of the inner "blade" of the petasma being well developed though small, and not overhanging the anterior margin of the outer "blade" to any extent. Often, these protuberances or knobs at the anterior ends of the inner blades of the petasma are very small or obsolescent, no doubt due to the relative stage of maturity attained by the specimen in question.

The thelycum as de Man has it, "has a somewhat different form from that of *P. latisulcatus*. The two lateral plates or lobes come in contact with each other at the median line, as in *P. latisulcatus*, the distal third or fourth excepted, but their form is semi-elliptical and their lateral margins that are slightly curved run nearly parallel, whereas in *P. latisulcatus*, they distinctly diverge backward. The lobes show about the form figured by Bate except that in this figure the lobes are not in contact. In *P. latisulcatus* the two lobes are therefore broader at their base than in the middle, whereas in the Australian species they are a little broader in the middle than posteriorly. The median protuberance differs likewise. Both in *P. latisulcatus* and in *P. plebejus* it consists of a posterior part, bounded at either side by a small ridge and an anterior portion that terminates anteriorly in two horns. In the female of *P. latisulcatus* this posterior part is shorter than the anterior, and the two horns are comparatively large and separated by a broad interspace. In *P. plebejus*, however, the posterior part is larger than the anterior, and the two horns are very small and almost contiguous. This protuberance has been quite wrongly figured by SPENCE

BATE: as a plate not in contact with the lobes." In occasional, possibly not fully mature, specimens of *P. latisulcatus* the horns of the anterior part of the median protuberance of the thelycum are rather small and close together, approaching those of *P. plebejus* in size and shape; in this latter species they also show some variation, being in some cases almost absent, merely suggested (knobs) but most often of a size equalling those in such variants as *P. latisulcatus* that have the small horns described by de Man for *P. plebejus*.

Size.—The type of this species, which de Man recently (*op. cit.*, p. 110) re-examined is "nearly 15 cm. long," but most of the "Endeavour" specimens are quite a bit larger, ranging from 14.3 to 20.5 cm. in length, the average of the 28 specimens being about 17.2 cm.; but one specimen was less than 15 cm. long.

PENEUS MACCULLOCHI,⁵³ *new species*.

(Plate lxvi., figs. 1-3.)

Type locality.—13 miles N.E. of North Reef, Queensland, 70-74 fathoms; one male, holotype (Reg. No.E.6619).

Description.—This species appears to be closely related to *P. plebejus* Hess, in possessing a secondary or accessory pair of lateral rostral carinæ, and having a double "loop" at the posterior end of the post-ocular ridge. Laterally as in that species, the telson is armed with three pairs of spinules.

The post-rostral carina extends backward nearly to the posterior margin of the carapace and is sulcate posterior to the last rostral tooth. The latter is situated a little in front of the middle of the carapace. However, distinguishing this species from all others is the interruption of the post-rostral carina at the middle of the posterior third of the carapace by a running together or crossing over of the lateral rostral grooves to form an X-shaped depression; before, this embraces the posterior end of the anterior portion of the sulcated post-rostral carina, and behind, it embraces likewise the sulcate, cut off, posterior end of the dorsal carina. The cervical

⁵³ Named for the late Allan R. McCulloch, formerly Zoologist at the Australian Museum.

groove ends below the posterior end of the accessory rostral carina, one-third the distance from the level of the hepatic spine to the rostral crest above.

Dorsally the rostrum is armed with eleven teeth, of which the first four are on the carapace, while the fifth has its base above the posterior margin of the orbit. The first tooth is about the size of the sixth, and the second is intermediate in size between the fourth and fifth. Anterior to the third, and largest tooth, the dorsal rostral teeth gradually decrease in size to the last one, which is about two-sevenths the length of the free portion of the rostrum removed from the tip. The rostrum extends as far forward as the spine of the antennal scale, a little in advance of the last segment of the antennular peduncle. The antennular flagella are shorter than their peduncle, but longer than the last two joints, being as long as the second, third, and about half the first joint taken together.

The petasmæ of this species, *P. plebejus*, and *P. latisulcatus*, are very much alike, and Kishinouye's figure of the petasma of the latter would do quite well for either of the other two. There is enough variation in the size of the median protuberances in each of these species, no doubt in direct ratio to the age of any particular specimen, to render it impossible to separate them on the basis of this character alone. However, the carination of the rostrum and the character of the lateral sulci will always serve to differentiate them.

Except for the peculiar crossing over of the lateral grooves on the carapace, the male of *P. maccullochi* might be mistaken for the male of *P. plebejus*. As in the latter, the last three somites of the abdomen are sharply carinated.

Measurements.—From the tip of the rostrum to the end of the telson the holotype measures 155 mm. in length; the carapace and rostrum together equal 58 mm., and the abdomen and telson 97 mm.; the free portion of the rostrum, 21 mm., and the telson alone 23 mm. The spine of the antennal scale is 23 mm. long and falls 2.5 mm. short of the extremity of the blade. The third legs are about 50 mm. long, and fail to reach the tip of the antennal scale by about 10 mm.

Tribe CARIDES.

Family CAMPYLONOTIDÆ.

Though the genus upon which this family is based was first described by Bate,⁵⁴ it was never well understood or properly appreciated until studied by Sollaud,⁵⁵ who instituted the present family in 1910. He has given a useful key to the families of the subtribe Hoplophorida, erected by Borradaile⁵⁶ in 1907—of which the Campylonotidæ must now be recognized as one—as well as a key to the known species of the typical and only genus included in the family. These keys have been introduced below; the new Campylonotid taken by the "Endeavour" has been added to the key of species.

Key to the Families of the Hoplophorida.

- I. Marine Hoplophorida; fingers of chelæ neither spoon-like nor ending in tufts of bristles.
 - A. Exopodite of the first maxilliped foliaceous, not provided with a lash, or distal flagelliform portion. Exopodites on all the legs.

Hoplophorida.
 - B. Exopodite of the first maxilliped composed of a basal foliaceous portion and distally provided with a lash, or "flagelliform portion."
 - a. Exopodites on the first four pairs of legs.

Nematocarcinida.
 - b. Legs without exopodites.

Campylonotida.
- II. Fresh-water Hoplophorida; fingers of chelæ spoon-like and ending in tufts of bristles.

Atyida.

Key to the Species of Campylonotus.

- I. Anterior margin of antennal scale broad and rounded; rostrum distally bent upward and exceeding the antennal scale, teeth $4\frac{2}{3}$.
 - A. Abdomen armed with tubercles or spines on mid-dorsal line.

rathbunæ, new species.
 - B. Abdomen dorsally unarmed.

semistriatus, Bate (*Anchistiella hani*,
M. Edwards, 1891).⁵⁷
- II. Antennal scale narrowing gradually toward anterior end and terminating in a point; abdomen dorsally unarmed.

⁵⁴ "Challenger" Rept. Zool., xxiv, Macrura, 1888, p. 767.

⁵⁵ Bull. Mus. Hist. Nat., xvi, 1910, pp. 185-190, text-figs. 1-2, *Ibid.*, xix., 1913, pp. 377-383, text-figs. 1-3.

⁵⁶ Ann. Mag. Nat. Hist. (7), xix., 1907, p. 471.

⁵⁷ Cf. Crust. Mission Sci. Cap Horn (1882-1883), i., 1891, pp. F. 37-F. 43, pls. iii., iv.

- A. Rostrum strongly up-curved distally.
- a. Rostrum exceeding the antennal scale; teeth
4 + 2 (small ones near tip)
- 8-9
- vagens* Bate (*A. hyadesi*, M. Edw., 1891).⁵⁷
- b. Rostrum falling short of the distal extremity of the antennal scale; teeth $\frac{5}{4}$.
- capensis*, Bate.
- B. Rostrum straight, much shorter than the antennal scale; teeth $\frac{3}{4}$.
- seneull.* M. Edw.⁵⁷

GENUS *CAMPYLONOTUS*, Bate.

CAMPYLONOTUS RATHBUNÆ,⁵⁸ *new species*.

(Plate lxxvii., figs. 1-5.)

Occurrence.—South of Eucla, Great Australian Bight, long. 129° 28' E., 250-450 fathoms, type locality; four males and four ovigerous females (Reg. Nos. E.3681, E. 6631, E.6632, E.6633, E.6634 and E.6635); E.3681 is the female holotype.

S.W. of Eucla, Great Australian Bight, long. 126° 45-25' E., 190-320 fathoms; one male (Reg. No. E.3692).

S.E. of Eucla, Great Australian Bight, long. 130° 50' E., 250-300 fathoms; two ovigerous females (Reg. No. E.3687).

East of Flinders Island, Great Australian Bight, 200-300 fathoms; two males (Reg. No. E.4808).

Description.—With respect to the shape and tothing of the rostrum, the configuration of the carapace and the form of the antennal scale, the species stands near Bate's *C. semistriatus*.⁵⁹ From the latter, however, it is strikingly distinguished by the prominent, dorsally flattened tubercle on the middle of the third abdominal somite, and the prominent compressed spines projecting backward from the posterior median border of the third, fourth and fifth somites.

The carapace is about as long as the first two, and half the third somite of the abdomen taken together. Dorsally it is carinated to within a short distance of the

⁵⁷ Cf. Crust. Mission Sci. Cap Horn (1882-1883), i., 1891, pp. F.37-F.43, pls. iii., iv.

⁵⁸ Named for Dr. Mary J. Rathbun, Associate in Zoology, United States National Museum.

⁵⁹ Bate, "Challenger" Rept., Zool., xxiv., Macrura, 1888, p. 768, pl. cxxvii., figs. 1, 2.

posterior margin. The carina ends in an evident, though not very conspicuous tubercle, corresponding to the one similarly placed in *C. semistriatus*, shown in Bate's figure of that species. Anteriorly this carina is continued forward, as the prominent, strongly laterally compressed, up-curved rostrum. As in *C. semistriatus*, the carapace laterally has two strong, but short carinæ. Of these the upper one, terminating anteriorly in the long prominent antennal spine, becomes posteriorly obsolescent and fades out at about the level of the second of the posterior rostral teeth; while the lower one, though prominent for a somewhat greater distance posteriorly, fades out more abruptly than the upper, so that in effect it extends backward for no greater distance. Anteriorly the lower carina terminates in a strong branchiostegal (Bate's second antennal) spine. This spine, arising a short distance behind the anterior border of the carapace extends a little outward and forward beyond it; there is a short, shallow groove extending back from the orbit, and a conspicuous indentation of the hepatic region between the two lateral carinæ.

The rostrum above is uniformly armed with four teeth, below with three, except in one young male from off Flinders Island, Great Australian Bight, with what certainly is an abnormally toothed rostrum. In this specimen the anterior dorsal tooth is twinned and the second obsolescent, being represented by only an obscure lobe. Typically the first two rostral teeth, of which the second is the larger, are situated at about the middle of the carapace, the second before, and the first just behind the mid-point. The last two teeth are smaller and rather widely spaced. The third tooth is placed over the eye, and the fourth at about half the distance between the third tooth and the acuminate tip of the rostrum.

The eyes are as described by Bate for *C. semistriatus*. The antennal scale has the blade broad and rounded anteriorly; the spine is much flattened and at the middle of its length is wider than the adjacent portion of the blade.

The third maxillipeds are of the same general shape and structure as those of *C. semistriatus*, though relatively stouter and shorter, scarcely reaching past the middle of the antennal scale. In *C. semistriatus* they reach forward more than two-thirds the length of the scale.

The first pair of legs exceed the third maxillipeds by two-thirds the length of their fingers and attain the proximal third of the palm of the second legs. In turn, these exceed the tips of the antennal scales by about three-fifths the length of their hands. The third, fourth and fifth pairs of legs all reach forward about equally far, to about or a little beyond the tip of the antennal scale. Between the bases of the second pair of legs there is a pair of long, slender, anteriorly directed, curved spines; a similar, much smaller pair occurs between the bases of the first pair of legs; between the third legs is a pair of thickened, blunt, forwardly inclined plates, corresponding in position to the spines between the two preceding pairs of legs.

The striking abdominal armature of this species is unusual for the genus as known heretofore. Medially on the third somite there is a thickened raised ridge which arises near the anterior margin and running backward attains its maximum elevation just behind the anterior third of the somite. Here, in lateral view, it appears to end in a backwardly directed point; viewed dorsally this is seen to be a truncated, tongue-shaped, backward extension of the ridge. The posterior margin of this somite is produced to form a sharp median spine. Similarly placed, but larger, bent, and more laterally compressed spines occur on the fourth and fifth somites. Each of these last-named spines is continuous with a median carina beginning near the anterior third of its respective somite. Anterior to the carina on the fourth somite is a faint impressed line and the carina itself is medially sulcate for slightly less than one-fifth its length. This sulcus begins at about half its own length behind the origin of the carina, and is not connected or continuous with the impressed line preceding it. The carina on the fifth somite is not sulcate, nor is there any impressed line on the somite in advance of it. The sixth somite is dorsally smooth and rounded. Its posterior margin is medially concave and is armed on either side with a spine which projects over the adjacent antero-lateral angle of the telson. Other than the spines just mentioned only the fifth somite is laterally armed. Each of its epimera tapers to an acute spine-like postero-lateral angle, above which there is a second spine situated a little below the articulation of the fifth with the sixth somite. The telson is longer than the sixth somite and

a little shorter than the inner branch of the uropods. On either side of its acute tip there is a much longer, movable, subterminal spine, and in juxtaposition to each of these another small external spinule, the most posterior of a series of six paired spines on the dorsum of the telson.

The male is of slighter build and comparatively smaller in size than the female. Otherwise, they are very much alike. The posterior median spines on the fourth and fifth abdominal somites seem to be comparatively longer than in the females; and between the fourth pair of legs there is a pair of plates, similar to, though smaller than, those between the bases of the third pair. These plates have no counterpart in the female.

The first pair of pleopods in the male differs from the corresponding more foliaceous appendages of the female. The outer branch in the male, though soft and flexible, is quite styliform; the inner branch is a flattened, slightly double curved, remotely "S"-shaped plate, medially more or less thickened, and terminating distally in a soft, blunt, flat-margined, recurved tip. Where the flattened inner margin of the "blade" of the inner branch of the pleopod would join the corresponding flattened margin of the tip, there is a small notch subtended proximally by a small tooth or tubercle.

Measurements.—The carapace of the female holotype is 27.5 mm. long, the rostrum 38.5 mm., the abdomen and telson 84 mm., and the telson alone 22 mm. The spine of the antennal scale on the right side is 19.5 mm., and on the left 21 mm. long; the anterior border of the blade in either case is but slightly in advance of the tip of the spine. The antennal peduncle, measured from the anterior border of the carapace in line with the branchiostegal spine, is 13 mm. long. The third maxillipeds are about 30 mm. long and reach by 5 mm. of the length of their terminal joint beyond the antennal peduncle. The first legs are between 35 and 36 mm. in length (the right palm 6.25 mm., fingers 8 mm., carpus 4 mm.), and exceed the third maxillipeds by two-thirds the length of the fingers. The right second leg is 55.5 mm. in length (palm 11.5 mm., fingers 9 mm., carpus 6 mm.), and it exceeds the corresponding third maxilliped by the length of the hand, and the blade of the antennal scale by the length of the fingers and the distal 3 mm. of the palm together.

The fifth legs exceed the antennal scale by about the length of the dactyl, the fourth by not quite half the length of the dactyl, while the third legs reach just about to the anterior border of the scale. Of the right fifth leg, which is about 58 mm. long, the dactyl measures 2.5 mm., the propodus 14 mm., and the carpus nearly 13 mm.

The several females are about the same size as the holotype, varying not more than a millimetre in the length of the rostrum, carapace and abdomen, or telson. The rostrum of the male specimens varies from 23 to 34.5 mm. in length, the carapace from 17 to 24 mm., and the abdomen and telson together from 52 to 71 mm. in length.

Remarks.—Certain differences in the tuberculation of the third abdominal somite between *Campylonotus* and *Gonatonotus* remarked by Bate⁶⁰ are rendered of no significance by the present species, and therefore his diagnosis of the former genus needs to be amended. Aside from a slight superficial resemblance, the two genera are fundamentally quite distinct, belonging to different families. The exopodite of the foliaceous first maxilliped in the *Campylonotus* is provided with a lash or flagellum, and the thoracic legs are without exopodites; while in the Hoplophoridae, to which the genus *Gonatonotus* belongs, just the reverse is true.

Incidentally the carina on the third abdominal somite of *Gonatonotus* (i.e., *crassus* M. Edw.⁶¹) ends in a spine, while the posterior margin of the same somite is provided with a pair of submedian spines instead of a single median one. The fourth somite has a median spine with a submedian one on either side, while the fifth again has only a submedian pair of spines. Laterally each of the epimera of the first to the fifth somites is armed with a spine.

Family PANDALIDÆ.

GENUS PLESIONIKA, Bate.

PLESIONIKA MARTIA (M. Edw.)

Pandalus martius, Milne-Edwards, Recueil de Figures de Crustacés nouveaux ou peu connus, 1883, pl. 21. *Id.*, McCulloch, Rec. Austral. Mus., vi., 1907, pt. 5, p. 355.

⁶⁰ "Challenger" Rept., Zool., xxiv., Macrura, 1888, p. 768.

⁶¹ Ann. Sci. Nat. (6), Zool., xl., 1881, Art. 4, p. 10.

Pandalus (Plesionika) martius, Alcock, Desc. Cat. Indian Deep-Sea Crustacea, 1901, p. 95. *Id.*, Lloyd, Rec. Indian Mus., i., 1907, p. 4.

Plesionika martia, Kemp, Fisheries, Ireland. Sci. Invest., 1908 (1910), 1, p. 93, pl. xii., figs. 1-4. *Id.*, Balss, Abh. der K. Bayer. Akad. Wiss., II., Math.-phys. Klasse, Suppl., 10 Abh., 1914, p. 30. *Id.*, De Man, "Siboga" Exped., xxxix,³ Decapoda, pt. iv., 1920, p. 116, and synonymy.

Occurrence.—Off Gabo Island, Victoria, 280 fathoms; one small female (Reg. No. E.4802).

40 miles S.S.E. of Genoa Peak, Victoria, 200 fathoms; one small male and one small ovigerous female (E.6146).

40 miles S.S.E. of Genoa Peak, 222 fathoms; two males and two females (E.6147).

S. of Eucla, Great Australian Bight, long. 129° 28' E., 250-450 fathoms; ten females (E.3680).

S. of Eucla, Great Australian Bight, long. 129° 28' E., 250-450 fathoms; three females (E.3677).

Distribution.—This rather widely distributed species has already been recorded off Australia, Sydney, 800 fathoms, by McCulloch. Otherwise, it has been "dredged in plenty" in the Andaman Sea, 194-405 fathoms, in the Bay of Bengal, off Ceylon, 224-284 fathoms, and in the Arabian Sea, 142-430 fathoms (Alcock) (Lloyd), and having been first described from the East Atlantic, 400-1,200 fathoms (Milne Edwards), is well known from off the coasts of Ireland, 250-627 fathoms (Kemp), the Bay of Biscay, 400-500 metres (Caullery), off the Spanish Coast (Wolfenden), and in the Mediterranean, 533-875 m. (Adensamer, Riggio, Senna).

It also was taken in considerable numbers by the "Albatross" about the Hawaiian Islands in from 165 to 684 fathoms (Rathbun).

Measurements.—The "Endeavour" specimens of *Plesionika martia*, in length of body from the posterior margin of the orbit to the tip of the telson of the extended abdomen, range up to 90, 95 and 105 mm., though the specimens with complete rostra do not exceed 66 mm. in length exclusive of the rostrum; of these latter the smallest is 47 mm. long.

Remarks.—To the varietal form of this species, *semilavis*, de Man assigns the "Challenger" material from between the Philippines and Borneo, 250 fathoms, off Sydney Harbour, Australia, 1,200 fathoms, off the Kermadec Islands, 520 fathoms, and off Matuka, Fiji Islands, 315 fathoms (Bate), as well as McCulloch's Sydney specimens (mentioned under *Distribution* above). De Man also cites this variety as occurring at Lion's Head, South Africa (Stebbing), probably also in Sagami Bay, 800 metres (Balss); and at the Hawaiian Islands (Rathbun; also mentioned under *Distribution* above).

An examination of the "Albatross" Hawaiian material reported on by Dr. Mary J. Rathbun shows it definitely to be the species proper. Measurements of thirteen specimens with complete rostra give a variation of rostral length to length of body (from orbit to end of telson) of from fifty to sixty-six per cent.

De Man's designation of McCulloch's Sydney specimens as the varietal form may likewise be in error, for McCulloch speaks of his specimens as "agreeing well with Alcock's detailed description." Regarding the species observed by Alcock, de Man remarked that whether it belongs to the variety appears doubtful, because according to the measurements mentioned by this author, the rostrum should be as long as in the typical species.

Furthermore, even though some of Bate's material came from the same general locality as McCulloch's, off Sydney, measurements of the only three of the twenty specimens taken by the "Endeavour" that had complete rostra—a fourth had the rostrum entire except for the extreme tip—showed that these further specimens from Australian waters—off Gabo Island and elsewhere in the Great Australian Bight—are like the typical species.

The rostra of these several specimens represented more than fifty per cent. of the length of the body measured from the back of the orbit to the end of the telson. In the variety *semilavis*, according to de Man, the rostrum is from thirty-four to forty-seven per cent. the length of the body.

It is not at all unlikely that Bate himself had both forms represented in the material he worked over. For, although a comparison with Milne Edwards' figure showed the rostrum of the latter to be relatively longer,

Bate⁶² noticed and remarked that the specimens taken near the Kermadec Islands "are generally more slender, the legs rather longer and the rostrum longer and more rigidly straight . . ." than the specimens he considered typical of *semilaris*. No doubt, at least, his Kermadec Island specimens are very close to, if not identical with typical *Plesionika martia*.

GENUS HETEROCARPUS, *Milne Edwards*.

HETEROCARPUS SIBOGÆ, *de Man*.

Heterocarpus sibogæ, de Man, Zool. Medd. Mus. Nat. Hist. Leiden, iii., 1917, afl. 4, p. 283. *Id.*, "Siboga" Exped., xxxix^a, Decapoda, pt. iv., 1920, p. 169, pl. xiv., figs. 42-42i.

Heterocarpus ensifer, Alcock, Desc. Cat. Indian Deep-Sea Crustacea, 1901, p. 107.

Occurrence.—30 miles S.W. of Gabo Island, Victoria, 240 fathoms; one female (Reg. No. E.6142).

Distribution.—Otherwise known from the Andaman Sea, 188-220 fathoms (Alcock); and the Dutch East Indies; north of the Island of Baljan, 397 metres, the Kei Islands, 397-560 metres, west of Saleyer, 462 metres, the southern entrance of the Straits of Makassar, 450 metres (de Man).

Measurements.—The carapace is 23 mm. long—the rostrum is wanting—the abdomen and telson together are 48 mm., and the telson alone is 14 mm. in length. The spine of the antennal scale slightly exceeds the blade and measures 15 mm. in length.

Remarks.—The distinguishing characters of this species are such as to permit ready determination by means of the "Key to the Indo-Pacific Species of the Genus *Heterocarpus*," prepared and published by de Man in his "Siboga" report.

In the same key de Man diagnoses *H. signatus* Rathbun⁶³ with an added footnote to the effect that "the length of the dactyli of the three posterior legs is not

⁶² "Challenger" Rept., Zool., xxiv., Macrura, 1888, p. 645.

⁶³ Bull. U.S. Fish Comm., 1903, xxiii., 1906, pt. iii., p. 918, pl. xxi., fig. 6.

mentioned in the description and cannot be ascertained from the photograph." I, therefore, avail myself of the present opportunity to supply that information. The dactyls in the third and fourth legs are about one-fifth the length of their respective propodi, a little more in the case of the third legs and a little less in the fourth legs. The length of the dactyls of the fifth pair of legs is contained from five and one-third to five and three-fourths times in their propodi. These proportions are based on the specimen photographed and figured in Miss Rathbun's report. In another larger specimen of the type lot, the third and fourth pairs of legs are wanting, and the dactyls of the fifth pair are contained five and three-fourths times in their propodi.

Heterocarpus longirostris MacGilchrist,⁶⁴ the species alternative with *H. signatus* in de Man's key cited above, as figured,⁶⁵ appears to have the dactyls about one-fourth the length of the propodus in the case of the third and fourth legs to about one-sixth the length of the propodus in the case of the fifth legs.

⁶⁴ Ann. Mag. Nat. Hist. (7), xv., 1905, p. 237.

⁶⁵ Illus. Zool. "Investigator," 1905, pl. lxxi., fig. 2, 2a.

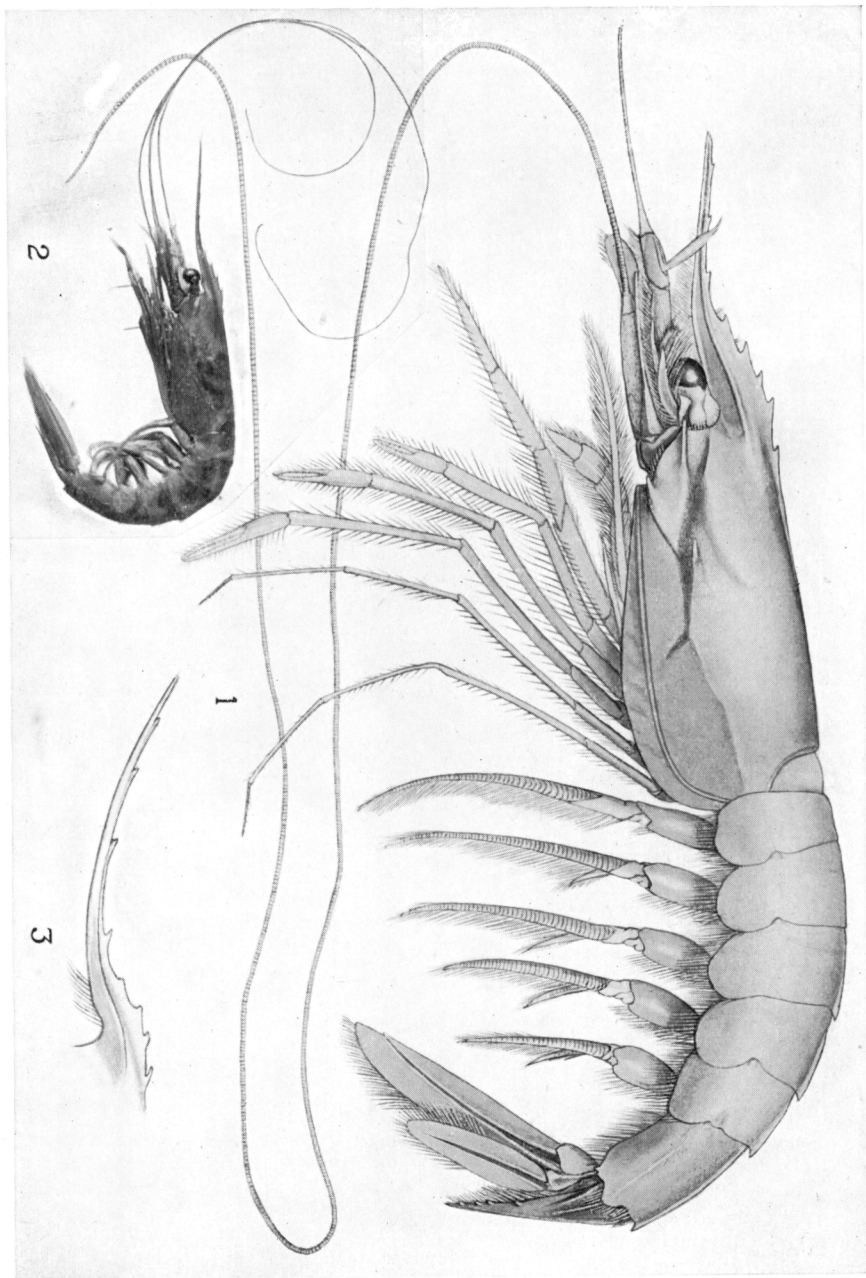


EXPLANATION OF PLATE LVII.

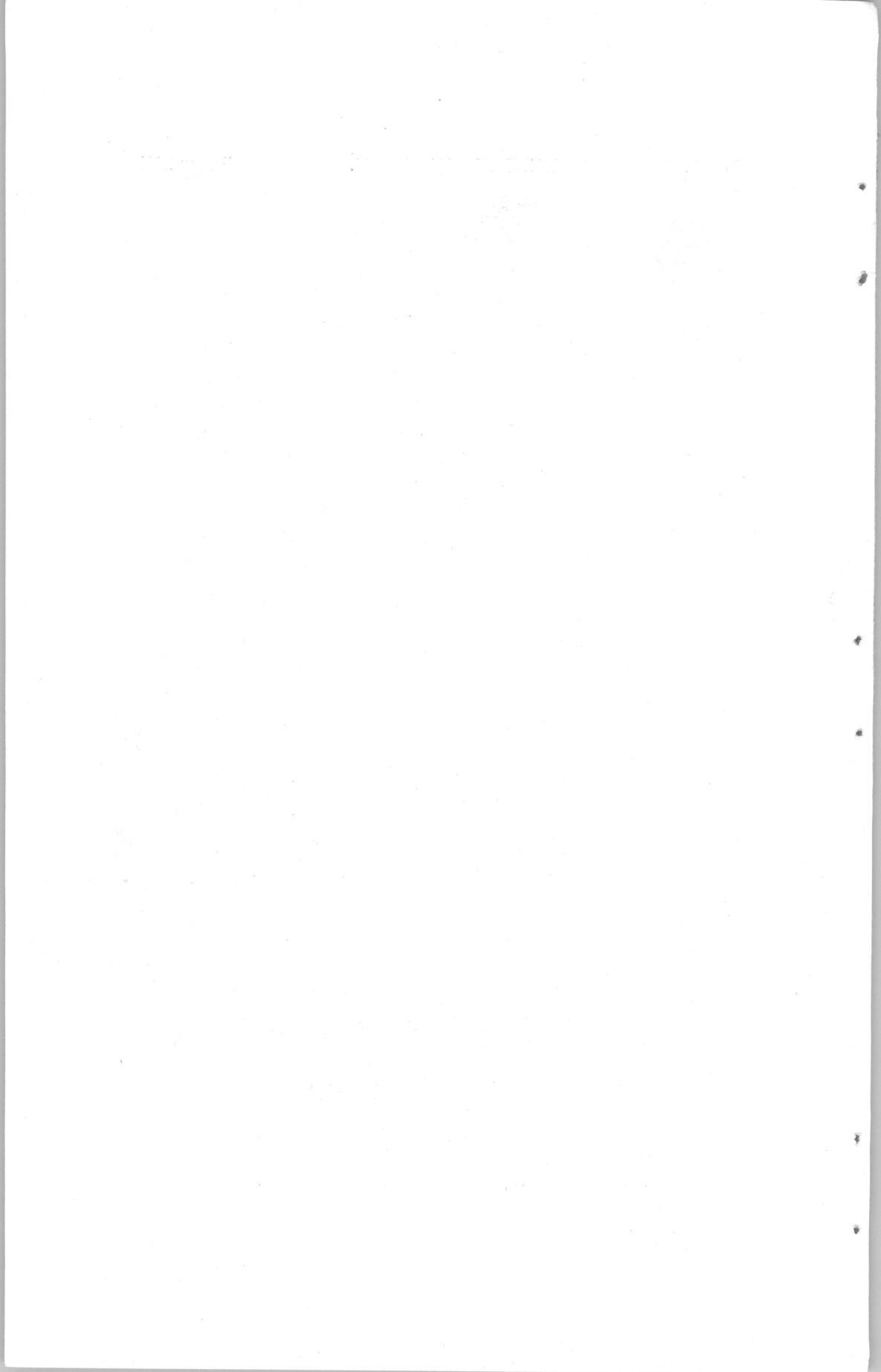
Aristæomorpha foliacea (Risso).

- Fig. 1. Lateral view of a female in the collection of the Australian Museum (Reg. No. P.4695),¹ measuring 70 mm. from the tip of the rostrum to the end of the carapace.
- Fig. 2. Lateral view of Smith's *Aristeus? foliaceus*, a young male in the collection of the United States National Museum, Washington (Cat. No. 7264, U.S.N.M.). Carapace and rostrum 56 mm. long.
- Fig. 3. Rostrum of a female specimen (Reg. No. E.6621) measuring 73 mm. from the tip of the rostrum to the end of the carapace.

¹Specimen not examined by Dr. Waldo Schmitt; see footnote in text.—F. A. MCNEILL.



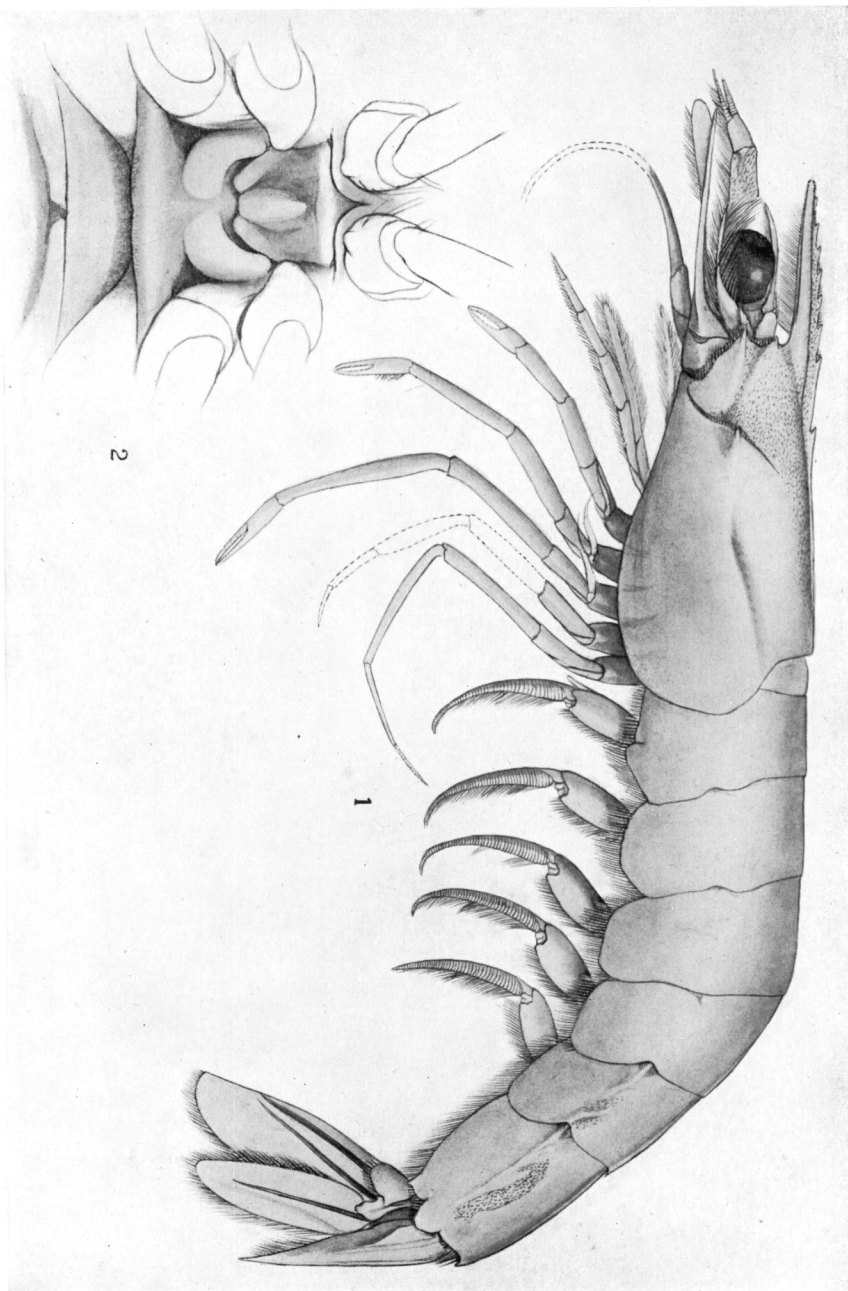
MISS E. A. KING, del. (1, 3).
C. R. SHOEMAKER, photo. (2).



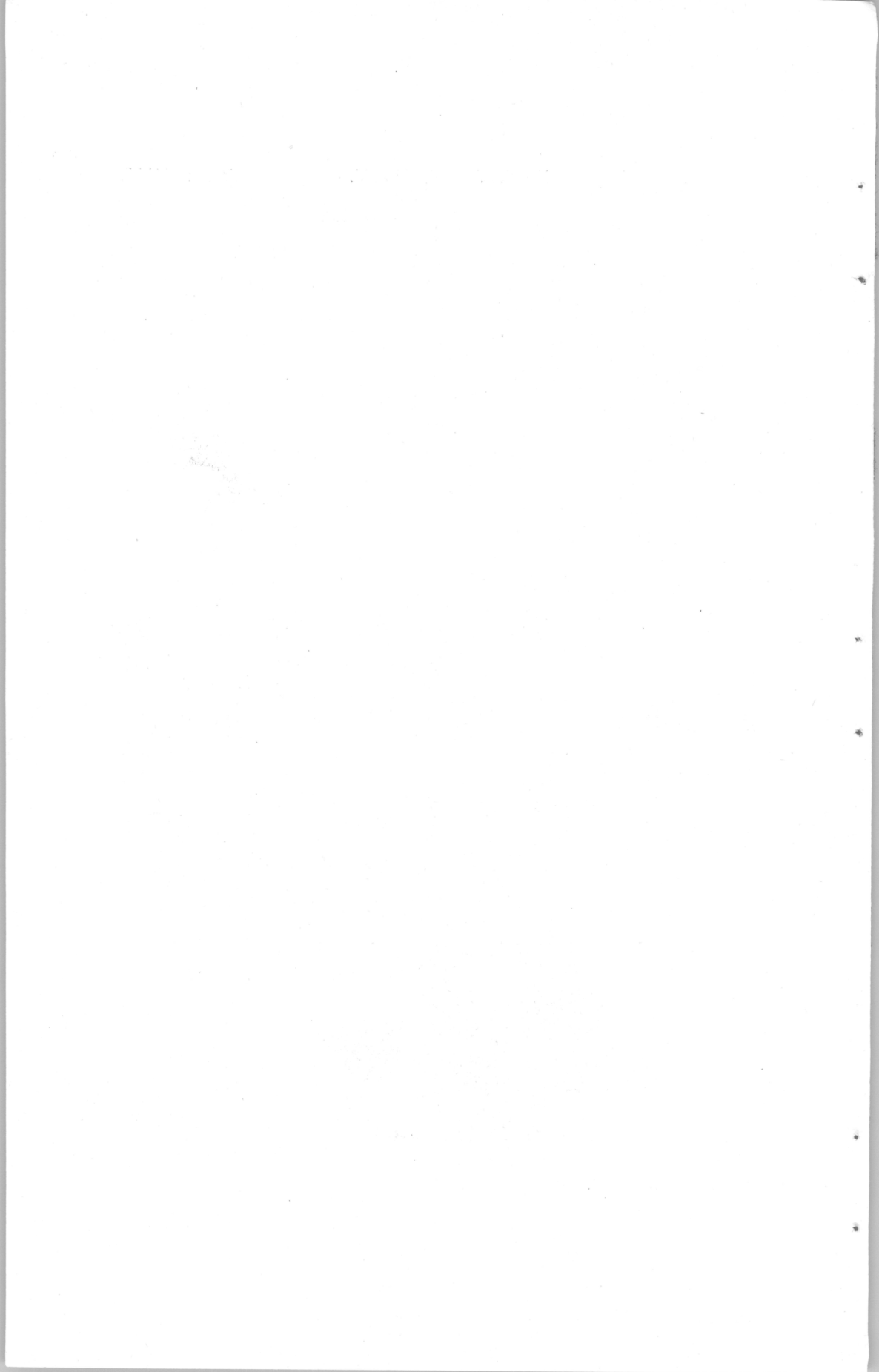
EXPLANATION OF PLATE LVIII.

Penæopsis monoceros (Fabricius).

- Fig. 1. Lateral view of an immature male cotype of Haswell's "*Penæus mastersii*" in the collection of the Macleay Museum, University of Sydney. Carapace and rostrum 26 mm. long (rostrum slightly damaged at tip).
- Fig. 2. Thelycum of a young female in the collection of the Australian Museum (Reg. No. P.4287 *part*), measuring 17 mm. from the tip of the rostrum to the end of the carapace.



Miss E. A. KING, del.



1e
EXPLANATION OF PLATE LIX.

Panæopsis endeavouri sp. nov.

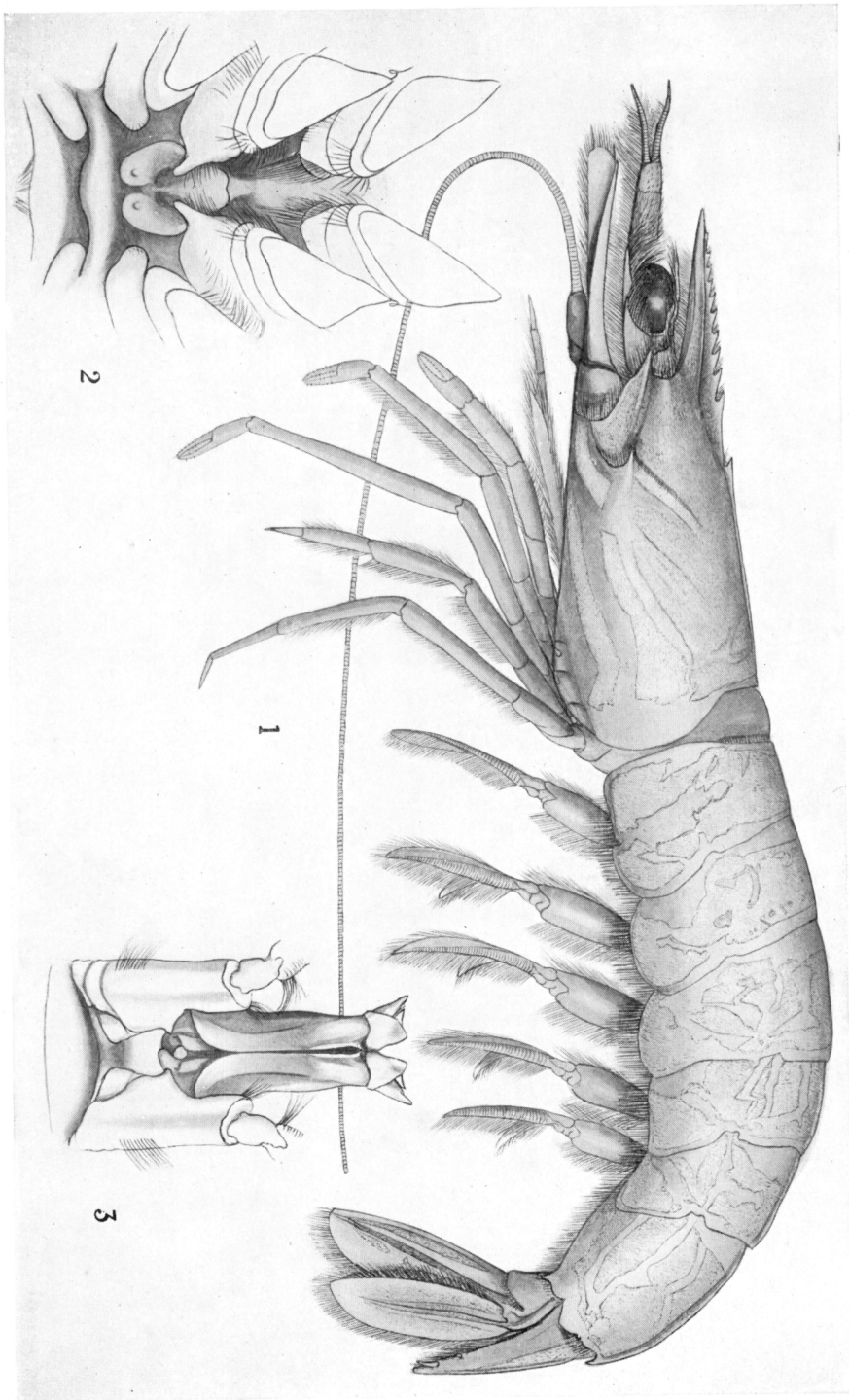
Fig. 1. Lateral view of the female holotype. Carapace and rostrum 56 mm. long.

(NOTE.—Antennular flagellum drawn from another specimen.)

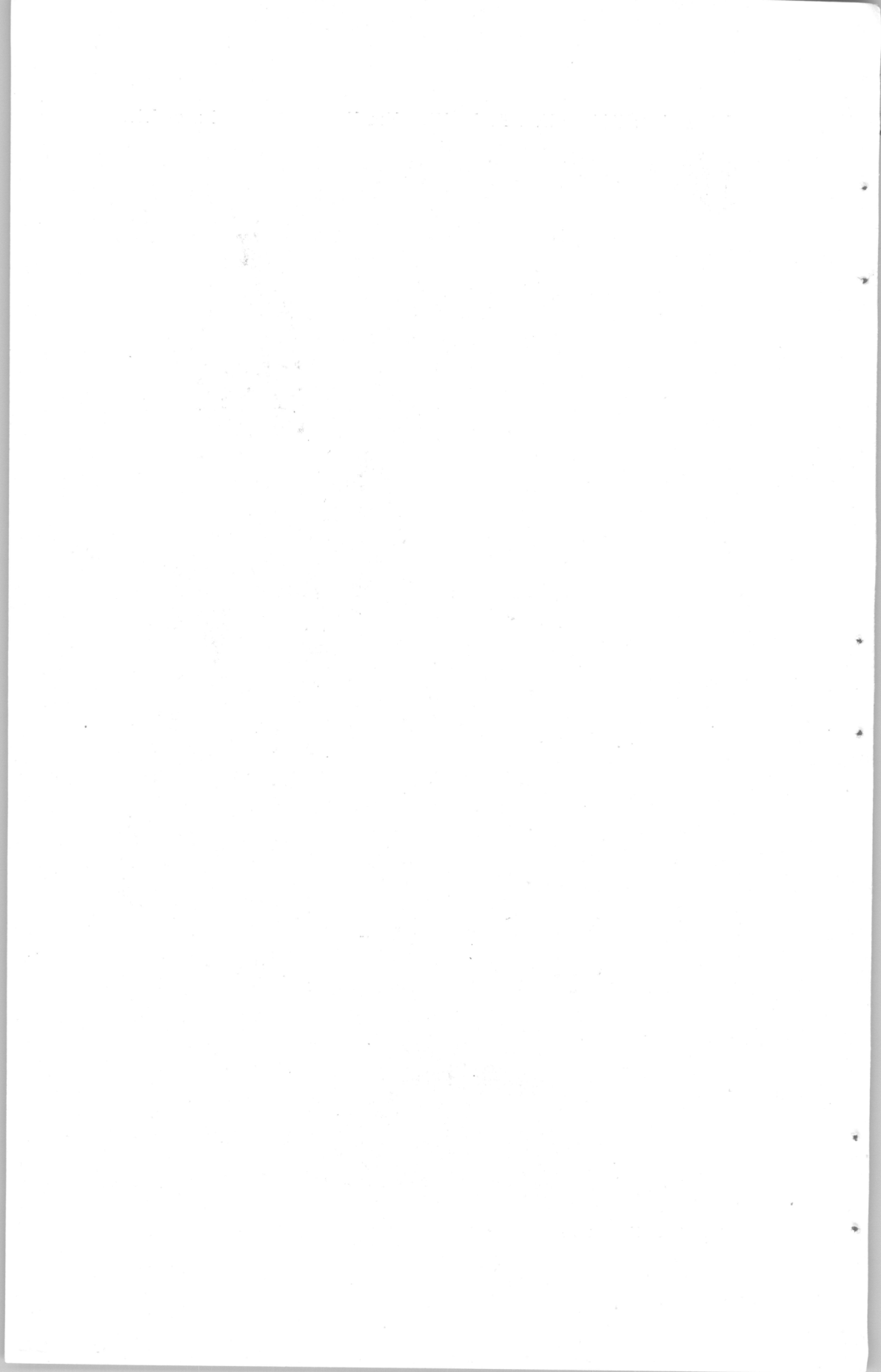
Fig. 2. Thelycum of female holotype.

Fig. 3. Petasma of a male specimen (Reg. No. E.6687), measuring 48.5 mm. from the tip of the rostrum to the end of the carapace.

(NOTE.—Prepared from the same male specimen as illustrated on Plate lxvi.)



Miss E. A. KING, del.



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PLANTS OF THE STATE OF TEXAS

1. *Asplenium platyneuron* (L.) Oakes
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4. *Asplenium platyneuron* (L.) Oakes
5. *Asplenium platyneuron* (L.) Oakes
6. *Asplenium platyneuron* (L.) Oakes
7. *Asplenium platyneuron* (L.) Oakes
8. *Asplenium platyneuron* (L.) Oakes
9. *Asplenium platyneuron* (L.) Oakes
10. *Asplenium platyneuron* (L.) Oakes

PLANTS OF THE STATE OF TEXAS

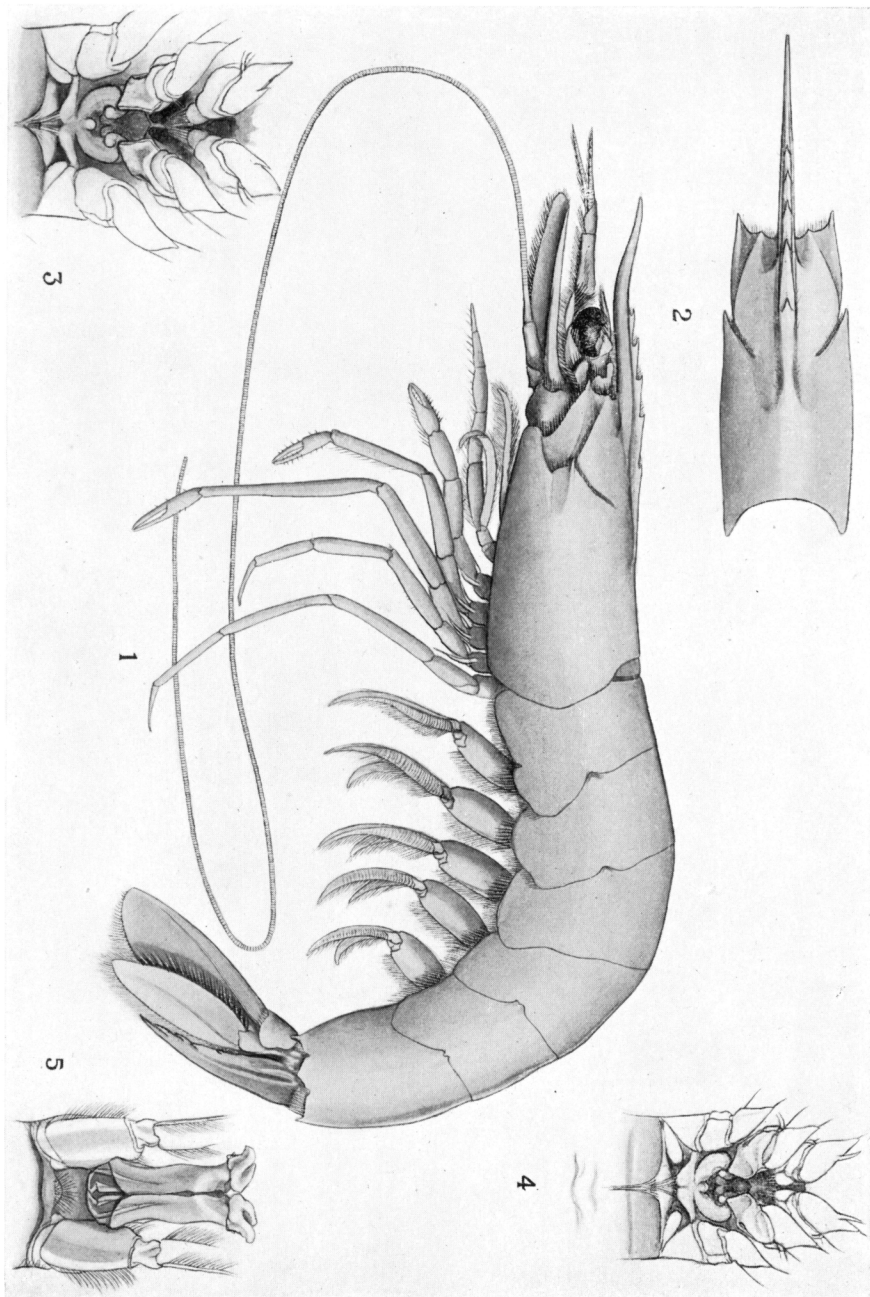
EXPLANATION OF PLATE LX.

Penæopsis macleayi (Haswell).

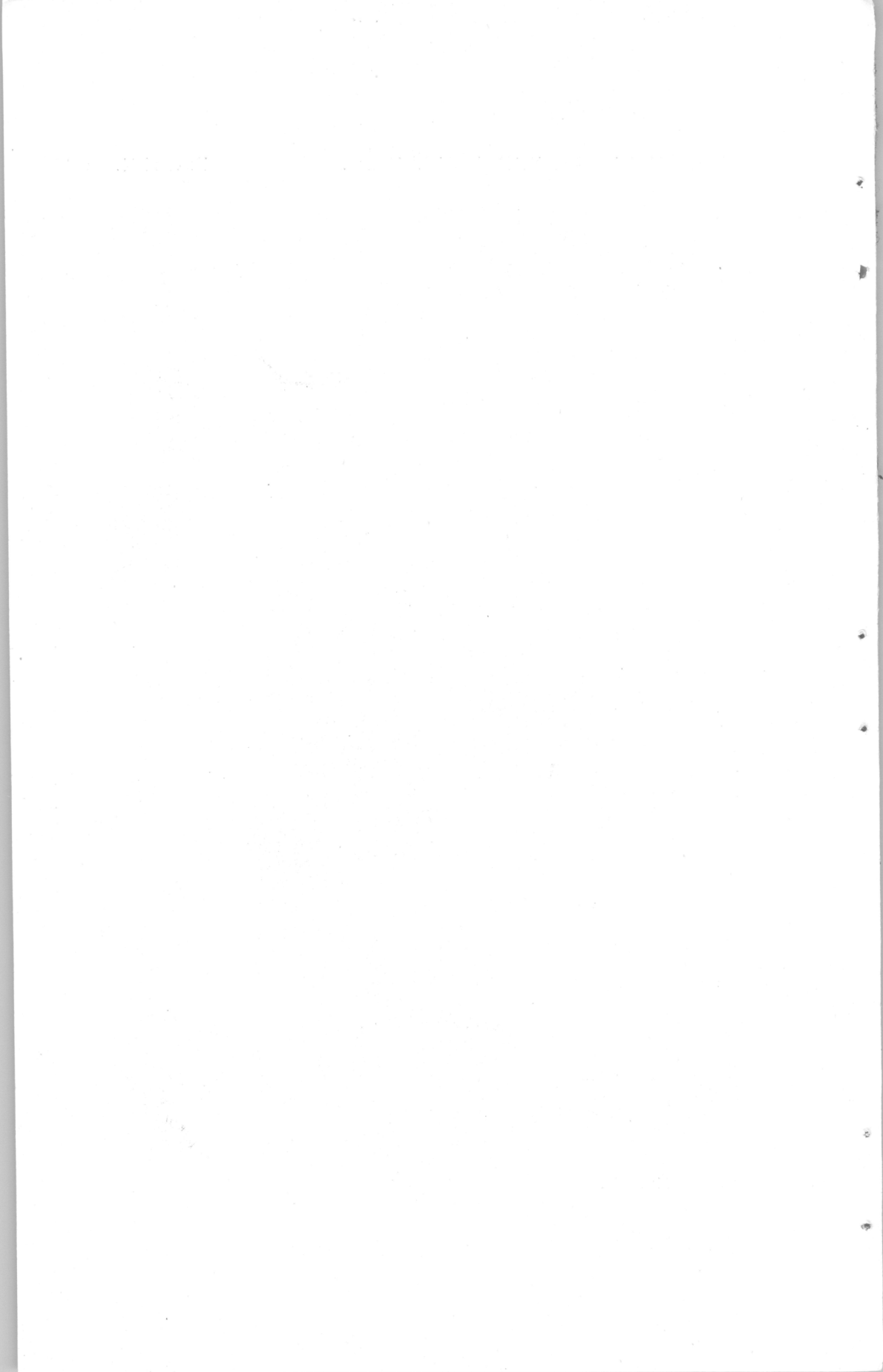
- Fig. 1. Lateral view of a female cotype¹ in the collection of the Macleay Museum, University of Sydney, from Port Jackson, New South Wales. Carapace and rostrum 39.5 mm. long.
- Fig. 2. Dorsal view of carapace and rostrum of same specimen.
- Fig. 3. Thelycum of same specimen.
- Fig. 4. Thelycum of a female specimen in the collection of the Australian Museum (Reg. No. P.1438). Carapace and rostrum 46.5 mm. long.
- Fig. 5. Petasma of an adult male specimen² in the collection of the Australian Museum (Reg. No. P.3639), from near Sydney, New South Wales. Carapace and rostrum 43 mm. long.

¹This cotype is not the one examined by Dr. Waldo Schmitt, but another more perfect duplicate of about the same size.—F. A. McNEILL.

²Not examined by Dr. Waldo Schmitt.—F. A. McNEILL.



Miss E. A. KING, del.



DECLARATION OF INDEPENDENCE

When in the course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the laws of nature and of nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation.

We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. — That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed, — That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness.

EXPLANATION OF PLATE LXI.

Penaeopsis novae-guinæ (Haswell).

Fig. 1. Thelycum of an adult female in the collection of the Macleay Museum, University of Sydney, from Darnley Island, Torres Strait. Carapace and rostrum 29 mm. long.

Fig. 2a-b. Stridulating organs on the posterior margins of the carapaces of two small females in the collection of the Australian Museum (Reg. No. P.412 *part*). The carapace and rostrum of each specimen measures 17 mm.

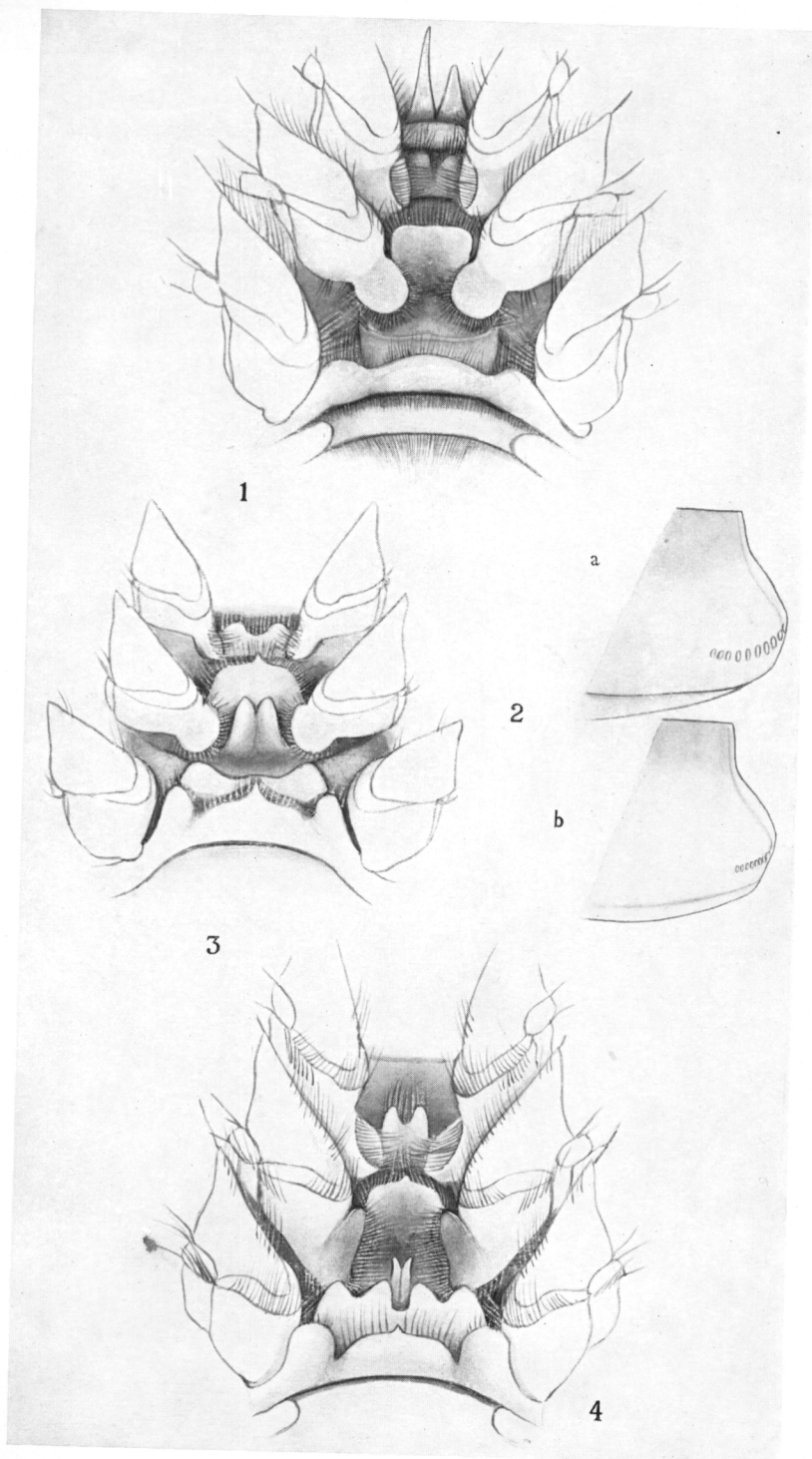
(NOTE.—These drawings were prepared from the two specimens illustrated on Plate lxvi.)

Penaeopsis mokiensis (Rathbun).

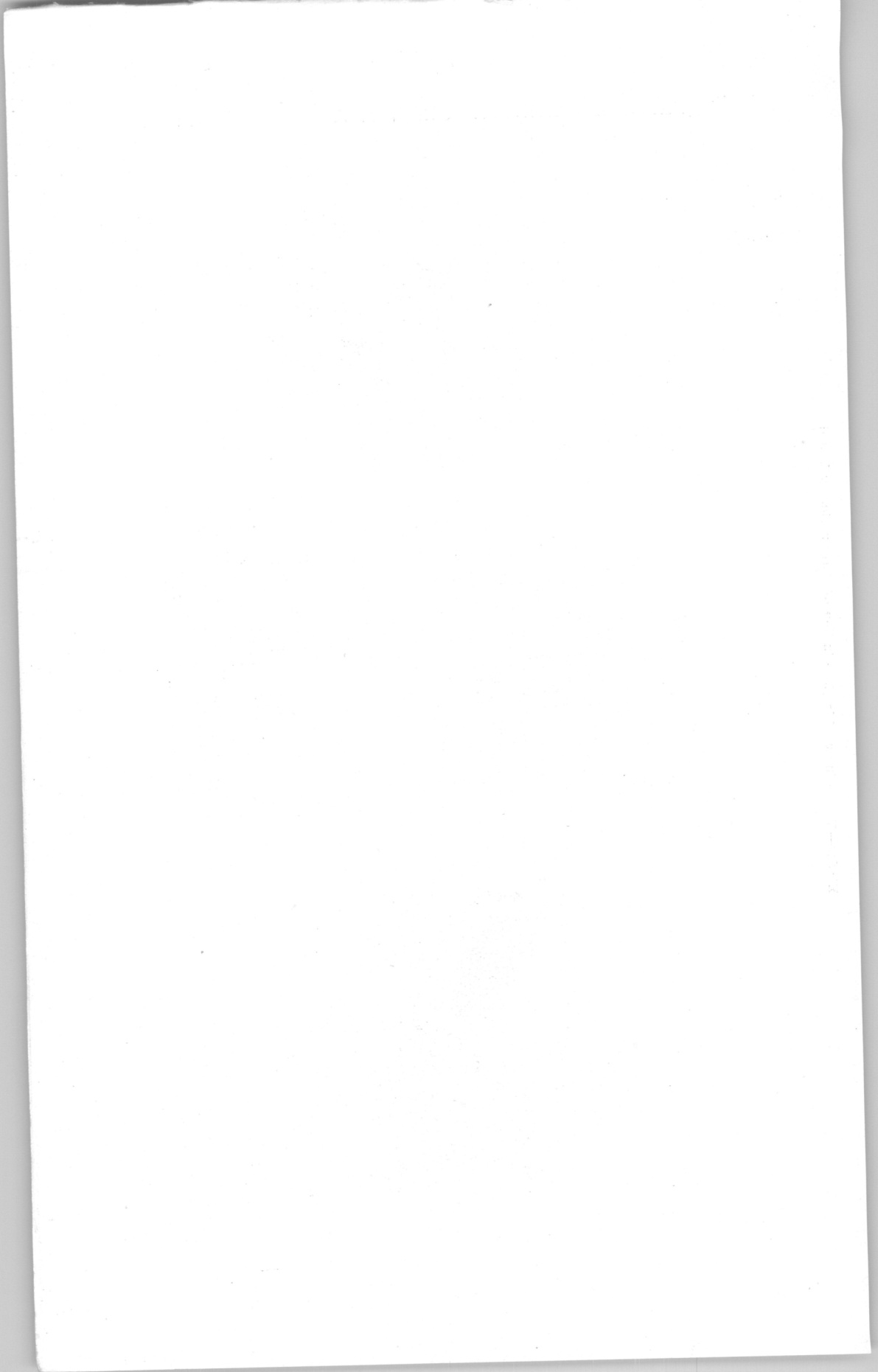
Fig. 3. Thelycum of a young female in the collection of the Macleay Museum, University of Sydney, from Darnley Island, Torres Strait. Carapace and rostrum 11.5 mm. long.

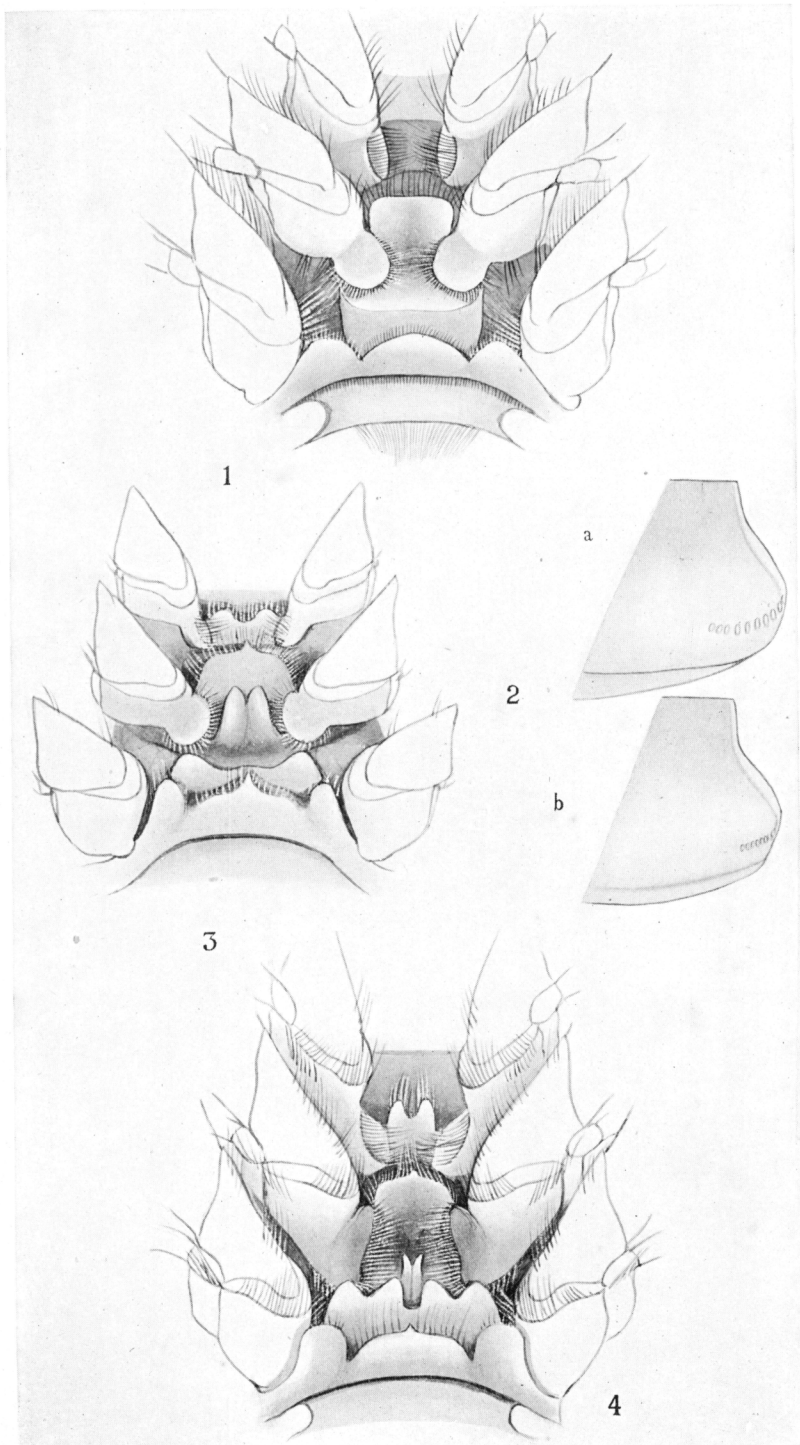
Fig. 4.—Thelycum of a female specimen in the collection of the United States National Museum, Washington (Cat. No. 49273, U.S.N.M.). Carapace and rostrum 28.5 mm. long.

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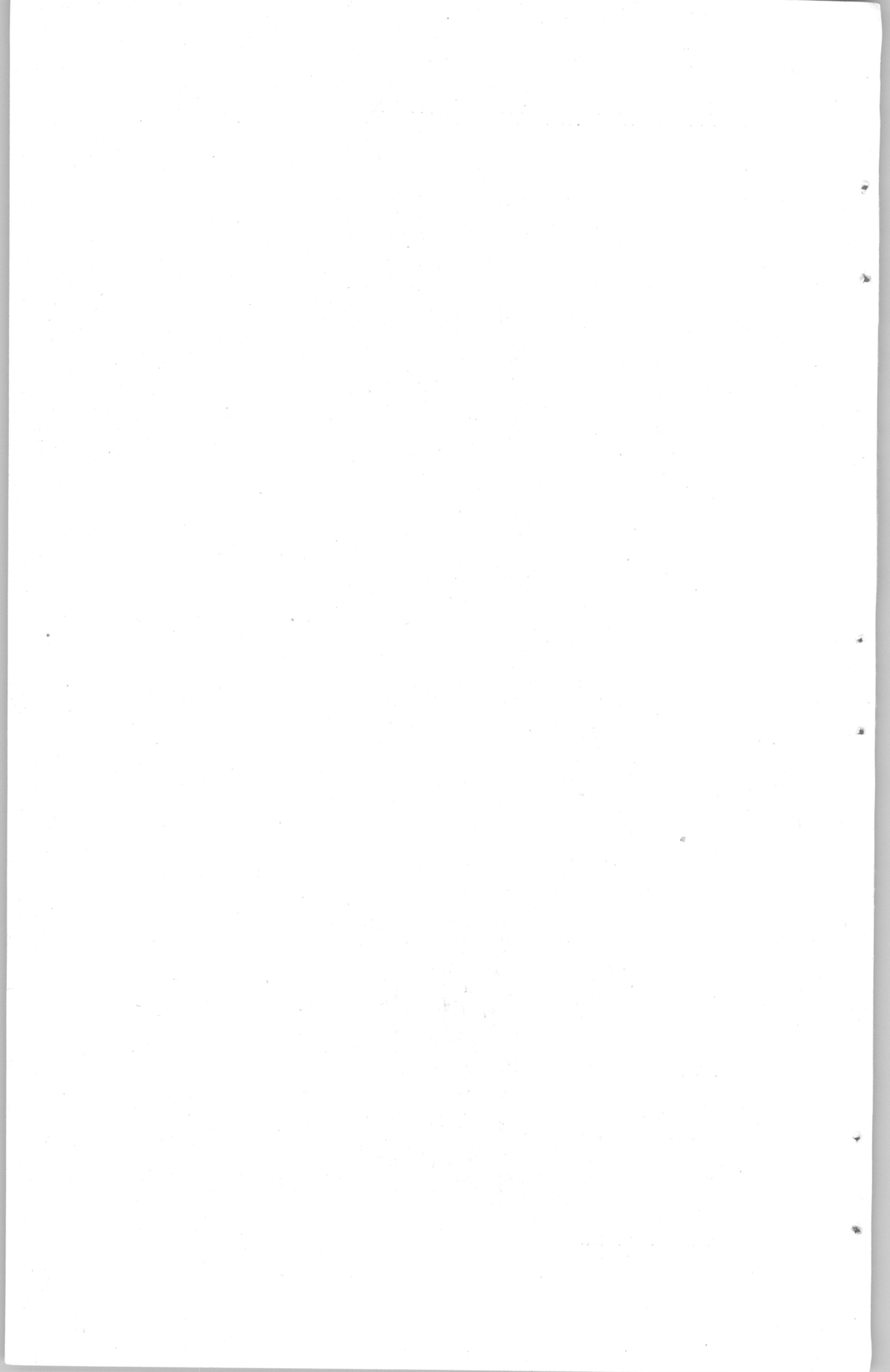


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EXPLANATION OF PLATE I

PLATE I. - THE BATTLE OF BULL RUN

The battle of Bull Run, fought on July 21, 1861, was a significant event in the American Civil War. It was the first major battle of the war, and it resulted in a Confederate victory. The battle was fought between the Union Army of the Potomac and the Confederate Army of Northern Virginia. The Union Army was led by General Irvin McDowell, and the Confederate Army was led by General Robert E. Lee. The battle was fought in a wooded area near Manassas, Virginia. The Union Army was defeated, and the Confederate Army advanced on Washington, D.C. The battle was a major morale boost for the Confederates, and it showed that the Union was not invincible. The battle also showed that the Confederates were capable of fighting a conventional battle. The battle of Bull Run was a turning point in the war, and it led to the Confederates' advance on Washington, D.C. The battle was a major victory for the Confederates, and it showed that the Union was not invincible. The battle also showed that the Confederates were capable of fighting a conventional battle. The battle of Bull Run was a turning point in the war, and it led to the Confederates' advance on Washington, D.C.

EXPLANATION OF PLATE LXII.

Trachypeneus anchoralis (Bate).

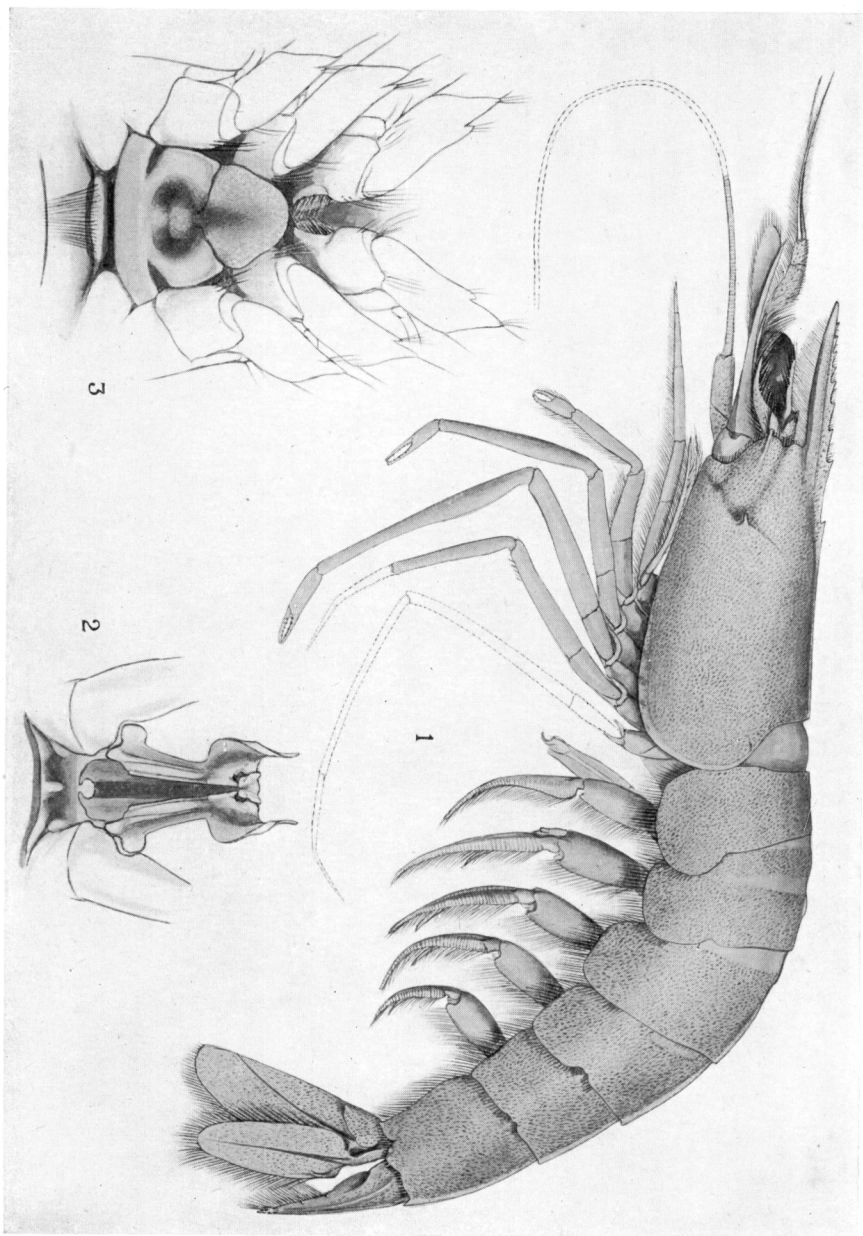
Fig. 1. Lateral view of a male specimen (Reg. No. P.3528 *part*), measuring 19.5 mm. from the tip of the rostrum to the end of the carapace.

(NOTE.—Tip of telson, fifth legs and portion of fourth legs missing, and drawn from a female specimen about the same size.)

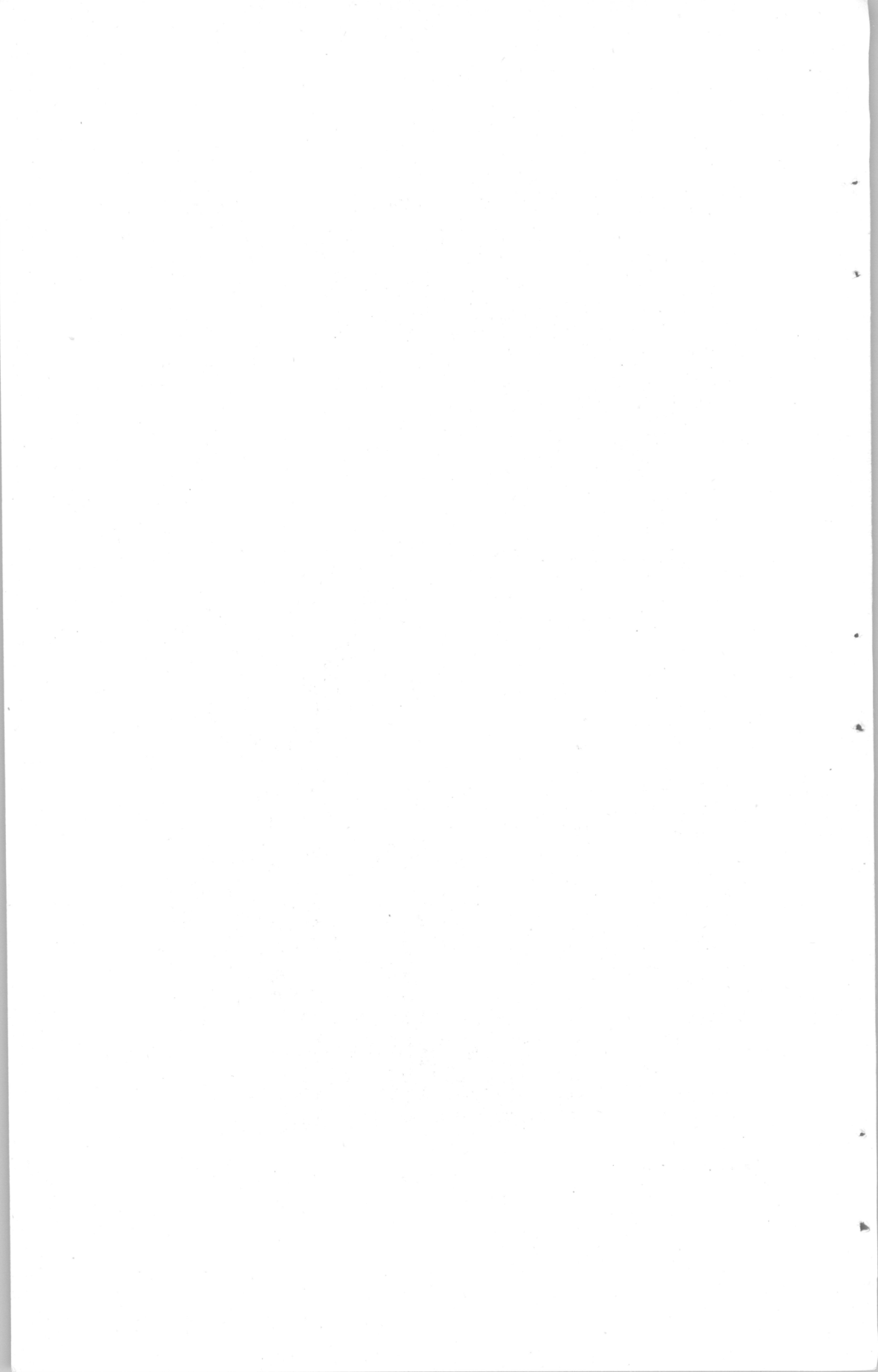
Fig. 2. Petasma of same specimen.

Fig. 3. Thelycum of a female specimen (Reg. No. P.3528 *part*), measuring 29.5 mm. from the tip of the rostrum to the end of the carapace.

(NOTE.—Prepared from the same female specimen as illustrated on Plate lxvi.)



Miss E. A. KING, del.



EXPERIMENTAL INVESTIGATION

OF THE EFFECTS OF

TEMPERATURE ON THE RATE OF
REACTION BETWEEN
SODIUM HYDROXIDE AND
SODIUM CARBONATE
IN AQUEOUS SOLUTION

BY

J. H. HARRIS

Department of Chemistry,
University of California,
Berkeley, California

EXPLANATION OF PLATE LXIII.

Trachypeneus granulosus (Haswell).

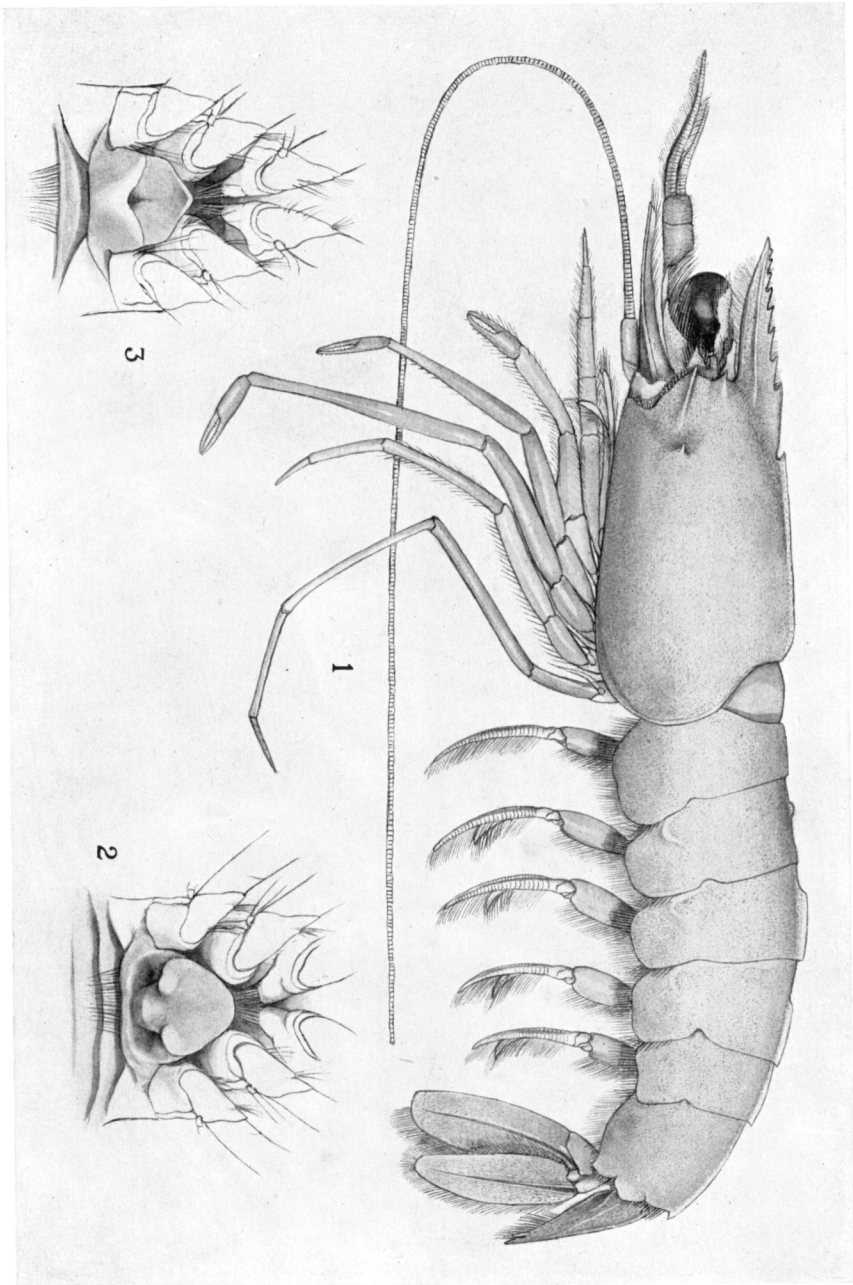
Fig. 1. Lateral view of a female specimen (Reg. No. P.3527), measuring 33.5 mm. from the tip of the rostrum to the end of the carapace.

(NOTE.—Pleuron of first abdominal somite drawn from the other side. Antennular flagellum and dactyls of fourth legs missing, and drawn from other specimens about the same size.)

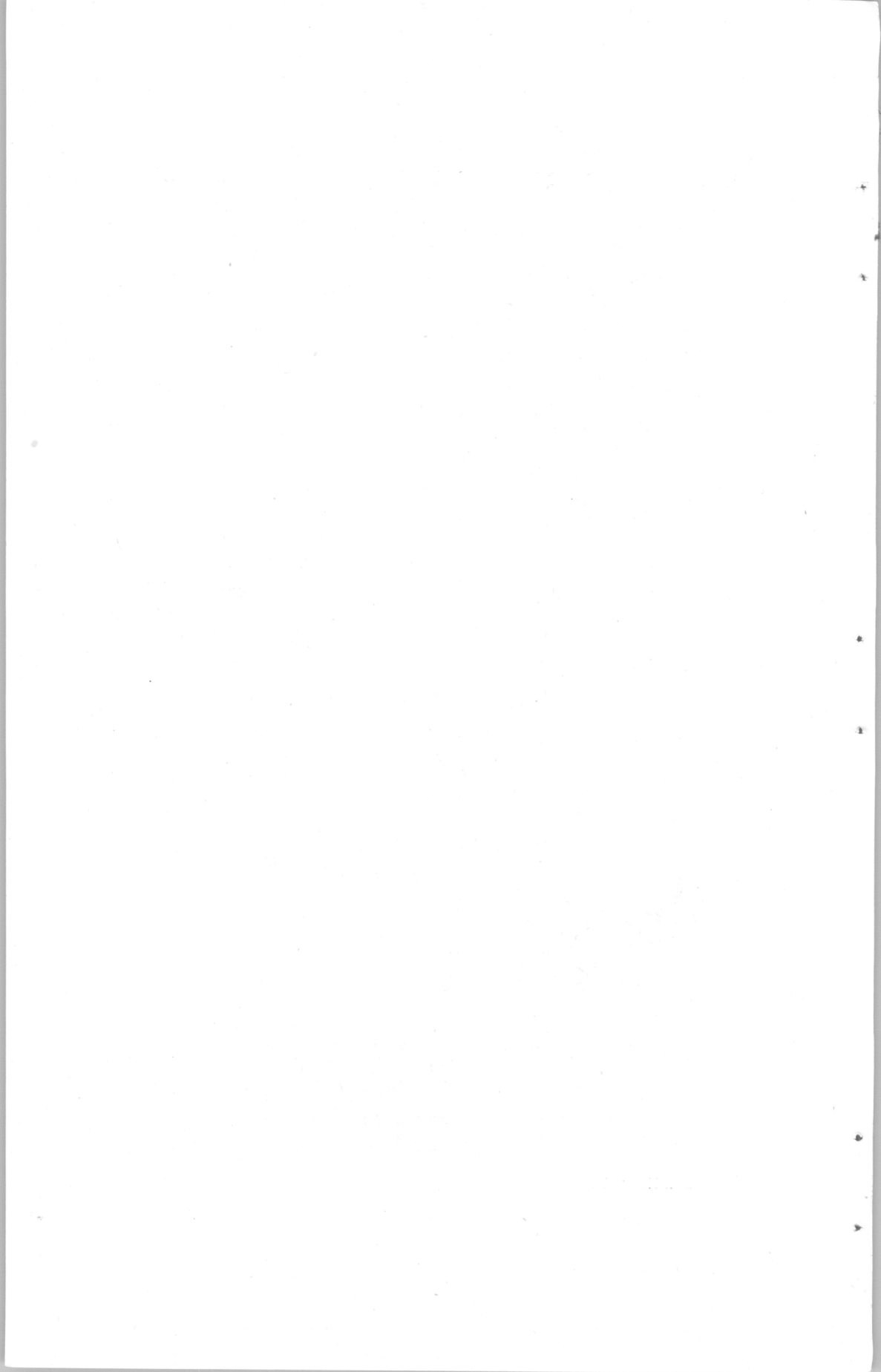
Fig. 2. Thelycum of same specimen.

Trachypeneus curvirostris (Stimpson).

Fig. 3. Thelycum of a female specimen (Reg. No. E.4472 *part*), measuring 18 mm. from the end of the incomplete rostrum to the hinder margin of the carapace.



Miss E. A. KING, del.



MEMORANDUM FOR THE RECORD

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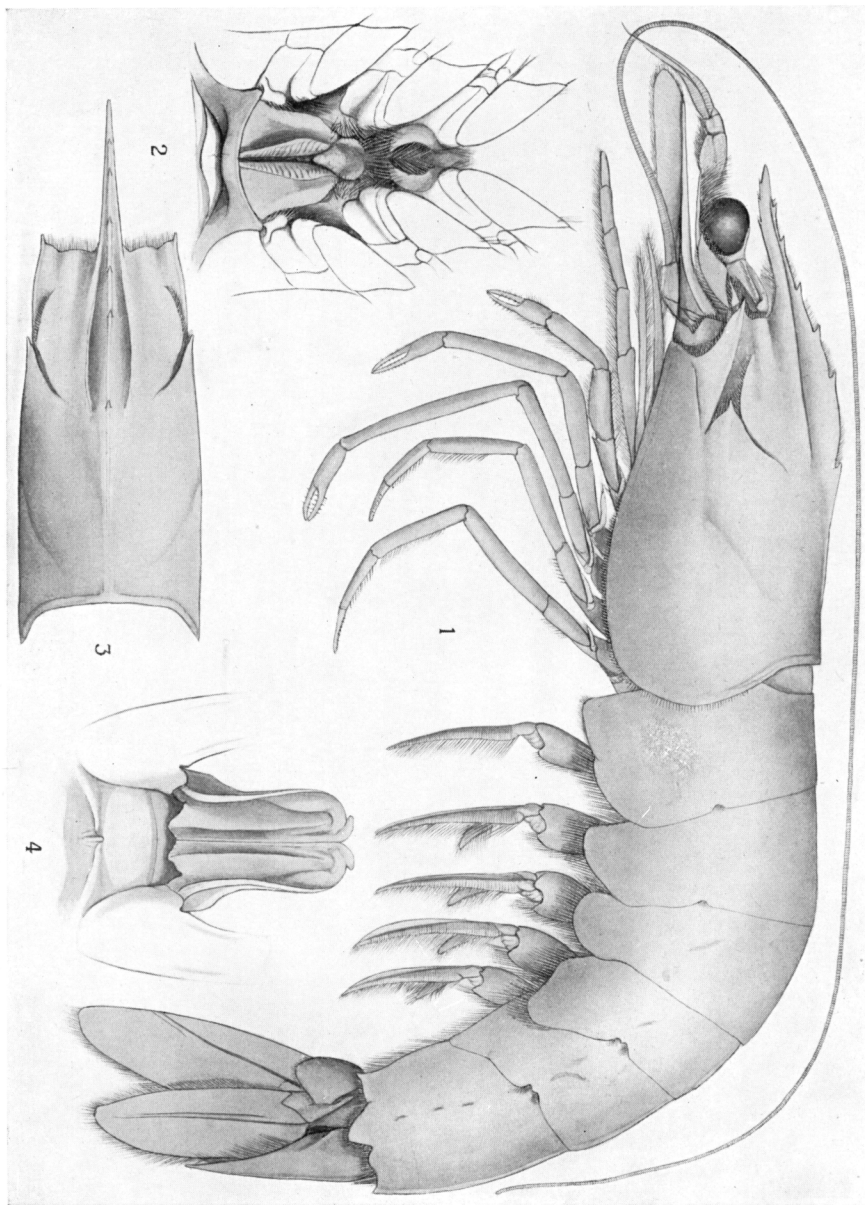
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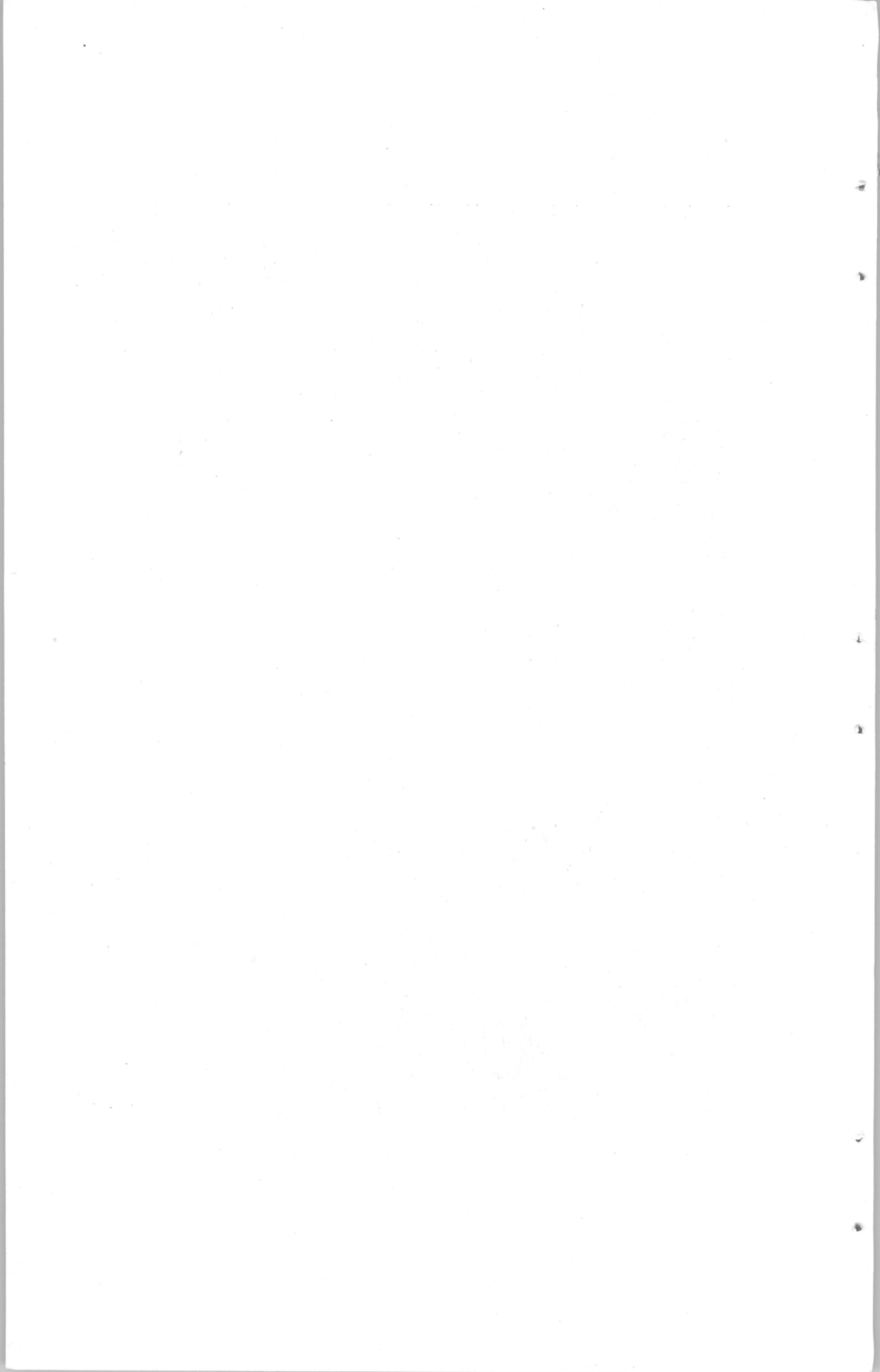
EXPLANATION OF PLATE LXIV.

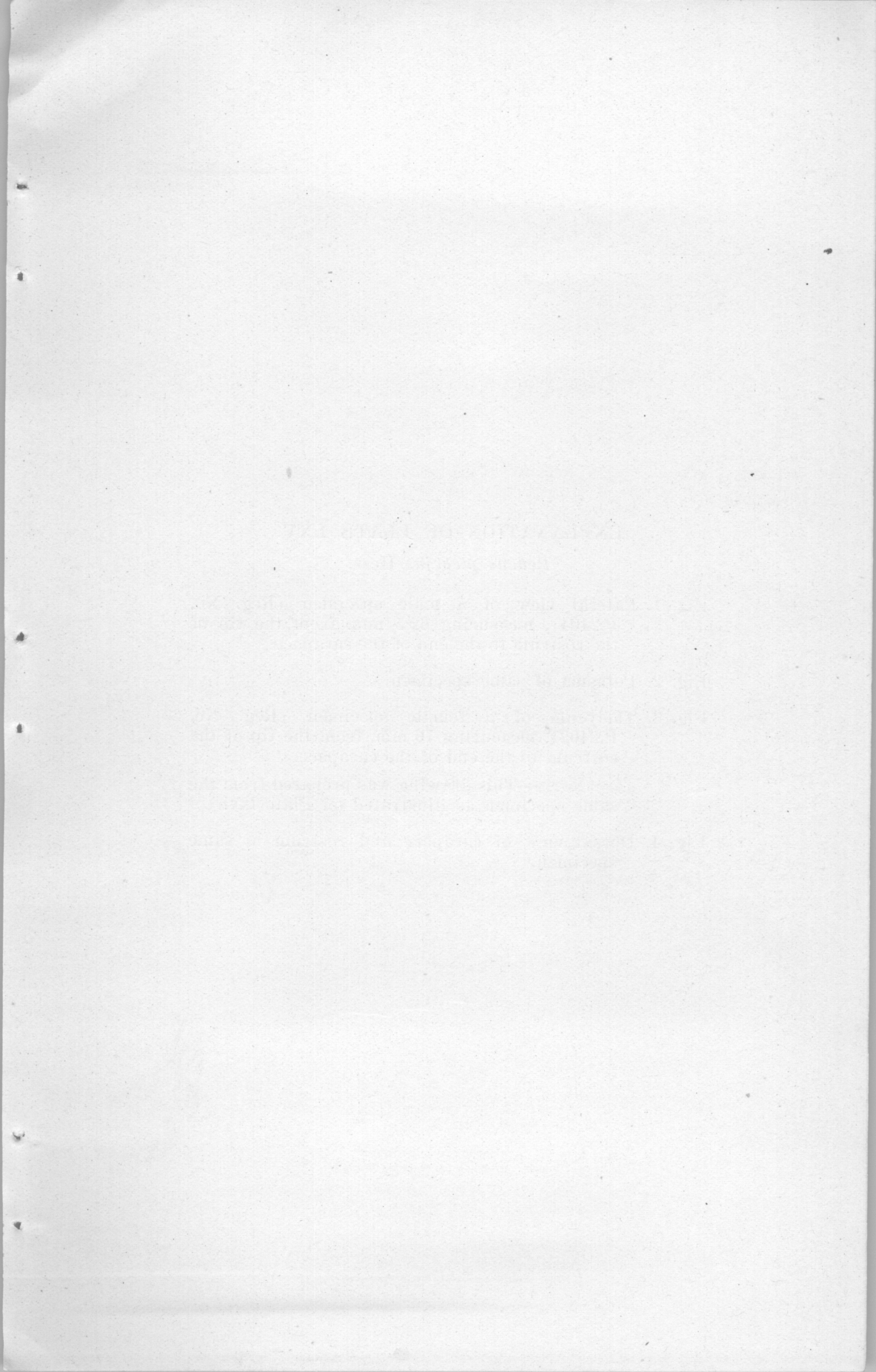
Peneus esculentus Haswell.

- Fig. 1. Lateral view of a female specimen (Reg. No. P.2399), measuring 75.5 mm. from the tip of the rostrum to the end of the carapace.
- Fig. 2. Thelycum of same specimen.
- Fig. 3. Dorsal view of carapace and rostrum of same specimen.
- Fig. 4. Petasma of a male specimen (Reg. No. P.3606), measuring 58 mm. from the tip of the rostrum to the end of the carapace.



Miss E. A. KING, del.





EXPLANATION OF PLATE LXV.

Peneus plebejus Hess.

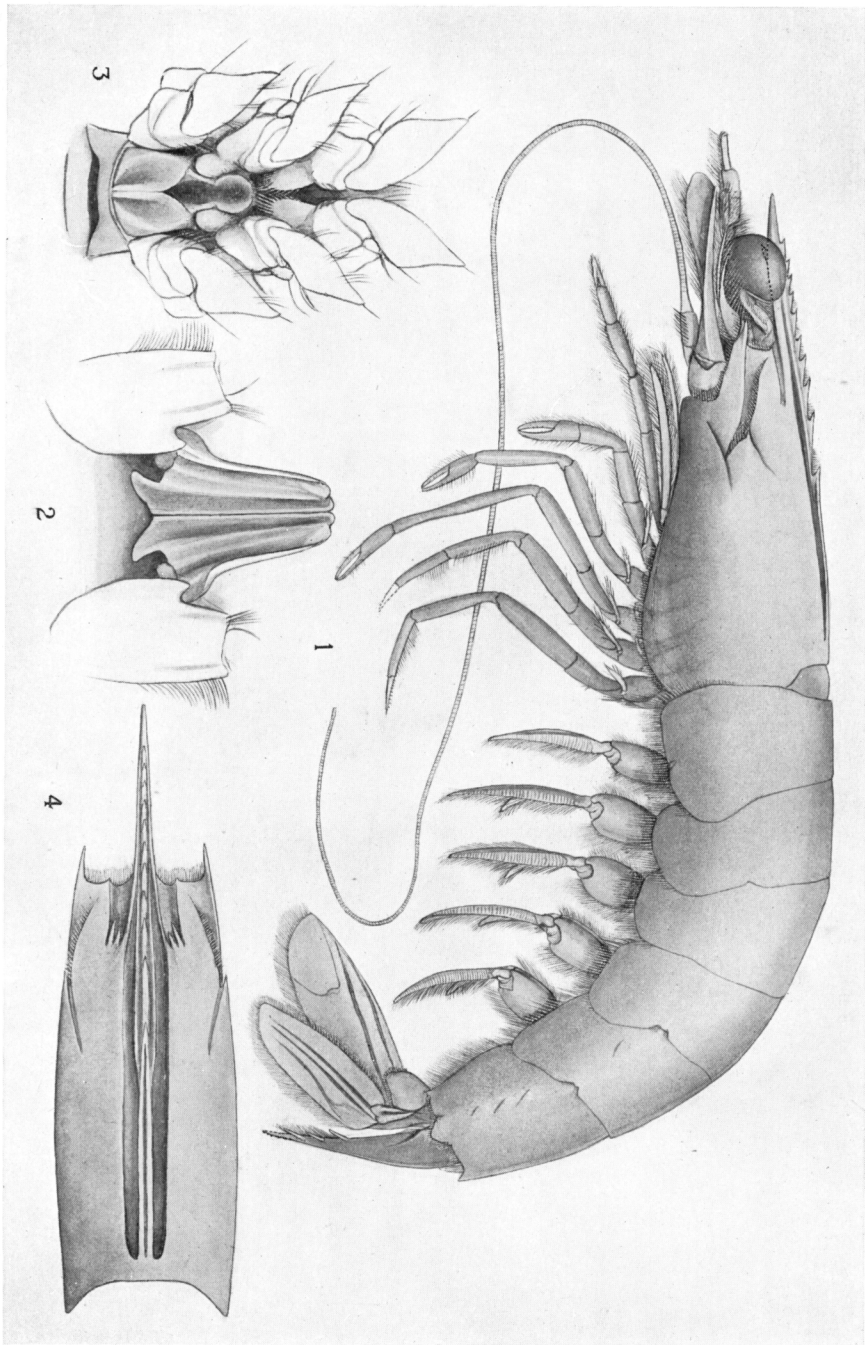
Fig. 1. Lateral view of a male specimen (Reg. No. P.2404), measuring 62.5 mm. from the tip of the rostrum to the end of the carapace.

Fig. 2. Petasma of same specimen.

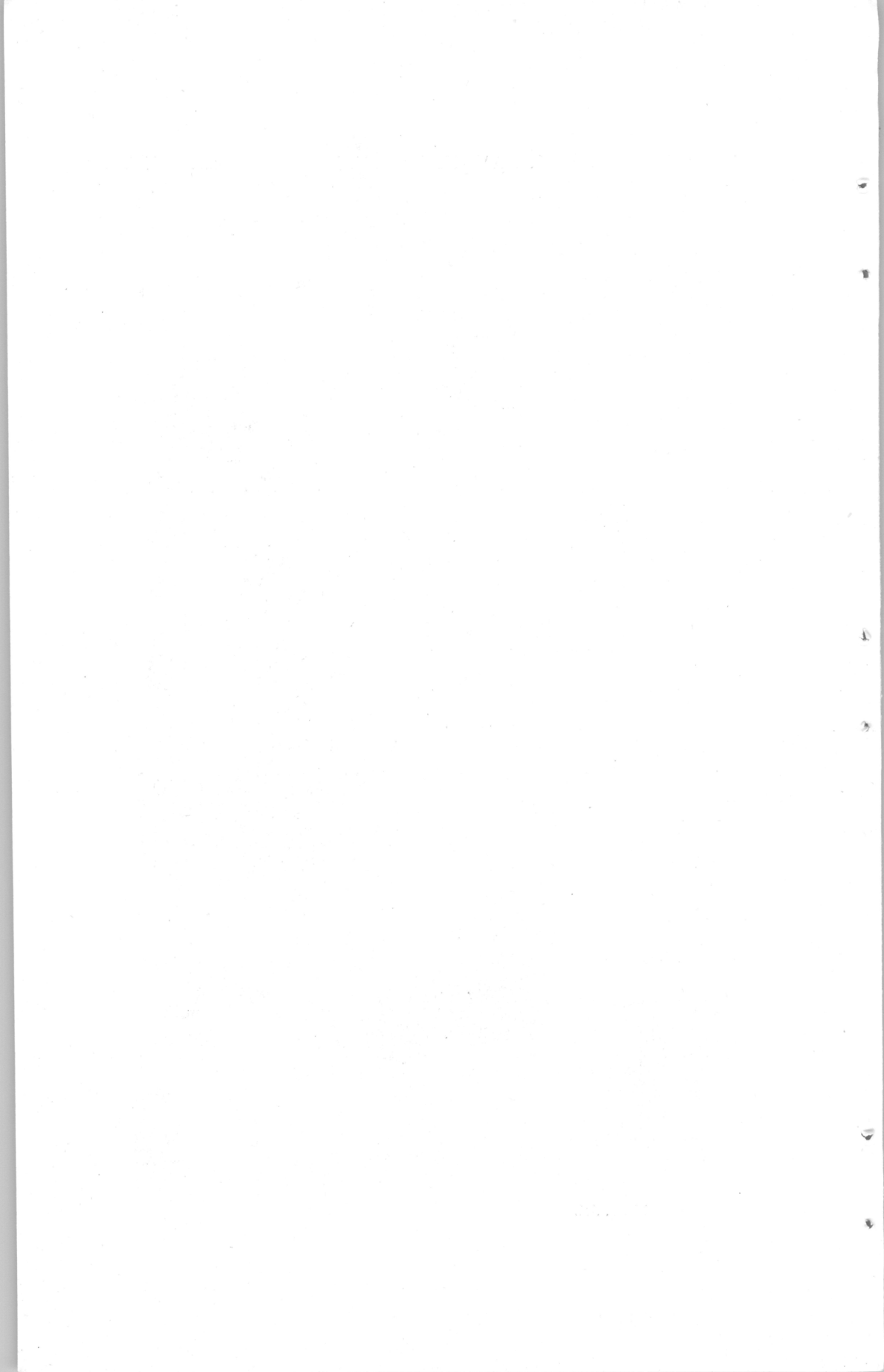
Fig. 3. Thelycum of a female specimen (Reg. No. P.2402), measuring 76 mm. from the tip of the rostrum to the end of the carapace.

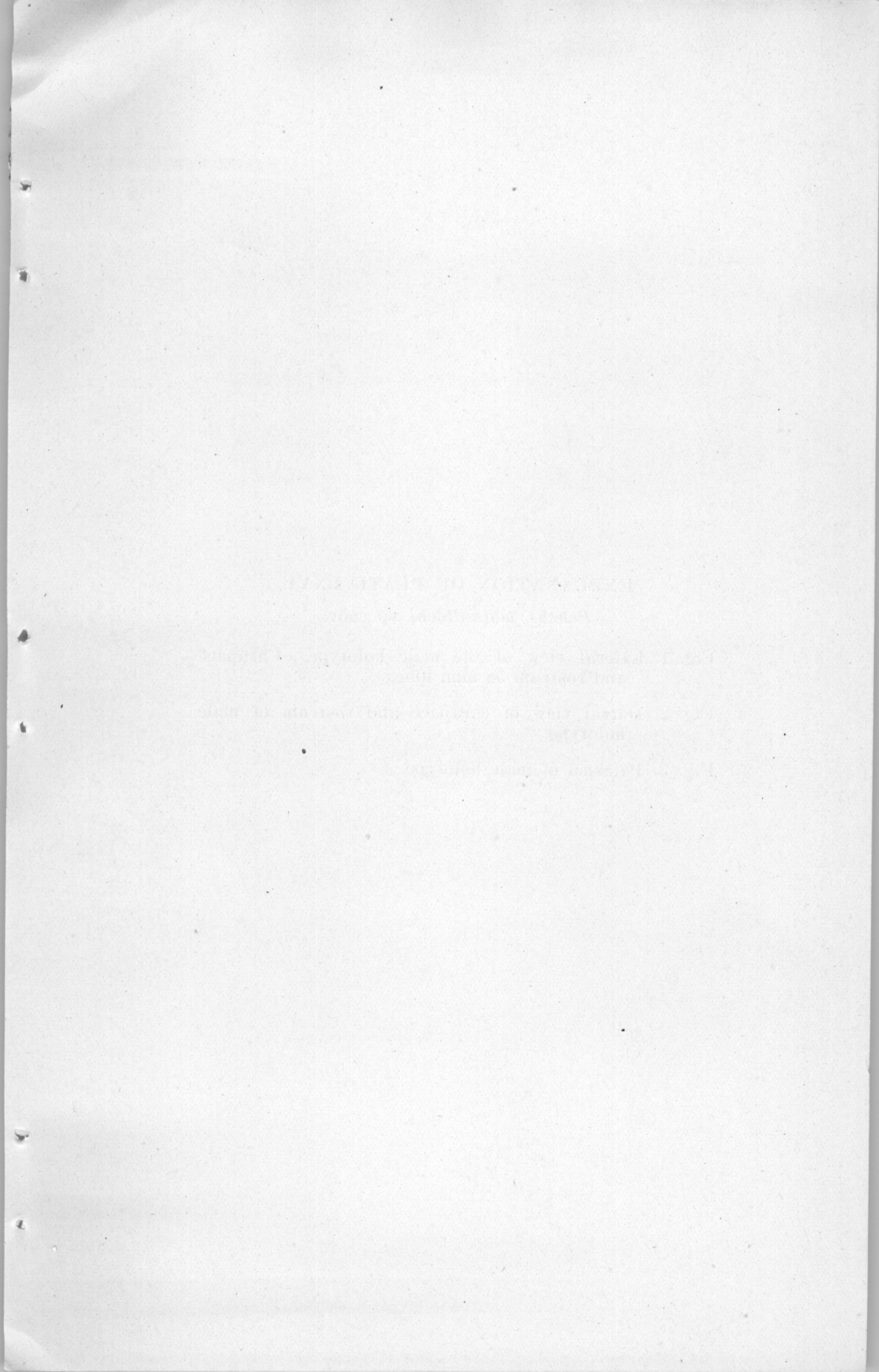
(NOTE.—This drawing was prepared from the same specimen as illustrated on Plate lxvi.)

Fig. 4. Dorsal view of carapace and rostrum of same specimen.



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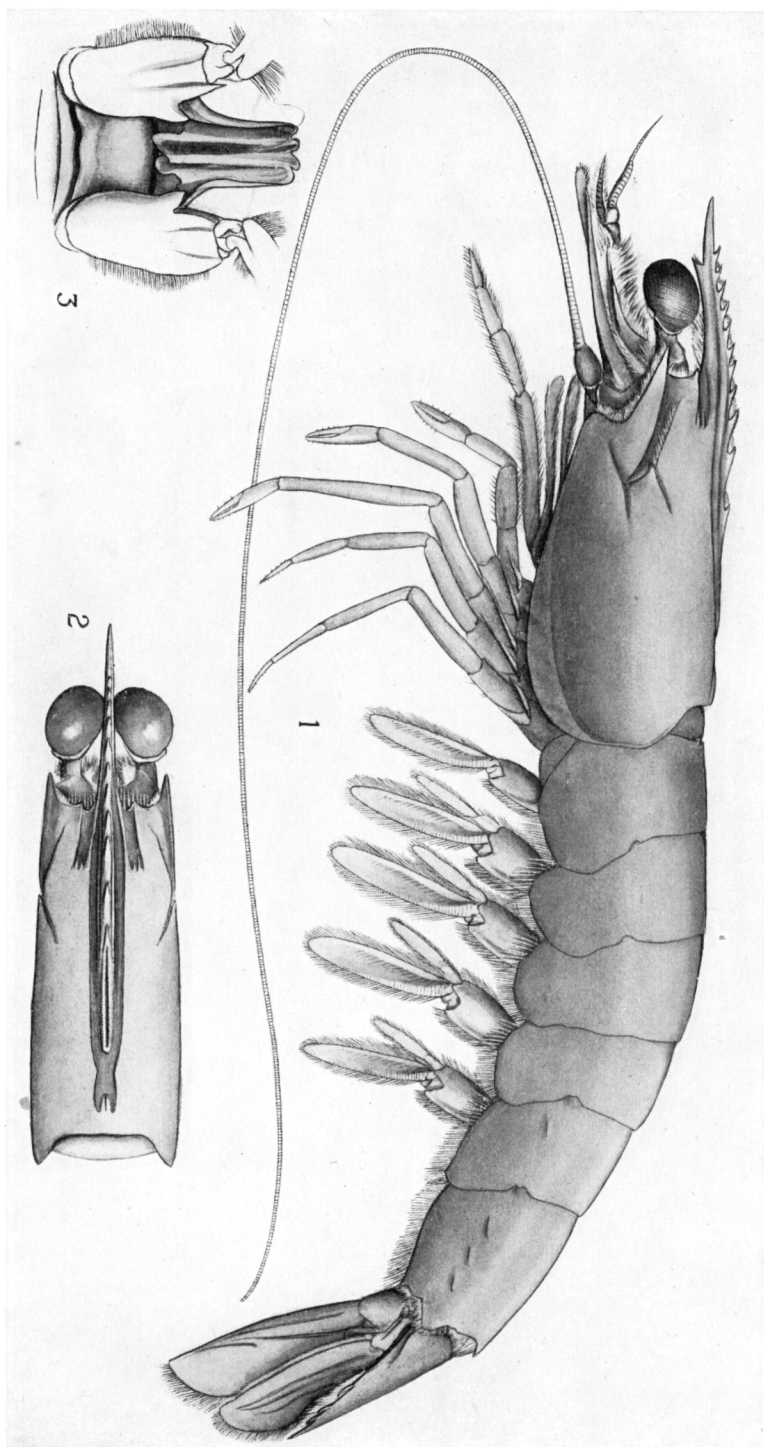
EXPLANATION OF PLATE LXVI.

Peneus maccullochi sp. nov.

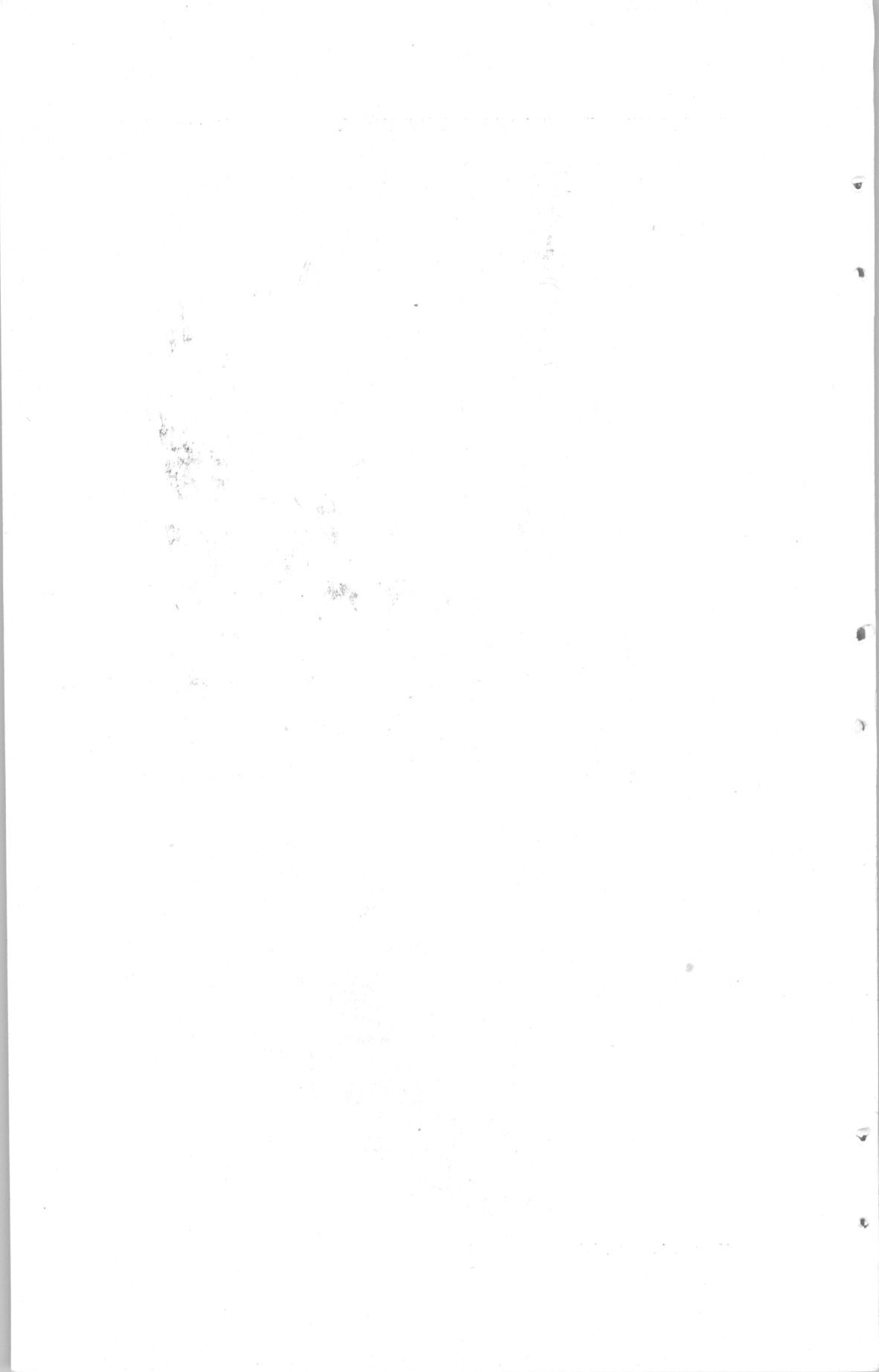
Fig. 1. Lateral view of the male holotype. Carapace and rostrum 58 mm. long.

Fig. 2. Dorsal view of carapace and rostrum of male holotype.

Fig. 3. Petasma of male holotype.



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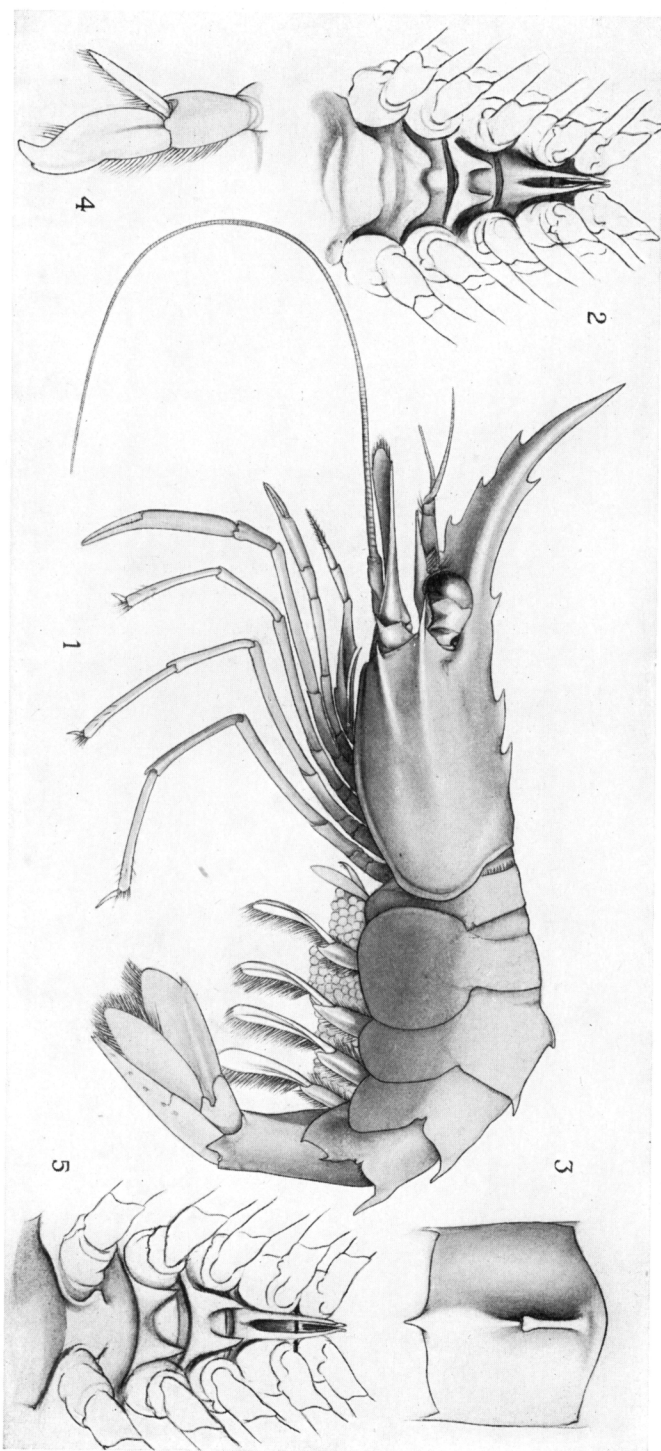
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EXPLANATION OF PLATE LXVII.

Campylonotus rathbunæ sp. nov.

- Fig. 1. Lateral view of the female holotype. Carapace and rostrum 61.5 mm. long (measured in a direct line from the tip of the former to the end of the latter).
- Fig. 2. Thoracic sterna of female holotype (denuded).
- Fig. 3. Dorsal view of third abdominal somite of female holotype.
- Fig. 4. Front view of right anterior pleopod of a male specimen (Reg. No. E.6633), measuring 61 mm. in a direct line from the tip of the rostrum to the end of the carapace.
- Fig. 5. Thoracic sterna of same male specimen (denuded).



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THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

PHYSICS 435

LECTURE 1

1.1. THE CLASSICAL LIMIT

1.2. QUANTUM MECHANICS

1.3. THE SCHROEDINGER EQUATION

1.4. THE HEISENBERG UNCERTAINTY PRINCIPLE

1.5. THE DIRAC EQUATION

1.6. THE PAULI EXCLUSION PRINCIPLE

1.7. THE SPIN-ORBIT INTERACTION

1.8. THE FINITE POTENTIAL WELL

1.9. THE HARMONIC OSCILLATOR

1.10. THE HYDROGEN ATOM

1.11. THE ADDITION OF ANGULAR MOMENTUM

1.12. THE HYPERFINE SPLITTING

1.13. THE ZEEMAN EFFECT

1.14. THE ANOMALOUS ZEEMAN EFFECT

1.15. THE SPECTRA OF ATOMS

1.16. THE SPECTRA OF MOLECULES

1.17. THE SPECTRA OF SOLIDS

1.18. THE SPECTRA OF NUCLEI

1.19. THE SPECTRA OF PARTICLES

1.20. THE SPECTRA OF QUANTUM FIELDS

1.21. THE SPECTRA OF QUANTUM GRAVITY

1.22. THE SPECTRA OF QUANTUM COSMOLOGY

1.23. THE SPECTRA OF QUANTUM INFORMATION

1.24. THE SPECTRA OF QUANTUM COMPUTING

1.25. THE SPECTRA OF QUANTUM COMMUNICATIONS

1.26. THE SPECTRA OF QUANTUM NETWORKS

1.27. THE SPECTRA OF QUANTUM ENTANGLEMENT

1.28. THE SPECTRA OF QUANTUM SECURITY

1.29. THE SPECTRA OF QUANTUM CRYPTOGRAPHY

1.30. THE SPECTRA OF QUANTUM KEY DISTRIBUTION

1.31. THE SPECTRA OF QUANTUM TELEPORTATION

1.32. THE SPECTRA OF QUANTUM SUPERDENSE CODING

1.33. THE SPECTRA OF QUANTUM STATE TRANSFER

UNIVERSITY OF MARYLAND

Faint, illegible text, likely bleed-through from the reverse side of the page. The text appears to be organized into several paragraphs, but the words are too light to transcribe accurately.

EXPLANATION OF PLATE LXVIII.

Peneus plebejus Hess.

Fig. 1. Lateral view of a female specimen (Reg. No. P.2402), measuring 76 mm. from the tip of the rostrum to the end of the carapace.

Penæopsis novæ-guinææ (Haswell).

Fig. 2a-b. Lateral view of two small females, showing variation in the shape of the rostra. Specimens in the collection of the Australian Museum (Reg. No. P.412 *part*). Carapace and rostrum of each measures 17 mm. long.

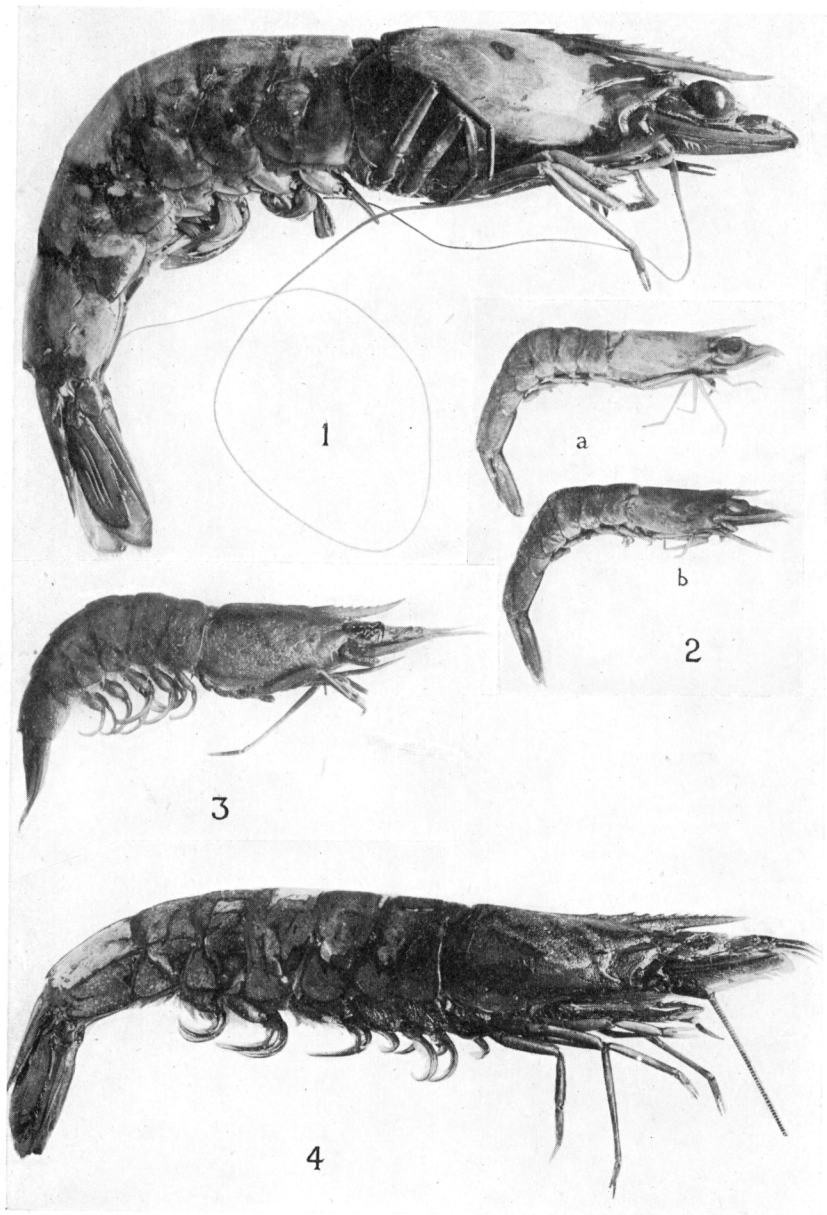
Trachypeneus anchoralis (Bate).

Fig. 3. Lateral view of a female specimen (Reg. No. P.3528 *part*), measuring 29.5 mm. from the tip of the rostrum to the end of the carapace.

Penæopsis endeavouri sp. nov.

Fig. 4. Lateral view of a male specimen (Reg. No. E.6687), to show pubescent areas. Carapace and rostrum 48.5 mm. long.

(NOTE.—The fifth pair of legs is missing from this specimen.)



C. R. SHOEMAKER, photo.

