The Malayan Penaeidae (Crustacea, Decapoda) Part II
Further taxonomic notes on the Malayan species

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THESE TAXONOMIC NOTES are to be considered a continuation of the paper *The Malayan Penaeidae*, Part I (Hall 1956). Reference should be made to the introduction to that paper, and also to the chart of the local Singapore waters on which are marked the positions of Agassiz trawling stations which in the present paper are indicated by a number prefixed by the letter "B".

Additional material included in the present paper was taken by the Singapore Regional Fisheries Research Station (= S.R.F.R.S.) Research Vessel *Manihine*. For such material an approximate locality only is given, as the general distributions of the various species will be considered in greater detail in a later paper.

It is emphasised that the carapace length is the distance measured between the post-orbital margin, and the mid-posterior margin of the carapace (Cole and Mistakidis 1953).

The following list records all of the species which have been examined by the present author, 45 in number: species marked by an asterisk are those which receive attention in the present paper. Six species are recorded here as new to science, and the types will be deposited in the British Museum.

Family **Penaeidae** Bate
Subfamily **Solenocerinae** Wood-Mason and Alcock
Genus **Solenocera** H. Lucas

Solenocera kuboi Hall
* **S. melantho** de Man
* **S. alticarinata** Kubo
* **S. pectinata** (Bate)
* **S. spinajugo** sp. nov.

Subfamily **Penaeinae** Burkenroad
Genus **Penaeus** Fabricius

Penaeus japonicus Bate
P. latisulcatus Kishinouye
P. longistylus Kubo
* **P. semisulcatus** de Haan
* **P. monodon** Fabricius
P. penicillatus Alcock
P. merguiensis de Man
P. indicus H. Milne-Edwards
P. jejunus Hall

Genus **Heteropenaeus** de Man

* **Heteropenaeus longimanus** de Man

Genus **Metapenaeus** Wood-Mason and Alcock

Metapenaeus monoceros (Fabricius)
M. intermedius (Kishinouye)
M. mastersii (Haswell)
M. lysianassa (de Man)
M. brevicornis (H. Milne-Edwards)
* **M. spinulatus** Kubo
* **M. mutatus** (Lanchester)
M. singaporensis Hall

Genus **Atypopeneus** Alcock

* **Atypopeneus stenodactylus** (Stimpson)

Genus **Parapeneopsis** Wood-Mason

* **Parapeneopsis tenella** (Bate)
* **P. maxillipedo** Alcock
* **P. cultrirostris** Alcock
* **P. hungerfordi** Alcock
* **P. gracillima** Nobili
* **P. hardwickii** (Miers)
* **P. affinis** (H. Milne-Edwards)
* **P. venusta** de Man
* **P. probata** sp. nov.

Genus **Trachypeneus** Alcock

* **Trachypeneus curvirostris** (Stimpson)
* **T. granulosus** (Haswell)
* **T. unicus** sp. nov.
* **T. furcilla** sp. nov.
* **T. sedili** sp. nov.

Genus **Parapenaeus** Smith

* **Parapenaeus fissurus** (Bate)

Genus **Metapenaeopsis** Bouvier

* **Metapenaeopsis barbatus** (de Haan)
* **M. stridulans** (Alcock)
* **M. novae-guineae** (Haswell)
* **M. mogiensis** (Rathbun)
* **M. andamanensis** (Wood-Mason)

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Subfamily **Sicyoninae** Ortmann
Genus **Sicyonia** H. Milne-Edwards

* **Sicyonia ommanneyi** sp. nov.

Subfamily **Solenocerinae** Wood-Mason and Alcock
Genus **Solenocera** H. Lucas

Solenocera melantho de Man

Solenocera melantho de Man 1907, 1911.
Solenocera depressa Kubo 1949.

The seven specimens available to the present author (4 males, 3 females) show excellent agreement with the descriptions given by de Man (op. cit.) and Kubo (op. cit.).

The differences between *S. depressa* Kubo and *S. melantho* de Man given by Kubo at the conclusion of the description of his species are:

1. The antennular flagella are 1·78 to 1·91 times as long as the carapace in *S. depressa* but only 1·5 times in *S. melantho*.
2. The scaphocerite does not surpass the tip of the antennular peduncle in *S. depressa* although it does so in *S. melantho*.

The antennular flagella of five specimens examined by the present author—the other two specimens had the antennular flagella missing—varied from 1·4 times the length of the carapace in the largest female, to 2·0 in the smallest male, which variation covers the entire range of the flagella length for the two alleged species combined. Of the five specimens examined, three (1 male, 2 females) had the scaphocerite exceeding the antennular peduncle, while two, both males, had the scaphocerite attaining the same level as the tip of the antennular peduncle.

The lower edge of the rostrum of the specimens to hand does not show the slight concavity indicated by de Man, but appears as illustrated by Kubo (op. cit. Fig. 96), while the telson, although generally attaining or surpassing the inner uropod elements, may fall very slightly short of the level. It may be noted that de Man (op. cit. p. 50) described the scaphocerite as having a straight outer margin, but his illustration of the feature (Pl. 5. Fig. 12b.) shows the margin concave: the specimens to hand agree with the text and not with the illustration.

There are slight differences in the lengths of the pereiopods between the specimens studied by the present author, and the accounts of both de Man and Kubo. The second leg is intermediate in length between *S. depressa* Kubo and *S. melantho* de Man: the carpus of the second leg attains the distal margin of the scaphocerite but it does not surpass the margin. The figure by de Man of *S. melantho* shows the ratio carapace length: carpus 3rd leg to be 1:1·5 but de Man noted that a single adult female and all young specimens do not have the third leg as long, relatively, as the other adults. Kubo's illustration of *S. depressa* gives this ratio as 1: 1·0. The five specimens examined for this feature by the present author (the other two being damaged) are intermediate between de Man's and Kubo's specimens, three specimens having the ratio 1:1·1 while two have the ratio 1:1·2. The fourth leg of the Malayan specimens falls slightly short of the tip of the scaphocerite, while the fifth leg exceeds the scaphocerite by the entire dactylus together with 2/3rd of the propodus: again the intermediate nature of the lengths is to be noted.

When all of the features are considered, *S. depressa* Kubo cannot be retained as a species distinct from *S. melantho* de Man.

The S.R.F.R.S. specimens were taken by the R.V. *Manihine* in the Malacca Strait, six of the seven being caught in the same haul. No specimen has been taken off Singapore Island.

Solenocera alticarinata Kubo

Solenocera alticarinata Kubo 1949.

There is excellent agreement between the original description and the specimens which have been examined by the present author; only in the arrangement of the teeth of the rostral crest is there any discrepancy. Kubo states (op. cit. p. 227) that his holotype bears six of the nine rostral teeth on the carapace, but his illustration (op. cit. Fig. 93) shows only eight rostral teeth of which five are carried by the carapace, unless it be that the prominent start of the post-rostral carina after the cervical groove has been counted as a tooth. The present author considers that this prominence cannot be included as a rostral tooth: it is variable in shape, and may or may not appear tooth-like, and further, its very presence is dependant solely on the peculiar lamellar form of the post-rostral carina. Of sixteen specimens examined for the feature, the following is an analysis of the rostral teeth:—

	Teeth on the carapace		Tooth above the orbital margin	Teeth on the rostrum			Total teeth	
	4	5		3	4	5	8	9
Number of specimens	15	1	3	1	14	1	12	4

In his original description, Kubo recorded that this species is quite distinct from all other species of *Solenocera* excepting *S. hextii* Wood-Mason. It may be noted that one of the distinctions which Kubo gave between his *S. alticarinata* and *S. hextii* Wood-Mason is not valid. Although the rostrum of *S. hextii* Wood-Mason is described by Alcock (1901) as "ascendant", the illustration of the feature (Illustrations of the Zoology of the Investigator. Pl. 26. Fig. 5) shows the rostrum to be no more ascendant than that of *S. alticarinata* Kubo (op. cit. Fig. 93, and the specimens to hand), which is described by Kubo as "horizontally straight". The following features however are valid, and distinguish *S. alticarinata* Kubo from *S. hextii* Wood-Mason, two specimens of which, from the original collection of the "Investigator" and now lying in the Cambridge University Museum of Zoology, the present author has examined:

1. Although the post-rostral carina of *S. hextii* is well defined, it is not lamelliform as in *S. alticarinata.*
2. There is no "L" shaped groove placed postero-laterally on the carapace as described and illustrated for *S. hextii* Wood-Mason (Alcock op. cit.).
3. The antennular flagella are longer than the carapace in *S. alticarinata,* not shorter.
4. The antennular flagella of *S. alticarinata* are not unusually broad.

5. *S. alticarinata* has no spine (supra-hepatic) on the cervical groove above and behind the hepatic spine.

Although the antennular flagella are longer than the carapace, the relative length decreases with increase in the carapace length. The range of the ratio carapace length: antennular flagella length in the S.R.F.R.S. specimens is from 1:2·42 in a specimen of 2·00 cm. carapace length to 1:1·13 in a specimen of 3·63 cm. carapace length.

In addition to the features of the species noted by Kubo (op. cit.), it is seen that the majority of the specimens possess a small area which appears irregular, and seems to consist of a number of small pits and carinae, placed dorso-laterally on the second to fifth abdominal segments inclusive, particularly on the third and fourth. Only two specimens of those examined, both of which were taken in the extreme north of the Malacca Strait, fail to show these areas.

Solenocera alticarinata Kubo has not been taken off Singapore Island. All of the specimens to hand have been taken by the R.V. *Manihine,* mainly from the South China Sea, but three specimens were caught in the extreme north of the Malacca Strait.

Solenocera pectinata (Bate)

Philonicus pectinatus Bate 1888.
Solenocera pectinata de Man 1911.
Solenocera pectinulata Kubo 1949.

Two specimens which the present author has examined, both females, agree in every detail with Kubo's description of his species *S. pectinulata,* yet when the features which distinguish *S. pectinulata* Kubo from *S. pectinata* (Bate) (Kubo op. cit. p. 255. Table 22) are considered, it is found that:

1. The vertical groove bridging the hepatic and the post-orbital spines is distinct, although shallow. This, Kubo stated, is in keeping with *S. pectinata* (Bate) although I am at a loss to find from whence this information was derived.
2. The post-rostral carina interupts the cervical groove at 0·47 and 0·48 of the carapace respectively for the two specimens to hand. Kubo stated that the post-rostral carina of *S. pectinulata* interupts the cervical groove ". . . at about middle of carapace.". Kubo's illustration of the feature (op. cit. Fig. 101) gives 0·45; Bate's illustration of *S. pectinata* (op. cit. Pl. 38) gives 0·39.
3. The antennular peduncles are 0·61 and 0·48 of the length of the carapace respectively for the two specimens: Kubo gave 0·55 for *S. pectinulata* Kubo and 0·67 for *S. pectinata* (Bate).

These three alleged differences between the species I believe to be intraspecific and, all things considered, I think that the arguments are insufficiently strong to warrant the segregation of *S. pectinulata* Kubo as a species distinct from *S. pectinata* (Bate).

The two specimens to hand were taken by the R.V. *Manihine* from the South China Sea; none has been taken off Singapore Island.

Solenocera spinajugo sp. nov. Plate 17, Figs. 1, 2, 3

The carapace and abdomen are glabrous save for an area of the rostrum lying dorsal to the adrostral carina which is tomentose. The epigastric and post-orbital spines are subequal in size, somewhat longer than the antennal and hepatic spines. The supra-orbital margin is dentiform, but not spiniform. A fifth spine, of about the same size as the hepatic spine, is borne by the carapace on the extreme anterior margin of the hepatic carina. This carina is sharp, and undercut considerably by the hepatic groove. The hepatic groove is continued backwards, well defined, until it ceases below the dorsal indentation where the deep cervical groove cuts the mid-dorsal line of the carapace at about 0·53 of the carapace length. The cervical carina is well defined, but ceases before the mid-dorsal line. A well defined groove runs a somewhat sinuous path from the hepatic fossa towards the base of the post-orbital spine, and there is present also on the carapace a straight, shallow, branchio-cardiac groove set in the posterior 1/3rd of the carapace.

The rostrum is straight and short, not attaining the mid-line of the cornea. In addition to the epigastric spine, it bears six teeth, the posterior two being carried by the carapace while the next is placed above the post-orbital margin. The post-rostral carina is discontinued immediately posterior to the cervical groove, but it is present further backwards, becoming more defined, although still blunt, towards the rear border of the carapace which it almost attains.

The first two abdominal segments are rounded dorsally. The third segment carries a low dorsal carina in the posterior 2/3rd, while the fourth, fifth and sixth segments are sharply carinate, the carina terminating posteriorly in the sixth segment in a slender spine. In addition to the mid-dorsal spine, the sixth abdominal segment, which has a ratio length: depth (measured at the posterior end) of about 1·4:1, carries also a spine set a little anterior to each postero-inferior angle. The posterior margin of the third abdominal segment is notched, and that of the fourth and fifth segments incised in the mid-dorsal line. The telson of the holotype is broken posterior to a pair of fixed lateral spines. A sternal prominence is carried by all of the abdominal segments, the prominence being spiniform in the first to fourth segments inclusive.

The cornea is brown in colour and is fairly large, in its longer diameter being about 0·29 the length of the carapace. The basal segment of the short eye-stalk bears dorsally an anteriorly directed scale. The prosartema reaches midway between the distal end of the eye-stalk and the anterior margin of the cornea. The stylocerite reaches about half way along the cornea. The basal segment of the antennular peduncle bears a spine at the outer distal angle. The antennular flagella are subequal in length, about 1·9 times the length of the carapace. The upper flagellum is reduced to an asymmetrical point in the distal six articles: the lower flagellum, which is much more hiruste than the upper, is reduced to a point also in the distal six articles. The basicerite bears a sharp spine on the outer distal margin. The lamina of the scaphocerite exceeds the lateral spine, and both surpass the distal end of the antennular peduncle.

The third maxilliped surpasses the scaphocerite by the dactylus and half of the propodus. The first leg, which has a long basial and a long ischial spine, surpasses the carpocerite by the fingers: the second leg, which has *no* basial spine, surpasses the scaphocerite by the entire chela: the third leg is missing: the fourth leg surpasses the scaphocerite by the dactylus and 1/3rd of the propodus, while the fifth leg, which is much more slender than any other leg, surpasses the scaphocerite by a small portion of the carpus together with the entire propodus and dactylus. A slender exopodite is carried by each leg.

The coxae of the fourth legs articulate towards the mid-line with a pair of setose sternal protuberances. Between the fifth legs is a plate, partially subdivided in the mid-line, each lateral half of which bears a rounded setose prominence. On the sternum, in the mid-line between the fourth and fifth legs, is a small setose papilla.

The absence of a pterygostomian spine, and the presence of a spine at the extreme anterior margin of the hepatic groove appear to distinguish the present species from all other species of *Solenocera* save *S. faxoni* de Man. The present species may be distinguished from *S. faxoni* by the following features:—

1. The rostrum is not sharply pointed as is that of de Man's species.
2. There is a post-rostral crest posterior to the cervical groove.
3. The cervical groove is continuous from side to side of the carapace.
4. The supra-orbital margin is dentiform.
5. The third abdominal segment has a low dorsal carina.
6. The eyes are fairly large and brown, not small and black.
7. The antennular flagella are much longer than the carapace plus rostrum.

and, according to Kubo (1949 pp. 241–245):

8. The third abdominal segment is not swollen.
9. There is no basial spine on the second legs.

This description is based on the only specimen available, a female of 1·7 cm. carapace length which is recorded as the holotype and will be deposited in the British Museum. It was taken by the R.V. *Manihine* from the north of the Malacca Strait (120 miles NW of Penang, 41 fm.).

Subfamily **Penaeinae** Burkenroad (emend)
Genus **Penaeus** Fabricius (emend)

Penaeus semisulcatus de Haan

Penaeus semisulcatus de Haan 1841.
Penaeus ashiaka Kishinouye 1900.
Penaeus monodon Alcock 1906.
Penaeus monodon Kubo 1949.
Penaeus semisulcatus Holthuis 1949.
Penaeus semisulcatus Kubo 1955.
Penaeus monodon Hall 1956.

and: **Penaeus monodon** Fabricius

Penaeus monodon Fabricius 1798.
Penaeus carinatus Dana 1852.
Penaeus tahitensis Heller 1862.
Penaeus monodon Kishinouye 1900.
Penaeus semisulcatus Alcock 1906.
Penaeus bubulus Kubo 1949.
Penaeus monodon Holthuis 1949.
Penaeus monodon Kubo 1955.
Penaeus bubulus Hall 1956.
NOT *Penaeus carinatus* Otto 1821.

In the light of Holthuis's revision of the specific name "monodon" as applied to species of the genus *Penaeus* (op. cit.), it is necessary to correct the nomenclature of these two species given earlier by the present author (op. cit.).

Genus **Heteropenaeus** de Man

Heteropenaeus longimanus de Man. Plate 17, Fig. 5. Plate 18, Fig. 6

Heteropenaeus longimanus de Man 1896.
Heteropenaeus longimanus Nobili 1903c.
Heteropenaeus longimanus de Man 1924.

In formalin preservative, the specimen described below is somewhat reddish in colour with blue markings. The body generally is smooth, but on the surface are arrangements of grooves and carinae, the carinae being adorned with rows of stiff setae which overlie the grooves. On the carapace the anterior hepatic groove and carina are very clearly defined, and curve downwards steeply below and immediately anterior to the hepatic spine. Posterior to the hepatic spine the hepatic groove is less clearly marked although still readily visible: it curves dorsally below the epigastric spine and may be traced for about half of the distance between the hepatic spine and the mid-dorsal line, after which it becomes confused with other setae-beset grooves placed dorso-laterally on the carapace. The deep cervical groove ascends steeply from the hepatic fossa, continuing dorsally to a position about ⅔ of the distance towards the mid-dorsal line where it turns posteriorly until it too is lost amid the setae-beset grooves placed dorso-laterally on the carapace. The deep antennal groove is overlain by setae posteriorly, these setae arising from the gastro-orbital carina, which carina extends about 1/3rd of the distance from the hepatic spine towards the anterior margin of the carapace: anteriorly the antennal groove is broader and less deep. A clearly defined branchio-cardiac groove runs postero-dorsally from beneath the posterior portion of the hepatic groove until it becomes confused within a heavily grooved area lying postero-dorsally on the carapace. A post-ocular groove runs from a little behind the orbital margin until it joins the cervical groove at the place where the latter turns posteriorly. In addition to the main grooves, there are further grooves on the carapace:—

1. On the branchial region: the grooves of this system are relatively short in length, each running a curved course generally dorso-ventrally.
2. Postero-dorsally across the carapace from side to side: each groove proceeds in a wavy line.
3. Set between the cervical and the branchio-cardiac grooves and almost blending with the grooves of the system enumerated at 2 above: these grooves are similar in form to the postero-dorsal grooves, but they do not cross the mid-dorsal line of the carapace.
4. A system of short, semicircular grooves lining the margins of the post-ocular groove.
5. Other small, scattered grooves confined mainly to the antero-dorsal area of the carapace.

The setae which overlie all of these grooves are attached to the posterior margin of the grooves, except for the horizontally directed post-ocular groove which has setae along both margins, a condition which is to be related to reducing the resistance to water-flow during the vigorous rearward motion of the escape reaction.

The positions of the setae-beset grooves of the abdominal segments are illustrated in Plate 18, Fig. 6. The direction in which the setae lie show a fine gradation from anteriorly directed on segment one, through generally ventrally directed on segment three,

to posteriorly directed on segment six. This change of direction in which the setae are laid, again related to water-flow during the escape reaction, is of course shown by all of the Penaeidae which bear setae, but it would be difficult to find a more perfect illustration than the present species.

The hepatic spine is the largest borne by the carapace. This spine is set towards the anterior margin of the carapace, lying, in distance measured along the carapace, midway between the epigastric spine and the antennal spine. The latter two spines are subequal in size although the antennal is the more sharply pointed. The epigastric spine is set posteriorly 0·4 of the length of the carapace. The antennal carina is bluntly defined, and glabrous. The supra-orbital margin has no spine and is not dentiform. The rostrum of the only specimen available is broken at the level of the tip of the antennular peduncle, but it is evidently strongly upcurved. It bears large teeth on both the dorsal and the ventral margins, one tooth in addition to the epigastric spine being borne by the carapace. The glabrous post-rostral carina is bluntly defined, decreasing rapidly in height after the epigastric spine, and ceasing entirely at about 6/7th of the carapace.

The first four abdominal segments are rounded dorsally, although posteriorly on the fourth segment there is some indication of a more angular mid-dorsal line. The fifth segment is bluntly carinate in the posterior 2/3rd while the sixth segment carries a high, blunt carina which terminates posteriorly in a strong tooth. The posterior border of the fourth and fifth segments is emarginate in the mid-dorsal line, more deeply so in the fifth than in the fourth segment. The sixth abdominal segment, which has a ratio length: depth (measured at the posterior end) of about 1·6:1, bears a spine, subequal in size to the dorsal spine, at each postero-inferior angle. The telson is a little longer than the sixth abdominal segment, but it is well surpassed by the uropod elements. The margins of the telson are armed with four pairs of movable spines set at about 0·16, 0·22, 0·28, and 0·47 from the tip.

The large cornea, in its longer diameter 0·28 the length of the carapace, is carried on a long eye-stalk. The upper surface of the basal segment of the eye-stalk bears a long, sharp spine, directed anteriorly, while a large, broad-based tooth, directed dorsally, is borne at the outer margin of the second segment. The slender prosartema attains mid-way between the end of the eye-stalk and the distal border of the cornea.

The first segment of the antennular peduncle bears a short spine at its outer distal angle. The antennular flagella are short, being about equal in length to the distal two segments of the peduncle taken together. The basicerite bears a prominent spine on its ventro-distal margin. The scaphocerite, the lateral spine of which falls short of the tip of the lamina, exceeds considerably the tip of the antennular peduncle.

The third maxilliped bears long setae on the inner margins; it, and the third leg, just surpass the apex of the antennular peduncle. The first leg reaches to about half way along the first segment of the antennular peduncle: the second leg exceeds the carpocerite by the entire chela: the fourth leg almost attains the distal margin of the carpocerite, while the fifth leg attains the proximal margin of the carpocerite. Well developed spines are borne by the basis and the ischium of the first leg, and by the basis of the second leg. The carpus and the propodus of the fourth and fifth legs are seen to bear spines on their rear margin, the positions of which spines are indicated in Plate 18, Fig. 6. All of the pereiopods bear an exopodite, the size of the structure decreasing posteriorly. A mastigobranch is carried by the second and third maxillipeds and by the first three pereiopods.

The anterior plate of the thelycum, in ventral view, gives the appearance of a "V" with the opening directed posteriorly: the paired lateral plates are in the form of a horse-shoe with the opening directed anteriorly. There is thus formed in the centre line a deep excavation, the deepest part being at the anterior end. A smooth posterior ridge, concave in its anterior margin, is present. This thelycum is in entire agreement with that figured by de Man 1924 Fig. 10.

This description is based on a single specimen, a female of 2·0 cm. carapace length: there is very close agreement with the original description. This specimen was taken by hand from a coral reef at Pulau Sudong, an island off the South coast of Singapore Island. It is noted that de Man (1924) recorded the species as rare.

Genus **Metapenaeus** Wood-Mason and Alcock

Metapenaeus mastersii (Haswell)

Penaeus monoceros H. Milne-Edwards 1837.
Penaeus mastersii Haswell 1879, 1882.
Penaeus affinis Kishinouye 1900.
Parapenaeus affinis Rathbun 1902.
Penaeopsis affinis de Man 1911.
Penaeopsis affinis Kemp 1915, 1918 (Part).
Metapenaeus affinis Kubo 1949.
Metapenaeus burkenroadi Kubo 1954, 1955.
Metapenaeus mastersii Racek 1955a, 1955b.
Metapenaeus affinis Hall 1956.
NOT *Penaeus affinis* H. Milne-Edwards 1837.
Metapenaeus affinis Alcock 1906.

Many authors for many years have considered *"Penaeus affinis"* to be one of the most "settled" species, taxonomically, of the Penaeidae, but the identification of *Penaeus* (*Penaeopsis, Metapenaeus*) *affinis* auctorum (e.g. de Man 1911) with H. Milne-Edwards' *Penaeus affinis* is false: equally false is the identification by Kubo (1954) of Alcock's *Metapenaeus affinis* (Alcock op. cit.) with *Penaeus affinis* H. Milne-Edwards (op. cit.). A full explanation of this statement is given here under the heading of *"Parapeneopsis affinis* (H. Milne-Edwards)".

The species which authors (e.g. de Man 1911) have considered to be *Penaeus affinis* was described by H. Milne-Edwards in his Histoire Naturelle des Crustacés under the name of *Penaeus monoceros*. The Milne-Edwardian type specimen of *Penaeus monoceros* is still lying in the Muséum National d'Histoire Naturelle, Paris, and has been examined by the present author (May 1957). It is a female of 1·95 cm. carapace length, and although somewhat damaged, it may be identified readily, but as there are extant no Fabrication type specimens (Holthuis 1949) it is not possible to determine whether or not Milne-Edwards' *Penaeus monoceros* is *Penaeus monoceros* Fabricius 1789.

There is a mass of literature devoted to a well known and economically very important species of penaeid prawn which has long been identified with *Penaeus monoceros* Fabr., but which is certainly not the Milne-Edwardian species of that name. The species *Penaeus affinis* auctorum (= *Penaeus monoceros* H. Milne-Edwards) is also an economically important species on which ecological and biological studies have been conducted. These two species have been confused frequently in the past, and were it

supposed that Milne-Edwards was correct in his identification of *Penaeus monoceros*, further undesirable complications inevitably must result. To insist on Milne-Edwardian infallibility in this respect would be to render a great disservice to the students of the Penaeidae. It is proposed to consider therefore that the specific name "monoceros" used by Milne-Edwards, 1837, was invalid, being preoccupied by the Fabrician species *Penaeus monoceros* for which species it is proposed to choose neotypes.

Haswell's Australian species *Penaeus mastersii* has been re-established recently by Dr. A. A. Racek (1955a) after a re-examination of a cotype. Although the photographs illustrating Racek's paper are good, they do not compare favourably with critical line drawings. However, the description and illustrations are sufficient to establish that *Metapenaeus mastersii* (Haswell) is the *Penacus affinis* auctorum. Obviously it is a species with a very wide distribution in the Indo-West Pacific.

Metapenaeus spinulatus Kubo. Plate 17, Fig. 4

Metapenaeus spinulatus Kubo 1949.
Metapenaeus spinulatus Hall 1956.

The male of this species, which had not been recognised previously, has now been taken in the commercial prawn catch of a prawn pond at Jurong.

The petasma is similar to that of *Metapenaeus brevicornis* (H. Milne Edwards), and even more closely related to *M. joyneri* (Miers) and *M. tenuipes* Kubo. Of these four species which have a similar petasma, *M. brevicornis* (H. Milne Edwards) may be distinguished by having the disto-lateral projections of the petasma directed outwards at an angle of about 45° to the mid-line of the petasma (Alcock 1906. Pl. 4. Fig. 10a.): the three species, *M. joyneri* (Miers), *M. tenuipes* Kubo and *M. spinulatus* Kubo have the disto-lateral projections diverging only slightly from the mid-line (Kubo op. cit. Fig. 31C, D, G, H. and the present Plate 18. Fig. 4). The main apparent distinction between the petasma of the three remaining species lies in the length of these disto-lateral projections. Kubo states in his key (op. cit. p. 108) that the disto-lateral projections of *M. tenuipes* Kubo are 1/5th as long, and of *M. joyneri* (Miers) 1/4th as long as the rest of the petasma, yet the illustrations of this feature show the projections of *M. tenuipes* Kubo to be the longer. However, in neither case do the disto-lateral projections attain the tip of the curved median projections, while in the specimens of *M. spinulatus* Kubo to hand, they almost attain, or even surpass slightly the tips of the median projections.

The males of *Metapenaeus spinulatus* Kubo follow closely the morphological characteristics detailed for the female in the original description. It may be noted, since the features serve to distinguish between this species and the two species, *M. joyneri* (Miers) and *M. tenuipes* Kubo, that the body is quite without setose depressed areas, the rostral crest is markedly elevated, and the ischium of the second leg carries a small spine.

Metapenaeus mutatus (Lanchester)

Penaeus mutatus Lanchester 1901.
Metapenaeus affinis Alcock 1905, 1906.
Penaeopsis affinis Kemp 1915, 1918 (part).
Metapenaeus affinis Kubo 1954.
Metapenaeus necopinans Hall 1956.

During the preparation of The Malayan Penaeidae, Part I, the present author realised that the species described by Alcock (1906) under the name of *Metapeneus affinis* differed from *Metapenaeus affinis* auctorum as described, for example, by Kishinouye (1900) and de Man (1911). As the identity of Alcock's species with Lanchester's *Penaeus mutatus* was not then appreciated, the species was re-described under the name of *Metapenaeus necopinans*. Opportunity is taken to correct the nomenclature.

The type specimens of *Metapenaeus mutatus* (Lanchester) are a male and a female of 2·8 cm. and 2·2 cm. carapace length respectively. They are lying in the Cambridge University Museum of Zoology and have been examined by the present author (May 1957). The male lacks all of the pereiopods of the left-hand-side, and three of those from the right-hand-side. The remaining pereiopods, the third and the fourth on the right-hand-side, are damaged distally. The antennular flagella are missing, and the rostrum is cracked immediately posterior to the distal tooth, but the petasma is entire and the rest of the specimen too is in good condition. The female possesses completely the first three pairs of pereiopods: the fourth and fifth pereiopods of the right-hand-side are damaged slightly, while those of the left-hand-side appear to have been dissected off. Both the antennular and the antennal flagella are absent, and the rostrum is cracked at ⅓ of its length from the tip. Otherwise the specimen is quite sound.

Comparing the two type specimens with the description of the species given by the present author (1956) under the name of *Metapenaeus necopinans* the following differences are noted:

1. The basicerite of the type specimens has no tooth on the outer distal margin.
2. In the female, the ischium of the first pereiopod of the left-hand-side bears a distinct although minute spine, while an even smaller spine was found in the corresponding position of the right-hand-side. The male itself could not be checked for this feature, and none of the debris in the bottle could be identified as a first leg of the male.
3. The rostrum of the female is almost perfectly straight, although that of the male is somewhat sigmoid as described (op. cit.).
4. The petasma of the male is a more robust structure than that illustrated by the present author (op. cit. Pl. 12. Fig. 16.) and the disto-median protuberances are directed more laterally, but not to the extent featured by Lanchester (op. cit. Pl. 34. Figs. 6b, 6c.).

In all other features which could be checked, perfect agreement was found. The first three discrepant features listed above appear to be intra-specific, while the fourth, the condition of the petasma, is to be ascribed entirely to a difference in size; the type male is considerably larger than any other male of the species examined by the present author. The synonymy of *Metapenaeus necopinans* Hall with *M. mutatus* (Lanchester) cannot be doubted.

Genus **Atypopeneus** Alcock

Atypopeneus stenodactylus (Stimpson). Plate 18, Fig. 7

Penaeus stenodactylus Stimpson 1860.
Penaeus compressipes Henderson 1892.
Atypopeneus compressipes Alcock 1906.
Atypopenaeus compressipes de Man 1911.
Parapenaeopsis brevirostris Kubo 1936.
Atypopenaeus compressipes Kubo 1949.

The only distinctions between *Atypopeneus stenodactylus* (Stimpson) and *Atypopeneus compressipes* (Henderson) given by de Man—who, in fact noted that these species are ". . . perhaps identical . . ." and Kubo (1949) are:—

1. The posterior quarter of the carapace of *A. stenodactylus* is noted by Stimpson (op. cit.) as not carinate, while the specimens studied by de Man, Kubo and Henderson have a post-rostral carina extending almost to the posterior margin of the carapace.
2. Stimpson noted that the carapace of *A. stenodactylus* is finely granulate dorsally, which granulation appears to be absent from de Man's, Kubo's and Henderson's specimens.
3. The third maxillipeds of *A. stenodactylus* surpass the antennal scale.

The present author has available for examination only a single specimen, a female of 1·2 cm. carapace length. Considering the dorsal carination of the carapace and the abdomen, the single Singapore specimen shows the post-rostral carina defined clearly for 5/6th the length of the carapace, after which the carina becomes ill-defined quickly, and ceases entirely at 11/12th of the carapace. The second to sixth abdominal segments bear a dorsal carina; that of the second segment is short, occupying the centre 1/3rd of the mid-line, but it is distinct, while the carina of the third segment is defined clearly throughout the posterior 2/3rd of the mid-line. Stimpson, Henderson and Alcock (it is to be observed that the illustration by Alcock (op. cit. Pl. 9. Fig. 29) shows a broken rostrum) noted that the abdomen is carinate dorsally only on segments four, five and six, although the latter two authors remarked on the presence also of a faint carina on the third segment, while de Man (op. cit.) and Kubo (1949) both described a condition similar to that observed by the present author. Kubo (1949 p. 368) noted that the carination of the abdomen may vary with age. It seems not improbable that this variation may be found also to some extent in the post-rostral carina: such a variation in the entire dorsal carination could account for the varying descriptions which have been given.

Henderson, Alcock and Kubo, other than noted in the first paragraph above, made no comment on the nature of the surface of the carapace. The Singapore specimen agrees with the description given by de Man (op. cit.) in the pubescence of the branchial regions, while almost the whole of the carapace gives the appearance of being minutely granulate.

The fact that the third maxilliped does not surpass the tip of the antennal scale in *A. compressipes* (Henderson) cannot be regarded as a distinction between that species and *A. stenodactylus* (Stimpson). Alcock, de Man and Kubo (1949—by inference, although a misquotation may be noted) and the present author all examined specimens in which the third maxilliped did not attain the tip of the scaphocerite, yet the original descriptions of both of the above named species (Stimpson op. cit. Henderson op. cit. Pl. 40. Fig. 21) indicate the alternative.

In other respects the descriptions given by the later authors agree well with the original description by Stimpson, and I can regard *A. compressipes* (Henderson) only as a synonym of *A. stenodactylus* (Stimpson).

The single S.R.F.R.S. record is:

B 78. Off Tanjong Stapa, 17 fm. Mud.

Genus **Parapeneopsis** Wood-Mason (emend)

Parapeneopsis tenella (Bate)

Penaeus tenellus Bate 1888.
Penaeus tenellus Kishinouye 1900.
Parapenaeopsis tenella de Man 1911.
Parapenaeopsis tenellus Kubo 1949.
Parapenaeopsis tenellus Liu 1955.

The Singapore specimens of this species, which to date have all been female, agree well with the description given by Kubo (op. cit.) and other authors, there being only slight differences in the lengths of the last three pereiopods, while a small post-ocular groove is noted which Kubo states is not present in his material.

S.R.F.R.S. records for this species are:

B 45. Outer Shoal, 6 fm. Mud/stone.

B 66. South of Singapore, 24 fm. Stone/shell.

B 74. South of Singapore, 50 fm. Clean bottom.

B 78. Off Tanjong Stapa, 17 fm. Mud.

B 79. Off Tanjong Stapa, 23 fm. Clean bottom.

Parapeneopsis maxillipedo Alcock

Parapeneopsis maxillipedo Alcock 1905, 1906.
Parapenaeopsis cornuta de Man 1911.
Parapenaeopsis maxillipedo Kubo 1949.

The condition of the Singapore specimens agrees closely with the original description and illustrations given by Alcock (1905, 1906).

In some respects the Singapore specimens might be considered to be intermediate between *P. maxillipedo* Alcock and *P. cornuta* (Kishinouye). Although it is possible that geographic segregation may have enabled *P. maxillipedo* Alcock to achieve the status of a species, I suspect that Alcock's species, although superficially distinct, is but a geographic variety of *P. cornuta* (Kishinouye). The Singapore specimens differ from *P. maxillipedo* Alcock in the dorsal carination of the carapace. The epigastric spine is not nearly so well pronounced in the Singapore specimens, and the post-rostral carina is sharp and prominent only immediately posterior to that spine; further back, the post-rostral carina is faintly grooved for a short distance (de Man 1911), the position of this indentation being about half-way between the epigastric spine and the rear border of the carapace. Posterior to the faint groove, the post-rostral carina continues, bluntly rounded, to the posterior margin of the carapace.

Of the basial spines borne by the legs Alcock (1906 p. 41) remarked "The basal spines of the chelipeds are big, and in the female there is one on the 3rd chelipeds as well as on the 1st and 2nd", which presumably indicates that the spine on the basis of the third leg is subequal to the other spines. The third leg of the female of *P. cornuta* (Kishinouye) has no basial spine (Kubo op. cit.). The third leg of both the females and the males of adult Singapore specimens posses quite clearly a basial spine, but the spine is small.

The basicerite of the Singapore specimens bears a prominent spine, which spine is illustrated by Alcock (1906 Pl. 8. Fig. 24) whereas *P. cornuta* (Kishinouye) has no such spine (Kubo op. cit.).

The petasma seems to be identical in the two species *P. maxillipedo* Alcock and *P. cornuta* (Kishinouye), and the thelycum nearly so. The specimens examined by the present author agree with both descriptions, there being only a slight difference in the form of the post-thelycal ridge (see also de Man 1911).

Should it be demonstrated that *P. maxillipedo* Alcock is but a variety of *P. cornuta* (Kishinouye) then the latter name must of necessity take precedence, but until such time the former name is to be preferred for the Singapore specimens.

Parapeneopsis maxillipedo Alcock may form a high percentage of Singapore Sungdong net catches.

S.R.F.R.S. records for the species are:

B 69. Siglap beach. Muddy sand substratum.

—— Changi Beach. Muddy sand substratum.

Parapeneopsis cultrirostris Alcock

Parapeneopsis sculptilis var. *cultrirostris* Alcock 1906.
Parapenaeopsis cultrirostris Kubo 1949.

A single specimen only, a male of 1·55 cm. carapace length, has been taken by the S.R.F.R.S. It shows no discrepancies with the accounts given by Alcock (op. cit.) and Kubo (op. cit.), but with reference to the latter work, it should be noted that the illustration of this species is on page 388 (Fig. 140) under the name of *P. hardwickii*.

The S.R.F.R.S. record is:

B 77. Off Tanjong Stapa, 6–7 fm. Mud.

Parapeneopsis hungerfordi Alcock

Parapeneopsis hungerfordi Alcock 1905.
Parapenaeopsis hungerfordi Burkenroad 1934b.
Parapenaeopsis hungerfordi Kubo 1949.

The adult females are found to be considerably larger than the adult males as indicated below:

Specimens	CARAPACE LENGTH	
	Range (cm.)	Mean length (cm.)
19 males	1.31 - 1.69	1.54
48 females	1.42 - 2.98	1.81

Further sexual dimorphism is found in respect of the relative lengths of the carapace and the sixth abdominal segment. Kubo (op. cit. p. 382) noted that the sixth segment is ". . . about half the length of carapace, . . ." but this is seen to be correct only for the smallest of the specimens examined by the present author. When the length of the sixth abdominal segment is plotted against the carapace length (Text Fig. 1) it is seen that the points for the males and the females fall into two readily distinguishable groups, the females having the relatively shorter sixth segment. The points for the males and for the smaller females conform approximately to the straight lines:

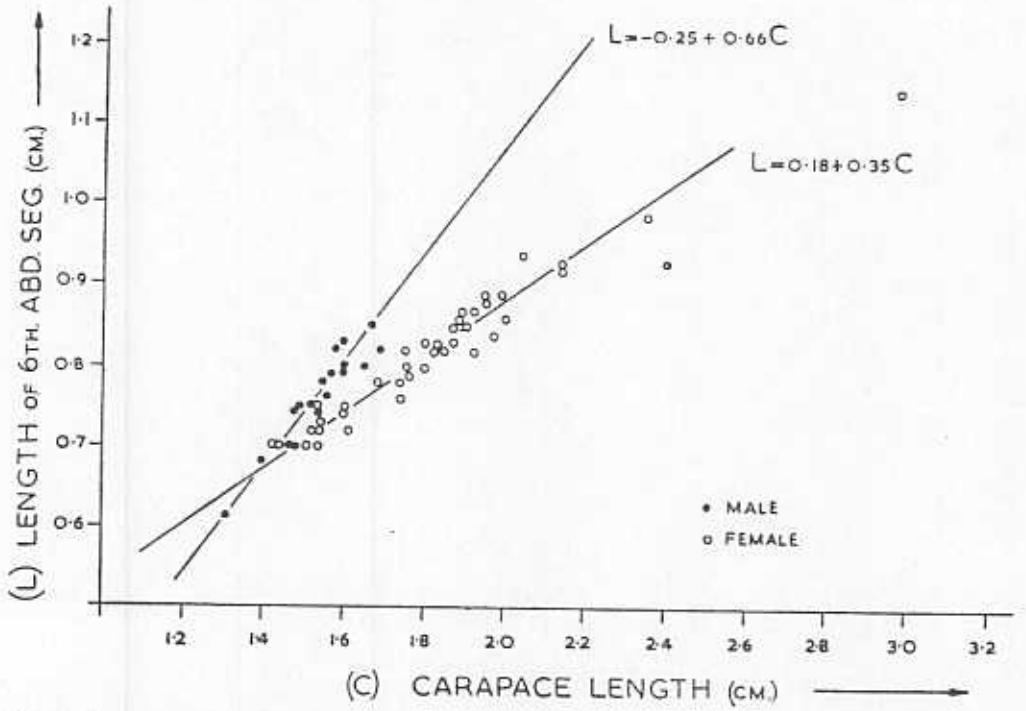

Fig. 1. *Parapeneopsis hungerfordi* Alcock. Relative growth rate of the sixth abdominal segment in the two sexes.

Male $L = -0{\cdot}25 + 0{\cdot}66C$

Female $L = 0{\cdot}18 + 0{\cdot}35C$

where L = length of the sixth segment.

C = carapace length.

Text Figure 1 indicates a possible decrease in the relative growth rate of the sixth abdominal segment in the larger females.

The rostrum of *P. hungerfordi* is subject to considerable variation. In no case was the rostrum found to be straight. In all of the males and in the smaller females it is slightly decurved posteriorly and upcurved anteriorly, while in the largest females it is markedly sigmoid. In 38 cases the rostral teeth were found to be distributed along the

length of the rostrum, but in a further 29 cases the teeth were so arranged as to leave a marked edentate anterior portion, varying in length from 1/4 to 1/3rd the length of the rostrum. The relative frequencies of the rostral forms are indicated below:

Specimens		Rostral teeth (excluding the epigastric spine)				
		5	6	7	8	Total
Male ..	Edentate anterior tip	..	7	2	..	9
	Uniformly dentate	..	1	9	..	10
Female ..	Edentate anterior tip	1	8	11	..	20
	Uniformly dentate	..	1	26	1	28
	Total ..	1	17	48	1	67

The first abdominal segment of some of the specimens to hand shows a faint double dorsal carina set in the anterior half of the segment, the second segment being rounded dorsally. The cervical groove is ill-defined and the branchio-cardiac groove barely recognisable. The outer distal margin of the basicerite and the dorsal surface of the basal segment of the eye-stalk both bear a well defined spine directed anteriorly.

All of the material examined by the present author is in the collection of the Raffles Museum, having been taken from the Singapore Fish Market during February 1934 and January 1935. No specimen has been taken by the S.R.F.R.S.

It may be noted that Kubo (op. cit.) illustrated *P. hungerfordi* Alcock on page 381 (Fig. 137) under the name of *P. cultrirostris*.

Parapeneopsis gracillima Nobili. Plate 18, Fig. 8

Parapeneopsis gracillimus Nobili 1903a.
Parapenaeopsis dofleini Balss 1913.
Parapenaeopsis gracillima Kubo 1949.

The Singapore specimens conform to the description given by Kubo (op. cit.). It may be noted that the scaphocerite barely attains the tip of the antennular peduncle in three males examined by the present author, and surpasses the tip only slightly in five females. The only other two specimens available, both females, are damaged in this feature. Six females possess the spine on the basicerite noted by Kubo, but the remaining female and the three males are devoid of this spine.

Concerning the differences noted by Kubo to exist between the specimens he examined and the description given by Balss (op. cit.), the Singapore specimens agree with Kubo in the longitudinal suture of the carapace reaching to ¾ of the carapace and in the first pereiopod surpassing the distal end of the basicerite by half of the dactylus. The length of the fifth leg in the only two undamaged Singapore specimens is intermediate between those of Balss and those of Kubo, surpassing the antennular peduncle by the dactylus and ¾ of the propodus.

The specimens to hand show the rostrum to be markedly sexually dimorphic, the male specimens having a very abbreviated rostrum, very different from the long, sigmoid, styliform tipped structure of the female. The overall size of the specimens appears to indicate sexual dimorphism too, the three adult males having a mean carapace length of 1·81 cm. while the seven females, which have a range of carapace length 2·02 to 2·53 cm., have the mean at 2·38 cm.

The ten specimens examined by the present author are all in the collection of the Raffles Museum, none having been taken by the S.R.F.R.S.

Parapeneopsis hardwickii (Miers)

Penaeus hardwickii Miers 1878.
Penaeus sculptilis Henderson 1893 (Part).
Parapeneopsis sculptilis var. *hardwickii* Alcock 1906.
Parapenaeopsis hardwickii Burkenroad 1934b.
Parapenaeopsis hardwickii Kubo 1949.

Apart from the unimportant points noted below, there is excellent agreement between the condition of the Singapore specimens of this species and the description given by Kubo (op. cit).

The third leg surpasses slightly the carpocerite. Kubo stated (op. cit. p. 386) "Third (leg) surmounts scaphocerite by a third of chela; . . ." but his illustration of the species, which it should be noted occurs on page 383 (Fig. 138) under the name of *P. hungerfordi*, indicates that he meant carpocerite, not scaphocerite. The fifth leg exceeds only slightly the carpocerite, not by the chela as stated by Kubo. The dorso-lateral spinules of the telson are not uniformly minute: the most posterior pair of these spinules is found to be considerably larger than those anterior to it.

The Singapore records for this species are:

B 28. Shoal west of Raffles Light, 5–6 fm. Shell/mud/sand.
B 64. South of Bedok, 22 fm. Clean bottom.
B 65. South of Bedok, 24 fm. Clean bottom.
B 66. South of Singapore, 24 fm. Stone/shell.
B 69. Siglap beach. Mud/sand.
B 73. South of Singapore, 38–42 fm. Clean bottom.
B 74. South of Singapore, 50 fm. Clean bottom.
B 75. South of Singapore, 35 fm. Clean bottom.
B 77. Off Tanjong Stapa, 6–7 fm. Mud.
B 78. Off Tanjong Stapa, 17 fm. Mud.
B 79. Off Tanjong Stapa, 23 fm. Clean bottom.

Parapeneopsis affinis (H. Milne-Edwards)

Penaeus affinis H. Milne-Edwards 1837.
Penaeus sculptilis Heller 1868.
Penaeus sculptilis Henderson 1893 (Part).
Parapenaeopsis sculptilis Nobili 1903a, b.
Parapeneopsis sculptilis Alcock 1906.
Parapeneopsis sculptilis Burkenroad 1934b.
Parapenaeopsis sculptilis Kubo 1949.

The type specimen of H. Milne-Edwards' *Penaeus affinis* is a female of 3·2 cm. carapace length. It is lying in the Muséum National d'Histoire Naturelle, Paris, and has been examined by the present author (May 1957). The abdomen and the cephalothorax are separated, but attached to one another by a piece of thread. The rostrum, which has eight teeth in addition to the epigastric spine, is entire, although cracked at its base between the first two proximal teeth. The antennular and antennal flagella are missing, as is also the tip of the telson. Notwithstanding the damage, it may be identified readily as *Parapeneopsis sculptilis* auctorum e.g. Heller 1868 and Alcock 1906, and indeed it was so identified in October 1936 by Professor Th. Monod, a note to the effect in his hand being enclosed with the specimen. The appreciation that this, and not *Metapenaeus mastersii* (Haswell) (— *Penaeus* (*Penaeopsis, Metapenaeus*) *affinis* auctorum), is the species of which Milne-Edwards wrote "Cette espèce ne diffère que fort peu du *P. indien,* dont elle se distingué cependant facilement par l'absence de dents sur le bord inférieur de rostre, . . ." enables the comment to be appreciated.

The five female specimens examined by Kubo (op. cit.) were obtained from Singapore, and with his description the twenty Singapore specimens examined by the present author, all of which are in the collection of the Raffles Museum, none having been taken by the S.R.F.R.S., agree in every respect.

In smaller females, including the type specimen, the anterior median plate of the thelycum is not semicircular in outline, but takes the form of a triangle with concave sides, which feature is well illustrated by Alcock (op. cit. Pl. 7. Fig. 22d): in larger females the thelycum has the appearance illustrated by Kubo (op. cit.).

The adult females are found to be considerably larger than the adult males as indicated below:

Specimens	CARAPACE LENGTH	
	Range (cm.)	Mean length (cm.)
7 males	2.30 – 2.63	2.45
13 females	2.60 – 4.27	3.61

Sexual dimorphism is marked also in the form of the rostrum, that of the male not possessing a recurved anterior portion. With regard to the rostral teeth, the nineteen undamaged Singapore specimens examined were distributed as follows:—

Sex	Rostral teeth (excluding the epigastric spine)			
	6	7	8	Total
Male	1	5	..	6
Female	..	5	8	13
Total ..	1	10	8	19

Parapeneopsis venusta de Man. Plate 18, Figs. 9, 10

Parapeneopsis venusta de Man 1907.
Parapenaeopsis venusta de Man 1911.

The body is uniformly smooth save for a small tomentose area around the epigastric spine and a second around the hepatic fossa. The carapace has a well developed antennal spine, an epigastric spine positioned above the hepatic spine with which it is subequal in size, and a small supra-orbital spine. The only well defined carina borne by the carapace is the anterior hepatic, which carina is adorned by a row of short setae which overlie the well marked hepatic groove. The post-rostral carina is confined to the buttress of the epigastric spine, the carapace being rounded dorsally posterior to this. Ill-defined cervical, antennal and posterior hepatic grooves are present and in addition there is a small post-ocular groove. The horizontal suture of the carapace ceases above the hepatic spine: a transverse suture is found at the level of the third pereiopod.

The rostrum is short and straight, directed slightly upwards, and does not attain the distal margin of the first segment of the antennular peduncle. It bears, in addition to the epigastric spine, eight teeth which are distributed along its length, the proximal tooth lying on the carapace.

The abdomen is carinate only on segments four, five and six, the carina terminating posteriorly in a spine. The sixth segment, which has a ratio length: depth (measured at the posterior end) of about 1·6:1, bears a small spine also at each postero-inferior angle. The telson, which is almost the same length as the sixth abdominal segment, is armed on its lateral margins with four pairs of small movable spines.

In its longer diameter the cornea is 1/4 the length of the carapace. The basal segment of the eye-stalk may or may not possess a prominent spine on its upper distal margin. The prosartema is small, not attaining the distal end of the eye-stalk: the stylocerite is also small attaining only about 1/4 to 1/3rd the length of the longer diameter of the cornea. The first segment of the antennular peduncle bears a spine at its outer distal angle. The antennular flagella are subequal in length, somewhat longer than their peduncle, but shorter than the carapace. The basicerite bears a distinct spine on its outer distal margin. The scaphocerite, both the lamina and the lateral spine, attains the apex of the antennular peduncle.

The third maxilliped is robust and setose; it extends to or a little further than about half-way along the second segment of the antennular peduncle. The first leg just surpasses the basicerite; the second and fourth legs reach to about half-way along the diameter of the cornea; the third leg reaches to about half-way along the second segment of the antennular peduncle, while the fifth leg reaches about half-way along the scaphocerite. The only spine borne by the legs is on the basis of the first leg: this spine is slender. All of the legs carry an exopodite, but a mastigobranch is borne by the first and second maxillipeds only.

The anterior median plate of the thelycum gives the appearance of a "spade" from a pack of cards. The paired posterior plates are pointed antero-laterally and have a concave anterior margin. The petasma is similar to that of *P. tenella* (Bate) bearing distally on each side a laterally directed horn, but in the present species the petasma generally is a more slender structure. Distally the petasma bears a pair of lobes, while from the proximal anterior (dorsal) surface there is directed laterally a pair of elongated, compressed, variably curved projections (marked "A" Pl. 19. Fig. 9).

Parapeneopsis venusta de Man is a small species, apparently fully adult males having a carapace length considerably less than 1 cm. In some respects *P. venusta* de Man resembles *P. tenella* (Bate), but apart from the petasmal and thelycal differences it may be distinguished by:

1. The presence of an epigastric spine.
2. The absence of a spine from the basis of the second leg.
3. The telson is armed with four pairs of movable spines.

From *P. nana* Alcock, which is also a small species and has a thelycum of similar form, although the petasma is quite different, the present species may be distinguished by:

1. The very much shorter rostrum.
2. The much shorter horizontal suture of the carapace.
3. The almost complete absence of a post-rostral carina.
4. The presence of four pairs of movable spines laterally on the telson.
5. The absence of a mastigobranch from the first and second legs.

This description is based mainly on a male and a female of 0·9 cm. and 1·3 cm. carapace length respectively. The male of this species has not been described previously.

S.R.F.R.S. records are:

B 25. Outer Shoal, 6 fm. Mud/shell/stone.
B 60. South of Bedok, 22 fm. Clean bottom.
B 65. South of Bedok, 24 fm. Clean bottom.

Parapeneopsis probata sp. nov. Plate 19, Figs. 11, 12, 13

The body is glabrous although the carapace is finely punctate dorsally. The carapace bears a large antennal spine, a well developed hepatic spine placed a little posterior to the epigastric spine, and a distinct though blunt supra-orbital spine. The antero-inferior angle of the carapace is distinctly dentiform. The hepatic groove is well marked both anterior and posterior to the hepatic spine. The cervical groove is distinct and occupies about 1/3rd of the distance between the hepatic spine and the posterior end of the mid-dorsal line of the carapace. The antennal groove is rather indistinct. A short branchio-cardiac groove is present, and a post-ocular groove, usually shallow, is placed at the base of the proximal rostral tooth (excluding the epigastric spine). The hepatic carina is defined sharply anteriorly where it ceases abruptly posterior to the base of the pterygostomian tooth, but it is only blunt posteriorly. The antennal carina is defined bluntly; the cervical carina is rounded. A horizontal suture extends from the post-orbital margin for about ⅔ the length of the carapace, and a short vertical suture across the branchiostegite is present at the level of the third leg.

The rostrum shows considerable variation with age and sex. Rarely is the tip of the rostrum not styliform and recurved: of 28 specimens examined by the present author (13 males, 15 females), only a single male, of 2·3 cm. carapace length, exhibited a rostrum which was almost uniformly toothed and not recurved at the tip. The adult females in particular exhibited a markedly sigmoid rostrum with the anterior 1/3rd styliform, devoid of teeth. In no male did the rostrum surpass the tip of the antennular

peduncle, but in only a single female, of 3·1 cm. carapace length, of the six specimens which had a carapace length greater than 1·7 cm. did the rostrum fail to surpass the apex of the antennular peduncle (marked † in the table below). The analysis of the rostral teeth, excluding the epigastric spine, of the 28 specimens studied showed:

Sex	ROSTRAL TEETH								Remarks
	4	5	6	7	8	9	10	Total	
Male ..	1*	..	..	..	..	10	2	13	* Rostrum not broken but teeth appear malformed.
Female ..	..	1†	..	..	1	10	3	15	† No apparent malformation.
Total ..	1	1	..	..	1	20	5	28	

The post-rostral carina extends to, or almost to, the rear border of the carapace, and in the adult bears a well marked median groove which is reduced in width towards the middle of its length and is tapered at each end. On each side of the post-rostral carina, in life, towards the posterior border of the carapace, is a well defined reddish area.

The abdomen is carinate dorsally from 1/3rd of the third segment backwards: the first two segments are rounded dorsally. In small specimens the carina of the third segment is less distinct than in adults. The sixth abdominal segment, which has a ratio of length: depth (measured at the posterior end) of about 1·5:1 bears a spine at the termination of the dorsal carina and a spine at each postero-ventral angle. The fourth and fifth segments are incised in the mid-dorsal posterior margin.

The telson, which is slightly longer than the sixth abdominal segment, is well surpassed by both the inner and the outer uropod elements. Dorsally it bears a median sulcus: it is quite unarmed.

The basal segment of the eye-stalk bears on the inner dorsal surface a prominent spine which is directed anteriorly. The eye, measured in the longer diameter of the cornea, is about 1/5th the length of the carapace. The prosartema is short in length, just attaining the distal end of the eye-stalk: the stylocerite reaches to about the middle of the cornea. The basal segment of the antennular peduncle bears a marked elevation on the distal dorsal margin, and a spine at the distal outer angle. The second segment of the antennular peduncle is about twice the length of the distal segment. The antennular flagella are as long as their peduncle, about half the length of the carapace. The basicerite bears a very prominent spine on the distal outer margin. The lateral spine of the scaphocerite attains or surpasses slightly the apex of the antennular peduncle and is in turn surpassed slightly by the lamina of the scale. Measured at its widest the scaphocerite is about 2½ times as long as wide.

The third maxilliped surpasses slightly the carpocerite. The segments of this appendage are robust, and ventrally and laterally bear long setae particularly on the inner margin, the dorsal surface being glabrous. The first leg is short and stout, barely attaining the tip of the pterygostomian spine. It bears a stout, curved basial spine: the second leg attains the proximal margin of the carpocerite and bears in the adult female a short

stout basial spine; the male and the juvenile female may or may not have a small basial spine; the third and fifth legs attain the distal margin of the carpocerite; the fourth leg attains about the same level as the second leg. The first two pereiopods bear a mastigobranch. The anterior margin of the second pleopod of the male is produced into a large lamina which bears apically the appendix masculina.

The anterior plate of the thelycum has a curved anterior margin. Partially dividing the plate into three approximately equal parts are two longitudinal blunt ridges. The lateral plates are larger than the anterior plate, and laterally project somewhat behind the transverse sternal ridge. This sternal ridge bears a fringe of setae, and superficially it appears that the setae are set across the centre of the lateral plates.

The petasma is very similar to that illustrated by Alcock (1906. Pl. 8. Fig. 25a.) for *Parapeneopsis uncta* Alcock, and there is a most marked similarity between that species and the species described here: it may be that the present species is but a geographic variety of *P. uncta* Alcock, but the following features are at variance with the description and illustration given by Alcock (1905, 1906):—

1. The rostrum has a styliform tip.
2. The rostrum is usually markedly sigmoid, particularly in the adult female.
3. The rostrum surpasses the tip of the antennular peduncle in the adult female—Alcock had four specimens and it could be that none was an adult female.
4. The antero-inferior angles of the carapace are markedly dentiform.
5. The telson is slightly longer than the sixth abdominal segment, and well surpasses the middle of the inner uropod elements.
6. The second leg of the adult female bears a stout basial spine while a small to minute spine may be borne by this leg in the male and the juvenile female also.

This description is based largely upon two females of 3·1 cm. and 2·8 cm. carapace length, and upon two males of 2·2 cm. and 2·1 cm. carapace length respectively. These specimens are recorded as the syntypes and will be deposited in the British Museum.

S.R.F.R.S. records for this species are:

B 65. South of Bedok, 24 fm. Clean bottom.

B 66. South of Singapore, 24 fm. Clean bottom.

B 73. South of Singapore, 45 fm. Clean bottom.

Genus **Trachypeneus** Alcock (emend)

Trachypeneus curvirostris (Stimpson)

Peneus curvirostris Stimpson 1860.
Penaeus anchoralis Bate 1888 (male only).
Penaeus curvirostris Kishinouye 1900.
Trachypeneus asper Alcock 1905, 1906.
Trachypenaeus anchoralis de Man 1911.
Trachypeneus curvirostris Schmitt 1926.
Trachypenaeus curvirostris Kubo 1949.
Trachypenaeus curvirostris Lui 1955.
Trachypenaeus curvirostris Racek 1955.
NOT *Trachypenaeus asper* Kubo 1949.

In general there is very close agreement between the condition of the specimens examined by the present author and the various accounts which have been published previously: there remains the problem of the validity of the species *Trachypeneus asper* Alcock.

Alcock (1906. Pl. 9. Figs. 28, 28a, 28b.) illustrated a species which is superficially distinct from *T. curvirostris* (Stimpson), in particular the straight rostrum, the wavy anterior edge of the transverse ridge of the thelycum, and the distal "crown" set between the lateral projections of the petasma appear to be distinctive. Schmitt (op. cit.) considered these differences to be intra-specific. This view was not shared by Kubo (op. cit.), who unfortunately confused completely *T. asper* Alcock with a totally distinct species, which is included in this paper under the name of *T. unicus* sp. nov. Kubo's description of *T. curvirostris* (Stimpson) allows of no possibility that the rostrum of large specimens could be straight as illustrated by Alcock for *T. asper*, since the rostrum Kubo's specimens shows increasing curvature with age.

The small specimens of *T. curvirostris* (Stimpson) taken off Singapore Island, of say 1·0 to 1·5 cm. carapace length, follow closely Kubo's account and illustrations of the developing rostrum (op. cit. Figs. 141F, B, E.): the rostrum is straight or only slightly upcurved in these small specimens. The larger offshore specimens which have been taken by the R.V. *Manihine*, of 2·0 to 2·5 cm. carapace length, in general retain the juvenile condition of the rostrum, the greater number having the rostrum straight, directed horizontally, or inclined upwards as depicted by Alcock (1906. Pl. 9. Fig. 28): such specimens appear to be identical with *T. asper* Alcock. Of those large specimens which have the rostrum curved, none has been seen with the curve as strongly accentuated as those illustrated by Kubo (op. cit. Fig. 141C.) and Lui (op. cit. Pl. 4. Fig. 3).

All of the females of up to about 2·0 cm. carapace length have the thelycum depicted by Kubo (op. cit. Fig. 47K.) in which the anterior margin of the transverse ridge is smoothly concave. The majority of the larger females which have been taken offshore show the thelycum illustrated by Alcock (1906. Pl. 9. Fig. 28b.) in which the anterior margin of the transverse ridge is markedly wavy; nor is this condition of the thelycum restricted to specimens with a straight rostrum.

Only two males have been taken offshore: they are both fully adult, and were taken in association with large females demonstrating the features of *T. asper* Alcock. The rostrum of the males is straight and inclined upwards slightly. These specimens must be considered to be males of *T. asper* Alcock, yet the petasma is that illustrated by Bate (op. cit. Pl. 35. Fig. 1″) for *Penaeus anchoralis* and by Kubo (op. cit. Fig. 32 I, J.) for *T. curvirostris* (Stimpson), but not that illustrated by Alcock (1906. Pl. 9. Fig. 28a.).

Trachypeneus asper Alcock must be considered a synonym of *Trachypeneus curvirostris* (Stimpson), and in consequence the following should be noted:—

1. The rostrum is subject to variation, possibly geographic, and the curved form cannot be considered to be a diagnostic feature of the species *T. curvirostris* (Stimpson).
2. The difference in the thelycum is one of age. Although Alcock's and Kubo's specimens were of about the same size, 2·0 and 2·1 cm. carapace length respectively, at about this size the transition to the fully adult form depicted by Alcock takes place.
3. The petasma illustrated by Alcock for *T. asper* must be regarded as an abnormality.

The Singapore records for *T. curvirostris* (Stimpson) are:

B 58. South of Singapore, 32 fm. Sand/stone.
B 59. South of Singapore, 25–30 fm. Clean bottom.
B 60. South of Bedok, 22 fm. Clean bottom.
B 64. South of Bedok, 22 fm. Clean bottom.
B 65. South of Bedok, 24 fm. Clean bottom.
B 73. South of Singapore, 45 fm. Clean bottom.
B 75. South of Singapore, 35 fm. Clean bottom.
B 78. Off Tanjong Stapa, 17 fm. Mud.

Trachypeneus granulosus (Haswell). Plate 19, Fig. 15

Penaeus granulosus Haswell 1879.
Trachypeneus granulosus Schmitt 1926.
Trachypenaeus granulosus Kubo 1949.

The description and illustrations given by Schmitt (op. cit.) are well in accord with the two Singapore specimens available to the present author, both females, of 1·1 and 1·5 cm. carapace length respectively. The following minor differences are noted:—

1. A minute ischial spine is found on the first pereiopod; Schmitt made no comment and it may have been overlooked.
2. The postero-lateral margins of the anterior median plate of the thelycum do not overlap the median posterior projection of that plate.

Schmitt noted that minute spines may be found on the margins of the telson in addition to the distinct movable spines set towards the apex, although according to McNeill's footnote (p. 352) to Schmitt's paper these spines could not be found by members of the staff of the Australian Museum. The Singapore specimens show these spines.

The available Singapore records are:

B 60. South of Bedok, 22 fm. Clean bottom.
—— West of Pulau Pawai, 5 fm. Shell gravel.

Trachypeneus sedili sp. nov. Plate 20, Figs. 18, 19

The carapace and abdomen are heavily setose. The antennal spine is large: the hepatic spine, which is rather small, is placed anterior to the epigastric spine: the supra-orbital spine is well developed. There are no well marked grooves on the carapace, but the antennal groove, the cervical groove and the hepatic groove are discernible. Laterally the only carina which may be distinguished is the antennal. A short horizontal suture can be traced for about half of the distance between the post-orbital margin and the hepatic spine: a vertical suture is present at the level of the third leg.

The rostrum of most of the specimens to hand is markedly upcurved, but a single specimen taken off Singapore Island has an almost straight rostrum. The rostrum attains about the distal margin of the second segment of the antennular peduncle. There are seven to nine rostral teeth excluding the epigastric spine, most of the specimens being in the upper part of this range. The most posterior tooth is borne by the carapace, the preceding tooth being placed above the supra-orbital margin. The post-rostral carina is low, but it may be traced for about 2/3rd of the way towards the posterior margin of the carapace.

The first abdominal segment is rounded dorsally: the second segment bears a small mid-dorsal elevation, while the abdomen is carinate dorsally continuously over the last four segments, the carina terminating in the sixth segment in a stout spinule. The sixth segment, which has a ratio length: depth (measured at the posterior end) of about 1·3:1, bears also a spinule at each postero-ventral angle. The posterior margins of the fourth and fifth segments are incised in the mid-dorsal line.

The telson is a little longer than the sixth segment, and is exceeded by the tips of the uropods. It bears dorsally a deep sulcus, and marginally four pairs of minute movable spinules. The largest pair of spinules is set immediately posterior to the smallest pair, close to the tip of the telson. The other two pairs are set at $\frac{1}{4}$ and a little posterior to $\frac{1}{2}$ of the length of the telson from the apex.

The basal segment of the eye-stalk bears on its dorsal surface a spine, directed anteriorly, subequal in size to, or a little larger than the supra-orbital spine. Measured in the longer diameter, the cornea is 2/7th the length of the carapace. The prosartema reaches to, or falls a little short of the anterior margin of the cornea: the stylocerite extends into the anterior half of the cornea. The basal segment of the antennular peduncle bears on its distal dorsal margin a laminar projection, and at its outer distal angle a spine. The second segment of the antennular peduncle is a little less than twice as long as the distal segment. The antennular flagella are as long as their peduncle, about 2/3rd the length of the carapace. The basicerite bears a small tooth on the outer distal margin. The scaphocerite, the lamina of which surpasses only slightly the lateral spine, barely attains the tip of the antennular peduncle.

The third maxilliped exceeds the carpocerite by the dactylus and about 1/3rd of the propodus. Dorsally its segments are glabrous, but ventrally and on each border, particularly the inner, are borne many long setae. The first leg, which bears a long curved basial spine but only the most minute ischial spine, attains the distal end of the carpocerite: the second leg, which bears a basial spine, surpasses the carpocerite by the entire chela and about 1/5th of the carpus: the third leg attains the distal end of the scaphocerite: the fourth leg surpasses slightly the carpocerite, while the fifth leg falls slightly short of the tip of the scaphocerite. The first three pereiopods bear each a mastigobranch.

The thelycum is distinctive and may be likened to the seat, sides and back of an arm chair, the open side of the structure facing the rear. The median anterior plate forms the "seat", the "back" and part of the "arms", the lateral plates forming the rest of the "arms" and the forward rim of the chair. Postero-laterally, between each elevated lateral plate and the flat ("seat") portion of the anterior plate is a deep depression, not seen readily in ventral view as the lateral plates project somewhat towards the mid-line. Posterior to the structure described above, but positioned considerably more dorsally, is a sternal ridge bowed somewhat posteriorly, bearing a fringe of setae.

This description is based mainly on a single specimen of 1·6 cm. carapace length, caught off Singapore Island. It is recorded as the holotype and will be deposited in the British Museum. Since the examination of the holotype, several more specimens have been taken by the R.V. *Manihine* from the Straits of Malacca, all females, and suitable amendments have been made to the text after the examination of this material.

The presence of a mastigobranch on each of the first three pairs of pereiopods distinguishes this species from all other species of *Trachypeneus* except *T. curvirostris* (Stimpson) which is an Indo-Pacific form, and *T. constrictus* (Stimpson) and *T. similis* (Smith) which are Atlantic forms. The highly characteristic thelycum described above

is quite sufficient to distinguish the present species from *T. curvirostris* and also from the two Atlantic forms, U.S.N. Museum registered specimens of which I have been able to examine. In other respects *T. sedili* is similar to *T. curvirostris* (Stimpson).

The single Singapore record for the species is:

B 65. South of Bedok, 24 fm. Clean bottom.

Trachypeneus unicus sp. nov.

Trachypenaeus asper Kubo 1949.

The prawn which was referred by Kubo (op. cit.) to the species *Trachypeneus asper* Alcock cannot be of that species since it possesses no mastigobranch on the first two pairs of pereiopods. Alcock's *T. asper* had a mastigobranch on each of the first three walking legs; indeed Alcock was unaware that species of *Trachypeneus* not conforming to this arrangement were in existence, hence his inclusion of the feature as one of the diagnostic characteristics of the (sub)genus *Trachypeneus*. (Alcock 1901 p. 15).

A description of the present species has been given by Kubo (op. cit.) and with this description the Singapore specimens are in very close agreement, there being only the following minor differences:—

1. The stylocerite reaches to about half way along the cornea and does not attain the tip of the eye-stalk.
2. In the single male available for study the antennular peduncle surpasses the tip of the rostrum by half of the second and the entire distal segment.
3. The antennular flagella are a little shorter than their peduncle.
4. The ischial spine of the first leg, when present, is minute. Of four specimens available for examination only a single specimen bore an ischial spine, this being found on the right-hand leg of a female.

Trachypeneus unicus is distinguished clearly from *T. curvirostris* (Stimpson), *T. similis* (Smith) and *T. constrictus* (Stimpson) by the absence of a mastigobranch from the first and second legs. There is no median longitudinal ridge on the anterior plate of the thelycum which distinguishes the present species from *T. pescadreensis* (Schmitt), nor does this plate possess the posterior projection characteristic of *T. granulosus* (Haswell). The petasma, which is very similar to that of *T. curvirostris* (Stimpson) does not have the points of the lateral projections curved distally as is the condition in *T. salaco* de Man.

A male of 1·25 cm. and a female of 2·3 cm. carapace length are recorded as the type specimens and will be deposited in the British Museum.

Of the four specimens examined, three are in the collection of the Raffles Museum: the single S.R.F.R.S. record is:

B 75. South of Singapore, 35 fm. Clean bottom.

Trachypeneus furcilla sp. nov. Plate 20, Figs. 16, 17

The body is scabrous: the carapace and the first five abdominal segments are tomentose dorsally, while the first five segments are also granulate dorsally. The carapace bears an antennal spine, an hepatic spine set below the epigastric spine, and a small but sharply pointed supra-orbital spine. The antennal carina is defined bluntly anteriorly; no other carina is well developed. Hepatic, antennal, cervical and post-orbital grooves are broad but shallow, excepting a short length of the anterior hepatic groove which is

narrower and more defined. The horizontal suture on the left-hand-side of the holotype can be traced for about half of the distance from the anterior margin of the carapace towards the hepatic spine, but on the right-hand-side it is hardly discernible. A vertical suture is present at the level of the third leg. The rostrum, which in the holotype is a little damaged distally, is inclined upwards and is slightly convex in the lower margin; it bears ten (?) teeth, excluding the epigastric spine, which are distributed along its length, the proximal tooth being placed on the carapace while the second tooth spans the post-orbital margin. The rostrum surpasses slightly the distal margin of the first segment of the antennular peduncle. The post-rostral carina is defined clearly almost to the posterior margin of the carapace.

The first abdominal segment is rounded dorsally: the second bears a very short but sharp dorsal carina, while the remaining segments are carinate continuously from 1/3rd of the third segment. Spinules are borne at the termination of the dorsal carina in segments four, five and six, and also at the postero-inferior angle of the sixth segment. The sixth abdominal segment has a ratio length: depth (measured at the posterior end) of about 1·4:1. The telson of the holotype is broken, but in a second specimen available it is seen to be 1·4 times the length of the sixth abdominal segment, although considerably shorter than the inner uropod elements. Laterally the telson bears a pair of prominent moveable spines set at about 1/7th from the apex, anterior to which are two pairs and posterior to which are three pairs of very small movable spines.

The basal segment of the eye-stalk bears a sharp spine directed anteriorly. The prosartema does not attain the tip of the eye-stalk: the stylocerite reaches about halfway along the cornea. The first segment of the antennular peduncle bears a spine at its outer distal angle. The basicerite bears a sharp spine on its outer distal margin. The third maxilliped surpasses slightly the distal end of the first segment of the antennular peduncle: the second leg surpasses the carpocerite by the entire chela: the other legs of the holotype are missing, but it is possible to see that the first and second legs bear each a slender basial spine. The second specimen available for study shows the first legs surpassing slightly the distal end of the carpocerite, and bearing in addition to the basial spine a small sharp ischial spine: the third leg surpasses the scaphocerite by a small portion of the carpus together with the entire chela: the fourth leg attains about the distal margin of the second segment of the antennular peduncle, while the fifth leg surpasses the scaphocerite by the dactylus and $\frac{3}{4}$ of the propodus. All of the legs bear an exopodite, that of the fifth leg being very small, but a mastigobranch is present on the third leg only.

The petasma is very similar in form to that of *Trachypeneus salaco* de Man (1907, 1911) resembling an abbreviated hayfork, but it differs from the petasma of de Man's species in the following respects:—

1. The distal margin of each lateral horn bears a roughly ovoid lamina: *T. salaco* de Man has a triangular lamina in this position. It may be noted that the holotype described here is bigger than the holotype of de Man's species and the specimen cannot be considered to be a more juvenile form of *T. salaco* de Man.
2. The triangular laminae of *T. salaco* de Man are directed posteriorly (ventrally) (de Man 1911. Pl. 9. Fig. 29b.), while in the present species the ovoid laminae are directed anteriorly (dorsally).
3. The tooth on the anterior surface of the petasma of *T. salaco* de Man is absent from the present species.

In other respects the similarity of the present species to *T. salaco* de Man is very close, only the following differences being apparent:—

1. The rostrum possesses two teeth more than *T. salaco* de Man.
2. The rostrum is more ascending than described by de Man.
3. A small spinule is noted at the termination of the dorsal carina in the fourth and fifth abdominal segments which spinules are not recorded by de Man although that of the sixth segment receives mention. These spinules may be broken easily and in fact are missing from the second specimen examined.

The present species is also very similar to *Trachypeneus anchoralis* (Bate 1888, female only) as described by Schmitt (1926), which species Schmitt considers to be distinct from *T. salaco* de Man. The differences of the present species from *T. anchoralis* (Bate) are:

1. The rostrum has one or two teeth more.
2. The petasma has two ovoid laminae, one at the distal end of each petasmal endopodite, which laminae are absent from *T. anchoralis* (Bate).
3. The lateral curved horns of the petasma are much less twisted.

The above description is based mainly on an adult male of 1·05 cm. carapace length. It is recorded as the holotype and will be deposited in the British Museum. The second specimen which was available for study is also an adult male, of 1·17 cm. carapace length.

The S.R.F.R.S. records are:

B 45. Outer Shoal, 6 fm. Mud/stone. (Holotype).

B 73. South of Singapore, 45 fm. Clean bottom.

Genus **Parapenaeus** Smith

Parapenaeus fissurus (Bate). Plate 19, Fig. 14

Penaeus fissurus Bate 1888.
Parapeneus fissurus Alcock 1906.
Parapenaeus fissurus de Man 1911.
Parapenaeus fissurus Kubo 1949.

The specimens which have been examined by the present author agree well with previous descriptions; they follow de Man (op. cit.) and Kubo (op. cit.) in having a sigmoid rostrum, and not the straight rostrum illustrated by Alcock (op. cit.)—although Alcock (op. cit. p. 31) described a double-curved rostrum—and Bate (op. cit.).

Alcock's illustration of the petasma (op. cit. Pl. 5. Fig. 16a.) lacks detail, but the petasma of the males to hand agrees precisely with Kubo's account and illustrations (op. cit. pp. 400, 402. Fig. 28A, B, C.): yet the illustration of the thelycum by Alcock (op. cit. Pl. 5. Fig. 16b.) is found to be the truer record. The thelycum illustrated by Kubo (op. cit. Fig. 47P.) differs from the specimens studied by the present author in a number of details seen best by comparing Kubo's illustration with that given here.

Parapenaeus fissurus (Bate) has not been taken from the waters off Singapore Island: the specimens to hand were taken by the R.V. *Manihine*, mainly from the South China Sea, but also from the extreme north of the Malacca Strait. It is indicated from this, and from the distributions given by Alcock, Kubo and de Man that *P. fissurus* (Bate) is an offshore species.

Genus **Metapenaeopsis** Bouvier (emend)

Metapenaeopsis barbatus (de Haan). Plate 21, Fig. 20

Penaeus affinis barbatus de Haan 1850.
Penaeus velutinus Kishinouye 1900.
Parapenaeus akayebi Rathbun 1902.
Penaeus (Metapenaeus) akayebi de Man 1907.
Penaeopsis barbatus de Man 1911.
Metapenaeopsis barbatus Kubo 1949.

Only minor differences are found to exist between the Singapore specimens of this species, the description following de Man's re-examination of the type specimen (1911. p. 88) and Kubo's (op. cit.) description. The short sub-carinae on the fourth abdominal segment, noted first by de Man (loc. cit.) and recorded also by Kubo (op. cit. p. 416) are present in the Singapore material.

It may be noted that Kubo (op. cit. p. 413) states "Telson well surmounts apex of outer uropods, . . ." yet his figure of the species (p. 414) shows the telson shorter than the uropods. The telson of the Singapore specimens may or may not surpass the uropods. Further, although Kubo (op. cit. p. 411) in his key to the species of the genus *Metapenaeopsis* uses the feature "Sixth pleonic somite much less than twice as long as wide measured near the posterior end" as a means of distinguishing *M. barbatus* (de Haan), his figures at 146 (p. 414), 147D (p. 417) and the text on page 417 indicate that the ratio length: depth of the sixth abdominal segment may be as high as 2·3:1. This ratio has been found even higher in some Singapore individuals, but the general decrease of the ratio with increase in the carapace length, noted by Kubo, is recorded also by the present author.

The lateral, anteriorly directed protuberances of the second sternal ridge of the thelycum of the Singapore specimens are rounded, not pointed as indicated by Kubo (op. cit. Fig. 46B. p. 112).

The stridulating ridges are found by the present author to show an increase in numbers with increase in the carapace length (Text Fig. 2).

As *Metapenaeopsis barbatus* (de Haan) is ubiquitous in the sea off Singapore Island, demonstrating no preference for the depth nor for the nature of the sea bed, no individual S.R.F.R.S. records are given here.

Metapenaeopsis stridulans (Wood-Mason). Plate 21, Figs. 21, 23 and

Metapenaeopsis novae-guineae (Haswell). Plate 21, Figs. 22, 24

The confusion in the literature of these two species arose in their original descriptions. In his description of *Metapenaeopsis stridulans* (Wood-Mason), Alcock (1906) noted that the stridulating ridges borne by the carapace ". . . vary in number, being usually 5, seldom less than 5, and occasionally as many as 12, or, in the female, more than 12." His main illustration of the species (op. cit. Pl. 5. Fig. 14) is of a specimen having (probably) five ridges which number is shown also at his Figure 14a., but Alcock's Figure 14b has 19 stridulating ridges.

It has been shown by Schmitt (1926. p. 339) that the holotype of Haswell's *Penaeus Novae-Guineae*, a badly preserved specimen from Katow in New Guinea, differs in a number of respects from Haswell's original description. Schmitt himself did not examine the holotype, but he was able to examine four specimens (1 male, 3 females) of which the single male had been compared closely with the holotype, with which it agreed approximately in size. Regarding this male, Schmitt (op. cit. p. 343) commented "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.". Schmitt's illustrations of this feature (op. cit. Pl. 61. Figs. 2a, 2b.) show only ten ridges and eight ridges respectively. Schmitt considered that *M. stridulans* (Wood-Mason) and *M. novae-guineae* (Haswell) were the same species. Schmitt included also in the species *M. novae-guineae* (Haswell) Haswell's *Penaeus Palmensis*. Of the latter species Schmitt was able to examine a small female which had been compared critically with the holotype, and he wrote "The stridulating organ has from 13 to 14 ridges.".

The present author has been able to examine 209 specimens of the genus *Metapenaeopsis* which bear stridulating ridges. Wherever possible the ridges of the right-hand-side only were counted since there may be some asymmetry: the analysis of these specimens is:

Ridges	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	*Total*
Frequency	—	—	—	1	13	12	—	—	3	4	2	4	10	9	4	17	36	40	33	17	4	209

The carapace length of as many of these specimens as possible (195 individuals) was measured in the preparation of Text Figure 2. On reference to this figure it may be seen that the points fall into three quite distinct groups. The largest of these groups is undoubtedly of *M. barbatus* (de Haan). All of the specimens of this group (156 individuals) were checked, and none showed a petasma or a thelycum which could be confused with *M. acclivis* (Rathbun 1903. p. 41. Figs. 13, 14 and Kubo 1949. Figs. 18A, 18B, 46C.). This species is reported to have from 13 to 18 stridulating ridges (Kubo op. cit. pp. 412, 419) although Rathbun herself showed none (op. cit. p. 41. Fig. 12). The range of stridulating ridges for the specimens of *M. barbatus* (de Haan) agrees well with previous reports, but it is to be noted that no specimen with a carapace length greater than 0·9 cm. was found to have fewer than 16 ridges, while below 0·9 cm. half of the specimens had 12 to 15 ridges; a marked increase in the number of stridulating ridges with increase in size is indicated for the smaller specimens, the rate of the increase in numbers of ridges falling off with increase in the length of the carapace.

The other two groups of points in Text Figure 2 are quite distinct from the group of *M. barbatus* (de Haan) *and from each other*. The larger of these two groups ("5-ridged" group, with 22 measured specimens) is a horizontal band: it shows no tendancy to merge or blend with the smaller group. The smaller group ("10-ridged" group, with 17 measured specimens) indicates an increase in the number of stridulating ridges with increase in the carapace length, in much the same manner as shown by *M. barbatus* (de Haan).

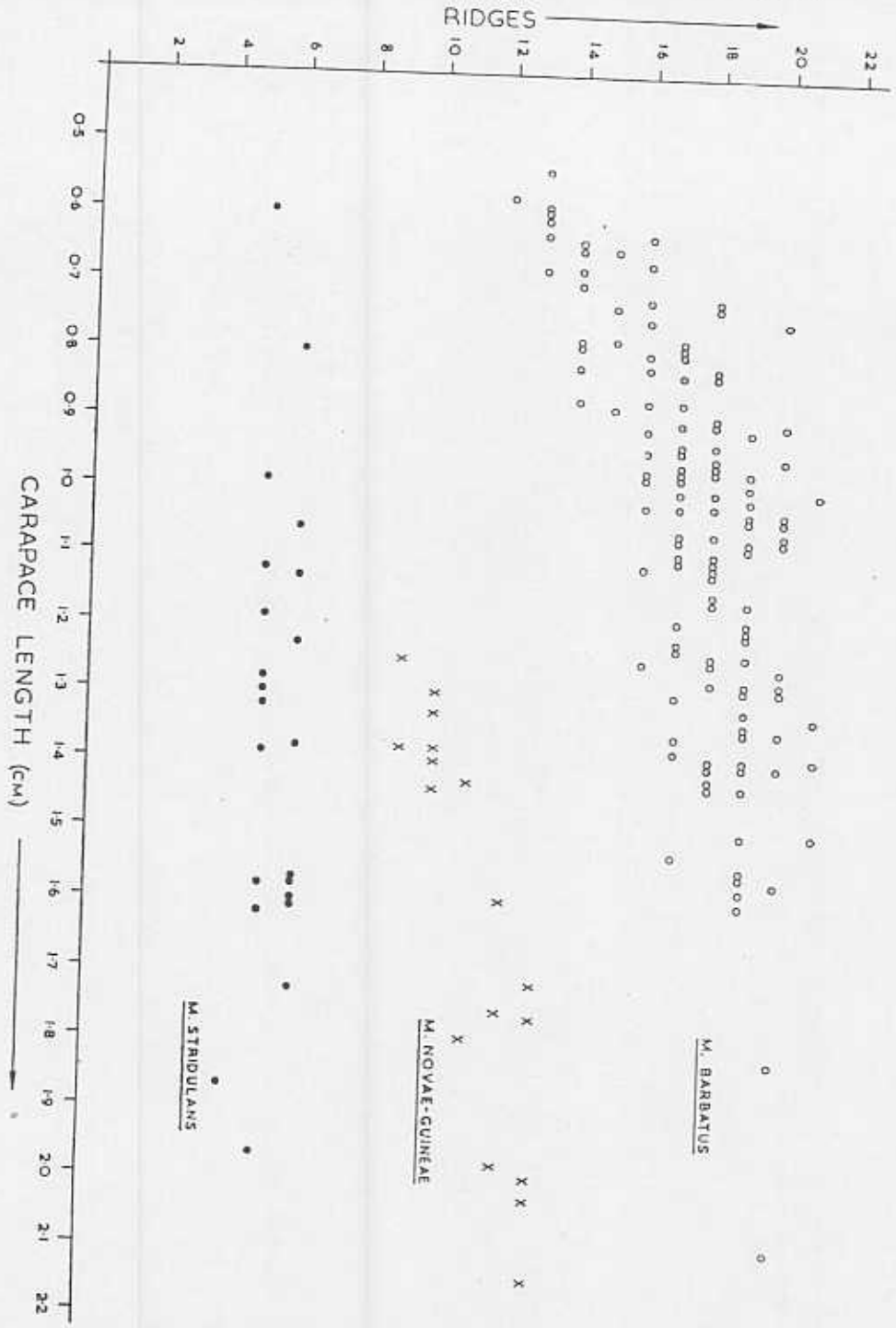

Fig. 2. Separation of three species of *Metapenaeopsis* by the number of stridulating ridges in individuals of different sizes.

The two forms taken by the stridulating ridges on the carapace ("5-ridged" form, "10-ridged" form) have been well illustrated by other authors (e.g. Alcock 1906, Schmitt 1926) but they deserve further illustration here (Pl. 22. Figs. 21, 22) while for comparison the form of the stridulating ridges of *M. barbatus* (de Haan) is illustrated in Plate 22, Figure 20. The "5-ridged" form and the "10-ridged" form are quite distinct: no transitional form has been seen by the present author. The "5-ridged" form has the ridges invariably in a short, straight, approximately horizontal band, while the "10-ridged" form has the ridges in a curved band, directed antero-ventrally from the posterior margin of the carapace much the same as in *M. barbatus* (de Haan).

It is obvious that the sample examined by Alcock consisted mainly of "5-ridged" specimens, together with some "10-ridged" specimens and some *M. barbatus* (de Haan) (Ref. Alcock op. cit. Pl. 5. Fig. 14b.), and it is suggested that the term *Metapenaeopsis stridulans* (Wood-Mason, MS. specific name, Alcock 1905, 1906) be restricted and used only for the "5-ridged" species of *Metapenaeopsis*. Further, since Haswell's *Penaeus novae-guineae* was probably of the "10-ridged" group, although some specimens of *M. stridulans* (Wood-Mason) have undoubtedly been identified with that species, it is suggested that the term *Metapenaeopsis novae-guineae* (Haswell) be restricted and used only for the "10-ridged" species. It is to be noted that, although large specimens of *M. novae-guineae* (Haswell) can be found with 13 stridulating ridges, no small female, such as that examined by Schmitt (1926) under the name of *Penaeus Palmensis* Haswell and considered by Schmitt to be identical to *M. novae-guineae* (Haswell), is to be expected with 13 ridges. Schmitt was in error in referring such a specimen to *M. novae-guineae* (Haswell).

In addition to the distinctions already indicated between *Metapenaeopsis stridulans* (Wood-Mason) and *M. novae-guineae* (Haswell), as restricted above, there are also petasmal and thelycal differences. The petasma of *M. stridulans* (Wood-Mason) was illustrated accurately by Alcock (1906. Pl. 5. Fig. 14c.), the only apparent difference between this illustration and the condition of the specimens to hand being the presence in the latter of a single small projection from the tip of the right-hand-side (smaller) petasmal lobe, which projection could be easily overlooked. The crown of filaments which is present distally on the left-hand-side petasmal lobe of *M. stridulans* (Wood-Mason) is quite absent from *M. novae-guineae* (Haswell), although the apex of the lobe may show some irregularities in its outline. This distinction between the two species was observed by Schmitt (op. cit. p. 344) who, however, failed to appreciate its significance. The single small filament at the apex of the right-hand-side lobe of *M. stridulans* (Wood-Mason) is absent from *M. novae-guineae* (Haswell). Alcock's illustration of the thelycum of *M. stridulans* (Wood-Mason) (1906. Pl. 5. Fig. 14d.) is in very close agreement with the Singapore material, and differs only in the shape of the lateral, anteriorly directed, projections of the posterior sternal ridge. Alcock illustrated projections which are considerably broader than long, having an anterior margin defined clearly almost to the mid-ventral line: these projections in the Singapore specimens are about as broad as long. It may be noted that Alcock's illustration is of a large specimen. In smaller specimens the anterior margin of the anterior median plate of the thelycum is not concave, but transversely straight or convex. The thelycum of *M. novae-guineae* (Haswell) differs from that of *M. stridulans* (Wood-Mason) in the shape of this anterior margin, which in the former bears a small denticulation in the mid-line. (Compare de Man 1911. Pl. 7. Figs. 20a, 20b.).

In other respects *M. stridulans* (Wood-Mason) and *M. novae-guineae* (Haswell) are very similar. Both have a well marked groove along the dorsal carina of the third abdominal segment which is a ready distinction from *M. barbatus* (de Haan).

Nine of the 17 specimens of *M. novae-guineae* (Haswell) which have been examined by the present author are in the collection of the Raffles Museum; the remaining eight specimens were taken by the R.V. *Manihine*, none having been taken from the sea off Singapore Island. Possibly there is also a biological difference between *M. novae-guineae* (Haswell) and *M. stridulans* (Wood-Mason). The former seems to be an offshore species while no specimen of *M. stridulans* (Wood-Mason) has been recorded by the S.R.F.R.S. from offshore although there are frequent inshore records:

B 50. Off Tanjong Rhu, 2 fm. Mud.
B 60. South of Bedok, 22 fm. Clean bottom
B 64. South of Bedok, 22 fm. Clean bottom.
B 73. South of Singapore, 45 fm. Clean bottom.
B 74. South of Singapore, 50 fm. Clean bottom.
B 75. South of Singapore, 35 fm. Clean bottom.
B 77. Off Tanjong Stapa, 6–7 fm. Mud.

Metapenaeopsis mogiensis (Rathbun)

Parapenaeus mogiensis Rathbun 1903.
Metapeneus mogiensis Alcock 1906.
Penaeopsis sp. (*"hilarulus"*) de Man 1911.
Penaeopsis mogiensis Schmitt 1926.

Schmitt (op. cit. pp. 346, 347) has discussed at some length the variations in the illustrations of the thelycum published by Rathbun (op. cit. p. 40. Fig. 8), Alcock (op. cit. Pl. 5. Fig. 15b.) and de Man (op. cit. Pl. 7. Figs. 22c, 22d.) and with his conclusion that "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." the present author concurs. It may be noted that in the illustrations of the controversial anterior transverse ridge of the thelycum given by Rathbun (loc. cit.), Alcock (loc. cit.) and Schmitt (op. cit. Pl. 61. Fig. 4) the outline of the base of the ridge appears to have received more attention, while the illustration of that feature by de Man (loc. cit.) emphasises the ridge itself; hence the apparent variations in the shape of the same structure.

S.R.F.R.S. records for *M. mogiensis* (Rathbun) are:

B 60. South of Bedok, 22 fm. Clean bottom.
B 73. South of Singapore, 45 fm. Clean bottom.
B 74. South of Singapore, 50 fm. Clean bottom.
B 75. South of Singapore, 35 fm. Clean bottom.

Metapenaeopsis andamanensis (Wood-Mason). Plate 21, Fig. 25

Metapenaeus philippinensis var. *andamanensis* Wood-Mason 1891.
Metapeneus coniger var. *andamanensis* Alcock 1906.

The highly characteristic thelycum of this species described by Alcock (op. cit. p. 27. Pl. 4. Fig. 13) serves immediately to distinguish the species from all other Malayan forms of the genus *Metapenaeopsis*.

The rostrum is found to be horizontally straight, and not uptilted as described by Alcock (op. cit.), and the following features are noted also:—

1. The branchiostegal spine is well developed in the Malayan specimens.
2. The telson is distinctly shorter than the inner uropod elements.
3. The spines between the bases of the second legs of the female have the form of sharply pointed triangular plates.
4. The eye-stalk bears dorsally a roughly triangular lamina, the anteriorly directed apex of which is sharply pointed.
5. The basicerite bears a sharply pointed spine on its outer distal margin.
6. The second legs carry a small basial spine.

No specimen has been taken from the sea off Singapore Island. The available specimens were taken by the R.V. *Manihine* in the northern Malacca Straits in 87 fm. which agrees well with the off-shore records given by Alcock.

Genus **Sicyonia** H. Milne-Edwards

Sicyonia ommanneyi sp. nov. Plate 21, Figs. 26, 27

The body is heavily setose save for the ventral 1/3rd of the carapace which is scabrous. In addition to the general covering of setae there are areas where the setae are much longer, in particular the entire rostral crest, both sides of the dorsal crest of the first four abdominal segments, the posterior end of the dorsal carina of the sixth abdominal segment, the anterior margin of the carapace dorsal to the pterygostomian angle, a band of sparse setae extending vertically from the base of the second tooth from the rear of the post-rostral crest, and the antero-ventral margin of the first abdominal segment. The pleura of the first five abdominal segments are grooved deeply.

Laterally the carapace bears only a single spine, the well developed hepatic, ventral to which there is an ill-defined hepatic groove. There is present also a small post-ocular groove. The rostrum is horizontally straight; it is short in length, not attaining the distal margin of the second segment of the antennular peduncle. The apex of the rostrum is tri-denticulate, the upper-most of these teeth being the distal tooth of seven which are arranged along the rostral crest. The teeth of the rostral crest decrease in size anteriorly: four of the teeth are carried by the carapace. An ad-rostral carina, present on the rostrum, does not extend rearwards along the carapace, but is continuous with the post-orbital margin.

The first abdominal segment carries dorsally a tooth which is directed antero-dorsally: this tooth is grooved deeply and incised, the groove and the incision becoming wider posteriorly. The second abdominal segment bears dorsally a carina which commences most abruptly at the anterior margin of the segment. This tooth is grooved and incised also, but the maximum width is attained about half way along the segment at which position the long dorsal carina of the third segment commences. The carina of the third segment carries a shallow groove anteriorly, but the groove becomes deeper gradually along its length, and suddenly wider about half way along the segment. The posterior margin of the third segment is incised deeply in the mid-line. In the second and third abdominal segments the margins of the groove in the dorsal carina are extended laterally so forming overhanging lips. The carina of the fourth segment is much less broad than in the more anterior segments, and only posteriorly does it bear a well defined groove. The posterior margin of the fourth segment is incised in the mid-line.

The fifth and sixth segments bear a well developed carina, that of the fifth being divided posteriorly by an incision in the margin of the segment, that of the sixth terminating in a strong tooth. The pleura of the first four abdominal segments are rounded ventrally: those of the fifth and sixth segments are angled, but not spiniform, postero-ventrally. The numerous grooves and carinae of the abdomen are best described by illustration. The first to fifth abdominal segments inclusive each bear in the mid-ventral line a well developed sternal spine, the first three almost straight, the fourth and fifth curved markedly rearwards.

The telson is longer than the fifth and sixth abdominal segments taken together. Dorsally the telson carries a wide groove the margins of which are continued posteriorly into two small fixed lateral spines between which the telson ends abruptly in a spine.

The eye is small and is borne on a short eye-stalk: in its longer diameter the cornea is about 1/5th the length of the carapace. The stylocerite is about 3/4 the length of the proximal segment of the antennular peduncle, surpassing considerably the cornea. The proximal segment of the antennular peduncle bears a prominent spine at its outer distal angle. The antennular flagella are short in length, being about equal to the second and distal segments of their peduncle taken together. The basicerite bears a large spine on its outer distal margin. The scaphocerite, the lateral spine of which is well separated from, and extends as far forwards as, the lamina, reaches to the distal end of the antennular peduncle. The ratio length: maximum breadth of the scaphocerite is about 1·5:1.

Compared with the pereiopods, the third maxillipeds are fairly robust structures: they extend to about the apex of the scaphocerite. The distal three segments of the third maxillipeds have the inner margin expanded into a lamina. The first leg attains about half way along the carpocerite: the second leg attains the apex of the antennal scale: the third leg surpasses the antennal scale by a little more than the digits: the fourth leg somewhat surpasses the base of the carpocerite, while the fifth leg surpasses slightly the distal end of the carpocerite. A small spine is found on the basis and the ischium of the first pereiopod. The first three pairs of pereiopods bear a mastigobranch.

The anterior plate of the thelycum is sharply pointed anteriorly. The maximum breadth of the plate is attained slightly before the level of the fourth legs; the margins of the plate are indented to receive the bases of the fourth legs. The anterior plate is excavated in the mid-line posteriorly, mainly in that portion lying between the lateral plates. These lateral plates are broad and flat although elevated considerably from the sternum at the anterior margin. At the level of the anterior point of the median plate there arises from the sternum a pair of long spines.

This description is based on an apparently adult female of 0·96 cm. carapace length, which specimen is designated as the holotype and will be deposited in the British Museum. A second, smaller, somewhat damaged specimen has been available for examination also.

This species is most closely related to *Sicyonia vitulans* Kubo (1949, p. 448) but the following features distinguish between them:—

1. In Kubo's species the dorsal carina of the second abdominal segment does not have the abrupt start described here, but arises in a smooth curve from the posterior margin of the first segment.
2. The fifth abdominal segment of the present species has no pleural spine.
3. The hepatic spine of the present species is well developed.
4. The sternal spine of the first abdominal segment of the present species is well developed.

5. There are considerable thelycal differences (Compare Kubo op. cit. Fig. 48G. with the illustration to this paper).

The thelycum of the present species is similar to that of *S. inflexa* Kubo (op. cit. p. 458. Fig. 48D.) but the much shorter, horizontally straight rostrum, and the greater number of teeth on the rostral crest serve immediately to distinguish the present species.

S. rectirostris de Man is similar superficially to the present species, but, in addition to the thelycal differences (de Man 1911. Pl. 10. Fig. 39b.), the form of the dorsal carina of the second abdominal segment, the greater number of teeth on the rostral crest, and the absence of a pleural tooth from the fourth abdominal segment distinguish the present species.

The brief original description of *S. ocellata* (Stimpson) cannot discriminate between that species and the present (the colour patterns of the specimens to hand have quite faded save for some of the longer setae which are purple) but the thelycum illustrated by de Man (op. cit. Pl. 10. Fig. 43) for *S. ocellata* (Stimpson) differs considerably from the thelycum of the present species.

The form of the carina of the second abdominal segment described here appears to be present in *S. laevis* Bate (1888. Pl. 43. Fig. 5), *S. lancifer* (Olivier) (Bate op. cit. Pl. 43. Fig. 4) and *S. lancifer japonica* (Balss) (Kubo op. cit. Fig. 151), but the form of the rostral crest distinguishes the present species from *S. laevis* Bate and *S. lancifer japonica* (Balss) while the absence of pleural spines from the present species distinguishes it from *S. lancifer* (Olivier) and also from *S. lancifer japonica* (Balss).

This species I dedicate to my colleague, Dr. F. D. Ommanney, the Director of the Singapore Regional Fisheries Research Station.

S.R.F.R.S. records for this species are:

B 64. South of Bedok, 22 fm. Clean bottom.

B 73. South of Singapore, 45 fm. Clean bottom.

Summary

The 45 species of penaeid prawn recorded from Malayan waters to date by the Singapore Regional Fisheries Research Station are listed, and notes made on those species which were not considered, or which were not dealt with adequately, in the first paper on the subject (The Malayan Penaeidae. Part I. Hall 1956). Of the 45 species, six are recorded as new to science, and the types are to be deposited in the British Museum.

A key to the species is given at the end of this paper.

Acknowledgements

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A Key to the Genera and Species of Penaeidae recorded recently from Malayan Waters

1. (*a*) Rostrum toothed on both the dorsal and the ventral margins ..... 2.
   (*b*) Rostrum toothed on the dorsal margin only although the tip of the rostrum may be subdivided ..... 3.

2. (*a*) Many grooves present on the carapace and the abdomen; each groove is adorned with a row of stiff setae along one margin, the setae overlying the groove .... *Heteropenaeus*.
   A single species ..... *Heteropenaeus longimanus* de Man.
   (*b*) Grooves of the carapace and abdomen not adorned in this manner ..... *Penaeus* .. 14.

3. (*a*) Cervical groove deeply marked, reaching or almost reaching from the hepatic fossa to the mid-dorsal line of the carapace ..... *Solenocera* .. 10.
   (*b*) Cervical groove varies from being barely discernable to extending about half of the way towards the mid-dorsal line ..... 4.

4. (*a*) Prosartema absent: exopodites absent from the pereiopods and from each of the two posterior maxillipeds: endopodites absent from the pleopods ..... *Sicyonia*.
   A single species ..... *Sicyonia ommanneyi* sp. nov.
   (*b*) Prosartema present: exopodites present on some or all of the pereiopods excepting *Parapenaeus:* endopodites present on the pleopods ..... 5.

5. (*a*) Telson provided with prominent fixed spines (movable spines may be present also) ... 6.
   (*b*) Telson without fixed spines although movable spines may be present ..... 7.

6. (*a*) Petasma asymmetrical: third maxillipeds with a basial spine: carapace without longitudinal sutures ..... *Metapenaeopsis* .. 37.
   (*b*) Petasma symmetrical: third maxillipeds without a basial spine: each side of the carapace provided with a horizontal suture extending almost to the posterior margin *Parapenaeus*.
   A single species ..... *Parapenaeus fissurus* (Bate).

7. (*a*) Carapace devoid of longitudinal sutures ..... 8.
   (*b*) Carapace bearing a longitudinal suture along each side arising from the post-orbital margin; the suture may be well developed, or it may be short and even difficult to see, not attaining the level of the hepatic spine ..... 9.

8. (*a*) Fifth pereiopod without an exopodite ..... *Metapenaeus* .. 20.
   (*b*) Fifth pereiopod with an exopodite ..... *Atypopeneus*.
   A single species ..... *Atypopeneus stenodactylus* (Stimpson).

9. (*a*) First pereiopod without an ischial spine: the longitudinal suture attains about the middle of the carapace ..... *Parapeneopsis* .. 27.
   (*b*) First pereiopod usually with an ischial spine which may be minute: the longitudinal suture short, ceasing above or before the hepatic spine ..... *Trachypeneus* .. 34.

Genus *Solenocera*

10. (*a*) Telson without a pair of fixed lateral spines ..... *S. kuboi* Hall.
    (*b*) Telson with a pair of fixed lateral spines ..... 11.

11. (*a*) Anterior portion of the hepatic carina curved ventro-posteriorly, elevated considerably from the carapace ..... 12.
    (*b*) Anterior portion of the hepatic carina curved antero-dorsally, not elevated unusually from the carapace ..... 13.

12. (*a*) Extreme anterior margin of the hepatic carina provided with a spine directed anteriorly *S. spinajugo* sp. nov.
    (*b*) Extreme anterior margin of the elevated hepatic carina blunt, not provided with a spine *S. pectinatus* (Bate).

13. (*a*) Post-rostral carina markedly elevated, laminar ..... *S. alticarinata* Kubo.
(*b*) Post-rostral carina posterior to the cervical groove defined sharply but not laminar *S. melantho* de Man.

Genus *Penaeus*

14. (*a*) Ad-rostral groove deep, nearly reaching to the posterior margin of the carapace: hepatic carina and gastro-frontal carina well developed ..... 15.
(*b*) Ad-rostral groove rather deep, extending to or somewhat beyond the epigastric spine: hepatic carina well defined: gastro-frontal carina absent ..... 18.
(*c*) Ad-rostral groove shallow, ceasing at about the level of the epigastric spine: hepatic and gastro-frontal carinae absent ..... 19.

15. (*a*) Post-rostral carina with a clearly defined median groove ..... 16.
(*b*) Post-rostral carina with only a trace of a median groove ..... *P. jejunus* Hall.

16. (*a*) Stylocerite reaching to or almost reaching to the distal end of the basal segment of the antennular peduncle: median groove of the post-rostral carina much less than half the length of the carapace: first pereiopod with an ischial spine ..... *P. longistylus* Kubo.
(*b*) These features not present ..... 17.

17. (*a*) Rostrum armed with 8–10 teeth above and 1–2 below: ad-rostral groove a little narrower than the post-rostral carina: anterior piece of the thelycum rounded at the apex *P. japonicus* Bate.
(*b*) Rostrum armed with 9–12 teeth above and 1 below: ad-rostral groove as wide as the post-rostral carina: anterior piece of the thelycum bifurcate at the apex *P. latisulcatus* Kishinouye.

18. (*a*) Hepatic carina considerably (ca. 20°) inclined antero-ventrally: gastro-orbital carina occupies about the posterior 2/3rd. of the distance between the hepatic spine and the post-orbital margin of the carapace: 5th. leg with a small exopodite *P. semisulcatus* de Haan.
(*b*) Hepatic carina horizontally straight: gastro-orbital carina occupies the posterior half of the distance between the hepatic spine and the post-orbital margin of the carapace: 5th. leg without exopodite ..... *P. monodon* Fabricius.

19. (*a*) The rostral crest considerably high and triangular in profile: dactylus of the third maxilliped of the adult male is 0·5–0·6 times the length of the propodus *P. merguiensis* de Man.
(*b*) Rostral crest not markedly elevated: dactylus of the third maxilliped of the adult male 1·5–2·7 times the length of the propodus ..... *P. penicillatus* Alcock.
(*c*) Rostral crest not markedly elevated: dactylus of the third maxilliped of the adult male 0·85 times the length of the propodus ..... *P. indicus* H. Milne-Edwards.

Genus *Metapenaeus*

20. (*a*) Carapace finely setose; the abdomen may have some glabrous areas: first abdominal segment not carinate dorsally although a glabrous mid-dorsal line may be present *M. mutatus* (Lanchester).
(*b*) Body with many setose *depressed* areas: first abdominal segment may or may not be carinate dorsally ..... 21.
(*c*) Excepting possibly the fifth and sixth abdominal segments and the branchio-cardiac groove, the body is generally glabrous and without setose *depressed* areas: first abdominal segment not carinate dorsally ..... 24.

21. (*a*) Telson armed with three pairs of large movable lateral spines: ischium of the first leg carries a spine subequal in size to that of the basial spine of the leg *M. intermedius* Kishinouye.
(*b*) These features not present ..... 22.

22. (*a*) Rostrum short, not reaching to the distal end of the first segment of the antennular peduncle, elevated triangularly at the base: the median and the lateral plates of the thelycum are subequal in size, and ovoid in shape ..... *M. lysianassa* (de Man).

(*b*) Rostrum not elevated triangularly at the base, reaching beyond the basal segment of the antennular peduncle ..... 23.

23. (*a*) Anterior portion of the hepatic groove straight, running antero-ventrally: the developed petasma has a pair of large distal lobes and a pair of large disto-lateral lobes (de Man 1911 Pl. 6. Figs. 15a, 15b.): anterior median plate of the thelycum depressed, lateral plates broad and flat (Hall 1956 Pl. 11. Fig. 14): the first leg may or may not have an ischial spine ..... *M. mastersii* (Haswell).

(*b*) Anterior portion of the hepatic groove "C" shaped: petasma without large disto-lateral lobes: anterior median plate of the thelycum elevated, lateral plates with a curved ridge: first leg usually with a small ischial spine
M. monoceros (Fabricius) (Setose form).

24. (*a*) Rostrum usually with an elevated crest and with a marked edentate distal portion ... 25.

(*b*) Rostrum without an elevated crest; teeth distributed evenly along the rostrum there being no marked edentate tip ..... 26.

25. (*a*) Upper antennular flagella 1/2 the length of the carapace: median plate of the thelycum larger than the lateral plates: disto-lateral projections of the petasma directed outwards at an angle of about 45° to the mid-line of the petasma
M. brevicornis (H. Milne-Edwards).

(*b*) Upper antennular flagella 2/3rd. the length of the carapace: median plate of the thelycum smaller than the lateral plates: disto-lateral projections of the petasma scarcely diverging from the mid-line of the petasma ..... *M. spinulatus* Kubo.

26. (*a*) Anterior portion of the hepatic groove somewhat curved but not "C" shaped: basal segment of the eye-stalk of adults bears dorsally a spine directed anteriorly: median plate of the thelycum much broader anteriorly than posteriorly and in the anterior margin elevated considerably from the sternum: distal lobes of the petasma broader distally than proximally (Hall 1956 Pl. 12. Fig. 19) ..... *M. singaporensis* Hall.

(*b*) Anterior portion of the hepatic groove "C" shaped. basal segment of the eye-stalk without a spine: median plate of the thelycum not markedly broader anteriorly: distal lobes of the petasma broader proximally than distally (Hall 1956 Pl. 10. Fig. 11)
M. monoceros (Fabricius) (glabrous form).

Genus *Parapeneopsis*

27. (*a*) Mastigobranch absent from the first and second pereiopods ..... 28.

(*b*) Mastigobranch present on the first and second pereiopods ..... 30.

28. (*a*) Epigastric spine absent ..... *P. tenella* (Bate).

(*b*) Epigastric spine present ..... 29.

29. (*a*) Post-rostral carina almost reaching to the posterior border of the carapace: rostrum exceeding the eye by more than the longer diameter of the cornea
P. hungerfordi Alcock.

(*b*) No post-rostral carina: rostrum short, only surpassing the eye slightly
P. venusta de Man.

30. (*a*) Epigastric spine absent: fifth pereiopods exceedingly long and slender
P. gracillima Nobili.

(*b*) Epigastric spine present: fifth pereiopods normal ..... 31.

31. (*a*) First and second abdominal segments carinate dorsally, the carina of the first at least being grooved ..... *P. affinis* (H. Milne-Edwards).

(*b*) First and second abdominal segments rounded dorsally ..... 32.

32. (*a*) Rostrum decurved, armed along its entire length ..... *P. cultrirostris* Alcock.

(*b*) Rostrum straight, upturned at the tip, or sigmoid, usually with a distal styliform portion 33.

33. (*a*) Post-rostral carina with a well defined groove along most of its length *P. probata* sp. nov.

(*b*) Post-rostral carina with an ill defined groove along most of its length; rostrum with a very long slender styliform distal portion ..... *P. hardwickii* (Miers).

(*c*) Post-rostral carina with a scarcely discernable groove set at about 2/3rd. of the carapace, or no groove at all ..... *P. maxillipedo* Alcock.

Genus *Trachypeneus*

34. (*a*) Mastigobranch present on the first three pairs of pereiopods ..... 35.

(*b*) Mastigobranch present on the third pair of pereiopods only ..... 36.

35. (*a*) The plates of the thelycum with raised anterior and lateral margins, the general appearance of the organ being that of an arm chair, the back of which is directed anteriorly *T. sedili* sp. nov.

(*b*) The anterior plate of the thelycum may have a raised anterior margin, but laterally the margins are not raised: a deep excavation present between the anterior plate and the transverse sternal ridge .... *T. curvirostris* (Stimpson).

36. Male

(*a*) The distal horns of the petasma which are directed laterally are almost straight *T. unicus* sp. nov.

(*b*) The laterally directed horns of the petasma are curved to a direction away from the base of the petasma; the distal margin of each horn bears a roughly ovoid lamina; the anterior (dorsal) surface of the petasmal endopodites is devoid of teeth *T. furcilla* sp. nov.

Female

(*a*) The anterior plate of the thelycum has a posterior projection on each side of which is a deep circular depression in the lateral plates ..... *T. granulosus* (Haswell).

(*b*) The anterior plate of the thelycum is semicircular in outline; the posterior margin has no marked projection, nor are there two deep depressions in the lateral plates *T. unicus* sp. nov.

Genus *Metapenaeopsis*

37. (*a*) Stridulating ridges present ..... 38.

(*b*) Stridulating ridges absent ..... 39.

38. (*a*) Four to six stridulating ridges, the ridges being arranged in a short, straight, approximately horizontal band ..... *M. stridulans* (Wood-Mason).

(*b*) Usually 9 to 12 stridulating ridges (7 or 8 in very small specimens, 13 in very large specimens): the ridges are arranged in a curved band directed antero-ventrally from the posterior margin of the carapace ..... *M. novae-guineae* (Haswell).

(*c*) 12 to 24 stridulating ridges (only specimens with a carapace length less than 0·9 cm. have less than 16 ridges): the ridges are arranged in a curved band directed antero-ventrally from the posterior margin of the carapace ..... *M. barbatus* (de Haan).

39. (*a*) Rostrum long and slender: sixth abdominal segment almost three times as long as deep measured at the posterior end ..... *M. andamanensis* (Wood-Mason).

(*b*) Rostrum not long and slender, surpassing the eye by a distance less than the longer diameter of the cornea: sixth abdominal segment less than twice as long as deep measured at the posterior end ..... *M. mogiensis* (Rathbun).

Explanation of Plates

PLATE 17

1. *Solenocera spinajugo* sp. nov. Female (1·7 cm. carapace).
2. *Solenocera spinajugo* sp. nov. Antero-inferior margin of the carapace.
3. *Solenocera spinajugo* sp. nov. Thelycum.
4. *Metapenaeus spinulatus* Kubo. Petasma (1·3 cm. carapace).
5. *Heteropenaeus longimanus* de Man. Thelycum.

PLATE 18

6. *Heteropenaeus longimanus* de Man. Female (2·0 cm. carapace).
7. *Atypopeneus stenodactylus* (Stimpson). Thelycum (1·2 cm. carapace).
8. *Parapeneopsis gracillima* Nobili. Petasma (1·9 cm. carapace).
9. *Parapeneopsis venusta* de Man. Petasma (0·9 cm. carapace).
10. *Parapeneopsis venusta* de Man. Thelycum (1·3 cm. carapace).

PLATE 19

11. *Parapeneopsis probata* sp. nov. Female (2·9 cm. carapace).
12a, b. *Parapeneopsis probata* sp. nov. Petasma (2·1 cm. carapace).
13. *Parapeneopsis probata* sp. nov. Thelycum (3·1 cm. carapace).
14. *Parapenaeus fissurus* (Bate). Thelycum (2·7 cm. carapace).
15. *Trachypeneus granulosus* (Haswell). Thelycum (2·4 cm. carapace).

PLATE 20

16. *Trachypeneus furcilla* sp. nov. Male (1·05 cm. carapace).
17. *Trachypeneus furcilla* sp. nov. Petasma.
18. *Trachypeneus sedili* sp. nov. Female (1·6 cm. carapace).
19. *Trachypeneus sedili* sp. nov. Thelycum.

PLATE 21

20. *Metapenaeopsis barbatus* (de Haan). Stridulating ridges (1·6 cm. carapace).
21. *Metapenaeopsis stridulans* (Wood-Mason). Stridulating ridges (2·0 cm. carapace).
22. *Metapenaeopsis novae-guineae* (Haswell). Stridulating ridges (1·4 cm. carapace).
23. *Metapenaeopsis stridulans* (Wood-Mason). Petasma (1·4 cm. carapace).
24. *Metapenaeopsis novae-guineae* (Haswell). Petasma (1·4 cm. carapace).
25. *Metapenaeopsis andamanensis* (Wood-Mason). Thelycum (1·8 cm. carapace).
26. *Sicyonia ommanneyi* sp. nov. Female (0·96 cm. carapace).
27. *Sicyonia ommanneyi* sp. nov. Thelycum.

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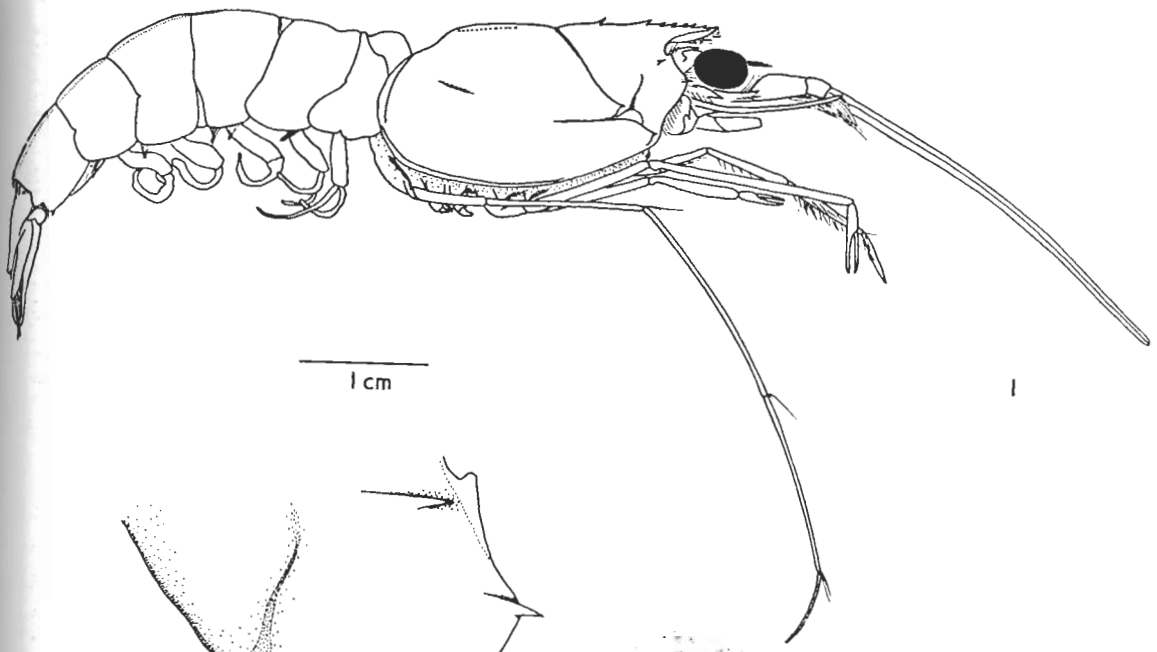

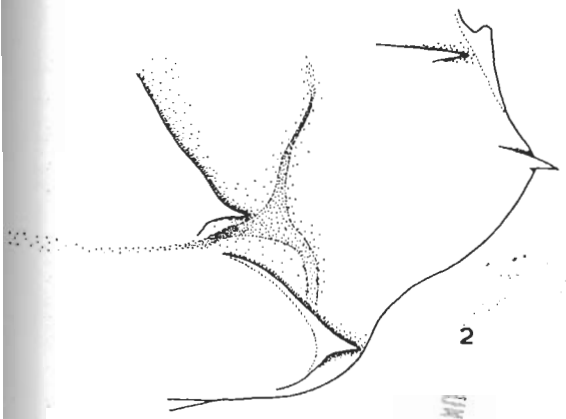

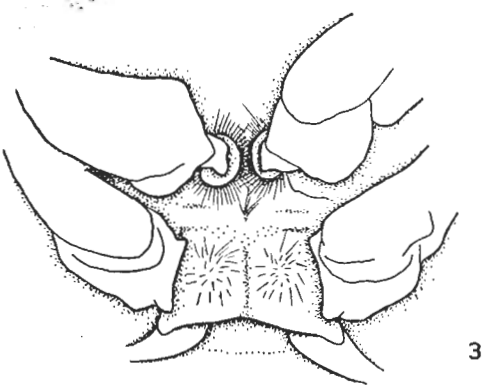

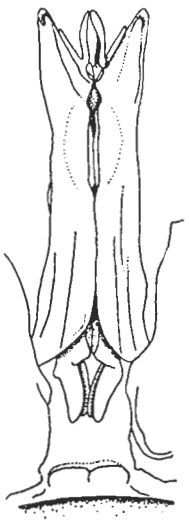

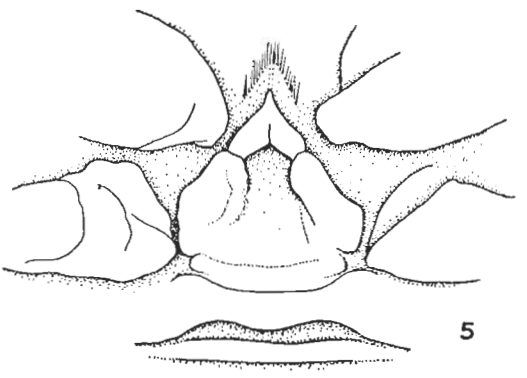

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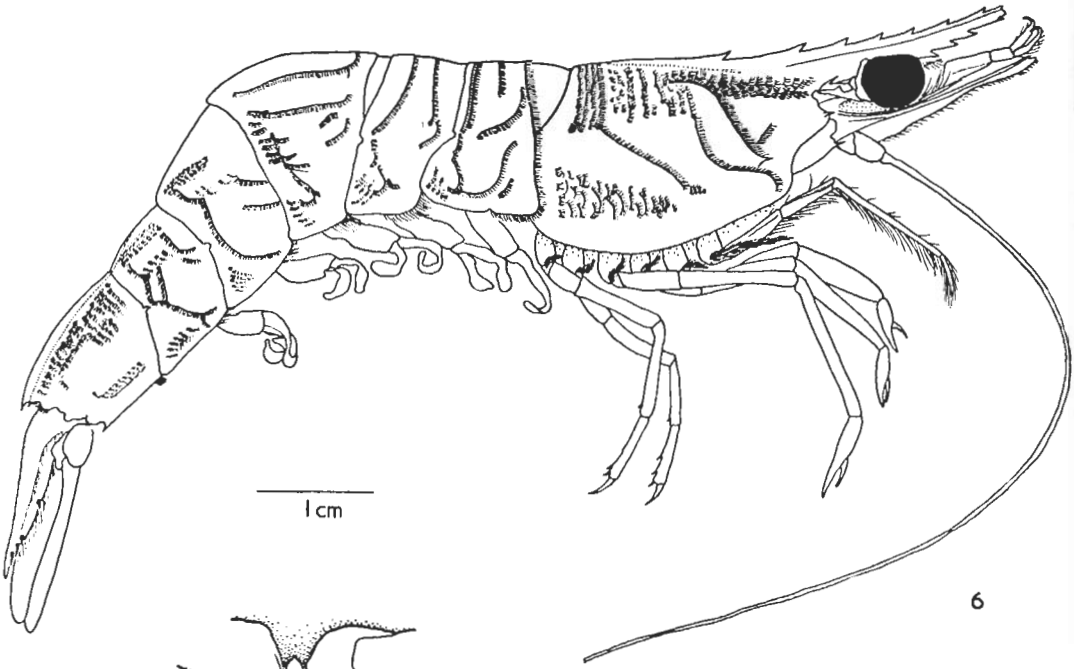

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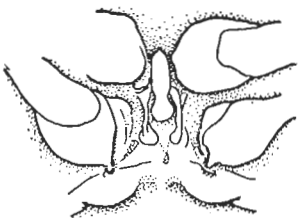

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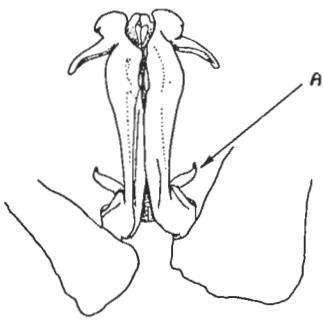

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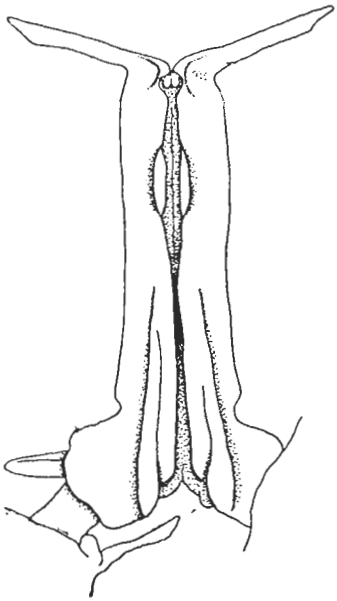

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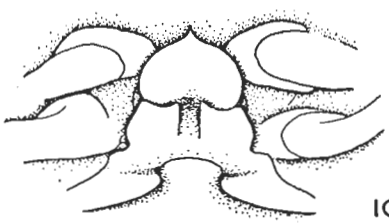

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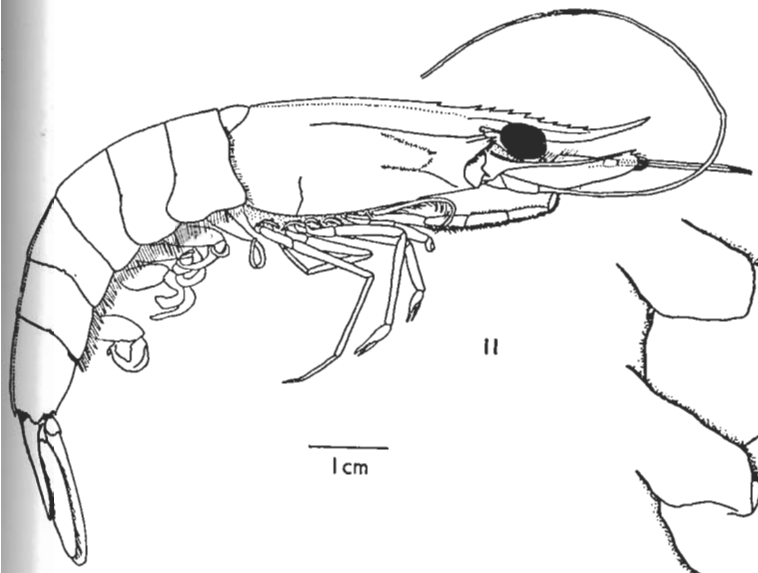

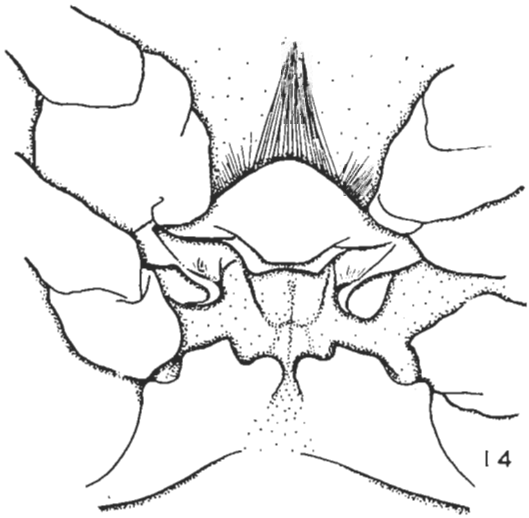

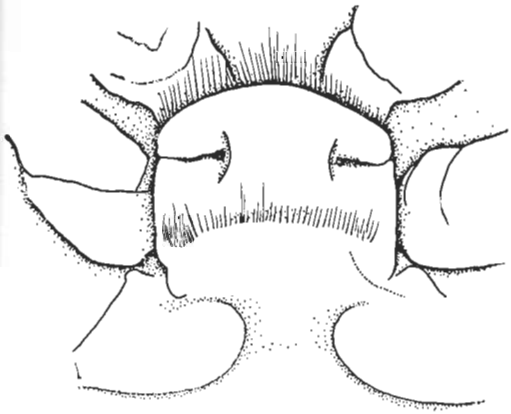

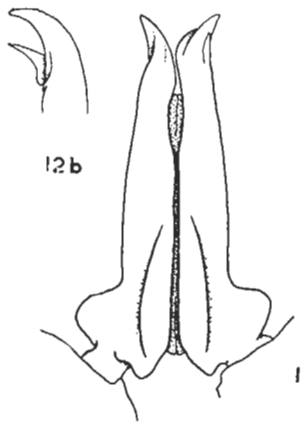

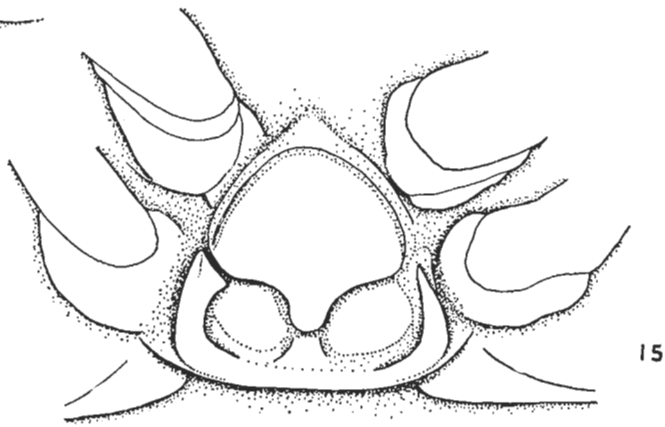

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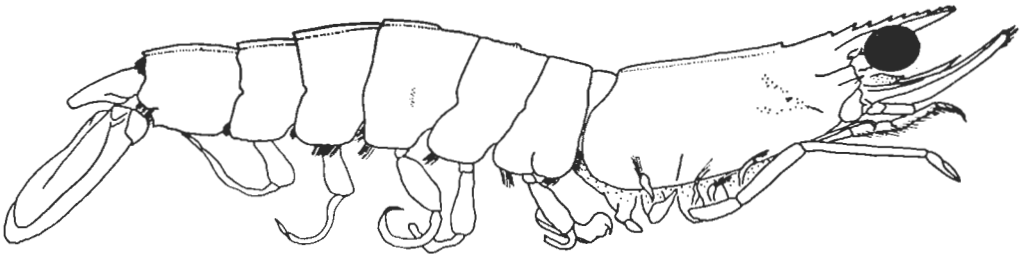

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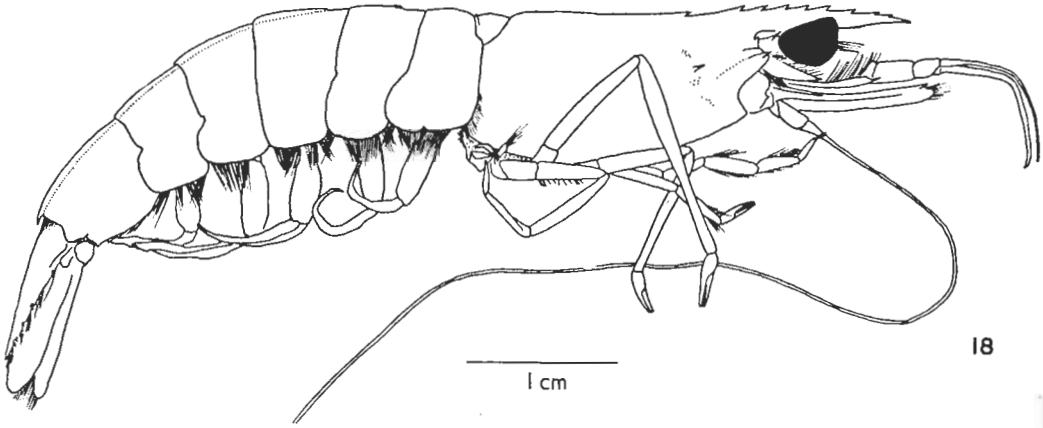

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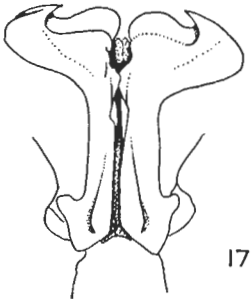

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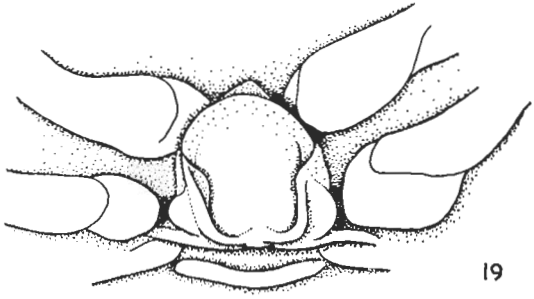

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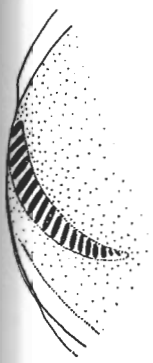

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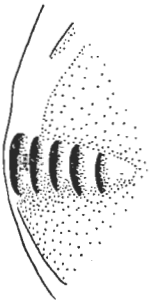

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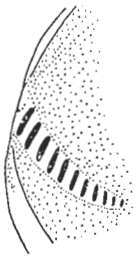

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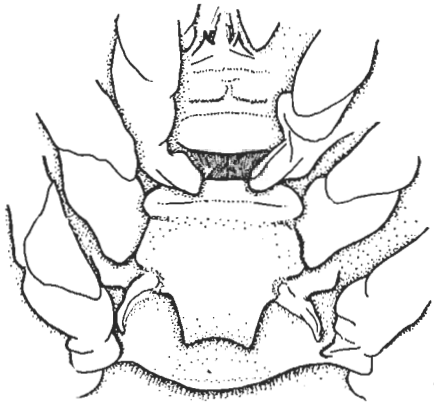

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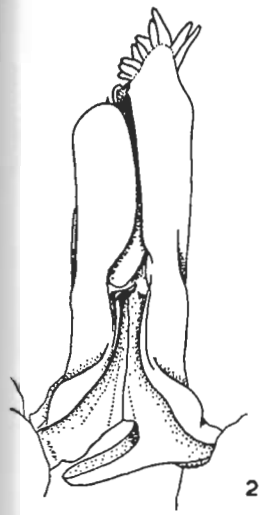

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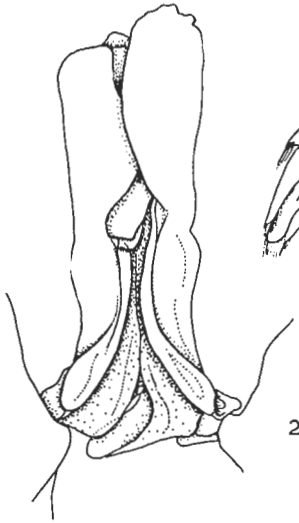

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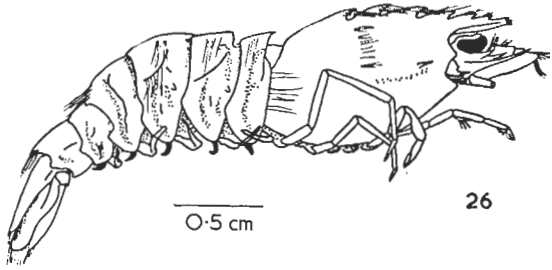

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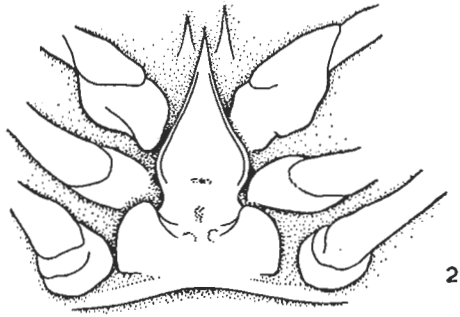

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Malayan Penaeidae (D. N. F. Hall).