

articulate, and fringed with long ciliated hairs, and the coxa carries a mastigobranchia without a podobranchial plume.

The second pair of gnathopoda (*i*) is long, slender and pediform; it is subcylindrical; the coxa carries a biramose mastigobranchia without a branchial plume attached, but to the membranous articulation are attached two well-formed arthrobranchiæ; the basis carries a long, biarticulate ecpysis, which resembles that on the first pair of gnathopoda; the ischium is long, furred with short hairs and armed on the inner margin with a series of curved hook-like spines and corresponding fasciculi of hairs; the meros is not so long as the ischium, becomes slightly narrowed distally, and is matted with hairs on the inner surface; the carpos is longer than the propodos, which is longer than the dactylos.

The first three pairs of pereiopoda are chelate; the propodos is not broader than the carpos, but the carpos is longer than the propodos; these three pairs successively increase in length as they proceed posteriorly, a circumstance that is due to the gradually increasing length of the carpos, which in each is longer than the meros; the two posterior pairs are subequal, but simple and more slender than the preceding. The first pair is armed on the inner side of the basis with a styliform, anteriorly-directed tooth, and on the outer side with an ecpysis, which is repeated on all the succeeding pereiopoda, but the styliform tooth exists on the second pair only.

There is a biramose mastigobranchia attached to all the pereiopoda except the posterior pair, and the podobranchial plume is absent from all, as well as from the gnathopoda. The arthrobranchiæ are present, two being attached to all the pereiopoda, except the posterior pair, and one only existing on the penultimate pair, while a single pleurobranchial plume pertains to each from the first to the fifth pair. The arrangement may be represented by the following formula:—

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	1	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	...	...
				h	i	k	l	m	n	o

On the ventral surface in both our specimens, between the posterior pair of pereiopoda, is a large thelycum, consisting of a dichotomous, calcareous capsule, which extends forwards as far as the base of the antepenultimate pair of pereiopoda, whence projects two large, leaf-like, membranous appendages (Pl. XXXII. fig. 4 ♀). They appear to be connected with the internal organs by means of foramina in the floor of the capsule, and have no connection whatever with the fifth pair of pereiopoda.

The five anterior pairs of pleopoda are formed on one general type. They consist of a large triangulate basal joint attached to the ventral surface of the pleon, and terminating in two leaf-like branches, both of which are smooth in the median and posterior portions, but strong and multiarticulate at the margins, which are posteriorly

fringed with hairs; the outer branch is always the larger and more conspicuous in the anterior pairs, the inner gradually lessening in proportion as it advances until it is little more than rudimentary in the first pair.

The sixth pair of pleopoda forms the outer plates of the rhipidura: the basal joint is short, the outer plate is longer than the inner, and the inner is longer than the telson, and both graduate towards the outer distal angle of the external branch.

Observations.—Both our specimens, which were purchased in the market at Yokohama, are females, and have the very peculiar apparatus on the ventral surface between the posterior pair of pereopoda, which, so far as I am aware, has never been previously figured or described by any naturalist.

The female of a variety taken at Port Jackson agrees with the Japanese form in every detail excepting that the thelycum consists of two oval plates attached in their entire width, at the posterior extremity to the ventral surface of the pereion, and at the anterior by a narrow process on the outer side only. This organ differs in form from the thelycum in the Japanese variety. I have only examined females of this species, and my experience of this peculiar apparatus is not sufficiently extensive to enable me to say whether or not it undergoes any change or modification of form or of growth on the approach of the power of reproduction.

Penæus canaliculatus, var. *australiensis*, nov. (Pl. XXXII. fig. 3).

This variety corresponds closely with the preceding, but differs in the form of the thelycum, which may be better understood by the figure on the plate than by a written description. There are, moreover, plates on the ventral surface, between the third and fourth pairs of pereopoda, that are not apparent in the typical varieties.

There is not a male of this variety in the collection.

Length (female), 100 mm. (4 in.).

Habitat.—Port Jackson, Australia; depth 2 to 10 fathoms; April 1874.

Penæus indicus, Milne-Edwards (Pl. XXXIII. fig. 2).

Penæus indicus, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 415.

„ „ Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 177, pl. xii. fig. 5.

Rostrum straight, just passing beyond the extremity of the peduncle of the first pair of antennæ, styliform towards the extremity, and surmounted at the base by a crest that gradually decreases towards the posterior margin of the carapace. Armed with eight (“or nine”) teeth on the dorsal surface, and four or five on the inferior. Flagella of the first pair of antennæ slender and equal in length to their peduncle. Telson about half the length of the outer branch of the rhipidura, terminating in a sharp point, with

the dorsal surface longitudinally grooved in the median line, and the lateral margins fringed with cilia.

Length, 127 mm. (5 in.) male.

Habitat.—Station 203, October 31, 1874; lat. $11^{\circ} 6' N.$, long. $123^{\circ} 9' E.$; depth, 20 fathoms; bottom, mud. One specimen; trawled.

The specimen in the Challenger collection appears to correspond more closely with the description that Milne-Edwards has given of the species than does the typical specimen preserved in the Museum of the Jardin des Plantes, of which I have given a figure in the *Ann. and Mag. Nat. Hist.* for September 1881. In the type the rostrum is slightly elevated at the extremity, and the crest at the base is not remarkable, whereas in our specimen the rostrum continues in a horizontal line to the apex, and the crest is strongly marked at the base. Our specimen is a male, while that of Milne-Edwards is a female. The Challenger specimen has eight teeth on the dorsal margin, of which the most anterior is small, and there are four on the lower margin. The rostral carina gradually decreases to the posterior margin of the carapace.

The posterior three somites of the pleon are compressed, and the last two are carinated.

In our specimen the sixth somite terminates in a small tooth, but in Milne-Edwards' specimen the tooth is somewhat larger.

The ophthalmus is moderately large and stands on a long ophthalmopod, of which the first joint projects laterally. The first pair of antennæ has slender flagella, the longer of which is slightly longer than the peduncle, which is subequal with the rostrum. The prosartema reaches beyond the ophthalmopod, and the stylocerite does not extend so far as the extremity of the eye. The second pair of antennæ has a flagellum that is long, slender, and twice the length of the animal, and the scaphocerite reaches a little beyond the extremity of the rostrum. Milne-Edwards remarks that the chelæ of the three anterior pairs of pereopoda are long and slender, but they do not appear to be remarkably so beyond those of other species. In our specimen the petasma corresponds with the same organ in *Penæus monodon*. And in all other respects I can find no definite separating feature beyond the existence of one little tooth at the anterior extremity of the rostrum, and another on the inferior margin. In the larger specimen, that is, in *Penæus monodon*, the first pair of antennæ has the outer flagellum much thicker at the base, but this is only a feature characteristic of a matured male. The longitudinal grooves on the inner and outer plates of the rhipidura are similar; and the telson and the details of the structure throughout appear to be identical.

Our only specimen that corresponds with Milne-Edwards' description of *Penæus indicus* is a male, and was taken, associated with two large females of *Penæus monodon*, among the Philippine Islands.

The ventral plate or thelycum in the female, from which Milne-Edwards drew his

description, is very similar to the same organ in *Penæus monodon*, and taking all things into consideration, I am induced to believe that *Penæus indicus* is but an overtoothed variety of *Penæus monodon*; it is interesting as showing from what small variations forms of importance may gradually proceed.

Penæus monodon, Fabricius (Pl. XXXIV. fig. 1).

Penæus monodon, Fabricius, Suppl. Ent. Syst., p. 408.

Penæus monodon, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 416.

Penæus semisulcatus, de Haan, Crust. in v. Siebold, Fauna Japonica, p. 191, pl. lvi. fig. 1.

Penæus carinatus, Dana, U.S. Explor. Exped., Crust., p. 602, pl. xl. fig. 2.

Penæus monodon, Sp. Bate, Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 178, pl. xi., 1881.

Rostrum straight, dorsally elevated into a laterally compressed crest that is armed with six or seven teeth, and on the lower margin with three. Rostral crest gradually lessens behind the last tooth, and is lost before reaching the posterior margin of the carapace; in the male it exists in the form of a simple carina, and in the female it is longitudinally grooved. On each side of the rostral crest is a sulcus, formed by a longitudinal ridge that commences at the apex of the rostrum and terminates in a line corresponding with the posterior tooth of the dorsal crest. There is one tooth on the basal joint of the anterior two pairs of pereopoda and none upon that of the third. The telson is grooved in the median line and fringed with fine hairs on the margins.

Length, 190 mm. (7.5 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59' S., long. 139° 42' E.; south of New Guinea; depth, 28 fathoms; bottom, green mud. Two specimens; a male and a female; associated with *Penæus incisipes*.

Station 203, October 31, 1874; lat. 11° 6' N., long. 123° 9' E.; off Panay, Philippine Islands; depth, 20 fathoms; bottom, mud. Two specimens; females, associated with a male of *Penæus indicus*; trawled.

The typical specimen of Fabricius of this species is not now in existence, and those from which Milne-Edwards drew up the short description in his *Histoire Naturelle des Crustacés*, are all small and immature animals, but he says that although he had not seen specimens that were more than 76 mm. (3 in.) in length, yet according to Fabricius they reach to a very large size.

The examination of the specimens preserved in the Museum of the Jardin des Plantes, and their comparison with others of a larger size, have convinced me that *Penæus monodon* is identical with *Penæus semisulcatus* of de Haan, as figured and described by him in Siebold's *Fauna Japonica*. De Haan rests the distinguishing feature, that separates the two species, on there being a median longitudinal groove between the base of the rostrum and the posterior margin of the carapace in *Penæus semisulcatus*, and none in *Penæus*

monodon, whereas in the specimens now under our observation in the Challenger collection, taken in the same haul, the female has a median groove, but in the male there is none, the dorsal carina being entire.

There are, however, some minute details that are at variance, although not sufficiently important to justify specific separation.

Both *Penæus monodon* and *Penæus semisulcatus* carry three teeth on the lower margin of the rostrum, but according to de Haan's figure they are situated, or at least two of them, posterior to the most anterior tooth on the upper margin, whereas in our specimens of *Penæus monodon*, they are all in advance of that position. In de Haan's figure there is also shown what may be considered as a supraorbital tooth, but judging from the specimens I have examined, it is rather the result of a somewhat sudden curve or bend in the orbital margin than a distinct tooth.

Desmarest has evidently mistaken the species, for he says that it has seven teeth on the upper margin of the rostrum and five below. Milne-Edwards says that it has eight or nine teeth above and three below; and de Haan says that it has eight teeth on the upper margin and three below. In the Challenger collection there are four specimens, all of them adult. Three of these are females and one is a male. The females have seven teeth on the dorsal crest, the male six, and all have three below. Mr. Miers,¹ of the British Museum, says in relation to this species that he thinks it to be synonymous with de Haan's species, *Penæus semisulcatus*. Moreover, he says, "In two specimens from Australia (Shark Bay) and one from Ceylon, the rostrum is 6-7-toothed above, the teeth towards the apex separated by much wider intervals than in the other specimens referred to *P. semisulcatus*, there is a short dorsal carina which does not reach to the posterior margin of the cephalothorax, and is not canaliculated above, and the gastro-hepatic sulcus is very deep and strongly defined." For the latter he proposes the name of *Penæus monodon* if the two species be distinct.

Such a difference can scarcely be recognised as a specific character, for the greater enlargement of the interdental spaces may be and probably is induced by age, sex, or local variation; and, as I have shown above, the postrostral groove cannot be accepted as more than a collateral feature, since it is found in the females and not in the males of the same species.

The flagella of the first pair of antennæ are subequal, whereas *Penæus semisulcatus* is described by the author as having the internal branch twice the length of the external.

De Haan described the female as having the sternum between the posterior pair of pereiopoda divided by a median cleft and reflexed. ("Sternum feminarum inter pedes quintos rima media continua divisum et reflexum.") These exist as two flattened calcified plates—which I distinguish by the name of *thelyca*—extending from the base

¹ *Proc. Zool. Soc. Lond.*, p. 299, March 5, 1878.

of the fourth pair of pereopoda to the posterior margin of the sternum; the inner margins are brought into contact and turned downwards, and form the cleft of which de Haan writes (*vide* fig 1^{'''}, ♀). The oviducts open at the base of the coxæ of the third pair of pereopoda by a foramen placed at the extremity of a short tubercle, the margin of which is copiously fringed with hairs. The first pair of pleopoda has the outer ramus long, flat, and subfoliaceous, and the inner reduced to little more than a rudimentary bud.

In the male the two oval plates are not present, but a small sharp prominence exists in the median line towards the anterior portion of the ventral surface of the posterior somite. The vas deferens debouches near the base of the coxa, where that joint articulates with the pereion.

The first pair of pleopoda has the external ramus similar to that of the female, but the inner branch is altogether altered from its normal form and condition. It articulates with the basal joint near its base, and is developed into a large, membranous and flexible plate, longitudinally folded on itself, and united with its fellow in the median line by a series of small cincinnuli, which thus form a large petasma that overlies the sexual apparatus.

The other pairs are biramose, but have the outer branch twice as long as the inner.

Milne-Edwards records his specimen from the coast of India, and Siebold obtained that which de Haan described from Japan.

Rather than multiply species upon grounds of slight variation, I have thought that as *Penæus monodon* has never been figured, and varies in some points in almost every description, and as the Challenger specimens so closely resemble *Penæus semisulcatus*, and correspond with the description given by Milne-Edwards and de Haan, they may be accepted as the typical form of the species.

Dr. Camil Heller, in his account of the "Novara" Crustacea, has described a species under the name of *Penæus takitensis*,¹ the figure of which varies but little from this species, but the description does not agree with his figure. He says that the inferior margin is without teeth ("margine inferiore edentulo"), but represents three teeth in his figure; he also says that the flagella reach to the last tooth on the rostrum, but figures them as being as long as the carapace. If the figure be correct, the species corresponds very closely with that given by Dana as *Penæus carinatus*, and which I think there is little doubt is identical with *Penæus monodon*. The extremity of the rostrum is very slightly turned up in both de Haan and Dana's specimens, whereas in the type according to Milne-Edwards the rostrum is straight, and the Challenger specimens agree with this.

Heller's species is 120 mm. in length, and was taken off the Island of Tahiti, while Dana's *Penæus carinatus* was taken near Singapore.

Penæus esculentus, Haswell, taken at Port Jackson, probably belongs to this species also.

¹ Reise der Fregatte "Novara," Crustacea, p. 121, Taf. xi. fig. 2.

Penæus velutinus, Dana (Pl. XXXIII. fig. 1).*Penæus velutinus*, Dana, U.S. Explor. Exped., Crust., p. 604, pl. xl. fig. 4.

Body tomentose. No carina on the posterior half of the carapace. Rostrum straight, lanceolate, the lower margin smooth, ascending anteriorly to the extremity, armed on the upper margin with eight equidistant teeth, and one posteriorly remote. Pleon dorsally carinated from the second somite to the posterior extremity of the sixth, which terminates in a small tooth. Eyes short, large, ovate. Peduncle of the first pair of antennæ reaching as far as the extremity of the rostrum. Flagella short, not longer than the last two joints of the peduncle. Scaphocerite of the second pair of antennæ not extending beyond the rostrum. First pair of pereopoda armed with one tooth on the basis, and one on the ischium, second pair with one on the basis. Telson as long as the outer ramus of the rhipidura, not carinated nor channelled, terminating in a sharp styliform point, and armed on each side with four long, articulated spines and one rigid spiniform tooth.

Length, 75 mm. (3 in.).

Habitat.—Station 188, September 10, 1874; lat. $9^{\circ} 59' S.$, long. $139^{\circ} 42' E.$; south of New Guinea; depth, 28 fathoms; bottom, green mud. Twenty-five males, eighteen females, two young.

Station 184, August 29, 1874; lat. $12^{\circ} 8' S.$, long. $145^{\circ} 10' E.$; between Australia and New Guinea, near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36° . Two specimens; females. Length 36 mm.

Station 186, September 8, 1874; lat. $10^{\circ} 30' S.$, long. $142^{\circ} 18' E.$; between Cape York and Arrou Islands; depth, 8 fathoms; bottom, coral mud. Two specimens, a male and female. Length, male 40 mm., female 58 mm.

Station 187, September 9, 1874; lat. $10^{\circ} 36' S.$, long. $141^{\circ} 55' E.$; Torres Strait; depth, 6 fathoms; bottom, coral mud. Two females, of a redish hue. Length of largest, 64 mm.

Station 190, September 12, 1874; lat. $8^{\circ} 56' S.$, long. $136^{\circ} 5' E.$; south of New Guinea; depth, 49 fathoms; bottom, green mud. Twelve females, seven males. Length, male 62 mm., female 44 mm.

Near Station 190, between that and 191 (September 18, 1874), a single specimen was taken with *Penæus anchoralis*.

Station 233, May 17, 1875; lat. $34^{\circ} 39' N.$, long. $135^{\circ} 14' E.$; channel between the Japanese Islands; depth, 8 fathoms; bottom, mud. Eleven females, ten males. Length 65 mm.

Station 234, June 3, 1874; lat. $32^{\circ} 31' N.$, long. $135^{\circ} 39' E.$; depth, 2675 fathoms; bottom, blue mud; bottom temperature, $35^{\circ} \cdot 8$. Two females. Length, 60 mm.

The body of the animal is covered over with a short, velvety pile, more scanty, apparently from friction, upon the sides of the posterior somites of the pleon and the lower part of the walls of the carapace. There is no crest on the dorsal surface of the carapace posterior to the last tooth of the rostrum, which is armed with seven teeth in the male and eight in the female that are equidistant, the last of the series terminating in a line with the orbital margin of the carapace, and one tooth being separated from the rest, standing on the gastric region.

On the pleon the evidence of a dorsal carina commences on the second somite and increases posteriorly on each successively until it forms a very distinct and perfect carina, which terminates in a short tooth at the extremity of the sixth somite, and is indicated at the posterior extremity of the two preceding somites.

The ophthalmus is large, reniform, and stands on a short biarticulate peduncle.

The first pair of antennæ is longer than the rostrum, being subequal to the length of the peduncle, and supports two short flagella which are not so long as the last two joints of the peduncle. The basal joint carries a prosartema that reaches to its distal extremity, and a sharp-pointed stylocerite that extends beyond it.

The second pair of antennæ has the first three joints of the peduncle consolidated into one, which articulates with the surface of the metope, and carries a scaphocerite, and the terminal joint supports a flagellum that is twice as long as the animal.

The mandible is a stout, short and powerful organ, and supports a quadrate, biarticulate synnhipod, broader and shorter than that of *Penæus canaliculatus*, smooth and evenly polished on the external surface, and projecting forwards, as a foliaceous plate, to overlie the base of the second pair of antennæ. The metastoma consists of two oblong plates lying against the posterior surface of the mandible.

The first pair of siagnopoda does not carry a long, slender, biarticulate outer ramus as in *Penæus canaliculatus*.

The second pair of siagnopoda corresponds closely with that of the preceding species, but has the posterior extremity of the mastigobranchial plate somewhat broader.

The third pair differs little from the typical form in the genus.

The first pair of gnathopoda likewise differs little from the typical generic form. The second pair carries a small, sharp tooth at the anterior extremity of the basis.

The first pair of pereopoda is armed with two teeth, one on the inner anterior extremity of the ischium, and another in a similar position on the basis; this latter joint carries a short and slender basephysis, and the coxa carries a short pedunculated equi-biramose mastigobranchia.

The second pair of pereopoda is longer than the first, and is armed with one long and slender tooth on the basis, which also supports a short and slender basephysis, and the coxa supports a pedunculated inequi-biramose mastigobranchia.

The third pair of pereopoda is longer than the preceding, it does not carry any tooth, but the basis supports an ecpysis, and the coxa carries a single-branched mastigobranchia, which is pedunculated, broad at the base, and tapering. The oviducts are attached to the coxal joints in the form of a projecting tubercle directed obliquely inwards and posteriorly.

The fourth and fifth pairs of pereopoda are long, tolerably robust, and terminate in long, flattened, lanceolate dactyli; each carrying a basecpysis but no mastigobranchia.

On the ventral surface (fig. 1''') between the second pair of pereopoda, two long spine-like teeth project, one on each side of the median line, and between the last two pairs lies a cordiform thelycum, flat in the middle, elevated, and surrounded by a margin fringed with hairs.

The anterior pair of pleopoda (*p*) has the outer branch long, flattened and tapering, the inner minute and rudimentary, and situated near the inner distal angle of the basal joint. The four following pairs are subequally biramose.

The male differs very little from the female in general aspect. The several parts appear to be a little more pronounced, but the two long and slender teeth, so conspicuous on the ventral surface in the female, are wanting.

The vas deferens projects from the posterior pair of pereopoda, and the petasma (fig. 1'', *p*) attached to the first pair of pleopoda springs from near the base of the basal joint, and is produced into a longitudinally folded leaf-like appendage, intimately linked together in the median line by small cincinnuli. All the other pairs are similar to those in the female; the sixth pair, which aids in the formation of the rhipidura, is long, narrow, and rounded at the extremity.

The telson (12) is as long as the lateral plates, furnished on each side with four spines, and one spine-like tooth, and terminates in a long and slender point.

Forty-five specimens of this species were taken both with the trawl and the dredge south of New Guinea, and several others at different Stations in the same region, associated in some instances with *Polycheles*; and twenty-one were dredged in the narrow channel between the islands on the southern coast of Japan.

Stimpson records specimens from Japan, at from 4 or 5 to 30 fathoms, on a sandy bottom.

This species is essentially an inhabitant of shallow water, and as such was found in the channel referred to, where the water is only from 8 to 50 fathoms deep, a depth that corresponds with that of most of the other recorded localities. The great variation in the depth at which two specimens were taken in the same region can only be accounted for by the fact that the deep water comes up close to the southern shores of Japan. I am therefore induced to believe that those obtained from the greater depth of 2675 fathoms were caught swimming in mid-water, and carried down previously to their being brought up in the dredge, a supposition that is supported by their soft and somewhat damaged condition.

This species, since first described by Dana, does not appear to have been identified by any naturalist except Stimpson; it is so much like *Penæus affinis*, Milne-Edwards, that it has probably been mistaken for it, as in general appearance the species correspond.

Penæus barbatus, de Haan,¹ differs from it in the number of teeth on the rostrum, which is figured with eight, the posterior of which is distant from the others and described "Rostro margine . . . , superiore 5-7 dentato;" the greater length of the flagella of the first pair of antennæ, and in having "Pedes tres antichi basi unispinosi;" a circumstance that separates de Haan's species from those that I have described (as *Penæus velutinus*) from off the southern coast of Japan. They may however with certainty be distinguished by several important points, of which the following are the most conspicuous.

The rostrum in *Penæus velutinus* is not quite so long in relation to the length of the carapace, the denticulation on the upper surface is deeper and closer, and the rostrum greater in depth and less styloform at the extremity. The flagella of the first pair of antennæ are shorter. The first pair of pereopoda is armed with two strong teeth, and the second pair with one. In the female two long slender teeth project from the ventral surface of the somite between the second pair of pereopoda; which, together with a variation in the form of the petasma attached to the first pair of pleopoda in the male, are decided points of specific separation.

Dana dredged his specimen off the Sandwich Islands, but records it as being only one and three-quarters of an inch long, or about one-half the length of those taken by the Challenger, excepting in the case of a few young ones, which I presume Dana's specimen must have been.

At Station 190 numerous specimens were taken, ranging in sizes from 25 mm. to 75 mm. The adult male corresponds with that of our type, except that it has the longer branch of the petasma tipped with radiating points; in the younger forms the extremity of that organ is smooth and not prolonged, and in a still younger male the two branches are separate and narrow. The females also correspond with the same sex in the typical specimens, except that the two spinous teeth between the second pair of pereopoda are short in the younger specimens, and in some they appear to be absent.

These may be recognised as a variety under the name of *radiata*.

The following species exhibit a resemblance in external form to *Penæus velutinus*, the variation in the number of teeth on the rostrum being inconsiderable, and in my opinion of secondary importance, and they each carry a solitary tooth planted on the gastric region, varying a little in position, being more or less distant from the posterior tooth on the rostrum. Notwithstanding this general similitude there are certain important details that appear to me to be neither directly or immediately transmit-

¹ V. Siebold's Fauna Japonica, Crustacea, p. 192, *Penæus barbatus*, pl. xvi. fig. 3.

table. I have arranged these several species in a tabular form so that the points of resemblance and separation may be the more readily appreciated, merely premising that the petasma in the male and the thelycum in the female are constant in the same and dissimilar in separate species.

Species.	Rostral Teeth.	Gastric Tooth.	Telson.		Ventral Teeth.	Hepatic Tooth.	1st Pereiopod Teeth.	2nd Pereiopod Teeth.
			Teeth.	Spines.				
<i>Penæus velutinus</i> , . . .	8	1	1	4	2 ♀	1	2	1
<i>Penæus incisipes</i> , . . .	7 to 9	1	0	0	0	1	1	1
<i>Penæus affinis</i> , . . .	8	1	0	0	(?)	1	(?)	(?)
<i>Penæus anchoralis</i> , . . .	6 to 9	1	0	1	0	1	1	1
<i>Penæus philippinensis</i> , . . .	7	1	1	3	0	1	2	0
<i>Penæus fissurus</i> , . . .	6	1	1	0	0	1	2	0
<i>Penæus rectacutus</i> , . . .	12	1	(?)	2	0	1	2	0
<i>Penæus monoceros</i> , . . .	8	1	0	0	(?)	1	(?)	(?)
<i>Penæus serratus</i> , . . .	12	1	1	2	0	1	2	0

Penæus incisipes, n. sp. (Pl. XXXIV. fig. 2).

Rostrum straight, slightly elevated, armed with seven to nine teeth on the upper surface, and one on the gastric region. Eye large, about half the length of the rostrum.

First pair of antennæ having flagella as long or nearly as long as the peduncle. Second pair of antennæ three times as long as the entire animal. First pair of pereopoda armed with one tooth. Second pair armed with one; third with none. Chelæ long and slender. Posterior pair of pereopoda long and slender, dactylos flattened, meros notched on the under or posterior margin. First pair of pleopoda in the male having the petasma long, narrow, and double-headed at the extremity; second pair furnished with a large tubercle on the anterior surface of the inner ramus; telson unarmed and shorter than the outer plates of the rhipidura.

Length of male, 88 mm. (3.5 in.). Female, 31 mm. (1.25 in.).

Habitat.—Station 190, September 12, 1874; lat. 8° 56' S., long. 136° 5' E.; Arafura Sea, south of Papua; depth, 49 fathoms; bottom, green mud. One female.

Station 203, October 31, 1874; lat. 11° 6' N., long. 123° 9' E.; off Panay, Philippine Islands; depth, 20 fathoms; bottom, mud. Three males and one small female.

The specimens of this species in the collection are three males, and two small females; they are smooth and almost polished, and tomentose in patches corresponding with various regularly situated elevations and depressions that mark the animal all over. The rostrum

is straight and almost in a horizontal line with the dorsal surface of the carapace, rising to the apex. The type specimen is armed with seven teeth, but the extreme tip of the rostrum is broken off. Two others, not quite so large, have nine each, the apical one being very small; the last is above and behind the orbital margin of the carapace, and one posteriorly remote upon the gastric region, whence the dorsal crest is continued with but a minimum of elevation to the posterior margin of the carapace. Two longitudinal ribs traverse the carapace in a slightly oblique direction, just above the branchial region. The orbital tooth is very minute, while the antennal tooth is well formed and prominent, as also is the tooth on the hepatic region.

The pleon is marked with a median longitudinal carina that is visible on the dorsal surface of the second somite, and gradually increases to a small ridge on the sixth somite, where it ends abruptly and is not produced to a tooth. The sixth somite is compressed laterally, and so to a less extent is the fifth. The telson is dorsally longitudinally grooved, and the sides ribbed, smooth, and fringed with fine hairs, and the extremity terminates in a sharp point.

This species differs from the type specimens of *Penæus affinis*, preserved in the Museum of the Jardin des Plantes, as described by Milne-Edwards, in having the rostrum straight, instead of being curved upwards at the extremity.

The notch on the meros of the fifth pair of pereopoda is equally distinct, but that on the rhipidura is less marked. There is a slight variation also in the folding of the petasma.

The females in the collection correspond with the males, except in the absence of the peculiar excisions on the base of the fifth pair of pereopoda, and on the outer plates of the rhipidura. The female specimens are small and probably immature, being only 31 mm. in length.

In the female the thelycum or ventral plate is shaped like the conventional figure of a heart, with the apex directed anteriorly.

The resemblance of this species to the type, *Penæus affinis*, is so great, that in spite of the various differences, I have some hesitation in considering it anything more than a modified form.

Penæus anchoralis, n. sp. (Pl. XXXV. fig. 1).

Surface tomentose. Rostrum dorsally horizontal, slightly elevated at the apex and armed with eight small teeth, subequally distant, and one small one further separated and situated on the gastric region. Lower margin smooth, gradually ascending in a curved line to the apex. Frontal margin armed with a small supraorbital and an antennal tooth, and one on the hepatic region. Third and succeeding somites of the pleon carinated, the sixth terminating in a small tooth. Telson pointed, dorsally flattened and

longitudinally grooved, fringed at the margins with fine cilia, amongst which one small spine is visible on close inspection.

Length—female 88 mm. (3.5 in.); male, 63 mm. (2.5 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59' S., long. 139° 42' E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom green mud. Six males and one female.

Station 190, September 12, 1874; lat. 8° 56' S., long. 136° 5' E.; Arafura Sea, south of Papua; depth, 49 fathoms; bottom, green mud. Two males having nine teeth on rostrum. Taken with one of the females of the preceding species.

Off Yokohama, in from 5 to 20 fathoms. Three males and three females.

On the 18th September 1874, near the Arrou Islands in the Arafura Sea, between Stations 190 to 191, a male specimen was taken associated with *Penæus velutinus*.

Rostrum horizontal on the dorsal surface, where it is armed with several small equidistant teeth. In the male they have a tendency to be fewer than in the female. In some specimens of the former I have counted as few as six (but two from Station 190 have nine), and in the latter the number is very constantly eight, and in addition there is one more distantly planted on the gastric region. The lower margin of the rostrum is free from denticulations, but closely fringed with ciliated hairs; in the male the lower margin is less curved in its ascent than in the female, and has consequently a narrower and sharper appearance. There is a small carina that traverses the median line to the posterior extremity of the carapace. It is lost on the first somite of the pleon, but reappears in the shape of a small tubercle near the centre of the second somite, after which it appears again on the third, whence it is continuous to the posterior extremity of the sixth and is there produced to a small tooth.

On the frontal margin of the carapace is a small orbital tooth and a tolerably strong antennal one, and between them a longitudinal depression that appears to be connected with the orbit; it carries a well-formed hepatic tooth, which, unfortunately, has been omitted by the lithographer in the figure.

The ophthalmi are ovate and moderately large. The first pair of antennæ has the peduncle longer than the rostrum, and supports two flagella equal to the peduncle in length; the outer and inferior is the larger and in both sexes tapers gradually to the extremity. The prosartema reaches to the extremity of the eye, but scarcely beyond it, and the stylocerite does not reach to beyond half the length of the ophthalmopod. The second pair of antennæ has the scaphocerite extending beyond the rostrum, but not quite as far as the extremity of the peduncle of the first pair, and the external distal tooth extends nearly as far as the distal extremity of the scaphocerite.

The first two pairs of pereopoda carry on the basis a long and spiniform tooth. The third pair in the female carries the external passage of the oviduct, projecting on a small

tubercle, posterior to which, between the coxæ of the fourth and fifth pairs, lies the thelycum (fig. 1'''), which consists of two divisions, the anterior being an elevated cordiform plate and the posterior a circular prominence surrounding a central depression.

In the male the fifth pair of pereopoda carries the foramen of the *vas deferens* on a prominence on the inner side of the base of the coxa, and the first pair of pleopoda supports a petasma (fig. 1'') that folds like a double-fluked anchor, the arms of which extend laterally and lie flat against the ventral surface of the pereion and its appendages. The second pair of pleopoda is two-branched; the inner branch supports at the base a button-like process. The succeeding pairs are only generic in character and become smaller in succession posteriorly. The posterior pair, which contributes to form the rhipidura, has no tooth projecting on the outer margin, but the external ridge terminates at the external distal extremity; a second ridge commencing near the centre of the basal joint traverses the plate diagonally, and meets the external margin at the same place as the obsolete diæresis. The inner plate is nearly as long as the outer, and is longitudinally traversed by two central ridges; one, commencing at the articulation, continues in a straight line to the apex; the other commences at the inner margin near the base, whence in a curved line it turns inwards and then continues parallel with the central ridge to the apex. The telson runs to a sharp point, the sides are depressed and fringed with hairs, amongst which is one small spine on each side, visible only on close observation through a hand-lens, whence it somewhat suddenly narrows. The dorsal surface is flattened, and traversed in the median line by a longitudinal groove.

Observations.—This species bears a close resemblance to *Penæus velutinus*, Dana. The two forms, moreover, are generally found associated in the same localities, and on casual observation might be mistaken for one another. Both are tomentose, carinated on the posterior somites of the pleon, have a number of teeth on the rostrum, and the ophthalmopoda resemble each other.

But in *Penæus velutinus* the flagella of the first pair of antennæ are very short, not being longer than the last two joints of the peduncle, while in *Penæus anchoralis* they are as long as the peduncle itself. There is no fissure between the supraorbital and the antennal tooth in *Penæus velutinus*, like that in *Penæus anchoralis*. In *Penæus velutinus* there is no fissure on the margin of the first somite of the pleon, but in *Penæus anchoralis* there is one that bisects it subequally. In *Penæus velutinus* the carina on the third somite of the pleon is double, or longitudinally grooved; in *Penæus anchoralis* it is entire. In *Penæus velutinus* the fourth and fifth somites are cleft at the posterior extremity, and the carina elevated in front of the cleft to a small tooth; in *Penæus anchoralis* the cleft is scarcely appreciable, and there is no tooth. The scaphocerite in *Penæus velutinus* is furrowed on the lower surface, and the diagonal ridges are not conspicuous, while in *Penæus anchoralis* the lower surface is polished, and the ridges are larger and conspicuous. In *Penæus velutinus* the first pair of pereopoda has a long

tooth on the basis and another on the ischium, and there is one on the basis of the second pair, but in *Penæus anchoralis* there is one only on the basis of each pair of legs. The telson in *Penæus velutinus* is as long as the outer plates of the rhipidura, and is laterally armed with four movable spines and one rigid tooth, while in *Penæus anchoralis* it is one-fourth shorter, and is armed with three small spines of so little importance that they are only appreciable by a lens under certain aspects. In addition, the form of the petasma in the male, and of the thelycum in the female, together with the unusual presence of two long ventral teeth between the coxæ of the second pair of pereopoda, go to make up the characters of two very distinct species of which the general external appearance is almost similar.

They appear not to be inhabitants of deep water, inasmuch as they have not been taken at a greater depth than 50 fathoms, and their range appears to be from Japan in the north to the northern shores of Australia in the south.

Penæus philippinensis, n. sp. (Pl. XXXV. figs. 2, 3).

Tomentose; no carina on the posterior half of the carapace. Rostrum horizontal, straight in the male, a little elevated in the female, armed with seven teeth that become smaller and further apart as they approach the extremity, and one very small tooth posterior to the rest and more remote, situated on the gastric region. Pleon laterally compressed and produced to a faint carina from the second to the sixth somite, where it culminates in a small point at the posterior extremity.

Ophthalmopod short, ophthalmus large, not quite half the length of the rostrum. Peduncle of the first pair of antennæ scarcely reaching to the extremity of the rostrum. Flagella short, slender, and rather longer than the last two joints of the peduncle. Stylocerite slender, sharp-pointed and curved upwards at the extremity, prosartema reaching a little beyond the extremity of the eye.

Second pair of antennæ long, slender, having the scaphocerite equal in length to the rostrum and subequal to the peduncle of the first pair of antennæ, and having the antero-external tooth parallel with the distal margin of its foliaceous plate. The pereopoda are not very long, none reaching, when extended forwards, as far as the extremity of the rostrum, and the dactyli of the last two pairs are short. The first pair carries a tooth on the basal and one on the ischial joint, but there is none on the second; a deep depression exists in the male between the coxæ of the two or three posterior pairs, in which the petasma, attached to the first pair of pleopoda, lies. The petasma (fig. 3") is folded longitudinally in a columnar form, somewhat resembling the same organ in *Penæus velutinus*, but the shaft on the left side, being the longer, is folded over in a coil in front of that of the right. The second pair of pleopoda has the complementary button-shaped appendage consisting of a long, curved, tubular process

lying contiguous to the inner margin of the smaller and inner branch. All the other pairs are of merely generic value.

The posterior somite of the pleon is long, being nearly twice the length of the preceding one.

The telson is not so long as the inner plate of the rhipidura; it is sharp-pointed, dorsally grooved, and armed at the margins on each side near the distal extremity with three long spines and with one posterior, rigid, slender spine-like tooth.

In the female the peduncle of the first pair of antennæ does not reach quite as far as the extremity of the rostrum, and the scaphocerite attached to the second pair is also shorter.

The sexual tubercle attached to the coxa of the third pair of pereopoda (fig. 2'') is longer than usual, projects obliquely backwards, and does not approach so near to its fellow as is generally the case in other species. The thelycum consists of two longitudinal plates united together in a straight line in the centre, and lobed on the outer sides, being held in position by clamp-like lateral processes, but which can best be understood by reference to the Plate (fig. 2''). In all other respects, except in the absence of the secondary sexual organs, the female resembles the male.

Habitat.—Station 192, September 26, 1874; lat. $5^{\circ} 49' 15''$ S., long. $132^{\circ} 14' 15''$ E.; off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud. Two male specimens; trawled.

Station 201, October 26, 1874; lat. $7^{\circ} 3' N.$, long. $121^{\circ} 48' E.$; off the Celebes Islands; depth, 82 fathoms; bottom, stones and gravel. Twenty-seven specimens; ten females, seventeen males; trawled.

Station 219, March 10, 1875; lat. $1^{\circ} 54' S.$, long. $146^{\circ} 39' 40'' E.$; off the Admiralty Islands; depth, 150 fathoms; bottom, coral mud. Numerous specimens; associated with *Panulirus angulatus*. Eight males and two females; trawled.

Observations.—The animal is slender, and has the pleon long, the sixth somite being twice the length of the preceding one. In the male specimens the rostrum is straight, being in the same horizontal plane as the dorsal surface of the carapace, and not gradually elevated from the base as in *Penæus velutinus*.

In most of the adult female specimens the extremity of the rostrum is slightly elevated. The eyes are very similar to those of *Penæus velutinus*. The first pair of antennæ has the flagella slightly longer, and the stylocerite on the outer margin is united to the first joint for half its length and then curved upwards, and is scarcely as long as in *Penæus velutinus*, and the prosartema is more pointed. The synhipod attached to the mandible is covered with a thick fur on the lower and external surfaces. In most respects the other parts resemble those described in *Penæus velutinus*, excepting that the posterior two pairs of pereopoda, which in *Penæus philippinensis* have the dactylos shorter and less flattened than in *Penæus velutinus*, have a furrow

longitudinally traversing the propodos, which does not exist in *Penæus velutinus*. But the great distinction from other species exists in the form of the ventral surface of the posterior somites of the pereion in the female, and in that of the petasma attached to the first pair of pleopoda in the male. In the female, originating within the posterior margin of the ultimate somite of the pereion, are two flat plates, separated from each other by a median furrow; they proceed forwards as far as the anterior margin of the penultimate somite, and anteriorly are widened outwards. The third pair of pereiopoda carries the oviducts, each of which opens by a small foramen at the extremity of an elongated tubercle, that is directed obliquely backwards nearly to the anterior margin of the thelycum; and there exist no long and slender teeth between the coxæ of the second pair as in *Penæus velutinus*. The first pair of pleopoda in the female does not differ materially from that in *Penæus velutinus*, but in the male the petasma differs in having the extremity of the left side, which is the longer, and which projects forwards in *Penæus velutinus*, coiled up and doubled inwards in this species (fig. 3"). Consequently the following distinctions will be found to be means of ready diagnosis in determining *Penæus philippinensis* from *Penæus velutinus*, namely, the length and horizontal position of the rostrum; the furry character of the synnhipod of the mandibles; the arrangement of the petasma attached to the first pair of pleopoda in the males; the absence of the long, spine-like, ventral teeth between the second pair of pereiopoda in the females; the reduced depth of the carina on the dorsal surface of the last two somites of the pleon, and the shortness of the telson, which is armed with three articulated spines and a small fixed tooth on each side behind and above the posterior spine.

The above description is drawn from specimens which were taken amongst the Celebes Islands, and it applies to all the adult forms.

In the younger males, judging from a solitary half-grown specimen, the foliaceous ramus of the first pair of pleopoda is neither broad nor well developed, and is probably immature. The extremity of the vas deferens projects from the coxa of the posterior pair of pereiopoda, and when elongated falls into a groove on the posterior surface of the petasma, and is probably in this way directed and held in position during coition.

From the branchial chamber of one or two male specimens I took a large species of *Bopyrus*.

Penæus fissurus, n. sp. (Pl. XXXVI. fig. 1).

Rostrum reaching but little beyond the extremity of the first joint of the first pair of antennæ; dorsal margin furnished with six small teeth and one remotely posterior upon the gastric region, from which a small carina passes to the posterior margin of the carapace; inferior margin ciliated. Pleon compressed and carinated from the third somite. The posterior margin of the fourth, fifth, and sixth somites

terminating in a small tooth. Telson long and pointed, dorsally channelled, and laterally armed with a strong tooth and with some hairs on each side.

The ophthalmus is large, oblong, and reaches to nearly the extremity of the rostrum.

First pair of antennæ having the peduncle extending considerably beyond the rostrum. The flagella unequal; the longest being half the length of the peduncle, the shortest half its length.

Second pair of antennæ about once and a half as long as the animal, and the scaphocerite reaching beyond the extremity of the peduncle of the first pair.

The first pair of pereopoda has a tooth on the infero-anterior angle of the basis, and another on the same position on the ischium; the second and third pairs are unarmed.

A linear fissure longitudinally traverses the carapace on each side, from the orbit to just within the posterior margin of the carapace, and a similar but shorter fissure vertically divides the branchial margin opposite the third pair of pereopoda.

Length of female, 105 mm. (4.2 in.). Male, 85 mm. (3.4 in.).

Habitat.—Station 190, September 12, 1874; lat. 8° 56' S., long. 136° 5' E.; depth, 49 fathoms; bottom, green mud. One male; two females. Trawled.

Station 204A, November 2, 1874; lat. 12° 43' N., long. 122° 9' E.; off Tablas Island; depth, 100 fathoms; bottom, green mud.

Station 204B, November 2, 1874; lat. 12° 46' N., long. 122° 10' E.; off Tablas Island; depth, 115 fathoms; bottom, green mud. Two females. Trawled.

Station 209, January 22, 1875; lat. 10° 14' N., long. 123° 54' E.; off Zebu; depth, 95 to 100 fathoms; bottom, blue mud; bottom temperature, 71°. Ten specimens. Five males, five females. Trawled and dredged.

This form approximates closely to *Penæus monoceros*, Fabricius, the most apparent distinctions being that *Penæus monoceros* has nine teeth on the dorsal surface of the rostrum, whereas *Penæus fissurus* has six, and the telson has a strong tooth on each side, while *Penæus monoceros* has none.

I have utilised this peculiar fissure as a name to the species so that it may receive the attention of naturalists. I have also seen it in a species, allied in form to *Penæus affinis*, in the Museum of the Jardin des Plantes. I do not know its value, but am inclined to think that it is not of much specific importance, and may be caused by an approaching moult; of this, however, I have no experience to guide me, as in all forms that have been observed, excepting in the Brachyura, the carapace is thrown off entire.

The rostrum is about one-third the length of the carapace and horizontal; it is armed with six teeth, and one on the gastric region, from which the dorsal carina extends to the posterior margin of the carapace. The frontal margin is hollowed close to the base of the rostrum, on the outer side it projects and is produced to a small tooth, from near

the apex of which the frontal margin continues in advance until it again forms a hollow on the inner side of the antennal tooth, in which depression a fissure in the integument originates and continues in an almost direct line to near the posterior margin, where it abruptly terminates. Another tooth stands on the hepatic region, and another small one projects from the fronto-lateral angle of the carapace.

There is no carina on the dorsal surface of the first and second somites of the pleon, but one commences on the third, increases posteriorly, and terminates in a tooth at the extremity of the sixth somite. The telson is nearly as long as the inner branch of the rhipidura, and is dorsally grooved in front in a longitudinal direction, longitudinal and flattened posteriorly, where the sides project into a strong tooth, and the margins are fringed with long cilia.

The ophthalmopod is biarticulate; the first joint carries on the inner distal extremity a broad, flattened, anteriorly-directed tooth; the second supports the ophthalmus, which is somewhat pear-shaped, being narrow at the peduncle, flattened on the inner side, rounded externally and oblong longitudinally, and reaching nearly to the extremity of the rostrum.

The first pair of antennæ reaches to about twice the length of the rostrum and supports two slender, unequal flagella, the inner being shorter than the peduncle and the outer half its length. The prosartema is not so long as the ophthalmopod and is fringed with long cilia; the stylocerite is nearly as long.

The second pair of antennæ is nearly twice as long as the animal, its scaphocerite reaches beyond the peduncle of the first pair, and its rigid outer margin is continued to a small tooth that projects near the distal extremity of the scale.

The first pair of pereopoda carries a sharp, strong tooth on the basal and one on the ischial joint, but there is none on the second and third pairs.

The fourth and fifth pairs are more slender than the preceding chelate limbs, and terminate in somewhat long and rather compressed dactyli. The fifth does not possess the excavation in the frontal margin of the ischium which is seen in the near allies *Penæus incisipes* and *Penæus affinis*.

The specimens that were trawled at Station 209 differ from those from Station 204, although in the same immediate region among the Philippine Islands, in having the rostrum longer, being quite half the length of the carapace, and in having the flagella of the antennæ somewhat longer. At first I thought that the two were distinct varieties, but I believe they can only be considered rather as strongly developed specimens of the same species. Among the former are several specimens of the male in which the first pair of pleopoda carries a petasma that is longitudinally folded on itself, and the apex or distal extremity is doubled in complex folds, forming two heads too complicated to describe, and the second pair carries a large button-shaped process; all the others are of only generic value.

The first pair of pleopoda in the female has the inner branch reduced to a rudimentary condition. There was no male taken at Station 204.

The sixth pair, which forms the movable plates of the rhipidura, has the inner plate a little, and the outer plate much longer than the telson; the outer is obliquely and longitudinally traversed by a groove which continues to just within the outer extremity of the diæresis, on each side of which groove is a longitudinal ridge that, becoming confluent beyond it, traverses the outer margin of the plate and terminates in a well-developed but not large tooth that falls considerably short of the distal extremity, which is thickly fringed with ciliated hairs. The diæresis is rigid and situated near the middle of the plate. The inner branch is longitudinally traversed in the median line by a straight groove, its margins being elevated to a ridge, the inner of which, not shown in the figure, bifurcates not far from the base and abruptly turns away and joins the inner margin.

Penæus rectacutus, n. sp. (Pl. XXXVI. fig. 2).

Rostrum horizontal, straight, pointed, armed on the upper surface with twelve teeth which diminish in size anteriorly to a rudimentary condition, and one solitary distinct tooth standing over the gastric region. The lower margin of the rostrum is straight and slightly elevated anteriorly, the outer orbital tooth is prominent but not large, and so is the one on the hepatic region. The dorsal surface of the carapace behind the gastric region exhibits a tendency to become carinated, which disappears entirely on the pleon until the posterior division of the third somite is reached, where it increases to a distal carina which culminates in a sharp tooth at the posterior extremity of the sixth somite.

The eyes are large, and the first pair of antennæ has the peduncle of about the same length as the rostrum, and the flagella are equal to one another in length.

The telson in the typical specimen has two small articulating spines on each side, beyond which it has been broken off.

Length (female), 114 mm. (4.5 in.).

Habitat.—Station 173, July 24, 1874; lat. 19° 9' 35" S., long. 179° 41' 50" E.; off Matuku, Fiji Islands; depth, 315 fathoms; coral mud. Five females. Dredged.

Station 209, January 22, 1875; lat. 10° 14' N., long. 123° 54' E.; between Bohol and Zebu; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71°·0. One female. Trawl and dredge both used.

This species comes near to *Penæus monoceros*, Fabricius, as described by Milne-Edwards, but differs in having the rostrum a little longer and the denticles on the upper margin rather more numerous, in having the flagella of the first pair of antennæ longer, and in the sides of the telson being armed with two or more spines.

In our solitary specimen, which is a female, the rostrum reaches as far as the extremity of the peduncle of the first pair of antennæ, and is styliform and armed on the upper side with twelve little teeth, the posterior of which are longer and placed nearer together, diverging and becoming smaller as they approach the anterior extremity of the rostrum, where they become almost rudimentary; posterior to these is one distant, solitary tooth, standing on the gastric region, behind which a slight compression is shown in the dorsal elevation of the median line of the carapace. The lower margin of the rostrum is smooth and fringed with long ciliated hairs. The frontal margin has no supraorbital tooth, and the outer antennal tooth, although well advanced, is small, as is also the tooth at the antero-inferior angle of the carapace.

The pleon commences to be carinated at the posterior dorsal extremity of the third somite, and rises into a small ridge on the three following; the posterior extremity of the fourth and fifth being slightly cleft in the median line; and the sixth, which is nearly twice the length of the fifth, terminates in a small tooth.

The ophthalmus is large, stands on a short bi-articulate peduncle and does not reach to the extremity of the rostrum.

The first pair of antennæ has the third or terminal joint cylindrical and longer than the second, and the flagella are as long as the peduncle. The prosartema is sharply pointed, the stylocerite is short and blunt, and the outer margin of the first joint is produced to an acute tooth.

The second pair of antennæ has the flagellum broken, but the scaphocerite is equal in length to the rostrum, and the tooth on the outer margin does not quite reach the extremity.

The pereopoda are rather long, the third pair reaching to a little beyond the extremity of the rostrum. The first pair carries a spine-like tooth attached to the basal and ischial joints; there is none on the second and third pairs.

The protuberance through which the oviduct projects is large and directed inwards, and the thelycum, which is divided, is posteriorly broad and anteriorly narrow, ending in a blunt point, and is studded with short hairs.

The pleopoda are of only generic value, possessing no specific feature except in the case of the posterior pair, which goes to form the lateral plates of the rhipidura; the outer plate is deeply grooved in the median line, the marginal ridge of which unites with one on the outer margin of the plate, and terminates in a tooth at the dieresis, about one-third distant from the extremity of the plate. The inner plate has a longitudinal groove in the median line with a strong ridge on each side, the inner, near the base, turning suddenly to the inner margin.

Our typical and only perfect specimen is a female, and was taken between Manila and Samboangan, associated with *Penæus fissurus*.

Several specimens were taken with the dredge off Matuku, one of the Fiji Islands, in a soft and damaged condition; the form of the thelycum in these corresponds with that

of the type, but differs from that of *Penæus serratus*, with which they were found associated. In these specimens the telson is armed with two teeth posterior to the two lateral spines, and therefore *Penæus rectacutus* may be only a variety.

Penæus serratus, Spence Bate (Pl. XXXVII. fig. 1).

Penæus serratus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 182, 1881.

Rostrum slightly arched, armed with a series of small teeth, twelve or thirteen in number, between the base and the apex, and one distant on the gastric region; lower margin fringed with long, ciliated hairs, each of which stands on its own defined point of attachment. Posterior somite of the pleon more than twice the length of the penultimate. Telson nearly as long as the inner branch of the rhipidura, terminating in a styliform point, and armed on each side with a long and rigid tooth, and at some little distance anteriorly with two minute separate spines, the intervening space being fringed with hairs.

The ophthalmus is large, and the peduncle of the first pair of antennæ is rather longer than the rostrum. The flagella, in a young specimen, are about as long as their peduncle; they are damaged in the others. The prosartema is pointed, the stylocerite short, and the scaphocerite of the second pair reaches to the extremity of the rostrum.

Length of the largest female, 114 mm. (4.5 in.); of the largest male, 76 mm. (3 in.).

Habitat.—Station 173, July 24, 1874; lat. 19° 9' 35" S., long. 179° 41' 50" E.; off Matuku, Fiji Islands; depth, 315 fathoms; bottom, coral mud.

Station 184, August 29, 1874; lat. 12° 8' S., long. 145° 10' E.; Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36° 0. One specimen, young.

Length, 26 min. (1 in.).

The surface of the animal is smooth and even polished. It is slender in general shape—a circumstance that is probably partly due to the length of the sixth or posterior somite of the pleon, which is rather more than twice the length of the fifth. The rostrum, instead of being horizontal, rises slightly from the base and is depressed at the apex, so as to give it a slightly arched appearance. The lower margin is without teeth, but fringed with hairs, each of which is extremely long and ciliated, stands upon its own little elevated point of attachment, and is generally of a dark colour. The upper or dorsal surface is serrate with small teeth, placed closely together towards the base, but distantly separated towards the apex; on the gastric region a solitary tooth stands apart from the rest, at the extremity of a carina, which disappears until the fourth somite of the pleon, where it reappears in the form of a small ridge. This ridge becomes larger on the fifth and sixth somites, having its posterior extremity cleft on the fourth and fifth, and produced to a small tooth on the sixth. The telson is not so long as the inner branch of the rhipidura, and terminates in sharp and styliform points (fig. 1z), it is broadly channelled

on the dorsal surface, the margins of which are produced on each side into a long, sharp tooth, and at some distance there are two minute spines standing in a fringe of small hairs.

The ophthalmopoda are tolerably large, and in the males reach nearly to the extremity of the rostrum. They stand on a short stalk.

The first pair of antennæ, in the male, has the peduncle longer than the rostrum, in some small specimens very much longer, a circumstance showing that the relative length of these parts is not so important as is generally supposed. The prosartema is sharp at the extremity, and the stylocerite is short and stunted, while the outer and anterior angle of the first joint is produced to a sharp-pointed tooth. The third joint is larger than the second, and cylindrical in form. The flagella of this pair are broken off in all the specimens excepting one; in this the outer branch is longer than the inner and also than the peduncle, and the antennæ are longer than the carapace.

The scaphocerite is about the same length as the rostrum, except in a small specimen where it is longer, but this appears to be due to the shortness of the rostrum rather than to the length of the appendage.

The pereopoda are subequally robust, the third pair reaches as far as the extremity of the rostrum.

The pleopoda are of only generic value, except the posterior pair, which form the lateral plates of the rhipidura; the outer plate is channelled by a longitudinal groove that strikes the outer margin at the line of the diæresis and considerably within the distal extremity of the plate. The inner plate is longitudinally grooved, much as in other species.

On the ventral surface of the pereion in the female the thelycum is very small, and will be better understood by reference to the figure in the Plate (fig. 1''' ♀) than from any verbal description.

The first pair of pleopoda carries a small and rudimentary appendage, which in the male is developed into a large and longitudinally folded petasma (fig. 1'' ♂), the lateral margins of which are turned backwards and the median portion forwards, while the extremity is furnished on each distal angle with an anteriorly-directed, sharp, slender process or tooth.

The second pair carries a double button-shaped tubercle at the base of the inner branch.

The branchiæ (fig. 1, *br*) in their ultimate structure resemble those of the type of the genus, and consist of a series of digital processes that divide into two branches and generally terminate in four processes.

The specimens referred to under *Penæus rectacutus* as having been taken off the Fiji Islands, were taken associated with this species. They were placed under *Penæus rectacutus* because the thelycum corresponds with that species rather than with the type of this.

Penæus tenellus, n. sp.

Animal slender and smooth. Rostrum slightly elevated above the dorsal surface, about one-half the length of the carapace, and armed with seven teeth anterior to the frontal margin, which is furnished with a rather large first antennal tooth, and a small one at the fronto-lateral angle. There is one also on the hepatic region. The rest of the animal is smooth, excepting on the dorsal surface, where there is a small carina that commences on the fourth somite and terminates in a small tooth at the extremity of the sixth.

The telson is short, tapering, free from armature, and dorsally channelled on the *median line*.

The ophthalmopoda are biarticulate, short, the ophthalmus large but not reaching to the extremity of the rostrum.

The first pair of antennæ has the peduncle much longer than the rostrum, and subequal in length to the scaphocerite of the second pair of antennæ, which carries a flagellum twice as long as the animal.

The other appendages, as far as have been examined, offer nothing very striking.

Length, 35 mm. (1.4 in.), female.

Habitat.—Station 235, May 17, 1875; lat. 34° 39' N., long. 135° 14' E.; Bay of Kobé, Japan; depth, 8 fathoms; bottom, mud. Dredged.

The body of the animal is slender, but not much laterally compressed, excepting the three posterior somites of the pleon. The carapace is but little more than one-fourth the length of the animal, and is dorsally compressed but not carinated; the anterior portion projects to a rostrum that is about half the length of the carapace, and is armed with seven small teeth, all in advance of the frontal margin, the largest being in the middle and the smaller at each extremity. The orbital notch is broad, and at the outer canthus projects into a large and well-defined tooth; there is none corresponding with the second pair of antennæ, but the fronto-lateral angle is produced to a small point. On the hepatic region is a small well-defined tooth, but there is none on the gastric region.

The three anterior somites of the pleon are dorsally smooth, but the fourth, fifth, and sixth are carinated and compressed, the posterior terminating in a small tooth.

The telson is about half the length of the lateral plates of the rhipidura, and gradually tapers to a point, and has no lateral armature, and is dorsally flattened and longitudinally grooved in the median line.

The peduncle of the ophthalmopod is short. The first joint has a small, round, flat, discoidal plate on its inner distal extremity, but the ophthalmus is large and reniform, reaching nearly to the extremity of the rostrum.

The first pair of antennæ carries a slender prosartema that reaches nearly to the

extremity of the ophthalmopod; on the outer side is a short stylocerite, and at the distal extremity of the first joint, which is subequal in length to the rostrum, is a short, sharp tooth; the second joint is nearly as long as the first, and furred with short hairs; the third is short and smooth, carrying at its extremity two flagella, of which the inner and lower is the more robust; they are subequal in length, nearly as long as the peduncle, and with it longer than the carapace.

The second pair of antennæ has the basal joint of the peduncle robust and the terminal slender, it carries a scaphocerite that is subequal in length to the peduncle of the first pair, and is very rigid on the outer surface, and terminates in a subapical tooth. The flagellum is slender, very flexible, and once and a half as long as the entire animal.

The mandible carries a synnhipod that has the first joint large and broad, the second narrow and short, and both roughly pilose.

The second pair of gnathopoda is slender, reaches as far as the distal extremity of the rostrum, and carries a basephysis that extends as far as the distal extremity of the carpos.

The pereopoda are slender, the third pair being the most slender, and longer than the preceding, and terminating in a slender chela. The fourth pair is more slender and slightly longer than the third, and terminates in a styliform dactylos that is nearly as long as the propodos. The fifth pair is lost.

The first pair of pleopoda is single-branched, the others are biramose. The sixth pair forms the lateral plates of the rhipidura, and the outer is nearly twice as long as the telson; it has a diæresis near the middle, and on the outer distal angle a small tooth.

The ventral surface of the pereion is smooth at the posterior extremity, continuing forwards to nearly the penultimate pair of pereopoda, and is further advanced on each side than in the middle, from which point the stalk of a spade-shaped plate projects, and covers the ventral space between, and overlaps the coxæ of the fourth pair of pereopoda.

Observation.—This species bears a close resemblance to the imperfect specimen described and figured by Dana, under the name of *Penæus tenuis*, taken from the stomach of a fish, caught in the Atlantic, off the coast of North Patagonia, excepting that instead of seven teeth on the rostrum, Dana's species has nine or more. "The beak is broken, and we cannot give the character of the under margin or extremity."¹ "Length one and a half inch."

Penæus gracilis, Dana.

Penæus gracilis, Dana, U.S. Explor. Exped. Crust., p. 606, pl. iv. fig. 7, *a*, *b*.

Slender; carapace about one-third the length of the pleon, rostrum dorsally armed with four or five small teeth, of which two are posterior to the frontal margin, and a third is on the gastric region. The lower margin of the rostrum is smooth. Anterior

¹ Dana, *tom. cit.*, p. 605, pl. xl. fig. 6.

five somites of the pleon subequal in length and dorsally smooth. The sixth equals in length the four preceding somites, is dorsally smooth and produced posteriorly to a small tooth, as is also the postero-inferior angle of the lateral margins.

Telson about two-thirds the length of the sixth somite.

The ophthalmopoda are short, long-ovate, and reach but little beyond the extremity of the rostrum.

First pair of antennæ having the peduncle subequal in length to the carapace. First joint nearly twice as long as the ophthalmopoda; second about two-thirds the length of the first, and the third about half the length of the second, supporting two flagella that are shorter than their peduncle. The longer branch has only five or six articuli, of which the basal is the longest and the terminal the shortest. The shorter branch has three or four articuli that are tolerably robust at the base, and three or four that suddenly become slender at the distal extremity.

The second pair of antennæ has the flagellum slender and about as long as the carapace, and carries a scaphocerite that equals in length the peduncle of the first pair.

The anterior three pairs of pereopoda gradually lengthen posteriorly.



FIG. 47.—*Penæus gracilis*, Dana.

The fifth or posterior pair is slender.

The pleopoda are all single-branched; the first pair is straight, rigid, and carries in the median line of the ventral surface of the somite a protuberance that is furnished with three or four long hairs. The second pair is more flexible and has a similar but narrower protuberance at the base crowned with long hairs. The succeeding pairs are long, flexible, gradually lessening posteriorly, and are furnished in the median line at their base with a protuberance, produced to a sharp tooth, which becomes gradually less important posteriorly. The terminal pair, which goes to form the outer plates of the rhipidura, are broad, foliaceous and as long as the telson.

Length, 10 mm. Dana's specimen is given as 8 or 9 lines, or about double the length of the Challenger specimens.

Habitat.—The New Hebrides, and Port Jackson, Australia, are the places at which specimens corresponding with this species were obtained by the Challenger.

Dana's specimen was taken in the "Sooloo Sea, twenty-five miles east of Penay. Collected Jan. 27, 1842. Some seaweed was seen floating by during the day."

Dana says, "Penult. abdominal segment as long as two preceding, and having a few minute spines on the back of it."

There are no small spines on the dorsal surface of the sixth somite of the pleon in our specimen; but they might have been rubbed off. Undoubtedly Dana's specimen, although twice the size of those in the Challenger collection, is immature.

There is no evidence of sexual character such as is visible externally in mature forms; all the pleopoda are single-branched, a circumstance that is not conformable with the condition of a mature specimen of the genus *Penæus*, but is consistent with that of *Sicyonia*. In *Haliporus* the two branches are present but in a very unequal condition.

It must therefore be left for future research to determine the relation of *Penæus gracilis* to the adult stage.

Penæopsis, A. Milne-Edwards.

Penæopsis, A. Milne-Edwards, MS.

„ Sp. B., Ann. and Mag. Nat. Hist. ser. 5, vol. viii. p. 182, 1881.

Like *Penæus*, but with the flagella of the first pair of antennæ longer than the carapace.

There is no species of this genus in the Challenger collection.

This genus is very closely allied to Milne-Edwards' second division of *Penæus*, or those Peneids in which the flagella of the first pair of antennæ are longer than the carapace.

Penæus tenellus approaches nearer to it than any other in the Challenger collection, but the flagella are not longer, if even quite as long, as their peduncle, although together they are longer than the carapace.

Philonicus,¹ n. gen.

Carapace armed with four teeth on each side, namely, the first antennal tooth on the frontal margin, one behind it, one behind the second antenna, and one on the hepatic region, and produced anteriorly to a sharp-pointed rostrum that is laterally compressed and armed on the upper surface with small teeth.

The ophthalmopoda are biarticulate, shorter than the rostrum, and support an ophthalmus of moderate proportions.

The first pair of antennæ has a prosartema and stylocerite attached to the first joint, and terminating in two extremely long and subequally sized flagella, the upper of which is very slender, the lower very broad, but not grooved on the upper surface to

¹ Φιλονικός, a rival.

receive the smaller one as in *Solenocera*, Lucas. Both flagella exceed in length that of the carapace.

The second pair of antennæ is furnished with a large scaphocerite that generally equals the length of the peduncle of the first pair, and terminates in a slender flagellum of great length.

The mandibles have a two-jointed, long, broad and foliaceous synphipod; of which the second joint is narrow, but not longer than the first, and reaches as far forwards as the distal extremity of the peduncle of the second antenna.

The oral appendages do not differ much from those of *Penæus*.

The first pair of gnathopoda carries a basephysis that reaches to the distal extremity of the meros, and the coxal joint supports a mastigobranchia that is pedunculated and supports a branchial plume at its base.

The second pair of gnathopoda is long, pediform, and carries a small basephysis and a mastigobranchia that is slightly forked at its distal extremity, but without a branchial plume.

The anterior three pairs of pereiopoda are chelate but neither stout nor very long. The posterior two pairs are long and slender, the ultimate being about two-thirds the length of the entire animal. Each pair carries a small basephysis diminishing to a rudimentary condition posteriorly. The mastigobranchiæ are all long and pedunculated, but carry no branchial plume.

The entire series of the branchial apparatus may be tabulated as follows:—

Pleurobranchiæ,	.	.	.	...	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	1	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...
					h	i	k	l	m	n
										o

The male carries a large petasma attached to the basal joint of the first pair of pleopoda. The rhipidura is long and narrow, the outer branch showing traces of an obsolete diæresis.

The telson is narrow and slender.

This genus resembles *Penæus* in the character of the ophthalmopoda, which are biarticulate and supported on a free and exposed somite, but *Penæus* may readily be identified from it—

1. By the postantennal teeth on the frontal walls of the carapace.
2. By the length of the antennæ, the flagellum of the second pair being three times the length of the animal, or more.
3. By there being two arthrobranchial plumes attached to the penultimate pair of pereiopoda, and by the presence of a podobranchial plume attached to the mastigobranchial plate of the first pair of gnathopoda. The presence of which is an essential

distinction, and brings this genus in its branchial arrangement near to *Spongicola* and *Stenopus*, which it also approaches in the absence of the small basal branch of the second pair of gnathopoda, which is rudimentary in these genera.

The general resemblance of some species to each other is very close, while others are easily distinguishable.

This genus very much resembles *Solenocera*, Lucas, from which in external structure it differs in having the flagella of the first pair of antennæ cylindrical, instead of one being grooved to receive the other.

I have not had an opportunity of examining the branchial arrangement of any species of *Solenocera*, and therefore cannot compare it with that genus.

It may from the description be mistaken for *Penæopsis*, A. Milne-Edwards, from which it can readily be distinguished by the form of the carapace, by the presence of post-orbital and postantennal teeth on it, and by the length of the peduncle of the first pair of antennæ.

It differs from the typical *Penæus* in having two arthrobranchiæ attached to the membranous articulation of the penultimate pair of pereopoda, and in all the mastigo-branchiæ being remarkable for a knee-like bend, by which the basal portion lies at right angles to the terminal half, which is placed between and separates the branchial plumes, and is liable to vary in form in different species.

Geographical Distribution.—Species of this genus have been found in the Sea of Banda, off the Kermadec Islands, among the Celebes Islands, off the Ki Islands, and in the Arafura Sea.

Penæus siphonoceros, Philippi and Heller, is undoubtedly synonymous with *Penæus membranaceus* of Milne-Edwards, and belongs to this genus, but not with *Penæus membranaceus* of Risso, from which it differs in the flagella of the first pair of antennæ not being distally truncated, nor in having the upper ramus longitudinally enclosed within a groove in the lower.

Penæus crassicornis, Milne-Edwards, also belongs to this genus, and is recorded by him as inhabiting the coasts of India. Sir Walter Elliot, S.I., F.R.S., procured numerous specimens at Waltair on the coast of Madras.

Philonicus mülleri, n. sp. (Pl. XXXIX.).

Carapace dorsally furnished with a small carina that commences at the posterior margin and continues anteriorly to the rostrum, which is armed on the upper margin with eight teeth in the female and with nine or ten in the male; the lower margin is smooth, slightly curving upwards to the extremity, and fringed with a row of hairs. The anterior margin of the carapace has an orbital and a first-antennal tooth, behind which are a postantennal and a hepatic tooth.

The pleon is dorsally carinated from the third somite to the extremity of the sixth, which is posteriorly produced to a sharp tooth; and the telson is dorsally grooved in the median line, and armed on each side with one strong tooth and a fringe of hairs.

The first pair of antennæ is nearly as long as the entire animal. The second pair is about four times as long; they are respectively shorter in the male than in the female.

Length—male, 76 mm. (3 in.); female, 152 mm. (6 in.).

Habitat.—Station 321, February 25, 1876; lat. 35° 2' S., long. 55° 15' W.; off Monte Video; depth, 13 fathoms; bottom, mud. Thirty specimens. Five males and twenty-five females. Trawled.

The rostrum, measured from the frontal margin of the orbit to the apex, is less than half the length of the carapace; it is produced horizontally and slightly crested over the orbit. It is armed with eight teeth in the largest female specimen, the posterior of which is situated slightly anterior to the cervical furrow, and they are continued, with a little tuft of cilia between each, to within a short distance of the apex, the largest teeth being over the orbit. The under margin is smooth, curved slightly upwards to the extremity, terminates in a point in the plane of the upper margin, and is fringed with hairs. The pleon is smooth except for a dorsal carina, which is slightly indicated on the first three somites, but is more conspicuous on the posterior three somites. The first somite laterally overlaps the posterior margin of the carapace, and posteriorly overlaps the anterior margin of the second; the second posteriorly overlaps the anterior margin of the third, and the same relation occurs in all the succeeding somites.

The ophthalmopod is large and biarticulate; the ophthalmus is oval and wider than its stalk.

The first pair of antennæ has the first joint of the peduncle armed on the outer side with a sharp-pointed stylocerite, and furnished on the inner side with a thickly ciliated prosartema that reaches to the extremity of the rostrum, between which and the stylocerite the eye, when at rest, is lodged. The second and the third joints are short and terminate in two subequal flagella, of which the upper is rather the longer.

The second pair of antennæ carries a broad scaphocerite that reaches considerably beyond the extremity of the rostrum, and even beyond the distal extremity of the third joint of the peduncle of the first pair, and terminates in a long and slender flagellum, which in one, the largest female specimen, was about four times the length of the animal. The mandible carries a large, ovate, foliaceous synhipod, the first joint of which is broader than the second, which tapers to a point, and the entire surface is furred with short hairs. The psalisiform margin is blunt, smooth, and connected with the molar tubercle, which is smooth and strong.

The first pair of gnathopoda is short, subpediform, six-jointed, with the two ultimate

joints reflexed; the basephysis is rudimentary, the coxa carrying a pedunculated mastigobranchia, to the base of which, near the joint, is attached a well-developed podobranchial plume.

The second pair is long, pediform, seven-jointed, and thickly pilose. The basephysis is slender, small, and almost rudimentary. The coxa carries a pedunculated mastigobranchia without any branchial plume, but two arthrobranchial plumes are attached to the membranous articulation between the coxa and the pleura.

The first pair of pereiopoda is shorter than the second gnathopod, chelate, having the carpos but little longer than the propodos, measuring from the tips of the pollex to the carpal joint; the ischium and basis are each armed with a strong tooth on the anterior distal angle, and a tubercle tufted with hairs projects on the inner side of the coxa; the basephysis is slender and as long as the ischium. The coxa carries a mastigobranchia without a plume attached. The second pair of pereiopoda is longer than the first, the carpos being twice the length of the propodos, and the basal joint is armed with a strong tooth; the basephysis is shorter than the meros and the mastigobranchia is without a plume. *The third pair of pereiopoda is much longer than the second, and nearly twice as long as the first, the carpos being slender and four times the length of the propodos.* There is a small tooth on the basal joint and the basephysis is rudimentary; the two following pairs are long, slender, and terminate in a simple styliform dactylos, the terminal pair being much longer and more slender, and having the propodos twice the length of the carpos and distally fringed with long hairs; both of these carry a short and almost rudimentary basephysis, but only the former carries a mastigobranchia, the rigid peduncle of which is long and the foliaceous plate short, and the last somite carries only a pleurobranchial plume.

The pleopoda are moderately long and biramose, except the first pair, which has the inner branch reduced to a rudimentary condition (fig. 1") in the female, and developed to a large and longitudinally corrugated petasma in the male (fig. 2").

The telson terminates in a sharp point, flanked on each side by a sharp but strong tooth, anterior to which is a row of hairs.

Judging from the numerous specimens in the collection, thirty of which were taken at one station associated with *Artemesia longinaris*, the males differ from the females in being one half shorter.

Philonicus lucasii, Spence Bate (Pl. XLII. fig. 4).

Solenocera Lucasii, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 185, 1881.

Rostrum short, dorsally crested and laterally compressed, armed with seven teeth on the upper margin; the lower margin smooth. Pleon compressed and carinated from the third somite, the carina terminating in a small tooth at the posterior extremity of the

sixth. Telson half the length of the rhipidura, truncated between two prominent teeth ; dorsal surface depressed.

The ophthalmopod does not reach to the extremity of the rostrum. The ophthalmus is orbicular. The first pair of antennæ has the first joint a little longer than the ophthalmopod, and carries on the inner side a prosartema that is as long as the joint, and on the outer side a stylocerite that is half the length, and a strong tooth at the outer distal angle. The second joint is nearly as long as the first, but the third is shorter and terminates in two subequally long, but unequally stout flagella, the length of which is rather more than that of the carapace. The second pair of antennæ carries a scaphocerite that reaches beyond the extremity of the peduncle of the first pair, bearing a tooth near the apex, and terminates in a slender flagellum that is about three times the length of the entire animal. The pereiopoda generally are short, except the posterior pair, which is long. The pleopoda are not remarkable for their length, and, excepting the first, are biramose. The posterior pair, which forms part of the rhipidura, has the inner branch ovate and the outer with its apex at the outer margin, where it terminates in a small tooth.

Length (female), 100 mm. (4 in.).

Habitat.—Station 192, September 26, 1874 ; lat. $5^{\circ} 49' 15''$ S., long. $132^{\circ} 14' 15''$ E.; off the Ki Islands, south of Papua ; depth, 140 fathoms ; bottom, blue mud. One specimen was trawled ; female.

The rostrum is short and horizontal, with the under margin curved upwards at the apex ; upper margin armed with seven subequidistant teeth, the spaces between them gradually increasing posteriorly, the last tooth standing behind the gastric region. The frontal margin is armed with an antennal tooth and one immediately behind it. There is also one on the hepatic region and one submarginal in advance of it below.

The pleon is compressed from the third somite posteriorly, and is dorsally furnished with a distinct and continuous carina from the third to the posterior extremity of the sixth somite, where it terminates in a small tooth.

The telson is half the length of the outer ramus of the rhipidura, and is dorsally grooved. It is terminally truncated and armed on each side with a long slender tooth.

The ophthalmopod is biarticulate, shorter than the rostrum, and terminates in an orbicular ophthalmus ; the somite that supports it is exposed and movable.

The first pair of antennæ has the first joint as long as the rostrum, armed on the outer side with a short stylocerite, and at the distal angle with a long and slender tooth, and bearing on the inner side a prosartema copiously fringed with hairs ; the second joint is nearly as long as the first, and the third is short and cylindrical, and supports two flagella, one more slender than the other and both longer than the carapace. The lower and more robust branch is longitudinally compressed, but not excavate as in *Solenocera*, in which the more slender flagellum when at rest lies imbedded in a groove in the larger.

The second pair of antennæ has a slightly tapering scaphocerite that reaches a little beyond the extremity of the peduncle of the first pair, and a flagellum that is twice the length of the animal.

The mandible carries a two-jointed synaphipod, the second joint is narrower than the first and reaches as far as the extremity of the peduncle of the second pair of antennæ.

The first pair of pereopoda is armed with two teeth, one on the inferior margin of the basis and another on the antero-inferior margin of the ischium. All the appendages of the pereion are furnished with a basephysis that decreases gradually to the posterior pair of pereopoda, where it is very reduced in size.

The first pair of pleopoda in the female carries a rudimentary membranous branch on the inner margin, near the distal extremity of the basal joint. The succeeding four pairs are subequally biramose. The sixth pair has the outer branch longer than the inner, and is armed with a sharp tooth on the outer side at the extremity.

Only a single specimen of this species, and that a female, was taken, and it differs from all the other species in having the basal branch attached to the several legs of the pereion, although small, yet much more important than the rudimentary ones which they possess.

Philonicus pectinatus, n. sp. (Pl. XXXVIII.).

Rostrum short, lanceolate, not reaching to the extremity of the ophthalmopod; dorsal margin armed with nine teeth, of which the posterior is slightly separated from the others and implanted on the gastric region a little in advance of the cervical furrow. Posterior dorsal surface of the carapace compressed but not carinated. Pleon carinated from the fourth somite to the sixth, where it terminates in a small tooth.

Telson dorsally longitudinally grooved, tapers to a point, and is distally armed on each side with a strong tooth; outer plates of the rhipidura nearly twice as long as the telson.

Ophthalmopoda with the ophthalmi reniform. First pair of antennæ having the pro-artema shorter than, and the stylocerite as long as the ophthalmopod. Second pair of antennæ having the scaphocerite longer than the peduncle of the first pair of antennæ, and narrowing to the distal extremity, which is rounded and carries a tooth on the outer angle.

All the other parts of the specimen are much broken except the pleopoda, the first pair of which is furnished with a petasma (*pp*) that carries a series of curved teeth on each side like a comb, from which the specific name is derived.

Length (male), 38 mm. (1.5 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59' S., long. 139° 42' E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom, green mud. One specimen; male.

There is only one specimen of this species and that is imperfect, but in its general aspect it appears to belong to this genus, and carries a post-antennal as well as a hepatic tooth, but the broken condition of the first pair of antennæ precludes me from determining the exact relationship.

The form of the petasma is very distinct from that of any other species known to me, either of this genus or *Penæus*, and one that will readily be recognised from its series of curved, comb-like teeth.

The smaller rami of the branchiæ (*br''*) are short, laterally compressed, dichotomous and obliquely attached to the larger branch.

The mastigobranchial plates (*mb*) are broad, forked, and supported on a cylindrical stalk that has a lateral lobular prominence near the coxal articulation. The stalk is supported by a series of globular deposits of lime crystals.

The ultimate structure of the branchial plumes approximates to that in *Philonicus mülleri*, and consists of a series of compressed branches that terminate in flattened lobes, and of others broader and more foliaceous that terminate in papilliform processes.

The flagella of both pairs of antennæ, the second pair of gnathopoda, and all the pereopoda are broken off close to their origin. The first pair of pleopoda, with its comb-like, fringed petasma, as well as the four succeeding pairs and the rhipidura, are preserved. The rostrum is broken but not detached.

Artemesia, n. gen.

Rostrum long, slender, and pointed, armed with a few teeth on the dorsal crest; body compressed, with a tendency to form a carina, more especially on the dorsal surface of the pleon.

Ophthalmopoda biarticulate and ophthalmi ovate.

First pair of antennæ having a stylocerite and prosartema attached to the first joint of the peduncle, and two subequal flagella that are as long as the carapace.

Second pair having a scaphocerite and a long and slender flagellum.

Mandibles furnished with a two-jointed, broad, foliaceous synnaphipod.

First pair of gnathopoda short, six-jointed and subpediform, the two distal joints being reflexed against the inner margin of the ischium and meros. The basis carries no ephysis and the coxa supports a mastigobranchia with a podobranchial plume.

Second pair of gnathopoda pediform, seven-jointed and straight. The basis carries a long and slender ephysis, but there is no mastigobranchia nor podobranchia, but two arthrobranchial plumes are attached to the membranous articulation.

First three pairs of pereopoda chelate, slender, and each carries a small basecephysis and a pedunculated and forked mastigobranchia, but no podobranchia; the last two pairs are slender and simple, the posterior being longer and more slender than the pre-

ceding, and neither of these carries a basephysis or mastigobranchia, and the posterior is without any branchial plume at all.

The branchiæ somewhat resemble in structure those of *Penæus*, but the dendritic branches appear to be more simple.

The following table shows their general arrangement:—

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	...
Arthrobranchiæ,	.	.	.	1	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	...	1	1	1	...	...
				h	i	k	l	m	n	o

The fourth pair of pereiopoda has two well-developed plumes, but one is pleurobranchial, interstitial between the fifth and sixth somites, and in one or more instance I have observed a rudimentary ephysis attached to the basal joint.

This genus bears some external resemblance to *Aristeus*, but differs in having two long flagella to the first pair of antennæ, in the form of the synnhipod and mastigobranchiæ, in the number of the branchiæ, in having no podobranchia except the one attached to the first pair of gnathopoda, and in the ultimate structure of the branchiæ.

In some of these points it corresponds with *Philonicus*.

Geographical Distribution.—As yet we only know one species of this genus, which was taken off the east coast of South America.

Artemesia longinaria, n. sp. (Pl. XL).

Carapace dorsally smooth and produced anteriorly to a horizontal rostrum that is half the length of the animal, measured from the orbit to the posterior extremity of the telson. Rostrum crested over the base and armed there with nine or ten teeth, from which to the apex it is smooth both above and below. The pleon is smooth to the fourth somite, which is dorsally angulate. The fifth and sixth somites are slightly carinated, the carina on each being produced posteriorly to a small tooth.

The ophthalmopod reaches nearly to the extremity of the serrate crest, and the ophthalmus is ovate.

The first antennæ carries a prosartema that does not reach to the extremity of the ophthalmopod, and a stylocerite that is short and almost rudimentary; the peduncle reaches to about half the length of the antennæ, supporting two flagella that are twice the length of the rostrum.

The second pair of antennæ carries a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair, and a flagellum that is once and a half as long as the animal.

The pereiopoda are slender and not very long.

The outer plates of the rhipidura are longer than the telson, which is slender, tapering to a sharp terminal point, dorsally grooved, and armed on each side with four teeth, of which the posterior is the largest.

Length, male, 70 mm. (2.75 in.); female, 76 mm. (3 in.).

Habitat.—Station 321, February 25, 1876; lat. 35° 2' S., long. 55° 15' W.; off Monte Video; depth, 13 fathoms; bottom, mud.

Thirty-nine specimens; twelve of which were males and the rest females; were taken with the trawl, associated with *Philonicus mülleri*.

Station 113A, September 2, 1873; lat. 3° 47' S., long. 32° 24' 30" W.; off Fernando Noronha, South America; depth 7 to 25 fathoms; bottom, volcanic sand and gravel. Only a doubtful fragment of a pleon, which may belong to this species, was here taken.

This species approaches *Aristeus*, but it is separated from it by the character of the antennæ, the structure and number of the branchial plumes, and also by the form of the mastigobranchial plates.

The rostrum is long, slender, and horizontal, it is slightly waved, and armed at the base above the orbit with from nine to twelve closely-packed teeth, forming an elevated crest, and further back on the gastric region is one small tooth, from which point to the posterior margin the carapace is smooth, with a slightly elevated line indicating a suppressed carina.

The pleon is smooth from the first to the fourth somite, where the suppressed carina reappears and increases to a decided degree on the fifth and sixth somites, on each of which it is produced posteriorly to a small tooth.

The ophthalmopod is biarticulate, as in the genus *Penæus*, and the ophthalmus is ovate.

The first pair of antennæ carries a short and stout stylocerite, and a prosartema on the inner side that does not reach to the extremity of the ophthalmopod. The peduncle reaches to half the length of the rostrum, and supports two long, slender, subequal flagella.

The second pair of antennæ has the scaphocerite a little shorter than the peduncle of the first pair, and a flagellum that is about once and a half as long as the animal.

The mandible (*d*) carries a broad, foliaceous, two-jointed synnaphipod, of which the terminal joint tapers to a blunt point. The molar process is continuous with the psalidoma, which is produced anteriorly to a blunt tooth.

The third pair of siagnopoda (*g*) is three-branched. The first branch is squamiform and biarticulate, the inner margin being thickly fringed with cilia. The second represents the basephysis, and bifurcates into two equally important divisions, of which one is biarticulate and the other squamous; at or near the base of the latter a foliaceous mastigobranchial plate originates.

The first pair of gnathopoda (*h*) is subpediform, having the three distal joints reflexed.

The basis does not carry a branch, or ephysis; but the coxa supports a short mastigobranhia that is broad for a short distance from the base, and then suddenly narrows to a slender lash. At the base, near the articulation, is a well-developed podobranhial plume.

The second pair of gnathopoda (*i*) is pediform and seven-jointed. The basal joint carries a long and slender ephysis, and reaches nearly to the extremity of the sixth joint or propodos. There is no mastigobranhia attached to the coxa, but two arthrobranchiæ arise from the membranous articulation.

The first pair of pereopoda is short, slender, and chelate, and carries a pedunculated, forked mastigobranhia without any podobranhial plume. The second and third pairs increase respectively in length, a circumstance that is chiefly due to the increased length of the carpos. They each carry a pedunculated and forked mastigobranhia similar to that of the first pair. The fourth and fifth pairs are long, slender, and terminate in a styliform dactylos, the posterior pair being much the longer of the two. Both of these are without either mastigobranhia or podobranhial plume; whereas the penultimate has two arthrobranchiæ, one of which, the anterior, is in a rudimentary condition. The general arrangement may best be understood by the table given under the description of the genus.

The ventral surface of the female, in all the specimens in the collection, shows the third pair of pereopoda with a protuberance directed obliquely backwards, on the inner side of which the oviducts open and come into contact with each other in the median line: behind these is a deep depression, which is chiefly caused by an elevated process that supports the coxal articulation of the penultimate pair of pereopoda. Posterior to this, approaching each other and slightly raised anteriorly in the median line, and posteriorly diverging outwards, are two long, slightly curved protuberances, the posterior extremities of which correspond with the articulation of the ultimate pair of pereopoda.

In the male the anterior pair of pleopoda carries a petasma that is longitudinally folded into a cylindrical form, with the posterior surface open; the terminal extremity is lobed and supplied with four hook-like processes, two on each side. In the female this pair of pleopoda has only one branch, and a rudimentary process attached to the inner side of the peduncle. In the male the second pair has two unequal branches, and at the base of the inner or smaller is a small button-shaped process. The succeeding pleopoda correspond in both sexes, and gradually diminish in size. The posterior pair, that forms the lateral plates of the rhipidura, are long and narrow, both reaching beyond the extremity of the telson. The diæresis of the outer branch is reduced to an obsolete condition, being represented only by the muscular attachments which are situated near the body of the animal, and the small tooth on the outer margin which generally corresponds with its outer limit.

Haliporus,¹ Spence Bate.

Haliporus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 185, September 1881.

Carapace submembranous, dorsal surface carinated, anteriorly produced to a rostrum. Frontal margin armed with an anteriorly projecting point or flattened tooth, corresponding with the outer side of the first pair of antennæ, and a second in a line behind it, with another tooth projecting outwards and forwards, corresponding with the outer side of the second pair of antennæ, and a fourth tooth on the inner side corresponding to the anterior portion of the hepatic region. The cervical suture is strongly defined upon the dorsal surface.

The pleon is laterally compressed, and the telson is long, slender, and laterally compressed.

The ophthalmopod is single-jointed and supports a small tubercle on the inner margin.

The first pair of antennæ carries only a short prosartema, and the stylocerite is short and stout. The peduncle is long, and so are the flagella, which in all probability are cylindrical as in other species, but are broken off in this the type-specimen.

The second pair of antennæ carries a long and narrow scaphocerite and a long and slender flagellum.

The mandibles carry a long two-jointed synnaphipod; the first joint is ovate and reaches as far as the frontal margin, the second is narrow and reaches as far forwards as the extremity of the peduncle of the second pair of antennæ.

The first pair of gnathopoda is subpediform and carries a short basecephysis.

The second pair is long and pediform, and carries only the rudiment of a basecephysis.

The pereopoda are long and devoid of a basecephysis.

The branchiæ consist of rather small and delicate plumes, and may be tabulated as follows:—

Pleurobranchiæ,	.	.	.	...	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	2	...	
Podobranchiæ,	.	.	.	1	r	r	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...	
					h	i	k	l	m	n	o

In general appearance the species of this genus are more slender and membranous than in either *Solenocera* or *Philonicus*, and the appendages are longer.

The arrangement of the branchiæ is very nearly the same as in *Philonicus* but the mastigobranchial plates are much larger and more leaf-like, and extend farther between the plumes; one or two of the anterior plates carry a rudimentary podobranchial plume. The flagella of the first pair of antennæ are both cylindrical, there being no groove in

¹ From ἀλιπόρος, going through the sea.

which the smaller branch lodges. Externally this genus closely resembles *Philonicus*, from which, however, it may be readily distinguished by having a small tooth on the margin of the carapace corresponding to the outer side of the second pair of antennæ, and a small tubercle on the inner side of the ophthalmopod; by the ophthalmopod being single-jointed; by the length of the second pair of gnathopoda and of the last two pairs of pereopoda; by the absence of a basephysis, however rudimentary, on any of the appendages of the pereion posterior to the gnathopoda, and by the presence of rudimentary podobranchial plumes on the mastigobranchial plate of the second pair of gnathopoda and the first pair of pereopoda.

Geographical Distribution.—The range of this genus is known only from the habitats of a few species; one from the Mid-Atlantic, and the others from the Mid-Pacific and the Polynesian Seas, and all from extremely deep water.

Haliporus equalis, n. sp. (Pl. XLI. fig. 1).

Rostrum in the male slightly elevated from the base, horizontal in the female, smooth below, fringed with long hairs, armed on the upper surface with nine teeth, six sharp, equally distant, and two on the gastric region. Both hepatic and antennal regions are furnished with four teeth; the second tooth, corresponding to the antenna, is situate behind the margin. Pleon smooth, laterally compressed. Last two somites dorsally carinated, the posterior terminating in a small but distinct tooth. Telson shorter than the inner branch of the rhipidura.

Ophthalmopod short, the ophthalmus orbicular and much larger than the diameter of the stalk.

The first pair of antennæ has a prosartema that is shorter than the ophthalmopod, and a stylocerite that extends beyond the outer angle of the first joint. The flagella are long and slender, equal in length to the entire animal.

The second carries a scaphocerite that extends beyond the extremity of the distal joint of the peduncle of the first pair, and terminates in a flagellum that is about twice the length of the animal.

The anterior three pairs of pereopoda are rather short; the posterior two are very long and slender.

Length, of both male and female, about 63 mm. (2.5 in.).

Habitat.—Station 200, October 23, 1874; lat. 6° 47' N., long. 122° 28' E.; between the Philippine Islands and Borneo; depth, 250 fathoms; bottom, green mud. Seven specimens; females.

Observation.—This species very closely resembles *Penæus crassicornis*, Milne-Edwards, but it may readily be distinguished by the eye being larger and the peduncle

shorter, by the small tooth corresponding with the outer limit of the second pair of antennæ being situated behind the frontal margin of the carapace, but most decidedly by the different formation of the ventral portion of the pereion. In the female (fig. 1" ♀) the calcified tubercles that carry the oviducts are large and hirsute, and a transverse, lunate, nearly vertical plate lies behind them; posterior to this the processes of the coxæ of the fourth pair of legs project nearly to the median line; behind which is a broad shield-like thelycum, and then comes a transverse bar that defines the posterior extremity of the pereion.

In the male there is a heart-shaped process in the median line between the fourth pair of legs (fig. 1" ♂), then a transverse bar supported by a nodular process in the median line, and posterior to this the enlarged coxæ of the fifth pair of pereiopoda, that support the vas deferens, nearly meet in the median line. The petasma is long, narrow when folded, and hooked to its fellow at the base, is nodulated, and furnished with small hairs at the extremity.

The branchiæ are of generic value, but the mastigobranchial plates are long, narrow, semi-forked at the extremity, and fringed with hairs.

Haliporus obliquirostris, Spence Bate (Pl. XLI. fig. 2).

Haliporus obliquirostris, Sp. B., *loc. cit.*

Rostrum elevated obliquely from the orbital margin of the carapace, armed with six or seven teeth on the upper surface, of which the last two are on the gastric region; none on the lower surface. Pleon laterally compressed, carinated from the anterior portion of the fourth somite, and terminating in a small tooth at the posterior extremity of the sixth somite. The ophthalmopod is short, being about half the length of the rostrum, and the ophthalmus is orbicular.

The first pair of antennæ carries a prosartema that is not so long as the ophthalmopod, and on the outer margin a short stylocerite which is scarcely as long as the eye, and a strong tooth arms the outer distal angle. The second joint is quite as long as the first, the third is short, and the flagella are rather more than twice the length of the peduncle.

The second pair carries a long and slender flagellum that is nearly three times the length of the animal; in one of the specimens it is spirally coiled, it having probably been injured, and is now undergoing renewal. The scaphocerite tapers distally and has a small tooth on the outer margin near the extremity. The synnhipod of the mandible reaches to the distal extremity of the last joint of the peduncle of the second pair of antennæ.

The first pair of gnathopoda carries an ephysis that is about half the length of the meros, and is shorter and stouter than the second, which is long, slender, pediform and hirsute, and supports a rudimentary ephysis.

The first pair of pereopoda is a little more robust than the second, and is fringed on the anterior margin with long hairs, while the two next pairs have none.

The posterior two pairs of pereopoda are long and slender, especially the last, which is as long as the entire animal, and when extended forward reaches considerably beyond the peduncle of the first pair of antennæ.

The pleopoda are short, and, as in *Penæus*, biramose, except the first pair, and they gradually decrease in length posteriorly.

Length (female), 76 mm. (3 in.).

Habitat.—Station 170, July 14, 1874; lat 29° 55' S., long. 178° 14' W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. Numerous female specimens. Trawled.

This species is generally large and robust. The teeth on the hepatic and frontal regions are longer and more spine-like, and the outer antennal tooth is post-marginal.

The first pair of antennæ has the peduncle rather longer than the rostrum, and the flagella about once and a half as long as the carapace; the first joint carries a short prosartema, and a strong, thick stylocerite that is nearly as long as the ophthalmopod.

The second pair of antennæ has the flagellum very long, being more than twice the length of the animal.

The pereopoda are long, and each carries a small and almost rudimentary ecphysis attached to the second or basal joint; the last two pairs are much longer, owing apparently to the extreme length of the ischium and meros. There are no teeth on the basis or meros of the first and second pairs of pereopoda. The genital tubercles on the third pair meet in the ventral median line, and behind them, between the fourth pair, is a transverse tubercle, and between the fifth pair is a less prominent triangular tubercle.

Between the first pair of pleopoda is a small tooth, and between the second a transverse ridge. The inner branch on the first pair in our specimens, which are all females, is very rudimentary, and the other pairs are not remarkable for their length.

The posterior pair of pleopoda, which helps to form the rhipidura, has the outer plates scarcely longer than the inner, and the outer margin is strengthened by a ridge terminating in a subapical tooth, and marked by an imperfect diæresis.

The telson is long, tapering, dorsally depressed in the centre, armed on each side with a long, sharp, spine-like tooth, and terminates in a sharp and styliiform point.

The ventral aspect of this species, of which we only know the female, differs from that of other species in having a large, prominent and pointed tubercle in the median line, posterior to the enlarged coxæ of the third pair of pereopoda (fig. 2" ♀). The posterior somites are not remarkable, and the first pair of pleopoda is only of generic importance.

Haliporus curvirostris, Spence Bate (Pl. XLII. fig. 1).

Haliporus curvirostris, Sp. B., *loc. cit.*

Carapace submembranous, long-ovate, covered with fine, short, hair-like spines, more abundant near the cervical fissure. Rostrum one-sixth the length of the carapace, anteriorly depressed and curved downwards, armed with ten or eleven small teeth on the crest, five of which are on the rostrum and the rest anterior to the cervical groove; a small carina exists in the median line, which culminates in two or three small teeth as it approaches the posterior margin.

Pleon smooth. The first somite is long, broad, and has the coxal plate large and well developed, slightly overriding the posterior margin of the carapace. Second somite rather longer than the first; the others subequal. Fifth and sixth terminating posteriorly in a small, sharp, dorsal tooth.

Rhipidura long, lateral plates narrow.

Telson long, narrow, dorsally grooved, laterally depressed, fringed with hairs, and armed with three small sharp teeth on the lateral margin.

Ophthalmopoda small, about half the length of the rostrum; ophthalmus not larger than the diameter of the ophthalmopod.

First pair of antennæ with the peduncle more than twice the length of the rostrum.

Second pair of gnathopoda extending considerably beyond the extremity of the scaphocerite.

Pereiopoda long, particularly the posterior pair.

Length (female), 88 mm. (3.5 in.).

Habitat.—Station 281, October 6, 1875; lat. 22° 21' S., long. 150° 17' W.; Pacific Ocean, south of the Low Archipelago; depth, 2385 fathoms; bottom, red clay; bottom temperature, 34°·9. One specimen (damaged). Trawled.

Station 285, October 14, 1875; lat. 32° 36' S., long. 137° 43' W.; South Pacific Ocean; depth, 2375 fathoms; bottom, red clay; bottom temperature, 35°·0. One specimen; female. Trawled.

This species may readily be distinguished from any of the others by the numerous small points that cover the carapace, by the marked curvature of the rostrum, the apex of which points downwards, and by the length and robustness of the posterior pair of pereiopoda.

The ophthalmi are not larger than the diameter of the stalk which supports them, which is scarcely half the length of the first joint of the peduncle of the first pair of antennæ, and the ophthalmic tubercle is small but prominent.

The peduncle of the first pair of antennæ is considerably longer than the rostrum, which equals the first joint, and carries a prosartema of a nodular and almost rudimentary form supporting a tuft of hairs. In the more perfect specimen the flagella are

broken off, but I suppose they are long and slender, as in the other species. The stylocerite is reduced to a rudimentary condition.

The second pair of antennæ possesses a scaphocerite that reaches beyond the distal extremity of the peduncle of the first pair, and the synhipoda of the mandibles equal it in length. The second pair of gnathopoda extends to nearly the length of the carapace beyond the frontal margin, but supports only the rudiment of an ephysis attached to the basal joint.

The anterior three pairs of pereiopoda are moderately long and very slender; the posterior two pairs are very long and slender but rather more robust than those of other species, their great length being due to that of the meral and carpal joints.

The pleon is free from the small spines so characteristic of the carapace, and is smooth, except that it has a small tooth at the posterior extremities of the dorsal surface of the last two somites, and a longitudinal ridge that traverses the lateral walls of the several compressed somites in a position corresponding with the union of the somites to the coxal plates.

The tip of the telson is broken, but as it is it reaches very nearly to the extremity of the inner branch of the tail fan, which is nearly equal in length to the outer branch, which carries a small tooth on the outer side near the distal extremity, and possesses an imperfect diæresis. The branchiæ are arranged as in the type species, but the mastigobranchial lash consists of long and broad plates attached transversely to long pedicles.

Like many of the specimens recorded from extreme depths, the external tissue is of a submembranous character.

This species is represented in the collection by two specimens taken near the middle of the South Pacific Ocean at a depth of nearly three miles.

Haliporus lævis, Spence Bate (Pl. XLII. fig. 2).

Haliporus lævis, Sp. B., *loc. cit.*

Carapace submembranous, smooth, free from small hairs or spines over the surface.

Rostrum about one-fourth the length of the carapace, horizontal, straight, armed on the upper surface with six teeth, and two larger and more distant on the gastric region; one orbital tooth and one in a line posterior; one antennal tooth, one immediately behind it, and one on the hepatic region.

The pleon is laterally compressed, smooth, and slightly carinated dorsally. The sixth somite terminates abruptly, with a tendency to form a small tooth.

Telson long and slender, laterally compressed and grooved dorsally, armed with one long spine-like tooth on each side near the extremity.

Ophthalmopod half the length of the rostrum; tubercle on the inner side small.

First pair of antennæ with the flagella about two-thirds the length of the animal, and the flagellum of the second pair rather longer than the animal.

Rhipidura with the rami long and narrow.

This species is long and slender.

Length (female), 63 mm. (2.5 in.).

Habitat.—Station 104, August 23, 1873; lat. 2° 25' N., long. 20° 1' W.; Atlantic Ocean, south-west of Sierra Leone; depth, 2500 fathoms; bottom, Globigerina ooze; bottom temperature, 36°.6. Two specimens; females.

Station 106, August 25, 1873; lat. 1° 47' N., long. 24° 26' W.; Atlantic Ocean, south-west of Sierra Leone; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°.6. One male, damaged and imperfect.

Station 205, November 13, 1874; lat. 16° 42' N., long. 119° 22' E.; off Manila, Philippines; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. One specimen; female.

This species differs from *Haliporus curvirostris* in having the rostrum (which is broken in our selected specimen) straight and horizontal with the dorsal line, and in being armed with eight teeth on the upper margin, of which the posterior two are distant and situated on the median ridge of the carapace. With the exception of the teeth on the frontal and hepatic regions, the whole surface of the animal is smooth and polished.

The cervical fossa is distinct, and the branchial and hepatic regions are defined by well marked lines.

The ophthalmi are small, being only a little broader than their stalk, which is about half the length of the rostrum and furnished on the inner side with a small blunt tubercle; they rest in a hollow on the upper surface of the first joint of the peduncle of the first pair of antennæ, which is about as long as the rostrum and furnished on the inner side with a short prosartema, and on the outer side with a short stylocerite and a sharp tooth at the distal angle. The second joint is nearly as long as the first, and the third is short, and the three which form the peduncle reach considerably beyond the rostrum, even to twice its length, and terminate in two long slender flagella that are more than half the length of the animal.

The second pair of antennæ carries a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair; it is narrow and terminates on the outer side in a subapical tooth. The peduncle supports a slender flagellum that is about twice the length of the animal.

The mandible possesses a large and foliaceous synaphipod, the second joint of which is more slender than the first, and it reaches as far forwards as the extremity of the peduncle of the second pair of antennæ.

The second gnathopod is broken in all the specimens, so that I cannot compare its length with other parts, except so far as to show that the basephysis is relatively the same as in *Haliporus curvirostris*.

The pereopoda are long and slender, especially the posterior two pairs.

Only one specimen of the male, and that considerably damaged, was taken off the Philippines. Neither the ventral surface of the male, nor the petasma attached to the first pair of pleopoda, is perfect enough for description. The female has the sexual tubercular process on the third pair of pereopoda very large, and covered with stiff, short hairs; posterior to which, arising from the ventral surface on each side, is a stout process directed backwards and inwards and sparsely covered with short hairs. In the median line between these processes is a narrow, straight-sided vertical projection, broken at the apex, and posteriorly is the lateral bar, marking the posterior limits of the pereion, and on the first somite of the pleon, between the pleopoda, is a pointed process beneath which a nervous ganglion lies.

The specimens are all of a semitransparent and submembranous structure, and live at a depth of about three miles, where the temperature is only 4°·6 F. above the freezing point.

The solitary female specimen, taken near the Philippine Archipelago, does not on the closest comparison exhibit any difference from the Atlantic specimens; it was captured at a depth of one mile and a quarter, and where the temperature was 5° F. above freezing point.

Haliporus neptunus, Spence Bate (Pl. XLII. fig. 3).

Haliporus neptunus, Sp. B., *loc. cit.*

This species closely resembles *Haliporus equalis*, and a very close comparison of the two species externally has failed to show that there is any differentiating feature to distinguish them, except that in *Haliporus neptunus* the flagella of the superior antennæ are shorter, and the form of the parts on the ventral surface of the pereion differs.

The coxal process of the third pair of pereopoda in the female is large and like the same part in *Haliporus equalis*; there is a transverse lunate process behind them, but the coxal process of the fourth pair of pereopoda is rounded instead of being sharp; and posteriorly in the median line is a narrow longitudinal prominence, instead of the broad shield-like plate as in *Haliporus equalis*. In the male the petasma between the first pair of pleopoda terminates in three prominent processes like a trident, hence the specific name.

Length (male and female), 63 mm. (2·5 in.).

Habitat.—Station 191, September 23, 1874; lat. 5° 41' S., long. 134° 4' 30" E.; off the Arrou Islands; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5. Trawled. Two specimens.

Station 196, October 13, 1874; lat. $0^{\circ} 48' 30''$ S., long. $126^{\circ} 58' 30''$ E.; near the Philippines; depth, 825 fathoms; bottom, hard ground; bottom temperature, $36^{\circ}.9$. Three specimens; one female and two males, one of the latter not fully developed. Trawled.

This species appears to be readily detected by its colour. All the others are pale and transparent, while the specimens of this species are all of a ferruginous red, although they were taken at two stations separated by five degrees of latitude and eight of longitude from each other. They all lived at nearly the same depth, and under nearly the same temperature. Besides the variation in the ventral aspect of the two species, the form of the mastigobranchial plates corresponds more closely with those of *Haliporus obliquirostris* than with those of *Haliporus equalis*.

It may be that the three forms are only varieties adapted to variable conditions of habitat; but resting upon the extent of our present knowledge of species, I consider myself justified in separating them from each other, if only to demonstrate that variable parts may under different conditions become permanent or specific characters.

Sicyonia, Milne-Edwards.

Sicyonia, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, tom. xix. p. 339, 1830; Hist. Nat. Crust., t. ii. p. 408.

Dermal structure extremely hard and rigid. Laterally compressed; anterior portion of the carapace and posterior portion of the pleon more compressed than the central region. Carapace furnished with a short rostrum, generally denticulated on the upper surface.

The ophthalmopod is short. Ophthalmus reniform.

The first pair of antennæ carries a sharp stylocerite and a rudimentary prosartema, and terminates in two subequally short flagella.

The second pair of antennæ supports a scaphocerite that is broad at the base, narrow at the apex, strong and rigid on the outer side, and terminates in a strong sharp tooth, and the peduncle carries a moderately long flagellum.

The oral appendages resemble those of *Penæus* generally, but differ in some details, as may be seen in the description of *Sicyonia carinata*, which I have taken as being typical of the genus.

The first pair of gnathopoda carries a mastigobranchial plate without a podobranchia attached to it, one arthrobranchial and one pleurobranchial plume, but no basecephysis.

The second pair of gnathopoda has a long and slender mastigobranchia, one arthrobranchial and one pleurobranchial plume, but no basecephysis.

The anterior three pairs of pereopoda are short, chelate, and carry a long and slender

mastigobranchia, one arthrobranchial and one pleurobranchial plume, but no basephysis. The penultimate pair carries the rudiment of an arthrobranchial plume in the form of a small papilla, and one well developed pleurobranchia. The posterior pair is stout, short, and carries no mastigobranchia, plume, nor basephysis. On the ventral surface, between the fourth pair, a large sharp tooth, flat and broad at the base, lies directed anteriorly and reaches as far as the second pair, and between the fifth or posterior pair in the male the foramen for the passage of the vas deferens, instead of being situated on the coxa, is placed on the ventral portion of the last somite of the pereion.

The pleopoda are all single-branched and very short; the anterior pair in the male is furnished with a petasma that is cincinnulated in the median line.

The second pair has the inner branch developed in the form of a petasma of a somewhat less pronounced condition than that of the first pair. The other pairs are simple, and the posterior forms the lateral plates of the rhipidura.

The branchial arrangement is shown in the following table:—

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	...
Arthrobranchiæ,	.	.	.	1	1	1	1	1	r	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	...	...
				h	i	k	l	m	n	o

This genus was described by Milne-Edwards in 1830, and embraced three species, *Sicyonia sculpta*, Milne-Edwards, from the Mediterranean, *Sicyonia carinata* (Olivier), from Rio Janeiro, and *Sicyonia lancifer* (Olivier). He describes the genus as being very near to *Penæus*, which it resembles in the compressed form of the body, in the termination of the first pair of antennæ, in the didactylous hands possessed by the first three pairs of legs, in the conformation of the pleopoda and in other details. But it differs most essentially in the structural character of the branchiæ, in the absence of any traces of pleurobranchiæ, in the reduction of the arthrobranchial plumes, and in the presence of one podobranchial plume attached to the first pair of gnathopoda; the branchiæ divide as in *Penæus*, but instead of being filamentous they are foliaceous in structure, and thus approximate to the condition seen in *Gennadas* and *Sergestes*.

Geographical Distribution.—In the Challenger collection there are four species; one from the West Indies, which I take to be closely allied to *Sicyonia carinata*, from which it differs in what may be only sexual features; one from Torres Strait, that closely resembles the figure of *Hippolyte cristatus*, de Haan, from the Japanese Seas, and coincides with the description of *Sicyonia lancifer* (Olivier), the habitat of which is stated to be the Indian Ocean; and the third is from the north side of New Guinea. This, together with the type, *Sicyonia sculpta*, that was taken in the Bay of Naples, and one described by Stimpson from the Chinese seas under the specific name of *Sicyonia ocellata*, gives the geographical distribution of this genus exceptional interest.

The following list, giving all the known localities, defines the geographical limits of the genus:—

Sicyonia sculpta, Milne-Edwards; Mediterranean, Cape Verde Islands.

Sicyonia carinata (Olivier); South America and West Indies.

Sicyonia (Hippolyte) cristata, de Haan; Japan. Gulf of Kagosima, Stimpson.

Sicyonia (Hippolyte) parvula, de Haan; Japan. Gulf of Kagosima, Stimpson.

Sicyonia (Hippolyte) bispinosa, de Haan; Japan.

Sicyonia ocellata, Stimpson; China.

Sicyonia lancifer (Olivier); Indian Ocean.

Sicyonia lævis, n. sp.; New Guinea.

Sicyonia sculpta, Milne-Edwards (Pl. XLIII. fig. 1).

Sicyonia sculpta, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, t. xix. p. 339, pl. ix. figs. 1-8, 1830; Hist. Nat. Crust., tom. ii. p. 409.

Rostrum as long as the peduncle of the first pair of antennæ; six large teeth on the dorsal crest of the carapace, and a solitary tooth on the under surface near the point of the rostrum. Flagellum of the second pair of antennæ slender and cylindrical.

Length about 50 mm. (2 in.).

Habitat.—Off St Vincent, Cape Verde Islands, and "The Mediterranean Sea." (Milne Edwards).

Such is Milne-Edwards' description of this species, with which our specimen, that was taken off St. Vincent, Cape Verde Islands, seems to agree. There are six teeth on the dorsal crest, the two larger ones are on the posterior half of the carapace, and the four others are smaller and gradually lessen from the gastric region to the extremity of the rostrum. There is a small tooth on the under surface near the point of the rostrum, but this appears to be common to all the known species.

The dorsal surface of the pleon is elevated into a narrow carina, of which the anterior portion on the first somite is produced to a small tooth, directed forwards, while that on the posterior extremity of the sixth somite is directed backwards.

The telson is shorter than the lateral plates of the rhipidura.

Length about 30 mm. (1.25 in.).

Sicyonia carinata (Olivier) (Pl. XLIII. figs. 2, 3).

Palæmon carinatus, Olivier, Encyclop., t. viii. p. 667.

Sicyonia carinata, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, t. xix. p. 344, pl. ix. fig. 44; Hist. Nat. Crust., t. ii. p. 410.

" " Dana, *loc. cit.*, p. 602, pl. xl. fig. 1.

The dorsal surface is carinated in the median line from the rostrum to the posterior somite of the pleon. Carapace with a short rostrum directed obliquely upwards, armed

with two small teeth, with indications of a third at the extremity, and with two larger teeth posterior to the gastric region; a short tooth on the anterior margin of the carapace, corresponding with the external orbital angle, and one posterior on the hepatic region.

The dorsal carina on the first somite of the pleon is produced into an anteriorly directed tooth, and on the sixth into a posteriorly directed one.

Telson tapering, dorsally depressed, and nearly equalling the lateral rami of the *rhipidura* in length.

Habitat.—St. Thomas, West Indies, in shallow water. One specimen; male.

Off Bahia, 20 fathoms. One specimen; female.

Our specimens differ in some details from Milne-Edwards' description and figure, but not sufficiently to mark it as specifically distinct.

Milne-Edwards' figure has the ophthalmopod long and cylindrical, but this may be, and probably is, only an artistic misrepresentation, and the flagella of the first pair of antennæ are represented as being very short, and the peduncle of the second pair of antennæ reaches nearly to the extremity of the scaphocerite, and the terminal flagellum is flattened and strongly ciliated on both borders.

The rostrum in our specimen is smooth below and directed obliquely upwards and forwards; it has on the dorsal surface two small teeth; an anterior apical one, only determinable with a lens, and a posterior one directly over the orbital margin, whereas Milne-Edwards says there are two small teeth and both near the point, although he figures a third as a rudimentary one on the under side of the apex. Behind these, on the dorsal surface, are two others in the median line, corresponding with Milne-Edwards' description, as also does the general plan, but the appendages of the animal require further description in detail.

In the Challenger specimen from the West Indies, there is no tooth on the lower surface. In that from the coast of South America there is one on the lower margin.

The ophthalmopod is very short and biarticulate, a small appendage being attached to the first joint; the ophthalmus, forming the larger portion, is broad, reniform, flattened on the inner side and rounded on the outer, and reaches anteriorly beyond the extremity of the rostrum.

The first pair of antennæ (fig. 3, *b*) has the first joint longer than the eye, deeply excavated and thickly fringed with hairs on the upper surface to receive and protect the eye when at rest; the inner margin is straight and in contact with its fellow throughout its entire length; the prosartema is rudimentary and the stylocerite is almost as long as the joint, and is separated nearly to the base, while another sharp tooth at the outer angle projects forwards to nearly half the length of the second joint, which is short and cylindrical, as also is the third, which carries at its extremity, in the male specimen, two slender flagella that are about half the length of the peduncle.

The second pair of antennæ (fig. 3, c) carries a triangular scaphocerite, that is stiff and rigid on the outer side and deeply cleft at the extremity by a long slit between the spine and the foliaceous portion. The terminal joint of the peduncle extends to about half the length of the scaphocerite, and in this respect differs from Milne-Edwards' description, wherein he says that it "nearly reaches the extremity of the scale which covers it." The flagellum is slightly compressed, and its length is about half that of the animal, and the phymacerite is implanted on the inner side.

The mandibles are large and very robust; the psalisiform margin is smooth and connected with a large, smooth, molar disc, and carries a strong foliaceous, two-jointed synaphipod.

The first pair of siagnopoda is three-branched, and resembles that of the genus *Gennadas* rather than the true *Penæus*.

The second pair of siagnopoda very closely resembles that of *Penæus*, differing only in having the first branch with its two foliaceous plates smaller.

The third pair of siagnopoda differs from that of *Penæus* in having the central branches shorter.

The first pair of gnathopoda resembles that of *Penæus* in the manner in which the terminal three joints are reflexed upon the inner and under surface, but differs in having the meral joint so thin and broad that it overlies and covers the terminal joints. The coxa carries a long and slender mastigobranchia shaped like that in *Penæus*, and, as in that genus, there is no branchial plume attached to it, and not even the rudiment of any basecephysis—an appendage that is so generally present in the Penæidea.

The second pair of gnathopoda is long, slender, and pediform; it carries no basecephysis and terminates in a dactylos that is oval and spatuliform. The mastigobranchia appears to be absent from this limb, also one of the arthrobranchia and the pleurobranchial plume.

The anterior three pairs of pereopoda are chelate and carry no branch on the basal joint, but a long and forked mastigobranchia, similar to those of *Penæus*, and two arthrobranchial plumes. The posterior two pairs are short, stout, and simple, and have neither branch, branchial lash, nor plume.

The ventral surface in our male specimen is furnished with a long and formidable styliform tooth, that originates on the penultimate somite of the pereion and reaches as far forwards as the coxa of the second gnathopod. In the female a similar broad-based ventral tooth exists, and behind it is a broad plate connected with the posterior somite of the pereion, and passing back to the posterior margin of the pereion.

The first pair of pleopoda carries a longitudinally folded petasma that meets its corresponding fellow and unites with it by several small hooks, and on the second pair is a second petasmiform appendage that terminates in a condyloid extremity, but does not unite in the median line. All the other pleopoda are single-branched, except the posterior

pair, which goes to form the outer plates of the tail-fan; this is biramose and supported by strong longitudinal ridges, the outer marginal one is very strong and terminates in a sharp tooth, short of the terminal extremity, in connection with a well-defined diæresis.

Observation.—The specimen supposed to be the type of *Palæmon carinatus*, from which M. Olivier drew his description, was found in the Museum of the Jardin des Plantes without any indication of the locality where it was obtained, but if it be the same as that author described, it was brought from New Holland by Péron, but that which Milne-Edwards gives in his *Histoire naturelle des Crustacés* came from Rio Janeiro, where Dana also procured some specimens and says that it is common.

Sicyonia lancifer (Olivier) (Pl. XLIII. fig. 4).

Palæmon lancifer, Olivier, *Encyclop.*, t. vi. p. 664, pl. cccxvii. fig. 2.

Sicyonia lancifer, de Haan, *Siebold's Fauna Japonica*, p. 194.

Hippolyte cristata, de Haan, *loc. cit.*, Tab. xlv. fig. 10.

Sicyonia lancifer, Milne-Edwards, *Ann. d. Sci. Nat.*, ser. 1, t. xix. p. 341, note, 1830; *Hist. Nat. Crust.*, vol. ii. p. 410.

Sicyonia cristata, Stimpson, *Prodromus descrip. Crust. muc.*; *Proc. Acad. Nat. Sci. Philad.*, p. 112, 1860.

The rostrum is obliquely elevated; armed with a single tooth on the lower surface at the extremity; crested on the dorsal median line of the carapace, and armed with four small teeth on the rostrum, four larger ones posteriorly, and one large sharp tooth on the hepatic region.

The pleon is carinated and but slightly compressed laterally. The carina on the first somite is produced anteriorly to a small tooth, and on the last to a large one directed posteriorly; the carina on each somite is double-ridged longitudinally, and cleft posteriorly to receive that of the next succeeding somite. The last three somites have the coxal plates posteriorly produced to sharp teeth. The telson is tapering and terminally flanked by a sharp tooth on either side, and with a fringe of strong hairs.

Length (female), 50 mm. (2 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59' S., long. 139° 42' E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom, green mud. One specimen; female.

This specimen appears to me to coincide with Milne-Edwards' description of *Sicyonia lancifer* (Olivier). De Haan's figure of *Sicyonia* (*Hippolyte*) *cristata* also corresponds with the Challenger specimen, and the descriptions of the two agree with that given by Olivier under the name of *Palæmon lancifer*. There is but one specimen in the collection, and that a female. It is less compressed laterally, both anteriorly and posteriorly, than *Sicyonia carinata*; the teeth are more numerous on the median dorsal ridge, and

the one on the hepatic region is considerably enlarged. The carina on the pleon, as pointed out by Olivier, is "flattened on the summit and ridged at the margin"; this is caused by a cleft existing in the median line of the posterior margin, which admits of the crest of the next somite being raised into it, and thus a more extensive vertical movement is provided. This peculiar condition I have seen in other carinated species of Crustacea, but to a less conspicuous extent.

The postero-lateral margins of the coxal plates are strongly denticulated. The first and second are only dentate at the apex; the third is bidentate, the fourth and fifth are tridentate, the posterior tooth being smallest. The sixth or posterior is bidentate, and has also a tooth in the median dorsal line. The body generally is pilose, and the margins of the pleonic somites are fringed with hairs.

The ophthalmopoda are short, being about half the length of the rostrum.

The first pair of antennæ is short, having the first joint of the peduncle scarcely longer than the rostrum; it carries a small prosartema and a long stylocerite that reaches nearly to a level with the distal extremity of the first joint, the outer angle of which terminates in a strong tooth; the second joint is short and cylindrical, and the third is very short and carries two very small and slender flagella.

The other appendages are very like those of the preceding species, except that the second pair of gnathopoda is scarcely so long and is more robust.

The ventral surface of the pereion is hirsute, especially marked on the coxal and basal joints of the pereiopoda. In our specimen the ventral plate or thelycum commences between the ultimate pair of pereiopoda, and projects in the form of a sharp styliform tooth as far forwards as the second pair of pereiopoda, a deep hollow existing in the median line at the base; between the anterior pairs of pereiopoda is a pair of sharp spine-like teeth, and between every pair of pleopoda is a strong tooth-like tubercle.

This specimen was taken south of New Guinea. De Haan records his specimen from Japan. Dr. Stimpson found his in 20 fathoms of water on a bottom of shells and sand in the Gulf of Kagosima, and M. Péron brought the typical specimen, described by M. Olivier, from "la mer des Indes."

Sicyonia lævis, n. sp. (Pl. XLIII. fig. 5).

Surface of the animal smooth.

Rostrum armed with five teeth above, and one below at the apex, and on the dorsal crest with two in the median line, one on the gastric region and the other on the cardiac, whence a small carina extends to the posterior margin of the carapace. Hepatic tooth small. Pleon slightly carinated. First and second somites armed with an anteriorly directed tooth; posterior margin of each somite cleft in the dorsal median line, last somite

armed with a posteriorly directed tooth, the extremity of which is depressed. Lateral margins of the coxal plates unarmed.

Telson subequal with the rami of the rhipidura.

Length (male) 30 mm. (1.25 in.).

Habitat.—Station 219, March 10, 1875; lat. $1^{\circ} 54' S.$, long. $146^{\circ} 39' 40'' E.$, north of New Guinea; depth, 150 fathoms; bottom, coral mud. One specimen; male.

This species differs from all those already described in the absence of deeply embossed markings on the surface, and in the less pronounced condition of a series of vertical ridges that mark the posterior portion of each somite of the pleon.

The rostrum is slightly elevated, bidentate at the tip, smooth on the lower margin; the teeth on the upper margin are rather larger than in the other species. The ophthalmus is large, reaching nearly to the extremity of the rostrum. The orbital angle is produced to a point and the tooth on the hepatic region is rather small. The teeth on the dorsal surface of the carapace are also small and not very elevated; the anterior stands on the gastric region and the posterior immediately behind the cervical fossa, whence a low but sharp carina extends to the posterior margin of the carapace.

The first pair of antennæ is short; the prosartema is rudimentary; the stylocerite falls short of the extremity of the first joint of the peduncle; the two succeeding joints are short and terminate in a pair of small and slender flagella, that are not as long as the last two joints.

The mandible carries a synnhipod that is broad and flat.

The first pair of gnathopoda is tolerably robust and hirsute, the second is long and slender. The anterior three pairs of pereopoda are slender; the second is the longest, the third very short, and the posterior two pairs are slender but not so long as the third pair. The ventral tooth is long and styliform. Our specimen is smaller than those of the other known species, but has all the features of an adult animal. It is a male, and carries the protuberance on the ventral surface near and posterior to the coxa of the fifth pair of pereopoda.

Hemipenæus, Spence Bate.

Hemipenæus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol viii. p. 186, 1881.

Animal slender, carapace without an hepatic tooth, rostrum short, horizontal, dentate. Pleon compressed. Telson shorter than the outer rami of the rhipidura.

Ophthalmopod single-jointed, having a small tubercle on the inner side. First pair of antennæ has the peduncle longer than the rostrum and terminates in two unequal flagella, the shorter of which arises from near the base of the terminal joint, the longer at the apex; the first joint carries a rudimentary prosartema, and the stylocerite is want-

ing, or is confluent with the margin. The second pair of antennæ has a long and wide scaphocerite, strengthened on the outer side by a ridge that terminates in a sharp tooth, near the distal extremity, and it carries a long and slender flagellum. The siagon or mandible carries a two-jointed synniphod that does not reach beyond the second joint of the peduncle of the second pair of antennæ.

The first pair of gnathopoda is subpediform and carries a long and slender basecephysis. The second pair is very long, slender, and carries a very long basecephysis.

The anterior three pairs of pereopoda are long and slender, and the dactyli are long. The posterior two pairs of pereopoda are slender, but not quite so long as the preceding.

The pleopoda are long, slender, and unequally branched.

In its external appearance this genus approximates to *Penæus*, but it may readily be distinguished by the character of the ophthalmopod, the rudimentary state of the pro-sartema, and the condition of the stylocerite of the first pair of antennæ, as well as by the difference in the character of the branchiæ. In this genus a podobranchial plume is attached to each of the five mastigobranchiæ, and two arthrobranchial plumes are attached to the antepenultimate pair of pereopoda.

In these two latter characters the branchial arrangement approximates to that of the genus *Benthesicymus*, from which it differs, first, in having no mastigobranchia attached to the penultimate pair of pereopoda, and, second, in a character that might be thought to possess only specific or even only varietal value, but which in reality is important: in *Benthesicymus* the mastigobranchial plates increase in size posteriorly, and the last is the longest, and is a very important appendage, and all the podobranchial plumes are large and well developed, and the pleurobranchiæ, although more important posteriorly than anteriorly, are all large and useful organs, whereas in *Hemipenæus* the pleurobranchiæ are all small and feeble organs, except the posterior pair, and the podobranchiæ are also small, those of the third pair of pereopoda being very feeble, and the mastigobranchiæ are absent from the last, and exist only as rudimentary lobes on the penultimate pair.

The arrangement may be tabulated in the following formula:—

Pleurobranchiæ,	.	.	.	...	...	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	...	...
				h	i	k	l	m	n	o

The structure of the branchiæ also differs from that of *Benthesicymus*, and corresponds more with that of *Penæus*, each plume consisting of a central stalk which carries a series of club-shaped filaments, each branch curling over so that the extremities of opposite branches approximate, and the whole plume forms an obliquely truncated or pen-shaped tube.

Hemipenæus spinidorsalis, Spence Bate (Pl. XLIV. fig. 1).*Hemipenæus spinidorsalis*, Sp. B., *loc. cit.*, p. 186.

Rostrum longer than the ophthalmopoda, thin, armed with three teeth on the dorsal surface; crest not elevated; inferior margin smooth and fringed with hairs.

Pleon having the third somite dorsally carinated posteriorly, from the crest of which a long, slender, posteriorly curved tooth projects, and a small dorsal ridge traverses the posterior somite longitudinally in the median line and terminates in a minute tooth.

Telson half the length of the outer ramus of the rhipidura.

The ophthalmopoda are slender, furnished with a small tubercle on the inner margin, and terminate in an orbicular, dark brown ophthalmus.

The first pair of antennæ has the first joint of the peduncle nearly as long as the rostrum, and supports a strong stylocerite that is confluent with the margin, and reaches nearly to the extremity of the joint; the second joint is as long as the first, and subcylindrical; third joint short, carrying two flagella, one long and slender, and the other short, flat and broad, the former articulating at the extremity, the latter at the base.

The second pair carries a scaphocerite that is twice as long as the peduncle of the first pair, and is armed on the outer margin with a small, sharp, subapical tooth; flagellum twice as long as the animal.

The first three pairs of pereopoda have the chelæ long and slender, the pollex and dactylus being twice the length of the palm; the last two pairs are long, slender, feeble and styliform.

The pleopoda are very long, the first pair is single-branched, and the succeeding pairs have a very slender second branch. The terminal pair is long, narrow, and unequally branched; the outer branch being much longer than the inner, terminating in an ovate extremity, and furnished with a tooth on the outer margin.

Habitat.—Station 133, October 11, 1873; lat. 35° 41' S., long. 20° 55' W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Two damaged specimens. Trawled.

Station 213, February 8, 1875; lat. 5° 47' N., long. 124° 1' E.; near the Philippines; depth, 2050 fathoms; bottom, blue mud; bottom temperature, 38°·8. One specimen. Trawled.

Length, male, 63 mm. (2·5 in.); female, 57 mm. (2·25 in.).

This species, which is remarkable for a spine-like tooth on the third somite of the pleon, has been taken in both the Pacific and Atlantic Oceans. The specimens from the above localities correspond with each other very closely, even in apparently unimportant details. Two of the teeth on the rostrum are situated near together in front of the

orbital margin, the third is more distant, and behind the marginal line of the orbit. The dorsal surface is horizontal, especially marked in the smaller specimen.

The ophthalmi are well developed, not large, but situated on tolerably long and slender ophthalmopoda.

The chelæ are long and slender, and the digital processes are longer than the rest of the hand.

The pleopoda are long, and similar to those of species in allied genera.

The telson is laterally fringed with hairs, and armed with three, small, spine-like teeth.

This is a deep-sea species, having been obtained from a depth of more than two miles in one case, and more than three in the other.

Hemipenæus gracilis, n. sp. (Pl. XLIV. fig. 2).

Very like *Hemipenæus spinidorsalis*, but without the dorsal tooth on the third somite of the pleon. Telson scarcely half the length of the outer ramus of the rhipidura.

Length, male, 50 mm. (2 in.); female, 50 mm. (2 in.). The female is the more robust.

Habitat.—Station 207, January 16, 1875; lat. 12° 21' N., long. 122° 15' E.; off Tablas Island, Philippines; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. Six specimens; two male, two female, and two young.

This species bears so close a resemblance to *Hemipenæus spinidorsalis*, that I could not discover any difference sufficiently important to determine specific distinction, except the absence of the characteristic dorsal tooth on the third somite of the pleon.

On comparing specimens of similar size side by side, it is seen that in *Hemipenæus spinidorsalis* the rostrum is scarcely shorter, and projects less in advance of the eyes, and the eye in *Hemipenæus gracilis* is wider than the stalk, and black instead of brown.

All the appendages bear a close resemblance to one another; the chelæ are slender, and the fingers longer than the palm.

The ventral surface of the pereion varies somewhat, projecting forward in this species in the form of a flat, broad-based and sharply pointed tooth, whereas in *Hemipenæus spinidorsalis* it is obtuse at the point, but the difference is not such as to separate them specifically; and certainly had there not been in the collection specimens of both males and females of this species, I should have considered them as being probably only sexually distinct.

The habitats of the two, though not distant, differ much both in depth and in temperature.

Hemipenæus speciosus, Spence Bate (Pl. XXXVII. fig. 3; Pl. XLIV. fig. 3).

Hemipenæus speciosus, Sp. B., *loc. cit.*, p. 186.

Carapace dorsally carinated from the anterior to the posterior margin, and produced to a sharp anteriorly depressed rostrum that is armed with three teeth, one of which is immediately behind the orbital margin.

Ophthalmopod long, slender, transversely compressed and hairy; the ophthalmus scarcely broader than the stalk, which carries on the upper and inner surface a small but prominent tubercle. Body smooth. Pleon having the posterior half of the third somite elevated to a small carina, which is repeated at the posterior extremity of the fourth and continued on the fifth and sixth, where it terminates abruptly.

Telson about half the length of the outer ramus of the rhipidura, and furnished near the apex on each side with three small spinules.

Length, about 63 mm. (2.5 in.)

Habitat.—Station 325, March 2, 1876; lat. 36° 44' S., long. 46° 16' W., east of Buenos Ayres; depth, 2650 fathoms; bottom, blue mud; bottom temperature, 32°·7. Two specimens; one male and one female. Trawled.

This species bears some resemblance to *Hemipenæus spinidorsalis*, but the rostrum is sharper and more depressed anteriorly, and the last somite of the pleon is not produced posteriorly to a small tooth-like process. The ophthalmopod is slender, the eye is small, and the posterior two pairs of pereopoda are rather more slender.

One of our specimens appears to be a male not yet well developed, and the other a female. They both have on the ventral surface a broad, smooth plate that occupies the entire space between the posterior pairs of pereopoda, which is produced to a sharp point in the median line anteriorly.

Hemipenæus virilis, Spence Bate (Pl. XLIV. fig. 4).

Hemipenæus virilis, Sp. B., *loc. cit.*, p. 187.

Rostrum horizontal, pointed, smooth and ciliated on the lower margin, armed with three teeth on the upper surface, one of which is slightly posterior to the orbital margin; carina lost at the gastric region. Dorsal surface smooth; regions not clearly defined. Pleon dorsally compressed; a small carina commences at the fourth somite and terminates posteriorly in a small tooth on each of the last three somites.

Telson half the length of the rhipidura, pointed, dorsally flattened, and grooved in the median line, laterally fringed with hairs, and four small spines.

Length (male), 100 mm. (4 in.)

Habitat.—Station 200, October 23, 1874; lat. 6° 47' N., long. 122° 28' E.; near the Philippine Islands; depth, 250 fathoms; bottom, green mud. Two male specimens, one having the petasma more developed than the other. Trawled.

The general surface of the animal is slightly pilose. The rostrum is horizontal, pointed, is not elevated at the apex, and does not reach beyond the distal extremity of the first joint of the peduncle of the first pair of antennæ; the upper margin is armed with three teeth, of which the anterior is near the apex and the posterior behind the orbital margin, and they stand upon a small compressed carina which fades away upon the gastric region, and does not reappear until at the fourth somite of the pleon, where it is slightly elevated, and it terminates in a small tooth at the posterior extremity of each of the last three somites.

The ophthalmi are large, orbicular, and supported on short, narrow and compressed peduncles that have a small tubercle on the inner side close to the eye.

The first pair of antennæ has the peduncle twice as long as the rostrum, and the first joint has a stylocerite that lies in contact with the margin, and terminates in a tooth a little short of the outer distal angle, which is also produced to a sharp tooth; the second joint is nearly as long as the first, and the third carries on the outer side a short, flattened flagellum, and at the extremity one that is once and a half as long as the animal, and which has near the base a slight but unusual curve and twist, corresponding to the length of the outer flagellum, and apparently due to its oblique compression.

The second pair has the phymacerite projecting downwards and inwards, and the scaphocerite extending forwards beyond the distal extremity of the smaller flagellum, and in both specimens in the Challenger collection the margins are thickened. In one specimen this thickened tissue is limited to the outer distal margin, commencing just beyond the small tooth and fading away at the apex, but the structure beyond exhibits evidence of being affected. In the other specimen the same dense substance commences at the corresponding point, that is, at the fissure beyond the outer tooth, and continues to about halfway on the internal margin, where it gradually decreases and terminates. I believe this thickening to be the result of disease, but it appears to produce in some specimens a singular constriction of the organ that is worthy of consideration as producing alteration of form, which appears to resemble specific variation (*vide* Pl. L. c.).

The mandible carries a synhipod of which the terminal joint is triangulate.

The first pair of gnathopoda carries a basephysis that extends considerably beyond the dactylos. The second reaches as far as the extremity of the rostrum and supports a basephysis that reaches to the extremity of the meros.

The pereopoda approximate to each other ventrally, the coxæ of first three pairs being almost in contact. Between the fourth pair is a small, pointed, obliquely projecting plate. The coxæ of the posterior pair are developed to an unusually large size, and approximate to

each other, without being in contact, in the median line for the purpose of supporting the vas deferens.

The first pair of pleopoda is long and single-branched, and from near the base of the first joint a protuberance projects that supports the petasma, which consists of a large, ovate, membranous plate that is hooked by a series of cincinnuli to its fellow on the opposite pleopod. The second pair of pleopoda is two-branched; the outer or posterior branch is long, and resembles that of the first pair, the anterior or inner branch is small, short, and furnished at the base with a broad, thin, hollow, scale-like appendage; it is firm, rigid, and forms a sexual distinction. All the other pleopoda are similar to those in other species.

The outer branch of the tail-fan is long, narrow, and very nearly double the length of the telson, which is tapering, fringed at the margins with a row of short hairs and three or four small spines.

This form was taken associated with two or three other species, among which was *Hemipenæus tomentosus*, and in spite of the great difference in the length of the rostrum, I am greatly inclined to believe that the latter will prove to be the female of *Hemipenæus virilis*, and I only hesitate so to regard them because it is more common for the male animal to possess the stronger characters. *Hemipenæus tomentosus* appears to be intermediate in form between *Hemipenæus virilis* and *Hemipenæus semidentatus*.

Hemipenæus semidentatus, Spence Bate (Pl. XLIX. fig. 1).

Aristeus semidentatus, Sp. B., *loc. cit.*, p. 189.

Rostrum long and slender, about two-thirds the length of the carapace, rising slightly towards the anterior extremity; armed with three teeth on the dorsal surface just over the orbit. Pleon posteriorly compressed, slightly carinated, and produced to a small tooth at the posterior extremity of the last three somites.

Telson tapering to a sharp point, dorsally grooved and laterally compressed, having the margins fringed with hairs and armed with three small movable spines.

The ophthalmi are rather large, orbicular, and supported on short slender ophthalmopoda that narrow gradually to the base.

The first pair of antennæ has a peduncle that is rather more than half the length of the rostrum; the first joint has the stylocerite traversing the outer margin, resembling a strong ridge, and terminating in a sharp tooth at the distal angle, and on the inner side the prosartema is reduced to a tubercle tipped with a tuft of short hairs. The shorter flagellum is about the length of the second joint, and the longer one is about the length of the animal.

The second antenna has a prominent phymacerite, and supports a membranous scaphocerite that is rigid on the outer margin and reaches beyond the extremity of the

peduncle of the first pair, but not quite to the extremity of the rostrum, and terminates in a flagellum about once and a half as long as the animal.

The dactyli of the anterior three pairs of pereopoda are long and slender.

The pleopoda are moderately slender and elongated.

Habitat.—Station 170, July 14, 1874; lat. 29° 55' S., long. 178° 14' W.; near the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°·0. Three specimens.

Length, largest female 107 mm. (4·25 in.), smallest male 51 mm. (2 in.). Trawled.

Station 171, July 15, 1874; lat. 28° 33' S., long. 177° 50' W.; north of the Kermadec Islands; depth 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. One specimen; female. Length 150 mm. (6 in.). Trawled.

Station 194, September 29, 1874; lat. 4° 34' S., long. 129° 57' 30" E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. One specimen; female. Length, 55 mm. (2 in.).

This species corresponds so closely in general appearance with Duvernoy's figure¹ of *Aristeus antennatus*, Risso, that it was only proved not to be a variety by comparing it with Risso's figure,² and by careful consideration of the details of the specimens in this collection. In Risso's figure it is without eyes, but at page 97 he says that "Les yeux sont gros, noirs, placés sur les courts pédicules;" he also says that "les antennes supérieures, ingalement bifides," and figures them subequal, slender, and not longer than the rostrum, and has the dorsal surface of the pleon smooth, "dont les deux (segmeros) derniers sont carénés." Duvernoy represents the eyes as standing on a long peduncle, but smaller in proportion to the diameter of the stalk than is the case in our specimens. He also figures the larger flagellum of the first pair of antennæ as being longer than that of the second, but this is probably an error in drawing. He also represents the dorsal surface of the pleon as being smooth, and the posterior margins of the fourth and fifth somites as produced in the median line to a point, whereas in the Challenger specimen the two somites are not so produced, but elevated into a small and distinct carina that terminates in a small point on the fifth and sixth somites, and in some specimens on the fourth also.

This species differs from *Aristeus armatus*, which it much resembles, in having the rostrum proportionally shorter, the teeth on the crest rather smaller, and none on the third somite of the pleon, where in *Aristeus armatus* it is very large, as are also those on the fourth and fifth somites, whereas in *Hemipenæus semidentatus* there is only a small carina which terminates almost abruptly.

The branchiæ in the Challenger specimens correspond with those of the other species

¹ *Ann. d. Sci. Nat.*, t. xv., 1841.

² *Hist. Nat. Crust. des Environs de Nice*, p. 96, pl. ii. fig. 6.

of this genus rather than with *Aristeus*, especially in the rudimentary condition of the pleurobranchiæ, and in having no mastigobranchia attached to the fourth pair of pereopoda.

The outer branch of the tail-fan is long and narrow, about one-half longer than the inner, which is about one-fourth longer than the telson. The outer margin is strengthened by two parallel ridges that meet in a sharp tooth some distance from the distal extremity. From near this tooth a rigid diæresis obliquely traverses the plate.

A fine specimen of a female, about 150 mm. long, measured from the frontal margin to the extremity of the telson, was taken by the trawl about 130 miles north-east of the Kermadec Islands, and three others were also trawled at a depth of nearly three-quarters of a mile close to the same islands; these were one adult female and two young animals, one of which carries an antenna that is more than three times its length, and the smallest specimen appears to be an immature male.

Hemipenæus tomentosus, Spence Bate (Pl. XLIX. figs. 2, 3; Pl. L.).

Aristeus tomentosus, Sp. B., *loc. cit.*, p. 189.

Body smooth, covered with a very short velvety pile. Rostrum equal in length to the extremity of the shorter flagellum of the first pair of antennæ; armed with three teeth, of which the posterior is just behind the orbital margin of the carapace, the second in advance of it, and the third near the middle of the rostrum. The dorsal carina is only just indicated in the median line behind the posterior tooth, feebly repeated on the posterior portion of the third somite of the pleon, and increases on each of the three posterior somites, where it is produced to a small pointed tooth.

The telson is pointed, dorsally flattened, with indications of a groove, and armed on each side with three small spines.

Habitat.—Station 177, August 18, 1874; lat. 16° 45' S., long. 168° 7' E., the New Hebrides; depth, 130 fathoms; bottom, volcanic sand. One specimen; female.

Station 200, October 23, 1874; lat. 6° 47' N., long. 122° 28' E.; the Philippine Islands; depth, 250 fathoms; bottom, green mud. Two females.

Length (female), 125 mm. (5 in.).

This species bears a general close resemblance to *Hemipenæus semidentatus*, but is easily distinguished by the slightly pilose character of the external surface, and by the shortness of the rostrum, which is only half the length of the carapace. The teeth on the rostral crest are further apart and not so large. There is not a very distinct ridge traversing the upper margin of the branchial chamber, and the mid-branchial rib is but feebly marked. The teeth on the frontal margin of the carapace correspond with those of the typical species.

The dorsal surface of the several somites of the pleon is smooth, but in the fourth it is produced to a point, which in the two succeeding ones is increased to a decided tooth.

The telson tapers to a very sharp point, and has the sides compressed and the dorsal surface flattened and slightly grooved in the median line.

The ventral surface of the pereion is narrow; the oviducts on the third pair of pereopoda come into contact in the median line. An almost vertical process, covered with short stiff hairs, lies between the coxæ of the fourth pair, behind which there is a circular depression bordered by a hirsute ridge between the coxæ of the fifth pair; the deep depression between the posterior two pairs of pereopoda is sometimes filled with a grey mass of firm and leathery texture (*vide*, Pl. XLIX. fig. 3 ♀).

Between the first pair of pleopoda is an elevated ridge, and a prominent point exists in the median line between the second.

The ophthalmi are round and considerably broader than the ophthalmopoda, which carry a rudimentary tubercle on the inner side near the eye.

The first pair of antennæ possesses on the inner side the rudiment of a prosartema covered with long hairs, and on the outer side a stylocerite, in connection with the side of the joint, extending to nearly the extremity of the external angle, which terminates in a sharp point just in advance of it. Between the stylocerite and the inner margin the surface is depressed into a deep hollow, the margins of which are thickly fringed with tolerably long hairs; the second joint is nearly as long as the first, and the third is shorter and carries the short, outer flagellum near the base, and the inner and longer at the apex.

The second pair of antennæ (Pl. L., *c*) carries a large scaphocerite, the outer side of which is strengthened by a slender ridge that terminates in a small sharp tooth somewhat distinct from the rounded, pointed apex.

The anterior three pairs of pereopoda slightly increase in length posteriorly, and the dactyli are adorned with small fasciculi of hairs at very regular distances.

The first pair of pleopoda is long, slender, and single-branched, and has a small rudimentary petasma attached to the basal joint. The succeeding pairs are biramose, the anterior branch, which is small in the second pair, increases gradually in size posteriorly. The sixth pair, which forms the outer plates of the tail-fan, has the rami long and terminate in a flat, foliaceous, ovate plate, the outer margin of which is strengthened by a rib in the middle that meets the outer margin and forms a tooth somewhat short of the extremity.

The specimen taken at the New Hebrides was rather longer than those from the Philippines, and was glabrous rather than tomentose. The rostrum was also a little longer, stretching beyond the denticulation. In all other respects it corresponded very closely with the typical form.

Aristeus, Duvernoy.

Aristeus, Duvernoy, Ann. d. Sci. Nat., tom. xv. p. 101, 1841.

Funchalia, Johnson, Proc. Zool. Soc. Lond., p. 895, November 28, 1876.

Body laterally compressed. Surface generally rigid, except the inferior portion of the branchial region, where it is soft and membranous.

Carapace laterally and posteriorly produced. Frontal margin produced to a long rostrum.

Pleon having the first somite transversely divided, the anterior division of the dorsal surface underlies the carapace, the posterior being connected with the coxal plate, which anteriorly overrides the postero-lateral margins of the walls of the carapace.

The ophthalmopoda are uni-articulate and support a small tubercle on the inner side.

The first pair of antennæ has the peduncle long; the first joint is but slightly excavate to receive the ophthalmus, it has no prosartema, or only a small process tipped with hairs, but carries a well developed stylocerite on the outer side; the second joint is generally long and subcylindrical, and the third joint is short, and carries two flagella; one, attached near the base of the joint on the outer and upper side, is short, longitudinally flattened, concave below and convex above, while the other, attached to the extremity, is long, slender, and cylindrical.

The second pair of antennæ has the several joints of the peduncle freely articulating with each other and with the metope. The first or coxal joint carries a well-formed phymacerite on the inner side; the second or basal joint carries a large and broad scaphocerite, which is double-jointed at the base on the under side so as to permit of a downward movement, and is strengthened on the outer side by a rigid margin that terminates anteriorly in a sharp tooth; on the outer side the lateral movement is checked by a small disk-like plate attached to the second joint, and on the inner and upper distal surface is a short, blunt, tooth-like process that is lodged in a depression formed on the under side of the first pair of antennæ, and prevents a too great upward and inward action; the third, fourth, and fifth joints, which are the homotypes of the ischium, meros, and carpos of the true legs, carries at its extremity a long flagellum.

The epistoma is anteriorly produced to a more or less important rostriform point in the median line, and supports posteriorly the cheiloglossa, the labial portion of which overrides the mandibles and meets the metastoma posterior to them; the glossal process passes into the oral cavity and lies anterior to and fills the space between the mandibles.

The mandibles are powerful organs, and have the molar process larger than the incisive, while the synphipod consists of two narrow joints which do not reach beyond the base of the second pair of antennæ. When the oral appendages are examined *in situ*, the psalisiform blades of the mandibles are seen to overlap each other and resemble "a pair of long sickle-shaped shears, which cross each other from opposite sides

of the mouth," a feature on which Mr. James Yates Johnson founded his genus *Funchalia*.

Posterior to the mandibles lie the two flattened pear-shaped metastomata.

The first pair of siagnopoda is three-branched, the two inner being flat and leaf-like, having the inner margins fringed with short spine-like hairs, and the third or outer articulating at right angles with the preceding.

The second pair of siagnopoda is three-branched; the two inner or basal are biramose, foliaceous, and tipped with short spine-like hairs; the third is short, flat, and pointed; outside this a large mastigobranchial plate is produced anteriorly to a rounded extremity, considerably in advance of the other parts of the appendage, and projects posteriorly, and diagonally outwards, as a valve closing the exit passage from the branchial chamber, the whole being fringed with finely ciliated hairs.

The third pair of siagnopoda consists of a broad, concavo-convex inner plate that is fringed with hairs, a slender three-jointed branch that represents the true limb of the appendage, behind which, and closely associated with it, is a broad membranous plate that at the distal extremity suddenly narrows to a point, and has at its base a broad but short mastigobranchial plate.

The first pair of gnathopoda is subpediform, having the three distal joints reflexed on the inner surface and thickly studded with hairs; the basal joint carries a long ephysis, and the coxa supports a mastigobranchial plate bearing a rudimentary podobranchial plume at the base.

The second pair of gnathopoda is pediform, longer than the first, and extended in advance of the frontal margin; it is generally fringed with hairs and terminates in a very straight dactylos capable of being bent to a right angle. The basis carries a long ephysis, and the coxa supports a mastigobranchial plate that bears a podobranchial plume.

All the pereopoda are without an ephysis; the three anterior pairs, which are chelate, support a mastigobranchial plate, carrying a podobranchial plume. The two posterior pairs are not chelate and are less robust, the fourth supports a mastigobranchial plate without a podobranchial plume, and the fifth pair has neither.

The arrangement of the branchial appendages is represented in the following table:—

Pleurobranchiæ,	.	.	.	r	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	1	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

The ventral surface of the female varies somewhat in the different species, but it appears generally to be provided with a hollow or deep depression, posterior to the pointed thelycum, in which apparently at certain periods a membranous substance is developed or deposited, the use of which is yet to be determined (*vide* Pl. XLIX. figs. 2, 3).

The pleopoda are long and two-branched, the inner branch of the first pair in the male being developed into a membranous petasma, while in the female it is reduced to a rudimentary condition.

The posterior pair is differentiated to form the outer plates of the rhipidura, and are long and ovate; the inner plate is strengthened by a double longitudinal median rib, and the outer by a similar rib that traverses the plate subcentrally, and another that lies along the outer margin, with which the median one coalesces at the margin, a short distance from the distal extremity, to form a lateral tooth, near which is an obsolete diæresis.

Aristeus differs from *Penæus* in many essential points. Those which are external and obvious, and can be readily used for the determination of the genus, are the first pair of antennæ, which have flagella unequal in length and different in form, and possess the notable feature that one springs from near the base of the third joint of the peduncle and the other from its distal extremity; the absence or rudimentary condition of the prosartema; the one-jointed character of the ophthalmopod, which bears on the inner side a small tubercular process which I believe can be demonstrated, in *Benthosicymus*, to be a complementary eye; the altered character of the appendage attached to the mandible, which in this species is comparatively small; certain differences in the form of the oral appendages; and, finally, the structure and arrangement of the branchial plumes.

Geographical Distribution.—This genus consists mostly of deep-water species, which swim freely in the sea, and during the cruise of the Challenger were never captured in less than 255 fathoms of water.

Penæus antennatus, Risso, the type of Duvernoy's genus, was taken in very deep water in the Mediterranean, where it has since been procured by Mr. James Yates Johnson, who obtained his specimens of *Funchalia woodwardi* at Madeira. The form nearest to the type that I have examined is *Aristeus armatus*, which was captured at seven different localities, at depths ranging from 1400 to 2350 fathoms. The average temperature of its habitat was about 36°, the highest being 38°·8, at a depth of 2050 fathoms, off the Philippines. Thus, this species lives in an Arctic temperature, and under the pressure of a column of water more than two miles in depth, between the latitudes of 35° north and 35° south of the Equator.

Running down the eastern coast of South America, in the month of September 1873, the Challenger must have passed through a great multitude of young animals of this genus, varying in size from 4 to 14 mm., all of which bore evidence of belonging to allied species. The specimens corresponded closely excepting in such features as may be dependent upon age.

Aristeus armatus, Spence Bate (Pls. XLV., XLVI.).

Aristeus armatus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 188, 1881.

Rostrum as long as the carapace, slender, slightly curved upwards, armed with three sharp teeth at the base; dorsal surface smooth, without any carina, anterior margin armed with two antennal teeth, the orbital tooth suppressed. A short longitudinal rib defines the branchial region, which is covered by soft and flexible tissue. The pleon is dorsally armed with three sharp teeth, situated on the third, fourth, and fifth somites, and there is a low carina on the sixth.

Telson narrow, tapering, dorsally flattened and laterally compressed; fringed with hairs and bearing four small spines near the distal extremity.

The ophthalmopoda are club-shaped and rigid.

The first pair of antennæ carries a stylocerite that reaches to the extremity of the second joint, and the third joint carries a very short and flat flagellum, and a second long and slender, being quite as long as the whole animal.

The female corresponds very closely with the male, except in having a greater width between the posterior pereopoda, and in having the ventral plate broader and flatter.

Habitat.—Station 133, October 11, 1873; lat. $35^{\circ} 41'$ S., long. $20^{\circ} 55'$ W.; South Atlantic Ocean, near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, $35^{\circ} \cdot 4$. One specimen. Trawled.

Length (male), 150 mm. (6 in.), measured from the orbit to the extremity of the telson.

Station 184, August 29, 1874; lat. $12^{\circ} 8'$ S., long. $145^{\circ} 10'$ E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36° . One female and two males. Trawled.

Length—male, 200 mm. (8 in.); female, about 12 mm. shorter.

Station 213, February 8, 1875; lat. $5^{\circ} 47'$ N., long. $124^{\circ} 1'$ E.; near the Philippines; depth, 2050 fathoms; bottom, blue mud; bottom temperature, $38^{\circ} \cdot 8$. One specimen. Trawled.

Length (male), 70 mm. ($2 \cdot 75$ in.).

Station 237, June 17, 1875; lat. $34^{\circ} 37'$ N., long. $140^{\circ} 32'$ E.; off Japan; depth, 1875 fathoms; bottom, blue mud; bottom temperature, $35^{\circ} \cdot 3$. One female. Trawled.

Station 246, July 2, 1875; lat. $36^{\circ} 10'$ N., long. $178^{\circ} 0'$ E.; Mid-Pacific; depth, 2050 fathoms; bottom, Globigerina ooze; bottom temperature, $35^{\circ} \cdot 1$. One specimen. Trawled.

Length (male), 177 mm. (7 in.).

Station 276, September 16, 1875; lat. $13^{\circ} 28'$ S., long. $149^{\circ} 30'$ W.; the Low Archipelago; depth, 2350 fathoms; bottom, red clay; bottom temperature, $35^{\circ} \cdot 1$. One specimen; female.

Station 323, February 28, 1876; lat. $35^{\circ} 39'$ S., long. $50^{\circ} 47'$ W.; east of Buenos Ayres; depth, 1900 fathoms; bottom, blue mud; bottom temperature, $33^{\circ} \cdot 1$ F. One specimen. Trawled.

Length (male), 164 mm. (6.5 in.).

Three fine specimens of this species, two males and a female, were taken in the middle of the Southern Indian Ocean. One, a female, was taken off the south coast of Japan; it was not so large nor so fine a specimen as the preceding. A small but well-formed female was taken near the Philippine Islands, and another east of the Torres Strait; a fine male specimen was trawled in mid-ocean in the North Pacific; one rather small female was taken near the Low Islands in the Pacific Ocean; a well-developed male was taken off Buenos Ayres; and a similar one not far from the island of Tristan da Cunha, in the South Atlantic Ocean, at an average depth of nearly two miles and a half.

In this species the carina from the dorsal crest is continued but a little distance behind the posterior tooth, where it becomes lost in the smooth surface of the carapace. There is no trace of the cervical suture. The rostrum is as far in advance of the orbital margin as the length of the carapace, measured from the same point. There is a small dorsal crest above the orbit crowned with three teeth, of which the posterior is the smallest. The orbit is imperfectly defined by a small prominence, chiefly visible in front of and below the margin of the carapace, and immediately outside of it is the first antennal tooth, which is small, being elevated rather than prominent. From this part of the orbital margin a ridge runs for a short distance and then divides, one above the other, ending in the hepatic groove. Beyond this is the second antennal tooth, both elevated and prominent, and continuous posteriorly with a ridge that extends to half the length of the carapace and forms the second antennal ridge. Below the second antennal ridge the middle branchial ridge runs horizontally, and parallel with the lower margin, from the anterior to the posterior border of the carapace, and becomes confluent with the latter, which is elevated into a marginal ridge. Below the median branchial ridge the walls of the carapace are soft and flexible.

The first somite of the pleon is long, and divided by a deep transverse groove into two parts; the anterior is convex and smooth, the posterior is shorter than the anterior and continuous with the coxal marginal plates.

The second somite has also a deep transverse sulcus, but the anterior division is shorter than the posterior, and, like the preceding, has the lower margin of the coxal plate slightly truncated, having the appearance of being cut straight, so that the lower margins of the coxal plates form a continuous line from the anterior to the posterior extremity of the pleon.

The third somite has a less conspicuous transverse groove nearer the anterior margin than in the preceding, and the posterior margin is produced into a strong, sharp,

laterally compressed tooth. The next two are similar but have no transverse groove; the dorsal ridge becomes slightly carinated, and this carina extends to the extremity of the sixth somite, but is not produced to a tooth.

The telson is long and laterally compressed, terminating in a sharp-pointed extremity, and reaching as far as the distal extremity of the inner branch of the tail-fan; it is smooth and slightly flattened on the dorsal surface, depressed at the margins, which are armed with four, unequally distant, small, movable spines, the anterior of which is near the middle of the margin.

The ophthalmopod is flattened and has the rudiment of a tubercle on the inner margin. The ophthalmus is orbicular and a little broader than the diameter of the stalk.

The first pair of antennæ has the peduncle about half the length of the rostrum. The first joint is a little longer than the ophthalmopod, and is flattened, but not deeply excavated, for its reception, and has only the rudiment of a prosartema on the inner side, while on the outer the stylocerite longitudinally overlaps the margin and projects beyond the anterior outer angle as far forwards as the distal extremity of the second joint, which is subcylindrical, and rather more than half the length of the first; the third is short and carries the smaller flagellum about midway between the base and the distal extremity, where the longer flagellum articulates; the shorter flagellum is about half the length of the peduncle, while the longer one is equal to the entire length of the animal.

The second pair of antennæ has all the five joints of the peduncle freely articulating one with the other; the coxal joint carries on the inner side a prominent phymacerite, the membranous surface of which is directed obliquely forwards and inwards. The second carries, on the upper and outer side, a large foliaceous scaphocerite, strengthened on the outer margin by a longitudinal ridge that terminates in a sharp tooth one-fifth from the distal extremity, and supporting, on the inner and upper margin, a small hook-like process, which, when at rest, is lodged in a hollow on the under surface of the first joint of the first antenna, just within the rigid base of the stylocerite; the third joint articulates longitudinally with the second on the inner side, the fourth joint is short, and the fifth reaches to nearly half the length of the scaphocerite, and terminates in a long and slender flagellum that is about once and a half as long as the animal. The epistoma is narrow, and projects in the form of a small rostrum; the cheiloglossa is prominent, triangulate, rigid anteriorly, and forming on each side posteriorly a large tubercular process that corresponds with, and occupies, the depression between the psalisiform and molar processes.

The mandibles are strong and powerful, and carry a two-jointed synaphipod, the first joint of which is long and narrow and the second short and triangulate, and both are thickly studded with hairs. The psalistoma is smooth, except for a single small denticle near the centre; it is sharp-pointed at the anterior angle, and overlaps its fellow.

The metastoma is double, somewhat pear-shaped, and flattened against the posterior walls of the mandibles.

The first pair of siagnopoda is three-branched; the first two branches are flat, strong, and fringed at the inner margin with short hairs and strong spines; the third is short, terminating in an ovate distal extremity that carries several long and simple hairs, while the outer margin is fringed with plumose cilia, and at the base there is a fasciculus of ciliated hairs.

The second pair of siagnopoda is three-branched, two of the branches are flattened, subfoliaceous and biramose, and each is tipped with short stiff hairs; the third is short, flat and pointed, and attached to the coxal joint is a large mastigobranchial plate that projects anteriorly beyond the extremity of the limbs, and posteriorly, while short, is broadly expanded.

The third pair of siagnopoda is five-branched; the coxa is short, studded upon the inner side with short stiff hairs, and carries externally a large, broad, mastigobranchial plate; the second or basis is short and carries on the inner side a broad, rigid, slightly flexed plate that is thickly fringed with stiff hairs, and on the outer side a long and flat ephysis; the three next joints articulate terminally, the last being ovate, and all are fringed with numerous, long, ciliated hairs.

The first pair of gnathopoda is subpediform; the coxa carries a well-developed mastigobranchia and podobranchial plume; the basis is very short and carries a small ephysis; the ischium is equally short, and closely associated with the basis; the meros is long, stout on the outer side and thin on the inner, where it is thickly fringed with hairs; the carpos is triangulate, stout, and thickly covered with hair; the propodos and dactylos are terminally articulated, and lie reflexed against the meros; they are widest at the carpal joint, and taper gradually to the unguiculate extremity, which is armed with three strong teeth, of which the most robust is at the extremity.

The second pair of gnathopoda is long and pediform; the coxa carries a mastigobranchia with a podobranchial plume attached; the basis carries a very small and slender ephysis, the ischium is long and narrow; the meros is half the length of the ischium, narrow and subcylindrical; the carpos and propodos are equal in length to the ischium, but more slender and cylindrical, and the dactylos is slender, tapering, and slightly shorter than the propodos, and has the under surface thickly covered with hairs.

The first three pairs of pereopoda are subequal, but not large, nor differing from those of *Penæus* proper; they each support well-developed mastigobranchial plates and well-developed plumes. The podobranchiæ and the arthrobranchiæ are the largest, the pleurobranchiæ being small but not rudimentary.

The posterior two pairs are long and slender, reaching as far forwards as the extremity of the smaller flagellum of the first pair of antennæ.

In the female the oviducts open on a flattened tubercular process, situated on the

inner and posterior side of the third pair of pereopoda, and protected by hairs around the orifice, exposed when the leg is directed backwards, and hidden when it is thrown forwards, being protected by the anterior margin of the thelycum, which lies between the penultimate pair as a flattened plate, which is pointed forwards. A similar plate, reversed in form, with a carinated ridge traversing the median line, stands between the ultimate pair. It is absent or reduced to a minimum in the male, its place being occupied by the enlargement of the coxal joints (Pl. XLV. fig. 2) of the posterior pair of pereopoda and the protuberance that carries the vas deferens, the slit-like aperture for which is narrow. These organs almost meet in the centre, and a narrow tooth-like process projects forwards from them on each side, and rests against the coxa of the preceding legs.

In the male the first pair of pleopoda (*p*) has the basal joint transversely triangulate; the inner margin near the base carries a small and rigid process, from near the root of which a large, foliaceous organ, the petasma, arises and spreads itself out until it reaches its corresponding fellow, to which it is linked, in the adult, by a series of small cincinnuli, thus forming a veil or curtain across the ventral surface. This pair of pleopoda carries a long, two-jointed branch, the first joint of which is simple, and the second multiarticulate.

In the female these pleopoda are similar, but the inner branch, which forms the petasma in the male, is reduced to a rudimentary condition. Between these pleopoda, in the median line, is a long and laterally compressed tooth-like process.

The second pair of pleopoda is biramose, the anterior branch being small, almost rudimentary, in both sexes, but in the male there springs from its base a two-jointed complementary appendage that is wide, flattened, and capable of being compressed closely against the anterior surface of the posterior branch. The third and succeeding pairs of pleopoda have the anterior or smaller branch gradually increasing in size until in the fifth pair it is subequal to the posterior branch.

The sixth pair forms the outer branches of the tail-fan; the inner branch is markedly ovate, strengthened in the median line by two longitudinal ridges, one of which is continuous from near the apex to the articular process, but the inner, or that nearer the telson, diverges and curves towards the margin near the root of the telson. The outer branch is also ovate, but much longer than the inner. It is strengthened by three longitudinal ridges, one along the outer margin, terminating nearly opposite the extremity of the telson; the second on the outer side of the median line, with which it runs parallel until towards the extremity, where it curves outwards and unites with the outer ridge to make a strong, sharp tooth; the third is in the median line and terminates at the extremity of an imperfect diæresis; between this ridge and the second is a deep sulcus. The rest of the plate is smooth, and its inner and distal margins as well as those of the inner or smaller plate, are fringed with ciliated hairs.