

Aristeus rostridentatus, Spence Bate (Pl. LI.).*Aristeus rostridentatus*, Sp. B., *loc. cit.*, p. 189.

Carapace smooth. Rostrum markedly elevated anteriorly, as long as the carapace. Dorsal surface crested above the frontal region, serrate with distantly placed teeth from the posterior portion of the crest to the extremity of the rostrum. Lower margin smooth. Frontal margin of the carapace armed with a first and a second antennal tooth; a sharp tooth on the hepatic region.

The pleon is slightly compressed posterior to the third somite. The third, fourth, fifth, and sixth somites are slightly carinated, and have the posterior margin produced to a small tooth in the median dorsal line. The telson is long, and tapers to a styli-form point; the dorsal surface is slightly grooved; the sides are depressed, and the margins are fringed with a thick row of hairs and four small spines.

The ophthalmopod is short and small, the ophthalmus large and round. The first pair of antennæ has the peduncle half the length of the rostrum; the first joint is a little longer than the ophthalmopod and supports a stylocerite that reaches beyond the eye, but does not extend to the extremity of the first joint. The second joint is rather shorter than the first; it is cylindrical and hirsute. The third joint is nearly as long as the first, and carries the smaller flagellum near the base and the longer at the apex; the former is not longer than the joint that supports it, whereas the latter is longer than the animal.

The second pair of antennæ is about four times the length of the animal, and has a scaphocerite extending as far as the extremity of the peduncle of the first pair.

The first pair of gnathopoda is short, and carries an ephysis much longer than itself.

The second is long, and carries an ephysis that is about one-third its length.

The pereopoda approximate to each other ventrally, and a small vertical plate projects between the coxæ of the fourth pair, which are hirsute. A prominent and sharp tooth stands between the pleopoda, which are of only generic value.

Length, largest about 131 mm. (5·25 in.), smallest 38 mm. (1·5 in.)

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

This species bears a general resemblance to *Aristeus armatus*, and might on a hasty examination be taken for a variety of that species, but a detailed examination shows that there are some very important differences that separate them widely. The rostrum, continuing the anterior slope of the carapace, is first depressed, and then it somewhat suddenly ascends. It carries on the dorsal surface numerous distantly situated small teeth. These, from their number and position, furnish a ready means of diagnosis, but it is

not impossible that they may be sometimes reduced in number and become less conspicuous in various specimens, and this would render the resemblance between this species and *Aristeus armatus* still greater. The carapace as well as the lateral walls of the pleon are tomentose generally, which is a character of considerable importance, but the pile is likely in old animals to be much rubbed off and therefore less noticeable. The shortness and small diameter of the eye-stalk, and the comparative largeness of the eye itself, which rests partially within a hollow thickly fringed with rather long hairs, is another conspicuous feature. The first pair of antennæ has the stylocerite waved, strong, and scarcely reaching to the extremity of the first joint, which is armed at the outer angle with a sharp tooth; the second joint is a little shorter than the first, is sub-cylindrical and covered all over with hairs; the third joint supports a flagellum rather shorter than in most species and attached near the base, while the other situated at the extremity is longer. The latter was broken off in our specimen at a length about equal to that of the entire animal, but, from comparison with other species, it was probably longer.

The second pair is remarkable for the great length of the flagellum, about four times that of the entire animal, and carries at its base a broad scaphocerite that is about as long as the peduncle of the first pair, extends inwards and dips between the antennæ, and partially encloses the last joints of the peduncle, which are rather long, reaching to about two-thirds of the scaphocerite. The ancecerite or hook-like process is reduced to a small rigid tubercle, but the phymacerite is prominent and horse-shoe-shaped.

The epistoma projects forwards as a rounded pilose prominence, from which the cheiloglossa projects downwards and overlaps the anterior margin of the mandibles, the glossal portion filling the space between them. The mandible (*d*) is a strong and powerful organ, and differs from that of the type only in the form of the synaphipod being more pronounced, having the second joint nearly as long as the first, and carrying a strong projecting process near the base; both joints are thickly covered with long and stiff hairs.

The metastoma is double and pear-shaped, overlaps the mandibles posteriorly and reaches to the anterior lip.

The first pair of siagnopoda has the first branch shorter and more quadrate, and the second longer and more spinose.

The succeeding pairs are very similar to those of *Aristeus armatus*.

The first pair of gnathopoda is subpediform, very hirsute at the margins, and carries an extremely long branch attached to the basal joint; the first joint of this branch is very short and simple, the second is multiarticulate and fringed with numerous long fine hairs.

The second pair of gnathopoda is long, slender, and fringed with long stiff hairs, each of which stands on its own protuberance on the inner and lower margin; the dactylos articulates with the propodos so as to attain a right angle only, at which degree two bunches of small curved spinules on the opposed sides, one on the propodos and the

other on the dactylos, come into contact, and acquire a prehensile power; it likewise carries a basal branch, which is very short, being about half the length of the meros or third joint; the first joint of the branch is almost rudimentarily short, and the second is multiarticulate and free from conspicuous hairs.

The first pair of pereopoda is chelate and armed with long stiff hairs, and differs from the second and third in being shorter and more hirsute, and in having, as in the second pair of gnathopoda, two fasciculi of spinous or serrate hairs near the carpal articulation, one bunch being in a depression on the anterior extremity of the flexor side of the carpos, while the other corresponds with it on the posterior extremity of the propodos. This arrangement appears to give prehensile power by the bending of the propodos against the carpos.

The posterior two pairs of pereopoda are long and slender; the posterior most so.

The ventral surface of the pereion (1") is much hidden by the long hairs attached to the coxæ of the legs; the oviducts on the third pair nearly meet in the median line, posterior to which there is a small thelycum and ventral plate much like those of *Hemipenæus tomentosus*.

The first pair of pleopoda is long and single-branched, the inner branch being rudimentary. The others gradually decrease in length; they are biramose, and the smaller branch increases posteriorly, until in the fifth pair the two branches are subequal.

The telson differs from that in the other species of the genus in being fringed with a thick and closely packed row of hairs, intermingled with four small spines on each side. The dorsal surface is flat and slightly grooved, and the sides, deflecting, become suddenly depressed, making on each side an angular longitudinal ridge from the base to the distal extremity.

The branchial arrangement is the same as in the typical species. The oral appendages, and those that belong to the anterior portion of the pereion, are remarkable for the length and rigid character of the hairs that fringe them, whereas the posterior pairs of pereopoda, as well as the pleopoda, are as remarkable for being free from hairs.

Hepomadus, Spence Bate.

Hepomadus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 189, 1881.

Supra-frontal margin of the carapace produced to a rostrum. Latero-frontal margin produced to a tooth that corresponds with the outer margin of the first pair of antennæ, another that corresponds with the second pair of antennæ, and a third over the hepatic region. The pleon is laterally compressed.

The ophthalmopoda stand on a movable somite; they are compressed and carry a small tubercle near the base on the inner margin, and the ophthalmus is scarcely of larger diameter than the peduncle.

The first pair of antennæ stands on a movable somite and has the first joint dorsally excavated to receive the ophthalmopod; it carries a long and pointed stylocerite on the outer margin, and the rudiment of a prosartema, in the form of a tubercle tufted with long hairs, on the inner side; the third joint terminates in two unequal flagella situated remotely from each other, the upper one, arising from the base, is half the length of the peduncle, whereas the lower, which is more slender, is probably as long as the animal, or longer.

The second pair of antennæ carries a broad scaphocerite, as long as the peduncle of the first pair, strengthened by a pointed tooth on the outer margin, and by one on the second joint of the peduncle.

The mandible has a lunate psalisiform margin and a broad molar tubercle, and carries a two-jointed synhipod, the terminal joint of which is laterally excavate.

The third pair of siagnopoda is four-branched; the inner branch is broad, foliaceous and hirsute, the second is three-jointed; the next is foliaceous, narrow, and terminates in a slender point, while the outer is a bifid membranous plate.

The branchiæ are arranged as in the following table:—

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

The rostrum in the single Challenger specimen is broken off, but I am inclined to believe that it corresponds in form to that in *Aristeus*. The outer antennal tooth is larger than in that genus, and there is also a hepatic tooth, which the species of *Aristeus* do not possess.

The ophthalmopod corresponds in form more to that in the genus *Benthesicymus* than in *Aristeus*, whereas the antennæ correspond rather to those of the latter genus.

The mandibles differ in having a larger molar tubercle, and in having the incisive margin simply curved, with a sharp tooth at either extremity, while in *Aristeus* there is a strong tooth in the centre also.

The first pair of oral appendages has the outer branch thin, foliaceous, and produced to a slender point, and in this it corresponds with *Benthesicymus* and differs from *Aristeus*.

The branchiæ differ from both genera in the number of the plumes; in ultimate structure they correspond with those in *Hemipenæus tomentosus* more than with those in either *Aristeus armatus* or *Benthesicymus crenatus*, the types of their respective genera.

Hepomadus glacialis, Spence Bate (Pl. LII.).

Hepomadus glacialis, Sp. B., *loc. cit.*, p. 190.

Rostrum broken off short; the base of a small tooth exists on the dorsal crest just behind the orbital margin. Dorsal surface of the carapace compressed, elevated, and surmounted by a small carina that commences just anterior to the cardiac region and continues to the rostral projection. The inner antennal tooth is well defined, but not so large nor so conspicuous as the outer antennal tooth. The hepatic tooth is large, sharp, and distinct.

The pleon is compressed, and has the third somite posteriorly produced to a well-defined sharp tooth that reaches nearly to half the length of the fourth somite, which is posteriorly produced dorsally to a small tooth, as is also the fifth somite, where it is still smaller. The sixth also carries a small terminal point. The telson is broken near the distal extremity.

The ophthalmopoda project from the lateral extremities of a conspicuous somite and are uniarticulate, slender, flattened dorsally, and have an ophthalmus that is not much broader than the peduncle.

The first pair of antennæ has the stylocerite reaching to the extremity of the first joint and the prosartema thickly tufted with hairs. The upper flagellum is short, about the length of the two last joints of the peduncle; the lower is slender and was probably very long, but is broken off at the length of the carapace.

The second pair is also damaged, the peduncle alone being preserved; the scaphocerite which is broad and foliaceous is strengthened by a ridge on the outer side that terminates in a small sharp tooth; the flagellum is broken off short; a sharp, strong tooth arms the outer side of the second joint of the peduncle, and the first joint or coxa carries a phymacerite on the inner side, just in front of the epistoma, which is produced to a point anteriorly and posteriorly supports the broad and movable cheiloglossa.

The mandible (*d*) has a broad, curved, lunate, incisive margin, and a large, smooth, molar protuberance; the synnhipod is two-jointed, having the second joint shorter than the first and excavated on the inner side.

The two pairs of oral appendages that succeed the mandibles are thin, foliaceous, and resemble those of *Aristeus armatus*, while the next (*g*) differs from that in *Aristeus* in having the outer branch long, and terminating in a slender extremity, and in this respect it resembles more nearly the same appendage in *Benthesicymus crenatus*.

The first pair of gnathopoda is short, subpediform, and consists of six joints. The coxa carries a short and broad mastigobranchia, to which a podobranchial plume is attached; the basis supports a long, slender, two-jointed cephalopod, that is as long as the gnathopod, the first joint being very short and the second multiarticulate: the ischium appears to be confluent with the basis (thus making one joint), and only definable by a

transverse ridge and the marginal lobes which are tufted with hair; the meros is long and broad, stout on the outer side and thin on the inner, which is fringed with hairs; the carpos is short, curved, and stouter at the propodal extremity than at the meral; the propodos is short, being not longer than the carpos, and matted on the inner side with many hairs; the dactylos is stout and blunt-pointed, as long as the propodos, and matted with hairs on the inner side.

The second pair of gnathopoda is seven-jointed, long and slender. The coxa carries a mastigobranchial plate that supports a podobranchial plume, and the basis supports a two-jointed ephysis that is about half the length of the limb; it is two-jointed, one joint being small and the second long and multiarticulate. The ischium is long and narrow, the margins parallel, the inner margin thin and fringed with hair, the outer robust and smooth; the meros is about half the length of the ischium and a little shorter than the carpos, which is rather longer than the propodos and terminates in a straight and pointed dactylos that is half its length, and is movable to the extent of a right angle; it is not armed with impinging spinules at the base, but is excavated and smooth, all the joints being fringed on the inner side with fine hairs.

The two anterior pairs of pereiopoda are similarly formed, the second being longer than the first; all the joints, including the basis and coxa, are smooth, the latter carries a mastigobranchia that supports a podobranchial plume, and the basis carries a small, rudimentary ephysis; the carpos is long and slender, equalling in length the meros and ischium together. The propodos is short, but the pollex is long and slender, equalling in length and resembling in form the long, tapering dactylos, the margins of which are sparsely fringed with a few, short, bristle-like hairs. The third resembles the two preceding pairs in form and general proportions, but differs in being longer and in having on the coxa a large, hirsute protuberance, that is cupped on the outer side, and carries on the inner the foramen opening into the oviducts. The fourth and fifth pairs are long, slender, and simple, terminating in a styliform dactylos; they both carry at the inner side of the coxa a similarly formed tubercle to that of the third pair, and on the ventral surface of the pereion, between the penultimate pair, is a large, anteriorly pointed and posteriorly truncated thelycum (1''); the oviducts lie just beneath the anterior extremity, which covers them until they are exposed by the outward and backward movement of the legs.

The pleopoda are long and slender, the first pair single, and having the second branch in a rudimentary form attached to the basal joint near the middle of the inner surface. The inner branches are throughout smaller than the outer; the outer gradually decrease, while the inner increase, posteriorly.

The plates of the rhipidura are long, tapering, strengthened by longitudinal ridges, and fringed with hairs.

The telson is broken off near the extremity.

Length (female), 196 mm. (7.20 in.).

Habitat.—Station 237, June 17, 1875; lat. 34° 37' N., long. 140° 32' E.; near Yokohama; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One specimen; female.

Hepomadus inermis, Spence Bate.

Hepomadus inermis, Sp. B., *loc. cit.*, p. 190.

Dorsal surface unarmed. Pleon smooth.

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

Length, 100 mm. (4 in.).

Habitat.—Station 289, October 23, 1875; lat. 39° 41' S., long. 131° 23' W.; South Pacific; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·8.

The specimen taken at this station is that which I have previously named *Hepomadus inermis*, because there was no tooth on the dorsal crest or pleon. It is in too imperfect a condition to fully describe its specific characters; the absence of the dorsal armature on the carapace may probably be due to the fracture of the rostrum, but the absence of the large tooth on the third somite of the pleon demonstrates it to be specifically distinct from *Hepomadus glacialis*.

Peteinura,¹ n. gen.

Carapace about one-third the length of the animal, deeper posteriorly than anteriorly, and produced forwards to a long and slender rostrum; armed with a tooth near the outer canthus of the orbit, another posterior to the second antennæ, and others corresponding with the upper margin of the branchial chamber.

The five anterior somites of the pleon are subequal, the sixth is about the length of the four preceding but not half the depth, and carries a pair of pleopoda that has the rami very unequal, the outer being nearly as large as the animal, the other small and rudimentary.

The telson tapers to a sharp point.

The ophthalmopoda are uniarticulate and pyriform.

The first pair of antennæ has a three-jointed peduncle and terminates in two short flagella.

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

The second pair of gnathopoda is pediform, and terminates in a styliform dactylos.

The first, second, and third (?) pairs of pereopoda are imperfectly chelate, the posterior two are simple.

¹ πετεινός, flying, and ουρα, tail.

The first pair of pleopoda is not determinable; the four following are short and biramose.

The branchiæ have not been examined because the specimen is unique and of exceptional character.

I believe the specimen to be an immature form, but in its general appearance it approximates more to that of *Aristeus* than to any other, but when other specimens have been taken and an opportunity has been afforded for an examination of the branchiæ, we shall be in a better position to determine with confidence its natural position in the order.

Peteinura gubernata, n. sp. (Pl. LIII.).

Viewed laterally, the carapace triangulate, posteriorly deep, anteriorly narrow. Rostrum, though broken off at the extremity, is much longer than the carapace, probably nearly as long as the animal, and is spinous or denticulated above, below, and along the sides from base to tip, the smaller teeth being towards the apex and the larger at the base on the upper surface; the posterior two are articulated spines, while all the others appear to be rigid points. One large spine-like tooth stands above the orbital margin, one further in, on the antennal region; six are implanted on the branchial region, three anterior and superior, and three inferior and posterior, of which the posterior is by far the longest.

The pleon has the first five somites subequal in length, the three posterior ones decreasing a little in length and depth. The dorsal surface of each is surmounted with a long spine-like tooth; the posterior margin is furnished laterally with a small tooth halfway between the dorsal and lateral margins; the lateral margin is posteriorly produced to a small point, and the ventral surface in the median line is produced to a short strong tooth, directed infero-posteriorly. The sixth somite is long, narrow and subcylindrical; it is about as long as the four preceding somites combined; the postero-dorsal margin is produced to a large spiniform tooth, broad at the base and acute at the point; at each side of the base is a strong but slender tooth, and the postero-ventral surface is armed with a strong and slender tooth that projects posteriorly between the basal joints of the rhipidura.

The telson is nearly as long as the sixth somite and terminates in a sharp point.

The ophthalmopoda are short and pyriform, the ophthalmus being much broader than the stalk, and the whole organ gradually tapering to the base.

The first pair of antennæ has a three-jointed peduncle, the length of which from the extremity to the base is about half the length of the carapace. The first joint reaches beyond the extremity of the ophthalmopod and is armed on the outer surface near the base with a sharp tooth (stylocerite). The second joint is about one-third the length of

the first, and the third is half the length of the second and supports at its extremity two flagella. The inner branch is the primary and is multiarticulate; the articuli, which are very slender and long at the extremity, become gradually shorter as they approach the base, where, instead of continuing extremely narrow, they coalesce into one bulb-like mass, from which a number of long and slender membranous hair-like organs spring. The outer branch is more slender; if it is formed of more than one articulation, as presumably it is, the divisions between them are not visible.

The oral appendages have not been examined.

The second pair of gnathopoda consists probably of seven joints. The basis and coxa are short and not visible in the mounted specimen; the ischium is moderately long and free from spines; the meros is smooth on the upper margin and armed with five smooth articulated spines on the lower margin; the carpos is longer than the meros, furnished on the upper surface submarginally with several minute spines, and on the lower with seven or eight long and slender spines that stand upon and articulate with a series of prominences like truncated points. The propodos is shorter than the carpos, somewhat irregular in form, the upper surface being waved or bent and the lower strongly tuberculated, each tubercle supporting a strong sharp spine; the upper margin armed with a few stiff hairs or spines which are not elevated on tubercles. The dactylos is half the length of the propodos; it is narrower than the preceding joints, bearing on the upper margin two small, spine-like hairs, and three on the lower, and tipped at the extremity with a long, straight, articulated spine.

The first pair of pereopoda has the lower margin of the ischium fringed with eight or nine strong hairs, springing from small prominences that gradually increase in size anteriorly, and the upper margin with a row of small spines or short hairs which stand on very small eminences, more apparent anteriorly than posteriorly; the meros is half the length of the ischium, and is armed above and below with long spines that stand on well-defined prominences, more especially on the lower margin, where they are also longer than on the upper. The carpos is shorter than the meros, without spines on the upper margin and with only two large and strong ones on the lower. The propodos is short, a little shorter than the carpos; it is armed on the upper surface with four spines standing on tubercles, and with one spine at the anterior margin on a prominent tubercle; immediately behind which is a prominent, smooth-tipped tubercle, that is developed as a pollex, and against which probably when fully developed the dactylos has the power of being flexed. The dactylos is short, narrow, and feeble, and tipped with a long and slender articulated spine.

The second pair of pereopoda I have not fully made out, but the carpos is long, cylindrical, and furnished with a few slender hairs on the upper side near the meral extremity, and anteriorly smooth and free from hairs. The propodos is shorter than the carpos and is at the lower distal extremity produced to a blunt

polliciform process, and armed above it with a long straight spine. The dactylos is less than half the length of the propodos, obtuse at the apex and carrying a long, slender, hair-like spine. The other pereopoda resemble the preceding, except that I could not determine any evidence of a rudimentary chela, and that they appear to lose the spinous character as they proceed posteriorly. The pleopoda, with the exception of the first, which I have not been able to determine, are short and biramose. The posterior pair which helps to form the rhipidura is remarkable, and, I believe, unique; the basal joint is short and is furnished with a tooth on the anterior distal angle, and at the extremity with two branches, one of which is very long, large, broad, and foliaceous; it is narrow at each extremity and wide in the middle, the distal end terminating truncately, and armed at each angle with a small tooth or spine; smaller points or teeth fringe the margins from the apex to the base, and at the base the lateral margins are curled over towards the plate, thus giving strength to the basal portion of the appendage. The inner plate is small, flat, rudimentary, and tipped with a few small hairs.

Length, 25 mm. (1 in.).

Habitat.—Atlantic Ocean; surface (captured at night).

Benthescymus,¹ Spence Bate.

Benthescymus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 190, 1881.

Body smooth. Tissue submembranous. Carapace anteriorly produced on the dorsal surface to a short rostrum, laterally compressed and elevated to a crest. Cervical fossa deeply marked; a strong calcified ridge separates the lateral cardiac from the branchial region.

Posterior somites of the pleon laterally compressed and shorter than the rami of the rhipidura. The telson is narrow, pointed, laterally compressed.

Ophthalmopoda transversely compressed in their whole length, single-jointed; furnished on the inner side with an ocular tubercle. Ophthalmus not broader than the peduncle.

First pair of antennæ has the first joint of the peduncle excavated to receive the ophthalmopod, armed on the outer margin with a stout stylocerite, but without a prosartema on the inner; the two succeeding joints are short, and the terminal one supports two long flagella articulating at the extremity, the upper and outer being more robust than the inner and lower.

The second pair of antennæ supports on the inner side of the first or coxal joint a well-developed phymacerite; the second joint carries a large, broad, and foliaceous scaphocerite, strengthened on the outer margin by a rigid rib that terminates in a small tooth or point; the third joint supports on the inner distal side a small, hook-like,

¹ *Βενθίσκυμος*, an inhabitant of deep water.

calcified process (ancecerite) that is lodged in a depression on the under surface of the first antennæ; the fifth joint of the peduncle coalesces rather than articulates with the fourth, and supports a long and slender flagellum.

The epistoma is anteriorly produced to a rostriform point, and the cheiloglossa has the labial portion short and divided into two lobular processes that do not cover the mandibles; the glossal division is reduced in size and unimportant.

The mandibles are large, powerful, and carry a two-jointed foliaceous synphipod, the first joint being broad, and the second narrow and pointed; the right mandible has a more obtuse cutting edge than the left, and they overlap each other instead of impinging at their margins. The metastoma consists of two membranous, subfoliaceous, rounded plates.

The rest of the oral appendages correspond in form with those of *Aristeus* rather than with those of *Penæus*.

The first pair of gnathopoda is subpediform and carries a long basephysis, the three terminal joints being permanently flexed upon the preceding one, and the ultimate terminates in two or three apical teeth.

The second pair of gnathopoda is pediform, carries a long basephysis, and terminates in a sharp-pointed dactylos. Both gnathopoda support well-formed mastigobranchial plates, which are furnished with large podobranchial plumes.

The three anterior pairs of pereopoda are chelate, slender, and increase in length posteriorly; the two succeeding ones are still longer, more slender, and terminate in simple dactyli. Each pereopod carries a small basephysis that becomes gradually less important posteriorly until it becomes rudimentary. The coxa, from the first gnathopod to the penultimate pair of pereopoda, supports a large and well-formed mastigobranchial plate that increases in length and size, and each, except the posterior, supports a well-developed podobranchial plume that also increases posteriorly. The general arrangement of the branchiæ is shown in the following table:—

Pleurobranchiæ,	.	.	.	...	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	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 pleopoda are extremely long, and all, except the first pair, are biramose in both sexes. In the male the basal joint of the first pair carries a membranous leaf-like petasma, which in the female is reduced to a rudimentary condition, and the sixth pair is modified to form the outer plates of the rhipidura, which are long, ovate, and lanceolate at the extremity. The outer plate is strengthened by a double marginal rib, terminating in a sub-apical tooth, that coincides with the traces of an obsolete diæresis.

This genus differs considerably from *Penæus* in the consistency of the general surface, which is soft and yielding, and more like flexible membrane than the shell of a crustaceous animal. The only rigid parts are the appendages and the caudal extremity.

The species of this genus may generally be recognised by the character of the rostral crest, which is shorter than in either *Penæus* or *Aristeus*. The form of the ophthalmopod also differs; it is flattened and two-jointed in *Penæus*, cylindrical and single-jointed in *Aristeus*, and single-jointed and flattened in *Benthesicymus*, where it also carries a tubercle similar to that in *Aristeus* and other genera. Owing to the semitransparent character of the superficial tissue in *Benthesicymus* I have been able to determine that this tubercle is a rudimentary, or rather a complementary, eye, a branch of the optic nerve leading directly to it from a ganglion situated within the base of the ophthalmopod.

The first pair of antennæ approximates to that of *Penæus* in its general form and in the arrangement of the flagella, but the prosartema is wanting, and in this respect it approaches *Aristeus*, to which genus also it seems allied by the form of the second pair of antennæ and the oral appendages.

The three anterior pairs of pereopoda are moderately robust, and the two posterior pairs are long and feeble, and probably of little use as organs of active locomotion.

The pleopoda are long and powerful organs and resemble those of *Aristeus* rather than of *Penæus*, and the rhipidura is well developed and comparatively large.

Geographical Distribution.—The genus evidently consists of species of natatorial habit, chiefly inhabiting the depths of the sea, although its closely allied congener, *Gennadas*, has been captured in towing nets within 500 fathoms of the surface.

Females of *Benthesicymus crenatus* were taken in the Pacific Ocean near the Marquesas Islands and the Low Archipelago, at a depth of about three miles. Female specimens of *Benthesicymus altus* were obtained near Torres Strait at little under two miles from the surface; but those that I believe to be the males of this species were taken in the Pacific in about 500 fathoms, off the Kermadec Islands; north of New Zealand; south of the Celebes, and off the southern shores of Japan. A male specimen of a species differing from the preceding in minute details, that I have named *Benthesicymus brasiliensis*, is recorded from the South-Western Atlantic at a depth of 1900 fathoms, with a bottom temperature of 33°·1 Fahr., or only 1°·1 above freezing point, while a near variety was taken at 2440 fathoms, or about three miles from the surface of the ocean, off the north-western extremity of the Australian continent, and off the western side of New Zealand at 1100 fathoms, and another amongst the narrow channels of the Philippine Islands at 1050 fathoms, and again off the Fiji Islands in about 315 fathoms.

Specimens of *Benthesicymus pleocanthus* were taken at 1050 fathoms, off the northern extremity of the Philippine Islands, and also in the same parallel of latitude in the

middle of the North Pacific Ocean. An imperfect specimen of what appears to be the same species was taken off the island of Sombrero, in the West Indies, at a depth of 450 fathoms. *Benthesicymus iridescens*, which approaches in form the genus *Gennadas*, was secured in 1900 fathoms, near the island of Tristan da Cunha, in the South Atlantic Ocean.

Thus, as will be more fully shown in that part of this Report dealing with the General Distribution, all the species, with the exception of *Benthesicymus altus*, were taken at a greater depth than 1000 fathoms. One specimen of *Benthesicymus brasiliensis* was taken near the Fiji Islands, at 315 fathoms, but this was probably a migrant from the deeper waters of the Eastern Pacific; one specimen of *Benthesicymus altus* was taken at 1400 fathoms, but that was in a deep ravine between two banks, where the water becomes shallow from the ocean towards Torres Strait, and another at 1900 fathoms in the South Atlantic.

In the nearly allied genus *Gennadas* a similar bathymetrical distribution is found; specimens were taken at six stations, where the depth was greater than 1000 fathoms, and at two where the depth was 345 and 565 fathoms respectively.

All the specimens of the two genera recorded from thirty stations were taken by the trawl, with the exception of those at Stations 23, 45, 173 and 214, where the dredge alone was used, and Station 232, where both dredge and trawl were employed. At Station 267 the depth is given as 2700 fathoms, but the specimen is labelled as having been captured in the towing net, which was sent down to 2000 fathoms, and therefore did not reach the bottom by some 700 fathoms. The fact that the specimens were captured more abundantly by the trawl than by the dredge seems to suggest that they are free-swimming animals and that their most frequented home is at some distance from the sea bottom. This appears, moreover, to receive support from the feeble condition of the pereopoda and the powerful natatory character of the pleopoda.

Most of the specimens, excepting those of *Benthesicymus altus*, were brought up in a soft, pulpy, and collapsed condition.

Benthesicymus crenatus, Spence Bate (Pls. LIV., LV.).

Benthesicymus crenatus, Sp. B., *loc. cit.*, p. 190.

Rostrum short, sharp pointed, laterally compressed, dorsally crested, and armed with three small teeth on the crest and one immediately posterior to it.

Posterior margin of the fourth somite of the pleon evenly crenated. Fifth somite produced posteriorly to a small sharp tooth.

Marginal tooth of the outer branch of the rhipidura not situated at the extremity.

Telson half the length of the rhipidura, tapering, unarmed and fringed with hairs.

Length (female), 200 mm. (8 in.).

Habitat.—Station 272, September 8, 1875; lat. $3^{\circ} 48' S.$, long. $152^{\circ} 56' E.$; north of the Low Archipelago; depth, 2600 fathoms; bottom, Radiolarian ooze; bottom temperature, $35^{\circ} 1.$ One specimen. Trawled.

Station 276, September 16, 1875; lat. $13^{\circ} 28' S.$, long. $149^{\circ} 30' W.$; near the Low Archipelago; depth, 2350 fathoms; bottom, red clay; bottom temperature, $35^{\circ} 1.$ Two specimens were taken; one a female 150 mm. (6 in.) in length, the other about 75 mm. (3 in.), apparently a female also. Trawled.

The external tissue is thin, soft and submembranous in structure.

Carapace furnished with a short, sharp-pointed rostrum, which is laterally compressed, elevated above the orbit to a crest armed with three small teeth and one behind it; inferior margin ciliated. Dorsal carina lost at the cervical fossa, scarcely visible over the gastric region, but reappears slightly over the cardiac. Cervical fossa deep; a slight groove divides the cardiac region into two portions, and the branchial region is defined by a strong elevated ridge, which is lost anteriorly in the hepatic sulcus, which is furnished with a short stout tooth. There is no distinct orbit, and no orbital tooth, but there is a small antennal tooth, and a smaller one below it on the frontal margin.

The pleon is dorsally smooth and even, but laterally compressed posterior to the third somite. The fourth somite is carinated in the median line and posteriorly projected in the form of a small tooth; and has the posterior margin more evenly crenated than shown in the plate. The fifth somite is carinated in its entire length, and terminates in a small sharp tooth; the posterior margin of the somite is smooth and even. The sixth somite is more distinctly crested, and terminates in a small tooth.

The telson is long and pointed, dorsally flat, and has the sides compressed.

The ophthalmus is borne on a moderately long, club-shaped, single-jointed ophthalmopod (Pl. LIV., *a*), which is curved, compressed, and fits into a hollow on the outer and upper surface of the first joint of the first antenna.

The first pair of antennæ (*b*, *b''*) has the first joint short, not longer than the ophthalmopod, and armed on the outer margin with a short robust stylocerite, between the base of which and the anterior margin is an oblique hollow in which the ophthalmopod is lodged. The second and third joints are scarcely equal in length to the first; the third bears two long flagella, the extremities of which are broken, so that their length cannot be determined.

The second pair of antennæ (*c*) carries a large scaphocerite that extends to more than twice the length of the peduncle of the first pair, and is armed with a sharp subapical tooth on the outer side, and the second joint of the peduncle is furnished on the inner distal angle with a strong ancecerite (*c''*).

The mandibles (*d*) are large, and have a two-jointed synhipod, the first joint of which is large, broad, and foliaceous, and the second narrow, long, and subfoliaceous. The

psalisiform margin is thick and smooth, and the left blade locks within the right. Anterior to the mandibles a large triangulate cheiloglossa is connected with a raised and anteriorly-directed epistoma. Posterior to the mandibles are the metastomata, a pair of membranous, pear-shaped, subfoliaceous appendages.

The first pair of siagnopoda (*e*) is three-branched; the first two branches are foliaceous, and broad at the extremity, where they are fringed with short spines; the third or outer is lunate, subfoliaceous, and terminates in a point.

The second pair of siagnopoda (*f*) consists of three foliaceous branches; the first two are biramose, the extremity of each branch being fringed with short, thick-set hairs, and the third is short, somewhat rigid and pointed; at the base is attached a broad, foliaceous mastigobranchial plate that projects both anteriorly and posteriorly and is fringed with hairs.

The third pair of siagnopoda (*g*) consists of three branches, of which the first or inner branch is broad, thick, ovate at the apex and fringed with hairs on the inner margin. The middle branch is three-jointed; the last joint is very small, the penultimate broad, and the first long, and from its base there springs a membranous branch, the extremity of which tapers and becomes thread-like; from the coxa arises a broad, divided, mastigobranchial plate, one portion of which is directed forwards, and the other posteriorly.

The first pair of gnathopoda (*h*) is seven-jointed; the coxa is short and carries a saccular, membranous, mastigobranchial plate, to the base of which a large podobranchial plume is attached; the basis is short and carries a long filiform ecpysis; the meros is long, broad, stout on the outer and thin on the inner side, which is fringed with hairs; the carpos is short, triangulate, and narrow at the meral articulation. The propodos is broader than the carpos, and the dactylos is short, ovate, and not unguiculate. The three distal joints lie folded back on the inner surface of the meros.

The second pair of gnathopoda (*i*) is pediform; the coxa is short and carries an ovate, pedunculated mastigobranchial plate, to which a branchial plume is attached; the basis is short and carries a filiform ecpysis, not so long proportionally as that of the first pair; the ischium is narrow and longer than the meros, which equals the carpos and propodos in length, while the dactylos is short, curved, having the margins fringed with hairs, and the extremity flattened and distally rounded, tipped with a small, curved, sharp, unguis.

The three anterior pairs of pereopoda are slender and chelate, of these the first pair is the shortest and the third the longest. The fourth pair is longer and more slender than the third, and terminates in a styliform dactylos. It likewise carries a mastigobranchia, but unlike those of the preceding pairs it has no podobranchial plume attached. The posterior pair of pereopoda is extremely long and very slender, and terminates in a styliform dactylos, but it carries no mastigobranchial plate or podobranchial plume.

The first pair of pleopoda in the female is single-branched, the ramus being long and tapering to a filamentous extremity, and supported on a stout basal joint, near the base of which on the inner side there is a rudimentary membranous appendage. The second

pair resembles the first in general form, but it has the second or anterior branch in the form of a small and slender filament attached to the anterior distal extremity of the basal joint. The three succeeding pairs resemble the second; the anterior branch gradually increases in size with each succeeding pair, and in the last two the anterior is subequal to the posterior branch. The sixth pair of pleopoda, which helps to form the rhipidura, has the outer branch longer than the inner, and is armed on the outer margin with a sharp subapical point that corresponds with the outer extremity of the obsolete diæresis; the inner branch is ovate, unarmed, and longer than the telson.

The description is drawn up from the female taken at Station 272.

Benthesicymus brasiliensis, Spence Bate (Pl. LVII. fig. 1).

Benthesicymus brasiliensis, Sp. B., *loc. cit.*, p. 191.

Rostrum short, flattened laterally, pointed, crest dorsally armed with two teeth and the carina produced posterior to the cervical fossa, gradually decreasing and finally disappearing before it reaches the posterior margin of the carapace. Pleon compressed posteriorly. Third, fourth, and fifth somites with dorsal median ridge, posteriorly produced to a small tooth, the sixth somite furnished with a distinct carina, but not posteriorly produced to a tooth.

Telson dorsally flattened, laterally compressed, terminally pointed, and marginally fringed with hairs, rather more than half the length of the outer branch of the rhipidura.

Length—male, 127 mm. (5 in.); female, 152 mm. (6 in.).

Habitat.—Station 323, February 28, 1876; lat. 35° 39' S., long. 50° 47' W.; east of Buenos Ayres; depth, 1900 fathoms; bottom, blue mud; bottom temperature, 33°·1. Four specimens; two males and two females; one of each half-grown and one full-sized. Trawled.

Station 168, July 8, 1874; lat. 40° 28' S., long. 177° 43' E.; off New Zealand; depth, 1100 fathoms; bottom, blue mud; bottom temperature 37°·2. Two females, half-grown. Trawled.

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. One male, full grown. Dredged.

Station 181, August 25, 1874; lat. 13° 50' S., long. 151° 49' E.; between Australia and the Solomon Islands; depth, 2440 fathoms; bottom, red clay; bottom temperature, 35°·8. One male, half-grown. Trawled.

Station 184, August 29, 1874; lat. 12° 8' S., long. 145° 10' E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·0. Three females and one male. Trawled.

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

The external tissue is soft and membranous.

The rostrum is short, and tapers rather suddenly to a sharp point. The crest is narrow, armed with two small teeth, and the carina can be traced to very nearly the posterior margin of the carapace. The dorsal surface of the pleon is smooth until the third somite, where a small carina commences, which culminates in a small but distinct tooth in the median line of the posterior margin of the third, fourth, and fifth somites, and increases to a distinct carina on the sixth somite, terminating abruptly on the posterior margin.

The telson is dorsally flattened, laterally compressed, tapering, and armed on each side with three small spinules; the last two are subapical, and between them are two others.

This species is exceedingly like *Benthesicymus altus*, but may at once be distinguished from it by the soft membranous condition of the external tissues, the presence of the small tooth on the posterior margin of the three somites preceding the last, and the absence of the transverse elevation of the posterior margin of the sixth somite.

The ophthalmopod is obliquely flattened, soft, and flexible, and is furnished near the middle of the inner margin with a very decided blunt tubercle, with a single lens.

The ophthalmus is orbicular, equal in breadth to the greatest diameter of the flattened stalk, and of a yellowish-white colour; a little dark pigment lies at its base near the centre. The ophthalmopod reaches as far as the extremity of the rostrum and equals the stylocerite in length.

The first joint of the first pair of antennæ extends a little beyond the extremity of the eye, and is armed on the outer side with a stylocerite that is large and flattened on the outer side, and has no tooth on the distal angle, but is reduced to a mere point at the extremity. The next two joints are short and terminate in two long, rather rigid, multiarticulate flagella.

The second pair carries a long and broad scaphocerite that terminates in an ovate extremity, and is strengthened by a median rib and an external ridge that ends in a small tooth considerably short of the extremity; on the inner side of the coxal joint is a small phymacerite, and on the upper side of the third joint of the peduncle a small, rigid, fixed hook (ancecerite); it terminates in a long and slender flagellum.

The other appendages may be compared with those of *Benthesicymus altus*.

The pereiopoda, especially the chelate pairs, are long and more slender. The ventral surface of the pereion, in the female, is thickly matted with hairs; the oviducts are large and come into contact with those on the opposite side; between the fourth pair is an ovate thelycum directed anteriorly, behind which the surface is small and smooth, and there is no tooth or tubercular process between the first pair of pleopoda.

The first pair of pleopoda in the female is similar to that in *Benthesicymus altus*. In the male the petasma is moderately large, pear-shaped, and carries a marginal process on the outer side. The second pair has two rami, one long, the other very short and slender, and at its base a small scale-like plate. All the others are similar in both sexes,

and the rhipidura much resembles that in *Benthesicymus altus*, except that the telson is scarcely as long in proportion.

The larger specimens of this species were taken off Brazil. Some were taken at the western side of Torres Strait, but these were all smaller, and close examination shows that they differ in the unimportant character of having no tooth on the posterior margin of the third somite of the pleon, and the thelycum on the ventral surface of the pereion is rather more conspicuous. These were taken at a depth of rather more than two miles and a half, where the temperature was 4° above freezing point; the bottom where specimens were taken was unlike in character; in two localities it was blue mud, in one it was red clay, in one it was coral mud, and in one *Globigerina* ooze.

Benthesicymus pleocanthus, n. sp. (Pl. LVII. fig. 2).

Surface membranous. Rostrum short, pointed, crest armed with two teeth, the anterior of which is the smaller. Cervical fossa clearly defined, but not deep. Pleon with the posterior somites laterally compressed, and the dorsal surface of the fifth somite posteriorly produced in the median line to a laterally compressed tooth, which nearly equals the somite in length. The sixth somite is deep, and carries a distinct but not high ridge in the median dorsal line. The telson tapers to a point, is smooth at the sides, and quite half the length of the outer branch of the rhipidura.

Length, 76 mm. (3 in.).

Station 23, March 15, 1873; lat. 18° 24' N., long. 63° 28' W.; off Sombrero Island; depth, 450 fathoms; bottom, Pteropod ooze. One specimen, female; evidently that from which Suhm's figure was taken. Dredged.

Habitat.—Station 205, November 13, 1874; lat. 16° 42' N., long. 119° 22' E.; Philippine Islands; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. Two specimens, one male and one female. Trawled.

Station 250, July 9, 1875; lat. 37° 49' N., long. 166° 47' W.; North Pacific Ocean; depth, 3050 fathoms; bottom, red clay; bottom temperature, 35°. Two specimens, both males. Trawled.

The specimens taken at both Stations differ in the position of the large dorsal tooth on the fifth somite of the pleon. In the males, of which there are three, it stands near the middle of the somite, in the fourth, which is a female, it stands on the posterior margin, but this variation in position appears to depend more upon the recession of the dorsal portion of the posterior division of the somite than upon any alteration in the dorsal tooth. In the males also the small patch of black pigment is situated as a spot near the middle of the ophthalmopod and distant from the base of the ophthalmus, while in the female it traverses the ophthalmopod from the eye to the base in an undefined mass.

The accompanying figure is slightly reduced from a drawing of this specimen made by Suhm when the animal was fresh, and was probably the first specimen ever captured of this genus. It has a small prominence on the middle of the fifth somite of the pleon (more clearly represented in the author's drawing than in the woodcut), which evidently

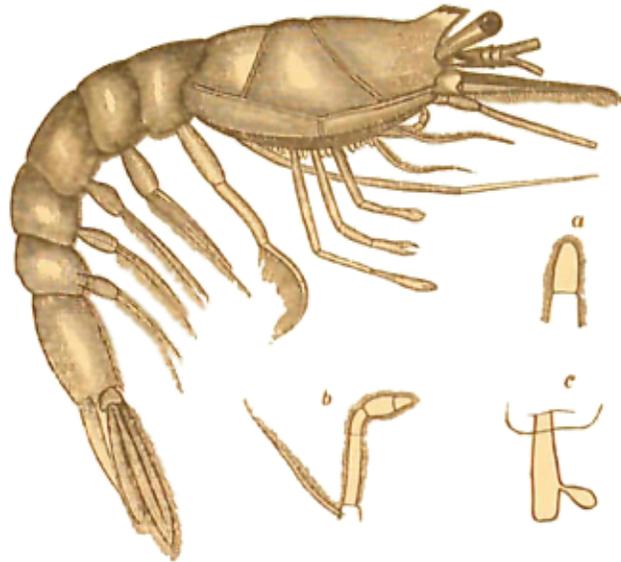


FIG. 48.—“Decapoden. $\times 2$ nat. size, male specimen. Journal 28th of April 73, No. 2. Close to Sombrero, W. I., 450 fathoms, 15 March 73, nat. size 80 mm.; a, mandible; b, 3d maxilliped; c, 1st joint of first pair of abdominal feet with small leaf-formed appendage at the inner side.” MSS. Willemoes-Suhm. Reduced one-third.

is the remains of the long spine-like tooth characteristic of this species, and in all other respects it appears to correspond closely with the eastern specimens. Although it is the only specimen recorded from the Atlantic, yet since it is represented in the Pacific and Eastern Archipelago we may assume it to be as freely distributed as some of the allied species.

Benthescicymus iridescens, Spence Bate (Pl. LVI. figs. 1, 2; Pl. LVII. fig. 3).

Benthescicymus iridescens, Sp. B., Ann. and Mag. Nat. Hist., *loc. cit.*

Rostrum short, pointed, but not sharply, laterally compressed, dorsally crested, armed with one small tooth rather behind the orbital margin, and a small point indicative of another tooth on the gastric region. There is no tooth on the dorsal surface of the pleon, the posterior margin of the fourth somite of the pleon is smooth, and the telson nearly as long as the inner ramus of the rhipidura.

The ophthalmopod is longer than the rostrum and terminates bluntly, carrying two unequal flagella.

The first pair of antennæ has the first joint of the peduncle a little longer than the ophthalmopod; the stylocerite is scarcely so long, but reaches nearly as far as the

extremity of the ophthalmopod. In most other respects the species resembles *Benthescycymus brasiliensis*.

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

Habitat.—Station 133, October 11, 1873; lat. 35° 41' S., long. 20° 55' W.; in the South Atlantic, near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Two specimens; the larger is a male, the smaller, which is a female about 50 mm. in length, is more slender, but I take it to be a younger specimen of this species. Trawled.

Benthescycymus altus, Spence Bate (Pl. LVIII. fig. 1).

Benthescycymus altus, Sp. B., *loc. cit.*, p. 191.

Rostrum short, compressed, thin, apex styliform, crest armed with two teeth and terminating at the cervical fossa, which is clearly marked. The posterior three somites of the pleon are much compressed, and the last is dorsally furnished with a small but decided carina. The males are like the females, but with the dorsal ridge on the fifth and sixth somites produced to a minute tooth at the posterior extremity. Telson half the length of the outer branch of the rhipidura, sides laterally compressed, posterior half armed with three small distant spines.

Habitat.—Station 184, August 29, 1874; lat. 12° 8' S., long. 145° 10' E.; between Australia and New Guinea; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. One specimen, associated with a smaller one closely resembling *Benthescycymus brasiliensis*. Trawled.

Length (female), 120 mm. (4·75 in.).

Station 214, February 10, 1875; lat. 4° 33' N., long. 127° 6' E.; south of the Philippines; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Three males. Dredged.

Length, 63 mm. (2·5 in.).

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°. 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. Numerous specimens. Trawled.

Station 174c, August 3, 1874; lat. 19° 7' 50" S., long. 178° 19' 35" E.; off Kandavu, Fiji; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. A sickly-looking specimen, destitute of scaphocerite and rostrum. Trawled.

Station 205, November 13, 1874; lat. 16° 42' N., long. 119° 22' E.; Philippine Islands; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°·0. One female. Trawled.

Station 232, May 12, 1875; lat. $35^{\circ} 11' N.$, long. $139^{\circ} 28' E.$; off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, $41^{\circ} \cdot 1$. Trawl and dredge both used.

Station 235, June 4, 1875; lat. $34^{\circ} 7' N.$, long. $138^{\circ} E.$; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, $38^{\circ} \cdot 1$. Four specimens; three males, one female. Trawled.

Station 133, October 11, 1873; lat. $35^{\circ} 41' S.$, long. $20^{\circ} 55' W.$; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, $35^{\circ} \cdot 4$. Three male specimens. Length, largest, 85 mm. (3.4 in.); smallest, 41 mm. (1.6 in.). Trawled.

The external tissue is more firm and rigid than usual in this genus. The rostrum is short and pointed, tapering slenderly; crest thin and armed with two small teeth; carina terminating at the anterior margin of the cervical suture, posterior to which the dorsal surface is smooth and even, excepting for a slight carina which commences on the posterior half of the fifth somite, culminates in a small but distinct carina on the middle of the sixth, and is finally lost before it reaches the posterior margin, which is transversely elevated. The telson (fig. 1z) is dorsally flattened and laterally compressed, tapering slightly, and armed with three small spines on each side, the first of which is just beyond the middle, and the last subapical; the spaces between the teeth are fringed with hairs.

This species is very like *Benthesicymus brasiliensis*, but may easily be distinguished by its being more slender, by the firmness and rigidity of the external tissue, by the absence of any teeth on the dorsal surface of the pleon, and by the peculiar transverse elevation of the posterior margin of the sixth somite.

The ophthalmopod (fig. 1a) is flattened, membranous and flexible, and is furnished on the inner margin near the base with a small tubercle; it reaches to the extremity of the rostrum, but falls short of that of the stylocerite; it is of a yellowish-white colour, with a transverse line of dark pigment across the base. The ophthalmus is orbicular, and of about the same diameter as the greatest breadth of the stalk.

The first pair of antennæ has the first joint of the peduncle scarcely longer than the ophthalmopod; it is armed on the outer side with a strong sharp stylocerite, that reaches to nearly the extremity of the joint, the outer angle of which is armed with a strong tooth. The second and third joints are short, subequal, and distally support two long flagella, the multiarticulation of which is very marked.

The second pair of antennæ supports a long scaphocerite, slightly tapering until beyond the external marginal tooth, which falls considerably short of the distal extremity; the flagellum is long and slender, more slender than the smaller flagellum of the first pair.

The metope is flat and smooth, and the epistoma projects over it in the form of an angular rostrum.

The synphipod of the mandibles has both the joints tolerably broad, flat and strong.

The second pair of gnathopoda is long and robust, reaching beyond the extremity of the peduncle of the first pair of antennæ, and terminating in a small, compressed, curved dactylos; it is thickly fringed with hairs and carries a long, slender basephysis; like the pereopoda it has no tooth at the base.

The first pair of pereopoda is short and moderately strong, and each succeeding pair increases in length and becomes more slender, so that the last two pairs are exceedingly long and slender.

On the ventral surface of the pereion there is an orange-coloured, discoid mass between the coxæ of the fourth pair of pereopoda, immediately posterior to the extremity of the projecting processes on the third pair of pereopoda that carry the oviducts, while the surface between, and posterior to the last pair of pereopoda, is smooth and even as far as the median line between the first pair of pleopoda, where there arises a large, laterally compressed, anteriorly pointed and posteriorly curved tooth.

The first pair of pleopoda is long, slender, and single-branched; a rudimentary membranous petasma exists on the inner side of the basal joint. All the other pleopoda are biramose, the outer or posterior branch being long, and the inner one short; they gradually decrease in length but gain in equality posteriorly. The posterior pair forms the branches of the rhipidura. The outer is much longer than the inner, and the inner is much longer than the telson, and is leaf-like and partly strengthened by a rib in the median line; the outer is ovate, and strengthened by a rib that meets the outer margin considerably short of the distal extremity.

The branchiæ are of generic value, but differ a little in the relative proportions of the several plumes. The pleurobranchiæ are small but increase in size posteriorly, yet the last, although the longest, is not a large or important appendage. The arthrobranchiæ are large and overlap each other, except in the last pair, where there is no podobranchial plume, whereas a long and well-developed podobranchial plume is attached to every mastigobranchia except that which belongs to the penultimate pair of pereopoda. The mastigobranchiæ are all thick and fleshy, and have the surface marked with numerous straggling hairs.

Thus there are seven pleurobranchiæ, twelve arthrobranchiæ, five podobranchiæ, and six mastigobranchiæ, the tendency of which is to increase in size posteriorly.

About fifty miles south of Japan, just where the water rapidly deepens from a hundred fathoms to between three and four thousand, four specimens were taken; three of them were males, about half the size of the female, and had the eyes in one instance dark brown all over, while in the others the brown pigment affected only the base of the eye, but to a greater extent than in the specimen described. The bottom was green mud, and the temperature was 2°·1 higher than at Station 184. At the eastern entrance of Torres Strait, it was taken with the trawl in a deep ravine between the hundred fathom areas that surround the New Guinea and Australian coasts, being the deepest water in which this species has been taken.

Benthesicymus mollis, n. sp. (Pl. LVIII. fig. 2).

This species very closely resembles *Benthesicymus brasiliensis*, so much so that I considered it to be that species, until I examined the structure of the branchial plumes and found them to have the ultimate lobes both broader and shorter. The telson (fig. 2z) which is partially damaged in the specimen taken as the type, is deeply grooved dorsally to the anterior extremity.

The texture of the external surface is extremely thin and soft, as in most specimens of this genus.

Length, 76 mm. (3 in.).

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. Trawled.

Gemadas, Spence Bate.

Gemadas, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 191, 1881.

Resembles *Benthesicymus*, but differs in having the dactylos of the second pair of gnathopoda spatuliform, instead of cylindrical and sharp. The rostrum is short, laterally compressed and dorsally crested. The ophthalmopod is flattened and carries a large tubercle or complementary eye on the inner margin. The first pair of antennæ is about half the length of the carapace and has the second and third joints broad. The first joint is deeply excavated to receive the eye, and the terminal joint articulates with the second at the inferior angle only, and carries two long flagella of unequal diameter. The second pair of antennæ is long and slender, and carries a large scaphocerite that gradually narrows towards the distal extremity.

The mandibles carry a two-jointed synniphopod of which the first joint is broad and ovate, and the second narrow.

The first pair of gnathopoda is short and has the meros broad and squamiform.

The second pair is seven-jointed, long and narrow, and terminates in a spatuliform dactylos.

The first pair of pereopoda is chelate, short and robust. The second is chelate, long and stout. The third is still longer and rather slender, and the two posterior are long, slender and feeble.

Both pairs of gnathopoda carry a mastigobranchial plate and a podobranchial plume, two arthrobranchiæ, and a small pleurobranchia. The mastigobranchiæ are rudimentary in their proportions, but become slightly larger on the penultimate pair of pereopoda, where there is no podobranchial plume, and are altogether absent from the ultimate pair of pereopoda, as also are the arthrobranchiæ, the pleurobranchial plume alone being retained.

The branchial arrangement consists of a series of evenly ranged branches disposed in pinnate fashion on each side of a central stalk, like the leaves of an ash tree, each lateral branch closely representing the whole plume, and increasing in size as they approach the base, the leaflets becoming changed from a cylindrical to a foliaceous condition (Pl. LIX., *Br*).

The several plumes fill the branchial chamber and may be formulated as in the following table:—

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

The bathymetrical range of the genus is from 300 to 3050 fathoms; it was chiefly got from the greater depths, and the animals are undoubtedly natatorial in habit and probably never rest upon the bottom of the ocean.

Gennadas is very closely allied to *Benthesicymus* but must be considered a distinct genus. It may be most readily distinguished by the form of the dactylos of the second pair of gnathopoda, and by having only one tooth surmounting the crest, but most especially by the more simple character and ultimate structure of the branchial plumes, and by the rudimentary condition of the mastigobranchial plates.

Geographical Distribution.—Species of this genus appear to be very generally distributed in the ocean at an average depth of about 2000 fathoms. But two of the three instances in which they were got in comparatively shallow water were at localities near the border line to the south of Japan, where the bottom rapidly dips from 100 to 1000 fathoms, and the other, in the Chinese Sea, was under similar conditions. It may be that at certain periods the animals ascend to a warmer stratum of water to deposit their ova.

Although the specimens are far from abundant (only in two instances have more than solitary specimens been taken, and then only three and four respectively), yet they have been found in the North and South Atlantic Oceans, near both the Old and New Continents, in the middle of the North and South Pacific, as well as near the coasts of Japan and China, in the Indian Ocean, and south of Australia.

Gennadas parvus, Spence Bate (Pl. LIX.).

Gennadas parvus, Sp. B., *loc. cit.*, p 192.

Rostrum short, laterally compressed, thin, apex pointed, crest armed with one tooth, Cervical fossa not deep. Posterior somites of the pleon laterally compressed, dorsal surface without a carina, but the posterior somite showing a median line or low ridge. Telson short, scarcely half the length of the outer branches of the rhipidura.

Habitat.—Station 230, April 5, 1875; lat. $26^{\circ} 29' N.$, long. $137^{\circ} 57' E.$; south of Japan; depth, 2425 fathoms; bottom, red clay; bottom temperature, $35^{\circ} \cdot 5$. Trawled.

Length of adult male, 30 mm. (1.25 in.).

Station 45, May 3, 1873; lat. $38^{\circ} 34' N.$, long. $72^{\circ} 10' W.$; off the mouth of the Delaware; depth, 1240 fathoms; bottom, blue mud; bottom temperature, $37^{\circ} \cdot 2$. Dredged.

Length (male), 25 mm. (1 in.).

Station 101, Aug. 19, 1873; lat. $5^{\circ} 48' N.$, long. $14^{\circ} 20' W.$; off Sierra Leone; depth, 2500 fathoms; bottom, blue mud; bottom temperature, $36^{\circ} \cdot 4$. Trawled.

A specimen was taken (fig. 2) rather more than 1 inch in length, that had been attacked by a worm that appears to be related to *Gordius*. There is nothing to show whether it was killed by the worm or only attacked after death. The structure of the external tissue is soft and submembranous, but the regions on the carapace are clearly marked.

Station 120, September 9, 1873; lat. $8^{\circ} 37' S.$, long. $34^{\circ} 28' W.$; off Pernambuco; depth, 675 fathoms; bottom, red mud. Trawled.

Length (male), 46 mm. (1.8 in.).

Station 159, March 10, 1874; lat. $47^{\circ} 25' S.$, long. $130^{\circ} 22' E.$; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, $34^{\circ} \cdot 5$. Trawled.

Station 206, January 8, 1875; lat. $17^{\circ} 54' N.$, long. $117^{\circ} 14' E.$; west of Manila, Philippines; depth, 2100 fathoms; bottom, blue mud; bottom temperature, $36^{\circ} \cdot 5$. Trawled.

Length (female), 32 mm. (1.25 in.).

Station 220, March 11, 1874; lat. $0^{\circ} 42' S.$, long. $147^{\circ} E.$; north of New Guinea; depth, 1100 fathoms; bottom, Globigerina ooze; bottom temperature, $36^{\circ} \cdot 2$. Three specimens, females. Trawled.

Length of largest, 25 mm. (1 in.).

Station 232, May 12, 1875; lat. $35^{\circ} 11' N.$, long. $139^{\circ} 28' E.$; south of Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, $41^{\circ} \cdot 1$. Four specimens; two males and two females. Trawl and dredge were both used, but by which taken is not recorded.

Length, 50 mm. (2 in.).

Station 235, June 4, 1875; lat. $34^{\circ} 7' N.$, long. $138^{\circ} E.$; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, $38^{\circ} \cdot 1$. Trawled.

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

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

Length, 52 mm. (2 in.).

Station 250, July 9, 1875; lat. $37^{\circ} 49' N.$, long. $166^{\circ} 47' W.$; mid-ocean, North Pacific; depth, 3050 fathoms; bottom, red clay; bottom temperature, $35^{\circ} \cdot 0$. Trawled.

Station 267, August 28, 1875, lat. $9^{\circ} 28' N.$, long. $150^{\circ} 49' W.$; mid-ocean, North Pacific; depth, 2700 fathoms; bottom, Radiolarian ooze; bottom temperature, $35^{\circ} \cdot 0$.

Station 289, October 23, 1875; lat. 39° 41' S., long. 131° 23' W.; South Pacific Ocean; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·8. Trawled.

Length (male), 25 mm. (1 in.).

The rostral crest is not greatly elevated, and is furnished with only one tooth on the upper margin, and behind it a very minute point. The animal offers no peculiar characters, except that there is a regular fringe of fine hairs on the infero-lateral margin of the sixth somite, and a slight indication of a dorsal carina; the telson in relation to the length of the other tail appendages is rather short, and the extremity is somewhat truncated and flanked by two small points or denticles.

The ophthalmopod is longer than the rostrum, flattened, and slightly curved; it is furnished near the base with a very prominent tooth-like process; the small tubercle common to the species of *Benthesicymus* being here largely developed. The ophthalmus, at the extremity of the ophthalmopod, is orbicular, not of greater diameter than the stalk, and of a brown colour, with a small mass of black pigment at the base.

The first pair of antennæ has the peduncle long. The first joint extends considerably beyond the rostrum and is hollowed on the upper surface to receive the ophthalmopod, the floor of the depression being paved with minute spinules; it is robust on the inner side, lobed anteriorly on the upper surface and very thin on the outer side, where it is armed with a short stout stylocerite. The second joint is short and lobed on the upper surface; the third is longer than the second, and articulates with it at the inferior angle, and is lobed on the upper surface posteriorly; it carries two flagella, of which the upper is broad at the base, and supports a closely-packed series of very long, slender, membranous cilia, and suddenly narrows to a slender filamentous termination. The lower is continuously slender from the base.

The second pair of antennæ has a slender flagellum, rather longer than the animal, and supports a scaphocerite that is longer than the peduncle of the first pair and terminates in an ovate extremity, and the margin is fringed with numerous multi-articulate ciliated hairs and is without an outer subapical tooth.

The mandible supports a large two-jointed synhipod, the extremity of which reaches beyond the distal extremity of the peduncle of the second pair of antennæ; the first joint is broad and foliaceous, the second narrow and foliaceous.

The second pair of gnathopoda is long, has the meros and ischium long and broad, the carpos long, narrow, and subequal to the propodos, and terminates in a broad, flat, palm-like dactylos.

The first pair of pereopoda is short, robust, and terminates in a short robust chela. The second pair is long and slender. The third is still longer and more slender, but is lost in the typical male specimen (but preserved in the female from another station). The penultimate pair is long, slender, and styliiform. The posterior pair is wanting in

our typical specimen, but the coxa in comparison with that of the preceding pair is remarkable for its large size.

The first pair of pleopoda is single-branched, moderately long, and has a large membranous curtain attached to the base of the first joint, which extends across the ventral surface and is united in the median line to its fellow on the opposite side by a series of cincinnuli.

The second pair of pleopoda is biramose, the anterior ramus being shorter than the posterior; two small membranous leaf-like appendages are attached to the anterior extremity of the peduncle.

The third and following pairs of pleopoda are two-branched, the outer or posterior branch being the longer.

The sixth or ultimate pair has the branches subequal, slender, tapering, fringed with tolerably long hairs, and twice as long as the telson.

This interesting form is so closely allied in general structure to *Benthesicymus*, that I hesitated to remove it from that genus. But the characteristic formation of the second pair of gnathopoda, the large secondary eye-tubercle, the peculiar form of the articulation of the third joint of the first pair of antennæ, together with the structure of the branchiæ, compel me to place it in a separate genus.

The specimens taken at Stations 232 and 235, near the southern shores of Japan, were got in comparatively shallow water, the depths being 345 and 565 fathoms respectively, or something less than from half to three-quarters of a mile from the surface.

The specimens from these stations, most of which are females, are nearly twice as long as the fully-developed male from Station 230 in the same locality, but where the water is three miles deep, which was only 30 mm. long, about the length of most others from similar depths.

Gennadas intermedius, n. sp. (Pl. LVIII. fig. 3).

External structure soft and membranous. Carapace anteriorly produced to a broad, sharply-pointed rostrum that is not more than half the length of the ophthalmopoda. Near the apex a thin carina arises which is dorsally elevated to a crest, that is armed with a single tooth above the frontal margin, and by the rudiment of another still further behind, but in advance of the gastric region. The rest of the animal corresponds in general appearance with *Gennadas parvus*.

The ophthalmopoda are nearly half the length of the peduncle of the first pair of antennæ, are obliquely compressed, support an ophthalmus which is not of greater diameter, and bear on the inner side a prominent tooth-like process that reaches as far as the base of the ophthalmus, and gradually tapers to a point which is furnished with one small lens.

The first pair of antennæ has the first joint broad, excavated on the upper surface, and armed on the outer with a stout stylocerite about half the length of the joint, the outer distal angle of which is rounded and fringed with long ciliated hairs. The second joint is about half the length of the first, and the third is stouter and rather longer than the second; the flagella are broken short off.

The second pair of antennæ is furnished with a long, slightly curved ancecerite, and with a broad and somewhat tapering scaphocerite, smooth on the outer surface and fringed on the inner with long, ciliated hairs, and reaching as far as the distal extremity of the third joint of the peduncle of the first pair.

The epistoma projects in the form of a rounded protuberance.

The mandibles support a long, two-jointed synnhipod of extreme thinness; the first joint is broad and ovate, and the second narrow and tapering, its extremity reaching as far as the distal border of the first joint of the first pair of antennæ.

The oral appendages are of extreme delicacy and tenuity.

The first pair of gnathopoda has the meral joint extremely broad and very thin, the margins being thickly fringed with hairs; the basis supports a long ephysis, and the coxa carries a podobranchial plume attached to a rudimentary mastigobranchia.

The second pair of gnathopoda carries a podobranchial plume borne upon a rudimentary mastigobranchia attached to the coxa; the basis carries a long and slender ephysis; the ischium and meros articulate, and the latter is enlarged to a broad plate of extreme tenuity; the two succeeding joints are narrow. The dactylos is spatuliform, curved, and terminates in a slender but stiff spine, more like *Benthesicymus* than *Gennadas*; on the outer surface the dactylos is furnished with a small but distinct process or tooth.

The first pair of pereopoda is short and slender, but more robust than the second and third, which are successively longer, slighter, and more feeble. The last two pairs are broken off at the ischium.

The first pair of pleopoda in the typical specimen, which is a male, supports a large and well-developed petasma, which resembles that of *Gennadas parvus*, as shown on Pl. LIX., p. The others are all biramose and subequal. The rhipidura is damaged, but the telson appears to have been more than half the length of the lateral plates.

Length (male), 45 mm. (1.75 in.).

Habitat.—Station 106, August 25, 1873; lat. 1° 47' N., long. 24° 26' W.; off Sierra Leone; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. One specimen. Trawled.

A specimen, 24 mm. in length, was taken at the surface between Bermuda and the Azores, in June 1873.

Station 137, October 23, 1873; lat. 35° 59' S., long. 1° 34' E. Surface. One male specimen. Length, 23 mm. (0.9 in.).

The chief differences that separate this species from *Gennadas parvus* are the pointed character of the prominent secondary eye-stalk, the less prominent lobe-like condition of the upper surface of the third joint of the first pair of antennæ, the greater amount of squamiform expansion of the meral and ischial joints of the gnathopoda, the presence of a short, stout tooth on the outer margin of the dactylos, midway between the base and the apex, and of a fine but stiff spine at the extremity, and probably the greater relative length of the telson as compared with the outer plates of the rhipidura.

This specimen was taken along with *Haliporus* and *Acanthephyra*.

Family SERGESTIDÆ.

In this family the diminishing value of the two posterior pairs of pereopoda is very conspicuous, both becoming small, enfeebled, and in some instances rudimentary, as in *Sergestes*. In *Acetes* the penultimate pair is reduced and the posterior is wanting, while in *Leucifer* they are both entirely absent. The branchial system has also become of diminished importance. The mastigobranchiæ are all wanting except a rudimentary discoid plate at the base of the first pair of gnathopoda; so also are the podobranchial plumes, except a small plume attached to the first gnathopod. The arthrobranchiæ are all wanting in the genus *Sergestes*, but are retained in *Petalidium*, except on the last two pairs of pereopoda, and the pleurobranchiæ are retained in all the genera in a more or less modified form.

Subfamily SERGESTINÆ.

This subfamily comprises those genera that possess branchiæ of an impoverished character.

The mastigobranchiæ and podobranchiæ are wanting, excepting a rudimentary pair, attached to the first pair of gnathopoda. The ovum of this subfamily has never been observed, but specimens of an early Zœa stage, believed to belong to this subfamily, have been taken and watched, and I therefore think it probable that the ova are deposited and hatched in the sea, and not carried by the animal. The brephalos is stated to be in the Nauplius form but as yet this is only hypothetical, since its connection with the parent has never been observed. The Zœa form to which Anton Dohrn¹ has given the name of *Elaphocaris*, is the earliest known stage according to the results of the Challenger exploration. But Professor Brooks states² that "the metamorphosis of *Sergestes* is more like that of *Leucifer* than is the case with any known Crustacean except *Acetes*, but our knowledge of *Sergestes* is incomplete."

In this subfamily there are several genera, *Petalidium*, *Sergestes*, *Acetes*, and *Sciacarus*.

¹ *Zeitschr. f. wiss. Zool.*, Bd. xx. p. 607, 1870.

² *Phil. Trans.*, p. 111, pl. i., 1882.

Petalidium.

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

Sergestes japonicus.

Pleurobranchiæ,	.	.	.	...	f1	f1	f1	f1	2	...
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	l	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	l	...	...	...	...	...	...
				h	i	k	l	m	n	o

Sergestes kröyeri.

Pleurobranchiæ,	.	.	.	...	f1	f1	f1	2	2	...
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	l	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	l	...	...	...	...	...	...
				h	i	k	l	m	n	o

Sergestes prehensilis.

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

I think it is desirable that the Preliminary Remarks on the Development of some Pelagic Decapods, by Dr. v. Willemoes-Suhm, communicated to the Royal Society, and published in their proceedings,¹ should in justice to him be reproduced here, so that they may have their full weight on the minds of those who may see the drawings of the animals, in which he took great interest.

“Since we left Australia I have investigated the metamorphoses of some Crustacea which have been constantly caught by us on the surface of the tropical and subtropical parts of the Pacific. Though these investigations will be continued, I have now arrived at certain results which I think will not be uninteresting to zoologists. The genera to which these remarks refer are *Amphion*, *Sergestes*, and *Leucifer*.

“*Amphion Reynaudi* has been on our lists as an animal ‘*incertæ sedis*’ (Milne-Edwards) for nearly forty years, until Dorn proved that a full-grown specimen of it, which he dissected, was in possession of branchiæ and of an ovary, therefore, no doubt, a

¹ *Proc. Roy. Soc.*, vol. xxiv. p. 132, 1876.

mature form. He also described one of its young stages, which has the number of appendages of a *Zoëa*, but in which caudal appendages are already developed.

“On our voyages in the ‘Challenger’ we have caught several specimens of *Amphion* and of its larvæ; and I am now able to produce drawings, not only of the true *Zoëa* with a simple telson, but also of all the intermediate stages between it and the adult form with two, three, four, five, and six pairs of walking-legs. Of the full-grown *Amphion* I have examined three specimens, two of which are undoubtedly males, as the testes (and the branchiæ) were plainly visible, the former opening into the last pair of legs.

“There is now no doubt that *Amphion* is not a larva, nay, even that there are several species and perhaps genera of this remarkable form.

“We have caught two very interesting mature animals which are certainly closely allied to *Amphion*. One of these has enormously long eye-stalks, which, having a length of 7 millims., are just as long as the whole animal’s body.

“Another form has got very long eye-stalks too, but is especially remarkable for the antepenultimate joints of its pereopods, being large paddle-shaped organs, terminated by a very small end-joint. Both have got, like *Amphion*, a central (Naupliar) eye and eight pairs of branched legs; but their body is more *Sergestes*-like and less flat than that of *Amphion*. They certainly belong both to the same genus, and may be called *Amphiones* until more than one specimen of each has been obtained.

“To me these Amphionidæ are especially interesting, as I can compare them with the larvæ of *Sergestes* and *Leucifer*, the former of which have also got eight pairs of branched legs and the central eye which persists in the Amphionidæ.

“There are good reasons for the statement that the larvæ of *Leucifer* and *Sergestes* pass through an *Amphion* stage; and this, it seems to me, throws a good deal of light on the relations and systematical position of *Amphion* itself.

“Dohrn, to whom we owe so many fine discoveries concerning the pelagic Crustacea, has described,¹ under the name of *Elaphocaris*, a small and very spiny *Zoëa*, caught in the harbour of Messina. He calls it the larva of a Decapod without fixing its position. This small larva was often seen by me in the Atlantic; but I only lately found out that *Elaphocaris* is the larva of a species, or rather of some species, of *Sergestes*. There is, however, one species of this genus in which the *Zoëa* is not an *Elaphocaris*, but a larger, less spiny form, similar, however, in all other respects to the former. Of the species which develops with an *Elaphocaris*-stage in the Western Pacific, I have collected numerous specimens of all the stages, from the youngest *Zoëas* up to the mature animal. The mode of development is very simple. After the first moulting the larva gets six more branched legs and loses many spines. It enters the *Amphion* stage, then moults, throws the branched legs off, gets branchiæ, and becomes a young *Sergestes*. Only after this last moulting the central eye, hitherto present, disappears.

¹ *Zeitschr. f. wiss. Zool.*, Bd. xx. p. 662, tab. 31, fig. 28.

“And very similar to that of *Sergestes* is the development of *Leucifer*. Here the earliest *Zoëa* of a species from the Western Pacific has at first no eyes, then sessile ones come out, and the animal then presents the form which Dana has called *Erichthina demissa*, and which Claus suspected to be not a Stomatopod but a Schizopod larva. After the second moulting this *Erichthina* gets stalked eyes and very long setæ on all its appendages, becoming a rather long, very delicate *Zoëa*. It now enters the *Amphion* stage, but never gets more than four pairs of pereopods, and loses another pair of these when it moults for the youngest *Leucifer* stage, in which two pairs of pereopods are absent.

“The next question, after having found this out, was, of course, whether *Amphion*, *Sergestes*, and *Leucifer*, leave the egg as a *Zoëa*, or whether there is a preceding *Nauplius* stage. My own impression is that in the two first-named genera this is not the case, as the youngest *Zoëas* which I caught had all the same size, and as none of them was without the large lateral stalked eyes. As for *Leucifer*, the question appears to me to be doubtful;¹ for it is, from what I have seen, quite possible that my youngest *Zoëa*, which has only got a central eye, may be preceded by a *Nauplius*. Of course the simplest thing would be to get the eggs; but there is the difficulty, for *Amphion* is caught very rarely, and has never been obtained at any other time but between 8 and 12 P.M., when it is extremely difficult by lamp-light to find out the youngest stages. *Sergestes* larvæ are commoner, appearing also in the day-time, and *Leucifer* is sometimes caught in abundance. I hope, therefore, that I shall succeed in completing my researches about this question, especially as far as the latter two genera are concerned.

“H.M.S. ‘Challenger,’ Honolulu, Sandwich Islands, July 30, 1875.”

Petalidium,² Spence Bate.

Petalidium, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 194, 1881.

External tissue membranous. Carapace about one-third of the length of the animal, dorsally elevated above the frontal region to a laterally compressed crest, and anteriorly produced to a small point. The cervical fossa is well defined. The rest of the animal is smooth. Pleon with the somites subequal, the fifth being a little shorter than those anterior to it, and the sixth somewhat longer.

The ophthalmopoda are uni-articulate, long, subcylindrical, and slightly compressed, and stand upon their own somite, which projects between them in advance of the frontal margin.

First pair of antennæ with the first joint excavated on the upper surface, and

¹ This has since been cleared up by Professor Brooks (*Phil. Trans.*, pt. i. p. 57, 1882), who has shown that the bcephalos of *Leucifer* is in the Nauplius-stage.

² πεταλίδιον, a small leaf.

furnished with a short, obtusely pointed stylocerite (the rest of the appendage is destroyed).

Second pair of antennæ carries a large scaphocerite but no ancecerite (the flagellum is lost).

The epistoma is thin, membranous and lunate.

The cheiloglossa is large, curved and wide.

The mandibles are deeply placed within the oral aperture, and have the psalistoma smooth and continuous with the molar process, at the base of which a long, two-jointed synsiphon exists.

The first pair of siagnopoda is three-branched, the second four-branched, and carries a mastigobranchial plate, the third is three-branched, the inner branch being broad, foliaceous and biarticulate, and fringed with hairs upon the inner side, the second or middle branch long, slender and triarticulate, and the third or outer long, slender, tapering, and free from hairs.

All the other appendages except the pleopoda are too much broken to allow their form to be determined.

The telson, which is perfect, is long, slender and tapering, but not so long as the lateral plates of the rhipidura, which are broken off in all our specimens.

Geographical Distribution.—Only one species of this genus is known, and that was taken in two localities, one near Marion Island and the other south of Australia.

The great distinction between this genus and *Sergestes* exists in the form, character, and arrangement of the branchial plumes, which consist of a series of plates and cylindrical filaments situated side by side in a series of rows at right angles to the stalk. There is but one plume to each of the five anterior somites of the pereion, the posterior two somites having none; between some of the somites is a large foliaceous plate. The arrangement may be tabulated thus:—

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

Petalidium foliaceum, Spence Bate (Pl. LX.).

Petalidium foliaceum, Sp. B., *loc. cit.*, p. 194.

Anterior margin dorsally elevated to a small, laterally compressed crest, produced in front to a very small point; body generally smooth. Ophthalmopod subcylindrical, long; ophthalmus not broader than the diameter of the stalk, furnished on the inner side with a small tubercle, close to the dark pigment. Dark brown hairs on the oral

appendages. Synnhipod reaching beyond the extremity of the peduncle of the second pair of antennæ.

The rest of the animal is so damaged that it is difficult to give a specific description.

Habitat.—Station 146, December 29, 1873; lat. $46^{\circ} 46' S.$, long. $45^{\circ} 31' E.$; near Marion Island; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, $35^{\circ} 6.$ Four specimens, females. Trawled.

Station 159, March 10, 1874; lat. $47^{\circ} 25' S.$, long. $130^{\circ} 22' E.$; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, $34^{\circ} 5.$ One specimen, female. Trawled.

This species, so far as it can be determined from the damaged specimens in the Challenger collection, is very like *Sergestes japonicus*, but it may be very readily discriminated by the dark brown colour of the hairs attached to the margins of the synnhipod and other oral appendages.

The nervous system in one specimen being in a tolerably good state of preservation, I was enabled to lay it bare in its entire length from the cephalon to the extremity of the pereion.

The cephalic lobes are very large and apparently divided into lobules, corresponding to the branches that are given off. The ophthalmic branch is very small and thread-like, while that which supplies the first pair of antennæ is very large, strong, and originates in a special ganglion in front of, but belonging to, the cerebral mass, while behind, from the largest mass, two stout nerves, independent of each other, lead to the second pair of antennæ, one apparently going to the green gland, and the other to the antennæ or antennal muscles, which are exceptionally strong. The oral branches of the nerves are small and arise from the œsophageal loop, while all the limbs attached to the pereion are supplied from the ganglionic masses on the ventral surface in the following manner. The anterior two ganglia supply the gnathopoda. The three next supply the corresponding pairs of pereiopoda, of which the posterior is connected with, and supports, the oviducts, and is a slightly larger ganglion than the preceding; the central cord at this point divides into two, and reunites at the next ganglion, which sends off two branches to the penultimate and two to the ultimate pairs of pereiopoda, after which the central cord becomes single as it traverses the median ventral line of the pleon; consequently there is no ganglion corresponding with the posterior pair of pereiopoda.

Sergestes, Milne-Edwards.

Sergestes, Milne Edwards, Ann. d. Sci. Nat., ser. 2, vol. xix. p. 346, 1830.

Body long and slender: Structure submembranous. Carapace scarcely produced to a rostrum anteriorly. Ophthalmopod single-jointed.

The first pair of antennæ is long and slender, having the peduncle long, without prosartema or stylocerite, terminating in one long, slender flagellum, and a short rudimentary one, which in the male is frequently furnished with a small tertiary branch, while the large flagellum becomes bulbous at the base, and supports a fasciculus of membranous cilia.

The second pair of antennæ is long and extremely slender, and carries a large scaphocerite. The mandibles have the incisive margin smooth, and carry a long and narrow two-jointed synaphipod; the other oral appendages correspond to those of *Gennadas* and *Benthesicymus*.

The first pair of gnathopoda is large and very robust, being generally reflexed upon itself, but not closely so, and terminates in a short blunt dactylos. The second pair is long, slender, and feeble.

The first pair of pereopoda has only six joints, the dactylos apparently being absent. The second and third pairs of pereopoda are long and slender, terminating in minute chelæ. The fourth and fifth pairs are short and feeble, and terminate in simple dactyli. The pleopoda are biramose, except the first pair, which carries a petasma attached to the basal joint in the male and which becomes rudimentary in the female. The posterior pair of pleopoda is modified to form the rhipidura, and is much longer than the telson.

This genus was first established by Professor Milne-Edwards, in November 1829, in a paper read before the Academy of Sciences upon a species taken in Mid-Atlantic. It has since been more fully elucidated by Krøyer in a monograph published in 1856,¹ in which he has modified Milne-Edwards' description by showing that the pereopoda, which Milne-Edwards says are "filiformes et monodactyles," are not so. The second and third pairs, when examined with a lens of low magnifying power, are seen to be minutely chelate, and the others appear to be wanting in a joint; and the gnathopoda have an increased resemblance to a pediform character, the first pair being the most powerful of all the appendages.

The general appearance is that of a depauperised Penæiform Crustacean, and the condition of the branchial organs supports this idea. These consist of a single row of branchial plumes, which, in accordance with the nomenclature that I have used, are all pleurobranchiæ, but the posterior plume, instead of being attached to the somite that carries the posterior pereopod, is attached to the penultimate somite, which consequently carries two plumes.

Thus there are seven plumes connected with six somites, which are arranged as follows. The first pair of gnathopoda carries a small, circular, discoid mastigobranchial plate, which calls to remembrance the form of the branchial appendage in the Amphipod

¹ Forsøg til en monographisk Fremstilling af Kræbedyrslægten *Sergestes*. *K. dansk. Vidensk. Selsk. Skriv.*, Bd. iv. p. 217, Copenhagen, 1856; *Zeitschr. d. gesamm. Naturwiss.*, vol. viii. p. 413, Halle, 1856.

Crustacea, with which Milne-Edwards says the species of this genus establish a connection. Attached to the mastigobranchial plate is a well-developed but small podobranchial plume. Between this and the next somite, deep in the interstitial groove, is a small foliaceous plate of a low degree of structure; on the somite that carries the second pair of gnathopoda is a larger branchial plume, which has no connection with the gnathopod or its membranous articulation; this is followed by an interstitial foliaceous plate on the three following somites; on the last somite the foliaceous plate is wanting, but a second branchial plume is present besides the normal one, while the last somite has neither plate nor plume.

The arrangement,¹ as seen in *Sergestes japonicus*, is as follows:—

Pleurobranchiæ,	.	.	.	...	f1	f1	f1	f1	2	...
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	...	...	...	...	...	...
					h	i	k	l	m	n	o

In *Sergestes kröyeri*, however, there are two branchiæ attached to the penultimate somite, two to the antepenultimate, an interstitial foliaceous plate between the next three somites, and one branchial plume but no interstitial leaf between the next. This may be better understood by the following tabular arrangement, by which it may be seen that one foliaceous plate has been replaced by a branchial plume.

Pleurobranchiæ,	.	.	.	...	f1	f1	f1	2	2	...
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	...	...	...	...	...	...
					h	i	k	l	m	n	o

In *Sergestes prehensilis* this feature is carried a degree still further, inasmuch as the interstitial foliaceous plates exhibit signs of breaking up into branchial plumes, too unimportant to be pronounced plumes, and too much differentiated to be called foliaceous plates.

Thus it appears that these interstitial foliaceous plates are rudimentary branchial organs.

Geographical Distribution.—The species of this genus are chiefly oceanic, and have been taken all over the globe, in the Arctic as well as in the Tropical seas.

¹ Claus in his *Morphologie der Crustaceen* (p. 52) has tabulated the branchiæ of *Sergestes* in accordance with the table given on this page for *Sergestes japonicus*, with the exception that he makes the foliaceous plates in his diagram (Taf. iii. figs. 31, 2c, 3c, 4c, 5c), which he has figured as large as those in the genus *Petalidium*, as well as the antepenultimate (6c), and ultimate (7c) plumes, to correspond with the arthrobranchiæ, and the other branchial plumes (c) to homologise with the pleurobranchiæ; but, according to my observation, none of the branchiæ are attached to the membranous tissue that unites the coxæ of the pereopoda to the somites of the pereon.

DEVELOPMENT OF SERGESTES.

Our knowledge of the development of this genus is still imperfect, although it is the result of the examination of numerous specimens obtained at different times by different persons, of their comparison with one another, and of deductions drawn from the general appearances of the animals and the relative proportions of their parts.

As in all the species of this order, the brephalos, or the organism as it first issues from the ovum, is unknown. The ovum is most probably deposited in the sea and hatched in the warmer waters of the ocean.

In the genus *Leucifer* Professor Brooks has fortunately been enabled to procure some ova, which he found not united to the parent, as they generally are in the higher Crustacea, by means of organic tissue attaching them to the pleopoda, nor carried in pouches, or in ovisacs, as in *Mysis*, *Gammarus*, &c., but rather as if they were entangled amongst the pereopoda and cohering to one another.

The youngest form that we know is that shown in the annexed figure (fig. 49) taken from the drawing of Dr. v. Willemoes Suhm.

“Zoea of *Sergestes*, $\times 244^1$ nat. size, just hatched, H $\frac{1}{7}$, 28 August, 1875, in the 10 of Latitude, on the passage from Hilo to Tahiti.

“Length of the abdomen,	0.21 mm.
Length of the carapace, without spines,	0.35 „
Length, entire,	0.56 „
Greatest breadth of the carapace,	0.38 „
Length of α^1 ,	0.7 „

“First antennæ four-jointed at the base, which disappears later.

“*oc.* The early formation of the eye; right and left of the deeply situated Nauplius eye. Mandibles apparent; first maxillæ and labium not visible and perhaps not yet formed, although the palpus of the first maxilla is very distinct, as also the second maxilla, maxilliped, and gnathopod. When the yolk mass in the interior does not hide anything one observes some grain-like substance with bright bladders between. The posterior spine of the carapace does not go exactly straight backwards but upwards. The rostrum is certainly wanting.”

The above are the notes made regarding this specimen by Dr. v. Willemoes Suhm, after whom I have named it.

Elaphocaris suhmi.

It differs from all other specimens at this stage in the absence of a rostrum, which is generally so persistent a feature. The great fronto-lateral spinous processes are remarkable for their length, and still more for being biramose, the division commencing at

¹ From which our figure, for convenience, is reduced one-third, or to about 163.3.

about a third of their length from the base, and these long processes are armed from base to summit with short teeth or spines, on both sides on the basal undivided portion, and on one side on the branches. The frontal margin between them is concave. The lateral margin between these spinous processes and the postero-lateral ones is also

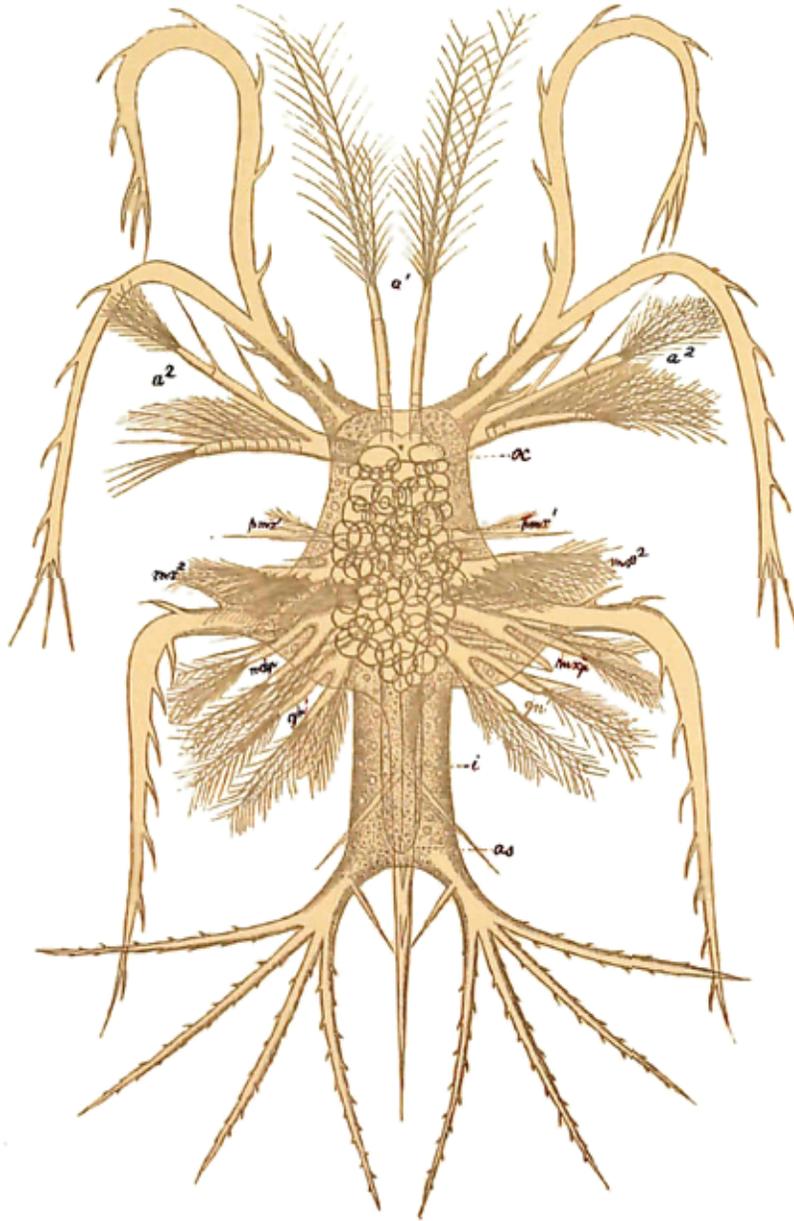


FIG. 49.—*Elaphocaris suhmi*. a^1 , first pair of antennæ; a^2 , second pair of antennæ; oc , incipient ophthalmopod; mx^1 , first pair of maxilla; mx^2 , second pair of maxilla; mxp , maxillipedes; gn^1 , first pair of gnathopoda; i , intestinal canal; as , anal foramen.

concave, sweeping gradually backwards and projecting outwards on each side to a long single spinous process, which is armed near the base on its frontal margin with two, and beyond this, on its posterior margin, with several short sharp teeth, similar to those on the anterior spines. From the base of these processes the margin of the carapace slopes

convexly inwards and backwards to the median line, whence a long and slender spine of like appearance and similarly armed projects upwards and backwards. The long spinous processes, judging from Suhm's drawing, appear to be flexible, and were probably bent or arranged in the positions in which they are represented for the convenience of being placed on the paper.

The pleon is shorter than the carapace and not segmented. It terminates by bifurcating into two narrow, widely separated lobes, each armed with four long, denticulated, terminal spines or processes, and a short smooth one on the inner side at the base pointing obliquely inwards and backwards.

The ocellus is visible between the antennæ, and Suhm says that the ophthalmopoda (*oc*) are visible in an incipient condition to the right and left of the nauplian eye (ocellus).

The first pair of antennæ (a^1) is four-jointed, the terminal joint supporting two long and one shorter ciliated hairs.

The second pair of antennæ (a^2) is biramose, the anterior branch, representing the flagellum in the adult, is two-jointed, and supports a scaphocerite, which in this stage is multiarticulate and fringed with ciliated hairs on one side and at the extremity, the outer side being smooth and free from hairs.

The mandibles are visible, and figured in the annexed cut, as well as the first and second pairs of maxilla, at pmx^1 and mx^2 , as also the maxilliped mxp , and the first pair of gnathopoda gn^1 . The second gnathopod is absent, and all are fringed with long ciliated hairs; posterior to these no appendage is present.

The specimen from which this drawing was taken appears not to have been preserved, and I only know it from Suhm's drawing. It was but little more than half a millimetre in length, and Suhm is most probably correct in believing that it had only recently been hatched, the presence of the yolk-mass clearly demonstrating its immature condition, but the long and plumose cilia are evidence that at least one moult had elapsed after it quitted the ovum. In this stage the ophthalmopoda are not developed, and no appendages are present posterior to the first pair of gnathopoda, and there is no evidence, except the embryonic condition of the ophthalmopoda, that shows any distinction between this *Elaphocaris* and the *Zoea* of a *Brachyurous* Crustacean.

The next stage of which we have any knowledge was taken on the 13th of March, 1875, at or near Station 221, in lat. $0^\circ 40' N.$, long. $148^\circ 41' E.$, north of the Admiralty Islands in the Pacific. It is labelled "*Sergestes zoëa, Elaphocaris*" by Willemoes Suhm, and is given on Pl. LXI. fig. 1. It is about 1.5 mm. in length, from the extremity of the rostrum to the middle of the caudal cleft, and evidently belongs to a species different from Suhm's previous specimen, since it has a long spinous rostrum. The ophthalmopoda are well developed, but no appendages posterior to the gnathopoda are present, and even these are in an immature condition.

The carapace is dorsally nearly circular, somewhat pointed posteriorly, and armed

with four compound spinous processes. The anterior forms the rostrum and is about as long as the carapace, and supports on each side and along the dorsal surface a series of about nine or ten long, straight, spine-like processes, besides two or three small teeth at the extremity. Two, one on each side, spring from the lateral surface in a line slightly posterior to the mandibles; these also carry seven or eight long, straight, spine-like processes; the fourth is produced posteriorly as a long, straight, spinous process directed backwards, and is armed with four long spines, two on each side near the base, the anterior pair directed outwards, upwards, and backwards, and the posterior horizontally outwards.

The pleon does not project posteriorly beyond the carapace for more than half the length of the latter, and it carries no appendage.

The telson is widely forked, each ramus being broad, flat, and armed with four long and two short spines. On the outer and anterior side of the base of the telson there is on each side one strong, straight tooth of moderate length, and on the distal extremity of each ramus are four very long spine-like processes, the posterior three terminally serrate, that appear to be flexible in character, and on the inner side, pointing diagonally towards each other, is another short curved tooth or spine.

The ophthalmopoda are well developed, pedunculated, pyriform and robust, the ophthalmus being slightly larger than the distal extremity of the stalk. They stand on an advanced projection of the cephalon that forms the base of the great rostral process, and their length is about one-third that of the carapace.

The first pair of antennæ is four-jointed; the terminal joint, which represents the future flagellum, is narrower than the preceding one, of about the same length as the third joint, and terminates in three long, slender hairs.

The second pair of antennæ is biramosc; the inner branch, which is nearly as long as the peduncle of the first pair, is smooth on one side and fringed with hairs on the other, and homologous to the scaphocerite; the outer branch is three-jointed and homologous to the two terminal joints of the peduncle and rudimentary flagellum.

The epistoma is armed with a long, straight, spine-like process which reaches as far forwards as the origin of the ophthalmopoda.

The mandibles consist of two large, robust organs, that even at this stage approach in appearance those of the adult; behind these there are probably two pairs of appendages, but I have not been able to determine them with certainty.

The pereiopoda are not yet visible even as buds.

The organism as it now appears is that of an early Zoea—I say early, because the gnathopoda are not yet discernible at this stage.

The next stage, but of which there is no specimen in the Challenger collection, is one closely resembling the last, and is figured by Claus in his *Crustaceen System* (Tab. v.

fig. 1). It evidently belongs to a species closely allied to the last, but is a little more advanced. It is 1.33 mm. in length, and the description I have given above will also do for this, except in the case of the appendages.

The ophthalmopoda are large and fungiform, the eye being very broad and the stalk slender.

The first pair of antennæ is single-branched, multiarticulate at the base, and terminates in a slender articulus that carries three fine hairs.

The second pair of antennæ is biramose, each branch terminating in three or four long hairs.

The epistoma is armed with a long spine or tooth that projects forwards, but does not reach to the base of the ophthalmopoda.

The oral appendages and gnathopoda are developed; the animal has reached the true Zoca stage, and there is nothing in its appearance or characters excepting the biramose condition of the second pair of antennæ that is sufficient to prove that it does not belong to one of the Brachyura. Several transverse lines, posterior to the carapace, define the position of the future somites, but no appendages even in the most incipient stage are visible.

Anton Dohrn,¹ to whom we are indebted as having been the first to discover and describe this remarkable form of Crustacean life, gives in his researches on the structure and development of the Arthropoda, the figure of a specimen taken off Messina during the month of March, which bears a general resemblance to that of the Challenger specimen represented on Pl. LXII., but differs in certain details that are suggestive of a distinct specific origin. The rostrum is smooth and free from spinous adornments. The orbital, lateral, and posterior dorsal processes of the carapace are furnished with long smooth spines, the extremities of which are tipped with three radiating teeth, except the central, which is armed with a series of small lateral teeth, but only on one side.

The carapace is contracted immediately behind the orbital processes, and enlarged in a line continuous with the lateral margins.

The somites of the pleon are short and broad, and the caudal fork is armed with six long spines, corresponding in number and position with those of Claus's figure, which possesses one more than that on our specimen.

The ophthalmopoda are long and have the ophthalmus of not much greater diameter than the stalk, and stand in the same line beneath the orbital processes.

The first pair of antennæ is four-jointed, and terminates in a few simple hairs.

The second pair is two-branched, the branch representing the scaphocerite being multiarticulate and fringed on one side with long hairs.

The rest of Anton Dohrn's description and figure corresponds with the degree of development shown in our specimen, excepting that the saccular sixth pair of pleopoda is shorter.

¹ Untersuchungen über den Bau und Entwicklung der Arthropoden, von Dr. Anton Dohrn. Zweites Heft, mit viii. Tafeln. Leipzig, 1870.

The next stage in the progressive life-history of the animals in this genus is that given in the annexed cut (fig. 50), from a drawing by Willemoes Suhm.

The following are Suhm's notes attached to his drawing :—

" Length of rostrum,	0.98 mm.
" carapace,	0.98 "
" pleon,	0.73 "
Entire length,	2.7 "
Length of ophthalmopoda,	0.35 "
Greatest breadth of carapace,	0.87 "
Length of lateral spinous processes,	0.31 "
Length of posterior do.,	0.70 "

"Taken 25 August 1875. Lat. 12° 42' N., long. 152° 1' W. South of the Sandwich Islands.

"At the next succeeding moult the great posterior process is divided into two, so that the Zoea has three of these processes on each side, after which the third Amphion-like larva is produced.

"The points on each side of the abdominal segments project considerably. It is only by destroying the animal that we can get any knowledge of the pereopoda or their development.

"After the second moult come the later forms of larva."

It differs from his previous figure in having a long rostrum, distally serrate at the margins, and dorsally armed at the middle with a long, slender, solitary spine, posterior to which the margins are smooth. The carapace is circular or nearly so; it is furnished external to the orbital angle, on each side of the frontal margin, with a large spinous process. On the lateral margin, in a line with the oral apparatus on each side, is a large spinous process; and in the median line of the posterior margin is a long dorsal spine, armed on each side with two lateral spines and dorsally with two, and having the distal portion laterally serrate.

The ophthalmopoda are fungiform and the antennæ are well developed.

The first pair of antennæ consists of one long and one short joint, distally furnished with three or four long ciliated hairs.

The second pair is biramose, a basal joint supporting an inner biarticulate branch which consists of one long and one short joint tipped with three or four long ciliated hairs, and a second multiarticulate branch, that represents the scaphocerite in the adult; it is smooth on one side and on the other furnished with many long plumose hairs.

The oral appendages are also present, and the epistoma is armed with a long spine-like tooth that reaches beyond the frontal margin.

The mandibles are present and the incisive margins are serrate.

The maxillipedes and gnathopoda are furnished with long plumose hairs.

The pereiopoda are present as long saccular buds, and their biramose character is visible.

The figure represents a dorsal view, and none of the pleopoda excepting the posterior pair is shown, and this consists of two long, narrow, cylindrical, tubular appendages of membranous appearance. These are directed laterally outwards and then curved forwards. The telson is biramose, each branch being furnished with five stout divergent spines, four of which are serrate at their extremity.

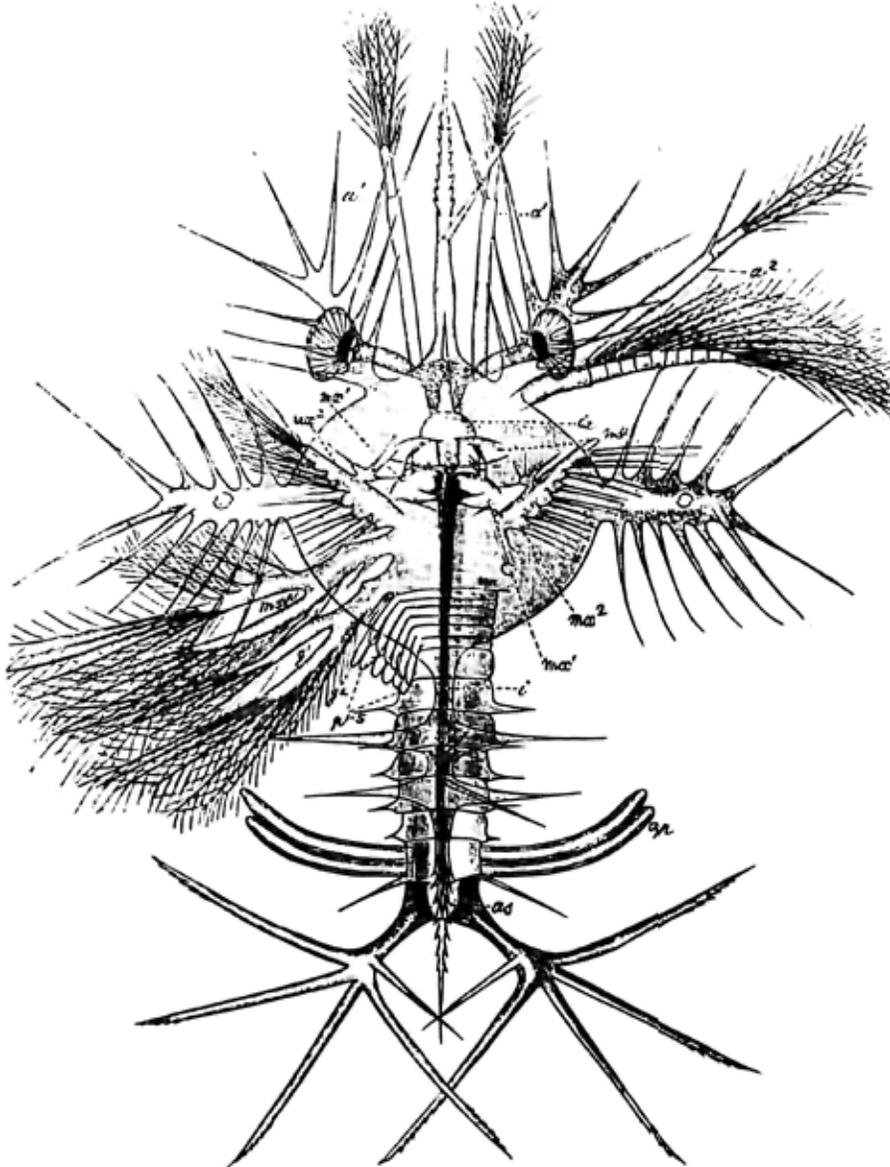


FIG. 50.—*Elaphocaris*—*Sergestes*. *a*¹, First pair of antennæ; *a*², second pair of antennæ; *la*, labium; *mth*, mandibles; *mx*¹, first pair of maxilla; *mx*², second pair of maxilla; *mxp*, maxillipede; *g*¹, first gnathopod; *g*², second gnathopod; *p*¹⁻⁵, five pairs of pereiopoda; *i*, intestinal canal; *ap*, posterior pair of pleopoda; *as*, anus.

Although the drawing made by Suhm differs in some details from that given by Claus (pl. vi. fig. 1, &c.), I think it must be recognised as showing a younger moult of the same or some closely allied species.

Some of the differences in the details, notably those relating to the rostrum and to

the arrangement of the spines on the posterior dorsal process of the carapace, are probably due to the more or less perfect display of the specimen; but there is one structurally important part that is essentially different, and demonstrates the specimen to be of a younger stage. For, in our figure of the next stage, as well as in that given by Claus, the two large spinous processes on the frontal margin, one on each side of the rostrum, are projected forwards on a process of the carapace, and the ophthalmopoda are implanted behind them, whereas in the figure given by Suhm the frontal spinous processes are represented as being external and posterior to the ophthalmopoda, and the frontal margin of the carapace does not project; an evidence of its younger condition.

The next stage we know is that given on Pl. LXII. of this Report, and agrees closely with that figured by Claus, which represents the ventral surface, whereas ours gives the dorsal, but the appendages are shown through the transparent integument so as to indicate their relative positions.

It is difficult to believe that this is a further development of the same animal, inasmuch as there are two large spinous processes thrown out at the base of the rostrum and anterior to the ophthalmopoda. Our specimen has two spines less on the telson than are given in Claus's figure, but in all other details they resemble each other, and are probably the young of very closely allied species.

The carapace is nearly circular, with the cephalic region considerably advanced and projecting forwards, and furnished with a central spinous rostrum and two lateral spinous processes. The rostrum is about half the length of the carapace and armed with two lateral spines opposite each other and directed obliquely forwards, and two on the upper surface, in a line one before the other. The lateral spinous processes at the base of the cephalic lobe much resemble those at the lateral margin, and are directed obliquely forwards, and covered with long spines pointing in every direction; I counted fourteen or fifteen on each. The depression formed between the base of these processes and the antero-lateral margin of the carapace, forms the orbital notch in which the ophthalmopod is situated. The lateral spinous processes are opposite each other in a line posterior to the mandibles, each is armed with very long spines, of which I counted fifteen, the one at the apex carrying a small hook at its side, somewhat distant from its apex, and three at the base are on the dorsal surface. The posterior spinous process is long, straight and slender, and reaches beyond the extremity of the telson; it is armed with eight long spines, two of which at the base on each side are directed obliquely upwards and forwards; two a little posterior pass laterally outwards, two on the under side, still more posteriorly, are directed obliquely downwards and forwards, and two from near the same point of origin are directed obliquely downwards and backwards.

The pleon is armed on each side of the posterior margins of the five anterior somites, with a long spine-like tooth passing outwards and probably downwards. The telson is

bilobed, each lobe being long, flat, and armed with five long and strong spines, those on each side of the base being directed forwards, and four radiating from the terminal surface of each lateral lobe.

The ophthalmopoda are fungiform, the stalk being slender and the eye broad, and broader anteriorly than posteriorly.

The first pair of antennæ (*b*) is three-jointed, the basal joint having the greatest diameter, the second being the longest, and the third the shortest and most slender; each is furnished with a hair or two, the third terminating in three long and two short subapical hairs.

The second pair of antennæ (*c*) is biramose. The basal joint is nearly as broad as long, and supports two rami, of which the longer is two-jointed, the first joint being long, slender, and free from hairs, excepting one on the inner distal extremity, and represents the future terminal joint of the peduncle, and the second is short, slightly tapering, and tipped with two long hairs; this joint represents the future flagellum. The shorter branch is as long as the first joint of the inner branch, it is also free from lateral hairs, but bears five long ones at its tip. This branch represents the scaphocerite of the permanent organ.

The mandibles I have not been able to determine, but they appear to have no synaphipod.

The maxillæ are also unknown to me except as viewed while attached to the animal.

The third pair of siagnopoda (*g*), or maxillipedes, consists of a six-lobed branch; each lobe increases in size posteriorly and is furnished with three or four strong hairs, as is also the distal extremity of the appendage, which gradually tapers to a point. The outer or convex margin supports a flattened lobe and is furnished with five or six long fine hairs.

The first pair of gnathopoda (*h*) is biramose; the basal joint is broad and supports the two branches, of which the inner is five-jointed, and supports a fasciculus of ciliated hairs at the inner distal extremity of each joint, while the outer surface is smooth; the outer branch is single-jointed, nearly as long as the inner, and furnished along both margins with a few isolated, ciliated hairs.

The second pair of gnathopoda resembles the first in its general details.

The first pair of pereopoda is biramose, one branch being a little longer than the other; the longer is furnished with two long hairs at the extremity, while the shorter is free from any.

The succeeding pairs of pereopoda are in a more immature condition, and in our specimen consist of three pendulous saccular appendages, whereas in Claus's figure they are longer and biramose, but still in a bud-like condition.

The pleopoda are all wanting, except the sixth or posterior pair, which are large and

considerably advanced in development, and are with the second pair of antennæ the only appendages that demonstrate the Zœa to be of Macrurous origin. They consist of a short basal joint and two unequally long, membranous branches directed outwards, downwards and forwards, and implanted at a distance from the terminal portion of the forked telson, which is not defined from the preceding somite.

Length, 2 mm. (0.08 in.).

Habitat.—South Atlantic, March 1 to 4, 1876; lat. 32° S., long. 45° W.; between Monte Video and Tristan da Cunha.

This is as far as we are able to trace the changes in the *Elaphocaris* of the same or of closely allied species.

Elaphocaris crassus, Willemoes Suhm, MS. (Pl. LXI. fig. 4).

This is another specimen which has been found in the Pacific. It differs in form in certain parts, particularly in the character of the spiny processes, which appear to show that it belongs to another, but in all probability more or less closely allied genus.

The carapace dorsally is nearly circular; the anterior central extremity is produced to a long rostrum, about two-thirds the length of the carapace; it is straight and tapers to a point, having the margins fringed with short sharp spinules. On each side of the base of the rostrum there is a long, curved, anteriorly-directed, spinous process, smooth on the inner side and armed on the outer with six long spines. The lateral spinous processes consist of one long central spine, armed towards the apex with small denticulations, while near the base there stand two anterior and three posterior long, blunt, and rather flexible spines. On the posterior margin of the carapace on each side of the pleon is a broad lobe or tubercle crowned with five or six long, blunt-pointed, finger-like, subflexible spines, but in the median line there is no spinous process as in other species.

The pereion in this specimen is developed and exposed posteriorly to the carapace.

The pleon has the five anterior somites subequal, and armed on each side with a long, slender, sharp spine.

The telson is large, bilobed, and armed with seven very long semiflexible spines. The most anterior is the smallest and most slender, and stands on each side not far from the posterior pair of pleopoda. The five succeeding are very long, flexible, and slender, and beyond these on the inner side is the last, that points diagonally backwards and inwards.

The ophthalmopoda are fungiform, the ophthalmus being much broader than the stalk.

The first pair of antennæ (*b*) is single-branched, four-jointed, and free from hairs, except the terminal joint, which is tipped with two long hairs and subapically with two short ones.

The second pair of antennæ (*c*) consists of a basal joint that supports two branches one of which is two-jointed, the first joint being long and cylindrical, the second short, more slender, and tipped with four long hairs; the other branch is also cylindrical, multi-articulate, and fringed with hairs, one being attached to each articulus on the outer side.

The labrum is armed with a long tooth or spine directed forwards and reaching beyond the frontal margin.

The mandibles and oral appendages I have not been able to determine in this unique specimen, but they, as well as the two pairs of gnathopoda, are present.

The pereopoda are still in an undeveloped condition, existing as long, narrow, saccular processes.

The pleopoda are not yet present, except the posterior pair, which consists of a basal joint that supports two subequal membranous branches.

Length, 1.5 mm. (0.06 in.).

Habitat.—The Pacific Ocean.

April 3, 1875; lat. 25° 0' N., long. 137° 50' E.; south of Japan, between Stations 229 and 230.

Platysacus crenatus,¹ n. gen. et sp. (Pl. LXIII.).

This form of *Elaphocaris* must, I think, belong to a very distinct species, and for the sake of convenience I propose to call it *Platysacus crenatus*. It differs from all the others in having a series of crenated or small tooth-like points crowning each of the ten lobes which are disposed around the margin of the carapace, and the dorsal surface is covered with eleven long spine-like teeth.

The rostrum is straight, free from ornamentation, and reaches a little beyond the ophthalmopoda. On each side of the frontal margin, corresponding with the outer canthus of the orbit, is a long spine-like tooth, subequal in length to the rostrum; posterior and a little external to this, within the margin, and standing on the antennal region, is another long spine-like tooth, and on the outer antennal angle is a broad flat lobe, directed obliquely outwards and upwards, and crowned with nine or ten fine points or teeth. Posteriorly, on the lateral margin, and corresponding with the line of the oral cavity, is another broad flat lobe of extreme tenuity, the margin of which is fringed with a series of ten or twelve fine, sharp, tooth-like points; within this on the dorsal surface, in a line with the oral organs, are two long and distinct spine-like teeth; posteriorly, on the lateral margin, are three more broad, flat, delicately thin lobes, crowned with numerous small tooth-like points, varying from six or seven to twelve or more, the posterior standing laterally to the median line of the carapace. In a transverse line corresponding to the anterior portion of the third or middle marginal lobes, there stand

¹ From *πλατύς*, flat, and *σάκος*, shield.

three long spine-like teeth, one in the median line of the carapace, and one on each side of it; they are directed upwards and a little backwards.

The pereion has five somites developed, visible posteriorly to the carapace.

The pleon has the five anterior somites subequal in length; each is armed with a central dorsal tooth on the posterior margin, and a large lateral spine-like tooth at the postero-lateral angle. The sixth somite is longer than the two preceding ones together, and is armed on each side at the postero-lateral angle with a long spine-like tooth.

The telson is bilobed, each lobe is long, flat, and armed with a series of eight teeth radiating from the margin.

The ophthalmopoda are short, stout, and pyriform, but not much longer than broad, and about one-fourth the length of the carapace.

The first pair of antennæ is one-branched and four-jointed; the first joint is the longest and is furnished with a ciliated hair on the one side and a small hair on the other; the second is about two-thirds the length of the first and similarly armed on each side at the distal extremity; the third is a little shorter, more slender than the second, and is similarly armed, except that it has two ciliated hairs instead of one, and the fourth joint is more slender than the preceding and is tipped with three ciliated hairs.

The second pair of antennæ consists of a broad basal joint, which supports another not quite so broad, that in turn supports two branches, the inner of which has three joints, two of which are distally armed on the inner side with a projecting point bearing two long ciliated hairs, and the terminal joint supports six. The branch on the outer side becomes the future scaphocerite, and is flat, broad, and multiarticulate; the outer margin is unarmed except for one small hair near the middle, but the inner margin including the distal extremity is furnished with nine or ten long ciliated hairs.

The oral appendages are not easily detected, as the specimen being unique is mounted for the microscope, and I hesitated to dismount it.

Four pairs of pereopoda are distinctly visible; each consists of a strong basal joint that supports two equal, flat and narrow plate-like appendages tipped with two small hairs.

The pleopoda are not yet visible even as buds, except the sixth pair, which is large and well developed, consisting of a short basal joint armed with a long spine-like tooth and bearing two long foliaceous rami, the external of which is tipped with five long ciliated hairs and the inner with two.

Length, 3 mm. (0.12 in.).

Habitat.—Station 352, April 13, 1876; lat. 10° 55' N., long. 17° 46' W.; on the surface of the Atlantic Ocean, off Sierra Leone; surface temperature, 77°.7.

I have said that the oral apparatus has not been well examined, but enough has been

done to show that a long, strong tooth, somewhat similar in character to the rostrum, projects from the anterior surface of the epistoma, and that the mandibles exist as sharp-pointed organs, but the presence of a synnhipod could not be determined. Only one pair of gnathopoda could be seen, which I took to be the second; it consists of a long cylindrical basal joint supporting two branches, the permanent ramus being four-jointed; each joint is furnished at its distal angle with a long ciliated hair, and the terminal joint has four; the outer or deciduous branch consists of one long and one minute joint, the former furnished with a long ciliated hair on the inner and one on the outer distal angle, and the latter with four at the extremity.

One feature of interest in the development of the species from which this specimen comes, is that all or at least five out of the seven somites that belong to the pereion are developed as perfect somites posterior to the carapace. This I also found to be the case in Claus's figure of the Protozoa of *Penæus*, and in his figure of *Erichthina*, but it is not the case in Dana's figure of the typical specimens of *Erichthina*, which is believed by Professor Brooks to be the Zœa form of the genus *Leucifer*.

The next form to be considered, and which Dr. v. Willemoes Suhm says comes from the latest *Elaphocaris*, is that which he has described as being in the *Amphion*-stage. It is desirable in tracing the life-history under the present circumstances, when one form is said to succeed and arise from another, to take into consideration the relative sizes of the specimens, for after allowing for the variations that may occur from various conditions and circumstances, the difference of size is a great factor when we consider how gradual are the changes in the progressive history of the stages that are known. The largest *Elaphocaris* is about 1.7 mm., and Suhm says the *Amphion*-stage is 3.5 mm., or more than double the length.

The specimens in the Challenger collection that belong to the *Amphion*-stage of Suhm in the progressive development of *Sergestes*, are similar to those that have been described by Claus under the name of *Acanthosoma*. Of these there are several varieties, as if they were the young of more or less closely allied species, but there are two forms in which the characters are so distinct, that I think there cannot be any doubt they are stages of two different but closely allied genera. These may be arranged for convenience under the names of *Acanthosoma brevitelsonis* and *Acanthosoma longitelsonis*, leaving it to future research to determine the parent of either form. None of our specimens correspond in minute details with that figured by Claus. That given by him in his Crustacean System (pl. v. fig. 5), of which he has represented the rhipidura only, corresponds with that of *Acanthosoma longitelsonis* (Pl. LXIV. fig. 3), whereas his figure 6, on the same plate, corresponds with that of *Acanthosoma brevitelsonis*. Professor W. K. Brooks¹ says:—"The telson is slightly notched in *Lucifer*; deeply forked in *Acetes*, and in *Sergestes* the prongs of the fork diverge so much as to form a right angle."

¹ *Phil. Trans.*, pt. i. p. 102, 1882.

The accompanying figure is that given by Suhm as the third stage of the development of *Sergestes*.

"*Sergestes* larva, in the *Amphion*-stage. Eight pairs of divided legs, pleopoda and otoliths are formed; n. s. 3.5 mm.; drawing taken from fresh specimens and by the aid of H¹ $\frac{1}{4}$.

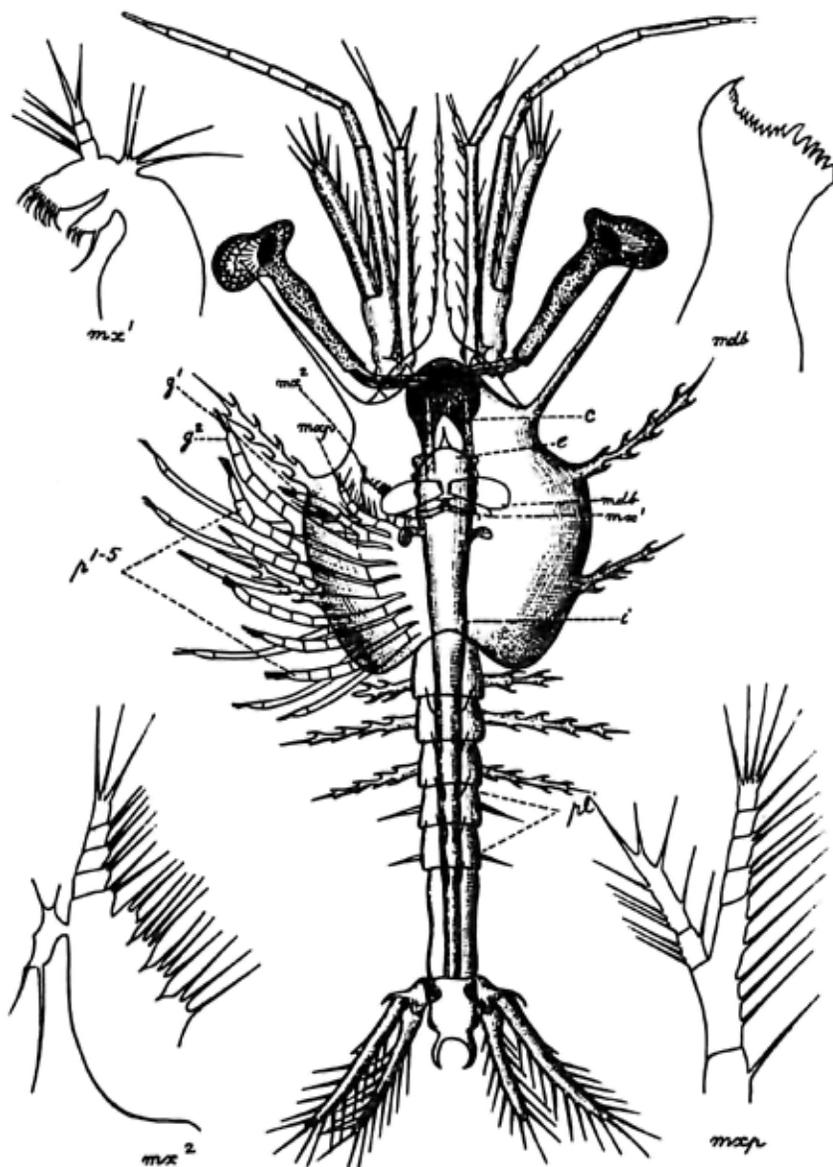


FIG. 51.—*Acanthosoma*. *e*, Cheilognatha; *pl*, pleopoda; other lettering as before.

"Taken April 3, 1875, consequently to the south of Japan, among the Islands of Bonin, 64 × n. s.²

"In the adult animal the mandibles have a palpus; on the other hand, the palpus of

¹ This abbreviation refers to the microscope used in the investigation; in this case a Hartnack with ocular 1, objective 7.

² Fig. 51 reduced for convenience one-third.

the first maxilla becomes very rudimentary, and on the second maxilla the flabellum (mastigobranchia) enlarges, the leg-like condition disappears, and large tubercles (Warzen) are developed. The first maxillipedes like the rest of the feet (pereiopoda) lose the flagellum (basecphysis)."

The above are the notes in reference to the specimen taken by Dr. v. Willemoes Suhm, and by the aid of his clearly drawn figure, may be compared with *Acanthosoma brevitelsonis* on Pl. LXIV. fig. 1. His drawing represents the ventral and mine the dorsal aspect.

In his figure the carapace is scarcely half the length of the animal and is but slightly compressed at the fronto-lateral margin, and the frontal spines are represented as being long, smooth, and situated posteriorly to the second pair of antennæ; whereas in my specimen, which was probably captured about the same time and place, the spines are slightly serrate and are undoubtedly situated at the outer angle of the frontal margin, just above the second pair of antennæ. In Suhm's drawing the rostrum is about two-thirds the length of the carapace and serrate at the margins, whereas in mine the proportional length of the rostrum is not so great and the surface is fringed with slender hair-like processes, which perhaps under certain conditions may resemble a serrate margin. The carapace in Suhm's specimen is armed at the margins with two lateral spinous processes, but as the view given is that of the ventral surface, the dorsal spine at the posterior margin, if it exists, cannot be seen.

The five anterior somites of the pleon are laterally armed with spines; in my specimen all the spines are spinous, in Suhm's those on the fourth and fifth somites are short and smooth. The telsons in all important points are similar.

All the appendages are at the same stage in each; the pleopoda, except the sixth pair, are in a state of gemmation.

Acanthosoma brevitelsonis (Pl. LXIV. fig. 1).

The carapace is about half the length of the animal and but slightly compressed laterally. The rostrum is long, straight, about half the length of the carapace, and fringed with numerous short points or teeth. The frontal or cephalic region is advanced beyond the rest of the carapace, from which it is separated by a constriction immediately behind the second pair of antennæ and anterior to the oral appendages. On each side, at the outer angle, just above the second pair of antennæ, a long spinous process, fringed with numerous tooth-like points, projects. On each side of the outer lateral margin of the carapace, just in a line with, or slightly anterior to, the mandibles, stands a second long, flat, tapering spine-like process, fringed with numerous teeth that are larger at the base than at the apex; posterior to this, on each side, and still on the lateral margin or very close to it, stands a smaller spine-like process, furnished with fewer teeth or points;

on the posterior margin in the median line there is a solitary, erect, spine-like process, fringed with teeth on the dorsal surface, and on each side, at the lateral margin, slightly anterior to the mandibles, between them and the anterior spinous process, there arises a short but prominent spine fringed with teeth.

The pleon has the five anterior somites subequal, smooth on the dorsal surface, but armed at the postero-lateral margin of each with a long spine-like process, fringed with sharp teeth.

The sixth somite is but little longer than the fifth; it is unarmed at the postero-lateral angles, but carries a small tooth on the posterior margin of the dorsal surface.

The telson is short and bifurcate, the caudal fork being short and broad.

The ophthalmopoda are about two-thirds the length of the rostrum, gradually increasing in diameter from the base to the distal extremity, where the ophthalmus is slightly broader than the stalk, more distinctly apparent on the outer than on the inner side.

The first pair of antennæ consists of one long joint, fringed with hairs, that reaches as far as the distal extremity of the rostrum, and terminates in two small single-jointed rami tipped with one or two small hairs.

The second pair of antennæ consists of a broad basal joint, an inner multiarticulate branch that corresponds to the future flagellum, and a long, narrow, foliaceous branch that corresponds to the future scaphocerite, the outer margin of which is smooth, and furnished at the outer angle of the distal extremity with a small tooth, while the inner, which is parallel with the outer, is thin and fringed with hairs.

The mandibles are sharp-pointed and do not appear to carry a synnhipod.

The other oral appendages I have not determined, except the third pair of siagnopoda or first maxillipede, which is in an immature condition, biramose, and tipped with one or two long hairs.

The first and second pairs of gnathopoda are biramose and correspond in development with the third pair of siagnopoda. The pereiopoda are all in a very similar condition.

The pleopoda are in a very immature stage of gemmation, except the sixth pair, which is long, slender, biramose, and well developed; it consists of a basal joint armed with a tooth on the outer distal angle, and supporting two long, narrow, slender branches, with subparallel margins. The outer, which is the longer, is smooth on the outer margin to about one-third of its length, where it is armed with a short strong tooth, beyond which it is fringed with short hairs to the distal extremity, while the inner margin is fringed with long hairs, which are probably ciliated. The inner branch is straight, narrow, tapering, and fringed with hairs, probably ciliated.

Length, 4 mm. (0.16 in.).

Habitat.—The Western Pacific Ocean.

*Acanthosoma tynitelsonis*¹ (Pl. LXIV. fig. 2).

The specimen represented in this figure corresponds in development with that shown in fig. 1 on the same plate. It is probably a slightly older moult of a different but closely allied species.

The carapace appears to be scarcely half the length of the animal. The rostrum is not quite half the length of the carapace, and is generally free from ornamentation, except for a few points near the apical extremity. The spinous processes are also nearly free from ornamentation, and the smaller dorsal teeth are quite smooth. The lateral processes in a line with the mandibles are strongly serrate, those posterior are smaller and but slightly serrate, and the dorsal one on the posterior median line is slender and almost free from teeth.

The pleon has the five anterior somites subequal, and dorsally armed with long slightly spinous teeth, of which that on the third somite is the longest; the sixth somite is twice as long as the preceding, and dorsally armed at the posterior margin with a short smooth tooth.

The telson is short, or less than a third of the length of the outer plate of the rhipidura, and terminates in a wide short fork.

The ophthalmopoda are about two-thirds the length of the rostrum, and have the eye considerably broader than the stalk.

The first pair of antennæ is longer than the rostrum, and terminates in two short unarticulate rami.

The second pair of antennæ has the inner branch multiarticulate, and the outer, which represents the scaphocerite, nearly three-fourths the length of the inner, scarcely broader, and armed on the outer margin with a tooth that is a considerable distance from the extremity, which, as well as the inner margin, is fringed with hairs that are rather short.

The oral appendages, as well as those of the pereion, are present, but, especially the latter, in an incipient condition.

The pleopoda are all developed, and the posterior pair which belongs to the rhipidura is biramose; they are all feeble organs except the posterior pair, which is long, narrow, and, like that of the preceding species, armed with a tooth about one-third distant from the base, the margin beyond being fringed with hairs.

Length, 4 mm. (0.16 in.).

Habitat.—The Western Pacific Ocean.

This specimen is nearly of the same size as the preceding one, but it differs in development in several points. The pleopoda are not yet visible in fig. 1, whereas in this

¹ *τυνός*, small.

specimen they are of considerable length, and have apparently assumed the features of the permanent organs.

The ophthalmopoda are shorter, and the scaphocerite differs in form.

Acanthosoma dorsispinalis (Pl. LXV. fig. 1).

The specimen from which this figure is taken differs very little as to the stage of its development from that represented in fig. 3, Pl. LXIII., but it differs in several important points of structure.

The carapace, exclusive of the rostrum, is about one-third the length of the body of the animal. The rostrum is nearly as long as the carapace, and thickly fringed with small spines. The postero-dorsal spine is long, robust, slightly curved backwards, and smooth, except for the presence of one small spine on the anterior margin, halfway between the base and apex; the outer antennal spine is slender and spinous; that which surmounts the mandibular area is short and denticulate, and the two lateral marginal spines are strongly serrate.

The pleon is dorsally armed with long spines which, including that on the sixth somite, are furnished with smaller spines both on the anterior and posterior margins. The postero-lateral angles of the second and three following somites are also produced into compound spines, of which the anterior is the largest and the posterior the smallest, that of the sixth somite being reduced to a simple, narrow, sharp, spine-like tooth.

The telson is short and curved upwards at the posterior extremity.

The ophthalmopoda are scarcely more than half the length of the rostrum.

The first pair of antennæ is as long as the rostrum, and terminally biramose, the two branches being short and single-jointed; the basal joint, which represents the three joints of the permanent peduncle, exists now as only one, while at the base the lateral enlargement to receive the otocyst is visible, and determined by a small, broad tooth.

The second pair of antennæ has the flagella broken off, but the terminal joint of the peduncle is preserved, as well as the scaphocerite, which is long, narrow, and armed with a small tooth on the outer and smooth side at a short distance from the apical extremity, which, as well as the inner margin, is fringed with hairs.

The oral appendages I have not examined, but the gnathopoda and pereopoda are fairly advanced, although as yet devoid of hairs.

The five anterior pairs of pleopoda are undeveloped, but each somite in the ventral median line is produced into a long, stout, anteriorly curved, sharp-pointed tooth; the sixth somite has no such ventral tooth, and has the pleopoda fully developed, the outer plate being furnished with a strong tooth near the middle of the outer margin, the rest being fringed with long slender hairs.

Length, 2.5 mm. (0.1 in.).

Habitat.—The Western Pacific Ocean.

Observations.—It is interesting to notice that this specimen, while only about two-thirds the length of those from which figs. 1 and 3, Pl. LXIV., were taken, yet has the appendages parallel with them in development.

Acanthosoma longitelsonis (Pl. LXIV. fig. 3).

The carapace is more than one-third the length of the animal including the telson; excluding the telson it is nearly one-half.

The rostrum is about as long as the carapace, and fringed from base to apex with small teeth; a long and slender serrate spine projects above the ophthalmic notch; a short, curved, serrate process stands at the antero-lateral angle of the carapace; a little way behind it on the margin there is a long, slender, smooth spine, and a little more posteriorly is another process or smooth tooth, broad at the base, short, and sharp-pointed; the postero-lateral and posterior margins are smooth.

The pleon has the five anterior somites subequal, and dorsally armed with long serrate spines, which project from the posterior margin and increase in length from the first to the fifth somite; each somite is likewise armed on each side at the postero-lateral angle with long, slender, serrate spines that increase posteriorly to the fifth somite. The sixth somite is about as long as the two preceding ones, it is dorsally smooth and unarmed, except at the postero-lateral angles, which are produced into long, slender, serrate spines, but not so long as those on the fifth somite.

The telson is long, quite as long as the sixth somite, posteriorly forked, the limbs of the fork being parallel at first and then slightly divergent, and armed on each side with one strong posteriorly-directed tooth, and distally with several small teeth.

The ophthalmopoda, about one-third the length of the rostrum or carapace, are slightly fungiform, gradually increasing from the base and suddenly enlarging at the ophthalmus.

The first pair of antennæ has the peduncle three-jointed, and reaching to about half the length of the rostrum; the first joint is longest, the second and third subequal, and the first joint is smooth excepting for two ciliated hairs on the inner and one on the outer distal angle; the second joint has two or three ciliated hairs on the inner and two on the outer margin, and the third joint has two or three ciliated hairs on the inner margin only; attached to the distal extremity are two short branches, the outer representing the long and permanent flagellum, and the inner and shorter the future small and rudimentary appendage.

The second pair of antennæ has a stout basal joint that supports a long, slender flagellum, apparently not multiarticulate, and a long and narrow scaphocerite that is

armed on the outer or smooth side near the apex with a very long and narrow tooth, slightly serrate at the margins, and on the inner side with long ciliated hairs.

The oral appendages are advanced in development.

The third pair of siagnopoda or maxillipede is biramose, and has the several joints fringed with hairs.

The first pair of gnathopoda consists of a long basal joint, which supports two branches; that which represents the permanent limb is four-jointed, while the branch is a slender, feeble appendage.

The second pair differs from the first in being longer and in having the branch or ephysis larger.

The five pairs of perciopoda are all similarly developed, but become slightly shorter posteriorly.

The pleopoda exist as long, narrow, bud-like sacs, except the sixth pair, which is large and well developed. Its two branches are subequal in length, fringed with long hairs, and not longer than the telson. The outer plate has the external margin smooth in its basal half, where it is armed with a long and slender tooth.

Length, 7 mm. (0.28 in.).

Habitat.—The South Pacific Ocean.

This form, as well as *Acanthosoma brevitelsonis*, should be studied in connection with the younger stages of *Mastigopus* (Pl. LXV. figs. 3, 4), and compared with *Sergestes brachyrorrhos* and *Sergestes caudatus*, Kröyer, in which the short and long telson respectively is persistent in the adult.

Another specimen was taken in the Atlantic, on the 13th April 1876, which corresponds in several respects with the present form, but differs in certain details that may depend upon a slight difference in age, and in others of more or less importance.

The form of the rostrum and carapace is the same as in the preceding, but the latter bears a large smooth tooth on each side of the gastric region, and a small tubercle in the median line between them, and just within the posterior margin; also in the median line there is another long anteriorly curved tooth.

The pleon corresponds in its adornment with that of the previous specimen, except that the posterior somite is dorsally armed with a long, serrate, spine-like tooth, and each of the postero-lateral angles terminates in a short, sharp, plain tooth, instead of in a long ornate one.

The appendages correspond with those of the specimen taken in the South Pacific, except that the pleopoda are a little more developed, and the outer plates of the rhipidura are slightly spatuliform, and have the tooth that arms the outer margin somewhat nearer to the distal extremity than to the base, and standing at the broadest diameter of the plate, which is furnished distally and on the inner side with very long ciliated hairs.

Length, 5 mm. (0·2 in.).

Habitat.—Station 352, April 13, 1876; lat. 10° 55' N., long. 17° 46' E.; surface temperature, 77°·7. The Atlantic Ocean; surface.

Acanthosoma macrotelsonis (Pl. LXVI. fig. 1).

Resembles *Acanthosoma longitelsonis*.

Carapace, without the rostrum, one-third the length of the animal including the telson. Rostrum as long as the carapace, smooth, except for a few points near the extremity. On each side, behind the orbital notch, stands a long, slender, spinous tooth or process, another, which is wide at the base, stands at the antero-lateral angle, and is fringed with long spines and short teeth; some distance within the margin on the dorsal surface, in a line with or slightly anterior to the mandibles, stands a third but smaller spinous process; posteriorly and nearer the margin, but at some distance within it, is a fourth small, spinous tooth, while a fifth about the same size projects from a little within the postero-lateral angle.

The pleon has the five anterior somites subequal in length, and dorsally armed with large, sharp, spinous processes projecting from the median line anterior to the posterior margin; that on the first somite is erect and curved forwards, with the anterior margin smooth and the posterior serrate; the second is like the first; the third is straight and armed with one tooth on the anterior margin, and with several on the posterior; the fourth is straight, pointing obliquely upwards and backwards, and armed with teeth on the anterior and posterior margins; the fifth resembles the fourth in form but is smaller. Each somite is likewise armed at the postero-lateral angle with a long, slender, spinous process, of which those on the third and fourth somites are somewhat the longest.

The sixth somite is as long as the three preceding; it is dorsally smooth and unarmed, and furnished with a small smooth tooth near the postero-lateral angle.

The telson is as long as the sixth somite; it is deeply forked and armed on the lateral margin with three fine, distantly placed teeth.

The ophthalmopoda are fungiform and about half the length of the rostrum; from a slender stalk at the base it increases at first suddenly and then gradually to the ophthalmus, which is nearly twice the diameter of the stalk.

The first pair of antennæ consists of two joints; the first is long and narrow except at the base, which is considerably enlarged, forming a broad tooth on the outer side for the purpose of enclosing the otocyst. The margins beyond are straight, parallel, and fringed on the inner side with a row of distantly placed hairs. The second joint is short, attached to the first obliquely, obtusely pointed, and tipped with a few hairs. The first joint probably represents the whole of the future peduncle, and the second the future flagellum.

The second pair of antennæ consists of a basal joint supporting a long and slender

flagellum that appears not to be multiarticulate, and a long and narrow scaphocerite that is not armed with a tooth on the outer side, but is tipped with long hairs at the extremity, and has others that gradually decrease in size from the extremity and disappear about halfway down.

The gnathopoda and pereopoda are advanced in development and biramose, but still in a saccular condition.

The pleopoda are also considerably advanced, but saccular in form, except the sixth pair, which is long and narrow, with the margins parallel and the branches equal. There is no tooth on the outer margin of the external plate, but its place is taken by a small hair or spine, one-fifth distant from the basal articulation, from which point the outer margin is fringed with short hairs, that increase in length to the apex; the inner side of this as well as both sides of the inner plate are also similarly adorned.

Length, 3 mm. (0.12 in.).

Habitat.—Samboangan, Philippines.

Acanthosoma lævirostratis (Pl. LXV. fig. 2).

Carapace about one-third the length of the body of the animal (a little longer than shown in the figure). Rostrum scarcely as long as the carapace, smooth and unarmed. The outer orbital angle carries a long serrate process (which is not clearly shown in the plate as being distinct from the first antenna), a second stands on the antero-lateral angle, another smaller one exists between it and the mandibular attachment, or over it, and a fourth projects from the lateral margin, near the branchial region.

The pleon has each somite dorsally armed with large spinous processes, that stand anterior to the posterior margin, and are all strongly but varyingly spinous; the largest is on the fourth somite, and the smallest on the sixth. The second, third, fourth, and fifth somites are also armed at the infero-lateral margins with strongly serrate spines, but the first somite is smooth and free from ornamentation, and the sixth is furnished with a small smooth denticle. The ventral surface has in the median line a longitudinally narrow, rounded protuberance on the five anterior somites.

The telson is long, slender, forked, and distally armed with a few tooth-like processes.

The ophthalmopoda are shorter than the rostrum and fungiform, the ophthalmus being more than twice the breadth of the stalk.

The first pair of antennæ is longer than the rostrum, and consists of two joints, the basal being long, slender, and reaching considerably beyond the extremity of the rostrum, the second obliquely attached to the extremity of the first, and about one-third of its length, and at its base is the rudiment of the second ramus.

The second pair of antennæ has a basal joint, and supports a slender flagellum that does not reach beyond the extremity of the first pair, and a narrow scaphocerite with

parallel margins, the outer margin being produced to a long blunt tooth at a distance from the extremity, and the inner fringed with long hairs that are rather distantly separated.

The gnathopoda and pereiopoda are biramose and tolerably advanced in development.

The pleopoda are developed on the third, fourth, and fifth somites as unequally biramose, saccular appendages, but I could not detect any on the first two somites; those of the sixth are large and well formed, and have the tooth on the outer margin of the outer plate situated about halfway between the apex and the base.

Mastigopus dorsispinalis (Pl. LXV. fig. 3).

The next stage in which I am able, with the specimens at my command, to trace the progressive development of the short telson form, is in that which Claus has named *Mastigopus*. In the Challenger specimens in this stage also, as previously in *Acanthosoma* and *Elaphocaris*, there appear to be more than one species represented.

The carapace, not including the rostrum, is rather less than a third of the length of the body of the animal. The rostrum is about half the length of the carapace, and unarmed; a small but strong tooth stands at the outer angle of the orbit, and another on each side slightly posterior to the gastric region.

The pleon has the posterior margin of the dorsal surface of each somite armed with a strong tooth, but the postero-lateral angles are smooth and rounded off, except the fifth and sixth, which are produced to a small tooth. The sixth somite is quite as long as the two preceding.

The telson is about half the length of the sixth somite.

The ophthalmopoda are subequal in length to the rostrum. The ophthalmus is broader than the stalk, which narrows gradually to the base.

The first pair of antennæ has the peduncle three-jointed. The first joint is long and slender, broad at the base for the reception of the otocyst, and armed on the outer side with a sharp, stout tooth, whence it suddenly narrows and continues cylindrical to the distal extremity, where it supports the second joint, which is about half the length of the first and a little longer than the third, and this, in turn, supports a flagellum about as long as the peduncle, and a small, secondary, single-jointed branch.

The second pair of antennæ has the flagellum broken off at the peduncle; it carries a long, narrow scaphocerite, subapically furnished with a sharp tooth on the outer side, and fringed with hairs on the inner.

The first pair of gnathopoda has so far assumed the adult character in having the carpos curved at the meral extremity.

The second pair has also much of the character of those of the adult animal; the first three or four joints being robust, and the two terminal ones slender and feeble.

The first pair of pereopoda is short, not half the length of the preceding pair of appendages, appears to be only four-jointed, and exhibits no sign of having any prehensile power at the ultimate articulation. The second pair is longer than the first and not chelate, but terminates in a feeble joint, tipped with one or two hairs. The third pair is longer than the second, and, like it, not chelate, but terminates in an immature dactylos. The fourth and fifth pairs are in an incipient stage of gemmation.

The pleopoda are in a tolerably advanced stage; the first pair is single-branched, the others biramous. The sixth pair, which helps to form the rhipidura, is well developed; the outer plate is armed near the middle of the outer margin with a sharp tooth, and beyond this it is furnished with long and slender hairs.

Length, 6 mm. (0.24 in.).

Habitat.—Taken on March 15, 1875; lat. 1° N., long. 146° E.; in the Pacific Ocean, north-west of the Admiralty Islands.

This form has the branchiæ undergoing development. A two-lobed plume is attached to the membranous articulation between the walls of the pereion and the coxa of the second pair of gnathopoda (*i*).

The first (*k*) and second (*l*) pairs of pereopoda have each a seven-lobed plume similarly situated, while those attached to the third and fourth pairs are smaller, and appear to be fixed to the pereion rather than to the membranous articulation of the leg.

The stomach is visible through the carapace, and contains small masses of undigested food.

On each side of the carapace, posterior to the gastric region, there is a strong tooth, which owing to compression from the mounting of the specimen is represented too high in the figure; from it a fasciculus of muscles appears to spring, and are attached to the apophysis of the mandible.

Observations.—The slide on which this specimen is preserved is labelled by v. Willemoes Suhm "Sergestes cr. larva ten., W. Pacific," by which I presume that he considered one specimen to be *Sergestes crassus*, and others to be the young of some species that he proposed to name *Sergestes tenuis*.

Mastigopus acetiformis.

Carapace one-third the length of the animal. Rostrum about two-thirds the length of the carapace, smooth, slender and horizontal; a small tooth situated behind the orbital angle on the dorsal surface; none corresponding with the position of the antennæ but a small cusp on the fronto-lateral angle; a small tooth stands above the mandibular attachment. The anterior five somites of the pleon are subequal in length, and all are

dorsally smooth except the posterior, which is furnished at the posterior margin with a small tooth. The infero-lateral margin of these somites is produced to a sharp tooth, which gradually increases in length posteriorly, the anterior three being directed forwards and the others obliquely backwards; in the median ventral line is a deep, longitudinally compressed, rounded cusp. The sixth somite is about equal in length to the two preceding, and posteriorly terminates on the dorsal surface in a small tooth.

The telson is about as long as the sixth somite, and terminally forked with two small teeth.

The ophthalmopoda are fungiform and subequal in length to the first joint of the peduncle of the first pair of antennæ.

The first pair of antennæ has the peduncle three-jointed and about as long as the carapace; the first joint is longer than the second, and is enlarged at the base, which is furnished with a sharp anteriorly directed tooth and encloses the otcyst, and the second a little shorter than the third, which supports a multiarticulate flagellum that is as long as the peduncle, and a small uniarticulate secondary ramus.

The second pair of antennæ is broken off at the extremity of the peduncle; it supports a scaphocerite with parallel margins, and nearly as long as the peduncle of the first pair, and is armed with a long and slender tooth near the distal extremity. The basal joint of the peduncle is also armed with a strong tooth at the outer distal angle.

The first pair of gnathopoda is formed after the type of the adult organ, as is also the second pair.

The pereopoda that are developed have lost their lateral ephyse, and have not attained the form of the minute chelæ, at the extremity of the second and third pairs, which are present in the mature form, while the fourth still exists as a small saccular appendage, and the fifth is very minute and rudimentary.

The pleopoda have attained much of their adult character, but their inner branch has not yet reached its normal proportions.

The posterior pair is long, slender, and slightly curved, and is armed with a strong tooth near the middle of the outer margin of the outer branch, while the inner is narrow, pointed, one-fourth shorter, and fringed with hairs.

Length, 6 mm.

Habitat.—The Western Pacific Ocean. (Labelled "Y." (? young) "*Sergestes* V." in Suhl's series.)

This specimen corresponds in general characters with that given on Pl. LXXVI. fig. 2, and it differs only in those temporary features which disappear with age.

It has the rostrum shorter and free from serrature along the margins. It is smooth and does not reach as far as the extremity of the peduncle of the first pair of antennæ. The tooth or spine that stands above the first pair of antennæ is reduced in

proportions, and is not serrate on the surface. That on the fronto-lateral angle of the carapace is reduced to a mere point, while that above the hepatic region is short and slender, and one of the marginal spines has disappeared. The pleon has no dorsal teeth anterior to the fifth and sixth somites, on each of which there exists a small tooth at the posterior extremity. The teeth on the lateral margins exist as sharp points that are smooth and free from ornamentation.

Observations.—This specimen appears to show the gradual transition of the form *Acanthosoma* into that of *Mastigopus*, by the loss of the ephyses and the gradual formation of the pereopoda, *pari passu* with the reduction of the spinous character of the animal.

Mastigopus suhmi, n. sp. (Pl. LXVI. fig. 2).

Carapace, excluding the rostrum, one-third of the length of the body of the animal. Rostrum less than half the length of the carapace, subapically armed with two or three small teeth; a small tooth stands on the outer angle of the orbit and another at the antero-lateral angle of the carapace; the lateral and posterior margins are smooth and free from ornamentation.

Pleon dorsally and laterally free from teeth or spines, except a small tooth on the posterior dorsal margin of the fifth and sixth somites.

Telson less than half the length of the sixth somite, broad at the base and suddenly narrowing towards the extremity, where it is minutely forked.

The ophthalmopoda are pyriform, narrow at the base and broad at the ophthalmus, but the widening is not very sudden.

The first pair of antennæ has the peduncle longer than the rostrum, and is three-jointed; the first joint is broad at the base, being expanded to contain the otocyst, and the outer angle is armed with a tooth, from which the joint suddenly narrows and reaches to about two-thirds of the length of the rostrum. The second joint is narrow, with parallel margins, and reaches to the extremity of the rostrum; the third joint is shorter than the second and supports a long and a short flagellum (the longer flagellum is broken off).

The second pair of antennæ has a broad coxal joint, which supports a flagellum that is broken off and a scaphocerite that is as long as the rostrum, armed with a tooth on the smooth side near the distal extremity, and furnished on the opposite and distal margins with long and slender hairs.

The oral appendages have not been closely examined.

The first pair of gnathopoda has assumed its appearance in the adult, the antepenultimate joint having a knee-like bend near the meral articulation.

The second pair of gnathopoda has the coxal joint short and broad, the second long

and robust, and fringed with hairs on the anterior margin, the third short and slender, and fringed with hairs on the anterior margin, as are the two following joints, which are subequal in length and terminally pointed.

The first pair of pereopoda is missing. The second and third pairs are long and slender. The basal joints are short and robust, the second long and stouter than the first, but not so long nor so stout as that of the second gnathopod; the three following joints are subequal in length to and a little slighter than the previous joints, and are fringed on each side with long and slender hairs. The fourth and fifth pairs of pereopoda exist as rudimentary buds.

The pleopoda are so far developed as to resemble their permanent form.

The first pair is long, slender, and single-branched, the terminal joint being fringed with hairs. The second is shorter and biramose, as are also the three succeeding pairs, each being a little shorter than the preceding, and all are fringed with hairs. The sixth pair is long and well developed, more than twice as long as the telson and nearly as long as the sixth somite; the outer branch is slightly longer than the inner and is armed on the outer margin with a tooth, about midway between the base and the apex, and beyond this fringed with long hairs, as well as on the inner margin, as are also the margins of the inner branch.

Length, 5 mm. (0.2 in.).

Habitat.—The North Atlantic Ocean.

Mastigopus spiniventralis, n. sp. (Pl. LXVII. fig. 4).

Carapace about one-third the length of the body of the animal, anteriorly produced to a long, sharp, straight rostrum, that is more than one-third the length of the carapace, nearly as long as the ophthalmopod, and armed on the dorsal surface at the base with a small tooth; a still smaller one exists on the median dorsal line of the posterior margin.

The pleon has the first five somites subequal in length. The first has the dorsal surface smooth, the second is armed with a small tooth on the posterior margin, the third, fourth, and fifth are similarly armed, but with larger teeth at right angles to the surface. The sixth somite is longer than the two preceding somites together, and is armed at the posterior margin of the dorsal surface with a small tooth directed horizontally backwards; it is also produced to a point at the postero-lateral angle, whereas those of the five preceding somites are smoothly rounded off. From the ventral median line of each somite except the sixth there projects a long tooth, broad at the base and sharply pointed. The anterior teeth are curved forwards, but the direction is gradually changed so that the posterior tooth is directed obliquely backwards.

The telson is stout, terminating in a short fork (4z).

The ophthalmopod is about half the length of the carapace, or a little longer than the rostrum, narrow at the base, and gradually widening until it reaches the ophthalmus, which is slightly broader than the stalk at its distal extremity.

The first pair of antennæ has the first joint of the peduncle as long as the ophthalmopod, broad at the base, where it is expanded to contain the otcyst, and armed with a small tooth or point, from whence it is narrow and cylindrical to the extremity; the second joint is about one-third the length of the first and slightly longer than the third, which supports a long and slender flagellum that makes the antennæ equal to two-thirds the length of the animal.

The second pair is longer than the first, being about equal to the length of the animal, and carries a scaphocerite that is as long as the peduncle of the first pair, armed near the distal extremity with a strong tooth, and having the inner margin fringed with long hairs.

The first and second pairs of gnathopoda are so far developed as to assume the character in the adult.

The first pair of pereopoda also resembles that of the adult animal, but has not yet prehensile power developed, and at the base, on the anterior margin, stands a small tubercle that is probably of specific value; a similar process is placed in the same position on the second pair of pereopoda, but is absent from the third. The second and third pairs differ from those in the adult in not terminating in a small chela; the small terminal dactylos is not yet developed, and in its place there are two long terminal hairs. The fourth and fifth pairs are not yet visible, even as buds.

The pleopoda are long, slender, and well advanced in development; the first pair is single-branched and the following pairs are biramose. The terminal pair is long and narrow, fringed with hairs on both sides, but not armed with a tooth on the external margin of the outer plate.

Length, 7 mm. (0.3 in.).

Habitat.—The Western Pacific Ocean.

A very closely allied specimen (Pl. LXVII. fig. 5) was taken in the North Pacific, but it differs in having the rostrum shorter, it being scarcely more than one-third the length of the ophthalmopod (5a), and in having a small tooth on the outer margin of the outer plate of the rhipidura (5v); the second and third pairs of pereopoda exhibit an incipient chela (5l). It is probably a later moult, as the animal has arrived at the *Sergestes* stage.

A third specimen was taken, also in the Western Pacific (Pl. LXVII. fig. 6), which differs from the two preceding in not having the rostrum armed with a small tooth on the dorsal surface, but a small elevation or protuberance occupies its place. There is also another variation. In the specimen we have described (fig. 4) there is a small tooth projecting from the outer angle of the orbit. This tooth is still more prominent in the

specimen given in fig. 5, but is entirely wanting in that from which fig. 6 is taken, and the fourth (*n*) and fifth (*o*) pairs of pereopoda are here in a stage of gemmation, whereas in fig. 4 they are not appreciable.

Length, 4 mm. (0·17 in.).

Habitat.—The Pacific Ocean; taken March 15, 1875, about 5° north of New Guinea.

Mastigopus crassus, n. sp. (Suhm, MS.).

“*Sergestes* (*crassus*)”.

“Larval stage previous to the moulting of the mature animal.”

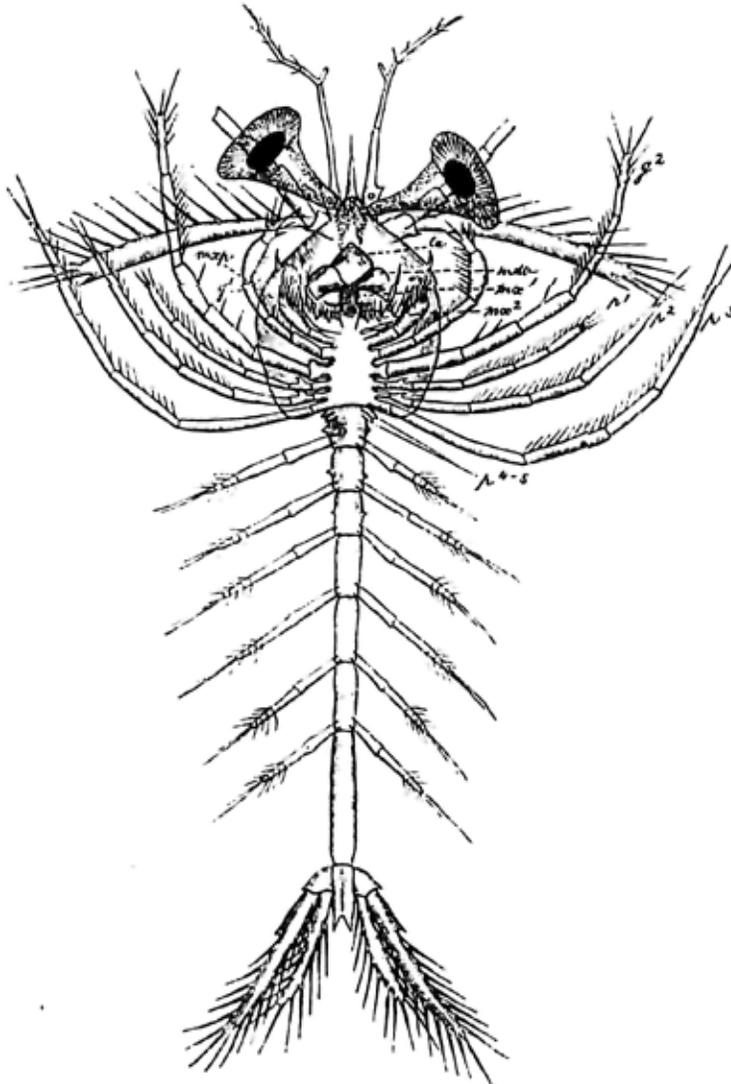


FIG. 52.—(IV) *Mastigopus crassus*. *la*, labrum; *mlb*, mandible; *mx¹*, first maxilla; *mx²*, second maxilla; *mzp*, maxilliped; *g¹*, first gnathopod; *g²*, second gnathopod; *p¹*, first pereopod; *p²*, second pereopod; *p³*, third pereopod; *p⁴⁻⁵*, fourth and fifth pereopoda.

“The posterior two pereopoda are only rudimentary, and the animal now morphologically resembles a *Leucifer*.”

" Otoliths present.

" H. $\frac{1}{7}$; about 35 times nat. size.

" Taken on the voyage from Hilo to Tahiti, lat. $5^{\circ} 0' N$.

" Length of rostrum,	.	.	.	.	.	.	0.31 mm.
" " carapace, without rostrum,	.	.	.	.	.	.	1.0 "
" " abdomen,	.	.	.	.	.	.	2.5 "
Entire length,	.	.	.	.	.	.	3.8 "
Length of ophthalmopod,	.	.	.	.	.	.	0.63 "
Width " "	.	.	.	.	.	.	0.49 "
Length of scale,	.	.	.	.	.	.	1.08 "
" " telson,	.	.	.	.	.	.	0.35 "
Width of carapace,	.	.	.	.	.	.	0.84 "

" Branchiæ still wanting.

" Of the lateral spines of the carapace one is still to be seen."

The preceding figure (fig. 52) is reduced one-third from Dr. v. Willemoes Suhm's drawing, and represents what he calls the fourth or *Leucifer*-stage, or that immediately preceding the adult form. It corresponds closely with that which I have just described as *Mastigopus suhmi*, and which is represented on Pl. LXVI. fig. 2. It differs, however, in some details of more or less importance; Suhm's specimen, for instance, is 3.8 mm. long, while mine is 5 mm., and the carapace is rounder in Suhm's than in that which I have drawn. He represents the ophthalmopoda as being more fungiform and the scaphocerite as being very much longer.

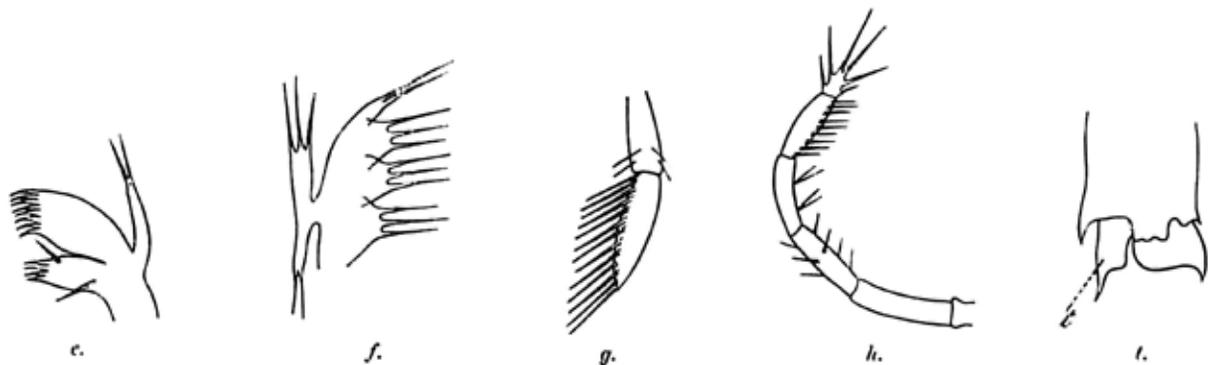


FIG. 53. Oral appendages of *Mastigopus crassus*. *c*, First maxilla; *f*, second maxilla; *g*, maxilliped; *h*, first gnathopod; *t*, telson. seen laterally.

The form of the oral appendages is shown in the annexed cuts (fig. 53).

The second pair of gnathopoda is well shown in fig. 52, as also are the several pairs of pereopoda; the first and second having the basis furnished with a small tubercular process on the anterior margin, similar to that shown in *Mastigopus spiniventralis* (Pl. LXVII. fig. 4). The second and third pairs have not as yet assumed the chelate

condition of the adult form, while the fifth and sixth pairs are in an early stage of gemmation.

The pleopoda are represented by Suhl as being single-branched, whereas in my specimen they are all, excepting the first pair, more or less perfectly biramosc.

The sixth pair differs only in being more slender, with the margins parallel, and in having the tooth on the outer margin nearer the basal articulation. The appendage is long and narrow when compared with that which I have given. The telson is short, as is relatively shown in the figure (at *t*). Suhl remarks that it much resembles the typical features of a young *Leucifer*.

Observations.—By tracing the several stages, we may safely conclude from the direct structural affinities, that *Mastigopus* is a young *Sergestes*, and that it is preceded by the Acanthosoma stage. But the interval between Acanthosoma and Elaphocaris is so great that a comparison of all the various forms which we believe to belong to distinct species requires us to insist upon a clearer demonstration of the developmental connection between the two. If we could bridge over this chasm we might safely trace the sequence, if not in a single direct line, certainly through closely allied genera, to the Elaphocaris, shown by v. Willemoes Suhl to have left the ovum so recently that the yolk-mass had not been all absorbed when he observed it.

Sergestes intermedius, n. sp.

Rostrum one-third the length of the carapace, armed with a tooth on the dorsal crest, just above the orbital margin, and with a small denticle just within the posterior margin in the dorso-median line; the rest of the carapace is smooth, excepting a small tooth on the hepatic region above the point of the mandibular attachment.

Pleon having the five anterior somites subequal in length; the sixth about twice that of the fifth somite. The anterior three are dorsally smooth, the posterior three are armed with a small tooth at the posterior dorsal margin, the last of which is horizontally produced; all the somites are furnished with a small tooth projecting from the lateral walls, and the ventral surface is armed in the median line with a large longitudinally compressed spine-like tooth between each of the anterior five pairs of pleopoda.

The telson is about half the length of the sixth somite and terminates in two small points.

The ophthalmopoda are nearly twice as long as the rostrum, and the ophthalmus is obliquely mounted on, and broader than the stalk, and fungiform in appearance.

The peduncle of the first pair of antennæ is enlarged at the base for the reception of the otcyst, reaches beyond the ophthalmus, and terminates in two flagella, of which the longer is broken off, and the smaller is unarticulate and rudimentary.

The second pair of antennæ is broken off at the extremity of the peduncle; a long and

narrow scaphocerite springs from the second joint and reaches as far as the distal extremity of the ophthalmopod, where, on the outer side, it is subapically armed with a small tooth.

The first pair of gnathopoda is robust, the terminal joint is ovate and much smaller than the penultimate, which is long, broad, flat and ovate, and the antepenultimate joint is genuflexed near the adjoining articulation.

The second pair of gnathopoda is very long; the basis is short and suddenly enlarged to a considerable diameter; the ischium is much narrower than the basis, but the two next succeeding joints are long, moderately broad, have the margins subparallel and reach as far as the extremity of the ophthalmopod; the next three succeeding joints narrow to about half the diameter of the preceding, and taper slightly to a blunt apex that has the margins sparsely furnished with a few hairs.

The first pair of pereopoda is short, five-jointed, and sparsely fringed with long hairs. The two succeeding pairs are long, slender, and furnished with minute chelæ. The penultimate pair is short, saccular and rudimentary, and the last pair is only in a state of gemmation.

All the pleopoda anterior to the rhipidura have only one branch developed; at the base of each branch is a small bud-like process that becomes larger on each successive pair.

Length, 5 mm. (0.2 in.).

Habitat.—China Sea, off Luzon. One specimen.

Observations.—Considerable interest is attached to this little species, which I have named in accordance with its apparently intermediate condition, and because it appears to possess features that are in part common to several species. It resembles *Sergestes læviventralis*, *Sergestes nasidentatus*, *Sergestes longispinus*, and the immature form *Mastigopus spiniventralis* in the character of the rostrum, which corresponds in relative proportion more nearly with that of *Sergestes longispinus* than with that of any of the others named.

It differs from all the preceding species in having a series of large, broad, and longitudinally compressed spine-like processes projecting in the median line, one on each of the ventral surfaces of the several somites; in this, however, it agrees with *Mastigopus spiniventralis*, as also in the form of the rostrum and in the presence of a small denticle at the postero-dorsal extremity of the carapace; it also corresponds with it in having no tooth on the outer margin of the outer plate of the rhipidura, in which respect it differs from the other allied species.

It differs from *Sergestes nasidentatus* in having a tooth on the dorsal surface of the three posterior somites, and from *Sergestes longispinus*, *Sergestes læviventralis*, and *Mastigopus spiniventralis* in having no teeth on the dorsal surface of the anterior three somites of the pleon.

Sergestes intermedius has the appearance of being the early stage of an animal that

has acquired specific features, but is not yet maturely developed, since the dactyli of the second and third pairs of pereopoda are shorter than the pollex, as if these minute chelæ were not yet fully developed; a condition that is also apparent in the incipient stage of the two posterior pairs of pereopoda, and in the immature condition of the inner ramus of the pleopoda.

It is highly probable that this species is a more advanced form in the development of that of which *Mastigopus spiniventralis* is but a younger stage.

Sergestes prehensilis, Spence Bate (Pl. LXXI.).

Sergestes prehensilis, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 193, 1881.

Carapace about one-fourth the length of the animal, slender and smooth, armed in front with a short, sharply-pointed rostrum, directed obliquely upwards. Pleon smooth. Telson half the length of the outer ramus of the rhipidura.

Ophthalmopod (*a*) about twice the length of the rostrum, without a tooth or tubercle on the side. Ophthalmus large, in breadth equal to half the length of the ophthalmopod.

The first pair of antennæ (*b*) has the peduncle three times as long as the ophthalmopod; the first joint is flattened and centrally hollowed, without a prosartema, which is represented by a tuft of hairs, and the stylocerite is short, stout, and terminates in a sharp tooth; the two succeeding joints are nearly as long as the first, cylindrical, and terminate in two flagella, one of which is extremely long, and has a small multiarticulate enlargement at its base supporting slender, flexible cilia; the second is short, slender, and feeble, being a little longer than the terminal joint of the peduncle.

The second pair of antennæ has the scaphocerite nearly as long as the peduncle of the first pair, and has the external tooth in a line with the distal extremity. The phymacerite exists as a small tubercle, directed forwards and upwards, and the ancecerite on the upper surface is curved and pear-shaped.

The mandibles (*d*) have sharp and even psalisiform margins, and carry a long, slender, two-jointed synhipod; behind them are two long bat-shaped metastomata, which overlie the mandibles, and the margins meet the cheiloglossa in front.

The first pair of siagnopoda (*e*) is three-branched, and resembles that of *Benthesicymus* and *Gennadas*.

The second pair (*f*) is three-branched, and carries a broad mastigobranchial plate that projects anteriorly as far forwards as the extremity of the second foliaceous branch.

The third pair (*g*) is three-branched; the first or coxa is short, and carries a long mastigobranchial plate; the second is foliaceous, and armed on the inner side with long serrate spines; the third consists of three joints articulating in succession, the basal being armed with two large and several small spines, and carrying on the outer side a long narrow, membranous plate.

The first pair of gnathopoda (*h*) is robust, long, and pediform, terminating in a short, reversely curved and obtusely pointed stout dactylos.

The second pair (*i*) is long, slender, and feeble, terminating in a long, straight, slender dactylos, bordered with long hairs.

The first pair of pereopoda (*k*) is rather short and generally feeble; it is six-jointed, the dactylos apparently being absent. The propodos is long, slender, and bordered with long articulated hairs, and near its articulation with the carpos there is a fasciculus of serrate hairs or spines mounted on a tubercle which corresponds with another on the adjacent portion of the carpos, and together forming a feeble prehensile organ. The meros is long and the ischium short.

The two succeeding pairs (*l*, *m*) are longer than the others; the two penultimate joints represent the carpos and propodos, and are slender, long, and terminate in a microscopically minute but perfect chela.

The fourth pair (*n*) is one-fourth shorter than the preceding; the terminal joints are broken off in our specimen.

The fifth pair (*o*) is short, six-jointed, and feeble, it is half the length of the second and third, and furnished with a few long hairs.

The branchiæ consist of a podobranchial plume attached to the small or rudimentary mastigobranchial plate belonging to the first pair of gnathopoda; a pleurobranchial plume, with an interstitial foliaceous plate, attached to the three next somites, and two well-developed plumes attached to the two succeeding somites. The branchial formula is represented in the annexed table.

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

The first pair of pleopoda is long, single-branched, and in the adult male carries a large petasma which is hooked in the median line to its fellow of the opposite side.

The second pair carries a small, pointed, scale-like appendage attached to the base of the inner branch, and tipped with a few short spines. The anterior two pairs are long and slender, the succeeding three are robust and short. The posterior pair forms the outer plates of the rhipidura, the telson being only half their length.

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

Habitat.—Station 236, June 5, 1875; lat. 34° 58' N., long. 139° 29' E.; off Japan; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°.6. One specimen, male. Trawled.

This species resembles *Sergestes cornutus*, Kröyer, from which, however, it differs in not having a small tooth on the dorsal surface of the rostrum, although there is an eminence