CEYLON CRUSTACEA.

Part 1.—Notes on the Alpheidæ.

By JOSEPH PEARSON.

(With three Plates.)

THE present report deals with a small collection of Alpheids from the Colombo Museum. The members of the genera *Alpheus* and *Synalpheus*, though numerous in individuals and species, are but little known to any but the specialist in marine carcinology. This is partly owing to their small size, but mainly due to the fact that they generally take up their abode in the deep recesses of some sponge or in the crevices of a fleshy alcyonarian, and even, for want of more favourable shelter, in some friendly hole in a coral. Thus the casual collector may be in the midst of a rich Alpheid fauna without being aware of the fact. Often, however, when sponges are brought up in the dredge and are emptied on deck, the Alpheids will emerge from their retreat.

These tiny creatures are characterized by having an asymmetrical pair of chelæ, one of them being extremely large, perhaps half as big as the body of the animal, while the other is of normal size. The large chela does not appear to be restricted to one side of the body in any particular species. It may be either on the left or on the right side. It is hard to say along what lines this single large chela has been evolved, and the exact meaning of its abnormal development. The Alpheids live in holes, and it is conceivable that, like the hermit crab, the single large claw may be used to block the entrance to the shrimp's retreat. But this does not afford a satisfactory explanation, especially in view of the fact that an Alpheid is much more independent of its place of shelter than is the hermit crab. Moreover, many active Macrurans, such as some of the *Palæmonidæ*, often have asymmetrical chelæ.

These small crustaceans are sometimes known as "snapping shrimps," on account of an interesting habit they have of snapping the fingers of their huge claw. When emptied on deck out of the dredge, or when put into a dish of water, they frequently betray their presence in this way, making a noise which may readily be heard at a distance of fifteen or twenty feet.

I give here an interesting note on the habit of Alpheids, contributed by my assistant, Mr. George Henry. He says :—

"On one occasion I watched two Alpheids, male and female, courting. They were in a pie-dish, full of sea water, with several other creatures, among which were some other Alpheids. The

larger specimen, which I took to be a male, was following the smaller (female) slowly round the pie-dish, and evidently "showing off," feeling her with his antennæ, &c. The pair slowly crawled round and round the pie-dish, the female first, followed by the male. After a while a third Alpheid, presumably another male, became interested in the proceedings and approached the pair. When he was within a few inches of them, the first male discovered his presence and smartly whisked round, at the same time vigorously snapping his large chela. He did not attempt to attack the interloper, but merely snapped a number of times in succession, and this appeared to have the desired effect, because the intruder promptly fled. I was unable to make any further observation as a large cuttle-fish came scrambling round and crawled over the pair, much to the indignation of the male, who snapped his disapproval of this treatment."

The knowledge of colour characters that one is able to derive from specimens of Alpheids preserved in spirit is naturally not very reliable. When living these tiny crustaceans are very daintily and even brightly coloured, and the large chela is always most conspicuous by reason of its well-defined colour, generally of a uniform scarlet. Perhaps nowhere else in Nature are the colours so vivid and so varied as those possessed by the coral fishes and other creatures which frequent the brightly coloured sponge masses and branching corals of tropical seas. The Alpheids form no exception to this rule. Owing to the small size the colours are not very noticeable, but their brilliancy harmonizes with the general colour scheme of the coral reefs and sponge banks where the Alpheids abound.

Our present knowledge of Ceylon Alpheids cannot be regarded as being by any means extensive, as it is based upon two small collections—one made by Professor Herdman in 1902, and the other lying in the Colombo Museum and forming the subject of the present paper. As marine biological research in Ceylon has been mainly concerned with the Pearl Banks, most of the Alpheids hitherto described, and the majority of those dealt with in the present report, have come from that locality. It is true that Professor Herdman made collections all around the Ceylon coast, but those made on the Pearl Banks were much more intensive than those taken elsewhere. Consequently it is not surprising to find that of the eighteen species of Alpheids collected by him fourteen were obtained between Chilaw and Adam's Bridge.

In January last I made a very careful examination of the fauna of Trincomalee Harbour and I found it surprisingly rich in Alpheids. Only six species were represented, but the number of individuals was very large. The presence of so many Alpheids may be accounted for by the abundant sponge fauna of Trincomalee Bay.

The following is a list of the species described in the present report :—

Synalpheus neomeris, var. *streptodactylus*, Coutière.
Synalpheus gravieri, Coutière.
Synalpheus biunguiculatus, var. *exilipes*, Coutière.
Synalpheus tumido-manus, Paulson.
Alpheus ventrosus, H. M.-Edwards.
Alpheus phrygianus, Coutière.
Alpheus bucephalus, Coutière.
Alpheus aculeipes, Coutière.
Alpheus frontalis, H. M.-Edwards.
Alpheus rapax, Spence Bate.
Alpheus bis-incisus, de Haan.
Alpheus audouini, Coutière.
Alpheus strenuus, Dana.

The following table gives a list of Alpheids which have been described from Ceylon up to the present :—

	Herdman's Collection.	Colombo Museum.	General Distribution.
Synalpheus neomeris	×		Indo-Pacific, Australia
—— var. *streptodactylus*		×	Maldives, Ceylon
Syn. gravieri	×	×	Maldives, Ceylon
Syn. biunguiculatus	×		Indo-Pacific
—— var. *exilipes*		×	Maldives, Ceylon
Syn. laticeps	×		Maldives, Ceylon
Syn. tumido-manus		×	Red Sea, Indian Ocean
Syn. comatulorum	×		Indo-Pacific, Australia
Syn. carinatus	×		Indian Ocean
Alpheus ventrosus	×	×	Indo-Pacific, Australia
A. idiocheles	×		Maldives, Ceylon
A. phrygianus	×	×	Maldives, Ceylon
A. bucephalus		×	Indian Ocean
A. aculeipes		×	Maldives, Ceylon
A. paraculeipes	×		Maldives, Ceylon
A. paralcyone	×		Maldives, Ceylon
A. frontalis		×	Indian Ocean
A. miersi	×		Indo-Pacific
A. rapax		×	Indo-Pacific
A. pareuchirus	×		Maldives, Ceylon
A. bis-incisus	×	×	Indo-Pacific
A. audouini	×	×	Indo-Pacific
A. strenuus		×	Indo-Pacific
A. macrodactylus	×		Australia, Ceylon
A. spongiarum	×		Maldives, Ceylon

It is not surprising to find that of the twenty-five species and varieties of the Alpheidæ obtained from Ceylon, only three species have not also been found in the Maldives, as one naturally expects the Maldivian crustacean fauna to be similar to that of Ceylon. Coutière has described sixty-six species and varieties of Alpheids from the Maldives, and there is every reason to believe that when the Ceylon fauna has been thoroughly investigated a large number of species will be added to the present list of Ceylon Alpheids.

In giving the sizes of the various species I have used the following symbols :—

a = Total length of carapace along the mid-dorsal line, commencing at the base of the rostrum.

b^1 to b^6 = Lengths along the mid-dorsal line of abdominal segments 1 to 6 respectively.

b^7 = Total length of telson.

e = Greatest length of propodite of large claw.

e^1 = Greatest height of propodite of large claw.

e^2 = Greatest length of dactylopodite of large claw.

I shall not follow Coutière's terms for the parts of the antennules and antennæ.

For "stylocerite" I shall use *antennular scale;* for "carpocerite," *antennal peduncle;* instead of "scaphocerite," *antennal scale;* and I shall use *basal scale* instead of Coutière's "basicérite."

The following is the literature which has been chiefly consulted in the compilation of the present lists :—

1. *Pearson.*—Herdman's Ceylon Pearl Oyster Report. Supplementary Report No. XXIV. The Macrura. 1905.

2. *Coutière.*—Gardiner's Fauna and Geography of the Maldive and Laccadive Archipelagoes. Les Alpheidæ. 1906.

Genus **Synalpheus,** Spence Bate, 1888.

Cephalothorax laterally compressed. Abdomen well developed. Rostrum small and extremely variable in shape and length. Eyes covered by carapace. The orbital arches well defined and separated from rostrum and antennal sulcus by more or less well-defined grooves. Orbital spines in front of orbital arch always present and well developed, often equal in length to rostrum. First antennular article longer than the others. The antennular scale well developed. Basal antennal scale well developed. Pereiopods without epipodites. First two pairs chelate. First pair extremely large and asymmetrical; the propodite without upper and lower notches; the dactylopodite short. Carpopodite of second pair subdivided into five parts; the first part at least equal in length to the sum of the three following parts. Dactylopodite of last three pairs either bifid or trifid.

Synalpheus neomeris, var. streptodactylus, Coutière.

Syndlpheus neomeris, var. *streptodactylus*, Coutière. Fauna of Mald. and Lacc., 1906.

Two specimens, from Trincomalee ; January, 1911.

The rostrum and orbital spines are equal in length and about two-thirds the length of the first antennular article.

The first antennular article is twice as long as the third and one and a half times as long as the second. The antennular scale extends to the middle of the median article.

The antennal peduncle extends beyond the antennular peduncle by a distance equal to the third antennular article. The antennal scale is slightly longer than the antennular peduncle, but the leaf-like portion is considerably shorter. The basal scale bears two spines: a larger ventral one which nearly reaches the middle of the median antennular article, and a smaller dorsal spine which extends as far forward as the orbital spine.

This variety only differs from de Man's species *neomeris* in the form of the dactylopodites of the third and following pereiopods, The main spine of the dactylos is narrower than in de Man's species, and not so curved. The dorsal spine is longer than in *neomeris*, and is about two-thirds as long as the main spine.

The two specimens are very small, and are, moreover, in a very bad state of preservation, so that satisfactory measurements of the body cannot be given. Measurements of the first three pereiopods are appended, but I cannot say with any certainty that they all belong to the same individual. The only value of these measurements, therefore, is that they give the proportions of the parts of the legs.

Large chela.

e = 5·0 mm.	e^2 = 1·1 mm.
e^1 = 1·5 mm.	

*Second pereiopod.**

i = 1683 ; 370†	c^4 = 165 ; 287
m = 2112 ; 363	c^5 = 429 ; 330
c^1 = 1501 ; 280	p = 1056 ; 363
c^2 = 231 ; 280	d = 676 ; 148
c^3 = 181 ; 277	

Third pereiopod.

m = 2310 ; 594	p = 2046 ; 363
c = 1122 ; 429	d = 660 ; 214

General Distribution.—Maldives, Ceylon.

SYNALPHEUS GRAVIERI, Coutière.

Synalpheus gravieri, Coutière. Fauna of Mald. and Lacc., 1906.

Ten specimens, from the Pearl Banks ; February, 1911.

This form is closely allied to *Synalpheus neomeris*, but differs from it in having a longer antennal scale and a slightly shorter basal scale.

* i = ischiopodite ; m = meropodite ; c^1 to c^5 = segments 1–5 of the carpopodite ; p = propodite ; d = dactylopodite.

† The first of these numbers refers to the length, and the second to the width, of the segment in terms of μ.

The dactylos of the third and following pereiopods is also different, the dorsal spine being extremely small. The propodite is proportionately shorter in this species than in *Syn. neomeris*.

Dimensions of the body.

a = 12·6 mm.	b^6 = 2·4 mm.
b^1 = 2·4 mm.	b^7 = 5·2 mm.
b^2 = 4·5 mm.	e = 11·5 mm.
b^3 = 3·2 mm.	e^1 = 4·9 mm.
b^4 = 3·2 mm.	e^2 = 3·65 mm.
b^5 = 2·4 mm.	

Second pereiopod.

i = 4356 ; 825	c^4 = 627 ; 627
m = 5181 ; 825	c^5 = 1254 ; 660
c^1 = 3762 ; 594	p = 2145 ; 693
c^2 = 792 ; 594	d = 1287 ; 244
c^3 = 627 ; 594	

Third pereiopod.

m = 4785 ; 1617	p = 3729 ; 825
c = 2310 ; 957	b = 1056

General Distribution.—Maldives, Ceylon.

SYNALPHEUS BIUNGUICULATUS, var. EXILIPES, Coutière.

Synalpheus biunguiculatus, var. *exilipes*, Coutière. Fauna of Mald. and Lacc., 1906.

Twelve specimens, from the Pearl Banks ; November, 1910.

The rostrum and the two orbital spines are about equal in length, and the rostrum is much narrower than the orbital spines. The rostrum extends beyond the middle of the first antennular article.

The first antennular article is one and a half times as long as the median article and two and a half times as long as the third. The scale reaches nearly to the middle of the median article.

The antennal peduncle is one-third longer than the antennular peduncle ; its scale is only slightly longer than the latter, and the leaf-like portion of the scale is poorly developed. The basal scale consists of two parts : a longer ventral portion which extends to the middle of the median antennular article, and a smaller dorsal piece which extends as far forward as the tip of the orbital spine.

The following are the dimensions of a typical specimen :—

a = 7·0 mm.	b^6 = 1·5 mm.
b^1 = 1·8 mm.	b^7 = 2·5 mm.
b^2 = 1·8 mm.	e = 9·5 mm.
b^3 = 1·6 mm.	e^1 = 4 0 mm.
b^4 = 1·6 mm.	e^2 = 3·0 mm.
b^5 = 1·25 mm.	

The large claw differs somewhat from that of *S. biunguiculatus* in having the spine at the distal end of upper palmar surface upturned so as to resemble the claw of *Synalpheus apioceros*.

The second pereiopod is richly clothed with setæ near its distal end. Its dimensions are as follows :—

i = 2046 ; 561	c^4 = 297 ; 379
m = 2706 ; 561	c^5 = 627 ; 412
c^1 = 1617 ; 396	p = 1254 ; 429
c^2 = 363 ; 396	d = 759 ; 198
c^3 = 297 ; 379	

The third pereiopod has a single spine at the distal end of the posterior border of the carpopodite, and eight spines on the posterior border of the propodite. The dactylopodite is biunguiculate, the two parts being almost equal. The dimensions are as follows :—

i = 1089 ; 825	p = 2079 ; 528
m = 3399 ; 1056	d = 396 ; 214
c = 1551 ; 627	

General Distribution.—Maldives and Ceylon.

SYNALPHEUS TUMIDO-MANUS, Paulson.

Synalpheus tumido-manus, Paulson. Red Sea Crustacea, 1875.

Synalpheus neptunus, Coutière. Bull. Soc. Ent., France, 1898.

Synalpheus tumido-manus, Coutière. Fauna of Mald. and Lacc., 1906.

One specimen, from the Pearl Banks ; November, 1910.

Six specimens, from bottom of ss. "Violet," Colombo ; October, 1910.

Twelve specimens, from Colombo Harbour ; September, 1907.

This species resembles *Synalpheus biunguiculatus*, but differs from it in the antennal peduncle being comparatively shorter. There is also a slight difference in the dactylopodite of the third pereiopod. The chela is also slightly longer in proportion to the height.

The rostrum and orbital spines resemble those of *Synalpheus buinguiculatus*, var. *exilipes*, except that the rostrum is slightly longer.

The first antennular article is twice as long as the distal article and slightly longer than the median. The scale extends past the middle of the median article.

The antennal peduncle is only slightly longer than the antennal and about the same length as the antennal scale. The ventral part of the basal scale extends beyond the basal antennular article, and the dorsal part is but feebly developed.

The dimensions of the body are as follows :—

a = 8·0 mm.	b^6 = 2·0 mm.
b^1 = 2·6 mm.	b^7 = 3·2 mm.
b^2 = 3·4 mm.	e = 10·6 mm.
b^3 = 2·56 mm.	e^1 = 4·5 mm.
b^4 = 2·25 mm.	e^2 = 3·2 mm.
b^5 = 1·9 mm.	

The dimensions of the second pereiopod are as follows :—

i = 2442 ; 660	c^4 = 363 ; 429
m = 3217 ; 660	c^5 = 825 ; 462
c^1 = 1914 ; 403	p = 1485 ; 495
c^2 = 379 ; 412	d = 785 ; 198
c^3 = 396 ; 429	

The dactylos of the third leg has the ventral part slightly shorter and broader than the dorsal part. There are eight spines on the propodite of the third leg. The distal end of the carpos bears a blunt process on the dorsal side and a sharp spine on the ventral. The dimensions are as follows :—

i = 1369 ; 891	p = 3069 ; 561
m = 3679 ; 1056	d = 858 ; 264
c = 1914 ; 693	

General Distribution.—Red Sea, Indian Ocean.

Genus **Alpheus,** *Fabricius*, 1798.

Cephalothorax laterally compressed. Abdomen well developed. Rostrum small, rarely extending beyond first antennular article. Eyes covered by carapace. The orbital arches well defined and separated from rostrum and antennal sulcus by more or less well-defined grooves. Orbital spines generally absent. First antennal article shorter than the second. Antennular scale much reduced. Basal antennal scale usually extremely small. Pereiopods with epipodites. First two pairs chelate. First pair of pereiopods extremely large and show well-marked asymmetry. Propodite with or without upper and lower notches. Carpus of second pair subdivided into five parts, the proximal part being less than the sum of the three following parts, the last three pairs of pereiopods ending in a simple dactylopodite.

Alpheus ventrosus, H. M.-Edwards.

(Plate V., Fig. 2.)

Alpheus ventrosus, H. M.-Edwards. H. Nat. Crust., t. 2, p. 352, 1837.

Alpheus lævis, Randall. J. Acad. Sci., Philadel., vol. VIII., 1839, and many others.

Alpheus ventrosus, Coutière. Fauna of Mald. and Lacc., 1906.

Six specimens, from Weligama.

Three specimens, from the Pearl Banks ; February, 1911.

According to Coutière this is the commonest species of Alpheus, and the most widely distributed.

I have followed Coutière in including Randall's species along with that of Milne-Edwards.

This is one of the few examples of an Alpheus possessing orbital spines.

The rostrum, which extends almost to the extremity of the first antennular article, is well developed, and is separated from the orbits by well-defined grooves.

The first and second antennular articles are almost equal and nearly twice as long as the distal article. The antennular scale reaches nearly to the middle of the second article.

The antennal peduncle and scale are about equal in length, and extend beyond the antennular peduncle by a distance nearly equal to the third antennular article. There is a basal scale present which is nearly as long as the first antennular article.

This species is characterized by having the cephalothorax laterally compressed to a marked degree. The carapace is very deep, and its greatest depth is equal to its mid-dorsal length. Instead of the lower edge of the carapace being rounded as in most species, there are several sharp angles which give this form a very characteristic appearance.

The following are the dimensions of a typical specimen :—

a = 9·0 mm.	b^4 = 3·5 mm.	e =14·9 mm.
b^1 = 1·7 mm.	b^5 = 2·8 mm.	e^1 = 6·0 mm.
b^2 = 4·25 mm.	b^6 = 3·0 mm.	e^2 = 5·0 mm.
b^3 = 3·6 mm.	b^7 = 5·0 mm.	

The large claw is laterally compressed, and possesses no upper and lower teeth on the palm. The hands of both the first pereiopods are coloured bright orange in the living specimen and have a mottled appearance. Some of the specimens have a setiferous ridge on the movable finger of the smaller hand. The presence of this setiferous ridge is doubtless a sexual difference, and is probably confined to males. I cannot, however, give any proof of this, as in every specimen the first pereiopods are detached and are lying loose at the bottom of the bottle.

The second pereiopod is not so slender as in most Alpheids. The hand is richly clothed with setæ.

The following are the measurements of the second pereiopod :—

i = 2112 ; 825	c^2 = 1023 ; 759	c^5 = 1221 ; 693
m = 4290 ; 990	c^3 = 858 ; 726	p = 1551 ; 693
c^1 = 2310 ; 792	c^4 = 825 ; 726	d = 359 ; 297

The third pereiopod is fairly strongly made. The dactylopodite is not nearly so slender as in most species of *Alpheus*. Dimensions of third pereiopod :—

m = 4290 ; 1551	p = 2706 ; 858
c = 2673 ; 1155	d = 1320 ; 660

Altogether this species is a very distinctive one, and in many ways is different from a typical member of the genus.

General Distribution.—Indo-Pacific.

ALPHEUS PHRYGIANUS, Coutière.

Alpheus phrygianus, Coutière. Fauna of Mald. and Lacc., 1906.

Three specimens, from the Pearl Banks ; February, 1911.

The rostrum is represented by an extremely small projection. It is continued back between the eyes as a well-defined ridge.

The antennular peduncle are comparatively long and slender. The proximal article is shorter than the distal and the median is twice as long as the distal. The antennular scale is rounded in front, and is half the length of the proximal article.

The antennary peduncle is short and only extends to the end of the median antennular article. Its scale is still shorter, and only reaches to the middle of the median article.

The following are the dimensions of the body :—

a = 7·6 mm.	b^6 = 2·1 mm.
b^1 = 1·9 mm.	b^7 = 2·69 mm.
b^2 = 2·0 mm.	e = 8·1 mm.
b^3 = 2·18 mm.	e^1 = 3·67 mm.
b^4 = 2·5 mm.	e^2 = 2·2 mm.
b^5 = 2·0 mm.	

The hand of the large claw is peculiar, and the dactylopodite has a process directed backward, which makes the dactylos hammer-shaped.

The second pereiopod is exceeding slender and has the following proportions :—

i = 5775 ; 693	c^4 = 792 ; 528
m = 7326 ; 5181	c^5 = 1221 ; 594
c^1 = 2772 ; 488	p = 2574 ; 693
c^2 = 2871 ; 528	d = 1154 ; 307
c^3 = 693 ; 528	

In the third and following legs the meros has a well-developed process near the distal end. At the distal end of the carpos there is a blunt process on the dorsal side and a spine on the ventral side,

The propodite has six spines, and the dactylos is well curved and single. The dimensions of the third leg are as follows : —

i = 1386 ; 990	p = 2508 ; 581
m = 3993 ; 1221	d = 792 ; 198
c = 3300 ; 726	

This form undoubtedly belongs to the *obeso-manus* group.

General Distribution.—Maldives, Ceylon.

Alpheus bucephalus, Coutière.

Alpheus crinitus, Coutière. Bull. Soc. Entom., 1898.
Alpheus bucephalus, Coutière. Fauna of Mald. and Lacc., 1906.

One specimen, from Trincomalee ; January, 1911.

The rostrum is short and is not half as long as the first antennular article. The rostrum is continued with a median ridge which extends backwards between the orbits.

The first and third antennular articles are equal, and both are slightly shorter than the median article. The scale is small, and only half the length of the first article. The peduncle is only five-sixths the length of the antennal peduncle, and equal in length to the antennal scale.

The single specimen is small, and is too mutilated for accurate measurement.

The dimensions of the chelæ are as follows :—

e = 7·0 mm. ; e^1 = 3·15 mm. ; e^2 = 2·7 mm.

The fingers are very short, and the palm is high in comparison to its length. Both upper and lower palmar borders are smooth.

The second pereiopod possesses a long second segment to the carpos. The dimensions are as follows :—

i = 2277 ; 462	c^4 = 462 ; 346
m = 2970 ; 330	c^5 = 660 ; 363
c^1 = 643 ; 297	p = 1221 ; 429
c^2 = 1840 ; 330	d = 627 ; 165
c^3 = 462 ; 330	

The third pereiopod is very broad. There is a well-developed spine on the ischium. The meros broadens out distally into a very prominent spine on the lower side. The carpos has a blunt spine at the distal end of its lower border. The propodus is short and has about eight spines irregularly arranged on the lower side. The upper side is richly clothed with setæ. The dactylos is strong and curved. Dimensions :—

m = 2310 ; 792	p = 990 ; 429
c = 1155 ; 495	d = 528 ; 165

General Distribution.—Indian Ocean.

ALPHEUS ACULEIPES, Coutière.

Alpheus aculeipes, Coutière. Fauna of Mald. and Lacc., 1906.

Two specimens, from the Pearl Banks ; February, 1911.

The rostrum is poorly developed.

The proximal antennular article is slightly shorter than the distal. The median article is nearly twice as long as the proximal. The scale is short, and does not reach to the end of the first article.

The antennal peduncle is one and a quarter times the length of the antennular peduncle. The spine of the scale is nearly as long as the antennal peduncle, but the leaf-like portion is shorter than the antennular peduncle.

The dimensions of the body are as follows :—

a = 5·0 mm.	b^4 = 1·67 mm.	e = 7·6 mm.
b^1 = 1·0 mm.	b^5 = 1·2 mm.	e = 3·3 mm.
b^2 = 1·2 mm.	b^6 = 1·3 mm.	e^2 = 3·0 mm.
b^3 = 1·2 mm.	b^7 = 2·0 mm.	

The chela is exceedingly large in proportion to the body, and is probably about three-quarters as large as the rest of the body. The fingers are short.

The dimensions of the second pair of pereiopods are as follows :—

i = 2277 ; 363	c^2 = 1534 ; 238	c^5 = 561 ; 264
m = 2442 ; 251	c^3 = 379 ; 247	p = 1105 ; 297
c^1 = 495 ; 231	c^4 = 379 ; 257	d = 627 ; 115

The third pereiopod has a small spine on the ischium ; the meros has numerous short spines on its ventral border ; near this border is a longitudinal ridge which ends distally in a well-developed spine. The short carpos has a similar ridge and spine. The propodite has about a dozen spines more or less irregularly arranged. The dactylos is curved, and is characterized by the presence of a small process on its ventral surface. The carpos and propodos are richly clothed with setæ. Dimensions :—

i = 792 ; 594	c = 1320 ; 462	d = 373 ; 99
m = 2475 ; 660	p = 1518 ; 363	

General Distribution.—Maldives, Ceylon.

ALPHEUS FRONTALIS, H. M.-Edwards.

(Plate VI., Fig. 3.)

Alpheus frontalis, H. M.-Edwards. H. Nat. des Crust., 1834.
Alpheus latifrons, H. M.-Edwards. J. Mus., Godefroy, 1874.
———— de Man., Arch. f. Naturg., 1887.
Alpheus frontalis, Coutière. Fauna of Mald. and Lacc., 1906.

One specimen, from the Pearl Banks ; February, 1911.

The frontal region of carapace has a very characteristic appearance. There is no well-defined, sharply-pointed rostrum, but instead there is a broad lobe covering the bases of both antennules. This lobe is carinated in the mid-dorsal line. The region of the carapace covering the eyes is greatly arched and bulges out considerably. The proximal and distal antennular articles are subequal, and together are equal in length to the median article. From the anterior end of the proximal article there arises a well-defined bunch of long setæ which point anteriorly and extend beyond the end of the peduncle. The antennular scale is poorly developed and is merely a broad lobe about half as long as the proximal article.

The antennal peduncle is slightly longer than the antennular. The scale is short and does not reach much beyond the end of the median antennular article.

The dimensions of the specimen are as follows :—

a = 10·65 mm.	b^6 = 3·0 mm.
b^1 = 3·0 mm.	b^7 = 5·25 mm.
b^2 = 4·5 mm.	e = 10·5 mm.
b^3 = 3·6 mm.	e^1 = 4·4 mm.
b^4 = 3·95 mm.	e^2 = 3·5 mm.
b^5 = 3·0 mm.	

The first pereiopods have no teeth on the palmar borders.

Dimensions of second pereiopod :—

m = 3960 ; 561	c^4 = 528 ; 462
c^1 = 2409 ; 330	c^5 = 858 ; 495
c^2 = 759 ; 396	p = 1452 ; 528
c^3 = 561 ; 429	d = 639 ; 231

The third pereiopod has three spines on the posterior face of the carpopodite, and the distal end of this face also ends in a spine. There are seven spines on the propodite. The following are the dimensions :—

m = 5082 ; 1221	p = 3531 ; 359
c = 2640 ; 858	d = 990 ; 264

General Distribution.—Indian Ocean.

ALPHEUS RAPAX, Spence Bate.

(Plate VI., Fig. 4.)

Alpheus rapax, Spence Bate. "Challenger," Macrura, 1888.

One specimen, from Nachchikuda, Tamblegam.

The median antennular article is more than twice as long as the distal. The proximal and distal articles are equal. The scale is not so long as the first article.

The antennal peduncle and scale are about equal in length and slightly longer than the antennular peduncle. Spence Bate figures the antennal scale as being much longer than the peduncle, but this appearance is due to the long setæ on the front border of the scale.

The following are the dimensions of the body :—

a = 10·5 mm.	b^6 = 3·5 mm.
b^1 = 2·95 mm.	b^7 = 4·4 mm.
b^2 = 4·35 mm.	e = 11·6 mm.
b^3 = 4·0 mm.	e^1 = 3·5 mm.
b^4 = 3·7 mm.	e^2 = 4·35 mm.
b^5 = 3·25 mm.	

The large claw is flattened laterally, and its length is two and a half times the height. Both upper and lower palmar surfaces are smooth.

There is nothing noteworthy about the second pereiopods. The measurements are as follows :—

i = 4620 ; 462	c^4 = 792 ; 297
m = 3861 ; 429	c^5 = 924 ; 330
c^1 = 2310 ; 297	p = 1386 ; 396
c^2 = 1947 ; 280	d = 825 ; 165
c^3 = 792 ; 297	

The third pair of pereiopods are characterized by having no regular row of spines on the propodite and by the lanceolate nature of the dactylopodite. The dimensions are as follows :—

m = 5610 ; 1023	p = 3861 ; 594
c = 3135 ; 759	d = 2310 ; 363

Distribution.—Indo-Pacific.

Alpheus bis-incisus, de Haan.

Alpheus bis-incisus, de Haan. Fauna Japonica, 1839.

Six specimens, from the Pearl Banks ; February, 1911.

Three specimens, from Trincomalee ; January, 1911.

One specimen, from Colombo Harbour ; September, 1910.

I have had considerable difficulty in deciding whether to place some of the above specimens in Coutière's varieties *malensis* and *stylirostris*. Minute investigation, however, has revealed the fact that there appears to be no constancy in the proportions of the hands of the first pereiopods and in the carpopodite of the second pereiopods upon which Coutière established his new varieties.

I have, in fact, several specimens which show intermediate conditions between de Haan's species and the variety *malensis*, both regarding the proportions of the hands of the first pereiopods and the relative lengths of the first and second articles of the carpos of the second pereiopods.

With regard to the rostrum, I have found that it shows considerable variation in this species, and consequently I do not consider that Coutière was justified in creating the new variety *stylirostris* upon the form of the rostrum of a single specimen. A careful consideration of the whole question makes me unwilling to separate any of these specimens from de Haan's species. Coutière's knowledge of the Alpheidæ is unsurpassed, and gives him an authority which one hesitates to question. But one cannot help feeling that many of the characters upon which he has established new species appear to be unimportant, and in some cases the material at his disposal does not appear to have been sufficiently abundant to enable him to say with any justification that these characters are constant.

In establishing his two new varieties, Coutière makes use of certain characters, the chief of which are, (1) the relation between the total length of the propodite of the first leg (p) and the length of the dactylopodite (d); (2) the relation between the height of the fingers (h^1) and the height of the palm of the first pereiopod (h^2); (3) the relation between the lengths of the first (c^1) and second parts (c^2) of the carpopodite of the second pereiopod; and (4) the relation between the length of the triangular rostrum (l) and the base of the triangle (b).

The following table gives Coutière's measurements for the three species :—

	$\frac{p}{d}$	$\frac{h^1}{h^2}$	$\frac{c^1}{c^2}$	$\frac{l}{b}$
Synalpheus bis-incisus ..	2·75 ..	1·6 ..	1·7 ..	about 1·5
S. bis-incisus, var. *malensis* ..	2·50 ..	1·34 ..	1·33 ..	about 1·5
S. bis-incisus, var. *stylirostris* ..	Not given		1·53 ..	about 3·5

To illustrate how the Ceylon specimens differ from the above measurements I append the following table, giving the characters of six specimens belonging to the present collection :—

Specimen.	$\frac{p}{d}$	$\frac{h^2}{h^1}$	$\frac{c^1}{c^2}$	$\frac{l}{b}$
A ..	2·61 ..	1·40 ..	1·43 ..	1·83
B ..	2·41 ..	1·41 ..	1·51 ..	2·48
C ..	2·73 ..	1·59 ..	1·56 ..	2·72
D ..	2·63 ..	1·36 ..	1·32 ..	2·60
E ..	Chela absent.		1·53 ..	2·77
F ..	2·82 ..	1·56 ..	1·60 ..	2·50

It will be seen that specimen C is the only one which approaches *A. bis-incisus* as diagnosed by Coutière, except that the rostrum is too long. Specimen E appears to be similar to *stylirostris*. None appear to correspond to the variety *malensis*.

I have no hesitation in identifying the specimens under discussion as *Alpheus bis-incisus*, and, as I have pointed out, my examination indicates a considerable amount of variation in all those characters upon which Coutière formed the new varieties.

The rostrum is triangular, and is separated from the orbits by deep depressions. The shape of the triangle is not constant, and varies between the type figured by Coutière as *malensis* and that of *stylirostris*. The rostrum does not reach the end of the first antennular article. The first antennular article is slightly longer than the second and twice as long as the third. The antennular scale reaches to the end of the first article. The antennal penduncle and scale are about equal, and are slightly longer than the antennular peduncle.

The dimensions of specimen A are as follows :—

a = 10·0 mm.	b^6 = 3·5 mm.
b^1 = 2·5 mm.	b^7 = 4·3 mm.
b^2 = 2·5 mm.	e = 17·0 mm.
b^3 = 3·2 mm.	e^1 = 7·0 mm.
b^4 = 3·25 mm.	e^2 = 6·5 mm.
b^5 = 2·6 mm.	

The large claw is of the "edwardsi" type, and this form undoubtedly belongs to that group of species.

The second pereiopod calls for no further comment. The following are the dimensions in specimen A :—

i = 4455 ; 643	c^4 = 693 ; 528
m = 4884 ; 561	c^5 = 1254 ; 544
c^1 = 2838 ; 528	p = 2376 ; 627
c^2 = 1848 ; 528	d = 1254 ; 247
c^3 = 726 ; 528	

The third pereiopod has about seven spines on the propodite. The propodite is richly clothed with setæ. The dactylopodite is long and curved. Dimensions :—

i = 1746 ; 653	p = 4092 ; 528
m = 5280 ; 726	d = 1518 ; 231
c = 3184 ; 627	

General Distribution.—Indo-Pacific.

ALPHEUS AUDOUINI, Coutière.

(Plate VII., Fig. 5.)

Alpheus edwardsi, Coutière (not *audouini*). Bull. Soc. Ent. France, 1898.

Alpheus audouini, Coutière. Fauna of Mald. and Lacc., 1906.

Five specimens, from the Pearl Banks; February, 1911.

This form is very similar to *A. edwardsi* (*audouini*), but differs from it in the form of the palmar projections of the large claw. In *A. edwardsi* they are spinous and in the present species rounded.

This species, although related to *A. strenuus*, differs from it by well-marked characters. The second antennular article is only one and a half times as long as the third.

In *A. strenuus* a line joining the two palmar ridges of the large claw divides the hand into two equal parts. In *A. audouini* the distal portion of the hand is comparatively shorter, and such a line divides the hand in the proportions of 6 : 5.

The second pereiopod shows a difference in the proportions of the first and second parts of the carpos in the two forms. In *A. strenuus* the first segment is only slightly longer than the second (1·12 : 1). In *A. audouini* the proportion is 1·6 : 1.

The third pereiopod of the present species is not so robust as in *A. strenuus*, and the propodite does not bear so many spines.

The following are the dimensions of this form :—

a = 6·6 mm.	b^6 = 2·0 mm.
b^1 = 1·7 mm.	b^7 = 2·62 mm.
b^2 = 2·51 mm.	e = 9·5 mm.
b^3 = 2·3 mm.	e^1 = 4·0 mm.
b^4 = 2·62 mm.	e^2 = 3·5 mm.
b^5 = 1·6 mm.	

Dimensions of second pereiopod :—

i = 2541 ; 462	c^4 = 396 ; 363
m = 2640 ; 462	c^5 = 693 ; 396
c^1 = 1584 ; 363	p = 1452 ; 429
c^2 = 990 ; 363	d = 825 ; 198
c^3 = 495 ; 363	

Dimensions of third pereiopod :—

m = 3300 ; 627	p = 2442 ; 363
c = 1914 ; 396	d = 1023 ; 165

General Distribution.—Indo-Pacific.

Alpheus strenuus, Dana.

(Plate VII., Fig. 6.)

A. strenuus, Dana. U. S. Expl. Exped., 1852.

A. strenuus, Coutière. Fauna of Mald. and Lacc., 1906.

Localities.—One specimen, from Weligama ; November, 1905.

One specimen, from the Pearl Banks ; February, 1911.

Five specimens, from Mandativu, Jaffna ; July, 1903.

One specimen, from Nachchikuda, Tamblegam ; September, 1908.

Six specimens, from Delft ; June, 1903.

Nine specimens, from Kapalturai, Tamblegam ; October, 1907.

This is a fairly common form, and is the largest of all the Ceylon Alpheids. It is closely related to *A. edwardsi* and *A. audouini*, but differs from them both in the relative lengths of the second and third antennular articles. The second article is twice as long as the third, and the first article is intermediate in size. The antennular scale reaches to the extremity of the first article. The antennal peduncle is longer than that of the antennule. The spine of the

antennal scale does not reach the extremity of the peduncle, but is longer than the antennular peduncle. The rostrum does not reach to the extremity of the first antennular article.

The dimensions of the body are as follows :—

a = 18·25 mm.	b^4 = 6·0 mm.	e = 24·0 mm.
b^1 = 3·6 mm.	b^5 = 4·0 mm.	e^1 = 10·5 mm.
b^2 = 5·8 mm.	b^6 = 4·8 mm.	e^2 = 10·0 mm.
b^3 = 5·2 mm.	b^7 = 6·4 mm.	

The large claw has been described and figured by Coutière.

The second pereiopod has the following proportions :—

i = 7920 ; 1089	c^2 = 3531 ; 825	c^5 = 2145 ; 858
m = 8151 ; 1056	c^3 = 1386 ; 825	p = 3465 ; 1023
c^1 = 3960 ; 858	c^4 = 1320 ; 825	d = 1848 ; 429

The third pereiopod has the propodite provided with seven or eight pairs of spines arranged more or less irregularly on the anterior side. The dactylos is a strong slightly curved hook. The following are the proportions of the parts :—

i = 2970 ; 1815	c = 6006 ; 1419	d = 2475 ; 495
m = 8580 ; 2442	p = 6105 ; 1320	

The above dimensions are taken from a typical form of this species.

The rostrum varies in length. In one specimen it passes well beyond the first antennular article, and in another it is as long as that article. Normally the rostrum is only about two-thirds as long as the first article.

General Distribution.—Pacific ; Maldives, Ceylon.

Explanation of the Plates.

Plate V.

Fig. 1.—*Synalpheus biunguiculatus*, var. *exilipes*.

Fig. 2.—*Alpheus ventrosus*. *2a*, frontal region of carapace, with antennæ and antennules × 8 ; *2b*, second pereiopod × 9 ; *2c*, third pereiopod × 9 ; *2d*, dactylopodite of third pereiopod × 21.

Plate VI.

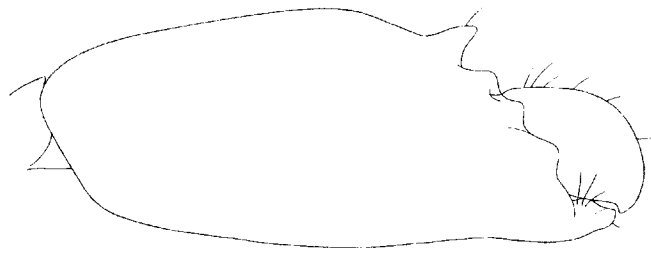
Fig. 3.—*Alpheus frontalis*. *3a*, frontal region of the carapace, the antennules, and antennæ × 6 ; *3b*, second pereiopod × 8 ; *3c*, third pereiopod × 8.

Fig. 4.—*Alpheus rapax*. *4a*, second pereiopod × 8 ; *4b*, third pereiopod × 8.

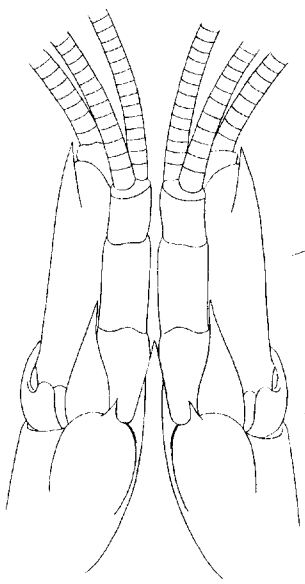
Plate VII.

Fig. 5.—*Alpheus audouini*. *5a*, frontal region of carapace, the antennules, and antennæ × 9 ; *5b*, second pereiopod × 10 ; *5c*, third pereiopod × 10.

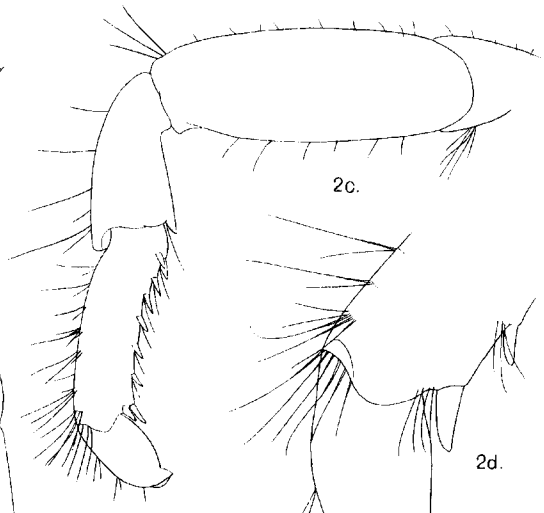
Fig. 6.—*Alpheus strenuus*. *6a*, second pereiopod × 4 ; *6b*, third pereiopod × 4.



1.

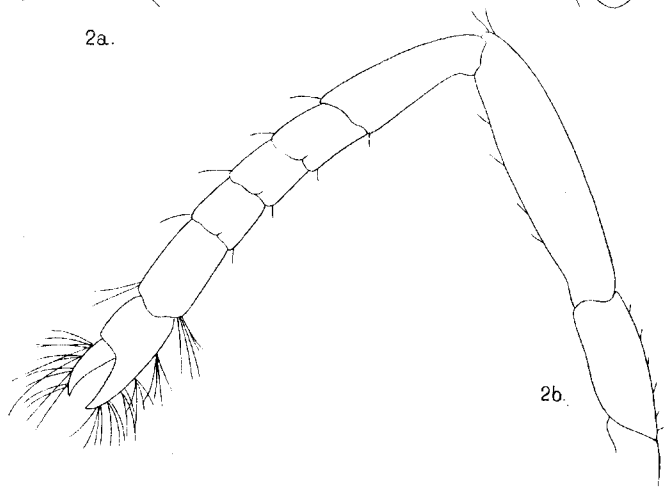


2a.



2c.

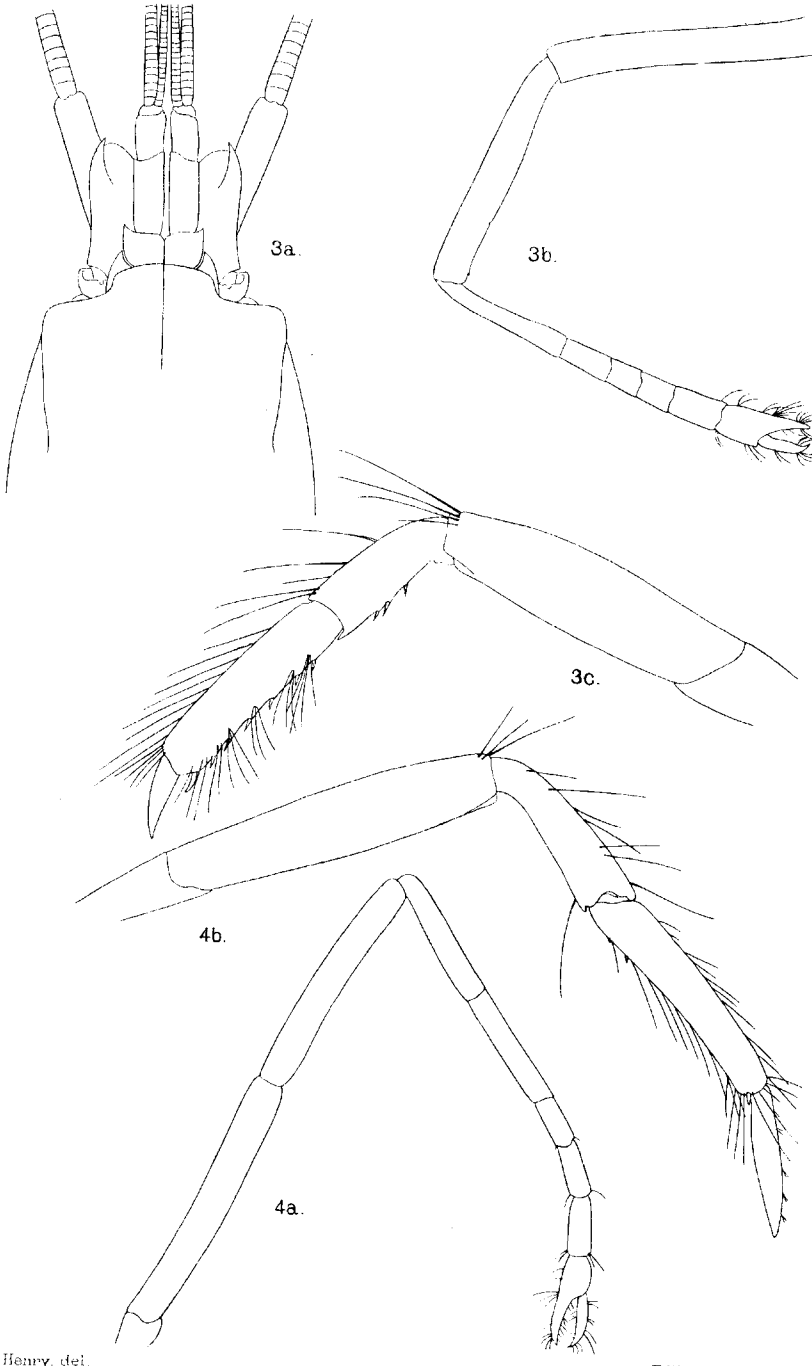
2d.



2b.

G Henry, del. E Wilson, Cambridge.

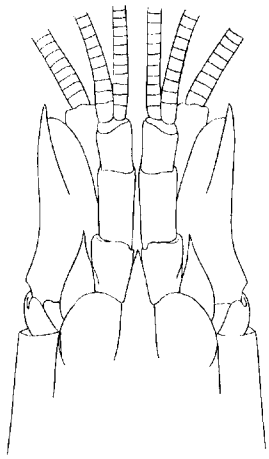
FIG. 1. SYNALPHEUS BIUNGUICULATUS *var.* EXILIPES.
FIG. 2. ALPHEUS VENTROSUS.



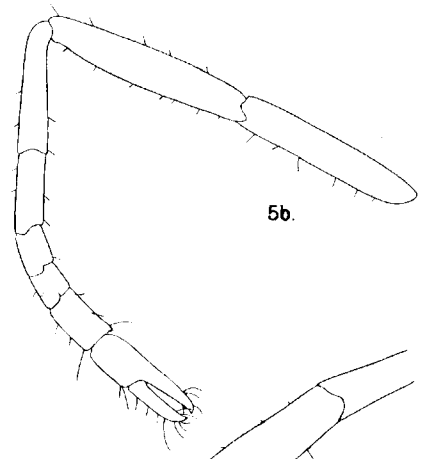
G.Henry. del.

E.Wilson, Cambridge

FIG. 3 ALPHEUS FRONTALIS
FIG 4 ALPHEUS RAPAX.



5a.



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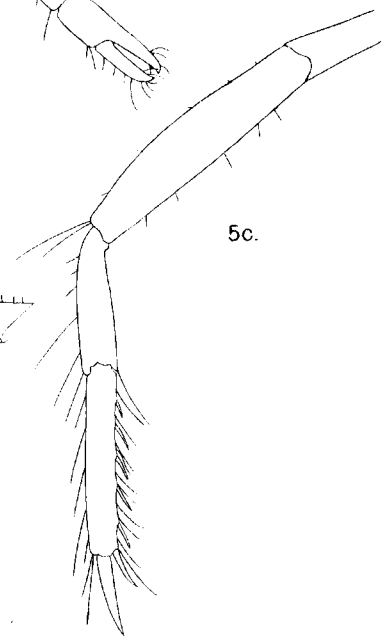

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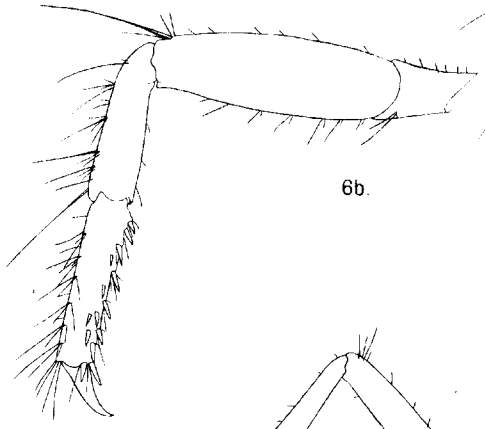
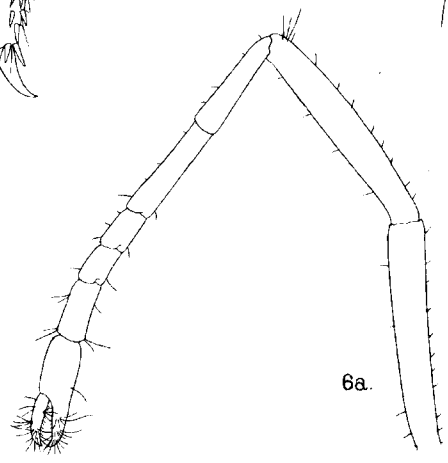


6b.



6a.

G. Henry, del. FIG. 5. ALPHEUS AUDOUINI J. Wilson, Cambridge.
FIG. 6. ALPHEUS STRENUUS.