Tiwari 1963

Ann. Fac. Sci. Saigon, 1963, 289-362.

Alpheid Shrimps (Crustacea : Decapoda : Alpheidae) of Vietnam

by

KRISHNA KANT TIWARI

Zoological Survey of India, Calcutta

INTRODUCTION

The present paper deals with a collection of alpheid shrimps from Viet Nam received through the courtesy of Monsieur R. Serene, formerly Director of the Institute of Oceanography, Nhatrang (Viet Nam). Though small in size the material has proved to be fairly rich. It contains 23 species belonging to the genera *Alpheopsis* Coutière. *Synalpheus* Bate and *Alpheus* Fabricius, the last named genus accounting for all but three species. Two new species, one each belonging to *Alpheopsis* and *Alpheus*, have been briefly described by the author (Tiwari, 1962) in an earlier paper. The remaining species are already known and some of them have an extensive distribution in the Indo-West-Pacific.

The following species are represented in the collection :

Genus **Alpheopsis** Coutière, 1897

1 — *Alpheopsis vietnami* Tiwari, 1962

Genus **Synalpheus** Bate, 1888

2 — *Synalpheus consobrinus* DeMan, 1909a

3 — *S. pescadorensis* Coutière, 1906

Genus **Alpheus** Fabricius, 1798

(*Megacheles* Group)

4 — *Alpheus deuteropus* Hilgendorf, 1879

(*Macrochirus* Group)

5. — *A. gracilis* Heller, 1861

6 — *A. lottini* Guérin, 1829

7 — *A. facetus* DeMan, 1908

(*Crinitus* Group :

a. Subgroup *Obesomanus*)

8 — *A. microstylus* (Bate), 1888

9 — *A. lutini* Coutière, 1906

(b. Subgroup *Crinitus*)

10 — *A. paraculeipes* Coutière, 1906

11 — *A. frontalis* H. Milne-Edwards, 1837

(a. Subgroup *Diadema*)

12 — *A. ehlersii* DeMan, 1909a

13 — *A. gracilipes* Stimpson, 1861

(*Brevirostris* Group)

14 — *A. pubescens* DeMan, 1908

15 — *A. rapacida* DeMan, 1908

(*Edwardsii* Group)

16 — *A. bisincisus* De Haan, 1849

17 — *A. audouini* Coutière, 1906

18 — *A. crassimanus* Heller, 1862

19 — *A. serenei* Tiwari, 1962

20 — *A. strenuus* Dana, 1852

21 — *A. pacificus* Dana, 1852

22 — *Alpheus* sp.

23 -- *A. malabaricus* Fabr. var. *dolichodactylus* Ortman, 1890

ACKNOWLEDGEMENTS

The present work was completed at the Marine Biological Laboratory, Plymouth, where the author worked during the tenure of Colombo Plan fellowship in 1959-1960. The author expresses his thanks to the United Kingdom Government and the British Council for the award of the fellowship, for all the facilities received during his stay in the United Kingdom and also for permission to visit the Museum d'Histoire Naturelle, Paris, the Rijksmuseum van Naturlijke Historie, Leiden and the Zoologisch Museum, Universitat van Amsterdam. Thanks are also due to Dr.

F.S. Russell, Director, Plymouth Laboratory, for all the facilities provided in the Laboratory ; to Dr. (Miss) Isabella Gordon, British Museum (Natural History) ; Prof. Goodhart, Zoology Department, Cambridge University ; Mon. J. Forest, Museum d'Histoire Naturelle, Paris ; Dr. Brongresma and Dr. Vervoort, Rijksmuseum van Naturlijke Historie, Leiden ; and to Dr. J.H. Stock, Zoologisch Museum, Universitat van Amsterdam, for placing at the author's disposal the material and facilities to work in their laboratories.

But for Mon. Serène, the author could not have had the priviledge of examining the present collection and the author expresses his sincere gratitude to him. Lastly thanks are due to Mr. Tran Ngoc Loi of the Institute of Oceanography of Viet Nam for supplying data regarding the localities from where the present material was collected.

LIST OF STATIONS

Most of the specimens where collected from the Nhatrang Bay and its vicinity as shown in the map (Text-fig. 1). A few specimens were obtained from other areas off the Viet Nam coast, including the Paracels (Patle) Islands. A list of stations, with species collected from each, are given in the following table :

Table I. — Stations from where collections of alpheids were made.

N°	Date	Locality	Deph	Nature of Bottom	Method of coll.	Species collected
Rtc. 57	29-4-34	Cauda	—	Coral	—	*Alpheus rapacida* *A. audouini* *A. pacificus*
Rtc. 92	27-7-34	Bich-Dâm (Hon Lon Island)	—	Coral	—	*A. lottini* *A. strenuus*
Rtc. 96	10-8-34	Nhatrang market	—	—	Purchased	*A. lottini* *A. paraculeipes* *A. gracilipes* *A. bisincisus*
Rtc. 120	8-4-36	Beach of Cua-Be	—	Sandbank	—	*A. malabaricus* var. *dolichodactylus*
Rtc. 131	21-4-37	Bay of Bay Miêu	—	—	By hand	*A. lottini*
Rtc. 141	24-5-37	Tortue Island	—	Coral	By hand	*A. lottini*
Rtc. 142	24-5-37	Bay in the west of Hon Lon Island	—	Coral	By diving	*A. facetus*
Rtc. 146	28-5-37	Bay Miêu Island	—	—	Dipnet	*A. gracilipes*
Rtc. 159	8-8-37	Estuary of Binh Tân	—	Sandy mud	By diving	*A. lottini* *A. sp.*
St. 772	20-9-33	Tagne Island	25 m.	—	Trawling	*A. audouini*
St. 801	23-9-34	Les Marionettes	—	Coral rocks	Dredge	*A. pubescens*

N°	Date	Locality	Depth	Nature of Bottom	Method of coll.	Species collected
St. 870	23-4-36	Anchorage Itu-Aba	—	Coral	Light fishing	*A. lottini*
St. 871	23-4-36	Anchorage Itu-Aba	—	Coral	Charcot Dredge	*Alpheopsis vietnami* *Synalpheus pseudorensis* *Alpheus lottini* *A. paraculeipes*
Rtc. 1002	19-11-46	Station Cauda	10-12 m.	—	Mud trawling	*A. lottini*
Rtc. 1003	28-11-46	Station Cauda	3-4 m.	Coral reef	By hand	*A. lottini* *A. serenei*
Rtc. 1005	25-1-47	Station Cauda	—	Rocks	By hand	*A. gracilipes* *A. audouini*
Rtc. 1006	24-3-47	Paracels (Pattle) Island	2-3 m.	Coral reefs	By hand	*A. frontalis* *A. serenei*
Rtc. 1008	3-4-47	Station Cauda	3-4 m.	Coral reefs	By diving	*A. dentiropes*
Rtc. 1037	30-4-48	Cua Bé	1-2.5 m.	Sand	By hand	*A. pacificus*
Rtc. 1039	9-6-48	Estuary of Cua Bé	0.40 m.	Coral reefs	By hand	*A. gracilipes*
Rtc. 1040	21-6-48	Station Cauda	0.30 m.	Coral reefs	By hand	*A. audouini*
Rtc. 1042	6-7-48	Station Cauda	—	Coral reefs	By hand	*A. lottini*
Rtc. 1051	3-8-48	Station Cauda	0.30 m.	Rocks	By hand	*A. audouini* *A. crassimanus*
Rtc. 1055	16-8-48	Station Trai Ca (Bangoi)	—	—	By hand	*A. crassimanus*
Rtc.1060	20-5-48	Pattle Island (Paracels)	0-3 m.	Rocks	By hand	*A. pacificus*

The precise localities of the following material could not be ascertained :

No.	*Name of species*
Indo-Chine E 435	*Alpheus lottini, A. ehlersii*
» E 448	*A. microstylus*
» E 452	*A. lottini*
» E 457	*A. gracilis*
» E 496	*Synalpheus consobrinus*

REMARKS ON GEOGRAPHICAL DISTRIBUTION OF SPECIES REPRESENTED IN THE COLLECTION

The area from where the present material was collected lies close to Malay Archipelago and zoogeographically forms a part of it. It is therefore not surprising that barring the two new species, *viz.*, *Alpheopsis vietnami* and *Alpheus serenei* all the other species represented in the collection are already known from the Malayan Region.

The species dealt with here can be arranged according to the following pattern :

I — Those known so far from Viet Nam only :

Alpheopsis vietnami
Alpheus serenei
Alpheus sp.

II — Species common to Viet Nam and Malay Archipelago

Alpheus facetus (also from S. Africa ?)
Alpheus pubescens

III — Species occurring in Viet Nam, Malay Archipelago and Indian Ocean

Synalpheus pescadorensis
Alpheus paraculeipes
A. ehlersii (only Red Sea and Bay of Batavia)
A. rapacida (only S. Africa in the Indian Ocean)

IV — Species occurring in Viet Nam, Malay Archipelago and West-Pacific

Synalpheus consobrinus (Marshall and Gilbert Islands)

V — Species widely distributed in the Indo-West-Pacific

Alpheus deuteropus
A. gracilis
A. lottini
A. microstylus
A. frontalis
A. gracilipes
A. bisincisus
A. audouini
A. crassimanus
A. strenuus
A. pacificus
A. malabaricus var. *dolichodactylus*

It will be noted from the above breakup that slightly more than half of the species contained in the collections are Indo-Pacific in distribution. Some of these, namely, *A. lottini*, *A. frontalis*, *A. crassimanus*, *A. strenuus*, *A. pacificus* are known from a large number of localities. Many others are not so widespread, judging from their records in literature.

Some of the species also occur in the East Pacific and the eastern Mediterranean. Thus *A. lottini* and *A. pacificus* have been recorded from the Gulf of California and Clipperton Island (off California Strait) respectively, whereas *A. strenuus* has been twice reported from the Galapagos. Those recorded from the eastern Mediterranean are *A. crassimanus* (from Tunis) and *A. audouini*, the latter being rather common on the Israeli coast of the Mediterranean. It appears that colonisation of the Mediterranean by these species should be recent, through the Suez Canal.

Alpheus audouini is said to be widely occurring in the Indo-West-Pacific. This name was proposed by Coutière (1906) for those specimens of *Alpheus edwarsii* (Audouin) in which the lobes on the upper and lower borders of palm overhanging the notch on large cheliped were obtuse and blunt. Specimens with acute lobes were included in *A. edwardsii*. Since the publication of Coutière's paper, all subsequent records of *A. audouini* are from Indonesia and the Indian Ocean. Whereas it is likely that earlier records, under the names *A. edwardsii* and *A. chiragaricus* may include specimens of *A. audouini* also, pending a revisionary work clarifying the taxonomic status of these three closely allied forms, only those records are listed in this paper which are mentioned under the specific name *audouini*.

SYSTEMATIC ACCOUNT

Class Crustacea
Order Decapoda
Supersection Natantia
Section Caridea
Superfamily Alpheoida
Family Alpheidae

Pleurae of second abdominal somites owerlapping those of first and third segments. No chelae on the third pereiopods. Gills phyllobranchiate. First pair of pereiopods chelate. Carpus of second pair of pereiopods subdivided into two or more joints. Chela of first pair of pereiopods distinct, on both sides. Eyes either partially or wholly covered by carapace, never very elongate. First pair of pereiopods distinctly stronger than second, often unequal and swollen.

Genus Alpheopsis Coutière, 1897

Thoracic and abdominal pleurae normal, not laid out horizontally. Pleurae of the first abdominal segment covering at most a very small part of the postero-lateral corners of carapace. Epipods present on at least first two pairs of pereiopods. Sixth abdominal segment with a movable plate articulated at the posterolateral angle. Rostrum prominent, slender, pointed in lateral view. An arthrobranch present at the base of the third maxilliped, or at that of the first pereiopod. Large chela carried extended. Posterior margin of telson straight or slightly arcuate.

Alpheopsis vietnami Tiwari, 1962
(Text-Fig. 2)

Material : Anchorage in Itu-Aba, 23 April 1936 — 1 ♀ (berried) c. 17 mm. [Holotype]

Description : Rostrum triangular (Text-fig. 2*a* & *b*), broad at base, apically acute, reaching slightly beyond the first segment of antennular peduncle. Supraorbital spines short ; margin between rostrum and supraorbital spines regularly rounded ; pterygostomian angle rounded, without a spine.

Second segment of antennular peduncle about 0.8 times as long as the exposed part of the first, 0.8 times as long as broad, the third segment almost as long as the breadth of the second segment ; stylocerite with an acute spine reaching as far as the middle of the third segment of antennular peduncle ; infero-internal crest of the basal article of antennular peduncle terminating in an acute spine that reaches upto the end of the segment ; outer antennular flagellum consisting of five articles before bifurcation, all segments of nearly the same length.

Blade of scaphocerite with a broad apex reaching as far as the end of antennular peduncle ; the final spine of scaphocerite exceeding the tip of blade. Carpocerite as long as the antennular peduncle. Basicerite with an acute tooth extending slightly beyond the first segment of antennular peduncle.

Third maxilliped (Text-fig. 2*c*) extending beyond the antennal scale by the entire length of its terminal segment ; penultimate segment 2.5 times as long as its distal breadth ; ultimate segment long, tapering towards apex, three times as long as the penultimate segment, and at least seven times as long as broad at base.

Chelipeds subequal in size, but otherwise similar on the two sides. In the longer cheliped (Text-fig. 2*d*, *e*) : — Merus 3.5 times as long as broad, almost twice as long as carpus, unarmed at the inner inferior edge, distal angles rounded. Carpus about 1.5 times as long as broad distally, its superior distal surface slightly notched, supero-internal angle with a blunt triangular projection. Chela 1.4 times as long as merus, 2.7 times as long as carpus, 4.5 times as long as broad, somewhat compressed, smooth ; lower surface of palm with a faint curvature at the level of junction with immobile finger, breadth of chela in the dactylar region about three-fourths of breadth in the palmar region ; dactylus and immobile finger simple, with apices acute and curved inwards, cutting edges entire.

Short cheliped (Text-fig. 2*f*) similar to large cheliped.

Merus of second pereiopods (Text-fig. 2*g*) about two-thirds as long as carpus. Carpal segments in the ratio of 26, 10, 10, 10, 16 ; second carpal segment 1.6 times as long as broad. Chela a shade longer than the last two carpal segments, fingers equal to palm.

Posterior pereiopods slender ; ischium and merus unarmed.

In the third pereiopods (Text-fig. 2*h*) merus about 6.4 times as long as broad. Carpus 0.6 times as long as merus, 4.5 times as long as broad, with its superior distal angle produced into a subacute tooth and with a movable slender spine at its inferior distal angle. Propodus twice as long

as carpus, about 1.2 times as long as merus, about 13 times as long as broad, armed along its inferior edge with four slender, equidistant, movable spines and at the apex with one long and another short spine. Dactylus about one-third as long as propodus, curved, with a simple, acute apex.

Fourth pereiopod slightly shorter than the third, but with almost similar proportions of joints.

Fifth pereiopod longer and slenderer than the third and fourth. Merus seven times as long as broad. Carpus 0.85 times as long as merus, eight times as long as broad with its superior distal angle only slightly produced, and inferior distal angle lacking a spine. Propodus (Text-fig. 2 *k*) about 1.5 times as long as merus, about 1.9 times as long as carpus, eighteen times as long as broad, its inferior margin armed with nine short, slender spines, and two additional apical spines of which one is long. Dactylus one-fourth as long as propodus, slender, with simple, curved and acute apex.

Telson (Text-fig. 2*l*) 1.75 times as long as its anterior breadth, 3.5 times as long as the breadth of its posterior margin; posterior margin half as broad as anterior margin; lateral margins convergent in the distal third; of the two pairs of spinules at the lateral angles of the posterior margin, the inner pair as long as the breadth of posterior margin between them; posterior margin somewhat arcuate; dorsal spinules of telson slender, situated in the distal half, and nearer the lateral margins.

Sixth abdominal segment with a movable plate articulated at the posterolateral angle.

Remarks: This species bears a close resemblance to *Alpheopsis chalciope* DeMan from which it differs in the following characters:

(1) Pterygostomian spine is absent.

(2) Outer antennular flagellum contains five segments before bifurcation.

(3) Spine on stylocerite is longer, reaching the middle of the third segment of antennular flagellum.

(4) Telson is less narrow, being about 3.5 times as long as the breadth of its posterior margin.

(5) In the first chelipeds merus is less slender, carpus is longer and fingers are slightly shorter than palm with cutting edges toothless.

(6) There are no movable spines on the ischium in the third pereiopods, and propodus is longer than merus.

In having a trispinose front it agrees with *A. chalciope* DeMan, *A. sibogae* DeMan and *A. trispinosus* Stimpson, but in the former the pterygostomian angle bears a small acute tooth, while the latter two have the chelae of first pair more or less grooved and dactylus lunulate.

Genus Synalpheus Bate, 1888

Thoracic and abdominal pleurae normal, not laid out horizontally. Pleurea of the first abdominal segment covering at most a very small part of the posterolateral corners of the carapace. No epipods on pereiopods.

Movable finger of the chela with a molar-shaped tooth that fits in the fixed finger. Dactylus of last three pereiopods bi-or triunguiculate. Chela of second legs normal. Third maxilliped normal in shape.

Synalpheus consobrinus DeMan, 1909
(Text-figs 3 & 4)

1909 — *Synalpheus consobrinus*, DeMan, Tidschr. d. Ned. dierk. Vereen (2), 11, pp. 111-113.

1911 — *Synalpheus consobrinus*, DeMan, Siboga Exped. Monogr. 39a1, Pt. 2. Alpheidae, pp. 204-208 ; also 1915. Suppl.. pl. vi, figs. 21-21e.

Material : Indo China (exact locality not recorded), 1 ♀, c. 19 mm.

Description : Front (Tex-fig. 3*a* & *b*) trispinose, far in advance of the lateral margins of carapace. Rostrum about as long as broad at base, reaching to the end of the first segment of antennular peduncle. Orbital spines about two-fifths as long as rostrum, margin between them and rostrum regularly rounded and curved towards the spines. Pterygostomian angle of carapace rounded.

Exposed part of first segment of antennular peduncle about twice as long as broad ; second segment three-fourths as long as the exposed part of the first and about 1.5 times as long as broad ; third segment two-thirds as long as the second. Stylocerite with an acute spine that just reaches to the end of first segment of antennular peduncle. Outer antennular flagellum with nine segments before bifurcation, first segment about twice as long as the second.

Blade of scaphocerite with a rather broad apex reaching to about two-thirds of the distal segment of antennular peduncle, the terminal spine exceeding the apex of blade and reaching to the distal extremity of the antennular peduncle. Carpocerite a shade longer than the antennular peduncle. Lower spine of basicerite ending a little behind the extremity of stylocerite, upper spine small, about half as long as the lower spine.

Third maxilliped (Text-fig. 4*a*) reaching as far as the tip of carpocerite, margins of its segments, especially the basal, fringed with soft pubsescence. Penultimate segment one-third as long as the ultimate segment, 1.5 times as long as its distal breadth. Ultimate segment thrice as long as the preceding, five times as long as broad at base, somewhat narrowing distally, apex rounded.

First pair of chelipeds unequal and dissimilar.

Upper margin of merus of the large cheliped (Text-fig. 3*c* & *d*) somewhat curved, produced distally into an acute tooth, the outer inferior margin with distal angle acute, length of upper edge about three times the maximum width. Supero-external and infero-internal angles of carpus with acute teeth. Chela compressed, about three times as long as high, its greatest height being in the proximal third. Palm without any grooves or depressions, about 2.2 times as long as fingers, with a small acute tooth at the far end of its inner face. Outer edge of dactylus rounded, apex horny and subacute, prehensile edge with a short blunt tooth not far from the tip.

Upper edge of merus of small cheliped (Text-fig. 4*b*) straight, ending distally in an acute tooth, inferior external angle acute, length of merus 3.6 times its breadth. Supero-external angle of carpus with a triangular tooth. Chela compressed, almost parallel-edged in profile, 3.8 times as long as high. Palm 1.5 times as long as fingers, without any tooth at the distal end. Dactylus with apex acute ; fixed finger proximally broadened on the inner face. Outer surface of palm and fingers covered with sparse, matty pubescence. Lower edge of merus and ischium with scattered tufts of soft pubescence. Upper edge of merus with scattered hair on the outer face. Carpus with tufts of setae on the superior and inferior-external angles.

Ischium of second pair of pereiopods (Text-fig. 4*c*) with scattered tufts of short hair on the inferior margin. Merus about 1.5 times as long as ischium, about seven times as long as broad. Carpus about 1.4 times as long as merus. Ratio of carpal segments 6, 1.5, 1, 1, 2 ; first segment six times as long as broad, second 1.5 times as long as broad, third and fourth as long as broad and fifth half as broad as long. Chela slightly less than twice as long as the last carpal segment. Fingers 1.2 times as long as palm. Scattered tufts of hair on the undersurface of distal carpal segments, palm and fingers.

Merus of third pereiopod (Text-fig. 4*d*) armed with a large tooth at the distal angle of its inferior margin, 2.4 times as long as ischium, slightly more than twice as long as carpus, 5.5 times as long as broad. Carpus about three times as long as its maximum breadth, its upper distal angle produced into a long acute tooth, inferior distal angle armed with five short, mobile spines. Propodus slightly less than twice as long as carpus, 7.5 times as long as broad, armed at its inferior border with 20 movables spines. Dactylus about twice as long as broad at the base, one-fifth as long as propodus, biunguiculate, main unguis acute and slightly curved, accessory claw almost at right angles to the main axis of dactylus. Upper and lower margins of all segments excepting dactylus fringed with tufts of soft hair ; posterior apex of propodus fringed with dense setae.

Fourth pereiopod like the third except that the inferior distal angle of carpus is armed with a single movable spine. Merus twice as long as ischium, 5.4 times as long as broad, twice as long as carpus. Carpus thrice as long as broad. Propodus 1.8 times as long as carpus, 6.4 times as long as broad. Dactylus one-fifth as long as propodus, twice as long as broad at base.

Merus of fifth pereiopod unarmed at lower distal angle, twice as long as ischium, one and a half times as long as carpus, 5.5 times as long as broad. Carpus without spines at inferior distal angle, four times as long as broad. Propodus 1.4 times as long as carpus, seven times as long as broad, with about 10 feeble spines on the inferior border mostly in the distal half. Dactylus one-fifth as long as propodus, twice as long as broad at base, accessory claw short.

Lateral margins of telson (Text-fig. 3*e*) converging strongly towards distal end ; length 1.3 times the breadth of anterior margin ; posterior margin one-third as broad as the anterior margin, moderately arcuate. Spines at lateral angles feeble and short. Dorsal surface of telson without a furrow, dorsal spines very short, situated close to lateral margins, in the posterior third of the telson. Uropods broadly oval.

Posterior angles of first and second abdominal segments (Text-fig. 4e), rounded, those of the following segment subacute.

Remarks : DeMan (1911) thought that *S. consobrinus* might prove to be identical with *S. stimpsonii* DeMan (1888) from Amboina. In fact the resemblance between these two species is fairly close and the differences may be bridged when larger series of material is examined. In the meanwhile, however, the question about the distinct identity of these two species is still open.

The single specimen from Indo-China, which is a female without eggs, is intermediate between the two species in some characters. It, however, shows greater resemblance to the description and figures of *S. consobrinus* (DeMan, 1911), specially in the structure of the dactylus of the larger cheliped which has a blunt tooth on the prehensile edge, not far from the apex. This tooth is missing in *S. stimpsonii*.

Distribution : *S. consobrinus* was originally described from a number of localities in Indonesia (DeMan, 1911). It has recently been reported from Marshall Islands (Banner, 1957) and Ontoa Atoll, Gilbert Islands (Banner, 1958) in the Central Pacific.

Synalpheus pescadorensis Coutière, 1905

1906 — *Synalpheus Pescadorensis*, Coutière, Faun. Geogr. Maldiv. Laccad. Archipel., pp. 877-878, pl. LXXIII, fig. 15.

1911 — *Synalpheus Pescadorensis*, DeMan, Siboga Exped. Monogr. 39a1, Pt. II. Alpheidae, pp. 298-299 ; and 1915. Suppl., pl. XIII, fig. 63-63d.

1926 — *Synalpheus Pescadorensis*, DeMan, Mitt. Zool. Mus. Berlin, 12. pp. 341-343.

Material : Anchorage Itu-Aba. 23 April 1936 — 1 ♀, c. 11 mm.

Description : Rostrum (Text-fig. 5a) short, slender, reaching to about one-third of the exposed part of first segment of antennular peduncle. Supra-orbital spines broad at base, reaching forwards almost as far as the end of rostrum.

Second segment of antennular peduncle about three-fourths as long as the exposed part of the first, about 1.5 times as long as broad, about 1.5 times as long as the third segment. Spine of stylocerite ending just behind the distal extremity of first segment of antennular peduncle outer antennular flagellum with first four segments fused, first segment about 1.5 times as long as the second, second to fourth of equal length.

Blade of antennal scale short, very narrow, reaching to the distal two-thirds of the second segment of antennular peduncle ; outer margin of scale moderately concave, final spine long, acute, reaching the end of antennular peduncle. Carpocerite exceeding the antennular peduncle by the length of the last segment of the latter. Outer spine of basicerite reaching as far as the end of first segment of antennular peduncle, inner spine about half as long as the outer.

Third maxilliped hardly reaching as far as the end of carpocerite ; penultimate segment (Text-fig. 5b) one-third as long as the ultimate seg-

ment, about 1.5 times as long as broad ; ultimate segment broad, slightly narrowing distally, 4.2 times as long as broad at base, apex rounded, margin fringed with setae.

First and second pairs of pereiopods missing.

Merus of third pereiopod (Text-fig. 5c) stout, four times as long as ischium, four times as long as broad, unarmed. Carpus 0.3 times as long as merus, 2.4 times as long as broad, superodistal angle produced, inferodistal angle bearing an acute movable spine. Propodus twice as long as carpus, 0.6 as long as merus, 4.8 times as long as its maximum breadth, armed with eight short, movable spines along its inferior margin. Dactylus one-sixth as long as propodus, biunguiculate, with the accessory claw rather stout.

Fourth pereiopods missing.

Fifth pereiopod resembling third in general appearance. Merus 4.4 times as long as wide, 1.3 times as long as carpus, unarmed at its distal extremities. Propodus equal in length to merus, seven times as long as wide, armed with six spines on its inferior edge. Dactylus half as wide as long, one-sixth as long as propodus.

Lateral margins of telson (Text-fig. 5d) straight, converging strongly towards distal end. Anterior border four-fifths as wide as the dorsal length of telson, three times as wide as the posterior margin. Posterior margin with a faint protuberance between the lateral spines. Dorsal surface of telson with a broad longitudinal groove in the distal half. Dorsal spines large, anterior pair situated a little before the middle of telson, posterior pair midway between the anterior pair and the distal margin ; posterior pair of spines larger than the anterior pair, as long as the width of posterior margin of the telson. Spinules at the lateral angle of posterior margin large, the inner pair twice as long as the outer pair, and almost as long as the posterior pair of dorsal spines. Uropods oval, with scattered tufts of long setae ; spine at the lateral angle of diaeresis of exopod slender, long and curved ; the sympodite of uropods with a long acute spine on its external angle, reaching as far as the middle of exopod.

Pleurae of second to fifth abdominal segments (Text-fig. 5e) somewhat acute below. Sixth abdominal segment with a curved, acute tooth at its posterior angle just near the point of insertion of uropods.

Remarks : This specimen, though lacking the first and second pairs of pereiopods, is undoubtedly referable to *Synalpheus pescadorensis* Coutière. It agrees well with the description and figures given by Coutière (1906) and DeMan (1911), except that the outer spine of basicerite in the present specimen is not as long as figured and described by Coutière.

Distribution : *S. pescadorensis* is known from Pescadores (Coutière, 1906) ; Indonesia (DeMan, 1911) ; Laccadives and Maldives (Coutière, 1906) and Buka Island, Salomons (DeMan, 1926).

Genus Alpheus Fabricius, 1796

Thoracic and abdominal pleurae normal, not laid out horizontally and not unusually broadened. Pleurae of first abdominal segment covering at most a very small part of the posterolateral corners of the carapace.

Epipods present on at least first two pairs of pereiopods. No articulated plate at the posterolateral angle of the sixth abdominal segment. Movable finger of larger chela with a large molar-shaped tooth that fits into a cavity in the fixed finger. Eyes entirely covered by carapace, anteriorly as well as dorsally. First pair of legs not folded beneath the body. Body not strongly compressed. Abdominal segments not carinated. Carina on carapace, if present, not extending over the full length of the carapace. Cardiac notch present in the posterior margin of carapace. Exopods of uropods with a transverse suture.

Alpheus deuteropus Hilgendorf, 1879

(Text-fig. 6)

1879 — *Alpheus deuteropus*, Hilgendorf, Monatsb. Königl. Akad. wiss. Berlin (1878), p. 834, pl. IV, figs. 8-10.

1953 — *Crangon deuteropus*, Banner, *Pacif. Sci.*, 7, pp. 70-72, fig. 22*a-g*.

Material : Station Cauda, 3-4 m, 3 April 1947 — 2 ♂♂, 23 mm. and 25 mm. ; 1 ♀, 25 mm.

Also 1 ♂. c. 21 mm. (label misplaced).

Description : Rostrum with a sharp carina (Text-fig. 6*a*) ; apex acute and abruptly curved upwards, reaching to the middle of the first segment of antennular peduncle. Orbital hoods rounded, armed with acute teeth of about the same length as rostrum. Orbito-rostral grooves broad, and frontal margin between orbits and rostrum somewhat arcuate.

Antennular peduncle slender and hairy ; second segment about 1.5 times the length of exposed part of first segment, three times as long as broad ; third segment half as long as first and one-third as long as the second. Stylocerite narrow, produced into an acute tip ending a little behind the distal end of first antennular segment.

Antennal scale narrow, about five times as long as broad at base ; squamous portion convergent and tapering towards the apex, and not quite reaching as far as the end of second segment of antennular peduncle ; final tooth with the outer margin moderately concave, reaching far beyond the apex of squamous portion to about the distal end of the antennular peduncle. Carpocerite hairy, slightly longer than the antennular peduncle. Basicerite with a lateral spine almost as long as the rostrum.

Third maxilliped (Text-fig. 6*b* & *c*) densely hirsuit. Penultimate segment three-times as long as broad, fringed with dense setae along both margins. Ultimate segment narrow and tapering towards the apex, 1.5 times as long as the penultimate segment, six times as long as its basal width, densely hairy.

Merus of large cheliped (Text-fig. 6*d*) heavy, 1.6 times as long as broad ; its superior distal angle sub-acute, inner inferior apex acute, margins fringed with setae. Carpus heavy and hirsuit. Large chela with prominent crests and grooves, densely hirsuit on the inner face and superior

portion of outer face, the hirsuit surface being papillose ; strongly compressed, upper margin serrulate in profile ; outer face with the following crests and depressions — a strong superior crest at the upper distal angle of palm projecting distally into a strong tooth, ending proximally in the transverse groove ; transverse groove narrow and deep extending across the inner surface of palm in the upper half ; plaque crest heavy with its upper edge sharp, extending obliquely behind to beyond the middle of the palm and gradually merging with its upper border ; superior depression well marked between the plaque crest and upper border of palm extending half way along ; inferior crest strong, projecting distally into a strong tooth, reaching proximally as far as the shoulder of inferior depression ; inferior depression shallow, its shoulder slight and rounded. Chela about 2.2 times as long as high, broadly ovate in shape. Fixed finger short and emarginate at the end to receive dactylus. Dactylus short, compressed, so rotated as to close laterally and distally across the chela.

Small chela (Text-fig. 6*e*) about 0.7 times as long as the large chela, 2.5 times as long as high, ovate in shape, densely hirsuit on inner face. Palm compressed, its upper margin serrulate in profile, and with superior crest projecting distally into an acute tooth and ending proximally in the transverse groove. Other grooves and crests absent. Fingers compressed, about half as long as palm, with thin cutting edges, placed normally with respect to palm. Carpus hirsuit, with a flat, subacute tooth at the supero-internal angle. Merus as in larger cheliped, 1.7 times as long as wide.

Second pereiopods (Text-fig. 6*f*) with scant hairs, about 2.5 times as long as the carapace. Carpal segments in the ratio of 10, 6.3, 2.6, 2.6 and 4.6 ; second segment about three times as long as wide. Chela as long as second carpal segment. Fingers 0.7 times as long as palm.

Third and fourth pereiopods of a heavy built. Ischium in both armed with a stout spine. Merus of the third pereiopod (Text-fig. 6*g*) stout, 3.1 times as long as broad, twice as long as carpus, armed with a strong tooth at the inferior distal angle, and with setae along the superior margin. Carpus 2.6 times as long as wide, setose along margin, with its upper and lower distal angles produced into acute teeth projecting over the propodus. Propodus (Text-fig. 6*g* & *h*) 1.2 times as long as carpus, 3.8 times as long as wide, armed on the inferior border with a single spine near the base and five pairs of spines along the rest of the margin upto the apex, its upper edge fringed with setae. Dactylus (Text-fig. 6*g* & *h*) about a fourth as long as the propodus, curved, ending in a simple acute apex. Fourth pereiopod like the third in appearance but with slightly different proportions of its individual joints. Fifth pereiopods much shorter and slender.

Telson (Text-fig. 6*j*) proximally wide, its lateral margins straight and converging posteriorly ; 1.3 times as long as its proximal width, 3 times as long as the width of posterior margin. Posterior margin 0.42 of anterior margin, arcuate. Inner pair of lateral spines twice as long as the outer pair. Dorsal spines short. Outer margin of endopod of uropods armed with about 10 short movable spines on its superior surface. Spine at the outer angle of the diaeresis of exopod large and heavy, almost as long as the width of posterior margin of telson.

Pleurae of abdominal segments (Text-fig. 6k) rounded.

Remarks : This is the only species of the « *Megacheles* group » represented in the present collection. Banner (1953) has recently given a detailed description and figures of specimens of this species from Hawaii. The material from Viet Nam agrees in most characters with Banner's description and figures. It, however, appears that the plaque crest on the large chela in the present specimens is much longer and somewhat differently shaped, and the upper border of palm is more irregular both in the large and small chela. In this respect the present specimens agree with figure of large chela of this species reproduced by Barnard (1950) from Coutière (1899), and also with large chela in specimens of *A. deuteropus* from l'Ile Tague recorded by Coutière (1906), preserved in the Paris Museum.

Distribution : Originally described by Hilgendorf (1879) from Zanzibar, this species is known from Perim, Obock, Jibouti (Coutière, 1906) ; Goidu Atoll, Hulule Male Atoll (Coutière, 1906) ; l'île Tague (Coutière, 1906) ; Oahu, Maui, Pearl & Hermes Reef (Banner, 1953), French Frigate Shoal (Edmondson, 1925) all in the Hawaiian Archipelago ; Saipan. Mariannas Archipelago (Banner, 1956) ; Marshall Islands (Banner, 1957).

Banner (1953, p. 72) while discussing the distribution of this species remarks « Elsewhere this species has been reported in the Pacific only from the Netherland East Indies... » I do not find any record of this species from this area. No doubt DeMan (1911) included *A. deuteropus* in his key to Indo-Pacific species, but it did not form a part of the Siboga material and he included it among species occurring in the Indian Ocean only.

Alpheus gracilis Heller, 1861

(Text-fig. 7)

1861 — *Alpheus gracilis*, Heller, Sitzungsber. Kais. Akad. wiss, Wien, 44. p. 271, pl. III, figs. 19-20.

Material : Indo-China (locality unspecified) — 1 ♂, 16 mm

Rostrum acute (Text-fig. 7*a*), triangular, about twice as long as broad at base, reaching forward almost to the end of the first segment of the antennular peduncle, fringed with scattered short hairs on its sides, carina subacute extending backwards just posterior to the base of orbital hoods. Orbital hoods armed at antero-external angles with acute spines pointing rather inwards and reaching to the middle of rostrum. Grooves between orbital hoods and rostrum rather deep and narrow. Frontal margin on either side of rostrum slightly arcuate.

Second segment of antennular peduncle almost equal to the exposed part of the first, a shade longer than the third, about 1.5 times as long as wide. Stylocerite narrow, terminating in an acute spine that reaches as far forward as the middle of the second segment of antennular peduncle. Blade of antennal scale narrow, reaching to the extremity of antennular peduncle, outer margin straight, the final tooth reaching beyond the tip of the blade to the distal extremity of the carpocerite. Carpocerite longer than the antennular peduncle. Basicerite armed with a triangular spine reaching almost to the end of the first segment of antennular peduncle.

Third maxilliped (Text-fig. 7*b*) reaching beyond carpocerite by about two-fifths of its penultimate segment. Penultimate segment about twice as long as thick at its distal extremity. Ultimate segment twice as long as the penultimate segment, four times as long as broad at base, apex narrow, truncate and fringed with dense setae.

Merus of large cheliped (Text-fig. 7*c*) about twice as long as broad; distal extremity of the upper margin obtuse; infero-internal margin with four spines, distal angle spiniform. Chela four times as long as broad, compressed, 1.6 times as long as cephalothorax, 2.5 times as long as high. Palm 2.25 times as long as finger, with a shallow notch on its upper edge behind articulation with dactylus, this notch being more conspicuous when viewed from the inner surface where it continues as a short groove; lower edge of palm also with a shallow notch (more conspicuous from inner side) at its junction with the immobile finger; no other grooves or depressions on the palm; a blunt lobe on the upper surface of the palm at the inner angle of its articulation with the dactylus. Dactylus with the upper edge rounded and convex, apex acute, cutting edge concave between the molar and the apex. (The dactylus looks like the beak of a parrot in profile). Fixed finger of the usual shape, very broad at base on the inner side and fringed with isolated tufts of setae along the margins of prehensile edge.

Small cheliped (Text-fig. 7*d*) slenderer than the large one. Merus 2.2 times as long as broad, with apex of superior edge dentiform, inner inferior margin armed with about four spinules, its distal angle acute. Carpus with a blunt tooth at the supero-internal angle. Small chela about 0.8 times as long as the large chela, 3.8 times as long as high. Palm without notches and grooves on its superior and inferior margins, slightly shorter (about 0.88) than fingers, with the inner angle of articulation with the dactylus produced into an acute tooth. Fingers with tips curved and acute.

Second pereiopod (Text-fig. 7*e*) about 1.6 times as long as cephalothorax. Carpal joints in the ratio of 10, 5, 2.8, 2.8, 4.2; second joint about 2.75 times as long as broad. Chela equal to the last two carpal joints. Fingers slightly longer than palm.

Ischium and merus of third pereiopod (Text-fig. 7*f* & *g*) unarmed. Merus about 4.4 times as long as wide. Carpus 0.7 as long as merus, 4.5 times as long as broad. Propodus narrowing distally, about 1.5 times as long as carpus, 7.7 times as long as broad in the middle, bearing 7 unpaired spines along the entire length of lower margin and a pair of spines at the apex below the insertion of the dactylus. Dactylus slender, about one-third as long as propodus, armed with a short accessory claw. Fourth pereiopod like the third. Fifth pereiopod short and slender, armed with five spines on the inner margin of propodus in addition to obliquely transverse tufts of very short setae in the distal half.

Telson (Text-fig. 7*h*). with sides rather straight, 1.6 times as long as its anterior width, 3.1 times as long as the width of the posterior margin. Anterior margin 1.9 times as broad as the posterior margin. Posterior margin slightly arcuate. Inner lateral spine on the posterior margin slightly more than twice as long as the outer spine. Dorsal spines large, situated 0.3 and 0.6 distance away from the posterior margin respectively. Uropods elongate oval; spine at the angle of diaeresis of exopod very thick, large and brown in colour.

Ventral margin of pleura of abdominal segments (Text-fig. 7*j*) more or less straight.

Remarks : The present specimen from Viet Nam agrees partly with DeMan's (1911) redescription of Heller's type of *A. gracilis*, and partly with his variety *luciparensis* of the same species. As DeMan's proposed variety depended upon a single specimen, and upon such characters which fall within the usual range of variation in a species, I hesitate to assign the present specimen to his variety *luciparensis* where it should belong on zoogeographical considerations.

Coutière (1906) described *A. gracilis* var. *allaudi* from Laccadives & Maldives on specimens which lacked chelipeds. In his material the dactylus of third pereiopod was simple and acute. He subsequently (1921) recorded var. *allaudi* from Providence Island in the Indian Ocean, again on the basis of a single mutilated specimen. Whether his material belonged to *A. gracilis* or some other species (possibly *Alpheus facetus* DeMan) is difficult to decide in the absence of better specimens.

Barnard (1950) considers Stebbing's (1919) record of *A. gracilis* from Isezela (Natal) doubtful. In Stebbing's specimen, a 30 mm. long female, the dactyli of the posterior pereiopods are simple, and other characters are difficult to make out from the illustrations except that the large chela does not seem to possess the notch on the upper border of palm which is characteristic of *A. gracilis*. Barnard states that « Stebbing's specimen is not unlike *facetus* DeMan ».

Finally another new variety of this species, *A. gracilis* var. *simplex* has been reported by Banner (1953) from the Hawaii Islands. This variety, like Coutière's *allaudi* lacks a secondary claw on the posterior pereiopods (there is a swelling instead in the position where the secondary claw should have been), and the shape of rostrum is also different in being dorsally rounded (instead of having a subacute rostral carina). Similarly the conspicuous notches on the upper and lower borders of palm of large chela seem to have been greatly reduced in Banner's variety.

Distribution : Originally described by Heller (1861) from the Red Sea, this species has been subsequently recorded again from there by Balss (1915), Tattersal (1921), Ramadan (1936) and Holthuis (1958). It is also known from the Western Indian Ocean (Coutière, 1906 ; 1921) and Indonesia (DeMan, 1911, including var. *luciparensis*). *A. gracilis* var. *allaudi* Coutière has been recorded from Hulule Male Atoll and Mahe (Coutière, 1906) and Providence Island in the Western Indian Ocean (Coutière, 1921). *A. gracilis* var. *simplex* Banner is known from Hawaii (Banner, 1953) ; Saipan in Mariana Archipelago (Banner, 1956) ; Arno Atoll in Marshall Islands (Banner, 1957) and Ontoa in Gilbert Islands (Banner, 1958 ; Edmondson, 1925, as *A. gracilis*).

The record of this species from S.E. Africa (Stebbing, 1919) requires confirmation.

Alpheus lottini Guérin, 1829
(Text-fig. 1)

1837 — *Alpheus ventrosus*, H. Milne-Edwards, Hist. Nat. Crust., 2, pp. 352-353.

1839 — *Alpheus laevis*, Randall, Journ. Acad. nat. Sci. Philad., **8**, p. 141.

1915 — *Alpheus lottini*, Stebbing, Ann. S. Afr. Mus., **15**, pp. 82-83.

1937 — *Crangon ventrosus*, Chace, Zoologica, **22**, pp. 118-119.

1953 — *Crangon latipes*, Banner, Pacif. Sci., **8**, pp. 72-64, fig. 27*a-j*.

Material : Tortue Island, 24 May 1937 — 1 ♂, 33.5 mm. Bich-Dâm (Hon Lon Island), 27 July 1934 — 1 ♂, 29 mm., 1 ♀, 29 mm. Bay of Bay Miêu, 21 April 1937 — 1 ♂, 28 mm. Indo China loc. unspecified) — 1 ♂, c. 20 mm, 2 ♀ ♀, 19 mm. and 23 mm. Anchorage Itu-Aba, 23 April 1936 — 1 ♂, 24 mm., 1 ♀, 27.4 mm. Anchorage Itu-Aba, 23 April 1936 — 1 ♂, c. 18 mm. Estuary of Binh-Tân, 8 August 1937 — 1 ♀, c. 27.6 mm. Nhatrang market (purchased) ; 10 August 1937 — 1 ♂ ; c. 24 mm. Stn. Cauda, 19 November 1946 — 1 ♂, 24 mm, 1 ♀, 27,4 mm. Indo-China (locality unsperified) — ♀ damaged.

Description : Rostrum triangular (Text-fig. 8*a*), flat, apex acute, reaching forwards to nearly the end of first segment of antennular peduncle. Orbital hoods armed with a short spine on each side, separated from rostrum by deep, narrow grooves.

Second segment of antennular peduncle equal to, or slightly longer than the exposed part of the first segment, about twice as long as wide ; third segment half to three-fourths as long as second. Stylocerite narrow at base, armed with an acute spine that reaches nearly to the middle of the second segment of antennular peduncle.

Antennal scale about 3 to 3.4 times as long as broad near the base, lamella narrowing towards the apex, exceeding the tip of antennular peduncle and in some cases reaching as far as the tip of carpocerite ; final spine extending slightly beyond the squamous portion. Carpocerite exceeding the antennular peduncle by about the length of distal article. Basicerite armed with an acute spine reaching as far forward as stylocerite.

Penultimate segment of third maxilliped (Text-fig. 8*b*) rather broad, ratio of length to distal breadth being 1.3, Ultimate segment more than twice as long as penultimate segment, 3.6-4.0 times as long as broad at base, distally narrowing, apex truncate, one-third as wide as the width at base, and reaching the end of carpocerite.

Large cheliped (Text-fig. 8*c*) heavy, Merus 1.6-2.0 as long as broad, superior apex acute but not spinuous, inner inferior edge unarmed at apex, but armed with 3-4 stout, movable spines marginally. Chela heavy, strongly compressed, without notches or grooves, somewhat inflated proximally, 2.4-2.5 times as long as high, about twice as high as thick, smooth. Dactylus slightly less than half as long as palm in males, about a third as long in female, compressed ; apex acute in males, blunt in females.

Small cheliped (Text-fig. 8*d*) almost as long as large cheliped but chelae rather slender. Merus 1.66 as long as wide, superior and inner inferior apex as in large cheliped. Carpus with a blunt tooth at the supero-internal angle. Chela slightly compressed, about three times (or slightly more) as long as high. Palm smooth, compressed, 1.2 to 1.4

times as long as dactylus. Dactylus broad near the base, gradually narrowing apically, apex acute, curved inwards. Fixed finger grooved along the cutting surface to receive the cutting edge of dactylus.

Ratio of carpal segments of second pereiopod (Text-fig. 8*f*) rather variable — usually 14, 7, 6, 6, 10 ; second segment about 1.5 times as long as broad, about half (or slightly more than half) as long as the first ; third and fourth segments more or less equal, shorter than second ; fifth segment longer than second but shorter than first ; all segments rather thick. Chela equal to or slightly longer than the fifth carpal segment. Palm and fingers usually equal.

Following legs rather thickset and stout. Ischium and merus unarmed. Merus of third pereiopods (Text-fig. 8*e*) compressed, broad, the ratio of length to breadth varying from 2.1 in the smallest individual to 2.7 in the largest ; about twice or somewhat less as long as carpus. Carpus about twice as long as broad, its lower distal extremity produced into a short acute tooth. Propodus 1.3-1.4 as long as carpus, 3 to 4 times as long as broad, armed with seven rather short, spines along its inferior edge. Dactylus thick, blunt, laterally compressed, tip with a « finger nail » of hard chitin, and another ridge of chitin in the shape of a horse's hoof ; anterior face of dactylus with thick longitudinal ridge ; inferior and lower posterior face of dactylus soft ; dactylus about 0.4-0.5 as long as propodus.

Telson (Text-fig, 8*g* & *h*) 1.8 to 1.9 times as long as the width of its anterior margin. Lateral edges straight. Posterior margin somewhat narrow, the ratio of the width of anterior and posterior margins being 2.2-2.4. Dorsal spines weak.

Remarks : This species is easily recognisable by its thickset appearance and by the blunt dactyli of posterior pereiopods, the latter character not met with in other species. The specimens at my disposal agree fairly well with the published descriptions of this species, specially that of Banner (1953). The sexual dimorphism in the shape of chela of large cheliped has been noticed by earlier authors (DeMan 1911 ; Banner, 1953). In the specimens at my disposal not only this dimorphism is confirmed, that is, the dactylus of male is acute while that of female is blunt, but it is also observed that the dactylus of male is proportionately longer in relation to palm, than that of the female. In the male large cheliped the dactylus is slightly less than half as long as palm, while in the females it is one-third or slightly less than third.

This species is known in literature as *A. ventrosus* H. Milne-Edwards. However, as was pointed out by Stebbing in 1915 and more recently by Holthuis (1958 ; 1961), its correct name should be *A. lottini* Guérin, 1829.

Distribution : This species has a wide distribution in the Indo-West-Pacific, and has also been recorded from Galapagos Islands and California straits in the East Pacific.

The following are its records in literature.

Delagoa Bay (Stebbing, 1915 ; Barnard, 1950) ; Durban (Barnard, 1950) ; Embotje ; Podoland (Barnard, 1957).

Dar-es-Salaam (Ortmann, 1894) ; Zanzibar (Hilgendorf, 1879).

Red Sea, without any specific localities (Heller; 1861 , Miers; 1884 , Ortmann, 1890 ; Coutière, 1897 *d* ; Nobili, 1906 ; Balss, 1915 ; Tattersal, 1921) ; Gulf of Suez ; Gulf of Aquaba ; El Tor ; Daedalus shoal ; Rodriguez (Miers, 1884) ; Gulf of Aquaba (Coutière, 1906) ; Ghardaqua, Red Sea (Ramadan, 1936) ; Eylath ; Abu Zabad ; Sinai Peninsula (Holthuis, 1918) ; Gulf of Aden including Obock, Perim, Jibouti (Coutière, 1906) ; Persian Gulf (Coutière. 1906) ; Madagascar (Coutière, 1906) ; Mauritius (H. Milne-Edwards, 1837 ; Richters, 1880 ; Coutière, 1906) ; Seychelles (Coutière, 1906 ; Miers, 1884) ; Eagle Island ; Etoile Island (Miers, 1884) ; Chagos ; Diego Garcia ; Salomon ; Coetivy (Coutière, 1921).

Hulule Male Atoll, Naifaro Reef, Fadifolu Atoll, South Nilandu Atoll, Suvadiva Atoll, Horsburgh Atoll — Laccadives & Maldives (Coutière, 1906).

Galle, Ceylon (Miers, 1884 ; Pearson, 1905) ; Weligama, Pearlbank, Ceylon (Pearson, 1911).

Rameswaram ; Tuticorin (Henderson, 1993) ; Krusadai, Island ; Shingle Island (Graveley, 1930) ; Nicobars (Heller, 1865) ; Bay of Bengal (Coutière, 1906).

Borneo Bank ; Kawio and Kamboling Islands, Karkalong Group ; Damar Island ; Saleyar Island ; Banda ; Anchorage between Nusa Besi and N.E. Point of Timor (DeMan, 1911) ; Ternate (DeMan, 1902) ; Java Sea (DeMan, 1397) ; Bay of Batavia (DeMan, 1888) ; Amboina ; Timor (Coutière, 1898*d* ; Ortmann, 1894) ; Philippines (Coutière, 1906).

Murray Island Reef, Torres Strait (Coutière, 1900) ; Sidney (Heller, 1865).

Hainan (Yü, 1936).

Tokyo Bay, Kagoshima (Ortmann, 1890) ; between Simoneski and Tusima (Yokoya, 1933).

Hawaii (Bate, 1888 ; Edmondson, 1925 ; Banner, 1953) ; Johnston Island ; Wake Island ; Palymyra Island (Edmondson, 1925) ; Saipan, Mariannas Archipelago (Banner, 1956) ; Marshall Islands (Banner, 1957) ; Gilbert Islands (Banner, 1958)) ; Caroline Archipelago (Banner, 1959).

Sandwich Islands (Randall, 1839 ; Dana, 1852) ; Fiji Islands (Dana, 1852) ; Miers, 1884 ; Coutière, 1906) ; Tonga (Coutière, 1906) ; Marquesas Islands (Boone, 1935) ; Tahiti (Heller, 1865 ; Coutière, 1906 ; Boone, 1935) ; Samoa Islands (Miers, 1884 ; Ortmann, 1890) ; Funafuti ; Rotuma (Borradaile, 1898) ; Rikitea, Polynesia (Nobili, 1907). New Britain ; Loyalty Islands (Borradaile, 1900) ; New Caledonia (Coutière, 1906).

Outside Indo-West Pacific :

Californmia Strait (Coutière, 1897*d* ; 1906 ; Chace, 1937) ; Galapagos Islands (Hult, 1938).

Alpheus facetus DeMan, 1908
(Text-fig. 9)

1908 — *Alpheus facetus*, DeMan, Notes Leyden Mus., 30. p. 100.

1911 — *Alpheus facetus*. DeMan, Siboga Exped. Monogr., 39a1, Pt. 2, Fam. Alpheidae ; p. 340 ; and 1915. Suppl. pl. XIV, fig. 67.

Material : Bay in West of Hon Lon Island, 24 May 1937 — 1 ♀ (berried) c. 18 mm.

Rostrum narrow (Text-fig. 9*a*), acute, about 3 times as long as broad at base, reaching forward to the end of first segment of antennular peduncle. Rostral carina low, rounded, separated from orbital hoods by broad, shallow grooves. Orbital hoods armed anteriorly with an acute tooth on each side, slightly directed inwards and reaching to about half the length of rostrum. An arcuate prominence on the frontal margin on each side between the rostrum and orbital spines.

Second joint of antennular peduncle a shade shorter than the visible part of the first, about 1.3 times as long as thick and slightly longer than the third. Stylocerite slender, terminating in an acute spine that reaches more or less to the middle of the second segment of antennular peduncle.

Scaphocerite about 2.7 times as long as broad near the base, outer margin straight ; the squamous portion slightly exceeding the antennular peduncle, and the final tooth overreaching the blade and extending as far as the end of carpocerite. Basicerite armed with a spine that does not quite reach as far as the tip of rostrum.

Third maxilliped extending beyond the carpocerite by about a third of its distal joint. Penultimate joint (Text-fig. 9*b*) 2.5 times as long as its distal thickness. Ultimate joint equal to the penultimate in length, 5.7 times as long as broad, narrowing towards its distal extremity, fringed along both margins with dense tufts of short, trimmed setae, and by long bristles apically.

Merus of the large cheliped (Text-fig. 9 *c, d* & *e*) twice as long as wide, upper distal edge ending in an acuminate spine ; infero-internal margin armed with four spinules and a large curved distal tooth. Chela about 3.5 times as long as merus, 1.2 times as long as carapace, three times as long as high, compressed (the ratio of thickness to height being 0.7). Palm twice as long as high, without any grooves or notches. Dactylus 0.47 as long as the palm, obtuse apically, and slightly longer than the immobile finger.

Small cheliped and second pereiopods missing.

Ischium of the third pereioped (Text-fig. 9*f*) armed with a spine. Merus about six times as long as wide, unarmed. Carpus half as long as merus, four times as long as wide. Propodus 1.6 times as long as carpus, eight times as long as wide, armed with seven spines on its posterior margin. Dactylus about one-fourth as long as propodus, five times as long as wide at base in lateral view, curved, apex simple and acute.

Telson (Text-fig. 9*g*) 1.7 times as long as broad anteriorly, slightly more than three times as long as the width of the somewhat arcuate posterior margin. Dorsal spines rather large, the anterior pair situated almost in the middle. The inner pair of postero-lateral spinules long, about three times as long as the outer pair and equal to the breadth of posterior margin. Spine at the angle of diaeresis (Text-fig. 9 *h*) of exopod of uropods large, heavy, about 0.31 as long as the telson, black in colour.

Remarks : The present specimen agrees with the types of *A. facetus* DeMan preserved in the Amsterdam Museum except that the large chela

lacks the longitudinal groove on the palm described by DeMan in the 18 mm. long specimen from Pulu Jedan (Stn. 273). The other two specimens of DeMan lack this groove. It is possible that the groove on the large chela of palm may be characteristic of adult males. The present specimen, in which it is missing, is a female.

Distribution : This species is only known from its type specimens collected by the Siboga Expedition from Pulu Jedan, East coast of Aru Islands and Pajunga Island in Indonesia (DeMan, 1908 ; 1911).

Alpheus microstylus (Bate), 1888

(Text-figs. 10 & 11)

1888 — *Betaeus microstylus*, Bate, Rep. Voy. Challenger Zool, **24**. p. 566, pl. CI, fig. 6.

Material : 1 ♀, locality unspecified.

Rostrum short (Text-fig. 10*a* & b), triangular, reaching to about two-fifths of the exposed par of first segment of antennular peduncle. Rostral carina sharp, arising from near the base of orbital hoods, sloping anteriorly in the interorbital region, separated from orbital hoods on each side by shallow, broad grooves, concealed in side view by the raised orbital hoods. Orbital hoods inflated, unarmed, projecting well infront of the antero-lateral borders of carapace. Frontal border almost straight on either side of rostrum. Carapace tumid in the anterior region.

Second segment of antennular peduncle about two times as long as the exposed part of the first, about 2.5 times as long as thick. Stylocerite short with an acute tip which extends as far as the middle of the exposed part of the first segment.

Outer margin of scaphocerite moderately concave, the final spine (which is rather acute) reaching beyond the distal end of the antennular peduncle ; the squamous portion narrow and short reaching to the distal two-thirds of the terminal segment of the antennular peduncle. Carpocerite of about the same length as the antennular peduncle. Basicerite without a spine.

Penultimate segment of third maxilliped (Text-fig. 10*c*) narrow, about three times as long as its maximum breadth. Terminal segment 1.6 times as long as the penultimate segment, four times as long as broad basally, gradually tapering towards the apex.

Merus of large cheliped (Text-fig. 11*a*, b & c) 2.3 times as long as broad, distal angle of its upper margin angular but not dentiform, inner inferior edge with a tooth just behind the distal angle. Large chela as figured by Coutière (1899) for *A. malleodigitus* ; subcyclindrical, rather inflated in the middle, upper margin sloping forwards towards the articulation with dactylus, lower margin more or less straight in the palmar region. Chela about 2.4 times as long as high, and 1.2 times as high as thick. Upper margin of palm with an oblique-transverse groove on the inner surface just behind its articulation with dactylus, this groove continuing backwards as a short furrow flanked by a rounded oblique ridge ; infront of the groove the palm abruptly slopes down to the dactylar arti-

culation. Dactylus hammer-shaped, having a setose groove on each side. Fixed finger fringed by setae in the basal half on both side of prehensile edge, with a shallow longitudinal depression on the inner face which continues backwards some distance on the palm.

Merus of short cheliped (Text-fig. 11 *d*) long and narrow, four times as long as broad, distal angle of upper edge rounded, no tooth on the apex of inner inferior edge. Chela about 1.4 times as long as merus, four times as long as high, without grooves. Palm 1.67 times as long as fingers. Fingers normal, tapering towards the apex which is curved inwards.

Second pereiopods absent.

Ischium of third pereiopods (Text-fig. 11 *e* & *f*) armed with a spine Merus compressed, 4.2 times as long as broad, with a large tooth at the distal end of its inferior edge. Carpus two-thirds as long as merus, 4.7 times as long as broad, with its inferior apex produced into a tooth projecting over the propodus. Propodus about 0.8 as long as carpus, with two rows of movable spines on its inferior edge, the marginal row consisting of five, and the submarginal row (on the outer face) of four, in both cases the distal most spines situated apically. Dactylus short and curved, with a simple, acute apex.

Lateral margins or telson (Text-fig. 10 d) straight, converging posteriorly. Length of telson 1.7 times its anterior breadth, and 4.3 times its posterior breadth. Anterior margin 2.5 times as broad as posterior margin. Dorsal spines rather large, situated respectively in the first and second third from the posterior margin. Posterior margin straight. Inner pair of disto-lateral spines twice as long as the outer pair. Spine at the outer angle of diaeresis of exopod (Text-fig. 10 *e*) (of uropod) long but slender.

Remarks : The specimen from Vietnam agrees well with the description and figures of Coutière (1899 and 1906) and DeMan (1911), though the posterior border of telson appears to be somewhat narrower.

Distribution : This species is recorded from Red Sea (Coutière, 1906 ; Tattersal, 1921 : Ramadan, 1936 ; Holthuis, 1958) ; Western Indian Ocean (Coutière, 1906 and 1921), Indonesia (DeMan, 1888, 1902, 1911), Mariana Archipelago (Banner, 1956), N. Australia (Bate, 1888). It is not so far recorded from Chinese and Japanese waters.

Alpheus lutini Coutière, 1906

(Text-figs. 12 & 13)

1905 — *Alpheus lutini*, Coutière, Fauna Geogr. Maldiv. and Laccad., p. 885, pl. LXXVI, fig. 23.

Material : Stn. Cauda, 6 July 1948 — 1 ♂, c. 15 mm. ; Stn. Cauda, 3-4 m, 28 November 1946 — 1 ♀ (berried), c. 12.5 mm.

Rostrum (Text-fig. 12*a* & *b*) very short, projecting as a tiny triangular protuberance just beyond the frontal border. Rostral carina, orbits and carapace as in *A. microstylus*.

Second segment of antennular peduncle about 2.5 times as long as broad ; 2.5 times as long as the exposed part of first segment in male,

but only twice as long in the female ; third segment half as long as the second. Stylocerite broad with a short, acute tip reaching to the middle of first segment of antennular peduncle.

Outer margin of scaphocerite moderately concave ; squamous portion narrow, short reaching upto the middle of second segment of antennular peduncle ; final spine far exceeding the tip of squamous part and reaching as far as the end of antennular peduncle or slightly beyond. Carpocerite of about the same length as antennular peduncle. Basicerite without a tooth.

Penultimate segment of third maxilliped (Text-fig. 13 *a*) about 2.75 times as long as broad, half as long as the ultimate segment. Ultimate segment long, narrower than the preceding joint, gradually tapering towards the apex, and measuring 6.7 times as long as its maximum width.

Large cheliped (Text-fig. 12 c & Text-fig. 13 b & c) as in *A. microstylus* but without a tooth at the far end of the inferior edge of merus, which instead bears a tiny protuberance at the place corresponding to the tooth in *microstylus*. Merus about two times as long as broad in the male, but somewhat slenderer in the female, being 2.4 times as long as broad. Large chela slightly longer than carapace in male, but somewhat shorter in the female ; 2.5 times as long as high, resembling that in *microstylus* except that the setose groove on both sides of dactylus is not so distinct.

Small cheliped of male missing. In the female merus (Text-fig. 13 *d*) without a tooth at the far end of inner inferior border, about 3.7 times as long as broad. Chela somewhat compressed, about 1.3 times as long as merus and 4.3 times as long as high. Fingers half as long as palm.

Second pereiopods unequal (Text-fig. 13 *e* & *f*). Longer pereiopod in female about twice as long as the cephalothorax, the shorter one being only 1.7 times as long. In the male, second pereiopod present only on one side, being about 1.6 times as long as carapace. Ratio of carpal segments in the longer pereiopod of female 10, 32, 7, 7, 10 ; chela slightly longer than the last two carpal segments with fingers a shade shorter than the palm. In the shorter second pereiopod of female the ratio of carpal segments being 10, 25, 6, 6, 9 ; chela a little longer than the last two segments. Ratio of carpal segments of second pereiopod in male — 10, 25, 7.5, 7.5, 10, agreeing with that of the shorter pereiopod of female.

Merus of third pereiopod (Text-fig. 13 *g* & *h*) robust, armed at the far end of inferior edge with a strong tooth, 3.8 times as long as broad. Carpus two-thirds as long as merus, 4 times as long as broad, with the lower distal angle produced into an acute tooth projecting over propodus, upper distal angle also produced but not so acute. Propodus as long as carpus, slightly more than 4 times as long as broad, with nine movable spines irregularly arranged along the lower margin, the distal most two being apical. Dactylus short, curved, with simple acute apex.

Telson (Text-fig. 12 *d*) somewhat narrower in the male than in the female ; its lateral edges and posterior margin straight in both sexes. Ratio of length to anterior breadth 1.75 in female, about 2 in male ; the same against breadth of posterior margin being 7 times in both sexes. Anterior margin about 3.5 times as broad as posterior margin. Dorsal

spines moderately large, the anterior pair being a shade more than twice as far away from the posterior border as the distal pair.

Remarks : These specimens agree fairly well with the type specimens of *A. lutini*, which I had the opportunity to examine in the Paris Museum of Natural History. There are, however, certain differences in measurements, and in this respect my specimens agree more with the material described by DeMan (1911) from the East Indies.

A. lutini bears a strong resemblance to *A. microstylus* (Bate) from which it can be easily distinguished by the structure of antennal scale, and the setose groove on the large cheliped.

Distribution : This species has been known from Western Indian Ocean (Coutière, 1906 & 1921) ; Malay Archipelago (DeMan, 1911) ; Samoa (Coutière, 1906) ; the Isle of Tague (Coutière, 1906) ; Mariana Archipelago (Banner, 1956) ; Arno Atoll, Marshall Islands (Banner, 1957) ; Ontoa, Gilbert Island (Banner, 1958) and Yap Island, Caroline Archipelago (Banner, 1959). It has not so far been recorded from the Red Sea and from the Chinese and Japanese waters.

Alpheus paraculeipes Coutière, 1906

(Text-fig. 14)

1906 — *Alpheus paraculeipes*, Coutière, Fauna and Geogr. Maldiv. & Laccad., p. 594, pls. LXXIX-LXXX, fig. 32.

Material : Anchorage, Itu-Aba, 23 April 1936 — 1 ♂, 9 mm. ; Nhatrang Market (purchased), 10 August 1934 — 1 ♂, 9 mm.

Rostrum (Text-fig. 14 *a*) as described and figured by Coutière (1906). Rostral carina low, hardly projecting beyond front. Orbits large, rounded, unarmed, higher than rostral carina, sloping anteriorly.

Second segment of antennular peduncle 1.75 times as long as the first and third, 2.3 times as long as broad. Stylocerite foliaceous, terminating in a short curved spine that reaches forward to the middle of the exposed part of the first segment of antennular peduncle.

Outer margin of scaphocerite somewhat concave, squamous part reduced, reaching only slightly beyond the first segment of antennular peduncle ; the final tooth of antennal scale somewhat shorter than antennular peduncle. Carpocerite slender, shorter than antennular peduncle. Basicerite without a tooth.

Third maxilliped (Text-fig. 14 *b* & *c*) overreaching carpocerite by half the length of its terminal joint. Penultimate segment about twice as long as broad. Ultimate segment about four times as long as broad at base, slightly more than twice as long as the penultimate segment.

Large cheliped (Text-fig. 14 *d* & *e*) as figured and described by Coutière. Merus with its upper distal angle acute, inner inferior border armed with a tooth at the far end, about twice as long as broad, and a quarter as long as the chela. Chela 1.8 times as long as carapace, more or less cylindrical, rather inflated basally and narrower in the distal region,

2.7 times as long as high, little compressed. Palm without any grooves or depressions, emarginate in front, with a large blunt tubercle at the inner angle of its articulation with the dactylus. Dactylus about one-third as long as the entire chela, apex blunt, crossing the fixed finger. Fixed finger with tip acute in one specimen, blunt in the other.

Short cheliped (Text-fig. 14 *f*) slender. Merus 2.4 times as long as broad, with a tooth at the far end of inner inferior margin. Chela cylindrical, smooth, 3.1 times as long as high, little compressed. Dactylus broad, flattened above, about one-third as long as the chela, half as long as palm.

Carpal segments of second pereiopod (Text-fig. 14 *g*) in the ratio of 10, 27, 6.6, 6.6, 10 ; chela about twice as long as the last carpal segment ; fingers longer than palm.

Merus of third pereiopod (Text-fig. 14 *h*) with a large tooth at the distal angle of its inferior edge, about 3.9 times as long as broad, lower margin fringed with about twenty short setiferous spines. Ischium unarmed. Carpus about half as long as merus, 2.6 times as long as broad, with about half a dozen setiferous spines on the lower border, five long setae on the upper border and a tiny spinule midway. Propodus 1.3 times as long as carpus, with seven spines on the lower margin, and an additional short spine at the apex. Dactylus small, curved, with a short secondary claw.

Merus of fourth and fifth pereiopods unarmed.

Telson (Text-fig. 14 *j* & *k*) about twice as long as its anterior width, four times as long as the posterior width. Posterior margin half as long as the anterior margin. Dorsal spines rather large, inserted in the first and second third. Posterior margin of telson somewhat arcuate.

Remarks : These specimens agree closely with the type material, though there are certain minor differences in the measurements of pereiopods.

Distribution : Originally described by Coutière (1906) from Maldives, this species has been recorded from Amirante Bank, Western Indian Ocean (Coutière, 1921), Cheval Parr, Ceylon (Pearson, 1905), and Timor. Indonesia (DeMan, 1911). It does not seem to be common in Indonesia, and is so far not reported from the West-Pacific.

Alpheus frontalis H. Milne-Edwards, 1837

1837 — *Alpheus frontalis*, H. Milne-Edwards, Hist. nat. Crust., **2**. pp. 356-357.

1873 — *Alpheus latifrons*, A. Milne-Edwards, Jour. Mus. Godeffroy, **4**. p. 87.

1880 — *Betaeus utricola*, Richters, Meersf. Mauritius, p. 164, pl. XVII, figs. 34-35.

Material : Paracels (Patle Island), 2-3 m, 24 March 1947 — 1 ♂, 34.5 mm.

Rostrum (Text-fig. 15 *a*) absent, frontal margin of carapace expanded, projecting beyond the eyehoods, covering half of the stylocerite on the first segment of antennular peduncle ; anterior margin of front slightly

arcuate, antero-lateral angles rounded, lateral borders running backwards to join the antero-lateral margin of carapace on level with the inner aspect of orbital hoods. A median dorsal keel over the front marks the position of rostral carina upto the bases of eye hoods. Eye hoods rounded, unarmed, slightly raised and divergent anteriorly, separated from the front by narrow grooves. Frontal margin of carapace half as wide as the combined width of fronto-orbital border.

Second segment of antennular peduncle three times as long as the exposed part of the first, three times as long as wide, third segment 1.4 times as long as exposed part of the first. Stylocerite short, rounded (not spinuous) reaching as far as the middle of first segment of antennular peduncle. All segments of the antennular peduncle fringed by long, stiff setae dorsally along the joints.

Antennal scale broad, (ratio of length to breadth 2.5) apex of lamella broadly arcuate, reaching a little beyond the second segment of antennular peduncle, the final tooth, which is strong, overreaching the lamella and extending beyond the middle of the third segment. Carpocerite longer than antennular peduncle, extending beyond the latter by the distal fourth. Basicerite without a spine.

Outer maxilliped (Text-fig. 15 b) of a characteristically stocky build, almost reaching the end of carpocerite, compressed. Penultimate segment subquadrangular, broader distally, the distal breadth almost equal to its dorsal length. Ultimate segment twice as long as penultimate segment, broadly oval near the base, tapering towards apex, twice as long as broad in the middle. Lower edges of both penultimate and ultimate segments covered with long, very dense setae, which also continue on the distal half of the upper edge of the ultimate segment. Superior distal angle of penultimate segment with a fringe of long setae.

Large cheliped (Text-fig. 15 c) heavy. Merus stout, almost as broad distally as long ; upper apex rounded, inner inferior edge serrulate, fringed with short scattered setae, far edge unarmed. Chela heavy, rotated on its axis so that the inner surface faces upwards, the outer face downwards and the upper edge octwards ; subcylindrical. rounded, somewhat inflated basally, upper border convex in profile, lower border concave near junction with immobile finger. No grooves or depressions on palm, outer face of palm smooth, inner face finely papillose, lower border densely hirsuit on the inner side, the setae being much denser distally. Dactylus compressed, more or less horizontal with respect to the main axis of the cheliped, apex acute, beak-shaped, molar tooth on the prehensile edge large ; inner face of dactylus somewhat papillose in the basal half. Fixed finger papillose on the inner face.

Small cheliped (Text-fig. 15 *d*) heavy. Merus 1.66 times as long as broad, inner inferior edge serrulate, distal angle rounded, unarmed distal margin setose, superior apex rounded. Inner inferior surface of carpus setose, chela rotated clockwise along its axis so that inner aspect faces obliquely upwards, outer face obliquely downwards, upper edge of palm pointing outwards. Chela 2.6 times as long as high. Distal half of palm compressed above so that the upper distal edge somewhat bluntly keeled, proximal part of upper margin rounded ; outer and inner faces of palm rather flattish, lower margin somewhat flattened in the palmar region ;

inner surface of palm papillose, outer surface smooth, lower border densely hirsuit on the inner side. Dactylus flattened along the vertical axis, elongate oval, 0.9 times as long as palm, twice as long as wide in the middle, margins densely hirsuit, outer surface smooth, inner surface densely hairy ; cutting edge in the form of a low ridge close to the lower margin, broadened apically ; apex acute, curved. Immobile finger with prehensile edge hairy on both sides, the setae on the inner side longer.

Second pereiopods 1.6 times as long as cephalothorax, slender. Merus 8.2 times as long as broad. Carpal segments in the ratio of 22.5, 10, 5, 5, 8.8 ; first segment 2.25 times as long as second ; second segment 2.6 times as long as broad. Chela almost as long as the last two carpal segments. Fingers equal to palm.

Ischium of third pereiopod armed. Merus unarmed, 4 times as long as broad. Carpus about half as long as merus, 2.8 times as long as broad, with three short movable spines on its inferior edge whose distal extremity is produced into an acute tooth. Propodus 1.3 times as long as carpus, 4.7 times as long as broad, armed with seven movable spines along the inferior edge and two spines on the infero-distal angle, upper and lower edges hirsuit, some of the setae on the lower margin very long. Dactylus one-third as long as propodus with a simple, acute apex.

Ischium of fourth pereiopod armed. Merus 2.4 times as long as carpus, 4.3 times as long as broad, unarmed. Carpus 3.2 times as long as broad, inferior edge without spines, lower distal extremity not produced. Propodus, 1.5 times as long as carpus, 4.8 times as long as broad, inner edge with nine movable weak spines, both edges less hairy. Dactylus one fourth as long as propodus, curved, with an acute, simple apex.

Posterior border of telson somewhat arcuate, sides straight, about twice as long as broad anteriorly. Anterior margin 1.5 times as broad as posterior margin. Dorsal spines weak situated nearer the lateral margins at 0.3 and 0.5 distance from the posterior border. Uropods oval, spine on exopod of caudal fans weak.

Remarks : The single male specimen at my disposal agrees well with the description and figures of this species recorded from time to time. Its characteristic rostrum and third maxillipeds make it easy to distinguish it from other species of this genus.

Distribution : This species appears to be widely distributed in certain areas of the Indo-West Pacific. The following are its records in literature :

Eyelath, Israel, Red Sea (Holthuis, 1958).

Amirante Bank, Chagos ; Egmont and Salomon ; Praslin Reef, Seychelles (Coutière, 1921) ; Mauritius (Richters, 1880) ; Laccadives and Maldives (Coutière, 1906).

Pearl Bank, Ceylon (Pearson, 1911) ; Tuticorin, South India (Henderson, 1893).

Amboina (DeMan, 1888 ; Ortmann, 1894) ; Ternate (DeMan, 1902) ; West Celebes, Java Sea, Atjeh (DeMan, 1897) ; Eighteen different stations in Indonesia (DeMan, 1911) ; Pulu Babi ; Sinabang, Simalur ; Nias (DeMan, 1922).

Murray Island Reef, Torres Strait (Coutière, 1900).

Liu Kiu Island, Amani Oshima, Japan (Ortmann, 1890).

Tahiti (Heller, 1865) ; Upolu, Samoa (A. Milne-Edwards, 1874) ; Samoa Islands (Ortmann, 1890) ; New Holland (H. Milne-Edwards, 1837) ; Funafuti, Rotuma (Borradaile, 1898) ; Saipan, Mariana Archipelago (Banner, 1956) ; Arnoa Atoll, Marshall Islands (Banner, 1957) ; Hamahomo Island, Tuamotu Archipelago (Banner, 1959) ; Loyalty Island (Borradaile, 1930).

It is not so far recorded from the South and East African Coasts, nor from the Hawaiian Archipelago !

Alpheus ehlersii DeMan, 1909

(Text-figs. 16 & 17)

1909 — *Alpheus ehlersii*, DeMan, Proc. zool. Soc. Lond., p. 663, pl. LXX, figs. 1-6.

Material : Indo-China (locality unspecified) — 1 ♀, c. 14 mm.

Rostrum (Text-fig. 16 *a*) acute reaching to the distal two-thirds of the visible part of the first segment of antennular peduncle ; rostral carina obtuse, beginning at the level of base of orbital hoods and separated from them by deep narrow grooves. Orbital hoods rounded, unarmed.

Second segment of antennular peduncle about 1.5 times as long as wide, slightly longer than the third and the visible part of the first. Stylocerite acuminate, just exceeding the first segment of antennular peduncle.

Outer margin of antennal scale slightly concave, squamous portion a little shorter than the antennular peduncle, the final spine exceeding beyond the antennular peduncle. Carpocerite longer than the antennular peduncle as well as the scaphocerite. Basicerite with a short, rather ventrally placed tooth.

Penultimate segment of the third maxilliped (Text-fig. 17 *a*) 2.75 times as long as its maximum width. Ultimate segment about 1.66 times the length of penultimate, six times as long as wide at base, gradually narrowing towards the rounded apex.

Merus of large cheliped (Text-fig. 16 b, c & *d*) slightly more than twice as long as wide, upper distal angle obtuse, inner inferior margin armed with a smooth tooth at the far end, and with five or six small movable spinules between the base and distal quarter. Chela 1.6 times as long as carapace, 3.3 times as long as merus, 2.8 times as long as high, somewhat compressed (the ratio of height to thickness being as 4 : 3). Upper and lower borders of palm nearly parallel ; lower border rounded, slightly concave near the base of immobile finger (but not notched) ; upper border also rounded but with a short narrow groove running obliquely inwards from behind the truncate distal extremity of palm. Dactylus about one-third as long as palm, and a fourth of the entire chela, with a broadly rounded apex.

Merus of the small cheliped (Text-fig. 17 b & c) about twice as long as broad, with three spinules on the inner inferior edge whose distal angle is acute. Carpus half as long as merus, with a blunt tooth at the

supero-internal angle. Small chela about 0.63 as long as the large chela, almost as long as carapace. Palm with upper and lower borders entire, 3.5 times as long as high. Finger as long as palm.

Ratio of carpal segments of second pereiopods (Text-fig. 17 *d*) 16, 9, 4, 5, 7. Chela slightly longer than the sum of last two segments. Fingers a shade longer than palm.

Ischium of third pereiopods (Text-fig. 17 *e*) unarmed. Merus about 3.5 times as long as broad, inner border unarmed at apex. Carpus two-thirds as long as merus, 3.8 times as long as broad, with distal extremities not produced. Propodus about 1.2 times as long as carpus, slightly narrower distally, about 4.8 times as long as broad near base, with nine spines on the lower margin of which the distal most are paired and apical. Dactylus one-third as long as propodus, breadth at base only a quarter of its length, slightly curved, with a simple, acute apex.

Fourth pereiopod like the third.

Fifth pereiopod with merus 4.8 times as long as broad, 1.3 times as long as carpus. Carpus 4.5 times as long as broad. Propodus 1.2 times as long as carpus, 7 times as long as broad. Dactylus about three-sevenths of propodus.

Telson (Text-fig. 16 *e* & *f*) broad anteriorly, abruptly narrowing in the distal region ; about 1.6 times as long as width of the anterior border. Posterior margin arcuate, about half as wide as the anterior margin. Only one pair of dorsal spines present, more or less in the middle. Outer distal margin of endopod of uropod armed with about 14 small movable spines. Spine at the angle of diaeresis of exopod large.

Remarks : The type specimens of *A. ehlersii* DeMan from the Bay of Batavia Lacked third and fourth pereiopods. The present specimen has all the pereiopods on it. It agrees completely with the description and figures of DeMan (*loc. cit.*). The telson, however, appears to be abnormal in lacking the posterior pair of dorsal spinules.

Distribution : Outside its type locality in the Bay of Batavia (DeMan, 1909) this species is only known from Iraeli coast of Red Sea (Holthuis, 1958).

Alpheus gracilipes Stimpson, 1861

(Text-figs. 18 & 19)

1861 — *Alpheus gracilipes,* Stimpson, Proc. nat. Acad. Sci. Philad., p. 31. [Proc. for 1860].

Material : Bay-Miêu island, 28 May 1937 — 1 ♂, c. 20 mm. Stn. Cauda, 25 January 1947 — 1 ♂, c. 19 mm., 1 ♀ (berried) c. 19 mm. Estuary of Cua-Bé, 40 mm, 9 June 1948 — 1 ♂, c. 17 mm. Nhatrang Market (purchased), 10 Aujust 1934 — 1 ♂, c. 19 mm.

Rostrum (Text-fig. 18 *a* & *b*) broad at base, narrowing anteriorly, flattened above, reaching between distal two-third to the end of first segment of antennular peduncle, or slightly exceeding it ; dorsal surface slightly concave in lateral view. Orbital hoods rounded posteriorly, with a vertical median keel anteriorly that slopes down towards the anterior

margin of front. Grooves separating orbital hoods from rostrum deep and narrow posteriorly, passing anteriorly into flat projections bound by the orbital keel and rostrum on each side.

Second segment of antennular peduncle about twice as long as broad, a little longer than the first segment ; third segment slightly shorter than the first. Stylocerite ending in an acute spine that reaches forward to the end of first segment of antennular peduncle.

Scaphocerite with outer margin concave ; squamous portion with a broad apex that reaches as far as the end of antennular peduncle ; final spine, whose tip is somewhat curved inwards exceeds the squamous portion. Carpocerite slightly shorter than the antennular peduncle. Basicerite armed with an acute spine that reaches to the middle of the first segment of antennular peduncle.

Penultimate segment of third maxilliped (Text-fig. 19 e) about two-thirds as long as the ultimate segment, about three times as long as broad. Ultimate segment narrow, tapering towards the apex which is truncate, about five times as long as broad at base ; apex with a few long setae, margins and undersurface fringed with short setae.

Merus of large cheliped (Text-fig. 19 *b* & *c*) about 2.5 times as long as its distal breadth, its upper margin produced into an acute tooth distally ; inner inferior margin with a large tooth just behind the distal angle, rest of the margin armed by 2-3 short spinules. Chela long, slender, subcylindrical, slightly compressed, 3.6-3.7 times as long as high. Palm with upper and lower margins straight ; upper margin with a transverse groove behind articulation with dactylus, the shoulder of palm in front of the groove rounded : no other grooves or ridges on the palm. Dactylus compressed, upper edge keeled and rounded, apex blunt, about 0.45 to 0.54 as long as palm.

Merus of small cheliped (Text-fig. 18 c) similar to that of larger one but slender, about 3.5 times as long as broad. Chela subcylindrical, somewhat compressed, 4.7 to 5.0 times as long as broad ; margins entire. Dactylus about three-sevenths as long as palm with fringe of setae on both sides running obliquely from near the point of articulation to the crown a little before the apex. Entire chela covered with scattered, long, stiff setae which are more numerous on the inner surface of fingers.

Carpal segments of second pereiopods (Text-fig. 19 *d*) in the ratio of 11-14, 9, 4, 4, 6-7 ; the second segment is 4.5 times as long as broad. Chela as long as the last two segments. Fingers equal to palm.

Third pereiopods (Text-fig. 19 *e*) more slender in male than in female. Merus in male 7.5 times as long as broad and 1.7 times as long as carpus, unarmed. Carpus 5.2 times as long as broad with its distal extremities not produced. Propodus slender, 1.5 times as long as carpus, 10 times as long as broad, armed with 8 spines on its lower edge of which the distal most two are apical. Dactylus slender, about a quarter of the length of propodus, with a simple, acute, curved apex.

Telson about twice as long as its maximum breadth anteriorly. Posterior margin arcuate, measuring two-thirds of the breadth of anterior margin.

Pleurae of the first three abdominal segments (Text-fig. 19 *f*) rounded, posterolateral angle of fourth pleura obtuse, that of the fifth acute.

Remarks : This appears to be a common species around the Vietnamese coast and is easily identifiable by its flat rostrum and keeled orbital hoods. The examples from Krusadai Island in South India referred by Gravely (1930, p. 78, pl. I, figs. 4 *a-b*) to *Alpheus* sp. appear to be conspecific with *A. gracilipes* as the figures of the rostrum and large chela indicate.

Distribution : This is a widely distributed species in the Indo Pacific Region. It is recorded by Coutière from Jedda, Red Sea (1897 *d*), from Jiboutie, Dar-e-Salaam, Mahe, and Maldive Islands (1906). Miers (1884) reports it from Ceylon, and Gravely's (1930) record of *Alpheus* sp. is from Krusadai Island, not far from Gulf of Mannar. DeMan (1888, 1902, 1911, 1924) and Coutière (1897 *d*) have recorded it from several localities in Indonesia. It is furthermore known from Japan (Yokoya, 1933) ; Tahiti (Stimpson, 1861) ; Marquesas Island and Samoa Islands (Ortmann, 1890 & 1894) ; New Caledonia (Coutière, 1906) ; Hawaii (Coutière, 1906 ; Edmondson, 1925 ; Banner, 1953) ; Mariana Archipelago (Banner, 1956) ; Marshall Islands (Banner, 1957) and Gilbert Islands (Banner, 1958).

Alpheus pubescens DeMan, 1908

(Text-fig. 20)

1908 — *Alpheus pubescens*, DeMan, Notes Leyden Mus., **30**, p. 109.

Material, Les Marionettes, 23 September 1934 — 1 ♀ (barried), c. 18 mm.

Rostrum (Text-fig. 20 *a* & *b*) acute, carinate, reaching forward to the middle of first segment of antennular peduncle. Rostral carina sharp, slightly concave in the inter-orbital region, continuing back as a keel to about the middle of carapace. Orbits unarmed, rounded, situated well in front of the antero-lateral borders of carapace, separated from rostral carina by deep, narrow grooves. Orbital region about two-thirds as wide as the anterior width of carapace.

Antennular peduncle pubescent ; second segment about 1.4 times as long as the exposed part of first segment, 2.8 times as long as broad, 2.3 times as long as the third segment Stylocerite with an acute apex reaching as far as the end of first segment.

Antennal scale about 3.6 times as long as broad ; squamous portion slightly narrower distally, not reaching to the end of antennular peduncle ; outer edge of scale slightly concave, the final spine reaching beyond the end of antennular peduncle as far as the tip of carpocerite, the latter being distinctly longer than the antennular peduncle. Basicerite with a small, sharp, lateral tooth.

Third maxilliped (Text-fig. 20 c) reaching as far as the end of antennal scale. Penultimate segment about half as long as the ultimate segment, 1.6 times as long as wide. Ultimate segment almost parallel-edged with a broad truncate apex, twice as long as the preceding segment, four times as long as wide, fringed with long, stiff setae on the apex, and short trimmed setae along the margins.

Merus of large cheliped (Text-fig. 20 *d*) 3.4 times as long as wide, its upper distal angle obtuse, inner inferior edge armed with four movable spinules, the far end bearing a sharp tooth, and fringed with rather stiff setae, some of which are long. Carpus with an acute tooth at the infero-internal angle. Chela as long as carapace, 2.5 times as long as merus, 3.2 times as long as high. Palm compressed (the ratio of height to thickness being 1.7), a transverse groove on the upper border just behind dactylar articulation ; lower border entire, a shallow longitudinal groove on the inner surface beginning from the distal end running backwards to the proximal third of palm ; lower border fringed with long setae along the inner surface which continue upto the end of fixed finger. Dactylus about 0.55 as long as palm, upper edge broadly rounded, apex blunt, cutting edge straight between molar and apex, fringed with setae on the inner side of upper edge.

Merus of small cheliped (Text-fig. 20 *e*) about four times as long as broad, inner inferior distal angle acute, and the same margin bearing four movable spinules and a fringe of long setae. Carpus about half as long as palm, with a blunt tooth at supero-internal angle. Chela slightly shorter than carapace, 5.5 times as long as high, compressed. Palm about 0.75 as long as fingers, its upper and lower borders entire, fringed with dense row of long setae on the inner surface that continue forward along to the tip of fingers. Fingers a quarter longer than palm, compressed, shutting together when closed, with tips crossing.

Ischium and merus of second pereiopods (Text-fig. 20 *f*) equal. Carpus 1.5 times as long as merus ; ratio of carpal segments being 8.8, 10, 4.1, 4.1, 4.7 ; second segment slender, about seven times as long as thick. Chela about 1.5 times as long as the last carpal segment. Fingers a shade longer than palm.

Ischium of third and fourth pereiopods with a movable spine. Merus of third pereiopods (Text-fig. 20 *g* & *h*) slender, six times as long as broad, lower margin unarmed. Carpus about two-thirds as long as merus, five times as long as broad, with superior distal angle very slightly produced. Propodus a shade longer than carpus, 6.5 times as long as broad, lower margin with five slender submarginal spinules and a pair of apical spines near the articulation with dactylus, both edges fringed with long setae which are denser distally. Dactylus (Text-fig. 20 *b*) 0.4 as long as propodus, slightly curved, apex acute and simple and tipped with two short hairs, upper edge with four short hairs.

Posterior margin of telson (Text-fig. 20 *j*) arcuate, lateral margins abruptly narrow down in distal third. Telson twice as long as its anterior breadth. Posterior margin two thirds as wide as the anterior margin. Dorsal spines strong, situated in the first and second third. Spine on the diaeresis of exopod of caudal fan heavy and curved.

Pleurae of abdominal segments broadly rounded.

Remarks : The specimen at my disposal agrees with the types of this species, which I had the opportunity to examine in the Amsterdam Museum. The only point of difference was in the pleurae of abdominal segments which in the type appear to be elongate oval, and not broadly rounded. Moreover the type is not so hirsuit as the present specimen.

Distribution : This species is not known outside Indonesia from where it was originally recorded by DeMan (1908 and 1911). In Indonesia it occurs at Postillon Islands, Timor, Makassar, Borneo Bank, West Coast of Salawatti and Aru-Islands.

Alpheus rapacida DeMan
(Text-figs. 21 & 22)

1908 — *Alpheus rapacida*, DeMan, Notes Leyden Mus., **30**, p. 105.

1911 — *Alpheus rapacida*, DeMan, Siboga Exped. Monogr., vol. **39a1**, Part 2. Fam. Alpheidae, pp. 394-397 ; and, 1915 suppl. pl. XX, fig. 91.

1921 — *Alpheus rapacida*, Stebbing. Ann. Durban Mus., **3**, p. 18.

1950 — *Alpheus rapacida*, Barnard, Ann. S. Afr. Mus., **38**, pp. 750-752, fig. 142 (*a-f*).

Material : Cauda, 29 April 1934 — 1 ♀ (without eggs), 53.6 mm.

Rostrum (Text-fig. 21*a*) short, acute, reaching to distal two-thirds of the second segment of antennular peduncle. Carina acute in the interorbital region, becoming obtuse posterior to orbital hoods, gradually disappearing behind, faintly visible up to about the middle of carapace. Orbital hoods unarmed, rather short, placed well in front of the anterolateral borders of carapace, separated from rostral carina on each side by broad, deep grooves. Frontal border feebly arcuate on both sides of the rostrum.

Second segment of antennular peduncle about twice as long as the exposed part of the first, about 3.75 times as long as broad ; third segment about one-third as long as the second segment. Stylocerite broad and foliaceous, ending in an acute apex reaching almost as far as the end of first joint of antennular peduncle ; in addition to the fringe of setae on the margins of segments, the upper surface of the peduncle beset with short, scattered bristles.

Antennal scale slightly exceeding the antennular peduncle, about 2.5 times as long as its maximum width near the base, outer edge feebly concave, inner margin gradually converging towards the apex ; the final spine just exceeding the squamous portion. Basicerite with short, acute, ventral tooth. Carpocerite slightly shorter than antennular peduncle, reaching to distal three-fourths of its terminal joint.

Third maxilliped (Text-fig. 21*b*) densely hirsuit. Penultimate segment about 1.6 times as long as its distal width, with a fringe of long setae at its inner angle, these setae extending considerably beyond the end of ultimate segment. Ultimate segment about three times as long as the penultimate, six times as long as broad, almost parallel edged, with the apex broadly rounded, margins fringed with dense, long setae, those near the apex being as long as the apex itself.

Large cheliped (Text-fig. 22 *b* & *c*) long, slender, with the chela not heavily built. Merus about 3.25 times as long as wide, apex of inner inferior margin with a large tooth, the margin itself bearing six small, movable spinules along its entire length (two spinules on ischium), and a fringe of long, stiff setae in the distal third. Chela slightly shorter than

carapace (ratio of length of chela/carapace 0.9), about 3.5 times as long as broad, compressed (being twice as high as thick ; about twice as long as merus. Upper and lower borders of palm entire, the lower border being rather sharp, outer and inner surfaces rough, and without any grooves or depressions. Palm twice as long as high, 1.8 times as long as dactylus ; a dense row of long stiff setae, set in a groove, along the lower border of palm on the inner surface, continuing upto the apex of fixed finger ; a similar setose groove on the upper border. Dactylus compressed, upper edge broadly rounded, cutting edge sinuous, apex blunt ; a short molar process near the base on the inner edge ; a setose ridge (in line with similar ridge on palm) along the upper border on the inner side, and scattered tufts of setae. Fixed finger with lower margin rather sharp, somewhat concave on the outer face, tip blunt, with tufts of setae along the margins of cutting edge.

Short cheliped (Text-fig. 21c & Text-fig. 22*a*) similar in appearance to that of large cheliped, though slightly less (about 0.9 times) in length. Merus about thrice as long as broad with apex of upper border acute, inner inferior border with a large tooth at its distal end, and 6-7 movable spimules (ischium with two spinules) along the margin that is fringed with long, stiff setae in distal half ; upper margin with scattered setae. Chela compressed (lower border sharp) about twice as wide as high. Palm slightly shorter than dactylus (about 0.9) and much shorter than fixed finger (about 0.7). Entire chela (measured upto the tip of fixed finger) 1.6 times as long as merus, 0.8 times as long as large chela and 0.73 times as long as carapace. Dactylus resembling that of larger chela but much shorter than the fixed finger ; upper border broadly rounded, cutting edge straight, molar small, near the base. Fixed finger much longer than palm, expanded in the distal third of the inner surface opposite the molar of dactylus, tip acute and curved inwards. No grooves or depressions on the chela except that the base of the fixed finger on the outer side rather concave. Setose ridge on the palm and fingers as in larger cheliped ; cutting edge of the fixed finger on the inner side fringed with rather dense setae.

Second pereiopod with ischium subequal to merus. Merus about eight times as long as broad. Carpus 1.5 times as long as merus ; the ratio of carpal segments 10.4 ; 10.0 ; 4.2 ; 3.8 ; 5.0 ; second segment six times as long as broad. Chela as long as last two carpal segments. Fingers 1.3 times as long as palm.

Third pereiopods with ischium armed. Merus unarmed, five times as long as broad, 3.6 times as long as ischium. Carpus about half as long as merus, four times as long as broad, with its superior distal angle produced. Propodus slightly (1.1 times) longer than carpus, five times as long as broad, slightly curved inwards with three short spinules in the basal half of lower edge, and one spinule at the apex near the articulation with dactylus ; margins fringed with scattered setae ; apex with a tuft of bristles. Dactylus (Text-fig. 21*d*) about half as long as propodus, broad and flattened at base (slightly concave ventral surface) and narrowing distally ; tip acute, a row of about twelve very short, equidistant, setae on each side on the superior surface.

Fourth pereiopod similar to third.

Ischium of fifth pereiopods unarmed. Other segments shorter and slender. Usual tufts of setae in the distal half of propodus.

Telson (Text-fig. 21*e* & *f*) with the lateral margins slightly constricted in the distal third, about 1.66 times as long as its anterior breadth, and 2.6 times distal breadth. Posterior margin two-thirds as broad as the anterior margin. Dorsal spinules rather short, the posterior pair situated much closer together ; distance of the anterior and posterior pairs from the posterior edge about 0.6 and 0.4 of the total length. Posterior edge of telson distinctly arcuate. Lateral spines on the distal margin rather short, the inner one being about twice as long as the outer one. Spine at the angle of diaeresis (Text-fig. 21*f*) of exopod of caudal fan short.

Remarks : Inspite of the very different shape of the dactylus of the small cheliped, which appears to be a case of abnormality, I refer the present specimen to *A. rapacida* DeMan. It agrees well with the description and figures given by DeMan (1911) and Barnard (1950) except for the above anomaly. There are some differences between measurements given by DeMan and in the present example, but DeMan's largest specimen was less than half as long as the one at my disposal, and no doubt when more material is examined this disparity in the measurements will possibly full within the range of normal variations in this species.

In case, however, future work proves that the structure of dactylus of short cheliped in the exemple from Indo-China is not an abnormality, this specimen may have to be referred to a new species.

Distribution : A. rapacida was originally recorded from different localities in Indonesia by DeMan (1911). Stebbing (1921) and Barnard (1950) report its occurrence in South Africa. It is not so far known from other areas.

Alpheus bisincisus deHaan, 1849

(Text-fig. 23)

1849 — *Alpheus bis-incisus*, deHaan, in Von Seibold's Faun. Japon. Crust., p. 179, pl. XLV, fig, 3. (Plate published in 1844).

Material : Nhatrang Market (purchased), 10 August 1934 — 1 ♀, c. 29 mm.

Rostrum triangular (Text-fig. 23*a*), flattened above, apex acute reaching to distal two-thirds of the first segment of antennular peduncle. Orbital hoods rounded, unarmed, separated from the rostrum by deep narrow grooves. Frontal margin with a rounded prominence separated from rostrum on each side by an emargination.

Second segment of antennular peduncle slightly more than twice (2.2 times) as long as broad, 1.2 times as long as the exposed part of the first ; third segment almost half as long as the second. Stylocerite broad with a short acute apex ending a little behind the distal end of the first segment of antennular peduncle.

Antennal scale 2.7 times as long as broad at base, outer margin slightly concave, lamella converging towards the apex, reaching as far as the end of antennular peduncle ; final spine extending beyond the lamella by about one-sixth of the length of the scale. Carpocerite longer than the antennular peduncle. Basicerite with a short ventral spine.

Third maxilliped (Text-fig. 23b) extending beyond antennal scale by about two-fifths of its terminal segment. Terminal segment 1.8 times as as long as penultimate segment, about six times as long as broad at base, apex narrow, truncate, fringed with scattered setae. Penultimate segment about 2.5 times as long as broad distally, slightly broader than the terminal joint.

Merus of large cheliped (Text-fig. 23c & d) about twice as long as broad, armed with an acute tooth at the far end of the inner inferior border, apex of superior border obtuse. Chela compressed, 2.5 times as long as high, 2.4 times as long as dactylus. Palm notched on upper and lower borders ; triangular grooves on both surfaces well developed, the palmar projection overhanging the notch on the upper border narrow and acute, but not sharply pointed ; the notch on the lower border with an obtuse tip ; palm 1.5 times as long as dactylus. Outer edge, of dactylus rounded, apex blunt.

In the small cheliped (Text-fig. 23*e*) merus 2.4 times as long as wide, armed with a short acute spine at the far end of inner inferior margin. Carpus with a blunt tooth at the supero-internal angle. Chela slightly compressed, 4.3 times as long as finger. Palm with a slight depression on the upper border behind dactylar articulation, the depression passing into a small quadrangular groove on the outer side, lower border straight. Dactylus simple, not balaeniceps-shaped, broad at base, narrowing distally, 1.2 times as long as palm.

Merus of second pereiopods (Text-fig. 23*f*) two-thirds as long as carpus. Ratio of carpal segments 16 : 10 : 5 : 4 : 7 ; second segments 3.3 times as long as wide. Chela as long as the last three carpal segments. Fingers longer than palm.

Ischium of third pereiopods (Text-fig. 23*g*) armed with a short, movable spine. Merus without a spine at its inferior distal angle, 1.8 times as long as carpus, 5.5 times as long as wide. Carpus 3.6 times as long as wide, its extremities not produced. Propodus 1.3 times as long as carpus, about 7 times as long as wide, armed with nine long and four short movable spines on its inferior margin, the distalmost two spines being apical. Dactylus slender, curved, acute and almost half as long as propodus.

Posterior margin of telson (Text-fig. 23*h* & *j*) slightly arcuate, two-thirds as wide as the anterior margin. Lateral margins somewhat constricted distally. Dorsal length of telson about 1.9 times the breadth of its anterior margin and 2.8 times the breadth of posterior margin. Dorsal spines large, situated in the first and second third. Spine on the diaeresis of exopod of uropods not heavy.

Abdominal pleurae broadly rounded.

Remarks : The present specimen shows greater resemblance to typical *A. bisincisus* deHaan than to its varieties *malensis* Coutière, 1906, *stylirostris* Coutière, 1906 and *variabilis* DeMan, 1911. This species can be easily distinguished from other species of « *edwardsii* » group by its dorsally flattened rostrum, merus of third pereiopods unarmed at its inferior distal end and acute dactyli of posterior pereiopods.

Distribution . This species is known from South Africa (Barnard, 1950 ; 1957) ; Laccadives & Maldives (Coutière, 1906) ; Ceylon (Pearson, 1905 ; 1911) : Indonesia (DeMan, 1911) and Japan (DeHaan, 1849 ; Stimpson, 1861 ;

Miers, 1879). It has so far not been recorded from the Red Sea, and Central and South Pacific.

Alpheus audouini Coutière, 1906, (Text-fig. 24)

1906 — Alpheus Audouinii, Coutière, Faun. Geogr. Mald. Laccad, pp. 911-912, pl. LXXXVII, fig. 52.

Material : Tagne Island, 25 m, 20 September 1933 — 2 ♂♂, c, 22 mm. and 28 mm. Stn. Cauda, 0.3 m, 3 August 1948 — 2 ♂♂, 16 mm, 1 ♀ (berried), 17 mm. Stn. Cauda, 25 January 1947 — 1 ♂, 18.5 mm. Stn. Cauda. 21 June 1948 — 2 ♂♂, 12 mm, & 13.5 mm, 1 ♀, c. 12 mm. Cauda, 29 April 1934 — 1 ♂.

Description : Rostrum (Text-fig. 24*a* & *b*) triangular, rather narrow at base (as in *A. chiragaricus* H.M. Edw.), apex acute, carina obtuse; somewhat variable in length from, slightly shorter to slightly longer than the first segment of antennular peduncle.

Orbital hoods rounded, unarmed, separated from rostrum by shallow grooves.

Second segment of antennular peduncle equal to or slightly longer (1.0 to 1.2) than the exposed part of first segment, about 1.6-1.7 times as long as broad ; third segment 0.6 to 0.8 as long as second. Stylocerite broad and foliaceous, ending in a short acute spine reaching forwards to the distal end of first segment of antennular peduncle.

Antennal scale about three times as long as wide at base ; lamella narrow, reaching as far as the end of antennular peduncle, the final spine exceeding the lamella. Carpocerite somewhat longer than the antennular peduncle. Basicerite with a short spine.

Penultimate segment of third maxilliped (Text-fig. 24*c*) broader than long (ratio of length/breadth c. 0.4). Ultimate segment twice as long as the preceding joint, gradually narrowing towards the apex, about six times as long as broad at base.

Superior distal angle of merus of large cheliped (Text-fig. 24*d* & *e*) subacute ; far end of its inner inferior edge armed with a spine ; proportion of length to breadth of merus varying from 1.7 to 2.6 (perhaps females have narrower merus). Chela stout, compressed, 2.4-2.5 times as long as high. Upper and lower borders of palm notched before articulation with fingers, the notch on the superior border overhung by an obtuse projection ; projection over notch on lower border also blunt ; usual grooves on the outer and inner faces of palm. Dactylus about three-fourths as high as, and 0.5 to 0.7 as long, as palm, outer margin rounded, apex somewhat acute in males, blunt in females.

Merus of small cheliped (Text-fig. 24*f*) 2.5 to 3.2 times as long as broad, spine at the far end of the inner inferior margin very short. Supero-internal angle of carpus acute. Chela somewhat compressed, about four times as long as high. Palm with upper and lower borders entire, without notches or grooves, no spiniform angle on the palm near articulation with dactylus. Dactylus in males subspatulate, balaeniceps-shaped ; in females simple, almost as long as or slightly shorter than palm.

Ratio of carpal segments in second pereiopods (Text-fig. 24*g*) as follows :

12.5-15.4 : 10.0 : 3.3-4.5 : 3.3-4.5 : 6.4-7.3 : Second segment three to four times as long as broad. Chela twice as long as last carpal segment. Fingers subequal to palm.

Merus in third pereiopod (Text-fig. 24*h*) without a spine at the far end of the inferior edge, five to six times as long as broad. Carpus 0.53-0.55 times as long as merus, about four times as long as broad, its extremities not produced. Propodus 1.2-1.4 times as long as carpus, about 7 times as long as broad, armed with 7-9 spines on its inferior edge (2 or 3 spines short), distalmost spine apical. Dactylus curved, simple, acute, 0.31-0.42 as long as propodus.

Telson (Text-fig. 24*j*) 1.5 times as long as the breadth of its anterior margin and three times as long as the breadth of posterior margin. Lateral margins straight. Posterior margins very slightly arcuate. Dorsal spinules moderate-sized.

Remarks : The present material has been identified as *A. audouini Coutière* because the palmar projections overhanging the notches on upper and lower borders of palm in the large cheliped are blunt, the only character which distinguishes this species from *A. chiragaricus* H. Milne-Edwards and *A. edwardsii* (Audouin). The taxonomic status of these three species is yet in a state of confusion and requires more study.

Distribution : It is practically certain that earlier records of *A. edwardsii* are mixed with those of *A. audouini*. It is, however, not possible here to straighten up this problem, hence I cite only those records which are definitely associated with the name *audouini*.

This species appears to be very common in Red Sea from where it has been reported many times by Coutière (1906), Nobili (1906), Balss (1915, 1927 — Port Said, Suez Canal) Fox (1926, 1927), Gurney (1927), Tortonese (1947, 1952), Tattersal (1921), Ramadan (1936, Ghardaqua). Recently it has been reported from Caeseria (Forest and Guinot, 1958) ; Haifa Harbour, Caeseria, Hertzlia and Bat Yam (Holthuis, 1958), all these localities being confined to the Mediterranean coast of Israel where it seems to have migrated via the Suez Canal.

It has also been recorded from Chagos and Salomon (Coutière, 1921) in the Western Indian Ocean ; from several localities in the Laccadives and Maldives Archipelago (Coutière, 1906) ; Gulf of Mannar (Pearson, 1905), and Pearl Banks (Pearson, 1911) in Ceylon and from Indonesia (DeMan, 1911).

Coutière (1906) also records it from New Caledonia and Sandwich Islands. Holthuis (1961) includes in its range « Indo-West Pacific area » (Red Sea to New Zealand and Hawaii).

Banner (1953) doubts the validity of Coutière's (1906) record of *A. audouini* from Hawaii.

Alpheus crassimanus Heller, 1865
(Text-figs. 25 & 26)

1865 — *Alpheus crassimanus*, Heller, Crust. Nov., pp. 107-108, pl. X, fig. 2.

Material : Station Trai-Ca (Bangoi), 16 August 1948 — 1 ♂, c. 32.5 mm., 1 ♀, c. 29 mm. Station Cauda, 3 August 1948 — 1 ♂, c. 13.5 mm.

Rostrum triangular (Text-fig. 25*a*) ; rostral carina subacute, separated from the unarmed rounded orbital hoods by rather deep, narrower grooves ; length of rostrum more in the male and female from Stn. Trai-Ca, reaching to the distal three-fourths of the first segment of antennular peduncle, but in the male from Cauda it reaches upto the middle only.

Second segment of antennular peduncle 1.4 times as long as first in the male from Trai-Ca, and 2.25 times the same in the specimen from Cauda ; ratio for length to breadth of this segment 2.5 and 2.25 resp. in the two males ; third segment equal to first in both cases. Stylocerite broad and foliaceous ending in an acute spine that just exceeds the first segment of antennular peduncle.

Antennal scale with outer margin somewhat concave, lamella narrow, reaching to about the end of antennular peduncle in the specimens from Trai-Ca, but only upto the middle of third segment in the small male from Cauda ; final spine exceeding the lamella and ending midway between the tips of antennular peduncle and carpocerite. Carpocerite long and stout, longer than the atennular peduncle. Spine on basicerite very short.

Third maxillipeds (Text-fig. 26*a*) projecting forwards to the tip of carpocerite. Penultimate segment half as long as the ultimate, 2.0-2.25 times as long as broad. Ultimate segment gradually narrowing towards the tip, about four times as long as broad at base in the male from Cauda, this ratio being six in the larger examples.

Large cheliped (Text-fig. 25*b* & *c* & Text-fig. 26*b* & *c*) present in both males but missing in the female. Though similar in appearance in the two males, proportions of merus somewhat different in the two. Merus about 1.5 times as long as broad in smaller male from Cauda (Text-fig. 26*b* & *c*) ; 2.4 times as long as broad in the male from Trai-Ca ; superior distal angle of merus obtuse, inferior inner edge armed with a spine at the far end, this spine being very short in the smaller male from Cauda. Chela heavy and compressed, the proportions between height and its length being 2.4 (small male) and 2.3 (larger example, Text-fig. 26*b* & *c*). Upper and lower borders of palm notched near the articulation with fingers, the shoulders of notch being rounded, and not overhung by palmar projections ; usual depressions on the outer and inner faces present ; on the lower margin of palm the proximal lobe of notch is blunt, continuing on the outer surface as a deep oblique groove backwards, and forming and ill defined circular depression on the inner face that continues upwards across the palm to the inner angle of articulation with dactylus as a shallow, transverse groove ; an oblique depression along the length of fixed finger on the outer surface.

In the short cheliped (Text-fig. 26*d* & *f*) the far end of the inner inferior margin of merus unarmed in the short male from Cauda (Text-fig. 26*d*), but provided with a short tubercle in the other male (Text-fig. 26*f*) ; ratio of length to breadth of merus 1.7 (short male) and 2.6 (the large male). Supero-internal angle of carpus armed with a blunt tooth. Chela narrower in the large male, the proportion of length to breadth being 2.3 in the small male and 3.7 in the larger one, in both it is 1.9 times as long as palm. In the shorter male only the lower border of palm is deeply notched, whereas in the larger one both upper and lower borders notched, with shallow depressions on the outer and inner faces on each side of the notch,

these depressions being absent in the short male. Dactylus subspatulate and balaeniceps-shaped, being somewhat longer than palm (1.3 times) in the short male, but slightly shorter (about 0.9 times) in the large male; an oblique setose ridge on each side beginning from the base and meeting at the crown about a fourth distance from the distal end. Immobile finger also with setose ridges on each side;: the setae on the inner side of both fingers long and dense.

Second pereiopods missing in the smaller male; about 1.5 times as long as cephalothorax in the large male. Proportions of carpal segments being 17 : 11 : 5 : 5 : 7; second carpal segment 3.7 times as long as broad. Chela a shade longer than the last two carpal segments taken together.

Ischium of third pereiopods (Text-fig. 26*e*) armed with a movable spine. Merus without a spine at the far end of the lower border, three times as long, as broad in the short male and four times the same in the large one; ratio of lengths of merus and carpus 1.66 (short male), 1.5 (long male). Carpus three times as long as broad in short male, 4.2 times in the large male, its upper extremity slightly produced. Propodus 1.33 times as long as carpus (short male) and only 1.2 times in large male, ratio of its length to breadth 5 (short male) and 6.25 (large male); lower border armed with 8 stout spines, two distalmost being apical, in short male; large male with a double row of spines on the lower border of propodus, an outer row of six long spines and an inner row of five short spines, distalmost of each series being apical, also long marginal setae. Dactylus about one-third as long as propodus, curved, with simple, acute apex.

Telson (Text-fig. 25*d*) in the short male 1.5 times as long as breadth of its anterior margin, ratio of breadth of anterior to posterior margin being 1.4. Posterior margin somewhat arcuate. Lateral borders straight. Dorsal spines large and stout, situated at 3/8 and 5/8 distance from the posterior margin. A shallow groove running mesially along the dorsal surface of the telson from base to distal end. Spine at the angle of diaeresis of exopod of uropod large and heavy. In the large male telson 1.6 times as long as its anterior width, anterior margin 1.5 times as wide as the posterior arcuate margin, and dorsal spines not so large.

The egg-bearing female is rather damaged, but agrees with the large male in appearance and proportions of carpal segments of second cheliped.

Remarks: The two males described above show certain differences in proportions, but that may be due to the difference in the size of the two. The only significant difference is the lack of a notch on the upper border of palm in the smaller male. In the original description and figures of this species by Heller (1865) the palm of the small cheliped is conspicuously notched on both upper and lower borders. This character is conspicuous in the small cheliped of the larger male only. Again the acute spine on the inner side of articulation with dactylus figured by Bate (1888) is not so conspicuous in the present specimens, and is represented by a short conical tooth. In the material from Hawaii figured by Banner (1953, p. 134, fig. 49*h*), this spine is very conspicuous but the upper and lower borders of palm are not notched and there are no depressions on the sides. However, Banner (1959) figures small chelipeds of three specimens from Yap Island, Caroline Archipelago showing progressive stages in the appearance of notches and depressions on the palm. It will thus appear that the sculp-

turing of palm in the small cheliped is variable with the size of the specimen. This also appears to be true for the spine at the far end of the inner inferior edge of merus in this cheliped. In the material at my disposal the shorter specimen lacks this spine whereas in the larger one it is represented by a blunt tubercle. Banner (1959) also reports absence of this spine in specimens less than 20 mm. in length from Hawaii.

Distribution : The present species has a wide distribution in the Indo-Pacific, and has, like the preceding one, also infiltrated into the Mediterranean where it has been known from a number of localities. The following are its records in literature :

Tunis (Forest and Guinot, 1956) ; Caeseria, Israel (Forest and Guinot, 1958) ; Suez Canal (Balss, 1936 ; Gruvel, 1936 ; Monod, 1937) ; Sharam-e-Sheikh, Sinai Peninsula (Holthuis, 1958) ; South Africa (Barnard, 1950) ; Chilka Lake, Bay of Bengal (Kemp, 1915) ; Nicobar (Heller, 1865) ; Indonesia (Coutière, 1897*d* ; DeMan, 1952, 1911 and 1924 ; Hawaii Archipelago (Edmondson, 1925 ; Banner, 1953) ; Johnston Island (Edmondson, 1925) ; Arno Atoll, Marshall Islands (Banner, 1957) ; Ontoa Atoll, Gilbert Island (Banner, 1958) ; Caroline and Tuamotu Archipelagos (Banner, 1959) ; Albany Island off Cape York, Australia (Bate, 1888). According to Barnard (*loc. cit.*) it seems to be fairly common in South African Coast, and it is also apparently abundant in the Hawaii Archipelago.

Alpheus serenei Tiwari, 1962
(Text-figs. 27 & 28)

1962 — *Alpheus serenei*, Crustaceana, (in press).

Material: Holotype — 1 ♂, c. 18 mm. ; loc. Stn. Cauda, depth 3 to to 4 m. (coral reef) 28 November 1946. (Rtc. 1003, E 1655) ; Paratypes — 2 ♂ ♂, c. 19 mm., loc. Paracels (Patle) Island, depth 2-3 m. (coral reef) 24 March 1947 (Rtc. 1006, E 468).

Rostrum acute (Text-fig. 27*a* & *b*), reaching forwards to the end of first segment of antennular peduncle ; carina obtuse extending backwards to about the anterior one-third of the carapace, slightly sloping forwards. Orbital hoods unarmed, separated from the rostrum by rather broad, deep grooves. Frontal border of carapace with a moderately arcuate prominence on each side between the orbital hoods and rostrum.

Second segment of antennular peduncle 1.5 times as long as the exposed part of the first, 2.5 times as long as broad, 1.7 times as long as the third. Stylocerite ending in an acuminate spine reaching slightly beyond the first segment of antennular peduncle.

Antennal scale 3.5 times as long as broad near the base, outer margin concave, lamella narrowed anteriorly reaching almost to the terminal segment of the antennular peduncle, the final spine sharp and acute, extending beyong the lamella by about one-fifth the length of the scale, reaching forwards to the tip of the carpocerite. Carpocerite longer than the antennular peduncle. Basicerite armed with an acute tooth, about as long as rostrum.

Third maxilliped (Text-fig. 28 *a*) with the penultimate segment slightly more than twice as long as its distal breadth. Ultimate segment 1.6 times as long as the penultimate segment, broad basally, narrowing towards the

truncate apex, about 4.2 times as long as its width near the base ; apex 0.4 as broad as basal width.

Large cheliped (Text-fig. 27 *c* & *d* ; Text-fig. 28 *b*, *c* & *d*) — Merus (Text-fig. 27 *c*) 2.3 times as long as its maximum width distally, upper margin ending in an obtuse angle, inner inferior edge with an acute tooth at the far end, and one or two short movable spinules in the middle. Chela heavy and compressed, 1.3 times as long as carapace, 3.6 times as long as merus, 3.3 times as long as finger and 1.45 times as long as palm ; ratio of length to height about 2.7. Upper and lower borders of palm notched distally ; a narrow rounded projection of palm overhanging the proximal shoulder of the notch on upper border, the notch passing into a subquadrangular groove on the outer surface, and into a deep triangular groove on the inner surface. Dactylus compressed, apex subacute. Fixed finger with an oblique depression along its length on the outer face. Scattered tufts of setae on chela.

Small cheliped (Text-figs. 27 *e* & 28 *e*) : Merus (Text-fig. 28 *e*) armed with a spine at the far end of the inner inferior margin in addition to two short movable spinules in the first and second third ; length of merus about 2.6 of its breadth. Carpus with an acute tooth at its supero-internal angle. Chela (Text-fig. 27 *e*) 2.15 times as long as merus, 1.9 times as long as palm, 3.4 times as long as high. Palm with upper and lower borders rounded, without grooves, with an acute tooth on the inner side near its articulation with dactylus. Dactylus not subspatulate, rather simple, with a hairy crest beginning from the base running obliquely forwards to the distal third on the inner surface, and with another oblique ridge on the outer surface disappering half way, without or with feeble hairs ; both fingers somewhat broad at base, narrowing distally ; cutting surfaces toothless, flanked by ridges on both sides ; inner face of fingers with tufts of long hair, the same face of palm also with similar though more scattered hairs.

Carpal segments of second pereiopods (Text-fig. 28 *f*) with the following proportions : — 23:10:5:5:10 ; second segment 2.5 times as long as broad. Chela a shade more than twice as long as the last carpal segment. Fingers slightly longer than palm.

Ischium of the third (Text-figs. 27 *f* & 28 *g*) and fourth pairs of pereiopods with a movable spine. Merus (Text-fig. 27 *f*) of third pereiopod about four times as long as broad and armed with a large subapical tooth at the far end of its inferior margin. Carpus about half as long as merus, 3.6 times as long as broad, with lower distal extremity spinuous. Propodus 1.2 times as long as carpus, six times as long as broad, armed with a marginal row of long, movable spines and a submarginal row of shorter spines, somewhat less in number ; upper margin fringed with setae, the distal extremity having a setiferous tuft. Dactylus (Text-fig. 28 *g*) about one-third as long as propodus, curved, tapering into an acute apex, and *in addition provided with a short accessory claw* and two tiny hairs on the distal fourth of the lower margin.

Fourth pereiopod like the third but with slightly different proportions of segments.

Ischium and merus of fifth pereiopod unarmed. Merus, carpus and propodus of almost the same length. Merus about 1.2 times as long as broad. Dactylus biunguiculate.

Telson (Text-fig. 27 *g*) broad in proximal two-thirds, abruptly narrowing in the distal third, posterior margin somewhat arcuate. Dorsal spines rather stout, situated at 0.3 and 0.6 distance from the posterior margin. Length of telson 1.5 times its anterior width and 3.75 times the width of the posterior margin. Spine at the angle of diaeresis of exopod of uropods heavy.

Abdominal pleurae broadly rounded.

Remarks : The above description is based on the 18 mm. long male [Holotype] from Cauda (Rtc. 1003, E1655). The two paratypes (No. Rtc. 1006, E468) come from Paracels (Patle Island), off the Vietnam coast. Though agreeing generally with the holotype, they show certain differences in proportions of appendages. The first two segments of the antennular peduncle bear the ratio 10:15, but the third segment is 8 in one and 9 in the other. The length of second antennular segment is twice its thickness in one, and 2.3 times the same in the other.

The ratios of other appendages are as follows :

Large cheliped, merus-length/breadth 2.12, 2.10 ; carapace/chela — 1.5, 1.3 ; chela length/height — 2.53, 2.50 ; chela/palm — 1.52, 1.45 ; chela/dactylus — 2.85, 3.20 ; chela/merus — 3.80, 3.80.

Small cheliped — merus length/breadth — 2.62, 2.73 ; carapace/chela — 0.92, 0.82 ; chela/palm — 1.83, 1.70 ; chela/merus — 2.00, 1.70.

Third pereiopod — Merus length/breadth — 4.0, 4.4 ; carpus/merus — 0.59, 0.55 ; carpus length/breadth — 4.30, 4.25 ; propodus/carpus — 1.23, 1.30 ; propodus length/breadth — 5.33, 5.50 ; propodus/dactylus — 3.5, 3.1.

Fourth pereiopod — Merus length/breadth — 5.5, 4.7 ; carpus/merus — 0.5, 0.53 ; carpus length/breadth — 3.66, — ; propodus/carpus — 1.45, 1.47 ; propodus/dactylus — 3.55, 3.14.

Telson — Length/anterior breadth — 1.65, 1.60 ; length/posterior breadth — 3.3, 3.0 ; anterior breadth/posterior breadth — 2.0 ; 1.9.

This species obviously belongs to the « *edwardsii* group » of species of *Alpheus*, in which the large chela is heavy and compressed and is provided with the characteristic notches on the upper and lower borders of palm and the usual depressions on its outer and inner faces. The small cheliped shows a stage midway between the subspatulate, balaeniceps condition and the straight, simple dactyli. Though the characteristic flattening of the dactylus is absent, the setose ridges are there, not so conspicuous as in many other species. Unfortunately there is no female in the collection, hence it is not possible to know the shape of dactylus in the other sex.

Only two species of the « *edwardsii* group » are so far known to possess biunguiculate dactylus in posterior pereiopods, namely, *A. hoplites* Nobili, 1907, and *A. polyxo* DeMan, 1909.

It agrees with *A. hoplites* in having an acute tooth on the apex of posterior margin of merus of third pereiopods, but differs in the following features.

1. According to Nobili the front in *A. hoplites* is tripunctate, that is in addition to rostrum, the orbital hoods are also armed. In the present species the orbital hoods are smooth.

2. In *A. hoplites* the basicerite has no spine, whereas it is present in *A. serenei*.

3. Merus of small cheliped does not have a spine at the far end of the inner inferior margin in Nobili's species.

4. In *A. hoplites* the first carpal segment of second cheliped is twice as long as the second, whereas it is more than twice in *A. serenei*.

5. Merus of third pereiopod is three times as long as broad in *A. hoplites*, while in *A. serenei* it is four times or more. The secondary claw on the dactylus of posterior pereiopods is also larger in *A. hoplites* than in the present species.

In *A. polyxo* DeMan the merus of third pereiopods is unarmed at the distal end of its posterior margin, and it also appears somewhat slenderer (5.26 and 5.31 times as long as broad). Unfortunately the second cheliped of *A. polyxo* is not known.

Alpheus strenuus Dana, 1852

1852 — *Alpheus strenuus*, Dana, Proc. Acad. nat. Sci. Philadel.; 6. p. 21.

Material : Bich-Dâm (Hon-Lon Island), 27 July 1934 — 1 ♀, 23.5 mm.

Description : Rostrum (Text-fig. 29*a*) acute, reaching nearly to the end of first segment of antennular peduncle ; carina subacute, separated from the unarmed, rounded orbital hoods by deep grooves.

Second segment of antennular peduncle 1.5 times as long as the exposed part of the first, 2.5 times as long as broad ; third segment equal to the first in length. Stylocerite with an acute tooth reaching as far as the end of first segment of antennular peduncle.

Lamella of antennal scale extending up to the end of antennular peduncle, the final spine projecting slightly beyond. Carpocerite somewhat longer than the antennular peduncle. Spine on basicerite short.

Third maxilliped (Text-fig. 29 *b*) reaching the end of carpocerite. Penultimate segment 2.3 times as long as wide. Ultimate segment twice as long as the penultimate, 6.5 times as long as wide at base, gradually narrowing towards the apex.

Merus of large cheliped (Text-fig. 29 *c*) armed with a tooth at the distal end of inner inferior margin in addition to seven small spinules along the edge ; apex of superior margin obtuse. Chela large and heavy, compressed, 2.6 times as long as wide, 1.7 times as high as thick. Palm 1.6 times as long as the dactylus, upper and lower borders notched behind articulation with fingers ; lobe of palm proximal to notch rounded, not overhanging as a projection ; usual depressions on the outer and inner faces of palm. Dactylus keeled, outer margin rounded, apex blunt.

Merus (Text-fig. 29 *d*) of short cheliped (Text-fig. 29 *e*) armed with a sharp tooth at the far end of the inner inferior edge, 2.2 times as long as wide. Carpus with a blunt tooth at the supero-internal angle. Chela 3.8 times as long as wide. Palm 1.2 times as long as fingers, its upper

and lower borders notched before articulation with fingers, shallow depressions on the outer and inner faces behind the notch on the upper border ; a blunt tooth on the palm at the inner angle of articulation with fingers. Dactylus subspatulate, « balaeniceps-shaped », flattened above, broad near the base, each side with an oblique hairy crest starting near the base, passing upwards to the crown a little behind the apex. Immobile finger with a fringe of setae running along the entire inner border, but only in the basal half of the outer border.

Second pereiopods (Text-fig. 29 *f*) 1.74 times as long as cephalothorax. Merus nine times as long as wide. Carpus 1.6 times as long as merus ; ratio of carpal segments — 30, 30, 10, 10, 18 ; second segment 4.8 times as long as wide. Chela as long as the last two carpal segments. Fingers equal to palm.

Ischium of the third pereiopod (Text-fig. 29 *g*) armed with a movable spines. Merus unarmed, 4.3 times as long as wide, 1.7 times as long as carpus. Carpus 3.8 times as long as wide. Propodus 1.2 times as long as carpus, six times as long as wide, armed on its lower margin with eleven movable spines arranged in two irregular rows of six long and five short spines, the distalmost in each rows being apical. Dactylus one-third as long as propodus, curved, with a simple, acute apex.

Telson (Text-fig. 29 *h*) about twice as long as its anterior width ; posterior margin two-thirds as wide as the anterior margin, arcuate. Dorsal spines rather large, anterior pair situated in the middle, posterior pair midway between the preceding pair and distal margin.

Remarks : The « balaeniceps-shaped » fingers of the smaller chela in females is the most reliable distinguishing character of this species. Often, when in a mixed lot the chelae get detached, it becomes almost impossible to distinguish this species from the similar looking *A. crassimanus* and *A. audouini*. The present specimen is a female, and has fingers of its small cheliped balaeniceps shaped, so there is no doubt as to its identity.

Distribution : It has a wide distribution in the Indo-West-Pacific, and is also known from the East Pacific. The following are its records in literature :

Mozambique, East Africa (Hilgendorf, 1879 ; Barnard, 1950) ; Chagos, Salomon ; Amirante Creek (Coutière, 1921) ; Fouquets, Mauritius (Richters, 1880) ; Goidu Atoll ; Hulule Male Atoll ; Minikoi (Coutière, 1906) ; Trincomalee (Muller, 1887) ; Weligama, Jafna ; Pearlbanks ; Delft (Pearson, 1911) ; Krusadai and Shingle Islands ; Pamban ; Rameswaram (Gravely, 1930) ; Pulau Bedan, Penang ; Kelantan (Lanchester, 1901) ; Banda Neira, Aru Islands ; Gorontalo Bay (Coutière, 1897 *d*) ; Samau Island near Timor ; Tawi Tawi Island near Sulu Archipelago ; Ambon Archorage ; Palu Passi Tanette ; South Lucipara Islands ; Kei Islands (DeMan, 1911) ; Sidney (Heller, 1865) ; Rockhampton, Queensland (Ortmann, 1890) ; Hong Kong (Stimpson, 1861) ; Arno Atoll, Marshall Islands (Banner, 1957) ; Ontoa Atoll, Gilbert Islands (Banner, 1958) ; Tomil Harbour, Yap Island, Caroline Archipelago (Banner, 1959) ; Tongatabu, Tonga Islands (Dana, 1852) ; Tahiti (Ortmann, 1890) ; Thursday Island (Ortmann, 1894) ; Hao, Polynesia (Nobili, 1907) ; Rotuma, Funafuti (Borradaile, 1898).

Banner (1953) doubts Stimpson's (1861) record of this species (under the name *A. avarus*) from Hawaii, which may be a case of mistaken identity of *A. crassimanus* which seems to be very common in these island.

Outside the Indo Pacific, *A. strenuus* is known from the Galapagos (Siversten, 1934 ; Hult, 1938).

Alpheus pacificus Dana, 1852
(Text-fig. 30)

1852 — *Alpheus pacificus*, Dana, Proc. Acad. nat. Sci. Philadel., 6, p. 21.

Material : Paracels (Patle Island), 23 May 1948 — 2 ♂ ♂, 26.3 mm. and 28 mm. Cua-Bé, 30 April 1948 — 1 ♂, c. 19 mm., 1 ♀ (berried), c. 22.4 mm. Cauda, 29 April 1948 — 1 ♂, c. 24 mm.

Rostrum acute (Text-fig. 30 *a*, *b* & *c*), triangular, almost twice as long as broad at base, somewhat sloping in front, reaching a little behind the distal end of first segment of antennular peduncle, fringed with short setae ; carina obtuse, springing from behind the base of orbital hoods. Orbital hoods rounded, unarmed, separate from rostrum by shallow grooves.

Second segment of antennular peduncle about 1.5 times as long as the exposed part of the first, 1.5 times as long as the third. Stylocerite with an acute spine reaching upto the end of first segment of antennular peduncle.

Lamella of antennal scale extending beyond the antennular peduncle, the final spine exceeding the lamella, reaching as far as the tip of the carpocerite. Carpocerite longer than antennular peduncle. Spine on basicerite of almost the same length as stylocerite.

Merus of large cheliped (Text-fig. 30 *d*, *e*, *f* & *g*) 2.1 times as long as broad, no spine at the distal end of inner inferior margin. Chela massive, compressed, three to four times as long as merus, 2.3 to 2.4 times as long as high, about three times as long as fingers. Upper and lower borders of palm notched behind articulation with dactylus, a narrow, rounded palmar projection overhanging the notch on upper margin ; upper notch continuous with the depressions on the outer and inner faces of palm, depression on the outer face triangular and more conspicuous than the one on the inner face which is narrow and shallow ; notch on lower border passing into a deep oblique groove on the outer face. Dactylus compressed, outer margin rounded, apex blunt in all except one specimen in which it is acute.

Small cheliped (Text-fig. 30 *h* & *j*) similar in both sexes. Dactylus simple, neither subspatulate nor balaeniceps-shaped. Merus 2.25 times as long as broad, inner inferior border without a spine at the distal end. Chela two times as long as merus in the female, 2.3 to 2.6 as long as merus in the males ; 3.74-3.77 times as long as high in the males from Paracels (Text-fig. 30 *d*), 3.4 times as long as high in the male from Cua-Bé (Text-fig. 30 *e f* & *g*) and four times as long as high in the female ; proportion of chela against finger in males from Paracels 1.73 and 1.80, in the male from Cua-Bé 1.5 and in the female 1.6. Palm much shorter than fingers with its lower border conspicuously notched behind the level of articulation with dactylus in all the specimens ; ratio of length to height of palm is 1.6 and 1.7 in males from Paracels, 1.13 in the male from Cua-Bé and 1.5 in the female ; the palm is 0.73 and 0.79 as long as palm in the two males from Paracels, 0.5 in the male from Cua-Bé and 0.6 in female.

Fingers fringed with hair along the prehensile edges, their tips curved and acute ; a tooth on the cutting edge of dactylus near the base in the males, but absent in the female, this tooth being rather large in the Cua-Bé male and slight in others and in the latter fingers are also less hairy ; in the Cua-Bé male fingers gape when closed, in others they shut.

Ratio of carpal segments of second pereiopod (Text-fig. 30*k*) as follows : — 13 : 10 : 4 : 4 : 6. Chela by the same measure being 12 (palm 5, finger 7).

Merus of third pereiopod (Text-fig. 30*l*) without a spine at the distal end of lower border, about four times as long as wide. Carpus slightly more than half as long as merus, its distal extremities not produced. Propodus about two-thirds as long as merus, with 8-9 movable spines on its inferior margin. Dactylus about one-third as long as propodus, apex simple and acute.

Telson twice as long as breadth of its anterior border ; posterior margin slightly arcuate, half as wide as anterior margin. Dorsal spines moderately large, about 0.3 and 0.6 distance away from the distal end.

Remarks : These specimens agree well with published descriptions of *A. pacificus* Banner (1953) has extensively described and figured the examples of this species from Hawaii. In having a tooth on the cutting edge of dactylus in males, the present material differs from the Hawaiian specimens !

Distribution : This species has a wide distribution in the Indo-Pacific.

The following are its records in literature :

? Zanzibar (Hilgendorf, 1879) ; Red Sea (Balss, 1915 ; ? Nobili, 1906) ; Eylath, Israel (Holthuis, 1958) ; Chagos, Salomon ; Coin, Paros (Coutière, 1921).

Maldives and Laccadives (Coutière, 1906) ; Travancore-Cochin (Pillai, 1955) ; Indonesia (DeMan, 1892 ; 1911) ; Doublebay, Somerset, Australia (Nobili, 1899) ; Hawaii (Banner, 1953, 1959 ; Edmondson, 1925) ; Saipan, Mariana Archipelago (Banner, 1956) ; Arno Atoll, Marshall (Banner, 1957) ; Ontoa Atoll, Gilbert Islands (Banner, 1958) ; Rikitea, Polynesia (Nobili, 1907) ; Fiji Islands (Miers, 1884) ; New Caledonia (Borradaile, 1900).

Outside the Indo-West-Pacific this species is recorded by Schmitt (1939) from Clipperton Islands off the California strait in the East Pacific.

It does not appear to have been recorded off the Chinese and Japanese coasts.

Alpheus sp.

(Text-fig. 31)

Material : Estuary of Binh Tân; 8 August 1937 — 1 ♂, c. 18 mm., 3 ♀ ♀ (berried) c. 16-17 mm.

Rostrum (Text-fig. 31 *a*) short, apex acute, reaching to about distal three-fourths of the first segment of antennular peduncle, carina obtuse. Orbital hoods rounded, unarmed, separated from rostrum by broad shallow grooves ; frontal border of carapace somewhat arcuate.

Second segment of antennular peduncle 1.3 to 1.5 times as long as exposed part of the first, nearly twice as long as the third, 2.0 to 2.2 times as long as thick. Stylocerite with an acute spine reaching as far as the end of the first segment of antennular peduncle or slightly beyond.

Antennal scale rather narrow (about 3.4 times as long as its basal width), lamellar portion exceeding the antennular peduncle, but not reaching upto carpocerite, the final tooth ending at the level of distal end of carpocerite. Carpocerite longer than antennular peduncle. Basicerite armed with a sharp lateral tooth of about the same length as stylocerite.

Third maxilliped (Text-fig. 31 *b*) extending almost to the tip of carpocerite. Penultimate segment about three times as long as wide. Ultimate segment about 1.7 times the length of preceding segment, 5.5 times as long as its basal width, apex narrow and truncate.

Chelipeds detached. In the large cheliped (Text-fig. 31 *c* & *d*) merus 2.06 to 2.33 as long as broad, with inner inferior margin without a spine at the distal end. Chela 3.1 to 3.3 times as long as merus, compressed, 2.2 to 2.5 times as long as high, 3.0 to 3.3 times as long as dactylus. Upper and lower borders of palm notched, a narrow rounded projection overhanging the proximal part of the notch on upper border ; well marked triangular depression on the outer surface of palm, the depression on the inner surface narrow ; notch on the lower border of palm passing into a narrow, oblique groove on the outer face, and continuing in a rounded depression on the inner face. Dactylus about half as long as palm, its apex broad and blunt.

Short cheliped (Text-fig. 31 *e*) slender. Merus 3.0 to 3.3 times as long as broad, without a spine at the far end of inner inferior border. Chela somewhat compressed, 1.8-2.1 times as long as merus, 4.2-4.6 as long as high, 1.92 to 2.1 times as long as fingers. Palm 2.0-2.4 as long as high, 0.92 to 1.1 as long as finger, upper and lower borders entire, without a notch, inner angle of articulation of palm with dactylus acute. Dactylus simple, not subspatulate and without hairy ridges.

Ratio of carpal segments of second pereiopod (Text-fig. 31 *f* & *g*) as follows — 10:7.5:2.5:2.5:4.5, second segment 3.5 times as long as broad. Chela longer than last two carpal segments.

Ischium of third pereiopod (Text-fig. 31 *h*) unarmed. Merus 4.2 times as long as broad, 1.7 times as long as carpus, without a tooth at the far end of the inferior margin. Carpus 4.1 times as long as broad, its distal extremities not projecting. Propodus 1.2 times as long as carpus, 5.8 times as long as broad, lower margin with seven movable spines, upper border setose. Dactylus slightly more than a third as long as propodus, with an acute, simple apex.

Telson (Text-fig. 31 *j*) 1.8-2.1 times as long as the width of its anterior margin 1.5-1.7 as wide as the posterior margin ; sides more or less straight. Dorsal spines moderately large.

Remarks : It is unfortunate that the chelipeds, specially the small ones, are detached from the specimens, hence it is not certain whether both belong to females or one of them is that of the male. The short chelipeds are not balaeniceps-shaped, and if one of them is from the male,

then these specimens come nearer to *A. pacificus* Dana with which they agree in some features. However, the small cheliped in the present specimens is different from that of *A. pacificus*. It is slender and the upper and lower borders of palm are not notched. The fingers are almost equal to palm, non-gaping, and not fringed with dense hairs characteristic of *A. pacificus*. The difference also extends to proportions of various segments of this appendage, as shown below.

Alpheus sp.	*A. pacificus*
Merus 3.0-3.3 times as long as broad.	Merus 2.5 times as long as broad.
Chela 1.8-2.1 times as long as merus.	Chela 2.34 to 2.9 times as long as merus.
Chela 4.2-4.6 times as long as high.	Chela 3.4 to 3.77 times as long as high.
Chela 1.9-2.1 as long as finger.	Chela 1.5-1.8 as long as finger.
Palm both borders entire	Palm lower border notched.
Palm 9.2-1.1 as long as finger.	Palm 0.5-0.7 as long as finger.
Palm 2.0-2.4 as long as broad.	Palm 1.1-1.6 as long as broad.

The above figures clearly show that in the present specimens the short cheliped is conspicuously different from that of *A. pacificus*. Unless the differences in the structure of short cheliped are due to age, these specimens may not be conspecific with *A. pacificus* and may possibly belong to a hitherto undescribed species.

Alpheus malabaricus var. *dolichodactylus* Ortmann, 1890

(Text-fig. 32)

1890 — *Alpheus dolichodactylus* Ortmann, Zool. Jahrb. Abt. f. Syst., 5, pp. 473-474, pl. XXXVI, fig. 11.

Material: Beach of Cua-Be, Sandbank, 8 April 1936 — 1 ♂, 33.5 mm.

Rostrum (Text-fig. 32 *a*) short, reaching to about the middle of the first segment of antennular peduncle, as long as broad at base, carina rounded, springing at the level of the base of orbital hood, sloping in the interorbital region and thus hidden between orbital hoods in lateral view. Orbital hoods rounded, unarmed, inflated, situated well ahead of the antero-lateral borders of carapace, separated from rostrum by narrow, moderately deep grooves.

Second segment of antennular peduncle — 2.6 times as long as thick, about 1.6 times as long as the visible part of the first segment ; third segment about half as long as second. Stylocerite very broad and foliaceous with a pointed apex reaching to the distal three-fourths of the first antennular segment.

Antennal scale, carpocerite and antennular peduncle of about same length. Antennal scale about 2.5 times as long as its basal width, apex broad, outer margin more or less straight, final spine distinctly reaching beyond the apex of lamella. Basicerite with a short ventral spine not reaching quite as far as the tip of rostrum.

Third maxilliped (Text-fig. 32 *b*) long, slender, exceeding the carpocerite by about a third of its distal segment. Penultimate segment three times as long as its maximum width. Ultimate segment long, narrow, about 2.25 times as long as the penultimate segment, and eight times as long as its basal width, gradually narrowing distally, apex truncate. Margins of penultimate segment fringed with scattered setae. Upper margin and apex of ultimate segment fringed with scattered long setae, some of which are as long as the joint itself ; setae on lower margin dense, trimmed and short, increasing in length distally.

Merus of large cheliped (Text-fig. 32 *c*) twice as long as broad, about one-third as long as palm ; distal end of superior margin angular ; inner inferior margin with a large curved tooth at its distal angle, no other marginal spines. Chela large, heavy, compressed 1.6 times as long as carapace, 2.1 times as long as dactylus. Palm notched on its upper and lower borders before articulation with dactylus, usual grooves on outer and inner surfaces. Dactylus like parrot's beak, apex acute, cutting edge between molar and distal end strongly concave.

Small cheliped (Text-fig. 32 *d*) slender, longer than large cheliped Merus 3.2 times as long as broad, inner inferior margin with three short, movable spines in the basal half and a strong curved tooth at the far end, also provided with scattered marginal setae of which the apical ones are long. Chela slightly compressed, seven times as long as broad. Palm without notches or grooves, slightly broader distally. Fingers very long, 3.4 times as long as palm. Dactylus with a strong tooth near the base, cutting surface gaping ; both fingers with acute, curved tips, and provided with long dense setae on the inner side but only with a submarginal row of less dense and short setae along the cutting edges on outer side ; dactylus not subspatulate.

Ischium and merus of second pereiopod (Text-fig. 32 *e*) equal. Merus slender, ten times as long as thick. Carpus 1.66 times as long as merus ; ratio of carpal segments 11.7:10:2.8:2.8. 3.3 ; second segment six times as long as broad. Chela as long as the last two carpal segments. Fingers twice as long as palm.

Third pereiopod missing.

Fourth pereiopod with a spine on the ischium. Merus unarmed, 6.7 times as long as broad. Carpus 0.6 as long as merus, 5.5 times as long as broad, its distal angles not produced. Propodus 1.25 times as long as carpus. 8.6 times as long as broad, both margins fringed with setae in addition to five or six spines on lower margin and two on the apex ; an apical tuft of setae near insertion of dactylus. Dactylus (Text-fig. 32 *f*) two-fifths as long as propodus, broadened at base, carinate above, triangular in cross section.

Telson (Text-fig. 32 *g* & *h*) 1.5 times as long as the width of its anterior margin ; posterior margin wide, 0.65 times as broad as anterior margin. Dorsal spines short. Spine at the angle of junction of diaeresis of exopod of uropod short.

Remarks : The present specimen agrees with the description of *A. malabaricus* var. *dolichodactylus* in having a tooth at the base of dactylus of short cheliped, long gaping fingers, the spine of antennal scale exceeding

the lamellar part and in the proportions of carpal joints of second legs. However, the carpocerite in this specimen is not longer than the antennular peduncle, and the chela of second pereiopods is relatively short.

Banner's (1959) var. *mackayi* from Hawaii has relatively much shorter fingers in the small cheliped, rostrum is shorter and the three distal carpal segments in second cheliped are together longer than the second segment.

There is one more variety *leptopus* DeMan (1911), which is based on relative proportions of fingers in short cheliped.

Distribution : Alpheus malabaricus var. *dolichodactylus* is known from Tokyo Bay (Ortmann, 1890) and Sagami Bay (Doflein, 1902) in Japan and from Indonesia (DeMan, 1911). *A. malabaricus* has been recorded from Delagoa Bay, South Africa (Barnard, 1950) ; Zanzibar (Hilgendord, 1879) ; Pulicat Backwaters, Madras (Henderson, 1893) ; Chilka Lake, Orissa India (Kemp, 1915), Indonesia (DeMan, 1911).

Alpheus dolichodactylus var. *mackayi* Banner (1959) is reported from Wailupe Fishpond at Oahu, Hawaii.

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Explanation of Text-Figures

Text-Fig. 1 — Map of the Bay of Nhatrang.

Text-Fig. 2 — *Alpheopsis vietnami* Tiwari.

a. Anterior part of cephalothorax in dorsal view ; *b*. The same, lateral view ; *c*. Distal part of third maxilliped ; *d*. Large cheliped, inner face ; *e*. The same, superior face ; *f*. Short cheliped, outer face ; *g*. Second pereiopod ; *h*. Third pereiopod ; *k*. Propodus and dactylus of fifth pereiopod ; *l*. Telson and uropods, dorsal view.

Text-Fig. 4 — *Synalpheus consobrinus* DeMan

a. Anterior cephalothorax, dorsal view ; *b*. The same in lateral view ; *c*. Large cheliped, outer face ; *d*. The same, inner face ; *e*. Telson, dorsal view.

Text-Fig. 4 — *Synalpheus consobrinus* DeMan

a. Distal part of third maxilliped ; *b*. Small cheliped ; *c*. Second pereiopod ; *d*. Third pereiopod ; *e*. Abdomen, side view (pleopods not shown). Figures *a*, *b*, *c* & *d* of the same magnification.

Text-Fig. 5 — *Synalpheus pescadorensis* Coutière

a. Cephalothorax, dorsal view ; *b*. Distal segments of third maxilliped ; *c*. Third pereiopod ; *d*. Telson and uropods ; *e*. Abdomen, lateral view (pleopods not shown). Figures *a*, *b*, *c* & *d*, same magnification.

Text-Fig. 6 — *Alpheus deuteropus* Hilgendorf

a. Cephalothorax, dorsal view ; *b*. & *c*. Third maxilliped ; *d*. Large cheliped, outer face ; *e*. Small cheliped ; *f*. Second pereiopod ; *g*. Third pereiopod ; *h*. Third pereiopod, distal segment, enlarged ; *j*. Telson and uropods, dorsal view ; *k*. Abdomen, lateral view (pleopods not shown). All figures except *h* of same magnification.

Text-fig. 7 — *Alpheus gracilis* Heller

a. Cephalothorax, dorsal view ; *b*. Distal segments of third maxilliped. *c*. Large cheliped, inner face ; *d*. Small cheliped, inner face ; *e*. Second pereiopod ; *f*. Third pereiopod ; *g*. Third pereiopod, distal segments enlarged ; *h*. Telson and uropods ; *j*. Abdomen. lateral view (pleopods not shown). Figures *a*, *b*, *g* and *h* — same magnification ; c, *d*, *e*, *f* and *j* — same magnification.

Text-Fig. 8 — *Alpheus lottini* Guérin

a. Cephalothorax, dorsal view ; *b*. Third maxilliped ; c. Large cheliped ; *d*. Small cheliped ; *e*. Third pereiopod ; *f* Second pereiopod ; *g*. Telson and uropods, lateral view ; *h*. Telson, dorsal view. Figures *b*, *e* & *f* — same magnification : rest drawn to same scale.

Text-Fig. 9 — *Alpheus facetus* DeMan

a. Cephalothorax, dorsal view ; *b*. Distal segments of third maxilliped ; *c*. Large cheliped ; outer face ; *d*. Distal part of chela of large cheliped, inner face ; *e*. The same. superior view ; *f*. Third pereiopod ; *g*. Telson, dorsal view ; *h*. Angle of diaeresis of uropod showing the movable spine. All figures except c drawn to same scale.

Text-Fig. 10 — *Alpheus microstylus* (Bate)

a. Cephalothorax, dorsal view ; *b*. The same, anterior view ; *c*. Distal segments of third maxilliped ; *d*. Telson ; *e*. Angle of diaeresis of uropod. All figures except b drawn to same scale.

Text-Fig. 11 — *Alpheus microstylus* (Bate)

a. Large cheliped showing merus, carpus and a part of palm, inner side ; *b* & *c*. Distal part of chela of the large cheliped, inner and superior faces resp. ; *d*. Small cheliped, outer face ; *e*. Basal segments of third pereiopod ; *f*. Distal segments of third pereiopod. All figures drawn to same scale.

Text-Fig. 12 — *Alpheus lutini* Coutière

a & *b*. Cephalothorax in dorsal and lateral views resp. ; *c*. Distal part of chela of large cheliped ; *d*. Telson and uropods, dorsal view ; *e*. Eggs. All figures drawn to same scale.

Text-Fig. 13 — *Alpheus lutini* Coutière

a. Third maxilliped ; *b*. & *c*. Large cheliped, inner and outer faces resp. ; *d*. Small cheliped ; *e*. Second pereiopod, left side ; *f*. Second pereiopod, right side ; *g*. Third pereiopod ; *h*. The same, enlarged. Figures *a* and *h* drawn to same scale : rest of same magnification.

Text-Fig. 14 — *Alpheus paraculeipes* Coutière

a. Cephalothorax, dorsal view ; *b* & c. Third maxilliped outer and inner faces ; *d*. Large cheliped ; *e*. Distal part of the chela of large cheliped ; *f*. Small cheliped ; *g*. Second pereiopod ; *h*. Third pereiopod ; *j*. Telson, dorsal view ; *k*. Angle of diaeresis of uropod. All figures drawn to same scale.

Text-Fig. 15 — *Alpheus frontalis* H. Milne-Edwards

a. Cephalothorax ; *b*. Third maxilliped ; *c*. Large cheliped ; *d*. Small cheliped. All figures drawn to same scale.

Text-Fig. 16 — *Alpheus ehlersii* DeMan

a. Cephalothorax, dorsal view ; *b*. Large cheliped ; *c* & *d*. Distal part of chela of large cheliped, enlarged, superior and inner faces resp. ; *e*. Telson, dorsal view. *f*. Telson and uropods, lateral view. All figures except *b* drawn to same scale.

Text-Fig. 17 — *Alpheus ehlersii* DeMan

a. Third maxilliped ; *b*. Short cheliped, basal part, seen from inner side ; *c*. Short cheliped ; *d*. Second pereiopod ; *e*. Third pereiopod. All figures except *c* drawn to same scale.

Text-Fig. 18 — *Alpheus gracilipes* Stimpson

a & *b*. Cephalothorax, dorsal and lateral views resp. ; *c*. Small cheliped. All figures drawn to same scale.

Text-Fig. 19 — *Alpheus gracilipes* Stimpson

a. Third maxilliped ; *b* & *c*. Large cheliped. outer and superior faces resp. ; *d*. Second pereiopod ; *e*. Third pereiopod ; *f*. Abdomen, lateral view (pleopods not shown). All figures except *e* drawn to same magnification.

Text-Fig. 20 — *Alpheus pubescens* DeMan

a & *b*. Cephalothorax, dorsal and lateral views ; *c*. Third maxilliped ; *d*. Large cheliped ; *e*. Short cheliped ; *f*. Second pereiopod ; *g*. Third pereiopod ; *h*. Distal segments of third pereiopod, enlarged ; *j*. Telson, dorsal view. Figures *a*, *b*, *c*, *h* and *j* drawn to same scale ; the rest of same magnification.

Text-Fig. 21 — *Alpheus rapacida* DeMan

a. Anterior part of carapace, dorsal view ; *b*. Third maxilliped ; *c*. Short cheliped, proximal segments and a part of chela, inner face ; *d*. Distal segments of third pereiopod ; *e*. Telson, dorsal view ; *f*. Uropods, seen from side. All figures to the same magnification.

Text-Fig. 22 — *Alpheus rapacida* DeMan

a. Short cheliped ; *b*. Large cheliped, inner side ; *c*. Chela of large cheliped, outer side. Figures *b* & *c* drawn to same scale.

Text-Fig. 23 — *Alpheus bisincisus* DeHaan

a. Cephalothorax, dorsal view ; *b*. Third maxilliped ; *c*. Large cheliped, inner face ; *d*. Distal part of chela of large cheliped, seen from above ; *e*. Short cheliped ; *f*. Second pereiopod ; *g*. Third pereiopod ; *h*. Telson, dorsal view ; *j*. Telson and uropods, lateral view. All figures drawn to same scale.

Text-Fig. 24 — *Alpheus audouini* Coutière

a & *b*. Cephalothorax, dorsal and lateral views resp. ; *c*. Third maxilliped ; *d* & *e*. Large cheliped, inferior and superior faces resp. ; *f*. Short cheliped ; *g*. Second pereiopod ; *h*. Third pereiopod ; *j*. Telson and uropods, dorsal view. Figures *a*. *b* & *j*. drawn to same scale ; rest with similar magnification.

Text-Fig. 25 — *Alpheus crassimanus* Heller

a Cephalothorax, dorsal view in the small male from Cauda ; b & c. Large cheliped, inner and outer faces in the male from Trai Ca (Bangoi) ; *d*. Telson and uropods in the male from Cauda. All figures drawn to same scale.

Text-Fig. 26 — *Alpheus crassimanus* Heller

a. Third maxilliped in the male from Cauda ; b & c. Large cheliped inner and outer faces in the male from Cauda ; *d*. Small cheliped in the male from Cauda ; e. Third pereiopod in the male from Cauda ; *f*. Small cheliped in the male from Trai Ca (Bangoi). Figures *a* & *e* — same scale ; Figures b, c, *d* & *f* — same magnification.

Text-Fig. 27 — *Alpheus serenei* Tiwari

a & b. Cephalothorax in dorsal and lateral views ; c. Merus of large cheliped ; *d*. Large cheliped, superior view ; *e*. Small cheliped, chela ; *f*. Third pereiopod ; *g*. Telson and uropods. All figures except c, same magnification.

Text-Fig. 28 — *Alpheus serenei* Tiwari

a. Third maxilliped ; b, c & d. Large cheliped, different views ; *e*. Basal segments of small cheliped ; *f*. Second pereiopod ; *g*. Dactylus of third pereiopod, highly magnified. All figures except *g* — drawn to same scale.

Text-Fig. 29 — *Alpheus strenuus* Dana

a. Cephalothorax ; *b*. Third maxilliped ; *c*. Large cheliped, inner face ; *d*. Merus of small cheliped, inner face ; *e*. Small cheliped ; *f*. Second pereiopod ; *g*. Third pereiopod ; *h*. Telson and uropods, lateral view. All figures drawn to same scale.

Text-Fig. 30 — *Alpheus pacificus* Dana

a & b. Cephalothorax, dorsal and lateral views in the male from Paracels ; c. Lateral view of carapace in the male from Cua-Bé ; d & *e*. Large cheliped in the males from Paracels and Cua-Bé resp., outer surface ; *f*. Large cheliped in the male from Cua-Bé, inner face and *g*. Superior view of the same ; *h*. Small cheliped in the male from Paracels. *j*. Small cheliped in the male from Cua-Bé ; *k*. Second pereiopod in the male from Paracels ; *l*. Third pereiopod in the male from Paracels. All figures drawn to same scale.

Text-Fig. 31 — *Alpheus* sp.

a. Cephalothorax in dorsal view ; b. Third maxilliped ; c & *d*. Large cheliped, inner and outer faces ; *e*. Small cheliped ; *f* & *g*. Second pereiopod ; *h*. Third pereiopod ; *j*. Telson, dorsal view. All figures drawn to the same magnification.

Text-Fig. 32 — *Alpheus malabaricus* var., *dolichodactylus* Ortmann

a. Cephalothorax ; b. Third maxilliped c. Large cheliped, outer face ; *d*. Chela of small cheliped ; *e*. Second pereiopod ; *f*. Dactylus of fourth pereiopod ; *g*. Telson, dorsal view ; *h*. Telson and uropods, lateral view. All figures except *f* drawn to same scale.

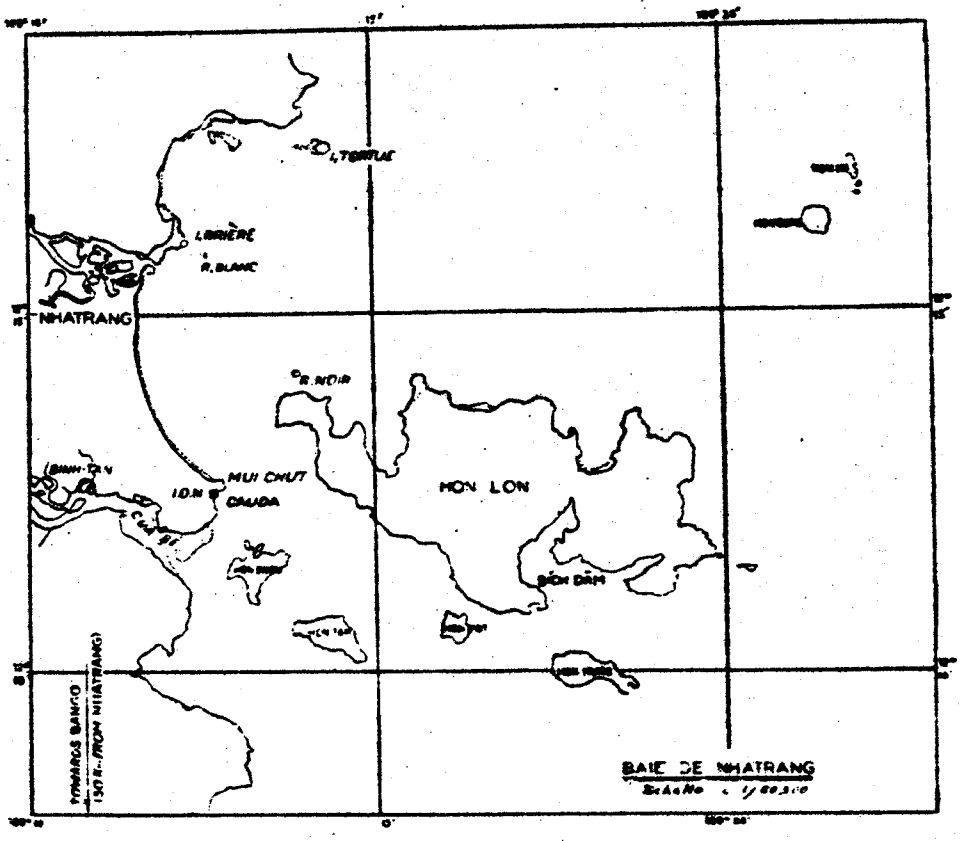
I.TRIPLE
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Fig. 1

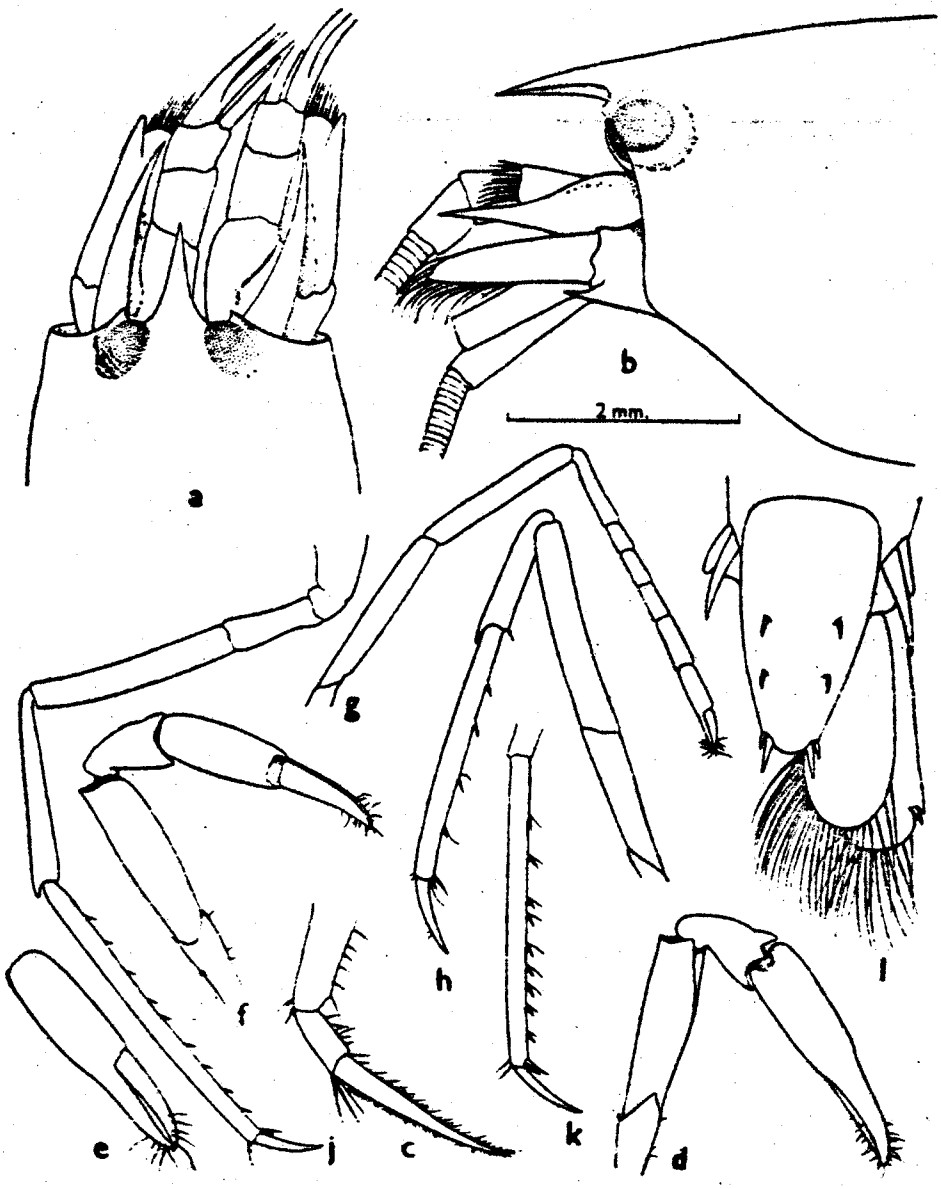


Fig. 2

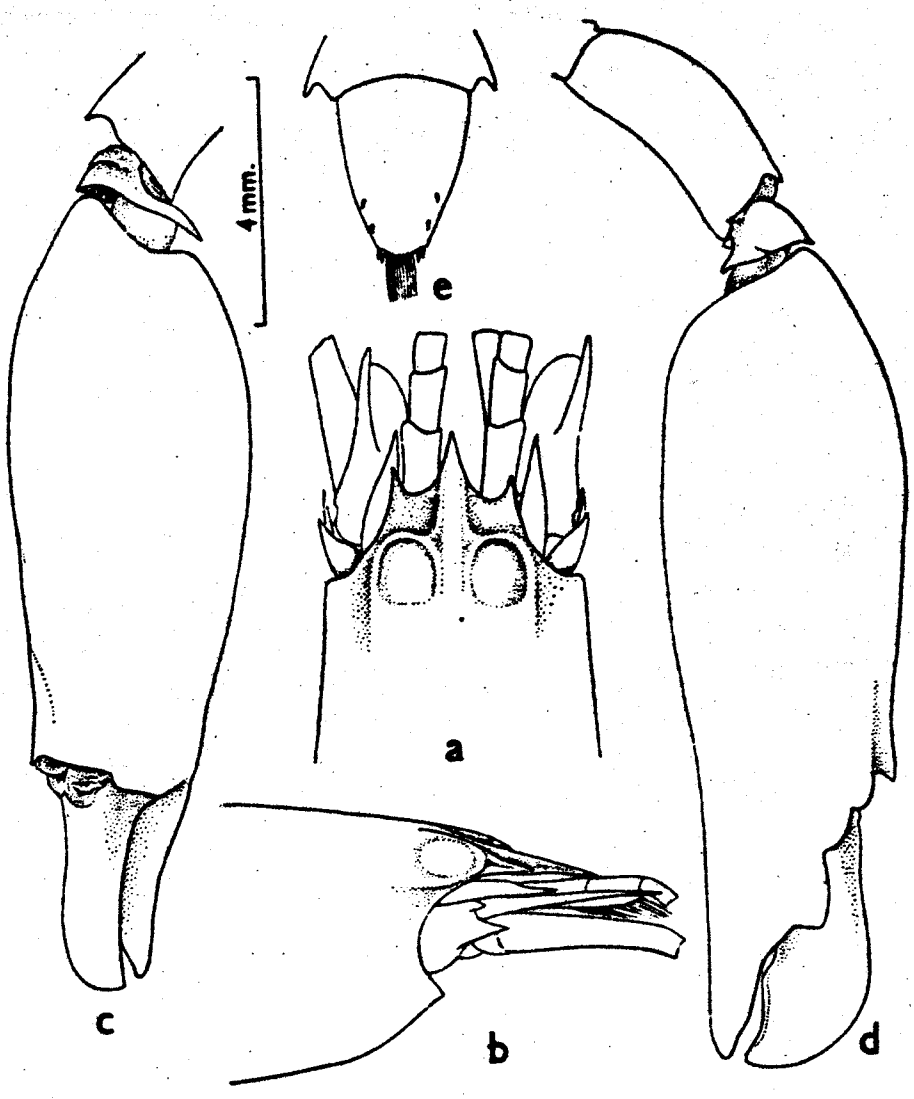


Fig. 3

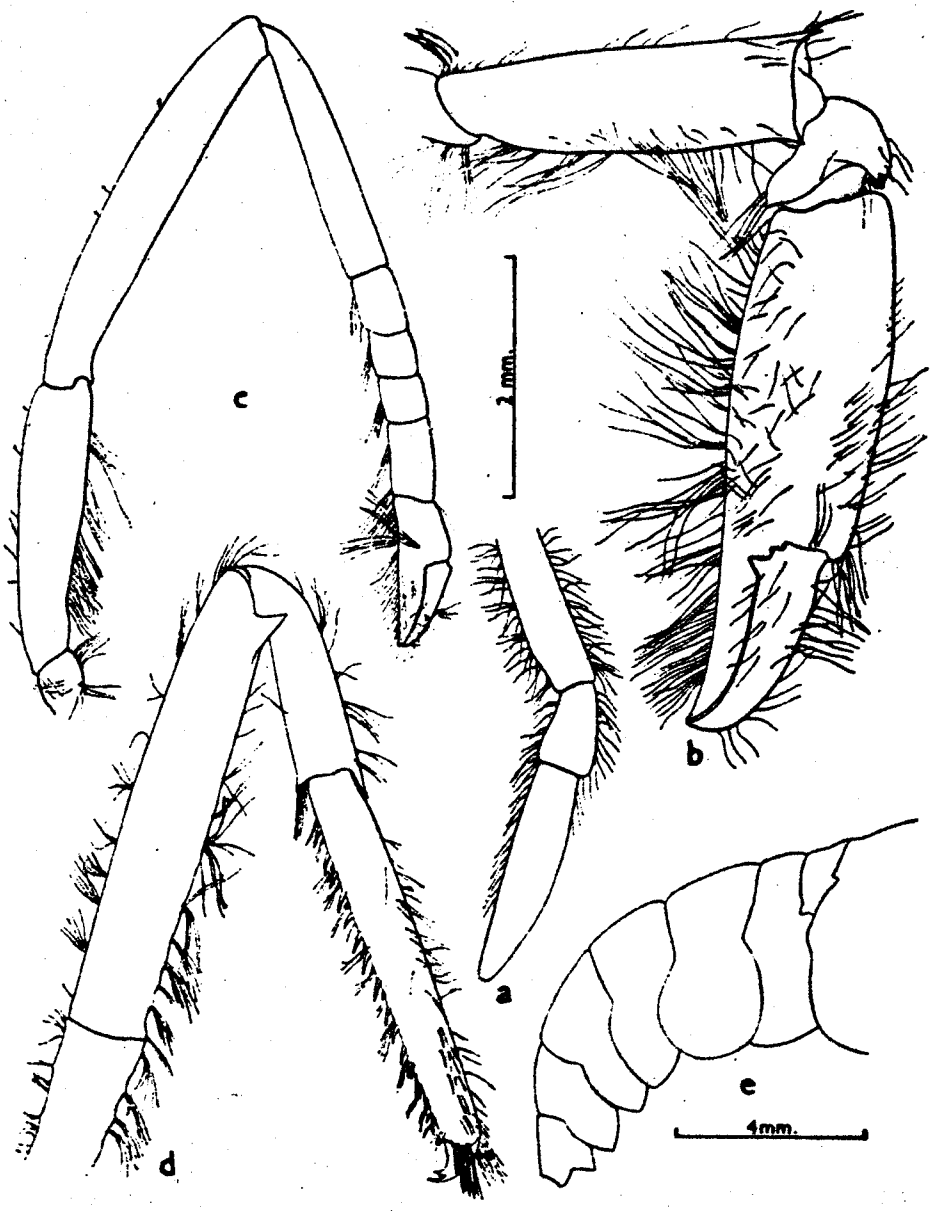


Fig. 4

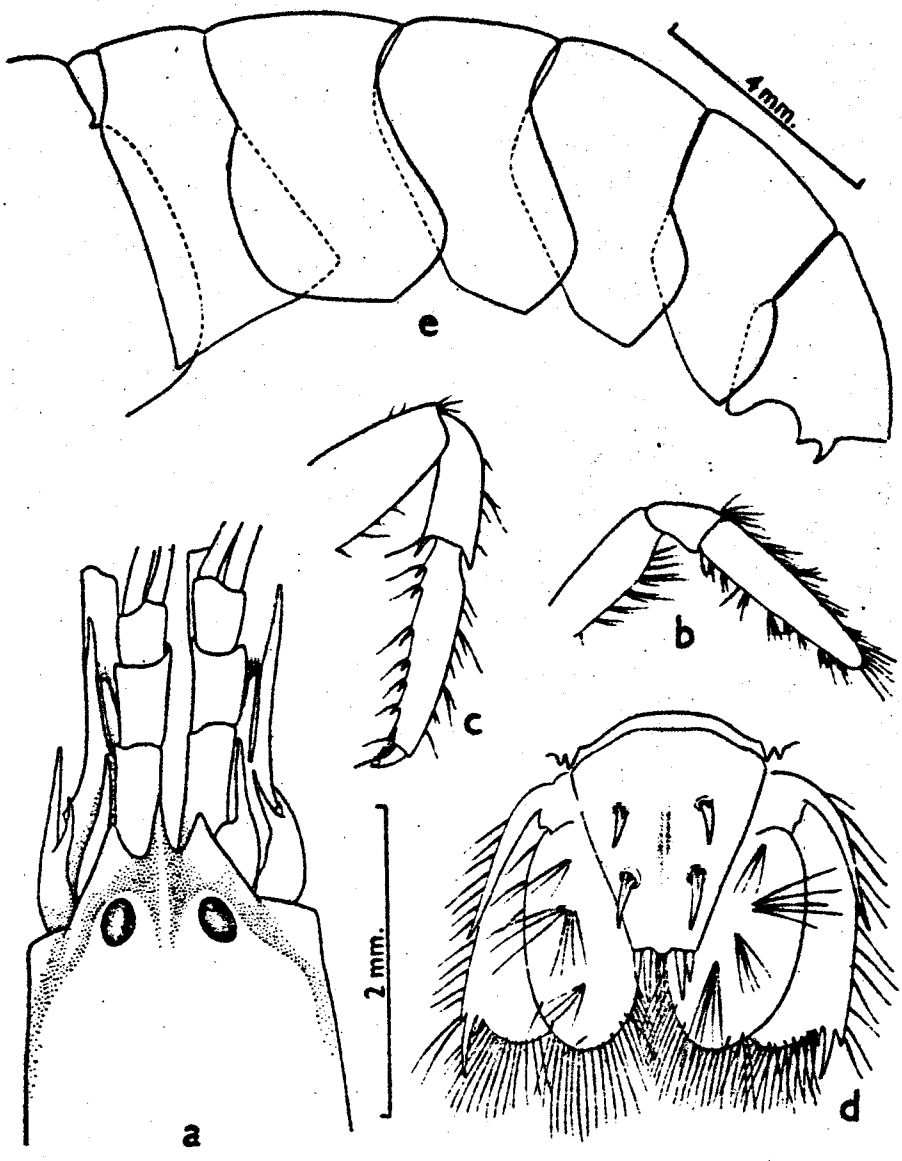


Fig. 5

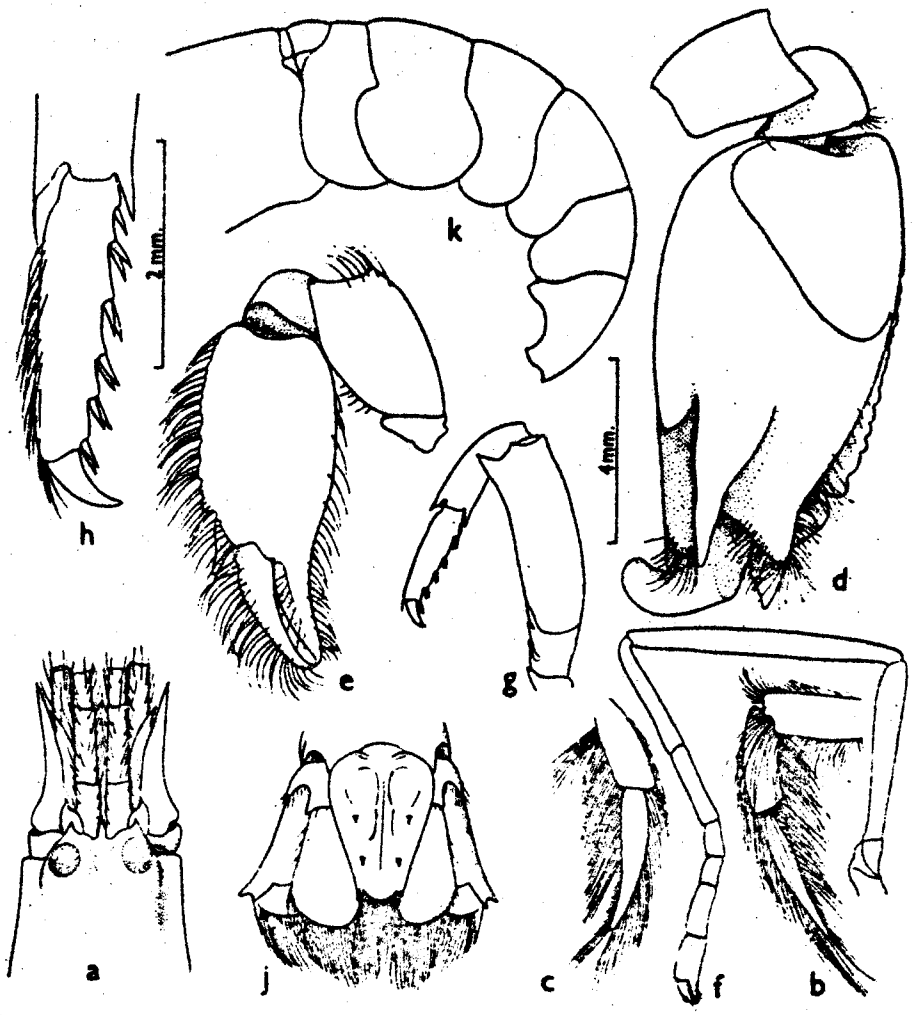


Fig. 6

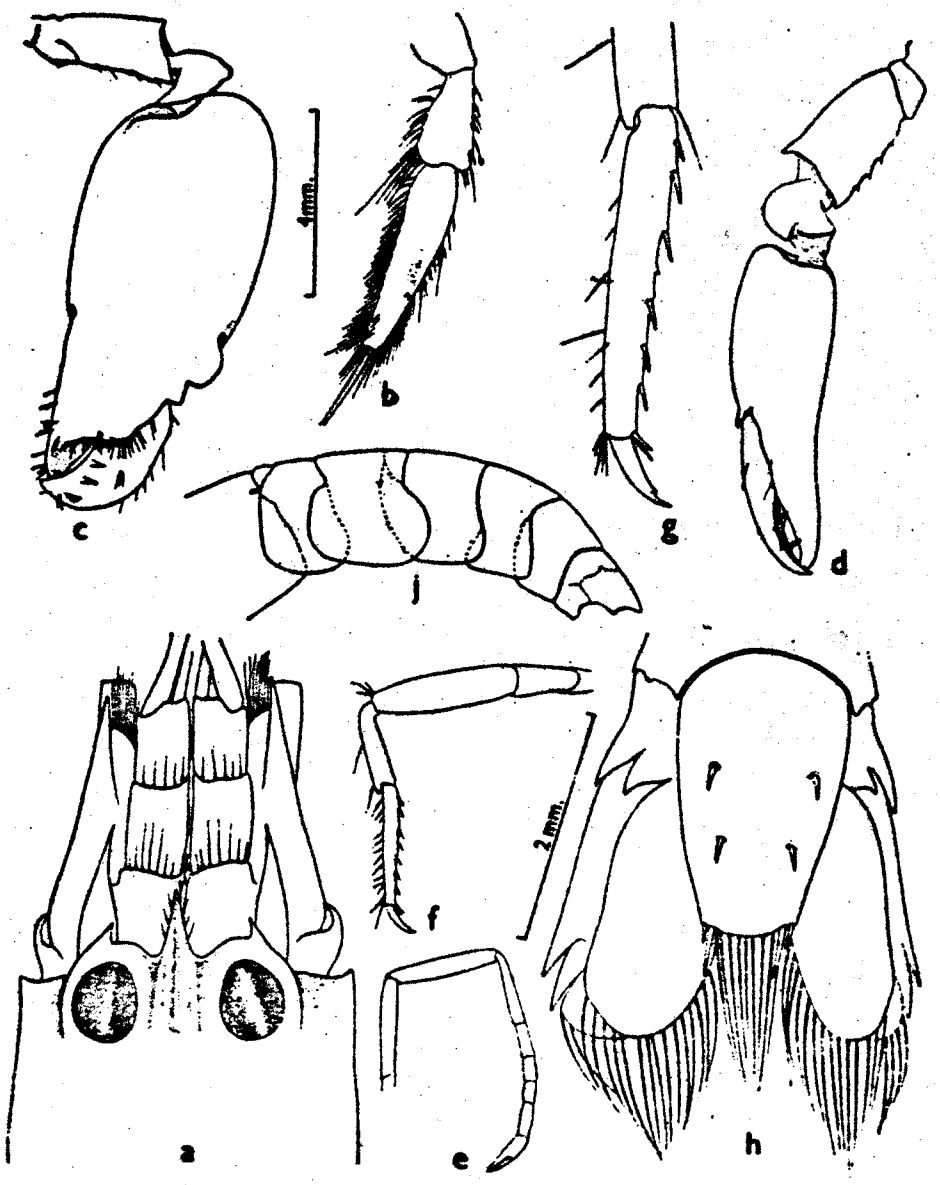


Fig. 7

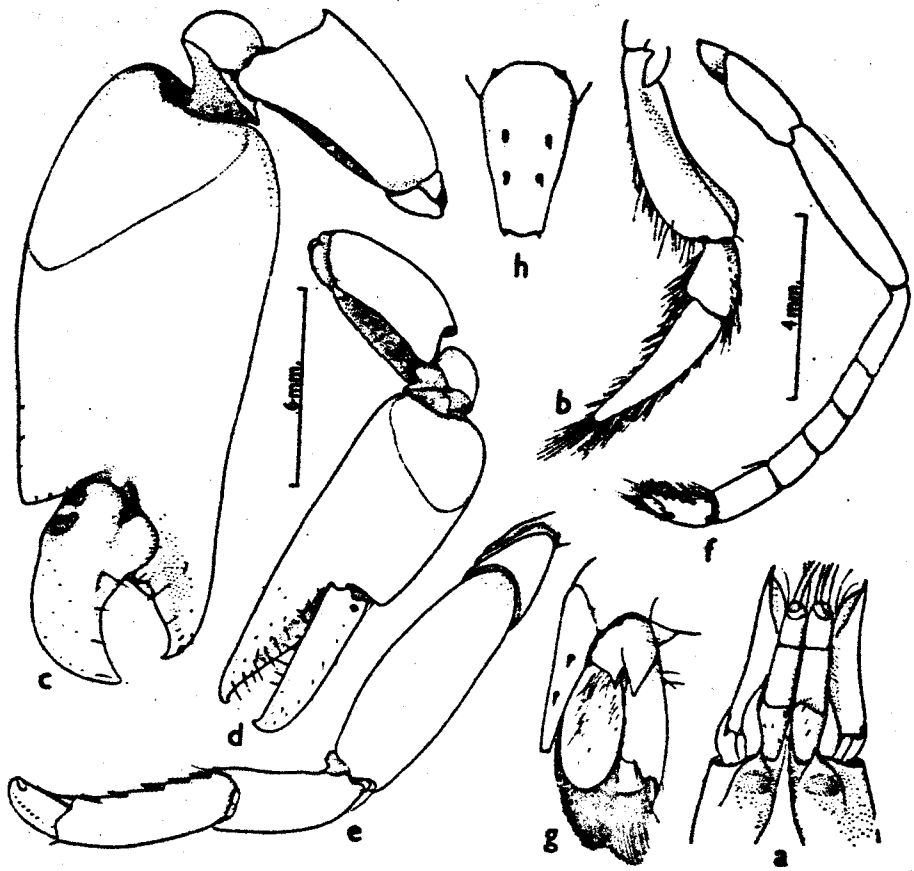
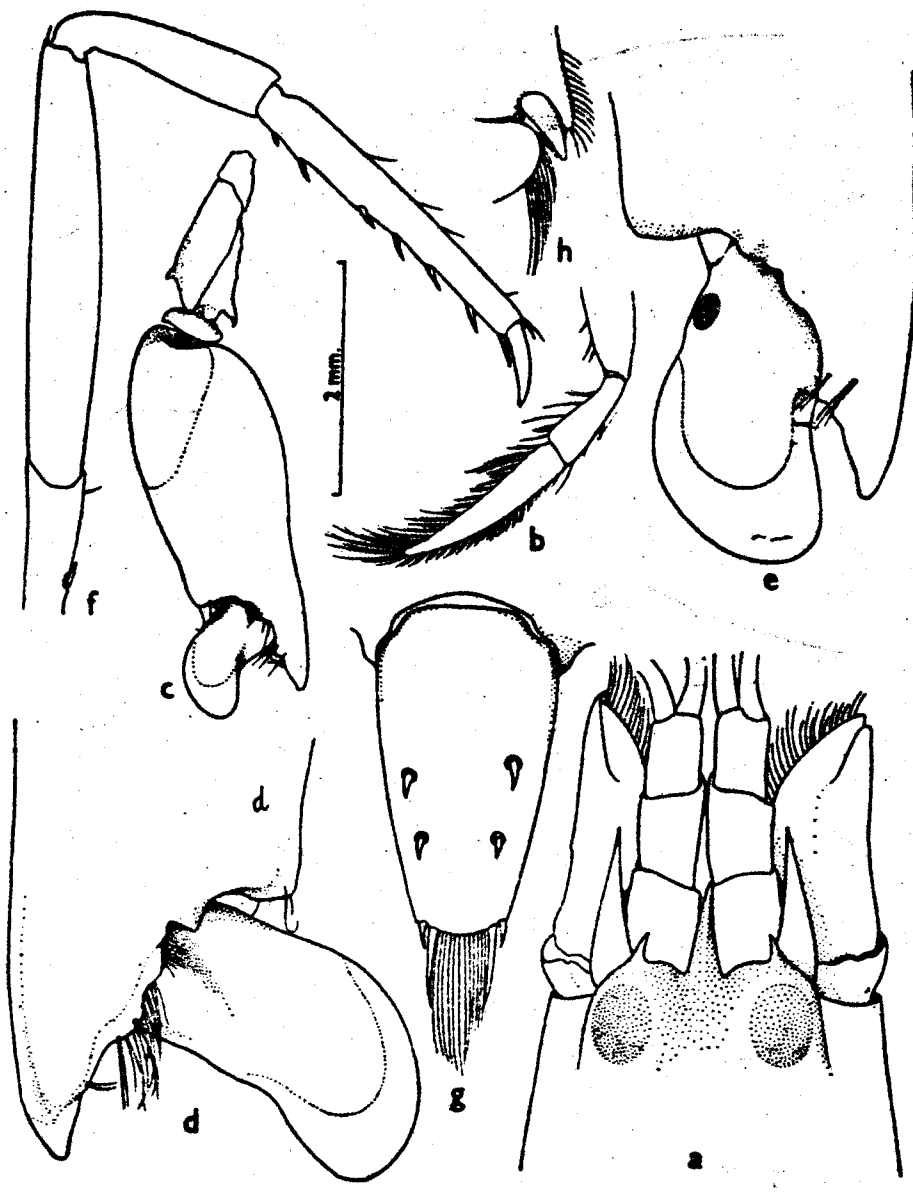


Fig. 8



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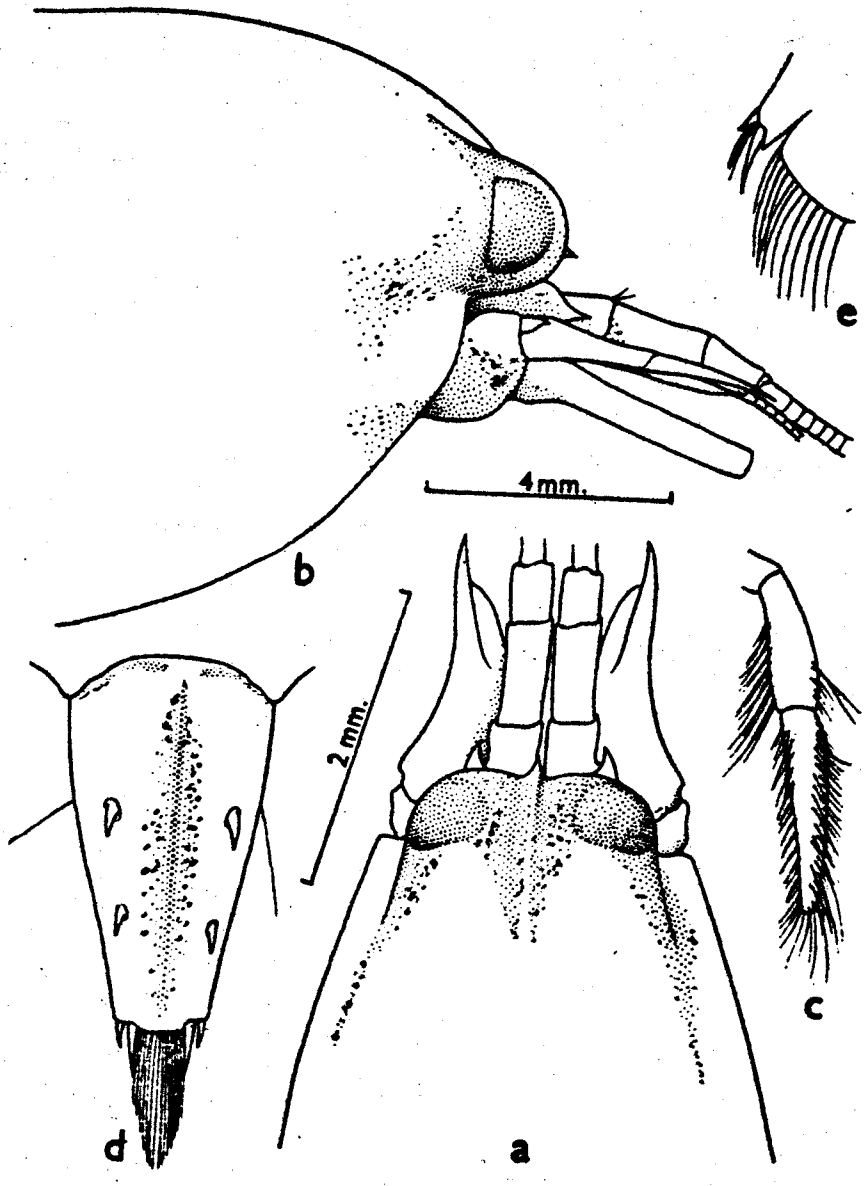

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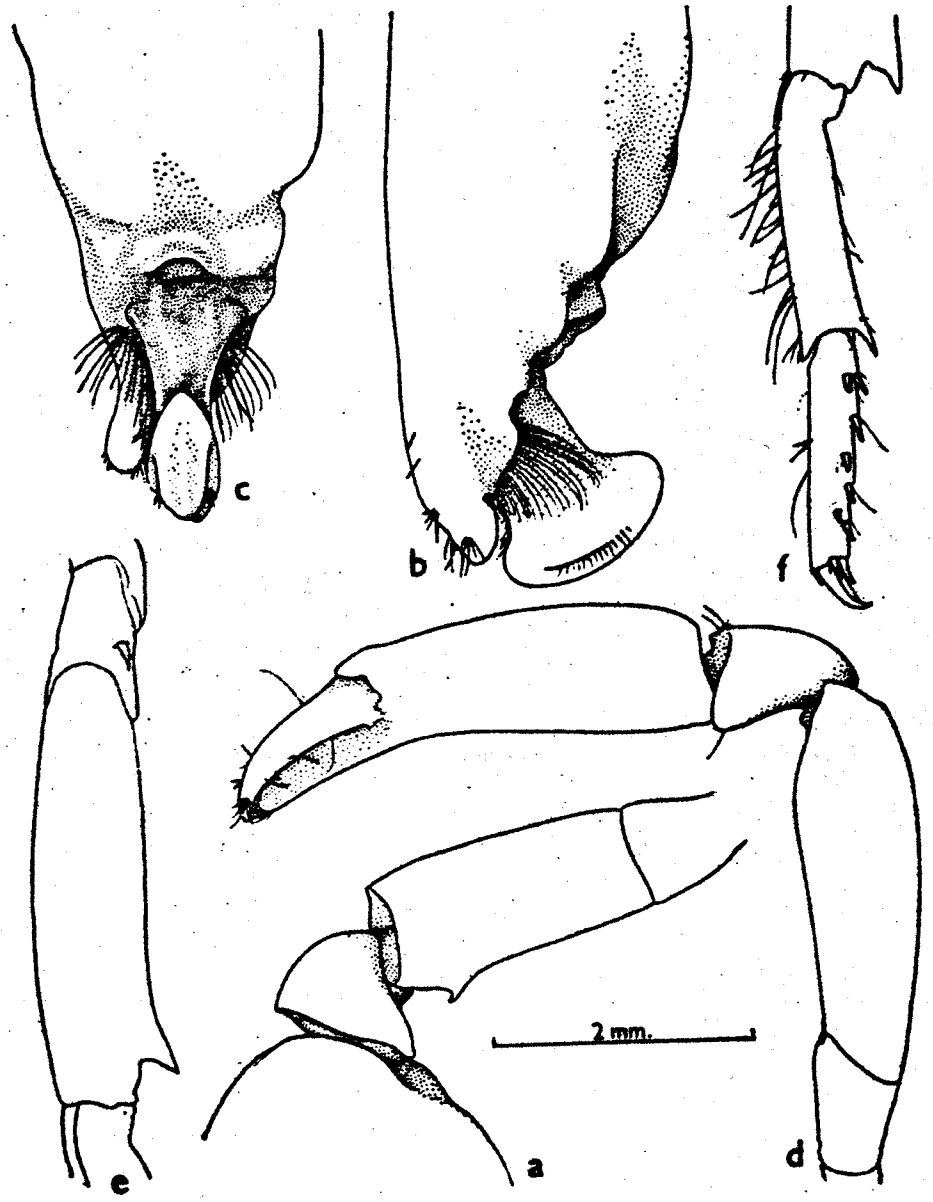

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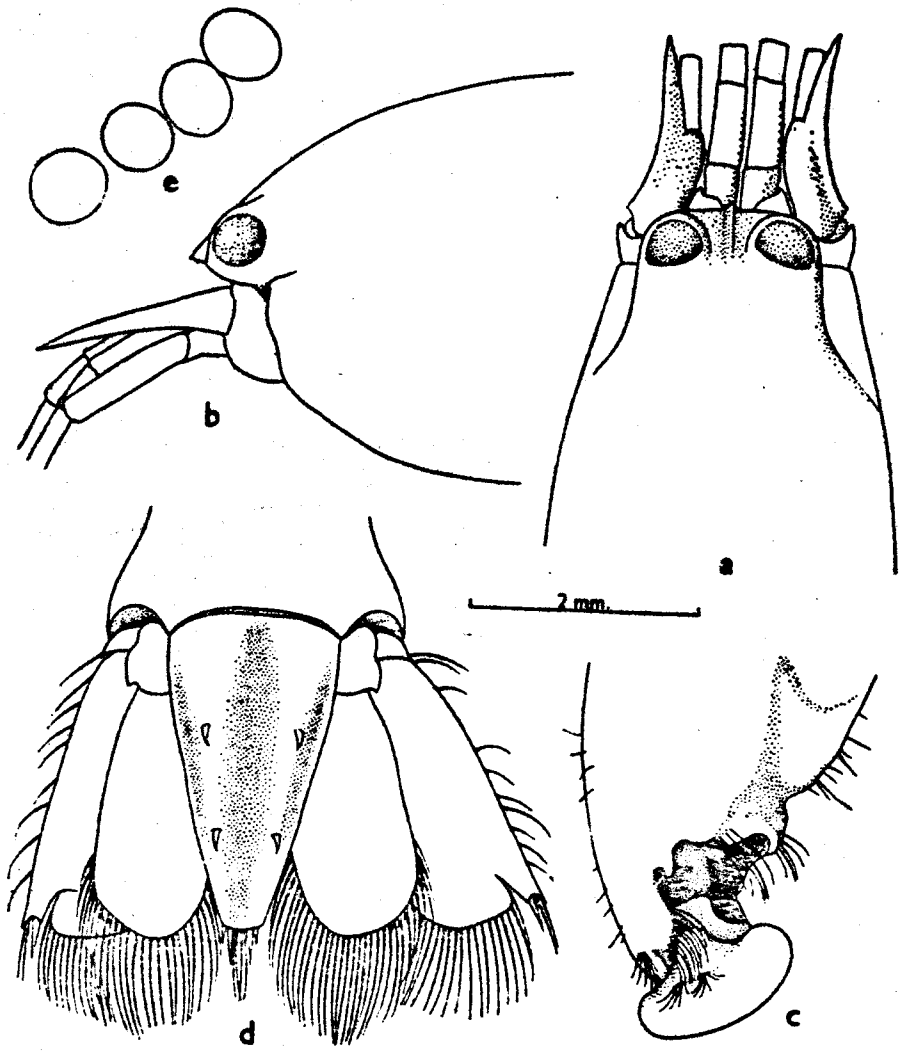


Fig. 12

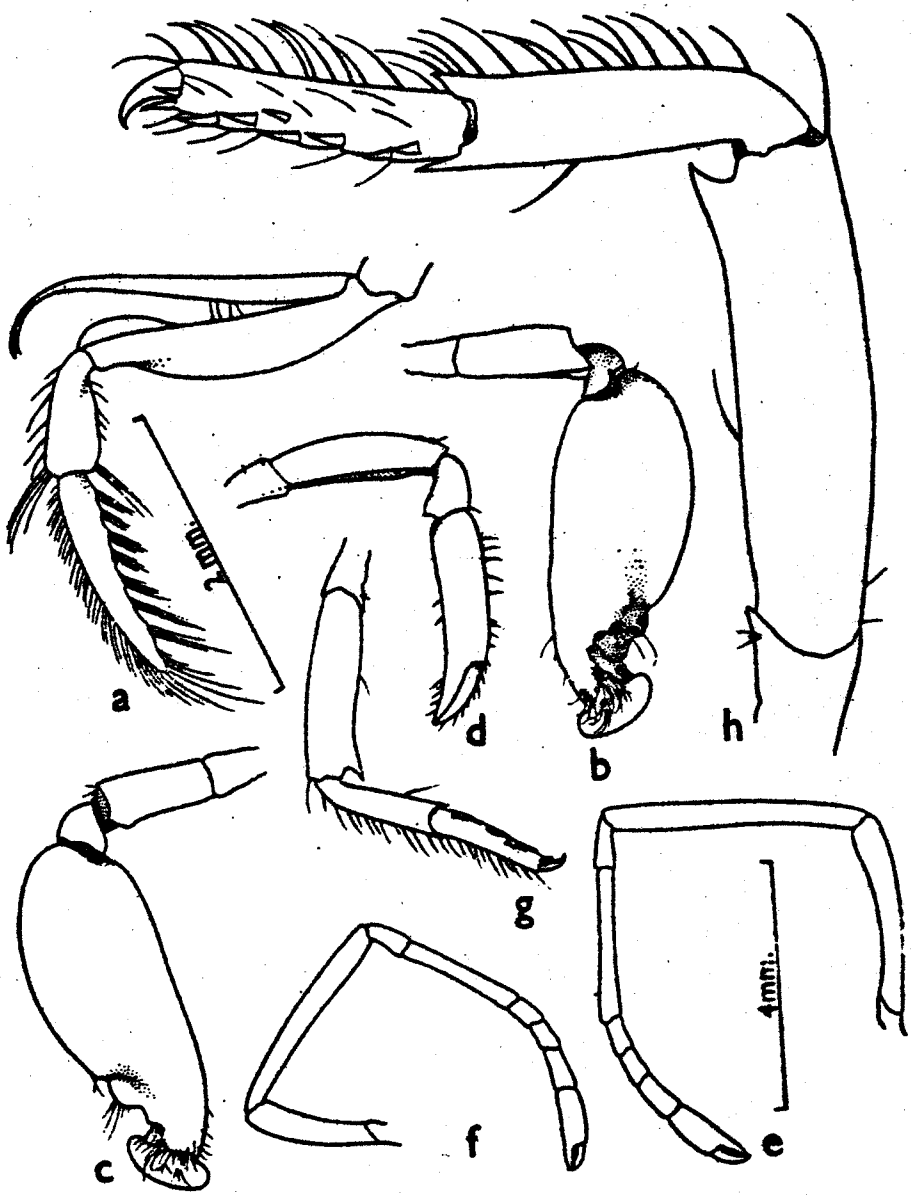
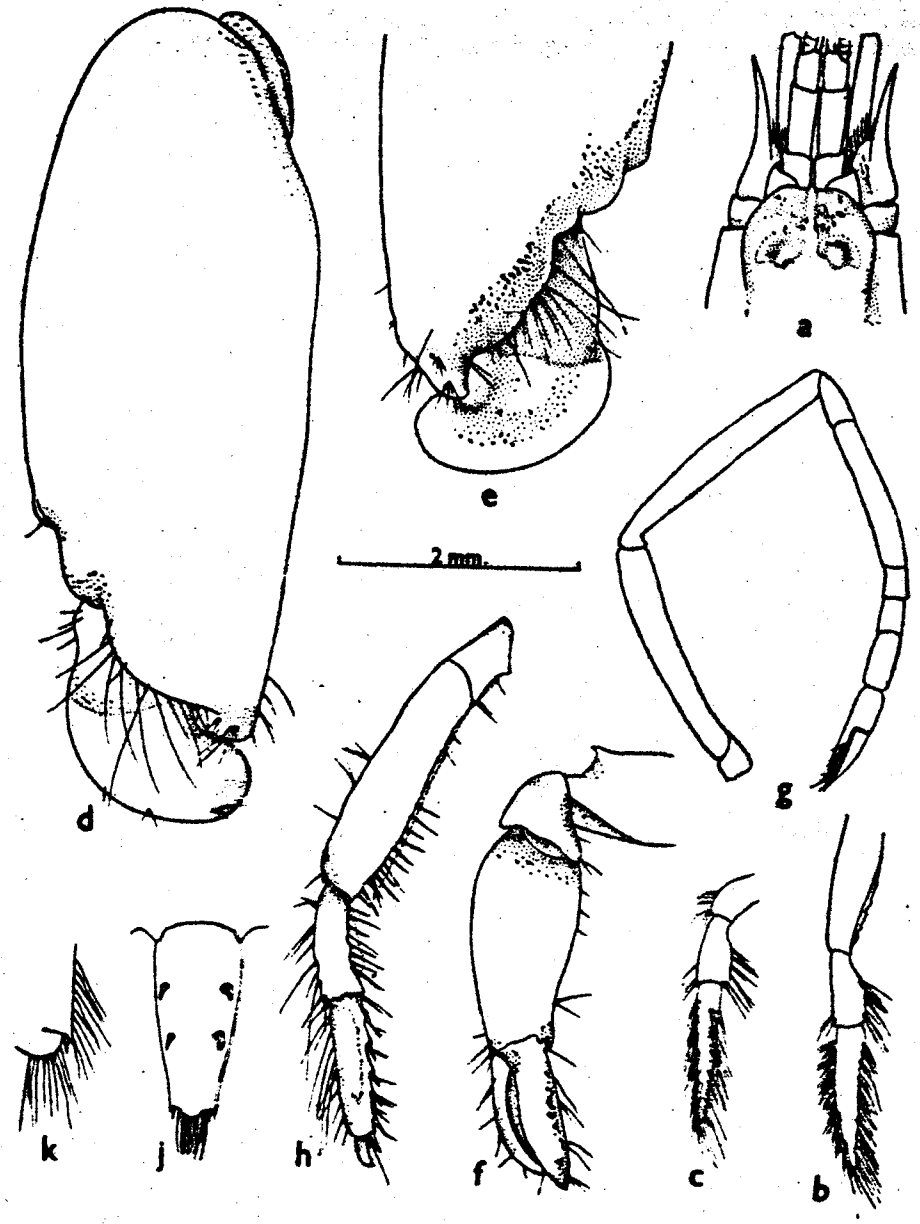


Fig. 13



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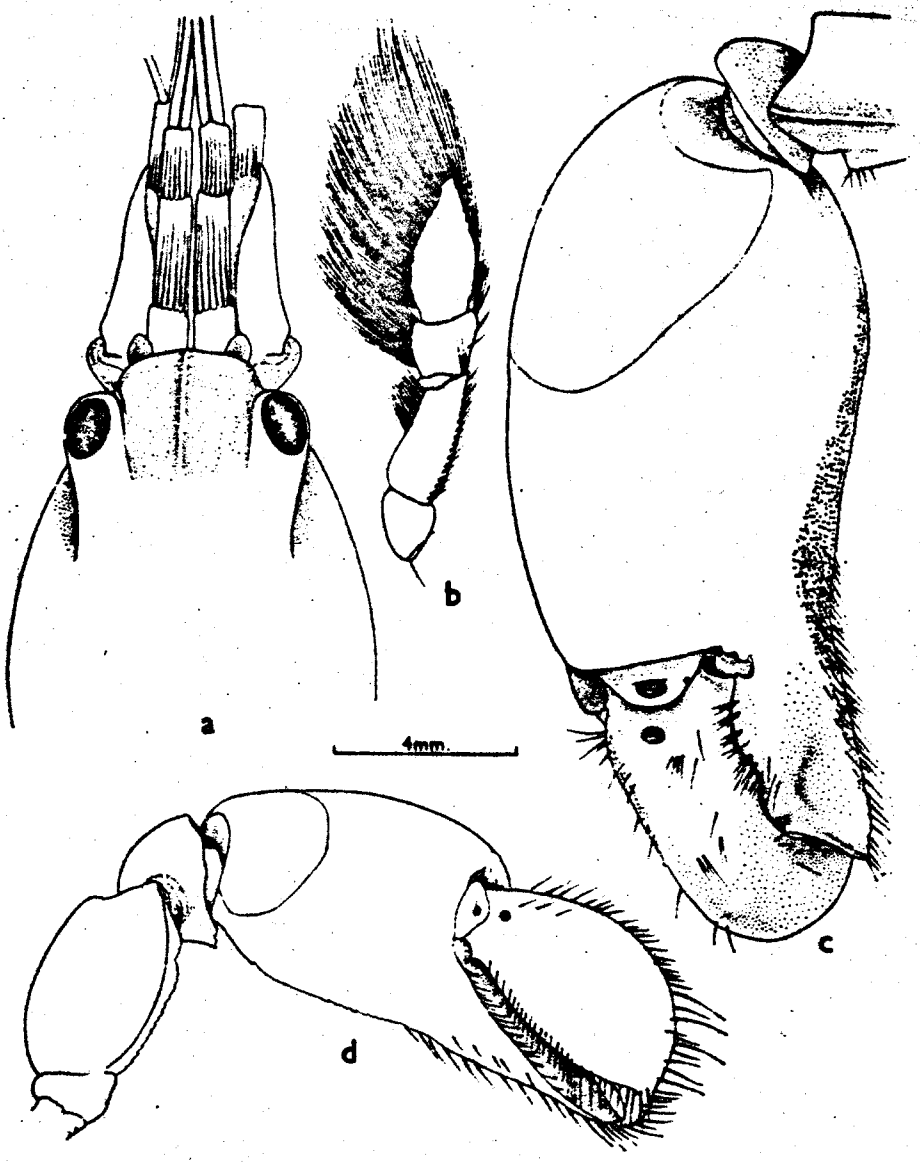

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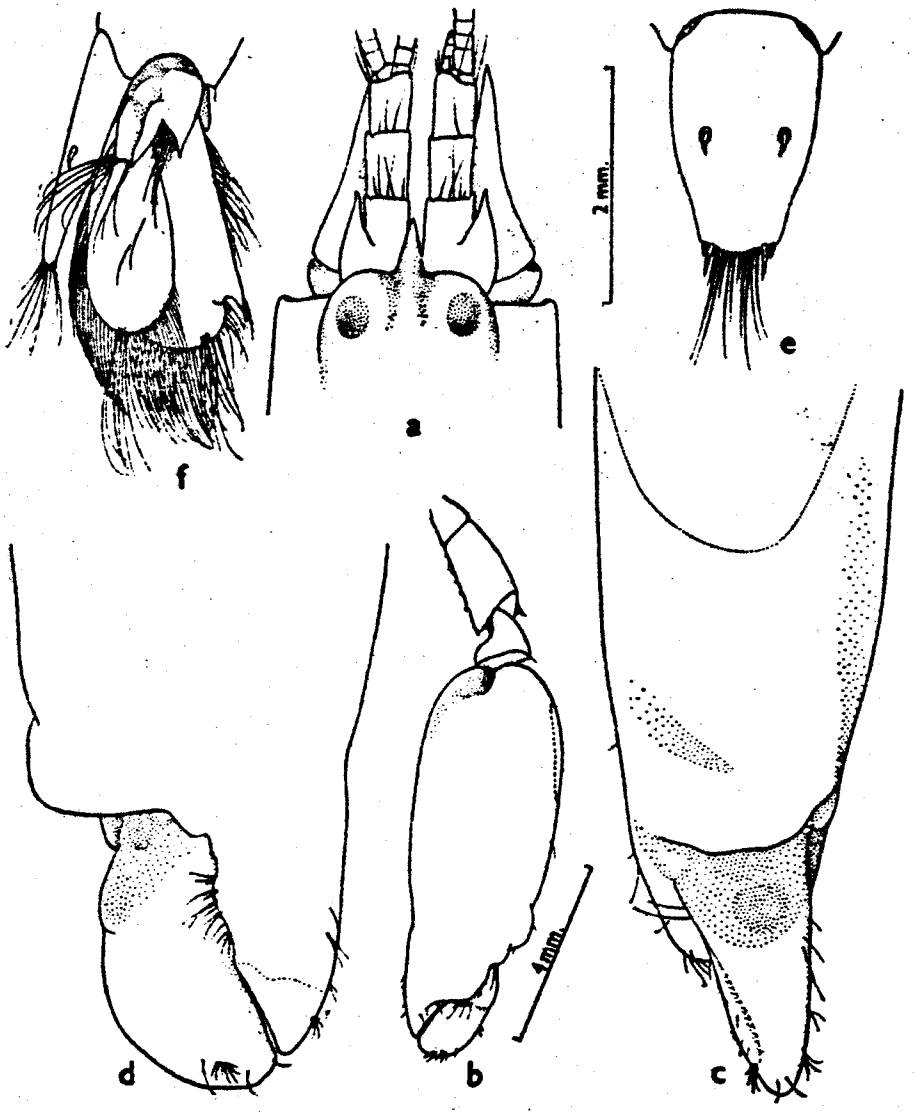

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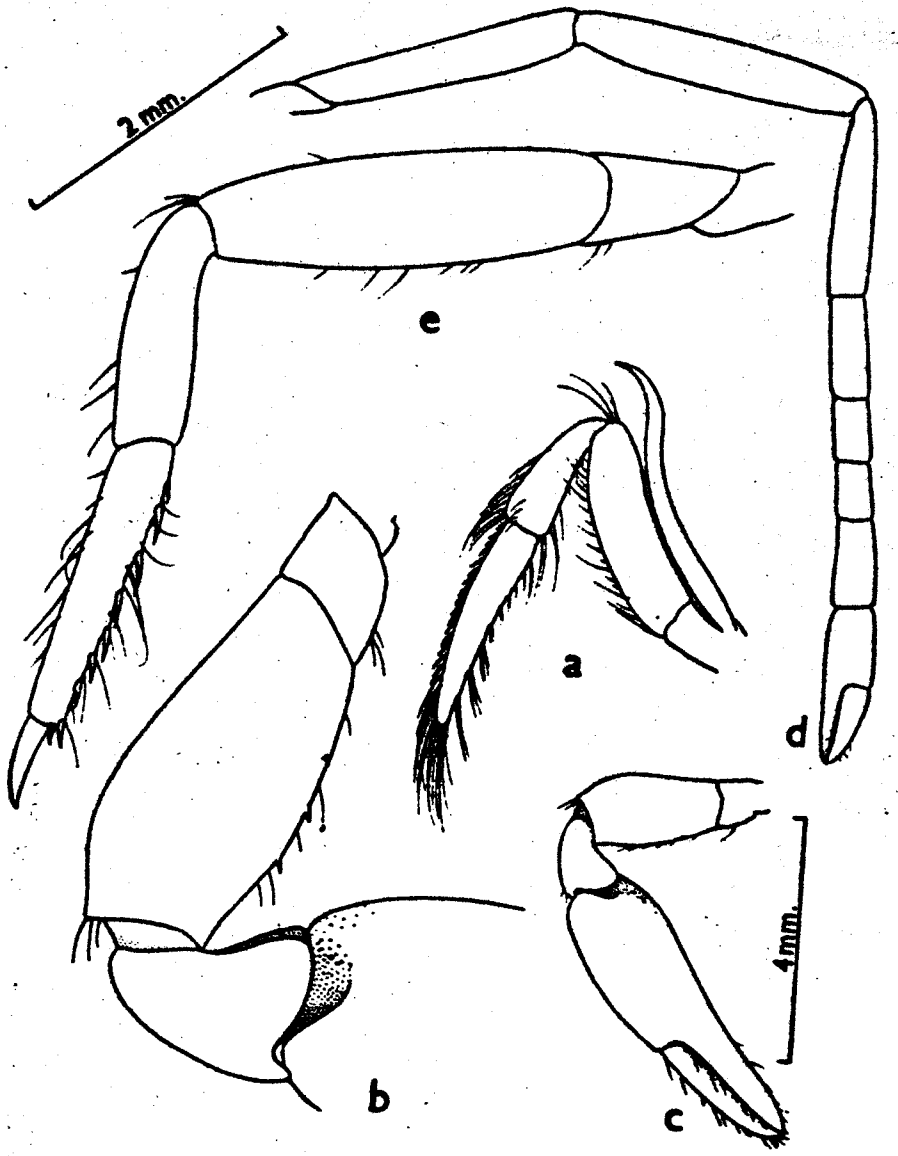

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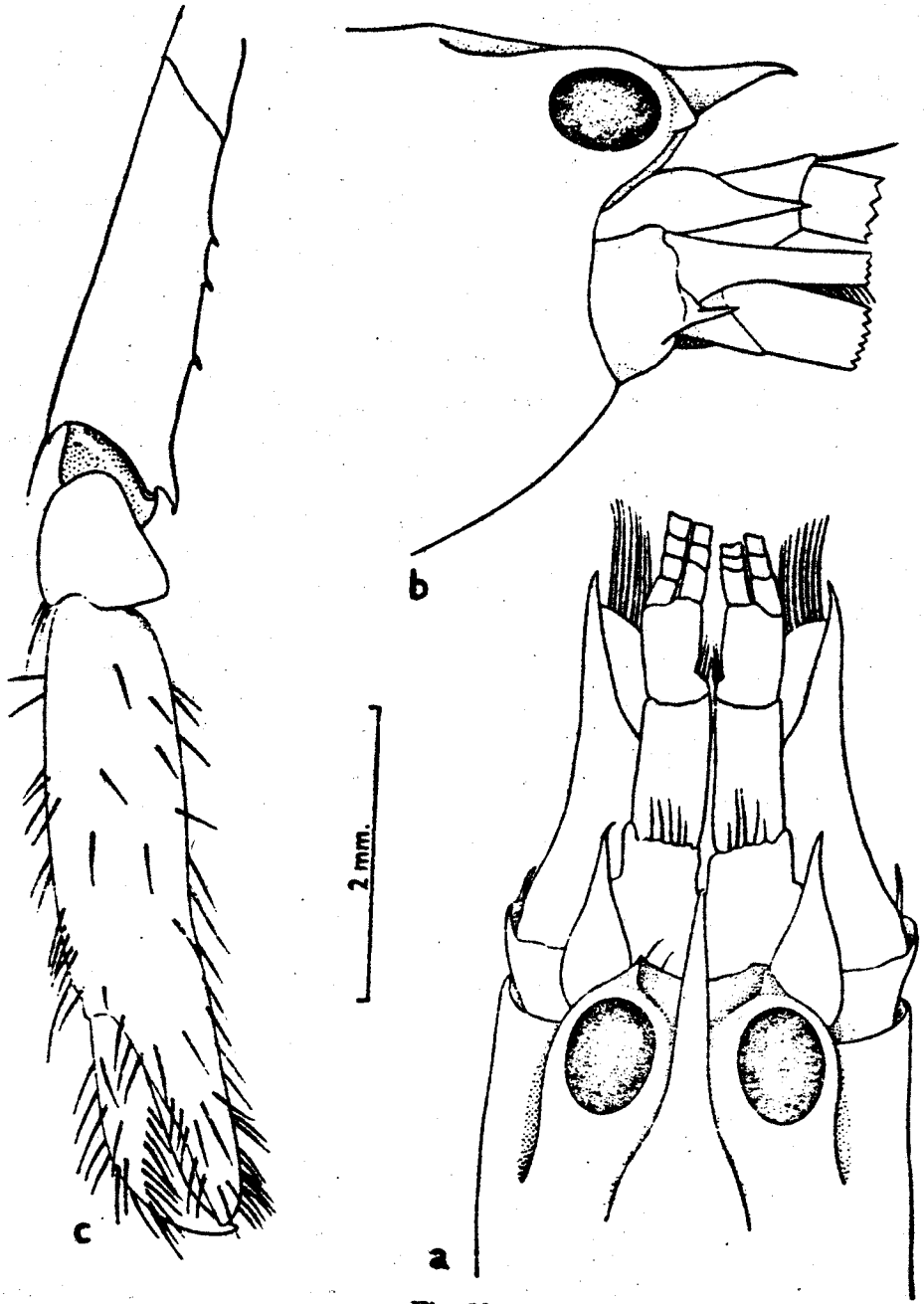

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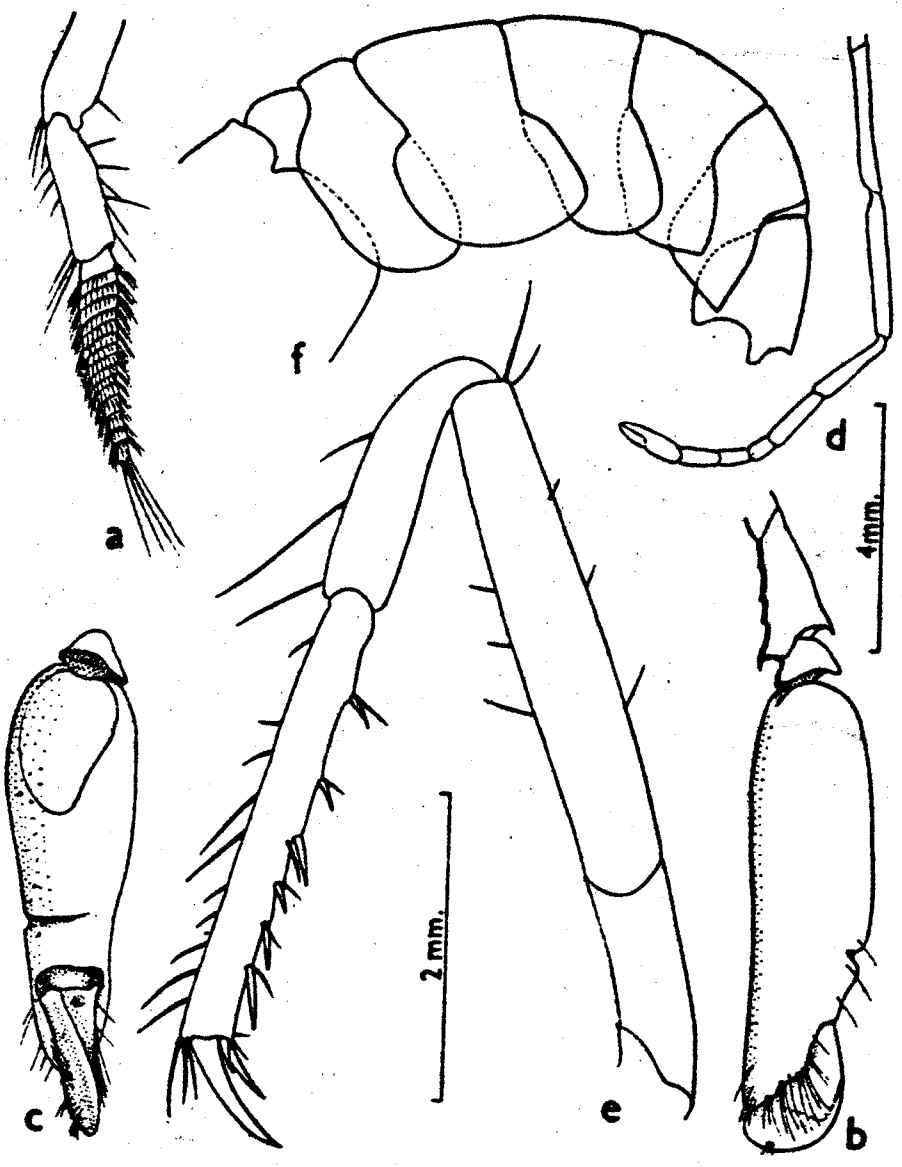

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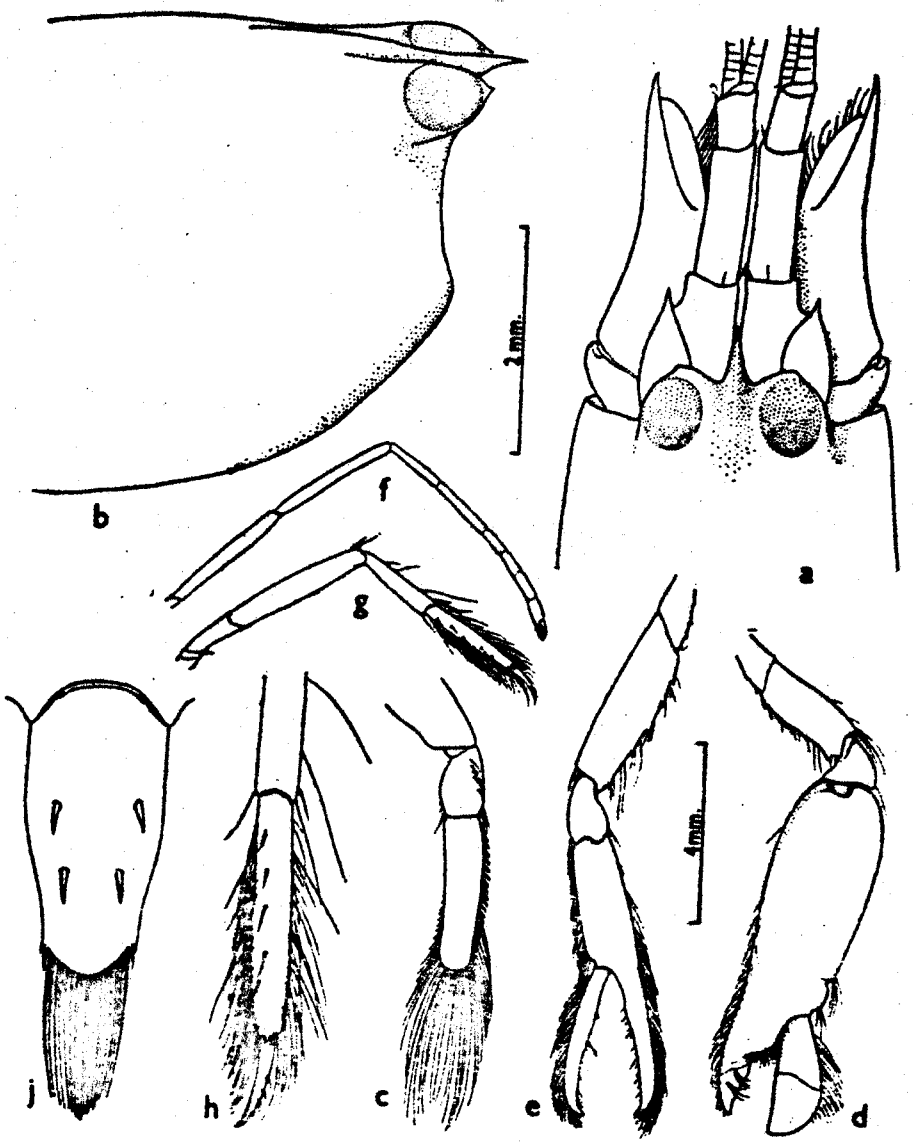

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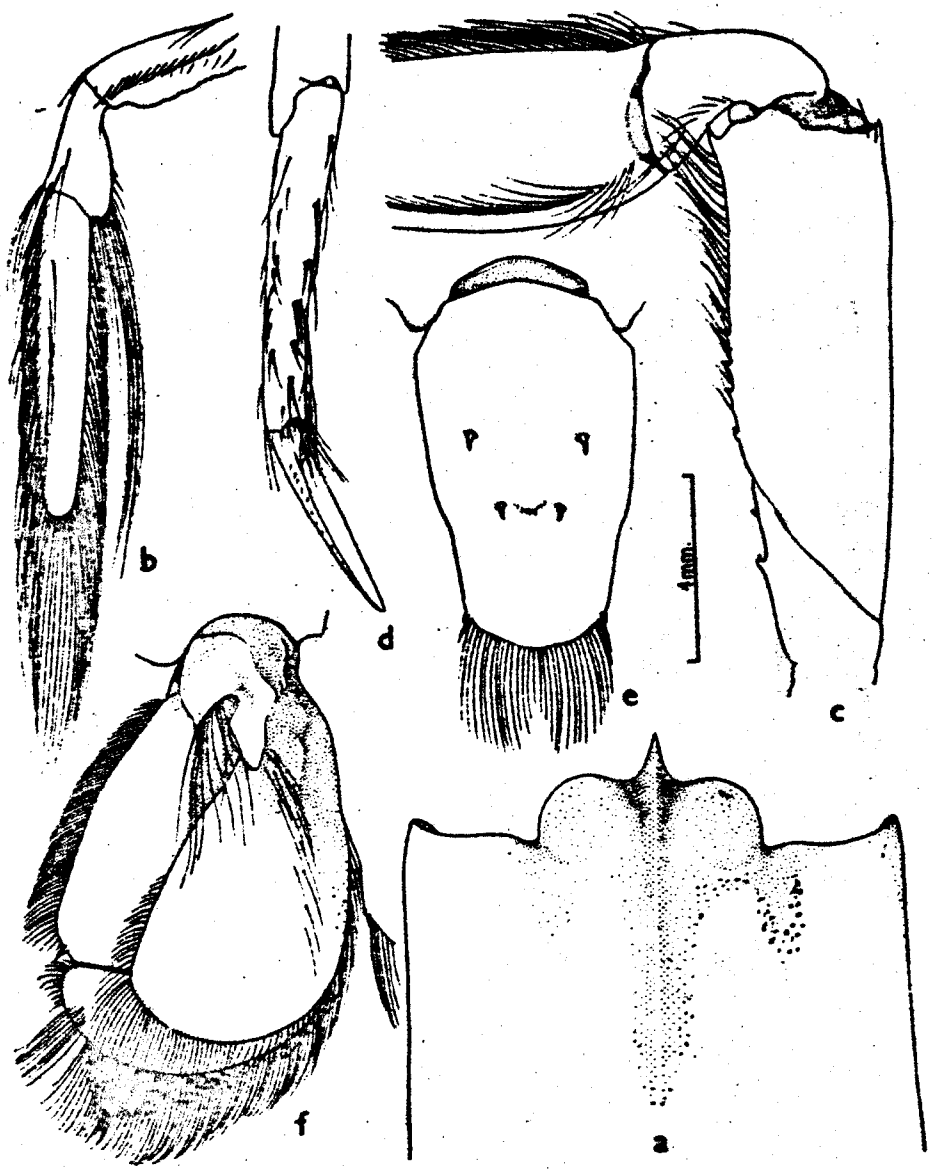

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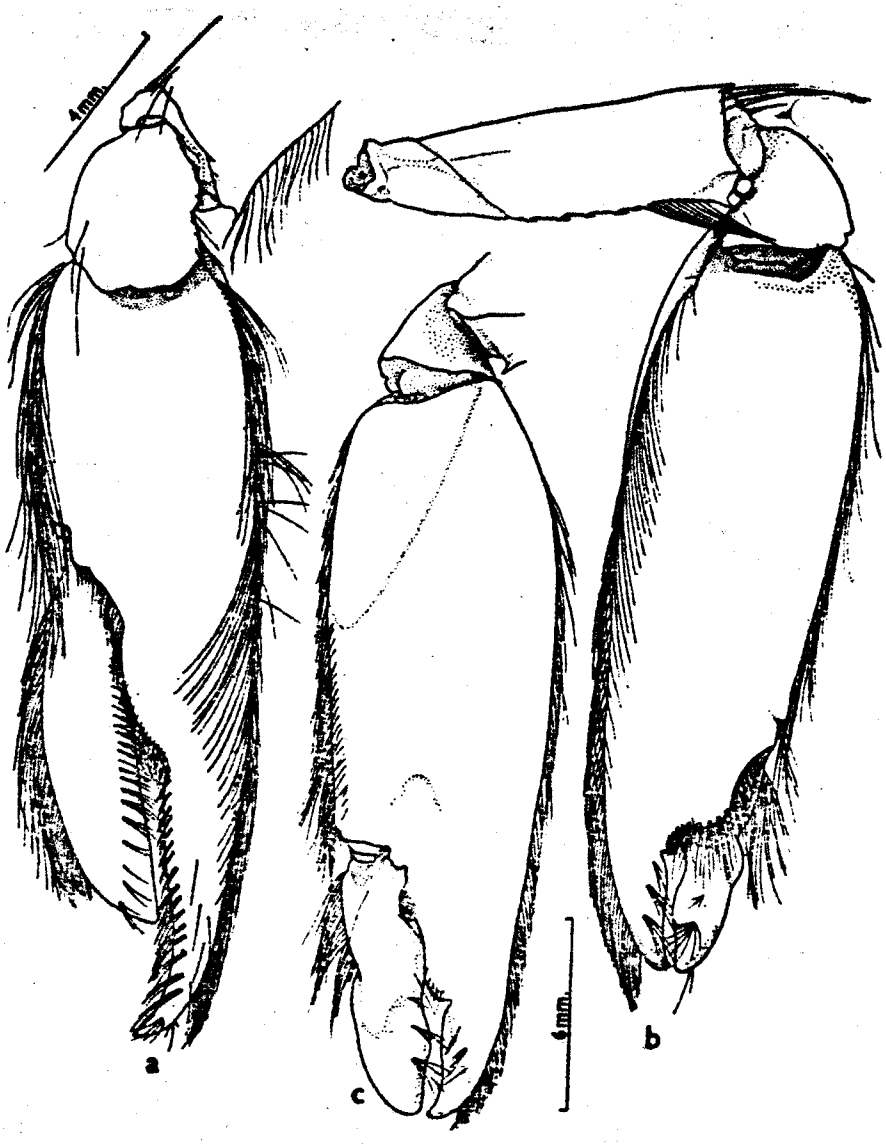

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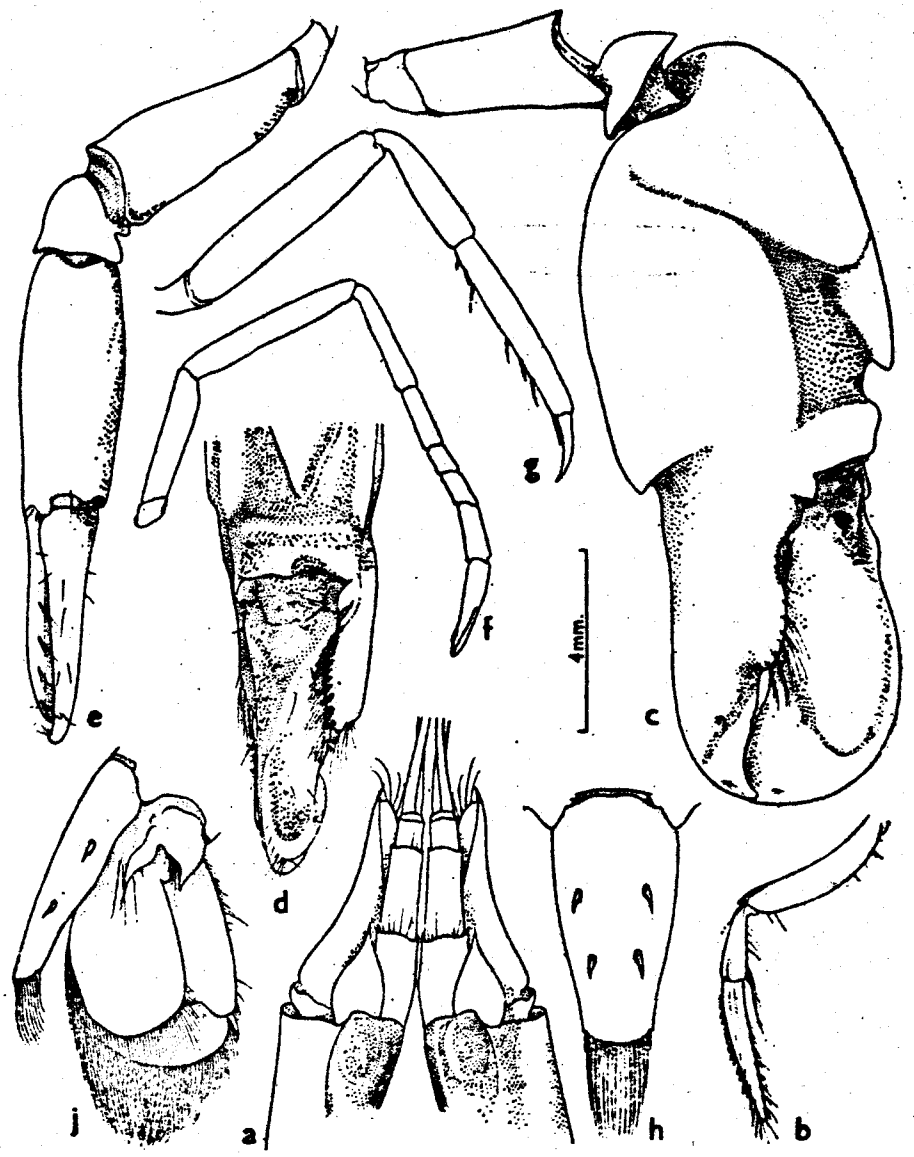

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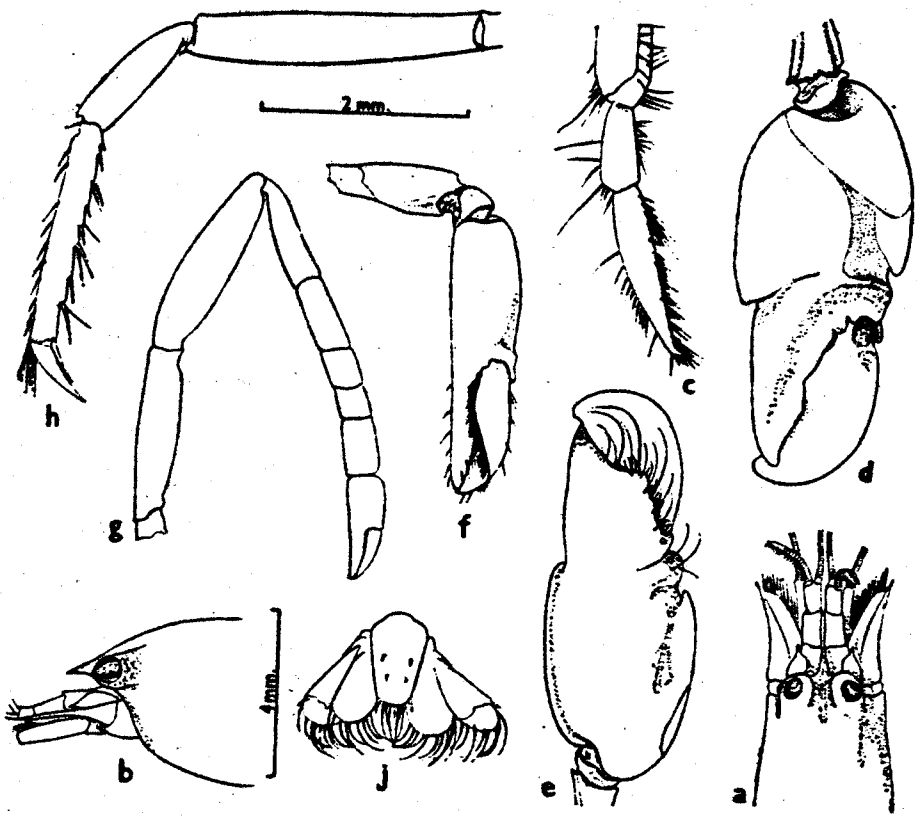

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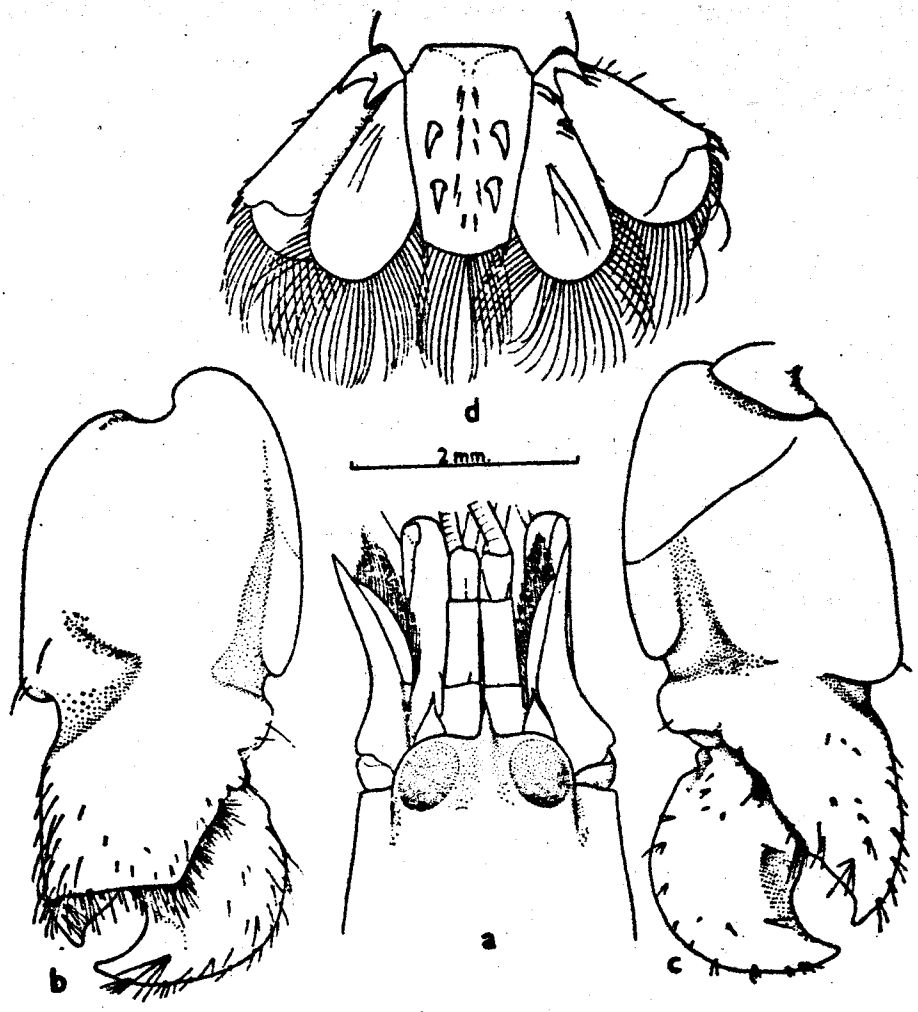

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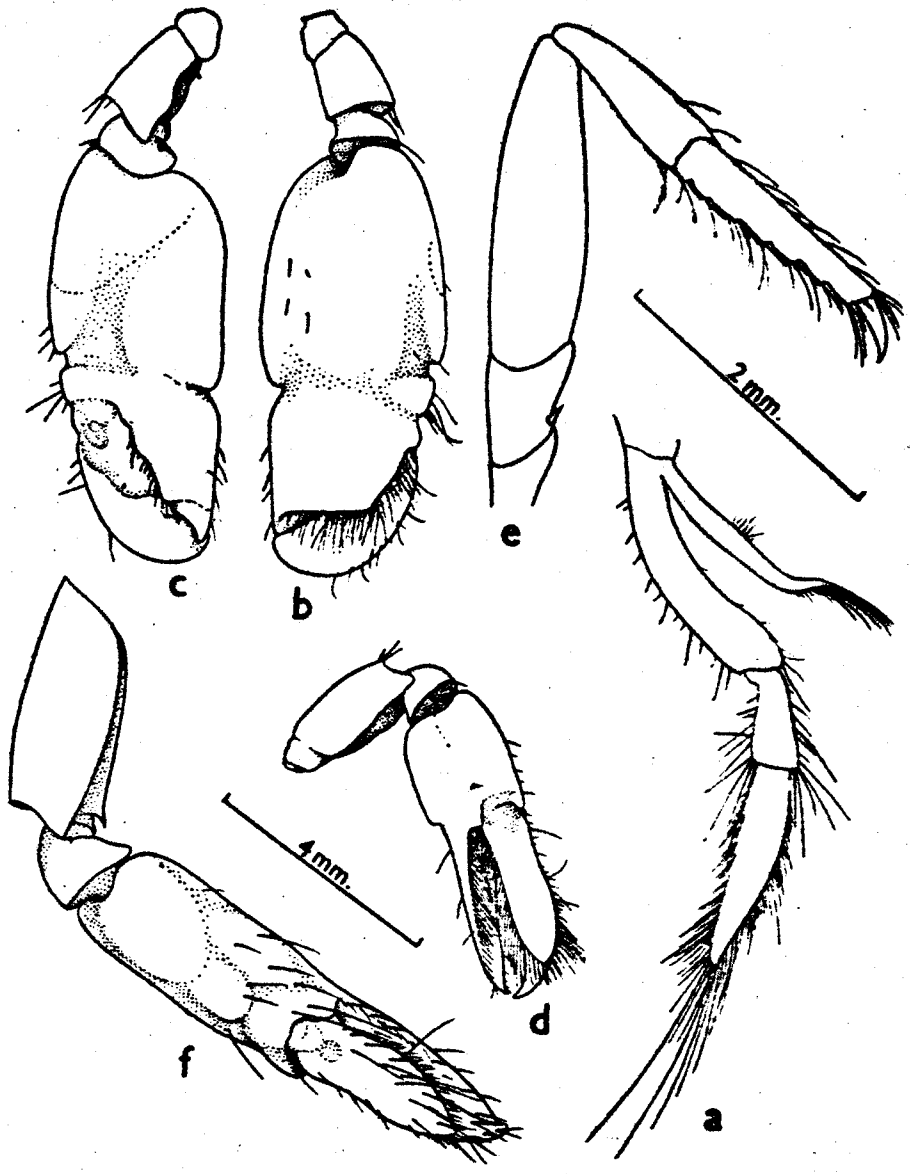

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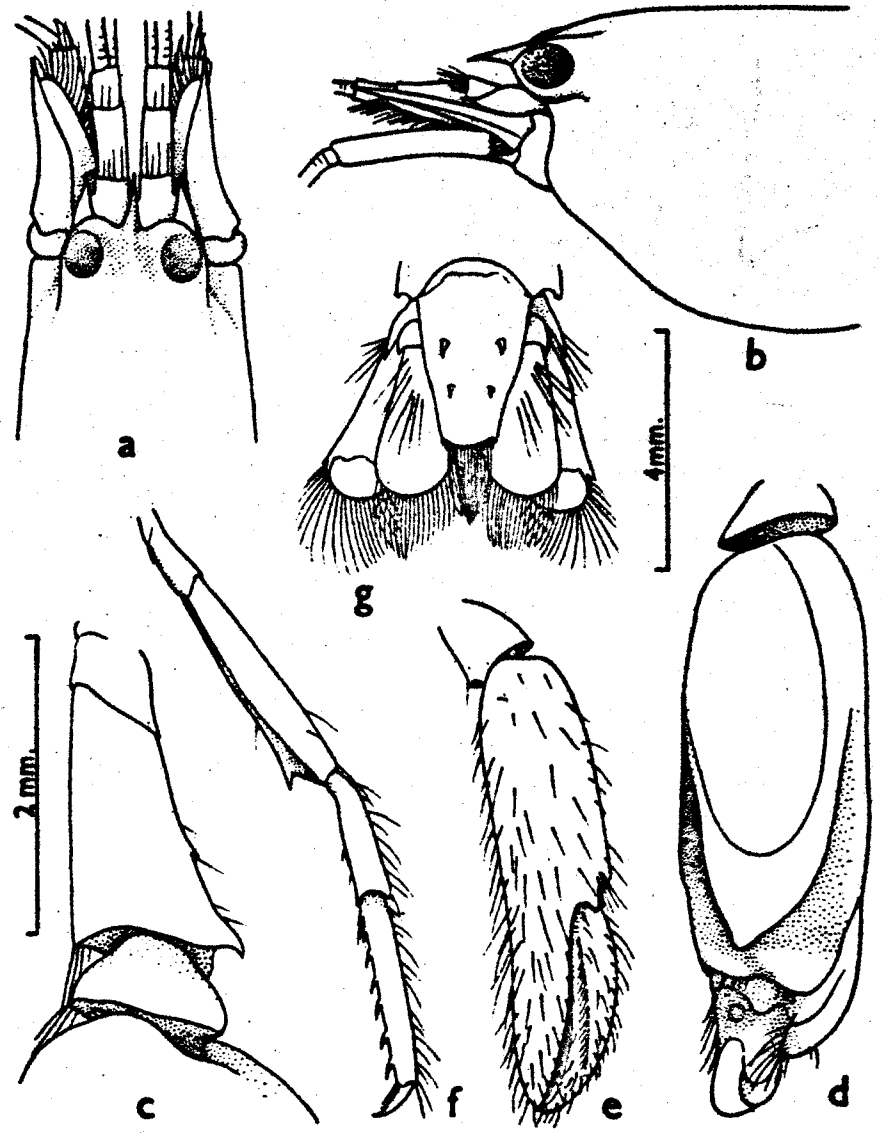

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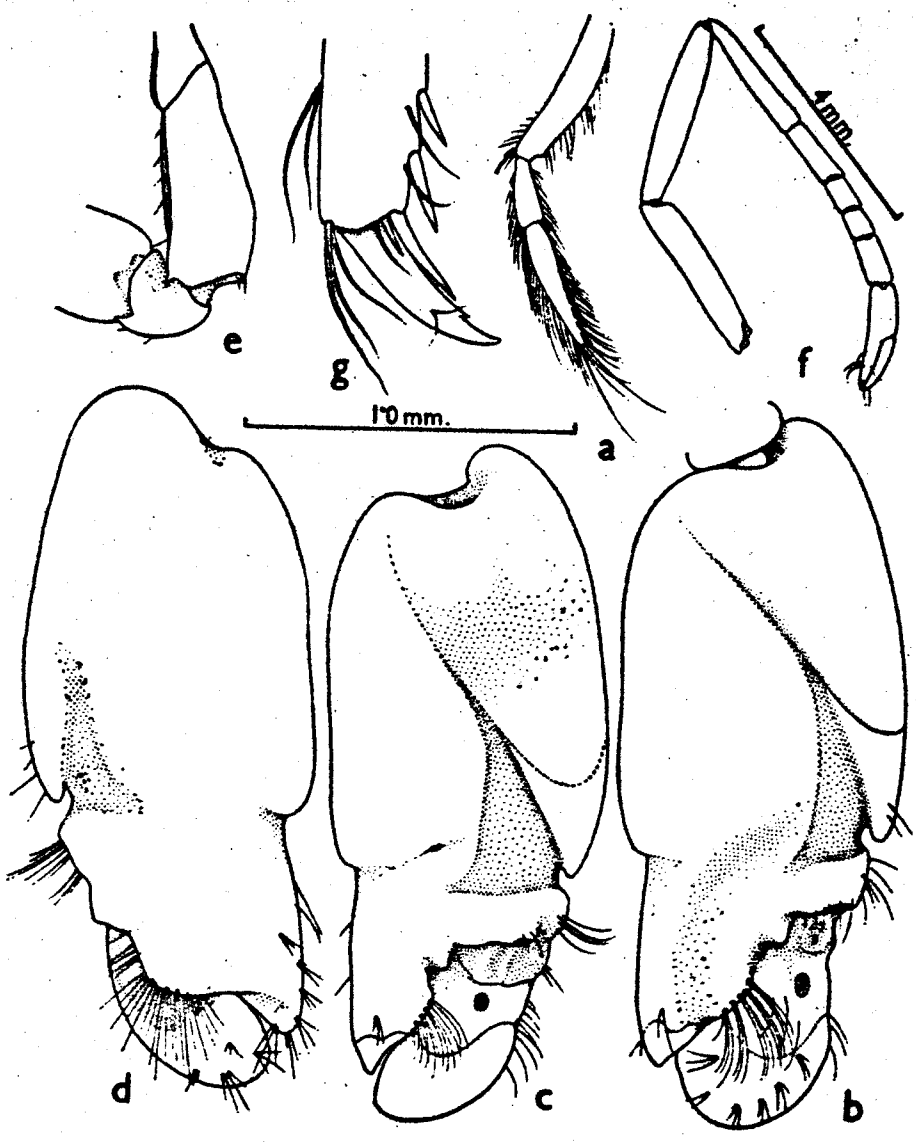

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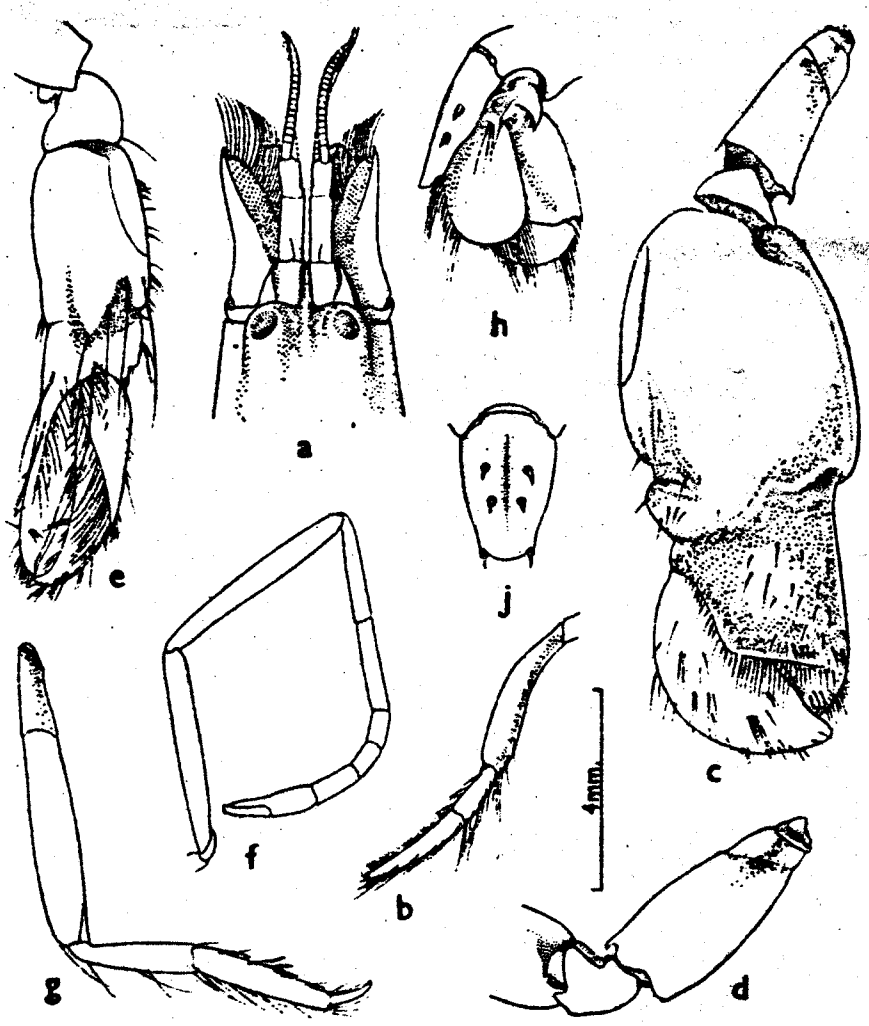

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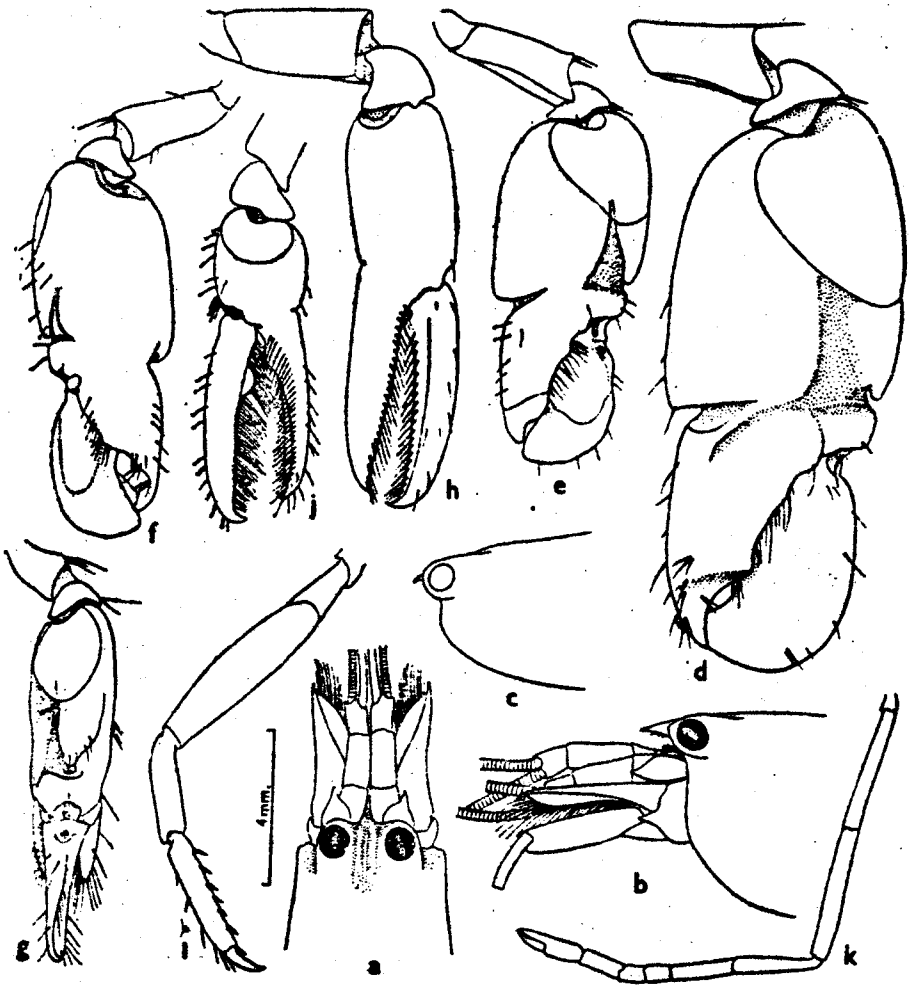

Fig. 30

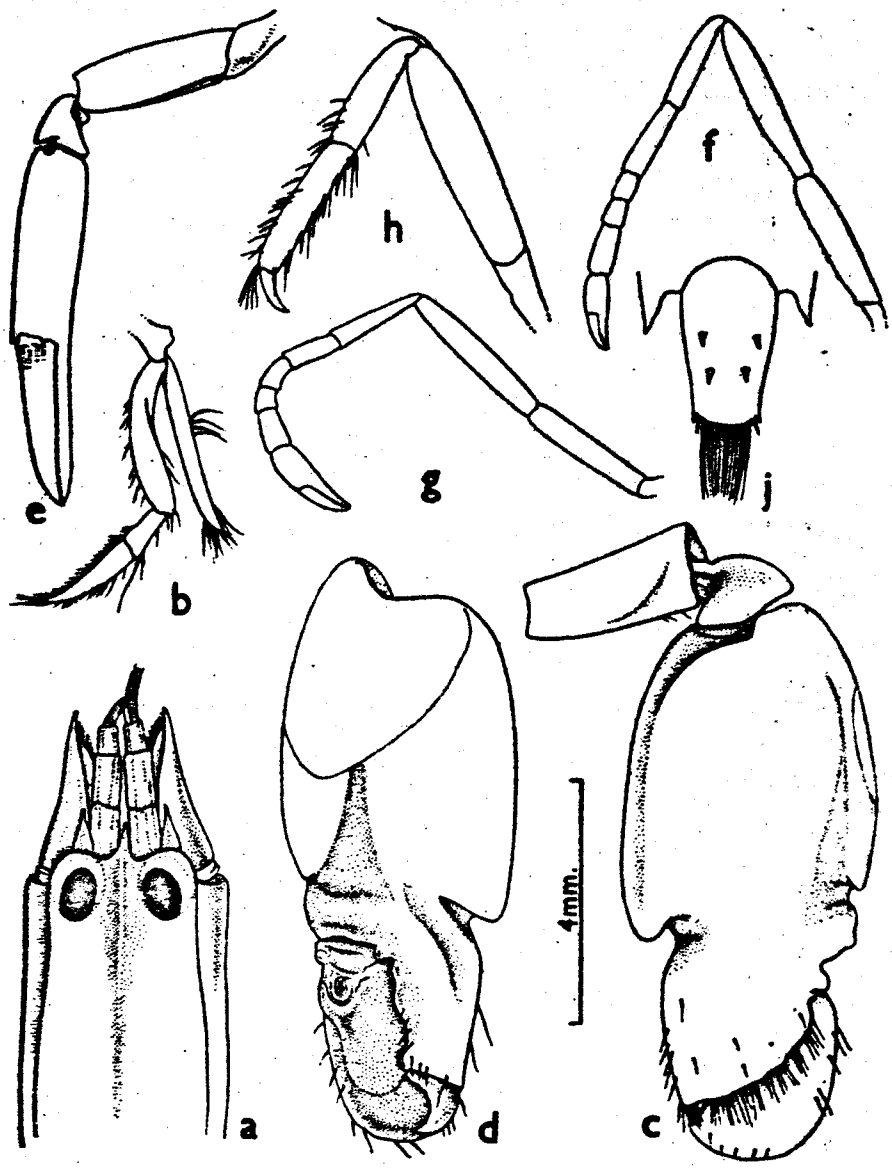

Fig. 31

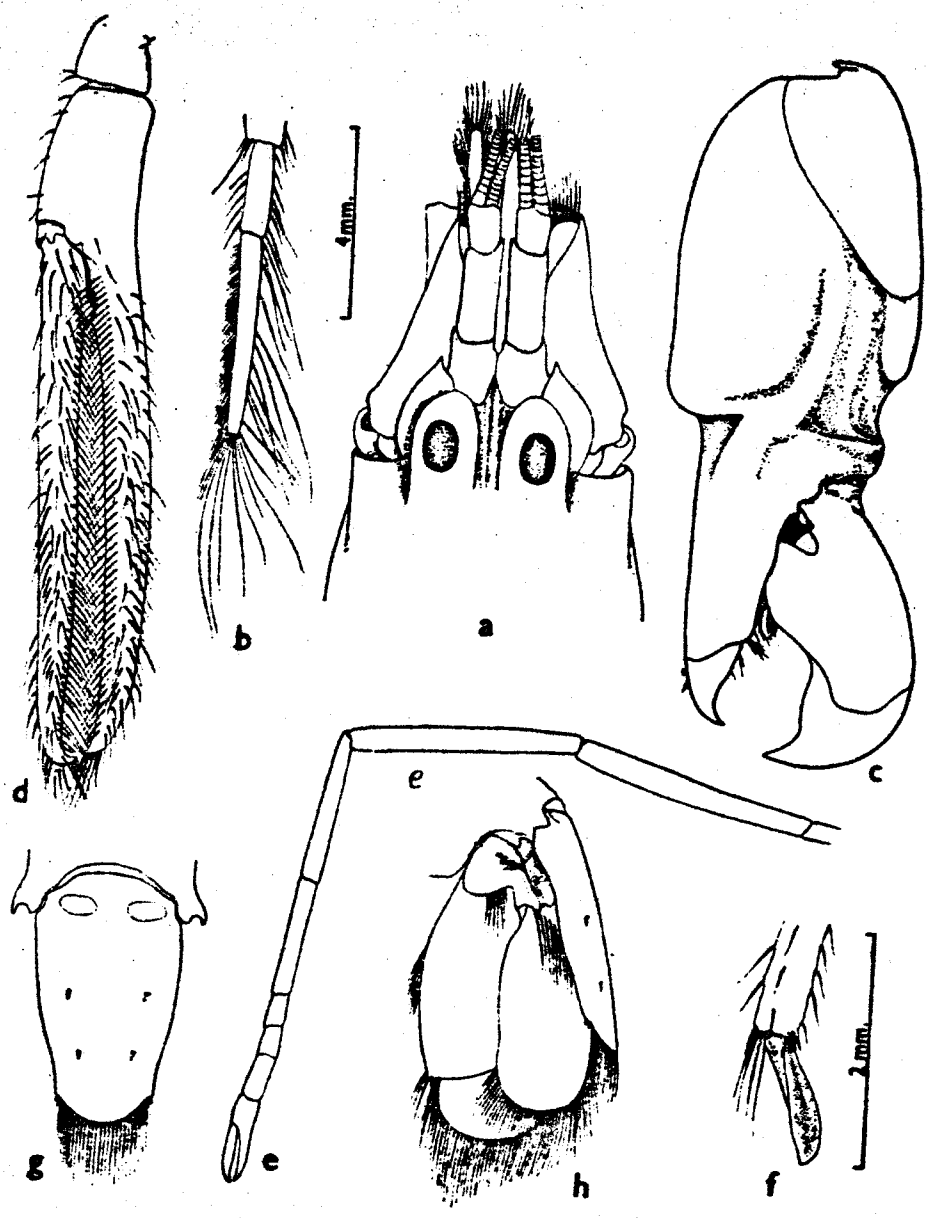

Fig. 32