

**The Alpheidae (Crustacea, Decapoda) of Japan and
its adjacent waters. Part II.**

Yasuhiko MIYA

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Yasuhiko MIYA

Zoological Laboratory, Faculty of Agriculture, Kyushu University
Fukuoka, Japan 812

With Plates 15-31

Contents

Systematics (continued)	103
Genus <i>Alpheus</i>	103
Definition of seven groups of the genus	105
Megacheles group	106
Obesomanus group.....	126
Crinitus group.....	132
Diadema group	151

Genus *Alpheus* Fabricius, 1798

Restricted synonymy:

- Crangon* Weber, 1795: *Nomencl. entomol.*, 94 (not seen; type species: *Astacus Malabaricus* Fabricius, 1775; monotypy).—Banner, 1953: 46 (definition), 48 (key to the Hawaiian species).
Alpheus Fabricius, 1798: *Suppl. Ent. Syst.*, 380, 404 (not seen).—Coutière, 1899: 336 (definition).—De Man, 1911: 299 (remarks).—Holthuis, 1955: 84 (key to genera), 89 (complete synonymy of the genus).—Banner and Banner, 1966b: 74 (definition), 76 (key to the species in Malayo-Thai waters).—Crosnier and Forest, 1966: 217 (key to the tropical Eastern Atlantic species).—Chace, 1972: 54 (key to genera), 57 (key to the Western Atlantic species).
c. f. Thunor Armstrong, 1949: 12 (type species: *Crangon rathbunae* Schmitt, 1924; monotypy).—Banner, 1956: 365 (discussion).—Banner and Banner, 1966a: 167 (species list), 175 (discussion).—Chace, 1972: 54 (key to genera), 105 (remarks).

Type species: *Alpheus avarus* Fabricius, 1798. Selected by Latreille, 1810 (see Holthuis, 1955: 89).

1) Contributions from the Zoological Laboratory, Faculty of Agriculture, Kyushu University No. 443. Contributions from the Amakusa Marine Biological Laboratory (Kyushu University), No. 226. Contributions from the Seto Marine Biological Laboratory, No. 585.

Definition. Carapace anteriorly developed into orbital hoods which completely enclose eyes except on ventral side. Orbital hoods frequently with spiniform apex and usually demarked from rostral base by more or less pronounced depressions. Rostrum usually present and carapace often with at least slight rostral carina. Pterygostomial margin rounded. Antennule usually short, frequently with reduced stylocerite. Basicerite either armed with ventral tooth or rounded. Scaphocerite frequently reduced. Mandible with palp of 2 articles. First pair of pereopods strongly asymmetrical; large chela of variable form, from subconical to compressed and twisted, surfaces from smooth and entire to deeply sculptured with grooves and pronounced "alpheopsidean" lobes; movable finger with molar-shaped tooth fitting into cavity on immovable finger; digital and palmar adhesive plaques present; small chela of simple form, at times showing marked sexual dimorphism. Second pereopod with carpus of 5 articles. Dactylus of third to fifth pereopods simple or biunguiculate. Pleura of sixth abdominal segment not articulated. Telson usually with posterior margin convex and lateral angles distinct but not acute. Anal tubercles almost always well developed. Branchial formula: 5 plbs. + 1 arthrb., usually + 7 eps. + 5 setbs. + 3 expds.; sometimes 1 supplementary arthrobranch on first pereopod. (Adapted from Banner and Banner, 1966b).

Remarks. The genus *Alpheus* was divided into five groups, Megacheles, Macrochirus, Crinitus, Brevirostris and Edwardsi, by Coutière (1899), and subsequently the third group was further divided into three subgroups, Obesomanus, Crinitus and Insignis, by him (1905). Further, these subgroups were recently raised to the group-rank by Banner and Banner (1966b) and the name, Insignis, was changed to Diadema with considering *A. insignis* to be synonymous with *A. diadema*.

The grouping was principally based upon the characteristics in the large cheliped, in the frontal region and in the dactylus and merus of the third pereopod. And the groups and subgroups originally defined to contain the limited number of species were of clearcut ones and valuable to facilitate the classification of the genus. The subsequent addition of many new species, however, demanded a modification of the definition of the respective groups to include them, and later the redefinition of every group was made by De Man (1911). Since then the definition of every group became much inclusive and so equivocal that some species could fall into two or three groups.

But in this paper the seven groups which were further redefined by Banner and Banner (1966b) will be adopted, because the groups seem to follow the natural relationships and to be very useful as a device to separate the large number of species in this genus, for in most cases a species can be placed in the correct group by rather

superficial and rapid examination.

As it will be mentioned in remarks of the *Obesomanus* group, the relation of the genus *Thunor* to a synonym of the genus *Alpheus* is proposed by Banner and Banner (1966a), and the three species are transferred to the *Obesomanus* group. Recently Chace (1972) records *T. rathbunae* (Schmitt, 1924), and retains *Thunor* for his reasons as shown below, although Banner and Banner's decision appears fully supported by him. Chace states that "There is little doubt that the two genera, as now defined, cannot remain separate. My only reasons for retaining *Thunor*, in spite of this evidence, are the fact that *T. rathbunae* is very different from the Atlantic species of *Alpheus* and the belief that *Thunor* may have to be recognized if and when the unwieldy genus *Alpheus* is eventually subdivided." In this regard, however, the author cannot offer any additional criteria for further discussion, because none of *Thunor* is present in the material collected for this study. The author has some hesitation, therefore, in relegating *Thunor* to a synonym of *Alpheus*.

Members of the genus are distributed throughout the tropical and temperate regions of all the oceans and typically littoral or sublittoral. Today the genus contains more than 200 species, and in number of the species they are by far the most abundant in the Indo-West Pacific region.

Definition of seven groups of *Alpheus*

Megacheles group

Orbital teeth present, except in *A. collumianus inermis* Banner. Large chela moderately compressed and twisted, bearing heavy crest leading to adhesive plaque almost always transverse groove present on inner crest. Dactylus and merus of third pereiopod variable.

Macrochirus group

Orbital teeth usually present. Large chela usually moderately compressed, margins rounded, with longitudinal grooves. Dactylus and merus of third pereiopod variable. External spine of uropod usually black.

Obesomanus group

Orbital teeth absent. Stylocerite and scaphocerite often reduced. Large chela proximally rounded, tapering, with distal portions carrying moderate grooves and ridges; movable finger hammer-shaped, crossing end of immovable finger. Second pair of pereiopods often elongated and asymmetrical in length. Dactylus of third

pereiopod usually simple, merus usually armed.

Crinitus group

Orbital teeth absent. Large chela cylindrical, entire, without grooves or ridges. Dactylus of third pereiopod variable, merus usually unarmed.

Diadema group

Orbital teeth present or not. Large chela usually subcylindrical with round margins, often with transverse groove. Movable finger of small chela of male at times balaeniceps. Dactylus of third pereiopod usually simple, merus variable.

Brevirostris group

Orbital teeth absent, except in *A. miyakei* sp. nov. which will be described in Part III. Large chela always strongly compressed, quadrangular in section, with sharp angles; often with transverse groove on dorsal margin. Movable finger of small chela of male often balaeniceps. Dactylus of third pereiopod always simple, at times laterally expanded and subspatulate, merus usually unarmed.

Edwardsi group

Orbital teeth always absent, except possibly in *A. hoplites* Nobili and *A. euchiroides* Nobili. Large chela compressed, rounded, with dorsal margin bearing transverse groove and usually with ventral shoulder; extensive depressed areas present on palm. Movable finger of small chela of male often balaeniceps. Dactylus of third pereiopod usually simple, merus usually unarmed.

Megacheles group

Megacheles group Coutière, 1899: 351 (definition).—De Man, 1911: 307 (definition), 308 (key to the Indopacific species).—Banner and Banner, 1966b: 80 (definition).

Definition. See p. 105

Remarks. The following four species and four subspecies are represented in the collections at hand. All but one, *A. collumianus* (= ? *A. c. probabilis*), are recorded for the first time from Japanese waters.

Key to the species of Japanese Megacheles group

1. Merus of 3rd pereiopod with strong tooth at distal corner 2

- Merus of 3rd pereopod without tooth at distal corner 4
2. Dactyli of 3rd-5th pereopods simple. Antennular peduncle and carpocerite densely covered with long hairs. Inner face of chelae of 1st pereopods covered with papillae attached with bundles of rather long hairs *deuteropus*
- Dactyli of 3rd-5th pereopods biunguiculate. Antennular peduncle and carpocerite almost naked. Inner face of chelae of 1st pereopods with scattered hairs only 3
3. Anteromedial margin of orbital hood produced as round flat projection; rostral base separated from that projection by deep, round indentation. Merus of 3rd pereopod with movable spines along ventral margin *collumianus probabilis*
- Anteromedial margin of orbital hood weakly produced as narrow flat projection; rostral base separated from that projection by prominent but shallow indentation. Merus of 3rd pereopod with long bristles only along ventral margin *collumianus medius*
4. Movable finger of large chela strongly twisted and strongly compressed, with high crest; plaque crest sharp 5
- Movable finger of large chela not twisted, distally expanded and bulbous; plaque crest rounded 6
5. Dactylus of 3rd pereopod with small dorsal and ventral teeth *hailstonei paucispinatus*
- Dactylus of 3rd pereopod slender, simple, with slight dorsal notch ... *hailstonei assimulans*
6. Dactylus of 3rd pereopod simple, with serrations dorsally 7
- Dactylus of 3rd pereopod biunguiculate *oahuensis*
7. In large chela inner crest interrupted by broad and deep transverse groove; shoulder distinctly projecting as blunt process overhanging shallow but distinct notch. Protopods of first 4 pleopods with a row of styliform bristles along inner ventral margin *albatrossae*
- In large chela transverse groove absent or, if present, very indistinct; inner crest not interrupted; shoulder rounded and obtuse. Protopods of first 4 pleopods without any styliform bristles *crockeri*

Alpheus deuteropus Hilgendorf, 1878

(New Japanese name: Kinuge teppo ebi)

(Plate 15)

Alpheus deuteropus Hilgendorf, 1878 : 834, pl. 4, figs. 8-10.—Coutière, 1905 : 880.—Barnard, 1950 : 743 (key), fig. 140, 1-m.—Banner, 1956 : 344; 1957 : 197.—Banner and Banner, 1964 : 88; 1966a : 159; 1966b : 80, fig. 26.

Crangon deuteropus: Edmondson, 1925 : 15. Banner, 1953 : 70, fig. 22.

Description. The only one specimen in hand measures 25.6 mm in body length (♂, 8.8 mm in carapace length); the third maxilliped and all the pereopods are densely covered with rather long hairs. The rostrum is spiniform, strongly compressed and separated from the markedly inflated orbital hood by the narrow and deep orbitorostral groove; the rostral apex reaches to the proximal third of first antennular segment. The acute orbital teeth extend slightly beyond the rostral apex. The frontal margin between each orbital tooth and the rostral base forms a narrow and flat projection.

The antennular peduncle is slender and densely hairy; the second segment is 4.0 times as long as broad; the 3 segments have a ratio, 0.6:1.0:0.5. The stylocerite reaches to the distal fourth of first segment. The basicerite has a long lateral tooth exceeding the rostral apex. The carpo-cerite is slender and densely hairy and extends beyond the end of antennular peduncle. The scaphocerite is strongly concaved laterally and ends in a strong lateral spine reaching to the proximal third of third antennular segment; the anterior margin of narrow lamella reaches to the distal fifth of second segment.

The large chela is oval and strongly depressed. It is 1.3 times the carapace length and 2.8 times as long as high. The dorso-outer surface is almost smooth; the ventro-inner surface is covered with papillae attached with bundles of rather long hairs; the inner crest (Banner's superior crest) is strong and rather sharp, terminating in a large triangular projection, and is proximally delimited by the deep and narrow transverse groove; the inner groove (superior groove) is broad, deep and short; the plaque crest is heavy, markedly projecting distally; the outer crest (inferior crest) is heavy and rounded, terminating in a strong and acute projection; the palmar groove is broad, rather deep and short; the outer depression (inferior depression) is well defined, broad and deep; the shoulder is distinct, perpendicular and rounded. The movable finger is short, cylindrical and not bulbous. The merus is 1.7 times as long as broad; the dorsal margin is markedly produced as a blunt, strong projection distally; the inner ventral margin bears a large triangular projection at the distal corner.

The small chela is oval and strongly compressed. It is 1.2 times the carapace length and 2.5 times as long as high. The ventro-inner surface is covered with papillae furnished with bundles of rather long hairs; the inner crest (Banner's superior crest) terminates in a sharp, strong and triangular tooth distally and is delimited by the deep and broad transverse groove proximally; the proximal edge of transverse groove slightly overhangs the floor of groove as a blunt top; the inner groove (superior groove) is very deep and short; the ill-defined plaque crest is rounded. Both fingers are subcylindrical, almost straight and tapering. The merus is 1.8 times as long as broad, and has the same but less distinct characters as in that of the large cheliped.

In the second pereopod the carpal articles have a ratio, 10:5:2:2:4. The dactylus of the third pereopod is simple and stout. The dorsal and ventral margins of the carpus terminate in a sharp, strong tooth distally. The merus is 3.4 times as long as broad, and has a strong triangular tooth at the distal corner of ventral margin. The ischium bears a strong spine ventrally. The fourth pereopod is similar in ap-

pearance to the third.

The telson is 2.6 times as long as broad at the posterior margin and shallowly depressed medially at the dorsal surface. The anterior pair of dorsal spines is situated before the middle and the posterior pair is behind 2/3 of the length. The uropodal endopod is fringed with 13 spinules distally.

Material examined.

Southern Japan.—Southern Kyushu: 1 ♂, ZLKU No. 9372, Yaku-shima I., Shitoko, tide pool, March 1967, MERS leg.

Colour in life. According to Banner (1953), "Specimens in life mostly colourless with scattered small red chromatophores on body and greenish-brown tracing of margins of anterior body regions and appendages; chelae with dark greenish cast."

Ecology. According to Banner and Banner's excellent observations (1964, 1966b), "throughout the Pacific (and presumably the Indian Ocean) this species is always found in pairs in branching fissures of many genera of the more massive living corals. The fissures, which are open to the surface of the coral, are often several centimeters deep and have yet deeper pockets into which the shrimp may retire. The fissures are usually lined by a fine filamentous algae" (the latter paper).

Distribution. The species is widely distributed throughout the Indo-West Pacific region, where it has been taken from the following localities: Zanzibar (type locality, Hilgendorf, 1878; Barnard, 1950); Red Sea (Coutière, 1905); Maldives (Coutière, 1905); Phuket I. (Banner and Banner, 1966b); Mariana Archipelago (Banner, 1956); Marshall Is. (Banner, 1957); Samoa (Banner and Banner, 1966a); Line Is. (Banner and Banner, 1964); and Hawaiian Archipelago (Banner, 1953).

Alpheus collumianus probabilis Banner, 1956

(Plate 16, figs. A-D)

Alpheus collumianus probabilis Banner, 1956 : 338, fig. 10; 1957 : 197.—Banner and Banner, 1966a : 159; 1966b : 83, fig. 27.

c. f. Alpheus collumianus Stimpson, 1860 : 99 (30).—Ortmann, 1890 : 483, pl. 36, fig. 15 k, m.—Borradaile, 1898 : 1012.—Coutière, 1900 : 414; 1905 : 881; 1921 : 419.—Nobili, 1907 : 354.—De Man, 1911 : 334; 1915 : pl. 14, fig. 65.—Balss, 1914 : 39.—Barnard, 1956 : 8.—Holthuis, 1958 : 21.

Description. The animals are small, measuring 17.5–17.8 mm in body length (6.0–6.2 mm in c.l.). The rostrum is styliform and extends to or almost to the middle of

first antennular segment; the rostral carina is distinct, narrow and rounded dorsally, reaching backward to the base of orbital hoods. The orbital hoods are strongly inflated and bear short acute teeth. The frontal margin between each orbital tooth and the rostral base forms a flat and expanded projection; the rostral base is demarked from these projections by the deep indentations laterally; the orbitorostral grooves are deep and narrow, reaching backward near the base of hoods.

The antennular peduncle is narrow; the second segment is 2.9 times as long as broad; the 3 segments have a ratio, 0.5-0.6 : 1.0 : 0.5. The stylocerite is slender and reaches near the end of first segment. The basicerite has the strong lateral tooth reaching the end of first antennular segment. The carpocerite extends forward as far as the end of antennular peduncle. The scaphocerite is strongly concave laterally and reaches to the end of carpocerite by the apex of lateral spine; the narrow lamella reaches near the end of second antennular segment.

The first pair of pereopods shows no sexual dimorphism, but that of the female is somewhat slenderer and less conspicuous in its characteristics than that of the male.

In the male the large chela is heavy and depressed, and is 1.3 times the carapace length and 3.4 times as long as high. It is sparsely hairy on the ventro-inner surface; the inner crest is strong and rather sharp, terminating in a sharp, triangular projection; the inner groove is well defined, broad and deep; the transverse groove is also well defined, narrow and deep, reaching downward to the middle on the inner surface; the inner crest and inner groove are distinctly delimited by this groove proximally; the plaque crest is heavy and rounded; the outer crest is rounded, terminating in a large subtriangular projection; the palmar groove is well defined, narrow and deep, running backward to the distal third of palm; the outer depression is ill defined, broad and rather deep; the shoulder is very slight. The merus is 2.0 times as long as broad; the dorsal margin is produced but rounded distally; the ventral inner margin is minutely serrated with some spinules, ending in a sharp triangular subterminal tooth.

The small chela of the male is stout and depressed, and is 0.8 times the carapace length and 3.5 times as long as high. It is rather densely hairy on the ventro-inner surface; the inner crest is rounded, terminating in a strong, sharp triangular projection, and delimited proximally by the transverse groove which is rather distinct and shallow; the plaque crest is rounded and poorly demarked; the outer crest is inconspicuous, terminating in a small sharp triangular tooth; the shoulder is rounded and very slight. The movable finger is curved, somewhat expanded proximally and slightly shorter than the palm. The merus is 1.9 times as long as broad, and has the same characters as in that of the large cheliped except for smaller and less distinct.

In the female the large chela is as long as carapace and 2.9 times as long as high; the merus is 2.1 times as long as broad. The small chela is 0.6 times the carapace length and 3.7 times as long as high; the movable finger is slender and not expanded proximally; the merus is 2.4 times as long as broad.

In the second pereopod the carpal articles have a ratio, 10:6-8:3:3-4:5-6. In the third pereopod the dactylus is rather slender, with the stout ventral tooth; the ventral margin of the carpus has 2 pairs of spines, one of them on the middle and the other at the truncated distal corner; the merus is 3.4-3.5 times as long as broad, the ventral margin is armed with 6 spines and a strong, sharp subterminal tooth; the ischium has a strong ventral spine. All the segments of the fourth pereopod are very similar to those of the third.

The telson is 3.6 times as long as broad at the posterior margin; the anterior pair of dorsal spines is situated on 1/3 of the length and the posterior is on 2/3 of it. The uropodal endopod is armed with 6 spinules distally.

Material examined.

Ryukyu Archipelago.—Amami Group: 1 ♂, 1 ovig. ♀, ZLKU No. 11192, Yoron-jima I., Hakebina, outer edge of barrier reef flat, from holes of dead coral, July 12, 1968, Y. Miya and T. Fujino leg.

Colour in life. Unknown.

Ecology. According to the previous authors, *A. collumianus* complex has commonly been collected from the dead or overgrown corals on the various parts of the exposed or submerged coral reefs. Sometimes it was dredged from deeper waters down to 160 m deep (Coutière, 1921).

Remarks. In 1956 Banner established the 3 subspecies, namely, *Alpheus collumianus probabilis*, *A. c. medius* and *A. c. inermis* on the specimens from Saipan. He supposed that *A. c. probabilis* was probably identical with Stimpson's typical species upon the merus of third pereopod having some spines. "....., but because of the distance from the Bonin Islands [Ogasawara Is.] to the Mariana Archipelago and the lack of specimens from the Bonins," he considered that "it was inadvisable to assume this [*A. c. probabilis*] to be exactly the same form as would be found there." Now the author also has no specimens from the Ogasawara Islands and cannot afford any clue for the question.

Distribution. The type locality of *A. c. probabilis* is the Mariana Archipelago

(Banner, 1956). The species is also known from Marshall Is. (Banner, 1957), Fiji (Banner and Banner, 1966a), Tonga (Banner and Banner, 1966a), Samoa (Banner and Banner, 1966a) and Phuket I. (Banner and Banner, 1966b).

The parent species, *A. collumianus*, is widely distributed in the Indo-West Pacific region, where it has been recorded from: Red Sea (Coutière, 1905; Holthuis, 1958); Delagoa Bay (Barnard, 1956); Pondoland (Barnard, 1956); Amirante Bank (Coutière, 1921); Providence Is. (Coutière, 1921); Cargados Carajos Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Is. (Coutière, 1905); Malay Archipelago (Coutière, 1900; De Man, 1911); New Caledonia (Coutière, 1905); Okinawa-jima I., Ryukyu Archipelago (Balss, 1914); Kagoshima, southern Japan (Ortmann, 1890); Bonin Is. [=Ogasawara Is.] (type locality, Stimpson, 1860); Tuamotu Is. (Nobili, 1907); and Funafuti Is. (Borradaile, 1898).

Alpheus collumianus medius Banner, 1956

(Plate 16, figs. E-G)

Crangon collumianus: Edmondson, 1923: 28; 1925: 11.—Banner, 1953: 67, fig. 21.

Alpheus collumianus medius Banner, 1956: 340, fig. 11; 1957: 197; 1958: 163; 1959: 138.—Banner and Banner, 1964: 88; 1966a: 159; 1967: 264; 1968: 279.

Description. Only 2 specimens (1 ♂, 1 ovig. ♀) are available, measuring 13.6–14.3 mm in body length (4.7–4.8 mm in c.l.). The general characters of this subspecies is the same as those of *A. c. probabilis*, except for the characters tabulated.

Material examined.

Southern Japan.—Sagami Bay: 1 ♂, 1 ovig. ♀, ZLKU No. 17357, Manazuru, April 1960, K. Sakai leg.

Colour in life. “In life body mostly transparent with red and yellow chromatophores, legs with yellow and green chromatophores; superior surface of chelae olive drab (Banner, 1953).”

Ecology. See under *A. c. probabilis*, above. According to Banner (1953), rarely *A. collumianus* (= *A. c. medius*) was found living in sponges.

Remarks. It is clear that the specimens in hand belong to *A. c. medius* and can be distinguished from the other 2 subspecies, *A. c. probabilis* and *A. c. inermis*, by the characteristics, which were enumerated by Banner (1956), compared in Table 5.

Table 5. Characteristics separating the 3 subspecies of *A. collumianus* s.l.

	<i>A. c. probabilis</i>	<i>A. c. medius</i>	<i>A. c. inermis</i> *
Frontal part of carapace	Orbital teeth sharp and stout; anteromedial margin of orbital hood produced as flat, rounded projection; rostral base separated from that projection by deep rounded indentation	Orbital teeth sharp and short; anteromedial margin of orbital hood flattened and slightly produced; rostral base separated from that projection by prominent but shallow indentation	Orbital teeth very short or rarely absent; anteromedial margin of orbital hood flattened but not extended; rostral base separated from that margin by only very slight rounded indentation
Stylocerite	With strong tooth	With less pronounced tooth than in <i>A. c. probabilis</i>	With much reduced tooth
Basicerite	With strong tooth	Similar to <i>A. c. probabilis</i>	Without tooth, but angled
Merus of third pereopod	Bearing several spines and very strong terminal tooth	Bearing some long bristles and subtriangular terminal tooth	Bearing rounded terminal tooth only
Carpus of third pereopod	Bearing spines on middle and at distal corner	Similar to <i>A. c. probabilis</i>	Unarmed

*) After Banner, 1956

Distribution. *A. collumianus medius* has been taken from scattered localities in Micronesia and Polynesia: Mariana Archipelago (type locality, Banner, 1956); Caroline Is. (Banner, 1959; Banner and Banner, 1968); Wake I. (Banner, 1959); Marshall Is. (Banner, 1957; Banner and Banner, 1968); Gilbert Is. (Banner, 1958); Fiji (Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); Samoa (Banner and Banner, 1966a); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967); Line Is. (Edmondson, 1923; Banner, 1959; Banner and Banner, 1964); Johnston I. (Edmondson, 1925); and Hawaiian Archipelago (Edmondson, 1925; Banner, 1953).

Alpheus hailstonei paucispinatus (Banner, 1953)

(Plate 17)

Crangon hailstonei paucispinatus Banner, 1953: 51, fig. 16.

Description. Animals are small, measuring 17.0-18.1 mm in body length (5.9-6.0 mm in c.l.). The rostrum is about 3.0 times as long as broad at the base, narrow and sharp, and reaches near the end of first antennular segment; a faint dorsal carina reaches backward near the base of orbital hoods. The orbital hoods are somewhat inflated, the sharp orbital teeth extend to or almost to the middle of rostrum; the margin between each orbital tooth and the rostral base is straight but an angle of about 30° to the transverse line of the body.

The antennular peduncle is slender, the second segment is 3.4-3.6 times as long as broad; the 3 segments have a ratio, 0.8:1.0:0.4-0.5. The stylocerite is sharply pointed and reaches to the end of first segment. The basicerite has a short lateral tooth. The carpocerite is slender and reaches near the end of antennular peduncle. The scaphocerite is slightly concave laterally; its sharp, slender lateral spine reaches forward as far as the end of antennular peduncle; the narrow lamella exceeds the end of second antennular segment.

In both sexes the large cheliped is same in size and characters. The large chela is 1.2 times the carapace length and 2.8-2.9 times as long as high, strongly compressed, smooth and naked. The inner crest is rounded and proximally delimited by the transverse groove, terminating in a sharp, moderately strong, triangular process; this groove is narrow and deep, with the proximal edge produced as a blunt top overhanging the floor of groove, and is traced as a shallow, ill-defined depression on the dorsal third of the inner surface; the inner groove is ill defined and shallow; the plaque crest is strong and has a rather sharp ridge proximally merging with the dorsal margin of palm near the middle; the palmar groove is well defined distally, broad

and deep, and proximally traced to the distal third of the length; the outer crest is rounded and projects distally as a blunt process which is smaller than that of the inner crest; the outer depression is well defined, shallow and distinct; the shoulder is only gently rounded; the movable finger is thin and strongly twisted with the sharp, high crest. The merus is 2.0-2.3 times as long as broad; the dorsal margin is entire, unarmed and slightly produced distally; the ventral inner margin bears 5-7 spinules and a sharp, strong tooth distally. The ischium is armed with a spinule at the distal corner of ventral margin.

The male specimen has the small cheliped lacking. In the female specimen the small chela is 0.8 times the carapace length and 5.0 times as long as high; it is cylindrical and entire except for a couple of the distal teeth on each side of the finger articulation, the inner tooth is strong and sharp, but the outer is very small and pointed; the movable finger is somewhat shorter than the palm, almost straight, crested and slightly concaved on the inner surface. The merus is 4.0 times as long as broad; the dorsal margin is truncated distally; the ventral inner margin is armed with 3 spinules and hairs, ending in a sharp, slender tooth distally. The ischium bears a spinule ventrally.

In the second pereopod the carpal articles have a ratio, 10 : 5 : 3 : 4 : 4-5. In the third pereopod the dactylus is slender, with very small ventral accessory tooth near the tip and with a slight tooth (or notch) opposite that tooth. The ventral margin of propodus bears 15-17 moderate spines in which the distal 10-14 are paired, the longer spines of the distal 3 to 4 pairs have minute serrations at the distal part of dorsal margin. The merus is 7.7-8.2 times as long as broad and unarmed. The ischium bears a ventral spine.

The telson is 4.0-4.3 times as long as broad at the posterior margin; the anterior pair of dorsal spines is situated behind 1/3 of the length and the posterior is just on 2/3 of it. The uropodal endopod is fringed with 8-10 spinules distally.

Material examined.

Southern Japan.—Sagami Bay: 1 ♂, BLIH Sp. No. 1237, 1.3 miles off SSW of Jogashima-Lighthouse, 80-85 m deep, Jan. 21, 1957; 1 ♀, BLIH Sp. No. 1980, 4 km off WSW of Jogashima I., 100 m deep, Feb. 4, 1962.

Colour in life. Unknown.

Ecology. This is probably an offshore species. According to Banner (1953), it has been collected at various localities in the Hawaiian water in depths between 23-24 fathoms ("Albatross" st. 3847) and 294-684 fathoms ("Albatross" st. 3868).

Remarks. The present specimens (1 ♂, 1 ♀) from Sagami Bay undoubtedly belong to this subspecies, but the frontal margin between each orbital hood and the rostrum appears straight but at angle of about 30° to transverse line of body instead of concave, as figured in the holotype.

Distribution. This subspecies is known otherwise only from the type locality, the Hawaiian Archipelago (Banner, 1953). This is one of the deep water species and has been recorded from about 40 m to over 536 m deep.

Alpheus hailstonei assimulans De Man, 1908

(Plate 18)

Alpheus Hailstonei var. *assimulans* De Man, 1908 : 99; 1911 : 331; 1915 : pl. 14, figs. 64-64c.

Description. Animals are closely allied to *A. h. paucispinatus* in general characters and measure 15.0-21.1 mm in body length (5.2-7.1 mm in c.l.). The rostrum is narrow triangular and 2.2-3.2 times as long as broad at the base, its sharp apex reaches variously in the distal third of the first antennular segment. The orbital hoods are slightly inflated, with sharp teeth reaching near the middle of rostrum. The frontal margin between each orbital tooth and the rostrum varies from concave to straight but at angle of about 30° to transverse line of body.

The antennular peduncle is slender, the second segment is 2.9-4.0 times as long as broad; the 3 segments have a ratio, 0.7-0.8 : 1.0 : 0.4-0.5. The stylocerite extends to or almost to the end of first segment. The basicerite has a slender lateral tooth. The carpocerite extends to or slightly beyond the end of antennular peduncle. The scaphocerite is slightly concave laterally and extends to or almost to the end of antennular peduncle by its sharp lateral spine; the narrow lamella reaches variously in the proximal half of third segment.

The only one female specimen (6.4+ mm in c.l.) has the first pair of pereopods. The large chela is about 1.2 times the carapace length and 3.0 times as long as high, and has the same characters as described in *A. h. paucispinatus*. The merus is 2.3 times as long as broad; the dorsal margin is almost truncated distally; the ventral inner margin bears 9 spinules and a sharp, strong tooth distally. The ischium bears a spinule ventrally.

The small chela is about 0.8 times the carapace length and 5.0 times as long as high, and has the characters quite similar to those of *A. h. paucispinatus* except for the following points. Both fingers slightly longer than the palm; their cutting edges

with close series of fine rugae, as observed in *A. oahuensis*; and the dorsal margin of the movable finger less crested than in *A. h. paucispinatus*. The merus is 4.0 times as long as broad; the dorsal margin is truncated distally; the ventral inner margin bears 7 spinules and a sharp, slender tooth distally. The ischium bears a spinule ventrally.

In the second pereopod the carpal articles have a ratio, 10 : 4-5 : 2-3 : 3-4 : 4-5. In the third pereopod the dactylus is slender and simple, having a faint notch with a tuft of bristles on the dorsal margin near the apex. The merus is 7.5-9.5 times as long as broad. The other characters in this pereopod are the same as in *A. h. paucispinatus*.

The telson is slightly convex laterally and 3.6-4.3 times as long as broad at the posterior margin; the anterior pair of dorsal spines is situated on 2/5 of the length and the posterior pair is just on 2/3 of it. The uropodal endopod bears more than a dozen of spinules distally.

Material examined.

Southern Japan.—Sagami Bay: 1 ♂, BLIH Sp. No. 1054, off Enoshima I., One, 150 m deep, Feb. 3, 1956.

East China Sea.—Norin gyoku (Official block) No. 226 : 5 ♂♂, 2 ovig. ♀♀, 4 ♀♀, ZLKU No. 17345, 32°24.8'N, 129°24.7'E, Oct. 24, 1962, SRFL leg.

Colour in life. Unknown.

Ecology. This subspecies is also an offshore shrimp. According to De Man (1911), it was collected at 3 localities (Siboga Sts. 260, 282 and 305) in the Malayan water from 27 m to 113 m deep. Bottoms were "sand, coral and shells," "sand, coral and Lithothamnion" and "stony."

Remarks. In the present specimens collected in a dredge, only one female (6.4 +mm in c.l., rostrum broken) has the intact first pair of pereopods and the others have only one or several pereopods attached. But the specimens show only slight variations in several characteristics and undoubtedly belong to this subspecies.

In *A. hailstonei* complex the following four subspecies have been established upon several minor differences. Banner (1953) prepared the table in which the characteristics differentiating *A. hailstonei* complex and other four closely allied species were enumerated, but, as he himself pointed out, most of the characteristics were "of move variable ones and therefore were of lesser worth." At present only four characteristics in Table 6 may be useful in separating the four subspecies from each other. However, the validity of each subspecies might be questionable and many more speci-

Table 6. Characteristics separating the 4 subspecies of *A. hailstonei* s.l.

	<i>A. h. hailstonei</i> ¹	<i>A. h. assimulans</i> ²	<i>A. h. laetabilis</i> ³	<i>A. h. paucispinatus</i> ⁴
Large cheliped				
Number of dorsal/ ventral spinules on merus	3/0	0/4-9	4-5/8-9	0/3-7
Number of dorsal/ ventral spinules on ischium	0/0	0/1	2/3	0/1-2
Small cheliped				
Number of dorsal/ ventral spinules on merus	0/6	0/7	Similar to <i>A. h.</i> <i>hailstonei</i> (?)	0/3
Third pereopod				
Dactylus	Slender, simple	Slender, simple with slight dorsal notch	With slight dorsal and ventral teeth	Similar to <i>A. h.</i> <i>laetabilis</i>

1, 3) After Banner (1953, Table 2). 2, 4) From the present materials and after Banner (1953, Table 2).

mens should be examined before a definit conclusion can be safely drawn.

Distribution. It is previously recorded only from the type localities in the Malay Archipelago: Kei Island; between Timor and Nusa Besi; and Solor Strait (De Man, 1908). This is also a deep water form and has been reported in depths between 27 and 113 m.

Alpheus oahuensis (Banner, 1953)

(New Japanese name: Akashima teppo ebi)

(Plate 19)

Crangon oahuensis Banner, 1953 : 64, fig. 20.

Alpheus oahuensis : Banner, 1956 : 338; 1958 : 163, fig. 3.—Banner and Banner, 1964 : 88.

Description. Animals are medium, measuring 30.3-31.4 mm in body length (10.3-10.9 mm in c.l.). The rostrum is 1.3 times as long as broad at the base, rounded and not carinated dorsally; the sharp apex reaches to the middle of first antennular segment. The orbital hoods are slightly inflated, with the sharp teeth which are

curved inward and reach to the distal third of rostrum. The frontal margin between the rostral base and the base of each tooth is weakly convex and makes a right angle with the lateral margin of rostrum.

The antennular peduncle is robust, the second segment is 1.3-2.0 times as long as broad; the 3 segments have a ratio, 0.7-1.3:1.0:0.8-0.9. The stylocerite extends beyond the end of first segment by the sharp apex. The basicerite has the acute lateral tooth reaching forward as far as the end of first antennular segment. The carpocerite is stout and extends far beyond the end of antennular peduncle. The scaphocerite has the lamella reaching to the distal half of third antennular segment and the strong lateral spine reaching near the end of carpocerite.

The large chela of the male is 3.2 times as long as high and 1.6 times the carapace length; and that of the ovigerous female is 2.8 times as long as high and 1.1 times the carapace length. It is subcylindrical, polished and furnished with long or short coarse hairs on the inner surface; the inner crest is distinct and rounded dorsally, ends in an acute triangular tooth distally, and merges with the dorso-inner margin proximally; the inner groove is well defined and deep distally and gradually shallows proximally, ending at the middle of palm; the transverse groove is short, well defined and deep; the plaque crest is rounded and heavy; the palmar groove is well defined, narrow and deep; the outer crest is rounded and ends in a large, sharp triangular tooth distally; the outer depression is rather well defined, broad and rather deep; the shoulder is gradual and rounded. The movable finger is distorted and bulbous distally. The merus is 1.6 times as long as broad in the male and 1.9 times in the ovigerous female; the dorsal margin is markedly produced as a round process; the ventral inner margin bears 11-15 spinules and terminates in a strong triangular process. The ischium is also armed with some spinules on the dorsal process and along the ventral inner margin.

The small chela is 1.5 times the carapace length in the male and as long as the carapace in the female, subcylindrical and 5.0-5.2 times as long as high in both sexes. The fingers are very slender and strongly curved outward, their tips slightly crossing; the movable finger is 1.3-1.4 times as long as the palm, and longer than the immovable; their cutting edges have the sharp, thin blade-like ridges with close series of fine rugae and have a row of short bristles along the inside of each ridge; the articulation of the finger is flanked by strong, sharp teeth on both sides; the ventral margin is gently curved. The other segments have the same characters as observed in those of the large cheliped.

In the second pereopod the carpal articles have a ratio, 10:6-7:3:3:5. In the third pereopod the dactylus is strong and has the distinct triangular ventral unguis.

The merus is 3.9 times as long as broad and unarmed. The ischium bears a very small spine.

The telson is 3.0-3.2 times as long as broad at the posterior margin; the anterior pair of dorsal spines is situated just before the middle and the posterior pair is on the distal fourth of the length. The uropodal endopod bears 6-8 spinules distally.

Variations. In the present material (1 ♂, 1 ovig. ♀) the variation was found in the movable finger of large chela. That of the female is normal while that of the male appears slightly tapering and almost truncated at the apex, instead of being narrow in the middle and expanded and bulbous at the apex. It may be similar to the condition found in the specimens from Saipan by Banner (1956).

Material examined.

Ryukyu Archipelago.—Amami Group: 1 ♂, 1 ovig. ♀, ZLKU No. 11254, Yoron-jima I., Ukachi, outer edge of ocean reef, in dead base of living coral, July 11, 1968, Y. Miya and T. Fujino leg.

Colour in life. The shrimp has the peculiar colouration and pattern as follows: The median part of carapace, abdomen and the base of telson is paralleled with two broad bands of carmine red. These bands gradually turn to the median line anteriorly, coalesce into a single median band on the rostrum and further extend anteriorly on each antennular peduncle except for the portion of stylocerite; on the other hand, the two bands also coalesce into a single broad one at the basal part of telson. Each longitudinal band has two somewhat narrow branches; one of them branches off at the posterior third of carapace and runs forward to the anterior margin of carapace at the level of antennal region; and the other branches off at the posterior part of sixth abdominal segment, runs parallel with the main band and extends forward to the middle of carapace at the level of the base of pleura.

The carapace and the first five abdominal segments have a narrow band of carmine red along the ventral margin of them. The tail fan is tinged with the same colour on the distal half portion. All the pereopods are also tinged with the same colour.

Ecology. As noted in the material examined, the specimens were found in crevices in the dead base of living coral under the low tide mark. According to Banner (1953), the specimens from the Hawaiian Archipelago are also collected from corals in water of 10-40 feet deep.

Remarks. Present specimens are clearly assigned to *A. oahuensis*, but have the ischium of the last three pereopods bearing a small spine, instead of being unarmed.

Distribution. *A. oahuensis* has been recorded only from the Mariana Archipelago (Banner, 1956), Gilbert Islands (Banner, 1958), Line Islands (Banner and Banner, 1964) and the Hawaiian Archipelago (type locality, Banner, 1956).

Alpheus albatrossae (Banner, 1953)

(New Japanese name: Arubatorosu teppo ebi)

(Plate 20)

Crangon albatrossae Banner, 1953: 60, fig. 18.

Description. Shrimps measure 10.2-20.7 mm in body length (3.5-7.0 mm in c.l.). The rostrum is triangular and 1.5 times as long as broad at the base, its sharp apex extends to or beyond the middle of first antennular segment. Orbital hoods are slightly inflated, with the pointed teeth reaching near the rostral apex. The margin between each orbital tooth and the rostrum is straight but at angle of about 30° to the transverse line of body or rarely concave.

The antennular peduncle is rather slender, the second segment is 1.9-2.9 times as long as broad; the 3 segments have a ratio, 0.5-0.9:1.0:0.4-0.7. The stylocerite is slender and overreaches the end of first segment. The basicerite bears a short ventral tooth. The scaphocerite is slightly concave laterally and reaches to the end of antennular peduncle by its sharp spine; the narrow lamella reaches variously in the proximal half of third segment. The carpuccerite is slightly longer than the scaphocerite.

The large chela shows no sexual differences; in both sexes it is 1.1-1.2 times the carapace length and 3.0-3.6 times as long as high and compressed. The inner crest is rounded, distally ending in a pointed, short triangular projection; the inner groove is indistinct and shallow; the transverse groove is broad and deep, the proximal edge projecting as a blunt process; the plaque crest is rounded and rather low; the palmar groove is broad, shallow and ill defined; the outer crest is rounded and terminates in a short, pointed triangular tooth distally; the outer depression is broad, shallow and ill demarked; the shoulder distinctly projects as a blunt process overhanging the shallow but distinct notch; the movable finger is strongly compressed and almost straight with the high crested dorsal margin, its apex appears slightly bulbous. The merus is 2.4-2.9 times as long as broad; the dorsal margin is unarmed, ending in a

blunt process; the ventral inner margin bears 6 to 10 spinules and a sharp, moderate tooth distally. The ischium is armed with 2 to 4 spinules ventrally and unarmed dorsally.

The small chela of both sexes is 0.9–1.0 times the carapace length and shows slight sexual differences in proportion, being 3.5 times as long as high in the male and 3.9 times as long as high in the female; the ventral margin is distinctly notched at the base of immovable finger; the movable finger is as long as the palm, compressed and provided with the sharp and high crest dorsally; the finger articulation is flanked by the teeth on both sides, the inner tooth is sharply pointed and longer than the outer. The merus is 2.4–2.6 times as long as broad; the dorsal margin is unarmed and truncated distally; the ventral inner margin bears 8 to 10 spinules and a sharp distal tooth. The ischium is unarmed dorsally and armed with 2 or 3 spinules ventrally.

In the second pereopod the carpal articles have a ratio, 10 : 5–6 : 3 : 3–4 : 4–5. In the third pereopod the dactylus is slender and simple, its dorsal margin has 2 notches with tufts of short bristles near the apex. The propodus bears 8 to 10 slender spines ventrally, some of them near the distal end are provided with the same minute serrations as found in *A. hailstonei* complex. The merus is 6.8–8.0 times as long as broad and unarmed. The ischium bears a spine ventrally.

The protopods of the first 4 pleopods are usually furnished with a row of transparent, pale yellow, styliform bristles along the inner ventral (posterior) margin. The uropodal endopod bears 5–13 spinules distally. The telson is slightly convex laterally and 4.0–4.3 times as long as broad at the posterior margin; the posterior margin appears subtriangular and bears the usual 2 pairs of spines, the inner pair being more than half the breadth of that margin; the anterior pair of dorsal spines is situated on 2/5 and the posterior pair is on 2/3 of the length.

Material examined.

Southern Japan.—Sagami Bay: 1 ♀, BLIH Sp. No. 1053, off Enoshima I., One, 150 m deep, Feb. 3, 1956; 1 ♂, BLIH Sp. No. 1055, off Enoshima I., One, 150 m deep, Feb. 3, 1956; 1 ♀, BLIH Sp. No. 1076, Amadaiba, Aoyama dashi 80 m deep, Mar. 13, 1956; 1 ovig. ♀, BLIH No. 1208, off Nagai, Goronba, 130 m deep, Dec. 2, 1956; 1 ♂, 1 ovig. ♀, BLIH No. 1553, between Maruyama dashi and Kannonzuka dashi, 70 m deep, July 12, 1959; 1 ♂, BLIH No. 2002, off Enoshima I., Hiramom, 65–73 m deep, Feb. 10, 1962.—Inland Sea of Japan: 1 ♂, 2 ovig. ♀♀, 1 ♀, ZLKU No. 10922, Bungo Straits, off Okinomuku-shima I., 150 m deep, bottom gravelly, Sept. 25, 1967, H. Tashibu leg.; 1 ♀, ZLKU No. 17356, Bungo Straits, off Tsurumi zaki, 187 m deep, bottom gravelly, Dec. 5, 1967, H. Tashibu leg.—Northern Kyushu: 1 ♀, ZLKU No. 1439, Genkai nada, Munakata-oshima I., off Sone, July 3, 1957, Y. Motomatsu leg.

East China Sea.—Norin gyoku (Official block) No. 474: 1 ♀ (?), broken, ZLKU No. 15578, 28°45.0' N, 126°14.5' E, 100 m deep, June 14, 1963 05 : 36, SRFL leg.

Micronesia.—Ogasawara Islands: 2 ♀♀, ZLKU No. 1427, Mukoshima I., July 17-21, 1938, S. Miyake leg.

Colour. In alcohol, a female collected from off Tsurumi-zaki was densely covered with red chromatophores entirely except for on orbital hoods.

Ecology. This is probably one of the offshore species. It has been collected at various localities in depths from 12 m to 187 m.

Remarks. As the present specimens were dredged from the deep sea, almost all of them have lost several pereopods, and some pereopods detached were found in bottles when the author received them. In the specimens only one male (4.1 mm in c.l., BLIH No. 2002) had the intact large cheliped; the large and small chelipeds detached in two bottles (BLIH No. 1553 and ZLKU No. 10922) are supposed to have belonged to a male (5.1 mm in c.l.) and an ovigerous female (7.0 mm in c.l.) in each bottles, respectively.

The specimens agree in almost all the respects with Banner's description and figures of the type specimen of *A. albatrossae* from the Hawaiian Archipelago (1953), but disclose the minor differences which may possible be significant for the subspecific recognition of the present material. 1. In all but two (1 ovig. ♀, 5.5 mm in c.l., one of BLIH No. 1553; and 1 ♂, 4.1 mm in c.l., BLIH No. 2002) of Japanese specimens the protopods of first four pleopods are furnished with a row of transparent, pale yellow, styliform bristles along the inner ventral (posterior) margin; in Hawaiian specimens Banner did not say anything in this respect. 2. In Japanese specimens, though only five of them have the intact large cheliped, the movable finger appears not to be so blubose as figured in Hawaiian specimens. 3. The merus of third pereopod of Japanese specimens is 6.8-8.0 times as long as broad instead of 5-6 times. 4. In Japanese specimens the uropodal endopod is fringed with 5-13 spinules distally, and the posterior margin of telson bears two pairs of spines, the inner pair is more than half the breadth of that margin; in Hawaiian specimens the uropodal endopod is unarmed, and the posterior margin of telson bears only a pair of short spines. It is very possible that the Japanese form is at least subspecifically distinct, but it is better to postpone the taxonomic recognition of these differences until more intact specimens can be compared.

Distribution. This is known only from the Hawaiian Archipelago (Banner, 1953). From shallow water down to 187 m in depth.

Alpheus crockeri (Armstrong, 1941)

(Plate 21)

Crangon crockeri Armstrong, 1941 : 8, figs. 2-3.*Alpheus crockeri* : Crosinier and Forest, 1966 : 225, figs. 4-5.—Banner and Banner, 1966a : 159; 1966b : 84, fig. 28; 1967 : 264; 1968 : 279.*Crangon tuthilli* Banner, 1953 : 63, fig. 19.*Alpheus tuthilli* : Banner, 1956 : 338, fig. 9.

Description. Shrimps are small, measuring 14.6–18.3 mm in body length (5.6–6.2 mm in c.l.). The rostrum is 1.5 times as long as broad at the base and not carinated dorsally; its sharp apex reaches to the middle or 2/3 of first antennular segment. The orbitorostral groove is absent. The orbital hoods are not inflated; the orbital teeth are slender and reach to 2/3 of the rostrum.

The antennular peduncle is robust, the second segment is 1.3–1.9 times as long as broad; the 3 segments have a ratio, 0.7–1.2 : 1.0 : 0.7–1.0. The stylocerite is slender and overreaches the end of first segment by the acute apex. The basicerite has the sharp ventral tooth reaching near the rostral apex. The carpocerite is slender and reaches forward as far as the end of antennular peduncle. The scaphocerite has the sharp, long lateral spine reaching forward as far as the carpocerite and the rather broad lamella extending to or almost to the middle of third antennular segment.

The large chela is 1.4 times the carapace length and 2.7 times as long as high in the male, and 1.1 times the carapace length and 3.2 times as long as high in the female. It is compressed and distally sculptured; the inner crest is rather sharp, terminating in a subacute triangular tooth, and merges soon with the dorso-inner margin of palm proximally; the transverse groove is shallow and ill defined; the inner groove is rather deep and broad distally, and traced on the distal half of palm; the plaque crest is heavy and rounded; the palmar groove is well defined, broad, and deeper and narrower than the inner groove; the outer crest is rather sharp, terminating in a large triangular tooth; the outer depression is ill defined, shallow and broad; the shoulder is rounded and obtuse; the movable finger is distally expanded and bulbous. The merus is 2.3–3.0 times as long as broad; the dorsal margin is slightly produced and rounded; the ventral inner margin bears 5–10 spinules, terminating in a small, sharp subterminal tooth.

The small chela of the male is 0.9 times the carapace length and 4.1 times as long as high and cylindrical; the finger articulation is flanked on each side by a small, sharp tooth; fingers are somewhat longer than the palm, slender and thin, their tips slightly crossing; the cutting edge of each finger has a thin blade-like ridge

flanked on the outside by a row of short bristles. The merus is 2.5 times as long as broad and has the same characters as shown in that of large cheliped.

The female specimen has the small cheliped lost.

In the second pereopod the carpal articles have a ratio, 10:5:3:4:4-5. The dactylus of third pereopod is simple and has only 3 bristles at the distal third of dorsal margin, where no trace of accessory tooth is found. The merus is unarmed and 4.8-4.9 times as long as broad. The ischium bears a spine ventrally.

The telson is 3.9-4.5 times as long as broad at the posterior margin; the posterior margin bears a pair of spines at each corner, the long inner spine is equal to the breadth of that margin; the anterior pair of dorsal spines is situated on the middle of the length, and the posterior pair is on 3/4 of it. The uropodal endopod is fringed with 6 spinules distally.

Material examined.

Ryukyu Archipelago.—Yaéyama Group: 1 ♂, 1 ovig. ♀, ZLKU No. 12182, Ishigaki-jima I., IBP 8, Mar. 10, 1968, A. H. Banner leg.

Colour in life. Unknown.

Ecology. According to previous records, this species is found living "in dead coral heads taken from the outer reef edge in about 2 meters of water" (Banner and Banner, 1966b), and "mainly living on the bottoms of rock, of corallin algae and of corals." (Crosnier and Forest, 1966).

Remarks. The author has some hesitation in identifying the specimens available with this species, because they show the marked differences in the following four important characteristics:

1. In the present specimens the large chela is provided with the ill-defined, slight transverse groove instead of lacking it. "No transverse groove" is one of the most valid characteristics of *A. crockeri*.

2. In the specimens the inner and outer crests of large chela seem terminating in larger teeth than those figured by Armstrong (1941, fig. 3, C), Banner (1953, fig. 19, C) and Crosnier and Forest (1966, fig. 5, C).

3. In the specimens the merus of third pereopod is 4.8-4.9 times as long as broad instead of 6.5-7.5 times (Crosnier and Forest, 1966; Banner and Banner, 1966b).

4. In the specimens the first antennular segment is shorter than that figured by the previous workers.

Distribution. *A. crockeri* is widely distributed in the West Pacific and East

Atlantic Oceans. In the West Pacific the species has been taken from: Phuket I. (Banner and Banner, 1966b); Gulf of Thailand (Banner and Banner, 1966b); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner and Banner, 1968); Samoa (typelocality, Armstrong, 1941; Banner and Banner, 1966a); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967); and Hawaiian Archipelago (Banner, 1953). In the East Atlantic it has been recorded only from Sao Tomé Island and Annobon Island (Crosinier and Forest, 1966). Intertidal zone to 50 m deep.

Obesomanus group

Crinitus group Coutière, 1899 : 351 (part, definition).

Obesomanus subgroup Coutière, 1905 : 884 (definition).—De Man, 1911 : 307 (definition), 312 (key to the Indopacific species).

Obesomanus group: Banner and Banner, 1966a : 162 (discussion), 173 (key to the species of group); 1966b : 99 (definition).

c. f. Thunor Armstrong, 1949 : 12 (definition).—Banner, 1956 : 365 (discussion).—Banner and Banner, 1966a : 167 (species list), 175 (discussion).—Chace, 1972 : 54 (key to genera), 105 (remarks).

Definition. See p. 105.

Remarks. This group was first proposed by Coutière (1905) and next clearly defined by De Man (1911). Prior to the revision of Banner and Banner (1966a) this group comprised a large number of species, of which most were described upon few specimens and showed much resemblance to each other, separating only in rather obscure and unstable differences. They closely studied some species of the group based upon the extensive material chiefly from the Central Pacific, and made a thorough revision of the group with considering the range of variation occurred in the following first three species. And they retained only eight species, *A. obesomanus* Dana, 1852, *A. microstylus* (Bate, 1888), *A. malleodigitus* (Bate, 1888), *A. danae* Coutière, 1905, *A. perplexus* Banner, 1956, *A. chamorro* Banner, 1956, *A. nobili* Banner and Banner, 1966 and *A. samoa* Banner and Banner, 1966, in this group. Further, in the revision of the group the relegation of the genus *Thunor* to a synonym of the genus *Alpheus* was also proposed by them, and the three species, *T. rathbunae* (Schmitt, 1924) which was only one Atlantic species, *T. idiocheles* (Coutière, 1905) and *T. microscaphis* Banner, 1959, were transferred to the *Obesomanus* group. For the differentiation of all the valid species they prepared a comprehensive key to the species of the *Obesomanus* group.

During the present investigations only the two species, *A. obesomanus* and *A. malleodigitus*, are represented in the material examined. *A. obesomanus japonicus* Ortmann, 1890, although previously recorded from Japan, must now be relegated to a synonym of *A. obesomanus*, as Banner and Banner suggested. *A. malleodigitus* recorded here is the first time from this region.

Most of the species have the soft integument and obligately live in crevices in coral rocks and in ramifying galleries of coralline algae.

Key to the species of Japanese Obsomanus group

- Scaphocerite reaching in the distal half of 3rd antennular segment; carpocerite reaching forward as far as scaphocerite; ratio of the first 2 carpal articles of 2nd pereopod, 10 : 22-46..... *obesomanus*
- Scaphocerite at most reaching to the end of 2nd antennular segment; carpocerite at most reaching to the middle of 3rd antennular segment; ratio of the first 2 carpal articles of 2nd pereopod, 10 : 10-22 *malleodigitus*

Alpheus obesomanus Dana, 1852

(New Japanese name: Yawa teppo ebi)

(Plate 22, figs. A-E)

- Alpheus obesomanus* Dana, 1852a : 21; 1852b : 547, pl. 34, fig. 7.—Richters, 1880 : 163.—De Man, 1888a : 520.—Borradaile, 1900 : 417.—Banner and Banner, 1964 : 91; 1966a : 168, 174, figs. 8a, b and 9-18 (part); 1966b : 101, fig. 35 G, H; 1967 : 269; 1968 : 282.
- Crangon obesomanus*: Armstrong, 1941 : 9.
- Alpheus obesomanus japonicus* Ortmann, 1890 : 478.—Balss, 1914 : 38.—Banner, 1966a : 168.
- Alpheus lutini* Coutière, 1905 : 885, pl. 76, fig. 24; 1921 : 423.—De Man, 1911 : 346; 1915 : pl. 14, fig. 69.—Banner, 1956 : 346; 1957 : 198; 1958 : 167; 1959 : 141.—Johnson, 1960 : 52.—Banner and Banner, 1966a : 170.
- Alpheus* sp. 2 Banner, 1956 : 351.—Banner and Banner, 1966a : 170.

Description. Present specimens are small, softly chitinous and polished, measuring 9.2-16.0 mm in body length (3.5-5.1 mm in c.l.). The rostrum is much reduced and triangular, and has the rather sharp, low dorsal carina reaching backward the base of orbital hoods. The orbital hood is strongly inflated and separated from the rostral carina by the broad, shallow depression. The frontal margin is gently rounded and sometimes weakly notched at the rostral base on each side.

The antennular peduncle is slender, the second segment is 2.1-2.6 times as long as broad; the 3 segments show a ratio, 0.5-0.8 : 1.0 : 0.5-0.8. The stylocerite is much reduced and subtriangular. The basicerite is unarmed. The carpocerite is elongated

and reaches variously in the distal half of the third antennular segment. The strong lateral spine of scaphocerite reaches forward as far as the end of carapocerite; the reduced lamella extends to or almost to the middle of second segment, and is sparsely fringed with short setae along the anterior margin.

The first pair of pereiopods shows no sexual dimorphism. The large chela is, in the male, 1.1-1.2 times the carapace length and 2.5-2.7 times as long as high, and is, in the ovigerous female, 0.9-1.0 times the carapace length and 2.3-2.5 times as long as high. It is almost cylindrical and much swollen proximally; there is a broad, shallow transverse groove proximal to the finger articulation, the groove is well delimited above the midline on the inner surface, and continues as a short oblique longitudinal groove on the outer surface; a short longitudinal groove is situated on the outer surface near the ventral margin. The merus is 2.1-2.4 times as long as broad; the dorsal margin is truncated; the ventral inner margin is slightly produced triangularly near the distal corner.

The small chela is, in both sexes, 0.5-0.7 times the carapace length and 3.7-4.4 times as long as high, cylindrical and entire; the movable finger is 0.5-0.6 times as long as the palm. The merus is 3.1-3.7 times as long as broad; the dorsal margin is truncated; the ventral inner margin is unarmed.

The second pereiopods are asymmetrical in length, one of them is 1.2-1.3 times as long as the other; in the larger one the carpal articles have a ratio, 10:28-30:6-7:6-8:10-11; in the smaller they have a ratio, 10:22-30:6-7:6-7:9-11. In the third pereiopod the dactylus is simple and slender. The ventral margin of carpus ends in a sharp tooth. The merus is 3.1-3.9 times as long as broad and bears a strong triangular tooth at the distal corner of ventral margin.

The telson tapers and is 4.0-6.8 times as long as broad at the posterior margin which is almost truncated; the dorsal surface is uneven with the medial and marginal depressions; the usual 2 pairs of spines are situated on the round ridges running parallelly, the anterior pair is situated on 2/5 of the length and the posterior pair is somewhat behind 2/3 of the length. The uropodal endopod is fringed with 5-11 spinules distally.

Material examined.

Ryukyu Archipelago.—Amami Group: 1 ♂, 1 ovig. ♀, ZLKU No. 10952, Amami-oshima I., Kasari-cho, Yo, Aug. 4, 1967, Y. Ushio leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 11248, Yoron-jima I., Terasaki, lagoon, interstices in basal part of living coral, July 8, 1968, Y. Miya and T. Fujino leg.; 1 ♂, 2 ovig. ♀♀, ZLKU No. 11250, Yoron-jima I., Panta, fringing reef, interstices of dead coral, July 10, 1968, Y. Miya and T. Fujino leg.; 1 ovig. ♀, ZLKU No. 11253, Yoron-jima I., Hakebina, small hole in dead coral, July 12, 1968, Y. Miya and T. Fujino leg.—Okinawa Group: 1 ♂, ZLKU No. 17358, Okinawa-jima I., Gushichan, July 3, 1962, S. Miyake, T. A. Uchida

and H. Minei leg.; 1 ♂, Kume-jima I., Shimajiri Bay, Nakasato, among branches of *Acropora*, July 1, 1970, E. Harada leg.—Yaéyama Group: 2 ♂♂, 1 ovig. ♀, AMBL, Ishigaki-jima I., Kabira, July 27, 1969, T. Kikuchi leg.

Colour in life. A shrimp is yellow entirely. Eggs freshly laid are green.

Ecology. *A. obesomanus* generally lives in holes of the basal part of living, overgrown and dead corals from all parts of the reef. "Specimens were found occasionally living in sponges" (Banner and Banner, 1966b) and "in algal tubes on heads of *Porites* and *Heliozoa*" (Banner and Banner, 1968).

Remarks. *A. obesomanus* was adequately described and discussed by Banner and Banner (1966a, b), and the present material has not offered any additional criteria for further discussion.

Banner and Banner's detailed morphological studies (1966a) revealed that *A. lutini* and *Alpheus* sp. 2 described by Banner (1956) were well within the range of variation in various characteristics of *A. obesomanus* and should be considered to be synonymous with it.

In addition, they considered that *A. obesomanus japonicus* had to be regarded as indistinguishable from *A. obesomanus*, because Ortmann's original description of *A. o. japonicus* was very inadequate to characterize that subspecies. In his description the only one characteristic which is definitely stated is the relative length of the carpal articles of second pereopod, and that ratio, "Zweites Carpalglied doppelt long wie das earste," lie merely on the extreme margin of the range of variation in *A. obesomanus* (see Banner and Banner, 1966b, fig. 15; present data).

Distribution. The species is widely distributed throughout the greater part of the Indo-West Pacific region and has been recorded in the literature from the following localities under several names. *A. obesomanus* occurs from: Mauritius (Richters, 1880); Phuket I. (Banner and Banner, 1966b); Gulf of Thailand (Banner and Banner, 1966b); Pulo Edam (De Man, 1888a); Loyalty Is. (Borradaile, 1900); New Britain I. (Borradaile, 1900); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner and Banner, 1968); Fiji (type locality, Dana, 1852a, b; Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); Samoa (Armstrong, 1941; Banner and Banner, 1966a); Phoenix Is. (Banner and Banner, 1964); Cook Is. (Banner and Banner, 1967); and Society Is. (Banner and Banner, 1967). *A. obesomanus japonicus* is obtained only from: Tokyo Bay (type locality, Ortmann, 1890) and Kagoshima Bay (Balss, 1914) in southern Japan. *A. lutini* is known from: Djibouti (Coutière, 1905); Mascate (Coutière, 1905); Coetivy (Coutière, 1921); Maldive Is. (Coutière, 1905); Singapore Straits (Johnson,

1960); Siau I. in Celebes Sea (De Man, 1911); Salomakiëe I. in Halmahera Sea (De Man, 1911); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner, 1959); Marshall Is. (Banner, 1957); and Gilbert Is. (Banner, 1958). *Alpheus* sp. 2 described by Banner (1956) is taken only from the Mariana Archipelago.

Alpheus malleodigitus (Bate, 1888)

(New Japanese name: Futoyubi yawa teppo ebi)

(Plate 22, figs. F, G)

Betaeus malleodigitus Bate, 1888: 565, pl. 101, fig. 5.

Alpheus malleodigitus: De Man, 1902: 866; 1911: 347; 1915: pl. 14, fig. 70.—Banner and Banner, 1964: 91; 1966a: 170, 174, figs. 8c, d and 9-18 (part); 1966b: 103, fig. 351, J; 1967: 270; 1968: 282.

Alpheus malleodigitus gracilicarpus De Man, 1911: 349; 1915: 14, fig. 70e.—Banner and Banner, 1966a: 171.

Alpheus phrygianus Coutière, 1905: 886, pl. 77, fig. 25; 1921: 423.—Banner, 1956: 346; 1959: 141.—Banner and Banner, 1966a: 171.

Crangon phrygianus: Armstrong, 1941: 9.

Alpheus persicus Nobili, 1906, *Bull. sci. France Belg.*, 40: 33 (not seen).—Banner and Banner, 1966a: 171.

Description. The species is closely allied to *A. obesomanus* in general characters. Present specimens measure 8.5-21.7 mm in body length (3.5-8.1 mm in c.l.). The rostrum is short and triangular, with the low but distinct carina reaching backward to the base of hoods. The orbital hoods are moderately inflated. The area between the rostral carina and each hood is shallowly and rather broadly depressed. The frontal margin is gently rounded and shallowly concave at the rostral base on each side.

The antennular peduncle is much elongated, the second segment is 3.8-5.2 times as long as broad; the 3 segments have a ratio, 0.3-0.4:1.0:0.2-0.4. The stylocerite is much reduced and subtriangular. The basicerite is unarmed. The carpopocerite is slender and extends variously in the distal fifth of the second antennular segment and the proximal half of the third segment. The scaphocerite reaches to the second third of second segment; the reduced lamella is sparsely hairy along the anterior margin and reaches variously in the second fourth of second segment.

The first pair of pereopods shows no sexual dimorphism. The large chela is 0.8-1.1 times the carapace length and 2.4-3.1 times as long as high; its characters are closely allied to those in *A. obesomanus*. The merus is 2.4-2.9 times as long as broad; the dorsal margin is truncated; the ventral inner margin is unarmed, sometimes with a gently subtriangular projection distally.

The small chela is 0.5-0.6 times the carapace length and 4.0-4.9 times as long as high, cylindrical and entire. The merus is 3.1-3.7 times as long as broad and unarmed.

The second pereopods are asymmetrical in length, one of them is 1.4 times as long as the other; in the larger one the carpal articles have a ratio, 10:14-16:5:6-7:7, in the smaller they have a ratio, 10:13-14:4-5:5:6-7. The third pereopod is very similar to that of *A. obesomanus*; the merus is 3.1-3.7 times as long as broad.

The telson is also allied to that of *A. obesomanus* and 3.9-5.4 times as long as broad at the posterior margin which is almost truncated; the anterior pair of dorsal spines is situated before the middle and the posterior pair is behind 2/3 of the length. The uropodal endopod is, or is not, armed with several spinules distally.

Material examined.

Southern Japan.—Southern Kyushu: 1 ♂, 1 ovig. ♀, ZLKU No. 11429, Kagoshima Pref., Matsugaura, May 3, 1968, MERS leg.

Ryukyu Archipelago.—Amami Group: 1 ♀, ZLKU No. 11247, Amami-oshima I., Kasari-cho, Suno, fringing reef, interstices of dead coral, July 24, 1968, Y. Miya and T. Fujino leg.; 1 ♀, ZLKU No. 11273, Yoron-jima I., Terasaki, lagoon, interstices in basal part of living coral, July 8, 1968, Y. Miya and T. Fujino leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 11274, Yoron-jima I., Panta, fringing reef, interstices of dead coral, July 10, 1968, Y. Miya and T. Fujino leg.

Colour in life. In the material examined *A. malleodigitus* had the same colouration as in *A. obesomanus*.

Ecology. *A. malleodigitus* was found generally living in the same micro-habitats as noted in *A. obesomanus*. In the material examined there were two cases that shrimps of the two species were found in the same coral heads. According to Banner and Banner (1966b), those species and also *A. microstylus* were found living in the same head of coral, and they noted that "differences in micro-habitats were not detected."

Remarks. *A. malleodigitus* was also adequately described and discussed by Banner and Banner (1966a, b), who considered that *A. malleodigitus gracilicarpus*, *A. phrygianus* and *A. persicus* should be placed in this synonymy. Nothing of importance can be added to the description of this species through the present study.

Distribution. The species has been recorded from scattered localities between Madagascar and Society Islands under several names. *A. malleodigitus* is known from: Phuket I. (Banner and Banner, 1966b); Gulf of Thailand (Banner and Banner, 1966b); scattered localities in Malay Archipelago (De Man, 1902, 1911); Marshall Is. (Banner and Banner, 1968); Fiji (type locality, Bate, 1888; Banner and Banner, 1966a);

Tonga (Banner and Banner, 1966a); Samoa (Banner and Banner, 1966a); Phoenix Is. (Banner and Banner, 1964); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967). *Alpheus malleodigitus gracilicarpus* is taken from type localities: South of Saleyer in Flores Sea; Sulu Archipelago; and Timor Sea (De Man, 1911). *A. phrygianus* is obtained from: Madagascar (Coutière, 1905); Tague I. (Coutière, 1905); Amirante (Coutière, 1921); Providence (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Is. (Coutière, 1905); Mariana Archipelago (Banner, 1956); Line Is. (Banner, 1959); Samoa (Armstrong, 1941). *A. persicus* occurs only from the Persian Gulf (Nobili, 1905).

Crinitus group s.s.

Crinitus group Coutière, 1899: 351 (part, definition).

Crinitus subgroup Coutière, 1905; 884 (definition).—De Man, 1911: 307 (definition); 314 (key to the Indopacific species).

Crinitus group s.s. Banner and Banner, 1966b: 106 (definition).

Definition. See p. 106.

Remarks. Most of the species of the group are known usually living in crevices and holes of dead fronds of coral or of coral rocks, and found sometimes living associated with sponges and other animals. Like *A. frontalis*, some are known as constructing tubes of fine and threadlike algae.

The following seven species except *A. crinitus* are represented in the material examined. The last five species are recorded here for the first time from this region.

Key to the species of Japanese Crinitus group

1. 1st carpal article of 2nd pereiopod markedly longer than 2nd article..... 2
 1st carpal article of 2nd pereiopod markedly shorter than 2nd article 3
2. Each merus of 3rd and 4th pereiopods with strong distal tooth ventrally..... *pachychirus*
 Each merus of 3rd and 4th pereiopod unarmed *frontalis*
3. Basicerite with ventral tooth 4
 Basicerite without tooth 5
4. Dactyli of 3rd-5th pereiopods simple. Posterior margin of 6th abdominal segment entire *crinitus*
 Dactyli of 3rd-5th pereiopods biunguiculate. Posterior margin of 6th abdominal segment with some blunt teeth..... *paralcione*
5. Lamella of scaphocerite well developed..... 6
 Lamella of scaphocerite reduced 7
6. Dactyli of 3rd-5th pereiopods simple. Carpus of 3rd pereiopod without movable spines; merus with strong distal tooth only. Merus of 4th pereiopod with distal tooth..... *bucephalus*

- Dactyli of 3rd-5th pereopods biunguiculate. Carpus of 3rd pereopod with movable spines; merus with movable spines besides strong distal tooth. Merus of 4th pereopod without distal tooth *alcyone*
7. Scaphocerite with elongated lamella and slender lateral spine. In small chela of both sexes fingers styliform and longer than palm *eulimene*
- Scaphocerite with rudimental lamella and strong lateral spine. In small chela of both sexes fingers heavy and markedly shorter than palm *spongiarum*

Alpheus pachychirus Stimpson, 1860

(New Japanese name: Midori amime teppo ebi)

(Plate 23, figs. A-C)

Alpheus pachychirus Stimpson, 1860 : 99 (30).—Ortmann, 1890 : 489, pl. 36, fig. 17 a, k.—Borradaile, 1898 : 1013.—De Man, 1902 : 875; 1911 : 366; 1915 : pl. 16, fig. 77.—Coutière, 1905 : 899; 1921 : 425.—Tattersall, 1921 : 380.—Banner, 1956 : 356; 1957 : 203; 1958 : 167.—Banner and Banner, 1966a : 176; 1967 : 275; 1968 : 283.

Nec. Alpheus pachychirus [= *A. frontalis*]: Cowles, 1913 : 121.—Nakazawa, 1927 : 1017, fig. 1957.

Description. The animals are medium, measuring 11.0-22.9 mm in body length (3.9-7.2 mm in c.l.). The front is slightly produced as a flat projection with the rather truncated anterior margin and has the short spiniform rostrum. The rostral carina is short and rather distinct. The orbital hoods are inflated.

The antennular peduncle is robust, the second segment is 1.7-2.5 times as long as broad; the ratio of 3 segments is 0.4-0.8 : 1.0 : 0.7-0.9. The stylocerite is sharply pointed and reaches near the end of first segment. The basicerite has a short sharp, ventral tooth. The carpuite is stout and markedly exceeds the end of antennular peduncle. The scaphocerite has the broad lamella reaching the middle of third antennular segment.

The large chela is 1.3-1.9 times the carapace length in the male and 1.0-1.2 times in the female; it is entire, compressed and 2.1-2.7 times as long as high. The merus is 1.5-1.8 times as long as high in the male and 1.8-2.1 times in the female; the dorsal margin is almost truncated distally, the ventral inner margin ends in a triangular projection.

The small chela shows the sexual dimorphism. That of the male is 0.7-1.0 times as long as carapace and closely allied to that of the male of *A. frontalis*, but is not so compressed as in the latter and projects as a large, blunt process at the inner dorsal corner of palm. That of the female is 0.4-0.5 times as long as carapace, slender and flattened on the inner surface. The merus of the male is 1.4-1.7 times as long as high and has the same characters as in that of the large cheliped; that of

the female is elongated, 2.4-2.5 times as long as high, and unarmed on the ventral inner margin.

In the second pereopod the carpal articles have a ratio, 10 : 5-7 : 3-4 : 3-4 : 5-6. The dactylus of third pereopod is simple and slender. The ventral margin of carpus is unarmed and sharply pointed distally. The merus is 3.4-4.0 times as long as broad and bears a strong triangular tooth ventrally. In the following 2 pereopods the merus of the fourth has a blunt, short tooth ventrally and that of the fifth is unarmed.

The telson is 2.9-4.3 times as long as broad at the posterior margin; the dorsal surface is flattened, the anterior pair of dorsal spines is situated on 2/5 of the length and the posterior pair is on 2/3 of it. The uropodal endopod is armed with 7 to 9 spinules distally.

Material examined.

Ryukyu Archipelago.—Amami Group: 2 ♂♂, 1 ovig. ♀, ZLKU No. 3092, Amami-oshima I., Kasari-cho, Suno coral reef, Aug. 5, 1964, K. Baba leg.; 1 ♂, ZLKU No. 3142, Amami-oshima I., Kasari-cho, Suno coral reef, July 29, 1965, K. Baba leg.; 1 ♂, ZLKU No. 3143, Amami-oshima I., Kasari-cho, Suno coral reef, Aug. 1, 1965, K. Baba leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 10981, Amami-oshima I., Kasari-cho, Yo coral reef, Aug. 4, 1967, Y. Ushio leg.; 1 ovig. ♀, ZLKU No. 10983, Kikai-jima I., Wan, Aug. 7, 1967, Y. Ushio leg.; 6 ♂♂, 3 ovig. ♀♀, 2 ♀♀, Yoron-jima I., Udonhama, Aug. 10 and 15, 1967, Y. Ushio leg.; 4 ♂♂, 2 ovig. ♀♀, ZLKU No. 11259, Yoron-jima I., Terasaki, lagoon, a couple (♂, c.l. 6.4 mm, ovig. ♀, c.l. 5.5 mm) found living in an algal tube, July 13, 1968, Y. Miya and T. Fujino leg.; 2 ♂♂, 1 ovig. ♀, ZLKU No. 11264, Yoron-jima I., Terasaki, lagoon, found living in crevices in dead *Pocillopora damicornis* (Linnaeus), July 14, 1968, Y. Miya and T. Fujino leg.—Okinawa Group: 2 ♂♂, 2 ovig. ♀♀ (2 couples living in algal tubes), ZLKU No. 17359, Okinawa-jima I., Gushichan, July 3, 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 3 ♂♂, 1 ovig. ♀, 1 ♀, ZLKU No. 17363, Okinawa-jima I., Gushichan, July 3, 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 2 ovig. ♀♀, ZLKU No. 17368, Okinawa-jima I., Baten, July 1962, S. Miyake, T. A. Uchida and H. Minei leg.—Yaéyama Group: 1 ♂, AMBL, Ishigaki-jima I., Kabira, July 27, 1969, T. Kikuchi leg.; 1 ♂, 2 ovig. ♀♀, ZLKU No. 17370, Taketomi-jima I., July 13 and 15, 1971, Y. Koyama leg.

Micronesia.—Caroline Islands: 2 ♂♂, 1 ovig. ♀, ZLKU No. 17372, Ifaluk I., Rawau, lagoon, Nov. 28, 1965, T. A. Uchida leg.; 3 ♂♂, 4 ovig. ♀♀, ZLKU No. 2495, Palau Is. Goréor I., S. W. Madalai, found in *Seriatopora*, "colour in life deep greenish brown," Apr. 14, 1939, S. Miyake leg.

Colour in life. Shrimps are entirely patterned with a greenish brown network on the transparent ground. Eggs freshly laid are green.

Ecology. The species is one of the commonest inhabitants of coral reefs in the Ryukyu Archipelago and seems essentially living in crevices in dead or overgrown corals, e.g., *Pocillopora damicornis* (Linnaeus), and *Seriatopora* spp., in the lagoon.

Like *A. frontalis*, this species is sometimes found living in pairs in algal tubes penetrating between fronds of dead or overgrown corals. In the present material

three pairs of shrimps (ZLKU No. 11259 and others) were collected doing this manner of life.

Distribution. *Alpheus pachychirus* is a widely distributed species occurring in the Indo-West Pacific region, but is not yet recorded from the Hawaiian Archipelago. From coral reef flat down to 36 m deep.

It is known from: Red Sea (Tattersal, 1921); Coetivy Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Is. (Coutière, 1905); Laccadive Is. (Coutière, 1905); Paternoster Is. (De Man, 1911); Talaud Archipelago (De Man, 1911); Ternate (De Man, 1902); Ryukyu Archipelago (type locality, Stimpson, 1860); Kagoshima, southern Japan (Ortmann, 1890); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1956; Banner and Banner, 1968); Gilbert Is. (Banner, 1958); Tahiti (Ortmann, 1890); Fiji (Banner and Banner, 1966a); Samoa (Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); Cook Is. (Banner and Banner, 1967); and Society Is. (Banner and Banner, 1967).

Alpheus frontalis H. Milne Edwards, 1837

(Japanese name: Tsunonashi teppo ebi)

(Plate 23, figs. D-G)

- Alpheus frontalis* H. Milne Edwards, 1837: *Hist. Nat. Crust.*, 2: 356 (not seen).—Haswell, 1882: 188.—Ortmann, 1890: 489; 1894: 15.—Henderson, 1893: 436.—Borradaile, 1898: 1012.—Coutière, 1900: 414; 1905: 899; 1921: 425.—De Man, 1911: 369; 1915: pl. 17, fig. 79.—Banner, 1956: 357; 1957: 203; 1959: 141.—Banner and Banner, 1966a: 175; 1968: 286.—Holthuis, 1958: 24.—Fishelson, 1966: 98, figs. 1-3 (habitat and behaviour).
- Crangon frontalis*: Armstrong, 1941: 10.
- Alpheus latifrons* A. Milne Edwards, 1874: *J. Mus. Godeffroy*, 4: 11 (not seen).—De Man, 1888a: 521, pl. 22, fig. 4; 1897: 758, pl. 36, fig. 37; 1902: 876.
- Betaeus utricola* Richters, 1880: 164, pl. 17, figs. 34-35.
- Alpheus pachychirus*: Cowles, 1913: 121.—Nakazawa, 1927: 1017, fig. 1957.

Description. The animals are large, measuring 27.3-41.2 mm in body length (8.0-16.0 mm in c.l.). The front is rather variable as shown by De Man (1911; 1915); it is truncated, sometimes rather produced anteriorly and provided with a slight median notch or not; there is a short, low but distinct or indistinct dorsal carina. Orbital hoods are strongly produced anterolaterally.

The antennular peduncle is rather slender, the second segment is 2.0-2.8 times as long as broad; the 3 segments have a ratio, 0.4-0.7:1.0:0.6-0.8. The stylocerite is subtriangular and reaches to the middle of first segment by a dull-pointed or rarely sharply pointed apex. The basicerite bears a blunt or sharp, short tooth. The

carpocerite is stout, somewhat exceeding the end of antennular peduncle. The scaphocerite has the broad lamella reaching to the middle of third antennular segment.

The first pair of pereiopods shows the distinct sexual dimorphism. The large chela of the male is 1.5-1.8 times the carapace length and 2.2-3.0 times as long as high; it is slightly compressed, entirely granulated on the inner surface, and densely covered with rather long soft hairs on the inner ventral surface, especially on the immovable finger. The merus is 1.4-1.7 times as long as high, the dorsal margin is truncated distally and turned upward, and the inner ventral margin ends in a subtriangular projection distally. The large chela of the female is 0.9-1.5 times the carapace length and 2.2-2.7 times as long as high. All the segments have the same characters as in those of the male, but are slenderer than those of the male.

The small chela of the male is 0.8-1.3 times the carapace length and 2.4-3.3 times as long as high; it is strongly twisted outward and strongly compressed; the outer (dorsal) surface is slightly convex and smooth, and the inner (ventral) surface is entirely granulated and densely covered with long hairs near the ventral margin; the movable finger is distinctly balaeniceps in shape with fringes of short plumose hairs along the outer and inner margins. The merus is 1.5-2.3 times as long as high; the dorsal margin is truncated and somewhat turned upward distally; the ventral inner margin is rounded distally. The small chela of the female is 0.4-0.6 times the carapace length and 3.3-4.6 times as long as high; it is slender and strongly compressed; the inner surface is flattened and more coarsely granulated than the outer surface; fingers are slender and densely covered with long hairs on the inner surface. The carpus and merus are elongate, the latter is 3.1-3.6 times as long as high, and its dorsal and ventral inner margins are rounded distally.

In the second pereiopod the carpal articles have a ratio, 10 : 4 : 2-3 : 2-3 : 3-4. In the third pereiopod the dactylus is slender and simple. The ventral margin of carpus bears 1 to 4 spinules and sharply pointed distally. The merus is 3.6-4.3 times as long as broad and unarmed.

The telson is 2.8-3.5 times as long as broad at the posterior margin which is rounded; the anterior pair of dorsal spines is situated just behind the middle and the posterior pair is on 3/4 of the length.

Material examined.

Ryukyu Archipelago.—Amami Group; 1 ovig ♀, ZLKU No. 3075, Amami-oshima I., Kasari-cho, Suno coral reef, Aug. 6, 1964, K. Baba leg.; 1 ♂, ZLKU No. 3139, Amami-oshima I., Kasari-cho, Suno coral reef, July 29, 1965, K. Baba leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 3140, Amami-oshima I., Kasari, Suno coral reef, July 29, 1965, K. Baba leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 10939, Yoron-

jima I., Udon-hama, Aug. 15, 1967, Y. Ushio leg.; 1 ♂, 1 ovig. ♀ (a couple), ZLKU No. 11224, Yoron-jima I., Terasaki, coral reef flat, found living in an algal tube, July 7, 1968, Y. Miya and T. Fujino leg.; 1 ♂, 1 ovig. ♀ (a couple), ZLKU No. 11226, Yoron-jima I., Tarasaki, lagoon, found living in an algal tube, July 8, 1968, Y. Miya and T. Fujino leg.; 2 ♂♂, 1 ovig. ♀, 1 ♀, ZLKU No. 11228, Yoron-jima I., Sena, lagoon, found living in algal tubes, July 9, 1968, Y. Miya and T. Fujino leg.; 1 ♂, 1 ovig. ♀ (a couple), ZLKU No. 11231, Yoron-jima I., Ukachi, in tide pool on coral reef flat, found living in an algal tube, July 11, 1968, Y. Miya and T. Fujino leg. —Okinawa Group: 1 ♂, ZLKU No. 17375, Okinawa-jima I., Komesu, July 2, 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 7 ♂♂, 7 ovig. ♀♀ (7 couples), ZLKU No. 17376, Okinawa-jima I., Gushichan, July 3, 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 1 ovig. ♀, ZLKU No. 17390, Okinawa-jima I., Gushichan, found in an algal tube, July 3, 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 2 ♂♂, 1 ovig. ♀, 2 ♀♀, ZLKU No. 17391, Okinawa-jima I., Gushichan, July 3, 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 1 ♂, ZLKU No. 17396, Okinawa-jima I., Baten, July 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 2 ♂♂, 1 ovig. ♀, ZLKU No. 17397, Kume-jima I., O-jima islet, Aug. 31, 1959, H. Minei leg.—Yaéyama Group: 1 ovig. ♀, ZLKU No. 1349, Ishigaki-jima I., July 3-27, 1933, S. Miyake leg.; 2 ♂♂, 1 ovig. ♀, ZLKU No. 17400, Ishigaki-jima I., Miyara, Mar. 26, 1969, H. Minei leg.; 1 ♂, ZLKU No. 17403, Ishigaki-jima I., July 1962, S. Miyake, T. A. Uchida and H. Minei leg.; 1 ♂, 1 ovig. ♀, AMBL, Ishigaki-jima I., Kabira, July 28, 1969, T. Kikuchi leg.

Micronesia.—Caroline Islands: 1 ♂, ZLKU No. 2468, Palau I., Ngadarák Reef, commensal with *Tridacna corocœa*, May 28, 1938, S. Wada leg.

Colour in life. The shrimps collected from the Ryukyu Archipelago are entirely purplish gray faintly tinged with blue and scattered with white minute spots. The third maxillipeds, small chela, pleopods and tail fan have the fringes of yellowish red long bristles. Eggs freshly laid are green.

According to Fishelson's note (1966), his specimens from the Red Sea have "pale transparent bodies, and the only blackish spots are the eyes and the stomach. On both sides along the dorsum, there are two rows of white spots on every tergite."

Ecology. This is one of the commonest species of *Alpheus* collected on the exposed and submerged reef flats of the Ryukyu Archipelago. The shrimps could be found living in pairs in tubes which they made from filamentous blue-green or dark brown algae. These tubes were found branching and penetrating between the fronds of dead corals or attaching to the undersides of the basal part of them. According to Mr. Minei's note and photographs the tubes collected from Gushichan, Okinawa-jima Island were branching, hollow and 100 to 350 mm long and 20-35 mm in diameter. That alga was identified as *Lyngbya confervoides* Agardh and Gomont.

The extensive observations on the habitat and behaviour of this species were previously given by Cowles (1913) under the name of *A. pachychirus* and Fishelson (1966). Some other workers briefly recorded also the interesting manner of life of this species living in felted tubes of *Lyngbya sordida* (Zan.) Gomont (Richters, 1880; De Man, 1911; Banner and Banner, 1968).

According to the specimen label a male (ZLKU No. 2468) was found to be commensal with *Tridacna corocea*. As far as the author knows, it may be a single case doing this manner of life.

Remarks. This widespread and common species is quite constant in its characteristics except for the front, as noted and figured by De Man (1911 : 370; 1915 : fig. 79).

Distribution. This species is widely distributed throughout the greater part of the Indo-West Pacific region, but is not yet recorded from the Hawaiian Archipelago. From the coral reef flat down to 130 m deep.

It has been recorded in the literature from the following localities under the four names. *A. frontalis* is known from: Red Sea (Holthuis, 1958; Fishelson, 1966); Amirante Bank (Coutière, 1921); Seychelles (Coutière, 1921); Coetivy Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Is. (Coutière, 1905); Laccadive Is. (Coutière, 1905); Gulf of Mannar (Henderson, 1893); Paternoster Is. (De Man, 1911); Sumba (De Man, 1911); Sumbawa (De Man, 1911); Sulu Archipelago (De Man, 1911); Kabaena I. (De Man, 1911); Roti (De Man, 1911); Solor I. (De Man, 1911); Binongko I. (De Man, 1911); Timor (De Man, 1911); Talaud Archipelago (De Man, 1911); Kai I. (De Man, 1911); Australia (Haswell, 1882); Torres Strait (Coutière, 1900); Amboina (Ortmann, 1894); Amami-oshima I., Ryukyu Archipelago (Ortmann, 1890); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1957; Banner and Banner, 1968); Ellice Is. (Borradaile, 1898); Fiji (Banner and Banner, 1966a); Samoa (Ortmann, 1890; Armstrong, 1941; Banner and Banner, 1966a); and Tuamotu Archipelago (Banner, 1959). *A. latifrons* is recorded from: Atjeh (De Man, 1897) Java Sea (De Man, 1897); West Celebes (De Man, 1897); Ternate (De Man, 1902); Amboina (De Man, 1888a); Samoa (type locality, A. Milne Edwards, 1874). Under the name *Betaeus utricola* it is known only from Mauritius (Richters, 1880). Further, the specimens reported as *A. pachy-chirus* from Mindoro (Cowles, 1913) and Japan (Nakazawa, 1927) belong to this species.

Alpheus crinitus Dana, 1852

Alpheus crinitus Dana, 1852a : 21; 1852b : 548, pl. 34, fig. 8.—Bate, 1888 : 548, pl. 98, fig. 2.—Ortmann, 1890 : 479.—Zehntner, 1894 : 206.—De Man, 1911 : 357.—Balss, 1914 : 38.
Nec. *Alpheus crinitus*: Coutière, 1899 : 226, fig. 273 [= *A. bucephalus*].

Diagnosis. Beak [rostrum] acute, prolonged into a carina between the eyes. Basal scale [scaphocerite] of outer antennae hardly shorter than base [carpocerite], somewhat shorter than base of inner antennae [antennular peduncle]; second joint of

inner antennae twice as long as first; basal tooth [stylocerite] of inner very short. Anterior feet very unequal; larger hand obese, sparingly compressed, rounded below, wholly smooth, in part light pubescent, fingers very short (one-fourth as long as hand), movable finger arcuate; smaller hand oblong, light crinite, fingers little shorter than part of hand preceding fingers. Feet of second pair very long, one and a half times as long as third pair, second joint of carpus a little longer than first, third, fourth, fifth each oblong, nearly equal; feet of third and fourth pairs light crinite, third joint [merus] having a tooth at lower apex. (Dana, 1852b).

Remarks. As the author has seen no specimens of *A. crinitus* in the present material, the diagnosis is given from the original description.

Distribution. The species is originally described from Balabac Straits (Dana, 1852a), otherwise known only from Amboina (Zehntner, 1894); Philippine Is. (Bate, 1888); Kagoshima, southern Japan (Ortmann, 1890); and Samoa (Ortmann, 1890).

Alpheus paralcione Coutière, 1905

(New Japanese name: Yadori teppo ebi)

(Plate 24)

Alpheus paralcione Coutière, 1905: 895, pls. 80-81, fig. 34.—Pearson, 1905: 85.—De Man, 1911: pl. 15, fig. 73.—Johnson, 1961: 52.—Banner and Banner, 1966a: 178; 1966b: 108, fig. 37; 1967: 275; 1968: 284.

Crangon paralcione: Banner, 1953: 99, fig. 34.

Crangon laysani Edmondson, 1925: 17, fig. 3.

Crangon bucephalus: Edmondson, 1925: 14 (part).

Description. The animals are medium, measuring 11.8-19.1 mm in body length (3.0-7.0 mm in c.l.). The rostrum is short and triangular, its blunt apex slightly turns upward and reaches to the middle of first antennular segment; the dorsal carina is low but distinct, running backward beyond the base of orbital hoods. The orbital hoods are inflated and depressed anteriorly as a flattened broad shelf between the rostral base and the anterior portion of orbital hoods; the frontal margin of this area is gradually rounded.

The antennular peduncle is robust, the second segment is 1.5-1.8 times as long as broad; the 3 segments have a ratio, 0.5-0.7 : 1.0 : 0.7-0.9. The stylocerite is small and dull pointed, reaching near the end of first segment. The basicerite bears a sharp lateral tooth of varying size, usually quite small. The carpocerite is elongated,

clearly exceeding the end of antennular peduncle by the length of third antennular segment. The scaphocerite is strongly concave laterally; its strong lateral spine extends to or beyond the end of carapocerite; its lamella tapers and reaches to the middle of third antennular segment.

The large chela is, in the male, 1.1-1.4 times the carapace length and 2.2-2.3 times as long as high and is, in the female, equal to the carapace length and 2.4-2.5 times as long as high; it is subcylindrical, tapering, and entire. The merus is 1.8-2.7 times as long as high, its dorsal margin is acutely pointed distally and its ventral inner margin ends in a strong triangular tooth. The ventral outer margin of ischium is slightly angled distally.

The small chela is 0.6-0.7 times as long as the carapace and 3.4-3.5 times as long as high in the male, and 0.5-0.6 times the carapace length and 3.6-3.7 times as long as high in the female. It is subtriangular in cross section and more or less hairy; the fingers of the male are slightly broader than those of female. The merus is 1.9-2.6 times as long as high, its armatures are similar to those in that of the large cheliped but small in size. The ventral outer margin of ischium is clearly angled distally.

In the second pereopod the carpal articles have a ratio, 10 : 18-22 : 5 : 5-6 : 8-10. The dactylus of third pereopod is slender, strongly curved and biunguiculate with the small but distinct ventral unguis. The ventral margin of carpus has 3 to 6 spines and ends in a sharp tooth distally. The merus is 3.6-4.5 times as long as broad, its ventral outer margin bears a strong subterminal tooth and its ventral inner margin is unarmed. The fourth pereopod has the same armatures as in the third, but they are smaller in size. In the fifth pereopod the propodus has the usual brushes, the ventral margins of carpus and merus are truncated distally.

In the male the pleura of first abdominal segment are produced as a dull-pointed dentiform process posteriorly, and in the female they are rounded posteriorly. The posterior margin of tergum of the sixth segment is armed with 2 to 7 teeth varying in size and form. The uropodal endopod bears 7-11 spinules distally. The telson tapers, being 2.0-3.3 times as long as broad at the posterior margin; this margin is slightly arcuate and bears several spinules besides the usual paired spines; the dorsal surface is broadly concave on the middle, the anterior pair of dorsal spines is situated on the proximal fourth or third of the length and the posterior pair is before 2/3 of the length.

Variations. In the present specimens, although they are small in number, the wide variation is found in the armature of the posterior margin of tergum of the

sixth abdominal segment. The number of teeth varies from two to seven, and their size and placement are also variable as shown in the figures. But there is no such specimen of no tooth as noted by Banner (1953) in his Hawaiian specimens.

Material examined.

Southern Japan.—Sagami Bay: 1 ♂, BLIH Sp. No. 2363, Amadaiba, between Kannonzuka and Maruyamadashi, 67-74 m deep, June 22, 1965; 1 ovig. ♀, BLIH Sp. No. 2364, off Sajima, Kasagone, 12.6-14.4 m deep, June 22, 1965.—Kii Peninsula: 1 ovig. ♀, SMBL, Tanabe Bay, Engetsu-jima, tide pool, associated with *Dendronephthya gigantia*, Aug. 6, 1967, Y. Miya leg; 1 ♂, 1 ovig ♀, SMBL, Tanabe Bay, To-shima, under low tide mark, in canals of a yellow sponge, *Halichondria* sp., enclosing a stinging polyp, *Stephanoscyphus racemosus* Komai, Aug. 6, 1967, Y. Miya leg.—West coast of Kyushu: 1 ovig. ♀, ZLKU No. 1933, Amakusa, Tomioka, near Uki-todai (Messone), 30-50 m deep, Oct. 20, 1958, T. Habe, Y. Ono and T. Kikuchi leg.; 1 ♂, AMBL, Amakusa, Tomioka, collected by lobster trammel-net, 36 m deep, living in a canal of a sponge, *Myxilla setoensis* Tanita, Sept. 7, 1966, A. Taki leg.; 1 ovig. ♀, AMBL, Amakusa, Tomioka, off Shiki, gravelly bottom, 7 m deep, from sponge, Aug. 9, 1967, A. Taki leg.

Colour in life. The living animals found in sponges are transparent and yellow or yellow-brown, scattered with red chromatophores uniformly.

Ecology. Several specimens in hand were found living in canals of sponges, e.g. *Halichondria* sp., *Myxilla setoensis* and others under the low tide mark.

According to the previous authors, Banner (1953), Johnson (1961), Banner and Banner (1963, 1966a), this species appears to be associated with living sponges and corals. It is a common offshore form.

Distribution. The species is widely distributed in the Indo-West Pacific region, ranging from the Maldive Islands eastward to the Hawaiian Archipelago.

Under the name of *A. paralcione* it is recorded from Maldive Is. (type locality, Coutière, 1905); Ceylon (Pearson, 1905); Singapore (Johnson, 1961; Banner and Banner, 1966b); Gulf of Thailand (Banner and Banner, 1966b); Borneo Bank (De Man, 1911); Lombok (De Man, 1911); Postiljon Is. (De Man, 1911); Sape Strait (De Man, 1911); West coast of Flores (De Man, 1911); North Ubian (De Man, 1911); Saleyer (De Man, 1911); Solor Strait (De Man, 1911); Samau I. (De Man, 1911); Timor (De Man, 1911); between Misool and New Guinea (De Man, 1911); Marshall Is. (Banner and Banner, 1968); Fiji (Banner and Banner, 1966a); Samoa (Banner and Banner, 1966a); Cook Is. (Banner and Banner, 1967); and Hawaiian Archipelago (Banner, 1953). It is known only from the Hawaiian Archipelago under the name of *Crangon laysani* and some specimens from the same locality are referred to *C. bucephalus* by Edmondson, 1925.

Alpheus bucephalus Coutière, 1905

(Plate 25)

Alpheus crinitus: Coutière, 1899 : 226, fig. 273.

Alpheus bucephalus Coutière, 1905 : 890, pl. 78, fig. 29; 1921 : 423.—Banner, 1956 : 355; 1957 : 201.

—Banner and Banner, 1964 : 91; 1966a : 176; 1966b : 110, fig. 38; 1968 : 283.

Crangon bucephalus: Edmondson, 1925 : 14 (part).

Alpheus consobrinus De Man, 1908 : 101; 1911 : 360; 1915 : pl. 16, fig. 75.—Tattersall, 1921 : 880.

Description. The animals are medium, measuring 9.9–13.7 mm in body length (3.2–5.0 mm in c.l.). The rostrum is spiniform and reaches to the distal half of first antennular segment; the sharp, high rostral carina runs backward to the base of orbital hoods, and is laterally separated from the orbital hoods by the broad, rather deep orbitorostral grooves. Orbital hoods are strongly inflated, with their anterior margins more or less projecting as a flat shelf.

The antennular peduncle is robust, the second segment is 1.7–2.0 times as long as broad; the 3 segments have a ratio, 0.5–0.8 : 1.0 : 0.6–0.8. The stylocerite is spiniform and faintly exceeds the rostral apex. The basicerite is unarmed. The carpocerite is slender and reaches beyond the end of antennular peduncle. The scaphocerite is strongly concave laterally and ends in a strong lateral spine extending to or almost to the end of carpocerite; the narrow lamella generally reaches to the distal half of third antennular segment.

The large chela is, in both sexes, 0.8–1.3 times as long as the carapace and 1.9–2.4 times as long as high; it is entire, slightly compressed and tapering. The merus is 1.5–1.6 times as long as broad in the male and 1.5–2.4 times in the female; the dorsal margin ends in a blunt top; the proximal half of ventral outer margin has some minute serrations, and the ventral inner margin bears a large triangular tooth or rarely rounded distally. The ventral outer margin of ischium projects as a sharp or dull-pointed process distally.

The small chela is 0.5–0.6 times the carapace length and 2.7–4.1 times as long as high in both sexes, triangular in cross section, tapering, and is rather hairy on the inner surface; in the male the movable finger is slightly broader than in the female, its inner margin is fringed with a row of short bristles or not. The merus is 1.8–2.1 times as long as broad; the dorsal margin is slightly produced distally; the ventral inner margin is unarmed distally. The ventral outer margin of ischium ends in a small sharp or dull-pointed process distally.

In the second pereopod the carpal articles have a ratio, 10 : 16–24 : 4–6 : 4–6 : 7–10. In the third pereopod the dactylus is simple, slender and curved. The ventral margin of carpus ends in a sharp tooth. The merus is 3.0–4.0 times as long as broad and

bears a strong terminal tooth. The fourth pereopod has the same characters as in the third. In the fifth the ventral margin of carpus and merus is truncated distally. In both sexes the pleura of all the abdominal segments are rounded posteriorly. The uropodal endopod bears 9 to 12 spinules along the distal margin. The telson slightly tapers and is 2.5-2.8 times as long as broad at the posterior margin which is gently rounded; the dorsal surface is broadly excavated on the middle; the anterior pair of dorsal spines is situated on 1/3 of the length, and the posterior is behind the middle.

Variations. According to Banner (1957) and Banner and Banner (1966b), the considerable variations were found in the following respects: The armature of basicerite; the meral tooth of large cheliped; the movable finger of small chela; and the ratio in the carpal articles of second pereopod. In their discussion (1966b), however, they said that no great importance should be placed on those points.

In the present specimens, although small in number, the author observed the similar variation in the above respects except for the first. Further, a considerable variation was found in the frontal part of carapace as follows: Generally the rostrum is sharp and rather long and has the distinct, high dorsal carina, but rarely is very short, with the indistinct, low carina as found in a male (ZLKU No. 11276). The frontal shelf-like projection is individually variable in shape. It varies from markedly projecting and rounded to slight and almost truncated.

Material examined.

Southern Japan.—Tosa Bay: 1 ♂, ZLKU No. 2159, Tosa-shimizu, coral reef, 5.4-9 m deep, August 1960, Kurohara leg.

Ryukyu Archipelago.—Amami Group: 1 ovig. ♀, ZLKU No. 10935, Yoron-jima I., Udon-hama, Aug. 10, 1967, Y. Ushio leg.; 1 ♂, ZLKU No. 10936, Yoron-jima I., Hanibu reef, Aug. 13, 1967, Y. Ushio leg.; 1 ♂, ZLKU No. 10994, Yoron-jima I., Udon-hama, Aug. 10, 1967, Y. Ushio leg.; 1 ♂, ZLKU No. 10999, Yoron-jima I., Hanibu reef, Aug. 13, 1967, Y. Ushio leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 11194, Yoron-jima I., Ukachi, lagoon side, from a hole in base of living coral, July 11, 1968, Y. Miya and T. Fujino leg.; 1 ♂, ZLKU No. 11276, Yoron-jima I., Sena, outer reef flat, July 9, 1968, Y. Miya and T. Fujino leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 11257, Yoron-jima I., Hakebina, from a hole in base of coral, July 12, 1968, Y. Miya and T. Fujino leg.—Yaéyama Group: 1 ♀, ZLKU No. 11400, Taketomi-jima I., July 1967, MERS leg.

Micronesia.—Caroline Islands: 1 ♂, ZLKU No. 1389, Palau Is. Ngaianges I., (134°23'E, 7°12'25"N.), July 16, 1939, S. Miyake leg.

Colour in life. The shrimp is transparent and patterned with a greenish brown network like the colour pattern in *A. pachychirus*, on the posterior halves of abdominal segments. Eggs freshly laid are green.

Ecology. The shrimps were found living among the interstices of dead bases

and living branches of corals on the intertidal zone of the barrier reef and lagoon reef.

Remarks. The excellent discussions of the variation and synonymy of the species were prepared by Banner (1957) and Banner and Banner (1966b).

Distribution. The species has been recorded throughout the Indo-West Pacific region from the Red Sea and East coast of Africa eastward to the Hawaiian Archipelago and southward to the Tonga Islands. From the intertidal zone down to 36 m deep.

Alpheus bucephalus is known from: Djibouti (Coutière, 1905); Fernando Veloso (Maaja) (Coutière, 1905); Amirante Bank (Coutière, 1921); Coetivy Is. (Coutière, 1921); Mahé I. (Coutière, 1905); Cap I. (Coutière, 1905); Providence Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Is. (type locality, Coutière, 1905); Laccadive Is. (type locality, Coutière, 1905); Gulf of Thailand (Banner and Banner, 1966b); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1957; Banner and Banner, 1968); Phoenix Is. (Banner and Banner, 1964); Fiji (Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); Samoa (Banner and Banner, 1966a); and Hawaiian Archipelago (Edmondson, 1925). *Alpheus consobrinus* is recorded from: Red Sea (Tattersal, 1921); and the type localities scattered in the Malay Archipelago (Borneo Bank; Paternoster I.; Saleyer I.; Kwandang Bay; Sulu Archipelago; and Siau I. De Man, 1908).

Alpheus alcyone De Man, 1902

(Plate 26)

Alpheus alcyone De Man, 1902: 870, pl. 27, fig. 61; 1911: 351.—Tattersall, 1921: 379.—Banner, 1957: 198.—Holthuis, 1958: 23.—Banner and Banner, 1966a: 176; 1966b: 107, fig. 36; 1968: 284.

Crangon alcyone: Armstrong, 1941: 10.

Alpheus aculeipes Coutière, 1905: 892, pl. 79, fig. 31; 1921: 423.

Description. Present specimens are small, measuring 8.4-8.9 mm in body length (3.1-3.2 mm in c.l.). The rostrum is very small, extending slightly beyond the anterior margin of orbital hoods; the rostral carina is low but distinct and extends backward beyond the base of hoods. The orbital hoods are strongly inflated and abruptly depressed anteriorly; the orbitorostral grooves are narrow and ill defined; the frontal margin is slightly curved sinuously.

The antennular peduncle is rather robust, the second segment is 1.6 times as long as broad; the 3 segments have a ratio, 0.4-0.6 : 1.0 : 0.6. The stylocerite is very small and pointed and reaches near the middle of first segment. The basicerite is unarmed. The carpopocerite is slender and extends markedly beyond the end of antennular peduncle. The scaphocerite reaches forward as far as the end of antennular peduncle by the strong lateral spine; the lamella is narrow and reaches beyond the end of second antennular segment.

The large chela is 1.1-1.4 times the carapace length and 2.1-2.3 times as long as high, almost cylindrical, swollen and entire. The merus is 1.6-1.9 times as long as broad; its dorsal margin ends in a strong process distally; its ventral inner margin is produced as a strong tooth distally.

The small chela is 0.6 times as long as the carapace, 3.6-4.0 times as long as high and cylindrical, tapering with slender fingers. The merus is 2.7-2.8 times as long as broad; its dorsal margin is somewhat pointed or truncated distally; its ventral inner margin bears a small tooth distally or not.

In the second pereopod carpal articles have a ratio, 10 : 27-35 : 6-8 : 6-8 : 11-12. In the third pereopod the dactylus is very slender, curved and biunguiculate with a minute ventral unguis. The ventral margin of carpus is armed with 1 or 2 spinules and sharply pointed apically. The merus is 4.1-4.5 times as long as broad; the ventral outer margin is hairy and provided with a sharp subterminal tooth; along the ventral inner margin there are 5-14 spinules, In the last two pereopods the carpus and merus are unarmed.

In the male the pleuron of first abdominal segment is produced as a subtriangular process posteriorly, and the pleura of second four segments are rounded posteriorly. The posterior margin of tergum of the sixth segment is entire. The uropodal endopod bears 5-7 spinules distally. The telson tapers and is 3.2-3.5 times as long as broad at the posterior margin which is rounded; the anterior pair of dorsal spines is situated on 1/3 of the length and the posterior pair is behind the middle.

Variations. As Banner and Banner (1966a) noted, when the author examined the present specimens, the ventral unguis of dactylus of the third pereopod is found to show a considerable variation in size. In one of them (ZLKU No. 10934) that unguis is so slight as to make only a minute notch.

Material examined.

Southern Japan.—Kii Peninsula: 1 ♂, Coll. TUF, Tanabe Bay, Seto, associated with a stinging polyp, *Stephanoscyphus racemosus* Komai, Aug. 16, 1953, H. Utinomi leg.

Ryukyu Archipelago.—Amami Group: 1 ♂, ZLKU No. 10934, Amami-oshima I., Kyono-ura,

Aug. 3, 1967, Y. Ushio leg.; 1 ♂, ZLKU No. 11191, Yoron-jima I., Hakebina, fringing reef, living in a yellow sponge among dead coral, July 12, 1968, Y. Miya and T. Fujino leg.

Colour in life. Unknown.

Ecology. The species was collected from the dead or living corals on the outer reef or in the lagoon or in the intertidal potholes, and found sometimes living in the large canals of sponges. One of the present specimens (Coll. TUF), together with a specimen of *Synalpheus modestus* De Man, was found living in association with a stinging polyp, *Stephanoscyphus racemosus* Kamai.

Distribution. In the Indo-West Pacific region the species has been recorded from scattered localities between the Red Sea to Samoa under the two names.

A. alcyone is taken from: Red Sea (Tattersall, 1921; Holthuis, 1958); Phuket (Banner and Banner, 1966b); Singapore (Banner and Banner, 1966b); Postillon Is. (De Man, 1911); off North Ubian (De Man, 1911); Rotti I., (De Man, 1911); Timor (De Man, 1911); Ternate (type locality, De Man, 1902); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1957; Banner and Banner, 1968); Fiji (Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); and Samoa (Armstrong, 1941; Banner and Banner, 1966a). *A. aculeipes* is known from: Djibouti (Coutière, 1905); Fernando-Veloso (Maaja) (Coutière, 1905); Amirante Bank (Coutière, 1921); Seychelles (Coutière, 1921); Coetivy Is. (Coutière, 1921); Saya de Malha Bank (Coutière, 1921); Chagos Archipelago (Coutière, 1921); and Maldive Is. (type locality, Coutière, 1905).

Alpheus eulimene De Man, 1909
(New Japanese name: Fukure teppo ebi)

(Plate 27)

Alpheus eulimene De Man, 1909: 101; 1911: 364; 1915: pl. 16, fig. 76.—Banner, 1956: 356.

Description. The animals are small, measuring 4.7–10.8 mm in body length (1.8–3.5 mm in c.l.). The rostrum is triangular, with the low but distinct dorsal carina running backward to the anterior third of carapace; the rostral apex reaches to the middle of first antennular segment. The orbital hoods are separated from the rostral carina by the shallow orbitorostral grooves, rather inflated and project anteriorly as a flat shelf-like projection which is truncated anteriorly.

The antennular peduncle is robust, the second segment is 1.6–2.0 times as long as broad; the 3 segments have a ratio, 0.8:1.0:0.6–0.8. The stylocerite exceeds the

rostral apex by the pointed apex. The basicerite is unarmed. The carpoperite is slender, exceeding slightly the end of antennular peduncle. The scaphocerite is strongly concave laterally and extends beyond the middle of third antennular segment by the sharp lateral tooth; the lamella is narrow and reaches to $2/3$ of the second segment.

The large chela is 0.8–0.9 times the carapace length and 2.1–2.3 times as long as high in both sexes; it is almost cylindrical and tapering; the movable finger is strongly compressed. The merus is 2.0–2.4 times as long as high; the dorsal margin ends in a sharp process distally; the ventral inner margin has the sharp distal tooth. The ventral outer margin of ischium is rounded distally.

The small chela is 0.6 times the carapace length and 3.2–3.3 times as long as high, showing no sexual dimorphism; both fingers are rather broad and somewhat longer than the palm, which is 1.5 times as long as high, markedly swollen proximally and tapering. The merus is 2.6–2.7 times as long as high and has the same armatures as in the merus of large cheliped.

In the second pereopod the ratio of the carpal articles is 10 : 16 : 4–5 : 4–5 : 8–10. In the third pereopod the dactylus is slender and curved, bearing a very small ventral unguis near the apex. The ventral margin of carpus is pointed distally or not. The merus is 4.5–5.0 times as long as broad and bears a sharp slender distal tooth. In the fourth pereopod the ventral outer margin of merus is unarmed but slightly angled distally. The carpus and merus of the fifth are truncated distally.

In the male the pleuron of first abdominal segment has a pointed triangular process posteriorly, but in the female it is rounded posteriorly as well as in the following segments. The posterior margin of tergum of the sixth segment is unarmed. The uropodal endopod bears few spinules along the distal margin. The telson is slender and strongly tapering, being 3.8–5.0 times as long as broad at the posterior margin. The anterior pair of dorsal spines is situated on $1/3$ of the length and the posterior is on $2/3$ of it.

Material examined.

Ryukyu Archipelago.—Amami Group; 1 ♂, 1 ovig. ♀, ZLKU No. 11222, Yoron-jima I., Terasaki, lagoon, a hole of dead base of *Pocillopora damicornis* (Linnaeus), July 14, 1968, Y. Miya and T. Fujino leg.

Colour in life. Unknown.

Ecology. The species seems to be a rare shrimp and has been collected in depths to 83 m.

Remarks. The present specimens are closely allied to De Man's description and

figures (1911, 1915) except for the following respects: 1. Each dactylus of the last three pereopods having a ventral unguis which is as slight as to be visible only under a high power of the microscope. In the specimens from Saipan Banner (1956) observed "a rounded thickening" in the same part of the dactylus. 2. The ventral outer margin of merus of the fourth pereopod appears slightly angled distally. According to De Man's and Banner's works, one of the differences between *A. eulimene* and *A. styliceps* Coutière, 1905 is the armature of this segment, i.e. in the former it is unarmed, while in the latter is armed with a tooth which is found "d'un cote seulement sur le type" by Coutière (1905, p. 890). In this respect the present specimens lie in an intermediate position. Thus, the armature cannot be applied as a reliable feature for the distinction of the two species.

The separation of the two species appears very doubtful as noted by Banner (1956), but in the present state it may be advisable to separate them by the form of the frontal part of carapace and the proportion in the third pereopod.

Distribution. The species is known at present only from off North coast of Waigeo Island (type locality, De Man, 1909) and the Mariana Archipelago (Banner, 1956).

Alpheus spongiarum Coutière, 1897
(New Japanese name: Kaimen teppo ebi)

(Plate 28)

Alpheus spongiarum Coutière, 1897b : 236; 1899 : 147, fig. 141; 1900 : 413; 1905 : 895, pl. 80, fig. 33.
—De Man, 1911 : 362.—Johnson, 1961 : 52.
Alpheus paraculcipes Coutière, 1905 : 894, pls. 79-80, fig. 32.—Pearson, 1905 : 84.—De Man, 1911 : 356.

Description. The animals are medium, measuring 8.6-20.6 mm in body length (3.0-7.5 mm in c.l.). The rostrum is triangular, with a distinct or indistinct low dorsal carina running backward beyond the base of orbital hoods, the dull-pointed rostral apex reaches to the middle third of first antennular segment. The orbital hoods are rather inflated and project anteriorly as a flattened shelf with the rounded margin; the orbitorostral depressions are ill defined and shallow.

The antennular peduncle is robust, the second segment is 1.8-2.4 times as long as broad; the 3 segments have a ratio, 0.4-0.7 : 1.0 : 0.6. The stylocerite reaches beyond the middle of first segment by the pointed apex. The basicerite is unarmed. The carpocerite is slender and markedly exceeds the end of antennular peduncle.

The scaphocerite is slightly concave laterally; its strong lateral spine reaches variously from the proximal third of third antennular segment to near the end of that segment; the short ear-shaped lamella extends to or almost to the proximal third of second segment.

The large chela is entire, voluminous and tapering; in the male it is 1.2-1.4 times the carapace length and 2.1-2.2 times as long as high, and in the female is 0.9 times the carapace length and 2.0-2.5 times as long as high. The merus is 1.7-2.0 times as long as high, the dorsal distal corner produces as a strong process and the ventral inner margin ends in a sharp tooth distally. The ventral outer margin of ischium is rounded distally.

The small chela is entire, with several long hairs on the inner surface, cylindrical and tapering; it is 0.5-0.6 times the carapace length and 3.3-3.5 times as long as high in both sexes and shows no sexual dimorphism. The merus is 2.3-2.8 times as long as high, the dorsal margin is rounded distally and the ventral inner margin bears a small terminal tooth. The ventral outer margin of ischium is rounded distally.

In the second pereiopod the carpal articles have a ratio, 10 : 18-27 : 4-6 : 4-6 : 7-10. The dactylus of third pereiopod is short, strongly curved and biunguiculated with a slight ventral unguis. The propodus is armed with 8 to 10 spines which are apically curved inward, with dense short hairs on the ventral margin and also with dense long hairs on the dorsal margin. The ventral margin of carpus ends in a short pointed tooth distally and is furnished with a row of long hairs along its outer margin and a row of short hairs along its inner margin; the dorsal margin bears sparse long hairs. The merus is 3.8-4.2 times as long as broad; its ventral outer margin has a row of long hairs and a strong subterminal tooth; its ventral inner margin bears a row of short hairs. The fourth and fifth pereiopods have the same characters as in the third except for the following respects: These 2 pereiopods are almost naked; the ventral margin of carpus of the fifth is truncated distally; the merus of them is unarmed with the distal tooth.

The first abdominal segment shows the sexual dimorphism in its pleuron; that of the male is narrow and ends in a triangular projection posteriorly and that of the female is broad and bluntly angled posteriorly. The pleura of the following segments are also narrow and subtriangular in the male and broad and rounded in the female. The uropodal endopod bears 2 to 5 spinules distally. The telson is 3.0-3.8 times as long as broad at the posterior margin which is gently rounded. It is faintly concave dorsally, the anterior pair of dorsal spines is situated on 1/3 of the length and the posterior pair is behind the middle.

Variations. As mentioned above, the dactylus of the third pereiopods is rather

stout and strongly curved apically and has a ventral unguis. But this unguis shows the considerable variation in shape. In the six specimens (3 ♂♂, 3 ovig. ♀♀) taken from a single sponge two have a small but conspicuous sharp unguis, and one has the unguis which reduces to only an obscure shoulder on the ventral margin. The rest show a gradation between these two conditions.

Material examined.

Southern Japan.—Tosa Bay: 1 ♂, ZLKU No. 3300, Kochi Pref., Hatagun, Ohama, from a hole of dead coral, Mar. 29, 1966, K. Sakai leg.—West coast of Kyushu: 3 ♂♂, 3 ♀♀, AMBL, Chijiwa Bay, Amakusa, Tsuji-shima Islet off Tomioka, under low tide mark, living in a gastrum of sponge, *Hyattella intestinalis* (Lamarck), Apr. 30, 1967, A. Taki leg.

Colour in life. The following description is based on the notes and colour slides made in the field by Mr. A. Taki. The entire shrimp is transparent tinged with pale yellow. The dorsal half of carapace is very dark or light carmine except for a large half moon-shaped median mark of transparent just behind the gastric region. The ventral half of carapace is transparent. Every abdominal segment has a broad transverse band of carmine red which covers its tergum except for the median transparent mark on the anterior half of it and which tapers and extends downward near the margin of pleuron along the posterior margin. The tail fan is also dark or light carmine proximally and transparent distally. The antennule and antenna are dark or light carmine. Chelipeds are also the same colour and much darker on the fingers. The second and following pereopods are transparent tinged with pale yellow.

Ecology. *A. spongiarum* appears almost strictly to be associated with massive sponges.

Remarks. When Coutière (1905) described *A. paraculeipes* which was closely related to *A. spongiarum*, he separated these two species based on the following characters in the third pereopod: 1, *A. paraculeipes* having the biunguiculate dactylus instead of the simple dactylus; 2, in *A. paraculeipes* the merus being 3.88 times as long as broad instead of 5.0 times; 3, the slight change in the arrangement of hairs or spinules in the propodus, carpus and merus between these two species. But De Man (1911) noted the variation in these respects and pointed out the possibility of *A. paraculeipes* to be synonymous with *A. spongiarum*.

In the six specimens from Amakusa the author closely examined these respects and found that the specimens lay intermediate between the two nominal species as follows: 1, the dactylus has the ventral unguis showing the considerable variation in shape as noted in *Variations*; 2, the merus is 3.8–4.2 times as long as broad; in this

character the specimens agree well with *A. paraculeipes*; 3, the arrangement of hairs or spinules in the three segments is similar to that figured in *A. spongiarum* (Coutière, 1905, pl. 80, fig. 33) rather than in *A. paraculeipes* (Coutière, 1905, pl. 80, figs. 32f, f').

These three criteria separating the two species cannot thus be relied upon, and *A. paraculeipes* must now be relegated to a synonym of *A. spongiarum*, as De Man (1911) suggested.

Distribution. This species has a rather restricted distribution in the Indo-West Pacific region under the two names. From the reef down to 113 m deep.

Under the name of *A. spongiarum* it is known from: Djibouti (type locality, Coutière, 1897b); Singapore (Johnson, 1961); Kuandang Bay (De Man, 1911); Salebabu I. (De Man, 1911); Aru Is. (De Man, 1911); and Torres Strait (Coutière, 1900). Under *A. paraculeipes* it is captured from: Amirante Bank (Coutière, 1921); Maldive Is. (type locality, Coutière, 1905); Ceylon (Pearson, 1905); and Timor (De Man, 1911).

Diadema group

Crinitus group Coutière, 1899 : 351 (part, definition).

Insignis subgroup Coutière, 1905 : 884 (definition),—De Man, 1911 : 307 (definition), 318 (key to the Indopacific species).

Diadema subgroup Banner, 1953 : 48.

Diadema group Banner and Banner, 1966b : 112 (definition).

Definition. See p. 106.

Remarks. The change of the group name from Insignis to Diadema is proposed by Banner (1953) to take consideration of the relegation of *A. insignis* Heller, 1861 to a synonym of *A. diadema* Dana, 1852.

Of the four species from this region, the three except *A. bidens* are represented in the collections at hand. *A. diadema* and *A. paracrinitus* are recorded for the first time from Japanese waters. The latter is well known of the pantropical species.

Key to the species of Japanese Diadema group

1. Rostrum arising from triangular flattened base between orbital hoods 2
 Rostrum not arising from triangular flattened base between orbital hoods 3
2. Rostrum separated from orbital hoods by shallow, broad orbitorostral depressions. Merus of 3rd pereopod with sharp ventral tooth..... *diadema*

- Rostrum separated from orbital hoods by deep, narrow orbitorostral grooves. Merus of 3rd pereopod without ventral tooth *gracilipes*
3. Point tooth flattened at its base present at the base of orbital hoods on either side of rostral carina. Long spiniform rostrum with sharp, strongly compressed carina. Merus of 3rd pereopod with sharp ventral tooth *bidens*
- No tooth at the base of orbital hoods on either side of rostral carina. Short triangular rostrum rarely with slight carina. Merus of 3rd pereopod without ventral tooth...
..... *paracrinatus*

Alpheus diadema Dana, 1852

(New Japanese name: Kasuri Teppo ebi)

(Plate 29)

Alpheus diadema Dana, 1852a : 23; 1852b : 555, pl. 35, fig. 7.—Borradaile, 1900 : 417.—Banner, 1956 : 357; 1957 : 203; 1959 : 141, fig. 7.—Holthuis, 1958 : 24.—Banner and Banner, 1964 : 91; 1966a : 179; 1967 : 276; 1968 : 287.

Crangon diadema: Banner, 1953 : 118, fig. 43.

Alpheus insignis Heller, 1862 : 269.—Richters, 1880 : 163.—De Man, 1888a : 502; 1902 : 864, pl. 26, fig. 60; 1911 : 377.—Coutière, 1905 : 899; 1921 : 426.—Nobili, 1907 : 5.—Tattersall, 1921 : 380.

Crangon insignis: Edmondson, 1925 : 12.

Description. Shrimps are large and stout, measuring 16.8–26.6 mm in body length (5.7–8.7 mm in c.l.). The rostrum is narrow triangular and reaches variously in the first antennular segment; the rostral base is broad and flattened and reaches backward beyond the base of orbital hoods, the lateral margins of rostral base are strongly concave in the middle and run almost parallel anteriorly; the dorsal carina is prominent in the middle only and posteriorly demarked by a slight protuberance. The orbital hoods are strongly inflated and produced anteriorly as a slight round vertical keel. The broad area between each orbital hood and the narrow orbitorostral furrow is flattened; its anterior margin is rounded, with few long hairs.

The antennular peduncle is rather slender, the second segment is 1.4–2.2 times as long as broad; the 3 segments have a ratio, 0.7–1.2 : 1.0 : 0.5–0.8. The stylocerite reaches to the end of first segment. The basicerite has a slender ventral tooth reaching near the end of first antennular segment. The carpocerite is slender and reaches to the distal half of third antennular segment. The scaphocerite is strongly concave laterally; the broad lamella extends beyond the antennular peduncle by almost the length of third antennular segment, and the lateral tooth markedly exceeds the lamella.

The large chela is 1.2–1.3 times the carapace length in the male and 0.8–0.9 times

in the female; in both sexes it is 2.6-2.9 times as long as high and markedly swollen in the palm, there is a narrow, deep transverse groove near the finger articulation on the dorsal margin; the inner surface is hairy. The merus is 1.6-1.7 times as long as broad in the male and 1.9-2.4 times in the female; the dorsal margin is markedly produced as a strong, sharp tooth; the ventral inner margin ends in a strong sub-terminal tooth.

The small chela shows the sexual dimorphism as follows: In the male it is 0.6-0.7 times the carapace length and 3.2-3.4 times as long as high, cylindrical and swollen, the movable finger is balaeniceps in shape; in the female it is 0.4-0.5 times the carapace length and 3.3-3.9 times as long as high, and slightly compressed, tapering, and the movable finger is simple. Its inner surface is furnished with long hairs. The merus is 1.9-2.0 times as long as broad in the male and 2.2-2.6 times in the female; it is quite similar to that of the large cheliped except for the lack of ventral inner tooth.

In the second pereopod the carpal articles have a ratio, 10 : 9-11 : 3-4 : 3-4 : 4-5. The dactylus of the third pereopod is simple, with slight convexity on the ventral margin near the apex. The ventral margin of carpus ends in a sharp, slender tooth distally. The merus is 3.0-3.9 times as long as broad, with a strong subterminal tooth ventrally.

The telson is 2.7-3.0 times as long as broad at the posterior margin and slightly concave laterally; the posterior margin is fringed with 6-11 spinules besides the usual pair of spines on each corner; the anterior pair of dorsal spines is situated on 2/5 of the length, and the posterior pair is on 2/3 of it. The uropodal endopod is fringed with 6-15 spinules distally.

Variations. The variation in the shape of rostrum was like that noted by Banner (1953). In the smaller specimens it is narrow and almost tapering, while in the larger the proximal half of rostral base is much broadened and the distal half is markedly concave and ends in the acute flattened rostrum apically.

Material examined.

Ryukyu Archipelago.—Amami Group: 1 ♂, 1 ovig. ♀, ZLKU No. 10937, Yoron-jima I., Udon-hama, Aug. 10, 1967, Y. Ushio leg.; 1 ovig. ♀, ZLKU No. 11220, Yoron-jima I., Terasaki, lagoon, July 13, 1968, Y. Miya and T. Fujino leg.; 1 ovig. ♀, ZLKU No. 11221, Yoron-jima I., Terasaki, lagoon, interstices of base of *Pocillopora damicornis* (Linnaeus), July 14, 1968, Y. Miya and T. Fujino leg.; 1 ♂, ZLKU No. 11267, Yoron-jima I., Terasaki, lagoon, interstices of *P. damicornis*, July 14, 1968, Y. Miya and T. Fujino leg.—Yaeyama Group: 1 ♂, ZLKU No. 2593, Ishigaki-jima I., coral reef, July 3-27, 1933, H. Ohshima, H. Ikeda and S. Miyake leg.; 1 ♂, 1 ♀, ZLKU No. 11401, Taketomi-jima I., July 25, 1967, MERS leg.; 1 ovig. ♀, 1 ♀, ZLKU No. 17404, Taketomi-jima I., July 13, 1971, Y. Koyama leg.

Formosa.—South west coast: 1 ♂, ZLFKU, Ping-tong Pref., Shiang-chiau Bay, corals, Aug. 20, 1965, MERS leg.

Colour in life. A living shrimp is reddish brown mottled with white irregular patches and specks. "Colour in life variable, but usually dark, olive green, reddish brown, etc., with pronounced irregular mottling of lighter colour; specimens at times almost transparent" (Banner, 1953).

Ecology. *A. diadema* is a common form of coral reef. According to previous records, it was found living between fronds and in holes of the bases of dead and overgrown corals of *Pocillopora*, *Heliopora* and *Porites* in the lagoon and intertidal potholes. Sometimes it was collected from coralline algal masses.

Distribution. This species has a wide distribution throughout the Indo-West Pacific region from the Red Sea to the Hawaiian Archipelago.

A. diadema is known from: Red Sea (Holthuis, 1958); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1957; Banner and Banner, 1968); Loyalty Is. (Borradaile, 1900); Fiji (Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); Samoa (Banner and Banner, 1966a); Phoenix Is. (Banner and Banner, 1964); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967); and Hawaiian Archipelago (type locality, Dana, 1852a; Banner, 1953, 1959). *A. insignis* is taken from: Red Sea (type locality, Heller, 1862; Tattersall, 1921); Djibouti (Coutière, 1905); Mauritius (Richters, 1880); Mahé (Coutière, 1905); Coetivy Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Is. (Coutière, 1905); Laccadive Is. (Coutière, 1905); Borneo Bank (De Man, 1911); Ternate (De Man, 1902); Amboina (De Man, 1888a); and Samoa (Coutière, 1905).

Alpheus gracilipes Stimpson, 1860

(New Japanese name: Ashiboso teppo ebi)

(Plate 30)

Alpheus gracilipes Stimpson, 1860: 100 (32).—De Man, 1888a: 500, pl. 21, fig. 5; 1902: 864; 1911: 380.—Bate, 1888: 561.—Ortmann, 1890: 488; 1894: 15.—Coutière, 1897: 1905: 901.—Borradaile, 1898: 1013.—Yokoya, 1933: 22.—Banner, 1956: 357; 1957: 204; 1958: 167.—Banner and Banner, 1964: 92; 1966a: 179; 1967: 276; 1968: 289.
Crangon gracilipes: Edmondson, 1925: 15.—Armstrong, 1941: 10.—Banner, 1953: 115, fig. 41.
Nec. Alpheus gracilipes: Miers, 1879: 55.

Description. Shrimps are slender, measuring 16.4–22.6 mm in body length (5.5–7.8 mm in c.l.). The rostrum is narrow triangular and dorsally flattened, without the

dorsal carina; the rostral apex reaches variously in the distal third of first antennular segment and the proximal third of second segment. The orbital hoods are strongly inflated, anteriorly projecting as a deep vertical keel. The area between each orbital hood and the rostrum is narrowly and deeply excavated, the anterior margin of this area is shallowly but markedly concaved.

The antennular peduncle is robust, the second segment is 1.5-2.1 times as long as broad; the 3 segments have a ratio, 0.8-0.9 : 1.0 : 0.8-0.9. The stylocerite is stout and reaches variously in the proximal third of second segment. The basicerite bears a strong ventral tooth reaching near the end of first antennular segment. The carpocerite is robust and reaches near the end of antennular peduncle. The scaphocerite is concave laterally and exceeds the antennular peduncle by its strong lateral spine; the broad lamella reaches forward as far as the carpocerite.

The first pair of pereiopods shows no sexual dimorphism. The large chela is 1.1-1.3 times the carapace length and 3.1-3.8 times as long as high in both sexes; it is subcylindrical, not so swollen as that in *A. diadema*, and naked; there is a deep and narrow transverse groove near the finger articulation on the dorsal margin. The merus is 2.0-2.8 times as long as broad; the dorsal margin ends in a sharp, strong tooth; the ventral inner margin bears 2 or 3 spinules and distally ends in a sharp, strong tooth.

The small chela is, in both sexes, 0.7-0.8 times the carapace length and 4.4-5.2 times as long as high; it is cylindrical and entire except for a slight notch near the finger articulation on the dorsal margin; in both sexes the movable finger is balaeniceps in shape, but in the female is narrower and not so hairy as in the male. The merus is 2.9-3.3 times as long as broad and quite similar to that of large cheliped.

In the second pereiopod the carpal articles have a ratio, 10 : 6-9 : 3 : 3 : 5. The dactylus of the third pereiopod is simple, with such convexity as found in *A. diadema*. The carpus is truncated at the distal corner of ventral margin. The merus is 5.6-7.4 times as long as broad and unarmed.

The telson somewhat tapers, being 2.7-3.8 times as long as broad at the posterior margin, which bears 3 to 6 spinules; the anterior pair of dorsal spines is situated behind the 2/5 of the length, the posterior is on the 2/3 of the length. The uropodal endopod is fringed with 8-16 spinules distally.

Variations. As described above, the certain variations were observed in the shape of the rostrum and the frontal part of orbitorostral depressions.

Material examined.

Ryukyu Archipelago.—Amami Group: 2 ♂♂, 1 ovig. ♀, ZLKU No. 10941, Amami-oshima I.,

Kyonoura, Aug. 3, 1967, Y. Ushio leg.; 1 ovig. ♀ ZLKU No. 11236, Yoron-jima I., Hakebina, fringing reef, July 12, 1968, Y. Miya and T. Fujino leg.; 1 ♂, ZLKU No. 11237, Yoron-jima I., Terasaki, lagoon, interstices of *Pocillopora damicornis* (Linnaeus), July 14, 1968, Y. Miya and T. Fujino leg.—Okinawa Group: 1 ♂, 1 ovig. ♀, 1 ♀, ZLKU No. 17406, Kume-jima I., O-jima islet, Aug. 31, 1959, H. Minei leg.; 1 ♂, ZLKU No. 17409, Okinawa-jima I., Gushichan, July 3, 1962, S. Miyake, T. A. Uchida and H. Minei leg.—Yaeyama Group: 1 ovig. ♀, ZLKU No. 1348, Ishigaki-jima I., July 3-27, 1933, H. Ohshima, H. Ikeda and S. Miyake leg.; 2 ♂♂, 1 ovig. ♀, ZLKU No. 11407, Taketomi-jima I., July 25, 1967, MERS leg.; 1 ovig. ♀, AMBL, Ishigaki-jima I., Kabira, dead coral, July 28, 1969, T. Kikuchi leg.

Micronesia.—Caroline Islands: 1 ♀, ZLKU No. 1414, Palau Is., Ngadarák Reef, (134°28'30" E., 7°17'30" N.), June 17, 1939, S. Miyake leg.

Colour in life. The living shrimp is entirely transparent and brown. There are some dark blue eye spots on the first five abdominal segments, each pleuron of which is provided with 2, 1, 1, 1 and 1 spot, respectively. The large and small chelae are also brown mottled with green.

Ecology. *A. gracilipes* is also one of the common alpheids of coral reef. According to the previous records, it was collected from the dead and overgrown corals of *Pocillopora* spp., *Stylophora mordax* and others in the lagoon and on the outer reef. From the intertidal zone down to 3.3 m deep.

Remarks. According to Banner and Banner (1967), the small chela of the male shows two forms, one has the balaeniceps-shaped movable finger and the other has the normal slender movable finger, as found in the female.

Distribution. This species is widely distributed throughout the Indo-West Pacific region, where it is taken from: Djibouti (Coutière, 1905); Mahé (Coutière, 1905); Dar-es-Salaam (Ortmann, 1894); Maldive Is. (Coutière, 1905); Celebes (De Man, 1911); Kabaëna I. (De Man, 1911); Ternate (De Man, 1911); Halmahera (Coutière, 1897); Waigeu I. (De Man, 1911); Bougainville Strait (De Man, 1911); Amboina (De Man, 1888a); New Caledonia (Coutière, 1905); Bass Strait (Bate, 1888); off Tanegashima I. (Yokoya, 1933); off Koshikijima I. (Yokoya, 1933); Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1957; Banner and Banner, 1968); Gilbert Is. (Banner, 1958); Rotuma (Borradaile, 1898); Fiji (Banner and Banner, 1966a); Tonga (Banner and Banner, 1966a); Samoa (Ortmann, 1890; Coutière, 1905; Armstrong, 1941; Banner and Banner, 1966a); Phoenix Is. (Banner and Banner, 1964); Cook Is. (Banner and Banner 1967); Society Is. (Tahiti: type locality, Stimpson, 1860; Banner and Banner, 1967); Marquesas Is. (Ortmann, 1890); and Hawaiian Archipelago (Edmondson, 1925; Banner, 1953).

Alpheus bidens (Olivier, 1789)

Alpheus bidens: De Man, 1911 : 371.—Balss, 1914 : 39.—Banner, 1957 : 203,—Banner and Banner, 1968 : 287.

Alpheus tridentatus Zehntner, 1894 : 204, pl. 8, fig. 24.

Diagnosis. Sharp rostrum exceeding the end of first antennular segment, with the acute, strongly compressed carina with the median tubercle. On either side of the rostral carina, at the base of orbital hoods, a pointed tooth, flattened at its base present. Second antennular segment almost twice as long as broad; anterior margin of the first segment bearing two small spines; stylocerite reaching forward as far as the apex of these spines. Large chela with the transverse groove near the finger articulation; the dorsal margin of the merus ending in a strong, spiniform tooth, two other margins unarmed. Small chela balaeniceps-shaped in the male and usual slender form in the female; the teeth at either side of the finger articulation present; palm without a transverse groove near the articulation. The carpal articles of second pereiopod showing a ratio, 10 : 11 : 4 : 4 : 6. In the third pereiopod dactylus simple; merus having a sharp ventral tooth. (Modified from De Man, 1911).

Remarks. As no specimen was available, the diagnosis was given from De Man's description.

The relationship between *A. bidens* and *A. praedator* De Man, 1908 was discussed by Banner and Banner (1968). They supposed that the latter might be synonymous with the former, because the differences between the two species seemed very slight.

Distribution. Apparently this has a narrow distribution in the West Pacific, where it is known only from: scattered localities of Malay Archipelago (Karakelong I; Salebabu I.; Bougainvill Strait; Banda I.; between Nusa Besi and N. E. point of Timor; Amboina: Zehntner, 1849; De Man, 1911); Okinawa-jima I., Ryukyu Archipelago (Balss, 1914); and Marshall Is. (Banner, 1957; Banner, 1968).

Alpheus paracrinitus Miers, 1881

(Plate 31)

Alpheus paracrinitus Miers, 1881 : 365, pl. 16, fig. 6.—Coutière, 1899 : 34, 92, 223, 226, 228, 229, 317, 349, 486, 501, 514; 1905 : 901, pl. 82, fig. 38 (part).—Holthuis, 1951 : 74.—Chace, 1962 : 609; 1972 : 69.—Banner and Banner, 1964 : 92; 1967 : 278; 1968 : 289.—Crosnier and Forest, 1966 : 253, fig. 15.

- Crangon paracrinitus*: Edmondson, 1923 : 29; 1925 : 12.—Schmitt, 1939 : 12.—Banner, 1953 : 10.
Alpheus paracrinitus var. *bengalensis* Coutière, 1905 : 901, pl. 82, fig. 37 (part).—Banner, 1956 : 358; 1957 : 204.
Crangon paracrinitus var. *bengalensis*: Banner, 1953 : 110, fig. 40.
Alpheus paracrinitus bengalensis: Banner, 1958 : 168.
Alpheus bengalensis: Holthuis, 1958 : 25.—Johnson, 1961 : 52.
Alpheus ascensionis Ortmann, 1893 : 45.
Crangon togatus Armstrong, 1940 : 2, fig. 1

Description. Shrimps are small and slender, measuring 12.7–13.9 mm in body length (4.2–4.8 mm in c.l.). The rostrum is narrow triangular and rounded dorsally, its apex reaches near the middle of first antennular segment; the faint, short dorsal carina is present in a male (4.2 mm in c.l.; ZLKU No. 12186). The orbital hoods are slightly inflated and weakly rounded anteriorly.

The antennular peduncle is robust, the second segment is 1.5–1.7 times as long as broad; the 3 segments have a ratio, 1.0–1.2 : 1.0 : 0.5–0.7. The stylocerite reaches to the end of first segment by its pointed apex. The basicerite bears a short spiniform ventral tooth. The carpocerite is slender and exceeds the end of antennular peduncle by more than the length of third antennular segment. The scaphocerite has the broad lamella reaching forward as far as the end of antennular peduncle; the lateral spine somewhat exceeds the lamella.

The large chela is, in an ovigerous female, 1.1 times the length of carapace and 3.4 times as long as high and subcylindrical; it has the smooth regular margins and surfaces except for a distinct carina (artificial ?), which is much clearer proximally, found along the dorsal margin of the palm. The merus is 4.1 times as long as broad; the dorsal margin is truncated dorsally; the ventral inner margin is armed with a sharp spiniform tooth slightly distal of the middle and unarmed distally.

The small chela shows no sexual dimorphism; it is 0.6–0.7 times the carapace length and 4.2–4.5 times as long as high, subcylindrical and entire; fingers are 1.1–1.3 times as long as palm, very slender and strongly curved apically; the finger articulation is flanked by a small subtriangular process on each side. The merus is similar to that of large cheliped; it is 3.5–4.2 times as long as broad, with the spiniform tooth approaching near the distal end of ventral inner margin.

In the second pereiopod the carpal articles have a ratio, 10 : 6–7 : 3 : 3 : 4–5. The third pereiopod has the elongated simple dactylus. The carpus is truncated at the distal corner of ventral margin. The merus is 5.7–5.8 times as long as broad and unarmed.

The telson abruptly tapers on the posterior half and is 3.5–3.8 times as long as broad at the posterior margin; the anterior pair of dorsal spines is situated on the

middle of the length and the posterior pair is on the distal third or fourth of it. The uropodal endopod is fringed with several weak spinules distally.

Material examined.

Ryukyu Archipelago.—Yaéyama Group: 1 ♂, 1 ovig. ♀, ZLKU No. 12186, Ishigaki-jima I., Kabira, intertidal, under boulders, May 27, 1968, A. H. Banner leg.

Colour. "Colour light yellowish (in spirit). Fingers of large cheliped pinkish." (Miers, 1881).

Ecology. According to the previous records, this species was found living in the dead corals and under boulders in the lagoon, in the intertidal potholes, on the reef flat and on turtle-grass and *Porites* flats. Sometimes shrimps were washed from corallines, other algae and *Tubipora*. It is a littoral form which has been taken from the intertidal zone down to 18 m deep.

Remarks. There is an excellent discussion of the variation and synonymy of this species in Banner and Banner (1967).

Present specimens (1 ♂, 1 ovig. ♀) apparently fall into the range of variation in the specific characters previously discussed by Banner (1953), Banner and Banner (1966b, 1967) and Chace (1962) except for the following two respects: 1, in the small chela of the male there are two forms, one provided with such normal slender movable finger that is possessed by the female, as observed in the present specimens, and the other with the balaeniceps-shaped movable finger, as noted by Banner and Banner (1966b); 2, in the carpus of second pereopod the ratio of the first two articles is 10 : 6-7 instead of 10 : 8-18.

Distribution. The present species is obviously one of the pantropical forms. From intertidal zone down to 18 m deep.

A. paracrinitus is captured from the following localities in the Indo-Pacific: Djibouti (Coutière, 1905); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner and Banner, 1968); Phoenix Is. (Banner and Banner, 1964); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967); Line Is. (Edmondson, 1923; Banner and Banner, 1964); Johnston I. (Edmondson, 1925); Hawaiian Archipelago (Edmondson, 1925; Banner, 1953); and Clipperton I. (Schmitt, 1939; Chace, 1962). On the other hand, it is found occurring sporadically in the Atlantic as follows: Tobago (Chace, 1972); Windward Is. (Chace, 1972); Leeward Is. (Chace, 1972); Santa Maria I. (Crosnier and Forest, 1966); Gorée, Senegal (type locality, Miers, 1881); Ghana (Chace, 1962; Crosnier and Forest, 1966); ? São Tomé and ? Angola (Osorio, 1889, see Crosnier

and Forest, 1966 : 254). *A. paracrinitus bengalensis* which was raised to the specific rank under the name of *A. bengalensis* by Holthuis (1958) is known from: Red Sea (Holthuis, 1958); Minikoi, Laccadive Is. (type locality, Coutière, 1905); Singapore Straits (Johnson, 1961); Mariana Archipelago (Banner, 1956); Marshall Is. (Banner, 1957); Gilbert Is. (Banner, 1958); and Hawaiian Archipelago (Banner, 1953). *A. ascensionis* is taken only from Ascension I. (Ortmann, 1893). *C. togatus* is known only from the type locality of the Bermudas (Armstrong, 1940).

[To be continued]

(Received 10 August, 1973)

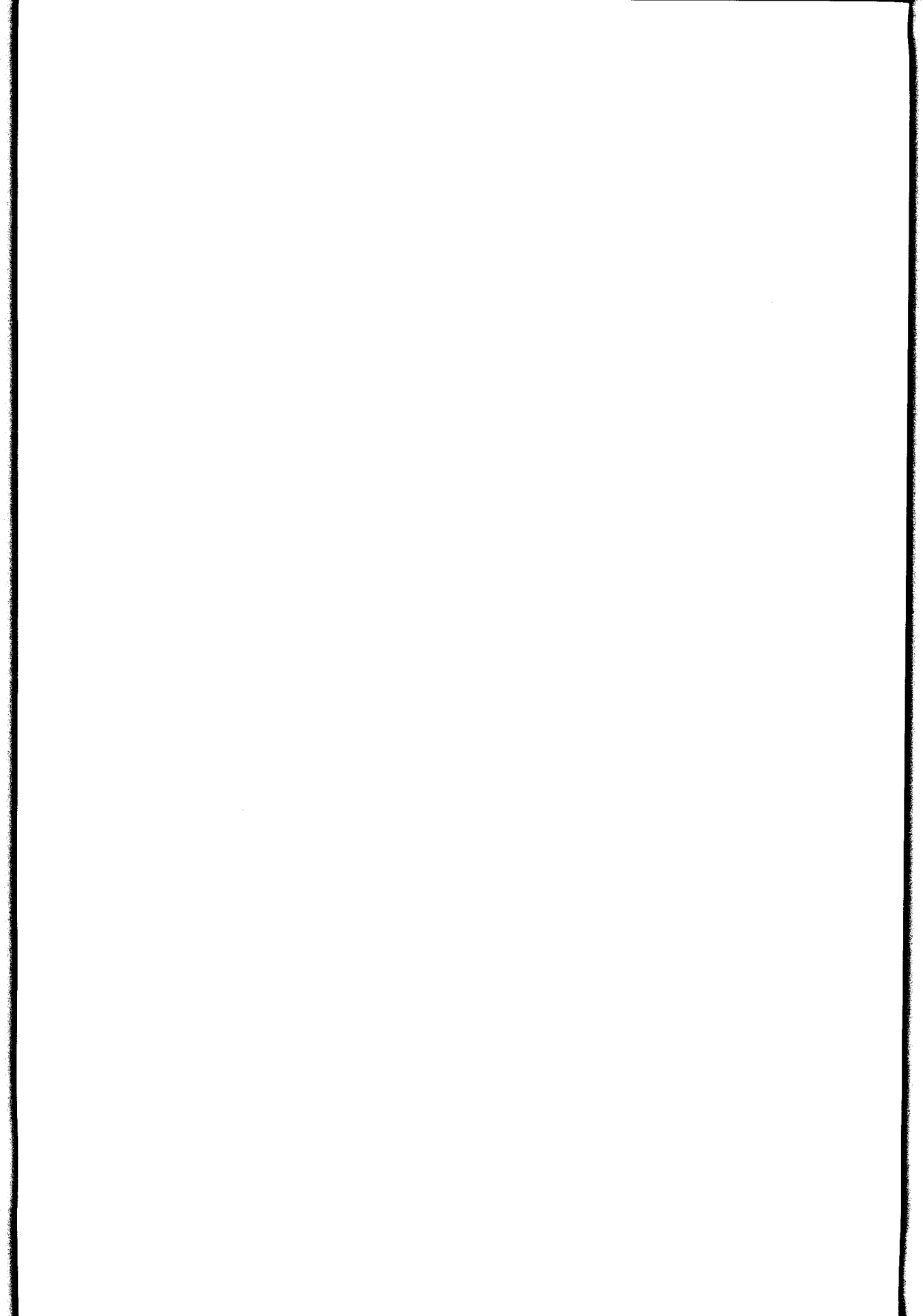
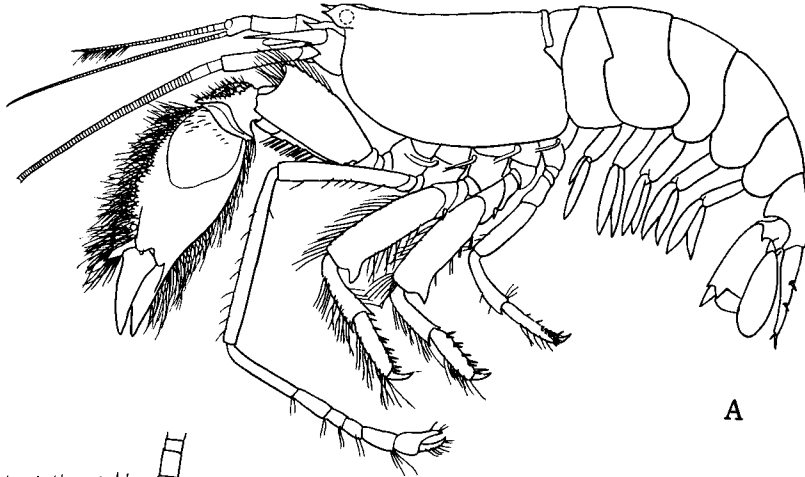


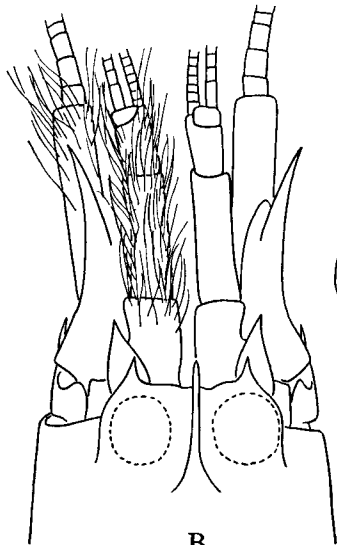
Plate 15

Alpheus deuteropus Hilgendorf, 1878

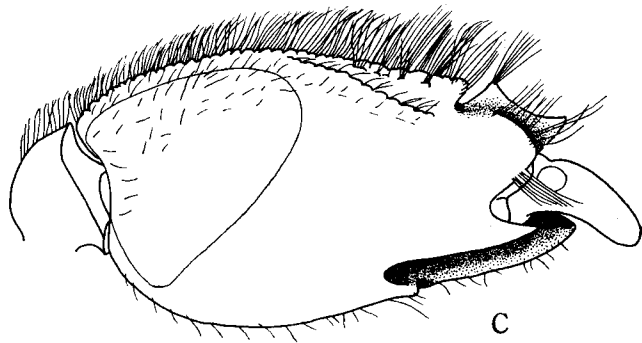
- Fig. A. Male, 8.8 mm in carapace length.
Fig. B. Anterior region, dorsal view.
Fig. C. Large chela, dorso-outer face.
Fig. D. Distal part of that chela, ventro-inner face.
Fig. E. Tail fan, dorsal view.



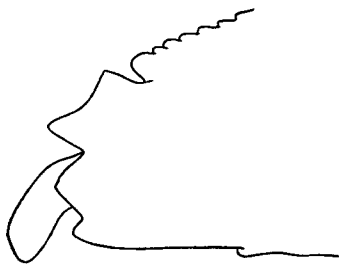
A



B

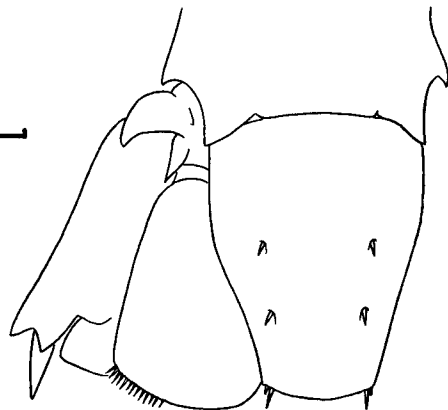


C



D

4 mm
A
2 mm
B, E
2 mm
C, D



E

Plate 16

Alpheus collumianus probabilis Banner, 1956

and

Alpheus collumianus medius Banner, 1956

A. c. probabilis: Fig. A. Male, 6.0 mm in carapace length.

Fig. B. Anterior region, dorsal view.

Fig. C. Distal part of large chela, ventro-inner face.

Fig. D. Tail fan, dorsal view.

A. c. medius: Fig. E. Anterior region, dorsal view, ♂
(4.8 mm in carapace length).

Fig. F. Distal part of large chela, ventro-inner face.

Fig. G. Left third pereopod.

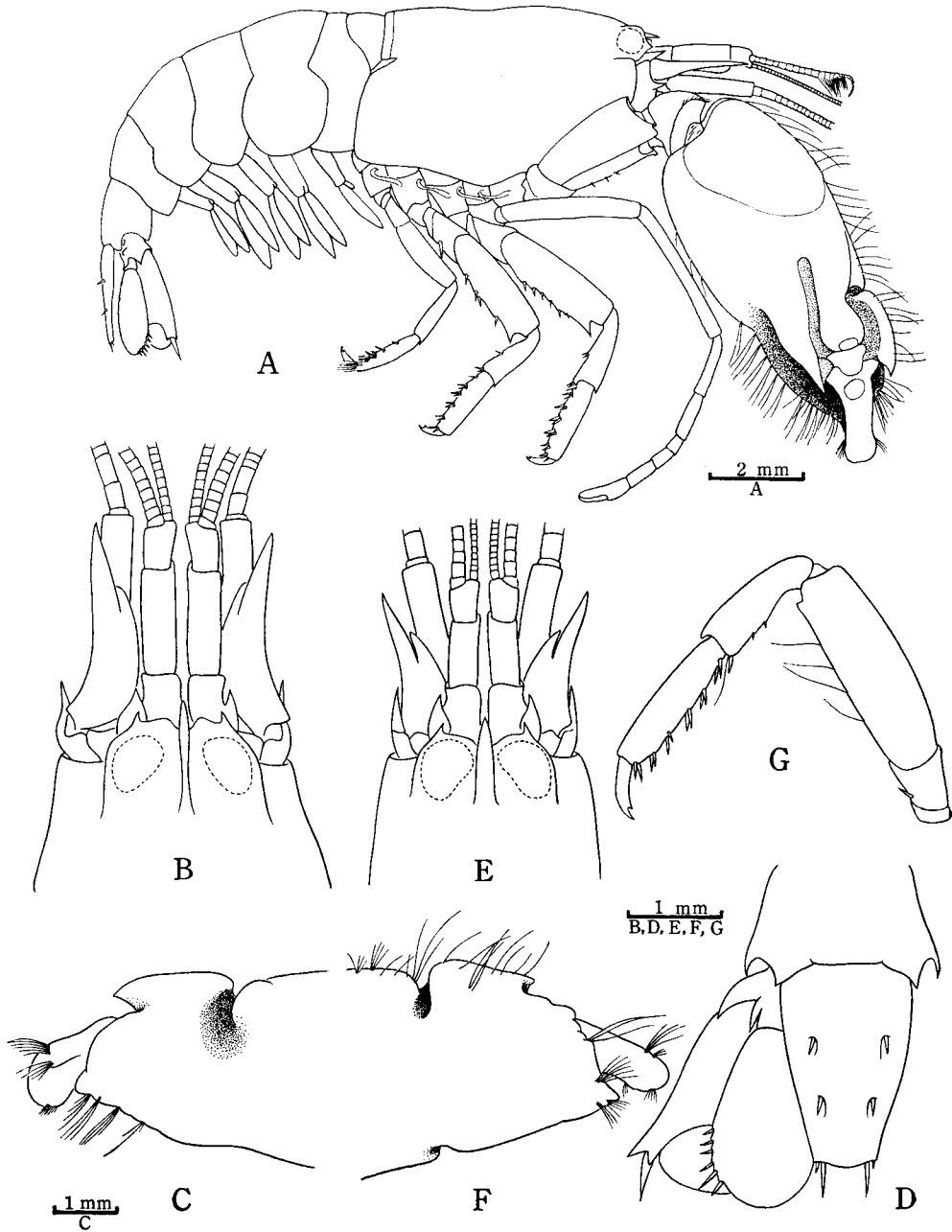
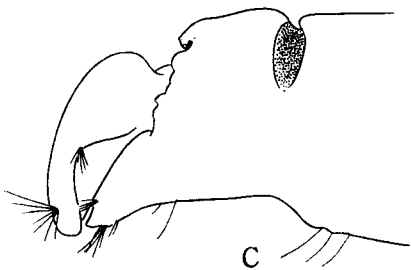
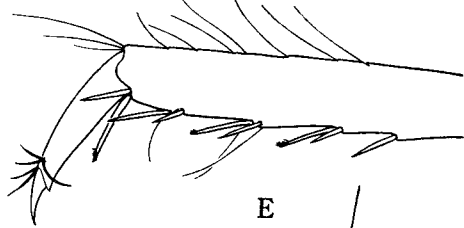
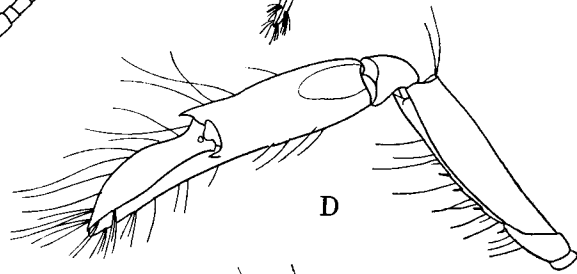
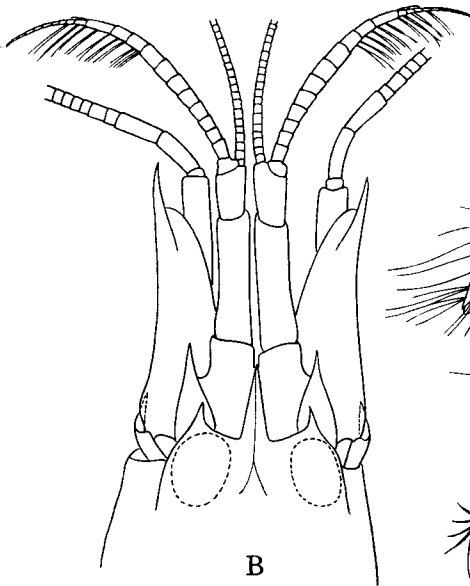
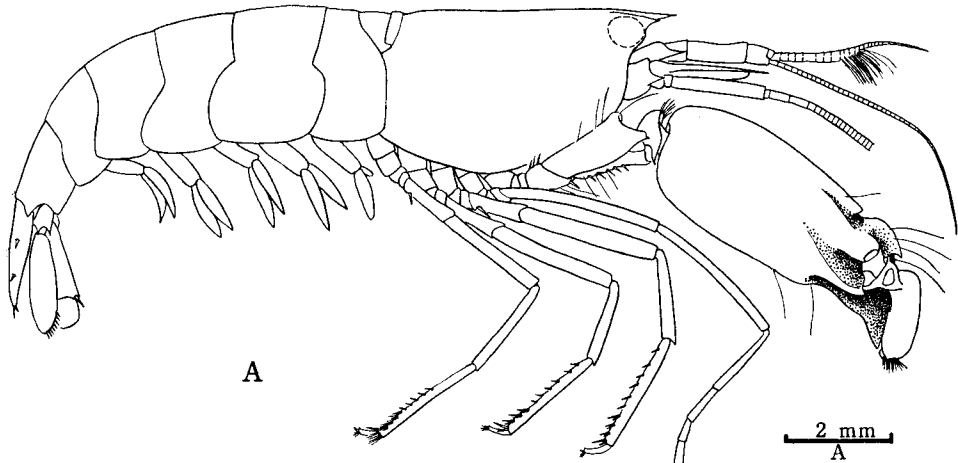


Plate 17

Alpheus hailstonei paucispinatus (Banner, 1953)

- Fig. A. Male, 5.9 mm in carapace length.
Fig. B. Anterior region, dorsal view.
Fig. C. Distal part of large chela, ventro-inner face.
Fig. D. Small cheliped, outer view.
Fig. E. Dactylus of left third pereopod.
Fig. F. Tail fan, dorsal view.



1 mm
B, C, F
2 mm
D
0.5 mm
E

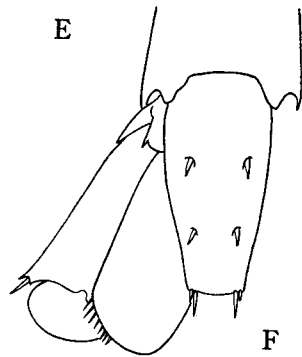


Plate 18

Alpheus hailstonei assimulans De Man, 1908

- Fig. A. Anterior region, dorsal view, ♂ (7.1 mm in carapace length).
Fig. B. Large cheliped, outer view, ♀ (6.4 mm in c.l.).
Fig. C. Distal part of large chela, ventro-inner face, ♀ (6.4 mm in c.l.).
Fig. D. Small chela, dorso-outer face, ♀ (6.4 mm in c.l.).
Fig. E. Dactylus of left third pereiopod, ♀ (6.4 mm in c.l.).

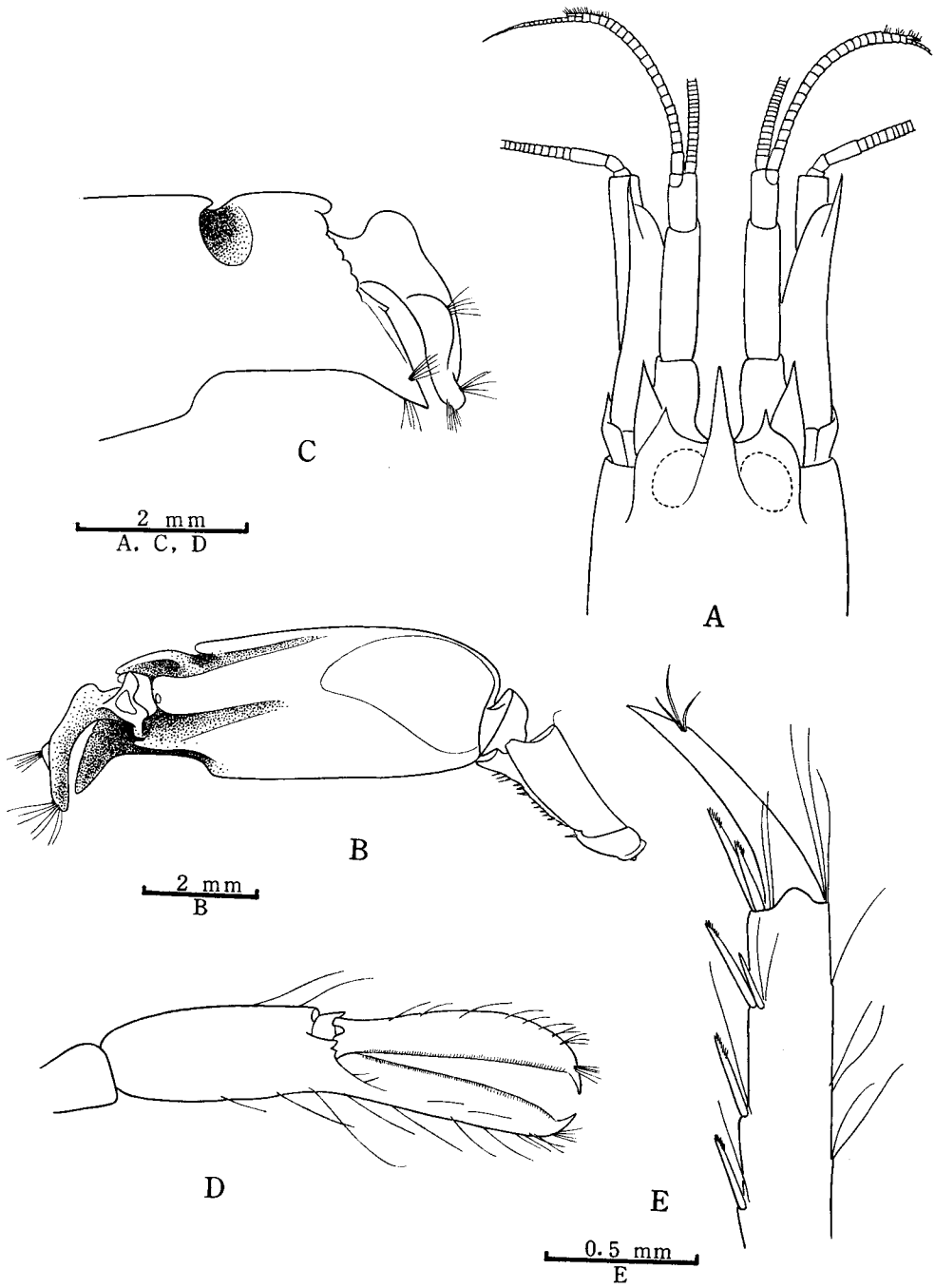


Plate 19

Alpheus oahuensis (Banner, 1953)

- Fig. A. Anterior region, dorsal view, ♂ (10.3 mm in carapace length).
Fig. B. Anterior region, lateral view.
Fig. C. Large chela, dorsal face.
Fig. D. Distal part of that chela, ventro-inner face.
Fig. E. Small cheliped, outer view.
Fig. F. Dactylus of left third pereopod.
Fig. G. Tail fan, dorsal view.

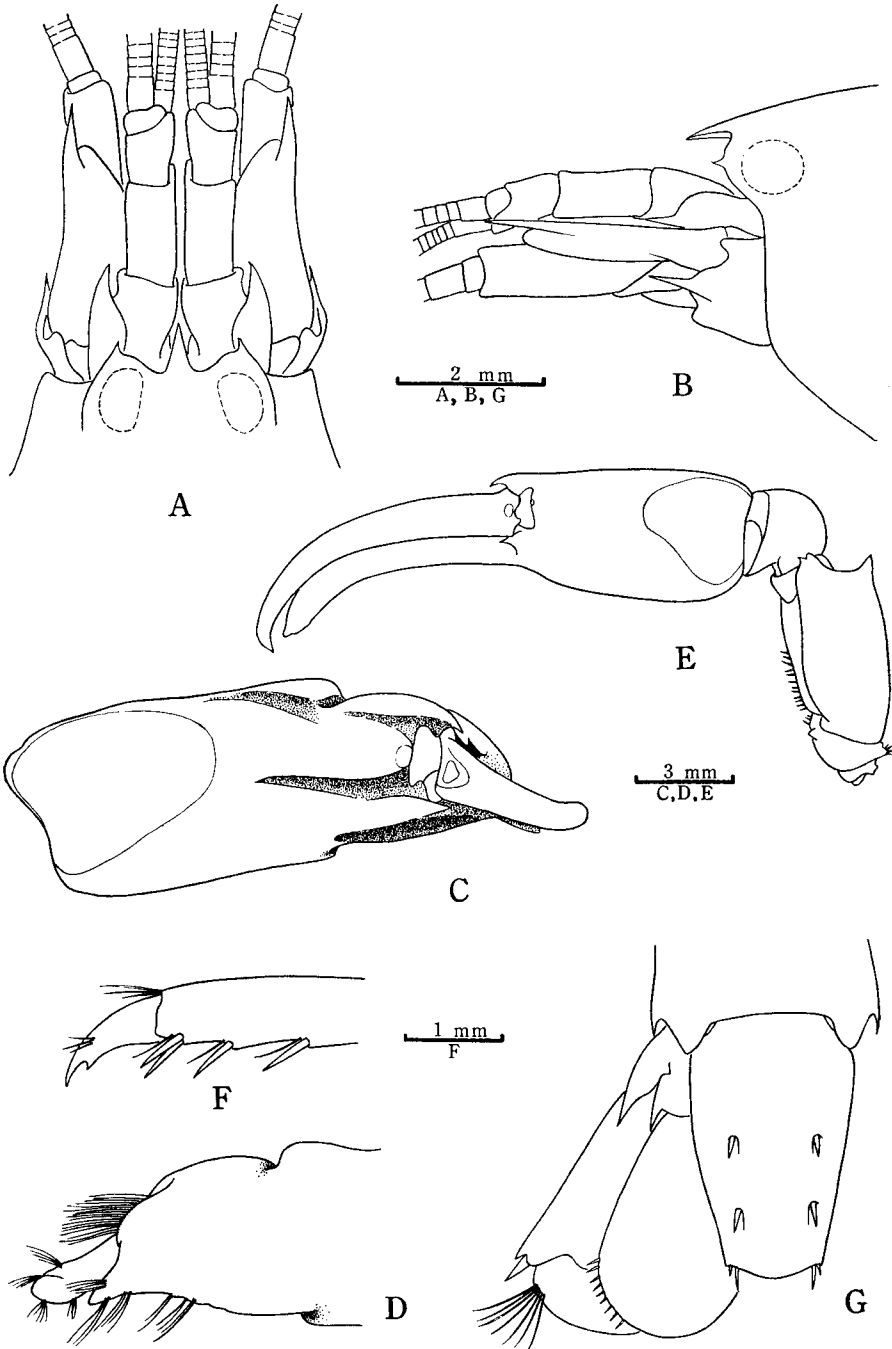


Plate 20

Alpheus albatrossae (Banner, 1953)

- Fig. A. Anterior region, dorsal view, ovig. ♀ (7.0 mm in carapace length).
Fig. B. Large chela, dorsal face.
Fig. C. Distal part of that chela, ventro-inner face.
Fig. D. Small chela, outer view.
Fig. E. Carpus, merus and ischium of small cheliped, outer view.
Fig. F. Dactylus of third pereopod.
Fig. G. Left second pleopod, inner view.
Fig. H. Tail fan, dorsal view.

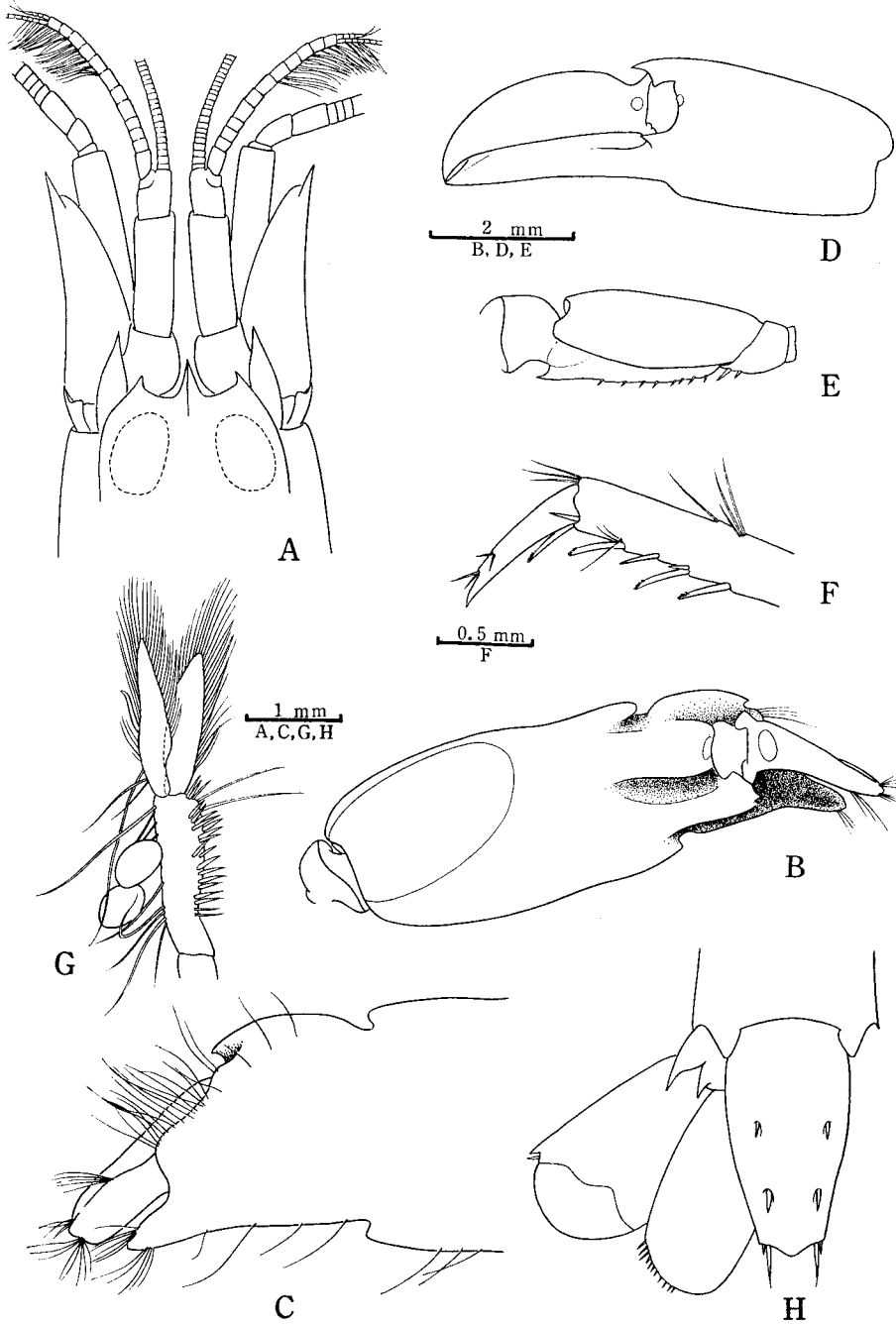


Plate 21

Alpheus crockeri (Armstrong, 1941)

- Fig. A. Male, 5.6 mm in carapace length.
- Fig. B. Anterior region, dorsal view.
- Fig. C. Distal part of large chela, ventro-inner face.
- Fig. D. Small chela, dorsal face.
- Fig. E. Dactylus of left third pereiopod.
- Fig. F. Tail fan, dorsal view.

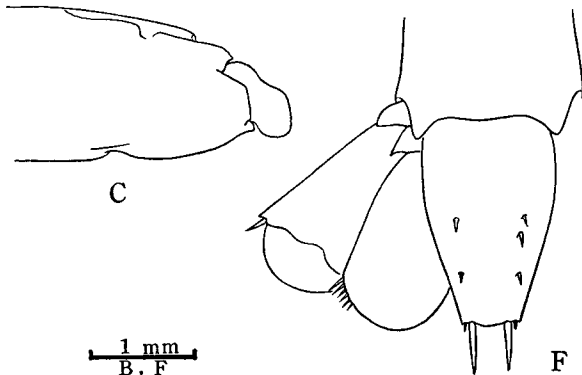
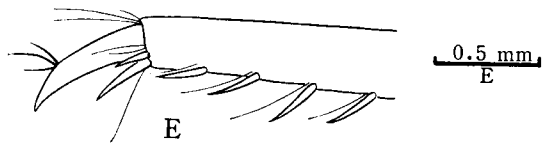
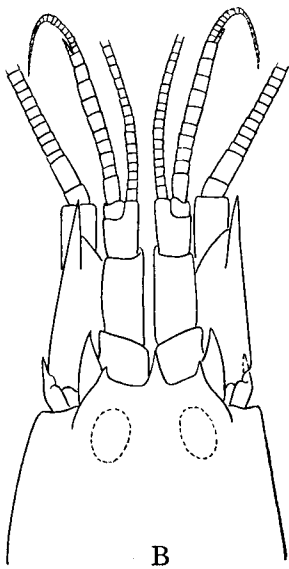
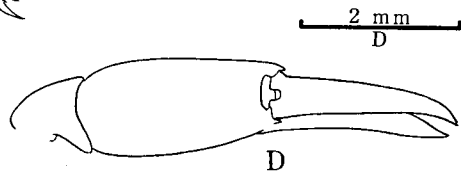
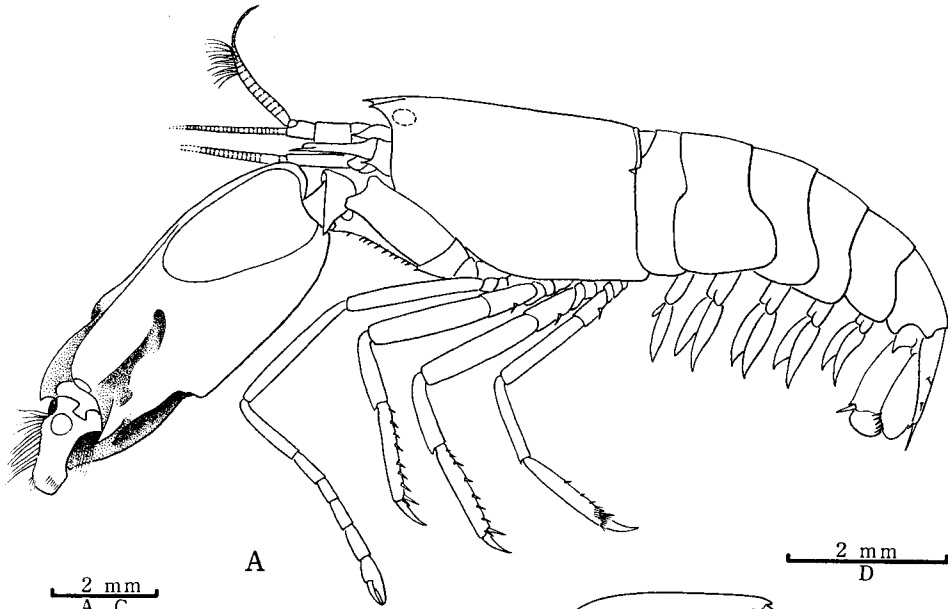


Plate 22

Alpheus obesomanus Dana, 1852

and

Alpheus malleodigitus (Bate, 1888)

A. obesomanus: Fig. A. Male, 4.7 mm in carapace length.

Fig. B. Anterior region, dorsal view.

Fig. C. Large chela, outer surface.

Fig. D. Small chela, outer surface.

Fig. E. Tail fan, dorsal view.

A. malleodigitus: Fig. F. Anterior region, dorsal view, ♂

(6.1 mm in carapace length).

Fig. G. Second pair of pereopods.

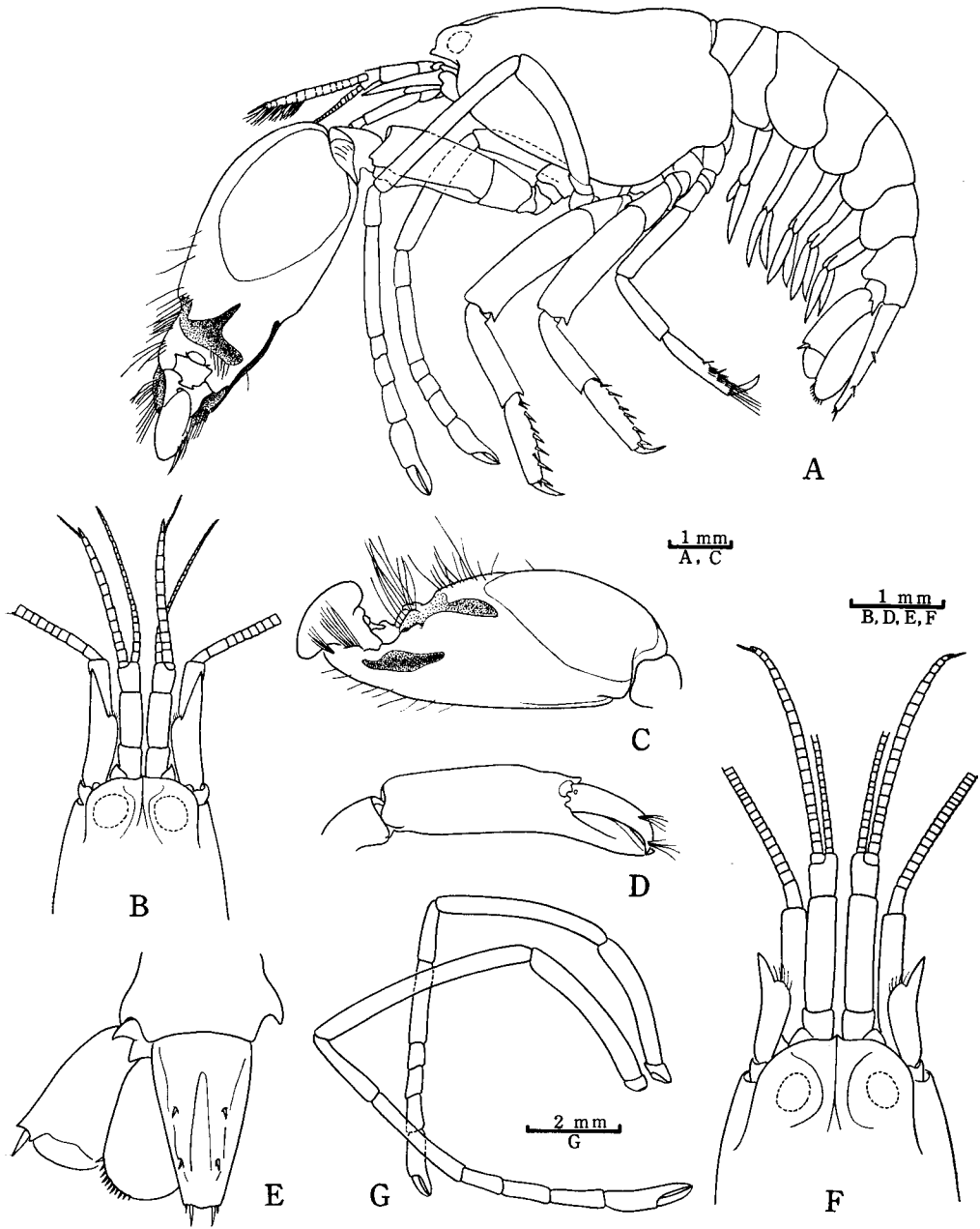


Plate 23

Alpheus pachychirus Stimpson, 1860

and

Alpheus frontalis H. Milne Edwards, 1837

A. pachychirus: Fig. A. Male, 6.8 mm in carapace length.

Fig. B. Anterior region, dorsal view.

Fig. C. Tail fan, dorsal view.

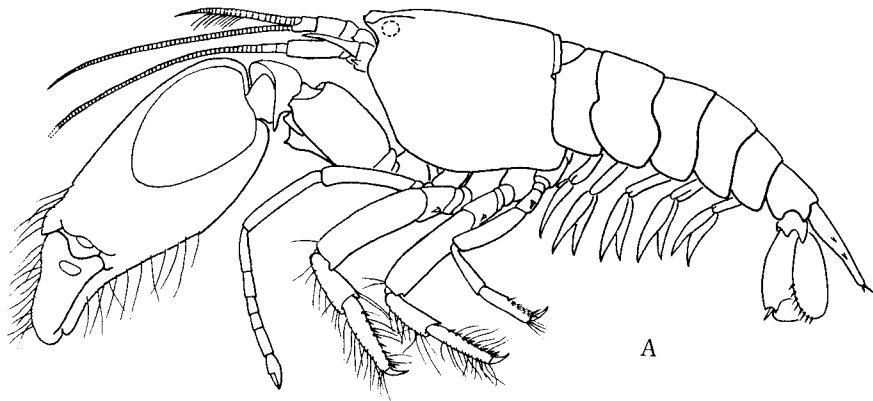
A. frontalis: Fig. D. Anterior region, dorsal view, ♂

(12.2 mm in carapace length).

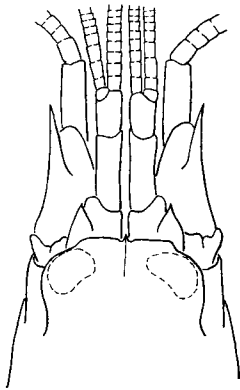
Fig. E. Left 2nd pereopod.

Fig. F. Left 3rd pereopod.

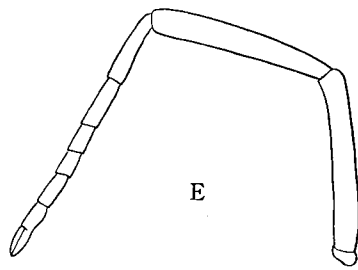
Fig. G. Tail fan, dorsal view.



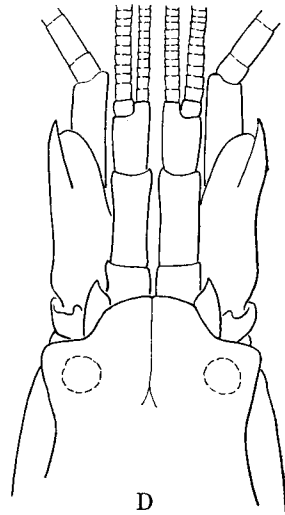
A



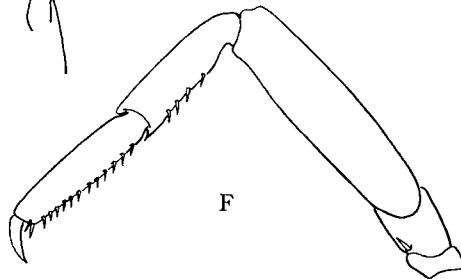
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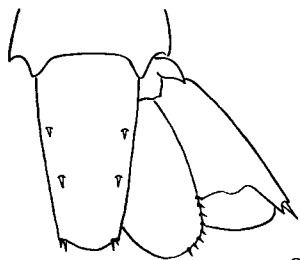
E



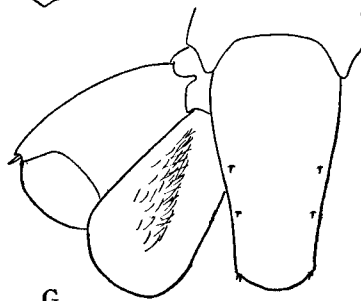
D



F



C



G

4 mm

A, E, F

2 mm

B, C

3 mm

D, G

Plate 24

Alpheus paralcyone Coutière, 1905

- Fig. A. Male, 3.5 mm in carapace length.
- Fig. B. Anterior region, dorsal view, ♂ (3.5 mm in c.l.).
- Fig. C. Dactylus of left third pereiopod, ovig. ♀ (5.0 mm in c.l.).
- Figs. D-F. Tail fan, dorsal view, showing variations, respectively,
ovig. ♀ (5.0 mm in c.l.), ovig. ♀ (5.6 mm in c.l.) and ♂ (3.0 mm in c.l.).

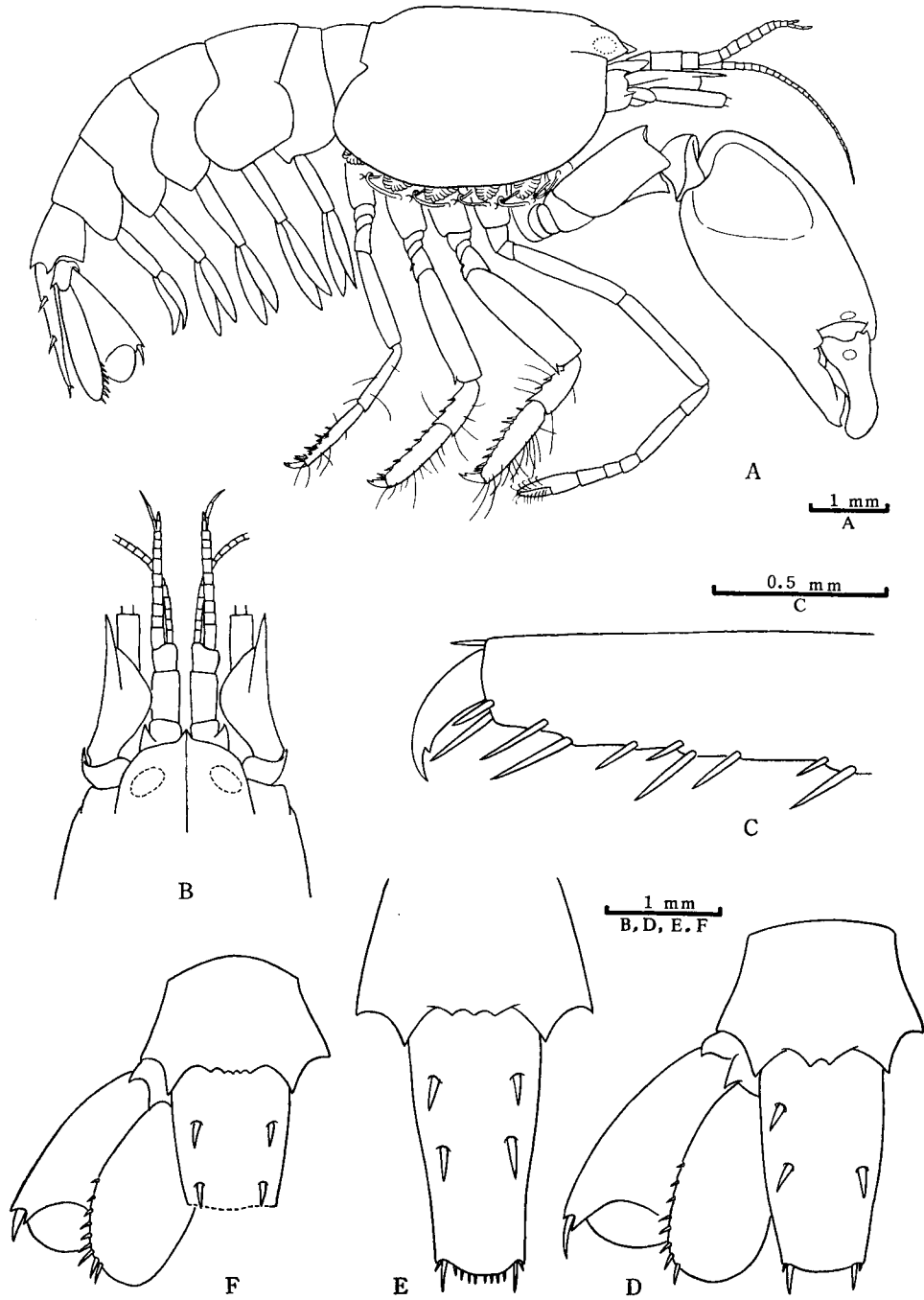


Plate 25

Alpheus bucephalus Coutière, 1905

Fig. A. Female, 4.0 mm in carapace length.

Figs. B-D. Anterior region, dorsal view, showing variations, respectively,

♀ (4.0 mm in c.l.), ♂ (4.0 mm in c.l.) and ♂ (4.0 mm in c.l.).

Fig. E. Small cheliped, outer view, ♂ (4.0 mm in c.l.).

Fig. F. Tail fan, dorsal view, ♀ (4.0 mm in c.l.).

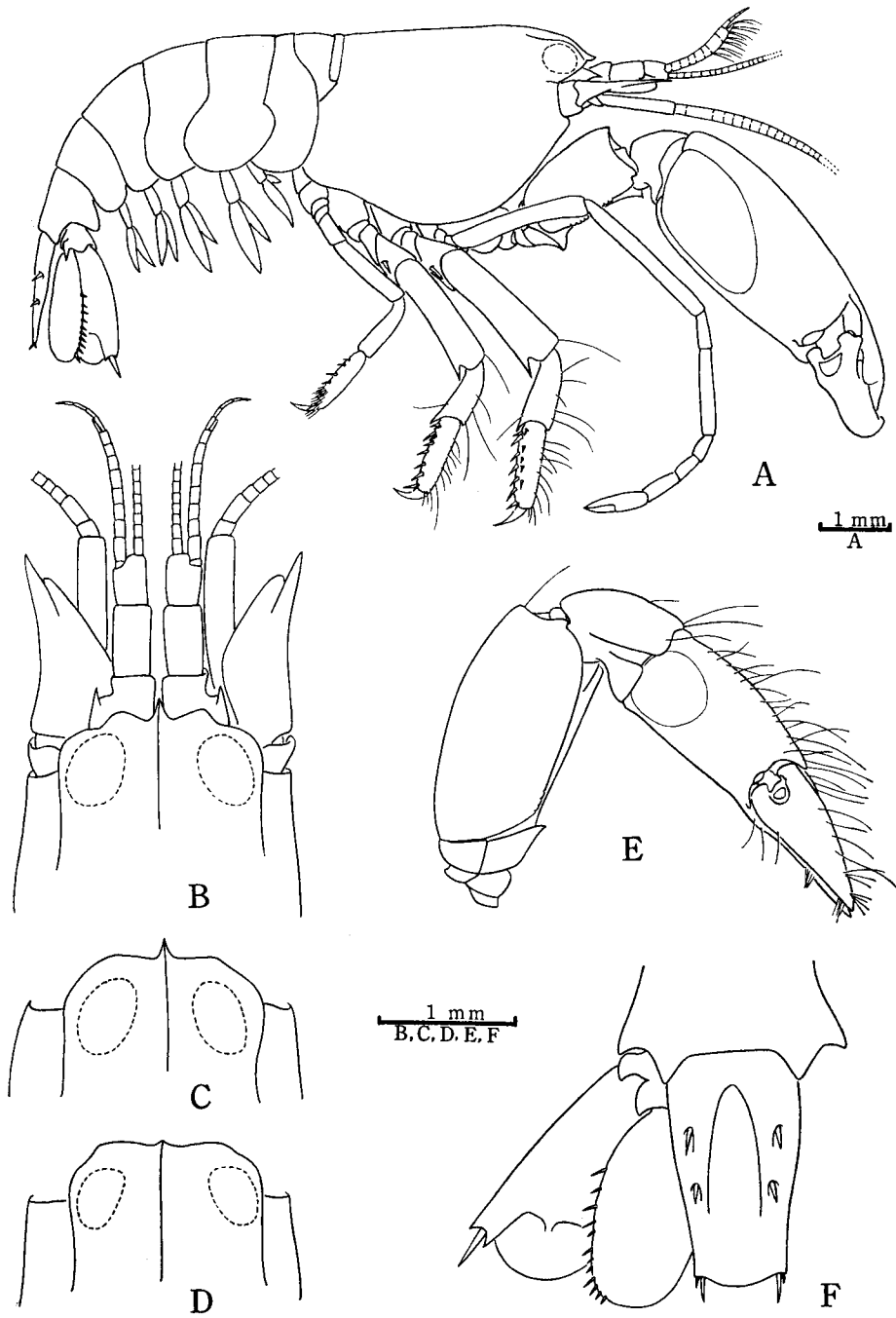


Plate 26

Alpheus alcyone De Man, 1902

- Fig. A. Male, 3.2 mm in carapace length.
Fig. B. Anterior region, dorsal view, ♂ (3.2 mm in c.l.).
Fig. C. Large cheliped, outer view, ♂ (3.1 mm in c.l.).
Fig. D. Dactylus of left third pereiopod, ♂ (3.2 mm in c.l.).
Fig. E. Tail fan, dorsal view, ♂ (3.2 mm in c.l.).

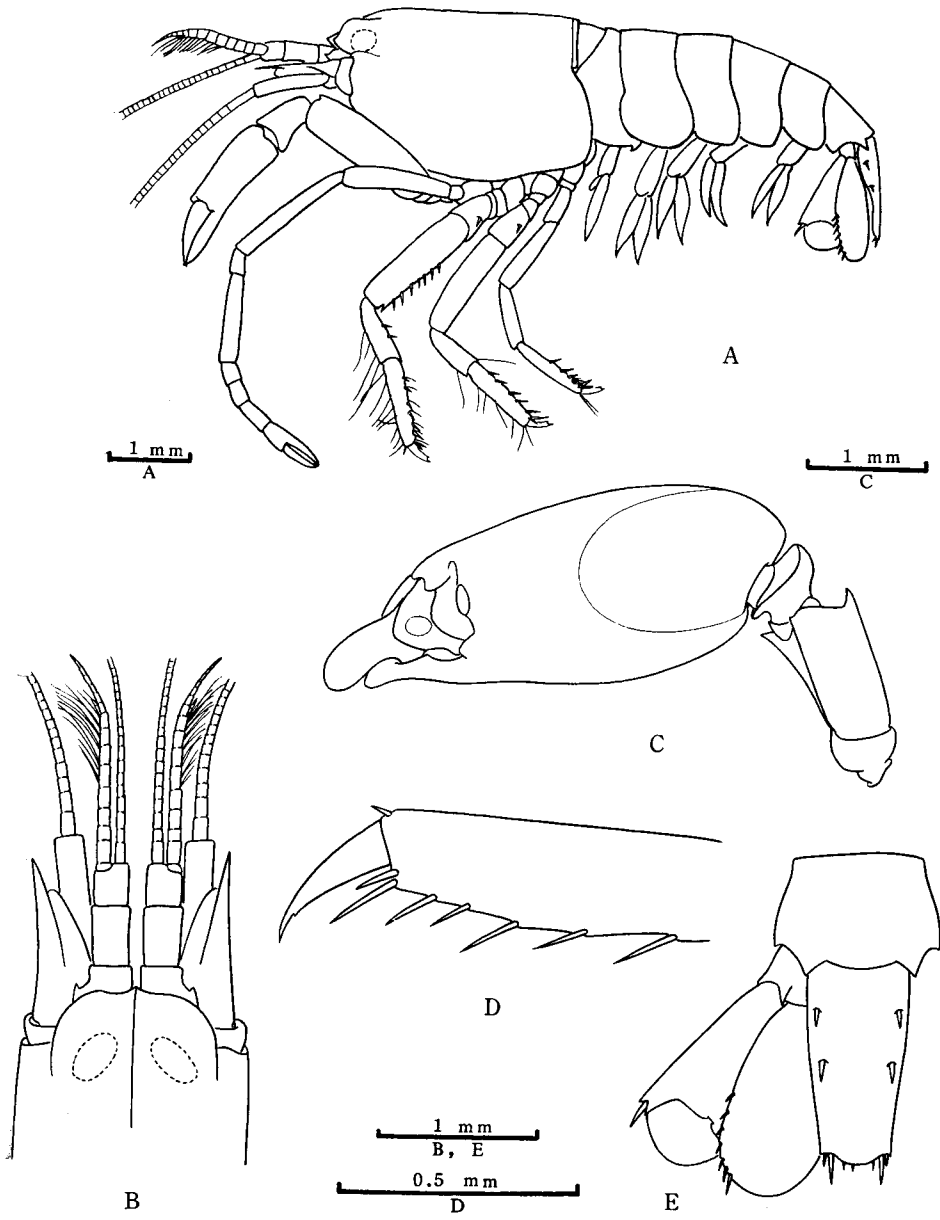


Plate 27

Alpheus eulimene De Man, 1909

- Fig. A. Ovigerous female, 3.5 mm in carapace length.
Fig. B. Anterior region, dorsal view.
Fig. C. Small cheliped, outer view.
Fig. D. Small chela, inner face.
Fig. E. Dactylus of right third pereiopod.
Fig. F. Tail fan, dorsal view.

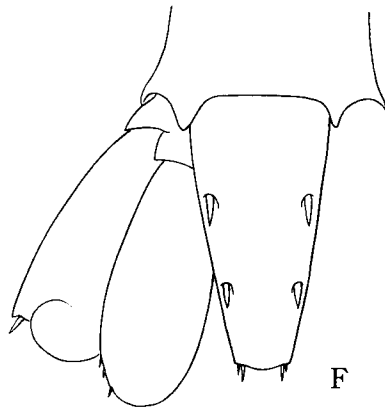
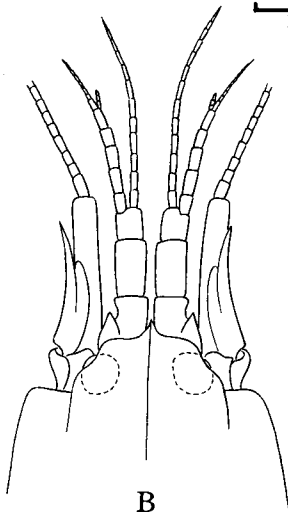
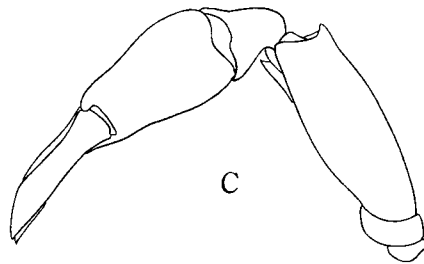
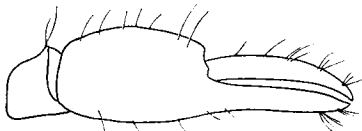
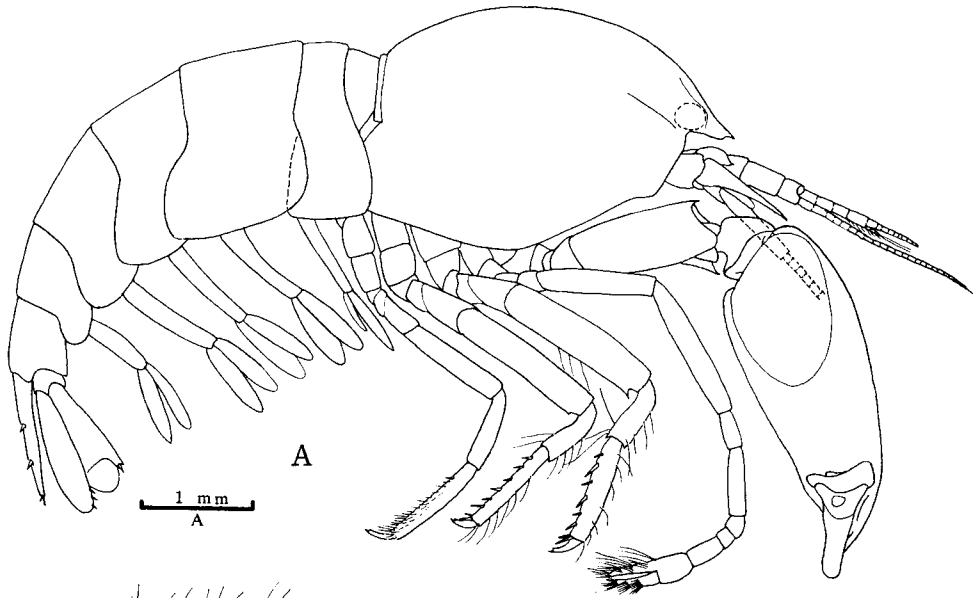


Plate 28

Alpheus spongiarum Coutière, 1897

- Fig. A. Male, 6.6 mm in carapace length.
Fig. B. Anterior region, dorsal view, ♀ (7.5 mm in c.l.).
Fig. C. Small cheliped, outer view, ♂ (6.6 mm in c.l.).
Fig. D. Dactylus and propodus of right third pereopod, ♀ (7.5 mm in c.l.).
Fig. E. Tail fan, dorsal view, ♀ (7.5 mm in c.l.).

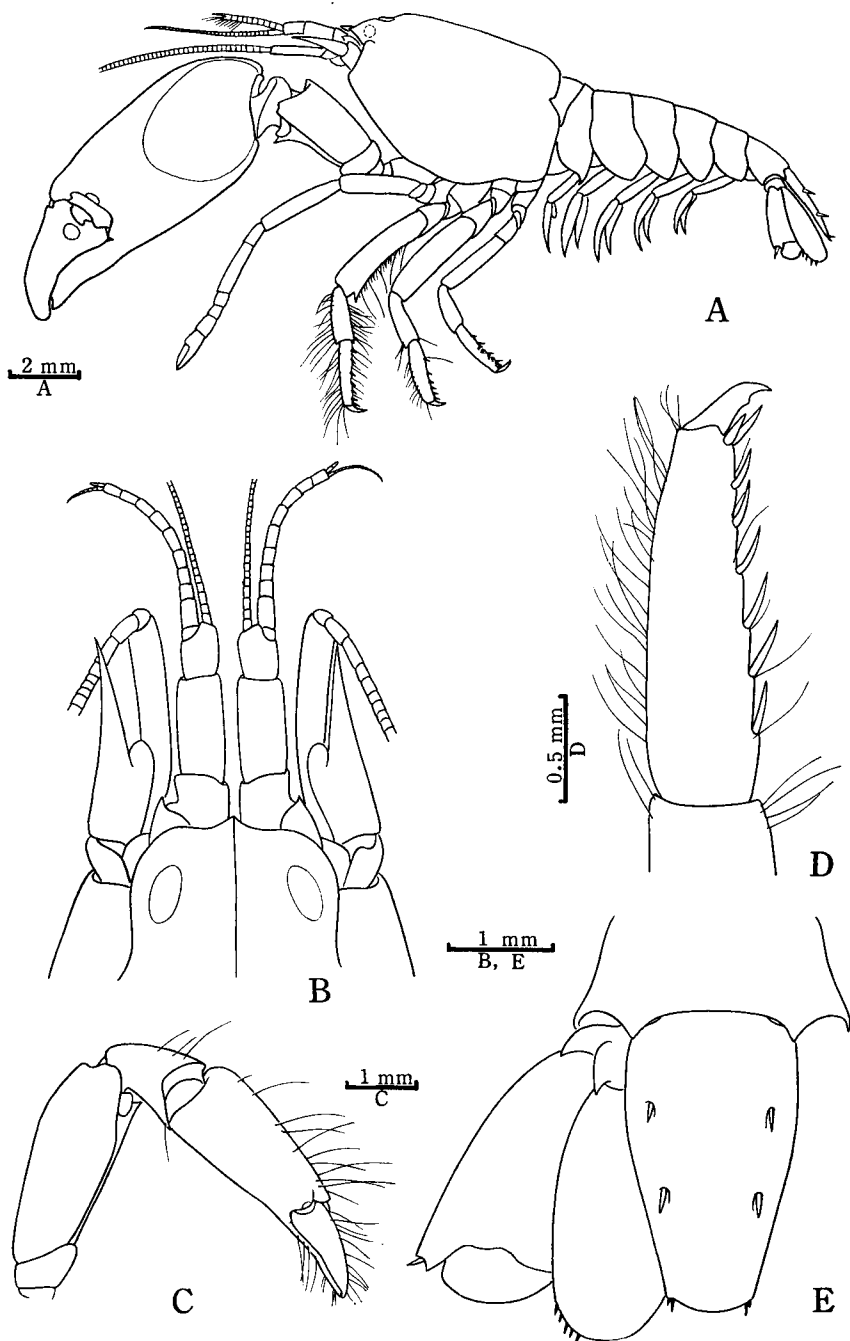


Plate 29

Alpheus diadema Dana, 1852

- Fig. A. Anterior region, dorsal view, ovig. ♀ (8.7 mm in c.l.).
Fig. B. Large chela, inner face, ♂ (7.1 mm in c.l.).
Fig. C. Small chela, dorso-outer face, ♂ (7.1 mm in c.l.).
Fig. D. Small cheliped, outer view, ovig. ♀ (8.7 mm in c.l.).
Fig. E. Dactylus and propodus of right third pereopod, ovig. ♀ (8.7 mm in c.l.).
Fig. F. Tail fan, dorsal view, ovig. ♀ (8.7 mm in c.l.).

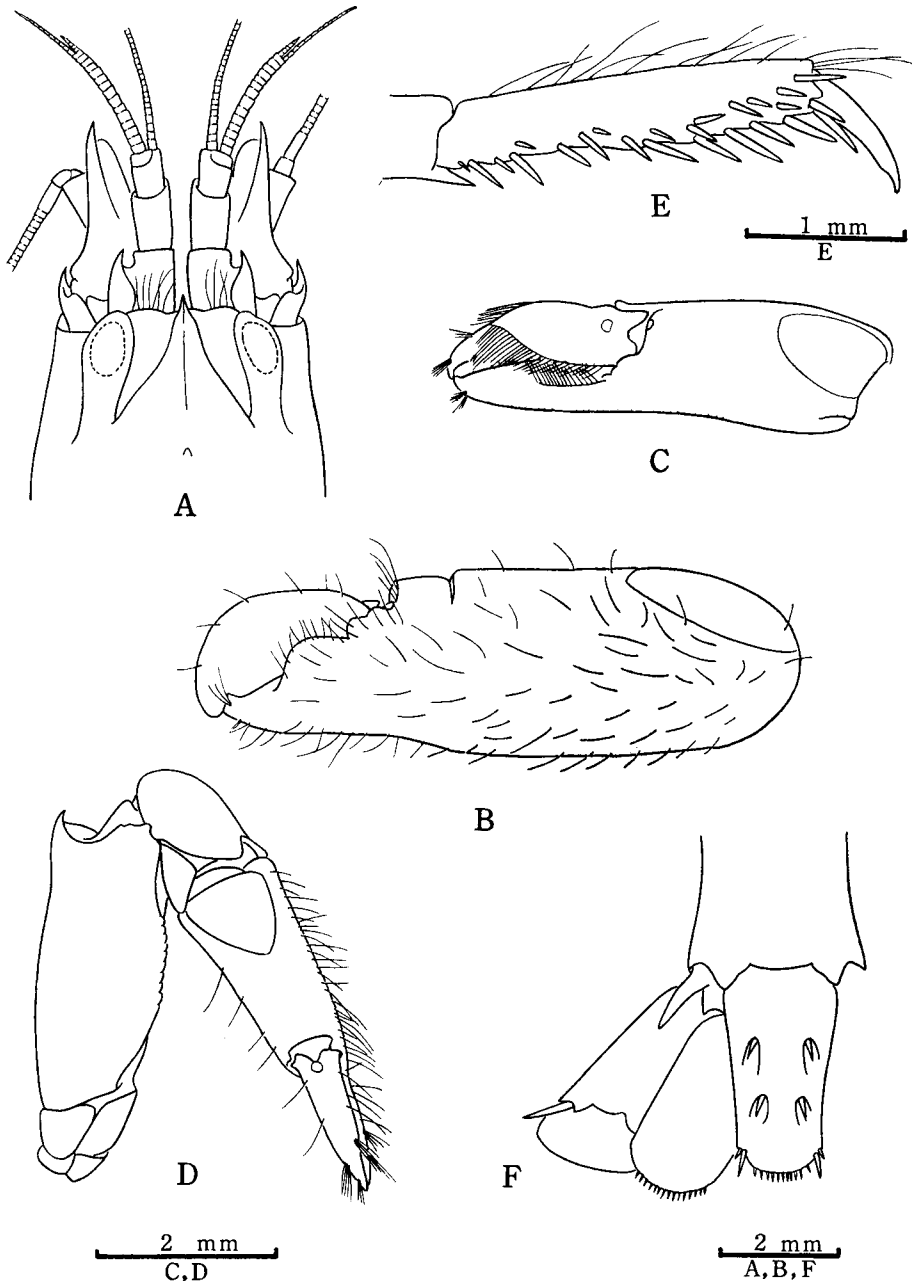


Plate 30

Alpheus gracilipes Stimpson, 1860

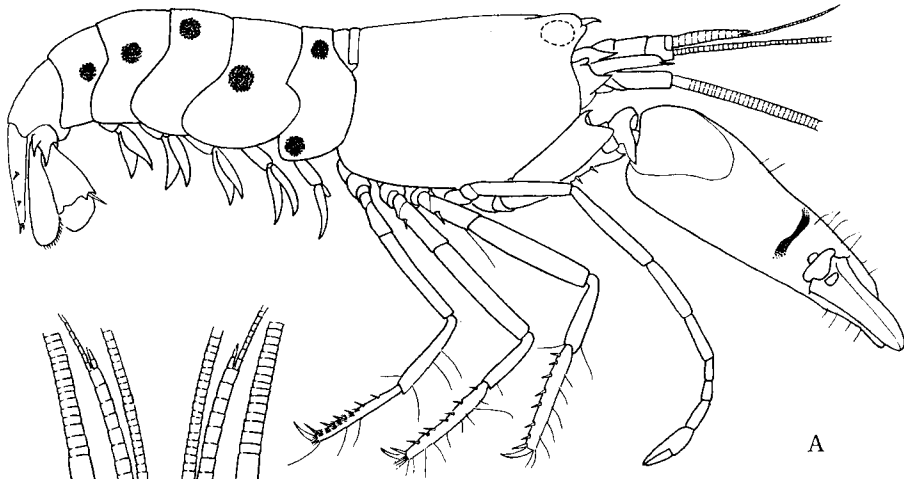
Fig. A. Male, 6.3 mm in carapace length.

Figs. B and C. Anterior region, dorsal view, showing variations, respectively,

♂ (6.3 mm in c.l.) and ovig. ♀ (7.8 mm in c.l.).

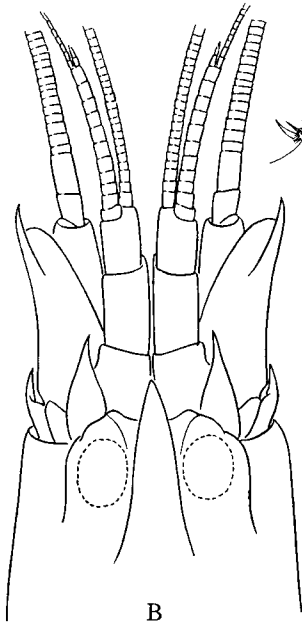
Fig. D. Small chela, dorso-outer face, ♂ (6.3 mm in c.l.).

Fig. E. Tail fan, dorsal view, ♂ (6.3 mm in c.l.).

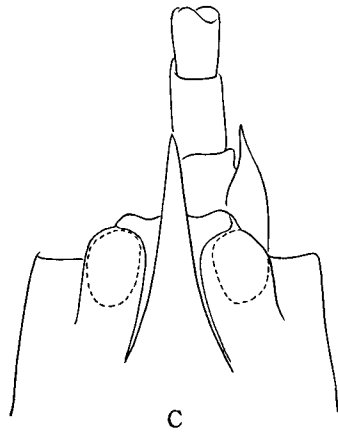


A

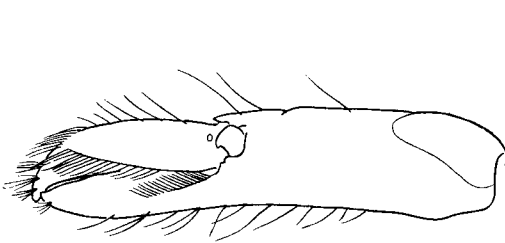
2 mm
A



B

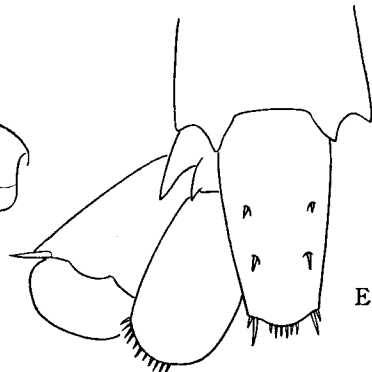


C



D

2 mm
B, C, D, E

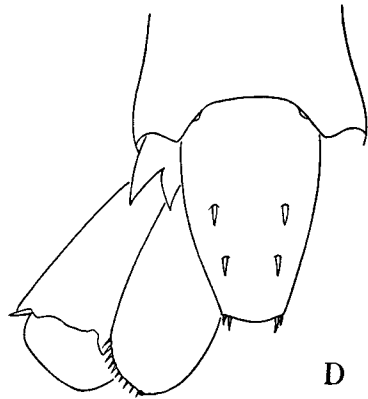
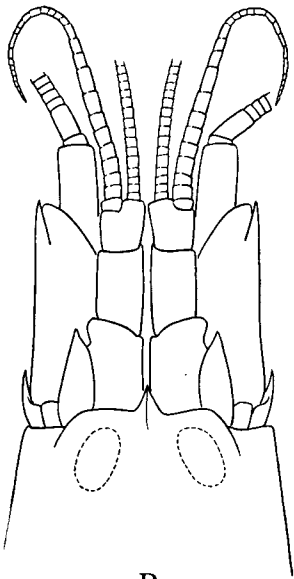
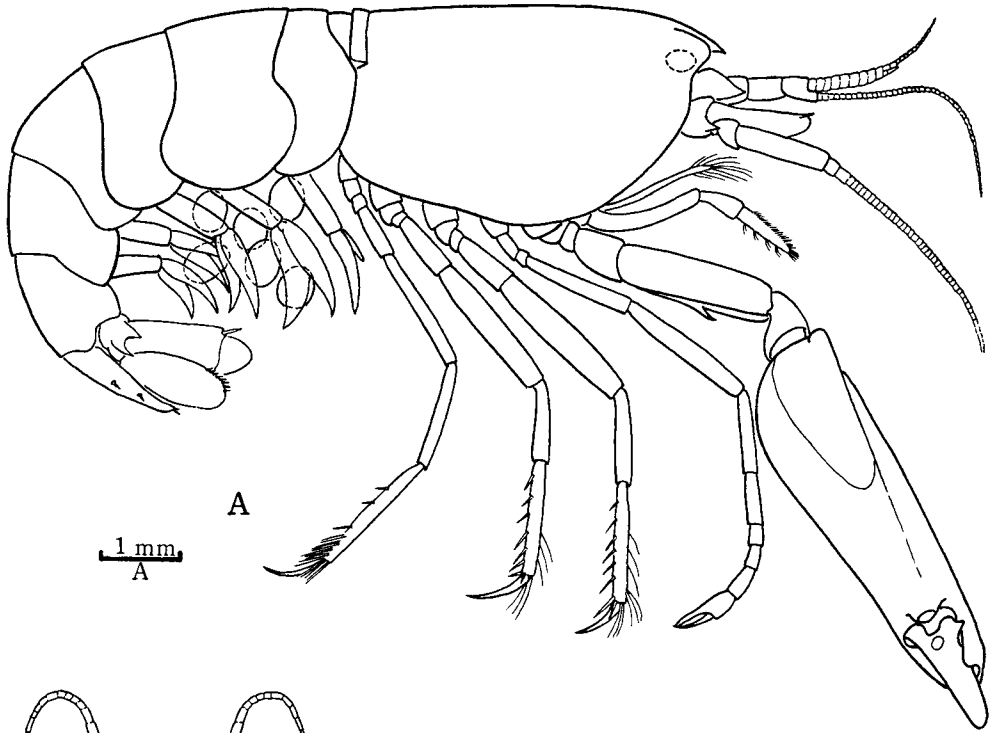


E

Plate 31

Alpheus paracrinitus Miers, 1881

- Fig. A. Ovigerous female, 4.8 mm in carapace length.
- Fig. B. Anterior region, dorsal view, ♂ (4.2 mm in c.l.).
- Fig. C. Small chela, inner face, ovig. ♀ (4.8 mm in c.l.).
- Fig. D. Tail fan, dorsal view, ♂ (4.2 mm in c.l.)



1 mm
B, C, D

B

C

D