Miya, Y. 1972

To Dr. F. A. Chace, Jr.
With my best thanks
Y. Miya

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

Yasuhiko MIYA

Reprinted from

Publications from the Amakusa Marine Biological Laboratory,

Kyushu University

Vol. 3, No. 1

1972

Publ. Amakusa Mar. Biol. Lab.,
Vol. 3, No. 1, 23-101, 1972

The Alpheidae (Crustacea, Decapoda) of Japan and its adjacent waters. Part I.[1,2,3]

Yasuhiko MIYA

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

With Plates 1–14

Contents

Introduction

The family Alpheidae is one of the members of the section Caridea, and contains about 400 species distributed in 20 genera. The shrimps of this family are small but stout animals which are characterized by the large, asymmetrical chelae of the first pereiopods. Their common Japanese name "Teppo ebi" is derived from the clicking or snapping sounds produced by the larger chela. They are abundant in shallow-water habitats, primarily on coral reefs in the tropical and subtropical regions. In the north-western Pacific the northern limit of the geographical distribution of the members may be situated in the seas around Japan where the geographical ~~the~~ limits of the present study are placed.

1) Contributions from the Zoological Laboratory, Faculty of Agriculture, Kyushu University, No. 442.
2) Contributions from the Amakusa Marine Biological Laboratory (Kyushu University), No. 222.
3) Contributions from the Seto Marine Biological Laboratory, No. 558.

The earliest record of the members of the family from Japan was made by De Haan (1849) in the "Fauna Japonica," where he described six species. After that, the taxonomic study on the Japanese alpheid shrimps has been promoted by such authors as Stimpson (1860), Miers (1879), Ortmann (1890), De Man (1907), Balss (1914), Parisi (1919), Yokoya (1927, 1930, 1933, 1936, 1939), Kubo (1936, 1938, 1940, 1942, 1951), and very recently by the author under Prof. Emer. Miyake's guidance (1966, 1967, 1968a, 1968b, 1969). Due to the efforts of these scientists have so far been recorded 41 species in the 8 genera.

Prior to the present study, however, the alpheid fauna of Japan and its adjacent waters has not been studied as a unit. In this study it is intended to throw light on the composition of the alpheid fauna of this region. The systematics contains the following 76 species, including 2 new species, 6 previously known species from the study area but not represented in the materials, and 2 species of doubtful record: *Betaeus* 1 sp., *Aretopsis* 1 sp., *Athanas* 9 spp., *Alpheus* 48 spp., *Automate* 1 sp., *Salmoneus* 3 spp., *Synalpheus* 12 spp. and *Batella* 1 sp. The ecological notes, such as the habitat types and the commensal relationships, and the geographical distribution of them are also tabulated and discussed.

The alpheid shrimps often show marked variations with size and sex even in the specific characters, such as in the shape and size of the first pereiopods and in the shape and proportions of the antennular and antennal segments. In the course of the present study the author paid the special attention to this account, and made an attempt to revise some species based upon the variations found in a great number of specimens examined.

Acknowledgments

This study would not have been possible without the generous assistance of many persons, whose aid it is a pleasure to acknowledge. The author should like to express here his deepest gratitude to Prof. Emer. Sadayoshi Miyake, Zoological Laboratory, Kyushu University, who gave him this opportunity of studying Japanese Alpheidae and offered him his advice throughout.

The following individuals extended many courtesies to the author while he was visiting their respective institutions, and gave him permission to study and report on the collections in their care: The late Prof. Itsuo Kubo, Tokyo University of Fisheries; Prof. Huzio Utinomi, Dr. Takasi Tokioka, Dr. Saburo Nishimura and Mr. Chûichi Araga, Seto Marine Biological Laboratory; Dr. Eiji Harada, Kyoto University; Prof. Emer. Sueo M. Shiino and Dr. Shigeko Ooishi, Prefectural University of

Mie; Prof. Taiji Kikuchi and Mr. Akio Taki, who is now on the staff of Kyoto University, Amakusa Marine Biological Laboratory, Kyushu University; Dr. Toshio Saisho and Mr. Yoshihiro Ushio, Kagoshima University.

The type specimens were sent on the author's request by the Muséum National d'Histoire Naturelle, Paris, for which the author was much indebted to Dr. Jacques Forest. The type and comparative specimens in their institutions were examined for the author, and the informations on them were provided by Prof. Lipke B. Holthuis, Rijksmuseum van Naturlijke Historie, Leiden; Dr. R. W. Ingle, British Museum (Natural History), London; and Prof. and Mrs. Albert H. Banner, Hawaii Institute of Marine Biology, University of Hawaii. Valuable suggestions and discussions on the taxonomy, ecological notes and the zoogeographical distribution were offered by Mrs. Banner, Dr. Harada, and Dr. Nishimura. The author would like to express here his deepest thanks the administration of the Biological Laboratory of the Imperial Household for permission to study its extensive collection from Sagami Bay which has aided materially in the preparation of this monograph. The rich material from the East China and Yellow Seas deposited in the Seikai Regional Fisheries Research Laboratory was placed at the author's disposal through the courtesy of Dr. Hideo Yamashita.

Finally, the author acknowledges his indebtedness to the members of the Zoological Laboratory, Kyushu University who followed and assisted the progress of this work from the beginning: Prof. Teru Aki Uchida who showed an interest in his work and encouraged him in many ways; Mr. Hisakatsu Minei who provided him the photographs; Dr. Takahiro Fujino who helped him in several drawings; Dr. Keiji Baba, who is now on the staff of Kumamoto University, and other members gave him their helpful advice.

Sources of materials

The materials on which this study was based were derived from the following sources. The abbreviation of each source in the parenthesis will be used showing the administration of the specimens examined in this paper.

1. Zoological Laboratory, Kyushu University (ZLKU). The extensive collection was made from time to time by Prof. Emer. Miyake and other members of staffs during the past more than thirty years. The major portion of the material came from various localities of southern Japan, the Ryukyu Archipelago and the Caroline Islands. The type specimens of *Salmoneus babai* Miyake and Miya, 1966, *Salmoneus gracilipes* sp. nov., *Batella bifurcata* Miya and Miyake, 1968, *Athanas acanthocarpus*

Miya and Miyake, 1968 and *Alpheus miyakei* sp. nov. are deposited at the laboratory.

2. Amakusa Marine Biological Laboratory, Kyushu University (AMBL). The rich material was collected by dredging operations from the ship, shore collecting, and washing from obstacles entangled with lobster trammel-nets from Chijiwa Bay and other localities around the Amakusa Islands, with Prof. Kikuchi and Mr. Taki as principal collectors.

3. Biological Laboratory, Imperial Household (BLIH). The extensive material was collected by dredging operations from the ship and shore collecting in Sagami Bay up to 200 metres deep. As the specimens derived from Sagami Bay were less well represented in the collection of ZLKU, the rich collection in BLIH was of particular value to the study.

4. Biological Laboratory, Kumamoto University (BLKU). Some specimens from the Sea of Ariake were collected by Dr. Baba.

5. Department of Zoology, National Science Museum (NSM). Some specimens from the Ogasawara Islands were collected by Dr. Minoru Imajima.

6. Zoological Laboratory, Prefectural University of Mie (PUM). It was a small collection from the Ogasawara Islands, and some specimens from Kii Peninsula and Amami-oshima Island, the Ryukyu Archipelago, with Prof. Emer. Shiino, Dr. Ooishi and Mr. Kunihiko Izawa as principal collectors.

7. Seto Marine Biological Laboratory, Kyoto University (SMBL). The collection was the rich material from the sea around Kii Peninsula, including the type specimens of *Synalpheus striatus* Kubo, 1938, *Athanas setoensis* Kubo, 1951, and *Alpheus bellulus* Miya and Miyake, 1969. Through the courtesy of Prof. Utinomi the author was permitted to search for the decapod crustaceans which were preserved in the same bottles together with their host animals (soft corals and comatulids). These specimens were used for an understanding of various aspects of the host specificity.

8. Seikai Regional Fisheries Research Laboratory (SRFRL). The East China and Yellow Seas are well represented by the rich material collected by dredging operations from its research vessels. The collection has aided materially in the preparation of this study.

9. Laboratory of Fishery Biology, Tokyo University of Fisheries (TUF). It was the late Prof. Kubo's collection from various localities in Japan, including the type materials of *Athanas japonicus* Kubo, 1936 and *Betaeus yokoyai* Kubo, 1936.

10. Zoological Laboratory, Faculty of Fisheries, Kagoshima University (ZLFKU). The major portion of the collection submitted for this study was made by the members of the Marine Ecological Research Society, Kagoshima University (MERS) from various localities of Kagoshima Prefecture, the Ryukyu Archipelago and Formosa.

Systematics

Supersection NATANTIA Boas, 1880
Section CARIDEA Dana, 1852
Superfamily ALPHEOIDA Holthuis, 1955
Family ALPHEIDAE Bate, 1888

Alpheidea: De Haan, 1849: 168, 173 (family; part, not *Hippolyte*, *Rhynchocinetes*, *Pandalus*, *Lysmata* and *Pontonia*).
Alpheinae: Dana, 1852a: 16 (subfamily; part, not *Alope*, *Hippolyte*, *Rhynchocinetes*).
Alpheidae Bate, 1888: 528.——Ortmann, 1891: 456.——Coutière, 1899: 322 (part, not *Ogyris*).——De Man, 1911: 133 (part, not *Ogyris*).——Balss, 1927: 1002 (part, not *Ogyris*).——Gurney, 1938: 44 (larval development).——Barnard, 1950: 724 (part, not *Ogyris*).——Holthuis, 1955: 12, 82.——Balss, 1957: 1544 (part, not *Ogyrides*).——Hart, 1964: 434.——Thompson, 1966: 315, table 1.——Banner and Banner, 1966b: 22.
Crangonidae: Banner, 1953: 8.

Definition. Body generally smooth. Carapace usually provided with cardiac notch. Rostrum reduced or absent. Antennal and branchiostegal spines absent. Eyes usually partly or wholly covered by carapace, never very elongate. Mandible bipartite, with palp of 2 articles, except in *Prionalpheus* (lacking molar process and palp) and *Batella* (lacking palp). Maxillula with bi- or rarely uni-lobed palp. Epipods of first and second maxillipeds always undivided. Third maxilliped with elongated ischio-meral segment (antepenultimate segment) except in *Pomagnathus*. First pair of pereiopods powerfully developed, with enlarged chelae which are usually asymmetrical and often show sexual dimorphism. Second pereiopod weakly chelate, with carpus of 5, 4 or rarely 3 articles. Third, fourth and fifth pereiopods with uni-, bi- or tri-unguiculated dactylus; propodus of fifth pereiopod with "brush" of transverse-oblique rows of bristles. Abdomen usually with gradual curve, without any pronounced bending at third segment; size and shape of pleura often showing sexual dimorphism; sixth segment with a movable plate articulated at posterolateral angle of pleuron in some genera. Telson almost always with 2 pairs of dorsal spines. Branchial formula: 5 pleurobranchs+0-1 arthrobranch+2-7 epipods+0-5 setobranchs+3 (+rarely 2 rudimental) exopods. (Adapted from Coutière, 1899).

Remarks. In the general scheme of the decapod crustacean classification the position, relationship and members of the family Alpheidae were the matters on which opinions were divided among previous workers. The early history of its classification was summarized by Coutière (1899), and the family was considered by him and others having its closest affinities with the family Hippolytidae.

When Borradaile (1907) proposed to group caridean families in superfamilies, he placed the Alpheidae in the superfamily Palaemonoida together with the Hippolytidae, Rhynchocinetidae and Palaemonidae, and considered that the Alpheidae was closely allied to the Hippolytidae. Borradaile's system was almost fully adopted by Balss (1927) in his classification of the Eucyphidea (=Caridea) which has been accepted by almost all of the subsequent authors. In his system, however, Balss did not accept the family Ogyridae erected by Hay and Shore (1918) for *Ogyris* Stimpson, 1860, which he retained in the Alpheidae.

With regard to the relationship within the Palaemonoida, however, Gurney (1938) gave a different opinion based on the knowledge of the larval development. He suggested that the larvae of *Rhynchocinetes* had the characters which completely excluded the family from the Palaemonoida, and concluded that the Alpheidae was more closely related to the Palaemonidae than to the Hippolytidae.

In 1955 Holthuis proposed the marked revision of the section (=tribe) Caridea, and erected the superfamily Alpheoida to contain the Alpheidae, Ogyrididae (=Ogyridae, nom. praeocc.), Hippolytidae transferred from the Palaemonoida, and Processidae from the Crangonoida. According to him the separation between the Alpheoida and the Palaemonoida s.s. is based on the differences in the following characteristics: "The Palaemonoida always has the second leg more robust than the first and the carpus of that leg undivided; in the Alpheoida the second leg practically always is slender with the carpus subdivided, while the first leg often is very heavy, being more robust than the second."

Later Balss (1957) adopted many Holthuis' fruits and revised his classification (1927) somewhat, e.g. the Rhynchocinetidae was removed from the Palaemonoida to the Hoplophoroida. But he did not accept the Bresilioida, in which the Rhynchocinetidae was inserted by Holthuis, and the Alpheoida in his system. As a natural result of no acceptance of this superfamily the Palaemonidae, Alpheidae and Hippolytidae were, as in the past, placed in the Palaemonoida. Further, he abandoned the Ogyrididae for *Ogyrides* Stebbing (=*Ogyris*, nom. praeocc.) so that the genus was again inserted in the Alpheidae.

In this paper the author follows Holthuis in recognizing the Alpheoida, because this category appears to be of a convenient one. As pointed out by Thompson (1966), however, the Alpheoida contains a number of diverse forms in its category, and the relationship between the Alpheoida and the Palaemonoida is by no means clear or settled.

In his excellent work on the Caridea Holthuis (1955) enumerated 19 genera in the Alpheidae. After that the 3 new genera: *Prionalpheus* Banner and Banner, 1960, *Leptalpheus* Williams, 1965 and *Betaeopsis* Yaldwyn, 1971 were erected and the 2 genera were perished, i.e. *Arete* Stimpson, 1860 was put into a synonymy of *Athanas* Leach, 1814 by Banner and Banner (1960a) and *Thunor* Armstrong, 1949 was inserted in the *obesomanus* group of *Alpheus* by Banner and Banner (1966a).

Of the 20 genera of the Alpheidae the following 8 genera are represented in the fauna of Japan and its adjacent waters, and may be distinguished in the key adapted from Holthuis (1955).

Key to the genera of Japanese Alpheidae

1. Epipods on at least first 2 pairs of pereiopods 2
   No epipods on pereiopods 7
2. A movable plate articulated at posterolateral angle of sixth abdominal segment 3
   No articulated plate at posterolateral angle of six abdominal segment 5
3. Rostrum prominent. No arthrobranch on third maxilliped 4
   Rostrum absent. An arthrobranch on third maxilliped .... *Betaeus*
4. Rostrum with a broad vertical lamella ventrally, rostral apex broadly rounded... *Aretopsis*
   Rostrum slender, pointed in lateral view .... *Athanas*
5. Eyes always visible in anterior view. Movable finger of large chela without a large molar-shaped tooth 6
   Eyes more or less completely covered with carapace anteriorly as well as dorsally. Movable finger of large chela with a large molar-shaped tooth .... *Alpheus*
6. Eyes dorsally fully exposed. Rostrum not reaching end of eyestalks. Posterior margin of telson convex .... *Automate*
   Eyes in dorsal view completely or almost completely covered by carapace. Rostrum reaching far beyond eyes. Posterior margin of telson with a median concavity.......... *Salmoneus*
7. Movable finger of large chela with a molar-shaped tooth. Chela of second pereiopod normal .... *Synalpheus*
   Movable finger of large chela without a molar-shaped tooth. Chela of second pereiopod very long with unusually short fingers .... *Batella*

Genus *Betaeus* Dana, 1852

Betaeus Dana, 1852a : 23 ; 1852b : 558.——Stimpson, 1860 : 100 (31).——Coutière, 1899 : 328.——Barnard, 1950 : 733.——Holthuis, 1955 : 83 (key), 88.——Hart, 1964 : 434.

Type species: *Betaeus truncatus* Dana, 1852. Selected by Fowler, 1912 (see Holthuis, 1955: 88).

Definition. Rostrum absent. Front emarginated between orbital hoods or evenly rounded, concealing eyes dorsally and laterally. Pterygostomial margin rounded. Short eyestalk having small conical tooth. Outer antennular flagellum weakly bifurcated. Mandible with palp of 2 articles. First pair of pereiopods carried extended, symmetrical or nearly so, with inverted chelae; movable finger without a molar-shaped tooth. Second pereiopod with carpus of 5 articles. Dactylus of third to fifth pereiopods simple or with well- or ill- developed secondary unguis. Sixth abdominal segment with a movable plate articulated at posterolateral angle of pleuron. Telson broad, posteriorly rounded. Branchial formula[1]: 5 plbs.+1 arthrb.+7 eps. +5 setbs. +3 expds.

Remarks. Of the 18 species previously known all but one from the Mauritius Islands have been recorded from coasts of continents and major islands in the Southern Ocean and the North and South East Pacific, i.e. 1 species from South Africa, 1 from South Australia, 2 from Chile, 7 from West coast of North America (from about 25°-57° N), and 6 from coasts of Far East Asia and Japan. Some of them, however, are insufficiently known till now and some may be synonyms.

In Japan the 3 species: ***B. granulimanus*** Yokoya, 1927, ***B. yokoyai*** Kubo, 1936 and *B. murayamai* Yokoya, 1936 have previously been represented in the Japanese fauna, however, it will be clearly discussed in the present study that they have shown only a narrow phase of ***B. granulimanus***, respectively. Such confusion might be arisen from the marked variations with sex and growth occurring especially in the shape of the first pair of pereiopods.

The variation in the first pereiopods was also known in ***B. truncatus*** Dana, 1852 from Chile (Holthuis, 1952), in *B. longidactylus* Lockington, 1877, *B. harrimani* Rathbun, 1904 and others from the Pacific coast of North America (Hart, 1964). The extent of this variation, however, is apparently inconstant from species to species.

Betaeus granulimanus Yokoya, 1927
(Japanese name: Teppo ebi modoki)

(Plates 1, 2; Tables 1, 2)

Betaeus granulimanus Yokoya, 1927: 173, pl. 7, figs. 17-22.——Nakazawa and Kubo, 1947: 778, fig. 2246.——Utinomi, 1956: 59, pl. 29, fig. 1 (colourphoto); 1969: 59, pl. 29, fig. 1 (colourphoto) (revised and new edition).——Kubo, 1965: 613, fig. 966.——Nishimura and Suzuki, 1971: 84, pl. 27, fig. 8 (colourphoto).
Betaeus yokoyai Kubo, 1936: 50, pl. 15, figs. A-G; 1960: 105, pl. 52, fig. 6.
Betaues murayamai Yokoya, 1936: 132, figs. A-C.

Description. The animals measure 12.6-60.7 mm in body length (3.6-17.0 mm in

1) Recently Yaldwyn (1971) established *Betaeopsis* on basis of *Betaeus aequimanus* Dana, 1852 and *B. indicus* De Man, 1910 which had the epipods on maxillipeds and 1st to 2nd pereiopods only. Excluding these two species from *Betaeus*, it seems that all the present members of the genus do not vary in number of the epipods and setobranchs.

carapace length); the entire surface of the body is polished and pubescent. The front has a U- or V-shaped emargination medially. The orbital hoods are slightly inflated dorsally, and their anterior margins are more or less produced forward and gently curved.

The antennular peduncle is robust, the second segment is 1.2-2.1 times as long as broad; the first segment has a small process near the base dorsally, its outer distal corner is produced as a sharp, strong tooth hardly reaching to the apex of the stylocerite. The acute, elongated stylocerite reaches to the distal half of the second segment. The basicerite has a strong, sharp tooth extending forward as far as the end of the first antennular segment. The carpocerite is stout and slightly exceeds the end of the antennular peduncle. The scaphocerite is shorter than the carpocerite; the anterior margin of the broad lamella reaches to or almost to the end of the antennular peduncle.

The third maxilliped usually extends to the end of the carpocerite by its apex; the antepenultimate segment bears coarse tubercles especially on the ventral margin.

In most of the specimens of both sexes the first pereiopods are of medium and slightly asymmetrical. In the large chela both fingers form a circular space enclosed with 4 medium teeth, 2 of them on the movable finger and the other 2 on the immovable finger, on the proximal halves of their cutting edges, and bear fine or coarse denticulations on the distal halves of them. In the small chela both fingers are slender and close without a gap, their cutting edges are furnished with fine denticulations entirely. Almost all the segments, especially the chelae and the distal half of the merus, are sparsely or densely scattered with ill- or well-developed tubercles. The first pereiopods of this type correspond closely with those of *B. yokoyai.*

In the smaller specimens of both sexes the first pereiopods are of slender and symmetrical. All the segments are almost entirely smooth without the tubercles. In the chelae both fingers are slender and straight, and end in small hooked tips; their cutting edges are almost entire. The first pereiopods of this type are closely allied to those of *B. murayamai.*

In the larger males the first pereiopods are of voluminous and considerably asymmetrical. In the large chela both fingers form a large circular space enclosed with 4 strong teeth proximally, and have coarse denticulations on the distal halves of their cutting edges. In the small chela both fingers are strongly curved, largely gape, and bear coarse denticulations on their cutting edges entirely. All the segments are densely covered with well-developed tubercles almost entirely. The first pereiopods of this type are similar in appearance to those of *B. granulimanus.*

The proportional measurements in the first pereiopods are shown in Table 1.

The second pereiopod exceeds the end of the carpocerite by the chela; the carpal articles have a ratio, 10 : 3-5 : 3-5 : 3-5 : 6-9.

In the third pereiopod the dactylus has a budding secondary unguis at the distal fourth of the ventral margin. The merus is 3.8-5.0 times as long as broad, and has a strong movable spine ventrally; the same spine is also found on the merus of the fourth pereiopod. The ischium is unarmed.

The telson is 3.4-4.8 times as long as broad at the posterior margin, which is usually strongly arcuate. The dorsal surface is flat and bears 2 pairs of spines; the anterior pair is situated at 2/5 of the length, and the posterior pair is at 2/3 of it.

Variations. The specimens available show the marked variations in all the characteristics that have been used for the separation of *B. granulimanus*, *B. yokoyai* and *B. murayamai* (Table 2).

1. Frontal part of carapace. In some of the specimens the frontal emargination is deep and U in shape as figured for *B. yokoyai*, while in others it is shallow and V in shape as in *B. granulimanus* or *B. murayamai*. There is a general tendency that the U-shaped emargination is more often found in the larger specimens rather than in the smaller.

The anterior margin of orbital hoods is more distinctly produced forward in the larger specimens rather than in the smaller.

2. Ratio of antennular segments. The antennular segments are found to vary in the ratio to the second segment: 1.2-1.7 : 1.0 : 0.7-1.0. In most of the specimens the first segment is about 1 1/3 the length of the second segment. There is no specimen having the ratio, as depicted for *B. granulimanus*.

3. First pereiopods. The variations in the shape of the first pereiopods with sex and size in the material examined may be summarized as follows:

The smaller specimens of both sexes have the slender, symmetrical first pereiopods of *murayamai*-type, and the larger males have the voluminous, considerably asymmetrical ones of *granulimanus*-type. Further, in most of the specimens of both sexes the first pereiopods are of the medium, slightly asymmetrical *yokoyai*-type. In the material examined (18 ♂♂, 9 ovig. ♀♀, 5 ♀♀), however, there are two atypical or intermediate types found: In the larger male (16.5 mm in c.l.) the first pereiopods may be placed in the *granulimanus*-type, except for the cutting edges of both fingers of the large chela provided with the coarse denticulations along the entire margins instead of the large gap. In the other male (13.1 mm in c.l.) the first pereiopods are also related to the *granulimanus*-type, however, the cutting edges of the fingers of the large chela have the coarse denticulations entirely, and the fingers of the small chela form a narrow gap only.

4. Telson. In most of the specimens the posterior margin of the telson is strongly arcuate, but is rounded in a few specimens.

A male (6.0 mm in c.l.) has no dorsal spines. An ovigerous female (9.0 mm in c.l.) has only a pair of dorsal spines, as was figured for *B. murayamai*. Each condition, however, is observed only one time respectively among more than 30 specimens examined.

5. Range of proportional measurements in first pereiopods. See Table 1.

Table 1. Measurements of *Betaeus granulimanus* Yokoya, 1927

			18 ♂♂	9 ovig. ♀♀	5 ♀♀
Body length (in mm)			21.4–55.5	26.7–51.8	12.6–33.3
Carapace length (in mm)			6.0–17.0	7.8–15.5	3.6–9.0
Large cheliped:					
	Chela	length/carapace length	0.9–2.3	0.9–1.1	0.7–0.9
		length/height	3.1–4.8	3.4–4.2	3.3–4.0
	Palm	length/height	1.6–2.8	1.8–2.2	1.7–2.0
	Merus	length/breadth	2.6–3.6	2.9–4.0	3.2–3.8
	Relative length of segments (in proportion to palm)				
		Dactylus	0.5–1.0	0.8–1.1	0.9–1.0
		Palm	1.0	1.0	1.0
		Carpus	0.3–0.5	0.4–0.5	0.5
		Merus	0.7–1.3	1.0–1.4	1.3–1.4
		Ischium	0.1–0.3	0.2–0.3	0.3–0.4
Small cheliped:					
	Chela	l/c.l.	0.6–1.7	0.7	0.6–0.8
		l/h	3.5–5.1	3.6–4.3	3.1–4.0
	Palm	l/h	1.7–2.7	1.8–2.2	1.7–2.0
	Merus	l/b	2.8–3.9	3.2–4.2	3.5–3.8
	Relative length of segments (in proportion to palm)				
		Dactylus	0.8–1.1	1.0–1.1	0.9–1.1
		Palm	1.0	1.0	1.0
		Carpus	0.4–0.5	0.4–0.7	0.4–0.6
		Merus	1.1–1.6	1.3–1.7	1.3–1.5
		Ischium	0.2–0.5	0.3–0.4	0.4
Second pereiopod:					
	Relative length of carpal articles		10 : 3–5 : 3–5 : 3–5 : 6–9		
Third pereiopod:					
	Merus	l/b		3.8–5.0	

Relative length of segments:	Dactylus		Propodus		Carpus		Merus		Ischium
(in proportion to propodus)	0.3–0.4	:	1.0	:	0.5–0.8	:	1.2–1.5	:	0.4–0.6

Material examined.

Southern Japan.——Sagami Bay: 1♂, ZLKU No. 2646, Kanagawa Pref., Manazuru, Apr. 1960, K. Sakai leg.; 1♂, 2 ovig. ♀♀, 1♀, ZLKU No. 13715, Kanagawa Pref., Misaki, Mito, rocky shore, under boulders near low tidemark, Aug. 20, 1967, Y. Miya leg.——Kii Peninsula: 2♂♂, SMBL Macr. No. 22, Wakayama Pref., Tanabe Bay, Seto, more data unknown; 4♂♂, 1 ovig. ♀, 1♀, SMBL Macr. No. 27, Tanabe Bay, Sakinoyu, Apr. 11, 1936; 1♂, 1♀, PUM, Shirahama, Seto, Apr. 19, 1954; 1♂, 1 ovig. ♀, SMBL, Tanabe Bay, Banshoshita, rocky shore, Nov. 12, 1969, S. Nishimura leg.——Northern Kyushu: 1♂, ZLKU No. 2651, Fukuoka Pref., Hakata Bay, Shika-no-shima I., Katsuma, under boulder on intertidal zone of rocky shore, May 2, 1965, K. Baba et al.; 1♀, ZLKU No. 1133, Fukuoka Pref., Munakata-oshima I., Apr. 1957, Y. Motomatsu leg.——Western Kyushu: 1♂, ZLKU No. 302, Amakusa Is., Shimo-shima I. Shimotsufukae, June 19, 1936, K. Baba leg.; 6♂♂, 3 ovig. ♀♀, 3♀♀, ZLKU No. 2652, Amakusa Is., Shimo-shima I. Tomioka, Shiroiwa-saki, June 14, 1965, S. Miyake and T. A. Uchida leg.; 4 ovig. ♀♀, 1♀ ZLKU No. 3222, Amakusa, Tomioka, Shiroiwa-saki, under rocks on intertidal zone of rocky shore, July 27, 1965, Y. Nakasone leg.; 1 ovig. ♀, ZLKU No. 13710, Amakusa, Tomioka, Shiroiwa-saki, under rocks on intertidal zone of rocky shore, Aug. 24, 1965, T. Kikuchi leg.; 2♂♂, 1 ovig. ♀, ZLKU No. 13711, Amakusa, Tomioka, Shiroiwa-saki, under rocks near low tidemark on rocky shore, June 22, 1966, Y. Miya leg.; 1♂, ZLKU No. 13714, Amakusa, Tomioka, Shiroiwa-saki, under rock on intertidal zone of rocky shore, Mar. 29, 1967, K. I. Hayashi leg.; 3♂♂, 1 ovig. ♀, ZLKU No. 2647, Danjo-gunto Is., Me-shima I., Apr. 2, 1962, S. Mito leg.——Southern Kyushu: 1♂, 1 ovig. ♀, ZLKU No. 13709, Kagoshima Pref., Shibushi Bay, under rocks on intertidal zone, Aug. 18-22, 1963, H. Minei and K. Baba leg.; 1♂, ZLFKU, Kagoshima Pref., near Makurazaki, Hanase, May 23, 1966, Y. Ushio leg.; 2♂♂, 2 ovig. ♀♀, ZLKU No. 17254, Tanega-shima I., Kumano, Apr. 6, 1970, H. Minei leg.; 1♂, ZLKU No. 17258, Tanega-shima I., Shimama, Apr. 8, 1970, H. Minei leg.

Colour in life. Recently the two colourphotos of the species were represented by Utinomi (1956, 1969) and Nishimura and Suzuki (1971). Utinomi's colourphoto shows the shrimp with the yellowish brown enlarged chelipeds, and Nishimura and Suzuki's one represents the shrimp with the colourful slender chelipeds, respectively. So far as the author has examined, the living animals show these two colour patterns in the chelipeds, and there may be some correlation between the patterns and the animal size as follows:

In the larger animals all the segments of the first pereiopods are light yellowish orange, sometimes mingled with bluish green; the tubercles apically tinged with bluish green are scattered over most of the surface of them. This colour pattern corresponds closely with Utinomi's colourphoto.

In the smaller animals the chelae of the first pereiopods are colourful, such as most of the palmal portion is pale yellow orange and furnished with the tubercles apically tinged with bluish green; there are a large yellow orange patch and same coloured tubercles at the narrow portion surrounding the finger articulation; a broad greenish blue transverse band and same coloured tubercles present at the medial portion of the fingers, the colour distally fades away into yellow orange or trans-luscent and also proximally fades away into the above-mentioned patch. This colour

Table 2. Characteristics used for separation of the 3 nominal species.

Characteristics	*B. granulimanus*[1]	*B. yokoyai*[2]	*B. murayamai*[3]
Frontal part of carapace	V-shaped emargination; anterior margin of orbital hoods projecting	U-shaped emargination; anterior margin of orbital hoods projecting	V-shaped emargination; anterior margin of orbital hoods almost truncated
Ratio of antennular segments	1st 2nd 3rd 1.0 : 1.0 : 0.5	1.2–1.4 : 1.0 : 0.8–1.0	1.3 : 1.0 : 1.0
First pereiopods			
Large chela	Fingers forming a circular space	Fingers forming a circular space	Fingers nearly straight, not forming a circular space
Length of large cheliped	Longer than total body length	Longer than 1/2 of total body length	Almost as long as 1/2 of total body length
Small chela	Fingers largely gaping	Fingers straight, not gaping	Fingers straight, not gaping
Length of small cheliped	About as long as total body length	Longer than 1/2 of body length without telson	Subequal to length of large cheliped
Tuberculations	Well-developed tubercles scattered over most of surface of all segments except basal one	Rather well-developed tubercles over most of surface of all but the basal two segments	All segments almost smooth
Telson			
Dorsal spines	2 pairs	2 pairs	1 pair

1) After Yokoya, 1927. Type specimen: 1 sp. [♂, probably], 38 mm in body length. 2) Type specimens (deposited in TUF) re-examined by the author: 8 ♂♂, 26.0–46.0 mm in body length. 3) After Yokoya, 1936. Type specimen: 1 ♂, probably, 15.5 mm in body length.

pattern is closely allied to the colouration represented by Nishimura and Suzuki.

Excepting the first pereiopods, the entire animal may be expressed as bluish green densely scattered with deep red chromatophores. The ventral margin of the carapace and abdominal pleura is sometimes tinged with deep red. The tail fan has the fringe of long hairs which is dark brown purple basally and dark orange distally. The antennular and antennal flagella are dark orange. The lamella of the scaphocerite bears the fringe of the same colouration as in the fringe of the tail fan. The second and following pereiopods are sometimes tinged with deep red; the second is often transparent. The pleopods are transparent and marginated with bluish green.

The eggs freshly laid are olive green.

Ecology. This alpheid shrimp is commonly found on the rocky reefs washed by the clear oceanic water, where it lives in small groups under rocks near the low tide level.

This is a very agile shrimp. As the shrimps move very quickly and rush into under the neighbouring rocks if the shelters which they are taking are removed, it may be not easy to catch them in any number at a single chance.

The ovigerous females have been taken from April until November.

Remarks. The variations, with sex and growth, especially in the shape of the first pair of pereiopods have resulted in the description of this species under the three names. Yokoya (1927) described *B. granulimanus* from the single specimen with the stout chelipeds having the chelae quite asymmetrical. Kubo (1936) described the species as *B. yokoyai* from the 8 specimens with the slender chelipeds having the chelae slightly asymmetrical. Yokoya's type of *B. murayamai* showed the characters typical of young specimens, and had much slenderer chelipeds with the chelae almost symmetrical (1936).

It is apparent that the other subtle differences which have been used for separating the 3 species are either within the range of variations found in the specimens examined or represent only slight extension of the range. It will be, therefore, advisable to place the 2 later species in the synonymy of *B. granulimanus.*

Distribution. The species is distributed throughout the Pacific coast of southern Japan; lower tidal zone of rocky shore. Further, it is also found from Hong Kong.[1]

1) This fact was checked from the figures of a specimen sent from Mrs. Banner to the author. When the author received them, he felt the necessary to compare *B. granulimanus* with *B. pingi* Yu, 1930 which was known only from Chefoo [=Yentai], northern coast of Shantung Peninsula. Through the courtesy of Dr. Forest the author was able to study closely a

B. granulimanus has been recorded from: Kagoshima Bay (type locality, Yokoya, 1927), Tosa Bay (Nakazawa and Kubo, 1947) and the Pacific coast of southern Japan (Utinomi, 1956, 1969; Nishimura and Suzuki, 1971). *B. yokoyai* is known from: Kominato, Boso Peninsula (type locality, Kubo, 1936). *B. murayamai* is taken only from: Misaki, Sagami Bay (type locality, Yokoya, 1936).

Genus *Salmoneus* Holthuis, 1955

Jousseaumea Coutière, 1896: 381; 1899: 325.——Banner, 1953: 10.
Salmoneus Holthuis, 1955: 83 (key), 88.——Banner and Banner, 1966b: 38.

Type species: *Jousseaumea serratidigitus* Coutière, 1896. Selected by Holthuis (1955: 88).

Definition. Carapace more or less carinated. Triangular rostrum and short but distinct orbital teeth. Pterygostomial margin rounded. Eyes entirely or almost entirely concealed by carapace dorsally. Outer antennular flagellum clearly bifurcated. Mandible with palp of 2 articles. First pair of pereiopods quite asymmetrical, having chelae turned outward and folded beneath body. In large cheliped chela swollen and more or less uneven; fingers strongly compressed, with serrated cutting edges; carpus cyanthiform; merus sinuous, depressed, and slightly excavated to accomodate palm. Second pereiopod with carpus of 5 articles. Dactylus of third to fifth pereiopods simple. Pleura of sixth abdominal segment not articulated. Telson tapering, its posterior margin medially excavated or rarely truncated. Branchial formula: 5 plbs. +1 arthrb.+7 eps.+5 setbs.+3 expds.

Remarks. According to Holthuis (1955), *Jousseaumea* Coutière, 1896 was preoccupied by *Jousseaumia* Sacco, 1894, a genus of Mollusca, there upon, he proposed *Salmoneus* as the new name of this genus.

Of the genus 13 species are known at present, 9 of them inhabit the Indo-West Pacific region, 3 are known from the Atlantic coast of America and only 1 from the West African coast.

The following 3 species are represented in the collections at hand: *S. gracilipes* is new to science, *S. tricristatus* is recorded for the first time from the Ryukyu

---

male specimen (15.6 mm in c.l.) of *B. pingi* from Amoy Island (specimen label) deposited at the Muséum National d'Histoire Naturelle de Paris. Although that specimen is closely related to the specimens of *yokoyai*-type, it appears that *B. pingi* is clearly distinguished from *B. granulimanus* by its very shallow frontal emargination.

Archipelago, and *S. babai* was previously described by Miyake and Miya (1966).

Key to the species of Japanese *Salmoneus*

1. Eyes partly exposed dorsally .... *gracilipes* sp. nov.
   Eyes entirely concealed dorsally 2
2. Carapace with faint rostral carina only; in large chela movable finger crescent and much longer than immovable finger .... *babai*
   Carapace with 3 sharp, long carinae dorsally; in large chela movable finger slender and as long as immovable finger .... *tricristatus*

Salmoneus gracilipes sp. nov.
(New Japanese name: Ashiboso nokogiri teppo ebi)

(Plate 3; Table 3)

Types. Holotype, ovigerous female, ZLKU No. 17259, Amakusa Is., Shimo-shima I., Tomioka, under boulder on sandy-mud flat at low tide mark near AMBL, June 9, 1968, T. Fujino leg. Paratypes, 1 ♂, 2 ovig. ♀♀, ZLKU No. 1440, Genkai-nada, Fukuoka Pref., off Munakata-oshima I., 10 m deep, July 3, 1957, Y. Motomatsu leg.; 1 ♂, ZLKU No. 12278, Ryukyu Archipelago, Ishigaki-jima I., Sakieda, under boulder on intertidal zone, May 26, 1968, A. H. Banner leg.

Diagnosis. Rostrum narrow triangular, 1 1/3-1 1/2 times as long as broad at its base, curved downward, extending beyond end of second antennular segment; weak dorsal carina present. Orbital teeth acute, 1/4 times of rostral length. Orbitorostral margin deeply concave. Eyes markedly exposed dorsally. Stylocerite elongated, reaching near rostral apex. Large chela 3.5-3.6 times as long as high and swollen. Dorsal surface of palm flattened, with shallow longitudinal depression; ventral surface of palm convex, uneven, with inconspicuous longitudinal depression on the proximal half portion. Fingers equal in length, with sharp hooked tips; their cutting edges bearing minute serrations entirely. Carpal articles of second pereiopod having a ratio, 10:2:1-2:1-2:2-4. Propodus of third pereiopod bearing 6-9 spines on ventral margin; merus 4.6-7.5 times as long as broad. Telson tapering, 5.2-5.5 times as long as broad at posterior margin; in large specimens that margin with deep, U-shaped median excavation, whereas in smaller ones with shallow, rounded excavation.

Description. Holotype.——The animal is slender and sparsely hairy on the dorsal surface. The rostrum is 1 1/3 times as long as broad at its base, and has the weak dorsal carina which is somewhat longer than the rostrum itself; the sharp rostral apex exceeds the end of the second antennular segment. The orbital teeth are acute and 1/4 times as long as the rostrum. The orbitorostral margin is deeply concave, so that the cornea is markedly exposed dorsally, and consists of about 45°. An inconspicuous suture is observed extending on the level of the antenna backward to the anterior third of the carapace.

The antennular 3 segments are robust and subequal in size; the second segment is as long as broad. The stylocerite is elongate and almost as long as the rostrum. The carpocerite is robust and extends beyond the middle of the second segment. The scaphocerite is 1.9 times as long as broad, and reaches the end of the antennular peduncle; the outer margin is slightly convex, and ends in a small triangular spine reaching forward as far as the anterior margin of the lamella.

The large cheliped (left) extends a little beyond the end of the antennular peduncle by the end of the merus. The chela is 3.6 times as long as high. The palm is twice as long as high; its dorsal surface is swollen but somewhat flattened, with a shallow longitudinal depression; its ventral surface is convex, uneven, with an inconspicuous longitudinal depression on the proximal half portion. The fingers are strongly compressed and have sharp hooked tips; their cutting edges bear numerous, small interlocking teeth. The carpus is short and forms a four-lobed corolla, the outer ventral lobe is small and triangular. The merus is sinuous, strongly depressed, and somewhat longer than the palm. The ischium is half as long as the merus.

The small cheliped (right) reaches near the end of the antennular peduncle by the end of the merus. The chela is 2.9 times as long as high and entire; the fingers are as long as the palm, and their cutting edges are smooth. The carpus and merus are subequal in length, and somewhat longer than the ischium.

In the second pereiopod the carpal articles have a ratio, 10:2:1:1:3.

The last three pereiopods are absent, except for the right third and fourth ones, which are slender and resemble each other. In the third pereiopod the dactylus is simple; the propodus has 5 weak spines on the ventral margin; the carpus bears a weak spine on the ventral distal corner; the merus is 5.8 times as long as broad; the ischium bears 3 spines on the outer surface.

The first 3 abdominal pleura have the rounded posterior margins, but the second 3 have the pointed posterior margins. The uropodal exopod is furnished with a distal spine and a diaeresis.

The telson is slightly damaged distally, and has 2 pairs of the dorsal spines, the proximal pair of them is situated on 2/5 of the length, and the distal pair (the right spine absent) behind 2/3 of it.

Paratypes.——The paratypes (1 ♂, 2 ovig. ♀♀) from off Munakata-oshima Island are slightly or heavily damaged, but show the same features as in the holotype. The holotype has the telson which is slightly damaged posteriorly and offers the incomplete information of it only. But the two of them (♂, c.l. 4.8 mm; ovig. ♀, c.l. 6.4 mm) have the telson in a good condition. It is tapering, 5.5 and 5.2 times as long as broad at the posterior margin in the respective specimens. The posterior margin is provided with the deep, U-shaped excavation bearing 2 pairs or 1 pair of the plumose hairs, respectively; there is a pair of long spines on either side of the median excavation. The 2 pairs of dorsal spines are situated on the same portions as in the holotype.

The paratype male (c.l. 3.5 mm) from Ishigaki-jima Island agrees well with the characteristics in the holotype and the above-mentioned 2 paratypes except for those of the telson and the proportions of the third pereiopod. The telson is 5.5 times as long as broad at the posterior margin, which has the shallow median excavation, as figured in *S. cristatus* by Holthuis (1958); the proximal pair of dorsal spines is situated on the middle, and the distal pair is on 3/4 of the length.

Measurements of types. See Table 3.

Colour in life. The animal is entirely transparent; the cornea is dull reddish orange. The eggs are yellowish orange.

Ecology. The holotype was collected together with a small group of *Athanas japonicus* under the same boulder at the level of low tide mark on the sandy-mud flat. The paratype male from Ishigaki-jima Island was also collected under a boulder on the intertidal zone. The other paratypes were dredged at a depth of 10 metres.

The eggs are elliptical, 0.5-0.55×0.35-0.4 mm, and small in number.

Relationships. This species apparently differs from all the members of the Indo-West Pacific region but *S. latirostris* (Coutière, 1896) and *S. bruni* Banner and Banner, 1966 by the eyes markedly exposed dorsally. However, *S. gracilipes* may be separated from *S. latirostris* by such characteristics as the narrower rostrum; a shallow longitudinal depression on the dorsal surface of the large chela; and the colour in life.[1] On the other hand, the new species differs from *S. bruni* in several features. *S. gracilipes* has the longer rostrum; the longer stylocerite; the cutting edges of the fingers of the large chela with minute serrations entirely; the ventral margin of the propodus of the third pereiopod spinouse; and a median excavation on the posterior

1) The colour in life of *S. latirostris* is "incolore, corps régulièrement annelé de rouge vif" (Coutière, 1897b).

margin of the telson.

Distribution. The species is known so far from only three type localities: Shimo-shima Island, Amakusa Islands; off Munakata-oshima Island in Genkai-nada; and Ishigaki-jima Island, Ryukyu Archipelago. Shore to 10 m deep.

Table 3. Measurements of *Salmoneus gracilipes* sp. nov.

	Holotype	Paratypes			
	ovig. ♀	♂	♂	ovig. ♀	ovig. ♀
Body length (in mm)	12.2	9.5	14.4	19.1	16.9+
Carapace length (in mm)	4.1	3.5	4.8	6.4	6.4
Large cheliped:					
Chela length/height	3.6	—	—	—	3.5
Palm length/height	2.0	—	—	—	2.0
Merus length/breadth	6.6	—	—	—	7.0
Relative length of segments (in proportion to palm)					
Dactylus	0.8	—	—	—	0.8
Palm	1.0	—	—	—	1.0
Carpus	0.4	—	—	—	0.4
Merus	1.2	—	—	—	1.2
Ischium	0.6	—	—	—	0.6
Small cheliped:					
Chela l/h	2.9	3.1	2.6	3.0	—
Palm l/h	1.5	1.6	1.3	1.5	—
Merus l/b	6.0	5.4	5.2	5.9	—
Relative length of segments (in proportion to palm)					
Dactylus	0.9	1.0	1.1	1.0	—
Palm	1.0	1.0	1.0	1.0	—
Carpus	2.3	2.1	2.7	2.5	—
Merus	2.6	2.5	2.8	2.7	—
Ischium	2.0	2.0	2.7	2.2	—
Second pereiopod:					
Relative length of carpal articles	10 : 2 : 1–2 : 1–2 : 2–4				
Third pereiopod:					
Merus l/b	5.8	4.6	—	—	7.5

Relative length of segments: (in proportion to propodus)	Dactylus		Propodus		Carpus		Merus		Ischium
	0.3–0.5	:	1.0	:	0.5–1.1	:	0.9–1.3	:	0.6–0.9

Salmoneus babai Miyake and Miya, 1966
(New Japanese name: Baba nokogiri teppo ebi)
(Plate 4)

Salmoneus babai Miyake and Miya, 1966: 133, fig. 1.

Diagnosis. As no additional material of this species was available, the characters most useful in separating the species from its relatives are extracted from the original description as follows:

Anterior part of carapace and antennal region closely allied to those of *S. sibogae*. Rostrum cutlass shape in lateral view and equilateral triangular in dorsal view; its sharp apex reaching the distal half of third antennular segment; short, obscure dorsal carina present. Orbital teeth short and triangular, making 90° with lateral margins of rostrum. Eyes entirely concealed by carapace dorsally. Stylocerite somewhat shorter than rostrum. Large chela less than 3.0 times as long as high and subcylindrical. Dorsal surface of palm slightly convex, without any longitudinal depressions; its inner surface with deep ventral notch at proximal portion; its outer surface with longitudinal broad depression on the distal half. Movable finger crescent and much longer than immovable finger; cutting edge of movable finger bearing 4 or 5 serrations which exactly fit 5 or 6 serrations on immovable finger. Carpal articles of second pereiopod having a ratio, 10:3:2:2:4. In third pereiopod ventral margin of propodus spinouse; merus 3.3-3.5 times as long as broad. Telson tapering, 4.0-4.5 times as long as broad at posterior margin; this margin having median semicircular excavation.

Material examined.

Ryukyu Archipelago.——Amami Group: 1♂, 1 ovig. ♀ (holotype), ZLKU No. 3246, Amami-oshima I., Kasari-cho, Suno, coral reef, July 31, 1965, K. Baba leg.

Colour in life. The colour in life of the animal is uniformly bright yellow (Dr. Baba's information). It resembles the colouration of *S. serratidigitus* described by Coutière (1897b).

Ecology. Unknown.

Remarks. In the type specimens the following slight differences are observed: The carapace of the holotype (ovig. ♀, 7.7 mm in c.l.) is heavily humpbacked, while that of the paratype (♂, 4.0 mm in c.l.) is even. In lateral view the rostrum of the holotype is deeper than that of the paratype. The median excavation of the posterior margin of the telson is deep and semicircular in the holotype, whereas it is shallow and gently excavated in the paratype.

Distribution. This species has been known only from the type material which was collected from Amami-oshima Island, the Ryukyu Archipelago. Coral reef.

Salmoneus tricristatus Banner, 1959
(New Japanese name: Misuji nokogiri teppo ebi)
(Plate 5)

Salmoneus tricristata Banner, 1959: 131, fig. 1.——Banner and Banner, 1967: 262.

Description. The animal is slender and pubescent dorsally, measuring 13.5 mm in body length (4.5 mm in c.l.). The rostrum is slightly longer than broad, and reaches the end of the second antennular segment. The sharp orbital teeth are apically pointed and 1/3 of the rostral length. On the carapace there are some carinae and a suture. The rostral carina is sharp and uneven, extending backward to 3/4 the length of the carapace. From the base of the orbital teeth the sharp carinae which are slightly shorter than the rostral carina run parallel with that carina. Each area between those carinae is clearly depressed and posteriorly marked off by a clear curved carina; an obtuse protuberance is present at the middle. In lateral view there are 3 other carinae, such as the short conspicuous carina on the level of the eye on the gastric region, the short inconspicuous carina near the above-mentioned curved carina on the cardiac region, and the longer inconspicuous carina on the level of the antenna on the branchial region. The inconspicuous suture is traced backward on the level of the antenna beyond the middle of the carapace.

The antennular peduncle is robust; the second segment is slightly broader than long. The stylocerite somewhat exceeds the end of the second segment by the sharp apex. The carpocerite is robust and reaches the end of the second antennular segment. The scaphocerite is oval shape and 1.7 times as long as broad; the rounded anterior margin of the lamella reaches beyond the middle of the third segment; the lateral margin is slightly convex and ends in a short triangular spine.

The first pereiopods are generally allied to those of *S. cristatus* figured by Holthuis (1958) and Banner and Banner (1966b). The large cheliped extends to the end of the antennular peduncle by the end of the merus. The chela is 3.0 times as long as high, swollen and nearly cylindrical in cross section. The dorsal surface of the palm is somewhat flattened, with an inconspicuous, longitudinal depression, and proximally overhangs the ventral half of the proximal portion. The fingers are strongly compressed and 2/3 as long as the palm; their cutting edges are provided with many blunt serrations almost entirely and end in the sharp hooked tips. The carpus is short and forms a four-lobed corolla; the inner 2 lobes are large and rounded, the outer lobe is small and triangular, and the ventral lobe is blunt and tooth shape. The merus is slender, sinuous and 1 1/3 times as long as the palm, the ventral surface is slightly flattened. The ischium is 1/3 the length of the merus.

The small cheliped extends beyond the end of the antepenultimate segment of the third maxilliped by the end of the merus. The chela is subcylindrical; the fingers are almost as long as the palm, and their cutting edges are entire. The carpus and merus are almost equal in length and slightly longer than the ischium; the ventral surface of the merus is somewhat flattened.

In the second pereiopod the carpal articles have a ratio, 10 : 3 : 2 : 2 : 3. The following three pereiopods are missing.

The telson tapers and is 4.0 times as long as broad at the posterior margin. This margin has the U-shaped excavation, which is somewhat deeper than broad and fringed with 4 plumose hairs; there is a pair of long spines on either side of the excavation. The proximal pair of the dorsal spines is situated on the middle and the distal pair is on 3/4 of the length. The endopod and exopod of the uropod are slender, the latter has a diaeresis and a distal spine.

Material examined.

Ryukyu Archipelago.——Yaĕyama Group: 1 ♂, ZLKU No. 17260, Ishigaki-jima I., coral reef, May 1969, S. Shokita leg.

Colour. The specimen preserved in 5 % formalin in three weeks was uniformly scattered with yellow chromatophores.

Ecology. According to Banner and Banner (1967), the animals are collected from the heads of coral at the vigorously growing outer face of the fringing reef.

Remarks. The present specimen plainly belong to the species, but shows the slight differences in the carapace and the uropods. The carapace has the above-mentioned six short carinae besides the three characteristic ones recorded by Banner (1959), and has the inconspicuous suture on the level of the antenna. The uropodal exopod is provided with a diaeresis, but is not observed in the figure of the type specimen.

Distribution. The species has been recorded from the Caroline Archipelago (type locality, Banner, 1959) and the Society Islands (Banner and Banner, 1967) only. Coral reef.

Genus *Synalpheus* Bate, 1888

Alpheus Paul'son, 1961 (1875): 107 (not *Alpheus* Fabr.).

Homaralpheus Bate, 1876: 378 (nomen nudum); 1888: 539 (type species: *Alpheus minus* Say, 1818. Selected by Holthuis, 1955).

Synalpheus Bate, 1888: 572.——Coutière, 1899: 334; 1909: 3.——De Man, 1911: 185.——Barnard, 1950: 735.——Banner, 1953: 26.——Holthuis, 1955: 84 (key), 93.——Banner and Banner, 1966b: 44.

Alpheinus Borradaile, 1899: 415 (type species: *Alpheinus tridens* Borradaile, 1899. Monotypy).

Type species: *Synalpheus falcatus* Bate, 1888=*Alpheus Comatularum* Haswell, 1882. Monotypy.

Definition. Anterior part of carapace with strong rostrum and orbital teeth. Eyes completely enveloped by orbital hoods except on anteroventral side. Pterygostomial margin angled. Antennular peduncle stout, with well-developed, sharp stylocerite; inner flagellum weakly bifurcated. Basicerite with 1 or 2 stout teeth. Lamella of scaphocerite shorter than strong lateral spine. Mandible with palp of 2 articles. First pair of pereiopods quite asymmetrical; large chela carried extended, entire and smooth, with molar-shaped tooth on movable finger; small chela normal. Second pereiopod with carpus of 5 or rarely 4 articles. Dactylus of third, fourth and fifth pereiopods bi- or tri-unguiculate. Abdominal segments generally showing sexual dimorphism in shape of pleura; sixth segment not articulated. Telson normal. Branchial formula: 5 plbs.+1 arthrb.+2 eps.+3 expds.

Remarks. As pointed out by De Man (1911), Paulson (1875) was the first who recognized the generic value of the genera *Alpheus* and *Synalpheus* by the number of epipods in the latter only 2 instead of 7 in the former. Erroneously, however, Paulson created the new genus *Alpheioides* for those species having the epipods on the pereiopods and left the name of *Alpheus* to those wanting the epipods on the pereiopods. In 1888 De Man recognized that *Alpheus* s.l. was possible to be divided into four natural groups, one of which named *spinifrons* group corresponded closely with the present genus.

On the other hand, in the Challenger Report Bate (1888) created *Homaralpheus* upon the fact that the eggs of *Alpheus minus* (=*Synalpheus minus*) and its ally hatched as Megalopa larvae, and noted as follows:

> The Megalopa was got from the ovum of a near ally of *Alpheus minus*, but differing in having a long powerful tooth on the outer margin of the scaphocerite, the foliaceous part being smaller, membranous and very thin. I previously (*loc. cit., supra*) named this specimen *Homaralpheus*, making it a separate genus, from the impression that species producing a Megalopa could not be placed in the same genus as those producing a Zoea.

But this brief note apparently has not any power to establish the new genus.

Further, in the same report he established *Synalpheus* upon *S. falcatus* (=*S. comatularum*) having the differences in the number of epipods and others. Afterwards the clear definition of the genus was finally given by Coutière (1899), and has been accepted by De Man (1911) and other subsequent authors.

In 1909 Coutière attempted the separation of the genus into 6 groups especially upon the characteristics in shape of the frontal region and others. But his definition of the groups shows the wide range of the overlap, so that it may be difficult to say it clear and useful. As in the present study there is no need for the author to use those grouping, they are not adopted.

From Japan and its adjacent waters 7 species (incl. 2 of doubtful record) have been known, *S. charon* (Heller, 1861), *S. gravieri* Coutière, 1905, *S. japonicus* Yokoya, 1936 which is a synonym of *S. tumidomanus* (Paulson, 1875), and *S. striatus* Kubo, 1938 are represented in the collections at hand, but *S. neptunus* Dana, 1852, *S. spiniger* Stimpson, 1860 and *S. neomeris* De Man, 1897 have not been reported since they were listed up by Balss (1914) nor are found in the present collections. In addition, the 5 species, *S. demani* Borradaile, 1900, *S. paraneomeris* Coutière, 1905, *S. streptodactylus streptodactylus* Coutière, 1905, *S. odontophorus* De Man, 1909 and *S. bituberculatus* De Man, 1910 are recorded here for the first time from this region.

S. neptunus was recorded once from Amami-oshima Island, the Ryukyu Archipelago by Stimpson (1860). However, it had not been clearly defined until Coutière (1905, 1909) studied the two type specimens from the Sulu Sea, so that it was impossible to state definitely whether or not Stimpson's material was the true *S. neptunus* from his brief description.

S. spiniger seems to be a rare species, and has been collected only from the Kerama Islands, the Ryukyu Archipelago and Manila, the Philippine Islands.

The first record of *S. neomeris* from Japan is found in Coutière's (1905) general distribution, but, as already pointed out by De Man (1911), Coutière's identification of the species is doubtful. Afterwards the species has not been recorded in Japan nor in the Pacific Ocean, with the exception of its appearance in "The illustrated Encyclopedia of the fauna of Japan" with brief notes and a figure (Nakazawa and Kubo, 1947; Kubo, 1965). But from those clues it is impossible for the author to identify their material as *S. neomeris* clearly.

Key to the species of Japanese *Synalpheus*[1]

1. Rostrum and orbital teeth narrow triangular and depressed; low but distinct rostral carina

1) *S. neptunus* and *S. neomeris* omitted from the key, see pp. 72 and 73, respectively.

present 2
Rostrum spiniform, without dorsal carina; orbital teeth narrow triangular or spiniform 3
2. Stylocerite overreaching the end of first antennular segment................................ *striatus*
Stylocerite at most reaching the middle of first antennular segment .... *odontophorus*
3. Basicerite armed with a tooth 4
Basicerite armed with 2 teeth 5
4. In dactyli of 3rd-5th pereiopods ventral unguis thick and obtuse, with broad spoon-shaped excavation on ventral surface; dorsal unguis, tapering to acute tooth, shorter than ventral unguis.. *charon*
In dactyli of 3rd-5th pereiopods ventral unguis solid and conical; dorsal unguis longer than ventral unguis .... *paraneomeris*
5. Large chela armed with a sharp tooth at the base of finger articulation 6
Large chela armed with 2 rounded tubercles at the base of finger articulation
.... *bituberculatus*
Large chela unarmed at the base of finger articulation .... *spiniger*
6. Telson armed with the usual 2 pairs of dorsal spines. Dactyli of 3rd-5th pereiopods biunguiculate 7
Telson unarmed dorsally. Dactyli of 3rd-5th pereiopods triunguiculate .... *demani*
7. Meri of 3rd and 4th pereiopods armed with several spines along ventral margin 8
Meri of 3rd and 4th pereiopods unarmed... *tumidomanus*
8. In dactli of 3rd-5th pereiopods ventral unguis three times as broad as dorsal unguis at base, and the former more than twice as long as the latter .... *gravieri*
In dactli of 3rd-5th pereiopods ventral unguis twice as broad as dorsal unguis at base, and they subequal in length .... *streptodactylus streptodactylus*

Synalpheus striatus Kubo, 1938
(New Japanese name: Hakusen komachi teppo ebi)
(Plate 6)

Synalpheus striatus Kubo, 1938: 89, figs. 1-2——Ooishi, 1970: 88, pl. 10, fig. 6 (photo).

Description. Present specimens are stout and polished, measuring 14.4-26.0 mm in body length (6.0-13.4 mm in c.l.). The rostrum is narrow triangular and usually reaches in the distal half of the second antennular segment by its sharp apex; the dorsal carina is sharp and high or low, reaching backward behind the base of the orbital hoods. The orbital teeth are narrow triangular and extend to or beyond the middle of the rostrum. The margin between each orbital tooth and the rostrum is of a U shape. The orbitorostral depression is deeper and more demarked in the larger specimens rather than in the smaller.

The antennular peduncle is robust, the second segment is 0.8-1.4 times as long as broad; the 3 segments have a ratio, 1.3-2.0 : 1.0 : 0.7-0.9. The stylocerite is stout and usually extends beyond the end of the first segment. The basicerite bears 2 sharp teeth, the ventral tooth is longer than the dorsal and reaches near the end of the first segment. The carpocerite is elongate and equal to the antennular peduncle in length. The slender spine of the scaphocerite is almost as long as the carpocerite; the broad foliaceous lamella reaches variously in the proximal half of the third segment.

The large chela is, in both sexes, 2.9–3.5 times as long as high and shows the sexual dimorphism in the relative length to the carapace, being 1.0–1.2 times the carapace length in the male and 0.5–0.8 times in the female. It is slightly compressed and smooth, with a small pointed tooth or a slight tubercle at the inner side of the finger articulation. The merus is 2.0–2.5 times as long as broad; the dorsal margin terminates in a strong triangular tooth. The dorsal margin of the ischium ends in a slender process.

The small chela is, in both sexes, 0.4–0.5 times the carapace length and 3.5–4.8 times as long as high. It is cylindrical and unarmed. The merus is 1.1–1.2 times as long as broad; the dorsal margin ends in a small pointed tooth. The dorsal margin of the ischium is rounded distatlly.

In the second pereiopod the carpal articles have a ratio, 10 : 2–3 : 1–3 : 1–3 : 4–7. In the third pereiopod the dactylus is short and biunguiculate, the ventral unguis appears short triangular and perpendicular to the axis. The propodus bears 9 to 15 spines ventrally. The carpus has a pair of spines at the distal corner of the ventral margin. The merus is 4.4–6.3 times as long as broad, with a sharp, small tooth at the distal corner of the ventral margin. The merus of the fourth pereiopod is also armed with the tooth, while that of the fifth is unarmed.

In the male all the pleura of abdominal segments are sharply pointed posteroventrally. In the female the first 2 or 3 pleura are rounded posteroventrally and the rest are sharply pointed as in the male. In both sexes the endopod of the second to fifth pleopods is provided with an appendix interna only.

The telson tapers and is 3.1–4.2 times as long as broad at the posterior margin. The dorsal surface is provided with a shallow medial depression and the usual 2 pairs of spines near the lateral margins; the anterior pair is situated behind the middle of the length, and the posterior pair is on 2/3 or 3/4 of it.

Variations. In the present specimens the certain variations are found in the following characteristics.

1. Rostrum. Usually the rostrum tapers away, but rarely is broad triangular at the proximal half and abruptly tapers at the distal half. As described above, the rostral apex usually reaches variously in the distal half of the second antennular segment; while at the extreme margin of the range of variation it reaches near 1/3

of that segment, and at the other extreme margin reaches markedly beyond the end of that segment.

2. Stylocerite. The sharp apex of the stylocerite usually extends beyond the end of the first antennular segment, as described above. But the apex reaches variously from 2/5 of the first segment to the middle of the second segment.

3. Meral teeth in 3rd-5th pereiopods. In all the specimens including the holotype the merus of the third and fourth pereiopods is armed with a spiniform tooth at the distal corner of the ventral margin. On the other hand, in all the specimens but two the merus of the fifth is unarmed, while in the two from the Ogasawara Islands it has a small spiniform tooth at the distal corner of the ventral margin.

Kubo (1938) described that "merus of fourth leg bore no spine at tip and fifth leg was depribed of terminal spines in merus and carpus." But in the holotype, when the author re-examined it, the merus of the fourth pereiopod had a spiniform tooth, and that of the fifth was unarmed.

Material examined.

Southern Japan.——Boso Peninsula: 1 ♀, TUF, Futomi, Sept. 6, 1947.——Kii Peninsula: 1 ♂, SMBL, Wakayama Pref., Tanabe Bay, Seto, associated with *Comanthina schlegeli* (Carpenter) (SMBL Cri. 24), August 1924; holotype male, SMBL Type No. 60, Wakayama Pref., Oshima I., 3-7 m deep, associated with a comatulid, August 1937, F. Hiro leg.; 1 ♂, SMBL, Tanabe Bay, Seto, 5 m deep, associated with *Comanthus parvicirra* (Müller) (SMBL Cri. 12), July 5, 1961, I. Kogo leg.; 1 ovig. ♀, SMBL, Tanabe Bay, Seto, rocky shore, 2 m deep, associated with *Comanthus japonica* (Müller) (SMBL Cri. 48), Aug. 7, 1961, I. Kogo leg.; 1 ♂, SMBL, Tanabe Bay, associated with a comatulid, more data unknown; 2 ♂♂, SMBL, Tanabe Bay, To-jima Islet, ca. 7 m deep, associated with *Comanthina schlegeli* (Carpenter), Jan. 20, 1969, H. Tanase leg.

Micronesia.——Ogasawara Islands: 1 ♂, 1 ovig. ♀, ZLKU No. 17261, Hitomaru-jima I., 6-10 m deep, associated with comatulids, July 6, 1968, S. Ooishi leg.; 4 ♂♂, 2 ovig. ♀♀, ZLKU No. 1421, Muko-jima I., July 17-21, 1938, S. Miyake leg.

Colour in life. "According to Mr. Hiro's information, the whole body is uniformly dark violet just like comatulids, together with which the specimens were obtained, except that carapace is striated with five longitudinal white bands. Hence the specific name" (Kubo, 1938).

Ecology. The species is an obligate commensal of comatulids and has been collected from littoral down to 7 m deep.

Remarks. The holotype male is safely deposited at the museum of the Seto Marine Biological Laboratory (SMBL Type No. 60).

Distribution. Until now, the species has been known only from Oshima I., southern end of Kii Peninsula (type locality, Kubo, 1938) and Ogasawara Islands (Ooishi, 1970).

Synalpheus odontophorus De Man, 1909
(New Japanese name: Toge tsuno teppo ebi)
(Plate 7)

Synalpheus odontophorus De Man, 1909: 113 (diagnosis only); 1911: 208; 1915: pl. 6, fig. 22.

Description. The animals are small, polished and sparsely hairy, measuring 12.8–15.3 mm in body length (4.9–6.1 mm in c.l.). The rostrum is broad triangular, with the low but distinct carina reaching backward to the base of the orbital hoods. Its acute apex reaches the middle or 2/3 of the second antennular segment. The triangular orbital teeth are slightly directed outward and 1/3 as long as the rostrum. The anterior margin between each orbital tooth and the rostrum is of a broad U shape.

The antennular peduncle is robust, the second segment is 1.0–1.3 times as long as broad; the ratio of the 3 segments is 1.0–1.3 : 1.0 : 0.7–0.8. The stylocerite is short and reaches the apex of the orbital tooth. The basicerite has 2 short, strong teeth; the ventral tooth reaches forward as far as the base of the orbital tooth and is twice as long as the dorsal tooth. The carpocerite is stout and slightly extends beyond the end of the antennular peduncle. The scaphocerite is concave laterally and ends in a strong lateral spine extending to or almost to the end of the antennular peduncle; the broad lamella reaches in the proximal half of the third segment.

The large chela is 3.0 times as long as high, 1.1 times the length of the carapace, cylindrical and swollen. The palm bears a sharp tooth at the far end of the inner surface. On the inner surface of the immovable finger there are 2 subtriangular lobes, the distal one of which is larger than the proximal one. The merus is 2.2–2.5 times as long as broad, its dorsal margin ends in a small acute tooth.

The small chela is 3.3 times as long as high, 0.4 times the length of the carapace and cylindrical. Both fingers are half as long as the palm. The merus is 4.0–4.6 times as long as broad, its dorsal margin is apically pointed.

In the second pereiopod the ratio of the carpal articles is 10 : 2–3 : 2–3 : 2–3 : 4. In the third pereiopod the dactylus is slender and biunguiculate, the ventral unguis is very small. The ventral margin of the carpus bears 1 or 2 spinules distally. The merus is 5.4 times as long as broad, its ventral margin ends in a small tooth distally. That segment of the fourth pereiopod is also armed with the tooth, and that of the fifth is unarmed.

In the male specimens the posterior margins of the pleura of the first 2 abdominal segments are acutely pointed, and those of the second 4 are subacute. Every endopod of the second to fifth pleopods of the male is furnished with an appendix interna only.

The telson is flattened dorsally and tapers, being 4.0-4.4 times as long as broad at the posterior margin. The anterior pair of dorsal spines is situated before the middle, and the posterior pair is on 2/3 of the length.

Material examined.

Southern Japan.——Sagami Bay: 1 ♂, BLIH Sp. No. 1987, Amadaiba, Kannontsukadashi, 70-80 m deep, Feb. 6, 1962; 1 ♂, BLIH Sp. No. 3636, Kannontsukadashi, 64-100 m deep, Feb. 11, 1970.

Colour. The colour of the specimen (BLIH Sp. No. 3636) preserved in 70 % alcohol for two weeks is as follows:

The carapace, abdominal segments and tail fan seem pale yellow. The interorbital portion of the rostral carina is yellowish brown. The ground colour of the large cheliped is yellowish brown; the dorsal half of the palm is deep yellowish brown, both fingers orange brown scattered with red chromatophores and their tips yellow; the carpus and the distal half of the merus are deep yellowish brown, with red chromatophores.

Ecology. The species has been known from the bottoms of mud; of sand, coral and shells; and of mud, sand and shells in depths of 90-400 metres.

Remarks. The specimens agree well with De Man's original description except for the armature of the immovable finger of the large chela, i.e. the inner side of the cutting edge is provided with a large two-topped subtriangular lobe medially which more resembles that of *S. consobrinus* (=*S. stimpsonii*) figured by De Man (1915, pl. 6, fig. 21 b). But the present species can be separated from *S. stimpsonii* by the much shorter stylocerite.

Distribution. The species has been recorded from the type localities only: Near Tanahdjampeah I.; Kai Is.; near East coast of Timor (De Man, 1909).

Synalpheus charon (Heller, 1861)
(New Japanese name: Sango tsuno teppo ebi)

(Plate 8)

Alpheus charon Heller, 1861: 272, pl. 3, figs. 21-22.——Paul'son, 1961 (1875): 110, pl. 13, fig. 4.
Nec. Alpheus charon: De Man, 1897: 743, fig. 63.
Synalpheus charon: Coutière, 1905: 873; 1909: 90; 1921: 416.——De Man, 1911: 245; 1915: pl. 8, fig. 37.——Edmondson, 1925: 9.——Ramadan, 1936: 19.——Chace, 1937: 122; 1962: 613.——Barnard,

1950: 738, fig. 139, j,k.——Banner, 1953: 37, fig. 11.——Holthuis, 1958: 29.——Banner and Banner, 1964: 87; 1967: 262.——Patton, 1966: 281.
Synalpheus Helleri: De Man, 1911: 194.
Synalpheus charon obscurus Banner, 1956: 329; 1958: 161; 1959: 133.
Synalpheus charon charon Banner, 1957: 194, fig. 3; 1966a: 158.

Description. Present specimens are small and polished, measuring 8.8-21.1 mm in body length (3.5-6.9 mm in c.l.). The rostrum shows the marked variation in shape and is generally elongate or lanceolate. The rostral apex reaches variously in the first antennular segment. The orbital hood is moderately inflated and projects anteriorly in a sharp or blunt tooth reaching near the rostral apex. The inner margin of the orbital hood is slightly concave and separated from the rostral base by a shallow depression.

The antennular peduncle is robust, the second segment is 1.0-1.2 times as long as broad; the 3 segments show a ratio, 0.7-1.1 : 1.0 : 0.9-1.1. The stylocerite is stout and reaches variously in the distal half of the second segment. The basicerite has a strong ventral tooth reaching variously in the proximal half of the second segment. The carpocerite is stout and exceeds the end of the antennular peduncle by half the length of the third segment. In the scaphocerite the slender spine reaches in the distal fourth of the third segment or sometimes beyond the end of the antennular peduncle; the broad lamella extends in the distal third of the third segment.

The first pair of pereiopods shows no sexual dimorphism. The large chela is, in the male, 1.3-1.4 times the carapace length and 2.7-3.1 times as long as high. It is, in the female, 1.1-1.2 times the carapace length and 2.3-3.0 times as long as high. It is slightly compressed, twisted and entire, with a small rounded process at the distal corner of the dorsal margin of the palm. The merus is 1.6-2.1 times as long as broad, the dorsal margin ends in a short, sharp or blunt tooth distally.

The small chela is 0.4 times the carapace length in both sexes, and is 2.6-3.0 times as long as high in the male and 2.4-2.8 times in the female. It is subcylindrical and entire. The merus is very similar to that of the large cheliped in shape and proportion.

In the second pereiopod the carpal articles have a ratio, 10 : 2-3 : 2-3 : 2 : 5-6. The third pereiopod has the dactylus of peculiar form. It is biunguiculate, the ventral unguis is thick and blunt with a broad spoon-like excavation on the ventral surface, and the dorsal unguis seems to be as long as the ventral one and slender spiniform. The propodus bears 5 to 7 spines ventrally. The carpus is truncated, with a spine at the distal end of the ventral margin. The merus is 2.6-3.4 times as long as broad and unarmed. The ischium is unarmed.

All the pleura are, in both sexes, rounded posteriorly. In the female the pleopods are foliaceous, with the appendix interna, while in the male they are much slender, without any appendices.

The telson is 2.3–2.8 times as long as broad at the posterior margin. The lateral margins are convex, and the posterior margin is markedly rounded. The anterior pair of the dorsal spines is situated variously in the second third of the length, and the posterior pair is on 3/4 of it.

Variations. According to Banner and Banner's discussion (1967), this species manifests the marked variations in the size and shape of the rostrum, in the length to breadth ratio of the merus of the third pereiopod, and in the shape of the dactylus of the last three pereiopods.

In the present specimens the marked variation is found in the shape of the rostrum. It varies from being extended and acute to being shortened and obtuse. This range of variation lies within that recorded by Banner and Banner. In addition, the shape of orbital teeth varies from tapering to terminating in an obtuse apex. These two variations seem to show some tendency for the larger specimens to have the short, blunt rostrum and the short, subtriangular orbital teeth rather than the extended rostrum and the slender orbital teeth. In the other two above-mentioned characters the present specimens are variable to such a extent as noted by Banner and Banner.

Material examined.

Southern Japan.——Sagami Bay: 1♂, ZLKU No. 17263, Kanagawa Pref., Manazuru, April 1960, K. Sakai leg.

Ryukyu Archipelago.——Amami Group: 1 ovig. ♀, ZLKU No. 11001, Amami-oshima I., Kyonoura, Aug. 3, 1967, Y. Ushio leg.; 1♂, ZLKU No. 11002, Yoron-jima I., Hanibu, reef, Aug. 13, 1967, Y. Ushio leg.; 1♂, 1 ovig. ♀, ZLKU No. 11341, Yoron-jima I., Terasaki, lagoon, among branches of living coral, July 8, 1968, Y. Miya and T. Fujino leg.; 2♂♂, 2 ovig. ♀♀, 1♀, ZLKU No. 11343, Yoron-jima I., Sena, inner side of barrier reef, among branches of living corals, June 9, 1968, Y. Miya and T. Fujino leg.; 1♂, 1 ovig. ♀, ZLKU No. 11348, Yoron-jima I., Ukachi, tide pool on outer reef flat, interstices of living coral, July 11, 1968, Y. Miya and T. Fujino leg.; 1♂, 1 ovig. ♀, ZLKU No. 11350, Yoron-jima I., Ukachi, outer edge of barrier reef, interstices of living coral, July 11, 1968, Y. Miya and T. Fujino leg.; 2♂♂, 2 ovig. ♀♀, ZLKU No. 11357, Yoron-jima I., Ukachi, outer edge of barrier reef, interstices of living coral, July 11, 1968, Y. Miya and T. Fujino leg.; 3♂♂, 2 ovig. ♀♀, ZLKU No. 11352, Yoron-jima I., Sena, inner side of barrier reef, July 9, 1968, Y. Miya and T. Fujino leg.

Colour in life. In life, the shrimp is transparent, densely scattered with red chromatophores entirely. The red colour is deep reddish purple in the larger specimens and orange red in the smaller. The eggs freshly laid are green. The colour is "often a brilliant orange red" (Banner, 1953); "orange-red or bright pink" (Banner and

Banner, 1966b).

Ecology. The habitat of *S. charon* is perhaps best summarized as follows: The species is commonly found to occur generally in pairs among the branches of living pocilloporid corals, such as *Pocillopora damicornis* (Linné) and *P. meandrina* Verrill. From the same host corals *Alpheus lottini, Trapegia cymodoce* and other xanthid crabs are usually collected together with this shrimp.

According to Patton's close observations (1966), *Synalpheus charon* and *Alpheus lottini* were only two alpheid shrimps of the obligate commensal on coral in the Great Barrier Reef.

Remarks. The excellent discussion to the variations and synonymy of the species is provided by Banner and Banner (1967).

Distribution. S. charon is widely distributed through the Indian and Pacific Oceans. Coral reefs.

S. charon is known from: Red Sea (type locality, Heller, 1862; Paulson, 1875; Ramadan, 1936; Holthuis, 1958); Delagoa Bay (Barnard, 1950); Coetivy Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Maldive Archipelago (Coutière, 1905); Kabaëna I. (De Man, 1911); Queensland, N.E. coast of Australia (Patton, 1966); Japan (Holthuis, 1958); Arno Atoll, Marshall Is. (Banner, 1957): Canton Atoll, Phoenix Is. (Banner and Banner, 1964); Samoa Is. (Banner and Banner, 1966a); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967); Hawaiian Archipelago (Coutière, 1909; Edmondson, 1925; Banner, 1953); Clipperton I. (Chace, 1962); and the Gulf of California (Chace, 1937).

S. helleri is collected only from Nicobar Is. (type locality, De Man, 1911).

S. charon obscurus is recorded from: Saipan, Mariana Archipelago (type locality, Banner, 1956); Onotoa, Gilbert Is. (Banner, 1958); Wake I. (Banner, 1959); and Hawaiian Archipelago (Banner, 1959).

Synalpheus paraneomeris Coutière, 1905
(New Japanese name: Aka tsuno teppo ebi)

(Plate 9)

Synalpheus paraneomeris Coutière, 1905: 872, pl. 71, fig. 7; 1909: 90; 1921: 415.——Edmondson, 1925: 9.——Banner, 1953: 40, figs. 13-14; 1956: 331, fig. 6; 1957: 195; 1958: 161; 1959: 133.——Banner and Banner, 1964: 86; 1966a: 158; 1967: 262; 1968: 275.

Synalpheus paraneomeris prolatus Coutière, 1909: 9.

Synalpheus paraneomeris var. *praedabundus* De Man, 1911: 240; 1915: pl. 8, fig. 34.

Synalpheus paraneomeris var. *prolatus:* De Man, 1911: 241; 1915: pl. 8, fig. 35.

Synalpheus paraneomeris var. *halmaherensis:* De Man, 1911: 243; 1915: pl. 8, fig. 36.
Synalpheus paraneomeris praslini Coutière, 1921: 415, pl. 61, fig. 6.
Synalpheus paraneomeris seychellensis Coutière, 1921: 415, pl. 61, fig. 7.

Description. The present specimens are small and polished, measuring 4.2-13.1 mm in body length (1.7-5.0 mm in c.l.). The rostrum is needle shape and varies from reaching near the end of the first antennular segment to exceeding the middle of the second segment. The orbital teeth run parallel with the rostrum, and are more than half of the rostral length.

The antennular peduncle is slender, the second segment is 1.0-1.5 times as long as broad; the 3 segments have a ratio, 1.9 : 1.0 : 0.7. The stylocerite reaches variously in the second segment. The basicerite bears the acute ventral tooth generally reaching forward almost as far as the stylocerite. The carpocerite is slightly swollen and markedly exceeds the end of the antennular peduncle. The scaphocerite has the elongated lateral spine extending to or beyond the end of the antennular peduncle; the narrow lamella is more than 2/3 of the length of the lateral spine.

The large chela is, in the male, 1.1 times the carapace length and 2.6 times as long as high. It is almost cylindrical, and has a slight projection instead of a sharp tooth at the base of the finger articulation. The merus is more than twice as long as broad, and the dorsal margin is pointed distally.

The small chela is, in the male, half the length of the carapace, 3.0 times as long as high, and cylindrical. The merus is 2.8 times as long as broad, with the dorsal margin pointed distally.

In the second pereiopod the carpal articles have a ratio, 10 : 2-3 : 2-3 : 2-3 : 4-6. The last 3 pereiopods resemble each other in shape. The dactylus of the third pereiopod is biunguiculate, the ventral unguis is shorter and broader than the dorsal one. The ventral margin of the carpus has a spine distally. The merus is 4.0-5.0 times as long as broad and unarmed.

The abdominal segments show the sexual dimorphism in shape of the pleura. In the female the first 4 pleura are rounded posteriorly, and the second 2 are angled. In the male the first pleuron is strongly produced at the posterior margin, the second is rounded, and the rest are pointed posteriorly. Every endopod of the second to fifth pleopods has, in the female, an appendix interna, but in the male has not an appendix interna nor an appendix masculina.

The telson is twice as long as broad at the posterior margin; the posterolateral corners are spiniform and more produced backward than the arcuate posterior margin. The anterior pair of the dorsal spines is situated slightly before the middle of the length, and the posterior pair is slightly behind the middle.

Material examined.

Southern Japan.——Kii Peninsula: 1♂, ZLKU No. 17264, Wakayama Pref., Tanabe Bay, To-jima islet, 1 m deep under low tide mark, within a canal of sponge, *Halichondria* sp., enveloping stinging polyp, *Stephanoscyphus racemosus* Komai, Aug. 6, 1967, Y. Miya leg.——Western Kyushu: 1♂, 2♀♀, ZLKU No. 17265, Amakusa Is., Shimo-shima I., Tomioka, lobster trammel-net, February 1966, A. Taki leg.; 1♂, 1♀, ZLKU No. 17268, Amakusa, Tomioka, lobster trammel-net, Mar. 19, 1966, A. Taki leg.; 1♂, 2 juv., ZLKU No. 17270, Amakusa, Tomioka, off Kakise, 35 fathoms, lobster trammel-net, Sept. 21, 1966, A. Taki leg.; 1♂, 1 ovig. ♀, ZLKU No. 17273, Amakusa, Tomioka, lobster trammel-net, May 31, 1967, T. Fujino leg.; 3♂♂, 1 ovig. ♀, AMBL, Amakusa, Ushibuka, 5-10 m deep, from broken up coral mass, Sept. 28, 1968, T. Kikuchi leg.

Ryukyu Archipelago.——Amami Group: 1♂, 1 ovig. ♀, ZLKU No. 11004, Amami-oshima I., Kasari, Yo, Aug. 4, 1967, Y. Ushio leg.; 4♂♂, 6 ovig. ♀♀, 2♀♀, ZLKU No. 11388, Amami-oshima I., Kasari, Suno, fringing reef, from broken up dead coral mass, July 24, 1968, Y. Miya and T. Fujino leg.; 1♂, 1 ovig. ♀, ZLKU No. 11006, Kikai-jima I., Wan, Aug. 7, 1967, Y. Ushio leg.; 5♂♂, 2 ovig. ♀♀, ZLKU No. 11363, Yoron-jima I., Sena, from broken up basal part of dead coral mass, July 9, 1968, Y. Miya and T. Fujino leg.; 2♂♂, 1 ovig. ♀, 3♀♀, ZLKU No. 11370, Yoron-jima I., Sena, barrier reef, inner side, July 9, 1968, Y. Miya and T. Fujino leg.; 1♂, 1 ovig. ♀, ZLKU No. 11376, Yoron-jima I., Ukachi, in tide pool, on barrier reef, from broken up basal part of dead coral mass, July 11, 1968, Y. Miya and T. Fujino leg.; 1♂, 2 ovig. ♀♀, ZLKU No. 11378, Yoron-jima I., Ukachi, barrier reef, in surge channel on outermost edge, from broken up living coral, July 11, 1968, Y. Miya and T. Fujino leg.; 2♂♂, 5 ovig. ♀♀, Yoron-jima I., Hakebina, from broken up basal part of coral masses, July, 13, 1968, Y. Miya and T. Fujino leg.——Okinawa Group: 1♂, ZLKU No. 17273, Kumejima I., Aradake, Mar. 31, 1960, H. Minei leg.; 2♂♂, 1 ovig. ♀, ZLKU No. 17275, Okinawa-jima I., Komesu, July 2, 1962, S. Miyake, T. A. Uchida and H. Minei leg.

Colour in life. When alive, the shrimp is transparent, sometimes coloured with pale blue on the ground, entirely scattered with red chromatophores. The eggs freshly laid are green. "Colour typically brown to gray, but those living in heads of *Pocillopora meandrina* reddish" (Banner, 1953).

Ecology. The species is one of the commonest forms on coral reefs and sublittoral habitats of this region. It is a crevice dweller. It is generally found to live in dead corals, sometimes in living corals, and also on sublittoral habitats limitted to hard bottoms.

A single specimen from Tanabe Bay was found to live together with a pair of *Alpheus paralcyone* in canals of a yellow sponge, *Halichondria* sp., enclosing a stinging polyp, *Stephanoscyphus racemosus* Komai.

Remarks. The specimens available plainly belong to this species. There are excellent discussions of the variations and synonymy of the species in Coutière (1905), Banner (1953, 1956), and Banner and Banner (1964).

Distribution. The species is widely distributed in the Indo-West Pacific region. From reef flat down to 126 m deep.

It has been recorded in the literature from the following localities under several names. *S. paraneomeris* is known from: Coetivy Is. (Coutière, 1921); Chagos Archipelago (Coutière, 1921); Laccadive Archipelago (type locality, Coutière, 1905); Saipan, Mariana Archipelago (Banner, 1956); Caroline Is. (Banner and Banner, 1968); Marshall Is. (Banner, 1957, 1959; Banner and Banner, 1968); Wake I. (Banner, 1959); Onotoa, Gilbert Is. (Banner, 1958); Canton Atoll, Phoenix Is. (Banner and Banner, 1964); Fiji Is. (Banner and Banner, 1966a); Tonga Is. (Banner and Banner, 1966a); Samoa Is. (Banner and Banner, 1966a); Cook Is. (Banner and Banner, 1967); Society Is. (Banner and Banner, 1967); Christmas I., Line Is. (Banner and Banner, 1964); Johnston I. (Banner and Banner, 1964); and Hawaiian Archipelago (Edmondson, 1925; Banner, 1953). The following subspecies are recorded only from their respective type localities: *S. paraneomeris praedabundus* from Lombok I.; Paternoster Is.; Karkaralong Group; and Kur I. (De Man, 1911). *S. paraneomeris prolatus* from Waigeu I. and Kabaëna I. (De Man, 1911). *S. paraneomeris halmaherensis* from Waigeu I. (De Man, 1911). *S. paraneomeris praslini* from Seychelles (Coutière, 1921). *S. paraneomeris seychellensis* from Seychelles (Coutière, 1921).

Synalpheus bituberculatus De Man, 1910
(New Japanese name: Futakobu tsuno teppo ebi)
(Plate 10)

Synalpheus bituberculatus De Man, 1910: 294 (diagnosis only); 1911: 276; 1915: pl. 11, fig. 53.——Johnson, 1961: 51.——Banner and Banner, 1966b: 66, fig. 22.

Description. The present specimens are stout and polished, measuring 8.7-17.8 mm in body length (3.5-5.9 mm in c.l.). The rostrum is short, triangular or awl shape, sometimes with the dorsal carina reaching backward to the base of the orbital hoods. Generally it is longer than the orbital teeth, and reaches at the proximal third of the first antennular segment by its apex.

The antennular peduncle is slender, the second segment is 1.4-1.5 times as long as broad; the 3 segments have a ratio, 1.1-1.6 : 1.0 : 0.8-0.9. The stylocerite is strong and reaches variously in the first third of the second segment. The basicerite has 2 acute teeth, the ventral tooth usually reaches the middle of the second segment, and the dorsal tooth extends to or almost to the middle of the first segment. The carpocerite is elongate and markedly exceeds the end of the antennular peduncle. The scaphocerite extends beyond the antennular peduncle by the apex of the slender lateral spine curved outward; the very narrow lamella generally exceeds the end of the second segment.

The large chela is 2.6–3.0 times as long as high in both sexes, and is 1.1–1.5 times the carapace length in the male and 1.0 times in the female. It is cylindrical and considerably twisted, and has 2 rounded tubercles at the base of the finger articulation. The merus is 2.1–2.4 times as long as broad, the dorsal margin is strongly arcuate and pointed apically.

The small chela is, in both sexes, 2.8–3.1 times as long as high and cylindrical, and is 0.5–0.6 times the carapace length in the male and 0.4 times in the female. The merus is 2.7–3.5 times as long as broad, with several slender spines along the ventral inner margin.

In the second pereiopod the carpal articles have a ratio, 10:2–3:2–3:2–3:5–6. In the third pereiopod the dactylus is short and biunguiculate; the ventral unguis is triangular and perpendicular to the ventral margin; the dorsal unguis is somewhat longer than the ventral one, and equals in breadth at the base of them. The propodus has 8 or 9 spines along the ventral margin. The carpus has 1 or 2 spines at the ventral distal corner. The merus is swollen and 3.3–3.8 times as long as broad; the ventral margin is armed with 3–8 spines, but is unarmed distally. The following 2 pereiopods are closely related to the third, but the merus of them has no spine.

The abdominal pleura differ with sex. In the female all the pleura are rounded. In the male the first pleuron is acutely pointed at the anteroventral corner, and is produced as a sharp triangular projection posteriorly; the second is rounded; the third and fourth are pointed at the anterior and posterior corners; and the fifth is pointed posteriorly. Every endopod of the second to fifth pleopods is, in the female, furnished with an appendix interna, but is, in the male, without an appendix masculina nor an appendix interna.

The telson is 2.4–3.1 times as long as broad at the posterior margin; the lateral margins are abruptly tapering on the distal half; the posterior margin is almost straight. The dorsal surface is slightly excavated medially; the anterior pair of the strong spines is situated just behind the proximal third of the length, and the posterior pair is situated at the distal third of it.

Variations. In the present specimens the considerable variation was found in the shape of the rostrum and orbital teeth. The rostrum is short, triangular or awl in shape, sometimes with the dorsal carina. Generally it is longer than the triangular orbital teeth, but is sometimes shorter than them.

Material examined.

Southern Japan.——Kii Peninsula: 1 ♂, 1 ovig. ♀, ZLKU No. 17282, Wakayama Pref., Tanabe

Bay, Ezura, 1 m deep under low tidemark, interstices of a living coral, *Leptastrea purpurea* (Dana), July 23, 1967, Y. Miya leg.; 2♂♂, 1 ovig. ♀, ZLKU No. 17284, Tanabe Bay, Ezura, 1 m deep under low tidemark, within canals of a sponge, *Halichondria* sp., enveloping a stinging polyp, *Stephanoscyphus racemosus* Komai, July 23, 1967, Y. Miya leg.; 2♂♂, 1 ovig. ♀, ZLKU No. 17287, Tanabe Bay, Engetsu-jima islet, 1 m deep under low tidemark, among branches of *Dendronephthya gigantia* (Verrill), Aug. 6, 1967, Y. Miya leg.; 1♂, 1 ovig. ♀, SMBL Macr. 29, Yuzaki, May 21, 1951, T. Yamamoto leg.; 1♂, 1 ovig. ♀, TUF, Seto, Aug. 5, 1951, T. Ishibashi leg.

Colour in life. The animal is transparent, chrome deep, uniformly scattered with carmine red chromatophores, which are absent on the second to fifth pereiopods and on the pleopods. The eggs are chrome deep.

Ecology. Generally the shrimps seek shelter in other living animals, such as sponges, corals and alcyonarians. For example the specimens (2♂♂, 1 ovig. ♀) from Ezura were found to reside in canals of a sponge, *Halichondria* sp., where *Synalpheus tumidomanus* and *Chlodiella cytherea* (Dana) lived together with them. The others (1♂, 1 ovig. ♀) from Ezura nestled down interstices of a living coral, *Leptastrea purpurea* (Dana), where a xanthid crab, *Pisidia dispar* (Stimpson), and two ophiuroids, *Ophiothrix marenzerelleri* Koehler and *Ophiomastix mixta* Lutker, were also found. Still others from Engetsu-jima islet hid among branches of *Dendronephthya gigantia* (Verrill), *Alpheus paralcyone* and a hippolytid shrimp, *Heptacarpus futilirostris* Bate, were also collected from same interstices.

Remarks. The present specimens are closely related to the original description and figures of the species, but there are such slight differences as the rostrum varying from awl in shape to triangular, and the merus of the small cheliped bearing several spinules along the ventral inner margin.

Distribution. The species has been recorded from the type localities in Java Sea, Flores Sea, Timor Sea and Ceram Sea (De Man, 1910, 1911); Singapore (Johnson, 1961); Phuket I. (Banner and Banner, 1966b); and the Gulf of Thailand (Banner and Banner, 1966b). From reef flat down to 54 m in depth.

Synalpheus spiniger (Stimpson, 1860)

Alpheus spiniger Stimpson, 1860: 32 (100).——Bate, 1888: 560, pl. 100, fig. 3.
Synalpheus spiniger: De Man, 1911: 202 (part).——Balss, 1914: 37 (general distribution).

Diagnosis. Allied to *A. neptunus* [=*S. neptunus*]. Body robust. Frontal teeth [=rostrum and orbital teeth] strong, acute; rostral apex reaching almost to second antennular segment; orbital teeth half as long as rostrum. Antenna armed with short and slender basal spine [=basicerite]. Antennal scale [=scaphocerite] acute and short. Ultimate segment of third maxilliped short, hairy and armed with spinules apically. Large chela stout, rounded, smooth and naked; palm unarmed; immovable finger bituberculatus on inner side; movable finger compressed, dorsal margin acute. In carpus of second pereiopod first article subequal to whole length of following four articles. In third pereiopod merus slender, unarmed and naked; dactylus armed with second unguis ventrally, curved postward. Length. 1 poll [=ca. 25 mm]. (Translated from original description).

Remarks. As no specimen of *S. spiniger* is contained in the material examined, the diagnosis is given from the original description.

Distribution. It has been recorded only from Manila, the Philippine Islands (Bate, 1888) besides Amakirrima [=Kerama Is.], the Ryukyu Archipelago (type locality, Stimpson, 1860).

Synalpheus demani Borradaile, 1900
(New Japanese name: Komachi teppo ebi)
(Plate 11)

Alpheus triunguiculatus De Man, 1887: 504, pl. 22, fig. 1 (nom. preoccu.).
Synalpheus demani Borradaile, 1900: 416.——De Man, 1911: 257; 1915: pl. 9, fig. 42.——Banner and Banner, 1968: 274.——Ooishi, 1970: 88, pl. 10, figs. 4, 5 (photos).

Description. The animals are robust and polished, measuring 7.3-26.9 mm in body length (3.0-10.2 mm in c.l.). The rostrum is narrow triangular, without the dorsal carina, and its apex reaches the proximal half of the second antennular segment. The orbital teeth are narrow triangular or needle shape, and extends to the distal third of the first segment.

The antennular peduncle is robust and hairy, the second segment is 0.8-1.2 times as long as broad; the 3 segments have a ratio, 1.6 : 1.0 : 0.9-1.0. The stylocerite is stout, slightly curved inward and hairy along the outer margin, its apex reaches forward as far as the rostral apex.

The basicerite has 2 strong teeth, the dorsal tooth reaches the middle of the first antennular segment, and the lateral one extends to or beyond the end of the first segment. The carpocerite is robust and exceeds the end of the antennular peduncle. The scaphocerite is slightly concaved laterally, and ends in a strong spine reaching the end of the carpocerite; the rounded anterior margin of the lamella extends to or almost to the end of the antennular peduncle.

The large chela is 0.9–1.3 times the carapace length and about 3.0 times as long as high. The palm is slightly compressed and twisted, its margins are rounded and entire except for the pointed tooth above the finger articulation. The merus is twice as long as broad, the dorsal distal margin is truncated.

The small chela is half the carapace length and 3.0 times as long as high. The palm is cylindrical and entire. The merus is 2.2–3.9 times as long as broad, the dorsal distal margin is truncated.

The carpus of the second pereiopod is subdivided into 5 or rarely 4 articles. In the third pereiopod the dactylus is stout and triunguiculate; the dorsal unguis is short and spiniform; the slender ventral unguis is 2/3 the length of the strong medial one, and markedly separated from the latter by the broad U-shaped emargination. The propodus is curved dorsoventrally, its ventral margin is furnished with 1 or 2 slender spines and 3 tufts of long hairs on the distal fourth of the length. The carpus is unarmed. The merus is 2.8–3.5 times as long as broad and unarmed.

The abdominal pleura differ with sex. In the female the margins of the first 5 pleura are rounded. In the male the margin of the first pleuron is rounded anteriorly and ends in a strong tooth posteriorly; that of the second is rounded; and those of the rest are bluntly pointed posteriorly. Every endopod of the second to fifth pleopods of the female has a long appendix interna; that of the male has no appendix interna nor an appendix masculina, but has rarely a rudimentary appendix interna only.

The telson is 2.7–3.6 times as long as broad at the posterior margin which is arcuate; the dorsal surface is shallowly excavated middorsally and unarmed with the usual dorsal spines.

Variations. In the four specimens from Tanabe Bay (3 ♂♂: 5.0, 6.2 and 6.2 mm in c.l., respectively; 1 ovig. ♀: 10.2 mm in c.l.) the carpus of the second pereiopod is subdivided into 5 articles with a ratio, 10:2–3:2–3:2–3:4–5. On the other hand, the rest (2 ♂♂: 3.0 and 4.9 mm in c.l.) from Tanabe Bay have the carpus of 4 articles with a ratio, 10:3:2–3:4–6. All the specimens from the Ogasawara Islands have the 5-articulated carpus of the second pereiopod.

Material examined.

Southern Japan.——Kii Peninsula: 1 ♂, SMBL, Wakayama Pref., Tanabe Bay, Seto, associated with *Comanthina schlegeli* (Carpenter) (SMBL Cri. 24), August 1924; 1 ♂, SMBL, Tanabe

Bay, Seto, 5 m deep, associated with *Comanthina schlegeli* (Carpenter) (SMBL Cri. 56), July 1961, I. Kogo leg.; 1 ♂, 1 ♀, SMBL, Tanabe Bay, Nada, associated with *Comanthina* sp. collected by lobster trammel-net, Feb. 11, 1962, T. Yamamoto leg.; 1 ♂, 1 ovig. ♀, SMBL, Tanabe Bay, Minabe, associated with *Comanthina schlegeli* (Carpenter) collected by lobster trammel-net, mid November 1969, S. Nishimura leg.

Micronesia.——Ogasawara Islands: 3 ♂♂, 1 ovig. ♀, ZLKU No. 17278, Hitomaru-jima I., 7–10 m deep, associated with a comatulid, July 6, 1968, S. Ooishi leg.

Colour in life. "A pair of shrimps which I was sending you were collected from a comatulid, *Comanthina schlegeli* (Carpenter). They are deep brown black entirely; but the colour of the first pereiopods is slightly lighter, that of the other pereiopods is much lighter, than that of the body. The antenna is tinted a light brown. The tip of the movable finger of the first pereiopods and the dactylus of the following pereiopods are tinged with red. Along the margins the tail fan is also tinged with red" (Dr. Nishimura, letter, 1970).

"They were black in life with red and blue chromatophores on the back. Each abdominal segment bore three large white chromatophores, one on each side, and one medially. Carapace with several white chromatophores symmetrically placed, uropods with one white chromatophore each. (Color notes from collector)" (Banner and Banner, 1968).

Ecology. All the present specimens were found living in association with *Comanthina schlegeli* (Carpenter) (Jap. name: Hana umishida). Banner and Banner (1968) also recorded two specimens collected from *Comanthus bennetti* in about 30 feet of water. But the other workers said nothing to the association with crinoids, and recorded their specimens from the bottoms of mud, coral and coral sand; of sand, small stones and shells; of coral and *Lithothamnion*.

Remarks. The two males with the carpus of 4 articles are furnished with a rudimentary appendix interna on the endopod of the second pleopod. But they, in spite of these differences, plainly belong to this species.

Distribution. The species appears to be restricted in the West Pacific region. It is known from: Amboina (De Man, 1887); Lombok I. (De Man, 1911); between Misool and New Guinea (De Man, 1911); Paternoster Is. (De Man, 1911); Marshall Is. (Banner and Banner, 1968); Ogasawara Is. (Ooishi, 1970); and Loyalty Is. (type locality, Borradaile, 1900). From shallow water down to about 50 m in depth.

Synalpheus tumidomanus (Paulson, 1875)

(New Japanese name: Midori tsuno teppo ebi)

(Plate 12)

Alpheus tumidomanus Paul'son, 1961 (1875): 101, pl. 13, fig. 2.
Alpheus tumidomanus gracilimanus Paul'son, 1961 (1875): 101, pl. 13, fig. 3.
Synalpheus tumidomanus: Coutière, 1909: 24, fig. 5.——De Man, 1911: 258; 1915: pl. 9, fig. 43.——Holthuis, 1958: 29.——Banner and Banner, 1964: 87; 1966a: 159; 1966b: 56, fig. 17; 1968: 275.
Synalpheus tumidomanus exilimanus Coutière, 1909: 10 (*nomen nudum*).
Synalpheus theophane De Man, 1911: 261; 1915: pl. 10, fig. 44.
Synalpheus japonicus Yokoya, 1936: 133, fig. 3.
Confer Synalpheus tumidomanus: Couitère, 1905: 876, pl. 73, fig. 14 (part); 1921: 417 (=*S. hululensis*).
Confer Synalpheus hululensis Coutière, 1908: 12; 1909: 24, fig. 4.——Holthuis, 1958: 31, fig. 11.——Lewinsohn and Holthuis, 1964: 19, fig. 2.——Crosnier and Forest, 1966: fig. 30 (figure of lectotype).
Confer Synalpheus hululensis africanus Crosnier and Forest, 1965b: 607, fig. 2; 1966: 292, fig. 29.
Confer Synalpheus hululensis congoensis Crosnier and Forest, 1965b: 608, fig. 3; 1966: 301, fig. 31.
Nec. Synalpheus tumidomanus: Coutière, 1905: 876, pl. 73, fig. 14 (part=*S. hululensis* in Coutière, 1909: 24 =*S. spinifrons* H. Milne Edwards, 1837, *Confer* Holthuis, 1952: 36).
Nec. Synalpheus tumidomanus: Kubo, 1940: 90, fig. 11 (=*S. hastilicrassus* Coutière, 1905, *Confer* Banner and Banner, 1968: 276).

Description. The specimens in hand are smooth and polished, measuring 12.5-22.0 mm in body length (4.8-8.0 mm in c.l.). The rostrum is narrow triangular or awl shape, with few hairs apically, and reaches variously in the distal third of the first antennular segment. The sharp orbital teeth extend to or almost to 2/3 of the rostrum.

The antennular peduncle is robust, the second segment is 1.0-1.3 times as long as broad; the 3 segments have a ratio, 1.4-1.9 : 1.0 : 0.8-1.0. The stylocerite is slender and reaches variously in the distal half of the second segment. The basicerite has 2 sharp teeth, the dorsal tooth reaches foward as far as the apex of the orbital tooth, and the ventral one reaches variously in the proximal half of the second segment. The carpocerite is elongate and markedly exceeds the end of the antennular peduncle. The scaphocerite has a narrow lamella extending to or almost to the end of the antennular peduncle, and has a slender lateral spine exceeding the end of the carpocerite.

The first pair of pereiopods shows no sexual dimorphism. The large chela is 2.8-3.1 times as long as high in both sexes, and is 1.3 times the carapace length in the male and 1.0-1.1 times in the female. It is almost cylindrical and polished, with a sharp tooth at the inner side of the finger articulation. The merus is 2.2-2.5 times as long as broad, and the dorsal margin ends in an acute tooth terminally.

The small chela is 3.1-3.9 times as long as high and 0.5-0.6 times the carapace length in both sexes. The movable finger is somewhat shorter than the palm, which is cylindrical and entire. The merus is 2.2-2.5 times as long as broad, and projects as a small pointed tooth at the distal end of the dorsal margin.

In the second pereiopod the carpal articles have a ratio, 10:2:2:2:4. The dactylus of the third pereiopod is slender and biunguiculate; the dorsal unguis is usually longer than the ventral, they are subequal in breadth at the base. The propodus has about 10 spines on the ventral margin. The carpus has a spine on the ventral distal corner. The merus is unarmed and 4.0-4.4 times as long as broad.

The abdominal pleura show the slight sexual dimorphism. In the female all the pleura but the last 2 are rounded posteroventrally. In the male all but the second and third pleura are acuminate posteroventrally. Every endopod of the second to fifth pleopods has, in the female, an appendix interna, while in the male it has no appendices.

The telson is 2.3-2.7 times as long as broad at the posterior margin, which is strongly arcuate. The lateral margins are certainly convex on the middle and abruptly tapering distally. The anterior pair of the dorsal spines is situated before the middle of the length, and the posterior pair is on 2/3 of it.

Material examined.

Southern Japan.——Boso Peninsula: 1♀, TUF, Chiba Pref., Kominato, Matsugahana, July 17, 1943.——Sagami Bay: 1 ovig. ♀, BLIH Sp. No. 704, Kasajima I., July 22, 1952; 1♂, 1 ovig. ♀, BLIH Sp. No. 2167, Warishima I., 6-7 faths., July 26, 1963; 1 ovig. ♀, BLIH Sp. No. 2280, off Sajima, E., of Kasagone, 6.5-7 faths., July 20, 1964.——Kii Peninsula: 1♂, ZLKU No. 17290, Wakayama Pref., Tanabe Bay, Ezura, 1 m deep under low tide mark, within canal of a sponge, *Halichondria* sp., enveloping a stinging polyp, *Stephanoscyphus recemosus* Komai, July 23, 1967, Y. Miya leg.——Western Kyushu: 1♂, ZLKU No. 17291, Amakusa Is., Shimo-shima I., Tomioka, washed from debris entangled in lobster trammel-net, Feb. 15, 1966, A. Taki leg.; 1♂, ZLKU No. 17292, Amakusa, Tomioka, off Akaiwa, ca. 15 faths., collected by lobster trammel-net, Apr. 17, 1966, A. Taki leg.; 1♂, ZLKU No. 17293, Amakusa, Tomioka, lobster trammel-net, Mar. 19, 1966, A. Taki leg.; 1♂, 1♀, ZLKU No. 17294, Amakusa, Tomioka, from a sponge entangled in lobster trammel-net, May 30, 1966, A. Taki leg.; 1♂, 1 ovig. ♀, ZLKU No. 17296, Amakusa, Tomioka, off Kakise, 35 faths., Sept. 21, 1966, A. Taki leg.; 1♂, ZLKU No. 17298, Amakusa, Tomioka, 35 faths., washed from *Dendrophillia* and debris entangled in lobster trammel-net, Oct. 6, 1966, A. Taki leg.; 2♂♂, ZLKU No. 17299, Amakusa, Tomioka, ca. 40 faths., from *Dendrophillia* entangled in lobster trammel-net, May 17, 1967, A. Taki leg.

Ryukyu Archipelago.——Amami Group: 1♂, 1 ovig. ♀, ZLKU No. 11361, Yoron-jima I., Terasaki, lagoon, interstices of *Pocillopora damicornis* (Linné), July 14, 1968, Y. Miya and T. Fujino leg.——Okinawa Group: 1♀, ZLKU No. 17301, Okinawa-jima I., Minatogawa, July 1962, S. Miyake, T. A. Uchida and H. Minei leg.

Colour in life. The animal is transparent and pale yellowish green, uniformly scattered with carmine red chromatophores. The first pereiopods are coloured with yellowish green; the distal halves of the fingers are deep green or bluish green; the carpus and merus are margined with deep green.

Ecology. Almost all of the specimens were washed from rock debris, *Dendrophillia* spp. and sponges entangled in lobster trammel-nets.

Remarks. Recently Banner and Banner (1968) closely studied the range of variation in the rich material from the Marshall and Caroline Islands. As a result of the study, they made it clear that *S. tumidomanus* showed a wide range of variation in the various characters used for the distinction of the species. And they concluded that *S. hululensis*, *S. theophane*, *S. t. gracilimanus* would be placed in the synonymy of *S. tumidomanus*.

In 1936 Yokoya described *S. japonicus* based upon an ovigerous female (ca. 20 mm in body length) from Sagami Bay. Unfortunately he did not compare the species with any species, however, it is clear that *S. japonicus* does not show any features indicating that it should not belong to *S. tumidomanus*.

In the course of the study the author found that the variation occurring in Japanese specimens fell well within the range of variation in the characters recorded by Banner and Banner. However, in the present material there is no specimen in which the large chela does not bear the tooth above the finger articulation, as shown in *S. hululensis*. This distinction may prove to be unimportant when additional material becomes available, as already noted by Banner and Banner (1966b), but it seems advisable for the present to consider *S. hululensis* and its two subspecies distinct.

Distribution. *S. tumidomanus* is widely distributed in the Indo-West Pacific region. From reef flat down to 70 m deep.

It has been recorded in literature from the following localities under several names. *S. tumidomanus* is known from: Red Sea (type locality, Paulson, 1875; Coutière, 1909; Holthuis, 1958); Malay Archipelago (De Man, 1911); Gulf of Thailand (Banner and Banner, 1966b); Caroline and Marshall Is. (Banner and Banner, 1968); Samoa (Banner and Banner, 1966a) and Phoenix Is. (Banner and Banner, 1964). *S. t. gracilimanus* is collected only from the Red Sea (Paulson, 1875). *S. theophane* is described from the Malay Archipelago (De Man, 1911). *S. japonicus* has been known only from Sagami Bay (Yokoya, 1936).

On the other hand, *S. hululensis hululensis* is known from: Maldive Archipelago (type locality, Coutière, 1905); Cargados Carajos (Coutière, 1921); Red Sea (Coutière, 1909; Holthuis, 1958); Mediterranean coast of Israel (Lewinsohn and Holthuis, 1964). *S. h. africanus* has been recorded in the East Atlantic, from Cap Vert Is., San Tomé

Is., Principe Is., to Annobón Is. (Crosnier and Forest, 1966). *S. h. congoensis* is known only from Djeno, near Pointe Noire (Crosnier and Forest, 1966).

Synalpheus gravieri Coutière, 1905
(Japanese name: Togetosaka teppo ebi)
(Plate 13)

Alpheus prolificus: Ortmann, 1890: 484.
Synalpheus gravieri Coutière, 1905: 870, pl. 70, fig. 2; 1909: 90; 1921: 414.——Pearson, 1905: 82.——De Man, 1911: 216; 1915: pl. 6, fig. 25.——Balss, 1914: 37 (general distribution)——Tattersal, 1921: 373.——Johnson, 1961: 50.——Banner and Banner, 1966b: 48, fig. 13.——Nishimura and Suzuki, 1971: 84, pl. 27, fig. 6 (photo).
? *Synalpheus gravieri:* Yokoya, 1936: 21.

Description. The specimens in hand are smooth and polished, measuring 11.7–26.3 mm in body length (4.4–9.7 mm in c.l.). The rostrum is awl shape and generally reaches 2/3 of the first antennular segment. The orbital teeth are generally curved inward and slightly shorter than the rostrum.

The antennular peduncle is slender, the second segment is 1.2–2.0 times as long as broad; the 3 segments have a ratio, 1.4–1.9 : 1.0 : 0.7–1.0. The stylocerite is elongate and reaches variously in the proximal third of the second segment. The basicerite has 2 slender teeth, the longer ventral tooth extends to, almost to or beyond the end of the first segment, and the shorter dorsal one reaches beyond the middle of that segment. The carpocerite is elongate and exceeds the end of the antennular peduncle. The scaphocerite has the slender lateral spine generally exceeding the end of the antennular peduncle and has the narrow lamella generally reaching in the second third of the third segment.

The large chela is, in both sexes, 2.2–3.1 times as long as high and almost cylindrical, and bears a strong, sharp tooth at the inner distal corner of the palm. It shows the slight sexual dimorphism in the relative length to the carapace, being 1.3–1.4 times the carapace length in the male and 0.9–1.0 times in the female. The merus is 2.0–2.8 times as long as broad, with a small, sharp tooth at the distal end of the dorsal margin.

The small chela is, in both sexes, 0.4–0.6 times the carapace length, 3.2–4.0 times as long as high and cylindrical. The merus is 2.3–3.6 times as long as broad, the dorsal margin is slightly produced.

In the second pereiopod the carpal articles have a ratio, 10 : 1–2 : 1–2 : 1–2 : 3–4. The dactylus of the third pereiopod is biunguiculate, with the strong, sharp ventral unguis and the short, spiniform dorsal unguis. The propodus bears 7 to 10 spines ventrally. The ventral margin of the carpus has a spine distally. The merus is 3.3-4.3 times as long as broad, and bears 1 to 4 strong spines along the ventral margin.

The abdominal segments show the sexual dimorphism in shape of the pleura. In the female the pleura of the first 4 abdominal segments are rounded posteriorly, and those of the fifth and sixth are pointed posteriorly. In the male the first pleuron is produced as a triangular projection posteriorly, the following ones are distinctly angled posteriorly. In the female every endopod of the second to fifth pleopods has an appendix interna, and in the male it has not an appendix masculina nor an appendix interna.

The telson is 2.5-4.0 times as long as broad at the posterior margin. The lateral margins are almost parallel on the proximal half and abruptly tapering on the distal half. The posterior margin is markedly rounded. The anterior pair of the dorsal spines is generally situated behind the middle of the length, and the posterior pair is generally on 3/5 of it.

Variations. In the present specimens the considerable variation is observed in the following characters:

1. Rostrum and orbital teeth. The rostrum is awl in shape and sometimes narrow triangular. Its sharp apex reaches variously from near the middle of the first antennular segment to the middle of the second segment. Generally it reaches to 2/3 of the first segment.

The orbital teeth are generally curved inward. But sometimes they run parallel with the rostrum or slightly curved outward, so that the margin between the orbital tooth and the rostrum is generally U and sometimes V in shape.

2. Scaphocerite. The sharp lateral spine is curved outward, and reaches variously in the distal half of the third antennular segment or markedly beyond the end of the antennular peduncle. The narrow lamella reaches variously in the third segment and rarely exceeds the end of that segment. Generally it reaches in the second third of that segment.

3. Situation of the dorsal spines of the telson. The situation of the anterior pair of the dorsal spines varies from the middle to 2/3 of the length. That of the posterior pair varies from 2/3 to 4/5 of it.

Material examined.

Southern Japan.——Sagami Bay: 1♂, 1 ovig. ♀, BLIH No. 269, Hayama, between Najima and Warishima, near Tegojima, 13 m deep, Sept 3, 1940; 1♂, BLIH No. 1989, Okinoyama, 75 m deep, Feb. 7, 1962; 1♀, BLIH No. 1994, off Jogashima, WSW 3.5 km, 93-95 m deep, Feb. 7, 1962;

1 ♀, BLIH No. 2150, off Kurosaki, Koronbane, 110 m deep, July 21, 1963.——Kii Peninsula: 1 ♂, SMBL, Wakayama Pref., Kushimoto, associated with *Dendronephthya flabellifera* (Studer), Jan. 29, 1952, T. Yamamoto leg.; 1 ♂, 1 ovig. ♀, SMBL, Wakayama Pref., Kushimoto, associated with *D. yamamotoi* Utinomi, Jan. 29, 1952, T. Yamamoto leg.; 1 ovig. ♀, SMBL, Wakayama Pref., Tanabe Bay, Seto, Nada, associated with *D. disciformis* Kükenthal, 1950; 1 ♂, SMBL, Tanabe Bay, Shiso-jima islet, 5 m deep, associated with *D. castanea* Utinomi, Apr. 19, 1952, T. Yamamoto leg.; 1 ♂, SMBL, Tanabe Bay, Shiso-jima islet, associated with *D. gloriosa* Utinomi, May 1, 1954; 1 ♂, 1 ovig. ♀, SMBL, Tanabe Bay, associated with *D. nipponica* Utinomi; 1 ♂, ZLKU No. 17302, Tanabe Bay, Shiso-jima islet, associated with *D. gigantia*, July 18, 1967, Ch. Araga leg.——Western Kyushu: 1 ♂, 1 ♀, ZLKU No. 2217, Nagasaki Pref., Nomo, lobster trammel-net, associated with *Xenia hicksoni* Ashworth, K. Matsubayashi leg.; 5 ♂♂, 4 ovig. ♀♀, SMBL, Amakusa Is., Shimo-shima I., Tomioka, off Akaiwasaki, 10–20 m deep, July 1957; 1 ♂, 1 ovig. ♀, 2 ♀♀, ZLKU No. 2664, Amakusa, Tomioka, off Uze, 45 m deep, associated with *Dendronephthya* sp., Apr. 14, 1964, T. Kikuchi leg.; 2 ovig. ♀♀, ZLKU No. 2668, Amakusa, Tomioka, 40–50 m deep, associated with *Dendronephthya* sp., June 9, 1965, T. Kikuchi leg.; 9 ♂♂, 7 ovig. ♀♀, ZLKU No. 17303, Amakusa, Tomioka, off Uze, 40 m deep, dredged, associated with *Dendronephthya* spp., June 21, 1966, T. Kikuchi and Y. Miya leg.; 4 ♂♂, 4 ovig. ♀♀, ZLKU No. 17331, Amakusa, Tomioka, off Uze, 40 m deep, dredged, associated with *Dendronephthya* spp., May 29, 1967, T. Fujino leg.

Micronesia.——Ogasawara Islands: 1 ♂, 1 ovig. ♀, ZLKU No. 1419, Muko-shima I., July 17–21, 1938, S. Miyake leg.

East China Sea.——Off Tsushima Islands: 2 ♂♂, 2 ovig. ♀♀, ZLKU No. 15536, 34°03.3′ N., 129°04.5′ E., 125 m deep, coarse sand, July 26, 1968; 7 ♂♂, 3 ovig. ♀♀, ZLKU No. 15540, 34°16′ N., 129°31.5′ E., 105 m deep, shell sand, Aug. 5, 1968.——Norin gyoku (Official block) Nos. 548–538: 1 ♀, ZLKU No. 15535, 26°05.0′–26°09.8′ N., 122°55.0′–123°01.9′ E., 110 m deep, Dec. 9, 1967, 14:17–16:45.——Norin gyoku (Official block) No. 559: 1 ovig. ♀, 1 ♀, ZLKU No. 15533, 25°58.0′ N., 122°32.0′ E., 103 m deep, June 7, 1962.

Colour in life. The living shrimp is entirely transparent, only with several red chromatophores between corneas, corresponding with the transparent trunk of the host alcyonaceans. The eggs freshly laid are green.

Ecology. This species appears the obligate commensal of alcyonaceans and may be one of the commonest forms in southern Japan. Generally it is found to live in a pair on a given host individual. From the present material it has been taken from the above 7 species of *Dendronephthya* and 1 species of *Xenia*, and appears fairy common on *D. gigantia* (Jap. name: Otogetosaka) which may be the dominant form in southern Japan.

Remarks. For differences among *S. tumidomanus*, *S. gravieri* and *S. streptodactylus streptodactylus*, see the remarks under the last species.

Distribution. The species has been recorded from the Red Sea, Indian Ocean, Malay Archipelago, Malay Peninsula northward to southern Japan. From under the low tide mark down to more than 200 m deep.

It is known from: Red Sea (Tattersal, 1921); Djibouti (Coutière, 1905); Amirante Bank (Coutière, 1921); Providense Is. (Coutière, 1921); Maldive Archipelago (type locality, Coutière, 1905); Ceylon (Pearson, 1905); Singapore Straits (Johnson, 1961); Gulf of Thailand (Banner and Banner, 1966b); Sapeh Strait (De Man, 1911); Paternoster Is. (De Man, 1911); Molo Strait (De Man, 1911); between Misool and New Guinea (De Man, 1911); Banda I. (De Man, 1911); Kei Is. (De Man, 1911); Roma I. (De Man, 1911), China Sea (Coutière, 1905); southern Japan (Ortmann, 1890; Coutière, 1909; Yokoya, 1936; Nishimura and Suzuki, 1971).

Synalpheus streptodactylus streptodactylus Coutière, 1905
(New Japanese name: Tsuno teppo ebi)

(Plate 14)

Synalpheus neomeris var. *streptodactylus* Coutière, 1905 : 870, pl. 70, fig. 1'.
Alpheus neomeris: De Man, 1897 : 738, fig. 61c (part); 1902 : 891.
Synalpheus streptodactylus: De Man, 1911 : 226; 1915: pl. 7, fig. 29.——Tattersal, 1921 : 373.——Banner and Banner, 1964 : 87.
Synalpheus streptodactylus streptodactylus: Banner and Banner, 1966a : 157; 1966b : 50, fig. 14; 1967 : 264.
Confer Synalpheus metaneomeris streptodactylus Coutière, 1921 : 414.
Confer Synalpheus streptodactylus hadrungus Banner and Banner, 1966a : 157 (new name of *S. metaneomeris streptodactylus*).

Description. The shrimps are small, polished and sometimes pubescent, measuring 9.6-13.7 mm in body length (3.8-5.0 mm in c.l.). The rostrum is needle shape, with few hairs apically, and separated from the inner margins of the orbital hoods at the base; it reaches variously in the distal third of the first segment. The orbital teeth are also needle shape and hardly reaches the apex of the rostrum.

The antennular peduncle is rather robust, the second segment is 1.2-1.4 times as long as broad; the 3 segments have a ratio, 1.5-1.7 : 1.0 : 0.9. The stylocerite is slender and extends to or beyond the middle of the second segment. The basicerite has 2 teeth, the ventral tooth is elongate and reaches forward as far as the end of the first segment, and the dorsal one is very short triangular. The carpocerite is elongate, and exceeds the end of the antennular peduncle by more than half the length of the third segment. The scaphocerite has the slender sharp spine exceeding the end of the antennular peduncle, and has the narrow lamella reaching variously in the third segment.

The first pair of pereiopods shows no sexual dimorphism. The large chela is 2.8-3.0 times as long as high in both sexes, 1.0-1.3 times as long as the carapace length in the male and 0.8 times in the female. It is smooth, cylindrical, and armed with a sharp tooth at the inner side of the finger articulation. The merus is 2.1–2.8 times as long as broad, its dorsal margin ends in a pointed tooth distally.

The small chela is, in both sexes, 3.1–3.2 times as long as high, and is 0.4–0.5 times as long as the carapace. The merus is 2.9–3.4 times as long as broad, and its dorsal margin terminates in a blunt top.

The carpus of the second pereiopods is subdivided into 5 articles with a ratio, 10 : 2 : 2 : 2 : 4. In the third pereiopod the dactylus is slender and biunguiculate; the ventral unguis is twice as broad as the dorsal one at the base of them, and they are subequal in length. The propodus bears about 10 spines along the ventral margin. The carpus is provided with a spine at the distal corner of the ventral margin. The merus is 4.0–4.7 times as long as broad and bears 2–5 spines along the ventral margin. In the fourth and fifth pereiopods the merus has 1–2 and no spine, respectively.

The abdominal segments show the slight sexual dimorphism in shape of their pleura. In the female the margins of the first 5 pleura are rounded posteroventrally, but in the male all the pleura but the second and third ones are acuminate at the posteroventral corner. In the female every endopod of the second to fifth pleopods has a distinct appendix interna. In the male it has not any appendices generally, but has an indistinct appendix interna rarely.

The telson is 2.7–3.3 times as long as broad at the posterior margin. The lateral margins are certainly convex on the middle and abruptly tapers distally; the posterior margin is strongly arcuate. The dorsal surface is somewhat concave medially, with the usual 2 pairs of spines near the lateral margins, the anterior pair of them is situated at the middle of the length, and the posterior pair is at 2/3 of it.

Material examined.

Southern Japan.——Northern Kyushu: 1 ovig. ♀, ZLKU No. 1438, Genkai-nada, off Munakata-oshima I., July 3, 1957, Y. Motomatsu leg.; 1 ♂, ZLKU No. 1443, Genkai-nada, off Munakata-oshima I., July 3, 1957, associated with a bopyrid, Y. Motomatsu leg.; 1 ♂, 1 ovig. ♀, ZLKU No. 17342, Fukuoka Pref., Tsuyazaki, trawling, living in interstices of bryozoans, July 18, 1967, S. Matsuura leg.; 1 ♀, ZLKU No. 9594, Fukuoka Pref., off Tsuyazaki, in *Sargassum* belt, June 23, 1967, S. Matsuura and T. Fujino leg.——Western Kyushu: 1 ♀, ZLKU No. 17341, Amakusa Is., Shimo-shima I., Tomioka, washed from rock debris entangled in lobster trammel-nets, Dec. 15, 1965, A. Taki leg.

East China Sea.——Norin-gyoku (Official block) No. 516: 1 ♀, ZLKU No. 17344, 27°14.5′ N., 124°45.0′ E., June 12, 1962.——Norin-gyoku (Official blok) No. 514: 1 ♂, ZLKU No. 15532, 28°43.7′ N., 124°42.5′ E., 83–85 m deep, June 30, 1962, 10 : 38.

Colour in life. The animal is pale pink entirely.

Table 4. Characteristics in 3rd pereiopod of *S. s. streptodactylus* and 4 related species

	Characteristics in 3rd pereiopod			
	Merus	Dactylus		
	Ventral margin	Shape	Length of dorsal unguis to ventral unguis	Breadth of dorsal unguis to ventral unguis at base
S. tumidomanus	Unarmed	Slender, ventral unguis parallel with dorsal unguis	Dorsal unguis usually longer but at times equal to ventral unguis	Dorsal unguis subequal in breadth to ventral unguis
S. gravieri	Armed with spines	Stout, ventral unguis strongly curved	Dorsal unguis 1/3 of ventral unguis	Dorsal unguis 1/3 of ventral unguis
S. s. streptodactylus	Armed with spines	Slender, ventral unguis parallel with dorsal unguis	Dorsal unguis subequal to ventral unguis	Dorsal unguis 1/2 of ventral unguis
S. s. hadrungus[1]	Armed with spines	Slender, ventral unguis parallel with dorsal unguis	Dorsal unguis 1/3 of ventral unguis	Dorsal unguis 1/2 of ventral unguis
S. neomeris[2]	Armed with spines	Slender, ventral unguis parallel with dorsal unguis	Dorsal unguis 0.33—0.43 times as long as ventral unguis	Dorsal unguis 0.27—0.4 times as broad as ventral unguis

1) After Banner and Banner, 1966a. 2) After De Man, 1911.

Ecology. Most of the specimens were washed from rock debris, bryozoans and other obstacles entangled in the lobster trammel-nets or trawl-nets. According to Banner and Banner (1966b), their specimens were found in dead coral heads in water up to 5 m deep, and a few were associated with sponges. In the Hawaiian Archipelago "the species is abundant on the spongocoel of a large sponge, *Zygomycale parishei* (Bowerbank)" (Banner and Banner, 1966a).

Remarks. Synalpheus tumidomanus Paulson, *S. gravieri*, *S. streptodactylus streptodactylus*, *S. s. hadrungus* Banner and Banner, 1966, and *S. neomeris* are apparently closely related each other. It seems rather difficult to separate them by the characteristics in the frontal part of the carapace together with the antennae, and in the first pereiopods, however, they may be separated each other by the shape of the third pereiopod as shown in Table 4.

Distribution. The species is known from the Red Sea to the South Pacific Ocean. From the littoral up to 120 m deep.

It has been recorded from: Red Sea (Tattersal, 1921); Maldive Archipelago (type locality, Coutière, 1905); Atjeh (De Man, 1897, 1902); Lombok (De Man, 1911), Postillon Is. (De Man, 1911); Flores (De Man, 1911); near Tenah Djampeah (De Man, 1911), Makassal (De Man, 1911); Celebes (De Man, 1911); Gulf of Thailand (Banner and Banner, 1966b); Singapore (Banner and Banner, 1966b); Canton Atoll, Phoenix Is. (Banner and Banner, 1964); Tonga Is. (Banner and Banner, 1966a); Samoa Is. (Banner and Banner, 1966a); and Society Is. (Banner and Banner, 1967).

Species of doubtful record

Synalpheus neptunus (Dana, 1852)

Alpheus neptunus Dana, 1852a: 22 (diagnosis); 1852b: 553, pl. 35, fig. 5.
? *Alpheus neptunus:* Stimpson, 1860: 32 (100).
? *Alpheus minor* var. *neptunus:* Miers, 1884: 288.
? *Alpheus neptunus:* Henderson, 1893: 436.
Synalpheus neptunus: Coutière, 1905: 876 (part, notes on type specimens from Sulu Sea); 1909: 87 (part, notes on type specimens from Sulu Sea).——De Man, 1911: 291; 1915: pl. 13, fig. 60.——Balss, 1914: 37 (part, general distribution).
Confer Synalpheus spinifrons: Holthuis, 1952: 36.

Remarks. Stimpson (1860) recorded *S. neptunus* from Amami-oshima Island, the Ryukyu Archipelago and Hong Kong. But the author doubts if it was the true *S. neptunus*, because the clear definition of the species had not been given until Coutière

(1905, 1909) studied its two type specimens from the Sulu Sea. Unfortunately Stimpson's description is too brief to state definitely his material as *S. neptunus*.

Although there were a certain confusion in the relationship between *S. neptunus* and *S. tumidomanus* (Paulson, 1875), and another confusion between *S. neptunus* and *S. latastei* Coutière, 1908=*S. spinifrons* (H. Milne Edwards, 1837), Holthuis (1952) gave a full account of all that had past.

Synalpheus neomeris (De Man, 1897)

Alpheus minor var. *neptunus:* De Man, 1888 : 272.
Alpheus neomeris De Man, 1897 : 734 (part), pl. 35. figs. 61a, 61d and 61e.
? *Synalpheus neomeris:* Coutière, 1905 : 869, pl. 70, fig 1; 1909 : 90.
Synalpheus neomeris: De Man, 1911 : 186, 212; 1915: pl. 6, fig. 24.——Balss, 1914 : 37.
? *Synalpheus neomeris:* Kubo and Nakazawa, 1947 : 778, fig. 2245.——Kubo, 1965 : 613, fig. 965.
Nec. Synalpheus neomeris: Nishimura and Suzuki, 1971 : 84, pl. 27, fig. 5 (photo, probably *Alpheus bisincisus* De Haan, 1849).

Remarks. *S. neomeris* is known only from the Mergui and Malay Archipelagoes except for the localities based upon the doubtful identification of the species. The first record of *S. neomeris* from an unspecified locality of Japan is made by Coutière (1905), but, as already pointed out by De Man (1911), Coutière's identification of the species is doubtful. Recently Kubo and Nakazawa (1947) and Kubo (1965; new edition) recorded *S. neomeris* with a figure in "The illustrated Encyclopedia of the fauna of Japan." From their notes and figures of it, however, it appears impossible that their material are clearly identified as *S. neomeris*. The author should rather refer it to *S. streptodactylus streptodactylus* Coutière, 1905 which may be confused most easily with *S. neomeris* or to *S. gravieri*. As there is no reliable record from this region and it is not contained in the present material, it is doubtful whether or not the presence of *S. neomeris* is true.

[*To be continued*]

(Received 16 January, 1972)

Plate 1

Betaeus granulimanus Yokoya, 1927

Fig. A. Male, 16.0 mm in carapace length.

Fig. B. Male, 8.2 mm in carapace length.

Fig. C. Ovigerous female, 9.0 mm in carapace length.

(Photographed by Mr. Minei)

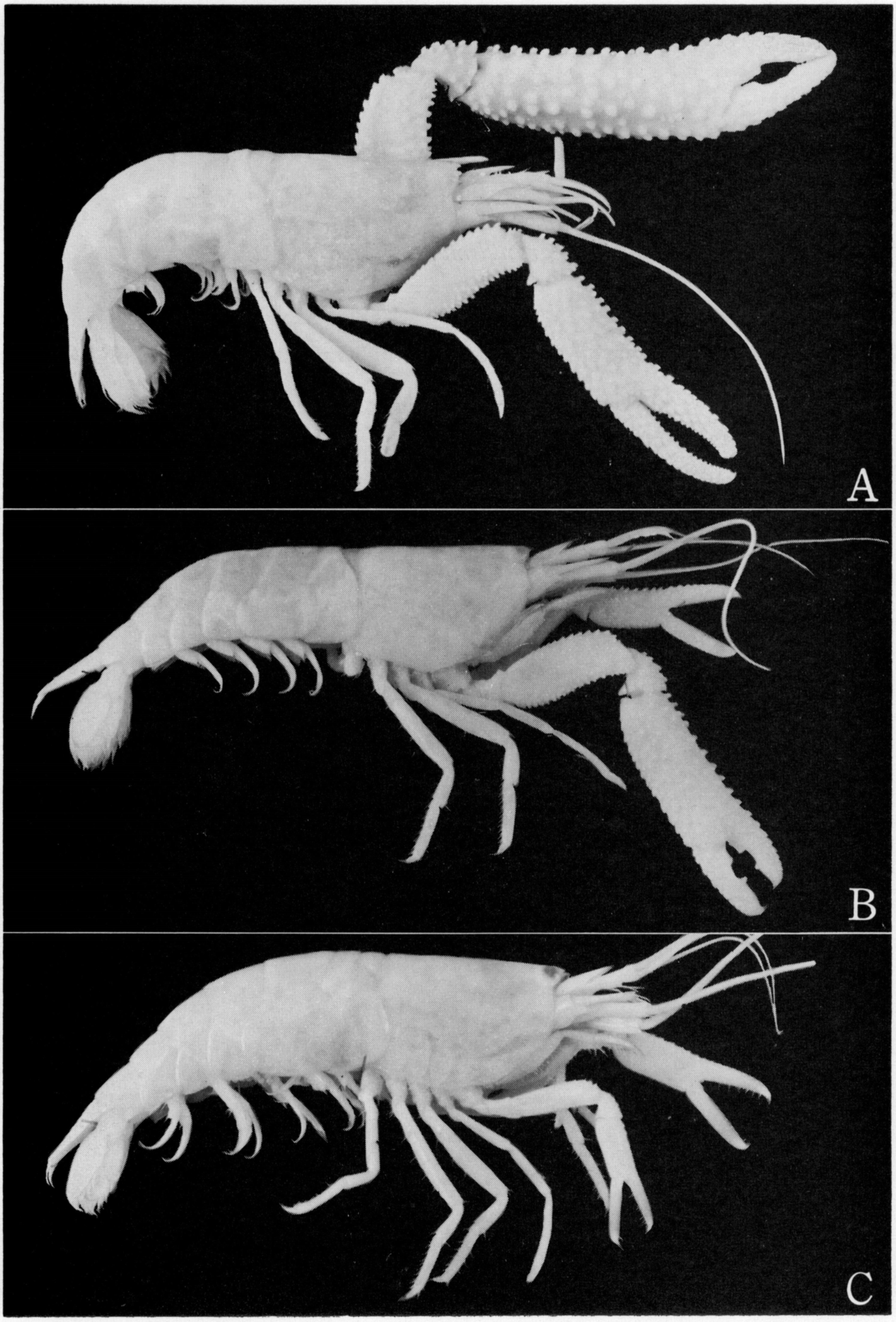
A
B
C

Plate 2

Betaeus granulimanus Yokoya, 1927

Figs. A–F. Anterior region, dorsal view, showing variations, respectively, ♀ (3.6 mm in c.l.), ♀ (4.9 mm in c.l.), ♂ (6.0 mm in c.l.), ♂ (7.0 mm in c.l.), ♂ (8.2 mm in c.l.), and ♂ (16.0 mm in c.l.).

Figs. G–I. Tail fan, dorsal view, showing variations, respectively, ♂ (6.0 mm in c.l.), ovig. ♀ (9.0 mm in c.l.), and ovig. ♀ (10.0 mm in c.l.).