

## Contributions to the Knowledge of the Alpheid Shrimp of the Pacific Ocean

### Part IV. Various Small Collections from the Central Pacific Area, including Supplementary Notes on Alpheids from Hawaii<sup>1</sup>

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IN THE COLLECTIONS made available to me are a number of small collections, in some cases only single specimens, made from various islands ranging from the Tuamotus to the Carolines, none being extensive enough to warrant separate papers. Some of these have been loaned by the United States National Museum, some by the Bernice P. Bishop Museum, and some by the individual collectors, e. g., the collection by R. W. Hiatt from the islands of Yap. Also, in the continuing collections made in Hawaii since the completion of my 1953 paper, three additional species have been found and two notable variations in the usual form or color of known species have been observed. Finally, a new name has been applied to a species previously described from Hawaii.

Because the specimens came from such widely separated localities and because so few species came from each collection, the collection data are listed under each species rather than in a preliminary comprehensive collection list, as has been done in previous articles.

As in previous papers in this series, instead of repeating the full synonymy for species which have been discussed in previous papers, I have made reference to the earlier papers in the series which have presented the synonymy.

The collections were made for numerous sponsors, some of whom have been forgotten

in the many years since the collections were made. This study has been done largely under a grant to the author from the National Science Foundation (NSF G-1754).

Type specimens of the new species described in this paper will be deposited in the institution from which they were borrowed; those types in my personal collection will be deposited either in the Bernice P. Bishop Museum or in the U. S. National Museum (USNM).

ARETE Stimpson

#### *Arete dorsalis* Stimpson

*Arete dorsalis* Stimpson, Acad. Nat. Sci. Phila., Proc. 12: 32, 1860.

LOCALITIES: 1 specimen, Station 1847, Raroia Atoll, Tuamotu Archipelago, "from green-black sea urchin from middle zone of outer reef flats Ngarumaoa Island. . ."; collected by J. E. P. Morrison, July 5, 1952. Four specimens from Station 1857, collection data as above.

DISCUSSION: These specimens will be discussed in a future paper dealing with this genus and the genus *Athanas* Leach.

#### *Arete indicus* Coutière

*Arete dorsalis* var. *indicus* Coutière, Soc. Philomath. Paris, Bul. IX, 5(2): 85, figs. 25-30, 1903.

*Arete indicus* Coutière, Fauna and Geog. Maldive and Laccadive Archipelagoes 2: 863, figs. 134-135, 1905.

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TABLE 1  
COLLECTION DATA FOR SPECIMENS STUDIED

LOCATION AND COLLECTOR'S NUMBER	ISLAND	ARCHIPELAGO	COLLECTOR	LOANING AGENCY
Tomil Harbor, Nos. Y-111, 122, 214, 215, 252.....	Yap	Caroline	R. W. Hiatt	R. W. Hiatt
No. 2063.....	Oneroa	Caroline	Morrison, Doty, Herre	USNM
Kwajalein Atoll.....	Kwadak	Marshall	P. E. Cloud, Jr.	USNM
Likiep Atoll, No. 827.....	Nado	Marshall	S. V. MacNeil	USNM
No. 1742.....	Canton	Phoenix	E. H. Bryan	Bishop Museum
	Jarvis	Line Islands	Toomey, Ahia, Graf	Bishop Museum
	Washington	Line Islands	C. H. Edmondson	Bishop Museum
	Palmyra	Line Islands	C. H. Edmondson	Bishop Museum
No. 3707.....	Midway	Hawaiian	C. H. Edmondson	Bishop Museum
Nos. 1497, 1498.....	Wake		C. H. Edmondson	Bishop Museum
	Wake		C. H. Edmondson	Bishop Museum
Pearl and Hermes Reef.....		Hawaiian	U. S. Navy Ship "Dranga"	Bishop Museum
	Midway	Hawaiian	Y. D. P. Spicer	Bishop Museum
Kaneohe Bay.....	Oahu	Hawaiian	A. H. Banner	
Ahoolaka, Kaneohe Bay.....	Oahu	Hawaiian	A. H. Banner	
Wailupe pond.....	Oahu	Hawaiian	Donald C. G. McKay	Donald C. G. McKay
Raroia Atoll, No. 1847.....	Ngarumaoa	Tuomotu	J. P. E. Morrison	USNM
Raroia Atoll, No. 2015.....	Otikaheru	Tuomotu	J. P. E. Morrison	USNM
Raroia Atoll, No. 2187.....	Kakipuku	Tuomotu	J. P. E. Morrison	USNM
Raroia Atoll, No. 2252.....	Ngarumaoa	Tuomotu	Maxwell Doty	USNM
Raroia Atoll, No. 1963.....	Hamahomo	Tuomotu	J. P. E. Morrison	USNM

LOCALITY: 1 specimen, Station 2187, Kakipuku Island, Raroia Atoll, Tuamotu Archipelago, from boring sea urchin; collected by J. E. P. Morrison, August 26, 1952.

DISCUSSION: This specimen, although it lacks all of its appendages, has been put in this species because it compares so well with specimens plainly of this species from the same habitat (holes made by the sea urchin *Echinometra*) collected from Aitutake, Cook Islands. This species will be discussed in a later paper.

#### SALMONEUS Holthius

##### *Salmonius tricristata* sp. nov.

Fig. 1a-e

LOCALITY: 1 specimen, Station Y-122, Tomil Harbor, Yap Island, Caroline Archipelago, an ovigerous female 12 mm. long lacking large chela, having one each of 2nd, 3rd, and 5th legs, and both 4th legs; collected by R. W. Hiatt, 1946.

DESCRIPTION: Rostrum with tip reaching to end of second antennular article, anteriorly narrow but broad at base. Orbital teeth about one-third length of rostrum, tips acute. Both orbital hoods and rostrum bearing dorsal keels, that of the rostrum extending posteriorly from tip to more than two-thirds the length of the carapace, those of the orbital hoods extending almost to the tip of the hood and somewhat shorter than rostral carina.

Antennular articles short and broad. Stylocerite reaching to end of second antennular article. Scaphocerite broad and rounded, lateral spine equal in length to rounded anterior portion.

Large chela lacking. Merus of small chela about 4.5 times as long as broad, broadest in middle; carpus equal in length and breadth to merus, but widest distally; palm a little less than half as long as carpus; fingers equal in length to palm.

First carpal article of second legs slightly longer than the sum of the four distal articles.

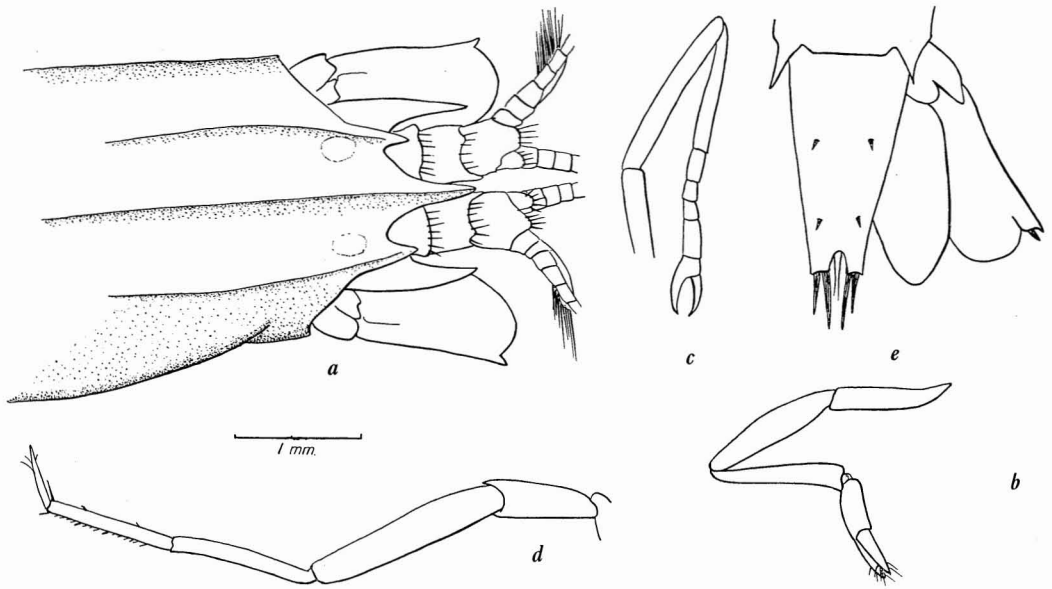


FIG. 1. *Salmoneus tricristata* sp. nov. a, Anterior region, dorsal aspect; b, small chela; c, second leg; d, third leg; e, telson and uropod. All drawn to same scale.

Third legs with ischium half as long as merus, a little more than twice as long as broad; merus 5 times as long as broad, unarmed; carpus about two-thirds as long and less than half as broad as merus; propodus slightly shorter and thinner than carpus, armed with 4 feeble spines on superior margin and two similar spines on inferior, armed on distal inferior margin with a longer and heavier movable spine; dactylus half as long as propodus, slender, tapering and with a slight curve.

Telson with anterior margin 2.5 breadth of posterior margin and length 4.5 times the posterior breadth; sides with uniform taper; terminal cleft one-ninth length of telson. Tip of telson armed with two pairs of spines, the inner as long as the tip is broad and the outer two-thirds the length of the inner. Cleft bearing two setae. Spines of dorsal surface of telson rather weak.

DISCUSSION: The original name of this genus, *Jousseaumea*, has been changed by Holthius (1955:88) to *Salmoneus*, as the original name was preoccupied.

With Coutière's entirely inadequate description of his three species it is difficult, if not impossible, to be certain of any species. His original description of *Jousseaumea latirostris* (1896:382) was:

"Les épines supra-oculaires sont très peu marquées et le rostre très large. L'une des pattes antérieures manque." In 1897 (p. 234) he added that the large chela was like that of *J. serraidigitus* Coutière, and in 1899 (p. 71, fig. 21) he supplied a dorsal view of the anterior carapace.

As a consequence, until the three species described by Coutière are redescribed adequately, every new species must be regarded as tentative. This species appears to be unique in the possession of the three crests on the anterior half of the carapace. *S. cristata* (Coutière) may have a somewhat similar medial crest, but the two lateral crests represent the continuation of the lateral margins of the rostrum and do not arise from the corneal teeth as do the ones on this species. Other species have the rostral crest, like *S. bilarula* (de Man), but in them it does not extend as

far posteriorly as it does on this species; *S. brevirostris* (Edmondson) has also the crests from the corneal teeth, but again, these do not extend far posteriorly and are not parallel.

If the development of the crests is consistent within a species, and if the interpretation of Coutière's sketches and brief descriptions are correct, this can be regarded as a separate species.

SYNALPHEUS Bate

*Synalpheus coutierei* Banner

*Synalpheus biunguiculatus* Coutière (*nec* Stimpson), Soc. Ent. de France, Bul. (11): 232, figs. 1-4, 1898.

*Synalpheus coutierei* Banner, Pacific Sci. 7(1): 36, 1953.

LOCALITY: 1 specimen, Bernice P. Bishop Museum No. 1742, Canton Island, Phoenix Archipelago; collected by E. H. Bryan, 1924.

DISCUSSION: While this specimen is definitely *S. coutierei*, it differs slightly in the rostrum and antennular peduncle from the illustration of Coutière. In his figures the orbital hoods are thinner than those in this specimen (which even exceeds the breadth as shown for *S. pachymeris*, *loc. cit.*, fig. 9) and the rostrum is definitely shorter than the orbital teeth and relatively thinner. In the antennular peduncle the articles are thinner and longer, but not markedly so, while the relative proportions of the parts of the antennular peduncle remain about the same. Considering the variation in the genus and the variation already reported for *S. coutierei*, this is probably not important.

*Synalpheus carinatus* (de Man)

*Alpheus carinatus* de Man, Arch. f. Naturgesch., 53: 508, pl. 22, fig. 2, 1887.

LOCALITY: 4 specimens, Kwadak, Kwajalein Atoll, Marshall Islands, from specimens of *Comanthus bennetti* (Müller) as determined by A. H. Clark, U. S. National Museum; collected by P. E. Cloud, Jr.

*Synalpheus charon obscurus* Banner

For synonymy, see Banner, Pacific Sci. 10(3): 329, 1956.

LOCALITIES: 1 specimen, Bishop Museum No. 3707, from Midway Island, Hawaiian Archipelago; 1 specimen, Bishop Museum No. 1497, from Wake Island (19°18' N., 166°35'E.), in coral; both collected by C. H. Edmondson, Tanager Expedition, 1923.

DISCUSSION: These specimens plainly belong to the new subspecies; the specimen from Midway, an ovigerous female, is 20 mm. long, the largest specimen yet seen.

*Synalpheus paraneomeris* Coutière

For synonymy, see Banner, Pacific Sci. 10(3): 331, 1956.

LOCALITIES: 2 specimens at Station 287, USNM 194726, from Likiep Atoll, Nado Island, Marshall Islands; collected by S. V. MacNeil. Two specimens from Jarvis Island, Line Islands; collected by Toomey, Ahia, and Graf, Itaska Expedition, 1935. One specimen from Wake Island; collected by C. H. Edmondson, Tanager Expedition, 1923.

DISCUSSION: The large chela of the male specimen from Wake Island has a ratio of the chela length to the finger length of 2.6, the longest finger yet encountered (see Banner, *loc. cit.*). The specimen otherwise agrees with the variable characteristics of this species.

*Synalpheus tutbilli* sp. nov.

Fig. 2a-j

TYPE SPECIMEN: An ovigerous female 12.6 mm. long, Station Y-215, Tomil Harbor, Yap Island, Caroline Archipelago; collected by R. W. Hiatt, 1946. An allotype, 10.5 mm. long, and 7 paratypes from same station.

DESCRIPTION: Rostrum short, reaching less than one-third the length of the visible portion of first antennular article; sides straight, with uniform taper, orbital teeth short, slightly shorter than rostrum, tips rounded, both medial and lateral margins slightly concave.

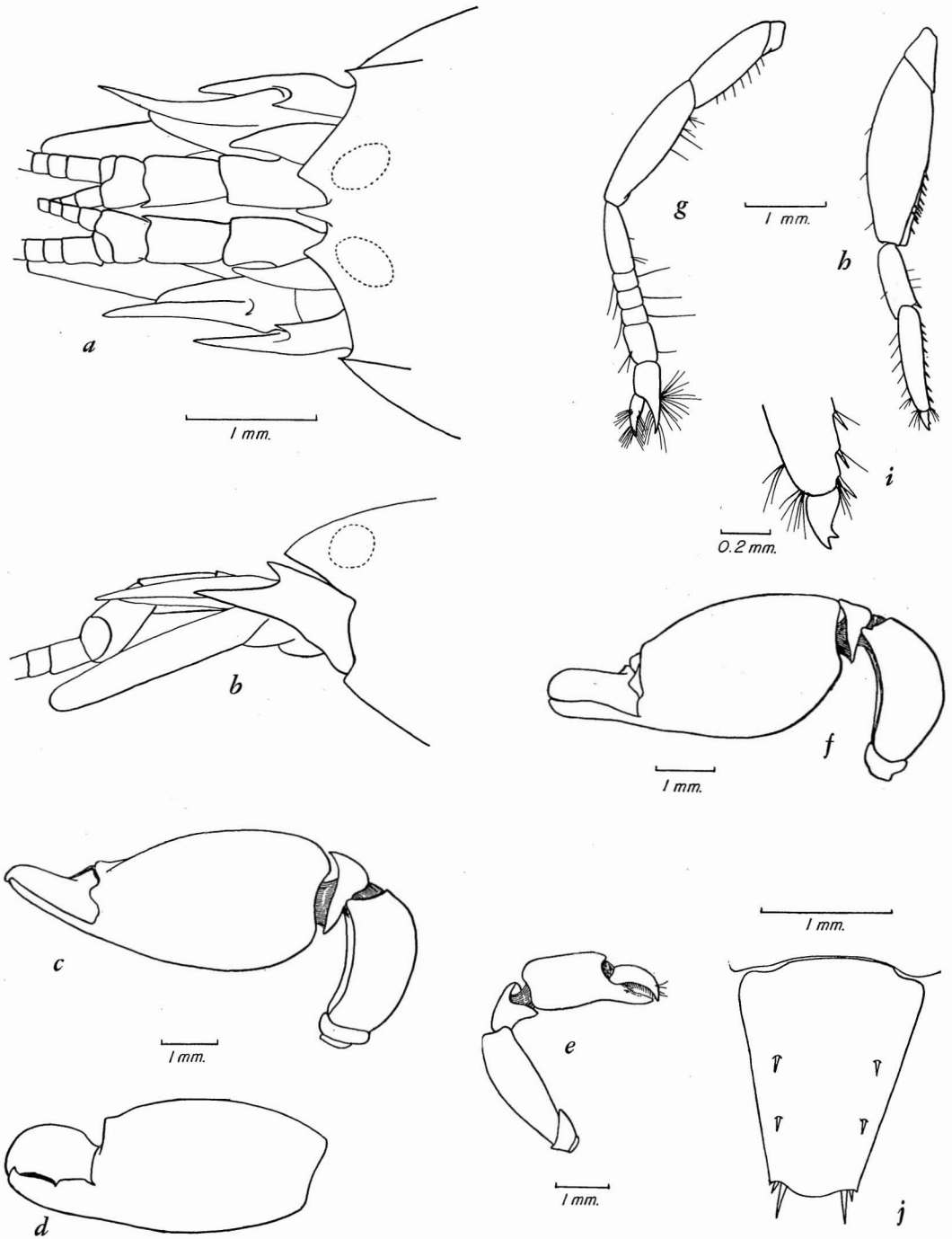


FIG. 2. *Synalpheus tubilli* sp. nov. *a, b*, Anterior region, dorsal and lateral aspects (asymmetry of scaphocerites are as found in specimen); *c*, large cheliped, female, lateral aspect; *d*, same, superior face; *e*, small cheliped, female; *f*, large cheliped, male; *g*, second leg; *h*, third leg; *i*, third leg, dactylus; *j*, telson.

Orbital hoods and rostrum depressed and rounded in lateral view.

Antennular peduncle with first article slightly longer than second; second article about twice length of third article. Stylocerites heavy, with slightly rounded tips not reaching to end of first antennular article. Lateral spine of basicerite reaching almost to middle of second antennular article. Stylocerite with lateral spine well developed (that of right side distorted on type specimen), reaching to end of antennular peduncle; blade reduced, narrow and reaching only to end of second antennular article. Carpocerite markedly longer than antennular peduncle.

Large chela inflated, subcylindrical in section, 2.4 times as long as broad, tapering strongly to fingers. End of palm above dactylar articulation unmarked by any prominences. Fingers occupying distal quarter of entire length of chela, twisted from axis of palm; dactylus high, narrow, with superior edge rounded. Merus short, less than half length of chela, heavy, twice as long as broad, and strongly curved, with superior margin more strongly curved than inferior; superior margin not terminated in angle, but curved towards dactylar articulation.

Small chela small but heavy, with palm 1.6 times as long as broad, and 1.7 times as long as fingers; fingers tapering, slightly broadened proximally. Merus about as long as that of large cheliped, almost as long as small chela proper; superior margin curved but not as strongly as that of large cheliped; inferior margin straight.

Carpal articles of second leg with ratio: 10:2.5:2.5:2.5:6.

Third legs with merus heavy, three times as long as broad, with inferior distal margin bearing numerous short spines which are usually concealed in normal side view by larger outer (or posterior) ridge. Carpus as long as merus is broad, superior margin ending in rounded tooth, inferior margin terminally armed with single weak spine. Propodus 0.56 as long as merus, 4.5 times as long as broad,

armed with 9 weak spines. Dactylus less than 0.2 length of propodus, with strong taper and small ungui.

Telson 2.7 times as long as broad at posterior margin, with anterior margin twice as broad as posterior; lateral margins slightly convex in middle, terminated by slight subacute angles; posterior margin with low convexity.

DISCUSSION: In the nine specimens in the collection little variation is present except for the large chela and the armature of the merus of the third legs. In the larger specimens the length of the finger in respect to the chela is like that of the type, but in some of the smaller specimens the fingers occupy up to 0.32 the length of the chela; the fingers of the small specimens are also more slender, being as much as 2.6 times as long as broad. It should also be noted that the merus of the allotype is more strongly curved than that of the type. The merus of the third legs bears from 3 to 9 spinules, with the small number being on the smaller specimens.

It is also interesting that of this small collection, two males and one female (ovigerous) bear parasitic isopods on their abdomens.

This form is plainly related to *S. pachymeris* Coutière (1905a: 873) and *S. bituberculatus* de Man (1910: 294), and less closely to *S. coutierei* Banner (1953: 36) of the Coutierei group (see description under the name *S. biunguiculatus* (Stimpson) in Coutière, 1898: 230). The last species differs from the first two and from this form in that the merus of the third legs is unarmed. This form differs from the first two species in that the margin of the palm above the dactylar articulation is unarmed and the palm itself is inflated, while in both others the palm is more slender and bears one (*S. pachymeris*) or two (*S. bituberculatus*) rounded projections above the dactylus. There are also slight differences in the armature of the anterior carapace, but it is unlikely that these are of significance. In *S. pachymeris* and *S. bituberculatus* (but not in *S. pachymeris cargadosi* Coutière) the stylocerites are longer than the

first antennular article, but they are shorter in this form. Coutière regarded the number of spinules on the merus of the third legs as important in his description of his variety *S. p. cargadosi* (1921: 417), but neither in de Man's species, nor in Coutière's original description (where he described *pachymeris* as a variety of *S. biunguiculatus* = *S. coutierei*), any more than in these specimens, were the number of spinules constant between individuals.

Unfortunately the name *tuthilli* used in the genus *Alpheus* will have to be put in synonymy in a subsequent paper; this is another attempt to express thanks to Dr. Leonard D. Tuthill, friend and former editor of *Pacific Science*, for the help he has given me.

ALPHEUS Fabricius

Megacheles Group

*Alpheus lanceostylus* sp. nov.

Fig. 3a-b

*Alpheus* species 1, Banner, *Pacific Sci.*, 10(3): 338, 1956.

TYPE: 28 mm. male collected at Pearl and Hermes Reef, Hawaiian Archipelago (27°N., 146°W.), by U. S. Navy Ship "Dranga" in 1927. Bernice P. Bishop Museum No. 2737.

PARATYPE: An ovigerous female 22 mm. long without chela collected from Saipan, Marianas (probably from the reef flat west of Cape Nafutan—exact data are lost), by A. H. Banner in 1945.

DESCRIPTION: Rostrum acute, reaching beyond end of first antennular article, broad at the base, dorsally only slightly rounded. Orbitostral borders slightly concave. Orbital teeth strong, similar in shape to rostrum and about half as long.

Antennular peduncle with the second article 1.6 times the length of the visible portion of the first article, 1.2 times the length of the second article, and 1.3 times as long as broad. Stylocerite acute and reaching to middle of second antennular article. Scaphocerite broken on right side, left side with broad squamous portion reaching almost to tip, and tip slightly

exceeding end of third antennular article. Carpocerite reaching slightly beyond end of scaphocerite. Lateral spine of basicerite not heavy, and reaching to level of tip of rostrum.

Merus of large cheliped with inner face 1.5 times as long as maximum breadth distally; superior margin terminating in subacute tooth; inferior external margin irregular but not bearing spines; inferior internal margin bearing 10 small movable spines and terminating distally in strong acute tooth. Ischium bearing 4 inferior spines and a strong superior tooth. Carpus bearing a rounded tooth on superior internal distal margin. Chela heavy, compressed, almost as broad distally through the fingers as proximally, 2.9 times as long as broad. Superior crest of palm terminating distally in strong acute tooth, interrupted by shallow and poorly defined transverse groove, and proximally merging with surface of chela. Superior groove shallow and flattened. Palmar crest broadly rounded and poorly defined proximal to transverse groove. Palmar groove broad and rounded. Inferior crest distinct only distally and ending in strong tooth. Inferior depression deep but rounded. Shoulder distinct but not abrupt. (For explanation of terms see Banner, 1953, fig. 17e). Fixed finger strongly curved. Dactylus closing across end of chela, thin with high sharp crest, and strongly curved; superior margin without marked lobes, inferior margin with what appears to be an extra rounded tooth. Cheliped bearing only scanty setae except near fingers where setae are somewhat heavier.

Small chela lacking in both type and paratype.

Carpal article of second legs with ratio 10:7:4:3:5.

Third legs with ischium bearing movable spine; merus 6.6 times as long as broad, unarmed; carpus unarmed and 0.5 length of merus; propodus bearing 7 weak spines, 0.7 as long as merus; dactylus slender, curved, with single superior serration.

Telson 1.4 times as broad proximally as distally, 2.5 times as long as tip is broad, with

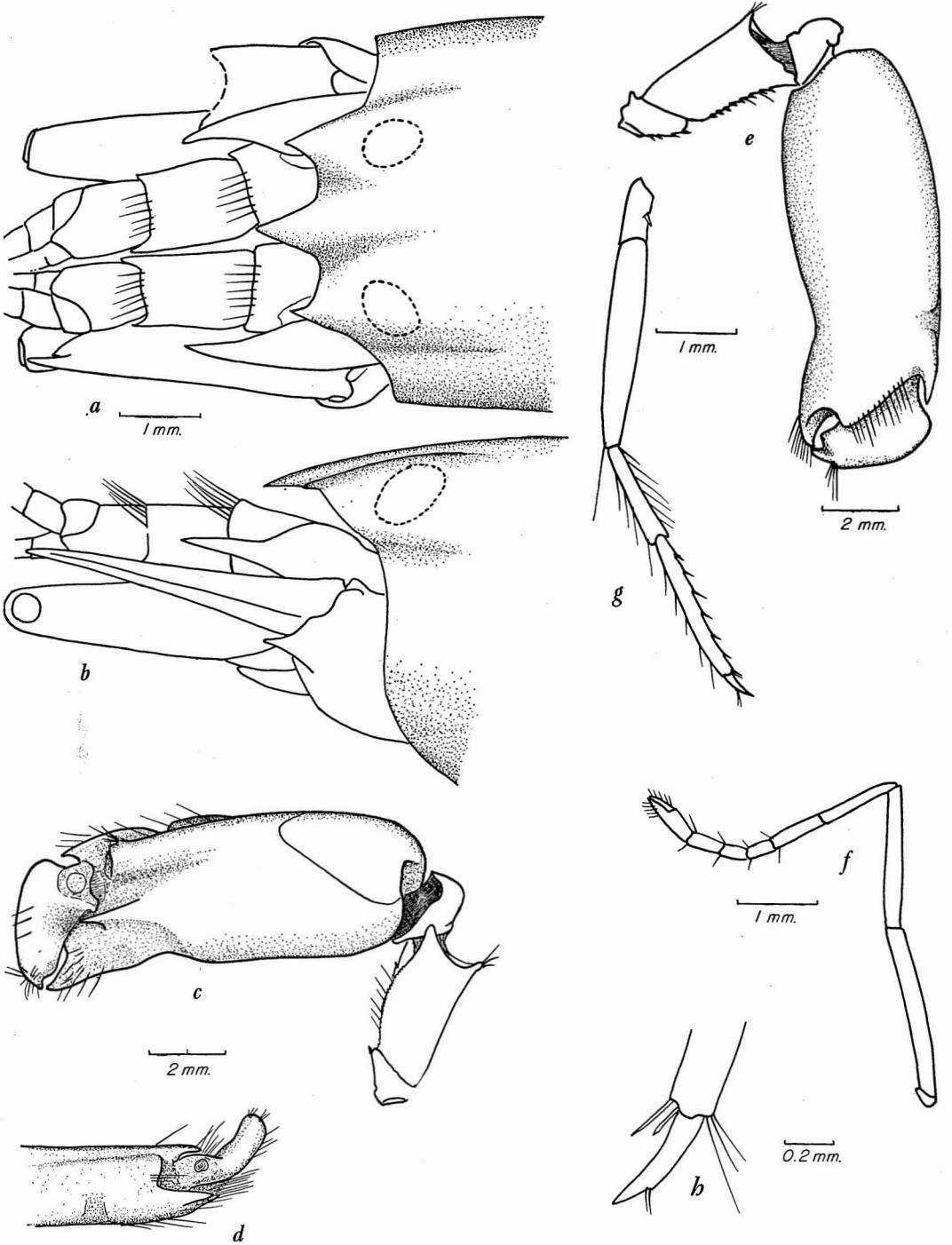


FIG. 3. *Alpheus lanceostylus* sp. nov. *a, b*, Anterior region, dorsal and lateral aspect; *c, d*, large cheliped, lateral and medial aspect; *e*, large chela, tip, superior aspect; *f*, second legs; *g*, third legs; *h*, third leg, dactylus.



lateral margins almost straight. Anterior dorsal spinules 0.3, posterior 0.6, of the length from articulation to tip.

DISCUSSION: The only difference noted between the incomplete specimen from Saipan and the type is that the propodus of the third legs carries 9 instead of 7 spines.

This species plainly belongs to the Megacheles group, and to the *A. bailstonei* Coutière complex (see Banner, 1953, p. 51 *et seq.*). However, it can be sharply separated from all others of that group (including *A. staphylinus* Coutière) by a series of characters, which include the broad second article of the antennular peduncle, the long stylocerite, and the nature of and direction of closure of the dactylus of the large cheliped. Other characteristics will separate it from one or more of the complex, as the presence of ischial spines will separate it from *A. bailstonei bailstonei* Coutière and *A. brachymerus* (Banner); the armature of the dactylus from several others, etc. (*op. cit.*, p. 55).

It is difficult to state which of the known species of the complex is most closely related to the new species. On the basis of the anterior carapace, large chela, and third leg it appears to be closest to *A. bailstonei paucispinata* (Banner).

#### *Alpheus collumianus medius* Banner

For synonymy, see Banner, Pacific Sci. 10(3): 340, 1956.

LOCALITIES: 2 specimens, Station Y-215, Tomil Harbor, Caroline Archipelago; collected by R. W. Hiatt. One specimen, Jarvis Island, Line Islands, Itaska Expedition; collected by Toomey, Ahia, and Graf, 1935. One specimen, Wake Island (19°18'N., 166°35'E.), collected by C. H. Edmondsom, Tanager Expedition, 1923.

DISCUSSION: Of the two specimens from Tomil Harbor, Yap, one was similar to the type in all respects, but the other, also similar, showed assymetry in the basicerites, with one normal for the subspecies and the other like that of *A. c. inermis* Banner (1956:342).

The one specimen from Midway was also very similar to the type specimens except that its only remaining second leg had the carpus divided into six rather than five articles. The ratio of these articles was 10:2:9:4:4:7, showing that the extra article was the short one between the first and second articles.

#### *Alpheus seurati* Coutière

Fig. 4

*Alpheus seurati* Coutière, Fauna and Geog. Maldive and Laccadive Archipelagoes 2(4): 881, pl. 75, fig. 20, 1905.

LOCALITY: 1 specimen from Jarvis Island, Line Islands; collected by Toomey, Ahia, and Graf, Itaska Expedition, 1935.

DISCUSSION: This sole specimen of the species agrees almost perfectly with the description and figures of Coutière, although it lacks the small chela.

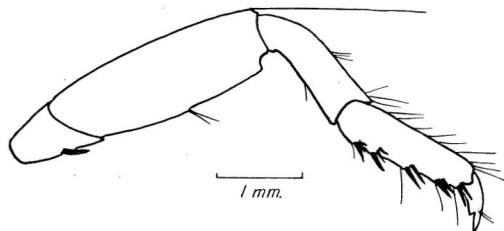


FIG. 4. *Alpheus seurati* Coutière. Third leg.

This species is plainly most closely related to *A. collumianus* Stimpson and within *A. collumianus* to the two subspecies, *A. c. medius* and *A. c. inermis* Banner (1956: 340). Coutière points out that the form of the anterior carapace, the large chela, the second legs, and the telson are like *A. collumianus* (actually, more like *A. c. medius*); the differences lie in the stylocerite—which is like that of *A. c. inermis*—and in the third legs, where the merus is broadened and lacking an acute distal tooth, but bears rather a rounded protuberance. He also points out several other characteristics that differ, but these, like the relative lengths of the second legs and the presence or absence of spines on the carpus of the third legs, are

variable characteristics, at least between the present subspecies.

I believe, therefore, that if the two subspecies are acceptable this species, too, should be made a subspecies of *A. collumianus*; however, I have deferred the action until more specimens can be examined.

#### Macrochirus Group

#### *Alpheus huikau* nom. nov.

Fig. 5*a-e*

*Crangon nanus* Banner, Pacific Sci. 7(1): 90, figs. 30, 31, 1953.

*Alpheus nanus* Banner, Pacific Sci. 10(3): 345, 1956.

*nec Crangon nanus* Krøyer, Naturhist. Tidsskr. 4(3): 231, 1842.

LOCALITIES: 13 specimens, Station 827, USNM 194726, Nado Island, Likiep Atoll, Marshall Islands; collected by S. V. MacNeil, 1952. One specimen, Station 2252, Ngaru-maoa Island, Raroia Atoll, Tuamotu Archipelago; collected by Maxwell Doty, Sept. 3, 1952.

DISCUSSION: It has been necessary to apply a new name to this species, which was named when the genus was called *Crangon* instead of *Alpheus*, because of Krøyer's use of *Crangon nanus* in 1842 for a species no longer in *Crangon* (or *Crago*) in 1953. The new name is from the Hawaiian, and means "confusion" or "mixed-up mess."

This group of specimens presents three points worthy of discussion. First, while the chelae on all of the females are like those described from Hawaii, the three males in the collection, all between 10 and 11.5 mm. in length, present an overgrowth of the fingers of the large and small chelae similar to that reported below for *A. paragracilis* Coutière. In the large chela the dactylus is very elongate, acute, and curved; the fingers occupy a large proportion of the length of the chela. The inferior internal margin of the merus only bears two feeble spinules, fewer than those reported in specimens in the Marianas and

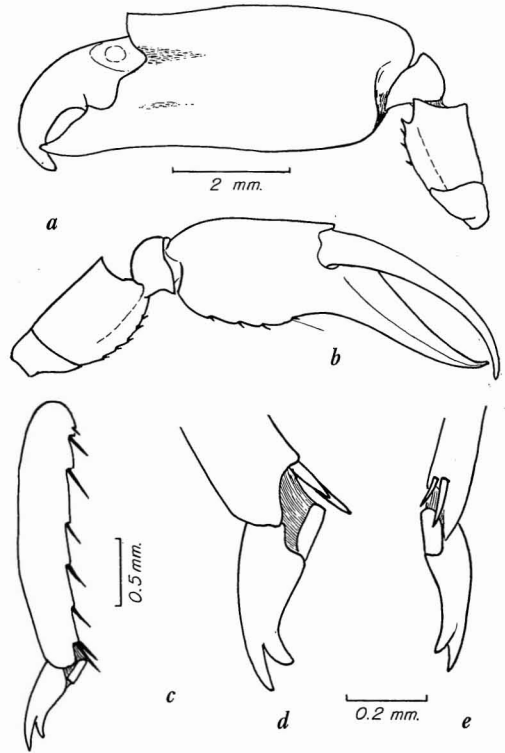


FIG. 5. *Alpheus huikau* nom. nov. *a, b*, Large and small chelipeds, showing overgrowth of fingers; *c*, third leg, merus and dactylus, anterior or medial aspect; *d, e*, third leg, dactylus, posterior and inferior aspects.

Arno. The small chela of the males also has the fingers elongate and curved; the merus is armed with two strong spines and three weaker spinules; the inferior margin of the palm bears two strong spines and two weaker spines, a characteristic not observed in previous specimens. This development of the chelae in the largest specimens is similar to that found for *A. paragracilis*. Unfortunately, neither this series of specimens, nor those from other islands, present a picture of gradual development as is found for *A. paragracilis*; however, a few other larger males, like those from Arno, do have a tendency towards the longer dactyli.

Second, is the peculiar development of an extra chitinized piece proximal to the dactylus and inferior to the distal end of the merus of

the third to fifth legs. This piece is borne by the tendon that reaches to the "heel" of the dactylus and is ordinarily obscured by the spines at the end of the dactylus if the animal dies with the dactyl straight or flexed towards the propodus. In many of these specimens, however, the dactylus was bent back on the propodus in death, so that the extra plate is apparent. The extra piece fits into an emargination of the inferior distal end of the propodus when the dactylus is straight or flexed. Other specimens of this species were re-examined and it was found that this development was carried by specimens from all areas studied. Moreover, specimens of the closely related *A. paragracilis* were also found to have the same structure.

Third, the outer uropods of these specimens bear several broad teeth on the distal articulation, and the inner uropod on its outer distal margin bears several small spines; neither of these characteristics was found in the specimens from Hawaii. This difference is not considered worthy of taxonomic emphasis.

The single specimen from the Tuamotus differs from the Hawaiian specimens in two minor ways. First, the rostrum is slightly shorter instead of slightly longer than the orbital hoods; second, the third and fourth carpal articles of the second legs are 1.3 and 2.0 times as long as broad instead of being broader than long. This latter characteristic may be important, but one specimen is not adequate for drawing such a conclusion.

### *Alpheus paragracilis* Coutière

Fig. 6a-d

For synonymy, see Banner, Pacific Sci. 10(3): 345, 1956.

LOCALITIES: 1 specimen, Station Y-252, Yap Island, Caroline Archipelago, under small rocks on outer reef; collected by R. W. Hiatt, 1946. Nine specimens, Midway Island, Hawaiian Archipelago; collected by Y. Speicer, 1941.

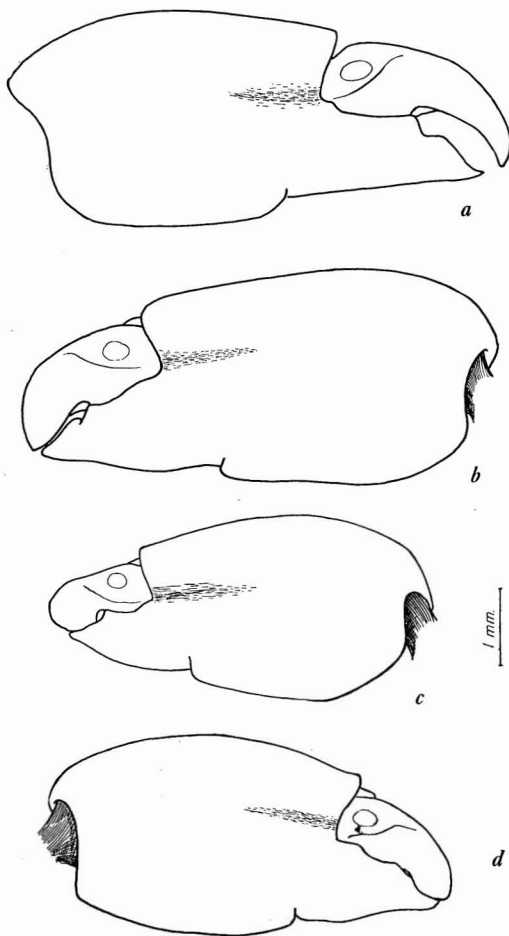


FIG. 6. *Alpheus paragracilis* Coutière, variation in the large chela. a, Male, 11.4 mm. long; b, male 10.8 mm. long; c, female, 11.4 mm. long; d, male, 9.6 mm. long. All drawn to the same scale.

DISCUSSION: These specimens present an interesting series on the change of form of the large chela with growth. The smaller males, less than 9.0 mm. long, and the females of all sizes have similar chelae, about twice as long as broad, and about 3.5 times the length of the fingers; the fingers of the dactylus are short, heavy, and rounded distally. However, on the largest male in the collection, 11.4 mm. long, the chela is 2.4 times as long as broad, and only 2.3 times the length of the fingers, and the dactylus is long, thin, curved and acute on the end. Between these two condi-

tions are found intermediate males, progressing from rounded condition of the immature forms to the acute form of the oldest male. It is also noteworthy that the chelae in the males are 1.5 times the length of those of the females of the same size.

In other collections examined and reported upon in previous papers, including those from Hawaii, this condition was not seen.

#### *Alpheus macrochirus* Richters

For synonymy, see Banner, Pacific Sci. 11(2): 198, 1957.

LOCALITIES: 2 specimens, Washington Island, Line Islands, in coral, Whippoorwill Expedition; collected by C. H. Edmondson, August, 1924.

#### *Alpheus edmondsoni* (Banner)

*Crangon edmondsoni* Banner, Pacific Sci. 7(1): 78, fig. 26, 1953.

LOCALITY: 1 specimen, Station 2063, One-roa Island, Caroline Archipelago, from surge channel, on outer reef beyond *Litbothanmion* ridge; collected by Morris, Doty, and Herre, August 6, 1952. (Specimen without chelae, therefore identification questionable.)

#### *Alpheus ventrosus* Milne-Edwards

For synonymy, see Banner, Pacific Sci. 10(3): 345, 1956.

LOCALITIES: 2 specimens, Station Y-214, Tomil Harbor, Yap Island, Caroline Archipelago, in *Pocillopora* at 3.0 feet; collected by R. W. Hiatt, 1946. Eight specimens from racimose coral heads east side Tomil Harbor, Station Y-215; other data as above. Two specimens from Kaneohe Bay, Oahu, Hawaiian Archipelago; collected by A. H. Banner, August 24, 1955.

DISCUSSION: The pair of specimens, male and female, from Hawaii are included in this paper because of their unusual color pattern. Wherever I have collected this species in the Pacific the color has been the same, a basic orange red, with spots and sometimes stripes of deeper red. This pair, from the same head

of *Pocillopora meandrina* var. *nobilis* Verrill, had in life a ground color of white with a tinge of pinkish yellow, and carried a series of paired irregular dark reddish-brown spots on either side of the middorsal line, three pairs on the carapace, and one pair on each abdominal somite. Similar but smaller spots were found at the bases of the abdominal pleura. Only the large and small chelae had the color usually characteristic of this species. The female carried larvae, recently hatched but still clinging to the pleopods, of pale violet color. No morphological differences were found between these and the normally colored specimens.

#### Obesomanus Group

#### *Alpheus lutini* Coutière

For synonymy, see Banner, Pacific Sci. 10(3): 346, 1956.

LOCALITIES: 1 specimen at Y-214, 2 at Y-215, collection data as in *A. ventrosus* above.

#### *Alpheus phyrgianus* Coutière

For synonymy, see Banner, Pacific Sci. 10(3): 346, 1956.

LOCALITY: 1 specimen from Palmyra Island, Line Islands, in coral; collected by C. H. Edmondson on Whippoorwill A Expedition, August, 1924.

#### Crinitus Group

#### *Alpheus frontalis* H. Milne-Edwards

For synonymy, see Banner, Pacific Sci. 10(3): 357, 1956.

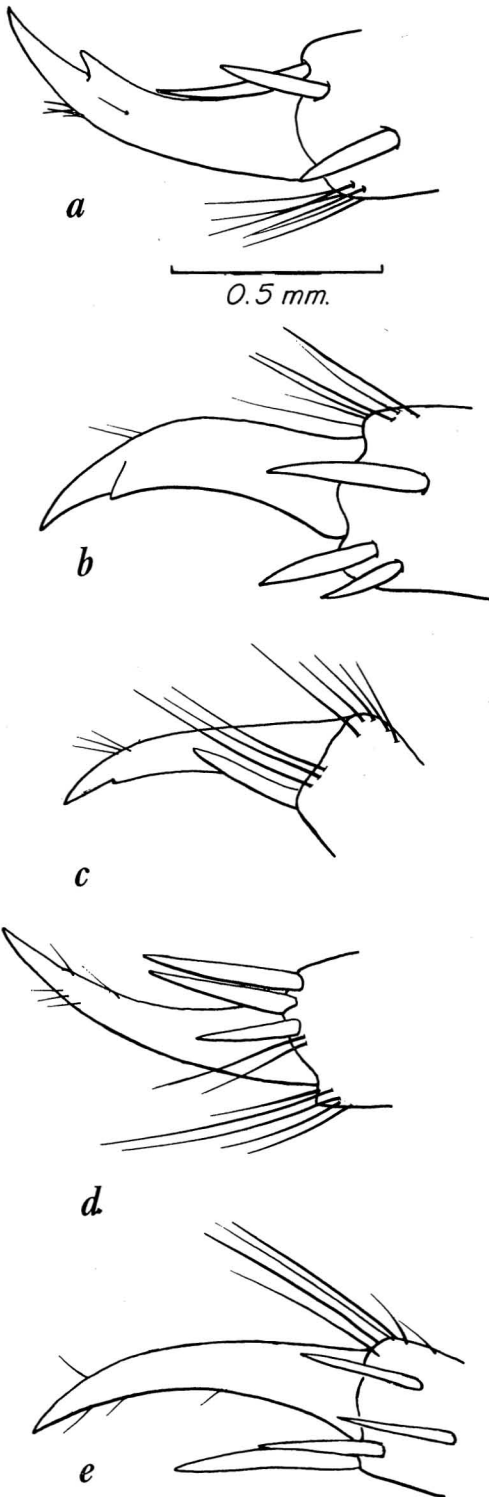
LOCALITY: 2 specimens, Station 1963 from Hamahomo Island, Tuamotu Archipelago, in algal tubes, under rocks, near shore; collected by J. E. P. Morrison, July 21, 1952.

#### Diadema Group

#### *Alpheus diadema* Dana

Fig. 7*d-e*

For synonymy, see Banner, Pacific Sci. 10(3): 357, 1956.



LOCALITIES: 2 specimens, Midway Island, Hawaiian Archipelago; collected by Y. D. P. Speicer, 1941. Six specimens, Ahoelaka ("Sand Island"), Kaneohe Bay, Oahu, Hawaiian Archipelago, under coral heads; collected by A. H. Banner, August, 1955.

DISCUSSION: In the group of specimens from Kaneohe Bay listed above an interesting variation occurs in the dactyli of the third, and to a lesser extent, the fourth legs. In most of the specimens from Hawaii these dactyli are either simple like the neotype (Banner, 1953, fig. 43j) or with a very small thickening or shoulder similar to those shown in Figure 7c, d. However, in this group of specimens from Kaneohe Bay, three specimens, male and female, have a definite and well-developed secondary unguis (Fig. 7a); the other specimens from the same locality had the secondary unguis developed as a shoulder only (Fig. 7b). There are no other noteworthy variations in either group of specimens. In the whole series of specimens it is the third legs that have the greatest development of the secondary unguis, and usually the fourth have but a slight thickening at most; moreover, often the accessory tooth or shoulder is not of uniform bilateral development.

The extensive collections of this species from the central Pacific area were spot checked for this characteristic, and it was found that most specimens were of intermediate development, similar to the conditions shown in Figure 7b-d. The extreme development, similar to the conditions shown in Figure 7a and e, were both rare.

Obviously, no significance should be attached to this variation.

An error in the redescription (Banner, 1953: 119) should be corrected. In describing the dactylus of the third legs, the text states: "Dactylus simple . . . as long as merus." In-

FIG. 7. *Alpheus diadema* Dana, variation in the dactyli of the third legs. a, Male, 19 mm. long, Kaneohe Bay, Hawaii; b, female, 24 mm. long, same locality; c, male, 15.5 mm. long, Tutuila, American Samoa; d, male, 18 mm. long, Midway Island; e, male, 17 mm. long, Tongatabu, Tonga. All drawn to the same scale.

stead, it should read: "Dactylus simple . . . as long as merus is broad."

***Alpheus lanceoloti* Coutière**

Fig. 8a-k

For synonymy, see Banner: 1958: 167.

LOCALITIES: 13 specimens, some ovigerous; Ahoolaka ("Sand Island") Kaneohe Bay, Oahu, Hawaii; collected from silty sand flats at tide level by A. H. Banner. Maximum length about 20 mm.

DISCUSSION: These specimens agree well with the original description by Coutière on the general configuration and most details; there are, however, some differences. The rostral front in general agrees with Coutière's description and figures (1905a: 900, pl. 63, fig. 39) but some variation occurs: the rostrum may be slightly longer, the rounded rostral ridge may not reach any further back than the middle of the orbital hoods, the frontal margin at either side of the rostrum may be definitely concave instead of almost straight, and finally the line or ridge at the inner margin of the orbital hoods is usually lacking. ("Le rostre est . . . séparé des voûtes orbitaires par un sillon. . . .") Slight and variable differences are similarly found in the proportions of the antennular peduncle and thoracic legs. In the large chela, as in the specimen already reported from Onotoa, the merus bears movable spines instead of teeth as shown by Coutière; moreover, the ischium of the same appendage bears three or four movable spines. The greatest difference is in the small chela of the male, which Coutière shows to be slender, with the fingers equalling the palm in length, while in these specimens the fingers are 1.2 times as long as the palm, slightly expanded in the middle, hooked on the end, and bear a fringe of setae, similar to a "balaeniceps-form," except that it does not cross over the superior face of the chela. The small chela of the females and immature males is similar to that drawn by Coutière. Coutière may have overlooked the sexual dimorphism. The small chela of the male from Onotoa was

similar to the form described by Coutière. It should be noted that the large chela is laterally compressed, approaching the condition found in the Rapax group, but twisted, so that in these figures, and presumably those of Coutière, the compression is not shown.

In life the specimens had a basic light "sandy color," similar in hue to their environment; the chromatophores on their abdomens were in irregular and imperfectly defined bands. Their eggs were bright green.

These specimens were found burrowing into the coherent fine sand of a broad sand flat. While their burrows were not traced, from the depths of the excavations necessary to capture the shrimp it is estimated that they penetrate into the sand about 12-15 inches. In the same environment, but burrowing more deeply, are found *A. rapax* (Fabricius) and a callianassid shrimp.

The figures are included to complete the series of figures of Hawaiian species.

Brevirostris Group

***Alpheus rapax* Fabricius**

Figs. 9a-d, 10b

For synonymy, see Banner, Pacific Sci. 10(3): 358, 1956.

LOCALITIES: About 40 specimens, Kaneohe Bay, Oahu, in shallow burrows on the in-shore mud flats, intertidal zone; two specimens from deep sand burrows on Ahoolaka ("Sand Island") low in the intertidal zone, Kaneohe Bay, Oahu, Hawaii; collected by A. H. Banner, 1955, 1956.

DISCUSSION: These specimens seem to be of two different size ranges according to their habitats; those from the shallow burrows (possibly up to 6 inches deep in the mud flats, with *A. platyunguiculatus* (Banner) occupying deeper burrows reaching into buried coral heads) were mature individuals with the carapace lengths up to 7.6 mm., while the two from the deep burrows in the fine sand of Ahoolaka were found from 12 to 18 inches down (with *A. lanceoloti* Coutière in shallow

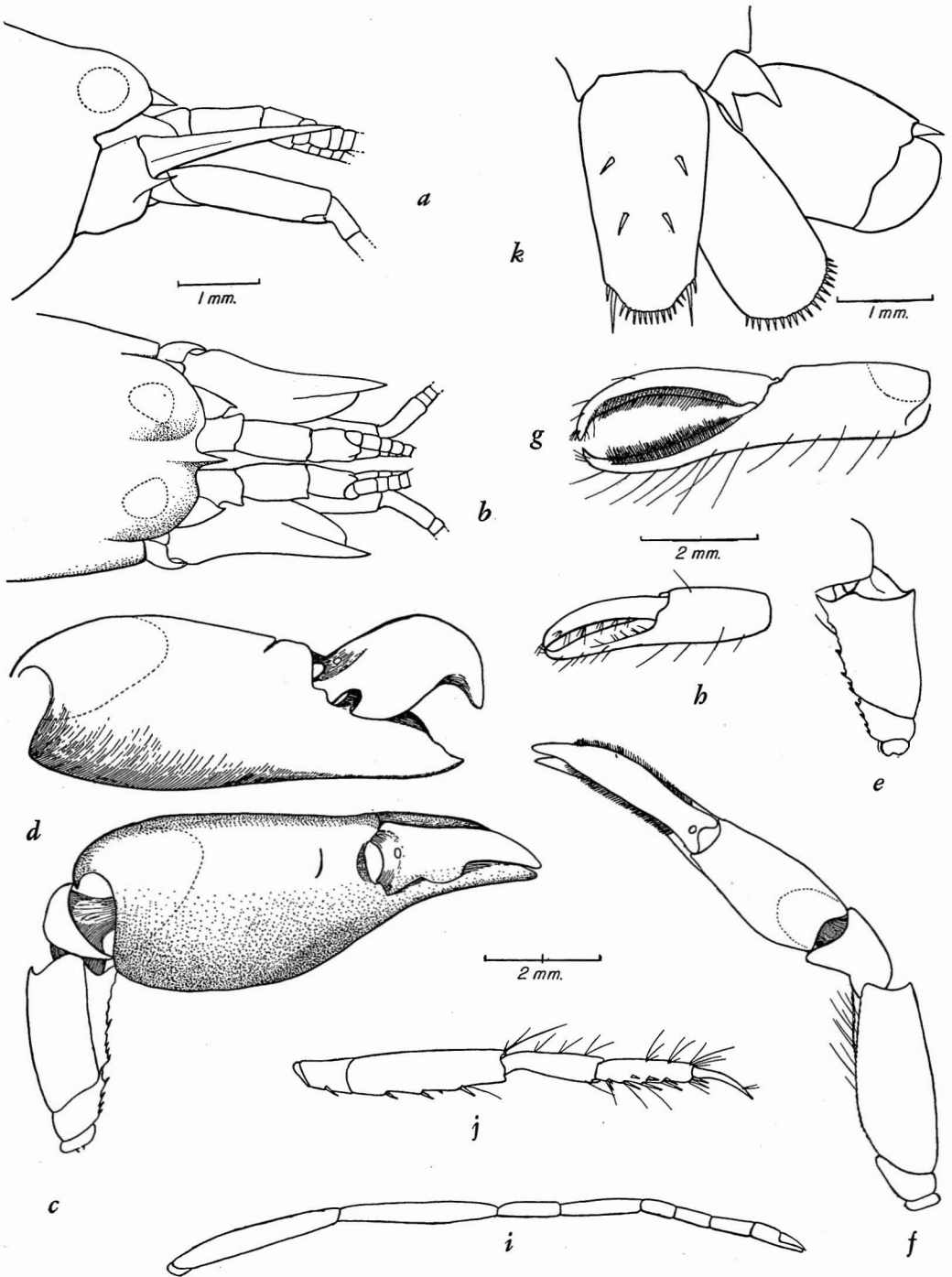


FIG. 8. *Alpheus lanceoloti* Coutière. *a, b*, Anterior regions, dorsal and lateral aspects; *c*, large cheliped; *d*, large chela, inferior aspect; *e*, large cheliped, merus, medial aspect; *f*, small cheliped, male; *g*, small chela, male, inferior aspect; *h*, small chela, female; *i*, second leg; *j*, third leg; *k*, telson and uropods.

burrows) and were almost twice that size (carapace length of 13.5 mm., total length to 32 mm.). Because of this difference in size and habitat the individuals were carefully studied to see if any specific differences occurred between them. The large specimens were found to fall well within the range of variation of the small specimens. The difference in size may be due to the difference in habitat. The difference in the depth of burrows may be due to the underlying substrate of coral in the mud flats which prevents them from excavating their burrows as deeply as they can in the pure sand of the bar.

The variation in a group of 30 specimens, including the 2 large specimens, was tabulated with the following results.

Antennular peduncle: Second article from 1.4 to 2.5 times the length of the first. Third article from 0.6 to 1.1 times the length of the first.

Scaphocerite: Usually slightly to definitely longer than both carapocerite and antennular peduncle.

Carpocerite: Usually equal or subequal in length to the antennular peduncle; in two specimens, otherwise normal, equal in length to the scaphocerite, definitely longer than antennular peduncle.

Large chela: Total length usually 1.5 to 1.8 times breadth. Fingers usually 0.4 to 0.7 length of palm.

Small chela: Palm 1.2 to 1.5 usually 1.4, times as long as broad in males, 1.1 to 1.8, usually 1.3, times as long as broad in females.<sup>3</sup> Fingers 1.5 to 1.8, usually 1.7–1.8, times the length of palm in males, 1.4 to 1.8, usually 1.4–1.6, times length of palm in females.

Carpus, second legs: Second article 0.7 to 1.0 times length of first article, with most 0.8 times.

In one specimen a very peculiar large and small chela was noted. In this specimen the

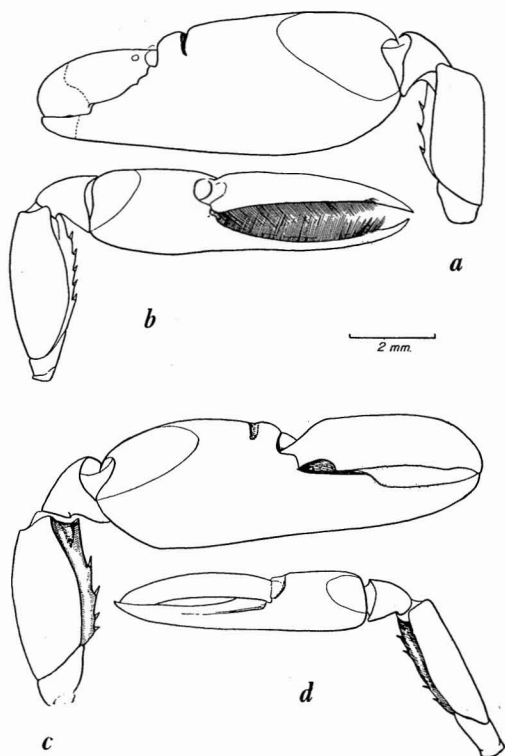


FIG. 9. *Alpheus rapax* Fabricius. Aberrant large and small chelae. *a, b*, Normal large and small chelae of male; *c, d*, aberrant large and small chelae, male. All drawn to same scale.

fingers of the large chela were 1.1 times the length of the palm, and the small chela was much thinner than usual, and not *balaeniceps*-shaped as would be expected for a male. (Fig. 9*c-d* contrasts these chelae with normal male chelae of approximately the same size.) All other characteristics are like those of the typical *A. rapax*. A similar condition has been previously reported. De Haan (1850: 178, pl. 45, fig. 4) described a new species, *A. digitalis*, separated from *A. rapax* only by the great elongation of the dactylus of the large chela. Coutière (1898*b*:248) examined the type of this species and two other species of the genus described on the basis of similar characteristics, and came to the conclusion that these were examples of regeneration where the development was arrested "à un stade

<sup>3</sup> In my original description of the Hawaiian specimens (1953: 128, top line, left column) there is an error for the palm was 1.5, not 2.5, times as long as broad.



moins profondément 'évolué' que sa forme habituelle," and that *A. digitalis* was a synonym of *A. rapax*. I believe a more logical explanation of this condition may be found in the process of either the normal replacement of a lost large chela, or the rather unusual replacement of both chelae. In the normal replacement of the large chela during successive molts, the small chela grows larger and takes on the appearance of the small chela; the condition drawn may be an intermediate stage where the small chela is regenerated, and the growing large chela has its size but not its final characteristics. In the replacement of both chelae, Darby (1934: 349, *et seq.*) reported that if the timing of loss of the individual appendages was controlled, they were replaced not by normal large and small chelae but by chelae of "intermediate" development.

Finally, many, but not all, of these specimens have the inferior external margin of the merus of the small cheliped bearing extremely fine and irregular movable spines or serrations; under ordinary magnification these are not noticeable, and even under 100 diameters of magnification it could not be discerned whether these projections were articulated. This, too, was not found in the regenerating chela mentioned above.

#### *Alpheus platyungiculatus* (Banner)

Fig. 10a

*Crangon platyungiculata* Banner, Pacific Sci. 7(1): 130, fig. 47, 1953.

LOCALITIES: 8 specimens, the largest a 34 mm. ovigerous female, all collected from silt-buried coral heads in the intertidal mud flats behind the shoreward reefs of Kaneohe Bay, Oahu, Hawaii. Collected by A. H. Banner.

DISCUSSION: Since the collection of the five specimens upon which the original description was based, continuing search has been made for more specimens of this species. As explained in the original description, these shrimp appear to be confined to burrows in the muddy to sandy areas where the burrows can reach down through the loose substrate

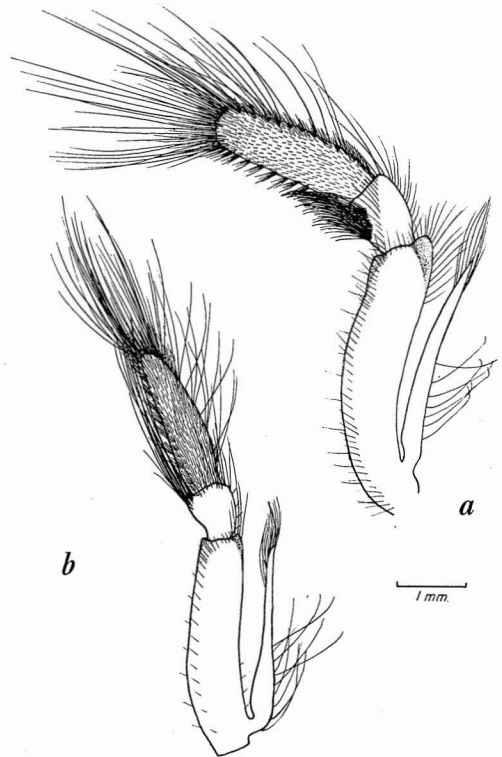


FIG. 10. *Alpheus platyungiculatus* (Banner) and *Alpheus rapax* Fabricius, third maxillipeds, medial aspects. a, *A. platyungiculatus*; b, *A. rapax*. Drawn to the same scale.

into buried coral heads. A section of inshore reef was found where the buried coral was loose and breakable; in this area these specimens were found, together with *A. rapax* (Fabricius). When only shallow holes were dug, several inches deep to the top of the imbedded coral, only *A. rapax* was found; when the imbedded coral itself was broken up from a depth of 8 inches or a foot, both *A. platyungiculatus* and *A. rapax* were found. It appeared that the *A. rapax* was probably carried down from the sides of the excavation.

In the examination of these specimens an excellent specific characteristic was found to separate this species from *A. rapax*. In *A. platyungiculatus* the middle article of the 3rd maxilliped bears a dense tuft of hairs, the longest reaching about one-third the length

of the ultimate article (Fig. 10a); in *A. rapax* this article bears a smaller group, not a tuft, of hairs, the longest of which reaches to the end of the ultimate article. In a few specimens of *A. platyunguiculatus* the tuft is not fully developed, but all lack the long setae of *A. rapax*.

*Alpheus platyunguiculatus* was separated from related species, especially from *A. sauensis* de Man, on the basis of a series of minor differences in the proportions of the appendages.<sup>4</sup> This series of specimens was closely examined in those points of distinction, the results of which are given below:

	TYPE SPECIMEN	RANGE OF THIS SERIES
Ratio of lengths of first two antennular articles . . .	1:1.3	1:1.4-1:2.0
Large cheliped		
Merus, length ÷ breadth . . .	2.5	2.2-2.8
Number of meral spines . . .	2	2-5
Chela, length ÷ breadth . . .	2.3	2.1-2.6
Chela, finger length ÷ palmar length . . . . .	0.5	0.4-0.7
Small Cheliped		
Merus, length ÷ breadth . . .	2.6	2.0-2.8
Spines . . . . .	4	2-5
Chela		
Palm, length ÷ breadth . . .	1.5 female 1.6 female	1.5 sole male 1.3-1.6 females
Finger length ÷ palmar length . . . . .	1.2 male 1.2 female	1.25 male 1.25-1.50 females
Second legs, ratio of first two carpal articles . . . . .	1:2.3	1:1.85-2.3
Third legs		
Merus, length ÷ breadth . . .	4.0	4.3-5.0

This range of variation destroys the value of most of the criteria set forth for the separation of *A. sauensis* and *A. platyunguiculatus*; it also casts some doubts on the value of couplets used in de Man's key to this group. However, de Man (1908:110) specified that

<sup>4</sup> In the tabulation on p. 132 of the original description the reference to the stylocerite should be to the scaphocerite, and in the comparison to *A. djeddensis* in the paragraph preceding the tabulation the text should read "small chela" instead of "third chela."

the dactyls of the third to fifth legs in his species were simple and rounded, and in all these specimens they are definitely flattened. Moreover, de Man did not describe the tuft of dense hairs on the penultimate joint of the third maxillipeds, and he did describe the terminal setae of the last article of this appendage as being over twice as long as the article, while in this species they are not even as long as the article. I believe, therefore, that this species is valid.

#### Edwardsii Group

#### *Alpheus bastardi* Coutière

*Alpheus bouvieri* var. *bastardi* Coutière, Soc. Ent. de France, Bul., 1898(5): 133, fig. 1a, 1898.

*Alpheus bastardi* Coutière, Fauna and Géog., Maldive and Laccadive Archipelagoes 2(4): 907, pl. 85, fig. 45, 1905.

LOCALITIES: 1 specimen, Station Y-111, Tomil Harbor, Yap Island, Caroline Archipelago, from holes in intertidal zone, rocky beach; collected by R. W. Hiatt, 1946.

DISCUSSION: This single specimen, a female, agrees perfectly with the short description and figures of Coutière. Unfortunately there is no male with which to confirm the identification.

#### *Alpheus crassimanus* Heller

Fig. 11a-e

For synonymy, see Banner, Pacific Sci. 11(2): 204, 1957.

LOCALITIES: 3 specimens from Station Y-111, collection data as above. One specimen, Station 2015, Otikahehu Island, Tuamotu Archipelago, on coral stones, under surface of muddy sand, near shore of brakish enclosed lagoon; collected by J. E. P. Morrison, July 29, 1952.

DISCUSSION: Most of the previous studies on this species have indicated that the small chela of the male not only has the dactylus subspatulate and fringed with long setae, but also that the palm bears sculpturing (see de Man, 1911, p. 417; Bate, 1888: pl. 99, fig. 2;

Coutière 1899: fig. 293). Yet the illustrations showed slight differences in the sculpturing (contrast Bate, fig. 2k to Coutière, *loc. cit.*). In contrast, the specimens reported from Hawaii (Banner, 1953: 134) did not show the sculpturing, nor did those reported from Arno

and Onotoa (Banner, 1957: 204; 1958: 168).

The three specimens from Yap indicate a possible reason for this difference. One of the specimens is an ovigerous 22 mm. female, which shows a slight trace of sculpturing in a shallow, ill-defined depression located longitudinally on the upper surface of the palm. The male of the same size has the characteristic dactylus of the adult male, yet the palm, like that of the female, bears only a slight longitudinal depression. However, in the 27 mm. male the palm is strongly sculptured. It is very roughly triangular in cross section, with the upper medial and lateral faces bearing extensive depressions that are quite well delimited (although not as definite as the corresponding depressions on the large chela); these are connected across the superior margin by a rounded, saddlelike transverse groove. On the inferolateral margin there is a strong shoulder; the inferior surface of the chela is flattened and demarked by abrupt but rounded margins; the inferolateral shoulder does not continue on the inner face.

Specimens from Hawaii were re-examined, and while the smaller males show almost no trace of the sculpturing, the largest male available (24.6 mm. long, collected in the mud flats at Heeia, Kaneohe Bay, Oahu in about plus 1 to 2 ft. tide zone) shows sculpturing similar to that of the 22 mm. Yap specimen.

Inasmuch as specimens less than 20 mm. long are often ovigerous, and inasmuch as specimens up to 44 mm. long have been reported (de Man, 1902: 880), it appears that the younger, but mature, males bear the subspatulate dactylus but may be entirely lacking in the sculpturing of the palm, while larger males develop the sculpturing. It is likely that the point of transition between the two forms may be around the body length of 25 mm., although this size may vary in different geographic areas. For example, none from Hawaii appear to reach the necessary size, while the specimen reported by de Man from Makassar (*loc. cit.*) evidently had the sculpturing at a body length of 25 mm.

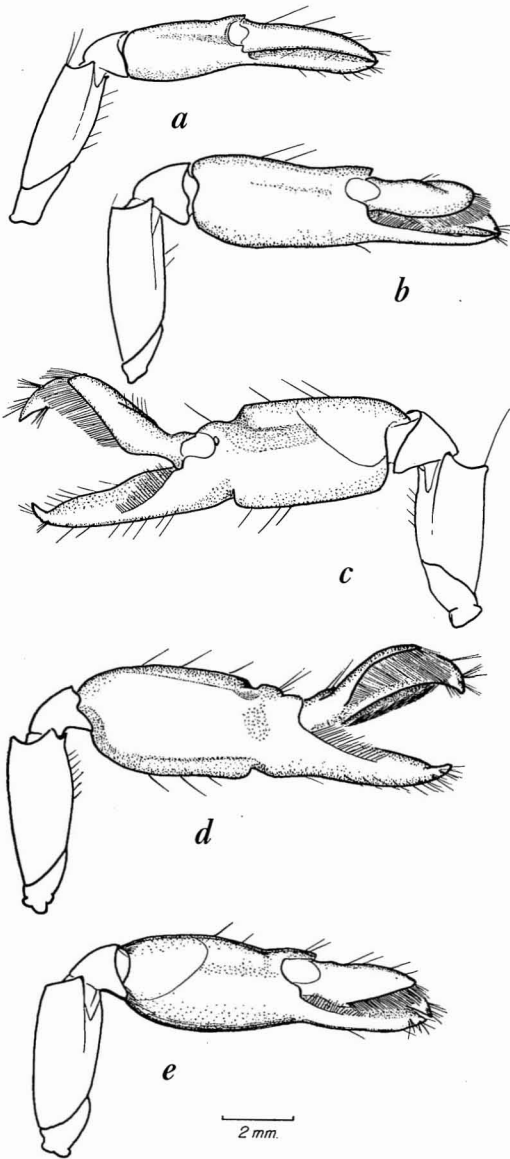


FIG. 11. *Alpheus crassimanus* Heller. Variation in form of small chelae. *a*, 22 mm. ovigerous female; *b*, 22 mm. male; *c*, 27 mm. male, lateral aspect; *d*, same, medial aspect; *e*, 24.6 mm. male. Specimens shown in *a-d* from Yap, *e*, from Hawaii; all drawn to same scale.

It may be that this is the wrong conclusion to draw from these specimens. Certainly two male specimens are not enough to prove or disprove the relationship. Only when a series of specimens of different body lengths are available can it be safely said that this is or is not a growth difference.

It should also be noted that the merus of the larger chelipeds of the 22 mm. female and the 27 mm. male bear a small acute tooth at the termination of the inferior internal margin, while the 22 mm. male, like those from Hawaii, lack this tooth.

The one specimen from the Tuamotus is a smaller male and similar in the form of the small chela to those from Hawaii.

#### *Alpheus strenuus* Dana

For synonymy, see Banner, Pacific Sci. 11(2): 204, 1957.

LOCALITY: 1 specimen, Station Y-122 from Tomil Harbor, Yap Island, Caroline Archipelago, in shallow burrows, intertidal zone; collected by R. W. Hiatt, 1946.

#### *Alpheus pacificus* Dana

For synonymy, see Banner, Pacific Sci. 10(3): 362, 1956.

LOCALITY: 2 specimens from Midway Island, Hawaiian Archipelago; collected by Y. D. P. Spicer, 1941.

#### *Alpheus malabaricus* (Fabricius) *mackayi* subsp. nov.

Fig. 12a-n

*Astacus malabaricus* Fabricius, System. Ent. p. 415, 1775.

*Alpheus malabaricus* Fabricius, Sup. Ent. System., p. 405, 1798.

*Alpheus malabaricus* Henderson, Zool. Soc. London, Trans., II, 5: 434, pl. 40, figs. 1-3, 1893. [Species reestablished and redescribed.]

*Alpheus malabaricus* de Man, Siboga Exped. 39a<sup>1</sup> (2): 429, 1911. [New subspecies with separate synonymy.]

*Alpheus malabaricus* Barnard, South African Mus., Ann., fig. 142 l-n, 1950.

*Crangon* species, McKay, Canad. Field-Nat. 61(4): 135, pl. 1, 1947.

TYPES: Holotype, an ovigerous female 37.8 mm. long; allotype, a male 27.7 mm. long; both collected by Donald C. G. MacKay in Wailupe fish pond, Oahu, Hawaii.

DESCRIPTION: Orbital hoods and rostrum protruding far beyond anterolateral margins of carapace. Orbital hoods inflated, high, rounded; rostrum short, not reaching beyond anterior margin of orbital hoods, carina short, rounded, not reaching to middle of orbital hoods; interorbital area behind termination of carina flat, anteriorly abruptly demarked from convexity of orbital hoods.

Antennular peduncle with second article about 2.4 times as long as broad, about twice length of visible portion of first article and not quite 3 times length of third article. First article terminating in high setose crest on superior margin; basicerite broad, flat, with small anterior tooth not reaching to end of first article. Basicerite with acute lateral tooth. Scaphocerite reaching to beyond end of antennular peduncle, squamous portion broad, slightly narrowing distally, and exceeded by the lateral spine; lateral spine curved inward at tip. Carpocerite reaching to end of lateral spine of scaphocerite.

Large chela of male and female of similar proportions, and almost identical size in spite of difference in body lengths. Merus with outer face 1.7 times as long as broad; superior margin ending distally in slight projection; inferior internal margin terminating in strong acute tooth, otherwise unarmed. Carpus of usual form. Large chela 2.4 times as long as maximum width, tapering towards fingers, with maximum width of fingers 0.66 as wide as palm; fingers strong, occupying the distal 0.3 of chela (about half as long as palm). Palm with rounded depressed areas on either face, both roughly triangular; superior margin of palm ending in shoulder overhanging shallow, rounded groove that connects de-

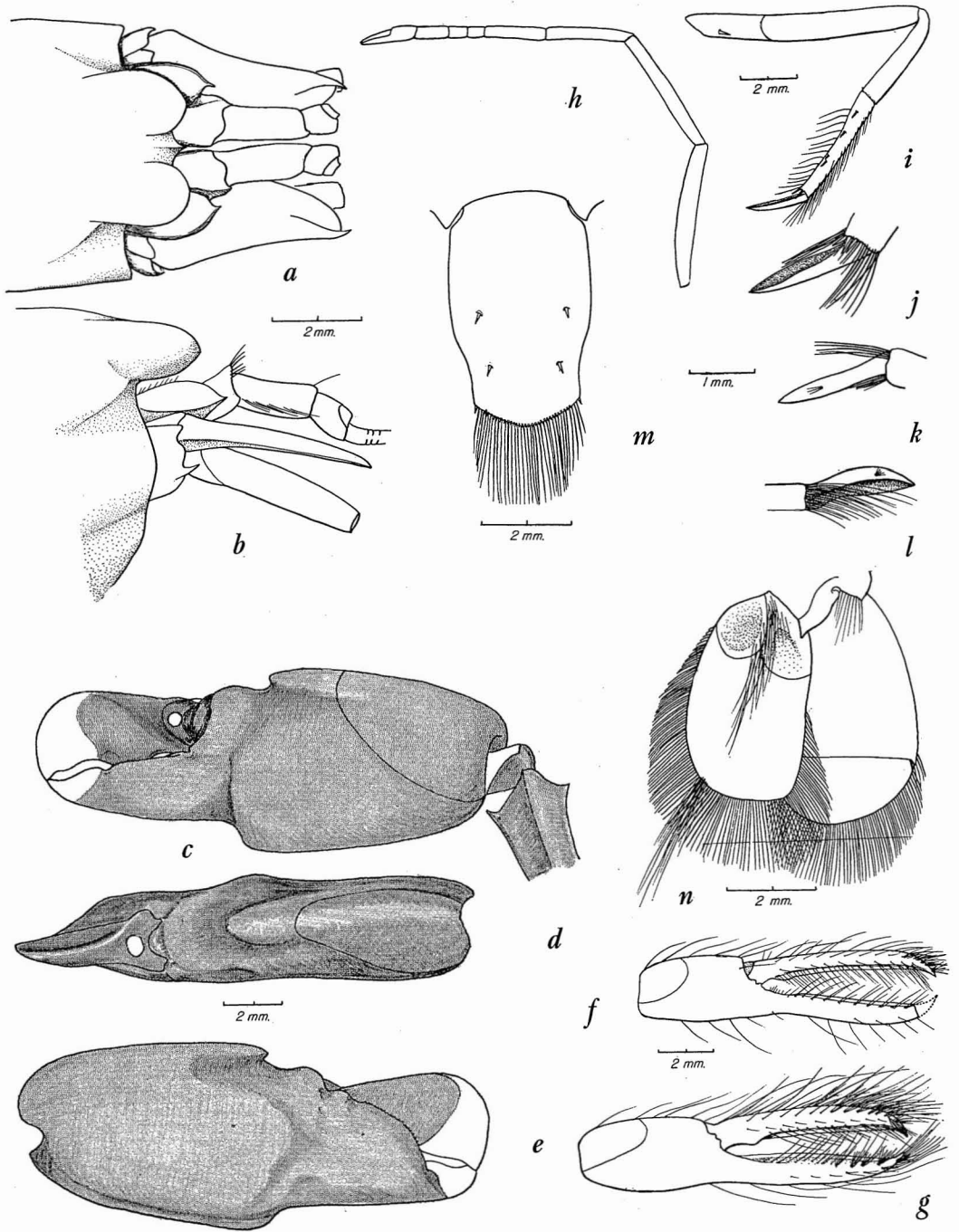


FIG. 12. *Alpheus malabaricus* (Fabricius) *mackayi* subsp. nov. *a, b*, Anterior regions, superior and lateral aspects, setae not shown; *c, d, e*, large chela, lateral, superior and medial aspects; *f, g*, small chela, male; *g*, small chela, female; *h*, second leg; *i*, third leg; *j, k, l*, dactylus, third leg, anterior, superior and posterior aspects; *m*, telson; *n*, uropod, showing proximal concavities.

pressed areas on either face; inferior margin terminating, almost right angled, in strong shoulder on outer face.

Small chelae also similar in both sexes. Merus unarmed on inferior internal margin. Palm slender, rounded, without sculpturing. Fingers 1.4 times length of palm in female, 1.7 times length of palm in male, straight except for slightly hooked tips, both movable and fixed fingers rounded on outer portion of opposing faces, bearing a sharp cutting edge on inner margin; dactylus bearing a low rounded tooth proximal to cutting edge.

Carpal articles of second legs with the ratio: 10:7.6:2.0:2.3:4.3; chela, in same ratio, 1.7.

Third and fourth legs with ischium bearing weak spine; merus 6 times as long as broad, unarmed; carpus 0.6 as long as merus, without distal teeth or projections; propodus 0.75 as long as merus, bearing 6 feeble spines and numerous long setae; dactylus 0.3 as long as merus, strongly curved in superior view, roughly triangular in cross section, with both superior faces somewhat convex, inferior face broad and flattened. Fifth leg with brush on propodus strongly developed.

Telson 2.4 times as long as posterior margin is broad, 1.3 times as broad anteriorly as posteriorly; in dorsal view, anterior 0.6 with slightly convex margins, without taper, then tapering abruptly to posterior portion with parallel margins; in lateral view, middle of lateral margin strongly depressed; tip strongly arcuate. Dorsal spinules feeble; inner pair of posterolateral spinules so slender that they can be confused with terminal setae; terminal setae numerous and heavy; posterior margin also armed with series of minute spinules. Outer uropod with spine on shoulder slight. Inner uropod with a shallow but well-demarcated basin to accommodate depressed lateral margin of telson.

DISCUSSION: These specimens agree very well with the species *A. malabaricus* as re-described by Henderson, and with the subspecies described by de Man (*loc. cit.*), except in the length of the rostrum and the relative

proportions of the small chela; apparently all are similar in form of the dactylus of the third legs, in the general shape of the large chela, etc. However, all specimens of *A. malabaricus* except that described and figured by Barnard from South Africa (*loc. cit.*), have longer rostrums, and in none are the fingers as short when compared to the palm. Both reported subspecies have fingers on the small chela that are gaping instead of straight. The habitat of these specimens—the thick soft mud of a fish pond—and those reported by Henderson from India are also similar.

Because of their great similarities it is not logical to consider these specimens as other than a geographically isolated subspecies; it may be that when other specimens are found between Hawaii and India intergrading specimens will be found.

The type locality, Wailupe fish pond, no longer exists. It was filled in and is now used for homesites, the area being called Wailupe Peninsula. Presumably the subspecies exists elsewhere in the Hawaiian Islands, but it has not yet been found in other areas.

#### THUNOR ARMSTRONG

##### *Thunor microscaphis* sp. nov.

Fig. 13*a-i*

*Thunor* sp. Banner, Pacific Sci. 10(3): 367, fig. 23*a-e*, 1956.

TYPE SPECIMEN: A 9.5 mm. male from Station 827, Likiep Atoll, Marshall Islands, USNM 194726; collected by S. V. MacNeil.

DESCRIPTION: Specimen with cephalothorax preponderant, abdomen reduced, only slightly more than equal in length to carapace.

Anterior carapace distorted in specimen with folds and wrinkles permitting the eyes to be partially exposed. Rostrum obtuse, short, not reaching beyond anterior margin of orbital hoods, and bearing low, rounded carina reaching to slightly past middle of orbital hoods. Orbital hoods large, inflated, evenly rounded anteriorly.

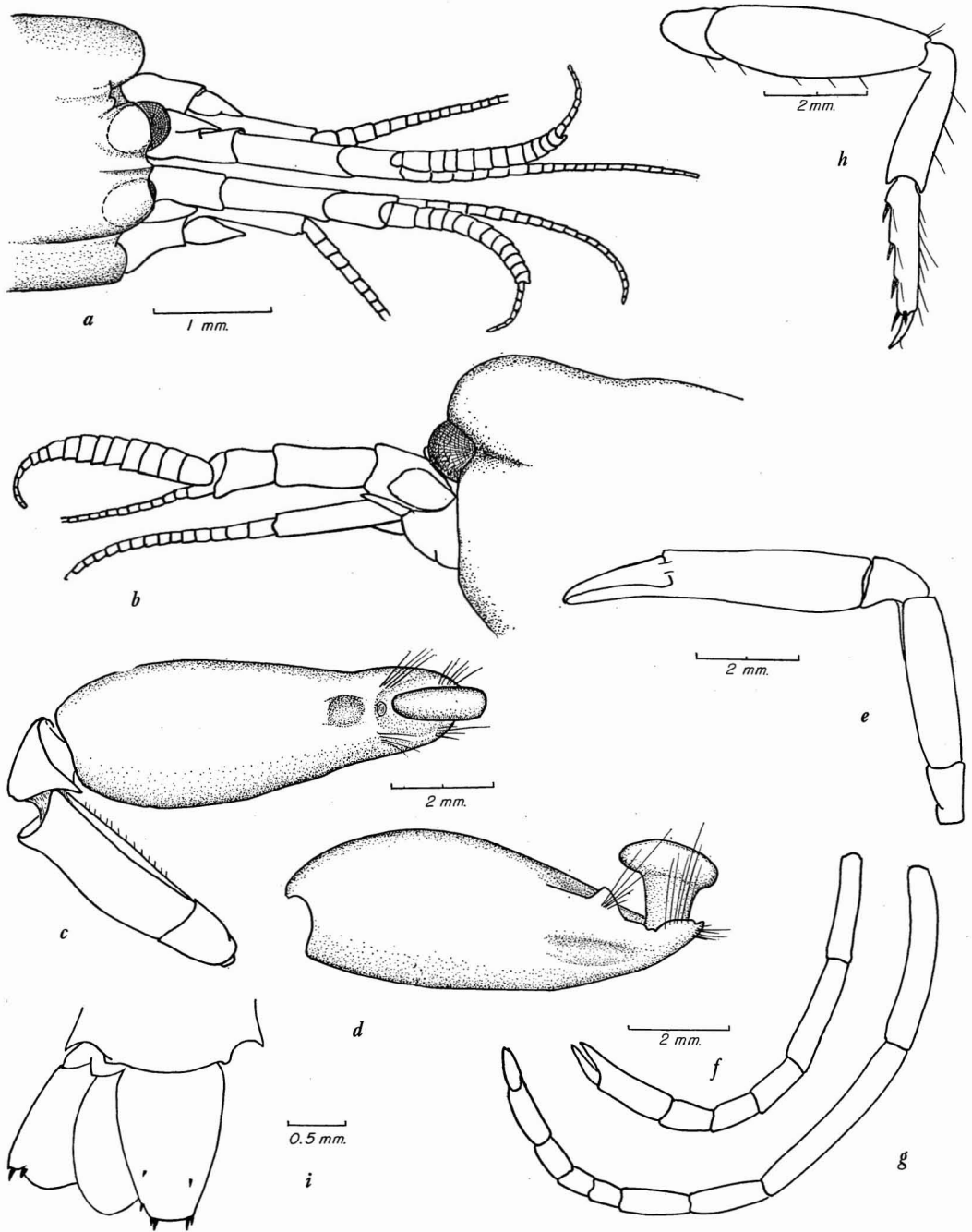


FIG. 13. *Thunor microscephis* sp. nov. *a, b*, Anterior regions, superior and lateral aspects; *c, d*, large cheliped; *e*, small cheliped; *f*, second leg, left, carpus to dactylus; *g*, second leg, right, ischium to dactylus; *h*, third leg; *i*, telson and uropods.

Antennular peduncle with second article 1.7 times length of first article; third article subequal to first; second article 3.5 times as long as broad. Stylocerite assymmetrically developed, with that on left almost rounded anteriorly and reaching about 0.7 the length of first article; that on right anterior irregular (but rounded) reaching only a little more than 0.5 length of first article.

Scaphocerite reduced to bract which reaches on left to end, on right to slightly beyond end of first antennular article. Basicerite unarmed. Carpocerite reaching 0.6 length of second antennular article. Antennal flagellum elongate.

Large chela 2.7 times as long as broad, with fingers occupying the distal 0.2; margins mostly regular and strongly tapering. Distally chela with a deep pit proximal to articulation of dactylus to accommodate protruding margin of dactylus; lateral and proximal to articulation of dactylus is located a shallow depression with poorly defined margins. Fixed finger very short. Dactylus hammer-shaped, with distal margin swollen and rounded, proximal portion broad and thin. Carpus of usual form. Merus about 0.4 length of chela, with outer face 3.5 times as long as broad; distally unarmed; inferior internal and external margins sharp; inferior internal margin bearing 13 slight and feeble spines.

Small chela 5 times as long as broad, with the simple fingers occupying the distal 0.35. Merus 0.55 length of chela, 0.25 as long as broad, unarmed.

Second legs assymetrical, with left as long as body, and right a little over half as long. Carpal articles of right legs with ratio: 10:9:4:5:6; left leg with first article slightly shorter, relatively.

Third leg with ischium unarmed; merus unarmed, 3.2 times as long as broad; carpus with distal angles rounded; propodus bearing 3 single inferior spines and paired spines distally; dactylus simple and curved.

Outer uropod bearing a single lateral spine without articulation, inner unarmed. Telson

3.5 times as long as tip is broad, 1.8 times as broad anteriorly as posteriorly; sides slightly curved. Dorsal spines abnormal, with anterior left about 0.7 length posterior from articulation, posterior left located on margin; anterior right posterior to corresponding left, posterior right missing.

DISCUSSION: This single specimen appears to be of the same species as the two fragmentary specimens previously described but not named from Saipan (Banner, *loc. cit.*). A number of slight differences are found between the two forms: the length of the interorbital carina, the proportion of the articles of the antennular peduncle, the ratio of the carpal articles of the second leg (only one second leg remained on the two Saipan specimens), the armature of the propodus of the third legs, and the proportions and armature of the telson. These differences, most of them in parts that have been found to be variable in *T. idiocheles* (Courtière) and *T. rathbunae* (Schmitt), as well as in related species of the *Obesomanus* group of *Alpheus*, are probably without significance. Another difference between the two lies in the development of the antennal peduncle: in the male specimen from Saipan the scaphocerite reaches to the middle of the second article of the antennular peduncle, and the carpocerite reaches to the end of the same article, while in the female from Saipan the development of these is shorter and more degenerate than that found in the male. As this male is similar to the Saipan female, the difference is obviously not sexual dimorphism, but may show the variability of the development of this appendage; however, the two Saipan specimens may be of different species. A final difference is found in the merus of the large chela, which in this specimen bears 13 feeble spines, and in the Saipan specimen bears a few bristles in corresponding locations. Opposed to these slight and seemingly insignificant differences are many and great similarities, as can best be seen by comparing the figures of the two forms.

This species plainly belongs to *Thunor* if



that genus is to be accepted, for it lacks the anal tubercles and the articulation of the outer uropod; in addition the specimens lack the ocular beak and in two of the three specimens the cardiac notch is lacking.

Within the genus, *T. microscaphis* is best distinguished from *T. idiocheles* by the form of the large chela, for in this species the dactylus is formed like a two-headed hammer, and the superior surface of the chela bears a marked depression to accommodate the superior projection of the dactylus when that article is flexed. In *T. idiocheles*, the dactylus of the large chela lacks this superior projection and there is no corresponding depression of the palm. From *T. rathbunae* this species is distinguished by the presence of a small rostrum as well as by the form of the large chela and the relatively greater length of the small chela.

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