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**Contributions to the Knowledge of the Alpheid  
Shrimp of the Pacific Ocean, XI**

**Collections from the Cook and Society Islands<sup>1</sup>**

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INTRODUCTION

This study is the third paper in a series that resulted from collections made by the senior author in 1954 while under a Yale-Bishop Museum fellowship. The previous studies dealt with collections from Canton Island, Phoenix group (Part IX), and from Fiji, Tonga, and Samoa (Part X). In this paper we report on collections made at Aitutake, Cook Islands, and at Tahiti, Moorea, and Bora Bora in the Society Islands (Fig. 1). Also we have included records of a few specimens from other islands in French Polynesia.

Like Part X, this manuscript was in a final form with completed plates when the Hawaii Marine Laboratory fire of 1961 destroyed the laboratory building. All that remained were the partially destroyed original rough notes, without drawings or specimens. However, as with the previous paper, we have decided to publish these notes, re-created to the best of our ability, as so little has been published on these ecologically important shrimp in the central Pacific.

The work on this study was supported in part by a series of grants from the Division of Systematic Biology of the National Science Foundation (NSF G-1754, 3863, 9937). The senior author wishes to acknowledge the hospitality and help extended by Mr. and Mrs. Francis

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<sup>1</sup> Contribution No. 269, Hawaii Institute of Marine Biology.

Sanford during his stay at Bora Bora; the Sanfords not only took the author into their home as a guest, but Mr. Sanford also had his students make collections of shrimp and personally collected specimens from Maupiti. The authors also acknowledge the gift of a collection of Tahitian, Tuamotuan, and Marquesan specimens from Dr. John E. Randall in 1956. Dr. Randall is now at the Bernice P. Bishop Museum and the Hawaii Institute of Marine Biology, University of Hawaii.

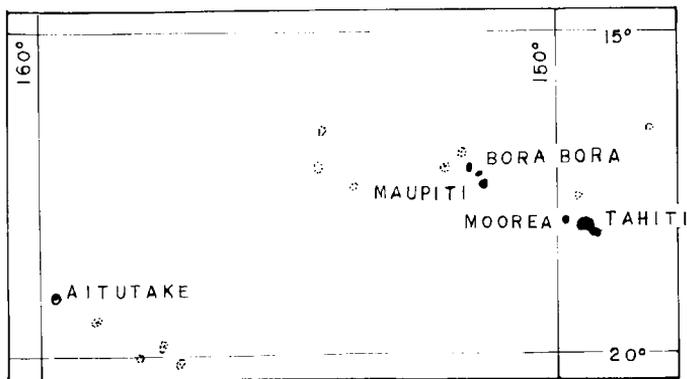


FIGURE 1.—Cook and Society Islands; labeled islands are sites of collections (map from U. S. Hydrographic Office 5800).

## DESCRIPTION OF STATIONS

### COOK ISLANDS

Collecting at Aitutake was done during the last two weeks of May 1954; almost all records of the collecting localities were lost in the fire. However, the senior author recalls collecting at the following localities (see Fig. 2).

Near Arutunga village: Here a transect was made across the fringing reef and other specimens were taken at scattered localities near the inner boat harbor and at the ocean side of the reef of the ocean anchorage, in water up to 20 or 30 feet deep (note: while snapping shrimps could be heard in this last locality, the vigorously growing and consolidated coral reef did not permit the collection of many specimens).

Off Papanutū: The exact location of a transect off the World War II airstrip cannot be recalled, but the ocean reef was studied from the shore to near the surf zone.

Off Vainamu and Nukuroa: Within the sandy lagoon, 6 to 10 feet deep; near these districts, coral was broken from the upstanding heads, some of which reached to the surface, and from scattered dead coral heads on the bottom.

Off the islet of Akaimai (possibly the same island as the one labeled on the charts as Rotuakakura): Here the collection was made on the windward ocean reef which was rugged and uneven, with some depressions as much as 6 feet below low-tide zone.

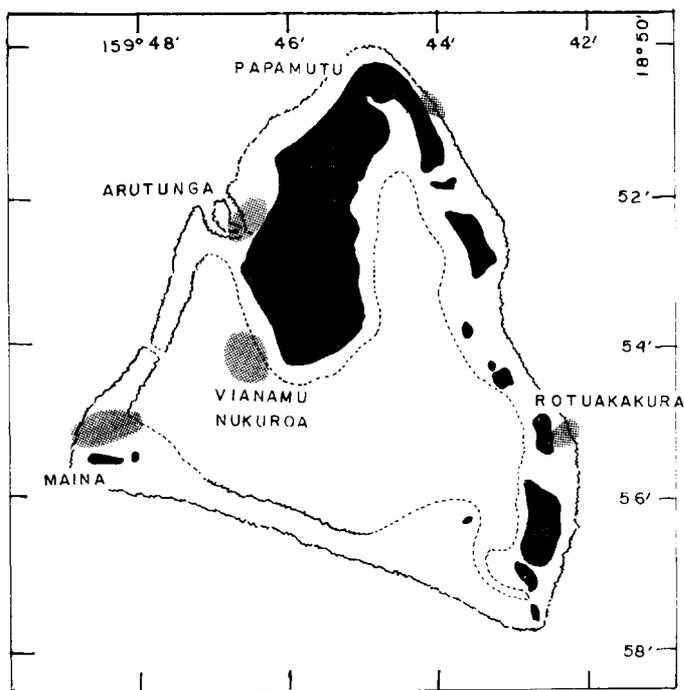


FIGURE 2.—Aitutake, Cook Islands; shaded areas indicate probable collecting areas (taken from U. S. Hydrographic chart 2000).

Maina Island: Specimens were taken on both the lagoon side and on the ocean reef.

In addition to the specimens personally collected by the senior author, after his departure a large collection was made by a youth (whose name was lost). No data remains on his collecting areas.

## SOCIETY ISLANDS

For the Society Islands, some fragmentary notes which had been transcribed from the original field notebook were saved; however, the notes were imperfectly transcribed, and the accompanying maps, both sketches in the field notes and annotated governmental maps showing the exact collecting areas, were burned. The data below are from this transcription with additional notes from memory (see Figs. 3, 4, 5):

BD 1-5. Collected on June 5, 6, 1954. Arue District, Tahiti, about 3 miles east of Papeete. These were probably from the northeast side of the point labeled on the maps as Patutoa.

BD 1. From under algal mat at about 0.0 tide level; small mussels also occurring in mat.

BD 2. From same locality as BD 1, from 0.0 to -0.6 tide level; from various coral heads; area subject to mild surge.

BD 3. From same locality as BD 1, from coral heads 5 to 10 feet deep, beyond reef front.

BD 4. From reef flat about 300 yards north of BD 1.

BD 5. From inner area with scattered broken coral, shoreward of BD 4.

BD 5. From outer ridge at BD 4; ridge subject to moderate surge and encrusted with smooth coralline alga.

BD 6. From the northern barrier reef beyond the ship channel, about a mile east of Papeete, near Rahere in Arue; numerous locations along the half-mile to one-mile wide expanse of reef were investigated in water from low-tide zone to 5 feet deep, but almost no alpheids were collected.

BD 7-29 were all from the island of Bora Bora which was chosen for study because it is smaller than Tahiti and almost all parts of the reef can be reached by boat or bicycle. The collections were made June 6-15, 1954.

BD 7. From a shallow fringing reef in the Vaitape district in water up to about 8 feet deep.

BD 8-10. From ocean reef of Motu Mute; BD 8, from inner reef; BD 9, from outer ridge of coralline alga; BD 10, specimen lost.

BD 11. From channel separating Motu Mute from Motu Manini; specimens collected from dead heads of *Porites* sp. that lay in tidal pool 1 or 2 feet deep in the channel, separated by a low dyke of beach rock from water on either side except at high tide.

BD 12. From mud and sand flats in Fanui at head of bay; most specimens collected under rocks. Specimens collected by Mr. Francis Sanford and members of his class at Fanui School.

BD 13-19 were collected on the south barrier reef in the vicinity of Pituu Uta and Pituu Tai.

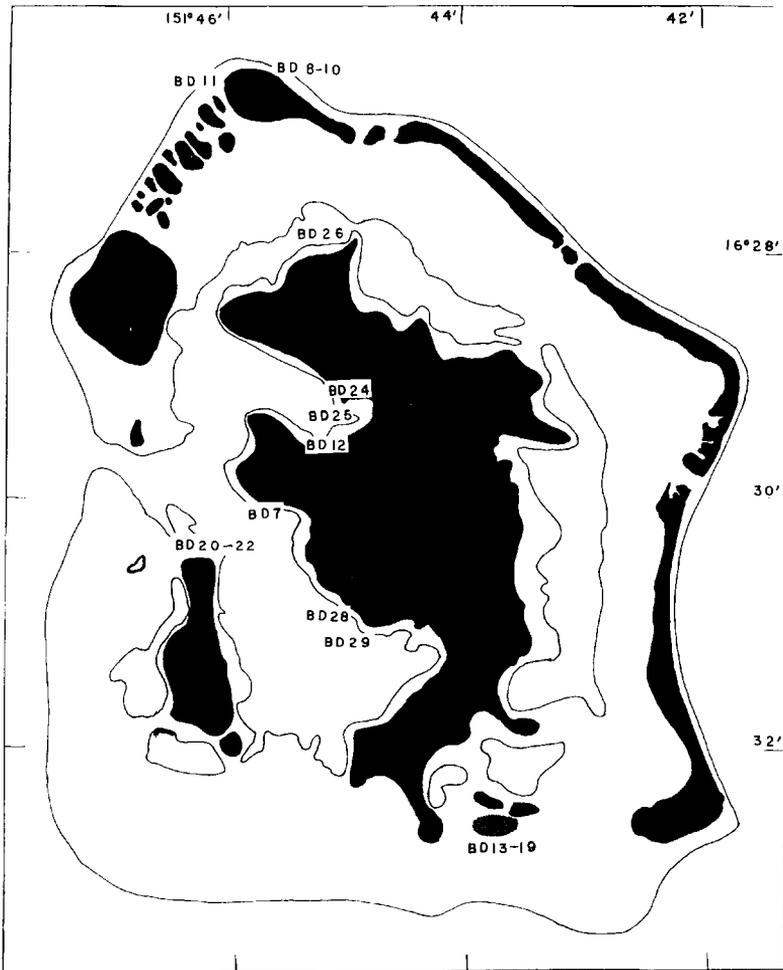


FIGURE 3.—Bora Bora, Society Islands; showing approximate collecting localities (map taken from U. S. Hydrographic Office 5742, fine line marking 10 fathoms).

BD 13. From inner portion of reef, sandy bottom up to 3 feet deep; wave action slight; from various living and dead corals.

BD 14. From ridge, about 6 inches to a foot deep, demarking outer margin of inner reef flat.

BD 15. From *Pocillopora* spp. in BD 13 and BD 14.

BD 16. From BD 15, a pair of cherry-red specimens (see *Alpheus collumianus* Stimpson).

BD 17. From uppermost part of ridge at BD 14, about a foot above low low water; from partially living *Acropora* and coral-line alga.

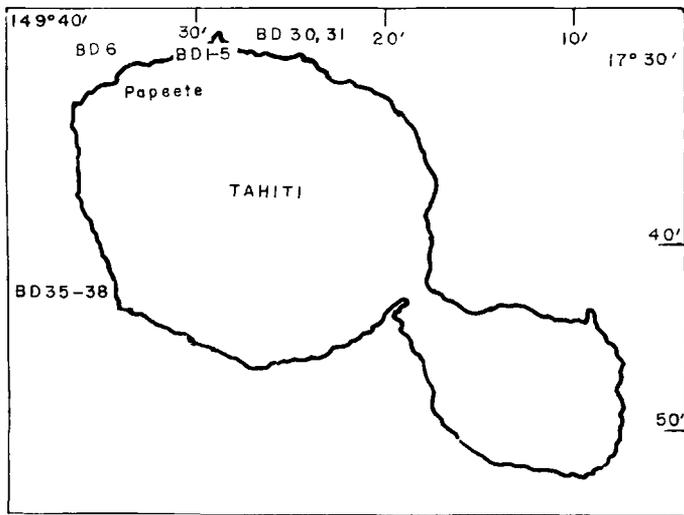


FIGURE 4.—Tahiti, Society Islands; showing approximate collecting localities (map from commercial sources, reefs not shown).

BD 18. From consolidated reef flat off Pituu Utu; flat made mostly of truncate-topped massive heads of *Porites* sp. and with numerous inset specimens of small *Tridacna*, and with *Diadema* abundant.

BD 19. From tidal channel off Pituu Tai, about 6 feet deep, from dead and overgrown heads of *Pocillopora* spp.

BD 20-22 were made at the north end of Tupua Island, the three collections running from shore to the channel.

BD 20. From near shore, from massive dead heads of *Porites*.

BD 21. From sandy area, about 2 feet deep, from scattered heads of dead coral.

BD 22. From inner edge of outer reef where dead coral heads were overgrown with calcareous and filamentous algae. (Note, it was impossible to obtain coral specimens from outer margin of reef for the vigorously growing coral was too coherent to be broken off with the tools available.)

BD 23. Specimens collected at Maupiti, near the central island of Mariti, by Mr. Francis Sanford.

BD 24 and 25 were collected from Fanui Bay (see also BD 12).

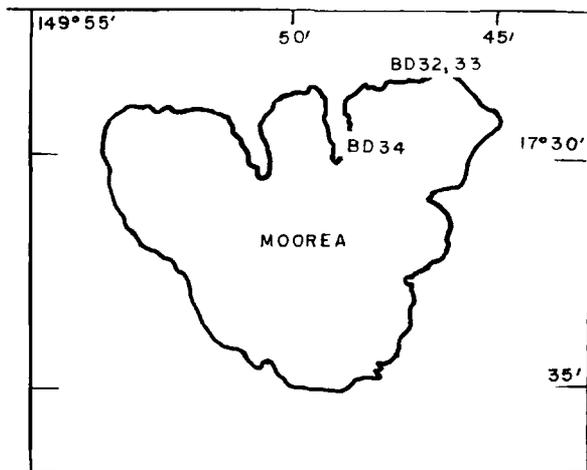


FIGURE 5.—Moorea, Society Islands; showing approximate collecting localities (map from commercial sources, reefs not shown).

BD 24. From coral boulders located high in the intertidal zone on a sandy beach south end of head of bay.

BD 25. From opposite side of the bay on a sand-mud spit, 2 feet below low-tide level (locality named Pupurueroa).

BD 26. From east side of Tahiti Point, from living and dead coral found less than a foot below low-tide zone.

BD 27. Specimen lost.

BD 28 and 29 were in the Nunue district, on north-east side of bay leading to Turapao.

BD 28. From near mouth of bay, from dead coral heads collected behind growing reef which was separated from shore by about 50 feet of sandy reef flat.

BD 29. From zone similar to BD 28 located two-thirds of the distance from the mouth of the bay toward the village of Turapao.

BD 30 and 31 were collected June 20, 1954 on the island of Tahiti, from the vigorously growing outer face of the fringing reef at the southwest side of Taharaa Head.

BD 30. From various heads of coral.

BD 31. Specimens lost.

BD 32 to 34 were collected June 22, 1954 and were from the island of Moorea. The exact location for BD 32 and 33 cannot be recalled, but they were probably located on the fringing reef at Marepa village inside Irihono pass.

BD 32. From a wave-washed ridge of calcareous alga, reaching possibly 0.5 foot above low-tide level.

BD 33. From the 4-foot deep depression shoreward of BD 32. Specimens of *Alpheus idiocheles* Coutière were collected here. In life they were a deep rose color, and found living in galleries. *Athanas indicus* (Coutière) was found living in excavations made by the sea urchin *Echinometra*.

BD 34. From near head of Cook's Bay; a few specimens were found behind the reef front in 5 or 6 feet of water; no specimens were found in the coralline alga slabs or in the bases of heads of living coral.

BD 35 to 38 collected June 27, 1954 from the reef in Paea district of Tahiti.

BD 35. From the barrier reef almost a mile from shore, from under coral heads lying slightly below the low-tide zone on a gravel and sand expanse.

BD 36. From the inner reef about 100 yards from shore; water about 3 feet deep.

BD 37. From inner reef about 200 to 300 yards from shore in water about 3 feet deep.

BD 38. From the outer edge of inner fringing reef; all specimens were collected in holes left by a boring clam in heads of corals.

SYSTEMATICS

Genus **Automate** de Man

**Automate gardineri** Coutière.

For full citation see Banner and Banner (1966a:150)<sup>2</sup>.

LOCALITIES. Cook Islands: 4 specimens (two questionable because of dehydration). Society Islands: 1 specimen from BD 17: 1, BD 33.

Genus **Athanas** Leach<sup>3</sup>

**Athanas areteformis** Coutière.

For full citation see Banner and Banner (1960:138).

LOCALITIES. Cook Islands: 4 specimens. Society Islands: 3 specimens.

**Athanas djiboutensis** Coutière.

For full citation see Banner and Banner (1960:140).

LOCALITIES. An unknown number of specimens from both the Society and Cook Islands.

**Athanas rhothionastes** Banner and Banner.

*Athanas rhothionastes* Banner and Banner, 1960. Pacific Sci. **14** (2): 142, fig. 2.

LOCALITIES. An unknown number of specimens from both the Society and Cook Islands.

**Athanas indicus** (Coutière).

For full citation see Banner and Banner (1960:149).

LOCALITIES. An unknown number of specimens from both the Society and Cook Islands.

**Athanas dorsalis** (Stimpson).

For full citation see Banner and Banner (1960:151).

LOCALITIES. 6 specimens from the Tuamotu Islands.

Genus **Salmoneus** Holthuis

**Salmoneus sibogae** (de Man).

For full citation see Banner and Banner (1964:86).

LOCALITIES. 3 specimens, locality notes lost.

<sup>2</sup> Dates in parentheses refer to Bibliography, p. 284.

<sup>3</sup> The sheets recording the collection data for the members of this genus were destroyed in the fire of the Hawaii Marine Laboratory and the records cited are taken from Banner and Banner (1960:138-154).

**Salmoneus tricristata** Banner.

*Salmoneus tricristata* Banner, 1959, *Pacific Sci.* **13** (2): 131, fig. 1.  
LOCALITY. Society Islands: 2 specimens from BD 30.

Genus **Alpheopsis** Coutière

**Alpheopsis diabolus** Banner.

*Alpheopsis diabolus* Banner, 1956, *Pacific Sci.* **10**(3): 325, fig. 3.  
*Alpheopsis diabolus* Banner and Banner, 1964, *Pacific Sci.* **18** (1):  
86 [spelling corrected]; Banner and Banner (in press, collec-  
tions from Marshall Islands).

LOCALITIES. Society Islands: 1 specimen from BD 8; 1,  
BD 22.

DISCUSSION. The only specimen with both chelae intact is a male from BD 22; these chelae show no asymmetry whatsoever in either size or configuration. Similar symmetry has been reported for *A. chalciope* de Man and *A. sibogae* de Man, but most species show asymmetry in at least the size of the appendages. It is not known whether this symmetry is also found in the female.

**Alpheopsis equalis** Coutière.

For full citation see Banner and Banner (1964: 86).

LOCALITIES. Cook Islands: 6 specimens from five collecting sites. Society Islands: 3 specimens from BD 3; 8, BD 4; 8, BD 6; 1, BD 9; 2, BD 13; 4, BD 14; 1, BD 18; 1, BD 30.

Genus **Synalpheus** Bate

**Synalpheus paraneomeris** Coutière.

For full citation see Banner (1956: 331).

LOCALITIES. Cook Islands: 9 specimens. Society Islands: 104 specimens from BD 2; 1, BD 6; 15, BD 17; 1, BD 30; 8, BD 32; 1, BD 33.

**Synalpheus charon** (Heller).

*Alpheus charon* Heller, 1861, *K. Akad. Wiss. Wien, Sitzungber.*  
**44**: 272, pl. 3, figs. 21, 22.

*Synalpheus charon*: Coutière, 1899, *Les Alpheidae*, 264, figs. 331,  
332.

*Synalpheus charon charon* Banner, 1956, *Pacific Sci.* **10**(3): 331.

*Synalpheus charon obscurus* Banner, 1956, *Pacific Sci.* **10**(3): 329,  
fig. 5.

*Synalpheus helleri* de Man, 1911, Siboga Exped. 39a (2): 246, pl. 8, fig. 37.

Nec *Alpheus charon*: de Man, 1897, Zool. Jahrb. 9: 743, vol. 10, pl. 35, fig. 63.

LOCALITIES. Cook Islands: 1 specimen. Society Islands: 20 specimens from BD 2; 1, BD 15.

DISCUSSION. In a previous work (Banner 1958: 161) we suggested that the variety *S. charon obscurus* Banner might not be valid. In these collections there are intergrading forms which substantiate this contention.

The separation for the variety (Banner, 1956: 331) was based on three points. 1, "The rostrum is parallel-sided in at least the basal half rather than uniformly tapered." In these specimens the variation ranged from forms with short, heavy rostrums with sides parallel to near the tip, through an elongated narrow rostrum with parallel sides, to a slender elongate rostrum with curved and tapering margins. The first condition is as illustrated for *S. c. obscurus* Banner (1956, fig. 5) and *S. charon* (later named *S. helleri*) by de Man (1897, fig. 63); the second by Paulson (1875, pl. 8, fig. 4) for *Alpheus charon*, and the third for *S. charon* de Man (1911, fig. 37) and Banner (1953, fig. 11). 2, "The meri of the third legs are 2.4 instead of 3.0 times as long as broad." Twelve specimens from BD 2 were measured, and it was found that the length of the merus of the third leg varied from 2.3 to 3.0 times its breadth, with most specimens falling in the intermediate range. 3, "The superior unguis of the dactyli of the third legs is not as broad basally and has a uniform taper to the tip rather than a broad basal plate which is abruptly narrowed to a curved tip." For this remaining character one most certainly does not find many examples of the extremes which were taken as characteristic of the two subspecific forms; in the 20 specimens from BD 2 a completely intergrading series of superior unguis was found between the two conditions described. These observations, made upon the Tahitian specimens, were confirmed by specimens in all the collections, especially by an extensive series from the Northern Marshalls, not as yet reported.

*S. helleri* de Man (1911: 246) was based upon specimens from the Nicobar Islands. Ramadon (1936: 19) found that when he tried to separate his Red Sea specimens on the basis of the five characteristics used by de Man, he could determine "no sharp specific distinc-

tions between *S. charon* and *S. helleri*." The variation in the specimens at hand confirms Ramadan's suggestion that *S. helleri* is a synonym.

**Synalpheus heroni** Coutière.

*Synalpheus heroni* Coutière, 1909, U. S. Nat. Mus., Proc. **36**: 42, fig. 24.

LOCALITIES. Society Islands: 1 specimen from BD 2; 5, BD 17; 3, BD 32.

**Synalpheus streptodactylus streptodactylus** Coutière.

For full citation see Banner and Banner (1966a: 157).

LOCALITY. Society Islands: 1 specimen from BD 34.

**Synalpheus anceps** Banner.

*Synalpheus anceps* Banner, 1956, Pacific Sci. **10** (3): 334, fig. 8, a-o.

LOCALITY. Cook Islands: 1 specimen.

Genus **Alpheus** Fabricius  
**Megacheles** Group

**Alpheus crockeri** Armstrong.

For full citation see Banner and Banner (1966a: 159).

LOCALITIES. Cook Islands: 1 specimen. Society Islands: 1 specimen from BD 3; 2, BD 8; 2, BD 12; 1, Moorea, collected by J. Randall.

**Alpheus collumianus medius** Banner.

*Alpheus collumianus medius* Banner, 1956, Pacific Sci. **10** (3): 340, fig. 11.

LOCALITIES. Cook Islands: 19 specimens. Society Islands: 2 specimens from BD 3; 1, BD 8; 1, BD 16; 2, BD 22; 5, BD 30; 3, BD 33.

**Alpheus collumianus inermis** Banner.

*Alpheus collumianus inermis* Banner, 1956, Pacific Sci. **10** (3): 342, fig. 12.

LOCALITIES. Cook Islands: 4 specimens. Society Islands: 2 specimens from BD 2; 4, BD 3; 1, BD 5; 2, BD 6; 1, BD 16; 3, BD 30; 12, BD 33.

DISCUSSION. According to field notes, a pair of cherry-red specimens apparently cohabiting were collected off southern Bora Bora and were bottled together as BD 16. By the criteria established to separate the two subspecies, one appears to be *A. c. medius* and one *A. c. inermis*. Obviously this collection throws considerable doubt on the validity of the subspecies, but more specimens should be examined before the subspecies, distinct anatomically, are discarded.

### Macrochirus Group

***Alpheus amirantei sizou*** Banner and Banner, new subspecies.

*Alpheus amirantei* Coutière, 1908, Soc. Philomath. Paris, Bull. IX, 11 (5): 15.

*Crangon amirantei*: Banner, 1953, Pacific Sci. 7 (1): 87, fig. 29, a-j.

DESCRIPTION. Body small, compact, heavy. Orbital hoods inflated, rounded, anteriorly projecting into a subacute and nearly vertical keel. Rostrum short, about half length of basal antennular article, acute, continued posteriorly as high, narrow but rounded keel, reaching to posterior limits of eyes; keel as high as orbital hoods and separated from them by relatively deep grooves; keel anteriorly curved downward, parallel to curve of orbital hoods so that rostral tip is at level of middle of eyes when viewed laterally; area between front of orbital hoods and rostral base flattened, with anterior margin arcuate. Anterolateral margin of carapace expanded over antennal base, and demarked from orbital hoods by deep groove.

Antennular peduncle with second article twice the length of first and of third, 1.5 times as long as broad; first and third articles subequal. Stylocerite short, lateral spine poorly developed, tip of spine reaching about two-thirds or more of length of first article. Lateral spine of scaphocerite reaching beyond end of antennular peduncle, squamous portion reaching to end of third antennular article. Carapocerite slender, tip reaching almost to end of spine or scaphocerite. Lateral spine of basiscerite reaching approximately to level of tip of spine of stylocerite; spine located ventral to base of scaphocerite and often difficult to see.

Large chela almost three times as long as broad in lateral view, with fingers occupying the distal third. Proximal portion of palm with inferior face flattened, palm otherwise rounded. Distal portion of palm with deep longitudinal groove on lower face, continuing from slightly proximal of palmar adhesive plaque, where it is deepest, to *linea impressa*, and even continuing along that line. Lateral and superior surface, immediately proximal to palmar adhesive plaque, marked by shallow, rounded transverse depression. Both fingers distally marked by region of calcification; dactylus high, narrow, curved. Merus about twice as long as broad, superior and inferior external margins unarmed, inferior internal bearing a single acute subterminal tooth of moderate development.

Small chela with fingers 0.4 length of entire chela, fingers slender, tapering, with scattered setae; palm rounded, without sculpturing. Merus heavy, slightly over twice as long as outer face is broad, without any sharp demar-

cation between outer face and inferior face; inferior internal margin angular but without armature.

Carpal article of second legs with ratio 10:27:7:7:11; second article seven times as long as broad.

Ischium of third legs with strong spine; merus 2.7 times as long as broad, armed with strong tooth distally; carpus slightly over 0.5 as long as merus, terminating at both inferior and superior margins in strong, acute, but not well-demarcated teeth; propodus almost 0.7 as long as merus, bearing six strong spines; dactylus simple, curved, acute, and one-fourth as long as merus.

Telson as described and figured for the Hawaiian specimens of *A. amirantei* (Banner, 1953: 88, fig. 29, *j*).

TYPES. Holotype, an ovigerous female, carapace length 3.5 mm., collected in about 1 foot of water on outer reef platform, north (lee-ward) side of Bora Bora (BD-8) June 10, 1954; paratypes, 13 specimens of both sexes, all fragmentary, carapace lengths up to 4.9 mm., collected on barrier reef 1 mile east of Papeete, Tahiti, June 7, 1954 (BD 6). These and other specimens of the species were lost in the laboratory fire.

DISCUSSION. This subspecies shows the usual amount of variation. In the specimens available, the antennular peduncle, spine of the scaphocerite, and carapocerite vary in length, with all three at times being equal, but the most common condition is that described for the type specimen. On the large chela both the longitudinal groove and transverse groove vary in development, but the most common condition is that described for the type. On some of the smaller specimens the transverse groove is entirely lacking. The distal tooth on the inferior internal margin of the merus of the large cheliped is at times absent. The varying development of the palmar grooves and meral tooth is not correlated one with the other. The development of hairs on the inner face of the chela also varies, with the hairs usually sparse and scattered; never is the cover dense, as in *A. amirantei*.

The small cheliped is sexually dimorphic, with the fingers longer in the males. In large males there is a broadening and flattening of the dactylus, which then bears a partial fringe of setae on either side; this, however, does not approach a full balaeniceps development. Similar to the large cheliped, the merus may or may not bear an inferior internal tooth; its presence or absence is not correlated with sex.

In the carpal articles of the second legs, the second article varies from 1.7 to 2.7 times as long as the first, with most specimens about twice as long; in general the smaller specimens have shorter second

articles. Some slight variations were noted for the third legs, but these were not measured.

This subspecies may be separated from the parent species as described by Coutière by the following differences. 1, The presence of a well-developed spine on the basicerite. 2, The lack of serrations proximal to the meral tooth on the large chela, and in many specimens, the lack of the meral tooth itself on both chelipeds. 3, The shorter second carpal article of the second legs (in these up to 2.7 times the length of the first, instead of more than three times). 4, The broader merus of the third legs, 2.5 to 2.7 times as long as broad instead of four times as long as broad.

This subspecies includes all central Pacific specimens we have previously listed under the name of the parent species.

In the earlier papers in this series, we did not feel the separation of the form was taxonomically justified. With so few specimens available, the limits of the variation could not be ascertained. However, with specimens from Hawaii, the Marshall Islands, Tonga and the Society Islands agreeing well among themselves, and all definitely different from Coutière's specimens from the Indian Ocean, it appears the description of this form as a subspecies is justified. When further collections are made in Indonesia, intergrading specimens may be found.

This subspecies and the parent species are closely related to *A. acutofemoratus* Dana; all have somewhat similar rostral fronts, somewhat similar sculpturing on the large chela, and somewhat similar second and third legs. However, in this subspecies the rostral carina is higher, with steeper sides, the rostral tip is lower and shorter. The large chela is more slender and less hirsute, the small chela does not bear the dactylar tooth and also is less hairy, and there is a slight difference in the third legs in the proportion and size of the meral spines (the differences in the proportions of the carpal articles of the second legs probably are not significant.)

This species is named in honor of Miss Louise Dexter ("Sizou") who arranged for permission for the senior author to collect at a private beach near Papeete, where these specimens were found.

#### ***Alpheus lottini* Guérin.**

For full citation see Banner and Banner (1964:88).

LOCALITIES. Cook Islands: 17 specimens. Society Islands:

4 specimens from BD 2; 9, BD 15; 5, BD 26; 1 specimen from Papatoa Bay, Moorea and 2 specimens from Terou Pass, Moorea, collected by J. Randall.

***Alpheus paragracilis* Coutière.**

For full citation see Banner (1956: 345).

LOCALITIES. Cook Islands: 75 specimens. Society Islands: 4 specimens from BD 6; 24, BD 8; 2, BD 14; 1, BD 17; 1, BD 18; 4, BD 20; 2, BD 30; 17, BD 35.

***Alpheus gracilis* Heller.**

*Alpheus gracilis* Heller, 1861, K. Akad. Wiss. Wien, Sitzungber. **44**: 271, pl. 3, figs. 19-20.

LOCALITY: Cook Islands: 1 specimen.

***Alpheus gracilis simplex* Banner.**

For full citation see Banner (1956: 345).

LOCALITIES. Cook Islands: 3 specimens. Society Islands: 1 specimen from BD 18; 1, BD 30.

***Alpheus rostratipes* Pocock.**

*Alpheus rostratipes* Pocock, 1890, Linn. Soc. London, Zool., Jour. **20**: 522.

*Crangon hawaiiensis clippertoni* Schmitt, 1939, Smithsonian Misc. Coll. **98** (6): 522.

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

*Alpheus clippertoni*: Chace, 1962, U. S. Nat. Mus., Proc. **113** (3466): 609.

*Alpheus rostratipes*: Crosnier and Forest, 1966, Ann. Inst. Ocean. Monaco **44** (7): 246, fig. 12, 13, 14 (with complete synonymy).

LOCALITIES. Cook Islands: 16 specimens. Society Islands: 43 specimens from BD 2; 4, BD 8; 21, BD 9; 2, BD 14; 1, BD 17; 4, BD 18; 2, BD 22; 2, BD 30; 20, BD 32; 2, BD 38.

DISCUSSION. Forest in 1966 reported that in the comparison of Atlantic specimens of *A. rostratipes* Pocock with Pacific species identified as *A. clippertoni* (Schmitt) there were no apparent specific differences. We have compared our specimens with his excellent description and figures and agree with him.

***Alpheus macrochirus* Richters.**

For full citation see Banner (1957: 141).

LOCALITIES. Cook Islands: 5 specimens. Society Islands: 2

specimens from BD 14; 1 specimen from Moorea collected by J. Randall, July 28, 1956. Marquesas Islands: Nukuhiva, 2 specimens, collected by Randall, 1956.

### Obesomanus Group

#### **Alpheus obesomanus** Dana.

For full citation see Banner and Banner (1966a: 174).

LOCALITIES. Cook Islands: 27 specimens. Society Islands: 34 specimens from BD 2: 1, BD 3: 22, BD 4: 8, BD 5: 1, BD 8: 4, BD 9: 45, BD 13: 2, BD 14: 4, BD 19: 2, BD 20: 4, BD 21: 2, BD 26: 3, BD 30: 21, BD 32: 1, BD 37.

DISCUSSION. In BD 5, the field notes show that these specimens came from roofed galleries excavated immediately below the surface of the encrusting coralline algae. The tubes communicated with the surrounding water through a regular series of round ports. Boone (1935: 136) has reported this species from Raiatea I. and Venus Point, Society Islands.

#### **Alpheus nobili** Banner and Banner.

*Alpheus sp.*, Nobili, 1906, Scient. France et Belgique, Bull. **40**: 34.

*Alpheus nobili* Banner and Banner, 1966, Pacific Sci. **20** (2): 172.

LOCALITY. Society Islands: 1 specimen from BD 30.

DISCUSSION. This specimen, a non-ovigerous female, carapace length of 6.4 mm., lacking the large chela, does not agree with any other specimens in the collections. However, it approaches the condition described by Nobili quite closely, especially in the relationship of the length of the spine and scale of the scaphocerite to the antennular peduncle, and in the relative ratios of the carpal articles of the second leg. The second carpal article of the second leg in this specimen is a little shorter in relation to the first than that of Nobili (1.1 times as long as the first, instead of about 1.4 times as long). In this specimen in the third leg the carpus is equal to the propodus instead of "un peu plus long." There are no other distinguishing criteria: no figure was given by Nobili.

Thus, this specimen appears to be the same species as that described by Nobili, in spite of the great distance separating the two localities where it has been collected. However, because at this Tahitian locality only one specimen of this species was collected together with 3 specimens of *A. obesomanus* Dana and 5 specimens of *A. mal-*

*leodigitus* (Bate), this species may be suspected to be either a hybrid of the other species, or possibly an atavistic form of *A. malleodigitus* showing more the ancestral form of the scaphocerite. The problem of the validity of *A. nobili* cannot be solved until more related specimens are collected and examined.

***Alpheus malleodigitus* (Spence-Bate).**

For full citation see Banner and Banner (1966a: 174).

LOCALITIES. Cook Islands: 110 specimens. Society Islands: 1 specimen from BD 3; 6, BD 4; 1, BD 6; 6, BD 8; 5, BD 13; 4, BD 14; 2, BD 18; 5, BD 20; 17, BD 28; 2, BD 29; 5, BD 30; 22, BD 33; 1, BD 34.

***Alpheus perplexus* Banner.**

*Alpheus perplexus* Banner, 1956, Pacific Sci. **10** (3): 347, fig. 13.

LOCALITY. Society Islands: 1 male from BD 30, carapace length 8.4 mm.

DISCUSSION. This male, considerably larger than either the holotype or allotype, agrees almost perfectly with them in many characteristics, such as the relative lengths and proportions of the antennules and antennae, the third maxillipeds, the large chela, the second and third legs, the uropods and telson. However, the fingers of the small chela are relatively longer than those of the allotype, a female; this difference can be either from sexual dimorphism or from maturity. The most remarkable difference lies in the frontal portion of the carapace. Here there is no trace of rostrum and the frontal margin bends posteriorly, similar to the condition found in the genus *Betaeus*. The orbital hoods, posteriorly normal, are abruptly truncate anteriorly, leaving the anterior portion of the eyes exposed. The interocular carina is similar to the rostral carina of the type except it is somewhat stronger and sharper.

It is difficult to account for this except as a congenital defect, for were it the result of accident the symmetry would not be so perfect. It definitely is not caused by rough handling as has been the case for specimens of *A. rostratipes* Pocock for in this specimen the carapace is firmly attached to the cephalothorax. However, there remains the slight possibility that this is a more mature stage common for the species, for the rostral fronts of the type and paratype are somewhat similar except that the eyes are completely enclosed.

**Alpheus idiocheles** Coutière.

*Alpheus idiocheles* Coutière, 1905, Fauna and Geog. Mald. and Laccad. 2 (4) : 883, pl. 75, fig. 21.—Pearson, 1905, Herdman Rept. Pearl Oyster Fish. 4 (24) : 84.

*Alpheus baculifer* Coutière, 1908, Soc. Philomath. Paris, Bull. 11 (5) : 16; 1921, Linn. Soc. London, Trans. 17 (10) : 422, pl. 63, fig. 22.

*Thunor idiocheles*: Banner, 1956, Pacific Sci. 10 (3) : 367, fig. 22.

LOCALITIES. Society Islands: 4 specimens from BD 2; 6, BD 9; 4, BD 32.

DISCUSSION. *Alpheus idiocheles* was described by Coutière from a single male specimen and placed in his *Macrochirus* group; it has been reported since only by Pearson, on the basis of 3 specimens, and by Banner with 6 specimens. *Alpheus baculifer* Coutière was described from a single female specimen and placed in the *Obesomanus* group; it has not been reported since the original description.

In our 14 specimens, the males are similar to *A. idiocheles* with heavy grooved chela and the females similar to *A. baculifer* with the extremely elongate and slender chela. In spite of this and other dissimilarities listed below, there is strong evidence that 10 or possibly 12 of these specimens represent cohabiting pairs, for the 4 each in BD 2 and BD 32, and at least 2 of those in BD 9 are matched perfectly in size and sex as pairs. In many characteristics, such as the frontal region of the carapace, walking legs, telson, and other characters, they are similar; finally, they are utterly unlike any other specimens collected at the same stations. The extra 2 or 4 specimens at BD 9 are paired sexually but not matched in size. For these reasons we believe the two nominal species are actually dimorphic forms of a single species, *A. idiocheles*.

To illustrate what we interpret as sexual dimorphism, a pair from BD 2 was selected for close study. The carapace length of the male was 5.2 mm., of the female, 5.4 mm. In their gross form there was considerable difference, with the cephalothorax of the female greatly inflated, and the carapace rounded and swelling strongly from the cephalic region; in the male the contours were straight and normal for the genus. The abdomen of the female was also large, swollen and soft, definitely larger than the inflated cephalothorax, while the abdomen of the male was greatly reduced, smaller than the cephalothorax, as shown by Coutière (1905: 21).

The dimorphism of the antennules and antennae was marked, with those of the female smaller and more poorly developed. It should also be noted that there was no trace of the secondary bifurcation in the short outer antennular flagellum in the males, but there was a single article of the extra branch in the female. The large and small chelae of the male were much heavier and somewhat longer than those of the female, and though the large chela of the female carried only a trace of the longitudinal groove, the distal end of the male chela was marked with several definite but shallow grooves. The second legs, as with other members of this group, were asymmetrically developed in both sexes, with one leg running about 20 percent longer than the other; however, here, too, there was a difference in size, with the shorter leg of the male as long as the longer leg of the female; there were no apparent differences in the proportions of the articles. The third to fifth legs were the same in both sexes, with the propodus twisted more than 45°, similar to that of *A. malleodigitus* (Bate).

On the abdomen the pleura were large and soft in the female, but much smaller and more compact in the male. The second pleopod of the male had the middle lobe of the endopod much longer than usual for the genus, similar to that found in *A. microscaphis* (Banner); the endopod of the pleopod also lacked the extra process characteristic of the males of other species of alpheidids; the very large pleopods of the females were of unusual form, with the base triangular in section, each of the three margins carrying many long setae; the exopod and endopod also carried similar setae.

The telson and uropods of the male were smaller than those of the female. The telson in both sexes carried two rounded longitudinal ridges; however, the telson of the male was almost flat from anterior to posterior, whereas in the female the posterior lateral margins were turned dorsally, so the final terminal setae and spines point dorsally. In both sexes the setae and spines of the telson were poorly developed; both pair of dorsal spinules were always present, but usually they were stronger in the male. Neither the male nor the female had any trace of anal tubercles. No specimen carried the two short uropodal spines specified by Coutière (1905: 884); the single spine of the males was quite heavy and light brown to black, while that of the female was light brown to colorless. The transverse articulation of the outer uropod appeared to be variable, being definite and marked in some specimens and impossible to discern in others. Both uropods of each of the specimens were examined with the tip of each uropod being flexed

with a dissecting needle. In those where the line of articulation was visible, the uropod would bend along the line; in those where no line of articulation could be seen, the uropod might flex sharply in the normal fashion, but in others the uropod would bow diagonally from the base of the outer spine to high on the inner margin. This appears to indicate that the articulation is functional in some but either absent or non-functional in other specimens.

There are slight differences between these specimens and the original description of *A. idiocheles*. The rostrum was consistently shorter than in the type, where it reached about 0.7 the length of the first antennular article, but this was found to be variable in the Saipan specimens. The third antennular article was longer and the rudimentary scale of the scaphocerite reached a more abrupt truncation in these than it did in the type. In the type specimen the telson was obviously defective, being very asymmetrically developed; in the type also, the small chela was lacking. Otherwise there is excellent agreement between the males and the description of *A. idiocheles* and between the females and the description of *A. baculifer*.

The general form of this species shows close relationship to *A. microscaphis* (Banner) and *A. samoa* Banner and Banner, but from both it can be distinguished by the longer scaphocerite. From *A. microscaphis* it can be further distinguished by the ridges on the distal end of the palm of the large chela and a sexually dimorphic large chela. In the type for *A. samoa* the larger chela is missing but the third leg carries a tooth on the distal end of the inferior margin; in *A. idiocheles* the third leg is inermous. The absences of anal tubercles and the variability of the articulation of the outer uropod in this species (previously reported in the Saipan specimens) confirms the placement of *Thunor* in synonymy (Banner and Banner, 1966a: 175).

In life these specimens were a deep rose color and were found living in galleries under a layer of coralline algae.

#### **Alpheus microscaphis** (Banner).

*Thunor microscaphis* Banner, 1959, Pacific Sci. 13 (2): 151.

*Alpheus microscaphis* Banner and Banner, 1964, Pacific Sci. 18 (1): 95, fig. 5.

LOCALITY. Society Islands: 4 specimens from BD 32, an ovigerous female, carapace length of 5.2 mm., and 3 males of carapace lengths 7.2, 4.9, and 3.1 mm.

DISCUSSION. As three of these specimens were considerably larger than the type specimen, they were carefully examined to note variations. None of the specimens had the longer scaphocerites found in the male from Saipan and the female from Canton. In other appendages the variation was minor; for example, the second carpal article of the second legs varied from 0.9 to 1.1 times the length of the first; the propodi of the third legs were armed variously with three to four spines; the "shoulder" of the outer uropod did not bear weak spines, but instead carried one to several setae.

The telson in none of these specimens was exactly like that of the female from Canton, but those of the largest male and of the female approached it closely. In these the groove of the posterior end was not as deep, and the lateral ridges of the telson did not overhang the groove; the margins anterior to the posterolateral spines bore only a few hairs in the female and none at all in the male. However, the telson of the smallest specimen was almost identical with the Saipan specimen, with only the ridges obvious. These differences may have been due to maturity, or to individual variation.

The largest male was also compared carefully to the female, and no apparent sexual dimorphism was noted in the appendages of the cephalothorax. In the abdomen, in addition to the telson just discussed, the whole form was longer, broader and softer in the female, similar to that described above for *A. idiocheles* Coutière.

In the second pleopods of the male, the additional process was unusually long. (It is apparently lacking in the related *A. idiocheles*.) All the pleopods of the female were very broad and covered with dense setae; in addition, the second pleopod of the ovigerous female carried the accessory process characteristic of the males. This is an anomalous condition, and no other female specimens of this or any other species have been observed to have the additional process.

#### Crinitus Group

##### **Alpheus brevipes** Stimpson.

*Alpheus brevipes* Stimpson, 1860, Acad. Nat. Sci. Philadelphia, Proc. 12: 30.—Banner and Banner, 1966, Pacific Sci. 22 (2): 177.

*Crangon brevipes*: Banner, 1953, Pacific Sci. 7 (1): 103, figs. 35-37 (Neotype established).

LOCALITIES. Cook Islands: 21 specimens. Society Islands: 1 specimen from BD 2: 1, BD 33.

***Alpheus bradypus* Coutière.**

*Alpheus bradypus* Coutière, 1905, Fauna and Geog. Mald. and Laccad. 2 (4): 891, pl. 78, 79, fig. 30.

LOCALITIES. Cook Islands. 4 specimens. Society Islands: 1 specimen from BD 8.

***Alpheus pachychirus* Stimpson.**

*Alpheus pachychirus* Stimpson, 1860, Acad. Nat. Sci. Philadelphia, Proc. 12: 30.

LOCALITIES. Cook Islands. 29 specimens. Society Islands: 2 specimens from BD 7; 7, BD 13; 3, BD 14; 3, BD 15; 20, BD 26; 6, Moorea, Papatoea Bay, Oct. 5, 1956, collected by Randall.

***Alpheus paralcione* Coutière.**

For full citation see Banner and Banner (1966a: 178).

LOCALITY. Cook Islands: 4 specimens.

***Alpheus ovaliceps* Coutière.**

*Alpheus ovaliceps* Coutière, 1905, Fauna and Geog. Mald. and Laccad. 2 (4): 888, pl. 77, fig. 27.—Banner, 1956, Pacific Sci. 10 (3): 357, fig. 18.

LOCALITIES. Cook Islands: 28 specimens. Society Islands: 19 specimens from BD 3, 2, BD 8.

DISCUSSION. These specimens, and those previously reported from Canton, Tonga, and Samoa, show little variation and are similar to the specimens reported from Saipan. Like the specimens from Saipan these do not show any marked taper to the palm of the large chela, and the external spine of the uropods is not black. Also they consistently have the two unusual bristles on the penultimate article of the maxilliped, as described by Coutière.

Like other members of the group, these specimens show wide variation in the relative proportions of the cephalic and thoracic appendages. As the form of the chela, however, is not quite constant and apparently different from the type described by Coutière from the Indian Ocean, possibly this form should be given a subspecific designation to differentiate it. With so much variation known in this group, without any specimens reported from the Marianas to the Maldives and without any knowledge of the variation in the type locality, we have decided to defer applying a new name.

### Diadema Group

#### **Alpheus diadema** Dana.

For full citation see Banner (1956: 357).

LOCALITIES. Cook Islands: 86 specimens. Society Islands: 2 specimens from BD 3; 1, BD 8; 1, BD 13; 2, BD 21; 1, BD 26; 3, BD 28; 3, BD 37.

DISCUSSION. In a group of 24 specimens from the first Cook Islands station (on the reef at Arutunga Village), one specimen, normal in other structure, has an unusual development of the anterior carapace. The carapace bears a low rounded medial ridge arising behind the eyes and extending anteriorly in a symmetrical arc to about the region of the middle of the eyes; between the orbital hoods, the carapace is flat without a trace of rostral base or orbitorostral grooves. The anterior margin of the carapace projects into a weak acute rostrum, not much shorter than the normal rostrum but as flat as the interorbital region behind. This specimen is interpreted to represent merely an aberrant development of no systematic importance.

#### **Alpheus gracilipes** Stimpson.

*Alpheus gracilipes* Stimpson, 1860, Acad. Nat. Sci. Philadelphia, Proc. 12: 31.

*Crangon gracilipes*: Banner, 1953, Pacific Sci. 7 (1): 115, fig. 41.

DESCRIPTION. Rostral base broad, slightly convex in section, without trace of carina; sides straight to tip; margins overhanging deep orbitorostral grooves; tip slender, acute, slightly depressed in lateral view, arising ventrally from a strong vertical keel. Orbital hoods in general hemispherical, but anteriorly bearing a rounded subvertical keel that slopes medially toward base; anterior margin of carapace between this keel and base of rostrum irregularly concave.

Second antennular article twice as long as broad, 1.5 times as long as first article and slightly less than twice as long as third article. Stylocerite acute, reaching slightly beyond end of first antennular article. Basicerite with small but acute lateral spine; scaphocerite with strong lateral spine, flattened portion slightly shorter than antennular peduncle, carapocerite reaching to near middle of third antennular article.

Merus of large cheliped ending in a strong tooth distally on superior ridge; inferior internal ridge bearing five movable spinules and terminating distally in a strong tooth; inferior external margin unarmed. Merus with outer face 2.7 times as long as broad; article about as long as chela proper is high. Chela proper elongate, slender, subcylindrical and tapering, 3.8 times as long as high, with fingers occupying distal third. Surface behind articulation with deep rounded groove. Fingers heavy, crossing.

Small cheliped of male slightly longer than that of large cheliped with outer face five times as long as broad, with superior distal tooth poorly devel-

oped and inferior internal margin unarmed except for a moderately strong tooth distally. Carpus elongate, slightly longer than broad. Chela slightly subcylindrical, less than five times as long as broad, without groove; fingers occupying the distal 0.46 of chela, dactylus four times as long as broad, tapering uniformly to acute tip, and without a fringe of setae.

Secondary articles of carpus of second legs with the ratio of 10:7:5:4:6.

Ischium of third legs slightly over one-third length of merus, with strong movable spine; merus seven times as long as broad, unarmed; carpus one-half length of merus, unarmed except for a slight rounded projection terminating superior margin; propodus almost as long as merus, 11 times as long as broad and bearing five strong spines and four weaker spines along inferior margin, and two spines distally; dactylus slender, one-fourth as long as propodus, slightly curved, simple with acute tip; entire appendage bearing only slight scattered setae.

Telson 3.0 times as long as posterior margin is broad, 1.6 times as broad anteriorly as posteriorly, bearing strong dorsal spine with larger posterolateral spines 0.4 as long as posterior margin is broad. Uropods of usual form.

LOCALITIES. Cook Islands: 17 specimens. Society Islands: 6 specimens from BD 3; 3, BD 7; 6, BD 13; 5, BD 14; 1, BD 19; 1, BD 21; 2, BD 22; 4, BD 25; 9, BD 26; 4, BD 28; 10, BD 29; 2, BD 30; 7, BD 36; 1 from Moorea, Papatoea Bay, collected by Randall.

DISCUSSION. Stimpson's type specimen of this species appears to be lost, as are the types of the other species he described. The re-description above was to establish a neotype; it is presented to aid future workers until a neotype can be described. Stimpson's type location was given only as Tahiti, but presumably his collection came either from Papeete or Matavai Bay, the usual ports of those days; the specimen described above came from BD 3, in Arue, lying between Papeete and Matavai Bay.

The specimen described is a male 16 mm. long and agrees very well with Stimpson's description, even to the approximate length. Only one difference is noted; Stimpson specified that the large chela was three times as long as broad, and in this specimen it is 3.8 times as long as broad. However, a 15.7 mm. female from the same locality has the chela 3.0 times as long as broad.

A detailed study of the variation found within this species was not made, but some variation is conspicuous and noteworthy. In the small chela of the male there are two forms, that with the "balaeniceps" type of hair and a broadened dactylus, and that with the normal slender dactylus like the female. The latter condition as described above came from a male which had a carapace length of 5.8 mm. The former condition is found in the two other males collected at the same time

which had carapace lengths of about 5.5 mm. This broadening of the dactylus is never found in smaller males.

Variation was also noted in the length of the rostrum which in some cases slightly exceeds the length of the first antennular article; in the shape of the rostrum which in some (especially some large specimens from Western Samoa) proceeds to the anterior edge of the carapace at the normal angle, and then abruptly changes the taper to a slightly less acute angle; in the relative proportions of the antennular and antennal article with the carapocerite in some approaching the end of the third antennular article; slightly in the proportions of the large and small chela (but never markedly different from the specimen described); in the armature of the merus of the large cheliped, which may have the distal teeth more or less strongly developed, and the spines on the inferior internal margin reduced to one or two; in the merus of the small cheliped which may have similar variation in the teeth and may, in some larger specimens, carry feebly developed spines, somewhat similar to those of the large chela; in the proportions but not the armature of the third legs. A series of telsons was not measured.

One specimen from BD 4 is markedly smaller than any others, being only 7.5 mm. long. It falls well within the range of variation noted except that the rostral base between the eyes is high and rounded, only showing a trace of broadening and flattening in its posterior portion; also the anterior keels of the orbital hoods are poorly developed. These differences are reminiscent of the growth changes in *A. lottini* Guérin (Banner 1958: 164 as *A. ventrosus* Milne Edwards).

The group of specimens from the Society Islands and the Cook Islands run about the same size, the specimen described being maximal. However, among the specimens from Samoa, a female reaches a length of 24 mm, and a male from Kapingamarangi 26 mm. These fall within the variation described.

Color in life was not noted, but on some preserved specimens the large chela has a pink mottled color and tips of the fingers are pale violet.

***Alpheus paracrinitus* Miers.**

*Alpheus paracrinitus* Miers, 1881, Ann. Mag. Nat. Hist. V, 8: 365, pl. 16, fig. 6.—Chace, 1962, U. S. Nat. Mus., Proc. 113 (3466): 609.

*Alpheus paracrinitus bengalensis* Coutière, 1905, Fauna and Geog. Mald. and Laccad. 2 (4) : 901, pl. 82, fig. 37.

*Alpheus bengalensis*: Holthuis, 1958, Sea Fish. Res. Sta., Bull. 17 : 25.

*Crangon paracrinitus bengalensis*: Banner, 1953, Pacific Sci. 7 (1) : 110, fig. 40.

LOCALITIES. Cook Islands: 72 specimens. Society Islands: 4 specimens from BD 4; 11, BD 11; 2, BD 13; 36, BD 21; 50, BD 25; 7, BD 28; 15, BD 30; 1, BD 34; 24, BD 36; 5, BD 37.

DISCUSSION. Miers' original specimens came from Senegambia on the west coast of Africa; Coutière's variety came from the Maldive and Laccadive Archipelagoes in the Indian Ocean. Coutière specified that the variety was differentiated from the parent species by four characteristics: 1. In the original species a strong tooth was found above the articulation of the dactylus of the small chela which was lacking in the variety. 2. The original species carried teeth terminating the inferior internal margins of the meri of both the large and small chelipeds but Coutière stated that in his variety the meral spines were lacking on the small cheliped and very small on the large cheliped. 3. Miers' specimens had the second article of the carpus of the second leg 1.75 to 1.85 times the length of the first, instead of being equal as in Coutière's. 4. Finally, the propodus of the third legs was 1.38 times the length of the carpus in Miers' description instead of 1.17 as in Coutière's.

In Hawaii (Banner 1953: 110) the specimens examined appear to be of the variety *bengalensis* in spite of variation noted in the armature of the margin of the meri of the large and small chelipeds. However, by combining a series of specimens from all of our central Pacific collections, we have an adequate sample of intact specimens in which the supposed points of difference can be investigated.

*Armature of the chelipeds*: Here 12 different combinations of characters theoretically may be found, if one considers the meral spine of the large cheliped as either strong or reduced, the corresponding spine of the small cheliped as distinct, reduced, or absent, and the spine above the dactylar articulation as present or absent. In a group of 30 intact specimens we found the spread of characteristics as shown in Table 1.

*Relative lengths of first and second carpal articles*: To determine the limits of variation in the carpal articles, 42 specimens were first assigned to either the nominal species or the variety by other charac-

Table 1

Tooth on merus of large cheliped	reduced			strong		
	none	reduced	distinct	none	reduced	distinct
Tooth on merus of small chela						
Number of specimens with spine above dactylus of small chela			3			11
Number of specimens without spine above dactylus of small chela	4	4	3	1	2	2

teristics, with primary emphasis on the presence or absence of the spine above the dactylar articulation of the small chela. In these the first two carpal articles were measured and their ratio obtained by assigning the length of 10 to the first article. The results are in Table 2.

Table 2

Relative length of second article	8	9	10	11	12	13	14	15	16	17	18
Number of specimens of " <i>paracrinitus</i> "	1			2	3	1	2	5	2	2	1
Number of specimens of " <i>bengalensis</i> "			1	7	3	1	1	3	2	2	3

*Carpal-propodal ratio of third leg:* In a group of 11 specimens from a single collection from Aitutake the ratio of the lengths of the carpus: propodus was found to vary from 10:9 to 10:16.

To confirm that these variations were inherent in a single population and did not represent a multitude of geographically separate races, our largest, most intact single collection, that of 12 specimens from Arutunga Village, Aitutake, was studied in detail. The results were:

Tooth above dactylar articulation, small cheliped: 7 present, 2 absent.

Meral tooth, small cheliped: 9 large, 1 reduced.

Ratio of carpal articles, second legs: 10:10 to 10:18.

This is a wide range of variation to be expected in a single species, but as the differences are only roughly correlated with each other, as they are correlated with neither geography nor sex, this species must be regarded as highly variable.

Holthuis (1958: 25) came to the tentative conclusion that the Indo-Pacific form was separate from the West African type and proposed that Coutière's name *benygalensis* be raised to specific rank. However, Chace (1962: 609) was able to compare some West African specimens with his from Clipperton Island and found no apparent differences except in the relative length of the antennal scale. As this characteristic had previously been reported as variable (Banner, 1953: 110), he concluded that there was but one, circumtropical species. Our present study on the variation destroys all of Coutière's criteria for the separation of the species, and establishes that there is only a single undivided species in the central Pacific and probably in the whole breadth of the Indo-Pacific. Our study thus supports Chace's conclusions.

#### **Brevirostris Group**

##### ***Alpheus platyunguiculatus* (Banner).**

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

*Alpheus platyunguiculatus* (Banner), 1959, Pacific Sci. **13** (2): 146.

LOCALITIES. Society Islands: 1, 16 mm, non-ovigerous female from BD 17; 1, 12 mm, male (newly moulted) from BD 33; 1, 10 mm, female from BD 30; 1, 6.5 mm, specimen from BD 4.

DISCUSSION. These four specimens, all apparently related, are single individuals from widely scattered areas; all are more or less broken and fragmentary, and all appear to be immature. They resemble *A. platyunguiculatus* in general form; in most characteristics they fall within the variation noted for the Hawaiian specimens (Banner, 1959: 146). However, all four differ from the Hawaiian specimens in three ways: 1. The second antennular article is shorter and broader, twice instead of three or more times as long as broad; 2, the tuft of setae on the inner side of the penultimate article of the maxilliped is not well developed, but neither does it approach the condition observed in the Hawaiian *A. rapax* (Fabricius) (Banner 1953: 126); 3, the dactylus of the third legs, while broadened and flattened on the inferior surface, is not as broad as that in the Hawaiian specimens. In addition, the 12 mm, male specimen has the second article of the carpus of the second legs 1.5 times the length of the first, instead of 2.0 times, and the small chela shows no traces of the characteristic fringe of setae on the dactylus. The 6.5 mm, specimen, obviously

immature, lacks the spines on the meri of the chelae and the telson is markedly more slender.

Some of these differences may be due to growth as in the 6.5 mm. specimen; some may be due to the variation inherent in the species, as the shorter carpal article; but some differences may actually be specific or subspecific differences, such as the lack of the tuft of setae on the maxillipeds and the heavier middle antennular article. However, with so few specimens, and with those few small and broken, it does not appear to be worthwhile to attempt to erect a new species or subspecies at this time.

***Alpheus cythereus*** Banner and Banner.

*Alpheus cythereus* Banner and Banner, 1966, Siam Soc. Mon. Ser. III: 125, fig. 45.

In our original work from Tahiti we had described and depicted a new species of this group. After the fire at the Hawaii Marine Laboratory all that remained was the draft of the description. We were surprised to find our Tahitian description almost perfectly matched a specimen from Phuket Island on the Indian Ocean coast of Thailand. The specimen had many characteristics in common, including a transverse groove on the palm and a unique curved tip of the fingers of the large chela. The Tahitian specimens differ from the Thai specimens in the following ways: 1. The third antennular article is a little longer in relation to the second. 2. The lateral spine of the scaphocerite and the carocerite are equal to the antennular peduncle instead of a little longer. 3. The lateral faces of the large chela in the Thai specimens are smooth instead of bearing slight longitudinal depressions, however, these depressions may be artifacts. 4. The second carpal article of the second leg is 2.0 times as long as the first instead of 1.5 as in the Thai specimens. 5. The small chela was missing in the Tahitian specimens. 6. The telson is a little longer in relation to its breadth in the Tahitian specimens. Since these characters are known to be variable in other species we have decided they are of little taxonomic significance in this case.

We therefore decided to establish the Phuket specimens as the type for the species, but to retain the name *Alpheus cythereus* which we had planned to apply in this study. *Cythereus* refers to Bougainville's name for Tahiti, *Nouvelle cythere*; the senior author feels that Bougainville's classic allusion is more appropriate for Tahiti than it is for this species.

**Edwardsii Group**

***Alpheus crassimanus* Heller.**

For full citation see Banner and Banner (1966a: 181).

LOCALITIES. Society Islands: 1 specimen from BD 1; 37, BD 12; 77, BD 23; 8, BD 24; 2, BD 25; 1, BD 33; 8, BD 35.

DISCUSSION. We still entertain doubts that these small specimens, so common and widespread in the central Pacific, are the same species Heller described from the Red Sea. The only constant differences are in the total body size and in the sculpturing of the small chela of the male. It appears that the sculpturing is a growth difference, with the small specimens showing no sculpturing on the small chela whereas specimens 27 mm. long and longer have marked sculpturing, similar to that of the 40 mm. male described by Heller. It is most strange if this be true that in the hundreds of specimens available in the collections from Tahiti, Hawaii, and other central Pacific Islands only those from Yap (Banner 1959: 148) attain sufficient size to show the characteristically sculptured chela. However, since there are no other criteria that can be used to separate these forms, we have decided to leave these specimens under the name of *Alpheus crassimanus*.

One other difference among our specimens is noted. In one collection of 37 specimens (BD 12), 30 have a well-developed spine on the distal end of the inferior margin of the merus of the third leg, a condition not previously reported. In another group of 77 specimens from Tahiti (collection data not noted), 55 have a meral spine. In other characteristics the specimens appear normal, so this variation does not appear to be of taxonomic importance.

***Alpheus dolerus* Banner.**

*Alpheus dolerus* Banner, 1956, Pacific Sci. **10** (3): 363, fig. 21.

LOCALITIES. Cook Islands: 2 specimens. Society Islands: 12 specimens from BD 4; 1, BD 14; 4, BD 18; 2, BD 20; 1, BD 33.

***Alpheus pacificus* Dana.**

*Alpheus pacificus* Dana, 1852, Acad. Nat. Sci. Philadelphia, Proc.

**6**: 21; 1852; U. S. Explor. Exped. **13** (1): 544, pl. 34, fig. 5.

*Crangon pacifica*: Banner, 1953, Pacific Sci. **7** (1): 138, fig. 50 (Neotype established).

LOCALITIES. Cook Islands: 43 specimens. Society Islands: 2 specimens from BD 8; 17 from Moorea collected by J. Randall.

**Alpheus strenuus** Dana.

For full citation and redescription see Banner and Banner (1966a: 181).

LOCALITIES. Cook Islands: 12 specimens. Society Islands: 2 specimens from BD 12; 20 from Moorea, collected by J. Randall.

**Alpheus parvirostris** Dana.

For full citation see Banner and Banner (1966a: 185).

LOCALITIES. Cook Islands: 315 specimens. Society Islands: 4 specimens from BD 4; 2, BD 6; 1, BD 7; 4, BD 8; 6, BD 11; 41, BD 13; 37, BD 14; 3, BD 17; 9, BD 19; 13, BD 20; 23, BD 21; 25, BD 22; 39, BD 25; 21, BD 26; 24, BD 28; 16, BD 29; 18, BD 33; 14, BD 34; 4, BD 36; 5, BD 37.

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