

# AUSTRALIAN MUSEUM SCIENTIFIC PUBLICATIONS

Banner, Dora M., and Albert H. Banner, 1973. The alpheid shrimp of Australia. Part I. The lower genera. *Records of the Australian Museum* 28(15): 291–382. [5 July 1973].

doi:10.3853/j.0067-1975.28.1973.407

ISSN 0067-1975

Published by the Australian Museum, Sydney

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# THE ALPHEID SHRIMP OF AUSTRALIA

## Part I: The Lower Genera

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Figures 1-19.

Manuscript received 7th September, 1971.

*This study is dedicated to the memory of our son, Alan Conrad Banner, who, while serving in the United States Peace Corps, was killed in a shark attack at Aliépata, Western Samoa, on 15th April, 1972. At the age of 25, Alan was training to become a marine biologist as he wished to contribute to the development of the potential tropical marine fisheries to aid the island peoples of the Pacific.*

### SUMMARY

This is the first section of a three-part monograph on the alpheid shrimp of Australia. The study is based upon a collection of 5,000 to 6,000 specimens, in part on loan from various institutions and individuals and in part collected by the authors. For each species recognitional characteristics are described and depicted, notes are given on taxonomy, variation, and biology, and the Australian and world distribution is listed. The present paper deals with lower genera; the future two papers will deal with *Synalpheus* and *Alpheus* respectively.

This paper discusses the following genera and species, those species marked with an asterisk being either new species or new records for the Australian continent:

\**Automate dolichognatha* De Man

\**Athanas areteformis* Coutière

*Athanas djiboutensis* Coutière

Rec. Aust. Mus., **28**, page 291.

45712-A

- \**Athanas japonicus* Kubo
- \**Athanas locincertus* sp. nov.
- \**Athanas dimorphus* Ortmann
  - Athanas haswelli* Coutière
  - Athanas granti* Coutière
- \**Athanas ornithorhynchus* sp. nov.
- \**Athanas sibogae* De Man
- \**Athanas dorsalis* (Stimpson)
  - Athanas indicus* Coutière
- \**Aretopsis amabilis* De Man
- \**Salmoneus tricristatus* Banner
  - Alpheopsis trispinosus* (Stimpson) [neotype established]
- \**Alpheopsis undicola* sp. nov.
- \**Alpheopsis equalis* Coutière
- \**Alpheopsis yaldwyni* sp. nov.
  - Betaeus australis* Stimpson [neotype established]
- \**Racilius compressus* Paulson

In addition to these records of new species and neotypes, we have placed the following species in synonymy:

- Automate gardineri* Coutiere (= *A. dolichognatha* de Man)
- Athanas setoensis* Kubo (= *A. dimorphus* Ortmann)
- Athanas dimorphus seedang* (= *A. dimorphus* Ortmann)
- Aretopsis aegyptica* Ramadan (= *A. amabilis* de Man)

We have accepted *A. sibogae* as the proper name for *A. parvus*, based on page priority (see Banner and Banner, 1960 and Miya and Miyake, 1968).

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## INTRODUCTION

The snapping or pistol shrimp were previously put into a single family, the Alpheidae (Crangonidae of some authors from 1904 to 1955). This family was united with the Hippolytidae and a newly created family, the monogeneric Ogyridae, into the superfamily Alpheoidea by Holthuis in 1955; the superfamily belongs to the section Caridae and the supersection Natantia of the order Decapoda. The hippolytids have not been closely associated with the alpheids; however, the genus *Ogyrides* Stebbing (*Ogyris* Stimpson) was considered to be within the family Alpheidae until its separation by Holthuis. For that reason we will append notes on *Ogyrides mjoebergi* (Balss) from Australia at the end of the monograph.

This study, which will cover all species previously reported from Australian waters as well as our new records and new species, will be issued in three parts; this initial portion is confined to the lower genera, but contains the locality records for the entire paper as well as the key to the genera. We plan the second section to contain nothing but the species of the genus *Synalpheus*, and the third will be devoted to Australian species of the genus *Alpheus*. In the third section we will also have the bibliography for the entire study and a discussion of Australian distribution of all the species with respect to Australian faunal provinces.

Our primary purpose for studying the Australian alpheids is as a part of a continuing study of coral reef biota in the tropical Indo-Pacific in which we will use these abundant shrimp as index organisms to indicate broad zoogeographic realms and provinces. Our second purpose is to provide future workers in Australia with a monographic guide to these shrimp in their waters. For the first aim, a simple species list with localities and descriptions of new species would have been adequate; however, for later workers we have provided keys, descriptions, illustrations, and references to all important descriptive works on the species as well as all previously published Australian records. We have given reported world distribution for each species and have added such biological notes as available.

### Adequacy of Sampling

Previous to this work 30 species from the family had been recorded from Australia in the literature; this work will increase the number to about 100 (this total is approximate, as the final work on *Synalpheus* and *Alpheus* is yet to be done). Our study collection was primarily on loan from each of the Australian museums. We also received specimens from many of the universities and from individuals (see *Acknowledgements* below). These collections we were able to supplement by personal collections made in Australia during three months in 1967-68. The total collections available amounted to between 5,000 and 6,000 individual specimens.

Our collections have come from every State in Australia, as well as Lord Howe Island and Norfolk Island. We have not included any records from New Zealand or New Guinea, although some of the museum collections include specimens from those localities.

As large as is this total, we have no hope that we have seen every species occurring off the coasts of the sub-continent, or that we have been able to delimit the extent of distribution for any species. The degree that these collections will represent the alpheid fauna will vary with region, for as any Australian worker knows the fauna of the Great Barrier Reef is more thoroughly sampled than that on reefs of the Northern Territory and the northern part of Western Australia. We also had but few samples from the Great Australian Bight, but whether that was solely because of the infrequency of collecting there, or whether the infrequency of collection was combined with an expected paucity of shrimp, we do not know.

In all, we hope that we have almost all of those species that occur normally in the usually examined habitats. We would hazard, from the basis of our previous studies, that we are reporting on perhaps ninety per cent of the species that eventually will be known from Australia. However, there are still many habitats, such as deeper muddy bottoms, that may yield many unrecorded species. We hope that with the tool that this monograph may be, future workers will be able to make the listing more exhaustive.

### General Notes on Alpheid Shrimp

The definition of the family is given on p. 298; here it will suffice to state that, while the lower genera of the family may be difficult to recognize except by careful examination under the microscope, the two higher genera *Synalpheus* and *Alpheus* almost always can be recognized by the excessive size and asymmetrical development of their large chelae. In these two genera, the dactylus (free finger) of this chela carries a rounded plunger that can be thrust into a socket at the base of the fixed finger; the violent closure of the chela produces a loud snapping, clearly audible under water and even when the hearer is out of water and walking across a tide flat. The mechanism of this sound production has been somewhat controversial (see Knowlton and Moulton, 1963) but Bowers, 1970, believes the primary production of sound is the actual meeting of the tips of the fingers, while the adhesive plaques on the opposing surfaces of the superior surface of the dactylus and end of propodus are a suction device to increase muscular tension, and the plunger-socket is for the propulsion of a forceful jet of water. Both of the higher genera, and, to a lesser degree, the lower genera, have short stalked compound eyes covered by a forward extension of their carapace; this characteristic, however, is of little use in the field, for in life the extension is transparent and the eyes are fully visible. The species are usually small in size, seldom exceeding 20 to 30 mm in length; many are only 5 mm long when mature.

Sexual dimorphism or even polymorphism is found in the family. Almost all of the species in the various genera of the family show the development of some secondary sexual characteristics, the most consistent of which is the presence on the males of two lobes (the *appendix interna* and the *appendix masculina*) on the medial side on the endopod of the second pleopods, in contrast to the *appendix interna* alone in the females. Other sexually dimorphic traits may be the pleura of the abdomen, the size of the abdomen itself, and the form of the large chela; the dimorphism is so pronounced that Coutière, the leading worker on the group in the early 1900's, described a male and a female of the same species as two separate species in separate subgeneric groups of *Alpheus*.

However, Suzuki (1970) studied carefully four species of the genus *Athanas*, especially *A. kominatoensis* Kubo, and found the species to show protandrous consecutive hermaphroditism. He found the youngest sexually mature forms to be functional males, those of intermediate sizes to be functional females, and the largest sizes again to be functional males; histological studies of the paired gonads showed that at all times both testicular and ovarian tissue could be found. With this partial alternation of sex there was confusion of characteristics previously thought to be dimorphic with the sex, especially in the form of the large chela and even in the *appendix masculina*, with some ovigerous females bearing the supposedly unique male structure.

Suzuki's work was confined to four species of *Athanas*, but his conclusions probably can be extended to other species, and possibly to other genera, explaining problems that have long perplexed the workers on the group. Thus, our questions

about the forms of the chelae in our review of the genus *Athanas* (1960a) as well as Kemp's (1915) concern about the multiple forms of his species, *A. polymorphus*, can probably be answered by Suzuki's studies. Miyake & Miya (1967) have reported that an ovigerous *Aretopsis amabilis* De Man from the Ryukyu Islands had the *appendix masculina* developed, so this species, too, may undergo a similar change in sex. Finally, as discussed in this paper, the sex of the members of *Automate* cannot be distinguished by external characters unless they are ovigerous, and this also may be the reflection of physiological changes in the sex of the individuals. To date, there is no evidence of sexual ambiguity in the higher genera.

Finally, some species are remarkably constant in their development, so that even such a minor characteristic as the angle of the margins of a groove on the large chela is constant amongst specimens collected as far apart as Hawaii, the Red Sea, and Australia. However, others, as those collected from the spongocoel of a single sponge or single living head of coral, exhibit wide variation in most parts considered to be of taxonomic value.

### General Distribution and Ecology

The alpheidids are characteristically associated with the complex of tropical coral reefs, from the inshore beaches across the growing reefs to the offshore muddy bottoms. There appears to be a greater penetration of the family into temperate waters in Australia than in the Northern Hemisphere. The members of the family may penetrate through brackish estuaries into fresh waters. The two cavernicolous species of *Metabetaeus*, known only from islands of the Central Pacific, appear in isolated brackish water pools which are largely fresh at time of high rainfall. Two species of *Alpheopsis* have been reported from fresh water in Western Africa. *Alpheus heterochaelis* Say is reported from fresh water in lakes of southern Florida (Kingsley, 1878; Hendrix, 1971). Johnson (1965: 9) has reported *Alpheus paludicola* Kemp (as *A. paludosus*) in "fresh water above the limit of tidal influence in the Sedili basin of South Johore" in Malaya. Probably the highest penetration through an estuary into fresh water in this region is that of *Alpheus microrhynchus* De Man in the Chaophya River system to at least the canals ("klongs") of Bangkok, Thailand, 15 miles from the river mouth and certainly completely fresh water during the rainy season; it was reported there by De Man (1898: 318) and Banner and Banner (1966b: 133). In Australia we have records of the genus *Alpheus* reaching up various rivers, for example up the Swan River to Perth, in Western Australia, and rivers in New South Wales and Queensland, but these are evidently brackish waters. While the habitats are undoubtedly washed with fresh water at time of heavy rain, we have no records of further penetration by alpheidids into strictly fresh water in Australia.

In the coral reef complex, however, they reach their maximal development, and there they probably are the most common family of the decapod crustaceans, both in number of species and in number of individuals. A few species live in the open in their habitats, as in tide pools, or free in algal mats. However, most species are cryptic, living hidden to some degree. A few species live between the fronds of living coral; one species makes fissures on the surface of living heads. Some construct tubes of living algae, others live in galleries constructed under sheets of calcareous algae (*Porolithon*). Most species either live in tunnels or cavities in dead coral, especially dead and overgrown heads, or burrow into the substrate; of the latter, some burrow under boulders, and others dig directly into the sand or silt bottoms. A number are associated in varying degrees of symbiotic relationship with other animals, such as molluscs, crinoids, and especially sponges; in none has the degree of mutualism-parasitism been determined, and in some cases the species are not obligate symbionts.

The role of the alpheid in reef ecology has been inadequately studied. Bowers found the species he studied, *Alpheus clypeatus* Coutière, to be entirely herbivorous in habit, eating the growing algae incorporated into its tube. We have observed other species which appear to be either omnivores or carnivores. The capture of food from their sequestered habitats is not understood, but some authors suggest that they stand at the front of their openings and stun prey by the forceful jet of water from the piston-cylinder arrangement of the large chela. Alpheids, of course, constitute a normal food for larger carnivores when they can be captured.

### **Support and Acknowledgments**

Our studies at the University of Hawaii and in Australia were supported by U.S. National Science Foundation grants GB 3804, GB 6386, and GB 25020. The Great Barrier Reef Committee extended to us the use of the Heron Island field station, and Mr G. G. T. Harrison, Chief Fisheries Officer, Fisheries Section, Queensland, issued a permit to allow us to collect specimens along the Queensland coast.

We wish to thank the following Australian institutions for the loan of specimens for our study:

Aquinas College, Manning, Western Australia; Australian Museum, Sydney, New South Wales; James Cook University, Townsville, Queensland; Macleay Museum, University of Sydney, New South Wales; National Museum of Victoria, Melbourne, Victoria; Queensland Museum, Brisbane, Queensland; Queen Victoria Museum and Art Gallery, Launceston, Tasmania; South Australian Museum, Adelaide, South Australia; Tasmanian Museum and Art Gallery, Hobart, Tasmania; University of Queensland, Brisbane, Queensland; Western Australian Museum, Perth, Western Australia.

The following museums not in Australia graciously lent collections and individual specimens upon request:

Allan Hancock Foundation, Los Angeles, California; Muséum National d'Histoire Naturelle, Paris; Smithsonian Institution, Washington D.C.; Rijksmuseum van Natuurlijke Historie, Leiden; Zoologisch Museum, Universiteit van Amsterdam; Musée Zoologique, Strasbourg.

In addition we wish to thank the following for the loan of specimens and for the assistance they gave us:

John Boase, Fannie Bay, Darwin, Northern Territory; A. J. Bruce, Mombasa, Kenya; Jacques Forest, Muséum National d'Histoire Naturelle, Paris; L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden; Yasuhika Miya, Kyushu University, Fukuoka, Japan; C. R. Smalley, University of Western Australia, Perth, W.A.

Above all, we would like to extend our deep appreciation to Dr John Yaldwyn, formerly with the Australian Museum and now at the Dominion Museum in Wellington, New Zealand, who suggested this monograph, helped us arrange for the loan of specimens from museums, and advised us on our field studies in Australia.

### **Locality Lists**

The full collection notes and explanation of the alpha-numerical code used in the text to designate individual collections is given in the appendix.



Family **ALPHEIDAE** Rafinesque

Carapace smooth, provided with cardiac grooves; rostrum reduced, antennal and branchiostegal spines always absent; in most genera the eyes, or their bases only, are covered by an anterior projection of the carapace. Antennular base cylindrical, with the basal article not longer than sum of other two; scaphocerite rarely longer than peduncles. Mandible always bipartite with palpus of two articles, except in *Prionalpheus*. Distal article of maxillule bifurcate at its extremity except in *Prionalpheus*. Epipodites of first and second maxillipeds always undivided. Chelae of the first thoracic legs, when fully developed, always larger than other legs, usually of massive and asymmetrical development. Carpus of chelipeds usually short, cup-shaped, or hemispherical. Second legs chelate, with chela weakly developed and carpus of three to five articles. Following legs short, compressed, with spinous propodi and dactyli with one to three ungui. Propodus of fifth leg with more or less well-developed "brush" of bristles placed in transverse-oblique rows. Abdomen usually with gradual curve, without any pronounced bending at third segment; sixth segment broad and short; size and shape of pleura usually showing sexual dimorphism. The branchial formula always includes five pleurobranchs.

**Key to the Genera of Alpheidae in Australian Waters\***

- |        |   |                           |
|--------|---|---------------------------|
| 1.     | Cornea of eye fully exposed in dorsal and lateral view except for anterior teeth of carapace .....  | 2                         |
| —      | Cornea of eye concealed in dorsal view and partially to completely concealed in lateral view by anterior extension of carapace .....  | 4                         |
| 2. (1) | Cornea only exposed, normally developed, rostrum well-developed, reaching beyond eyes .....   | 3                         |
| —      | Cornea and peduncle exposed in dorsal view, cornea somewhat degenerate; rostrum vestigial, not reaching far on peduncle.....<br>..... <i>Automate</i> (p. 299)  |                           |
| 3. (2) | Dactylus of large chela usually carried in lateral position; rostrum long and, in lateral view, acute .....   | <i>Athanas</i> (p. 303)   |
| —      | Dactylus of large chela always carried in inferior position; rostrum short and, in lateral view, rounded .....  | <i>Aretopsis</i> (p. 330) |
| 4. (1) | Large chela carried flexed at carpus, fitting precisely into merus; tip of telson notched .....   | <i>Salmoneus</i> (p. 334) |
| —      | Large chela carried extended; tip of telson convex .....  | 5                         |
| 5. (4) | Fingers of large chela with serrations of fine to heavy teeth, never with a plunger and socket .....  | 6                         |
| —      | Fingers of large chela without serrations or teeth, with a strong plunger on dactylus that fits into socket on base of propodal finger (in some species the device is reduced to a heavy crest and a propodal groove) ..... | 7                         |

\* To prevent added confusion in this difficult family, we have limited the key to those genera known to Australian waters. If a species is found that does not fit the key, the reader is referred to Holthuis' key to the family (1955: 83), which includes eight genera not known from Australia. In the use of Holthuis' key, however, it should be recalled that the genus *Arete* has been placed in synonymy (Banner & Banner, 1960: 135) and that the Pacific species of *Thunor* are placed in the genus *Alpheus* (Banner & Banner, 1966a) but the genus is retained for the Atlantic species (Chace, 1972: 104). Since the publication of Holthuis' key, three new genera have been added (*Prionalpheus* Banner & Banner 1960, *Leptalphus* Williams 1965, *Betaeopsis* Yaldwyn 1971) and the genus *Metalpheus* Coutière 1908 has been revived by Chace (1972).

6. (5) Rostrum present of various development; dactylus of large chela carried in superior or lateral position ..... *Alpheopsis*\* (p. 336)  
 — Rostrum completely lacking and extended front of carapace rounded in dorsal view; dactylus of large chela carried in inferior position ..... *Betaeus* (p. 347)
7. (5) Body highly compressed; carapace with knife-like mid-dorsal keel for its entire length ..... *Racilius* (p. 350)  
 — Body not markedly compressed; if carapace bearing a keel, keel not knife-like posteriorly ..... 8
8. (7) With pterygostomial margin produced into a definite angle; without anal tubercles; without mastigobranchs and setobranchs ..... *Synalpheus* (pt 2)  
 — With pterygostomial margin rounded, never angular; with anal tubercles; bearing mastigobranchs and setobranchs at least on anterior thoracic legs ..... *Alpheus* (pt 3)

### Genus **AUTOMATE**

*Automate* De Man, 1888a, Arch. Naturgesch. 53 (1): 529.

*Type Species: Automate dolichognatha* De Man.

*Definition:* Carapace laterally compressed, rostrum if present only slight, without orbital teeth. Eyes not covered by carapace, free with reduced corneas.

Antennular peduncles extremely elongate with second article frequently the longest. Stylocerite reduced, scaphocerite reduced, carapocerite elongate. Third maxilliped longer than antennular peduncles.

Chelipeds carried extended, asymmetrical and sexually dimorphic, compressed, with surfaces smooth and without sculpture; dactyls without cylinder and plunger characteristic of *Alpheus*.

Second legs with five articles in carpus. Following thoracic legs unarmed, with simple dactyl.

Pleura of sixth abdominal somite not articulated. Telson of normal form, without anal tubercles.

Branchial formula: 5 pleurobranchs, 1 arthrobranch, and 8 epipodites.

### **Automate dolichognatha** De Man

*Automate dolichognatha* De Man, 1888a, Arch. Naturgesch. 53 (1): 529, pl. 22, fig. 5. Lanchester, 1901, Proc. Zool. Soc. Lond. 2 (1): 564, pl. 34, fig. 3. Coutière, 1903, Bull. Soc. Philomath. Paris IX, 5 (2): 74, fig. 8.

*Automate gardineri* Coutière, 1902, Bull. Mus. Hist. Nat., Paris 8 (5): 337; 1903, Bull. Soc. Philomath. Paris IX, 5 (2): 72, figs 1-7; 1905a, Fauna Geog. Mald. Laccad. 2 (4): 854, figs 127, 128 [same as 1903]. Holthuis, 1958, Bull. Sea Fish. Res. Stn., Israel, Bull. 17 (8): 17, fig. 6. Miyake & Miya, 1966, J. Fac. Agric. Kyushu Univ. 14 (1): 137, fig. 2. Banner & Banner, 1966b, Siam Soc. Monogr. (3): 37, fig. 8.

\* Under this dichotomy also falls *Batella* Holthuis (= *Cheirothrix* Bate, 1888), described on the basis of a single specimen from Cape York. It can be distinguished from *Alpheopsis* principally by the lack of a mandibular palp, extremely small and hairy fingers on the chelae of the second legs, and the lack of articulated pleura on the sixth abdominal segment. It will be discussed in Part III of this paper.

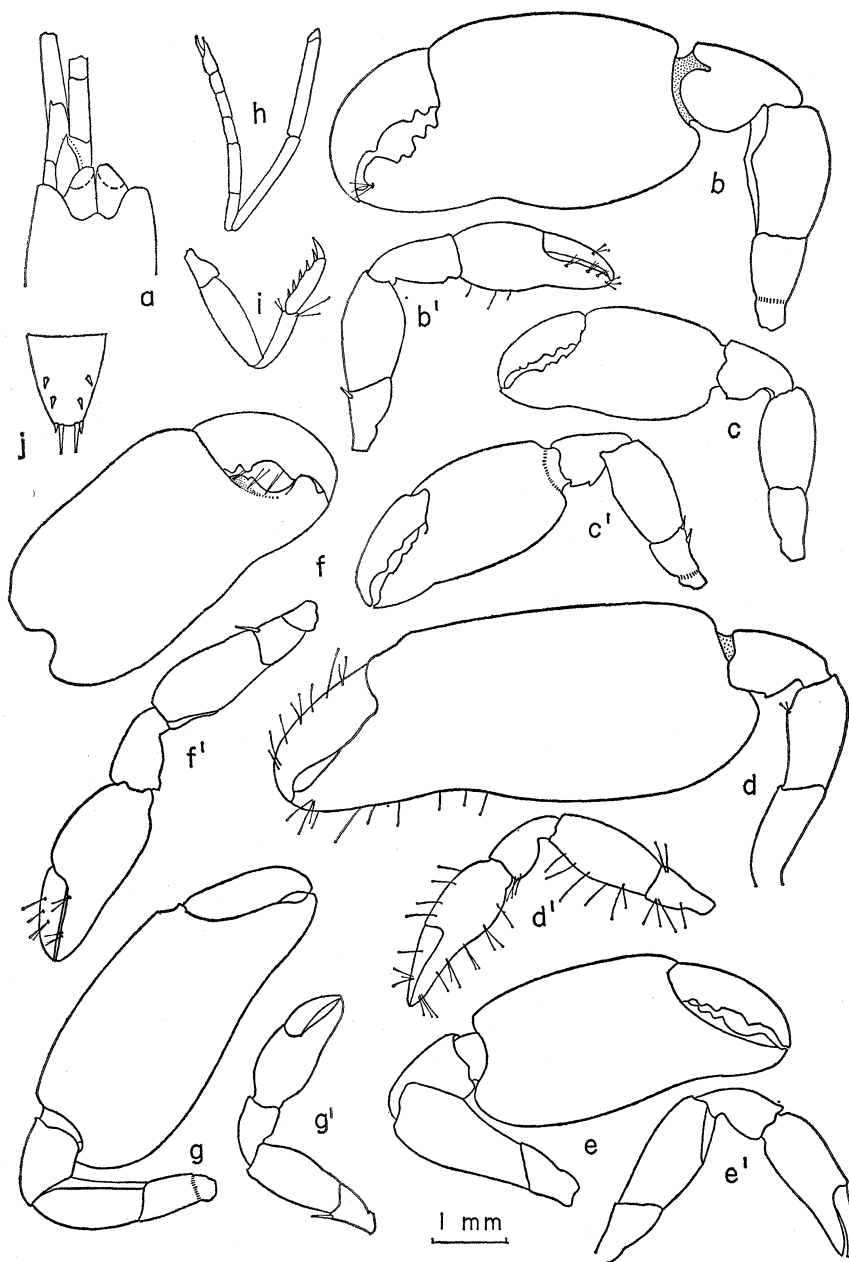


Figure 1.—*Automate dolichognatha* De Man. a, anterior region of 17 mm ovigerous female from BAU 46, dorsal view; b, b', large and small cheliped of fig. a; c, c', large and small cheliped of 15 mm ovigerous female from BAU 46; d, d', large and small cheliped of 17 mm ovigerous female from BAU 36; e, e', large and small cheliped of 18 mm female from Mirs Bay, Hong Kong; f, f', large and small cheliped of 10 mm ovigerous female from US 123609; g, g', large and small cheliped of 12 mm ovigerous female from BAU 46; h, second leg of figure a; i, third leg of figure a; j, telson of figure a.

*Automate* sp. De Man, 1911, Siboga Exped. 39a<sup>1</sup> (2): 140, fig. 2.

*Automate johnsoni* Chace, 1955, Proc. U.S. Natn. Mus. 105 (3349): 13, fig. 7.

*Specimens examined*: 1 specimen from AM P.8677; 3, BAU 36; 5, BAU 46; 3, US 123609.

*Diagnosis*: Central section of anterodorsal margin of carapace recessed above eyestalks, leaving them exposed to near base. Rostrum small, rounded, at times triangular, not reaching to near level of frontal margin of carapace. Eyestalks flattened medially, convex laterally with poorly developed corneal area occupying only a small portion of distolateral surface. Second antennular article about 2.5 times as long as portion of first beyond eyestalks, varying from 2.5 to 4.0 times as long as broad. Third article 0.3 as long as second. Stylocerite reaching to near end of first antennular article. Scaphocerite reaching variously from 0.5 to 0.8 length of second antennular article; squamous portion shorter than lateral spine. Carpocerite from equal to, to slightly longer than, antennular peduncle. Spine of basicerite small.

Third maxillipeds much longer and stouter than antennular peduncles, reaching almost the length of the antennular articles.

Large chela compressed, varying from 1.8–2.4 times as long as broad. Contours of chela, viewed laterally, variable due to differing development of rounded constriction in lower margin proximal to dactylar articulation. Dentition on cutting surfaces of dactylus and fixed finger various (see figs 1b–g), not correlated with size or sex. Merus swollen in the middle, varying from 1.6–2.6 times as long as broad. Small cheliped about half as long as large cheliped. Chela 2.5 times as long as broad, palm and fingers subequal. Carpus similar to that of large chela. Merus over 2 times as long as broad. Ischium as long as carpus, slender, bearing one or 2 strong stiff setae or spines on superodistal margin.

Carpal article of second legs with the ratio: 10 : 12 : 7 : 6 : 7.

Merus of third leg 3.4 times as long as broad. Carpus 0.6 as long as merus. Propodus nearly equal to carpus, bearing 5 spinules on inferior margin; dactylus simple.

Telson shorter than uropods, 3.0 times as long as broad at its posterior margin. Lateral margins slightly curved. Inner spines of posterior pair unusually long, outer spines short, as long as spines on upper surface of telson.

*Discussion*: De Man's original description was based on a single male specimen from Noordwachter, "Indian Archipelago" (= Indonesia?), from which the chelipeds were lacking. In 1901 Lanchester described the chelipeds of a specimen of *A. dolichognatha* from Penang. However, in his figures he did not depict the complete meri of the chelipeds, nor did he state the length-breadth ratio of that article.

Coutière established *A. gardineri* in 1903 on three differences that he considered to separate it from *A. dolichognatha*: (1) a ratio of less than 2 for the length : breadth ratio of the large chela in contrast to a ratio of more than 2 for *A. dolichognatha*; (2) a ratio of 1.38–1.5 for the length : breadth ratio in the merus of the large cheliped in *A. gardineri*, in contrast to 1.6–2.0 in *A. dolichognatha*; (3) the proportion in the carpus of the second leg wherein his specimens had 3rd and 5th article equal with 4th a little shorter, in contrast to having the 4th and 5th equal with the 3rd a little shorter in *A. dolichognatha*.

In the first place, it is difficult to reconcile Coutière's statements with the previous descriptions and with his own specimens. As indicated, until Coutière stated the proportions of the cheliped they had not been mentioned in the literature. It is true that Lanchester's figures of the chelae of *A. dolichognatha* were published in 1901, but he did not publish measurements; moreover, Coutière was apparently unaware of Lanchester's work as nowhere does he mention it. Coutière (1903: 74) states of the large chela of the female: "le rapport de la longueur à la hauteur, pour la pince entière, est toujours inférieur à 2, alors qu'il dépasse presque toujours ce chiffre chez l'*A. dolichognatha* ♀, dont la grande pince est plus longue et moins renflée." But in his figure the ratio of the total length to width is 2.0 for the female (fig. 6) and 2.4 for the male (fig. 3). It should be noted that figures 3, 4, 4' were drawn from a detached chela and the appendage was merely presumed to have come from a male. We have examined some specimens at the National Museum of Natural History in Paris from Djibouti which Coutière had identified as *A. dolichognatha* and found that they varied from typical forms of *A. dolichognatha* to forms Coutière later separated as *A. gardineri*.

Our specimens appear to bridge the gap between the two described forms. In our 5 ovigerous female specimens the ratio of length to height in the large chela varied from 1.8–2.4. The ratio of the length to the width of the merus of the large cheliped varied from 1.6–2.4. In the carpus of the second legs the extent of variation in the carpal articles was as follows: 10 : (14–25) : (6–9) : (6–8) : (6–10). It is obvious that the slight differences in proportions that Coutière used to separate the two species were not meaningful.

We did note that in this small group of female specimens we appeared to have 2 types of chelae. The first is stout, square-shaped with large teeth on opposing surfaces of the dactyls, and the other being more slender and narrowing distally with either small or no teeth on dactyls. These 2 types of chelae are the same as those in Coutière's description (1905a: 74) which he assumes are the differences between the chela for the male and the chela for the female. We have figured the chelipeds of 6 ovigerous females (fig. 1b, b'-g, g') to show the wide variation in the chelae as well as meri and carpi. These figures rule out the criteria used by Coutière to separate the males from the females. In the genus *Automate* the second pleopod carries only the *appendix interna* in both sexes. We have found no other character by which we can separate the sexes. It may be that *Automate* is hermaphroditic, as Suzuki (1970) has pointed out for some members of the genus *Athanas*.

We feel, in view of the many contradictions between Coutière's illustrations and his stated figures, and the variations noted in our own specimens, that *A. gardineri* is a synonym of *A. dolichognatha*. We have already placed *A. johnsoni* Chace in synonymy with *A. gardineri* (1966a: 150). Holthuis (1958) pointed out that *Automate* sp. of De Man (1911) might also be referred to this species; we have placed that form in synonymy.

This leaves 3 valid species of *Automate* in the Central Pacific, *A. dolichognatha*, *A. anacanthopus* De Man and *A. salomoni* Coutière. *A. salomoni* is distinguished from the other two by the form of the acute triangular rostrum which passes the frontal margin and reaches to the last one-fourth of the eyestalks. *A. anacanthopus* is separated from the other two by having no spines on the propodi of the thoracic legs. In addition, there are 6 other presumably valid species: *A. talismani* Coutière from the Azores; *A. evermanni* Rathbun from Porto Rico; *A. kingsleyi* Hay & Shore from North Carolina; *A. rugosa* Coutière and *A. haightae* Boone from the Bay of Panama, and *A. rectifrons* Chace from the Caribbean.

*Biological notes:* Specimens of this species are most commonly found under rocks in the tidal zone. They are usually pale orange in colour with orange eggs. Miyake & Miya (1966: 139) note “. . . pale orange when alive, with red chromatophores distributed over the entire body. The lateral side of the carapace is dark orange. In the large cheliped the movable finger and margins of the chela are tinged with light-yellowish orange, the carpus is dark orange. Eggs are dark orange”.

*Australian distribution:* This species has been collected off Queensland in the Capricorn and Whitsunday groups.

*General distribution:* This species has been reported from Djibouti, Eylath Israel, Maldives and Laccadive Archipelagoes, Malaysia, Japan. In the Central Pacific it has been collected from the Marianas Islands to as far east as Samoa.

### Genus **ATHANAS**

*Athanas* Leach, 1814, *Edinb. Encycl.* 7 (2): 432. (Confer: Banner & Banner, 1960: 134.)

*Arete* Stimpson, 1861, *Proc. Acad. Nat. Sci. Philad.* 1860: 32.

*Type species:* *Palaemon nitescens* (Leach?). [According to Coutière (1899: 8), this species was originally *Cancer (Astacus) nitescens* (author undesignated), and was placed in the genus *Palaemon* by Leach on page 401 of his 1814 work, yet on page 432 he created the genus *Athanas* for the species.]

*Definition:* Rostrum well developed; supra-, extra- and infracorneal spines usually present with varying degrees of development; corneas of eyes exposed anteriorly and largely dorsally and laterally; chelae of the first legs well developed, either carried extended or flexed against an expanded merus, usually asymmetric and sexually dimorphic, always without the cylinder and plunger characteristic of *Alpheus*; carpus of second leg with four or five articles; dactylus of third legs simple or biunguiculate; pleura of sixth abdominal segment articulated; telson without anal tubercles, tip arcuate. Branchial formula variable.

#### Key to the Species of the Genus *Athanas* in Australian Waters

- |        |  |    |
|--------|--|----|
| 1.     | Carpus of second leg with 5 articles .....   | 2  |
| —      | Carpus of second leg with 4 articles .....   | 10 |
| 2. (1) | Dactyl of third leg simple .....   | 3  |
| —      | Dactyl of third leg biunguiculate .....  | 8  |
| 3. (2) | Anterior margin of carapace bearing supracorneal teeth .....   | 4  |
| —      | Anterior margin of carapace without supracorneal teeth .....   | 5  |
| 4. (3) | Chelipeds of male carried almost straight forward; chelae cylindrical; extracorneal teeth much more prominent than infracorneal teeth; chelipeds of both male and female almost symmetrical .....                          |    |
|        | ..... <i>A. areteformis</i> (p. 304)   |    |
| —      | Chelipeds of male carried flexed; chelae inflated, flexed against excavate merus; infracorneal teeth acute, more prominent than extracorneal teeth; male chelipeds almost symmetrical, female chelipeds asymmetrical ..... |    |
|        | ..... <i>A. djiboutensis</i> (p. 306)  |    |

5. (3) Merus of third leg more than 5 times as long as broad; propodus bearing only an occasional spine on the inferior margin..... *A. japonicus* (p. 308)  
 — Merus of third leg less than 5 times as long as broad; propodus bearing many short spines on inferior margin ..... 6\*
6. (5) At least one chela of mature female enlarged ..... *A. locincertus* (p. 311)  
 — Neither chelae of mature female other than slender ..... 7
7. (6) Carpus of female cheliped from as long as to almost twice length of chela ..... *A. dimorphus* (p. 313)  
 — Carpus of female cheliped shorter than chela ..... *A. haswelli* (p. 316)
8. (2) Chelipeds carried extended ..... *A. granti* (p. 316)  
 — Chelipeds carried flexed ..... 9
9. (8) Palm of large chela bearing pronounced lobe on inferior margin; fingers of small chela dorsoventrally flattened .. *A. ornithorhynchus* (p. 319)  
 — Palm of large chela smooth, without lobes; fingers of small chela as usual, not dorsoventrally flattened ..... *A. sibogae* (p. 321)
10. (1) Rostrum 1.0–1.7 times as long as broad; merus of third leg 3.0–4.0 times as long as broad; tooth on distal end of inferoventral margin of merus of third leg feeble ..... *A. dorsalis* (p. 327)  
 — Rostrum 1.8–2.5 times as long as broad; merus of third leg 4.1–5.0 times as long as broad; tooth on distal end of inferoventral margin of merus of third leg well developed ..... *A. indicus* (p. 327)

### **Athanas areteformis** Coutière

#### Fig. 2

*Athanas areteformis* Coutière, 1903, Bull. Soc. Philomath. Paris IX, 5 (2): 79, fig. 17, 18; 1905a, Fauna Geog. Mald. Laccad. Arch. 2 (4): 860, fig. 132 [same as 1903]. Banner & Banner, 1960, Pacif. Sci. 14 (2): 138 [synonymy].

*Athanas naifaroensis* Coutière, 1903. Bull. Soc. Philomath. Paris IX, 5 (2): 77, figs 14–16.

*Athanas erythraeus* Ramadan, 1963. Bull. Fac. Sci. Egypt. Univ. 6: 13, pl. 1, fig. 1.

*Athanas dubius* Banner, 1956, Pacif. Sci. 10 (3): 322, fig. 2.

*Specimens examined*: 1 specimen from AM 43; 3, AM 305; 9, BAU 10; 1, BAU 13; 1, BAU 15; 1, BAU 30; 2, BAU 32; 2, BAU 50; 2, BAU 56; 1, BAU 58.

*Diagnosis*: Rostrum variable, reaching from near the end of the second antennular article to middle of third. Supracorneal teeth well developed. Extracorneal teeth prominent, reaching beyond cornea. Infracorneal teeth small, rounded or acute. First and third antennular articles equal, second article a little shorter than first and almost as wide as long. Stylocerite reaching just past end of second antennular article. Scaphocerite reaching slightly past end of antennular peduncle. Carpocerite reaching middle of third antennular article. Well-developed spine on basicerite.

\*We know nothing of the third legs of *A. haswelli*, but as Coutière described it as resembling both *A. dimorphus* and *A. minikoensis*, we assume the third legs are similar.

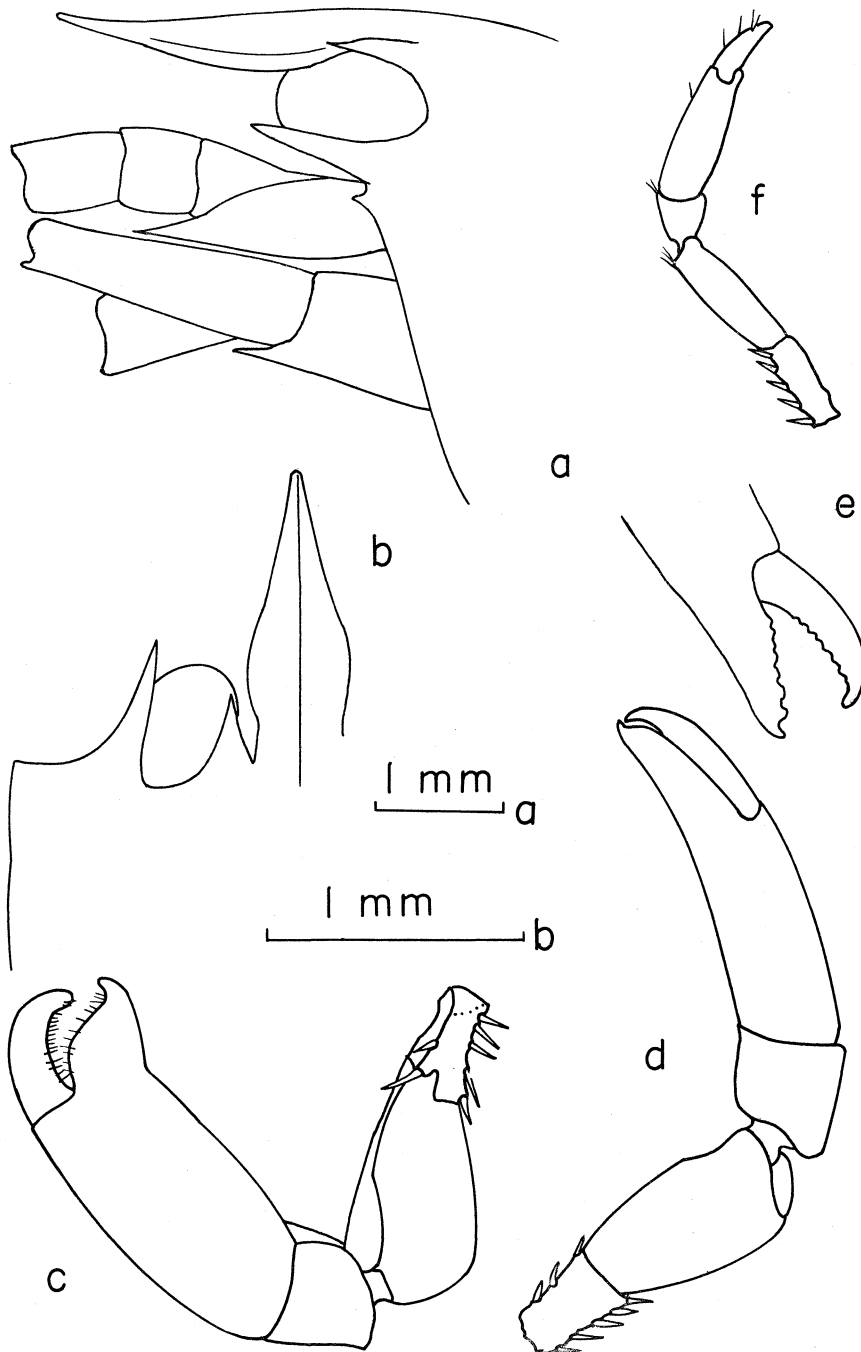


Figure 2.—*Athanas areteformis* Coutière. a, b, anterior region of 10 mm male from BAU 10, lateral and dorsal view; c, large cheliped, male, inner face; d, small cheliped, male; e, detail of fingers of small chela; f, large cheliped of 9 mm female from BAU 10. c, d, f, scale a; a, b, e, scale b.



Chelipeds sexually dimorphic and nearly symmetrical. Chelipeds not flexed, but carried directed forward. Large male chela heavy, cylindrical in form, slightly over twice as long as broad. Fingers, when viewed from the inner face, short, curved, 0.3 as long as palm; fixed finger with broad, rounded projection on cutting surface that fits into cavity on dactyl. Cutting surfaces often bearing short, stiff setae. Small chela a little more slender, cutting surfaces of fingers bearing irregular teeth that mesh when dactyl is closed. Carpus 0.3 as long as merus, rounded with distal end encompassing the base of palm. Merus, measured near the distal end, 2.2 times as long as broad, broader at distal end. Ischium as long as carpus, bearing on its superior margin 5-7 strong spines. Female chelae smaller, more slender, cylindrical, 2.5 times as long as broad with fingers occupying 0.6 the total length. Cutting surfaces of fingers bearing many short stiff setae. Carpus cup-shaped, distal end fitting over base of palm. Merus 3.7 times as long as broad. Ischium almost as long as merus, bearing movable spines on its superior margin similar to large cheliped.

Carpal articles of second leg with a ratio of 10 : 3 : 3 : 3 : 4.

Third leg much larger than second leg, merus 5 times as long as broad. Carpus 0.5 as long as merus, almost the same length as the ischium; propodus equal to merus; dactylus simple.

*Discussion:* Variations in the diagnostic characters of this species were discussed in a revision of the genus *Athanas* (Banner & Banner, 1960: 138). The Australian specimens show the same variations. The species is easily recognized by the well-developed supracorneal teeth combined with the forward directed chelipeds. *Athanas djiboutensis* also bears supracorneal teeth, but the chelae are carried flexed into an excavate merus.

*Biological notes:* The specimens were collected only in dead coral heads. This is a small species, our largest specimen being only 10 mm in length.\*

*Australian distribution:* Seventeen of the 19 specimens were collected on coral reefs off the Queensland coast, the remaining two in the Torres Strait region.

*General distribution:* South Africa, Red Sea, Philippines, Marshall, Fiji, Tonga, Samoa, and Society Islands.

### ***Athanas djiboutensis* Coutière**

Fig. 3

*Athanas djiboutensis* Coutière, 1897a, Bull. Mus. Hist. Nat., Paris, 3 (6): 233; 1905a, Fauna Geog. Mald. Laccad. 2 (4): 856, fig. 129. Banner & Banner, 1960, Pacif. Sci. 14 (2): 140, Table 1. Miya & Miyake, 1968, Publ. Amakusa Mar. Biol. Lab. 1 (2): 131, fig. 1 [see for bibliography].

*Athanas sulcatipes* Borradaile, 1898, Proc. Zool. Soc. Lond. 1898: 1011, pl. 65, fig. 9.

Previous Australian records:

Gurney, 1938, Sci. Rep. Gt. Barrier Reef Exped. 6: 54, figs 249-252 [larval forms].

*Specimens examined:* 5 specimens from AM 74; 8, AM 109; 2, AM 123; 2, BAU 50.

\*In this study the "length of specimens" is always the total length from rostrum to tip of telson unless carapace length is specified.

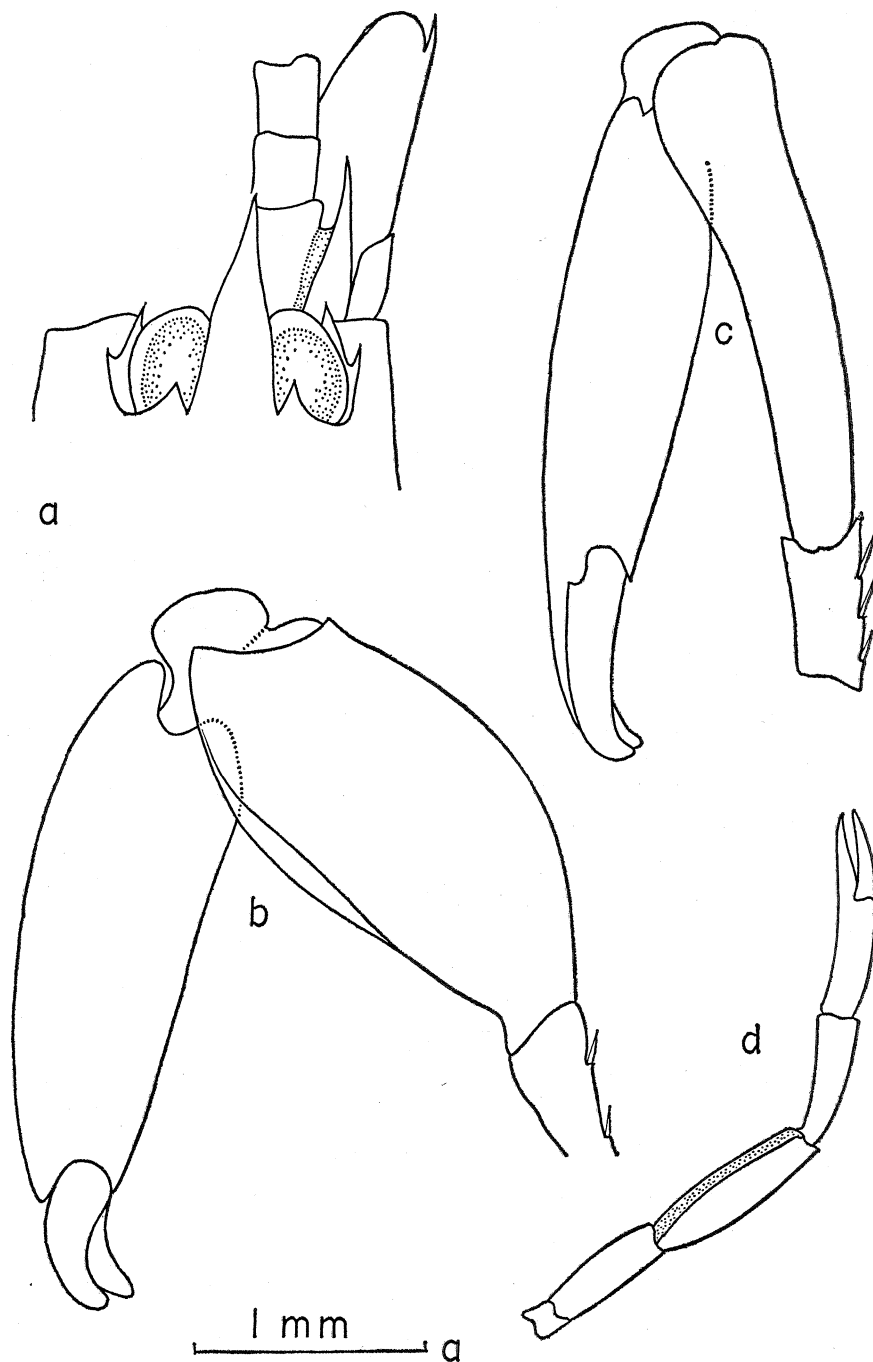


Figure 3.—*Athanas djiboutensis* Coutière. a, anterior region of 11 mm male from AM 74, dorsal view; b, large cheliped of male; c, large cheliped of 10 mm female from AM 109; d, small cheliped of same female.

*Diagnosis:* Rostrum variable, reaching from past end of first antennular article to proximal third of third antennular article. Supra-, extra- and infracorneal teeth present and acute. First article of antennular peduncle almost twice length of second; second and third articles subequal. Stylocerite reaching middle of second antennular article. Scaphocerite reaching well beyond antennular peduncles, carpocerite reaching just past end of second antennular article.

Chelipeds of male nearly symmetrical. Palm and merus almost equal in length, both heavy. Palm round, merus excavated to accommodate palm when flexed. Fingers only one-quarter length of palm. Carpus short and bulbous. Ischium bearing 2-3 spines on superior margin. Female chelipeds asymmetrical. Large chela similar to that of male in proportions but more slender. Inner face of merus excavated to accommodate palm when flexed. Ischium bearing 3 spines. Small cheliped of female less than one quarter as long as large cheliped. Merus 4 times as long as wide. Ischium 0.6 as long as merus. Carpus slender, 0.7 as long as merus. Chela as long as merus.

Second and third legs similar to those of *A. areteformis*.

*Discussion:* *Athanas djiboutensis* is widespread and has often been discussed and figured in the literature. The most perplexing thing about this species is the variation in the chelipeds. We analyzed the chelipeds of 24 specimens, both male and female, and have presented our findings in tabulated form (1960: 140). Tattersall (1921: 368) implies that possibly *A. djiboutensis* becomes sexually mature before it is fully grown. It is likely there may be consecutive hermaphroditism here similar to that reported upon by Suzuki (1970: 15) for some other members of this genus.

*Biological notes:* This species has been collected intertidally under rocks as well as in heads of dead coral.

*Australian distribution:* This species has only been collected at Heron Island and some islets in the Coral Sea.

*General distribution:* Israel, Red Sea, South Africa, Maldives and Laccadive Arch., Indonesia, Japan. In the Central Pacific it has been collected in the Marshall, Ellice, Fiji, Tonga, Samoa, Phoenix, Society and Marquesas Islands.

### ***Athanas japonicus* Kubo**

Fig. 4

*Athanas japonicus* Kubo, 1936, J. Imp. Fish. Inst., Tokyo 31 (2): 43, pl. 13. Miya Miyake, 1968, Publ. Amakusa Mar. Biol. Lab. 1 (2): 139, figs 4-6.

*Athanas lamellifer* Kubo, 1940, Annotnes Zool. jap. 19 (2): 102, figs 3-5.

*Specimens examined:* 1, 10 mm female from BAU 75.

*Diagnosis:* Rostrum thin, reaching to end of second antennular article. Rostral carina slight, extending to just beyond orbits. Extra- and infracorneal teeth present and acute, reaching almost to middle of cornea; infracorneal tooth slightly longer than extracorneal. First and second antennular article equal, third a little shorter. Second article longer than broad. Stylocerite reaching past end of second antennular article. Lateral spine of scaphocerite as long as antennular peduncle, squamous portion a little longer. Carpocerite reaching to end of second antennular article. Lateral tooth of basicerite acute.

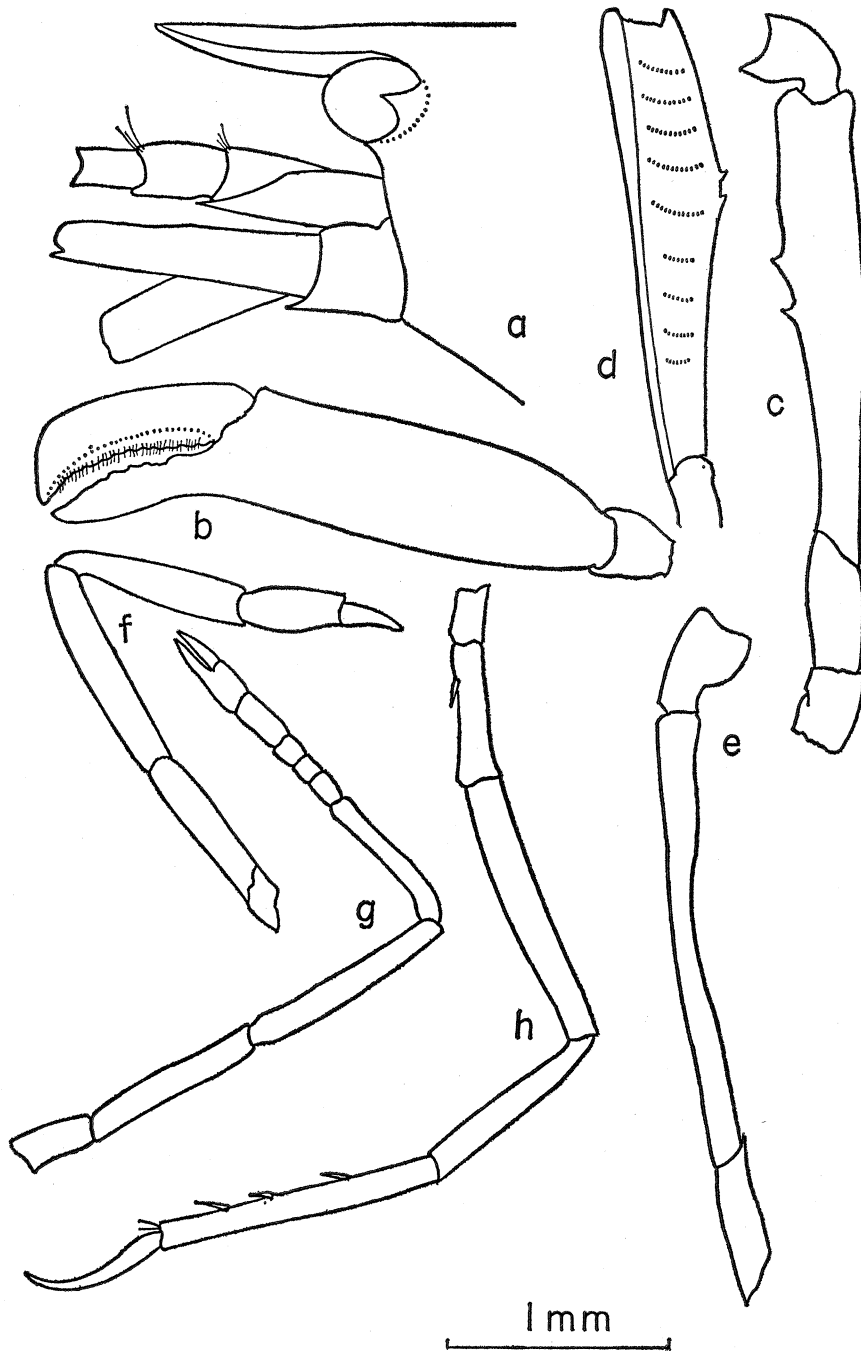


Figure 4.—*Athanas japonicus* Kubo. a, anterior region of 11 mm female from BAU 75, lateral view; b, large chela; c, d, e, merus of large chela, inferior, superior and internal aspect; f, small cheliped; g, second leg; h, third leg.

Large chela slender, 5 times as long as broad, with fingers occupying distal 0.3. Dactylus with knife-like ridge on superior surface; inner side of dactylus flattened, outer a little convex. Cutting surface with fringe of closely-set setae; cutting surface of fixed finger bearing row of irregular teeth. Carpus cup-shaped. Merus elongate, slender, 5 times as long as maximum breadth, excavated to accommodate chela when flexed; superior and inferointernal margins rounded, inferoexternal margin produced and knife-like, bearing 2 dentate projections; distal tooth larger than proximal.

Small cheliped of the *dimorphus* type, with chela about one-quarter the length of large chela. Carpus 0.8 length of merus, subequal to ischium and to chela; fingers 0.7 length of palm.

Ratio of articles of second leg 10 : 1.7 : 1.5 : 1.4 : 4.

Third leg with merus 7 times as long as broad. Ischium 0.5 as long as merus, bearing on its superior margin one movable spine. Carpus 0.7 length of merus; propodus thin, equal to length of merus, bearing 2 spines on inferior surface and a pair distally. Dactylus one-half as long as propodus, thin, curved and acute.

Telson 4 times as long as wide at posterior margin. Posterior margin slightly arcuate.

*Discussion:* Miya and Miyake (1968: 139) with a collection of 38 specimens<sup>8</sup> of *A. japonicus* reviewed the range of variation for this species. The rostra varied from just beyond the end of the first antennular article to the end of the third. "In the majority of the specimens the infracorneal tooth is well developed, but in varying degree, and longer than the extracorneal one, while in the rest the infracorneal tooth is as long as, or shorter than, the extracorneal one." The second antennular article varied from 0.7–2.5 times as long as broad. The stylocerite varied from reaching the proximal third of the second antennular article to the proximal half of the third article. The chelipeds varied considerably in the arrangement and shape of the teeth on the cutting edge of the fingers, and the teeth on the inferointernal margin of the merus varied from one to several. The chelipeds varied in development only roughly with size and sex with the smaller females and some males bearing symmetrical small chelipeds like our figure 4f, larger females and smaller males with symmetrical chelipeds as described above, and the largest males with almost symmetrical large chelipeds like our figure 4b. The chelae also varied markedly in the teeth of the cutting edges, and the merus in the teeth along the lamellar margin. This type of variation is not uncommon in the genus *Athanas*.

*Biological notes:* Our specimen was collected from a muddy foreshore interspersed with rock and mangrove roots near the pier at Darwin, N.T. It is interesting to note that Miya and Miyake's specimens were also taken from a muddy environment. Miya and Miyake report the ground colour in life is "bluish purple . . . with scattered red chromatophores. The eggs are green". On this ground-colour is a line or varying series of broken patches of pale yellow or no pigment along the midline of carapace and abdomen, often with smaller patches laterally, especially on the abdomen. The tips of the outer uropods and at least the tip of the telson bear similar patches. Miya and Miyake also noted that *A. japonicus* usually keeps the chelipeds folded beneath the body when walking, but when approached by another specimen they extended their chelae in a threatening fashion.

*Australian distribution:* This specimen came from Darwin, N.T. It is the first time this species has been reported from Australia.

*General distribution:* This species has previously been reported only from Japan.

**Athanas locincertus** sp. nov.

Fig. 5

*Holotype*: 10 mm male from Panchoran Buoy [Western Australia?] WM 61-65.  
Coll. 13/7/61.

*Allotype*: 11 mm female from same location.

*Diagnosis*: Rostrum reaching to near end of second antennular peduncle. Eyes almost entirely exposed. Supracorneal spine absent; extracorneal spine acute and reaching about half the length of cornea, infracorneal spine also acute and a little longer. Antennular articles subequal, second article a little longer than wide. Pterygostomial angle obtuse, not projecting. Stylocerite reaching to near end of second antennular article. Scaphocerite when viewed dorsally reaching just past end of antennular peduncle, lateral spine a little longer than squamous portion. Carpocerite reaching almost to end of antennular peduncle. Lateral spine of basicerite acute.

Male chelipeds without marked asymmetry. Basis bearing single spine; ischium short, bearing 3 spines. Merus inflated, 2.4 times as long as wide in the middle; inferior surface deeply excavate to accommodate palm. Carpus short, cup-shaped. Chela inflated, 3 times as long as broad, 1.3 times length of merus, dactyls occupying distal quarter. Cutting surface of fixed finger abruptly bent distally toward both medial and inferior plane; with proximal half smooth and without teeth; with a heavy flattened tooth proximal to bend, and a few small irregular teeth distally; tip curved and acute (not shown in figures because of angle). Dactylus crossing fixed finger on its smooth proximal half so that the heavy tooth of the fixed finger lies on inner surface, and acute tip of dactylus lies outside of fixed finger; dactylus with small serrate teeth proximal to tip where it contacts fixed finger. Small male cheliped similar to large, but smaller and more slender. Chela itself almost 0.7 length of large chela, over 4.5 times as long as broad; fingers slender, bearing on their cutting surfaces serrated teeth that intermesh when fingers are closed. Serrated edges interspersed with short stiff setae. Female with one cheliped missing. Basis and ischium bearing 7 spines of moderate development. Merus excavated but not markedly inflated. Ratio of lengths of articles of cheliped: ischium, 10; merus, 35; carpus, 7; palm, 34; fingers, 15. Both fingers slightly curved and bearing on outer face in distal two-thirds serrated teeth that intermesh when closed, upper teeth interspersed with short setae; tips crossing when closed. Dactylus bearing on outer face of cutting surface a short but dense fringe of setae that obscures from view the teeth on the inner side.

Ratio of carpal articles of second leg: 10 : 1.8 : 1.8 : 1.8 : 4.0.

Ischium of third leg unarmed. Merus 4 times as long as broad, without spine. Carpus 0.5 as long as merus, superior margin extending as a blunt tooth. Propodus slender, a little longer than merus, bearing on its inferior margin 8 short movable spinules and 2 distally. Dactylus robust, curved, simple, 0.3 as long as propodus. [Description of allotype; holotype too fragmentary.]

Telson 2.7 times as long as posterior margin is broad. Anterior margin 1.6 times wider than posterior.

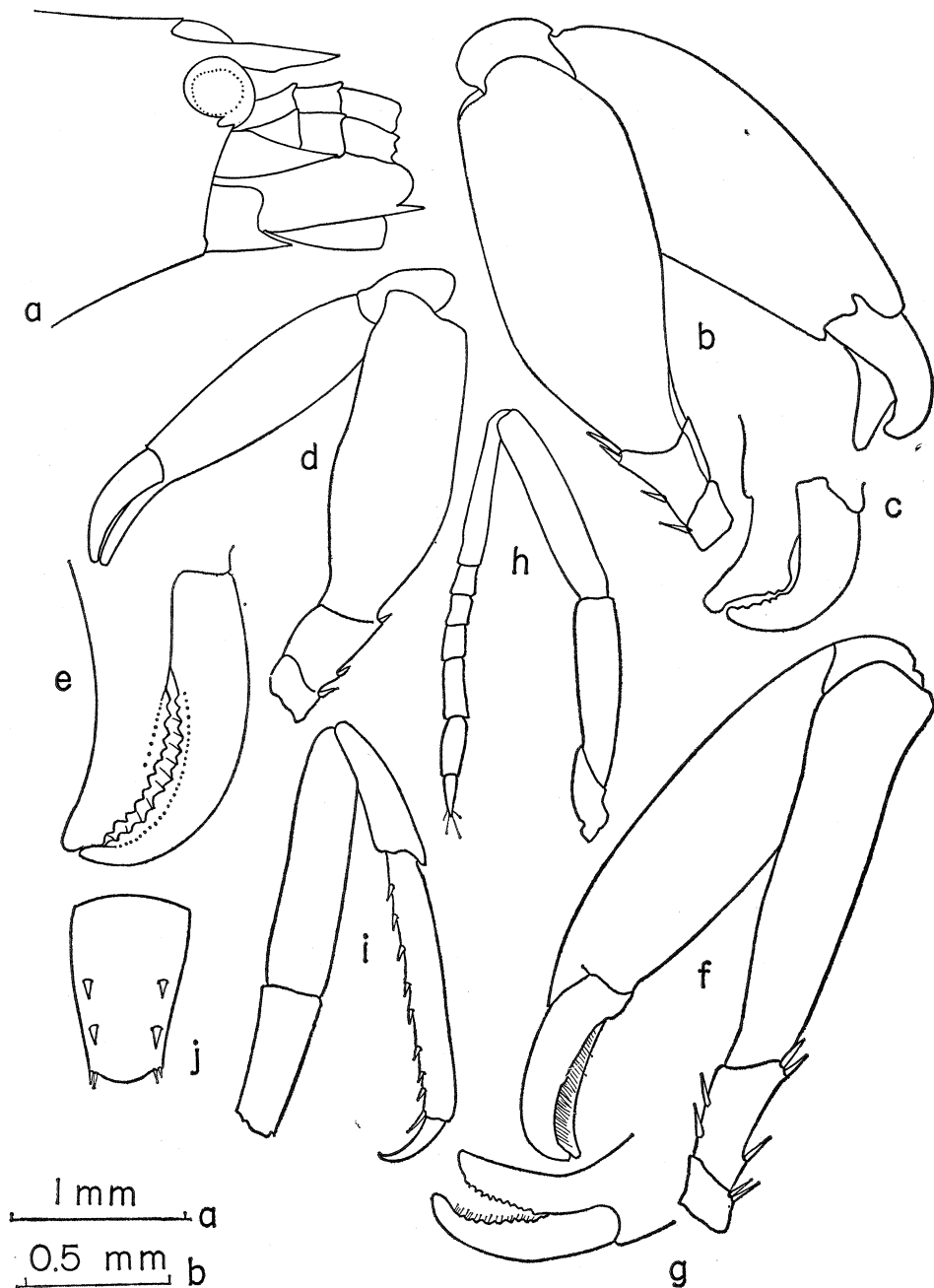


Figure 5.—*Athanas locincertus* sp. nov. a, anterior region of holotype, lateral view; b, large cheliped; c, detail of fingers of large cheliped; d, small cheliped, inner face; e, detail of fingers of small chela; f, small cheliped of allotype, outer face; g, detail of fingers of fig. 5f, inner face; h, second leg of allotype; i, third leg of allotype; j, telson. All figures but e scale a; e, scale b.

*Discussion:* These specimens are most closely related to *A. japonicus* Kubo because of the presence of an infracorneal tooth; the development of the chelae, especially that of the female, falls well within the range of variation given for *A. japonicus* by Miya & Miyake (1968). However, the extreme twist of the fingers of the large chela of the male and the fringe of closely set setae on the inner face of the dactylus of the small chela is different from *A. japonicus* and apparently unique to the genus. This species also lacks the lamellar extension of the merus and the teeth on its margin so characteristic of *A. japonicus*. There are also marked differences in the third legs: in *A. japonicus* the merus is 7 times as long as broad, in this species but 4 times; in *A. japonicus* the propodus bears few spines, while in this species they are numerous; in *A. japonicus* the dactyl is slender and 0.6 as long as propodus, while here it is heavy and 0.3 the length of the propodus. This species differs from *A. dimorphus*, in which neither the chelipeds of the female have the inflated palm and merus, nor the very short carpus.

Unfortunately, we cannot give the type locality for this species. The specimens were lent by the Western Australian Museum, and the label carried only "Panchoran Buoy", without a collector's name. The Western Australian Museum could not find a buoy by that name in any gazeteer or sailing directions for any part of Australia; we requested the Honolulu office of the U.S. Hydrographic Office to search its references, but they could find nothing. We can only suggest that perhaps the name is mis-spelled, or that it might be in Indonesian waters where somewhat similar phonetics may be found. All we may presume is that the buoy is some place that can be reached by sailing from Fremantle or other Western Australian ports, and that it lies in the tropics or subtropics.

The name given reflects this lack of specific locality, as it is derived from *locus incertus*. The type and allotype will be deposited at the Western Australian Museum.

### **Athanas dimorphus** Ortmann

#### Fig. 6

*Athanas dimorphus* Ortmann, 1894, Denkschr. med. naturw. Ges. Jena, 8: 12, pl. 1, fig. 1.

*Athanas setoensis* Kubo, 1951, J. Tokyo Univ. Fish., 38 (2): 265, figs 5, 6. Miya & Miyake, 1968, Amakusa Mar. Biol. Lab. 1 (2): 150, fig. 8.

*Athanas dimorphus seedang* Banner & Banner, 1966b, Siam Soc. Monogr. (3), 28, fig. 4.

*Specimens examined:* 1 specimen from AM P.9077; 1, BAU 4; 5, BAU 6; 33. BAU 46; 12, BAU 51; 5, BAU 72; 3, US 123608; 1, WM 105-65; 3, WM 229-65.

*Diagnosis:* Rostrum reaching to or past end of second antennular article, Supracorneal teeth lacking, extracorneal teeth acute, infracorneal teeth slightly projecting and rounded, pterygostomial angle subacute. Visible part of first antennular article 1.6 times longer than second, second and third article subequal. Stylocerite reaching variously from end of second antennular article to middle of third antennular article. Scaphocerite broad, reaching past end of antennular peduncle. Carpocerite reaching past end of second antennular article. Basicerite with strong inferolateral tooth.



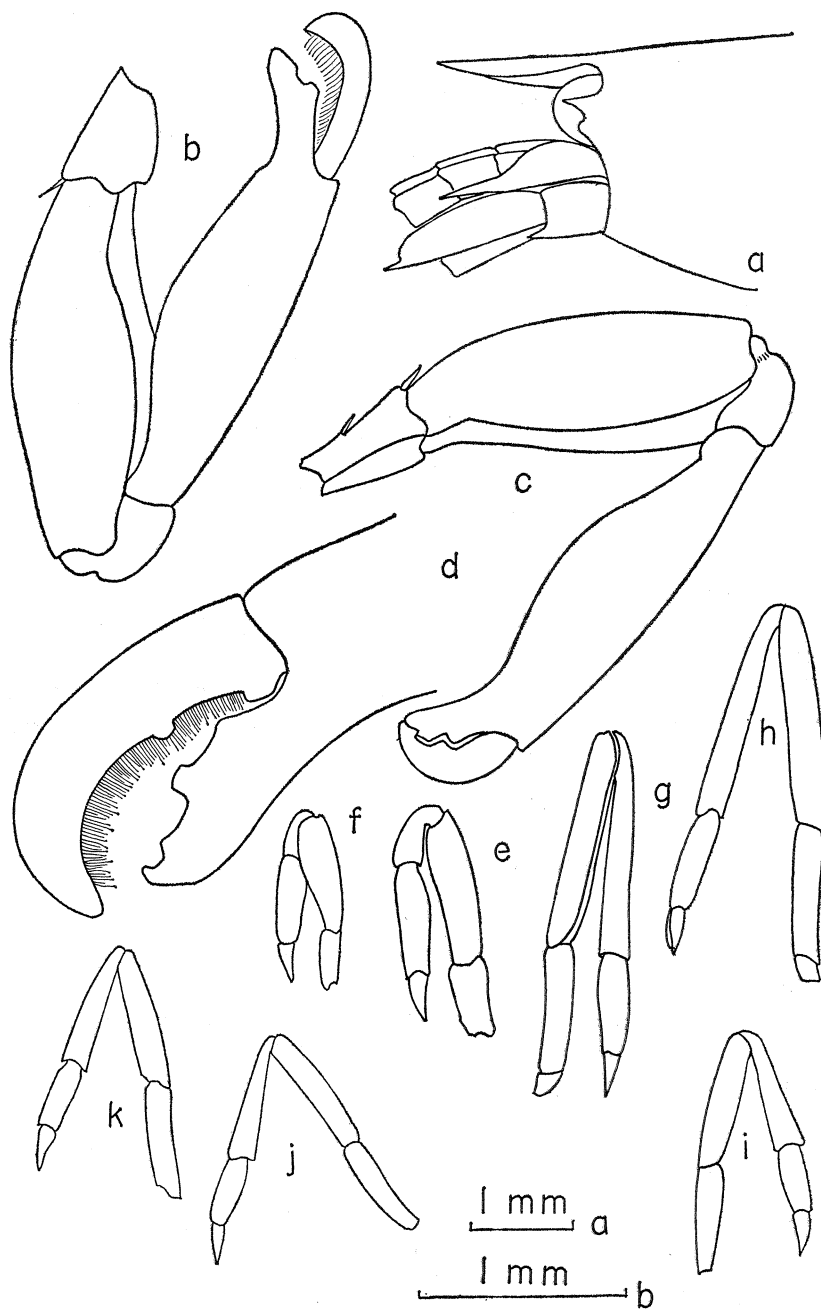


Figure 6.—*Athanas dimorphus* Ortmann. a, anterior region of 14 mm male from BAU 46, lateral view; b, c, large and small chelipeds of 11 mm male from BAU 46, inner face; d, detail of fingers of large chela; e, f, chelipeds from 9 mm male from BAU 46; g, h, chelipeds of 11 mm female from BAU 46; i, j, k, chelipeds of three different females from BAU 46, from 9–10 mm in length. All figures but d, scale a; d, scale b.

Chelipeds sexually dimorphic, but of nearly symmetrical development in both sexes and carried flexed at the meral-carpal articulation. In the female the chelipeds are small and slender. The articles opposed in flexion—the chela and ischium, the merus and carpus—are of similar lengths. The merus varies from 6.5 to 8.8 times as long as broad. The adult male chelipeds are large, robust, inflated. The chela is cylindrical in section but not uniform in diameter, 3 times as long as broad at the greatest diameter at midsection and tapering towards fingers. Dactylus curved, 0.4 as long as palm, fingers at times bearing rounded teeth on both cutting surfaces which pass each other when dactylus is closed, at times without teeth. Cutting surface of dactylus bearing fringe of setae in fully mature males. Carpus one-sixth length of chela. Merus 0.8 length of chela; 3 times as long as broad with inferior face strongly excavated to accommodate chela when flexed. Ischium a little longer than broad, bearing one or two spines on superior margin.

Carpal articles of second legs with ratio of 10 : 1 : 1 : 1 : 4.

Merus of third leg 4.6 times as long as broad. Carpus 0.5 as long as merus. Propodus as long as merus, bearing several spines on inferior margin. Dactylus simple.

Telson as usual, 3.2 times as long as posterior margin is wide.

*Discussion:* Our specimens agree well with Ortmann's description and figures. The only important variation appeared to be in the small cheliped of the female. We compared the ratio of the chela to the merus in 25 specimens, 14 of them from the same location, and found that the chela varied from half as long as, to equal to, the merus. This variation could not be correlated with size. We also were able to examine 10 females from the Red Sea identified by Coutière at the National Museum of Natural History in Paris and found that in these specimens the chela varied from 0.6–0.9 times as long as the merus.

Ortmann's original figure shows the chela to be 0.6 as long as the merus and Ortmann states only “. . . der merus schlanker, der carpus ebenfalls schlank, mindestens ebenso lang als der merus. Die Scheere ist kurz, kürzer als der carpus”.

In 1966b we erected a subspecies *Athanas dimorphus seedang* which we separated from the nominate form by having the chela and merus almost equal in length. The variation we now report destroys the validity of the separation.

In 1951 Kubo established a new species, *A. setoensis*, based on a single 8.6 mm ovigerous female collected in Japan. In 1968 Miya & Miyake further elaborated the description of this species. They had 2 specimens, a male without chelipeds and a female with chelipeds which they found agreed well with the type. The only difference between Kubo's and later specimens was apparently in the infracorneal tooth which Kubo stated was lacking and Miya & Miyake found to be produced but blunt. Ortmann does not mention a tooth and his figure is not clear on this point. We feel that no great importance should be attached to this as this is known to be a variable character in the genus.

Both Kubo and Miya & Miyake separate *A. setoensis* from *A. dimorphus* principally by the relative length of the rostrum to the second antennular article, and the relative lengths of the carpus and merus in the female cheliped. We asked Dr Miya his opinion of the validity of the separation in view of our findings on the variation in these characteristics. He kindly examined 22 specimens from the type locality (near the Seto Marine Biological Laboratory) and found the same type of variation as in our specimens. He supports our conclusion that *A. setoensis* is a synonym of *A. dimorphus*. (Personal communication; perhaps Dr Miya will publish the details of his study in the future.)

*Biological notes:* Most of our specimens were captured in pools under rocks and coral heads at low tide, but they have also been taken from broken-up coral. The specimens from Thailand were bright red in colour. The specimens from Wistari Reef (US 123608) were described by Moulton as "tan and white striped; blue spot on dorsum of thorax". Our specimens ranged from 8–15 mm in length.

*Australian distribution:* *A. dimorphus* has been collected near Perth in Western Australia, from Darwin in the Northern Territory, and in eastern Australia from Yeppoon, Queensland to Port Jackson, N.S.W.

*General distribution:* This species has been recorded from East Africa, the Red Sea, Thailand, Japan, and New Caledonia. We have some unreported specimens from Hong Kong and the southern Philippines in our collections.

### **Athanas haswelli** Coutière

*Athanas haswelli* Coutière, 1908, Bull. Soc. Philomath, Paris IX, 11 (5): 2. [Coutière was in error in the spelling of W. A. Haswell's name in his original description; it is hereby officially changed to *A. haswelli* according to Article 33 (a) (i) of the *International Code of Zoological Nomenclature*, 1961.]

*Athanas haswelli* Hale, 1927, Crust. of S. Australia, pt. 1; 47 [citation of Coutière only].

*Translation of original description:* "*Athanas haswelli* n. sp. This species is closely related to *A. dimorphus* Ortmann and *A. minikoensis* H. C. It differs by the different proportions of the first pair on the female, the only known specimen. The carpus is equal to the meropodite in *A. dimorphus* and larger than the chela (about 1.8). The carpus is here shorter than the meropodite and shorter than the chela (around 0.85). The appendage has the same cylindrical and slender form, which distinguished it from the species *A. minikoensis*, where the chela is more robust and the carpus short. 1 mutilated female from South Adelaide coast, coll. W. H. Baker". [Description without illustrations.]

*Discussion:* This species has not been reported since Coutière's original description and is not represented in our collections. There is some question as to its validity, for if Coutière was describing an immature female, then its separation from *A. dimorphus* on the basis of the relative length of the carpus of the chelipeds is invalid (see our fig. 6e and f). As can be seen in other species of *Athanas*, the separation Coutière makes between *A. haswelli* and *A. minikoensis* is questionable. Finally, should the species again be found from South Adelaide coast, it should be carefully compared to *A. marshallensis* which is similar in many ways. In case they are found to be identical (which is doubtful, considering the differences in zoogeographic regions), *A. marshallensis* is a junior synonym.

### **Athanas granti** Coutière

Fig. 7

*Athanas granti* Coutière, 1908, Bull. Soc. Philomath. Paris IX, 11 (5): 192. Hale, 1927, Crust. S. Australia, 47 [citation of Coutière only].

*Specimens examined:* 2 specimens from AM 61; 1, AM 220; 1, AM 222; 1, AM 261; 1, AM 266; 2, AM 268; 1, AM 269; 2, AM 270; 1, AM 271; 2, AM P.3071; 7, AM P.5028; 2, AM P.6913; 1, AM P.8437; 1, AM P.11271; 5, AM P.11733; 7, WM 153/173.

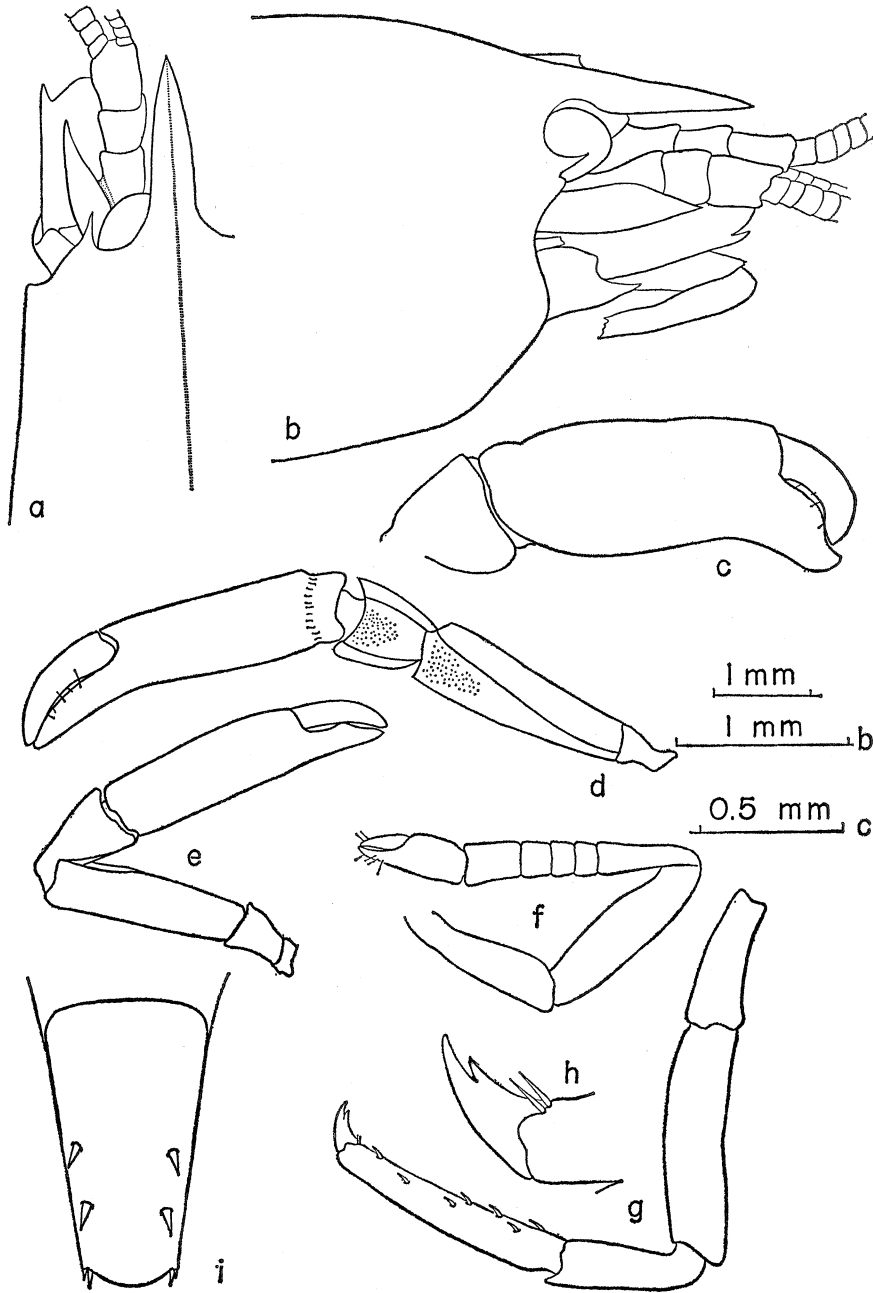


Figure 7.—*Athanas granti* Coutière. a, b, anterior region of 13 mm male from AM P. 5028, dorsal and lateral view; c, large chela, inner face; d, small cheliped, outer face; e, small cheliped of 15 mm male from AM 270; f, second leg; g, third leg; h, dactylus of third leg; i, telson. c, d, e, i scale a; a, b, f, g scale b; h, scale c.

*Diagnosis:* Rostrum reaching past middle of third antennular article. Supracorneal teeth absent; extracorneal teeth acute, extending forward to past middle of cornea; infracorneal teeth small, rounded. Visible part of first antennular article 1.3 times as long as second. Second antennular article a little wider distally than long; third antennular article 0.7 longer than first. Stylocerite reaching to end of second antennular article. Scaphocerite with outer spine prominent, but not longer than squamous portion which reaches to near end of third antennular article. Carpocerite reaches slightly past middle of third antennular article. Lateral tooth of basicerite acute and triangular, reaching to near end of first antennular article.

Chelipeds not sexually dimorphic in mature specimens, carried extended, but capable of flexion. Chelae almost symmetrical, the larger being 2.3–3.0, the small chela 3.2–3.8 times as long as broad. Both chelae usually with constriction near proximal end. Large chelae often carry a broad, rounded projection on inner side of fixed finger (fig. 7c) fitting into curvature of dactyl when closed; these chelae with stouter palms and carpi than those without teeth. Fingers of small chelae lacking tooth; however, in one specimen the fixed finger carried a slight rounded projection (fig. 7e). Fingers of the small chela usually slender, slightly curved, bearing only a few bristles between fingers. Carpus of large chela cup-shaped, a little more than half as long as merus, expanded distally to accommodate proximal end of palm; merus 2.8 times as long as broad. Ischium half as long as carpus, carrying a superior distal spine. Inferior face of carpus flattened to slightly concave to fit against flattened area on distal end of merus when joint is flexed. Proximal articles of small cheliped similar.

Second leg with ratio of carpal articles 10 : 2 : 2 : 2 : 5.

Ischium of third legs unarmed. Merus inermous, 3.8 times as long as broad with slight superior curvature, 1.6 times longer than ischium. Carpus a little longer than ischium, 3 times as long as broad, bearing strong tooth on its superior margin. Propodus slender, 6.3 times as long as broad, slightly longer than merus, carrying on lower margin 7–12 spines and a pair distally. Dactylus heavy and biunguiculate, 0.17 as long as merus and less than 2 times as long as broad at base. Superior ungui markedly longer and heavier than inferior; inferior unguis often carried at almost right angles to propodus, at other times only slightly curved on inferior surface.

Telson as usual for the group, 3 times as long as broad at posterior margin; anterior margin 1.8 times broader than posterior.

*Discussion:* Coutière's description, though brief, was explicit. We were also able to confirm the identity of our specimens by comparison with the type at the Museum of Natural History in Paris. *A. granti* most closely resembles *A. areteformis* Coutière, but can be separated by the lack of supracorneal teeth and the biunguiculate dactylus of the third leg. *A. sibogae* De Man and *A. jedanensis* De Man also have biunguiculate dactyli on the thoracic legs, but both show sexual dimorphism in the chelae.

Many of the males of this species bear the small flat process on the fifth abdominal sternum extending posteriorly, similar to that reported for *A. dorsalis* (see fig. 10f).

*Biological notes:* Almost all of the specimens were collected intertidally. Two were reported from living coral and one was associated with the sea urchin *Centrostephanus rogersii*. J. C. Yaldwyn supplied the following colour notes from a specimen from Long Reef, Collaroy, N.S.W.: "Very dark purple-black in colour, completely opaque; walking legs 2-5 paler and with alternating bands of purple and very pale purple. Details (through the lens shortly after death): purple colour due to dense mass of interlocking simple red stellate chromatophores and granular blue chromatophores; fewer red chromatophores on carapace than on rest of body; close examination showed a paler stripe down back where there are less red chromatophores and fewer blue granules; eyes black". It was also reported by Miss Pope (AM P.11733) as being "Deep blood red with pale dorsal stripe".

*Australian distribution:* This species appears to live only in the cooler waters of Australia (below 30° S.) and has not been reported elsewhere. Seven of our specimens were collected in Western Australia at Rottneest; in eastern Australia they were collected only from the coasts of New South Wales. As Coutière's type came from South Australia the species may extend along the entire southern coast of Australia.

***Athanas ornithorhynchus* sp. nov.**

*Holotype:* 11 mm ovigerous female from Chambers Bay, Van Diemen Gulf, N.T. Taken from pearl shell growth by V. Wells and A. A. Racek, Oct. 1959 (AM P.17999).

*Paratypes:* One, 10 mm non-ovigerous female from same collection as type (AM P.18000). One, 9 mm ovigerous female from Shark Bay, W.A. (AM P.18001). One, 9 mm female and 1, 10 mm male from Cockburn Sd, W.A., dredged at 10 fms. (CS 2a, 2b).

*Description:* Rostrum narrowly triangular and acute, reaching well beyond antennular peduncle; with dorsal carina that extends from tip to posterior of corneas, broadening slightly in region of eyes. Supracorneal teeth lacking; extracorneal teeth large, acute, located well above cornea when seen in lateral view, reaching almost to end of first antennular article; slight prominence at usual location of infracorneal tooth. Visible part of first antennular peduncle 2 times longer than second; third 1.5 times longer than second. Second article a little broader than long. Stylocerite heavy, reaching to middle of third article. Scaphocerite with prominent lateral spine reaching past squamous portion; squamous portion reaching almost to end of antennular peduncle. Carpocerite reaching to near end of third antennular article. Spine on basicerite prominent, triangular, reaching almost to end of first antennular article.

Chelipeds asymmetrical. Large cheliped as long as carapace. Ischium 2.3 times as long as broad, bearing 5 spines on superior margin. Merus excavated to accommodate the propodus, 6 times as long as wide in middle, broadening slightly distally; inferomedial margin expanded into a thin lobe that lies over part of the carpus and the carpal-propodal articulation when appendage is flexed. Carpus small, shorter than ischium, cup-shaped, exactly fitting base of palm except for pronounced lobe which extends distally on inferior side (lobe visible in lateral view). Large chela 4.4 times as long as broad in middle. On the inferior side, about two-thirds length of palm, lies a thin lobe which extends over the inferolateral edge of merus when cheliped is flexed. Tips of fingers rounded and slightly crossing. Fixed finger with a low ridge occupying about two-thirds of length, abruptly

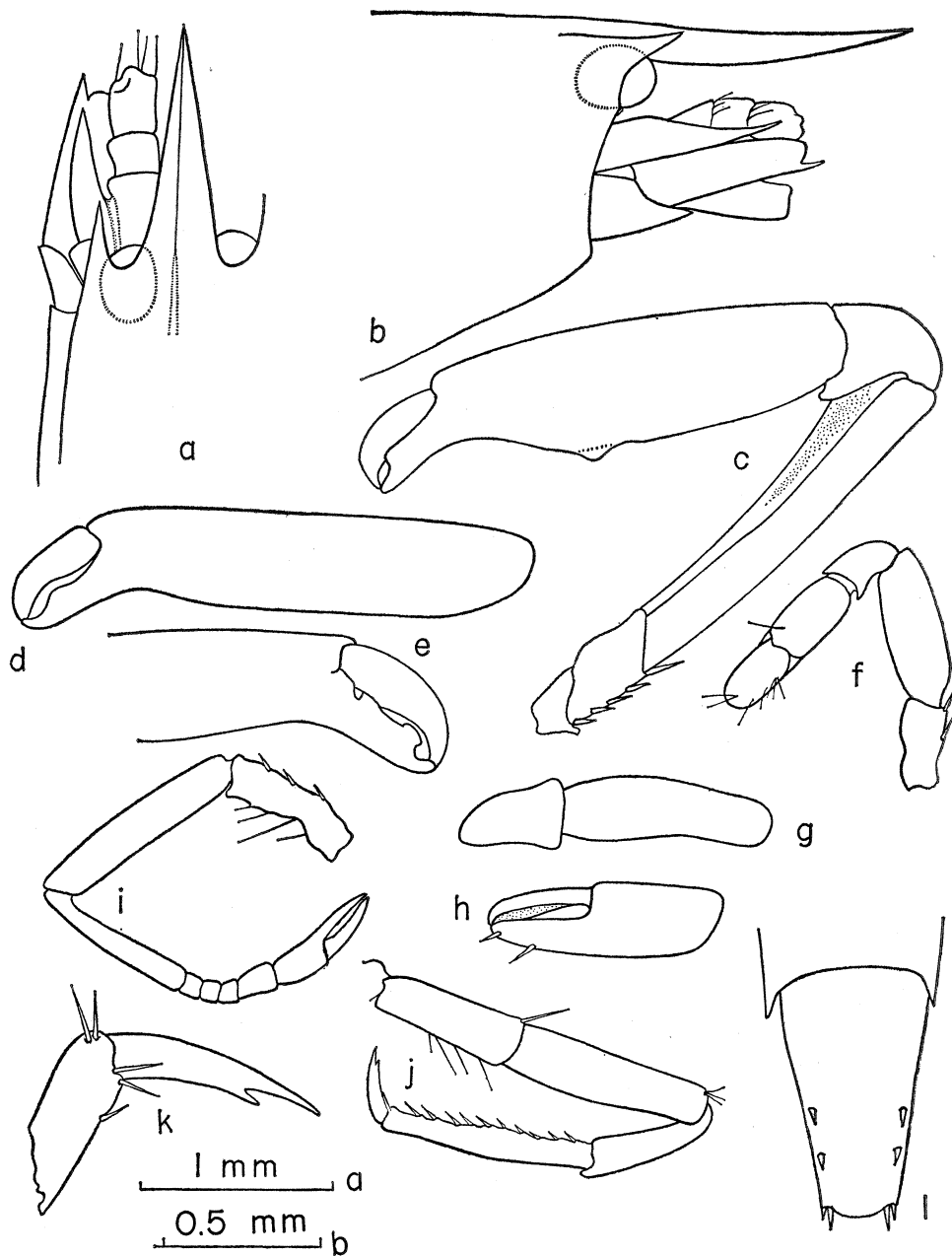


Figure 8.—*Athanas ornithorhynchus* sp. nov. a, b, anterior region of holotype, dorsal and lateral views; c, large cheliped, outer face; d, large chela, inner face; e, detail of fingers of large chela, inner face; f, small cheliped, lateral view; g, small chela, medial view; h, small chela, lateral view; i, second leg; j, third leg; k, dactylus of third leg; l, telson. All figures but k, scale a; k, scale b.

terminating proximally and rising to a low truncate tooth distally that terminates at right angles to cutting surface; distal tip narrow and acute. Dactylus slender, with slight flange proximally and towards middle of article that covers ridge on fixed finger; ridge again expanded into rounded lobe at and beyond truncate tooth of fixed finger; tip curved and acute.

Small cheliped about one-third the length of the large chela. Ischium almost 2 times as long as broad, 2 spines on superior margin. Merus 2.7 times as long as broad, inermous, not excavated. Carpus only 0.3 as long as merus, cup-shaped, slightly broadened at its distal end. Chela 3.2 times as long as wide, fingers 0.7 as long as palm. Fingers flattened and broadened, only twice as long as broad when viewed from lateral aspect. Tips of dactyli broadly rounded and forming a closure like the bill of a duck with opposing surfaces excavated or spoon-shaped. Sparse patches of setae on chela.

Ratio of carpal articles of second leg: 10 : 1 : 1 : 1 : 2. Ischium 0.6 as long as merus bearing 3 spines on superior margin. Inferior margin bearing several strong setae.

Third leg with ischium 0.7 as long as merus and bearing one spine on superodistal margin. Merus 3.8 times as long as broad, inermous. Carpus 0.6 as long as merus, superodistal margin projected. Propodus slender, 7 times as long as broad, slightly longer than merus and bearing numerous spines on inferior margin. Dactylus 0.3 as long as propodus, biunguiculate with inferior unguis only 0.2 as long as superior.

Telson as usual, 3.2 times as long as posterior margin is broad.

*Discussion:* This species differs from all others known from this genus by the broadened and spatulate nature of the fingers of the small chela and by the flat lobe on the inferior margin of the large chela. Possibly the closest related species is *A. naga* Banner & Banner, which bears 4 small protuberances on the lower margin of the large chela and a similar extracorneal spine; however, in *A. naga* the small chela does not bear spatulate fingers, and the dactylus of the third leg is not biunguiculate.

The name is derived from the similarity of the fingers of the small chela to the bill of the Australian platypus.

The holotype will be deposited in the Australian Museum; the paratypes will be distributed between the Australian Museum and the Western Australian Museum.

### **Athanas sibogae** De Man

Fig. 9

*Athanas sibogae* De Man, 1910b, Tijdschr. ned. dierk. Vereen. II, 11 (4): 314; 1911, Siboga Exped. 39a<sup>1</sup>(2): 151, fig. 6. Miya & Miyake, 1968, Publ. Amakusa Mar. Biol. Lab. 1 (2): 134, fig. 2. [extensive redescription.]

*Athanas parvus* De Man, 1910b, Tijdschr. ned. dierk. Vereen. II, 11 (4): 315; 1911, Siboga Exped. 39a<sup>1</sup>(2): 148, fig. 4. Kubo, 1940b, Annot. Zool. jap. 19 (2): 99, figs 1, 2. Banner & Banner, 1960, Pacif. Sci. 14 (2): 141, fig. 1.

*Specimens examined:* 1 specimen from AM 15; 3, AM 68; 1, BAU 27; 4, BAU 40; 2, BAU 43; 8, CS, 1a-1k; 1, WM 40-65; 1, WM 136-65; 1, WM 152-65; 2, WM 187-65; 1, WM 265-65; 1, WM 266-65; 12, WM 288-65; 1, WM 302-65.





Figure 9.—*Athanas sibogae* De Man. a, b, anterior region of 13 mm male from AM 68; c, large cheliped of fig. a; d, small cheliped of fig. a; e, f, large and small chelipeds of 12 mm female from AM 68; g, second leg; h, third leg; i, dactylus of third leg; j, large cheliped of 14 mm male from 288-65; k, detail of fingers of fig. j; l, detail of fingers of 8 mm male from BAU 27; m, n, o, small chelipeds of three females showing variation. All figures but i, scale a; i, scale b.

*Diagnosis:* Rostrum reaching to end of second antennular article, with strong rostral carina on anterior half of rostrum which completely disappears at base of orbits. Supracorneal teeth lacking; extracorneal teeth acute, extending far beyond cornea; infracorneal teeth acute, extending slightly beyond cornea. Visible part of first antennular article longer than either second or third article, which are subequal. Stylocerite extending beyond end of second antennular article. Scaphocerite extending beyond end of antennular peduncle, squamous portion broad, lateral tooth acute, as long as squamous portion. Inferolateral spine of basicerite broad at base, acute.

Chelipeds almost symmetrical, sexually dimorphic. Male cheliped stout with chela cylindrical, folding back into an expanded and excavated merus. Chela 3.5 times as long as broad. Ischium 0.2 as long as merus, bearing on its superior margin several strong spines. Dactylus crescent shaped; dentition of opposing margins of fingers variable, bearing either a row of small irregular teeth or one or two large rounded teeth (see fig. 9c, d, j, k, l). Female chelipeds feeble. Ischium bearing about 6 strong spines and equal in length to cylindrical carpus. Merus slightly excavated at distal end, unarmed and equal in length to chela. Fingers slender, almost straight, tapering. Ratios of chelipeds beginning with ischium lie in the range from 10:23:1:23 to 10:15:8:15.

Ratio of carpal articles of second leg 10:3:3:3:5.

Ischium of third leg with single superior spinule; merus 4.5 times as long as broad; carpus distally with rounded tooth on superior margin, spinules on inferior; propodus with 9 spinules; dactylus biunguiculate, inferior unguis much shorter and more slender than superior.

*Discussion:* In a group of 13 specimens from Rockingham, W.A., the rostrum was found reaching variously from the end of the second to the end of the third antennular peduncle, the second antennular article of the antennular peduncle was at times longer than wide and at times wider than long, and the numbers of spines on the ischium of the chelipeds varied from 1-5.

In our collection we found only one male with chela that carried the large teeth on the opposing surfaces of the fingers that both De Man, and Miya & Miyake, figure. However, in the genus *Athanas*, characteristically the largest specimens bear the heaviest teeth, and perhaps the specimens in our collections were not fully mature. The other males in the collection carried the type of dentition as shown in our figure 9 d, i, j, k.

De Man established as type and allotype for *S. sibogae* what was apparently a mature male and a younger male which he regarded as a non-ovigerous female, while he separated an ovigerous female with chelipeds typical of this species into another new species, *A. parvus*. We (Banner & Banner, 1960:214) pointed this out and placed *A. sibogae* in synonymy to *A. parvus*. Miya & Miyake (1968:134) supported our findings, but pointed out that, on the basis of page priority, *A. sibogae* is the senior name. We accept their views.

*Biological notes:* This species has been collected in dead coral as well as sponges. It is common intertidally under rocks on sandy beaches. It has been dredged as deep as 70 metres. Our specimens ranged in size up to 13 mm. Miya & Miyake (1968) supply some colour notes for specimens collected in Japan. "The entire animal is generally pale blue in ground-colour, densely scattered with carmine red chromatophores. A broad longitudinal stripe free from pigment or of pale yellow,

occurs along the median from the tip of the rostrum to the posterior margin of the sixth abdominal segment. The antennular peduncle except the portion of the stylocerite is free from pigment or pale yellow. The tail fan is uniformly pale blue to deep purplish blue. The eggs are yellowish red."

*Australian distribution:* This species was collected from Dampier to Rockingham W.A. In the north it was collected from Van Diemen Gulf and Torres Strait. On the eastern coast it was collected from the Whitsunday Group and from the Capricorn Group.

*General distribution:* Red Sea, Singapore, Indonesia, Japan, Philippines, Tonga, and Samoa Islands.

### **Athanas dorsalis** (Stimpson)

*Arete dorsalis* Stimpson, 1861, Proc. Acad. Nat. Sci. Philad. 1860: 32. Coutière, 1905a, Fauna Geog. Mald. Laccad. 2 (4): 866, figs 136, 137.

*Athanas dorsalis* Banner & Banner, 1960, Pacif. Sci. 14 (2): 141, figs 5, 6 [see for synonymy]. Sankarankutty, 1962, J. mar. biol. Assoc. India, 4 (2): 167. Hipeau-Jacquotte, 1965, Bull. Recl. Trav. Stn. mar. Endoume, 37 (53): 247. Suzuki, 1970, Sci. Rep. Yokohama Natn. Univ. Sec. II, #17, p. 12.

*Specimens examined:* 1 specimen from AM 24; 2, AM 59; 4, AM 90; 2, AM 109; 3, AM 119; 1, AM 225; 11, AM 235; 1, AM 238; 3, AM P.5275; 1, AM P.10312; 2, AM P.13553; 1, RG 536; 1, RG 540; 1, RG 551; 11, RG 620a; 1, RG 620c; 4, RG 620d; 6, RG 620(2)d; 5, RG 621a; 13, RG 622a; 25, RG 622(3)c; 5, RG 623 1/2; 1, WM 22-65; 2, WM 368/9.

*Diagnosis:* Rostrum broad, varying from 1.0-1.8 times as long as broad; reaching variously from end of first antennular article to middle of third antennular article, with most specimens reaching to end of second antennular article. Lateral margins of rostrum sometimes slightly depressed to form a narrow shelf. Occasionally anterior margins of orbits, lateral to rostrum, with slight prominences. Extracorneal teeth well developed, reaching variously from middle to end of cornea. Supra- and infracorneal teeth absent. Stylocerite curving inward, reaching to near end of antennular peduncle. Scaphocerite reaching to end of antennular peduncle, lateral tooth strong, longer than lamellar portion. Carpocerite stout, as long as scaphocerite.

Large and small chelae similar in size and shape, directed forward. Chelae exhibiting strong growth and sexual differences (see discussion).

Second legs with four carpal articles with the approximate ratio: 10: 2.5: 2.5: 5

Thoracic legs stout. Length-breadth ratio of merus of third leg varies from 3.3-4.0. Tooth on distal end of inferointernal margin is sometimes only an obtuse angle. Dactylus biunguiculate.

Lower border of telson arcuate. Telson varies from 3.2-4.0 times as long as posterior margin is broad.

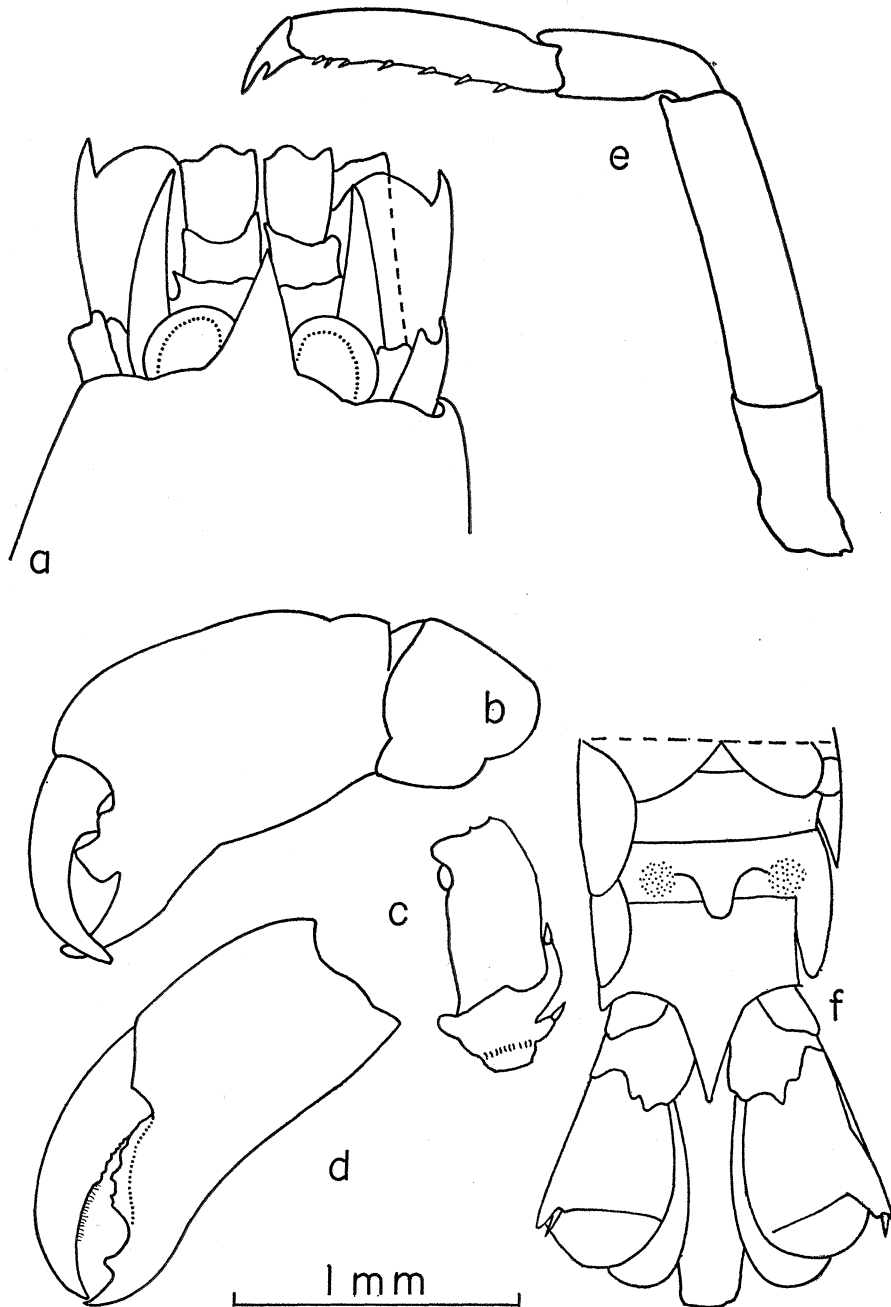


Figure 10.—*Athanas dorsalis* (Stimpson). a, anterior region of 18 mm male from AM P.5275, dorsal view; b, c, large chela and merus, inner face; d, large chela from 10 mm male from AM P.5275; e, third leg; f, ventral view of lower abdomen.

*Discussion:* In 1960 we discussed the extreme variation of this species. That analysis placed *A. mascarinicus* Richters and *A. maruteensis* (Coutière) into synonymy and left some question as to the validity of the closely related species *A. indicus* (Coutière). To review the separation, we selected 17 complete specimens of *A. dorsalis* in the Australian collection, and 11 complete specimens of *A. indicus* for close comparison. We carefully reviewed the literature on the two species also. We conclude that these two species are separate and can be differentiated by 4 characters, but each of these characteristics is variable:

|  | <i>A. dorsalis</i>                                | <i>A. indicus</i>                                |
|--|---|--|
| Length of rostrum  | Usually to near end of second antennular article. | Usually to near end of third antennular article. |
| Length/breadth ratio of rostrum.   | 1.0-1.7   | 1.8-2.5  |
| Length/breadth ratio of merus of third leg.                                | 3.0-4.0   | 4.1-5.0  |
| Size of tooth on distal end of inferoventral margin of merus of third leg. | Feeble  | Well developed                                   |

Four male specimens of *Athanas dorsalis* (all living commensally with sea urchins) carry on the fifth abdominal sternum a long, rounded flap (see fig. 10e) that protrudes ventrally and posteriorly. We also have on hand many specimens of *A. dorsalis* from other areas in the Pacific such as Guadalcanal, New Hebrides, New Britain, Rennell, etc. in which the males carry this flap. Male specimens as small as 5 mm often have this character. One ovigerous female from Samoa carried the flap, but it was much reduced. We also observed a similar flap in *Athanas granti*, but did not observe it in any other species or genera. We offer no suggestions as to the function of the flap, nor of its possibly systematic significance.

As we mentioned in the introduction, Suzuki (1970) shows that *A. dorsalis* and *A. indicus* are protandrous consecutive hermaphrodites. He states: "The external male character can be found in the first pereopod and second pleopod; in the typical male, the first pereopods are symmetrical and on the cutting edges of fingers there are prominent teeth, besides minute serrations, and the second pleopod is provided with both an *appendix masculina* and an *appendix interna* on the inner middle portion of its endopodite; in the typical female the first pereopods are symmetrical, there are nothing but minute serrations and the second pleopod has no *appendix masculina*, the *appendix interna* only". However, as the gonads have both ovarian and testicular tissue at all times, but of varying proportions, these external characteristics are variable in appearance related to degree of male/female function at any particular stage in its life-history.

*Biological notes:* This species is commonly associated with sea urchins, living between the spines on the oral surface and assuming the colour of its host (Hipeau-Jacquotte, 1965: 47). Specimens from Australia, Norfolk Island, and Lord Howe Island were reported associated with 6 species of sea urchins: *Heliocidaris erythrogama* (Valenciennes), *Heliocidaris tuberculata* (Lamarck), *Centrostephanus tenuispinus* H. L. Clarke, *Centrostephanus rogersi* (A. Agassiz), *Tripneustes gratilla* (Linnaeus), and *Echinothrix diadema* (Linnaeus). Julie Booth reported upon two different specimens from *Heliocidaris tuberculata* with 2 different colour patterns (notes in collecting vial). One specimen was "orange-red with flesh-coloured dorsal stripes", the other specimen

“dark greenish brown. Masses of small green chromatophores and a scattering of simple red chromatophores to give an overall dorsal colour greenish, but laterally and on limbs much paler. No dorsal stripe and no pattern on hand. Eyes black . . .”. Suzuki’s specimens from Japan were all from *Stomopneustes* sp. and were uniformly black in colour. At Eniwetok in the Marshall Islands it has been found associated with a species of brittle star, *Ophiocoma anaglytica* Ely. In our own collections we found this species only in dead coral heads from reef flat to water 10 ft deep; however, they may have been associated with echinoderms in the coral heads.

*Australian distribution:* This species has been collected off Western Australia and in eastern Australia from New South Wales to the Herald Group in the Coral Sea. We also have specimens from Lord Howe Island and from Norfolk Island.

*General distribution:* Stimpson’s original specimens came from Hong Kong. It has been reported from the Red Sea, Indian Ocean, Indonesia, Thailand, Japan, China, Kermadec Is., S. Africa, and across the central Pacific from the Marianas Islands to the Tuamotu Archipelago.

### ***Athanas indicus* (Coutière)**

#### Fig. 11

*Arete dorsalis indicus* Coutière, 1903, Soc. Philomath. Paris IX, 5 (2): 84, figs 25–30; 1904, Bull. Mus. Nat. Hist., Paris, 10 (2): 59 [notes on commensalism].

*Arete indicus* Coutière, 1905a, Fauna Geog. Mald. Laccad. 2 (4): 863, figs 134, 135.

*Athanas indicus* Banner & Banner, 1960, Pacific. Sci. 14 (2): 149 [see for synonymy]. Hipeau-Jacquotte, 1965, Recl. Trav. Stn. mar. Endoume 37 (53): 247 [notes on commensalism]. Miya & Miyake, 1968, Publ. Amakusa Mar. Biol. Lab., 1 (2): 151, figs 9–12. Suzuki, 1970, Sci. Rep. Yokohama Natn. Univ. Sec. II, #17, 5, figs 4, 5, 6, 7.

*Previous Australian records:* McNeill 1968. Sci. Rept. Gt. Barrier Reef Exped. 7 (1): 18. Low Isles.

*Specimens examined:* 2 specimens from AM 74; 6, AM 109; 4, AM 272; 1, AM 392; 1, AM P.8027; 1, BAU 23; 2, RG 536; 1, RG 538; 2, RG 451; 1, RG 542; 1, RG 547a; 1, RG 551; 1, RG 624; 1, WM 135–65; 1, WM 153/173.

*Diagnosis:* Rostrum triangular, lateral margins slightly depressed forming slight platforms, tip reaching past first quarter of third antennular article. Extra-corneal teeth well developed, reaching usually to end of cornea; supra- and infra-corneal teeth absent. Antennular peduncle stout, second article broader than long. Stylocerite curved inward, reaching almost to end of antennular peduncle. Scaphocerite reaching to end of antennular peduncle. Carpocerite stout, a little shorter than antennular peduncle.

Chelipeds slightly asymmetrical, carried forward. Carpus cup-shaped, inferior face excavate. Chela exhibiting the same variation in dentition as discussed for *A. dorsalis*.

Four articles of carpus of second leg with ratio: 10:2.5:2.5:5.

Thoracic legs stout. Merus of third leg 4 to 5 times as long as broad, and bearing strong acute tooth on distal end of inferoventral margin of merus. Dactylus biunguiculate.

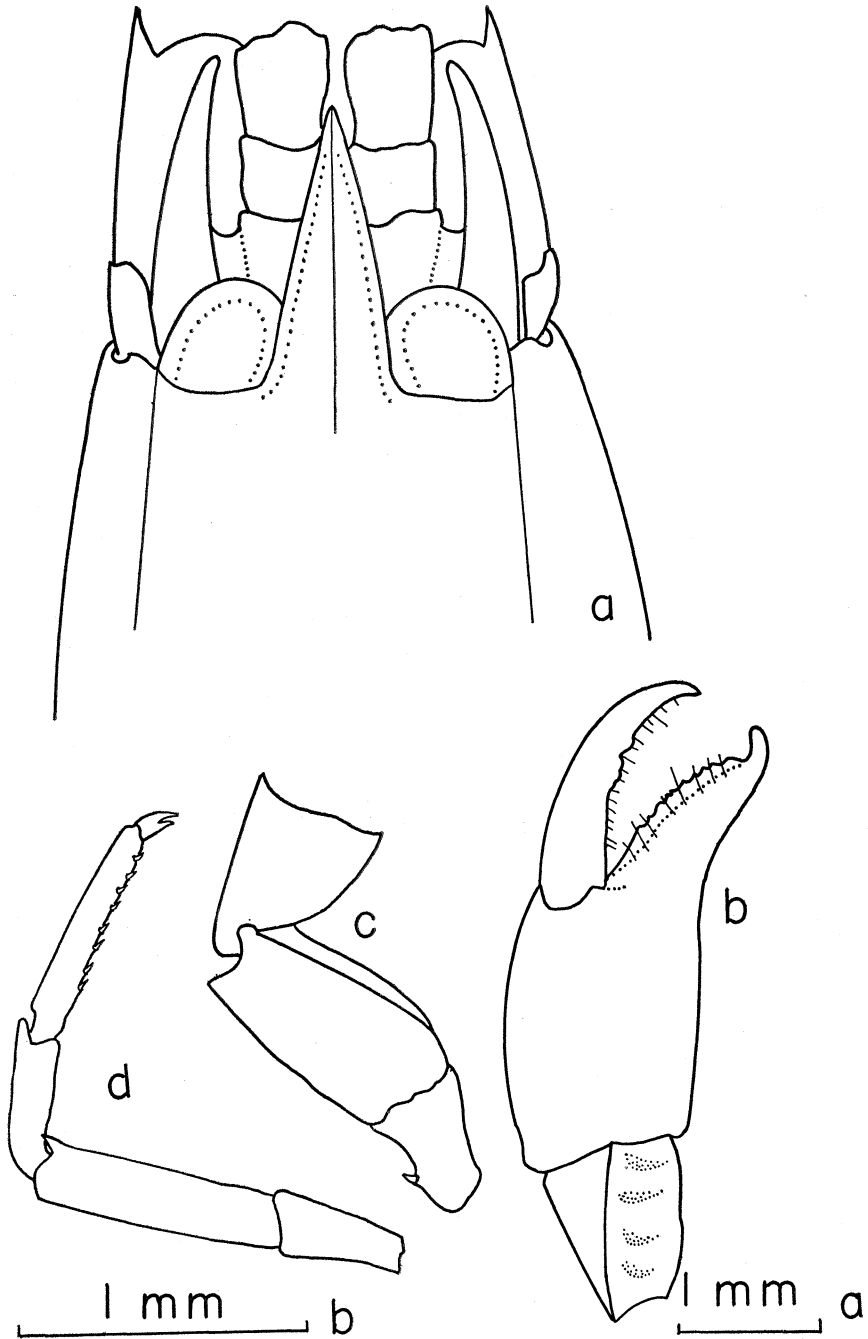


Figure 11.—*Athanas indicus* (Coutière).—a, anterior region of 12 mm male from BAU 23, dorsal view; b, c, large chela and merus, inner face; d, third leg. b, c, d, scale a; a, scale b.

Posterior border of telson arcuate. Telson 3.4 times as long as posterior margin is broad.

*Discussion:* The similarities between this species and its close relative, *A. dorsalis*, were discussed under that species (see Banner & Banner, 1960: 149). This species, like *A. dorsalis*, has been reported by Suzuki to be a protandrous consecutive hermaphrodite (1970: 32).

Suzuki (1970: 5) feels that *A. kominatoensis* is different from *A. indicus* in 2 characteristics: the pterygostomial angle is rounded in *A. kominatoensis* while it is more angular in *A. indicus*, and the distolateral margin of the palm is rounded in *A. kominatoensis* while it is angular in *A. indicus*. We have found these two characteristics to be variable and we reserve judgement on the validity of his separation.

Suzuki also gives a colour key to the species of *Athanas* from Japan. He reports for Japan but a single echinoderm host for each individual species. As we and some of the individuals who furnished specimens for this study have remarked, the colour of the shrimp matches that of the host echinoderm (see also Potts, 1915a: 61), and as these species apparently are associated with various hosts in the richer tropical Indo-Pacific fauna, we doubt if these colour distinctions will be valid for the tropics.

*Biological notes:* This species is apparently always associated with various echinoderms, and in our collections it was reported from urchins of the genera *Echinometra*, *Diadema*, *Centrostephanus*, and *Echinothrix*. Perhaps it is most common in association with *Echinometra* (Banner & Banner, 1960: 149) both amongst the spines and in the cavity ground into the substrate by the urchin. On Gillett Cay and on Swain Reefs it was found associated both with the urchin *Diadema* and an unidentified crinoid.

For some specimens associated with *Diadema* sp. (AM 392) the following colour notes were supplied by J. C. Yaldwyn. "White line dorsally along carapace; laterally a red-brown band above and below with a white band between, all longitudinal; irregular white along ventral edges of abdominal segments; hands, legs, pleopods all bluish-green, but colour not dense." When seen through the lens he observed "simple, stellate, red chromatophores, granular blue chromatophores (usually associated with simple red ones) and simple opaque white chromatophores. Eyes black and visible under carapace, white dorsal and abdominal ventrolateral bands with opaque white chromatophores. Lateral white stripe along body clear with no chromatophores; lateral red-brown band of simple red chromatophores and some granular blue; hand with more granular blue chromatophores than red; legs, pleopods and tail fan with both simple red and granular blue; fresh eggs yellow-brown".

Our specimens ranged in size up to 15 mm.

*Australian distribution:* In Western Australia this species was collected at Rottneest and Cape Naturaliste. In eastern Australia it has been collected from south Queensland to the Coral Sea. We also have 3 specimens from Norfolk Island.

*General distribution:* Red Sea, Persian Gulf, Indian Ocean, Madagascar, Indonesia, China, Japan; across the Central Pacific from the Marshall Islands to the Tuamotu Archipelago.



Genus **ARETOPSIS**

*Aretopsis* De Man, 1910b, Tijdschr. ned. dierk. Vereen. II, 11: 310.

*Type species: Aretopsis amabilis.*

*Definition:* (From De Man, loc. cit.) “. . . closely related to *Arete* Stimpson. Looked at from above, the short rostrum appears acute, triangular, carinate, without any trace of supracorneal teeth; in a lateral view it appears strongly compressed, with rounded tip, as in the genus *Athanopsis*. Extracorneal teeth wanting, infracorneal teeth (outer angles of the orbits) acute, dentiform. Eyes as in *Arete*. Pterygostomial angle rounded. Pleura of sixth abdominal somite articulate, movable.

“Antennal region as in *Arete*, but stylocerite shorter, only one cheliped is known, it resembles the smaller of *Arete*. Meropodite short, not vaginiform; carpus short, cyathiform. [Small] chela compressed, turned outward, with both margins of the palm entire, but with a small groove on the upper (inner) surface just behind the articulation of the dactylus. Fingers compressed, cutting-edges sharp, that of the dactylus finely denticulate.

“Legs of second pair with the carpus as in *Synalpheus*, 5-articulate. Following legs stout, meropodite unarmed, dactylus biunguiculate.”

To De Man's analysis can now be added: large chela laterally compressed, superior and inferior margins sharply carinate, fingers with heavy molar processes. Anal tubercles present; posterior border of telson truncate to rounded.

***Aretopsis amabilis* De Man**

## Fig. 12

*Aretopsis amabilis* De Man, 1910b, Tijdschr. ned. dierk. Vereen. II (4): 311; 1911, Siboga Exped. 39a<sup>1</sup> (2): 171, fig. 14. Miyake & Miya, 1967, J. Fac. Agric. Kyushu Univ., 14 (2): 267, figs 1, 2. Banner & Banner, 1968, Micronesica 4 (2): 272. Bruce, 1969, J. Mar. biol. Ass. India 11 (1 & 2): 175, figs 1-4.

*Aretopsis aegyptica* Ramadan, 1936, Bull. Fac. Sci. Egyptian Univ., No. 6: 16, pl. 1, figs 9, 10; pl. 2, figs 9-17. Holthuis, 1958, Bull. Sea Fish. Res. Stn., Israel, No. 17: 14, fig. 5.

*Specimens examined:* 1 specimen from AM 120; 1, AM P.8028.

*Diagnosis:* Rostrum triangular, broader at base than long, tip rounded and reaching just past first antennular article; inferior side of rostrum compressed laterally. Infracorneal tooth strong, acute, reaching past midcornea in lateral view; pterygostomial angle rounded, not protruding. Corneas almost fully exposed in lateral view, but half concealed in dorsal view. Antennular articles subequal; second article as long as wide, third article the longest. Acute tip of stylocerite reaching to middle of second antennular article. Squamous portion of scaphocerite broad, reaching to end of antennular peduncle. Terminal spine on outer margin heavy, twice as long as broad at base and reaching well beyond squamous portion. Carpocerite heavy, reaching more than the length of the third article beyond that article. Basicerite bearing strong tooth laterally.

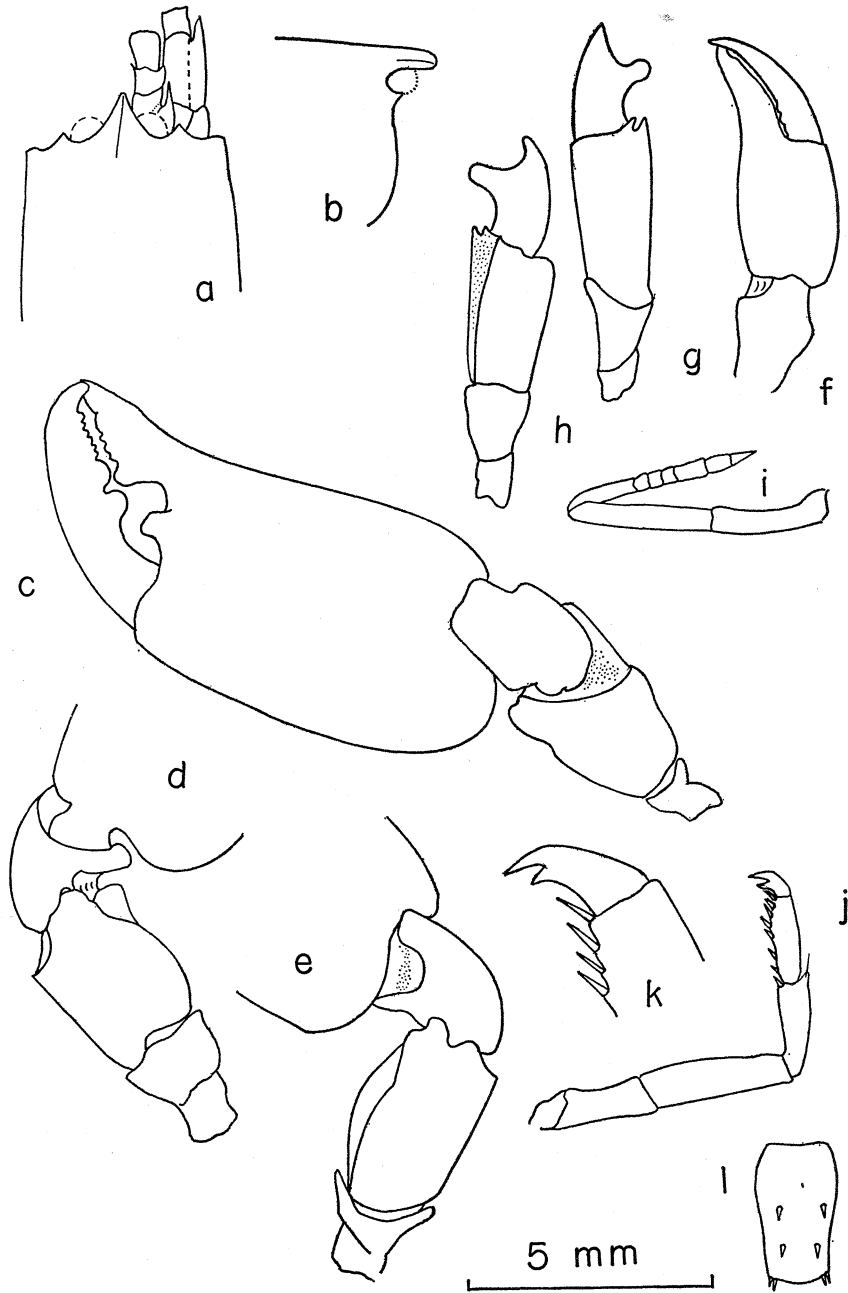


Figure 12.—*Aretopsis amabilis* De Man. a, b, anterior region of 21 mm male from AM 120, dorsal and lateral views; c, large cheliped, outer face; d, e, merus of large cheliped, inner and outer face; f, small chela; g, h, merus of small cheliped, inner and outer face; i, second leg; j, third leg; k, dactylus of third leg; l, telson.

Chelipeds asymmetrical, carried extended in an inverted position with propodal finger uppermost. Large chela laterally compressed, 2 times as long as broad with fingers occupying distal third. Superior and inferior margins sharply carinate. Dactylus strong, curved towards fixed finger. Dactylus with 2 heavy molar processes while fixed finger carries a similar process which fits into the curve of the dactylus proximally. Distally both fingers carry a series of rounded serrations that mesh when fingers are closed; serrate ridge on fixed finger demarcated proximally by smaller molar process; serrate ridge on dactyli continues almost to hooked acute tip; tips of fingers acute and crossing. Carpus cup-shaped, 1.5 times as long as broad, distally carrying one broad flat projection reaching over basal portion of palm and on opposite distal edge a more narrow projection (see fig. 12 c, d, e). Merus almost 2.0 times as long as broad, bearing distally on outer face two rounded projections and on inferoventral face a slight rounded projection.

Small chela 2.7 times as long as broad with dactylus also in inverted position. Fingers equal to palm. The cutting edge of dactylus bearing rounded serrations its full length while fixed finger is smooth and sparsely setose. Fingers crossing at tips. Carpus of small chela similar to that of large chela. Merus 3.0 times as long as broad, bearing distally on inferoventral margin two acute teeth; distally on infero-external margin only a rounded projection.

Second leg bearing numerous fine setae on carpal articles particularly on end of terminal article. Fingers hirsute. Ratio of carpal articles 10: 2: 2: 2: 5.

Third leg with ischium unarmed, 3.5 times as long as broad and 0.7 as long as merus. Merus 4 times as long as broad, unarmed. Carpus 0.5 as long as merus; superodistal margin not projected; distoinferior margin bearing spine; superior margin with a few setae. Propodus only slightly longer than carpus, inferior margin bearing 6-8 movable spines on proximal half and 5 pairs of spines on distal half. Dactylus biunguiculate with ungui subequal in basal breadth, but with superior unguis much longer.

Telson as normal for family, 3.2 times as long as broad posteriorly, spines on dorsal surface small, posterior margin slightly convex.

*Discussion:* Our specimens agree well with De Man's (1911: 171) except for the ratio of the antennular articles, small differences in the appearance of the chela, and the appearance of the distal margin of the telson. In his 11 mm specimen from Indonesia the second antennular article is shorter than the visible part of the first while in our specimens the antennular articles are very nearly equal. The chela figured by De Man was without doubt the small chela which normally lacks the heavy molar processes that occur in the large chela of the adult form. Finally in De Man's specimen the posterior margin of the telson is truncate while in ours it is rounded. The significance of this character is difficult to interpret. De Man stated of his 11 mm female "Anal tubercles probably wanting". In all of our specimens the anal tubercles were present, but in the small specimens they are difficult to see.

Miyake & Miya (1967: 267) described and figured an 18 mm ovigerous female from Okinawa. The only difference between their specimen and our specimens is the length of the scaphocerite, which extends well beyond the antennular peduncle in their specimens.

The matter of secondary sexual characteristics in this species may be confused, as it is in the genus *Athanas* which has species that are protandrously hermaphroditic (see Suzuki, 1970: 1). Miyake & Miya (loc. cit.) reported that their ovigerous female carried an *appendix masculina* on the second pleopod. We have cohabiting

“pairs” collected from the interior of shells of hermit crabs in the Marshall Islands. In all cases one specimen was notably larger than the other and none were ovigerous. We presumed that the individuals in the pair would be of opposite sexes, as they are in the higher genera. However, in one pair both individuals carried an *appendix masculina* although their body lengths were 16 mm and 12 mm; in the other two pairs one had the male the larger, the other had the female the larger. In a specimen from Swain Reefs of 25 mm the *appendix masculina* was larger than the *appendix interna*, while in Miyake & Miya’s ovigerous female and in a 15 mm specimen from the Marshalls the *appendix masculina* is markedly shorter and thinner than the *appendix interna*.

In two of our specimens less than 12 mm in length the fingers of the large chela lacked the heavy molar processes and bore serrated edges on the cutting surfaces similar to the small chela for the larger specimens (fig. 12f). We feel that the type of dentition on the fingers of the large chela may be an indication of maturity, but we do not have enough specimens to present a growth series.

Ramadan (1936) described another closely related species of this genus, *A. aegyptica*. He separated the two species by only two criteria; first, in *A. aegyptica* the eyes were completely covered by the carapace; second, *A. aegyptica* had anal tubercles. In the ovigerous female of *A. amabilis* described by Miyake & Miya the eyes appear to be half covered by the carapace; in De Man’s figure 14 (1915) the carapace covers about one-fourth of the eyes. In the specimen of *A. aegyptica* figured by Holthuis (1958: fig. 5) the carapace covers more than half the eyes. Holthuis said that he believed in the case of Ramadan’s specimens the eyes were merely retracted and we support this view. We have seen rotation of eyes in respect to carapace margin in other genera as well. We do not believe that such a variation in the coverage of the eyes by the carapace can constitute a valid character for specific separation.

On the basis of examination of our specimens and careful comparison of those reported in the literature, we have concluded that we are dealing with a single species that is variable in degree of eye coverage, chela formation, antennular proportions, and other slight variations. We therefore place *A. aegyptica* into synonymy and combine the reported ranges.

Only one other species of this genus has been described, that of *A. manazuruensis* by Suzuki (1971: 19) from Sagami Bay, Japan. It is separated from *A. amabilis* principally by having symmetrical first chelipeds.

*Biological notes:* This species has been reported as dwelling on coral reef flats by De Man, by Miyake & Miya, and in the Australian collection notes. However, all of our Marshall Island specimens were symbionts, one pair in the pelecypod *Pterocera* and three pairs in the shells of hermit crabs. Bruce (1969) reported three pairs from the Seychelles Islands, each pair living in the shell carried by a large hermit crab [*Dardanus sanguinolentus* (Quoy & Gaimard), *Dardanus megistos* (Herbst)]. He suggested that they may be “faecal feeders and help to keep the cavity of the gastropod shell clean”. Bruce also reports that the basic colour of these specimens was a deep red with a broad, white, dorsal strip lying mid-dorsally. The band is separated from the red by a narrow zone of orange. *A. manazuruensis* was also living commensally with a hermit crab *Aniculus aniculus* (Fabricius).

*Australian distribution:* The only two Australian specimens were found on the southern portion of the Great Barrier Reef.

*General distribution:* Gulf of Aqaba; Eylath, Israel; Seychelles Is.; Indian Ocean; E. Borneo; Okinawa and Marshall Islands.

Genus **SALMONEUS**

*Salmaneus* Holthuis, 1955, Zool. Verh., Leiden (26): 88.

*Jousseamea* Coutière, 1896, Bull. Paris Mus. Hist. Nat., 2 (8): 381.

*Type species*: *Jousseamea serratidigitus* Coutière.

*Definition*: Carapace anteriorly projecting far beyond eyes as a broad triangular rostrum, and usually with shorter orbital teeth. Eyes completely concealed dorsally and usually laterally.

Chelipeds markedly asymmetrical. Large chela massive, carried under the body, flexed at meral-carpal articulation. Carpus of large cheliped cyathiform, anterior border trilobate, merus of palm of chela excavate to accommodate flexion. Small chela diminutive, with chela shorter than carpus; carpus elongate and slender.

Second legs with carpus of five articles. Posterior thoracic legs as usual for *Alpheus*, dactyli simple.

Pleura of sixth abdominal segment not articulate.\* Telson attenuated, no anal tubercles, posterior border usually emarginate.

Branchial formula: 5 pleurobranchs; 1 arthrobranch; 8 epipodites.

***Salmaneus tricristatus* Banner**

Fig. 13

*Salmaneus tricristata* Banner, 1959, Pacif. Sci. 13 (2): 131, fig. 1. Banner & Banner, 1968, Micronesica 4 (2): 270.

*Specimen examined*: 1 specimen from BAU 46.

*Diagnosis*: Triangular rostrum and orbital teeth each bearing slight carinae which extend posteriorly almost the full length of the carapace. Rostral carina bearing slight rounded projection about mid-carapace. Antennular articles short and thick. Stylocerite large, bearing on inner proximal section a slight ridge that demarcates a medial triangular area. Squame broad with lateral tooth small. Carpocerite reaching only to end of second antennular article.

Large chela angular, somewhat square in section, 2.7 times as long as broad, finger occupying distal 0.4. Upper margin with ridges, lower margin with two ridges extending from base of finger to full length of palm, area lateral to the ridge on inner side slightly flattened. Shallow depression on proximal portion of inner face of palm to accommodate merus when cheliped is flexed. Opposing surfaces of fingers gaping, carrying 10–12 distinct teeth that intermesh when fingers are closed. Distal section of fingers free of teeth; tips acute, curving and crossing. Carpus corolla-shaped with 5 lobes on distal margin in part enclosing, and in part fitting into, the irregularities of the proximal end of palm (see fig. 13e). Inner face flattened but not excavated. Small chela extremely small and thin, not longer than second leg.

Ratio of carpal articles of second leg: 10: 2: 2: 2: 3.

\* Dr Chace has called our attention to an error we made in the discussion of *Salmaneus tafaongae* Banner & Banner (1966: 156) wherein we stated the species, has, rather than lacks, the articulated pleura of the sixth abdominal somite. We have re-examined the original notes (the holotype was lost) and discover the error crept in during the rewriting of the paper for publication.

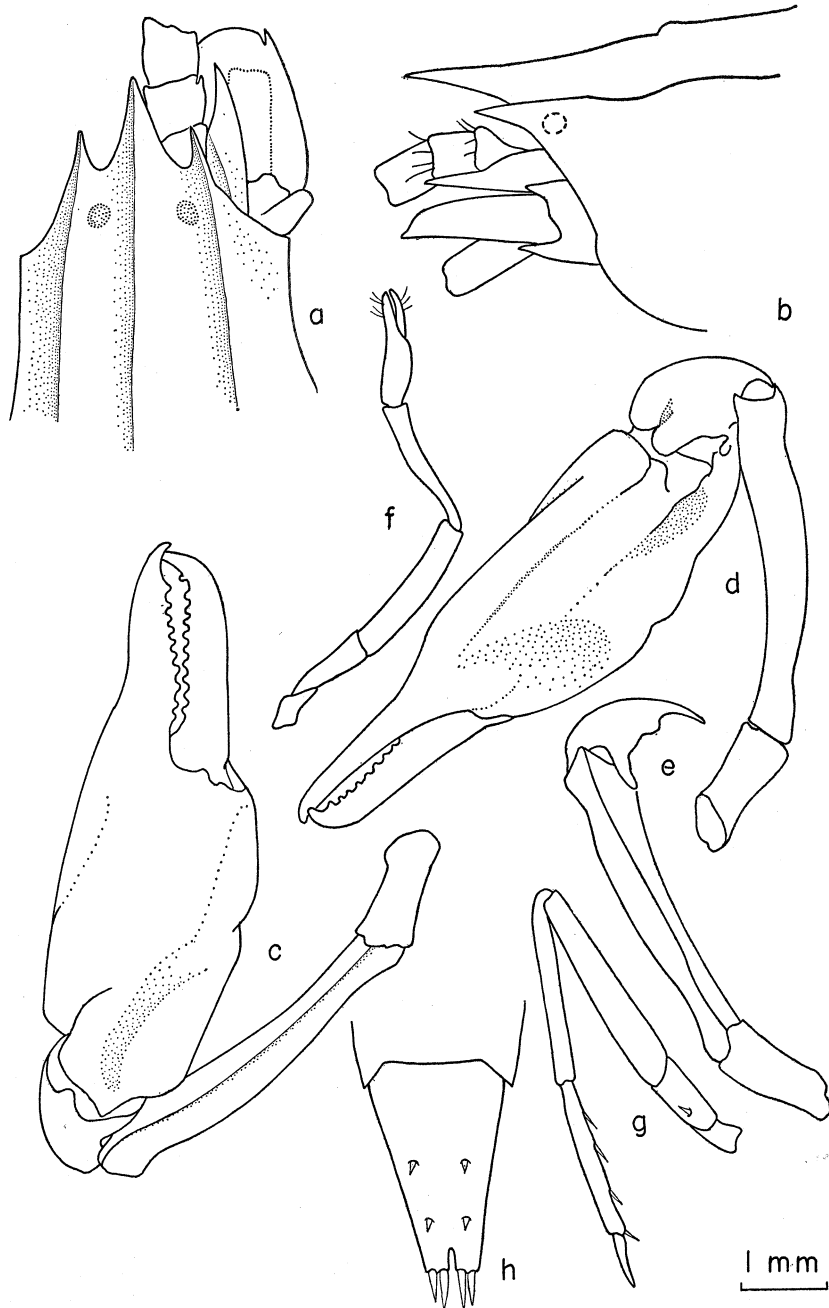


Figure 13.—*Salmoneus tricristatus* Banner. a, b, anterior region, dorsal and lateral view of 17 mm female from BAU 46; c, large cheliped, dorsal view; d, large cheliped, ventral view; e, merus of large chela, inner view; f, small cheliped; g, third leg; h, telson.

Merus of third leg 5 times as long as broad, inermous; 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, distally bearing a pair of strong spines; dactylus half as long as propodus, slender, tapering, and with slight curve.

Telson 4 times as long as broad at posterior end; posterior margin with deep notch with parallel sides and anteriorly rounded.

*Discussion:* We do not know how much of the sculpturing that we have depicted on the large chela is natural and how much is from shrinking in preservation. Our 4 specimens with intact chelae from the Marshall Islands were lost (Banner & Banner, 1968), but from our notes it is evident they carried the longitudinal ridges and flattened areas. Thus the longitudinal ridges on the lower side of the chela as well as the groove for the merus are characteristic, but the depressed area near the base of the fingers on the lower face, the depressed areas on the upper face and the notch on the margin towards the merus may be artifacts.

This species is most closely related to *S. sibogae* (De Man) the only differences being: (1) in the lateral crests of the carapace which are lacking in *S. sibogae*; (2) in the more slender proportions of the third leg; and (3) in the notch in the posterior end of the telson which in this species has parallel sides while in *S. sibogae* it is more triangular in shape.

*Biological notes:* This specimen, like all previously reported specimens of this species, was found under beach rock at low tide; no symbiotic association has been observed.

*Australian distribution:* Our only specimen was found at Heron I. in the Capricorn Group.

*General distribution:* Caroline and Marshall Islands.

#### Genus **ALPHEOPSIS**

*Alpheopsis* Coutière, 1896, Bull. Mus. Hist. Nat., Paris, 2 (8): 382.

*Type species:* *Betaeus trispinosus* Stimpson.

*Definition:* Frontal border of carapace produced into rostrum and projecting flange that screens eyes from above; orbital teeth present or absent. Cornea of eyes always visible from front and in some species from sides.

Antennular peduncle short and stout; stylocerite variable. Scaphocerite usually broad, lateral spine of moderate development. Carpocerite long.

Chelipeds showing asymmetry. Large chela carried extended, without sheaths or grooves. Carpus cup-shaped, merus roughly triangular. Palm either entire and subcylindrical or with lines and depressions. Fingers compressed, either without teeth or with simple arrangement of exactly fitting teeth.

Second thoracic legs with carpus of three (*A. idiocarpus* Coutière), four (*A. tetraarthri* Banner) or five secondary articles.

Following legs robust, without teeth on merus; propodus weakly spinose; dactylus biunguiculate or simple. Propodus of fifth legs with or without "brush" or bristles.

Sixth abdominal segment lacking articulated pleura only in *A. biunguiculatus* Banner. Posterior border of telson convex.

Branchial formula: 5 pleurobranchs, 0-1 arthrobranch, 6, 7 or 8 epipodites.

**Key to the Species of the Genus *Alpheopsis* in Australian Waters**

1. Anterior region of carapace with rostrum and orbital teeth ..... 2  
 — Anterior region of carapace without orbital teeth ..... 3
2. (1) Chela with longitudinal as well as transverse groove.... *A. trispinosus* (p. 337)  
 — Chela without sculpturing ..... *A. undicola* (p. 340)
3. (1) Chela subcylindrical ..... *A. equalis* (p. 342)  
 — Inner face of chela flattened, outer face rounded ..... *A. yaldwyni* (p. 344)

***Alpheopsis trispinosus* (Stimpson)\***

Fig. 14

*Betaeus trispinosus* Stimpson, 1861, Proc. Acad. Nat. Sci. Philad. 1860: 32 [Port Jackson]. Haswell, 1882, Cat. Australian Crust.: 192 [translation of Stimpson's description].

*Alpheopsis trispinosus* Coutière, 1896, Bull. Mus. Hist. Nat., Paris 3: 382. Hale, 1941 Rep. BANZ Anarct. Res. Exped. 4 (9): 266, fig. 4 [E. Tasmania]. Holthuis 1951, Atlantide Rep. (2): 94. Coutière, 1899, Les Alpheidae: 73, 190, 259 315, figs 26, 96, 120, 168, 228, 231, 315, 396.

*Nec Alpheopsis* sp. De Man, 1922, Siboga Exped. 39a<sup>4</sup> (5): 24, pl. 3, fig. 12.

*Nec Alpheopsis* sp. Banner & Banner, 1966a, Pacif. Sci. 20 (2): 156.

Additional Australian records:

Whitelegge, 1889, J. Roy. Soc. N.S.W., 23 (2): 224. [Port Jackson.]

*Neotype*: 19 mm male from Green Cape, N.S.W. Trawled from 30 fms. Coll. M. Boardman, 20/7/25 (AM P.8230).

*Additional specimens*: 1, 14 mm female from Two Fold Bay, N.S.W. (AM 122); 1, 14 mm male from 40 mi. W. of Kingstone, S.A. (AM E.6274); 1, 11 mm male, 1, 15 mm female from Norah Head, N.S.W., 26–28 fms. (AM P.5349); 1, 16 mm male from Ulladulla, N.S.W., 74 fms. (AM P.9221); 1, 17 mm female, 1, 11 mm female, 1, 15 mm female and 1, 12 mm male from off Green Cape, N.S.W., 39–40 fms. (AM P.7379).

*Diagnosis*: Rostrum reaching half the length of the first antennular article and a little longer than wide, with concave margins. Orbital teeth acute, broader and shorter than rostrum. Eyes largely covered in dorsal and half covered in lateral view. Pterygostomial angle not produced, rounded. Articles of antennular peduncle subequal, second antennular article 1.5 times as long as wide. Stylocerite reaching to middle of second antennular article. Squamous portion of scaphocerite relatively narrow and reaching just past middle of third antennular article, lateral spine well developed, reaching to end of antennular peduncle. Carpocerite almost as long as squame. Lateral spine of basicerite heavy and acute.

\* In personal correspondence Dr J. C. Yaldwyn has indicated that he believes his species *A. garrick* (1971: 87) may prove to be a synonym of this species as redefined. We will await his further analysis.



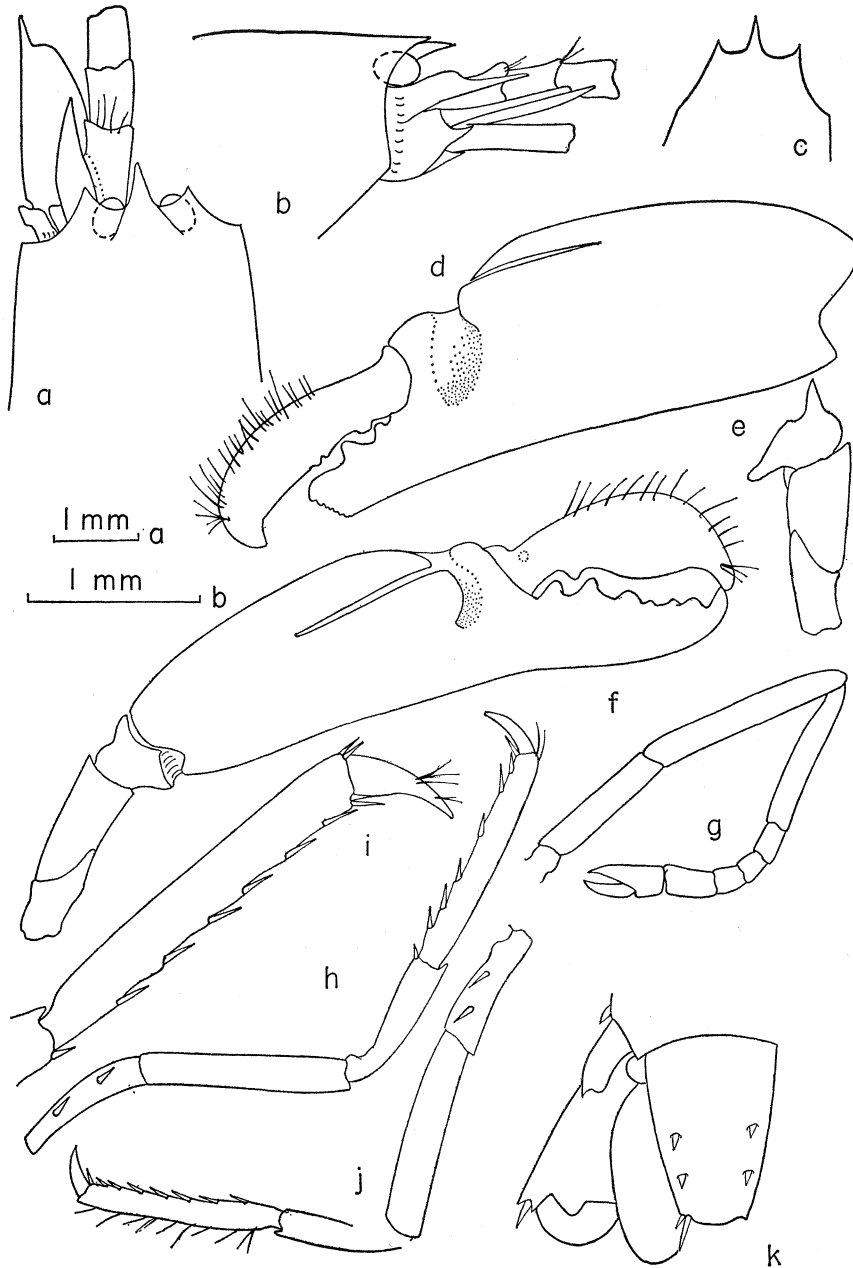


Figure 14.—*Alpheopsis trispinosus* (Stimpson), neotype. a, b, anterior region of neotype, dorsal and lateral views; c, anterior region of 16 mm female from AMP 7221; d, large chela inner face (tip of fixed finger broken); e, merus and carpus of large chela; f, small cheliped, inner face; g, second leg; h, third leg; i, propodus and dactylus of third leg enlarged; j, fourth leg; k, telson and uropods. All figures scale a, except i; i, scale b.

Chelae of nearly the same size, with identical sculpture and exhibiting only slight differences in dentition of fingers. Large chela viewed laterally 3.5 times as long as broad with fingers occupying the distal 0.4. Inferior margin without grooves, superior margin marked by deep and narrow longitudinal groove between 2 sharp ridges running from dactylar articulation to end of palm. Distal shoulder on medial ridge more abrupt than on lateral ridge. Proximal to dactylus the groove extends laterally as a shallow depression for about half the width of the chela. Outer face without groove. Fixed finger of neotype broken but bearing 2 heavy teeth proximally that mesh with dactylus. Dactylus with one truncate tooth proximally, and 2 small rounded teeth near middle. Superior surface of dactyl bearing a brush of fine curving setae that extends three-fourths the length of the dactyl. Carpus cup-shaped, encompassing the base of the chela. Merus slender and unarmed, 2.4 times as long as broad. Dactylus of small chela proximally armed with heavy blunt tooth that fits between 2 on the fixed finger; distal to proximal teeth on fixed finger are 4 irregularly spaced, low rounded teeth; tips of fingers curved, acute and crossing. Carpus and merus similar to large chela.

Second leg with ratio 10: 2.0: 1.7: 1.7: 3.3.

Ischium of third leg 0.4 as long as merus, bearing on its inferior margin 2 movable spinules. Merus inermous, 8 times as long as wide. Carpus 0.5 as long as merus, propodus only a little longer than merus bearing 8 movable spinules on its inferior margin and 2 distally, proximal to dactylus. Dactylus conical, simple, almost 0.3 as long as propodus.

Telson 3.0 times as long as its posterior margin is broad. Proximal article of outer uropod bearing a rounded lobe on the transverse articulation.

*Discussion:* None of Stimpson's type specimens can be located in any American museum (see Banner, 1953: 34, and elsewhere) so a specimen from this collection has been selected as a neotype. While Green Cape, the locality for the neotype, is about 400 km away from Port Jackson, the type locality, the species ranges along the coast of New South Wales without great variation, and the Green Cape specimen is the largest and best preserved. Our specimens range in size from 11 mm to 19 mm with only minor differences. The rostrum was longer in relation to the orbital teeth in some; the breadth of the bases of the orbital teeth also varied (fig. 14a, c). Only 3 specimens had both chelae; in all 3 the chelae were symmetrical, but in one the small chela was about 10 per cent smaller than the large chela.

We believe Hale's specimen from Tasmania is definitely *A. trispinosus*. The rostrum in his figure appears extremely thin but we suggest this may be a poor drawing. *Alpheopsis* sp. (Banner & Banner, 1966a: 156) might also belong to this species, but, as the specimen was fragmentary, we hesitate to make a firm statement. The telson of this specimen agrees with that of the neotype.

It has been suggested several times (Hale, 1941: 266; Holthuis, 1951: 94; Banner & Banner, 1966a: 157) that *Alpheopsis* sp. De Man (1922: 24) from Indonesia was this species. However, we doubt this identity, for: (1) the anterior portion of the carapace is more projected; (2) the antennules are stouter; (3) the scaphocerite is shorter in relation to the antennules; and (4) the dactyl of the third leg is more slender and longer in relation to the propodus than the neotype. The dentition on the cutting surfaces of the fingers of the chelae are minimal compared to the neotype, but this is well known as a variable character, depending for the most part on age and sex. Finally, De Man states the telson is "0.98 mm long, 10 times as long as the

distance between the postero-lateral angles, while the width at the base, 0.46 mm is almost half the length". In our specimens the telson is not more than 3.5 times as long as the posterior margin is broad. We (1966a: 157) have suggested that De Man's figures for the telson may be in error. De Man's specimen was only 8 mm long and apparently young, so its true status will have to await description of an adult form.

Coutière's specimens from the Azores furnished the material for many figures in *Les Alpheidae*, and we have compared our neotype with these figures. There are no obvious major differences between the Australian specimens and Coutière's from Azores, but until material from this region is compared with the Australian specimens there will still be question as to the true identity of Coutière's specimens.

On the basis of distributional pattern, we feel as we did in our 1966 paper that there may well be 3 species, one from the tropical Pacific, one from the south temperate Pacific, and another from the tropical and subtropical Atlantic.

*Biological notes:* Stimpson's specimen was taken from 6 fathoms. All of our Australian specimens were collected with trawls in water from 25-75 fms. De Man's specimen was taken from about 7 fms. Coutière did not state the depth of his specimens from the Azores, but Sollaud (1932: 376) reported specimens that were dredged near the Azores, presumably from deep water. *Alpheopsis* sp. Banner & Banner (1966a) from Samoa was collected intertidally.

*Australian distribution:* Stimpson's specimen came from Port Jackson, N.S.W., and Hale's from Tasmania. All of our specimens came from the coasts of New South Wales except for one specimen from South Australia.

*General distribution:* Until the true identity of De Man's, Coutière's, Sollaud's, and our specimens are confirmed, we are loath to ascribe any non-Australian distribution to this species.

### ***Alpheopsis undicola* sp. nov.**

Fig. 15

*Holotype:* 10 mm male from coral head collected on outermost margin of the Great Barrier Reef on Opal Reef (AM P.18002). In area of normal violent wave action, in 5 ft of water.

*Allotype:* 11 mm female without chela from same locality as type (AM P.18003).

*Description:* Rostrum 1.8 times as long as broad, tip reaching past end of second antennular article. Orbital teeth similar but slightly shorter. Rostral front without grooves. Pterygostomial angle produced into small acute tooth. Antennular articles almost equal; second article a third wider than long. Stylocerite reaching slightly beyond end of second antennular article. Scaphocerite with strong lateral tooth reaching to end of antennular peduncle; squamous portion almost as long as lateral tooth. Carpocerite 2.8 times as long as broad, reaching past end of antennular peduncle. Basicerite with both superior and inferior lateral teeth acute and equal in development, reaching beyond middle of first antennular article.

Chelipeds nearly symmetrical, rounded and without grooves. Large chela 2.7 times as long as broad with fingers 0.4 as long as entire chela. Inferior margin concave opposite articulation of dactylus. Opposing surfaces of fingers bearing blunt teeth arranged close to medial face of appendage, lacking near tips; tips acute and crossing. Teeth on dactylus beset with short stiff setae on both sides, but teeth on

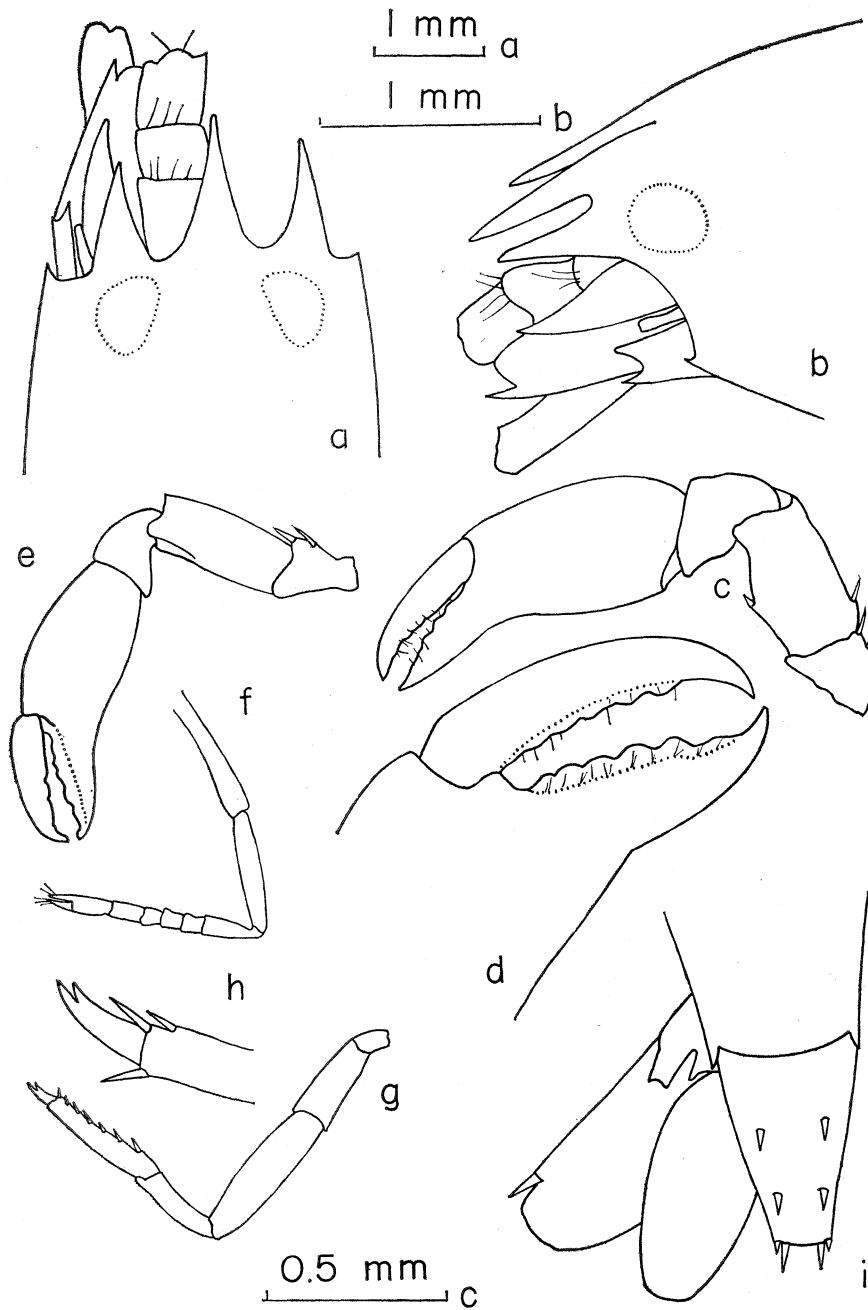


Figure 15.—*Alpheopsis undicola* sp. nov. a, b, anterior region of holotype, dorsal and lateral view; c, large cheliped, inner face; d, detail of fingers of large chela; e, small cheliped, inner face; f, second leg; g, third leg; h, dactylus of third leg; i, telson and uropods. c, e, f, g, scale a; a, b, d, i, scale b; h, scale c.

fixed finger with stiff setae only on outer side. Carpus cup-shaped, a little longer than broad distally. Merus of large cheliped heavy, 1.7 times as long as broad, infero-internal margin bearing a small strong spine near middle and heavy spine on proximal portion of superior margin, superior margin of ischium bearing 2 strong movable spines.

Small chela similar to large chela, but with less teeth on opposing surfaces of fingers. Merus 3.4 times as long as wide, inermous. Ischium similar to that of large cheliped.

Ratio of carpal articles of second leg: 10: 3: 3: 3: 5.

Ischium of third leg 0.6 as long as merus, unarmed. Merus 3.7 times as long as wide, inermous. Carpus as long as ischium, superior margin projecting as rounded tooth. Propodus as long as merus, bearing on inferior margin 8 movable spinules. Dactylus biunguiculate, with superior unguis curved and slightly longer than inferior unguis, ungui almost equal at base.

Telson 3.6 times as long as posterior margin is broad. Anterior margin 2.7 times as wide as posterior margin. Posterior margin very slightly arcuate.

*Discussion:* This species is related to the group of species in the genus *Alpheopsis* which bear orbital teeth. However, only *Alpheopsis diabolus* Banner of this group has both orbital teeth and the dactylus biunguiculate on the thoracic legs. In *A. diabolus* the dactyl of the large chela is twisted on its axis, and the orbital teeth are much shorter in relation to the rostrum than those of this species.

*Biological notes:* The two specimens, probably a pair, were collected when breaking up an encrusted head of dead coral in a location which, under normal weather conditions, bears the full brunt of the open ocean waves. (See Capt. James Cook's and Sir Joseph Banks' account of the near shipwreck of the *Endeavour* on this barrier a few hundred miles north.) Other species that are known to live in this zone are *Athanas rhotionastes* Banner & Banner (1960: 142) and species of the *Alpheus obesomanus* group throughout the Indo-Pacific.

The name is derived from Latin, meaning "one that lives below the waves".

### ***Alpheopsis equalis* Coutière**

Fig. 16

*Alpheopsis equalis* Coutière, 1896, Bull. Mus. Hist. Nat., Paris, 2 (8): 382; 1905a, Fauna Geog. Mald. Laccad. 2 (4): 868, fig. 138. Armstrong, 1941, Am. Mus. Novit. (1137): 5, fig. 1, table X. Banner, 1953, Pacif. Sci. 7 (1): 15, fig. 4.

*Alpheopsis equalis truncatus* Coutière, 1903, Bull. Soc. Philomath., Paris IX, 5 (2): 89, figs 37, 38.

*Alpheopsis consobrinus* De Man, 1910b. Tijdschr. ned. dierk. Vereen. II, 11 (4): 305.

*Specimens examined:* 2 specimens from AM 73; 2, BAU 23; 1, BAU 47; 1, BAU 54.

*Diagnosis:* Rostrum narrow, triangular, reaching to end of first antennular article. Pterygostomial angle either acute or rounded. Antennular peduncle with articles subequal, but first article usually slightly the longest. Stylocerite reaching to near end of second antennular article. Scaphocerite as long as antennular peduncle, lateral spine a little longer than squamous portion. Carpcerite equal to antennular peduncles.

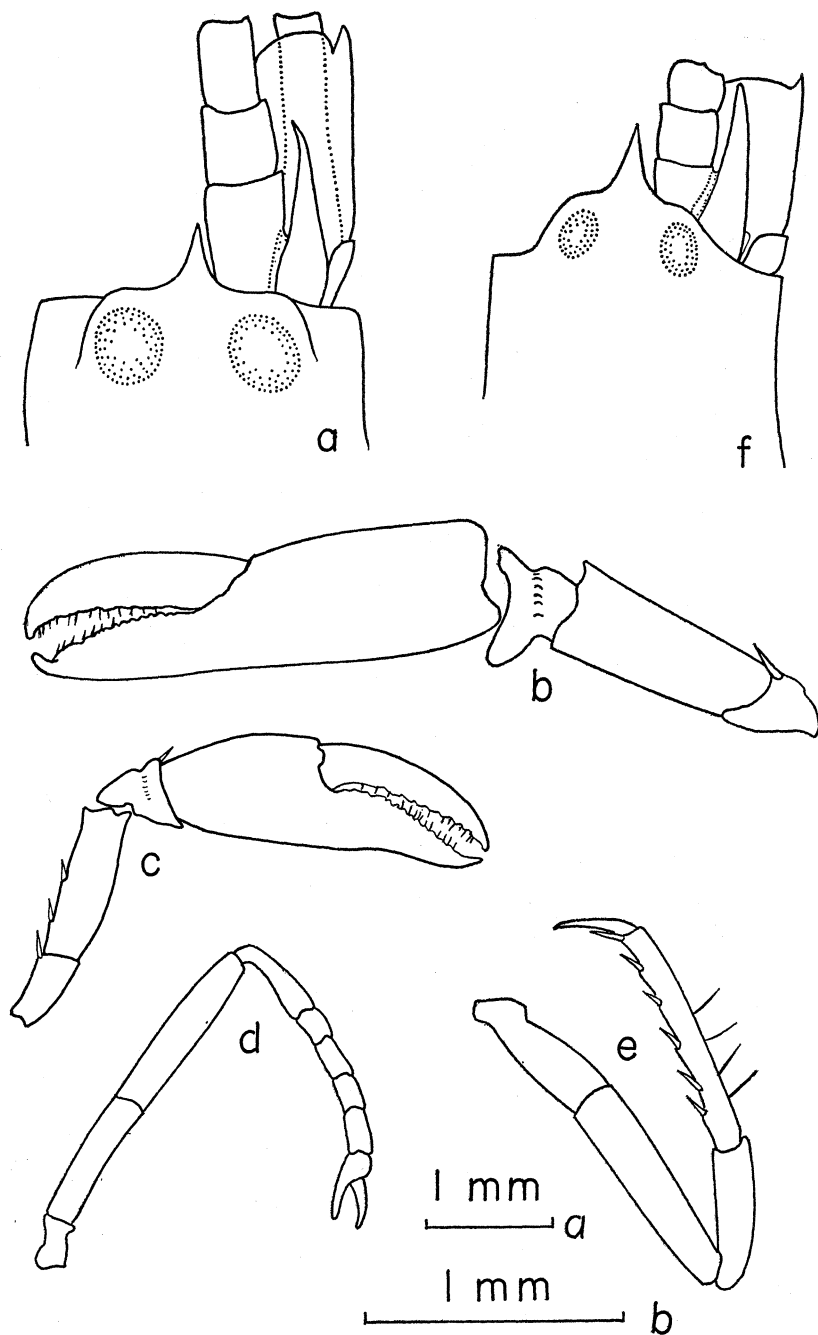


Figure 16.—*Alpheopsis equalis* Coutière. a, anterior region of 10 mm male from AM 73, dorsal view; b, large cheliped; c, small cheliped; d, second leg; e, third leg; f, anterior region of 12 mm male from BAU 23, dorsal view. b, c, d, e, scale a; a, f, scale b.

Cheliped at times symmetrical in size and shape, but usually showing about 10 per cent difference in size. Chelipeds of female similar to those of males, but about one-half the size. Fingers and palm of small chela almost equal in length, but in large chela palm longer than fingers. Opposing surfaces of fingers bearing slight irregular serrations or a series of variably shaped truncate teeth. Carpus elongate with outstanding flange into which proximal end of propodus fits, with slight constriction before this flange. Merus approximately 3 times as long as wide, bearing on its superior margin 2 or more spines; ischium also usually bearing movable spinules on superior margin.

Carpal articles of second legs with ratio: 10: 5: 5: 5: 6.

Third leg slender, merus 6.5 times as long as wide, dactylus simple; all articles unarmed except for propodus that bears about 6 strong spines.

*Discussion:* Of the six reasonably intact specimens in the collection there were 2 in which the rostrum reached well past the end of the first antennular article and the stylocerite reached to the end of the third article (see fig. 16f). The wide range of variation in many characteristics of this species has been discussed by Armstrong, 1941, and Banner, 1953; and we feel that when enough specimens of *A. equalis* are collected from Australia these specimens may fall within the range.

*Biological notes:* Our specimens were taken from dead coral broken off the reef flat in water not over 10 ft deep. Coutière reported that some specimens he collected at Djibouti (1898h: 198) were uniform orange in colour with the extremities of the chelae darker. Our specimens ranged in size up to 15 mm.

*Australian distribution:* This species has been collected only at Heron Island and Green Island, near Cairns.

*General distribution:* Israel, Red Sea, Maldive and Laccadive Archipelagoes, Philippines (to be reported), Fiji, Tonga, Samoa, Phoenix and Society Islands, and Hawaii.

### ***Alpheopsis yaldwyni* sp. nov.**

Fig. 17

*Holotype:* 25 mm female collected by J. C. Yaldwyn, December, 1966, at One Tree Island, Capricorn Group, Qld. (AM P.18005.)

*Paratypes:* 1, 25 mm male and 1, 19 mm female, collected by Melbourne Ward, 1926, at Heron I., Capricorn Group (AM P.18006); 1, 25 mm ovigerous female and 1, 22 mm male collected at Heron I. by Julie Booth, 1965 (AM P.18007); 1, 22 mm female and 1, 18 mm male without chelae collected by A. P. McCulloch near Cooktown, Qld 8/10/06 (AM 298).

*Diagnosis:* Rostrum triangular, 1.5 times as long as broad at base, reaching to end of first antennular article. Carapace margin anterior to eyes and lateral to rostral base truncate, almost straight in dorsal view. Eyes concealed in dorsal and lateral view; carapace not inflated over eyes. Pterygostomial angle itself rounded, but margin of carapace slightly dorsal to angle produced into a short acute tooth.

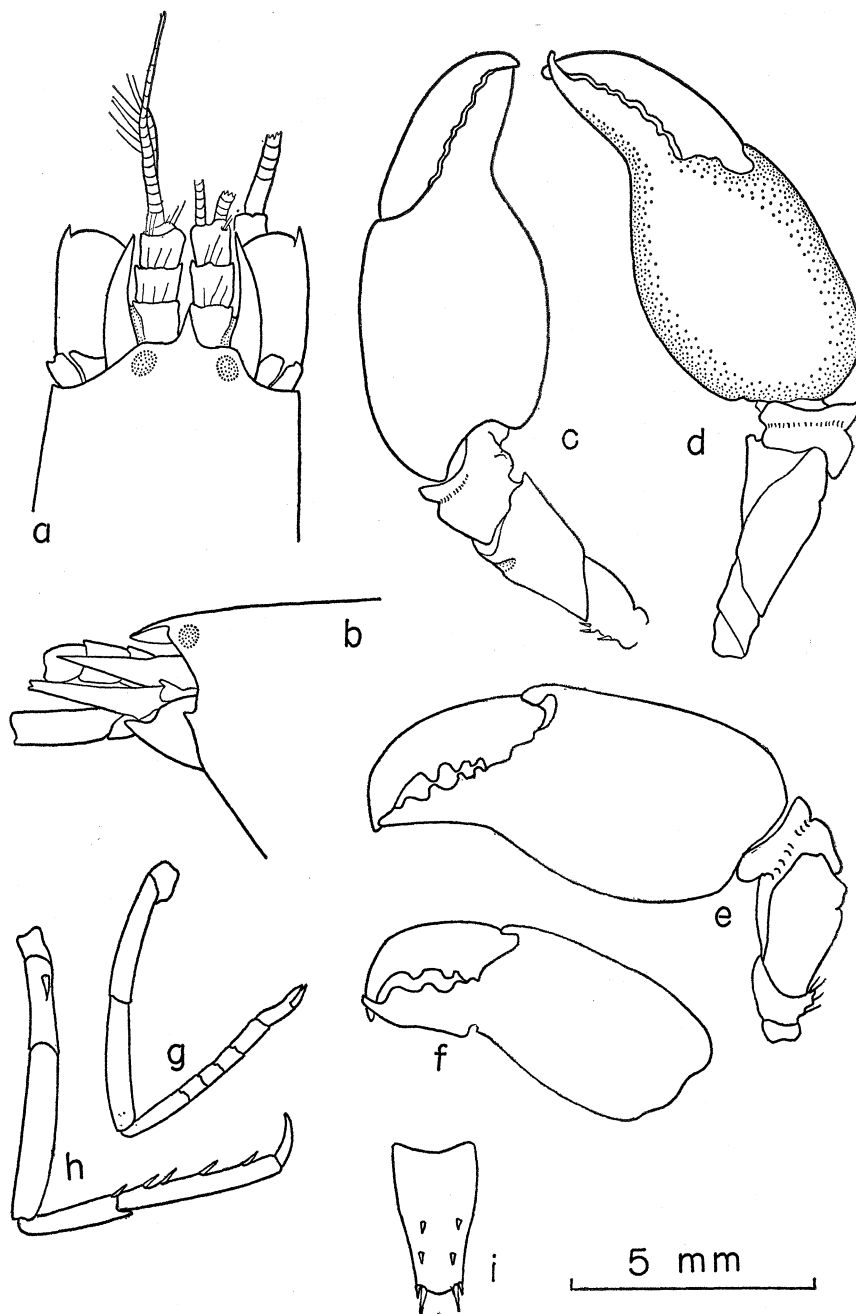


Figure 17.—*Alpheopsis yaldwyni* sp. nov. a, b, anterior region of holotype, dorsal and lateral view; c, large cheliped, inner face; d, large cheliped, outer face; e, large cheliped of paratype, 22 mm male from AM 390; f, large chela of paratype, 25 mm male from AM 283; g, second leg; h, third leg; i, telson.



Antennular peduncle thick, articles subequal, and each article about as broad as long. Stylocerite slender, acute, reaching almost to end of third antennular article. Scaphocerite reaching to end of stylocerite; lateral margin curved slightly inward distally, lateral spine a little longer than broad squamous portion. Carpo-cerite slightly longer than antennular peduncle. Inferolateral margin of basicerite projecting as a heavy blunt tooth.

Only one cheliped available in holotype. Chela 2.2 times as long as broad, with fingers 0.4 as long as entire chela. Palm of large chela inflated in lateral view, constricting on lower margin towards fingers. Palm without grooves, outer face convex, inner face completely flat; superior margin rounded, inferior margin knife-edged. Fingers 0.7 length of palm, slightly crossed at ends, opposing faces with 6 pairs of low rounded teeth which intermesh. Carpus heavy, broader than long; distally bearing superior transverse constriction or groove and expanding into collar around base of palm. Merus 2.2 times as long as broad, superior margin distally incised with groove continuing a short distance on adjacent face; distal margins of lateral and medial faces extended. Ischium bearing 3 short heavy spines on superior margin.

Carpal articles of second leg ratio: 10: 3: 3: 3: 4.

Third leg with ischium 0.4 as long as merus, proximally bearing strong spine. Merus 5 times as long as broad, inermous. Carpus 0.6 as long as merus, distally with a single spine on the inferior margin and rounded tooth on superior margin. Propodus 0.9 length of merus, bearing 5 spinules along inferior margin and 2 proximal to dactylus. Dactylus simple, conical, 0.3 as long as merus.

Telson 1.7 times as long as broad at its anterior end. Inner spine of postero-lateral spines about 2.0 times as long as outer spine, outer spine the same size as those on dorsal surface.

*Discussion:* In the two paratypes from Heron Island collected by Miss Booth in 1965 there are two loose chelae—one exactly like the one which was attached to the holotype (fig. 17c) and one like we have figured (fig. 17e). This type of chela was also found attached to the 25 mm specimen collected by Mel Ward. This is not enough evidence to prove that fig. 17c is the typical female chela and that fig. 17e represents the male chela, but it suggests the possibility that there is sexual dimorphism in the chelae.

This species conforms well on almost all points to *Alpheopsis equalis* when the variability of that species is considered. The only important difference is the form of the large chela both in general configuration and in its unique flattened inner face. In *A. yaldwyni* the first carpal article of the second leg is 3 times the second, while in *A. equalis* it is never more than 2.3 times. However, this character is so variable we do not attach much importance to this difference. This species is also larger with 25 mm in length in the type as opposed to 15 mm, the largest *A. equalis* in our collection. The two specimens from Cooktown were without chelae and are therefore doubtful.

This species is named in honour of Dr John Yaldwyn, not only for the collection of the holotype, but also for the help and encouragement he has given to this study.

*Biological notes:* J.C. Yaldwyn made the following colour notes on this species in the field: "Body, hard, compact with 8 broad transverse bands of bright red. One across each antennular appendage, one across distal end of palm, one down carapace medially, across each leg, and one across tail". Miss Booth's field notes read, "red stripe, one per segment". All of the specimens were taken from broken-up coral heads from shallow water.

Genus **BETAEUS**

*Betaeus* Stimpson, 1861, Proc. Acad. Nat. Sci. Philad. 1860: 31.

*Type species: Betaeus australis* Stimpson.

*Definition:* Rostral front without rostrum or any teeth, rounded or depressed to varying degrees medially. Eyes completely covered by carapace. Pterygostomial angle rounded.

Stylocerite longer than first antennular article.

Chela rounded, showing slight asymmetry, carried in an inverted position with propodal finger uppermost. Chelipeds carried extended. Fingers often with heavy molar processes; often with simple arrangement of meshing teeth. Dentition various.

Second leg with carpus of 5 secondary articles.

Dactylus of third leg simple or biunguiculate. Merus usually with movable spinules proximally on outer face.

Pleura of sixth abdominal segment articulated. Males bearing *appendix masculina*. Telson with anal tubercles; posterior margin rounded.

***Betaeus australis*** Stimpson

Fig. 18

*Betaeus australis* Stimpson, 1861, Proc. Acad. Nat. Sci. Philad., 1860: 31 [Port Jackson, N.S.W.]. Haswell, 1882, Cat. Australian Stalk and Sessile Eyed Crust: 192 [translation of Stimpson's description]. Hale, 1927, Crust. S. Australia, pt 1: 48.

*Neotype:* 21 mm non-ovigerous female from Long Reef, Collaroy, N.S.W. Collected from intertidal rock platform by J. C. Yaldwyn, 20/4/62 (AM P.18008).

*Additional specimens:* 2 specimens from AM 61; 1, AM 284; 1, AM 344; 3, AM 413; 1, AM 427; 1, AM P.4073; 2, AM P.4933; 1, AM P.5305; 4, AM P.6565; 9, AM P.6910; 15, AM P.6911; 1, AM P.7165; 1, AM P.9064; 1, AM P.10981; 4, AM P.11731; 1, AM P.13548; 1, AM P.13577.

*Diagnosis:* Anterodorsal margin of carapace extended and convex, with neither rostrum nor notch; eyes completely covered dorsally and laterally. First and second antennular article subequal in length; second article 1.6 times as long as broad; third antennular article 0.6 as long as second. Stylocerite slender, of uniform taper, reaching to middle of third antennular article. Squamous portion of scaphocerite reaching past end of antennular peduncle. Lateral spine a little longer than squamous portion and separated from it by a deep incision. Carpocerite a little longer than scaphocerite. Lateral spine of basicerite strong and acute. Pterygostomial angle rounded.

Chelae almost symmetrical, slightly compressed without sexual dimorphism, carried extended with dactylus in inferior position. One chela 3.8 the other 3.4 times as long as broad; fingers a little shorter than palm; inner surface of palm bears a small rounded tooth flanking the articulation of dactylus. Lower margin of palm bearing fine hairs forming a "brush". Large chela with cutting surface of both fingers bearing small rounded teeth almost the full length. Small chela (fig. 18e)

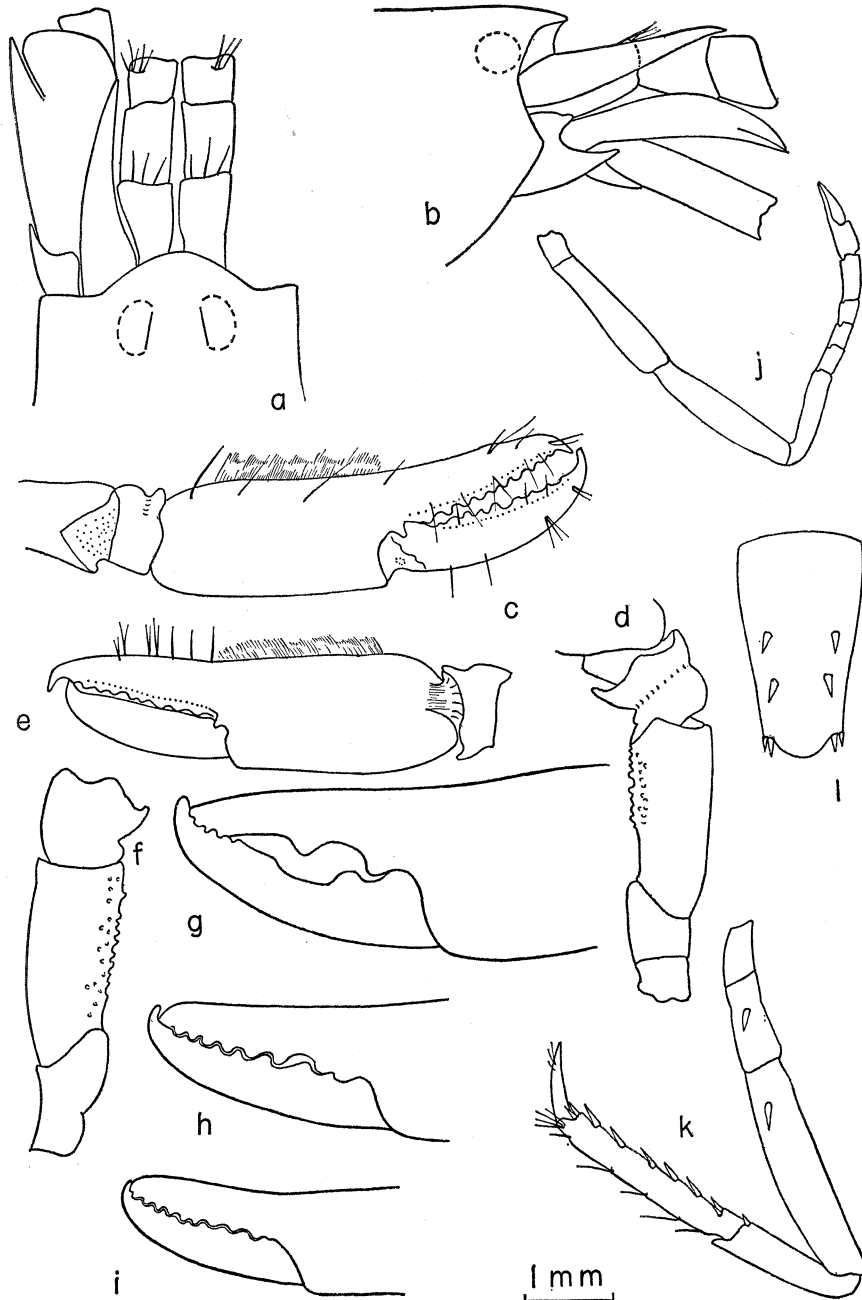


Figure 18.—*Betaeus australis* Stimpson. a, b, anterior region of neotype, dorsal and lateral view; c, large chela, inner face; d, merus and carpus of large chela, inner face; e, small chela, inner face; f, merus and carpus small chela, inner face; g, fingers of 27 mm male; h, fingers of 24 mm male; i, fingers of 25 mm female (g, h, i, from AM P.6910); j, second leg; k, third leg; l, telson.

with cutting margin of fixed finger bearing 10 small rounded teeth, opposing margin on dactyl not dentate. Tips of fingers of both chelae crossing. Carpus cup-shaped, 0.2 as long as chela, distal margin flared and encompassing base of chela. Distal margin bearing 2 strong rounded projections proximal to lateral sides of chela; between these 2 projections lies a smaller rounded projection. Merus 2.5 times as long as broad, inner face slightly papillose, inferointernal margin strongly papillose, appearing roundly serrate in profile. Inferior face bearing a triangular flattened portion on distal section which accommodates carpus when cheliped is flexed. Ischium unarmed and smooth.

Carpal articles of second legs with ratio: 10:3:3:3:5.

Third leg with spine on lateral face of ischium. Merus 5 times as long as broad and bearing spine proximally on its lateral surface. Carpus half as long as merus; superodistal margin produced into rounded tooth, inferodistal corner bearing small movable spine. Propodus slender, 0.8 as long as merus and bearing at least 6 movable spines on inferior margin, with fine setae adjacent to most spines. Superior margin also bearing several strong setae.

Pleura of sixth abdominal segment articulated.

Telson of usual form for family, 3.7 times as long as posterior margin is wide; anterior breadth 1.6 times as wide as tip; posterior margin strongly convex, posterolateral spinules not reaching level of distal margin.

*Discussion:* None of Stimpson's original type material is available (see *Alpheopsis trispinosus*, p. 339) and it is desirable to establish neotypes for his species. Stimpson's specimen came from Port Jackson and was 25 mm in length. Our specimen is smaller (21 mm), but we chose it because it was the best complete specimen we had from close to where Stimpson's specimen was collected.

In the neotype the antennules were deflected downward, thus in the drawings the scaphocerite and carpocerite appear a little longer than in the majority of specimens where the antennular peduncle is extended, making the scaphocerite and carpocerite more nearly the length of the peduncle. The stylocerite varied in length from the end of the second antennular article to the middle of the third article. In our 40 specimens the greatest amount of variation occurred in the dentition of the fingers of the chelae. We have figured 3 of the most common types (figs 18g, h, i), but occasionally we found a specimen in which both chelae were almost devoid of teeth. In the genus *Athanas* only the older and larger specimens bear the heavy irregular teeth, but in *B. australis* the development of the teeth could not be correlated with either size or sex. The roughness of the inner side of the meri of the chelipeds appeared to be influenced by age as the inner face of the large specimens were more strongly papillose than in the small specimens. In very large specimens the surface of the carpus was also rough.

*Biological notes:* This species is found intertidally under rocks. Our largest specimen was 35 mm long.

Stimpson states his specimen was green and Hale (1927: 48) states: "Upper surface rich purplish-brown; sides and tips of uropods white". J. C. Yaldwyn, who collected the neotype, supplied the following colour notes for it: "Dorsally purplish, laterally much lighter; transparent areas along back dorsally on each segment; hand reddish purple contrasting with the dark purple of the body; branchial region of carapace and lateral area of first few abdominal segments, as well as walking legs, virtually colourless. Purple colour due to dense mat of small, simple, stellate, red

chromatophores with the whole area of red chromatophores surrounded by a mass of granular blue chromatophores extending a little beyond the red mat in places; anterodorsal part of the carapace is green with a mat of granular green chromatophores (similar in every way to the granular blue except for colour) on the dorsal half of the carapace; the eyes are black and clearly visible under the carapace hoods as the hoods are extending to the front of the carapace between the eyes. I am convinced that the red chromatophores are simple and not compounded with the blue. The white edge of the uropods which Hale (1927) mentions for this species is presumably the white setal fringe and not the appendage itself. This white fringe is quite obvious and shows no sign of colour”.

*Australian distribution:* Our specimens, like Stimpson's, came mostly from the Sydney area. They were collected as far north as Yamba, N.S.W. One specimen was collected off Victoria, and Hale (1927: 48) reports it from South Australia. The species is apparently limited to south and southeastern Australia.

### Genus **RACILIUS**

*Racilius* Paulson, 1875, Invest. Red Sea Crust., 1: 107.

*Type species:* *Racilius compressus* Paulson.

*Definition:* “The body is unusually compressed, in the form of a sheet [of cardboard] and has sharp edges on the abdominal segments; there is a crest on the cephalothorax which continues in a short rostrum. The eyes are covered by the spinous cephalothorax. The antennules have two flagella. Appendages, similar to those of *Alpheoides*, are present at the base of the pereopods. The first pair of legs are the same length and equally strong and have giant chelae; their dactyli move in the vertical plane. The carpopodite of the second pair of legs is made up of five joints. The mandibles are like those of *Alpheus*. The anterior joint of the last maxilliped is not as short as that of *Alpheus*. The uropod is quite different from that of *Alpheus* and *Alpheoides*. This genus is closely related to the genera *Alpheus*, *Alpheoides*, *Arete* and *Betaeus*, forming a homogenous group with the subfamily of the *Alpheinae* with them.” [Translated from the Russian by F. D. Por, 1961.]

To this description we should add that the pleura of the sixth abdominal segment are not articulated, and that in the type and only species the outer uropod bears a strong movable spine and on the inner uropod often a strong triangular projection.

We agree with both Paulson and Coutière (1899: 337) that this genus is near to *Alpheus* and was probably derived from it. The second leg bears five articles as is true of all *Alpheus*; the chela, though extremely compressed, has the general appearance and bears a plunger so typical of that genus.

### **Racilius compressus** Paulson

Fig. 19

*Racilius compressus* Paulson, 1875, Recher. Crust. Mer Rouge, 107, pl. 14, fig. 2. Coutière, 1899, Les Alpheidae, 87, fig. 46; 243, fig. 296 [description and figures after Paulson]. Balss, 1927, Trans. Zool. Soc. Lond., 22 (2): 226. Barnard, 1958, Ann. Mag. Nat. Hist. XII, 10 (118): 732. Banner & Banner, 1966b, Siam Soc. Mono. No. 3: 159, fig. 62. Bruce, 1972, Crustaceana 22 (1): 91, 92.

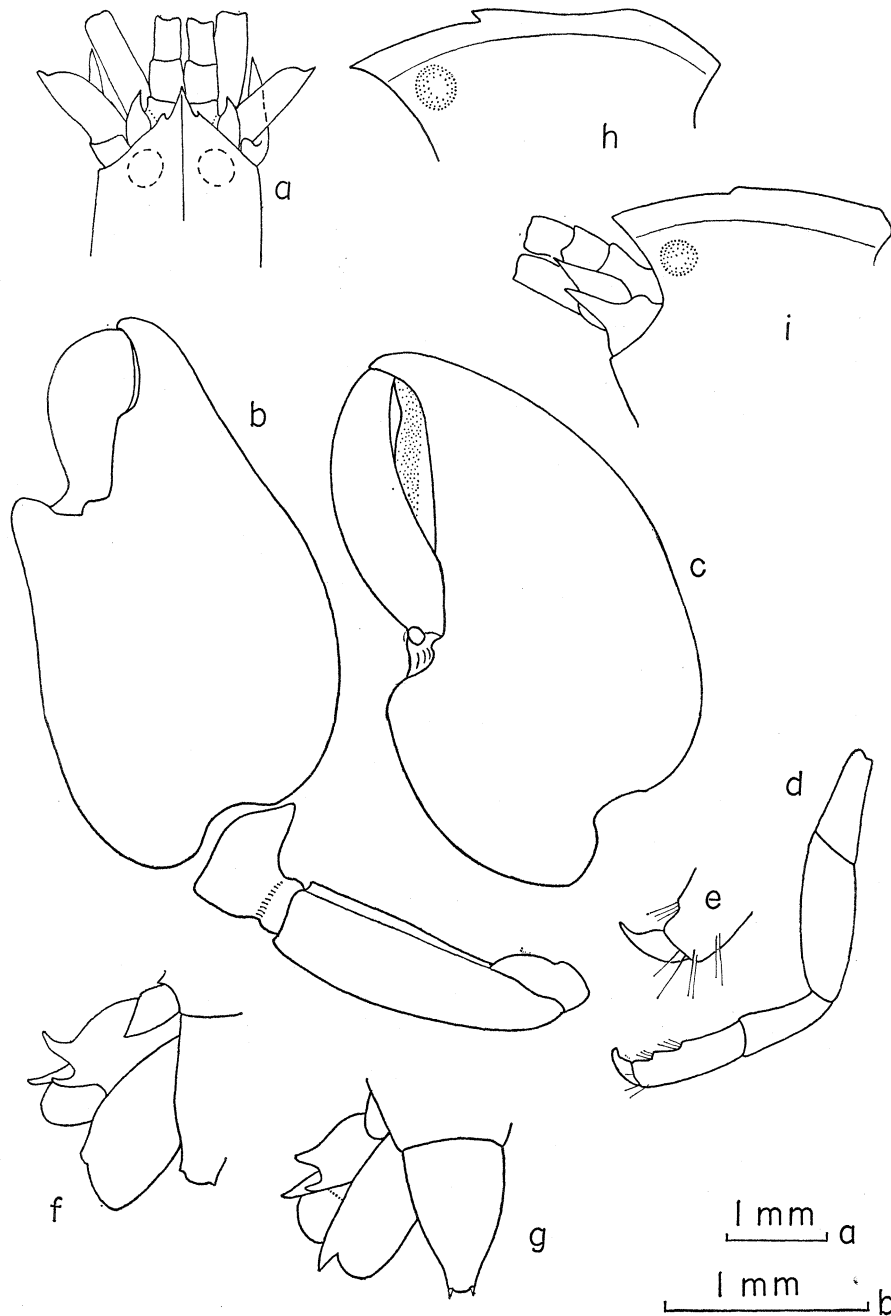


Figure 19.—*Racilius compressus* Paulson. a, anterior region of 15 mm female from AM 327, dorsal view; b, large cheliped; c, small cheliped; d, third leg; e, dactylus of third leg; f, telson; g, telson of 11 mm male from AM 327; h, lateral view of anterior region of 14 mm female from AM 337; i, lateral view of anterior region of 10 mm male from AM 337.

*Specimens examined:* 2 specimens from AM 327; 3, AM 337.

*Diagnosis:* Entire body and chelae with strong lateral compression. Eyes covered by carapace, but without inflated orbital hoods; with anterior orbital teeth. Rostrum broadly triangular, reaching to middle of second antennular article. Dorsal carina of carapace high and knife-like, extending from rostrum to posterior end of carapace; with variable notches. Stylocerite as long as first antennular article. Antennular articles short and thick. Scaphocerite reaching beyond end of second antennular article. Chelae similar in size, almost 1.6 times as long as broad, but on "large" chela, dactylus rounded and less than half as long as palm, while on "small" chela dactylus is curved and acute, equal to length of palm. Carpus expanded distally. Merus triangular in section, slender unarmed.

Carpal articles of second leg with ratio: 10 : 2 : 2 : 1 : 4.

Merus of third leg inermous, 2.6 times as long as broad. Propodus bearing distally on inferior margin one spine and a few setae, bearing proximally occasional patches of setae. Dactylus simple, broad at its proximal end, tapering abruptly to acute tip; tip so curved that it lies at a right angle to the propodus.

Telson strongly tapering, 6 times as long as posterior margin is broad. No movable spinules on upper surface. Posterior margin of proximal portion of outer uropod forms a flap bearing strong teeth with a large movable spine inserted between the two teeth. Distally outer uropod bears usual transverse articulation. Inner uropod with lateral margin projected into a triangular tooth of variable size, at times very small (fig. 19).

*Discussion:* The notch in the dorsal carina near the level of the eyes showed the usual variation in shape (19h, i; see also Banner & Banner, 1966b: 162). The variation in the lateral tooth on the inner uropod is described above (fig. 19f, g). About 25 specimens from a large collection of *R. compressus* from the Philippines exhibited the same variations.

*Biological notes:* All of our specimens were symbiotic on living coral of the genus *Galaxia*; all Australian specimens came from *G. vesiculatus*. We will report from the Philippines that it occurs in those species of *Galaxia* with closely-set polyps, occasionally in those with moderately-set polyps, and never in species with large, widely-set polyps. The lateral compression of the body and chelae allow the species to move about in the narrow spaces between the corallites. The body is transparent with a close scattering of minute red chromatophores. The eyes are blue-black and the female bears green eggs. (Colour notes supplied by J. C. Yaldwyn.) This species is usually small, but we had one specimen that was 15 mm.

*Australian distribution:* Our 5 specimens were collected on the reef flat on One Tree I. in the Capricorn Group.

*General distribution:* South and East Africa, Red Sea, Suez Canal, Singapore, Thailand, and the Philippines (the last to be reported on in a future paper).

## APPENDIX

**Locality Lists for the Alpheid Collection**

In the listing given below are the localities and, at times, ecological notes for all specimens of all genera of the alpheids from Australia presently at hand. This, then, is the master listing for all three portions of the paper to be published. If additional specimens are obtained before the publication of the second and third parts of the paper, those listings will be added to Part 3. In an effort to keep the listing as short as possible, we have at times summarized the information on the labels of the specimens or referred back to an earlier listing.

The specimens came to us with a variety of designations, sometimes with museum catalogue numbers, either numerals alone or alphanumerics, at other times without any coded reference. To shorten locality lists under the various species, and to facilitate the use of this master listing, we have prefaced each separate collection from an institution or an individual with a two to three letter code which is followed either by the official catalogue numbers or, where these were lacking, by numbers that we have assigned for this study. It may be presumed that if the institutions assign new catalogue numbers to the specimens that we have numbered, they will keep a cross-reference file.

In the listing below, the collections are arranged alphabetically by code designations. The codes are assigned as follows:

|       |  |
|-------|--|
| AC    | Aquinas College.   |
| AH    | Allan Hancock Foundation.  |
| AM    | The Australian Museum, our assigned numbers.                     |
| AM E. | The Australian Museum, F.I.S. <i>Endeavour</i> Register numbers. |
| AM G. | The Australian Museum, General Invertebrate Register numbers.    |
| AM P. | The Australian Museum, Crustacea Register numbers.               |
| BAU   | Banner, Australian collection.                                   |
| CS    | C. R. Smalley.   |
| JB    | John Boase.  |
| JC    | James Cook University.   |
| MM    | Macleay Museum.  |
| QM    | Queensland Museum.   |
| QV    | Queen Victoria Museum.   |
| RG    | R.U. Gooding.  |
| SM    | South Australian Museum, our assigned numbers.                   |
| SMC   | South Australian Museum.   |
| TM    | Tasmanian Museum and Art Gallery.                                |
| UQ    | University of Queensland.  |
| US    | United States National Museum.                                   |
| VM    | National Museum of Victoria.                                     |
| WM    | Western Australian Museum.                                       |

All specimens on loan will be returned to their institutions; we have indicated the repository of collections made by individuals.



### COLLECTIONS FROM AQUINAS COLLEGE, MANNING

These collections, lent by the College, were made by students during yearly expeditions to the Houtman Abrolhos Islands off the coast of Western Australia. Their field numbers we have prefaced with "AC". These collections will be donated to the Western Australian Museum.

- AC C-1. 1 mi. N. of Jubilee I. 19 fms. 4/1/68. Collected by scallop trawl, found in small cavities in coral and sponges. Coll. A. James and G. Davempport.
- AC C-28. From small island S. of Gun I. 4 ft. 5/1/69. From living coral. Coll. A. James and G. Davempport.
- AC C-29. 5 mi. N. of Rat I., in Easter Group. Collected by scallop trawl in 20 fms. 6/1/68. Sandy bottom. Coll. A. James and G. Davempport.
- AC C-50, 54. E. side of Jubilee I. 4 ft. 7/1/68. On and in coral rocks on bottom. Coll. A. James and G. Davempport.
- AC C-59. S. end of Pelsart I. 8/1/68. On and in coral rocks on bottom. Coll. A. James and G. Davempport.
- AC S. 1. N. of Suomi I., in Easter Group. 3-4 ft. 23/8/70. Living on crinoid. Coll. G. Murphy.
- AC S. 2. 3 mi. NW. of Basile I. 19 fms. 25/8/70. Dredged with scallop trawl. From living sponge. Coll. G. Murphy.
- AC S. 3. 4 mi. N. of Gun I. 19 fms. 27/8/70. Coll. G. Murphy.
- AC S. 4. 4 mi. N. of Gun I., Pelsart Group. 19 fms. 8/27/70.
- AC S. 5. N. side of Wooded I., Easter Group. 3-4 ft. 27/8/70. From reef area, living on crinoid. Coll. G. Murphy.

### COLLECTIONS FROM THE ALLAN HANCOCK FOUNDATION, LOS ANGELES, CALIFORNIA

AH Accession number 1968-11.

1. Heron I., Capricorn Group, Qld. Coll. Miss J. Haig, from *Acropora cunneata*.
2. Same as #1. Under rocks on exposed sand flat.
3. Same as #1. 11/6/68. From live *Pocillopora damicornis*.
4. Same as #1. 11/6/68. Outer reef flat from *Acropora*.
5. Same as #1. Coll. S. Domm. From *Pocillopora damicornis* in 15 ft of water over edge of reef.
6. Myora, Stradbroke I., Qld. Coll. Miss J. Haig, 27/6/68. Among oysters and under oyster clumps in mud and sand flat.

### COLLECTIONS FROM THE AUSTRALIAN MUSEUM, SYDNEY

For collections not yet assigned a museum catalogue number we have assigned numbers prefaced with "AM"; the E, G, P series prefaced with "AM" are the museum register designations.

- AM
1. Clovelly, near Sydney, N.S.W. 80 ft. Coll. N. Coleman, 1965. On sponges.
  2. Heron I., Capricorn Group, Qld. J. S. Hynd collection. 27/5/47.
  3. Off Ninety Mile Beach, between Cape Jaubert and Wallal, W.A. Dredged 5 miles off shore in 5 fms. Coll. A.A. Livingstone, Sept. 1929.
  4. Gillet Cay, Swain Reefs, Qld. AM 1962 Swain Reefs Exped. Sta. 1, Oct. 1962. Under beach rock.
  5. Geraldton, W.A. Coll. A. A. Livingstone, Oct. 1929. Intertidal, under rocks.
  6. Lord Howe I., Tasman Sea, S. end lagoon. Coll. Miss J. Booth, 18/9/62.
  7. Norman River mouth, Gulf of Carpentaria, Qld. Coll. D. F. McMichael and J. C. Yaldwyn, Dec. 1963.
  8. Between Cape Bossutt and Broome, W.A. 5 fms. Coll. A. A. Livingstone, 11/9/29.
  9. Cape Leveque, W.A. Coll. intertidal, coll. A. A. Livingstone, 20/8/29.
  10. Between North and South Shell Is., Port Darwin, N.T. 3-7 fms. Coll. A. A. Livingstone, 15/7/29. Dredged among dead coral and sponges.
  11. Fairlight, Manly, Port Jackson, N.S.W. Coll. Miss E. Pope, 1/2/64. Subtidal.

- AM 12. Intertidal rock platform, Minnie Waters near Grafton, N.S.W. Coll. J. C. Yaldwyn, Feb. 1965.
13. Trawled off Karumba, Gulf of Carpentaria, Qld. 14 fms. Coll. J. C. Yaldwyn and D. F. McMichael on CSIRO prawn survey, Dec. 1963.
14. Same as AM 12.
15. Chambers Bay, Van Diemen Gulf, near Darwin, N.T. Taken from pearl shell growth by V. Wells off A. K. "Paxie" for A. A. Racek, Oct.-Nov. 1959.
16. Same as AM 11. 13/8/64.
17. Myora, Stradbroke I., Moreton Bay, Qld. J. S. Hynd collection, 8/3/46. From *Acropora* sp.
18. Thursday I., Torres Str., Qld.
19. Tale Head, Port Darwin, N.T. Coll. A. A. Livingstone, 24/6/29. Intertidal under stones.
20. Cape Leveque, W.A. Coll. A. A. Livingstone, 1929.
21. Same as AM 10.
22. Gantheaume Point, Broome, W.A. Coll. A. A. Livingstone, 5/8/29. Collected intertidally on reef under stones. Commensal on urchin *Heliocidaris tuberculata*.
23. Moreton Bay, Qld. American Fisheries Assoc.
24. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, 27/2/63. Commensal on urchin *Heliocidaris tuberculata*.
26. Mary River Heads, Sandy Str., Qld. 2 fms. J. S. Hynd collection, 6/6/46. Commensal with an Alcyonarian.
27. Minnie Waters, near Grafton, N.S.W. Coll. J. C. Yaldwyn, 3/11/63. From intertidal rock platform.
28. Bountiful I., Gulf of Carpentaria, Qld. Coll. J. C. Yaldwyn, 30/11/63.
29. Heron I., Qld. Coll. L. R. Thomas, Oct. 1958.
30. Elliot River Heads, S. of Bundaberg, Qld. J. S. Hynd collection, 3/6/46.
31. Shelly Beach, Yamba, Clarence River mouth, N.S.W. Coll. A. A. Cameron from under stones below low tide mark.
32. Ship Rock, Little Turriell Point, Port Hacking, N.S.W. Coll. D. Wilson and party, 20/6/65.
33. Near entrance Roebuck Bay, Broome, W.A. 5-8 fms. Coll. A. A. Livingstone, 26/6/29. Lithothamnion ridge, reef bottom. [Inasmuch as the term "Lithothamnion Ridge" persists in the literature, but the algal ridge itself is composed mainly of alga known today as *Porolithon*, we have elected to retain the collector's name, but we do not italicize it as we would a proper generic name.]
34. Same as AM 3.
35. Entrance Roebuck Bay, Broome, W.A. 9 fms. Coll. by diver for A. A. Livingstone, 15/8/29.
36. Sandgate, Moreton Bay, Qld. J. S. Hynd collection, 27/7/46.
37. Same as AM 27. Feb. 1965.
38. Same as AM 36. 9/3/45.
39. Off Roebuck Bay, Broome, W.A. 5-9 fms. Coll. A. A. Livingstone, 1929.
40. Same as AM 35.
41. Long Reef, Collaroy, N.S.W. Coll. J. C. Yaldwyn, 21/4/63. From intertidal reef pools.
42. Same as AM 13.
43. Gillett Cay, Swain Reefs, Qld. Coll. by AM 1962 Swain Reefs Exped. Sta. 1, Oct. 1962. From broken coral from reef flat.
44. Same as AM 10.
45. Same as AM 8.
46. Long Reef, Collaroy, N.S.W. Coll. Miss E. Pope, 12/3/64. From intertidal platform.
47. Same as AM 10.
48. Gantheaume Point, Broome, W.A. Coll. A. A. Livingstone, Sept. 1929. Commensal with comatulid *Comanthus angulata*, intertidal.
49. Bottle and Glass Rocks, Port Jackson, N.S.W. Coll. Miss B. Campbell, 18/1/61.
50. Same as AM 33.
51. Manly, near Sydney, N.S.W. Coll. A. F. Basset-Hull.
52. Same as AM 43.
53. Same as AM 43, under beach rock.
54. Same as AM 48.
55. Off Broome Jetty, W.A. 4 fms. Coll. A. A. Livingstone, 16/8/29. Commensal on crinoids.
56. Scarborough, Moreton Bay, Qld. 2 fms. J. S. Hynd collection, 5/7/46. From weed.
57. Same as AM 22.

- AM 58. Heron I., Capricorn Group, Qld.  
 59. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, 18/9/62.  
 60. Same as AM 27.  
 61. Same as AM 51.  
 62. Same as AM 27.  
 63. Same as AM 10, 2/7/29.  
 64. West Cay, Diamond Islets, Coral Sea, Qld. Coll. J. C. Yaldwyn and D. F. McMichael, 23/10/63. From intertidal pools in beach rock.  
 65. South end lagoon, Lord Howe I., Tasman Sea. Specimens from dead coral.  
 66. Thursday I., Torres Str., Qld. Coll. M. Ward.  
 67. Same as AM 15.  
 68. Heron I., Capricorn Group, Qld. Coll. Outward Bound School Party, Dec. 1960. From coral reef.  
 69. Same as AM 27.  
 70. Scarborough, Moreton Bay, Qld. J. S. Hynd collection, 19/5/46. Trawled below low water mark.  
 71. Wistari Reef, Capricorn Group, Qld. J. S. Hynd collection, 2/6/47.  
 73. Heron I., Capricorn Group, Qld. Coll. Miss J. Booth, 2/7/63.  
 74. Same as AM 64. 7/11/64. From coral head washings.  
 75. Sellicks Beach, St Vincent Gulf, S.A. 10 ft below tide level, sargassum zone, 25/3/39.  
 76. Long Reef, Collaroy, N.S.W. Coll. Miss J. O. Campbell, 12/1/63. Under rocks.  
 77. Long Reef, Collaroy, N.S.W. Coll. Miss E. Pope, 22/10/57. Intertidal rock platform.  
 78. Ned's Beach, Lord Howe I., Tasman Sea. Coll. E. Pope, July 1959. Intertidal, among boulders.  
 79. Myora, Stradbroke I., Moreton Bay, Qld. J. S. Hynd collection, 27/10/46. From coral.  
 80. Heron I., Capricorn Group, Qld. Coll. Miss I. Bennett, 18/8/61.  
 81. Monkey I., Ross Creek, Townsville, Qld. Coll. W. McNae, 9/2/62.  
 82. Elliot Heads, S. of Bundaberg, Qld. J. S. Hynd collection, 3/6/46.  
 83. Same as AM 73.  
 84. Hopetoun, near Albany, W.A. Intertidal. CSIRO. Fisheries, 1947.  
 85. Same as AM 50.  
 87. Scamander, Tasmania. W. A. Haswell collection.  
 88. Heron I., Capricorn Group, Qld. Coll. H. Cogger, 1956. From coral reef.  
 89. Same as AM 73.  
 90. Thomas Cay, Swain Reefs, Qld. Coll. L. R. Thomas, Nov. 1960. From coral on reef.  
 91. Off Gillett Cay, Swain Reefs, Qld. Dredged in 20 fms. AM 1962 Swain Reefs Exped. Sta. 4, Oct. 1962.  
 92. Townsville, Qld. Coll. W. McNae, March 1962. From mangrove swamp.  
 93. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, Sept. 1962.  
 94. Lady Elliot I., Qld. Coll. Mrs C. Wright, 1964.  
 96. Barron River, Cairns, Qld. Coll. B. Campbell, 6/11/63. Downstream from road bridge. Salinity at low water was c. 90/00. 3 ft below surface of river bank at water table, within meshwork of interconnecting *Sesarma* crab burrows and chambers.  
 97. Pearl Shoals, off Broome, W.A. Coll. A. A. Livingstone, 14/9/29. On disc of crinoid *Comanthus* sp.  
 98. Kenn Reef, Coral Sea, Qld. Coll. D. F. McMichael, 2/10/60.  
 99. Endeavour River, Cooktown, Qld.  
 101. Moonta Bay, Spencers Gulf, S.A. Coll. K. Sheard.  
 102. Karumba, Gulf of Carpentaria, Qld. Trawled in less than 14 fms. Coll. D. F. McMichael and J. C. Yaldwyn, Dec. 1963 during CSIRO prawn survey. Commensal on "cow udder" sponge.  
 103. Same as AM 87.  
 104. Heron I., Capricorn Group, Qld.  
 105. Same as AM 104.  
 106. Same as AM 43.  
 107. Same as AM 43.  
 108. Same as AM 104.  
 109. North East Cay, Herald Group, Qld. Coll. J. C. Yaldwyn, 9/11/63. From coral washings.  
 110. Tyroom Roads, Sandy Str., Qld. 10 fms. J. S. Hynd collection, 6/6/46. From alcyonarian.  
 112. South Bank, Pancake Channel, Port Curtis, Qld. J. S. Hynd collection, 25/8/46. Under living coral, on dead coral.

- AM 113. Seal Rocks, Port Curtis, Qld. J. S. Hynd collection, 28/8/46.  
 114. Gulf of Carpentaria, 17° 24.7' S., 140° 31.7' E., CSIRO Prawn Survey. Sta. 19, 5 fms, 2/8/63.  
 114a. Sandgate, Moreton Bay, Qld. J. S. Hynd collection, 25/6/44.  
 115. Norfolk I., Tasman Sea. Coll. Mrs L. March, Oct. 1960.  
 116. Shark Bay, W.A. Collected by CSIRO Fisheries, 27/9/48. Trawled from sponges.  
 117. Scarborough, Moreton Bay, Qld. J. S. Hynd collection, 3/9/45. From weed flat.  
 118. Shoals light buoy, off Cape Moreton, Qld. 11 fms. Coll. J. S. Hynd on S.S. *Cape Leeuwin*.  
 119. The Brook, Lord Howe I., Tasman Sea. Coll. Miss J. Booth, 3/6/62.  
 120. Same as AM 43.  
 121. Albany Passage area, Torres Str., Qld. Coll. M. Ward, Sept. 1928.  
 122. Two Fold Bay, Eden, N.S.W. W. A. Haswell collection.  
 123. Same as AM 104.  
 124. West Side, Fort Hill Point, Darwin, N.T. Coll. A. A. Livingstone, 1929. Intertidal.  
 125. Same as AM 102.  
 126. Elliot Heads, S. of Bundaberg, Qld. J. S. Hynd collection, 3/6/46. Under stones.  
 127. Proulee Beach, 1/2 miles from footbridge, South Coast, N.S.W. Coll. R. E. Barwick, 14/5/62.  
 128. Cape Leveque, W.A. Coll. A. A. Livingstone, 19/8/28. Intertidal.  
 129. Same as AM 27.  
 130. Off Mary River, North Head, Sandy Str., Qld. J. S. Hynd collection, 6/6/46. From sandy mud flat.  
 131. Same as AM 27, Feb. 1965.  
 132. Woody Head, Clarence River mouth, N.S.W. Coll. A. A. and M. Cameron, 28/8/65. Intertidal.  
 133. Same as AM 79, 27/3/46. From outer sandbank.  
 134. Same as AM 9.  
 135. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, Nov. 1962. Found in coral south end of lagoon.  
 136. Same as AM 102.  
 137. Same as AM 10. 4/7/29.  
 138. Same as AM 48.  
 139. Entrance to Roebuck Bay, Broome, W.A. 9 fms. Coll. by diver for A. A. Livingstone, 15/8/29.  
 140. Same as AM 10. 2/7/29.  
 141. Same as AM 50.  
 142. Lady Elliot I., off Bundaberg, Qld. Coll. Mrs C. Wright, 1964.  
 143. Hook Reef, Great Barrier Reef, E. of Whitsunday Passage, Qld. Coll. F. A. McNeill, July 1962.  
 144. Reef Point, Scarborough, Moreton Bay, Qld. Coll. J. S. Hynd, 17/4/47. Intertidal rock pools.  
 145. Same as AM 110.  
 146. Same as AM 41.  
 147. Same as AM 104.  
 148. Angourie, mouth of Clarence River, N.S.W. Trawled in 18 fms. Pres. A. A. Cameron, Sept. 1963.  
 149. Albatross Bay, near Weipa, Gulf of Carpentaria, Qld. Dredged. Coll. H. Foley, 1962-63.  
 150. Same as AM 27.  
 151. Same as AM 20.  
 152. Same as AM 27.  
 153. Port Curtis, Qld. J. S. Hynd collection, August 1916.  
 154. Same as AM 102.  
 155. Same as AM 43.  
 156. Same as AM 43, sta. 2.  
 157. Same as AM 43.  
 158. Same as AM 41, 2/1/64.  
 159. Roebuck Bay, Broome, W.A. Coll. A. A. Livingstone, Sept. 1929. From tidal flat.  
 160. Same as AM 15.  
 162. Mangrove Creek, just south of Ross River, Townsville, Qld. Coll. W. MacNae, March 1962.  
 163. Gillett Cay, Swain Reefs, Qld. Dredged from 20 fms. Coll. J. C. Yaldwyn with Australian Museum 1962 Swain Reefs Exped. Sta. 4.  
 164. Jacob's Well, S. end Moreton Bay, Qld. J. S. Hynd collection, 10/5/42.

- AM 165. Same as AM 79, 22/5/45.  
 167. Pancake Channel, Bustard Head, Port Curtis, Qld. J. S. Hynd collection, 25/8/46. Intertidal pools.  
 168. Green I., off Cairns, Qld. J. S. Hynd collection, 14/7/46.  
 169. Same as AM 102.  
 170. Same as AM 43.  
 171. West Cay, Diamond Islets, Coral Sea, Qld. Coll. J. C. Yaldwyn and D. F. McMichael, Oct. 1963.  
 172. Mouth of Norman River, Gulf of Carpentaria, Qld. Coll. D. F. McMichael and J. C. Yaldwyn, 16/12/63. From burrows in intertidal mud flats.  
 173. Same as AM 102.  
 174. Same as AM 43, 13/10/62.  
 175. Manly, Moreton Bay, Qld. J. S. Hynd collection, 27/7/46. From weed.  
 177. Off Cape Varquar, between North West Cape and Shark Bay, W.A. CSIRO Fisheries, 12/11/48.  
 179. Scarborough, Moreton Bay, Qld. J. S. Hynd collection, 17/9/45.  
 180. Gulf of Carpentaria, 17° 5.7' S., 140° 30.0' E., CSIRO Prawn Survey. Sta. 805, 8 fms, 24/4/64.  
 182. NE. up Rainbow Channel from Myora Light, Stradbroke I., Moreton Bay, Qld. Dredged in coarse sand, 6-8 fms. Coll. W. Stephenson, 12/10/61.  
 183. Same as AM 102, Sta. 55.  
 184. Townsville, Qld. W. A. Haswell collection.  
 185. Same as AM 27.  
 186. Heron I., Capricorn Group, Qld. Coral reef. Coll. Outward Bound School Party, Dec. 1960.  
 187. Same as AM 144, 8/12/46.  
 188. Same as AM 102.  
 189. Same as AM 27.  
 190. Entrance Point, Broome, W.A. Coll. A. A. Livingstone, 1929. From intertidal region on rocky reef shore.  
 191. Same as AM 3.  
 192. Same as AM 41. 20/4/62.  
 193. Gulf of Carpentaria, 17° 21.4' S., 139° 53.0' E., CSIRO Prawn Survey. Sta. 78, 6 fms, 21/8/63.  
 194. Southern Gulf of Carpentaria, NE. of Albert River, Qld. 14 fms. CSIRO Prawn Survey. Coll. D. F. McMichael, Dec. 1963.  
 195. Port Jackson, N.S.W. W. A. Haswell collection.  
 196. Heron I., Capricorn Group, southern Barrier Reef, Qld. Coll. J. A. Bishop, 9/1/61. From broken coral on reef flat.  
 197. Same as AM 142.  
 198. Bountiful I., Gulf of Carpentaria, Qld. Coll. J. C. Yaldwyn, Dec. 1963. From intertidal rock platform.  
 199. Same as AM 15.  
 200. Same as AM 40.  
 201. Heron I., Capricorn Group, Qld. Coll. K. Gillett, Dec. 1960. From reef flat.  
 202. Barron River, Cairns, N. Qld. Coll. J. C. Yaldwyn, 2/11/63. From *Sesarma* crab burrows deep within river bank. Same loc. as AM 96.  
 203. Entrance Point, Broome, W.A. Coll. A. A. Livingstone, Aug. 1929. Intertidal rocky reef shore.  
 205. South end lagoon, Lord Howe I., Tasman Sea. From dead coral.  
 206. Norman River Mouth, Karumba, Gulf of Carpentaria, Qld. Coll. J. C. Yaldwyn, Dec. 1963.  
 207. Same as AM 79. 28/9/46.  
 208. Same as AM 159. 8/8/29.  
 209. Lady Elliot I., off Bundaberg, Qld. Coll. Mrs C. Wright, 1964.  
 210. Same as AM 27.  
 211. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, 6/3/63.  
 212. Long Reef, Collaroy, N.S.W. Coll. Miss I. Bennett, May 1964. Intertidal, under rocks.  
 213. North of Norman River, Gulf of Carpentaria, Qld. Coll. D. F. McMichael and J. C. Yaldwyn, Dec. 1963. Under intertidal beach rock boulders.  
 214. Off Cape Moreton, Qld. Trawled 11 fms. S.S. *Cape Leeuwin*, J. S. Hynd collection.  
 215. Same as AM 41, 20/4/62.  
 216. Same as AM 27, Feb. 1965.  
 217. Same as AM 216.

- AM 218. Same as AM 112. Upper part of intertidal zone.  
 219. North East Cay, Herald Group, Coral Sea. Coll. J. C. Yaldwyn and D. F. McMichael. 7/11/63. Under beach rock.  
 220. Shark I., Port Jackson, N.S.W. 9/11/68.  
 221. Same as AM 43.  
 222. Same as AM 216.  
 223. Same as AM 211, 27/2/63.  
 224. Same as AM 50.  
 225. Ned's Beach, Lord Howe I., Tasman Sea. Coll. D. Linklater, March 1967. Intertidal under rocks, commensal among spines on under side of *Helicoidaris tuberculata*.  
 226. Same as AM 171, 23/10/64.  
 227. Same as AM 168.  
 228. Same as AM 20, 19/8/29.  
 229. Jervis Bay, N.S.W. Dredged, 25/1/31.  
 230. Long Reef, Collaroy, N.S.W. Coll. Miss I. Bennett, 27/7/62. Intertidal.  
 231. Same as AM 79.  
 232. Long I., Whitsunday Group, Qld. Coll. F. A. McNeill, July 1962.  
 233. Same as AM 27.  
 234. Same as AM 213.  
 235. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, March 1962.  
 236. Off Mary River Heads, Sandy Str., Qld. Trawled, 2 fms. J. S. Hynd collection, 6/6/46.  
 237. East Point, near Point Darwin, N.T. Coll. A. A. Livingstone, 3/7/29. Intertidal.  
 238. Heron I., Capricorn Group, Qld. Coll. Sydney Univ. Zool. Dept., Aug. 1960.  
 239. Entrance Point, Broome, W.A. Coll. A. A. Livingstone, Aug. 1929.  
 240. Hayman I., Whitsunday Group, Qld. Coll. Miss B. Campbell, 28/10/60.  
 241. Black Ned's Bay, Lake Macquarie, N.S.W. CSIRO Fisheries Survey, 27/9/65. Silt and *Zostera*.  
 242. Same as AM 41.  
 243. Same as AM 104.  
 244. Same as AM 79.  
 245. 1 mi. NE. Seal Rocks, Port Curtis, Qld. 7-8 fms. J. S. Hynd collection, 2/9/46.  
 246. Bustard Head, Port Curtis, Qld. J. S. Hynd collection, 28/8/46. Intertidal rocks.  
 247. Same as AM 102.  
 248. Off Gantheaume Point, Broome, W.A. Dredged 4 fms. Coll. A. A. Livingstone, Aug. 1929.  
 249. Heron I., Capricorn Group, Qld. Coll. Miss I. Bennett, Aug. 1961.  
 250. Thursday I., Torres Str., Qld. Coll. Miss B. Campbell, 16/10/60.  
 251. Same as AM 102.  
 252. Off Heron I., Capricorn Group, Qld. 20 fms. Coll. K. Gillett, 1959.  
 253. Scarborough, Moreton Bay, Qld. J. S. Hynd collection, 8/12/46. Under rocks.  
 254. Long Reef, Collaroy, N.S.W. Coll. J. C. Yaldwyn, 27/1/64. Intertidal.  
 255. Quail I., about 35 mi. W. from Port Darwin, N.T. Coll. A. A. Livingstone, 8/7/29. Intertidal on coral reef.  
 256. Port Jackson, N.S.W. W. A. Haswell collection.  
 257. Off Gillett Cay, Swain Reefs, Southern Barrier Reef, Qld. Australian Museum 1962 Exped. Sta. 6. Dredged from 36-40 fms. Oct. 1962.  
 258. Dredged W. side of South Shell I., Port Darwin, N.T., about 25 yds off shore. Dredged 5 fms. Coll. A. A. Livingstone, 24/7/29.  
 259. Same as AM 10, 4/7/29.  
 260. Same as AM 181.  
 261. Same as AM 41.  
 262. Trawled Shark Bay, W.A. CSIRO Fisheries, 21/9/48. From sponges.  
 264. Ned's Beach, Lord Howe I., Tasman Sea. Coll. Miss J. Booth, Oct. 1962.  
 265. East Point, Port Darwin, N.T. Coll. intertidal, 22/6/29.  
 266. Long Reef, Collaroy, N.S.W. Coll. A. Healy, 20/12/64.  
 267. Same as AM 41, 27/1/64.  
 268. Off Solitary I., near Woolli, Grafton Area, N.S.W. Coll. G. Biddle, 1964. From living coral head.  
 269. Glacier Point, Port Hacking, N.S.W. 2-4 fms. Coll. C. Lawler, 20/11/64. Associated with urchin *Centrostephanus rodgersii* in excavation in rock.  
 270. Watson's Bay, Port Jackson, N.S.W. Coll. F. E. Grant.  
 271. Same as AM 41, 2/1/64.  
 272. Minnie Waters, near Grafton, N.S.W. Intertidal rock platform. Coll. G. Bidd and A. Healy, Dec. 1964.

- AM 273. Dredged off Shark I., Port Jackson, N.S.W. W. A. Haswell collection, 25/9/15.  
 274. Cape Don, Darwin, N.T. Coll. Miss E. Pope, 17/10/65. On reef.  
 275. North West I., Capricorn Group, Qld. Coll. M. Ward and W. Boardman, July 1929.  
 276. Same as AM 275.  
 277. SE. corner, Gulf of Carpentaria, Qld. CSIRO Prawn Survey 1963-65. Caught on mud flats of Norman River at Karumba.  
 278. Port Curtis, Qld. Coll. M. Ward, 1930.  
 279. Edge of creek near Sander's Beach about 20 mi. north of Townsville, Qld. Coll. W. Macnae, 17/3/62. Edge of *Rhizophora* fringe.  
 280. Dredged off Gatcombe Head, Facing I., Port Curtis, Qld. 9-12 fms. Coll. M. Ward, Dec. 1929.  
 281. Fannie Bay rocks, Darwin, N.T. Coll. Miss E. Pope and J. Boase, 11/10/65.  
 282. Same as AM 275.  
 283. Heron I., Capricorn Group, Qld. Coll. M. Ward, 1926.  
 284. Long Reef, Collaroy, N.S.W. Coll. J. C. Yaldwyn. Intertidal.  
 285. East Point, Darwin, N.T. Coll. Miss E. Pope and J. Boase, 25/10/65. Intertidal.  
 286. Dredged off Peak Point, Cape York, Torres Str., Qld. 3-6 fms. Coll. M. Ward, 31/8/28.  
 287. SE. corner, Gulf of Carpentaria, Qld. CSIRO Prawn Survey Trawl Stn. 555. 17° 24' S., 140° 42' E. 2 1/2 fms. 16/1/64.  
 288. Trawled off Yamba, near Clarence River mouth, N.S.W. Coll. G. Biddle, May 1965.  
 289. Long Reef, Collaroy, N.S.W. Coll. Miss E. Pope, Oct. 1965.  
 290. One Tree I., Capricorn Group, Great Barrier Reef, Qld. Coll. Museum Party, 25/9/65. Coral reef stn. Ft. 30.  
 291. Same as AM 277.  
 292. Darwin Power House screens, Darwin, N.T. Coll. Miss E. Pope, 22/10/65.  
 293. Cape Don, N.T. Coll. Miss E. Pope and party, 17/10/65. Under stones and in crevices.  
 294. Same as AM 283.  
 295. Same as AM 277.  
 296. Dredged D'Entrecasteaux Channel, Tasmania. 5 fms. Coll. M. Ward, Oct. 1929. On scallop banks.  
 297. SE. corner, Gulf of Carpentaria, Qld. Norman River at Karumba. CSIRO Prawn Survey, 10/2/64.  
 298. Hope I., near Cooktown, Qld. Coll. A. R. McCulloch, Aug. 1906.  
 299. Same as AM 275.  
 300. Port Curtis, Qld. Coll. M. Ward, 1930.  
 301. Fannie Bay rocks, Darwin, N.T. Coll. Miss E. Pope, Oct. 1965. Intertidal.  
 302. North West I., Capricorn Group, Qld. Coll. M. Ward, May 1930.  
 303. Same as AM 286, 1/9/28.  
 304. Same as AM 301, 12/10/65.  
 305. Murray I., Torres Str., Qld. Coll. C. Hedley and A. R. McCulloch, Aug.-Oct. 1907.  
 306. Same as AM 280. July 1929.  
 307. Same as AM 286.  
 308. Stokes Hill Power Station screens, Darwin, N.T. Coll. Miss E. Pope, 22/10/65.  
 308a. SE. Gulf of Carpentaria, Qld. CSIRO Prawn Survey 1963-65. From sponge.  
 309. Rat I., Port Curtis, Gladstone, Qld. Coll. M. Ward and W. Boardman, July 1929.  
 310. Three Mile Creek between Townsville and Cape Pallerenda, Qld. Coll. W. McNae, 7/12/62. From sand mud in islet in creek.  
 311. Michaelmas Cay, Capricorn Group, Great Barrier Reef, Qld. Poison St. Coll. F. H. Talbot and Museum party, 16/10/65.  
 312. SE. corner, Gulf of Carpentaria, Qld. CSIRO Prawn Survey trawl Sta. 606. 16° 29' S., 141° 02' E. 2 fms. 18/2/64.  
 314. Dredged Albany Passage Area, Torres Str., Qld. 9-12 fms. Coll. M. Ward, Sept. 1928.  
 315. Low Isles, near Port Douglas, Qld. Great Barrier Reef Exped. Coll. Iredale, McNeill, Livingstone. Oct. to Nov. 1928.  
 316. One Tree I., Capricorn Group, Qld. Coll. J. C. Yaldwyn and Museum party, Dec. 1966.  
 317. One Tree I., Capricorn Group, Qld. Among piecrust and sand, lagoon.  
 318. Same as AM 316. From broken coral, lagoon shallows, Dec. 1966.  
 319. Same as AM 316. On outer reef space. From living coral and lithothamnion surface about 12 ft deep.  
 320. Same as AM 316.

- AM 321. Same as AM 316. Among living corals on sandy bottom of lagoon, shallow water, Nov. 1966.
322. Same as AM 316.
323. Same as AM 321.
324. Same as AM 316. Lagoon, in *Halimeda* and mixed weed in "bombies" and piecrust near southern tip of reef, 1 mile from island. Coll. M. Cameron and D. J. Griffin, 7/10/67.
325. Same as AM 316.
326. Same as AM 316. From broken piecrust, transect B. Nov. 1966.
327. Same as AM 326. From large head of *Galaxea vesiculatus* from lagoon.
328. Same as AM 316. 6 ft FT 202, outer southern face of reef, near island from *Acropora* sp. Coll. F. H. Talbot and party, 28/9/67.
329. Same as AM 328. 10 ft. 29/9/67.
330. Same as AM 316. From living coral. 18/11/66.
331. Same as AM 318.
332. Same as AM 316. From algal mat, lagoon shallows.
333. Same as AM 316. 20 ft. FT 205. Outer southern face of reef, near island. Coll. F. H. Talbot and party, 23/9/67.
334. Same as AM 316. From broken coral piecrust, lagoon near island, transect B., Nov. 1966.
335. Same as AM 332.
336. Same as AM 332.
337. Same as AM 327.
338. Same as AM 321.
339. Same as AM 321.
340. Same as AM 324. Reef crest in *Halimeda* and mixed weed and under stones, NW face, low tide. Coll. M. Cameron and D. J. Griffin, 9/10/67.
341. Same as AM 334.
342. Same as AM 334.
343. Same as AM 334.
344. Long Reef, Collaroy, N.S.W. Coll. I. Smith, 16/7/67. In rock pool.
345. Darwin, N.T. Coll. B. McCann, 1966.
346. Minnie Waters, near Grafton, N.S.W. Coll. G. Biddle early in 1967 from intertidal rock platform.
347. Port Hacking, N.S.W. Coll. G. Lewin, 1966. Taken with bait prawns.
348. Hunter River between Newcastle Harbour and Raymond Terrace, N.S.W. Coll. N. Ruello and J. C. Yaldwyn, 2/11/67. Prawn trawl from mud bottom.
349. Same as AM 346.
350. Wellington Point, Brisbane, Qld. Coll. E. F. Reik, 30/8/60.
354. Same as AM 102.
356. Hunter River, between Newcastle Harbour and Raymond Terrace, N.S.W. Coll. N. Ruello and J. C. Yaldwyn, 2/11/67.
382. Off Doole I., in Gales Bay, Exmouth Gulf, W.A. 12 ft. Coll. I. Monro, 7/9/66. CSIRO Survey, Sta. 4.
383. Off Headland, Quarantine Bay, North Head, Sydney Harbour, N.S.W. Museum party 5/4/67. Shallow water.
384. Stradbroke I., Moreton Bay, Qld. Subtidal, Sept.-Oct. 1968. From yellow crinoid.
385. Same as AM 27, May 1967.
386. Careel Bay, Pittwater, near Sydney, N.S.W. Coll. J. C. Yaldwyn and A. Healy, 26/10/68.
387. 2 mi. off mouth of Yardi River, NE. of Onslow, W.A. 23 ft. CSIRO Survey, 13/9/66. Commensal on crinoid. Coll. I. Monro.
388. Bottle and Glass Rocks, Sydney Harbour, N.S.W. Coll. J. C. Yaldwyn and party, 29/11/68.
389. Ashburton River north of Exmouth Gulf, W.A. Coll. I. Monro, CSIRO Survey.
390. Heron I., Capricorn Group, Qld. Coll. Julie Booth, 1965.
391. Strand, near Queens Hotel, Townsville, Qld. Coll. D. R. Fielder, Oct. 1966.
392. Gillett Cay, Swain Reefs, Qld. Australian Museum Swain Reefs Exped. 20/10/62. From crinoid.
393. Long Reef, Collaroy, N.S.W. Coll. J. Holloway, 5/9/67.
394. One Tree I., Capricorn Group, Qld. 40 ft. Coll. J. C. Yaldwyn, 28/11/66. From lemon-yellow comatulid (Sta. FT 97).
- 394a. East Point, Darwin, N.T. Coll. E. Pope, Oct. 1965. Among arms of dark crinoids.
395. Intertidal rock platform, Long Reef, Collaroy, N.S.W. Coll. A. Healy, 1/1/68.
396. Long Reef, Collaroy, N.S.W. Coll. J. C. Yaldwyn and party, 21/11/68. On reef flat.



- AM 397. Dredged 2 mi. NE. of Gillett Cay, Swain Reefs, Qld. 38 fms. Australian Museum Swain Reefs Exped. Stn. 6.
398. Same as AM 396.
399. Same as AM 395, 3/11/67.
400. Same as AM 317, Nov. 1966.
401. Scarborough, Moreton Bay, Qld. J. S. Hynd collection, 17/9/45.
402. Manly, Moreton Bay, Qld. J. S. Hynd collection, 27/7/46. From weed.
403. Off Mary River Heads, Sandy Str., Qld. J. S. Hynd collection, 6/6/46.
404. Lord Howe I., Tasman Sea. Coll. Miss J. Booth, 27/2/63.
405. Same as AM 404, July 1962.
406. Same as AM 27, 12/5/64.
407. Mouth of Norman River, Gulf of Carpentaria, Qld. Coll. D. F. McMichael and J. C. Yaldwyn, Dec. 1963. Intertidal beach boulders.
408. Sandgate, Moreton Bay, Qld. J. S. Hynd collection, 19/3/45.
409. Townsville, Qld. Trawled in 15-20 fms. Coll. T. Nielson, Nov. 1964.
410. Same as AM 43. 35-40 fms, Sta. 6.
411. Same as AM 302.
412. Same as AM 102.
413. Long Bay, N.S.W. A. R. McCulloch, 28/4/07.
415. Shark Bay, W.A. CSIRO Fisheries, 27/9/48. Trawled, from sponges.
416. Same as AM 43.
417. Same as AM 410.
418. Coral Reef, Myora, Stradbroke I., Moreton Bay, Qld. J. S. Hynd collection.
419. Cape Inscription, Dirk Hartog I., W.A. CSIRO Fisheries, 24/9/48. From sponge.
420. Bountiful I., Gulf of Carpentaria, Qld. Coll. J. C. Yaldwyn, 30/11/63. From intertidal rock platform.
421. Same as AM 355.
422. Long Reef, Collaroy, N.S.W. Coll. Miss B. Campbell, 19/3/61. Intertidal rock platform.
423. Same as AM 281, 12/10/65.
424. Seal Rocks, Port Curtis, Qld. J. S. Hynd collection, 28/8/46. Intertidal rock pool.
425. Murray I., Torres Str., Qld. Coll. M. Ward, Oct. 1928.
426. Southern Gulf of Carpentaria, Qld. CSIRO Prawn Survey. Coll. D. F. McMichael, Dec. 1963. From holes in massive sponge trawled in less than 14 fms.
427. Same as AM 41. 27/1/64.
428. Kenn Reef, Coral Sea, Qld. Coll. D. F. McMichael, 2/10/60.
429. Curtis Channel, off Bundaberg, Qld. Dredged 20 fms. 30/8/46.
430. Same as AM 27.
432. Heron I., Capricorn Group, Qld. Coll. Mrs F. Evans, Dec. 1962.
436. Same as AM 27.
437. Off Cape Moreton, Qld., trawled from S.S. *Cape Leeuwin*. 11 fms. J. S. Hynd collection, 19/12/46.
438. Same as AM 43.
439. Same as AM 103. Commensal on brown alcyonarian.
440. Same as AM 50.
441. Same as AM 41, 20/4/62.
442. Same as AM 41, 20/4/62.
443. Curtis Channel, off Bundaberg, Qld. 20 fms. 30/8/46.
444. Sweers I., Gulf of Carpentaria, Qld. CSIRO Prawn Survey. Trawled in less than 14 fms. Coll. D. F. McMichael and J. C. Yaldwyn, Dec. 1963.
445. Anchorage Spit, Manly, near Brisbane, Moreton Bay, Qld. J. S. Hynd collection, 27/7/46.
446. S. of Peel I., Moreton Bay, Qld. 3-6 fms. Coll. W. Stephenson, 17/7/61.
447. Dredged off Roebuck Bay, Broome, W.A. From crinoid.
448. Same as AM 79, 26/10/46.
449. Gantheaume Point, Broome, W.A. Coll. A. A. Livingstone, 8/8/29. Intertidal, on reef, under stones.
450. Dredged between two beacons at S. end of Peel I., 18 ft. Coll. W. Stephenson.
451. Outer Banks, Myora, Stradbroke I., Moreton Bay, Qld. J. S. Hynd collection, 28/7/46.
452. Long Reef, Collaroy, N.S.W. 5/9/67. Reef platform.
453. Heron I., Capricorn Group, Qld. Sept. 1960. From coral reef, commensal on comatulid.
454. Orpheus I., Townsville, Qld. 15-20 ft. Coll. J. Bloomfield, 27/2/69.
456. Curtis Channel, off Bundaberg, Qld. 20 fms. J. S. Hynd collection, 30/8/46.

- AM 459. Barron River, Cairns, Qld. Coll. B. Campbell, Oct. 1963. Downstream from road bridge (salinity at low water c. 90/00) within network of interconnecting *Sesarma* crab burrows and chambers, 3 ft below surface of river bank at water table. Same loc. as AM 96.
- AM E. 3147. 13 mi. SE. of Cape Capricorn, Keppel Bay, Qld. 13 fms. 27/10/10.\*  
[\*All "E" numbers refer to collections made by the Fisheries Investigation Ship *Endeavour* between 1909-1914.]
- AM E. 3159. 12 mi. NNE. of Bowen, Qld. 19-25 fms. 2/8/10.  
3180. Off Point Inskip, Great Sandy Str., Qld. 10 fms. 27/7/10.  
3190. 11-14 mi. NW. of Pine Peak, Percy Isles, Qld. 24-26 fms. 27/10/10.  
4494. 18 mi. S. by W. of Lady Elliot I., Qld. 18 fms. 1913.  
4495. Spencers Gulf, S.A. 16 fms. Before 1913.  
4497. Same locality. 20 fms. 1913.  
4499. Same locality. 16 fms. Before 1913.  
4500. Cape Marsden, Kangaroo I., S.A. 1913.  
5679. 10 mi. N. of Circular Head, Tasmania. Before 1914.  
6274. 40 mi. W. of Kingstone, S.A.  
6667. 20 mi. NNE. of Double I. Point, Qld. 30 fms. 29/6/10.
- AM G. 614. Port Phillip, Victoria. Pres. J. B. Wilson, 1892.  
1789. Houghton I., Howick Group, Qld. Pres. Dr De La Garde, 1898.  
2190. *Thetis* Stn. 14, off Norah Head, N.S.W. 25-32 fms. 27/2/98.  
3283. Green I., near Cairns, Qld. Coll. C. Hedley.  
4101. Calloundra Beach, Qld. Pres. H. L. Kesteven, 1902.  
4249. Launceston, Tasmania. Exchanged 1903.  
5782. Mossman's Bay, Port Jackson, N.S.W., before 1907. Coll. Mrs F. E. Grant.  
6139. Manly, near Sydney, N.S.W., before 1907. Coll. Bassett-Hull, Jr.
- AM P. 836. Fraser I., Qld. Rec. 1908. Coll. Kirton.  
858. Miller's Point, Port Jackson, N.S.W., before 1908. Coll. A. R. McCulloch.  
1182-3. Lord Howe I., Tasman Sea. Rec. 1908. Coll. Mrs Nichols.  
1418. Watson's Bay, Port Jackson, N.S.W. Rec. 1908.  
1436. Port Jackson, N.S.W. 1892.  
1441. Same as 1436, before 1908.  
1452-3. Same as 1441.  
1632-5. Upper reaches Sydney Harbour, N.S.W. June 1961. Coll. Miss I. Bennett in prawn trawl.  
1649. Lord Howe I., *Thetis* Expedition, March-April 1898.  
1695. Shell Beach, Balmoral, Port Jackson, N.S.W. 4/7/01. Coll. T. Whitelegge.  
1966. Port Curtis, near Gatcombe Head, Qld. 6 fms. Pres. A. McCulloch, Jan. 1909.  
2006-7. Rat I., Port Curtis, Qld. Pres. A. R. McCulloch, 1909.  
2021-2. Ryde, Parramatta River, near Sydney, N.S.W. Pres. Fry and Kinghorn, 1909.
2055. Port Phillip, Victoria. Pres. A. R. McCulloch, 1909.  
2149. Shark I., Port Jackson, N.S.W. Pres. A. R. McCulloch, 1909.  
2152. Rose Bay, Port Jackson, N.S.W. Pres. A. R. McCulloch, 1909.  
2218. Mud I., Moreton Bay, N.S.W. Pres. A. R. McCulloch, 1909.  
2220. Lord Howe I., Tasman Sea. Pres. A. R. McCulloch, 1909.  
2289. Dunk I., near Tully, Qld. Pres. I. J. Banfield, 1909.  
2329. 10 mi. N. of Circular Head, Tasmania. Pres. Comm. Fish Bureau, 1909.  
2344, 47, 49. South Australia. Exch. Baker, 1909.  
2577-80. Masthead I., Qld. Rec. 1911. Coll. D. B. Fry.  
2768. Albany District, W.A. Rec. 1911. Coll. A. Abjornsen.  
3014. Western Port, Victoria. Pres. J. Gabriel, 1912.  
2071-2. Maroubra, near Sydney, N.S.W. 1912. Coll. A. R. McCulloch.  
3127. Albany Passage, Cape York, Qld. 1912. Coll. Hedley and McCulloch.  
3544. 12 mi. SE. of Cape Capricorn, Keppel Bay, Qld. 29/7/10.  
3566. Great Sandy Str., Qld. 27/7/10. Coll. *Endeavour* Exped.  
3574. Pine Peak, SE. Percy I., Qld. 1/8/10. Coll. *Endeavour* Exped.  
3581. No collection information.  
3662. Near Fremantle, W.A. Exch. W.A. Museum, 1913.  
3956. Portsea Pier, Port Phillip, Victoria. Pres. Chas. J. Gabriel, 1914.  
4073. Narooma, south coast of N.S.W. Coll. C. Hedley, Feb. 1916.  
4103. Eagle I., N. Qld. 23/7/16. Coll. C. Hedley and E. A. Briggs.

- AM.P. 4229. Port Denison, Qld. July 1918. Coll. E. H. Rainford.  
 4288. Finches Bay, Cooktown, Qld. Sept. 1918. Coll. A. R. McCulloch.  
 4303. Outer edge, St. Crispin Reef, off Port Douglas, Qld. Sept. 1918. Coll. A. R. McCulloch.  
 4313. Hope I., near Qld. Coll. A. R. McCulloch, Sept. 1918.  
 4480. Port Arthur, Tasmania. Pres. E. Mawle 1919.  
 4497. Woolwich, Lane Cove River, Sydney, N.S.W. Coll. R. Kinghorn, 18/12/19.  
 4601-2. Lagoon, South West Rocks, Trial Bay, about 1/4 mi. from ocean beach, N.S.W. Coll. J. R. Kinghorn, before 1920.  
 4681. Port Hunter, Newcastle, N.S.W. Pres. D. G. Stead, 15/3/07.  
 4760. Straw Beach Quarantine, Port Jackson, N.S.W. Pres. D. G. Stead. Rec. 1920.  
 4761. Same as P. 4681.  
 4837-39. Kingscote, Kangaroo I., S.A. Coll. E. L. G. Troughton. Rec. 1920.  
 4863. Port Stephens, N.S.W. Jan. 1920. Dredged. Exch. E. A. Briggs, Sydney Univ.  
 4933. On coast at Coogee, near Sydney, N.S.W. Pres. F. A. McNeill. August 1920.  
 4950. Long Reef, Collaroy, N.S.W. Pres. Miss E. Helms, 6/3/12.  
 4996. Norfolk I., S. Pacific. Pres. R. M. and W. Laing, and J. C. Quintal by Prof. Chilton and A. Liddell. Rec. 1920.  
 5028-29. On coast at Coogee, near Sydney, N.S.W. Coll. McNeill and Livingstone, 1920. From rock pool.  
 5116. Rose Bay, Port Jackson, N.S.W. Pres. State Trawling Industry, 1921. From dredge.  
 5137. Trial Bay, N.S.W. Coll. A. Kinghorn, before 1921.  
 5215. Bowen Harbour, Qld. Coll. E. H. Rainford, before 1921.  
 5275-77. Lord Howe I., Tasman Sea. Pres. A. R. McCulloch, before 1921.  
 5305. Hole in Wall, on coast near Broken Bay, N.S.W. Coll. F. A. McNeill. Rec. 1921. From rock pool.  
 5314. Saddleback I., Qld. Pres. E. H. Rainford, before 1921.  
 5349. Off Norah Head, N.S.W. 23-38 fms. Coll. McNeill and Livingstone, June 1921.  
 5356. Brighton le Sands Beach, Botany Bay, N.S.W. Pres. A. Livingstone, 4/7/21. Washed up after storm.  
 5491. Wilson's Point, Port Jackson, N.S.W. Pres. P. Barkie. Rec. 1921. From pile.  
 5572-73. Holbourne I., N. Qld. Pres. E. H. Rainford, 1921.  
 5610. Port Denison, N. Qld. Pres. E. H. Rainford, 1921.  
 5710-11. Lord Howe I., Tasman Sea. Coll. A. R. McCulloch and E. L. G. Troughton, before 1922.  
 6102. Western Port, Victoria. Pres. C. J. Gabriel, May 1915.  
 6107. Double Cone I., Whitsunday Group, Qld. Pres. E. H. Rainford, 1923. From cavities in dead coral dredged from depth of 20 ft.  
 6308-9. Shell Harbour, N.S.W. Pres. G. McAndrew, 1923.  
 6350-53. Caloundra, Qld. Coll. A. A. Livingstone, 11/14/22.  
 6354-55. Point Cartwright, Qld. Coll. A. A. Livingstone, 2/8/22.  
 6449. Sailor's Bay, Middle Harbour, Port Jackson, N.S.W. Pres. W. Boardman, 1923.  
 6468. Clareville Beach, Pittwater, Broken Bay, N.S.W. Pres. G. P. Whitley, 1923.  
 6487-88. Dredged between Sow and Pigs Reef and Green Point, Port Jackson, N.S.W. Coll. H. O. Fletcher, 25/8/23.  
 6495. Bottle and Glass Rocks, Port Jackson, N.S.W. Coll. A. A. Livingstone, 28/7/23. Intertidal.  
 6514-15. Dredged between Sow and Pigs Reef and Shark I., Port Jackson, N.S.W. 5-7 fms. Coll. F. A. McNeill, 16/5/23.  
 6526-27. Fairybower, Manly, N.S.W. Coll. A. A. Livingstone, 20/10/22.  
 6565. Long Reef, Collaroy, N.S.W. Coll. F. A. McNeill, 6/11/22.  
 6605. Base Beach, Vanderlin I., Sir Edw. Pellew Group, Gulf of Carpentaria, Qld. Pres. W. E. J. Paradise, before 1923. From a clump of live coral hauled in by seine net on a beach.  
 6682. Shark I., Port Jackson, N.S.W. Coll. F. A. McNeill and A. A. Livingstone, Jan. 1922.  
 6710. Gunnamatta Bay, Port Hacking, N.S.W. Coll. F. A. McNeill, 6/10/22.  
 6786. Great Barrier Reef, Qld. Pres. W. E. J. Paradise, R.A.N., 1923.  
 6825. Rail Pier, Port Darwin, N.T. Coll. W. E. J. Paradise, 1923.  
 6861. Freshwater Beach near Manly, Sydney, N.S.W. 6-10 ft below low tide mark. Pres. A. F. Basset-Hull, 5/1/24.  
 6862-3. Lord Howe I., Tasman Sea. Pres. G. P. Whitley, 1924.  
 6910-14. On coast 2 mi. south of entrance of Tuggerah Lakes, N.S.W. Coll. A. A. Livingstone and H. Fletcher, 1924. From intertidal rock pools.

- AM P. 7027. Bowen Harbour, Port Denison, Qld. Pres. E. H. Rainford, 1924. Dredged, hard sand and mud bottom, 15-20 ft.
7050. Alongside Bowen Jetty, Port Denison, Qld. Pres. E. H. Rainford, 1924. Hand netted in patch of weed, low tide in 3 ft of water.
- 7164-65. Shellharbour, N.S.W. Coll. F. A. McNeill, 1924. Intertidal, under stones.
7187. Long Reef, Collaroy, N.S.W. Pres. W. Boardman, 5/4/24. Intertidal under stones on sandy beach.
7221. E. of Ulladulla, N.S.W. 35° 20' S., 150° 47' E. 74 fms. Pres. C. W. Mulvey, May 1924. Off conglomerate boulder taken by trawler *Goonambee*.
7224. 16-18 mi. NE. of South Head, Port Jackson, N.S.W. 75-80 fms. Pres. J. Wright, 1924. From Conglomerate boulder taken by trawler *Goonambee*.
7234. Off Towra Point, Botany Bay, N.S.W. Pres. J. H. Wright, April 1924. From kelp holdfast.
7240. Shellharbour, N.S.W. Intertidal. Pres. G. McAndrew, 1924.
7309. Armit I., Whitsunday Group, Qld. Pres. E. H. Rainford, 1924. From coral.
7377. 79. 12-22 mi. NE. from Cape Green, N.S.W. 36-46 fms. Coll. A. A. Livingstone and H. O. Fletcher, June 1924
- 7421-22. Masthead I., Capricorn Group, Qld. Coll. A. R. McCulloch, Nov.-Dec. 1913.
- 7440, 43, 54. Murray I., Qld. Coll. C. Hedley and A. R. McCulloch, Aug.-Oct. 1907.
- 7463, 76. Long Reef, Collaroy, N.S.W. Intertidal. Exch. M. Ward, 1924. In holes amongst sand and pebbles, under boulders.
- 7520-24. Queensland. Coll. A. R. McCulloch, 1924.
7557. Cairns Reef, off Cooktown, Qld. Coll. A. R. McCulloch, 1924.
7711. No collecting information.
- 7902-3, 7952. Shell Harbour, N.S.W. Pres. G. McAndrew, 1925.
- 7981-2. Reef, High I., Frankland Group, Qld. Pres. W. E. J. Paradise, 1924.
8009. North Barnard I., Qld. Pres. W. E. J. Paradise, 1924.
- 8026-28. Frankland Group, Qld. Pres. W. E. J. Paradise, 1924.
8043. Low (Woody) I., off Port Douglas, Qld. Pres. W. E. J. Paradise, 1924.
8230. 8 mi. S. of Green Cape, N.S.W. 30 fms. Coll. M. Boardman, on trawler S.S. *Bar-ee-mul*. 20/7/25.
8255. Gunnamatta Bay, Port Hacking, N.S.W. Coll. C. Anderson and F. A. McNeill, 1925.
8266. Port Phillip, Victoria. Pres. M. Ward, 1925. Dredged.
8416. Gunnamatta Bay, Port Hacking, N.S.W. Coll. Museum Party, 3-5 Oct. 1925. From tidal flats.
- 8437-38. Shellharbour, N.S.W. Pres. G. McAndrew, 1925. Intertidal.
8550. Sandy Point, Broken Bay, Hawkesbury River, N.S.W. Pres. M. Ward, 1926.
- 8565-67, 77. Reef, North West I., Capricorn Group, Qld. Pres. G. P. Whitley, Dec. 1925.
8695. Bottle and Glass Rocks, Port Jackson, N.S.W. Pres. M. Ward, 1926.
- 8701-02. Sea Port, Port Phillip, Victoria. Pres. M. Ward, 1926.
8706. Long Reef, Collaroy, N.S.W. Pres. M. Ward, 1926.
8786. Sea Port, Port Phillip, Victoria. Pres. M. Ward, 1926.
8787. Hook Reef, E. of Bowen, Qld. Pres. Surg. Lieut. L. Lockwood, 1927.
8793. Gt. Barrier Reef, near Bowen, Qld. Pres. Surg. Lieut. L. Lockwood, 1927.
8794. Knight Reef, Clarence Str., N.T. Pres. Surg. Lieut. L. G. Courtney, 1927.
8866. Shellharbour, N.S.W. Pres. G. McAndrew, 1927.
8963. Botany Bay, N.S.W. 15 ft. Coll. F. A. McNeill, 6/10/27.
8970. Walsh Bay, No. 3 jetty, Port Jackson, N.S.W. Coll. F. A. McNeill, 11/10/27. On piece of test timber.
9064. Long Reef, Collaroy, N.S.W. Intertidal. Pres. M. Ward, 21/4/28.
9068. Woodford Bay, Lane Cove River, Sydney, N.S.W. Pres. G. R. Kinghorn. In shallows on tidal flats.
9072. Long Reef, Collaroy, N.S.W. Pres. M. Ward, 21/4/28.
- 9076-77. Shore, Woolloomooloo Bay, Port Jackson, N.S.W. Intertidal. Pres. M. Ward, 7/3/28.
9337. Shell Harbour, N.S.W. Pres. G. McAndrew, 1929.
- 9422-23. Port Willunga, S.A. Pres. H. M. Hale, 1930.
9431. Long Reef, Collaroy, N.S.W. Coll. F. A. McNeill, 1930.
9448. WSW. from Gabo I., Victoria. 70 fms. Pres. Capt. K. Moller, 1930.
9481. Port Darwin, N.T. Pres. L. B. Wilson, 1930.
9670. Port Curtis, Qld. Pres. C. Bedsor, 1930.
10038. North West I., Capricorn Group, Qld. 9 fms. Coll. A. A. Livingstone and W. Boardman, Dec. 1930-Jan. 1931.

- AM P. 10092. Sow and Pigs Shoal, Port Jackson, N.S.W. Low water mark. Pres. Capt. L. Comtesse, 1931.
10114. Sow and Pigs Shoal, Port Jackson, N.S.W. Coll. F. A. McNeill, 14/2/30.
10125. Sandgate, Brisbane River, Qld. Pres. C. J. Watson, 1931.
10201. Broome, W.A. Pres. H. L. Clark and E. W. Bennett, June 1932.
- 10311-12, 22. Lord Howe I., Tasman Sea. Coll. A. A. Livingstone, 1933. From reef.
10364. North West I., Capricorn Group, Qld. Coll. F. A. McNeill, 1933.
10401. Hayman I., Whitsunday Group, Qld. Pres. F. A. McNeill, Jan. 1933.
- 10533-34. Hayman I., Whitsunday Group, Qld. 5 fms. Pres. F. A. McNeill, 1934.
10770. Brunswick Heads, N.S.W. Coll. E. Troughton and A. Musgrave, Aug. 1936.
10784. Middleton Reef, N. of Lord Howe I., S. Pacific Ocean. Coll. G. P. Whitley, April 1936.
10837. Moonta, S. Australia. Coll. K. Reed, 1937.
- 10979-81. Reef, Shelly Beach, near Yamba, N. of Clarence River, N.S.W. Coll. A. A. Cameron, May 1938.
11187. Shelly Beach, Yamba, N.S.W. Pres. A. A. Cameron, 18/10/39.
- 11271-72. Angourie, near Yamba, N.S.W. Pres. A. A. Cameron, 22/2/40.
11296. Near mouth of Clarence River, Yamba, N.S.W. Pres. A. A. Cameron.
11340. Woody Head, near Yamba, N.S.W. Pres. A. A. Cameron.
11359. Angourie, near Yamba, N.S.W. Coll. Joyce Allan and A. A. Cameron.
- 11400-01. Claremont Islands, Princess Charlotte Bay, N. Qld.
11408. Port Molle, Whitsunday Passage, Qld. Coll. W. A. Haswell, while with H.M.S. *Alert*. On reefs.
11416. Botany Bay, N.S.W. A. H. S. Lucas and Museum party.
11440. Between Peel I. and Cleveland, Moreton Bay, Qld.
11451. Gunnamatta, Port Hacking, N.S.W.
11730. Gunnamatta Bay, Port Hacking, N.S.W. Coll. E. Pope, March 1947. Hand-netted in weed on tidal flat.
- 11731-33. Long Reef, Collaroy, N.S.W. Coll. E. Pope, March 1947. Intertidal, under stones.
11734. Near Watson's Bay, Port Jackson, N.S.W. Coll. E. Pope, 1946. From growths on boom pile defence drawn after war.
11759. Ulladulla, N.S.W. Coll. M. E. Coles, 1947. Seine netted by small fishing trawler.
11763. Kennedy Sound, Cumberland Group, Qld. Pres. G. P. Whitley, 1935. Dredged.
11779. Lindeman I., Cumberland Group, Qld. Pres. G. P. Whitley, 1935.
11877. Newcastle district, N.S.W. Coll. C. Moreley. In batch of prawns.
11882. Brampton I., near Mackay, Qld. Pres. Miss B. Dew.
12127. Long Reef, Collaroy, N.S.W. Pres. P. Colman, Jan. 1952. From coastal reef at low-tide in encrusting sponge.
- 12426-27. Cottesloe Beach, W.A. Aug. 1954.
12920. Heron I., Capricorn Group, Qld. Pres. Miss B. Dew, Jan. 1955. From coral reef flat.
- 12927, 36. Port Jackson, N.S.W. Coll. A. A. Racek, Jan. 1953.
12928. Off Port Jackson, N.S.W. 10 ft. Coll. A. A. Racek, Dec. 1953.
12952. Stockton Bight, N.S.W. Pres. A. A. Racek, Jan. 1955. From trawl.
13487. Woody Head, Iluka, mouth of Clarence River, N.S.W. Coll. A. A. Cameron, 3/9/60.
13509. Backy Point, near Whyalla, S.A. Coll. B. Flounders, Feb. 1961. Intertidal.
13546. Watson's Bay, Port Jackson, N.S.W.
- 13547, 49. Mast Head I., Capricorn Group, Qld. F. E. Grant. From coral reef flat.
13548. Shoreham, Victoria. 31/3/02. Under stones, low tide.
13549. Masthead I., Capricorn Group, Qld. Coral reef flat. Coll. F. E. Grant.
13550. Port Curtis, Qld. 5-11 fms. Dredged.
13551. Off North Head, Flinders, Victoria. 30/13/00. Dredged.
- 13553, 55, 57. Lord Howe I., Tasman Sea.
13554. Murray I., Torres Str., Qld. 17 fms. Coll. A. R. McCulloch, 1907.
- 13556, 59. Between Ball's Head and Goat I., Port Jackson, N.S.W. Coll. J. Brazier. Dredged.
13558. Port Jackson, N.S.W.
13560. Watson's Bay, Port Jackson, N.S.W.
13561. Mapoon, Gulf of Carpentaria, Qld. Coll. Park. June 1907.
13562. Nelson's Bay, Port Stephens, N.S.W.
13563. Port Jackson, N.S.W.
13564. Port Curtis, Qld. Dredged 4 fms.

- AM P. 13565. Between Ball's Head and Goat I., Port Jackson, N.S.W. Dredged.  
 13567. Farm Cove, Port Jackson, N.S.W.  
 13568. Cairns Reef, Cooktown, Qld. Coll. A. R. McCulloch.  
 13569. Yeppoon, near Townsville, Qld.  
 13570. Port Jackson, N.S.W.  
 13571. Lord Howe I., Tasman Sea.  
 13572-73. Cairns Reef, Cooktown, Qld. Coll. A. R. McCulloch.  
 13574. Mast Head I., Capricorn Group, Qld. Coll. F. E. Grant. From coral reef flat.  
 13575-76. Port Jackson, N.S.W.  
 13577. Botany Bay, N.S.W.  
 13578. Nelson's Bay, Port Stephens, N.S.W.  
 13579. Victoria. Coll. F. E. Grant.  
 13580. Port Jackson, N.S.W.  
 13581. Port Stephens, N.S.W.  
 13582. Port Phillip, Victoria. Coll. J. Gabriel, March 1907.  
 13583. Encounter Bay, S.A. 10-15 fms.  
 13584. Cairns Reef, off Cooktown, Qld.  
 13585. Nelson's Bay, Port Stephens, N.S.W.  
 14630. Botany Bay, N.S.W. Como side of Georges River bridge. 15 ft. Coll. D. Lelliot, 4/6/62.  
 14631. Upper reaches of Sydney Harbour, N.S.W. Coll. Miss I. Bennett. Caught in prawn trawl.  
 14639. Old Settlement Beach, Lord Howe I., Tasman Sea. Coll. J. Booth, 24/9/62.  
 14958. Bowen, Qld.  
 14959. Victoria. Pres. F. E. Grant.  
 14960. Cairns Reef, Cooktown, Qld. Coll. A. R. McCulloch.  
 17999-17800. Same as AM 15.  
 18001. Same as AM 415.  
 18002-18003. Same as BAU 32.  
 18004. Same as UQ 34.  
 18005. Same as AM 338.  
 18006. Same as AM 283.  
 18007. Same as AM 390.  
 18008. Same as AM 215.

#### PERSONAL COLLECTIONS MADE BY A. H. AND D. M. BANNER

The bulk of these collections will be deposited at the Bernice Pauahi Bishop Museum, Honolulu, but some duplicates will be deposited in the Australian Museum, Sydney.

- BAU 1. Point Peron, W.A. 3-6 ft. 13/12/67. Off Physical Fitness Camp, N. side of point within surf line, from coralline algae. [Only the first of each day's collections are dated.]  
 2. Point Peron, W.A. 2-4 ft. Off S. side of point, in loose pieces of beach sandstone with holes, within the surf line.  
 3. Lancelin I., W.A. 14/12/67. From dead coral heads almost at surf line, 1/4 mi. from shore, on outer reef.  
 4. Same locality. 4-8 ft. From reef flat on NE. side. From scattered calcium carbonate boulders beyond a narrow terrace.  
 5. Same locality. 2-10 ft. From potholes on inner side of "barrier reef" front. From live *Pocillopora* sp., a few dead coral heads and coralline algae masses.  
 5a. Jurien Bay, Perth, W.A. 3-4 m. 16/12/67. Trawled at night over weed.  
 5b. City of Gold, Qld. 26/12/67. Mangrove swamp, intertidal.  
 6. Yeppoon, Qld. 29/12/67. Intertidal, near low tide zone, under rocks.  
 7. Same locality. Similar to BAU 6 but isolated rock patch and more exposed to wave action.  
 8. Yule Beach, near Port Douglas, Qld. 2/1/68. Intertidal.  
 9. Pebble Beach, N. Qld. 3/1/68. Intertidal, under rocks, sandy rocky beach.  
 10. Green I. (off Cairns), Qld. 4/1/68. On reef flat extension, not over one foot below low-low water. From dead and overgrown coral heads, mostly *Acropora* sp.  
 11. NE. side of Green I., Qld. 2-6 ft below low-low water. 4/1/68. Patch reef, dead and overgrown *Acropora* sp.

- BAU 12. Same locality. 5/1/68. Intertidal, under rocks.
13. Same locality. Intertidal, reef flat. From dead base of small head of *Pocillopora* sp.
14. Arlington Reef (about 1.5 miles off Green I.), Qld. 6-8 ft. 6/1/68. Vigorous reef.
15. Same locality. 6-8 ft deep. Near reef edge.
16. Same locality. From middle reef exposed at low water.
17. Same locality. 8 ft deep. From massive *Porites* sp.
18. Same locality. Near reef edge.
19. Same as BAU 16. About 2 mi. E. of Home Reef. From under coralline algae.
20. Same locality. Reef flat, near exposure at low-low water. From various dead and overgrown heads.
21. Same locality, outer edge of reef. 2-8 ft deep.
23. Home Reef, Green I., Qld. 7/1/68. From reef flat at zero tide level, from heads of *Porites* sp., mostly dead.
24. Green I., Qld. SE. tip. Slightly below low-low water. Area with 10 ft broad pot holes with sand bottoms and much dead coral and live soft corals.
25. Thursday I., Torres Str., Qld. 0-6 ft deep. 9/1/68. From reefs E. of village and "channel" between Thursday and Horn I. Collected at edge of eel grass from dead coral heads and sponges, in general bottom of very fine lime sand.
26. Thursday I., Qld. About low-low tide level. 10/1/68. In front of village at low tide. Under rocks, sandy to muddy bottom.
27. Hammond and Waiwea I., Torres Str., Qld. Three reefs, from 0-10 ft depths. Reef tops of fine sand, nearer edge mostly dead madreporarians and live alcyonarians. Currents strong.
28. Thursday I., Qld. 2-10 ft deep. NE. side and N. end of Thursday I., Qld. Collected from various heads of dead coral.
29. Rudder Reef, off Port Douglas, Qld. 14/1/68. Exposed at low water. From outer reef flat, 200 yds from reef edge. Almost no sand, but composed of broken pieces carried inward by storms. Reef subject to heavy surf and SE. winds.
30. Same locality. Exposed at low-low water, reef flat at edge, subject to heavy surf.
31. Opal reef, off Port Douglas, Qld. 15/1/68. 5-10 ft deep. From lee side, sand bottom with coral patches, all pried from consolidated heads.
32. Same locality. 0-5 ft deep. From frontal edge where seas normally break. From consolidated heads broken loose from reef, mostly heads covered with coralline algae.
33. Chinaman's Reef, midway between Rudder and Opal Reef, off Port Douglas, Qld. From 0-10 ft deep. Frontal edge depth and general condition same as BAU 32, but not so much coral, and coral not as rich in alpheids.
34. Rowes Bay, Townsville, Qld. 18/1/68. Intertidal, under rocks. Substrate granite sand to slightly muddy sand.
35. Molle I., Whitsunday Group, Qld. 20/1/68. From causeway between South and Middle Molle. From beach near mid-tide level, under large rock in sandy substrate, area apparently subject to strong currents at high tide.
36. Hayman I., Whitsunday Group, Qld. Under rocks at near low water.
37. Bali Hai I., off Hayman I., Whitsunday Group, Qld. 2-6 ft deep. 21/1/68. At growing edge of reef. Coral growth not vigorous.
38. N. side, Bali Hai reef, Qld. Reef flat at -2 ft. Substrate of sand, littered with both granite and coral.
39. Off Bali Hai I., towards Hayman I., Qld. From 2 dead overgrown coral heads. Bottom of sand with much sea weed; only occasional loose pieces of dead coral.
40. Reef edge, E. of Bali Hai, towards Hook I., Qld. 2-6 ft deep. Much soft coral, some growing corals.
41. Langford I., near Hayman I., Qld. 22/1/68. About medium low tide under terrigenous rocks and under beach rock, both lying embedded in coarse to fine sand, apparently in areas of fresh water seepage.
42. Hook I., in cover SE. of Hayman I., Qld. 2-6 ft deep. In dead coral, mostly *Porites* sp., from reef in middle of cave.
43. Same locality, near small point to W. of BAU 42. 2-6 ft deep. Coral more sparse, but currents stronger than BAU 42. Mostly from overgrown heads of *Acropora* sp. and one massive head, genus unknown.
44. Hayman I., Qld. 2-6 ft, on W. end of northern reef. 23/1/68. Bottom mostly consolidated dead coral with some coral rubble.
45. 10 mi. N. of St Lawrence, Qld. 25/1/68. Under rocks at mid-tide level. Quite a bit of organic matter mixed with substrate.
46. Heron I., Capricorn Group, Qld. 28/1/68. Shore collecting on a +2.8 tide. Under pieces of broken beach sandstone, low in intertidal where sand substrate was wet from beach run off. Water salty to brackish.

- BAU 47. Same locality. From low-low tide level to about —5 ft. 29/1/68. At outer edge of coralline ridge on reef directly S. of Heron I., Qld. Pieces pried off consolidated ridge surface, some overgrown with coralline algae, some living coral.
48. Same locality. Depths —5 to —25 ft. From seaward face of reef. Face mostly consolidated living and dead corals cemented by coralline algae. Specimens mostly from small fragments broken from consolidated coral, many from associated sponges.
49. Same locality. About 0 tide level. 30/1/68. On coralline ridge directly N. of island. Ridge composed of solid plates, cemented together with a thick layer of coralline algae with almost no holes for shrimp.
50. Same locality. 30/1/68. On SE. side of island, at edge of tidal "stream" next to island on reef flat. At low tide this is 50 ft wide and 1 ft deep and carries the water from the reef flat at high speed. Collection from mostly dead, coarsely branched heads and between layers of encrusting coral.
51. Same locality. Same as BAU 46. Shore collecting under stones, tide slightly lower than in BAU 46.
52. Same locality. From reef flat —2 to —3 ft below low-low water. 31/1/68. About 1.5 miles due east of island. Isolated coral patches on sand substrate; coral mostly loose. Heads in patches arising several feet above sand flats.
53. Same locality, further east than BAU 52, at edge of "lagoon". Conditions similar to BAU 52 except sand bottom several feet deeper and living coral reaching 5 ft above level of sand. Specimens mostly from dead heads of *Pocillopora* sp. A massive head of coralline algae yielded almost nothing.
54. Same locality. Same as BAU 50, but middle of reef flat at —1 ft depth. Sand bottom with numerous loosely consolidated coral masses of many species. Dominant coral a heavily branched *Porites* sp.
55. Same locality, in eastern lagoon (see BAU 53). 10 ft. 1/2/68. Sand bottom with large coral mounds reaching to near 0.0 tide level. Specimens collected from mostly dead coral, some pried off top or side of massive mounds, some lying free on bottom near mounds.
56. Same locality, immediately shoreward of ridge at BAU 47, through boulder zone into outer growing reef area. Tops of coral and lithothamnian ridge exposed at low-low tide, moderate wave action. Specimens rare.
57. Same locality. 2–15 ft deep. 2/2/68. Reef front S. of eastern end of island, below and beyond consolidated ridge. Corals mostly living and firmly fixed. Specimens from dead and dying coral pried loose from reef front, specimens not plentiful.
58. Same locality. Area to west of BAU 56, similar except ridge with more coral and less coralline algae; zone behind ridge filled with coral detritus, with almost nothing alive. Specimens came from behind dead zone where sand packets were 30–40 ft across, and 2 ft below reef surface with vigorously growing coral on edges.
59. Stradbroke I., near Dunwich, Qld. 7/2/68. Under rocks on sandy-muddy substrate. At edge of neap tide.
60. Same locality. In muddy sand covered with short eel grass at edge of neap tide. No associated rocks.
61. Same locality. Under clusters of mussels at edge of neap tide, sandy substrate.
62. Shelley Beach, Port Macquarie, Qld., at 2.6 tide. 10/2/68. Under rocks on ocean beach. Specimens found only in areas where medium sized rocks, up to 18 inches across rested in a stable configuration on a substrate of small rocks and sand. Evidently this arrangement could withstand the onslaught of waves.
72. Dudley Point, Darwin, N.T. 18/2/68. Collection made at +2.7 tidal level. Under rocks on shore. Much of shore muddy and without alpheids, but specimens were found under rocks on clean sand, particularly if there was a trickle of beach water.
73. Point at eastern edge of Night Cliff, Darwin, N.T. 19/2/68. About —3 to —4 ft tide. Area unprotected from northerly winds and waves. Sand well washed without any silt and the rocks are usually deeply embedded. No specimens were found under fully exposed rocks lying in loose sand, but occurred under rocks bedded in sand at edge of tide pools; this latter area semi-protected from onslaught of waves by numerous much larger rocks.
74. Same locality. Approximately one ft higher in tidal zone than BAU 73. In area of smooth ochre clay substrate with small fissures through which water from beach "weep" flowed. Specimens under fine rocks (up to 2–3 inches across) wedged in fissures.
75. Darwin Harbour, N.T. 20/2/68. S. of piers at edge of mangrove area. Substrate soft mud with gravel and small rocks embedded and interlaced with mangrove roots. Alpheids found in shallow burrows in more gravelly areas, relatively high in tide zone.



**COLLECTIONS LOANED PERSONALLY BY C. R. SMALLEY\***

\*Present address, University of Western Australia, Perth, Western Australia. Mr Smalley also collected many of the specimens under the "UQ" designation. We are using his designation from his field work and prefacing them with CS.

- CS 1a-1i, 2a-2c (specimen number). Cockburn Sd. near Perth, W.A. 10-11 fms. Coll. C. R. Smalley, 9/7/70. Trawled by the *Flinders*. From sponges.
- 1j-1k. Near Perth, W.A. 1970-71. From sponges.
- 1-10, 13-21, 33-36, 39 (batch number). Collection data same as for CS 1a-1i.
- 11, 12, 22-24, 38, 39. Collection data same as CS 1a-1i. 2-3/7/70.
- 25-28. Exmouth Gulf, W.A. Coll. C. R. Smalley, 22-23/10/70. Trawled. From sponges.
- 29, 30. Exmouth Gulf, W.A. Coll. T. White. Trawled. From crinoid.
- 31, 32, 40. Collection data same as CS 25. 24/10/70. From crinoid.
- 41-43. Bay of Rest, Exmouth Gulf, W.A. Coll. T. White, Aug. 1970. In mud of tidal pools.
44. Fremantle, Swan River, W.A. Coll. J. Kowarski, 7/3/71.
45. Collection data same as CS 44, 13/12/71.
46. Freshwater Bay, Swan River, W.A. Coll. C. R. Smalley, 4/6/70. In loose rock, muddy sand.
47. Same collection data as CS 46, 22/9/70.
48. Australind, Leschenault Inlet, W.A. Coll. C. R. Smalley, 3/5/70.
49. Mandurah, Pell Inlet, W.A. Coll. C. R. Smalley, 25/4/71.
- 50, 51. Exmouth Gulf, W.A. Coll. C. R. Smalley, 22-25/10/70. Trawled.
- IIA3. Moreton Bay, South West Rocks, Peel I., Qld. Coll. S. Cook, Sept. 1970.
- IIC2. Same as CS IIA3.
- IIIB1. Same as CS IIA3.
- IIIB2. Same as CS IIA3, March 1970.
- IIID1. Same as CS IIA3.
- IIIE2. Same as IIA3, June 1970.

**COLLECTIONS MADE BY MR JOHN BOASE OF FANNIE BAY, DARWIN, N.T.**

These specimens will be deposited in The Australian Museum.

- JB 1. From mud flats in front of Fannie Bay Hotel, Darwin, N.T. 30/9/68.
2. Darwin, N.T. 3-35 ft. 30/9/68. Beside the main wharf, from crinoids.
3. Dudley Reef, in front of Fannie Bay Hotel, Darwin, N.T. 30/9/68. Commensal with crinoids.
4. Same as JB 3.
5. East Point, Darwin, N.T. 9/10/68. Commensal with crinoids.

**COLLECTIONS FROM JAMES COOK UNIVERSITY OF NORTH QUEENSLAND, TOWNSVILLE**

This collection, loaned by the University, was without catalogue designations, so we have assigned numbers prefaced with "JC". They will be catalogued upon their return to the University.

- JC 1. Geoffrey Bay, Magnetic I., Qld. 17/12/62.
2. 10 mile beach via Bloomsbury, Qld. Coll. Zoology Dept, 22/5/66. On sandy beach.
3. Lodestone, off Townsville, Qld. Coll. Zoology Dept, 15/8/62. In coral reef.
4. Townsville breakwater, Qld. Coll. Blackman, 16/7/66. At low tide under rocks.
5. Kissing Point, Qld. 14/4/61. Pools at low water.
6. Far Beach, Mackay, Qld. Coll. Zoology Dept, 4/5/66. Sand beach.
7. Magnetic I., Qld. 3/4/66.
8. Arcadia Bay, Qld. Coll. M. S. Hopkins, May 1966. Under rocks.
9. Kissing Point, Qld. 3/4/66.
10. Magnetic I., Qld.
11. Bingil Bay via El Arish. 18/5/64. Under rocks, low water.
12. Cardwell, Qld. Coll. Zoology Dept, 23/6/63. Sandy beach.
13. Geoffrey Bay, Magnetic I., Qld. Coll. J. A. Johnson, 4/4/64. Under rocks.
14. Wilson's Beach near Proserpine, Qld. Coll. Zoology Dept, 17/5/66. Sandy-mud beach.
15. Lodestone Reef off Townsville, Qld. Coll. Zoology Dept, 15/8/62. From coral reef.

- JC 16. Mackay, Qld. Coll. Zoology Dept, 21/5/64. Under piece of coral on sandy beach.  
 17. Ross River, Qld. Coll. C. Fell, 28/9/66. In burrow.  
 18. Geoffrey Bay, Magnetic I., Qld. Coll. RK and JB, 14/5/61.  
 19. Magnetic I., Qld. Coll. M. Scott, 5/8/66. From reef.  
 20. No collection information.  
 21. Kissing Point, Townsville, Qld. Coll. K. McCable, March 1968. In small intertidal pool.  
 22. No collection information.  
 23. Geoffrey Bay, Magnetic I., Qld. Coll. E. Gregson, 1/8/68. From coral.  
 24. Taylor Reef, E. Proserpine, Qld. Coll. A. Hansen, 14/4/68. From coral reef.  
 25. Kissing Point, Townsville, Qld. Coll. J. Tweddell, 9/6/68. From under rocks.  
 26. Alva Beach, Ayr, Qld. Coll. W. A. Green, 9/2/66. In mud bank.  
 27. Rowes Bay, Townsville, Qld. Coll. J. Tweddell, 24/5/68. Under rocks.  
 28. Beach near breakwater, Townsville, Qld. Coll. L. Ward, 12/6/68. Commensal with giant anemone.  
 29. Cape Pallarenda, Townsville, Qld. Coll. B. Dickson, 14/5/68. From sandy beach.  
 30. Rowes Bay, Townsville, Qld. Coll. M. Scott, 7/5/68.  
 31. Shelley Beach, Townsville, Qld. Coll. C. Patterson, 10/7/68.  
 32. Townsville, Qld. 15/8/70. From a large sponge dredged N. of Magnetic I.  
 33. Rowes Bay, Townsville, Qld. Coll. W. R. Dowd, 4/3/68. Under small rocks.

#### COLLECTIONS FROM MACLEAY MUSEUM, UNIVERSITY OF SYDNEY

The collections from Macleay Museum were on loan to the Australian Museum, thus they were originally labelled consecutively with our numbers of the Australian Museum series, (AM)

- MM 72. Port Darwin, N.T.  
 86. Cape Grenville, Qld. 20 fms.  
 111. Percy I., Qld.  
 161. Tasmania.  
 166. Port Darwin, N.T.  
 176. Princess Charlotte Bay, Qld.  
 178. No collection information.  
 181. Sue Ilset, Torres Str., Qld.  
 204. Tasmania.  
 263. Endeavour River, Cooktown, Qld.  
 355. Same as MM 263.  
 414. Darnley I., Great Northeast Channel, Qld.  
 421. Same as MM 263.  
 434. Sue Ilset, Torres Str., Qld.

#### COLLECTIONS FROM THE QUEENSLAND MUSEUM, BRISBANE

The "W" series is the Museum's catalogue designation; we have prefaced it with "QM".

- QM W 835. Bird I., Moreton Bay, Qld. Coll. Univ. Qld. Sci. Students' Assoc.  
 838. Goat I., Moreton Bay, Qld. Coll. Univ. Qld. Sci. Students Assoc.  
 999. Heron I., Capricorn Group, Qld. Coll. T. C. Marshall, 12/9/39.  
 1000. Same as W 999.  
 1052. Green I., Moreton Bay, Qld. 23/1/40.  
 1053. Same as W 1052.  
 1055. Same as W 1052. Alcyonarian zone in Keratose sponge.  
 1193. Moreton Bay, Qld. Coll. V. F. Collin, 15/1/41.  
 1224. Myora mud flats, Moreton Bay, Qld. Coll. Univ. Qld. Sci. Students Assoc., 4/6/41.  
 1265. Townsville, Qld. Coll. G. Coats, 23/6/41.  
 1296. Angourie, N.S.W. 9/7/41.  
 1417. Mud I., Moreton Bay, Qld. 15/1/41. Coll. U. F. Collin.  
 1467. Mud I., Moreton Bay, Qld.  
 2105. Coll. G. Coats, 23/5/41.  
 2234. Amity, Moreton Bay, Qld. Coll. J. E. Young, Sept. 1924.  
 2235. Cardwell, Qld. Jan. 1889.  
 2236. Darnley I., Qld. Coll. Dr Tosh.  
 2237. Sandgate, Qld. Coll. C. J. Wild, 3/4/07.

- QM W 2238. Moreton Bay, Qld. Coll. D. Connor.  
 2239. South Port, SE. Queensland.  
 2240. Sandgate, Qld. Coll. T. C. Marshall and G. P. Whitley, 25/10/28.  
 2242. Dunwich, Qld. -/4/62. Mid shore *Zostera*.  
 2243. Victoria Point, Moreton Bay, Qld. 17/2/62. F. C. Vohra's Sta. 3. *Zostera*.  
 2244. Moreton Bay, Qld. Coll. F. C. Vohra, 1962.  
 2245. Victoria Point, Moreton Bay, Qld. 13/6/62.  
 2246. Moreton Bay, Qld. Coll. F. C. Vohra, 25/7/62.  
 2247. Southport, SE. Qld. Coll. R. Puhlman, 1920.  
 2248. Princess Charlotte Bay, Qld. Coll. Capt. T. Kerr.  
 2249. Bribie I., SE. Qld.  
 2381. Trawled off C. Moreton, SE. Qld. Coll. B. Harris, April 1965.  
 2391. Norman River, N. Qld. Coll. Dept Harbours & Marine, 7/6/65. From prawn trawl.

#### COLLECTIONS FROM THE QUEEN VICTORIA MUSEUM AND ART GALLERY, LAUNCESTON

The numbers are of the Museum's catalogue; the "QV" is our designation.

- QV 1971-10-2, -3, -4, -5, -6, -7, -8, -10, -11, -12, -14. Collected at Green's Beach on the western side of mouth of Tamar River, N. Tasmania, from 1965-68.  
 1971-10-9. Collected at Kelso, 3 mi. S. of Green's Beach, Tasmania, 8/1/67.

#### COLLECTIONS MADE BY R. U. GOODING, BARBADOS, W.I.

This collection by Dr Gooding was entirely from Diadematid Sea Urchins; we have prefaced his collection numbers with "RG". The collection will be returned to him.

- RG 536. Radar Reef, Rottneest I., W.A. 1 m. Coll. R. Mahon, A. Baynes, R. Gooding, 12/5/69. Among spines on ventral side of *Centrostephanus tenuispinus* collected under ledges in rock pools.  
 538. The Blowholes, near Quobba Point, N. W.A. 1-2 m. 21/6/69. From chloretone washings of *Diadema setosum* collected under coral heads and rocks in the deeper pools.  
 540. Point Moore, Geraldton, W.A. 3 m. 7/6/69. From *Centrostephanus tenuispinus* collected in niches and caves in coral rock on reef.  
 541. Off Glacier Point, near Cronulla, near Sydney, N.S.W. 4-5 m. Coll. C. Lawler and other Underwater Research group members and R. Gooding, 28/6/69. From *Centrostephanus rogersi* collected between rock ridges on reef.  
 542. Bare I., near N. head of Botany Bay, N.S.W. 3-4 m. Coll. R. Gooding and Underwater Research Group members, 29/6/69.  
 547a. On reef between light-beacon and Clark I., NE. Qld. ½ m. July 1969. Coll. from *Echinometra* in rock pool.  
 551. Waterwich Reef, NE. Qld. 1 m. 25/7/69. From *Echinothrix diadema* collected in hollow at base of coral head.  
 620a. Off Signal Point, Lord Howe I., N.S.W. 0.5-1.5 m. 6/2/70. From *Centrostephanus rogersi* in lagoon under rocks and coral.  
 620c. Same as 620a. From *Tripneustes gratilla*.  
 620d. Same as 620a. From *Heliocidaris tuberculata*.  
 620(2)d. Same as 620d.  
 621a. Escott's Pass, W. side of Lord Howe I. 1 1/2 m. 7/2/70. From *Centrostephanus rogersi* collected in hollows on rocks and coral.  
 622a. Ned's Beach, NE. end of Lord Howe I. ¾-1 m. 8/2/70. From *Centrostephanus rogersi* collected in hollows and crevices of rocks and coral.  
 623a. Norfolk I. From lagoon side of reef at E. end of Sydney Bay near entrance to Emily Bay. 1-2 m. 15/2/70. From *Centrostephanus rogersi* collected from spaces under rocks and coral.  
 623b. Same as 623a. 1 1/2 m. From *Diadema savignyi*.  
 623(3)c. Norfolk I., off mouth of Emily Bay, E. side. 1-3 m. 26/2/70. From *Tripneustes gratilla*.  
 623 1/2. Norfolk I., rocks on S. side of Anson Bay. 1-1.5 m. 22/2/70. From chloretone washings of *Heliocidaris tuberculata*.  
 624. Norfolk I., "Crystal Pool" on W. side of Point Ross. 1-3 m. Coll. R. Gooding and S. Blaxland, 24/2/71. From *Centrostephanus rogersi* found in holes and rocky sides of pool.

### COLLECTIONS FROM THE SOUTH AUSTRALIAN MUSEUM, ADELAIDE

The "SM" is our preface; the "C" numbers are the museum catalogue numbers, while the four collections without the "C" are our designations.

- SM C-166. East side of Groote Eylandt, N.T. Coll. N. Tindale, Aug. 1921.  
 C-501. Queenscliffe Reef, Kangaroo I., S.A. Coll. W. H. Anderson, registered 1925.  
 C-502. St Vincent Gulf, S.A. Coll. W. H. Baker.  
 C-504. Marino Reef, W.A. Coll. W. H. Baker and H. M. Hale, 1923.  
 C-505. Northern Territory, registered 1925.  
 C-511. Glenelg, St Vincent Gulf, S.A. Coll. H. M. Hale, Aug. 1920. Collected after storm.  
 C-515. Queenscliffe Reef, Kangaroo I., S.A. Coll. A. Zietz, 1888.  
 C-517. Nuyts Arch, S.A. 3-4 fms. Coll. F. Wood-Jones, registered 1925.  
 C-518. Kangaroo I., S.A. Coll. A. Zietz.  
 C-805. Queenscliff, Kangaroo I., S.A. Coll. Hale & Tindale, January, 1926. Intertidal from under stones.  
 C-1066. 5 mi. off Semaphore, S.A. 5 fms. Coll. H. M. Hale.  
 C-1074. Glenelg, S.A. Coll. H. M. Hale, registered 1926.
- SM 1. Coll. W. B. Greenwood, 30/8/09.  
 2. Hallets Cove, S.A. Coll. J. Formby Collin.  
 3. Point Lincoln, S.A. Coll. M. Dredge, 29/3/64.  
 4. Smoky Bay, S.A. Coll. F. Wood-Jones.

### COLLECTIONS FROM THE TASMANIAN MUSEUM AND ART GALLERY, HOBART

The preface "TM" is ours; the following designations are Museum catalogue numbers.

- TM G1102. Eaglehawk Neck, Tasmania. Sept. 1935.  
 12877/G51. Kingston Beach, Derwent Estuary, Tasmania. Nov. 1952. Coll. J. R. Cunningham.  
 12879/G52. Green I., D'Entrecasteaux Channel, Tasmania. 21/7/48.  
 15121/G325. Point Esperance, Tasmania. 54 ft. 2/3/58. Coll. M. Tobias. From woodwork of wreck.  
 16630/G425. Near Woody I., D'Entrecasteaux Channel, Tasmania. Coll. L. Hughes, July 1962. From scallop dredge.

### COLLECTIONS FROM THE UNIVERSITY OF QUEENSLAND, BRISBANE

These collections were made by various individuals in the Brisbane area, including some attached to the CSIRO; in some cases they lent us the specimens directly, but in some cases the specimens came from the University of Queensland. All will be returned to the University of Queensland, and probably will eventually be placed in the Queensland Museum. The full designation is ours.

- UQ 1. Moreton Bay, Qld. Coll. E. Ellway, 25/5/67. Collected from piles at end of Dunwich Jetty, substrate sandy-mud.  
 2. Moreton Bay. 3-6 fms. Coll. C. R. Smalley, 13/5/68. Collected in one-half hour prawn trawl during day, from channels of a large sponge caught in trawl, substrate sandy-mud.  
 3. Moreton Bay. Coll. C. R. Smalley, 14/5/68. Dug up on intertidal *Zostera* beds at Dunwich. Shrimp occupied burrows dug about 6 inches into sandy-mud substrate.  
 4. Moreton Bay. Coll. S. Cook, May 1968. Caught intertidally near jetty at Victoria Point. Substrate mud and rubble.  
 5. Moreton Bay. Coll. C. Ellway, 25/5/67. From prawn trawl near Dunwich.  
 6. Moreton Bay. Coll. C. Ellway, 25/5/67. Collected by hand from piles at end of Dunwich Jetty. Substrate sandy-mud.  
 7. Moreton Bay. Coll. C. Ellway, 25/5/67. From near Dunwich.  
 8. Moreton Bay. 3 fms. Dredged in morning. Substrate gritty-muddy sand.  
 9. Jumpinpin, Qld. 5 fms. Coll. T. Helbig, 30/4/68. In bottom of plankton haul. Substrate sandy.  
 10. Moreton Bay, Qld. 3-6 fms. Coll. C. R. Smalley, 13/5/68. From one-half hour shrimp trawl at day. From channels of large sponge. Substrate sandy-mud.

- UQ 11. Moreton Bay. Coll. C. R. Smalley, 17/5/68. Collected by grab off Dunwich Jetty off a vessel moored at jetty. Substrate sandy-mud.
12. Moreton Bay. 7 fms. Coll. Liron, Feb. 1968. From inside large sponge.
13. Moreton Bay. Coll. Moore. Grid Square 72316, *Marelda* Stn. 40.
14. Moreton Bay. 7 fms. Coll. Liron, Feb. 1968. From inside edge.
15. Moreton Bay. Grid square 47, *Marelda* Stn.
16. Moreton Bay. Lot 12.
17. Moreton Bay. 2 1/2 fms. Coll. Moore. Lot 9. *Marelda* Stn. 222.
18. Moreton Bay. 10 fms. Coll. Moore, 4/8/67. Lot 3, Grid Square 73337. *Marelda* Stn.
19. Moreton Bay. Coll. Moore. Lot 11, Grid Square 71. *Marelda* Stn. 445.
20. Moreton Bay. 1967. No further data.
21. Moreton Bay. Coll. A. J. Bruce, 24/9/68. Collected by Pronoxfish at Peel I. from pools amongst oysters and mussel flats.
22. Moreton Bay, Peel I., 0.5 m. Coll. A. J. Bruce from yellow sponge.
23. Norman River at Karumba, Gulf of Carpentaria, Qld. Coll. A. J. Bruce, 1/7/67. From under stones.
24. Gulf of Carpentaria, Qld. Coll. Liron, 14/7/67. From Grid Square 6805. Trawled.
25. Gulf of Carpentaria, Qld. 8 fms. Coll. Moore, 17/11/67. *Santa Maria* Stn.
26. Gulf of Carpentaria, Qld. Coll. Moore, 1/2/68. Grid Square 6798. *Santa Maria* Stn. 38.
27. 1 mi. NE. Mud I., Moreton Bay, Qld. 5.5 fms. Coll. C. R. Smalley, 25-26/3/68. Smalley Coll. No. 8.
28. 1-2 mi. NE. Mud I., Moreton Bay, Qld. 3-6 fms. Coll. C. R. Smalley, 7-8/2/68. Smalley Coll. No. 15. In mud.
29. Same as UQ 28. Smalley Coll. No. 17.
30. Same as UQ 28. Smalley Coll. No. 22.
31. 2-4 mi. E. of lower one-half of Redcliffe Peninsula, Moreton Bay, Qld. 4-6 fms. Coll. C. R. Smalley, 2-3/5/68. Smalley Coll. No. 30.
32. Same as UQ 31. Smalley Coll. No. 40.
33. 2 mi. E. Mud I., Moreton Bay, Qld. Coll. L. Wale from shrimp trawl.
34. 8 mi. E. of Scarborough, Moreton Bay, Qld. 4 1/2 fms. Coll. W. Stephenson, 10/11/61. Sandy bottom.

**COLLECTIONS FROM THE NATIONAL MUSEUM OF NATURAL HISTORY,  
SMITHSONIAN INSTITUTION, WASHINGTON, D.C.**

These collections were made by Dr James M. Moulton, of the Department of Biology, Bowdoin College, Brunswick, Maine, and deposited in the Smithsonian Institution by him. The "US" is our prefix; the numbers are the catalogue numbers of the Crustacea section of the Museum.

- US 106163. Dunwich, North Stradbroke I., Qld. 3/9/60.
106164. Same as US 106163.
106165. Same as US 106163.
106166. Same as US 106163. Under rocks at low tide.
106167. Same as US 106166. 3/11/60.
123562. Same as US 106166. Intertidal, under rocks in *Callianassa* burrows.
123563. Heron I., Capricorn Group, Qld. 15/11/60. Under beach rock W. side, in damp sand only.
123564. Same as US 123563. 28/1/60. S. side.
123565. Wistari Reef, Capricorn Group, Qld. 30/10/60. Under dead coral on S. side.
123566. One Tree I. Reef, Capricorn Group, Qld. 1/12/60.
123567. Quoin I., N. end, Port Curtis, Qld. 25/1/61. Intertidal zone, under rocks. Rocks and coarse sand.
123568. Unnamed islet, W. side of Facing I., Port Curtis, Qld. 27/1/61. Intertidal, under rocks. Muddy silt, mangrove island.
123569. W. reef, Heron I., Capricorn Group, Qld. 6/10/60. From mid-reef, dead staghorn coral.
123570. Same as US 123569. 20/10/60. 20 yds out, from pit in base of coral head.
123571. Same as US 123569. Low tide, coral head crevice. Western shallows.
123572. N. of Heron I., Capricorn Group, Qld. 5/10/60. From crevices in dead coral.
123573. Same as US 123572. Outer edge of N. reef in dead coral. Larger one under *Tridacna*.

- US 123574. Same as US 123572. 9/10/60. Coral heads and roots between island and outer edge of northern reef.
123575. Same as US 123572. 20/10/60. Crevices in coral heads. Western shallows, low tide.
123576. Same as US 123572. 22/10/60.
123577. Same as US 123565.
123578. Same as US 123565. Under dead coral.
123579. Same as US 123565.
123580. Heron I., Capricorn Group, Qld. 19/11/60. Under coral heads in SE. corner.
123581. Same as US 123580.
123582. North West I., Capricorn Group, Qld. 29/2/60. SW. part of reef, under dead coral pieces.
123583. Same as US 123566. Under dead coral pieces.
123584. Same as US 123566. 6/10/60. Reef W. of lab., in dead coral.
123585. Same as US 123565. 10/10/60. S. side, under dead coral.
123586. Same as US 123585.
123587. Same as US 123565. Under coral rocks.
123588. Same as US 123565. 19/10/60. Crevices in dead coral bases.
123589. Same as US 123565. 20/10/60. S. side, under dead coral.
123590. Same as US 123565. 21/10/60. Western reef, coral head crevice.
123591. Same as US 123565.
123592. Same as US 123565. 14/11/60. E. side, dead coral, living coral base 20 ft below low tide.
123593. Same as US 123563. 9/10/60. Under coral heads, outermost edge of reef N. of island.
123594. Same as US 123593.
123595. Same as US 123565.
123596. Same as US 123565.
123597. Same as US 123565.
123598. Same as US 123565. 18/12/60. SE. corner of reef, under dead coral.
123599. Same as US 123565.
123600. Same as US 123565. 9/10/60. N. reef between island and outer edge of reef. Coral heads and roots.
123601. Same as US 123565. 5/10/60. Reef edge.
123602. Facing I., W. side, Port Curtis, Qld. 26/1/61. Intertidal, under rocks. Rocks and coarse sand.
123603. Dunwich, North Stradbroke Is., Qld. 10/4/61. Intertidal area under rocks in *Callianassa* burrows.
123604. E. side, Port Curtis, Qld. 27/1/61. Coral debris 5 ft below low tide level.
123605. Same as US 123565. Western Reef in dead coral.
123607. Same as US 123604.
123608. Same as US 123565. 30/10/60. Under coral head.
123609. Same as US 123565. 28/11/60. S. side, under beach rock in most sand.

#### COLLECTIONS FROM NATIONAL MUSEUM OF VICTORIA, MELBOURNE

This collection was without museum catalogue numbers, and we have assigned the full designation.

- VM 1. Western Port Bay, Victoria. Coll. S. W. Fulton, 23/5/1906.
2. Green I., Qld. Coll. A. Tubb, Jan. 1935.
3. Mordialloc Beach, Victoria. Coll. W. Kershaw, Nov. 19, 1888.
4. Portland, Victoria. From C. Kurtze, 20/6/1952.
5. South Australia. Cummins, 1902.
6. Mordialloc Beach, Victoria. Pres. C. Johnston, 25/3/1907.
7. Point Cook, Victoria. Coll. C. L. Barrett, 1/4/1905. From dredge.
8. Portland, Victoria. Coll. N. Learmonth, 24/8/1950.
9. S. Brighton, Victoria. Pres. W. Kershaw.
10. Cheltenham, Victoria. Coll. W. Kershaw, 20/7/1891. Found on beach after storm.
11. Same as VM 10. 21/7/1891.
12. San Remo, Victoria. Coll. A. Tubb, 17/10/1934.
13. Western Port, Victoria. Coll. J. H. MacPherson, 2/9/1957. From SE. Oyster beds.
14. Mordialloc Beach, Victoria. May 1877.
15. Newport Power House, Victoria. Coll. H. A. Morrison, 21/7/1949.

- VM 16. Portland, Victoria. Coll. Mr Butler, Dec. 1883.  
 17. Coast of Adelaide to Kangaroo I., S.A. Coll. R. H. Cummins, 1902.  
 18. Same as VM 14.  
 19. Barrier Reef off Cape York, Qld. Coll. C. French, Sept. 1881.  
 20. Same as VM 16. Oct. 6, 1879.  
 21. Phillip I., off Cowes, Victoria. 16-20 fms. 1/6/1951.  
 22. Port Willunga, S.A. Coll. R. H. Cummins, 6/4/1906. Fulton collection.  
 23. Elliot Heads near Bundaberg, Qld. Dec. 1963.  
 24. Beaumaris, Victoria. 1-2 fms. Coll. S. W. Fulton, 24/11/1900. In rotten reef.  
 25. Norfolk I.  
 26. Same as VM 24. In rocks, dredged.  
 27. San Remo, Western Port, Victoria. Coll. Coghill, 28/1/1909.  
 28. Hobson's Bay, Victoria. Coll. J. A. Kershaw, 1901.  
 29. Low Isles, Great Barrier Reef, Qld.  
 30. Off Rhyll, Western Port, Victoria.  
 31. Normanville, S.A.  
 32. St Vincent Gulf, S.A. Coll. R. Cummins, 1902.  
 33. Port Albert, Victoria. Coll. Mattingly, 1903. Dredged.  
 34. New South Wales, July 1892. Purchased from Mr Brown, N.S.W.  
 35. Western Port Bay, Victoria. Pres. S. W. Fulton, 23/5/1906.  
 36. Tom Thumb Lagoon, Port Kembla, N.S.W. Coll. A. G. Hamilton, March 1902.  
 924. 925, 935, 948, 949, 956, 957, 962. Port Phillip Bay, near centre, Victoria. 22-24 m. 1970-71. Soft silty substrate. [These collections were made during the Port Phillip Bay Zoobenthos Survey by the Marine Pollution Section, Fisheries and Wildlife Department of Victoria, and will be stored, in part, in the National Museum. We use the Museum prefix followed by the Fisheries and Wildlife station numbers.]  
 941. Port Phillip Bay, Western Arm, Victoria. 9 m. 1970. Soft silty substrate.

#### COLLECTIONS FROM THE WESTERN AUSTRALIAN MUSEUM, PERTH

All numerical designations are of the Museum, to which we have assigned the prefix "WM".

- WM 22-65. Near National Fitness Camp, Point Peron, W.A. Coll. R. W. George, 1/12/61.  
 23-65. Carnarvon Area, W.A. Trawled. 1/12/69.  
 23-65a. 2 mi. WNW. of Cottesloe, W.A. (near buoy). 2 fms. Coll. R. W. George on *Davena*, -1/5/60.  
 24-65. Channel Rock Buoy, Darwin, N.T. Coll. R. E. Hannan, 1/9/63.  
 25-65. Between Malus and Gidley I., Dampier Arch., W.A. Coll. Royce on *Davena*. Sand and coral.  
 26-65. Same as 25-65, 1/6/60.  
 29-65. Pelsart Group, Houtman Abrolhos, W.A. Coll. J. Allahis, 13/6/60. In crayfish pot.  
 30-65. 3-4 ft off E. end of Delambre I., Dampier Arch., W.A. Coll. B. R. Wilson on *Davena*, 5/5/60.  
 31-65. Garden I., W.A. Coll. L. R. Thomas, 14/1/64. On reef flats.  
 32-65. Rottneest I., W.A. Coll. G. Dittmer, 1/7/65. From sponge.  
 33-65. E. of Pelsart I., Houtman Abrolhos, W.A. Dredged at 20 fms. Coll. M. Cramer, -1/6/62.  
 34-65. Exmouth Gulf or Shark Bay, W.A. Trawled. Coll. R. M. McKay on the *Peron*. Winter, 1960.  
 35-65. NE. of Garden I., W.A. 15 ft. Coll. P. Barrett-Lennard, 14/3/59. From an old boom pile.  
 36-65. Yardie Creek Station, North West Cape, W.A. Coll. Douglas and Mees, 2/8/59. Under stones on sandy beach.  
 37-65. Dirk Hartog I., W.A. Coll. J. Sells, -1/4/57. From crayfish pots.  
 38-65. 7 mi. SW. of Bunbury, W.A. 11 fms. Coll. F. R. V. *Lancelin*, 13/4/63.  
 39-65. Yule Point, N. of Cairns, Qld. Coll. G. F. Mees, 11/10/61.  
 40-65. Careening Bay, Garden I., W.A. Coll. B. R. Wilson and Marine Group, 26/11/61.  
 41-65. Shark Bay, 40 mi. SW. of Carnarvon, W.A. Trawled. Coll. A. Snell, 1/6/60.  
 42-65. Lancelin I., W.A. Coll. Neptune Submariners, 14/1/58.  
 43-65. Point Quobba, W.A. 24° 30' S., 113° 24' E. Coll. Jan. 59.  
 44-65. Exmouth Gulf, W.A. Coll. W. Dall, 10/9/53.  
 45-65. NW. of Jurien Bay, W.A. 30° 00' S., 114° 32' E. Beam Trawl at 70-75 fms. CSIRO Sta. 3, 25/1/64. Sponge and bryozoa.

- WM 47-65. Victoria Station, Cottesloe, cable station, Perth, W.A. Coll. W. H. Butler, 16/3/61.
- 48-65. Trawled off Mandurah, W.A. Coll. Poole Bros, 4/1/63.
- 49-65. D'Estrees Bay, S.A. Sample 47. 5/4/53.
- 51-65. Carnac I., S. reef platform, W.A. Coll. E. P. Hodgkin, 20/12/61.
- 52-65. South Reef, Penguin I., W.A. Coll. B. Lindsay, 14/11/64. From sponge.
- 53-65. North of Darwin, N.T. Coll. R. Kersting, 12/11/19?. From buoys and beacons near light house.
- 54-65. W. of Bluff Point, Geraldton, W.A. 24° 40' S., 113° 03' E. 20 fms. CSIRO Sta. 131. 22/8/68.
- 55-65. Exmouth Gulf, W.A. Trawled at 1-10 fms. Coll. R. W. McKay on the *Peron*. Winter, 1960. From sponge.
- 58-65. Same as WM 35-65.
- 60-65. W. side of Exmouth Gulf, W.A. 8-9 fms. 23/9/53. From sponge.
- 61-65. Panchoran Buoy, 13/7/61.
- 62-65. Woody I., Houtman Abrolhos, W.A. Coll. R. P. McMillan.
- 63-65. SW. of Geraldton, W.A. 29° 05' S., 113° 56' E. 71-81 fms. CSIRO Sta. 54, 16/2/64.
- 64-65. NW. of Bluff Point, W.A. 27° 40' S., 113° 20' E. 7 1/2 fms. CSIRO Sta. 208, 10/10/63.
- 65-65. Between Long and Table Is, NW. of Onslow, W.A. F. R. V. *Lancelin*, 1/8/63. Coarse sand and dead shells.
- 69-65. N. of Leschenault, W.A. 47-49 fms. Coll. CSIRO 11/10/63.
- 70-65. Cockatoo I., W.A. Coll. N. Hoffman, March 1963. In dead coral cracks and hollows.
- 71-65. NW. of Bluff Point, W.A. 27° 40' S., 113° 03' E. 70 fms. CSIRO Sta. 31, 22/8/63.
- 72-65. 5 mi. NE. end of Rottnest I., W.A. 19 fms. Coll. R. W. George on *Davena*.
- 73-65. Cable Beach, Broome, N. W.A. Coll. W. Goode on the *Dorothea*, 6/10/62.
- 76-65. Point Peron, W.A. Coll. D. G. Bathgate, 11/7/62. In limestone from reef.
- 77-65. Zeewyk Channel, Houtman Abrolhos, W.A. 21 fms. Coll. F. R. V. *Lancelin*, 6/3/63.
- 79-65. 60 mi. W. and N. Bedout I., W.A. Dredged at 25 fms. Coll. R. W. George on the *Dorothea*.
- 81-65. 23 mi. W. and N. of Bedout I., W.A. Dredged at 25 fms. Coll. R. W. George on the *Dorothea*, 12/10/62.
- 82-65. Lancelin I., W.A. Coll. R. Ackerman, -/3/64.
- 83-65. Cockburn Sd, W.A. 2 mi. W. of naval base. Dredged in 10 fms. Coll. P. Cawthorn on *Lancelin*.
- 84-65. NNW. of Busselton Jetty, W.A. Dredged at 5 fms. Coll. B. R. Wilson and J. Seabrook on *Lancelin*.
- 85-65. Near National Fitness Camp, Point Peron. Coll. R. W. George, 1/11/61. In "worm" rock.
- 86-65. 5 mi. W. of North Beach, Perth, W.A. 50 ft. Coll. D. Blair, 9/9/61. In sponge.
- 87-65. Kwinana, Cockburn Sd, W.A. 200-300 yds NW. off #2 buoy. Coll. B. R. Wilson, 10/1/58.
- 88-65. NW. of Bluff Point, W.A. 27° 18' S., 113° 16' E. 54 fms. CSIRO Sta. 204, 9/10/63.
- 89-65. Yampi Sd, W.A. Coll. G. A. Robinson, 1/19/60.
- 90-65. W. of Geraldton, W.A. 28° 14' S., 113° 28' E. 60 fms. CSIRO Sta. 40, 4/2/64.
- 91-65. NW. of Carnarvon, W.A. 22° 59' S., 113° 25' E. Beam Trawl at 71 fms. CSIRO Sta. 17, 31/1/64.
- 92-65. Triggs I., near Perth, W.A. Coll. W. H. Butler, 20/4/61.
- 93-65. Off Cleveland Cape, Qld. Dredged in 16 fms. Coll. W. Goode, 24/11/63.
- 94-65. NW. of Cape Naturaliste, W.A. 33° 40' S., 114° 28' E. 75 fms. CSIRO, Aug. 1963.
- 95-65. Near bar of South Passage, Shark Bay, W.A. Coll. R. W. George on *Davena*, 14/4/60.
- 96-65. Cockburn Sd, W.A. Coll. F. V. *Dante*, 9/2/57.
- 97-65. Emu Point Channel, Albany, W.A. Coll. R. W. George, 15/1/59.
- 98-65. Reef flat Yanchep, W.A. Coll. B. Wilson, 27/1/59. Low tide, under stones.
- 99-65. Same as WM 85-65, 1/10/61.
- 101-65. Roeburne, W.A. Coll. C. Lambert, 21/9/59. Under stones on reef flat.
- 102-65. "Flat Rocks", Greenough, near Geraldton, W.A. Coll. B. R. Wilson, 23/8/58.



- WM 103-65. Busselton, W.A. Coll. W. H. Butler, -/3/62.  
 104-65. Heron I., Capricorn Group, Qld. Coll. R. W. George, 5/12/61. Reef flat, beach edge under rocks.  
 105-65. Same as WM 92-65.  
 106-65. Dirk Hartog I., W.A. Coll. J. Sells, -/3/57. From crayfish pot.  
 107-65. Denham, Shark Bay, W.A. Coll. B. R. Wilson, 29/12/59.  
 108-65. Same as WM 95-65, 14/5/60.  
 109-65. Same as WM 92-65, 14/3/61.  
 111-65. 1-2 mi. W. of Seal I., King George Sd, W.A. Coll. R. W. George, -/3/62.  
 112-65. Esperance Bay, W.A. Coll. W. H. Butler, 20/11/59.  
 113-65. Rockingham, near Perth, W.A. 8/2/58. From rocks near old piles.  
 114-65. Jervis Groyne, Cockburn Sd, W.A. Cockburn Sd Survey, 13/12/58. From coral rock N. of groyne.  
 115-65. Same as WM 95-65. 14/5/60.  
 116-65. Same as WM 95-65. 14/5/60. 6 fms. Coll. with Honolulu dredge. Sand and gravel.  
 117-65. Fremantle, W.A. WM collection, -/10/12. From jetty piles.  
 118-65. Wreck Point, Southern Group, Houtman Abrolhos, W.A. Coll. A. Robinson, 20/4/58.  
 119-65. Same as WM 98-65.  
 120-65. Pidgeon I., Wallabi Group, Houtman Abrolhos, W.A. Coll. P. Barrett-Lennard, -/5/59. From crinoids.  
 121-65. Busselton, W.A. Coll. W. H. Butler, 1/3/62.  
 122-65. No data, almost certainly northern W.A. Coll. K. Godfrey on *Lancelin*, 1954.  
 123-65. Same as WM 107-65.  
 125-65. Point Gregory, NW. side of Peron Peninsula, Shark Bay, W.A. Coll. B. R. Wilson, 1/1/60.  
 126-65. Lancelin I., W.A. Coll. J. Shea, Dec. 1965. On deck from cray pots and sponges.  
 127-65. Good Friday Bay, Houtman Abrolhos, W.A. Coll. F. R. V. *Lancelin*, 26/2/63.  
 128-65. Same as WM 95-65, 14/5/60.  
 129-65. W. of Lancelin I., W.A. 31° 05' S., 114° 55' E. CSIRO Sta. 46, 5/2/64.  
 130-65. Port Gregory Reef, NW. side of Peron Peninsula, Shark Bay, W.A. Coll. B. R. Wilson, 6/12/62. Under stones at low tide.  
 131-65. Yampi Sd. Coll. G. A. Robinson, -/9/60. Low tide.  
 132-65a. WNW. Rottneet I., W.A. 90-94 fms. Coll. R. W. George on *Bluefin*, 4/8/62.  
 132-65b. Point Gregory, NW. side of Peron Peninsula, Shark Bay, W.A. Coll. B. R. Wilson, 1/1/60. Under stone on limestone reef flat at low tide.  
 133-65. Same as WM 120-65. -/5/59.  
 134-65. North of Peron Flats, Shark Bay, W.A. Coll. Poole Bros, -/7/62.  
 135-65. Eagle Bay, Cape Naturaliste, W.A. Coll. B. R. Wilson, 7/8/63. Under intertidal granite boulders.  
 136-65. Same as WM 114-65. 3/12/61.  
 139-65. NW. end of Rosemary I., Dampier Arch., W.A. Coll. B. R. Wilson and G. W. Kendrick, 24/8/61.  
 140-65. Off Garden I., W.A. Beam Trawl, 2 fms. Coll. CSIRO *Lancelin*, -/7/63.  
 141-65. Hopetoun, N. Jetty, W.A. Coll. R. W. George, 9/1/59. Granite rocks, low tide.  
 142-65. S. W. Herald Cay, Qld. 14/11/61.  
 143-65. Lancelin I., W.A. Coll. J. McKay, March or April 1958. On cray pots.  
 144-65. Gidley I., Dampier Arch., W.A. Coll. Royce on *Davena*, 1/6/60. From coral rubble.  
 145-65. W. of Rottneet I., W.A. 32° 00' S., 115° 08' E. 75 fms. CSIRO Sta. 154.  
 147-65. 1/2 mi. SE. Mistaken I., King George Sd, Southern W.A. 17 fms. Coll. B. R. Wilson and G. W. Kendrick.  
 152-65. Same as WM 139-65. 27/8/61.  
 155-65. Norfolk I., limestone platform at Kingston. Coll. E. P. Hodgkin, 19/9/61. Washed from *Caulerpa*.  
 156-65. Between Gidley and Rosemary Is, Dampier Arch., W.A. Muriel King Exped. Coll. Royce on *Davena*, 3/15/60.  
 159-65. Owen Anchorage, trawled off Fremantle power house, W.A. Coll. R. W. George on *Lancelin*, 6/12/59.  
 160-65. NW. of Point Cloats, W.A. 22° 52' S., 113° 29' E. 73 fms. CSIRO Sta. 178, 6/10/63.  
 161-65. Cape Inscription and Cape St Creig, Shark Bay, W.A. 38 fms. Coll. R. W. George on *Davena*, 16/5/60.

- WM 162-65. Exmouth Gulf, W.A. Trawled. Coll. Poole Bros, Oct.-Nov. 1958.  
 163-65. Cable Station Victoria St, Cottesloe, W.A. Coll. W. H. Butler, 16/3/61.  
 164-65. Point Peron, W.A. 6 ft. Coll. W. H. Butler, 26/6/60.  
 165-65. West Point, Darwin, N.T. Coll. R. I. Hannan, 4/11/63. Low water.  
 166-65. Good Friday Bay, Houtman Abrolhos, W.A. Dredged 5 fms. Coll. F. R. V. *Lancelin*, 3/3/65.  
 167-65. Shark Bay, W.A. F.R.V. *Peron*, Sta. H. 137. 2/7/62.  
 168-65. Monkey Mia, Shark Bay, W.A. Coll. A. Kalnias, 25/3/50. In sand at low tide.  
 169-65. Same as 166-65, 9/7/62.  
 170-65. N. end Oyster Harbour, W.A. 20° 23' S., 118° 29' E. 3 fms. Coll. B. R. Wilson, 2/7/65. In mud.  
 171-65. Same as WM 95-65. 14/5/60.  
 172-65. Port Walcott, W.A. 20° 39' S., 117° 10' E. 8 fms. Coll. Royce on *Davena*, 3/6/60.  
 173-65. Shark Bay, 40 mi. SW. of Carnarvon, W.A. Trawled. Coll. R. Snell, 1/6/60.  
 174-65. Off Parker Point, Rottne I., W.A. Coll. Mr Pollard, 7/8/63.  
 175-65. Same as WM 92-65, 20/3/61.  
 176-65. Cockburn Sd, 2 mi. off Rockingham, W.A. Coll. R. Slack-Smith and G. W. Kendrick, 6/1/65.  
 177-65. Same as WM 176-65.  
 178-65. Albany, W.A. From octopus stomach collected at town jetty, Oct. 1965.  
 179-65. Shark Bay, W.A. Coll. by F. R. V. *Peron* haul 5, 2/3/62.  
 180-65. Lancelin I., W.A. Coll. J. Shea, -/12/56. On deck from craypots and sponges.  
 181-65. Rat I., Houtman Abrolhos, W.A. Coll. F. Greco, 10/3/63. Inside coral piece caught on crayfish pot rope in shallow water.  
 182-65. 5 mi. E. of North I., Houtman Abrolhos, W.A. Honolulu dredge. Coll. R. W. George on *Davena*, 13/5/60. Sea weed, coral, sponge.  
 183-65. Between "Y" and Whalebone I., Exmouth Gulf, W.A. Coll. K. Godfreys, 5/8/53.  
 184-65. SW. of Geraldton, W.A. 29° 5' S., 113° 56' E. 71-81 fms. CSIRO Sta. 54, 16/2/64.  
 185-65. Yampi Sd, N. W.A. Coll. G. A. Robinson, 1/1-/59.  
 186-65. 7-8 mi. N. of Long I., off Onslow, W.A. Coll. B. R. Wilson on *Davena*, 17/6/60.  
 187-65. Palm Beach Jetty, Cockburn Sd, W.A. Zool. Dept Univ. W.A., 16/4/59.  
 188-65. Between Green I. and Cervantes I., W.A. Coll. R. H. Amm, early 1963.  
 189-65. Shark Bay, Block 16, W.A. Coll. F. R. V. *Peron*, 7/8/62.  
 190-65. Shark Bay, W.A. Coll. F. R. V. *Peron* Haul 147, 13/7/63.  
 191-65. Yampi Sd, W.A. Coll. G. A. Robinson, -/2/61. Reef at low tide.  
 192-65. W. of Dirk Hartog I., W.A. 25° 54' S., 112° 38' E. Beam trawl at 70-72 fms. CSIRO Sta. 35, 3/2/64.  
 193-65. Reef bottom, near flashing light, Port Hedland, W.A. Coll. Mr B. Duncan, -/7/63.  
 196-65. Patches Point Charles, 12 mi. from Darwin, N.T. Coll. R. J. Hannen, 13/11/63.  
 197-65. Same as WM 114-65, 1/12/55.  
 198-65. 2 mi. E. of E. end of Rottne I., W.A. 9 fms. Coll. R. W. George on *Davena*.  
 199-65. Exmouth Gulf, W.A. Trawled 6 fms. Coll. CSIRO, Oct. 1955.  
 200-65. W. side of Friday Bay, Houtman Abrolhos, W.A. Dredged 10-15 fms. Coll. F. R. V. *Lancelin*, 8/3/63.  
 201-65. 3 mi. NW. of Lodge Point, W.A. 34° 28' S., 119° 13' E. 8-9 fms. Coll. I. Patterson, -/1/61. From craypot.  
 202-65. Beagle I., W.A. 29° 40' S., 114° 52' E. 33 ft. Coll. Poole Bros, March-April, 1959. From crayfish pots or ropes.  
 203-65. Same as WM 95-65. Honolulu Dredge at 6 fms. 14/5/60. Sand and weed.  
 204-65. W. side of North West Cape, W.A. Coll. H. Roberts, -/6/61. Under stones.  
 205-65. Cockburn Sd, W.A. 8 ft. Marine Naturalist Club. Inshore.  
 208-65. Jetty area, Woodman's Point, near Perth, W.A. Coll. R. W. George, 19/2/61. Living under sea urchins *Heliocidaris* sp.  
 209-65. 2 mi. after Legendre Is, Dampier Arch., W.A. Coll. Wilson on *Davena*, 9/11/60.  
 210-65. Port Hedland, W.A. Coll. Mr Brown, -/9/61. Among sponge and rubble.  
 211-65. Point Peron, W.A. Coll. W. H. Butler, 9/4/60. In "worm rock".  
 212-65. Esperance, W.A. Coll. W. H. Butler, -/11/60.  
 213-65. SW. of Geraldton, W.A. 29° 49' S., 114° 24' E. 70-72 fms. CSIRO Sta. 214, 11/10/63.  
 214-65. Cockburn Sd, Jervis Groyne, W.A. Coll. G. W. Kendrick, 20/10/63. Inter-tidal, under stones.

- WM 217-65. 2 mi. SW. of Peak I., W.A. Honolulu dredge at 10 fms. Coll. B. R. Wilson on *Davena*, 8/6/60.
- 220-65. Shark Bay, W.A. Pres. 1/7/64.
- 221-65. Yampi Sd, W.A. Coll. G. A. Robinson, -2/3/60.
- 222-65. Same as WM 211-65, 8/11/62.
- 223-65. NW. of Bluff Point, W.A. 27° 18' S., 113° 16' E. 54 fms. CSIRO Sta., 9/10/63.
- 225-65. Wood I., Houtman Abrolhos, W.A. Coll. R. P. McMillan, -/5/63.
- 226-65. 40 mi. W. of Cape Jaubert, W.A. 23 fms. Coll. R. W. George on *Dorothea*, 13/10/62. On sponge.
- 227-65. Yanchev, W.A. 31° 33' S., 115° 41' E. 15 fms. Coll. B. Hughill, -/5/59.
- 228-65. Same as WM 95-65, 14/5/60.
- 229-65. Same as WM 92-65, 14/3/61.
- 230-65. SW. of Point Cloats, W.A. 23° 05' S., 113° 23' E. 73 fms. CSIRO Sta. 182.
- 231-65. 3-4 mi. off end of Delambre I., Dampier Arch. Coll. B. R. Wilson on *Davena*, 5/6/60.
- 233-65. NW, Malus Is, Dampier Arch., W.A. 10 fms. Coll. Royce on *Davena*, 31/5/60.
- 235-65. Woody I., Houtman Abrolhos, W.A. Coll. R. P. McMillan.
- 237-65. Bay of Exmouth Gulf—data uncertain, W.A. Coll. K. Godfrey of CSIRO.
- 238-65. Eagle Hawk I., Dampier Arch., W.A. Coll. B. R. Wilson, 13/6/60.
- 239-65. Cockburn Sd, Sta. 31. Coll. W. A. Naturalist Club, 22/2/59.
- 240-65. Point Peron, W.A. Coll. B. R. Wilson, 1/9/63. Among "worm" rocks.
- 241-65. Shark Bay, W.A. Coll. Poole Bros, -/7/63.
- 242-65. Kuri Bay, northern W.A. Coll. Kuri Pearl Ltd, -/17/64.
- 243-65. Shark Bay, W.A. Coll. by F. R. V. Peron, block 16, 8/7/62.
- 244-65. Shark Bay, W.A. Coll. by F. R. V. Peron, haul 1, 1/3/62.
- 245-65. Heron I., Capricorn Group, Qld. Coll. R. W. George, 23/6/61. From reef flat.
- 246-65. NW. of Rottneest I., W.A. Dredged 90-91 fms. Coll. R. W. George on *Bluefin* Sta. 32, 5/8/62.
- 247-65. 10-20 mi. W. of LaGrange, W.A. 12-15 fms. Coll. R. W. George on *Dorothea*, 13/10/62.
- 248-65. 1 1/2 mi. W. of S. end of Garden I., W.A. Dredged at 10 fms. Coll. R. W. George on *Bluefin*, 13/10/62.
- 250-65. NW. of Rottneest I., W.A. Dredged at 37 fms. Coll. R. W. George on *Bluefin* 12/8/62. From sponge.
- 251-65. Riddell Beach, Broome, W.A. Coll. R. Baird and M. MacDonald, 28/12/61. Intertidal, under rocks.
- 252-65. Between Roebourne and Onslow, W.A. Coll. R. B. Sharp, 8/9/62. Intertidal.
- 255-65. NW. of Rottneest I., W.A. 100-103 fms. Coll. R. W. George on *Bluefin*, 14/8/62. From sponges.
- 256-65. Port Hedland, W.A. Coll. Capt. Beamish, 5/7/63. Intertidal.
- 257-65. Jervis Groyne, Cockburn Sd, W.A. Coll. B. R. Wilson, 3/12/61.
- 258-65. 1 1/2 mi. W. of S. end of Garden I., W.A. 10 fms. Coll. R. W. George on *Bluefin*, 13/8/62.
- 265-65. Garden I., near Perth, W.A. 100 yds offshore. Coll. R. Dawson and Marine Group, 25/11/61. In coral.
- 266-65. Garden I., Careening Bay, under naval jetty, W.A. Coll. Marine Group and Nats Club, 1/3/59. From sponge.
- 267-65. Garden I., W.A. Beam trawl. CSIRO *Lancelin*, -/7/65.
- 268-65. Garden I., W.A. 15 ft. Coll. P. Barrett-Lennard, 1959.
- 269-65. W. of W. end of Rottneest I., W.A. Dredged in 74-75 fms. Coll. R. W. George on *Bluefin*, 10/8/62.
- 270-65. WNW. Rottneest I., W.A. Dredged 95-96 fms. Coll. R. W. George on *Bluefin*, 4/8/62. On sponges.
- 271-65. Bunbury, W.A. Coll. W. H. Butler, 3/65.
- 272-65. Mouth of Murchison River, near Gantheaume Bay, W.A. Coll. I. McDonald, -/1/63.
- 273-65. S. side of Point Peron, W.A. Coll. B. R. Wilson, 7/12/58. Among worm tubes.
- 274-65. Exmouth Gulf, W.A. Dredged at 2 fms. Coll. F. R. V. *Lancelin*, 28/8/63.
- 275-65. Port Hedland, W.A. Coll. A. McKay via P. Barrett-Lennard, 3/5/59. Intertidal.
- 276-65. Port Dennison, W.A. 29° 17' S., 114° 53' E. Coll. B. R. Wilson, 24/8/58.
- 277-65. Cable Beach, Broome, W.A. Coll. M. McDonald, 27/12/61. In rock pools.
- 278-65. Yampi Sd, W.A. Coll. G. A. Robinson, -/12/60.
- 279-65. W. approaches to Mermaid Str., Dampier Arch., W.A. Coll. Royce on *Davena*, 27/5/60.
- 281-65. Adele I., W.A. Coll. W. Goode on *Dorothea*, 18/1/62. From large clam shell.

- WM 282-65. Cockatoo I., W.A. 16° 06' S., 123° 08' E. Coll. N. Hoffman, Nov. 1962. From among crinoids.
- 284-65. Shark Bay, W.A. Coll. Poole Bros on *Bluefin*, -/14/63.
- 285-65. Dampier Arch., W.A. Coll. Neptune Submariners.
- 286-65. Point Gregory, NW. side of Peron Peninsula, Shark Bay, W.A. Coll. B. R. Wilson, 1/1/60.
- 288-65. Palm Beach, Rockingham, W.A. Coll. P. Barrett-Lennard, 1959. From jetty piles.
- 289-65. Same as WM 211-65. -/6/59.
- 290-65. W. of Carnarvon, W.A. 24° 59' S., 112° 27' E. 71 fms. CSIRO Sta. 197. 8/10/63.
- 292-65. Cockatoo I., W.A. 16° 06' S., 123° 08' E. Coll. N. Hoffman, mid-1963.
- 293-65. N. side of Triggs I., W.A. Coll. W. H. Butler, 8/12/63. From sponge.
- 294-65. Swan River, Perth, W.A. Coll. G. Oloughtha, -/13/65.
- 295-65. Canning River, near Fremantle, W.A. Coll. K. Sheard, -/12/65.
- 296-65. Yancheep reef flat, W.A. Coll. B. R. Wilson, 27/1/59.
- 297-65. Same as WM 211-65. -/6/59.
- 298-65. Same as WM 211-65. -/6/59.
- 299-65. Yampi Sd, W.A. Coll. G. A. Robinson, -/12/61.
- 300-65. Same as WM 211-65. -/6/59.
- 301-65. NE. of Garden I., W.A. Coll. P. Barrett-Lennard, 15/3/50. On old boom piles.
- 302-65. Same as WM 301-65. 4/3/59.
- 304-65. Off Cheyney Beach, Cheyney Point, W.A. 33° 54' S., 122° 32' E. Coll. S. Barker, -/5/59.
- 305-65. Busselton, W.A. Coll. Univ. W.A., 3/4/59.
- 44-49. Mandurah, W.A. Coll. P. H. Gard, 2/4/49.
- 93/94-96. Swan River, Fremantle, W.A. Coll. R. H. Holland, 3/6/46.
- 153/173. Bathurst Point, Rottnest I., W.A. Coll. L. Glauert, Jan. or Feb. 1931.
- 251-78-32. Cottesloe, W.A. Coll. L. Glauert, July 1932.
- 368/9. Bathurst Point, Rottnest I., W.A. Coll. L. Glauert, Feb. 1930. Found living under urchin *Heliocidaris erythrogamma*.
- 403/5-38. Swan River, Perth, W.A. Coll. F. E. Capstick, 26/5/38.
- 409/11-30. Bathurst Point, Rottnest I., W.A. Feb. 1930.
4985. Between Fremantle and Geraldton, W.A. Trawled F.I.S. *Endeavour*. Coll. W. B. Alexander, 1912.
4986. Same as WM 4985.
6052. Fremantle, W.A. Coll. W. B. Alexander, Nov. 1912. From piles of old jetty.
8752. Garden I., W.A. Coll. W. B. Alexander and Mr Justice Burnside's party, 14/1/14.
8972. Broome, W.A. Coll. W. B. Alexander, Oct. 1914.
8973. Same as WM 8972. Oct. 1929.
9522. Rottnest I., W.A. Coll. Chief Inspector Fisheries, Jan. 1920.
9982. Cottesloe, W.A. July 1922.
9991. Cottesloe, W.A. Coll. L. Glauert, 14/8/22. From dead sponge.
10011. Cottesloe, W.A. Coll. L. Glauert, 2/7/22. From *Posidonia*.
- 10199/10208. Freshwater Bay, off Swan River, W.A. Coll. C. L. Glauert, 26/12/22.
- 10229-34. Same as WM 10199/10208. Coll. A. E. Wear, 1923.
10274. Same as WM 10229-34.
10380. Cottesloe, W.A. Coll. L. Glauert, June 1923. From sponge.
10381. Same as WM 10380.
10410. Same as WM 10380.
10467. Same as WM 10011. 12/12/22. From living sponge.
10468. Same as WM 10410. July 1928.
10472. Same as WM 9991. 1928.
10481. Same as WM 9991. 21/1/23.
10487. Same as WM 9991. 2/6/23.
10570. Same as WM 10410.
- 10571/72. Same as WM 10410.
- 10591/92. Same as WM 10410.
10876. Point Gantheaume, Broome, W.A. Coll. W. C. Mansbridge, 21/2/24.
- 11100/1. Same as WM 10410. Sept. 1924.
- 11129/30. Same as WM 9991. Dec. 1924.
11644. Freshwater Bay, off Swan River, W.A. Coll. Mr Justice Burnside, April 1926.
- 11664, 65, 70, 71, 72, 73. Canning River, Fremantle, W.A. Coll. Capt. Abjornson, -/6/26.
11788. Swan River, Fremantle, W.A. Coll. D. McKenna, 14/8/26.
12112. North Beach, W.A. 31° 52' S., 115° 45' E. Coll. L. Lullfitz, 4/6/27.

- WM 12822-12823. Bathurst Point, Rottnest I., W.A. Sept. 1928. Reef.  
 15057. Swan River, Fremantle, W.A. Coll. H. Wood, -/1/29.  
 15108/9. Swan River, Fremantle, W.A. Coll. I. Galeman, Feb. 1929.  
 108-60. Garden I., W.A. Coll. by foreman, -/30/24.  
 115-33. Same as WM 12112. Coll. Mr Webb.  
 120-37. Swan River, Fremantle, W.A. Coll. A. R. Stephenson.  
 169-37. Swan River, at Crawley, W.A. Coll. H. McHall, 7/6/37.  
 173-60. Houtman Abrolhos, South Group, W.A. 6/8/60.  
 209-57. SE. end Dirk Hartog I., W.A. Coll. B. R. Wilson, -/1/57.  
 270-52. Swan River, Fremantle, W.A.  
 338-39. Bunbury, W.A. Coll. T. K. Moriarty, 6/3/39.  
 449-32-454-32. Swan River, Fremantle, W.A. Coll. F. E. Remist.  
 497-39. Swan River at narrows, Fremantle, W.A. Coll. Mrs Murfitt, 2/39.  
 583-31. Same as WM 9991, 27/6/31.  
 605-39. Swan River at Crawley, W.A. Coll. 7/10/39.  
 759-30. Canning Bridge, Swan River, Fremantle, W.A. Coll. 24/2/30.

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