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ATYIDAE OF SOUTHERN POLYNESIA

By

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No adequate survey of the fresh-water crustacean fauna of southern Polynesia has yet been made. The immense area from Fiji and Samoa on the west to the Marquesas, Mangareva, and Pitcairn on the east includes many islands, most of which are low, without permanent streams or rivers and incapable of maintaining a fresh-water fauna. The few high islands of this intervening area, interspersed among the Cook, the Society, and the Austral archipelagoes, although ~~two~~²⁰ degrees of longitude distant from Fiji and Samoa, doubtless served as stepping stones in the eastern migrations of fresh-water organisms whether the dispersal was brought about through human agencies or otherwise. A thorough study of the aquatic fauna of the high islands between Fiji and the Marquesas would doubtless bring to light zoogeographical relationships of even greater interest than those now known for that area.

A few early collections of fresh-water crustaceans were taken from Fiji, Samoa, and Tahiti, but until recent years the aquatic fauna of the Marquesas and southeastern Polynesia was quite unknown. From our inadequate knowledge at the present time it seems certain that the fresh-water crustacean fauna moved from west to east through southern Polynesia. How this fauna, quite incapable of self-dispersal, succeeded in making its way from the western to the extreme eastern border of Polynesia is not yet clear.

During 1929 and 1930 A. M. Adamson made a collection of fresh-water prawns from several islands of the Marquesas. In 1933 I made a brief survey of the crustacean fauna of the fresh waters of Vitilevu and Tahiti. Harry S. Ladd in 1926 collected a few prawns in Vitilevu and in 1934 took a new species in the islands of Namuka and Wangava of the southern Lau Islands. The Mangarevan Expedition of Bernice P. Bishop Museum in 1934 secured specimens of fresh water crustaceans in Mangareva, Rapa, and Rai-vavae, extending the knowledge of their distribution into southeastern Polynesia. This brief report is concerned with the distribution of the family Atyidae from Fiji eastward through southern Polynesia.

The fauna of Fiji is of interest to the student of Polynesian zoogeography in that this archipelago represents a natural gateway for migrations from the East Indian region into Polynesia proper. The large size of some of the islands of Fiji, the heavy rainfall, and the numerous rivers and streams make a favorable habitat for a large and varied population of fresh-water prawns. Fiji is deserving of a more complete survey of its inland waters than it has yet received.

Mesocaris lauensis Edmondson.

Mesocaris lauensis Edmondson (8, p. 13, fig. 4).*

A small atyid collected by H. S. Ladd from a cave containing brackish water on the island of Namuka and also from a salty lake on the island of Wangava, both of the southern Lau Islands, described by Edmondson under a new genus. The species, which shows an adaptation to cavernicolous existence in the modification of the eye stalks and in the reduction of ocular pigment, is characterized by the presence of exopods on all the thoracic appendages and by seven pairs of gills.

This is the first record of one of the more primitive atyids in Polynesia. Geographically, the nearest relative of this species seems to be a representative of the genus *Paratya* (*Xiphocaridina*) known to inhabit Norfolk Island.

Caridina nilotica variety **brachydactyla** de Man. (fig. 1, a-f).

Caridina zeyckii de Man (11, p. 386, part, pl. 24, fig. 29, cc, dd, f, g, i, ii, k).

Caridina zeyckii variety *paucipara* Bouvier (3, p. 79, part).

Caradina nilotica variety *brachydactyla* de Man (12, p. 269, pl. 20, fig. 8).

Caridina brachydactyla Bouvier (5, p. 463).

Caridina nilotica variety *brachydactyla* Bouvier (6, p. 155, figs. 321, 322).

This variety is one of 13 recognized by Bouvier (6) and differs from the typical form in the relatively short dactyli of the last three legs. In the first walking leg the dactylus is less than one fifth the length of the propodus. The carpus of the first cheliped is slender, from 2.1 to 2.5 times as long as broad. In each of the three posterior legs the merus is armed with 3 spines.

Among the specimens collected a wide variation was seen in the number of teeth of the rostrum and some difference in the number of spinelets on the

* Numbers in parentheses refer to the bibliography, p. 9.

dorsal surface of the telson and the hairs on its posterior margin. In 19 specimens observed the formula of the rostral teeth varied from $\frac{22}{18}$ to $\frac{34}{35}$. The largest specimen was taken at Vunindawa and measured 42 mm in length.

In a specimen from Suva (fig. 1, *a-f*) the rostral formula is $\frac{28}{18}$ with two teeth near the distal extremity of the upper border. The hand of the first cheliped is slightly longer than the corresponding carpus while in the second cheliped the carpus slightly exceeds the hand in length. Six spines are borne on the border of the dactylus of the third leg and the hairs on the dactylus of the fifth leg are very numerous. The dorsal surface of the telson bears 5 pairs of spinelets and there are 6 long hairs on its posterior border. The total length of this specimen, from tip of rostrum to extremity of telson is 25 mm.

The variety was taken in Vitilevu near Vunindawa and also in Suva from a small stream running through the garden of Dr. H. W. Simmonds. It was well represented in number of specimens in each locality.

This variety has previously been recognized in Madagascar, Mauritius, Poulo Condor, Salayer, New Caledonia, and the Marianas.

***Caridina nilotica* variety *brachydactyla* form *peninsularis* Kemp**
(fig. 1, *g-k*; fig. 4, *i-j*).

Caridina brachydactyla subspecies *peninsularis* Kemp (10, pp. 279-282, fig. 10); Bouvier (6, p. 156).

Kemp described this form as a subspecies of *Caridina brachydactyla* but since the term *brachydactyla* now represents a variety of *Caridina nilotica* I have reduced the subspecific name *peninsularis* to a form of the variety.

Kemp's *peninsularis* is characterized primarily by numerous teeth on the upper border of the rostrum arranged in a continuous series extending to the distal extremity.

A specimen taken near 8-mile Point near Suva in 1933 seems to correspond closely to Kemp's description of *peninsularis*. The rostral teeth are numerous with an uninterrupted series on the upper border, the formula being $\frac{32}{15}$. The chelipeds are quite similar to the corresponding appendages in the variety *brachydactyla*. Five spines are borne on the border of the short dactylus of the third leg. In this specimen the fifth legs are both damaged. The telson bears 3 pairs of spinelets on the dorsal border and 6 long hairs on the posterior margin. Uropodal spines number 14 on the left side and 15 on the right side.

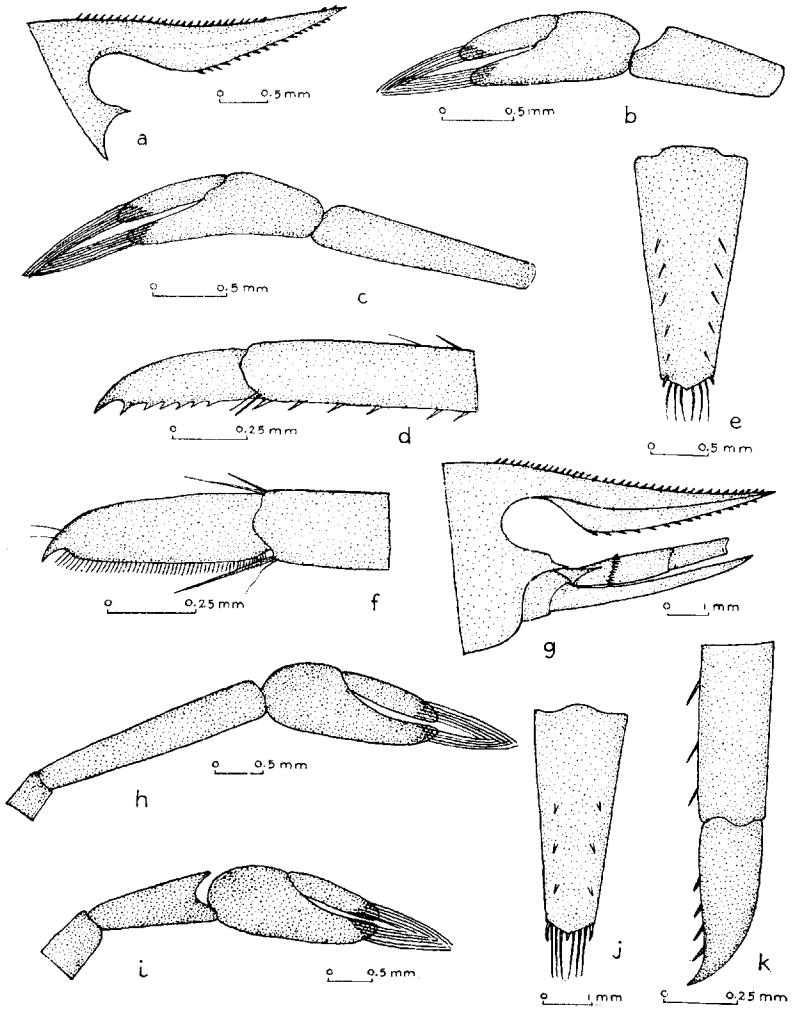


FIGURE 1.—*Caridina nilotica* variety *brachydactyla* (a-f) and *Caridina nilotica* variety *brachydactyla* form *peninsularis* (g-k): a, rostrum; b, manus and carpus of first cheliped; c, manus and carpus of second cheliped; d, dactylus of third leg; e, telson; f, dactylus of fifth leg; g, rostrum and anterior border of carapace; h, manus and carpus of second cheliped; i, manus and carpus of first cheliped; j, telson; k, dactylus of third leg.

In addition to the specimen taken at 8-mile Point, which has a total length of 31 mm, a larger specimen 36 mm long collected at Vunindawa has been tentatively assigned to this form. (See fig. 4, *i, j*.) The teeth on the upper border of the rostrum number 31 forming a continuous series while there are 14 on the lower border. There are numerous hairs on the margin of the dactylus of the fifth leg.

Kemp's specimens were taken from near Patani, Siamese Malay States, and on Penang Island.

***Caridina nilotica* variety *wyckii* (Hickson).**

Atya wyckii Hickson (9, p. 357, pls. 13, 14).

Caridina wyckii Borradaile (2, p. 1003); Roux (17, p. 554);
Bouvier (3, p. 79, part).

Caridina nilotica variety *wyckii* de Man (12, p. 269); Bouvier
(6, p. 151).

Borradaile records this variety from the Tamavria River, Suva, and states that it differs from varieties *longirostris* and *minahassa* in the short dactyli of the three posterior legs, that of the fifth leg being one fourth the length of the propodus. The formula of the rostral teeth of Borradaile's specimen is given as $\frac{29}{14}$. The variety was previously known from the Celebes. It was not taken in Fiji in 1933.

***Caridina vitiensis* Borradaile.**

Caridina vitiensis Borradaile (2, p. 1003, pl. 63, fig. 3, 3a).

Caridina vitiensis Bouvier (3, p. 74; 4, p. 918; 5, p. 462; 6, p. 160,
figs. 336-340).

According to Borradaile the species is characterized by a straight rostrum with 24 teeth above, none being on the carapace, and 9 below. The type specimen was 22 mm long. Borradaile considered it close to *Caridina weberi* but there are more rostral teeth, the second chelipeds are stouter and the last two legs longer than in that species.

The type locality was Tamavria River, Suva. It was not taken in 1933. Additional records of distribution include New Guinea, Bismarck Archipelago, and Solomon Islands.

***Caridina brevicarpalis* de Man (fig. 2, a-f).**

Caridina brevicarpalis de Man (11) p. 397, pl. 24, fig. 30 a-c;
Roux (17) p. 553; Bouvier (4) p. 919; Bouvier (5) p. 463;
Bouvier (6) pp. 178-180, figs. 372-374.

The chief characteristic of this species is the short carpus of the first cheliped. In this feature the species resembles an atyid. The distal extremity of the upper border of the rostrum is free from teeth and the hairs or spinelets on the border of the dactylus of the fifth leg are few in number. The uropodal spines range from about 10 to 13.

Among the specimens collected the typical one (fig. 2) has 18 teeth on the upper border of the rostrum and 7 below. There are 4 spinelets on the border of the dactylus of the third leg, 13 on the border of the dactylus of the fifth leg. Five pairs of spinelets are borne on the dorsal surface of the telson and 6 long hairs on its posterior margin. In each of these features some variation exists among the specimens observed.

In 1933 the species was collected only at Vunindawa, Vitilevu, where it was relatively common, 11 specimens being obtained. Previous records are from Celebes, Flores, and Amboina.

***Caridina serratiostris* variety *typica* de Man (fig. 2, *g-l*).**

Caridina serratiostris variety *typica* de Man (11, p. 385, pl. 23, fig. 28, *a-c*); Bouvier (6, pp. 219-220, figs. 480-486).

In this species the rostral teeth of the upper border extend backward on the carapace for nearly half its length. The chelipeds are very slender and there are few spinelets on the border of the dactylus of the fifth leg. Numerous hairs are borne on the posterior margin of the telson and the uropodal spines number about 14.

The larger of the two specimens collected is 18 mm long, the smaller 16 mm long. In the specimen figured (fig. 2) the formula of the rostral teeth is $\frac{23}{7}$ with 11 teeth behind the orbit. In each of the slender chelipeds the carpus exceeds the hand in length, that of the first only slightly. There are 4 teeth on the border of the dactylus of the third leg and 10 spinelets on the border of the dactylus of the fifth leg. Four pairs of spinelets are borne on the dorsal surface of the telson and 11 long hairs on its posterior margin.

Two ovigerous females were taken at Vunindawa, Vitilevu, in 1933. The variety *typica* has been previously recorded from the Seychelles, Salayer, Flores, and Ternate. Another variety, *celebensis*, was described from the Celebes by de Man (11).

***Caridina weberi* de Man (fig. 3, *a-f*; fig. 4, *g, h*).**

Caridina weberi de Man (11, p. 371, pl. 21, fig. 23); Bouvier (6, p. 242, figs. 562-571).

The six varieties of this species recognized by Bouvier are distinguished chiefly by the characters of the rostrum, the walking legs, and the telson. The form of the rostrum and the number of rostral teeth vary greatly. Numerous short hairs border the dactylus of the fifth leg and usually 10 to 13 long hairs are carried on the posterior margin of the telson. Uropodal spines usually number from 19 to 22.

Specimens assigned to this species, variety *typica*, were taken in 1933 at 8-mile Point and Vunindawa, Vitilevu. They were not common at either locality. The specimen figured (fig. 3) has a nearly straight rostrum with 12 teeth above and 4 below. The hand of the

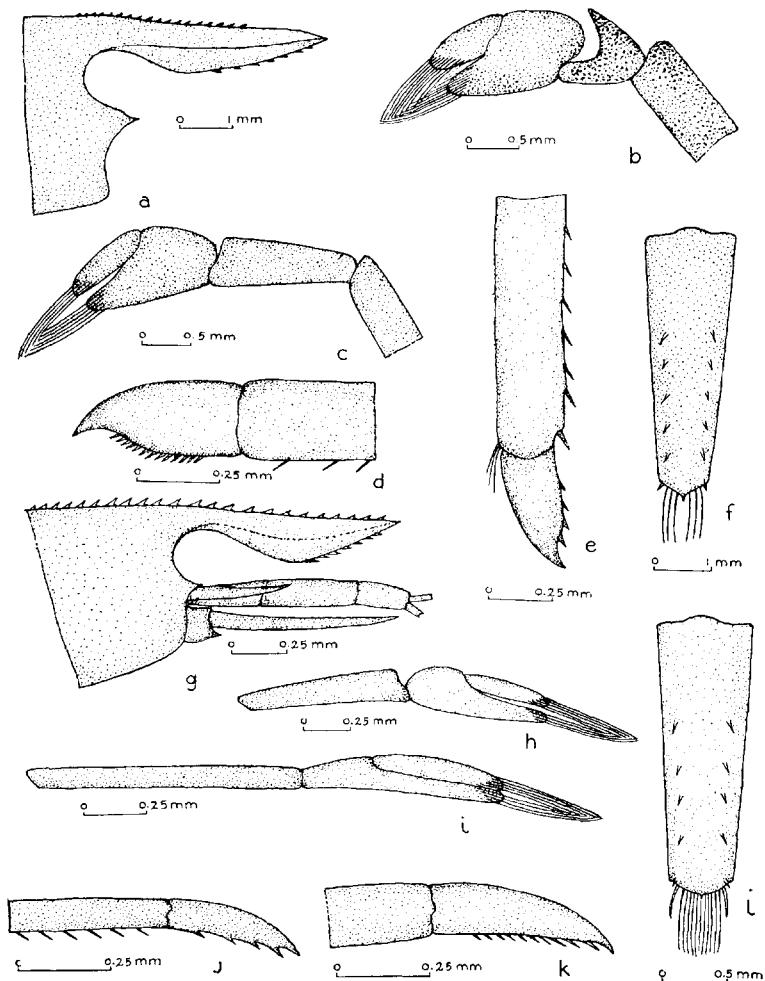


FIGURE 2.—*Caridina brevicarpalis* (a-f) and *Caridina serratiostris* (g-l): a, rostrum and anterior border of carapace; b, manus and carpus, first cheliped; c, manus and carpus, second cheliped; d, dactylus, fifth leg; e, dactylus, third leg; f, telson; g, rostrum and anterior border of carapace; h, manus and carpus, first cheliped; i, manus and carpus, second cheliped; j, dactylus, third leg; k, dactylus, fifth leg; l, telson.

first cheliped slightly exceeds the carpus in length while in the second cheliped the carpus is longer than the hand. Ten long hairs are carried on the posterior margin of the telson, the lateral ones being stouter than the others.

During a survey of fresh-water Crustacea in Tahiti in 1933 I secured numerous specimens of a form which corresponds closely with *Caridina weberi*. In most of these specimens the rostrum is slightly curved down and the teeth both above and below show considerable variation in number. (See fig. 4, *g.*) This form seems to be the prevailing species of *Caridina*, if not the only one, in Tahiti.

Specimens collected in the Marquesas by the Pacific Entomological Survey have also been assigned by me to the species *Caridina weberi*. These differ in formation of rostrum from those of Tahiti and Fiji more closely resembling varieties *sumatrensis* or *parvirostris* in which the rostrum is distinctly bent down. In a typical specimen from the Marquesas the tooth formula of the rostrum is $\frac{2}{2}$. (See fig. 4, *h.*)

Previous distribution of the species included Sumatra, Java, Salayer, Celebes, and Flores. This should now be extended to Fiji, Tahiti, and the Marquesas.

Caridina typus Milne-Edwards (fig. 3, *g-l*).

Caridina typus Milne-Edwards (14) vol. 2, p. 363, vol. 4, pl. 25, figs. 4, 5; de Man (11) p. 367, pl. 21, fig. 22; Bouvier (6) p. 249, figs. 271-297.

The chief characteristic of this species is the absence of teeth on the upper border of the rostrum. Uropodal spines are numerous, usually 19 or 20.

A typical specimen (fig. 3) has a rostrum gradually curved downward and reaching to the distal extremity of the second segment of the antennular peduncle. A single tooth is borne on the ventral border of the rostrum. The hand of the first cheliped is slightly longer than the carpus while in the second cheliped the hand and carpus are approximately equal in length. Seven spinelets are on the border of the dactylus of the third leg and the short hairs on the border of the dactylus of the fifth leg are numerous. There are numerous spinelets on the dorsal border of the rostrum and 10 long hairs on its posterior margin in addition to 2 stout spinelets.

Seven specimens were taken at 8-Mile Point near Suva in 1933. The range of the species is extensive. Previous records are from Madagascar and other high islands of the Indian Ocean, numerous islands of the East Indian region, Siam, the Loo-choo and Bonin islands, the Marianas, and New Caledonia.

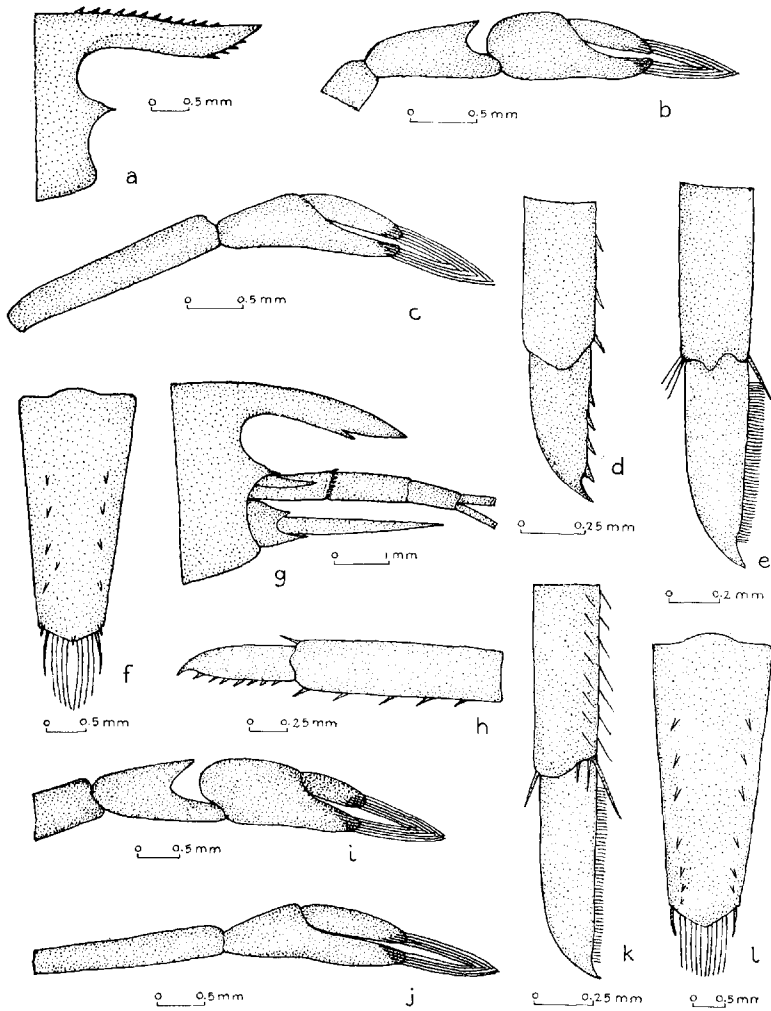


FIGURE 3.—*Caridina weberi* (a-f) and *Caridina typus* (g-l): a, rostrum and anterior border of carapace; b, manus and carpus, first cheliped; c, manus and carpus, second cheliped; d, dactylus, third leg; e, dactylus, fifth leg; f, telson; g, rostrum and anterior border of carapace; h, dactylus, third leg; i, manus and carpus, first cheliped; j, manus and carpus, second cheliped; k, dactylus, fifth leg; l, telson.

Caridina species (fig. 4, *a-f*).

Rostrum slender, almost straight, reaching to the distal extremity of the second segment of the antennular peduncle; rostral tooth formula in 6 specimens $\frac{10}{4}, \frac{13}{5}, \frac{16}{7}, \frac{17}{6}, \frac{18}{6}, \frac{19}{6}$; from 1 to 4 teeth of upper border behind the orbit; teeth of lower border minute obscure notches. Suborbital spine of carapace prominent; pterygostomial angle rounded.

Lateral spine of first segment of antennular peduncle slender, not reaching to the distal extremity of the segment. Scale of the antenna outreaching the peduncle of the antennule.

Carpus of first cheliped shorter than manus, deeply excavated; carpus of second cheliped slightly longer than manus. Border of dactylus of third leg bearing 4 spines; dactylus of fifth leg slender, slightly curved, bordered by about 40 spinelets. Telson with 5 pairs of spinelets on dorsal surface and 8 long hairs on posterior margin. Uropodal spines 13 in number.

Sixteen small specimens were taken at 8-Mile Point near Suva in 1933. The largest, an ovigerous female, is 19 mm in length from tip of rostrum to extremity of telson. Eggs large, 1.1 mm in length. Bishop Museum collections no. 3932.

Although this doubtful form of *Caridina* bears some resemblance to *C. weberi*, the small number of rostral spines would exclude it from that species. The number and position of the rostral teeth separate it from *C. vitiensis* Borradaile.

Caridina rapaensis, new species (fig. 5, *a-h*).

Rostrum slender, slightly turned down, reaching to the middle of the second segment of the antennular peduncle. Rostral teeth small and few, stronger above than below, those above occupying the distal fourth of the border, the first (basal) tooth below is posterior to the first one of the upper border; tooth formula of rostrum $\frac{4}{4}$ in type specimen. Suborbital spine with a broad base;

pterygostomial angle rounded. Basal segment of antennule concave dorsally; second segment shorter than the first; third segment subequal in length with the second, a transverse crest of spinelets at the distal extremity of the first segment; lateral spine of basal segment reaching to the extremity of that segment; a dense fringe of long feathered hairs on the ventrolateral borders of second and third segments; flagella long. Basal segment of antenna short; scale exceeding in length the peduncle of the antennule, a broad, blunt tooth on its outer margin; peduncle of flagellum about one half the length of the scale; flagellum long.

Eyes large, the cornea occupying more than one half the exposed portion. First cheliped reaching to distal extremity of basal segment of antennular peduncle when extended forward; propodus longer than carpus; dactylus as long as upper border of palm. Carpus deeply excavated. Second cheliped reaching to distal extremity of scale of antenna, more slender than first cheliped; propodus and carpus subequal in length.

Dactylus of third leg one sixth the length of the propodus, its border provided with a stout tooth just proximal of the tip, and four other small spines.

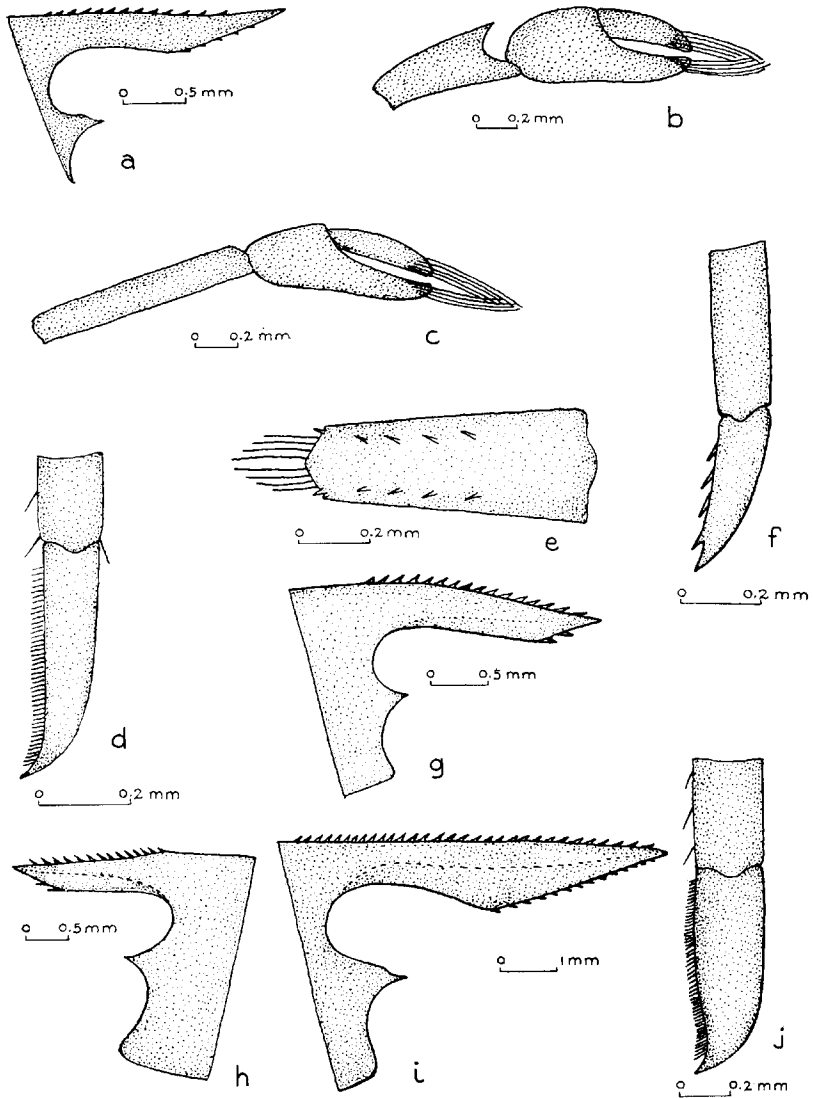


FIGURE 4.—*Caridina* species (a-f), *Caridina weberi* (g-h) and *Caridina nilotica* variety *branchydactyla* form *peninsularis* (i-j) (?): a, rostrum; b, manus and carpus, first cheliped; c, manus and carpus, second cheliped; d, dactylus, fifth leg; e, telson; f, dactylus, third leg; g, rostrum of specimen from Tahiti; h, rostrum of specimen from Marquesas; i, rostrum of specimen from Vunindawa, Vitilevu; j, dactylus of fifth leg of same specimen.

Dactylus of fifth leg approximately one fifth the length of the propodus, its margin bearing numerous short hairs and a strong supplementary tooth near the tip.

Telson with 6 pairs of small spinelets on upper border, its posterior margin bearing a small median tooth, 9 feathered hairs, and a long slender spinelet at each lateral angle. Uropodal spinelets are 20 in number.

Type specimen a female, length 19 mm from tip of rostrum to extremity of telson. Specimens preserved in alcohol without color except a reddish tint of the carapace and some of the appendages of the head; cornea of eye black.

Type locality a fresh-water stream, Rapa. Type, Bishop Museum collections no. 3932.

The three specimens of the genus *Caridina* collected by the Mangarevan Expedition of 1934 on Rapa in southeastern Polynesia apparently represent this unrecorded species. Previously the genus was recognized in eastern Polynesia only from Tahiti and the Marquesas.

The numerous uropodal spinelets bring this species near *Caridina zoeberi*, which ranges into eastern Polynesia, being reported in Tahiti and the Marquesas. The species from Rapa differs from *C. zoeberi*, however, in the fewer rostral spines and their position, in the shorter carpus of the first cheliped, and the biunguiculate character of the dactyli of the third, fourth, and fifth legs.

The two cotypes, both females, present variations in the rostral tooth formula from the type specimen. In one the formula is $\frac{-4-}{3}$ the other $\frac{-4-}{3}$, the latter showing injury to the upper margin of the rostrum.

Atya serrata Spence Bate (fig. 5, i).

Atya serrata Bate (1, p. 699, pl. 119, fig. 2, part).

Atya brevirostris de Man (11, p. 360, pl. 21, fig. 21).

Atya serrata Bouvier (6, pp. 294-297, figs. 611-615, and synonymy).

In *Atya serrata* the short rostrum curves downward and is unarmed or provided with a few small teeth below. The supraorbital border of the carapace is salient and the anteroventral border rounded. The species bears some resemblance to an endemic species of Hawaii, *Atya bisulcata* (Randall), which, however, has a relatively long, straight rostrum usually unarmed but sometimes with one or two teeth close to the tip on the upper or lower margins. Another distinction between *Atya serrata* and *A. bisulcata* is in the anteroventral border of the carapace which, in *A. bisulcata* is drawn out into a sharp spine.

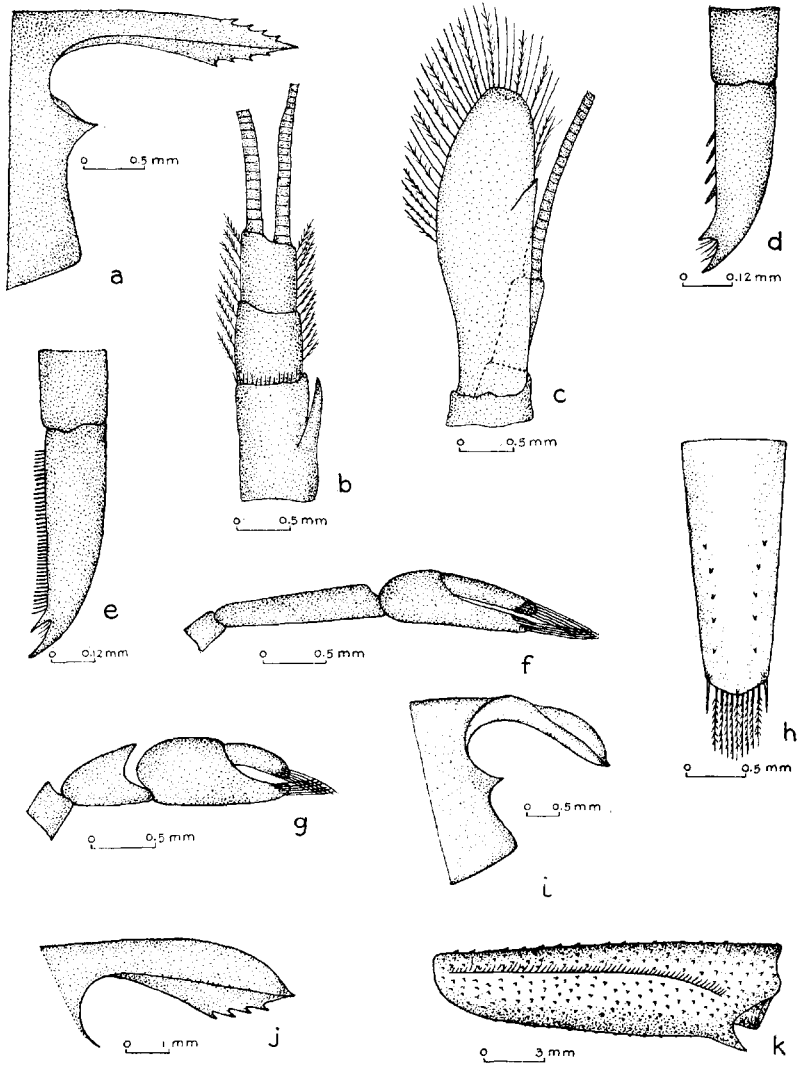


FIGURE 5.—*Caridina rapacensis*, new species (a-h), *Atya serrata* (i), and *Atya spinifera* (j-k): a, rostrum and anterior border of carapace; b, antennule; c, antenna; d, dactylus, third leg; e, dactylus, fifth leg; f, manus and carpus, second cheliped; g, manus and carpus, first cheliped; h, telson; i, rostrum and anterior border of carapace; j, rostrum; k, merus of third leg.

The range of *Atya serrata* is very extensive. There are records from Liberia, West Africa, and it is a typical species throughout the high islands of tropical latitudes in the Indian Ocean and has been reported from numerous localities in the East Indian archipelago.

In the Pacific Ocean the species is known from the Marianas, the Solomon Islands, Fiji, Samoa, and eastern Polynesia, including Tahiti, Marquesas, Mangareva, and Rapa. Its range into southeastern Polynesia (Mangareva and Rapā) was determined by collections taken by the Mangarevan Expedition of Bernice P. Bishop Museum in 1934. Specimens were collected in the Marquesas in 1922 by Pére Delmas and more recently by the Pacific Entomological Survey, 1929-30. The species was recorded from Tahiti in 1860 by Stimpson, was collected there by Gaston Seurat in 1903 and 1905, and by me in 1933. Extensive collections from Tahiti and the Marquesas and limited ones from Mangareva and Rapa would suggest that *Atya serrata* is the sole representative of the genus throughout eastern Polynesia.

Atya spinipes Newport (fig. 5, *j, k*).

Atya spinipes Newport (15, pp. 159-160).

Atya spinipes and *A. pilipes* Miers (13, p. 382, pl. 15, figs. 5, 6).

Atya pilipes Ortmann (16, pp. 466-467, pl. 36, fig. 8).

Atya spinipes Bouvier (6, pp. 304-305).

This species is closely related to *Atya moluccensis* de Haan of the East Indian area. In *Atya spinipes* the rostrum is deep, entire above, curved downward, and abruptly pointed, its lower border toothed. The merus of the third leg is stout and in the male bears a strong spine at the distal extremity of the lower border. In the female the spine is more slender and is carried higher up on the lateral surface. In *Atya moluccensis* the rostrum is straighter, more pointed, and has less depth than that of *Atya spinipes*. The stout tooth of the merus of the third leg in the male of *Atya moluccensis* is borne nearer the middle of the segment.

Among specimens of *Atya spinipes* from Fiji in Bernice P. Bishop Museum is a male 75 mm long from tip of rostrum to extremity of telson.

In addition to the Philippines the species has been recorded from the Marianas Islands, Samoa, and Fiji. Ortmann recorded it from Fiji in 1890. Specimens were collected in Vitilevu by H. S. Ladd in 1926 and again in 1933 by me.

ZOEAE OF ATYIDAE COMPARED

Apparently few studies of the larvae of atyids have been made. It was pointed out by Edmondson (7) that *Atya bisulcata* (Randall) and *Ortmannia henschawi* Rathbun are identical species, the young of *Atya* being of the "Ortmannia" form some of which by the natural process of growth and successive molting are transformed into the "Atya" type. It was the observation of Edmondson that in aquaria without circulating water the eggs of *Atya* may hatch into the zoea stage but under a strong current the zoea is passed in the egg and the young is released as a mysis-like form.

While investigating the aquatic fauna in Vitilevu in 1933 and later in the same year in Tahiti I attempted to secure larval stages of some of the Atyidae collected. During the brief period spent in Fiji larvae in the zoea stage were obtained from but one species, *Caridina nilotica* variety *brachydactyla* form *peninsularis*. Better success attended efforts in Tahiti, where by confining ovigerous females in specially prepared containers under natural conditions in fresh-water streams, and also from laboratory-controlled specimens, large numbers of zoea were hatched from two Atyids, *Caridina weberi* and *Atya serrata*. By comparison there is seen a close similarity between the first zoea of different species of *Caridina*, of *Caridina* and *Atya*, and of two species of *Atya*, *Atya serrata* of Tahiti and *Atya bisulcata* of Hawaii.

In the zoea of both *Caridina* and *Atya* (fig. 6) three pairs of thoracic appendages are about equally developed and in front of these are two pairs of rudimentary appendages. In these biramous appendages the inner branch which is shorter than the outer is relatively longer in the posterior appendage. There are no marked differences between corresponding thoracic appendages of any of the larval forms observed. The telson of *Caridina nilotica* is longer and the posterior median notch is narrower and more acute than in *Caridina weberi*. In the median notch of the telson *Caridina weberi* closely resembles *Atya*. In all larval forms studied seven pairs of bristles are borne on the posterior border of the telson.

Between *Atya serrata* and *Atya bisulcata* but slight and insignificant differences can be detected in the early free-swimming stages. The telson of *Atya bisulcata* is a little longer but the sixth segment of the abdomen is slightly shorter than in *Atya serrata*. The antennules and antenna of the two species of *Caridina* compared show no

appreciable differences and the same may be said of the corresponding appendages of the two species of *Atya*. In *Atya*, however, there is a longer and stouter basal segment in the peduncle of the antennule than in *Caridina*.

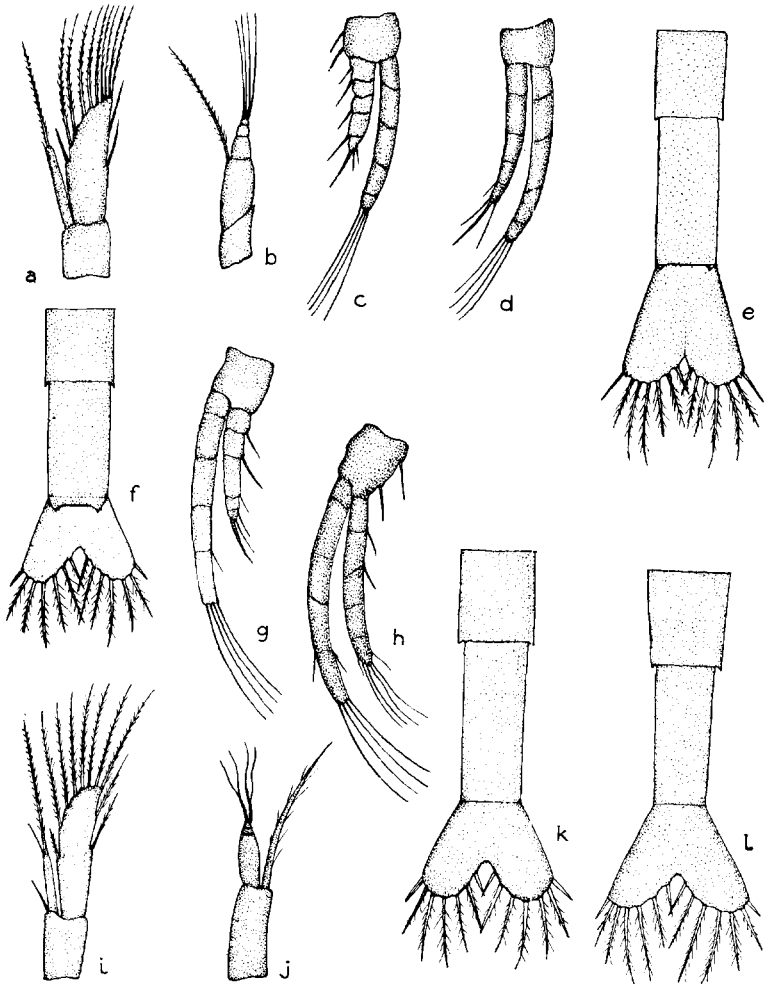


FIGURE 6.—Larval stages of *Caridina* and *Atya*. *Caridina nilotica* variety *brachydactyla* form *peninsularis* (a-e); *Caridina weberi* (f); *Atya serrata* (g-i, l); *Atya bisulcata* (j, k): a, antenna; b, antennule; c, next to last thoracic appendage; d, last thoracic appendage; e, telson; f, telson; g, next to last thoracic appendage; h, last thoracic appendage; i, antenna; j, antennule; k, telson; l, telson. All greatly enlarged.

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