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**Hawaiian Crustacea: Goneplacidae, Pinnotheridae
Cymopoliidae, Ocypodidae, and Gecarcinidae**

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INTRODUCTION

This paper is the fourth and last of a series in which I have revised the records of brachyuran crabs of the Hawaiian area. The earlier reports have appeared in the Bernice P. Bishop Museum Occasional Papers series [Portunidae, 21 (12), 1953; Grapsidae, 22 (10), 1959; and Xanthidae, 22 (12), 1962]. This report, although it deals with five families, lists only 16 species, four of which are almost certainly not found among the Hawaiian fauna today.

The apparent paucity of representatives of certain families discussed here may signify either a dearth of species in Hawaiian waters or limited investigations. Furthermore, the inclusion of forms in the report once accredited to Hawaii but not now recognized among local fauna may suggest errors in early records or the possible extermination of species subsequent to the reports. Which of these alternatives is more nearly correct cannot now be determined.

Apart from the efforts of numerous individual collectors, the results of the extensive operations of the United States Fish Commission vessel *Albatross* about the Hawaiian Islands in 1902, as recorded by Mary J. Rathbun (7),¹ have served as a basis for the material in this report. Valuable contributions were also made as a result of the 1949 dredging activities of the *Makua*, the survey ship of the Fish Division, Territorial Board of Agriculture and Forestry. The Pele Expedition (1959) directed by Mary Eleanor King of Honolulu procured considerable crustacean material from about the Hawaiian Islands, but

¹ Numbers in parentheses refer to the Bibliography, page 27.

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none of it has been assigned to either of the groups here considered.

Each of the five families treated in this paper is discussed as a unit. Included are species now known to exist in the Hawaiian area, and those recorded from the islands at some earlier time.

I am greatly indebted to Dr. Danièle Guinot-Dumortier of the Muséum National D'Histoire Naturelle, Paris, for information about the specimens in the Paris Museum that were collected in Hawaii at an early date. Dr. Guinot-Dumortier also kindly supplied the sketch of figure 9, *c* of this report.

SYSTEMATICS

FAMILY GONEPLACIDAE

Carapace squarish or subquadrate, front rather broad; antennular septum thin, antennules folding transversely or obliquely. Palp of external maxillipeds arises from or near antero-internal angle of merus. Fingers of chelipeds usually straight. Genital openings of male sternal or coxal.

Crabs of the family Goneplacidae are not sharply distinguished from those of the Xanthidae, and authorities are not in complete agreement about the taxonomic position of forms which present characters apparently justifying their assignment to either of these closely allied families. The Goneplacidae were once classified under the Oxycypodidae, a group with which they have no close affinity, especially from an ecological viewpoint.

The Goneplacidae, as now recognized, are strictly marine in habits, never frequenting the shores or even shoal water, but typical of the sea at moderate or considerable depths. Records by Sakai (9), Rathbun (8), Tesch (11), and others indicate that various regions of the warmer seas are rich in representatives of this family. By comparison, our knowledge of the Goneplacidae in the Hawaiian area is limited indeed. During the *Albatross* survey of 1902 only two species of the family were taken in Hawaiian waters, and in 1949 the *Makua* dredged only one specimen referable to this group.

Key to Hawaiian genera of Goneplacidae

- Anterolateral border of carapace usually bears well-defined teeth, more or less acute; flagellum of antenna rests in orbital hiatus.....**Pilumnoplax**.
 Anterolateral border of carapace cut into blunt lobes; flagellum of antenna excluded from orbital hiatus.....**Eucrate**.

Pilumnoplax cooki Rathbun, U. S. Fish Comm., Bull. 23 (3): 835, pl. 7, fig. 3, 1903 (1906). (See figure 1, a.)

Carapace a little broader than long, markedly convex, especially fore-and-aft, sparingly punctate, areas faintly outlined. Front advanced, slightly concave in middle, a transverse groove above margin. Anterolateral border of carapace short, cut into three lobes or teeth, in addition to external orbital angle. First tooth a low lobe confluent with orbital angle, the second tooth blunt, the third a conical spine directed upward and forward, arising from a level dorsal to other teeth. Upper margin of orbit with a single notch near middle.

Chelipeds in male slightly unequal, fairly long and stout. Arm finely granular, a small subterminal tooth on upper margin. Wrist quite smooth, a blunt tooth at inner angle. Palm smooth, fingers gaping. Walking legs long, slender, smooth, and unarmed.

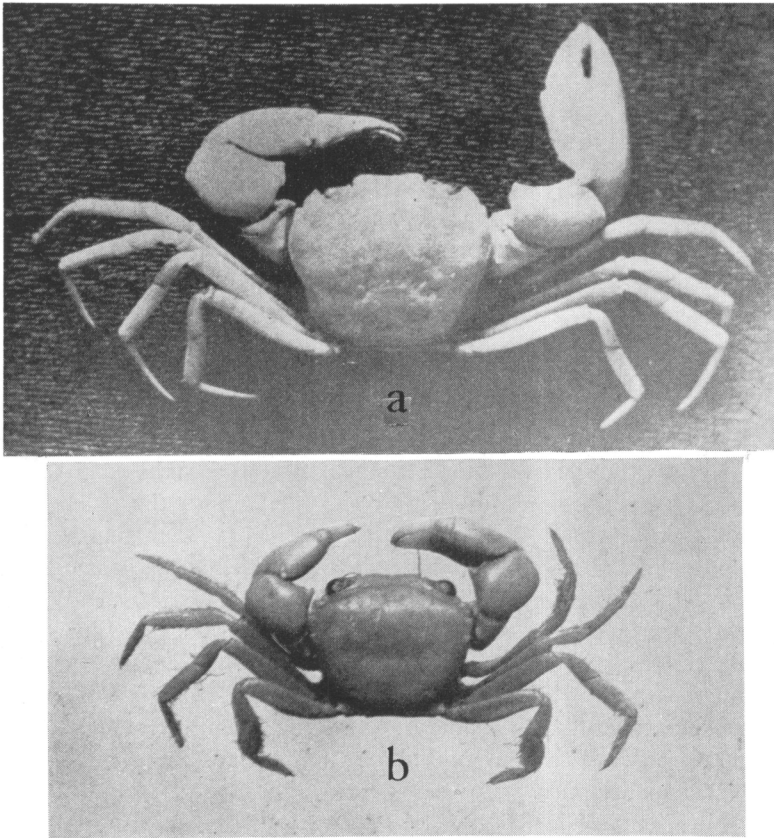


FIGURE 1.—a, *Pilumnoplax cooki* (after Rathbun); b, *Eucrater sulcatifrons*.

The type specimen, which is 15 mm. in breadth of carapace, is in the United States National Museum.

P. cooki is known only from the Hawaiian area, where specimens were dredged by the *Albatross* at several stations from depths ranging down to more than 300 fathoms.

Eucrate sulcatifrons (Stimpson), Acad. Nat. Sci. Philadelphia, Proc. 1858: 93 (as *Pilumnoplax sulcatifrons*).—de Man, Linn. Soc. London, Jour. 22: 89, pl. 5, figs. 5-7, 1888 (as *Eucrate affinis*).—Borradaile, Fauna Geogr. Maldives and Laccadive Arch. 1: 243, text fig. 45, 1902 [as *Pseudozius (Platyzius) laevis*].—Rathbun, U. S. Fish Comm., Bull. 23 (3): 861, pl. 11, fig. 7, 1903 (1906) (as *Platyzius laevis*); Linn. Soc. London, Trans., Zool. 14 (2): 237, 1911 (as *Eucrate crenata*).—Tesch, Siboga-Exped. Monogr. 39c: 159, 1918. (See figures 1, *b*; 2, *a-c*.)

Carapace slightly broader than long, smooth, without indications of regions. Front broad, almost straight, with a small indentation in middle and small notches separating it from orbits. Anterolateral border short, cut into two blunt teeth posterior of external orbital angle, a small notch marking junction with posterolateral border.

Chelipeds equal, smooth, without spines, a blunt tooth at inner angle of wrist. Fingers compressed, cutting edges toothed. Walking legs long, slender, sparingly haired, propodus and dactylus of last leg shorter and broader than corresponding joints of other legs.

The above diagnosis was adapted from Borradaile.

Specimens of *E. sulcatifrons* dredged by the *Albatross* in the Hawaiian area were referred to *Platyzius laevis* Borradaile by Rathbun (7), who considered them identical with the small form (6 mm. in breadth of carapace) described from the Maldives Archipelago. Tesch (11), recognizing the similarity of *Platyzius* with the older established *Eucrate*, brought it into the synonymy of that genus. Tesch also noted that a form of *Eucrate* widely dispersed in the Indian Ocean and portions of the Pacific had similar characteristics throughout its distribution except for size. The Indian Ocean forms were consistently small, ranging up to about 12 mm. in breadth of carapace, whereas Japanese waters yielded specimens exceeding 37 mm. in breadth. Tesch suggested that the name *E. crenata* de Haan be retained for the larger forms and that *E. sulcatifrons* (Stimpson) be used to designate the smaller ones.

Hawaiian specimens appear to conform to the *sulcatifrons* group, of which the largest taken by the *Albatross* is a female 13.2 mm. in

breadth of carapace. The suggestion that the small individuals represent juveniles is apparently ruled out, inasmuch as operations in many parts of the Indian Ocean have failed to obtain specimens approaching in size those of Japanese waters.

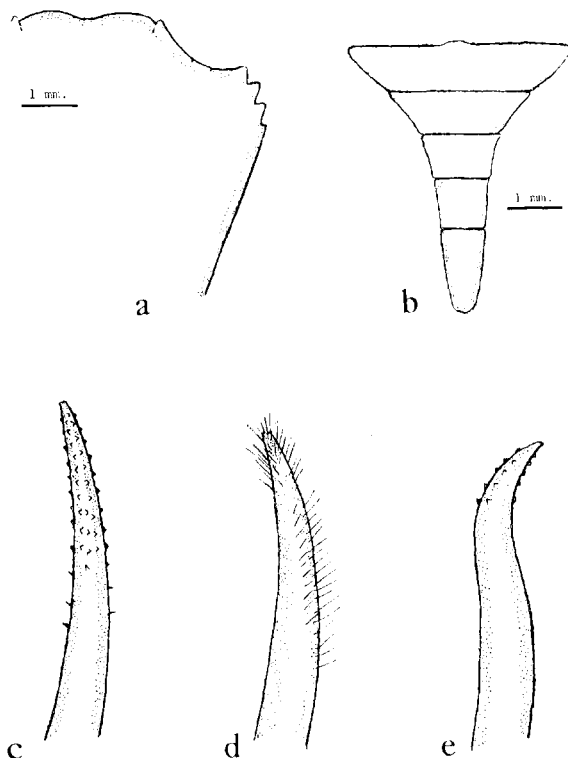


FIGURE 2.—a, *Eucrate sulcatifrons*, outline of carapace, front and lateral border; b, *E. sulcatifrons*, abdomen, male, last five segments; c, *E. sulcatifrons*, first pleopod, male; d, *Aphanodactylus edmondsoni*, first pleopod, male; e, *Manella spinipes*, first pleopod, male.

On comparison of Borradaile's specimen with typical examples of the *sulcatifrons* group, Tesch (11) notes some differences. In typical forms the frontal lobes are separated by a small notch instead of a broad, shallow depression; a hairy patch on the wrist of the cheliped is observed only in typical specimens; and a transverse sulcus above and

parallel with the frontal margin appears in the usual form but not in Borradaile's specimen. In describing Hawaiian specimens Rathbun (7) refers to a transverse ridge above the frontal margin and parallel with it. This ridge may represent the boundary of a sulcus. A critical comparative study of the Hawaiian specimens and typical examples of the *sulcatifrons* group should result in a clarification of the taxonomic position of the central Pacific forms and might fully justify their transfer from the Xanthidae to the closely allied Goneplacidae.

A Bishop Museum specimen, taken by the *Makua* during August 1949 off the southwest coast of Oahu at depths of 6 to 50 fathoms, closely conforms with typical examples of this species. It also agrees in most features with Borradaile's specimen and the Hawaiian forms taken by the *Albatross*. However, a well-defined sulcus extends across the carapace a little distance from the frontal margin and continues close behind the orbits to the anterolateral borders. This specimen, a male, is 11 mm. in breadth of carapace. A feature of the abdomen is the abrupt narrowing of segments 3 to 7 with the last joint twice as long as the breadth of the base (fig. 2, *b*). The tapering extremity of the first pleopod of the male is thickly covered with short, sharp denticles (fig. 2, *c*).

FAMILY PINNOTHERIDAE

Usually small crabs. Carapace often membranous or poorly calcified, regions not outlined. Sensory organs, including antennules, antennae, eyestalks and eyes, usually very small. Various modifications of the external maxillipeds occur. Typically commensal in habits.

Pinnotherid crabs are usually associated with such other invertebrates as bivalve mollusks, echinoids, holothurians, or tube worms; and many have characteristics correlated with their commensal habits. To my knowledge, only one species of this family has been recorded from the Hawaiian area. In 1931 a pair of crabs (male and female) representing the Pinnotheridae was taken from a tide pool on the Waimanalo shore of Oahu. They were occupying the shelly tube enclosing a large terebellid worm. The tube, about 12 inches long and attached to the underside of a flat stone, was in 8 inches of water at low tide. Rathbun recognized these crabs as representatives of the genus *Aphanodactylus* and a new species, *A. edmondsoni*.

Aphanodactylus edmondsoni Rathbun, Washington Acad. Sci., Jour. 22 (7): 181, 1932.—Edmondson, B. P. Bishop Mus., Sp. Pub. 22: 302, fig. 182, 1946. (See figures 2, *d*; 3.)

Surface of carapace smooth and shiny, broader than long, slightly convex; front bent down, bilobed with a shallow depression in middle. Lateral border of carapace broadly arched, entire. Antenna resting in orbital hiatus, flagellum 10-jointed, ending in a slender seta. Merus of external maxilliped shorter than ischium, its inner margin almost straight.

Chelipeds equal, smooth; cutting edge of immovable finger with convex, serrated lobe. Merus of walking legs 1 to 3 bears a strong tooth on distal third of lower border; two smaller spines on lower border of last leg. Carpus of walking legs taper distally; dactyli very short. Lower margin of merus and both margins of carpi and propodus of walking legs hairy. Also hairs on lower margin of carapace, above frontal border, on borders of arm, inner angle of wrist, inner surface of palm, and cutting edges of fingers.

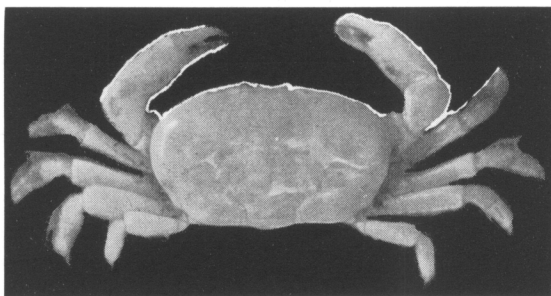


FIGURE 3.—*Aphanodactylus edmondsoni*.

The type specimen, a female, 16.2 mm. in breadth of carapace, is larger than the male, which has a breadth of 12 mm. In the male the tapering extremity of the first pleopod is heavily bristled (fig. 2, *d*).

Tesch (11) established the genus *Aphanodactylus* to accommodate a species taken in the tube of a terebellid at a depth of 36 meters in Sapeh Bay on the coast of Sumbawa by the Siboga Expedition. Apparently this specimen and those now in Bishop Museum are the only known representatives of the genus.

FAMILY CYMOPOLIIDAE²

Carapace broader than long or subcircular, front and lateral border lobed or toothed; external maxillipeds with small meral segments,

² Palicidae of some authors.

closing buccal cavity proximally but not distally. Last walking leg very small, dorsally placed. Genital openings of both sexes sternal, opposite first walking legs.

Key to Hawaiian genera of Cymopoliidae

- Fourth walking leg greatly reduced in size, filiform; inner suborbital tooth not greatly produced beyond roof of orbit; posterolateral border of carapace not toothed.....**Cymopolia**
 Fourth walking leg reduced in size but not filiform; inner suborbital tooth greatly produced beyond roof of orbit; posterolateral border of carapace toothed**Manella**

Key to Hawaiian species of Cymopolia

- Front cut into four narrow teeth, medial pair larger and on lower level.
 Anterolateral teeth of carapace acute, decreasing in size from first to last**fisheri**
 Front cut into four rounded lobes; anterolateral teeth of carapace not decreasing in size from first to last.
 Medial pair of frontal lobes the smaller; second and third anterolateral teeth subequal, acute.....**oahuensis**
 Medial pair of frontal lobes the more prominent; third anterolateral tooth largest.
 Accessory tubercles between anterolateral teeth.....**medipacifica**³
 No accessory tubercles between anterolateral teeth.....**maculata**

Cymopolia fisheri (Rathbun), U. S. Fish Comm., Bull. 23 (3): 835, pl. 7, fig. 5, text fig. 1, 1903 (1906) (as *Palicus fisheri*).—Edmondson, B. P. Bishop Mus., Sp. Pub. 22: 310, 1946 (as *Palicus fisheri*).

Carapace slightly broader than long; surface irregular, convexities covered with large and small granules and numerous conspicuous tubercles, small granules giving rise to short, curved hairs. Of the more prominent tubercles, about 14 extend in curved row across cardiac area; about nine tubercles borne on gastric area, six on branchial region, and a median one with several smaller ones in a row on each side immediately in front of a transverse row across intestinal area of carapace.

Front bears four narrow teeth with upturned points, medial pair longer, on a lower level, and more acute than lateral ones, separated from each other by deep U-shaped sinus. Anterolateral border of carapace cut into four acute teeth, in addition to sharp, toothlike outer orbital angle; teeth decreasing in size from first to fourth, which is very small. Posterior margin of carapace ornamented with numerous minute lobules.

Chelipeds short, somewhat lobular and granular, unequal, the larger stouter than first pair of walking legs, palm almost as high as long. First walking legs

³ New specific name suggested to supersede original one, *tuberculatus* (p. 9), preoccupied by *Cymopolia tuberculata* Faxon, Mus. Comp. Zool., Mem. 18: 23, pl. 6, figs. 3, 3, a, 1895.

a little longer than carapace, anterior border of merus spinous with a sharp tooth at distal end, posterior margin toothed. Second and third legs much longer and stouter than first; meral joints broad in middle, anterior border spinous, posterior border spinulate; propodus and dactylus broad. Last walking leg shorter than carapace, filiform, granular, and spinulose. Carina on first segment of abdomen of both sexes granular, terminating on each side by a sharp, upturned spine; adjoining segment of sternum with a similar spine.

The type, a male, has a breadth of carapace of slightly more than 14 mm. (Specimens in U. S. National Museum.)

Apparently *C. fisheri* has an extensive range at moderate depths in the central Pacific. Specimens were dredged by the *Albatross* at a number of widely separated stations in the Hawaiian area.

Cymopolia oahuensis (Rathbun), U. S. Fish Comm., Bull. 23 (3): 836, pl. 7, fig. 4, text fig. 2, 1903 (1906) (as *Palicus oahuensis*).—Sakai, Studies on the crabs of Japan IV . . ., 609, text fig. 90, a, 1939.—Edmondson, B. P. Bishop Mus., Sp. Pub. 22: 309, 1946 (as *Palicus oahuensis*).

Carapace broader than long, surface irregular, high in middle, covered with scattered tubercles interspersed with large and small granules. Front consisting of two pairs of lobes; median pair small, round, close together on a level lower than lateral pair, which are broad, shallow, and separated by a small notch from minute supraorbital lobes. Three small notches mark upper margin of orbit; outer orbital angle is a long, triangular, sharp tooth.

Anterolateral border of carapace cut into four teeth, in addition to external orbital angle; first tooth lobe-like at some distance from orbit; second and third subequal, sharp, the last very small, acute.

Chelipeds in female not much larger than first walking leg, granular, palm and fingers long, the latter crossing when closed. Merus of first walking leg bluntly denticulate on margins, two lobes on upper margin of carpus, margins of propodus and dactylus smooth. Second and third legs longer and larger than first; merus granular, margins toothed, teeth larger and fewer on anterior border, which in second leg terminates in a sharp tooth, in third leg terminates in a lobe. Propodus and dactylus in both second and third legs smooth. Fourth leg short, filiform, granulate.

The type specimen, a female 10.3 mm. in breadth of carapace, was dredged by the *Albatross* off the south coast of Oahu at 257 to 220 fathoms; another female specimen was taken on a Hawaiian reef (U. S. National Museum).

C. oahuensis is also known from Japanese waters.

Cymopolia medipacifica (Edmondson), B. P. Bishop Mus., Bull. 27: 57, pl. 4, A-G, text fig. 8, e-g, 1925 (as *Palicus tuberculatus*); B. P. Bishop Mus. Sp. Pub. 22: 310, 1946 (as *Palicus tuberculatus*). (See figure 4, a-c.)

Carapace a little broader than long, surface marked by irregular elevations and ridges separated by broad, shallow grooves. A transverse ridge crosses gastric region, one crosses cardiac area, and one is near posterior border, the first two of these ridges subdivided by longitudinal furrows. Ridges and elevations closely covered by tubercles of unequal size; carapace also bears a pile of short, feathered hairs. Front turned down, margin cut into four short, rounded lobes, or teeth, separated by shallow grooves, median pair more prominent and on lower level than lateral ones. Anterolateral border of carapace marked by four blunt teeth, in addition to outer orbital angle. First tooth a tubercle slightly more prominent than orbital angle, with a similar tubercle beneath it; second tooth a little larger than first, with a small tubercle in front and behind it; third tooth

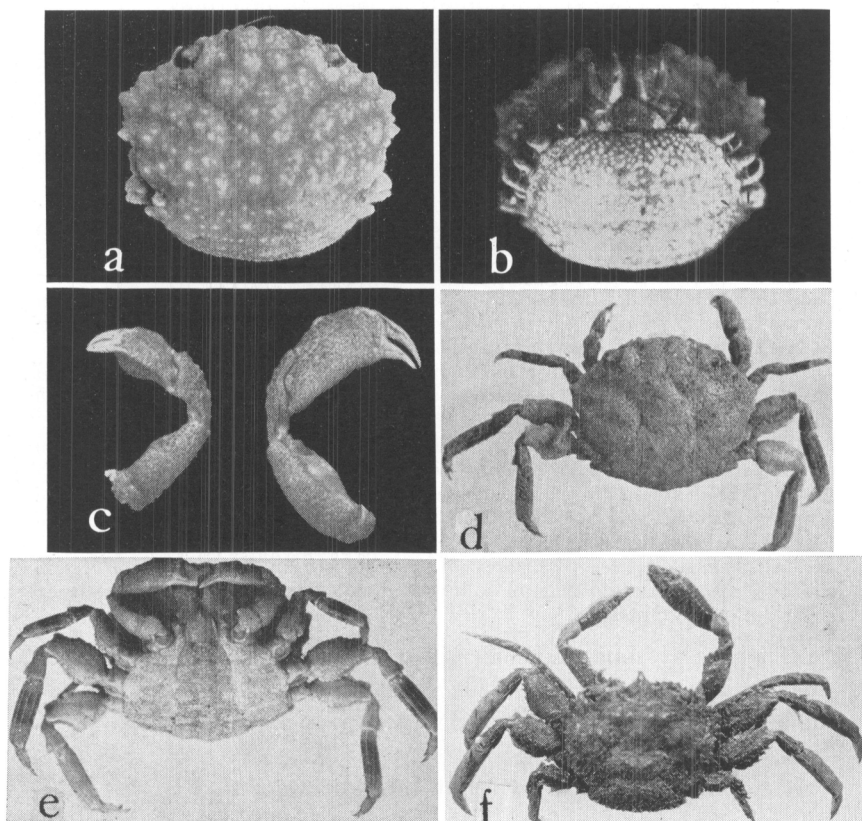


FIGURE 4.—a, *Cymopolia medipacifica*, carapace, dorsal view; b, *C. medipacifica*, carapace, ventral view; c, *C. medipacifica*, chelipeds; d, *C. maculata*, dorsal view; e, *C. maculata*, ventral view; f, *Manella spinipes*.

largest of all, broadly triangular, with a small tubercle in front and behind it; last tooth as long as preceding one but narrower. Posterolateral border of carapace irregularly tuberculate.

Chelipeds unequal in both sexes, outer surface covered by tubercles and a coating of hair similar to that of carapace. A prominent swelling marks outer surface of palm near upper border; fingers compressed, tips pointed, crossing when closed, cutting edges thin, smooth. First three walking legs quite similar, except in size, the first smaller than second and third. Meral joint of legs roughly dentate on upper and lower borders, upper terminating distally in a rounded lobe; upper border somewhat smoother in first leg. Propodus elongate, compressed, crest of anterior border bearing a row of feathered bristles; dactylus short, broad with feathered bristles on upper border and two small spines below. Fourth walking leg very short and slender, tuberculate. Under surface of carapace, external maxillipeds, and abdomen densely covered by tubercles and short hairs.

This species, so far reported from only the central Pacific area, appears to be a shoal-water form. In the type specimen, a female taken on the reef at Kure Island, the carapace is 12 mm. broad and 9 mm. long (Bishop Museum no. 1134). A male specimen taken in the same locality is slightly smaller than the type. Other specimens in Bishop Museum were collected on the reefs of Oahu and Molokai; and one specimen from the shallow water off Oahu is in the United States National Museum.

Cymopolia maculata (Edmondson), B. P. Bishop Mus., Occ. Papers 9 (10): 15, pl. 1, C, text fig. 6, *a-g*, 1930 (as *Palicus maculatus*); B. P. Bishop Mus., Sp. Pub. 22: 310, fig. 184, *c*, 1946 (as *Palicus maculatus*). (See figure 4, *d, e*.)

Carapace a little broader than long, convex in transverse and fore and aft directions, surface very irregular, elevations separated by broad, shallow grooves, entirely covered by tubercles of unequal size, interspersed by a coating of very fine, short hairs. Front deflexed, margin cut into four rounded lobes, the medial pair more prominent. Anterolateral border of carapace bears four lobes, or teeth, in addition to outer orbital angle. First lobe minute, rounded, a little larger than orbital angle; second lobe somewhat triangular, a little larger than first; third tooth broadly triangular and largest of all; last tooth very inconspicuous.

Chelipeds unequal, outer surface closely covered by tubercles of almost uniform size; a swollen, elongated area on outer surface of palm near upper border; fingers compressed, sharp at tips, crossing when closed, cutting edges thin, entire.

First walking leg smaller and with a narrower merus, otherwise resembles second and third legs, which are of nearly equal size. In second and third legs, outer surface of carpus and elongated propodus grooved with fine hairs arising from furrows; upper and lower margins fringed with hairs, lower borders armed with small spines. Fourth leg very short and slender, its surface roughened by tubercles.

The holotype, a male, is 9 mm. in breadth of carapace and its length is 6 mm. (Bishop Museum no. 3337). It was recovered from a clump

of coralline algae taken on Waikiki reef, Oahu, in very shallow water. In the living specimen, broad crimson bands of color crossed the propodi of the walking legs and hands of chelipeds, and large spots of the same color marked the carapace immediately behind the orbits.

Manella spinipes (de Man), *Archiv Naturgesch.* **53** (1): 344, pl. 15, fig. 1, 1887 (as *Pleurophricus spinipes*).—Rathbun, U. S. Fish Comm., Bull. **23** (3): 837, pl. 7, fig. 6, text fig. 3, 1903 (1906).—Sakai, *Studies on the crabs of Japan IV. . .*, 610, pl. 103, fig. 3, 1939.—Edmondson, B. P. Bishop Mus., Sp. Pub. **22**: 310, fig. 184, b, 1946. (See figures 2, e; 4, f.)

Carapace slightly broader than long, flattened, with some elevated regions separated by broad, shallow depressions; surface granular and tomentose. Front with four rounded lobes, medial pair longer and on a lower level than lateral lobes, tips of which are curved upward. Suborbital border cut into strong teeth, the inner one very large, forked, with a small tooth on outer margin. Lateral margin of carapace bears numerous teeth or tubercles behind stout external orbital angle. First three teeth of lateral border much larger than others, the second the largest, bifurcate. Posterolateral border of carapace also strongly tuberculate; posterior border slightly convex, bearing a row of numerous fine teeth.

Chelipeds very unequal, inner border of arm broadly triangular, serrate; wrist tuberculate, a stout tooth at inner angle; palm almost as high as long, outer border hairy, upper border bicarinate, carinae denticulate; fingers short, stout, cutting edges entire, inner margins of both fingers bearing long hairs. First walking legs small, second and third larger, subequal, fourth pair smallest of all. All walking legs quite similar morphologically. Meral segments of legs broad in middle, anterior and posterior borders bearing spines, increasing in size distally. On outer border of merus, close to upper border of second and third legs, is a row of small teeth and a similar row occurs near middle of outer border of all legs. Carpus bears a row of sharp spines on anterior border, and a similar row occurs in median line of outer border, lower border haired. Propodus and dactylus serrated on anterior and posterior borders, the serrations of propodus low and distant; upper margins of both segments fringed with long feathered hairs.

In general, *Manella spinipes* resembles a *Cynopolia*; but it differs from members of that genus as follows: it has a flatter carapace; its entire lateral border is toothed or tuberculate; the fourth walking leg, though greatly reduced, is not filiform; and individuals may attain a larger size.

De Man described the species from Amboina, and Sakai (9) records a Japanese specimen (31.1 mm. in breadth of carapace). In the Hawaiian area, specimens were dredged by the *Albatross* at stations south of Molokai at between 23 and 43 fathoms. In Bishop Museum are specimens from Kaneohe Bay, Oahu, taken by Ted Dranga in 1925 at 1 to 2 fathoms. The largest of these, a male, is 20 mm. in

breadth of carapace. A specimen was taken by the *Makua* in 1949 southwest of Oahu between 6 and 60 fathoms.

FAMILY OCYPODIDAE

Crabs of the several subdivisions of this family present few structural features common to all members. The following characteristics, however, are generally applicable to the group: Carapace squarish or markedly broader than long; front narrow, depressed or turned down; eyestalks of many slender and elongated.

Species representing the various groups of the family are more closely united by ecological relationships than by morphological characters. All are strictly littoral forms; and in many tropical and subtropical regions they are typical of the sandy beaches and muddy flats between the limits of high and low tides. For protection, they habitually excavate burrows in the sand or mud.

Some species of the family have stridulating organs, by means of which they doubtless communicate with others of their kind. In one representative group only the males present an enormous development of one chela, which gives them the common name fiddler crabs. Two subfamilies of the Ocypodidae are recognized in the Hawaiian area.

Key to Hawaiian subfamilies of Ocypodidae

- Carapace rather deep, squarish or quadrangular; anterolateral borders entire behind external orbital angle; buccal cavity closed by external maxillipeds; a hairy-bordered cavity between bases of second and third walking legs **Ocypodinae**
- Carapace rather flat, much broader than long; anterolateral borders toothed; buccal cavity not closed by external maxillipeds; no hairy-bordered cavity between bases of walking legs..... **Macrophthalminae**

Key to Hawaiian genera of Ocypodinae

- Carapace squarish, slightly broader than long; cornea of eye elongate, occupying much of the thick eyestalk; chelipeds unequal in both sexes... **Ocypode**
- Carapace much broader than long; cornea of eye on distal extremity of long, slender eyestalk; one chela greatly developed in male only..... **Uca**

Characters of Hawaiian genus of Macrophthalminae

- Eyestalks very long, slender, cornea terminal; a narrow space between external maxillipeds **Macrophthalmus**

Key to recorded Hawaiian species of *Ocypode*

- Eyestalks extending beyond cornea as a slender style.
 Fingers of cheliped truncate at tips.....*gaudichaudii*
 Fingers of cheliped not truncate at tips.....*ceratophthalma*
 Eyestalks not extending beyond cornea.....*laevis*

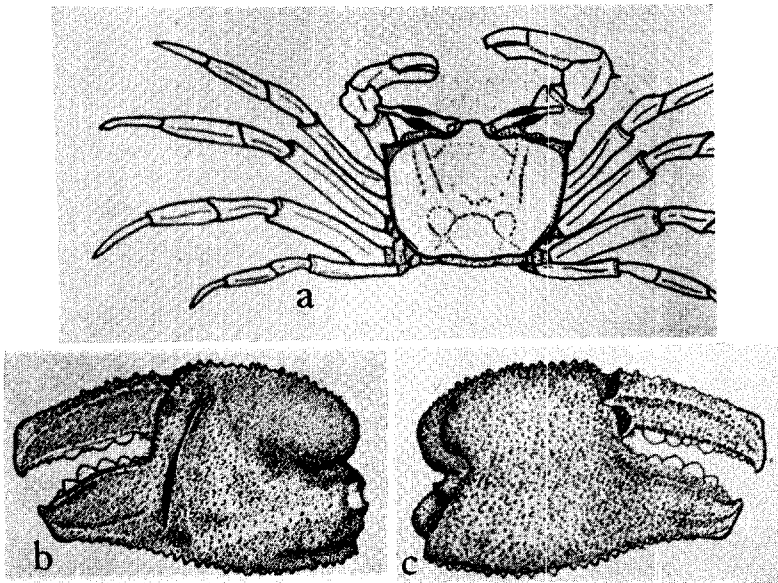


FIGURE 5.—a, *Ocypode gaudichaudii* (after Schmitt); b, *O. gaudichaudii*, chela, outer surface (after Crane); c, *O. gaudichaudii*, chela, inner surface (after Crane).

Ocypode gaudichaudii Milne Edwards and Lucas, IN Orbigny's Voy. l'Amérique Meridionale 6 (1): 26, 1843; 9, pl. 11, fig. 4, 1847.—Rathbun, U. S. Fish Comm., Bull. 23 (3): 834, 1903 (1906); U. S. Nat. Mus., Bull. 97: 373, pls. 129, 130, fig. 1, 1918.—Schmitt, Univ. Calif. Pub. Zool. 23: 278, fig. 163, 1921.—Boone, Zoologica 8 (4): 267-271, fig. 96A (not 96B), 1927.—Crane, Zoologica 26: 297-310, pls. 1, 2, text figs. 1-7, 1941.—Garth, Allan Hancock Pacific Expeditions 5 (10): 514, pl. 87, fig. 7, 1946. (See figure 5, a-c.)

Carapace squarish, broader than long, anterior corners flattened; front between eyes narrow, bent down. Eyestalks large, elongated, prolonged beyond

corneae in a slender style. Chelipeds stout, somewhat unequal, rough; fingers with truncated ends. Ambulatory legs long, finely roughened. (After Schmitt.)

The normal range of *O. gaudichaudii* appears to be the warmer waters of the eastern Pacific from El Salvador, Central America, to the coast of Chile, including the Galapagos Islands. Cano (1) cites Honolulu as lying within the range of dispersal, but Rathbun (7) questions this record. It is included in this report with reservations, as there is no confirmation of its occurrence in Hawaii or anywhere else in the central Pacific area.

Crane (2) presents a detailed report on the growth and ecology of this species, based on extensive field observations on the Pacific coast of Panama.

Adult specimens are reported to be about 40 mm. in breadth of carapace.

Ocypode ceratophthalma (Pallas), Alcock, Asiatic Soc. Bengal, Jour. 69 (2) : 345, 1900.—Rathbun, U. S. Fish Comm., Bull. 23 (3) : 833, 1903 (1906).—Sakai, Studies on the crabs of Japan IV . . . , 614, pl. 104, fig. 5, text fig. 91 *a*, 1939.—Edmondson, B. P. Bishop Mus., Sp. Pub. 22 : 310, fig. 185, *b*, 1946. (See figures 6, *a*; 7, *a*.)

Carapace almost square, granulate, fore and aft convexity more pronounced than lateral. Front narrow, deflexed; orbit sinuate, oblique, anterolateral corner nearly a right angle; lateral border of carapace entire. Eyestalk in adult specimen extending beyond cornea and orbit as a cylindrical style.

Chelipeds unequal; merus of larger appendage with anterior and posterior margins spinose. Carpus granulate, inner angle bearing a sharp tooth, sometimes bifid. Palm tuberculate on outer and inner surfaces, serrate on upper and lower margins. Inner surface of palm of larger chela in both sexes bearing a vertical stridulating ridge, bordered in front by a fringe of hairs. Stridulating ridge consists of four rather distinct divisions. Dorsally, a short row of tubercles is followed by a long section of transverse striae, rather coarse, widely spaced and increasing in length; these merge into a short section of very fine striae, closely approximated, which is followed ventrally by a few heavier striae, more widely spaced and decreasing in length. Narrow ventral extremity of ridge bends slightly posteriorly (fig. 6, *a*). Fingers compressed, granular, dactylus spinulose above, cutting edges with strong teeth.

Walking legs long, slender, roughened by transverse and diagonal squamous ridges; propodus and dactylus longitudinally grooved, propodus of first pair of legs with two rows of hairs on anterior surface.

The "ghost crab" is a very common species on sandy shores from the Red Sea and East Africa to Japan and islands of the central Pacific region. It is abundant and is a prevailing species on Hawaiian sandy beaches; and the familiar small mounds of sand between tide marks, especially during early evening, show the diligence of this

crab, which excavates a burrow as a place of concealment. The crab guards the completed burrow against intruders; and if it is disturbed in its burrow, produces low grating sounds made by rubbing the stridulating organ of its palm over a ridge on its arm, doubtless a no trespassing signal.

Large specimens are close to 50 mm. in breadth of carapace.

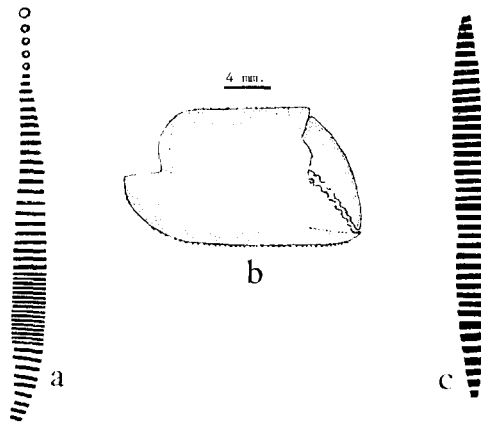


FIGURE 6.—a, *Ocyropsis ceratophthalma*, stridulating ridge; b, *O. laevis*, right chela; c, *O. laevis*, stridulating ridge.

Ocyropsis laevis Dana, U. S. Exploring Exped., Crustacea 13(1): 325, 1852 and pl. 20, fig. 2, 1855; op. cit., 324, pl. 20, fig. 1 (as *Ocyropsis pallidula*).—Lenz, Zool. Jahrb. Abt. Syst. 14: 476, 1901 (as *Ocyropsis urvillei*).—Rathbun, U. S. Fish Comm., Bull. 23 (3): 834, pl. 7, fig. 2, 1903 (1906).—Stimpson, Smithsonian Misc. Coll. 49 (2): 111, 1907.—Edmondson, B. P. Bishop Mus., Sp. Pub. 22: 311, 1946. (See figures 6, b, c; 7, b.)

Carapace almost square, very thick, convex anteroposteriorly, granular, anterolateral angle acute, directed forward. Front deflexed, its width approximately one-sixth that of carapace. Orbit sinuate, upper margin entire, lower margin finely dentate; eyestalk reaching lateral extremity of orbit but not extending beyond cornea, which occupies about three-fourths its length.

Chelipeds unequal in both sexes, smooth, finely granular throughout; palm of large hand short, high, finely dentate on lower margin; immovable finger as high at base as long; a raised row of fine granules extends longitudinally on lateral surface of immovable finger of each hand; cutting edges of fingers bear a row of small teeth. In male, stridulating organ on inner surface of larger palm

consists of almost straight vertical row of short transverse striae, longer in middle, growing shorter toward each end (fig. 6, *c*).

Walking legs granular, smooth, unarmed, sparingly haired on distal half of posterior margin of propodus, a feature more pronounced in first two legs. A minute longitudinal furrow traverses outer surface of propodus. Abdomen of male with seven distinct segments, lateral borders slightly concave, seventh segment subtriangular, narrowly rounded at tip.

Early records of *O. laevis* are from numerous localities in the Hawaiian area. Among Bishop Museum collections are specimens which closely conform with Dana's species from Oahu, Laysan Island, the Line Islands, and Rarotonga; and about 40 specimens collected on

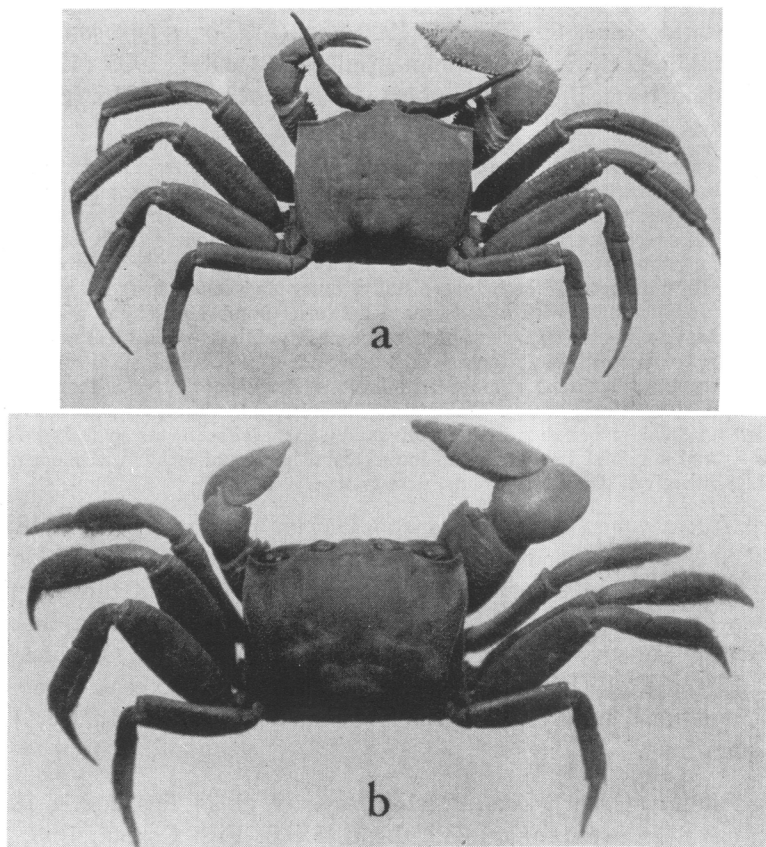


FIGURE 7.—a, *Ocyropsis ceratophthalma*; b, *O. laevis*, specimen from Johnston Island.

Johnston Island in 1923 compared favorably with *O. lacvis*. The largest of these, an ovigerous female, is 30 mm. in breadth of carapace; males are slightly smaller.

Key to recorded Hawaiian species of *Uca*

Large species; no teeth on basal portion of cutting edge of fingers of large chela **tetragonon**
 Small species; several teeth on basal portion of cutting edge of fingers of large chela **minor**

Uca tetragonon (Herbst), IN de Man, Carcinological studies in Leyden Museum 13 : 24, pl. 2, fig. 6, 1891.—Alcock, Asiatic Soc. Bengal, Jour. 69 (2) : 357, 1900 (as *Gelasimus tetragonum*).—Rathbun, U. S. Fish Comm., Bull. 23 (3) : 834, 1903 (1906).—Edmondson, B. P. Bishop Mus., Sp. Pub. 22 : 314, 1946. (See figure 8, *a*.)

Carapace strongly convex anteroposteriorly, front approximately one-tenth breadth of carapace; orbit oblique, lower margin finely dentate, outer angle a sharp tooth directed outward and a little forward; lateral borders of carapace slightly converging posteriorly. Chelipeds very unequal in male; anterior margin with a prominent subterminal tooth; wrist smooth, inner angle a broad, low tooth. Palm increasing in height distally, outer and inner surfaces granular; fingers long, slender with a wide space between; immovable finger with a depressed area on outer surface at base, cutting edge with two small teeth on distal half; dactylus with a few granules on cutting edge. Small cheliped of male slender, except for hand no stouter than first walking leg, fingers without teeth, straight, tufts of hair at tips. Walking legs slender, smooth, unarmed, second and third subequal, larger than first, fourth smallest; meral segments sparsely haired below and a tuft of hair borne on lower distal border of ischium. Abdomen of male with seven distinct segments, first two very short.

U. tetragonon was reported from Hawaii by Kingsley (4) in 1880, but there is no other record for this part of the central Pacific. However, it is widely dispersed, ranging from the Red Sea through the Indo-Pacific region to Tahiti and other Polynesian areas. In Bishop Museum are specimens from the Line Islands, Fiji, the Caroline Islands, and Wake Island. A male specimen from Wake has a carapace 35 mm. broad and a large chela; the hand alone (palm and fingers) is 60 mm. long.

Uca minor (Owen), Zool. Beechey Voy., 79, pl. 24, figs. 2, 2, *a*, 1839 (as *Gelasimus minor*).—Rathbun, U. S. Fish Comm., Bull. 23 (3) : 834, 1903 (1906).—Edmondson, B. P. Bishop Mus., Sp. Pub. 22 : 314, 1946.

Carapace broader than long, convex, smooth, lateral borders converging posteriorly; compressed lines near middle of carapace in form of letter H; slightly raised lines mark branchial regions. Front narrow, breadth at base about one-fifth that of anterior border of carapace. Margins of orbit finely crenate, eye-stalk extending to its lateral angle which is slightly produced.

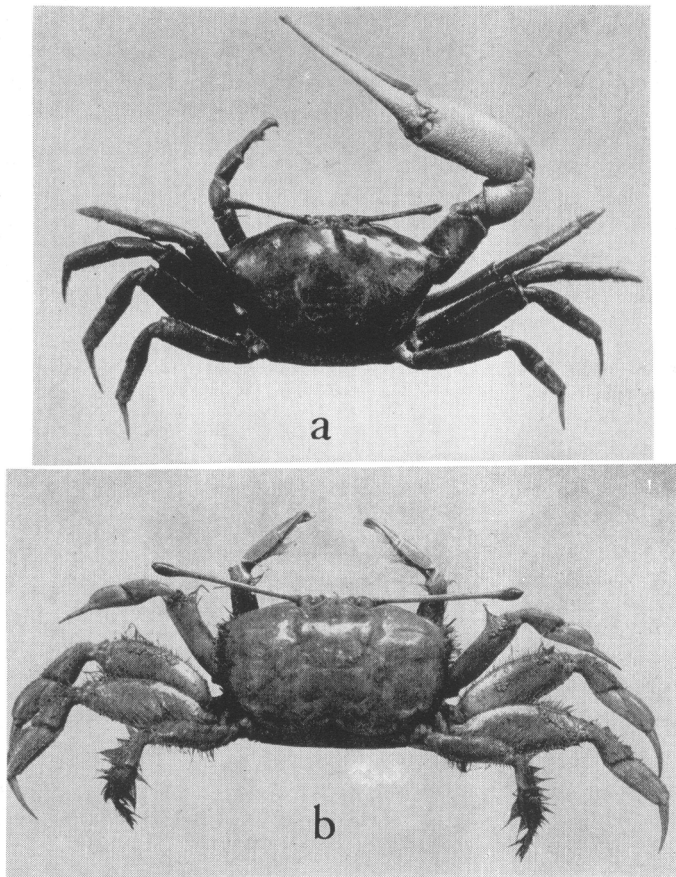


FIGURE 8.—**a**, *Uca tetragonon*, specimen from Palmyra Island; **b**, *Macrophthalmus telescopicus*.

Right cheliped much the larger, arm very small, carpus with a tooth at inner angle. Palm granular, outer border convex, a raised line of granules along upper and lower borders; inner surface bearing two transverse rows of small tubercles near base of pollex. Fingers with a gap between when closed, pollex slightly longer than dactylus; pollex with tooth on distal third of cutting edge and three

or four teeth near base; dactylus with six or seven teeth near base and one near tip. Fingers of small hand spooned and haired at tips.

Walking legs with merus compressed, notched on anterior margin near distal extremity; dactylus slender, slightly curved; third walking leg longest. Breadth of carapace about 14 mm.

The above description is adapted from Owen (5).

Owen reports that several specimens of this small species were taken on Oahu during the voyage of the *Blossom*. However, as no other record for Hawaii is known, representatives of the genus *Uca* may have become extinct here. It would be exceedingly interesting if "fiddler crabs" were rediscovered among Hawaiian fauna.

Key to Hawaiian species of *Macrophthalmus*

- Eyestalk very long, reaching far beyond external orbital angle; external orbital angle narrow, spine-like, directed outward and forward; two teeth behind orbital angle, narrow, acute, the second smaller.....**telescopicus**
 Eyestalk not reaching beyond external orbital angle; external orbital angle rather broad, directed outward and forward; two teeth behind orbital angle, first broad, second rudimentary.....**convexus**

Macrophthalmus telescopicus (Owen), Zool. Beechey Voy., 78, pl. 25, fig. 1, 1839 (as *Gelasimus telescopicus*).—Eydux and Souleyet, Voy. Bonite 1 (Crustacea): 241, pl. 3, figs. 6, 7, 1843 (as *Macrophthalmus podophthalmus*).—Rathbun, U. S. Fish Comm., Bull. 23 (3): 834, 1903 (1906).—Sakai, Studies on the crabs of Japan IV . . . 614, pl. 104, fig. 5, text fig. 91 *a*, 1939.—Edmondson, B. P. Bishop Mus., Sp. Pub. 22: 310, fig. 185, *b*, 1946. (See figure 8, *b*.)

Carapace about one and one-half times broader than long, slightly convex, surface smooth. Front narrow, orbits somewhat oblique with margins finely serrate. Eyestalks extending far beyond outer border of orbits. External orbital angle a narrow sharp spine curving outward and forward. Lateral borders of carapace slightly converging posteriorly, scantily haired and bearing two small teeth close behind orbital angle, second tooth smaller.

Chelipeds subequal in both sexes, much larger in male. In male, inner border of arm covered with short hairs; upper surface of wrist smooth, granular on outer margin and inner angle; palm high, outer surface smooth, a longitudinal ridge close to and parallel with lower margin. Upper anterior portion of inner surface of palm covered with hair, which extends forward on fingers. Dactylus finely toothed above, cutting edge entire; a broad, triangular tooth on immovable finger. A wide gap between base of fingers when closed.

Walking legs somewhat compressed, second and third subequal, first smaller than second, fourth slightly smaller than first. Lower margin of merus of third leg finely toothed, upper margin haired, bearing a sharp, subdistal tooth; outer surface of carpus and propodus well covered with acute granules; dactylus slen-

der, almost as long as propodus. A diagonal row of granules on outer surface of carpus of first leg; two rows of granules with a smooth area between on corresponding surface of carpus of second leg; a similar pattern on carpus of third leg but less prominent. Segments of fourth walking leg more hairy than those of first three legs.

M. telescopicus has a very wide range; it is known from the Red Sea through the Indo-Pacific region to Japan, Australia, and the central Pacific. Specimens in Bishop Museum are from Pearl Harbor and Kaneohe Bay, Oahu, and from the coast of Maui.

The exceedingly long eyestalks apparently distinguish this species from other known members of the genus. Even in juvenile specimens 5 mm. broad the eyestalks extend far beyond the orbits. Sakai (9) records *M. telescopicus* as a small species, noting a breadth of carapace of 10.5 mm. Hawaiian specimens are much larger, a male from Pearl Harbor being 32 mm. broad and a female being slightly larger.

Macrophthalmus convexus Stimpson, Acad. Nat. Sci. Philadelphia, Proc. 1858: 97; Smithsonian Misc. Coll. 49: 97, pl. 13, fig. 2, 1897.—Edwards, A. Milne, Nouv. Arch. Mus. d'Hist. Nat. Paris 9: 277, pl. 12, fig. 5, 1873 (as *Macrophthalmus inermis*).—de Man, Linn. Soc. London, Jour. (Zool.) 22: 354, pl. 15, fig. 4, 1888.—Alcock, Asiatic Soc. Bengal, Jour. 69 (2): 378, 1900.—Rathbun, U. S. Fish Comm., Bull. 23 (3): 834, 1903 (1906) (as *Macrophthalmus inermis*).—Tesch, Zool. Mededeel. 1: 175, pl. 7, fig. 8, 1915.—Sakai, Studies on the crabs of Japan IV. . . , 625, text fig. 97, 1939.—Edmondson, B. P. Bishop Mus., Sp. Pub. 22: 312, 1946 (as *Macrophthalmus inermis*). (See figures 9, a-c; 10, a.)

Maximum breadth of carapace a little less than twice its length, lateral borders slightly converging posteriorly. Middle portion of carapace with gastric and cardiac regions well marked by shallow grooves but quite smooth; lateral areas of carapace, including hepatic and branchial regions granulose, granular zone growing narrower anteroposteriorly. Front narrow, about one-ninth breadth of anterior border of carapace. Two transverse grooves, the posterior one more distinct, extend inward from lateral border toward gastric area. Orbit sinuose, borders dentate, external angle rather broad, directed diagonally forward, its posterior margin tuberculate. Lateral border of carapace with two teeth behind external orbital angle, first shorter than angle, second rudimentary; lateral border also fringed with hair.

Chelipeds subequal, long, smooth, anterior margin of arm fringed with hair, inner angle of wrist granular. Palm of hand elongate, increasing in height distally, a raised line of fine granules traverses outer surface near lower border, extending to tip of immovable finger. Distal portion of inner surface of palm densely haired, hair extending on fingers. Fingers somewhat deflexed, immovable one with a strong, serrated tooth near middle, dactylus with a stout tooth near base.

Walking legs slender, second and third subequal, first smaller than second, fourth smallest of all. Meral joints of first three legs sparsely fringed with hair, segments of last leg densely haired. Abdomen of male with seven distinct segments, second very short, seventh broader than long and broadly rounded at tip.

Rathbun (7) concludes that the Hawaiian specimens, recorded by Edwards (3) as *M. inermis* and deposited in the Muséum National D'Histoire Naturelle, Paris, represented a species quite distinct from *M. convexus* Stimpson. She uses the differences in breadth-length pro-

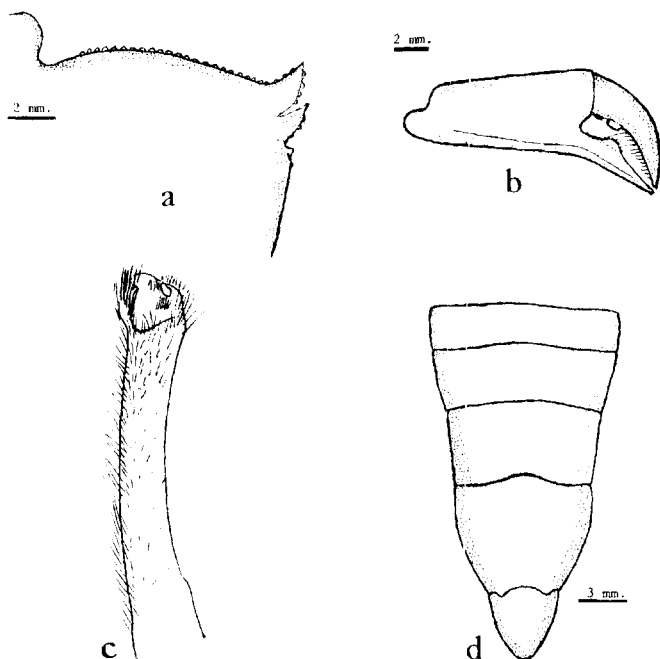


FIGURE 9.—**a**, *Macrophthalmus convexus*, outline of carapace, half front and lateral border; **b**, *M. convexus*, right chela; **c**, *M. convexus*, first pleopod, male (courtesy of Guinot-Dumortier); **d**, *Cardisoma hirtipes*, abdomen, male, last five segments.

portions as the basis for her conclusions. However, upon critical comparative examination of typical examples of *M. convexus* from Fiji with Edward's type of *M. inermis*, Guinot-Dumortier of the Paris museum was convinced that the two forms were identical and that the proportionate differences noted by some authors were sexual variations instead of specific characters (letter of July 10, 1959). Dr. Guinot-

Dumortier supplied a sketch of the first pleopod of *M. inermis* (male) which conforms with the corresponding appendage of *M. convexus* (fig. 9, c).

Although there are no recent records of *M. convexus* in the Hawaiian Islands, the discovery of another member of the genus (*M. telescopicus*) at a number of localities among the islands adds weight to the possibility that *M. convexus* may still be in the Hawaiian area.

In 1933 *M. convexus* was a rather abundant species on the mud flats of Suva Bay, Fiji. Among the Bishop Museum collection of 32 specimens from that locality the largest male is 28 mm. in breadth of carapace, whereas the maximum breadth of the largest female is 24 mm.

FAMILY GECARCINIDAE

Representatives of this family are land crabs of considerable size which habitually burrow in the ground, some excavating tunnels several feet in length and depth.

Carapace thick, with inflated branchial regions; areas of surface usually faintly outlined or not at all; lateral borders not well defined; pterygostomial regions densely haired in some species.

These large land crabs, typical of many islands and land areas of tropical and subtropical regions, have a very wide distribution. In some localities on low islands where the human population attempts to cultivate vegetable gardens the crabs have become a noxious pest. Fencing the garden plots in the usual way, from the ground up, is little protection to the crops, as the crabs burrow beneath the fences. Reports from other localities, however, indicate that the land crab plays a different role in human economy, for it is highly esteemed as an article of human diet. In such areas its destructive potentials are kept at a low level.

Land crabs of the family Gecarcinidae are cited in this report because specimens in the Museum of Comparative Zoölogy were reportedly collected on Oahu by Mann in 1864.

Cardisoma hirtipes Dana, U. S. Exploring Exped. 13 (1): 376, 1852: pl. 25, fig. 2, 1855.—Rathbun, U. S. Fish Comm., Bull. 23 (3): 838, 1903 (1906) (as *Cardisoma rotundum*).—Calman, Zool. Soc. London, Proc. 1909: 711.—Tesch, Siboga-Exped. Monogr. 39c: 137, 1918.—Sakai, Studies on the crabs of Japan IV . . . , 704, pl. 111, fig. 1, 1938. (See figures 9, d; 10, b.)

Carapace broader than long, surface quite smooth, gastric and cardiac regions well defined, post-frontal lobes pronounced. Front about as wide as orbit, margin slightly convex. Lateral border of carapace strongly convex, bearing a weak ridge anteriorly, marked by oblique lines posteriorly; one small tooth behind external orbital angle.

Chelipeds in male unequal, subequal in female, surface smooth; large cheliped (male), upper margin of arm haired, a sharp tooth at inner angle of wrist; palm short and high, a wide gap between fingers when closed, a few low teeth on cutting edges. Walking legs long, rather slender, unarmed, some joints fringed with bristles.

Rathbun (7) identified the Hawaiian specimens collected by Mann as *Thelphusa rotunda* of Quoy and Gaimard (6), suggesting the name *Cardisoma rotundum* and placing in synonymy under it Dana's name

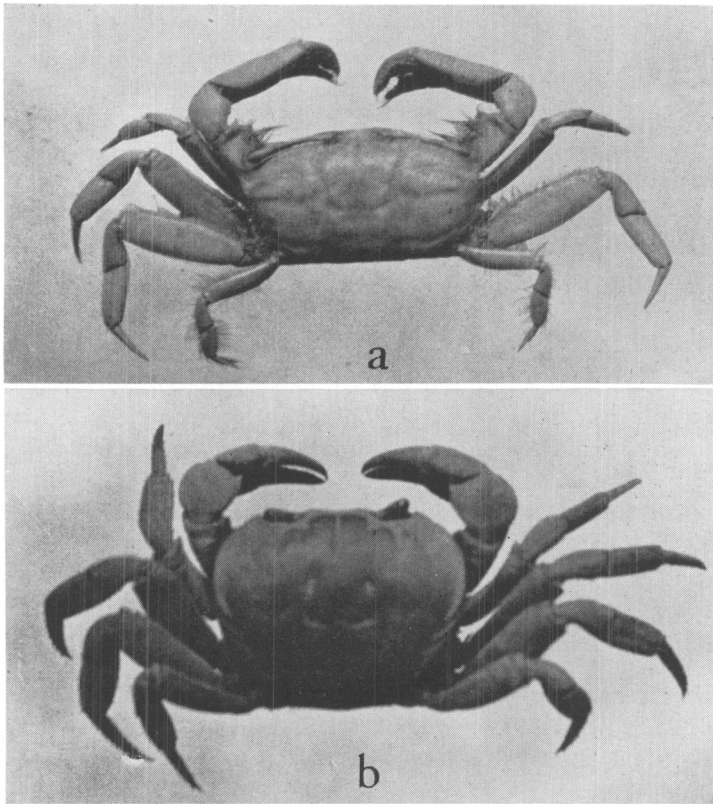


FIGURE 10.—a, *Macrophthalmus convexus*, specimen from Fiji; b, *Cardisoma hirtipes*, female specimen from Jaluit Island.

C. hirtipes, with which the Hawaiian form apparently agrees. However, since Rathbun's publication authors have generally preferred that the name suggested by Dana designate this particular land crab.

Apart from the specimens collected by Mann on Oahu nearly 100 years ago, there is no record to justify the inclusion of any member of the genus *Cardisoma* among the Hawaiian fauna at the present time.

The two species of *Cardisoma* which have a wide and parallel dispersal in the Indo-Pacific region are *C. hirtipes* and *C. carnifex* (Herbst), much alike in size and general appearance, both ranging into the central Pacific area but not now found in Hawaii.

The two species, *C. hirtipes* and *C. carnifex*, may usually be distinguished as follows: (1) The prominent post-frontal lobes of the carapace of *C. hirtipes* are only slightly developed in *C. carnifex*. (2) The ridge of the anterolateral border of the carapace in *C. hirtipes* stops short of the level of the cervical groove (posterior boundary of gastric area), whereas in *C. carnifex* it extends posteriorly beyond this level. (3) Well-developed diagonal striae mark the posterolateral border of the carapace in *C. hirtipes*; whereas in *C. carnifex* the striae are poorly developed or absent. (4) In *C. hirtipes* the infra-orbital border of the orbit meets the lateral border in an acute angle instead of a right angle as in *C. carnifex*.

Bishop Museum has specimens of *C. hirtipes* from the Line Islands, Fiji, Jaluit Island, and Guam; and it has specimens of *C. carnifex* from the Line Islands, Penrhyn Island, Raiatea, and Australia. One male specimen of *Cardisoma carnifex* from Fanning Island is 95 mm. in breadth of carapace, the hand (palm and fingers) of the large cheliped is 120 mm. long and the palm is 50 mm. high.

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