American coast. Rathbun records the size of an ovigerous female specimen as being 13.8 mm. in breadth of carapace and 11.4 mm. in length.

Cyclograpsus granulatus Dana, U. S. Exploring Exped., Crustacea **13**: 361, 1852 (pl. 23, 1855).—Rathbun, U. S. Fish Comm., Bull. **23** (3): 840, 1903 (1906).

A small species characterized by dense microscopic granulation on nearly whole of anterior half of upper surface of carapace. Merus of external maxilliped shorter than ischium, its crest crossing only antero-external angle of ischium; surface of maxilliped without hair except the crest. Chelipeds stout, smooth; fingers gaping, without teeth. Walking legs stout, quite smooth, merus marked by irregular transverse series of microscopic granules. Abdomen of male with sides slightly concave, terminal segment broadly rounded at free end. (See figures 20, *a*; 21, *a, b*.)

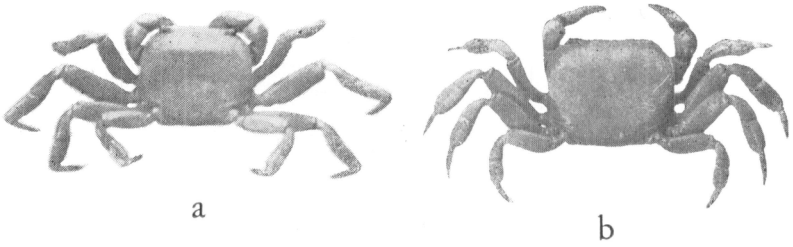

FIGURE 20.—**a,** *Cyclograpsus granulatus;* **b,** *C. henshawi.*

Specimens of *Cyclograpsus granulatus* in Bishop Museum are from Hilo, Hawaii; Maliko Beach and Makena, Maui; and Kahana Bay, Oahu. This species may sometimes be found in considerable numbers about the shores under stones above the water line. Specimens from Oahu have a breadth of carapace of 9 mm. and length of 7 mm. The species is known only from the Hawaiian Islands.

Cyclograpsus henshawi Rathbun, U. S. Nat. Mus., Proc. **26**: 75, fig. 1, 1902; U. S. Fish Comm., Bull. **23** (3): 840, 1903 (1906).

Carapace broader than long, surface punctate on front and anterolateral areas; front sharply turned down, free edge straight. Lateral borders of carapace entire, parallel except for a little distance behind orbits. Six smooth spots may be seen on anterior half of carapace, one on each side of gastric area and two on each side farther forward and nearer lateral border, in an irregular transverse line.

Chelipeds subequal, massive in male; merus somewhat granular above and on outer surface; carpus smooth, inner angle granulated. Hand and fingers smooth; fingers gaping, armed with a few low teeth stronger on pollex. Walking

legs somewhat roughened by granules; propodis and dactylus bearing short black bristles. Abdomen of male with sides distinctly concave. (See figures 20, *b*; 21, *c, d.*)

In Bishop Museum are many specimens of *C. henshawi* taken from the shores of Oahu, Maui, and Hawaii. In 1953 large numbers were observed under stones on the rocky shore of Kahului Harbor, Maui, inside the breakwater. Some of the larger specimens have a carapace 18 mm. broad and 15 mm. long. The species is known only from the Hawaiian Islands.

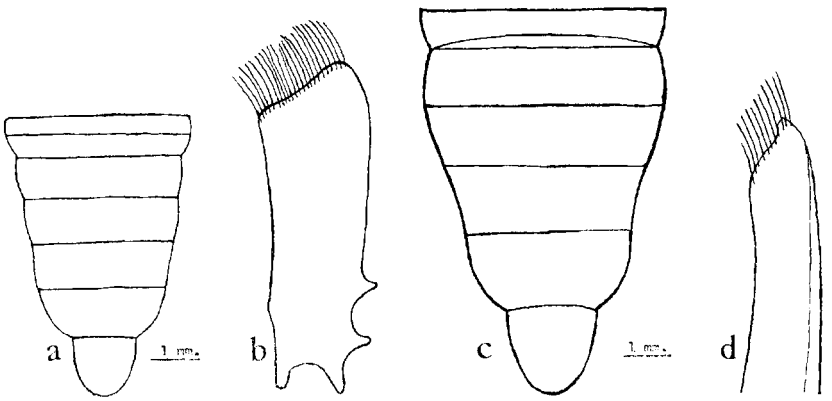

FIGURE 21.—**a, b,** *Cyclograpsus granulatus: a,* abdomen, male; *b,* first pleopod, male. **c, d,** *C. henshawi: c,* abdomen, male; *d,* first pleopod, male, distal extremity.

Key to Hawaiian genera of Plagusinae

Carapace thick; merus of external maxilliped as broad as ischium; walking legs without spines.....**Plagusia.**

Carapace thin; merus of external maxilliped narrower than ischium; walking legs spinous.....**Percnon.**

Key to Hawaiian species of Plagusia

Upper surface of carapace covered with squamiform tubercles bordered with short, stiff hairs, also squamiform markings of upper surface of merus of walking legs densely fringed with hairs.....**P. depressa tuberculata.**

Upper surface of carapace covered with depressed tubercles which are wholly or almost wholly devoid of marginal hairs. Also, squamiform markings of upper surface of merus of walking legs are not fringed with hairs.....**P. immaculata.**

Plagusia depressa tuberculata (Lamarck) Laurie, Ceylon Pearl Oyster Fisheries **5**: 430, 1906.—Rathbun, U. S. Fish Comm., Bull. **23** (3): 841, 1903 (1906); U. S. Nat. Mus., Bull. **97**: 334, pl. 102, 1918.—Tesch, Siboga-Exped., Monogr. **39c**: 128, 1918.—Sakai, Studies on crabs of Japan IV . . ., 702, pl. 109, fig. 4, 1939.

Carapace subcircular in outline, nearly as long as broad. Surface of carapace covered by flat tubercles bordered in front by short, stiff bristles of uniform length. Antero-lateral border armed with three teeth behind sharp external orbital angle, decreasing in size from first to last. Chelipeds in adult male stout, longer than carapace, in female and young male small and shorter than carapace. Palm and dactylus ornamented by rows of tubercles. Dorsal surface of basal joint (coxal) of walking legs bears a prominent lobe with entire margin. Anterior border of merus with a strong subterminal spine; upper border of carpus, propodus, and dactylus fringed with long bristles. Abdomen of male triangular in shape, segments 4 to 6 fused, sides of segments 4 to 5 concave. (See figures *22, a; 23, a-c.*)

This subspecies apparently differs from the typical species *P. depressa*, common in the Atlantic Ocean, in the character of the coxal lobes, which in the typical species are dentate but in the subspecies entire. The many specimens of *Plagusia* in Bishop Museum, collected from Hawaii and other central Pacific areas, are all typical forms of the subspecies. One of the larger specimens, from Lisiansky Island, has a maximum breadth of carapace of 70 mm. The subspecies has a very wide dispersal in the Indian and Pacific Oceans.

Plagusia immaculata (Lamarck) Miers, Voy. Challenger, Zool. **17** (49): 273, pl. 22, fig. 1, 1886.—Laurie (as *Plagusia depressa* var. *immaculata*), Ceylon Pearl Oyster Fisheries **5**: 430, 1906.—Rathbun, U. S. Fish Comm., Bull. **23** (3): 842, 1903 (1906); U. S. Nat. Mus., Bull. **97**: 335, pl. 103, 1918.

Carapace similar in shape and form to that of *P. depressa tuberculata*, and, like the subspecies, bearing three teeth on the lateral margin behind the external orbital angle. The tubercles of the carapace in this species are not so well pronounced as in the subspecies and not fringed with hair. In male specimens of *P. immaculata* chelipeds are subequal and stout. Entire surface of palm is thickly covered with small tubercles disposed in longitudinal rows on upper border and, to some extent, on outer border and extending over base of fingers. Fingers stout, horny, and hollowed out at tips; cutting surfaces bear strong, rounded teeth. In female chelipeds subequal, small, and slender. Palm quite smooth; upper border traversed by a narrow groove, a larger one in the upper lateral border. Inner border marked by a longitudinal row of hairs. Fingers are long, straight, with horny tips hollowed out; cutting surfaces bear tufts of hairs instead of teeth. Lobes of coxal joints of walking legs entire, as in subspecies *P. depressa tuberculata*. (See figure *22, b.*)

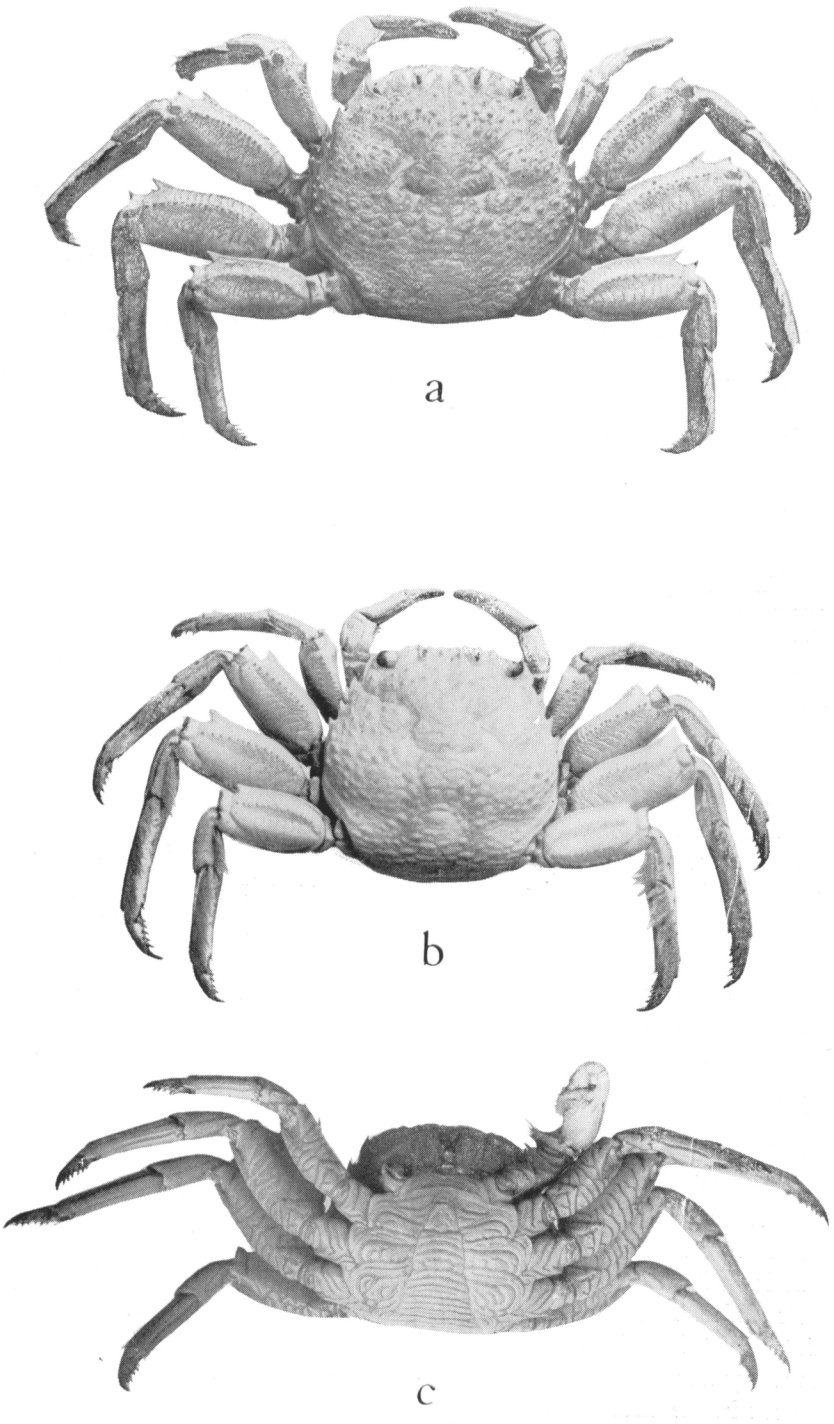

FIGURE 22.—**a**, *Plagusia depressa tuberculata;* **b**, *P. immaculata* (specimen from Indochina; Nhatrang Institute of Oceanography); **c**, *P. speciosa* (specimen from Washington Island).

Male abdomen of *P. immaculata* triangular, segment 3 notched on lateral margins, and segments 4 to 6 fused. Differs from that of *P. depressa tuberculata* in that sides of segments 4 to 5 are less concave than in subspecies. Abdomen of female also presents a slight distinction from that of *P. depressa tuberculata*, in which terminal segment is broadly triangular with almost straight sides. In *P. immaculata* it is broadly rounded, the sides being arched. This segment is also shorter in *P. immaculata* than in subspecies. (See figure 23, *c-e*.)

The species *P. immaculata* was accredited to Honolulu by Miers (10), who suggested that it might be a smoother, glabrous form of the typical *P. depressa*. Laurie (5), on reviewing the genus *Plagusia*, was satisfied that *P. immaculata* represented a variety of *P. depressa*. Rathbun (18), however, concluded that the series in the United States National Museum was specifically distinct and accepted the validity of the species *P. immaculata*.

A specimen of *P. immaculata* in Bishop Museum, received from the Nhatrang Institute of Oceanography, Indochina, was compared with a specimen from the collections of the Allan Hancock Foundation, taken from Cocos Island, Costa Rica. These specimens, both females and of nearly the same size, agree in general features and are distinguished from the subspecies *P. depressa tuberculata* by the depressed character of the tubercles of the carapace which are wholly or almost wholly devoid of marginal hairs.

In the female specimen from Indochina a few tubercles on the epigastric areas of the carapace bear marginal hairs, whereas in the female specimen from Costa Rica a mere trace of marginal hairs is seen in corresponding areas of the carapace. And a male specimen from Costa Rica, slightly larger than the female from the same locality, lacks the epigastric marginal hairs entirely. Although the specimens of *P. immaculata* seen from Indochina and Costa Rica are quite similar in most respects, it is clearly seen that in the Indochina specimen the tubercles of the carapace, though depressed, are more distinctly outlined than in either of the specimens from Costa Rica.

From time to time, there have been reports of forms of *Plagusia* among typical examples of *P. depressa tuberculata* which agree with that subspecies except in the tubercles which are depressed and almost or entirely devoid of hair. Pillai (12) noted male specimens with low and indistinct tubercles entirely without bordering hair among individuals which, in other respects, would conform with the subspecies *P. depressa tuberculata*. These observations revive the opinion of some investigators that there may be only one highly variable form of *P. depressa* in the Indo-Pacific region.

The reported range of *P. immaculata* includes localities on the west coast of Central America, the Indian Ocean, the China Seas, and Honolulu. However, there is no recent record of the species being in Hawaiian waters, and none of the numerous specimens of the genus collected in the central Pacific area now in Bishop Museum appears to represent *P. immaculata.*

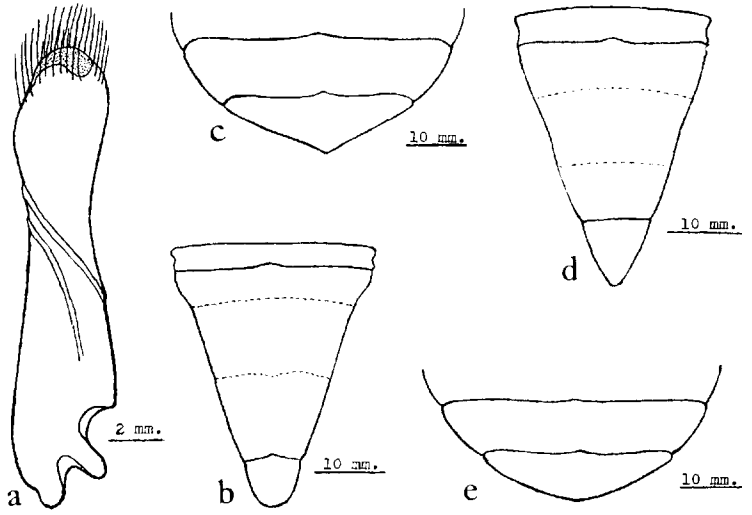

FIGURE 23.—a-c, *Plagusia depressa tuberculata: a,* first pleopod, male; *b,* abdomen, male, segments 3-7; *c,* abdomen, female, showing terminal segment. d, e, *P. immaculata: d,* abdomen, male, segments 3-7 (specimen from Cocos Island, Costa Rica; Allan Hancock Foundation); *e,* abdomen, female, showing terminal segment (specimen from Indochina).

Attention is called to another species of the genus, *P. speciosa* Dana, in which the lateral teeth of the carapace are only three in number, including the external orbital angle. Tubercles of the dorsal surface of the carapace are quite similar to those of *P. depressa tuberculata.* In both sexes the sternum, the abdomen, and the ventral surface of the walking legs, proximal of the carpi, are marked by transverse impressed lines bordered by short, stiff hairs. Lateral of the abdomen the lines form scroll-like patterns. (See figure 22, *c.*)

Although this species has not yet been recorded from the Hawaiian area, it may eventually appear in local waters. Previous records indicate a wide range of distribution in the south Pacific, including the

Tuamotus (type locality), Tahiti, Funafuti, and Rotuma. Bishop Museum has specimens from Guam and Washington Island. The male specimen from Guam has a carapace 30 mm. in breadth.

Key to Hawaiian species of Percnon

A longitudinal groove in the upper border of the palm extending nearly or fully the length of the segment. Anterior border of the epistome with three spines.

Carapace subcircular, lateral margin bearing three spines behind external orbital angle, decreasing in size from first to third. A large species.....**P. pilimanus.**

Carapace squarish, lateral margin nearly straight, bearing three spines behind external orbital angle, first and third small, second large. A small species.....**P. abbreviatum.**

Longitudinal groove in upper border of palm inconspicuous. Anterior border of epistome with three spines. Lateral margin of carapace bearing three spines behind external orbital angle, decreasing in size from first to third. A small species.....**P. planissimum.**

Percnon pilimanus (A. Milne Edwards).

Acanthopus pilimanus A. Milne Edwards, Nouv. Arch. Mus. d'Hist. Nat. Paris, Bull. **9**: 300, pl. 14, fig. 5, 1873.

Leiolophus pilimanus Miers, Ann. Mag. Nat. Hist. V, **1**: 154, 1878. —Kingsley, Acad. Nat. Sci. Philadelphia, Proc. **1880**: 224, 1881.—Ortman, Zool. Jahrb. **7**: 731, 1894.

Percnon pilimanus Rathbun, U. S. Fish Comm., Bull. **23** (3): 842, 1903 (1906).—Tesch, Siboga-Exped., Monogr. **39c**: 130 (key), 1918.

Carapace a little longer than broad, surface slightly convex, covered by a very short pile of black bristles. Two stout teeth diverge from terminal extremity of median frontal lobe, lateral margins of which each bears a stout tooth near middle, followed by four or five very small ones. Lateral borders of carapace bear three sharp teeth behind external orbital angle, last one smallest. Ischium of external maxilliped large quadrangular, the merus very small. Chelipeds (female) very small, merus spinous on upper and lower margins; carpus spinous above; palm with a few short spines and a shallow, longitudinal sulcus on upper border, otherwise quite smooth. Patch of short hairs marks upper part of inner border of hand. Fingers rather broad, hollowed out, no teeth on sharp cutting edges. Walking legs long and slender; outer border of merus, carpus, and propodus (in part) covered by a fine pile, as on carapace; inner border smooth. Row of strong spines on anterior margin of merus, and close behind a parallel row of smaller ones which diminish in size from first to fourth leg; lower distal end of merus bears a strong tooth. Three rows of long hairs borne on propodus and one on hooked dactylus, which is provided with a row of spines on lower border. Abdomen of female very broad, rounded, segments 3 to 5 fused, terminal segment short, impacted in preceding one. (See figures 24, *a, b*; 25, *a*.)

Specimens of this apparently rare form are known from New Caledonia, Fiji, Tahiti, and Hawaii. One specimen now in Bishop Museum, an adult female, was collected by Daniel Kuhns on Fort Armstrong reef, Honolulu, in 1917. The length of the carapace of the specimen is 38 mm., the breadth, 34 mm.

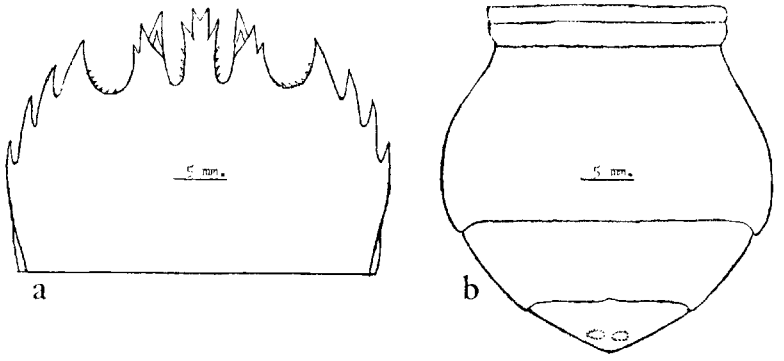

FIGURE 24.—*Percnon pilimanus:* a, outline of anterior portion of carapace; b, abdomen, female.

Percnon abbreviatum (Dana) (as *Acanthopus abbreviatus*), U. S. Exploring Exped., Crustacea **13**: 373, 1852 (pl. 23, fig. 11, 1855). —Rathbun, U. S. Fish Comm., Bull. **23** (3): 842, 1903 (1906).—Schmitt, Smithsonian Misc. Coll. **98** (6): 22, 23, 1939.

Carapace subquadrate, length equal to greatest breadth, surface slightly convex, covered for most part by short pile but with a few irregular bare spots. Also, carapace bears a series of small tubercles arranged symmetrically on the postfrontal, gastric, and branchial regions. There is an uneven line of tubercles close to and parallel with posterior margin. Four sharp teeth are borne on lateral border of carapace behind external orbital angle; first tooth, which is smallest, close in front of second, which is larger than third.

Chelipeds subequal; merus rather short and stout, in male upper and inner borders densely coated with long hairs; a sharp, recurved spine on upper border of merus near distal end and similar one at inner distal angle. Carpus with a few sharp, short spines on upper border. Palm smooth, upper border with groove filled with hair extending entire length of margin. Inner surface of palm with an elongated area covered with sharp pile and small tubercles. Fingers stout, shorter than palm. In female, merus of cheliped sparsely haired, inner border bearing two or three small spines in addition to larger one at distal extremity. Fingers in female relatively longer than in male and more broadly hollowed out at tips.

Abdomen of male triangular, segments 3 to 5 fused, their lateral borders converging distally giving sides of abdomen a concave appearance. Terminal segment of abdomen, elongate, subtriangular. (See figures 25, *b*; 26, *a-c*.)

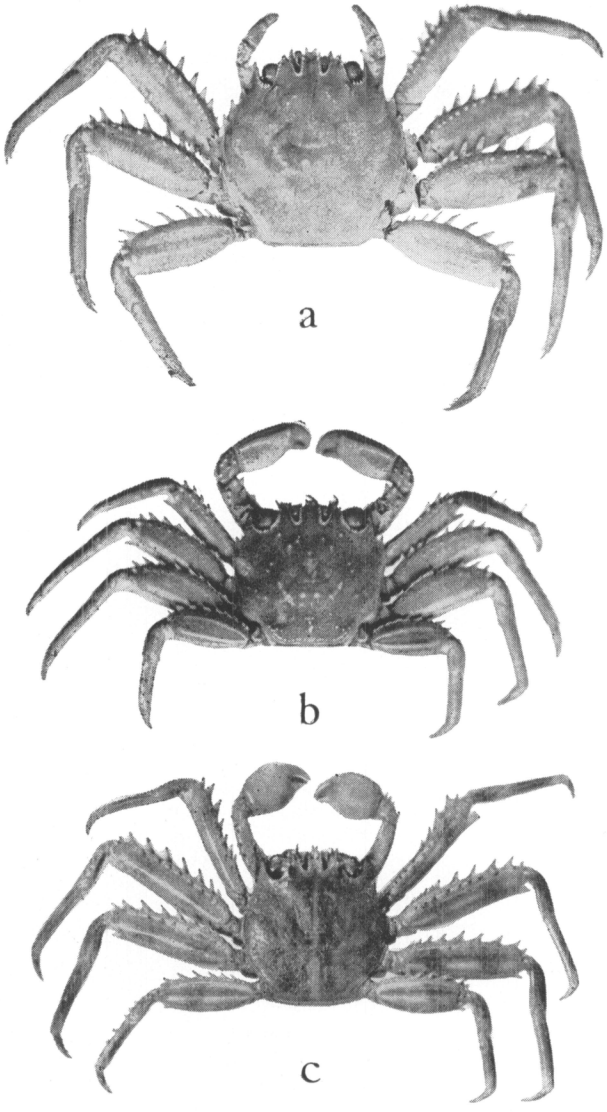

FIGURE 25.—**a**, *Percnon pilimanus;* **b**, *P. abbreviatum;* **c**, *P. planissimum.*

P. abbreviatum was first described from Tahiti, and since that time has been reported from the Indian Ocean and from the Marshall, Gilbert, and Fiji Islands in the Pacific. However, inasmuch as there has been confusion between this species and *P. demani* Ward (p. 198), some of the Indo-Pacific records may be accepted with reservations. Specimens of the true *P. abbreviatum* in Bishop Museum are from the Hawaiian Archipelago, the Line Islands and Wake Island, and American Samoa. Schmitt (21) reported it from Clipperton Island in the eastern Pacific. In Hawaii, where it appears to be less abundant than *P. planissimum,* the species is often concealed under stones or in dead coral heads in shallow water. Adult male specimens are about 18 mm. in breadth of carapace.

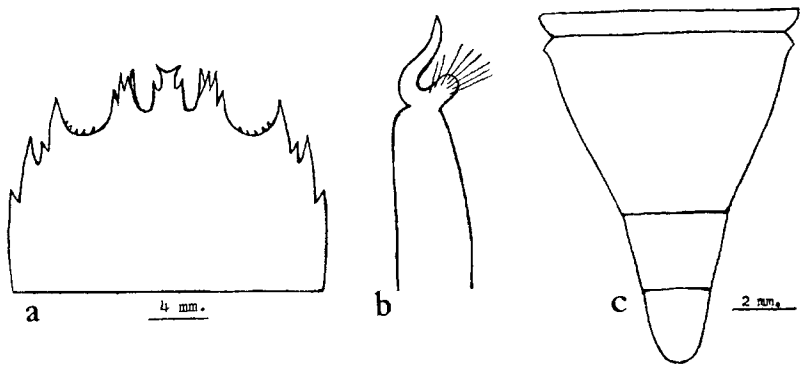

FIGURE 26.—*Percnon abbreviatum:* **a,** outline of anterior portion of carapace; **b,** first pleopod, male, distal extremity; **c,** abdomen, male, segments 3-7.

Percnon planissimum (Herbst) Alcock (as *Liolophus planissimus*). Asiatic Soc. Bengal, Jour **69** (2) : 439, 1900, and synonymy.—Rathbun, U. S. Fish Comm., Bull. **23** (3) : 842, 1903 (1906).—Tesch, Siboga-Exped., Monogr. **39c** : 130, 1918.—Sakai, Studies on crabs of Japan IV . . ., 703, pl. 79, fig. 4, 1939.

Carapace very flat, slightly longer than broad, lateral borders convex; surface well covered by a short pile of black bristles but leaving some symmetrical patches and linear bands bare. Four sharp teeth, including external orbital angle, are borne on anterolateral border, decreasing in size from first to last. Merus of cheliped slender, elongate, a row of four or five widely separated teeth on upper border; inner border coated with long and short hairs; carpus spinous on upper border. Palm short, broadly oval in male, compressed and smooth except for a few short spines close to junction with carpus; fingers short, hollowed out, with sharp cutting edges. Walking legs long, slender, flattened, well covered on

upper surface with short pile as on carapace; merus with row of long, sharp spines on anterior margin and in first three legs; close behind margin is another row of shorter spines which decrease in size from first to third leg and are absent on fourth leg. Two bare longitudinal stripes are seen on merus segments. Longitudinal rows of long hairs are borne on outer border of carpus, propodus, and dactylus. Abdomen of male broadly triangular, sides slightly concave, terminal segment short, broadly rounded. General color in life dark green, bare areas of a lighter tint. (See figures 25, *c*; 27, *a-c*.)

This crab is one of the most common of the Grapsidae within its range. It is very widely distributed in the Indo-Pacific region and from Japan eastward through the central Pacific area. In the eastern Pacific the species is displaced by *P. gibbesi* Milne Edwards (p. 199). The species is abundant in Hawaiian waters, where it is found under stones at the shore line or between tides. Many specimens in Bishop Museum are from the island of Oahu, from American Samoa, from the Line Islands, and from the Marquesas. Adult male specimens have a carapace about 20 mm. in length.

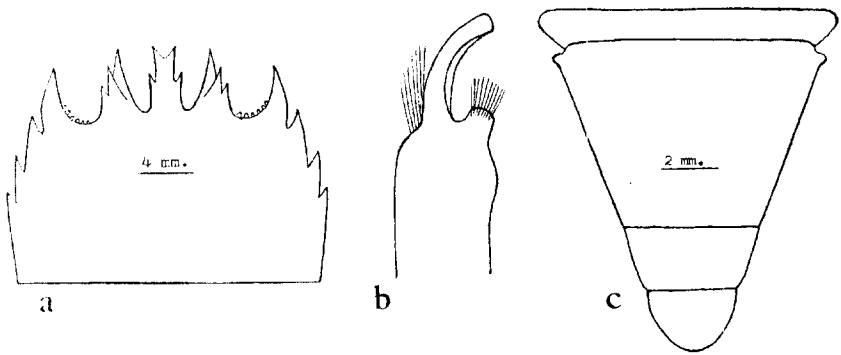

FIGURE 27.—*Percnon planissimum:* **a**, outline of anterior portion of carapace; **b**, first pleopod, male, distal extremity; **c**, abdomen, male, segments 3-7.

Besides the species of *Percnon* recorded from the central Pacific two others may be mentioned which have affinity with Hawaiian forms but are morphologically and possibly geographically distinct. One is *P. demani* Ward (28) recorded from Christmas Island, Indian Ocean. This species is close to *P. abbreviatum* but differs from it in that the carapace narrows anteriorly and there is but one spine on the epistome instead of three. Also, from Ward's figure, it appears that the chelae (male ?) are broadly expanded, which is not the case in either sex of *P. abbreviatum*. Apparently, previous to 1934 investigators did not

recognize the difference between the form to be described by Ward and the true *P. abbreviatum*. In a key to species of *Percnon*, Tesch (25) obviously characterizes *P. demani* instead of *P. abbreviatum*.

It would be of some scientific interest to reexamine specimens from the Indo-Pacific region designated as *P. abbreviatum* to learn whether there is an overlapping of the two forms, or to determine whether *P. demani* is confined, as now seems likely, to the Indian seas and the western Pacific. *P. abbreviatum* apparently ranges through the central and eastern Pacific.

It was once believed that *P. planissimum* was almost cosmopolitan in the warm seas of the world. However, in 1918 Rathbun (18) concluded that the species of *Percnon* common to the American and east Atlantic shores differs from the Indo-Pacific *P. planissimum*, and she designated it *P. gibbesi* (Milne Edwards). According to the key to species of *Percnon* by Schmitt (21), a chief distinction between the two species is the furrow in the upper border of the palm, which in *P. planissimum* is very short and inconspicuous. In *P. gibbesi* it is longer; from a fourth to half of the length of the upper margin. In the eastern Pacific *P. gibbesi* apparently takes the place of *P. planissimum*, having been reported from the Galapagos Islands and from Lower California to Chile. It ranges in the Atlantic from southern Florida through the Caribbean area to Brazil and also occurs in the Bahamas and the Bermudas. In the eastern Atlantic it is reported from the Azores to Cape of Good Hope.

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