

as I know, on rocky shores. This preference for a sandy bottom is correlated with certain structural peculiarities and a group of habits which may be mentioned here on account of their bearing on the methods of fishing. Observation of the crab where accessible in shallow water and of the young in aquaria furnish the following facts: The crabs may often be seen moving quietly along over the

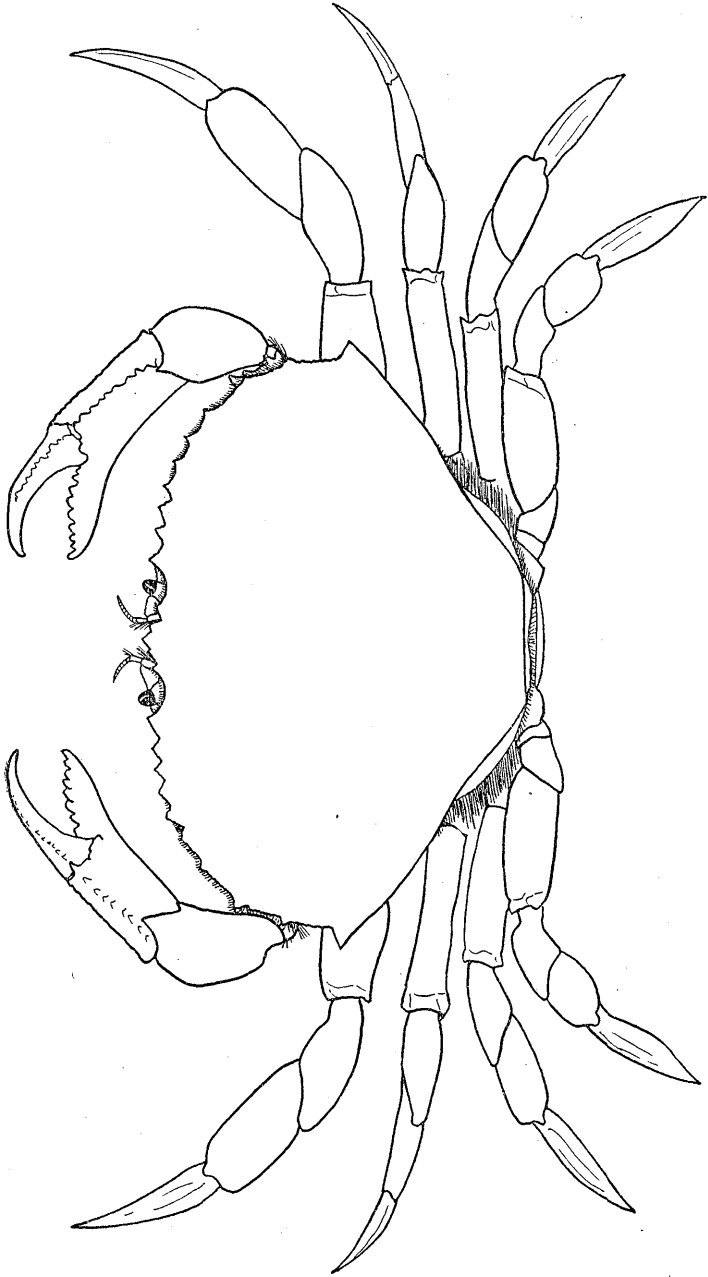


Fig. 138. *Cancer magister*, reduced (after R. Rathbun).

bottom; where buoyed up by the water they move lightly over the ground on the tips of their legs, presenting a striking contrast to their heavy and clumsy movements as ordinarily seen on land. If frightened they dart away with surprising speed. Some of the fish eaten by them must require much agility in their capture, though how this is accomplished is unknown. For the greater part of the time, however, they lie almost entirely buried in the sand, as may be seen from observation in the aquarium or in shallow bays. If examined at such a time, only the stalked eyes, antennules, and antennae will be visible, and below these a sort of chink between the anterior part of the shell and the flattened maxillipeds which are held slightly separated from the body. From this cleft issues a current, evident if the water is roily, or in the laboratory if India ink, for instance, be added.

When thus buried two conditions must be met: First and most important, a supply of fresh water for respiration must be obtained; and, second, the animal must be informed of the presence of food or enemies. Under ordinary conditions the water is forced through the gill-cavity by the rhythmic beating of a specialized appendage lying in an anterior prolongation of the chamber; the water is drawn in near the bases of the legs and escapes near the mouth, forming the exhalent current already noted. When buried, the water must be drawn from the surrounding sand, but it must also be freed from fine sediment which soon coats the plates of the gills and interferes with respiration. If India ink be discharged on the surface of the sand above a buried crab, it will be drawn into the sand along two lines corresponding to the front borders of the shell, and closer observation will show that it passes into a crevice between the shell and the large pincers, which, when folded, accurately fit the contour of the sides of the body, here covered with a dense plush-like coat of hair. The teeth on the overhanging edge of the shell exclude large grains of sand, while the hair acts as a very efficient strainer, removing all fine particles from the inhalent stream. At times the direction of this current is reversed.

These facts explain certain of the habits. Other forms, though closely related, may lack this straining apparatus and thus be unable to burrow in sand; this is the case with *Cancer productus*, which, as a result, is restricted to rocky or gravelly bottoms. In the edible crab this straining apparatus, though efficient in removing the sediment found in the sand, seems less satisfactory in dealing with the finer particles of muddy bottoms, and crabs found in these locations have the gills badly discoloured and seldom appear healthy. Other questions, such as food and the adaptation of the legs to sand-burrowing, may have some influence, but the preference for sand is largely due to the method of respiration.

The bay specimens of this species, like those of *C. productus* and *C. antennarius*, are for the greater part much undersized. Of the total three hundred and eleven specimens taken, very few, only one or two, were really of notable size; a great number were at best of medium size, and a still greater number were small or juvenile; ninety-six measured specimens averaged only 31.6 mm. in width. This is quite in keeping with Weymouth's observations (1914, p. 124) regarding the reduction in size of this species as a result of over fishing:

The following quotation pictures the condition about 1880: "The common crabs are caught along the sandy beaches on the San Francisco side of the bay, especially on the south side of the Golden Gate between the city and the sea. They

are taken in immense numbers in seines, together with many shoal-water species of fish, yet the supply seems to be undiminished. Three or four good-sized crabs sell in the market at retail for 25 cents." To-day no crabs could be taken by shore-hauled seines in the locality mentioned, and very few of marketable size by any method in any part of the bay; profitable fishing is confined to the bar three or four miles outside the Golden Gate. One good-sized crab sells for 25 cents in the market on rare occasions, but more commonly for 30 or 35 cents. The supply seemed "to be undiminished" only because of the short time under observation. The history of this fishery, which even under protective legislation has markedly diminished in thirty years, is significant for yet unexploited regions.

We obtained eight specimens ranging from 39 to 55 mm. in width, in two hauls of the 250-foot seine at Fort Baker; at Sausalito three small individuals in a 150-foot seine; and at Tiburon with the same gear a single male, 46 mm. in width.

Outside, strange to say, not a single specimen was dredged in water exceeding 14 fathoms in depth, although on the fishing grounds, in 30 to 40 fathoms, one haul made by the commercial trawlers (July, 1912) yielded thirty-five juvenile specimens, ranging from 10 to 18 mm. in width (av. 12.5 mm.). Within the bay, except for thirty-seven specimens taken in four hauls (D 5739, 5742, 5808, 5809) in 20 to 53 fathoms, the vast majority of the records (63%) were made in less than 10 fathoms, and of these nearly half (47%) did not exceed 5 fathoms in depth.

All told, *Cancer magister* was taken at fifty-one dredging, one hydrographic, and five shore stations as follows: D 5702, 5705, 5708, 5710, 5712-5722, 5725, 5731, 5732, 5734, 5735, 5739, 5741-5743, 5745, 5749, 5750, 5752-5754, 5762-5764, 5766, 5776, 5778-5780, 5784, 5795, 5796, 5798, 5799, 5801, 5802, 5804, 5806-5809, 5816, 5818, 5819, 5822, 5825, 5826, 5828; H 5168; Sausalito, March 23, 1912; "fishing grounds," July, 1912; north of Key Route Pier, August 2, 1912; Richmond shore, north of Standard Oil pier, August 3, 1912; Fort Baker, April 19 and May 13, 1913; Tiburon, April 29, 1913.

Cancer gracilis Dana

Plate 35, figure 2

Cancer gracilis Dana, Proc. Acad. Nat. Sci. Phila., 6, 73, 1852; Crust. U. S. Expl. Exped., 1, 153, 1852, pl. 7, fig. 2, 1855; Holmes, Occas. Papers Calif. Acad. Sci., 7, 52, 1900; Rathbun, H. A. E., 10, 177, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 42, pl. 9, figs. 26-28, 1910.

Characters.—Carapace quite strongly convex, very slightly areolated; antero-lateral teeth low, projecting less than one-third the length of base, not spiny-pointed; front not produced, the three median teeth reach farther forward than

the outer pair; the central tooth is smaller than the others but projects farther anteriorly. Merus of outer maxillipeds elongated, rounded anteriorly. Carpus of chelipeds with two spines, one above, at distal angle, and a second below this, on inner angle; fingers of chelipeds without dark color. Dactyls of ambulatory legs slender, not flattened.

Dimensions.—Type: length of carapace 27.3 mm., greatest width 40.2 mm. Specimens collected in San Francisco Bay ranged from 3 to 76 mm. in width of carapace.

Color.—In life color is olive overlaid with minute reddish brown spots, which are more numerous on the teeth of the anterolateral margin and on the front, giving to the whole a brownish tinge; edges of teeth, under parts, and greater portion of legs, yellowish. There is little variation in color among individuals and small difference between fresh and alcoholic specimens (Weymouth).

Type Locality.—San Francisco, California.

Distribution.—Kasaan Bay, Prince of Wales Island, Alaska, to Playa Maria Bay, Lower California. Shallow water to 56 fathoms (Rathbun).

Biological Survey of San Francisco Bay.—*Cancer gracilis* (see pl. 6) ranges from a little north of Point San Pedro, in the upper bay (D 5716), well down toward the lower end of the lower bay (D 5847), and outside to the San Francisco bar (D 5733) and the fishing grounds (D 5785, and by the commercial trawlers in July, 1912). In all it was taken at fourteen dredging stations and at two shore stations: Sausalito, along shore and in the seine, and Point Bonita, between tide marks. Of the dredging stations only one (D 5716) occurs in the upper bay, eight (D 5702, 5742, 5797–5799, 5826, 5828) in the middle bay, three (D 5802, 5847, 5849) in the lower bay, and two (D 5733, 5785) outside. *Cancer gracilis* occurs more abundantly at stations of 12 fathoms and less in depth. Of such there are ten at which the average number of specimens taken was two and seven-tenths. Of the other four dredging stations at which this species was taken, one is intermediate, 10 to 16 fathoms, with one specimen, and three exceed 13 fathoms (D 5702, 13 to 17 fathoms; D 5742, 20 to 30 fathoms; D 5785, 39 to 40 fathoms), with an average of one and three-tenths specimens taken at each.

There also appears to be a fairly close correspondence between depth and number of specimens per haul, and the character of the bottom. All of the stations of 12 fathoms or less within the bay were made on a predominantly muddy bottom, running from the upper bay through the eastern part of the middle bay, behind Angel Island, down into the lower bay. The station of intermediate depth designated above should be included in this series with respect to character of bottom. The outside station of less than 12 fathoms had a bottom of "fine, very clean, gray sand," and returned only a single

specimen of 23 mm. in width. The deeper stations, D 5702, off Sausalito, D 5742 in the upper end of Raccoon Strait, and D 5785, on the fishing grounds, were made on rocky, shelly, on clean dark gray sand with a few fragments of stone and occasional small compact masses of black mud, and on "fine dark green sand" bottoms respectively.

The temperatures at which this species was taken range from 8.8° to 15.9° C; while in no case was any specimen taken in water of a salinity less than 21.3.

Cancer oregonensis (Dana)

Plate 36, figures 3 and 4

Trichocera oregonensis Dana, Proc. Acad. Nat. Sci. Phila., 6, 86, 1852; Crust. U. S. Expl. Exped., 1, 299, 1852, pl. 18, fig. 5, 1855.

Trichocarcinus oregonensis Holmes, Occas. Papers Calif. Acad. Sci., 7, 54, 1900.

Trichocarcinus walkeri Holmes, Occas. Papers Calif. Acad. Sci., 7, 53, 1900.

Cancer oregonensis Rathbun, H. A. E., 10, 178, pl. 7, fig. 1, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 49, pl. 11, fig. 34, 1910; Way, Puget Sd. Mar. Sta. Publ., 1, 366, fig. 23, 1917.

Characters.—Carapace elliptical, more or less evenly rounded at sides, anterolateral and posterolateral margins not meeting at a distinct angle, carapace widest at seventh or eighth tooth; twelve or thirteen teeth; fronto-orbital width nearly one-half the width of the carapace. Merus of outer maxillipeds with antero-external angle produced. Carpus of chelipeds with a spine at the antero-internal angle below which there is a tooth; hand thick and high, the short upper edge of palm with two rows of small tubercles, outer surface with five delicate granulated lines; fingers of chelipeds with dark color reaching more than half the length of the outer margins, movable finger almost entirely dark colored.

Dimensions.—Type: length of carapace 18 mm., width 23 mm.; large female, 36.5 mm. long, 47.1 mm. wide (Rathbun).

Color.—Areolae bright red, chelipeds and legs flesh color, fingers black (Holmes). Dark red above, lighter beneath; walking legs in some cases with light spots which tend to give the legs a somewhat banded appearance. There is considerable variation in color; in some specimens a very irregular band of orange or yellow extends across the carapace anterior to the cardiac groove, with the whole carapace more gray and more or less spotted; in others the median line from the posterior end to beyond the cardiac groove shows very gray (Way).

Type Locality.—Puget Sound.

Distribution.—Aleutian Islands to Lower California (Holmes). Low water to 238 fathoms (Rathbun).

Family ATELECYCLIDAE

Carapace subcircular; front with several teeth, with either a median notch or tooth. Antennules fold back longitudinally. Antennal flagella long and hairy, or wanting. Third maxillipeds overlapping endostome.

Genus **Telmessus** White

Carapace broader than long, more or less pentagonal; front divided into three lobes; median lobe cut into four teeth or denticles, lateral lobes forming the inner angles of the eyes. Chelipeds short, ambulatory legs moderately long.

Telmessus cheiragonus (Tilesius)

Cancer cheiragonus Tilesius, Mém. Acad. Impér. Sci. St. Pétersb., 5, 347, pl. 7, fig. 1, 1815.

Telmessus cheiragonus Benedict, Proc. U. S. Nat. Mus., 15, 224, pls. 25, 26, figs. 2-4, 1892; Holmes (mis-spelled *Telemessus*), Occas. Papers Calif. Acad. Sci., 7, 69, 1900; Rathbun, H. A. E., 10, 179, 1904; Way, Puget Sd. Mar. Sta. Publ., 1, 363, fig. 17, 1917.

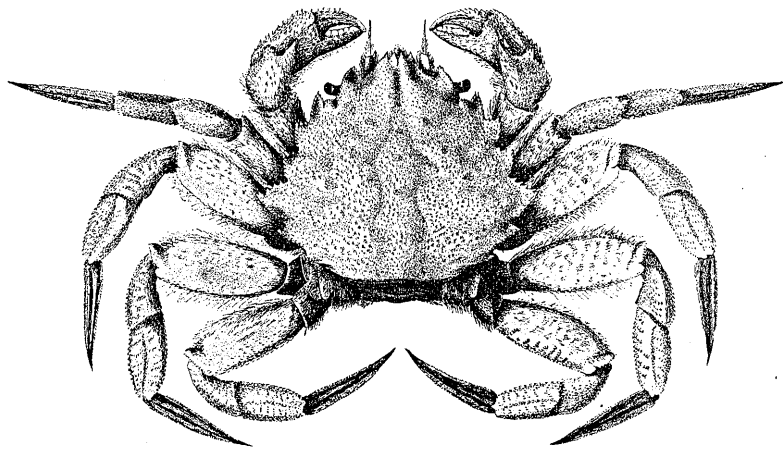


Fig. 139. *Telmessus cheiragonus* (from Benedict, U. S. N. M.).

Characters.—Carapace deeply areolated; teeth or denticles of median lobe of front often wanting in old worn specimens; lateral lobes triangular, forming the inner angles of the eyes; lateral teeth of carapace triangular, six in number, including the angles of the eyes, anterior three with two denticles on anterior margin, points of teeth bent forward and on a line with the denticles; the fourth tooth forms the lateral angle of the carapace and has four denticles on the anterior margin, one close to the point of the tooth, then a space followed by three denticles evenly placed; posterior teeth without denticles; surface of carapace set with large granules, forming lines in the posterior region; from these granules arise numerous bristles of even length, which bend forward and are enlarged at the points.

Dimensions.—Length of carapace 50 mm., width 64 mm. (Holmes). A large specimen measures: length of carapace 83 mm., width 102 mm. (Benedict).

Color.—Varying from a yellow-brown to dark red; the propodi, dactyls, and some portions of the carapace show the red distinctly (Way).

Type Locality.—Avacha Bay, Kamchatka.

Distribution.—Northeastern Siberia; Kamchatka; Kurile Islands; Bering Sea to California (Holmes). Low water to 20 fathoms (Rathbun).

Family PORTUNIDAE

Carapace moderately transverse, usually widest at last anterolateral marginal tooth; front with or without median tooth. Antennules fold back transversely or obliquely. Third maxillipeds not overlapping endostome. Ambulatory legs flattened, and more or less distinctly adapted for swimming.

KEY TO THE CALIFORNIA GENERA OF THE PORTUNIDAE

- I. Abdomen of male \perp shaped. Merus of outer maxillipeds prominent, and curved outward at the antero-external angle. (Not known north of Point Loma.)
Callinectes, p. 236.
- II. Abdomen of male triangular. Merus of outer maxillipeds not markedly prominent at antero-external angle, more or less obtuse.
Portunus, p. 237.

Genus *Callinectes* Stimpson

Abdomen of male very narrow, \perp shaped; merus of outer maxillipeds strongly produced outwardly at antero-external angle. Otherwise very similar to *Portunus*.

Callinectes bellicosus (Stimpson)

Lupa bellicosa (Sloat MS.) Stimpson, Ann. Lye. Nat. Hist. N. Y., 7, 57, 1859 (1862); Lockington, Proc. Calif. Acad. Sci., 7, 105, 1877.

Callinectes bellicosus Rathbun, Proc. U. S. Nat. Mus., 18, 365, pls. 22, 24, fig. 10, pl. 25, fig. 8, pl. 26, fig. 8, 1895; H. A. E., 10, 180, 1904.



Fig. 140. *Callinectes bellicosus*, slightly enlarged; a, abdominal outline of σ ; b, frontal outline (after Rathbun).

Characters.—Carapace minutely granulated; front with two slender, sharp teeth, widely separated, and between them two very faintly marked median teeth; inner supraorbital fissure open, often throughout its length; postorbital tooth long, exceeding preorbital. Carpus of chelipeds with two or three external ridges and a few pointed tubercles near the anterior end; hand with a strong spine above the upper hinge joint, at the proximal end of a tuberculated costa; ridge on the posterior upper edge ending distally in a spine; fingers obscurely if at all ridged on outer face.

Dimensions.—Male: length of carapace about 64 mm., width 134 mm.; immature female 43.5 mm., width 86 mm. (Rathbun).

Color.—Almost brown above, cream color below, the tubercles and ridges of the manus tinged with red (Lockington).

Type Locality.—Guaymas, Mexico, Gulf of California.

Distribution.—Point Loma, California, to Gulf of California (Rathbun).

Genus *Portunus* Fabricius

Carapace usually broad transversely and depressed, or a little convex, often with surface areolated; front proper well delimited from inner supraorbital angles, and cut into three to six, usually four teeth; anterolateral borders oblique, arched, longer than posterolateral, cut into nine teeth (including outer orbital angle), of which the ninth may be enlarged. Merus of outer maxillipeds not markedly produced at antero-external angle. Abdomen of male triangular.

Portunus xantusii (Stimpson)

Achelous xantusii Stimpson, Ann. Lye. Nat. Hist., N. Y., 7, 222, 1860 (1862).

Neptunus xantusii, A. Milne Edwards, Crust. Rég. Mex., p. 213, pl. 38, fig. 1, pl. 39, fig. 3, 1879.

Portunus xantusii Holmes, Occas. Papers Calif. Acad. Sci., 7, 71, 1900; Rathbun, H. A. E., 10, 179, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 49, pl. 12, fig. 35, 1910.

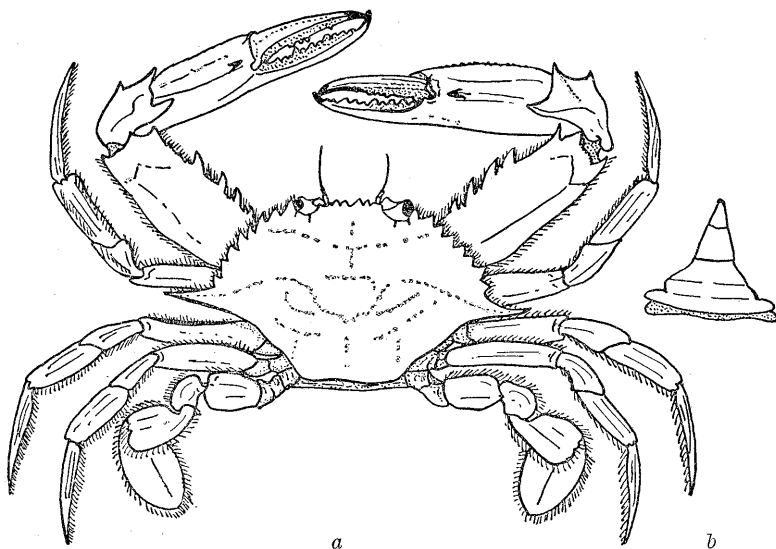


Fig. 141. *Portunus xantusii*, ♂, $\times \frac{1}{2}$; a, dorsal view; b, ventral view of abdomen (after A. Milne Edwards).

Characters.—Carapace markedly transverse, upper surface pubescent; front short, four frontal teeth equally prominent, the middle ones slightly narrower than the outer pair, and separated from the latter by a slightly wider interval than

they are separated from each other; inner supraorbital fissure more or less closed; postorbital tooth extends nearly as far forward as the teeth of the front. Carpus of chelipeds with several granulated ridges on the outer surface, a strong spine at the distal end of upper margin, and a smaller one on lower side, at distal end of lowest granulated ridge; hand with a spine at external hinge joint, the granulated ridge on the upper margin terminating in a spine a little behind the distal end of the palm; there are four granulated ridges on the outer surface of hand, not counting the upper one; fingers strongly and distinctly ridged on outer face.

Dimensions.—Type, female: length of carapace 13.7 mm., width 26.7 mm. Of male: length of carapace 25.25 mm., width 53 mm. (Holmes).

Type Locality.—Cape St. Lucas, Lower California, common on the beaches.

Distribution.—From Puget Sound to Chile. Except for a single specimen taken by the "Albatross" in Puget Sound, this species is not known north of Santa Monica Bay, California. It almost seems that the Puget Sound record is the result of an incorrect label.

Family XANTHIDAE (PILUMNIDAE)

Carapace more or less transversely oval; front moderately broad, often toothed, in the latter case always with a median notch; anterolateral margins arcuate, and armed with several lobes, teeth or spines. Antennules fold back transversely or obliquely. Fingers of chelipeds more or less curved.

KEY TO THE CALIFORNIA GENERA OF THE XANTHIDAE

- I. The ridges that define the efferent branchial channels, if present, are low and are confined to the posterior part of the endostome, never reaching the anterior part of the buccal cavern.
 - A. Fronto-orbital border less than half the greatest width of the carapace. (Not known north of San Pedro.) *Cycloxanthops*, p. 239.
 - B. Fronto-orbital border half or more than half the greatest width of the carapace.
 1. Carpal joints of ambulatory legs armed above with a horned or lunate crest. (Not known north of San Diego.) *Heteractaea*, p. 248.
 2. Carpal joints of ambulatory legs not armed with a horned crest.
 - a. Carapace transversely oval; front divided by an open, rounded notch. Ambulatory legs devoid of a crest on upper margin. (Not known north of Monterey.) *Xanthias*, p. 245.
 - b. Carapace more or less hexagonal or subquadrate; front divided by a more or less closed fissure. Ambulatory legs with carpal and propodal joints more or less cristate. *Lophopanopeus*, p. 240.
- II. The ridges that define the efferent branchial channels extend to the anterior boundary of the buccal cavern and are often very strong. Fronto-orbital border much more than half the greatest width of carapace. Ambulatory legs not carinated. (Not known north of Venice.) *Pilumnus*, p. 247.

Genus **Cycloxanthops** Rathbun

Carapace broad; front horizontal, prominent, and divided by a median fissure into two lamellate lobes, which are truncated and separated from the inner orbital angle by a rather deep fissure; orbits small, with two fissures in supraorbital margin, external orbital angles inconspicuous, continuous with anterolateral margins, which are very long, strongly curved, extending far backward; fronto-orbital border less than half the greatest width of the carapace. Abdomen of male five-jointed.

Genus **Cycloxanthops** Rathbun

KEY TO THE CALIFORNIA SPECIES OF CYCLOXANTHOPS

- I. Carapace flattened, convex, granular and rugose in front, and more or less punctate behind. (Not known north of Monterey Bay.)
novementatus, p. 239.
- II. Carapace very uneven, prominently granulated, and thickly covered with small circular pits. (Known only from San Diego. Not seen since originally described.)
rugosus, p. 240.

Cycloxanthops novementatus (Lockington)

Plate 37, figure 7

Xanthodes? novem-dentatus Lockington, Proc. Calif. Acad. Sci., 7, 32, 1877.
Cycloxanthops novementatus Holmes, Occas. Papers Calif. Acad. Sci., 7, 56, pl. 1, fig. 2, 1900; Rathbun, H. A. E., 10, 180, pl. 7, fig. 10, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 50, pl. 12, fig. 36, 1910; Baker, Rept. Laguna Mar. Lab., 1, 100, 1912.

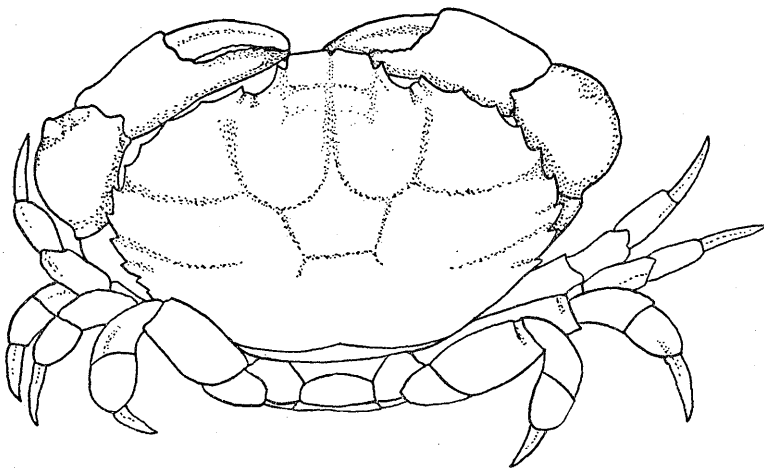


Fig. 142. *Cycloxanthops novementatus* (after Holmes).

Characters.—Carapace wide, slightly convex, flattened behind, punctate and anteriorly rugose; front produced, more advanced in the middle than at the orbits, with a deep, closed median notch, which may become obliterated above by

the fusion of the two sides; anterolateral margin armed with eight or nine small subacute teeth besides the postorbital; a small tenth tooth often occurs behind the ninth; preorbital tooth distinct. Merus of maxillipeds obliquely truncated at anterior end. Carpus of chelipeds rugose, and furnished with two blunt teeth at antero-internal angle; hand rugose above, and rather long, with upper and lower margins nearly parallel; fingers long, sulcate, not gaping. Ambulatory legs with margins hairy; dactyls longer than the propodi, and terminating in nearly straight, corneous claws.

Dimensions.—Type, male: length 23.9 mm., width 31.8 mm.

Color.—The general color in life is a dull reddish brown, showing traces of purple at the posterior part of the carapace and still more strongly on the ambulatory legs and below, thus somewhat resembling *Xanthias taylori*; fingers of chelipeds black, with teeth along inner margins white. One young specimen shows the tendency to white markings so common in the young of *Lophopanopeus heathii* (Weymouth).

Type Locality.—San Diego, California.

Distribution.—Monterey Bay, California, to Guadalupe and San Martin islands, Lower California.

Remarks.—Frequent under stones between tides (Baker).

Cycloxanthops rugosus Holmes

Cycloxanthops rugosa Holmes, Occas. Papers Calif. Acad. Sci., 7, 59, 1900.

Cycloxanthops rugosus Rathbun, H. A. E., 10, 180, 1904.

Original Description.—Carapace very uneven, granulated, and thickly covered with small, circular pits. Postorbital tooth small; anterolateral teeth irregular. Anterior portion of the subhepatic region prominently granulated and pitted and not sharply separated from the strongly sloping anterior portion of the hepatic area. Front shorter and more depressed than in *novemdentatus*. External maxillipeds much as in the preceding species; merus pitted and granulated. Carpus of the chelipeds strongly reticulated above; a prominent tooth at the antero-internal angle, below which is a smaller tooth. Hands narrow, strongly reticulated above and on the upper portion of the outer surface, the inner margin of the upper side furnished with several irregular tubercles. Ambulatory legs much as in *novemdentatus* but less hairy (Holmes).

Type Locality.—San Diego, California.

Remarks.—This species has not been found since Holmes's original specimen was taken and described (no measurements were given). Holmes says it is "easily distinguished by the conspicuous pits and prominent granulations of the carapace."

Genus *Lophopanopeus* Rathbun

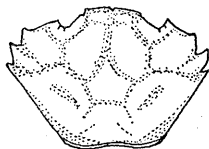
Carapace more or less hexagonal or subquadrate; front short, divided by a closed or nearly closed fissure into two sinuous lobes; orbits transverse; postorbital tooth small, anterior half of anterolateral margin more or less straight, furnished with a single low obscure tooth which is more or less coalesced with the postorbital, posterior half of anterolateral margin nearly longitudinal and furnished with three prominent, subequal teeth; fronto-orbital border half or more than half the greatest width of the carapace. Ambulatory legs more or less cristate. Abdomen of male five jointed.

KEY TO THE CALIFORNIA SPECIES OF *LOPHOPANOPEUS*

- I. Hands smooth, without lobes or teeth on upper margin; dark color of fingers does not run back on the palm. *bellus*, p. 241.
- II. Hands with one or more lobes or teeth on upper margin.
- A. Carpus of chelipeds smooth or nearly so.
1. Color of fingers runs back on palm. (Not known north of Venice.) *frontalis*, p. 242.
 2. Color of fingers does not run back on palm. (Not known north of Monterey Bay.) *heathii*, p. 243.
- B. Carpus of chelipeds very rough.
1. Carpal joints of ambulatory legs strongly bilobed. Color of fingers does not run back on palm.
 - a. Carpus of chelipeds with reticulating ridges enclosing pits of irregular shape. (Not known north of Monterey.) *leucomanus*, p. 243.
 - b. Carpus of chelipeds covered with tubercles. (Not known north of Monterey Bay.) *diegensis*, p. 245.
 2. Carpal joints of ambulatory legs slightly bilobed. Carpus of chelipeds is crossed by a few thickened ridges incompletely reticulating, anterior margin having a thick, granulated ridge, distinctly separated by a deep sulcus from the rest of the carpus; a large granulated tubercle near articulation with hand; color of fingers does not run back on palm. (Not known north of Venice.) *lockingtoni*, p. 244.

***Lophopanopeus bellus* (Stimpson)**

Plate 37, figure 4

Xantho bella Stimpson, Ann. Lye. Nat. Hist. N. Y., 7, 204, pl. 5, fig. 2, 1860 (1862).*Lophoxanthus bellus* A. Milne Edwards, Crust. Rég. Mex., p. 257, pl. 46, fig. 4, 1879 (part); Holmes, Occas. Papers Calif. Acad. Sci., 7, 60, pl. 1, fig. 3, 1900.*Lophopanopeus bellus* Rathbun, H. A. E., 10, 180, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 51, pl. 12, fig. 37, 1910.Fig. 143. *Lophopanopeus bellus*, carapace (after Holmes).

Characters.—Carapace is roughened anterolaterally but not conspicuously so; frontal lobes are slightly sinuous and oblique, the outer tooth faintly indicated. Carpus of chelipeds is slightly roughened in the older specimens, but it often is roughly tuberculous in young ones; hand smooth, without a tooth on the upper

margin; the proximal end of the inner margin of the upper surface is, however, well marked; dark color of fingers does not run back on palm. Carpal joints of ambulatory legs slightly bilobed on the anterior or upper margin; propodal joints have a convex anterior margin without lobes.

Dimensions.—Type, male: length of carapace 13.7 mm., width 20.3 mm. Male specimen examined by Miss Rathbun: length 22.5 mm., width 33.8 mm., proportion of length to width 1 : 1.5, fronto-orbital width 16 mm., proportion of fronto-orbital width to width of carapace 1 : 2.11.

Color.—Crimson or beet red; carapace sometimes lighter in color, or yellowish, maculated with deep red. Northern specimens are more transverse, rougher, more pubescent, and more sober in coloration than those found in warmer latitudes (Stimpson). Color in life of this species as of *Lophopanopeus heathii* is extremely variable. . . Some specimens are almost pure white while others show various irregular patterns of bluish and dark red or are wholly of the latter color (Weymouth).

Type Locality.—Monterey, California.

Distribution.—Prince William Sound; Kasaan Bay, Prince of Wales Island, Alaska (Rathbun). Vancouver Island, British Columbia to Monterey Bay, California (Holmes). Lower California (A. Milne Edwards).

Remarks.—Miss Rathbun says: "There are on the Pacific Coast six closely allied species of *Lophopanopeus*; some of these have been confused with *L. bellus* and *L. leucomanus*; therefore the published localities from which I have not examined specimens, are accepted with a reservation."

In the collection of the U. S. National Museum this species is not represented from any locality south of Puget Sound.

Lophopanopeus frontalis (Rathbun)

Plate 37, figure 3

Lophozozymus (Lophoxanthus) frontalis Rathbun, Proc. U. S. Nat. Mus., 16, 236, 1893.

Lophoxanthus frontalis Holmes, Occas. Papers Calif. Acad. Sci., 7, 64, pl. 1, figs. 5-6, 1900.

Lophopanopeus frontalis Rathbun, H. A. E., 10, 181, pl. 7, fig. 8, 1904.

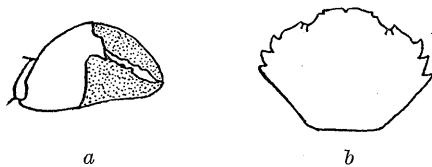


Fig. 144. *Lophopanopeus frontalis*; a, chela; b, carapace (after Holmes).

Characters.—Carapace almost smooth; frontal lobes markedly oblique and sinuous, middle lobes very convex. Carpus of chelipeds is smoother than in *L. bellus*; hand smooth, with a large tooth projecting inward on the inner side of the upper margin, and extending half the length of the upper margin; dark color of fingers runs back on the palm, in this respect differing from all other allied species. Carpal joints of ambulatory legs are slightly bilobed on the anterior or upper margin; propodal joints have a convex anterior margin but are narrower than in *L. bellus*.

Dimensions.—Male: length 17.2 mm., width 23.7 mm., proportion of length to width of 1:1.32; fronto-orbital width 12.5, proportion of fronto-orbital width to width of carapace 1:1.9 (Rathbun).

Color.—The dark color of the fingers runs back on the palm, in this respect differing from all other allied species (Rathbun).

Type Locality.—San Diego, California.

Distribution.—Santa Monica Bay and Santa Catalina Island to San Diego, California.

Lophopanopeus heathii Rathbun

Plate 37, figure 1

Lophopanopeus heathii Rathbun, Amer. Nat., 34, 137, 1900.

Lophoxanthus leucomanus Holmes, Occas. Papers Calif. Acad. Sci., 7, 61, 1900 (part).

Lophopanopeus heathii Rathbun, H. A. E., 10, 182, pl. 7, fig. 9, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 51, pl. 12, fig. 38, 1910; Hilton, Jour. Ent. Zool., Pomona Coll., 8, 71, 1916.

Characters.—Carapace smooth except on outer half of hepatic region, where it is slightly roughened; margin of frontal lobes slightly oblique, outer tooth inconspicuous. Carpus of chelipeds smooth or nearly so; hand smooth, one tooth on inner side of upper margin; dark color of fingers not running back on the palm. Carpal joints of ambulatory legs with anterior or upper margin slightly bilobed; propodal joints with slightly convex anterior margins.

Dimensions.—Type, male: length 12.2 mm., width 16.5 mm., proportion of length to width 1:1.35; fronto-orbital width 11.6 mm., proportion of fronto-orbital width to width of carapace, 1:1.42 (Rathbun).

Color.—Extremely variable, see note under *L. bellus*. Hilton remarks: "A young male was marked as follows: white claws with dark tips, last legs white, other legs and body dark red. A young female had red claws, hind legs white and body darker. Another young male was white."

Type Locality.—Monterey Bay, California.

Distribution.—Monterey Bay, Santa Catalina Island, and Laguna Beach, California.

Lophopanopeus leucomanus (Lockington)

Plate 37, figure 6

Xanthodes leucomanus Lockington, Proc. Calif. Acad. Sci., 7, 32, 1877 (not *leucomanus*, p. 100).

Lophoxanthus leucomanus Holmes, Occas. Papers Calif. Acad. Sci., 7, 61, pl. 1, fig. 4, 1900 (part).

Lophopanopeus leucomanus Rathbun, H. A. E., 10, 182, 1904; Baker, Rept. Laguna Mar. Lab., 1, 100, fig. 53, 1912.

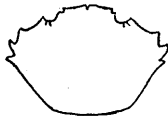


Fig. 145. *Lophopanopeus leucomanus*, carapace (after Holmes).

Characters.—Carapace with anterior half deeply rugose, the roughness on the hepatic region not divided from that on the two adjacent teeth; frontal lobes strongly oblique, except the outer tooth, which is quite strongly marked. Carpus of chelipeds covered with numerous small, irregular pits, separated by reticulating lines; upper portion of hand pitted, reticulated like carpus, and with two or more irregular, inwardly directed teeth on upper margin, the proximal one being the larger; dark color of fingers not running back on palm. Carpal joints of ambulatory legs have on the anterior or upper margin a very thin crest, strongly bilobed; propodal joints are wide, and have a prominent lobe at the proximal end.

Dimensions.—Type: length 8.6 mm., width 12.7 mm. A male, examined by Miss Rathbun: length 8.7 mm., width 11.6 mm., proportion of length to width 1 : 1.33, fronto-orbital width 7.1 mm., proportion of fronto-orbital width to width of carapace 1 : 1.63.

Type Locality.—Monterey, California.

Distribution.—From Monterey to San Diego, California (Rathbun).

Remarks.—Occasional under stones between tides (Baker).

Lophopanopeus lockingtoni Rathbun

Plate 37, figure 2

Xanthodes leucomanus Lockington, Proc. Calif. Acad. Sci., 7, 100, 1877
(not *X. leucomanus*, p. 32).

Lophoxanthus leucomanus Holmes, Occas. Papers Calif. Acad. Sci., 7, 61,
1900 (part).

Lophopanopeus lockingtoni Rathbun, H. A. E., 10, 183, pl. 7, fig. 7, 1904.

Characters.—Carapace with anterior half irregularly roughened; the obliquely oval granulated patch on the hepatic region separated from the granules on the adjacent teeth; frontal lobes slightly oblique but the outer tooth well marked. Carpus of chelipeds crossed by a few thickened ridges incompletely reticulating, anterior margin having a thick granulated ridge distinctly separated by a deep sulcus from the rest of the carpus; a large tubercle near the articulation with the hand; upper margin of hand with two longitudinal ridges, outer one straight, the inner curved and ending proximally in a tooth; outer surface of hand granulate, granules tending to form in longitudinal and transverse lines, and becoming fainter toward the fingers; dark color of fingers not running back on palm. Carpal joints of ambulatory legs distinctly but not markedly bilobed on the anterior or upper margin; the propodal joints with a slightly convex anterior margin.

Dimensions.—Type, male: length of carapace 9.6 mm., width 13.3 mm., proportion of length to width 1:1.39; fronto-orbital width 7.9 mm., proportion of fronto-orbital width to width of carapace 1:1.68.

Color.—Shows great variation, some have black fingers with white tips, others have colored fingers, and the general tint of the carapace varies considerably (Lockington).

Type Locality.—San Diego Bay, California.

Distribution.—San Pedro, California, to Gulf of California (Rathbun).

Lophopanopeus diegensis Rathbun

Plate 37, figure 5

Lophopanopeus diegensis Rathbun, Amer. Nat., 34, 137, 1900; H. A. E., 10, 184, pl. 9, fig. 3, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 52, pl. 12, fig. 39, 1910.

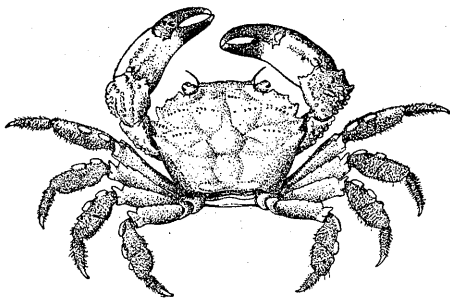


Fig. 146. *Lophopanopeus diegensis*, ♂, × 1½ (from Rathbun).

Characters.—Carapace with a few granulate lines on the anterolateral regions; frontal lobes slightly oblique and sinuous, outer tooth inconspicuous. (The front is deflexed so that its true edge does not show in the view figured.) Carpus of chelipeds with about thirty-five irregularly placed tubercles, some of them forming lines; hand bicarinate above, the inner carina having a small prominence at the proximal end; inner surface of hand with a few tubercles on upper part; outer surface with upper and proximal portion rough, with five granulated rugae; dark color of fingers not running back on palm. Carpal joints of ambulatory legs with two prominent, naked, truncate tubercles on the anterior margin, a character by which this species may at once be recognized; propodal joints with a slightly convex anterior margin.

Dimensions.—Type, male: length 7.9 mm., width 11.4 mm., proportion of length to width 1:1.44; fronto-orbital width 6.6 mm., proportion of fronto-orbital width to width of carapace 1 : 1.37.

Color.—In life dull brown or blackish, occasionally tinged with red but never conspicuously marked as in *L. heathii* (Weymouth).

Type Locality.—San Diego, California.

Distribution.—Monterey Bay to San Diego Bay, California, 10 to 31 fathoms (Rathbun).

Genus Xanthias Rathbun

Carapace transversely oval; front broad, bilobed; anterolateral border cut into three or four tuberculiform or even spinous lobes or teeth, fronto-orbital border considerably more than half the greatest width of the carapace. Ambulatory legs devoid of a crest, but more or less spinous or granular on upper margin. Abdomen of male five-jointed.

KEY TO THE CALIFORNIA SPECIES OF XANTHIAS

- I. Movable fingers of chelae very long and curved abruptly downward. (Only one specimen known, from San Diego.)
latimanus, p. 247.
- II. Movable fingers of chelae stout, not abruptly curved downward. (Not known north of Monterey.)
taylori, p. 246.

Xanthias taylori (Stimpson)

Plate 37, figure 8

Xanthodes taylori Stimpson, Ann. Lye. Nat. Hist. N. Y., 7, 208, pl. 3, fig. 3, 1860 (1862); A. Milne Edwards, Crust. Rég. Mex., p. 260, pl. 45, fig. 3, 1879.

Xanthias taylori Holmes, Occas. Papers Calif. Acad. Sci., 7, 65, 1900; Rathbun, H. A. E., 10, 185, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 52, pl. 13, fig. 40, 1910; Baker, Rept. Laguna Mar. Lab., 1, 102, fig. 54, 1912.



Fig. 147. *Xanthias taylori*, ♂, chela, slightly enlarged (after A. Milne Edwards).

Characters.—Carapace flat behind, in front quite strongly convex longitudinally but nearly plane transversely; lobes of front separated by a wide, rounded notch and furnished with a rounded tooth at the inner and outer angles, between which are several small baccate protuberances; inner orbital angle prominent, separated by a deep notch from outer angle of front; upper orbital margin with a rounded tooth which is bounded by a pair of sulci; postorbital tooth small and continuous externally, with a rounded protuberance; the latter separated by a smooth sulcus from a pair of smooth, rounded prominences, one of which is situated directly above the other; the three posterior teeth on the anterolateral margin prominent, the last two curved forward, the first obtuse and generally more or less bifid; usually there is a small tooth behind the one at the anterolateral angle. Chelipeds stout, more or less unequal; carpus thickly covered with prominent, rounded, smooth, glossy, rose colored tubercles; hand oblong, with palm longer than wide, upper and outer surface covered with tubercles like those on the carpus, arranged in seven or eight longitudinal rows; fingers stout and black colored, color not extending back upon hand.

Dimensions.—Type, female: length of carapace 17.3 mm., width 27.7 mm. An egg-laden female measures 24.6 mm. long on the median line of the carapace and 42 mm. wide (Rathbun).

Color.—In life a uniform dark red, lighter below, fingers black (Weymouth). In the alcoholic specimen the carapace is rose color, like the tubercles of the chelipeds, which are set on a bluish ground; fingers black, the black not spreading on the hand (Stimpson).

Type Locality.—Monterey, California.

Distribution.—Monterey, California, to Magdalena Bay, Lower California. Beach to 55 fathoms (Rathbun).

Remarks.—Abundant under stones between tides and also in kelp holdfasts from deeper water (Baker).

Xanthias latimanus (Lockington)

Xanthodes latimanus Lockington, Proc. Calif. Acad. Sci., 7, 31, 1877.

Xanthias latimanus Holmes, Occas. Papers Calif. Acad. Sci., 7, 66, 1900;
Rathbun, H. A. E., 10, 185, 1904.

Characters.—Carapace but slightly transverse; front sinuate, inner angle of orbit raised into a point. Hands of chelipeds subequal, the right somewhat the larger; movable fingers very long and curved abruptly downward; margin of hand continuous with the broad base of the fixed finger so as to form a sinuous sloping line.

Dimensions.—Type, male: length 18.5 mm., width 22.4 mm.

Type Locality.—San Diego, California. Not seen since Lockington's record.

Remarks.—This species may readily be identified by the delicate marbling of the carapace and chelipeds, and the downward bend of the movable fingers (Lockington).

Genus Pilumnus Leach

Carapace transversely oval or subquadrilateral, not greatly broader than long; front usually about a third the greatest width of the carapace, sometimes broader, cut into two lobes, the outer angle of each of which commonly forms an independent dentiform or spiniform lobule, separated from supraorbital angle by a groove or notch; orbits generally have a gap or fissure just below outer angle and one or two gaps or notches in upper border; anterolateral margins not longer than the posterolateral, commonly shorter, and cut into teeth which very commonly are spiniform; fronto-orbital border much more than half the greatest width of the carapace. Ambulatory legs generally covered thickly with hair, not carinated, usually stout, and of moderate length. Abdomen of male seven-jointed.

Pilumnus spinohirsutus (Lockington)

Plate 37, figure 10

Acanthus spino-hirsutus Lockington, Proc. Calif. Acad. Sci., 7, 32 and 102, 1876 (1877).

Pilumnus spino-hirsutus Holmes, Occas. Papers Calif. Acad. Sci., 7, 67, 1900.

Pilumnus spinohirsutus Rathbun, H. A. E., 10, 185, pl. 7, fig. 2, 1904.

Characters.—Carapace strongly convex, nearly smooth, but covered with stiff setae; median frontal lobes truncated, separated by a prominent notch, each armed with four or five spines; lateral lobes of front small, separated from the median lobes by a deep notch and ending in a spine; orbits with upper, lower and outer margins armed with strong spines of unequal size, the two spines at the intero-inferior angle large and situated on a kind of lobe; besides the post-orbital the anterolateral margin is armed with three strong spines in front of the first of which is a small spine below the margin. Chelipeds unequal, setose; carpus with outer surface thickly covered with spines; upper and outer surface of hand covered with several series of spines, lower margin finely denticulated, fingers dark colored.

Dimensions.—Type: length 25.4 mm., width 28.4 mm.

Color.—One peculiarity of this form is the bright red tint of the prominent transverse ridge in front of the buccal area (Lockington).

Type Locality.—San Diego, California.

Distribution.—Venice to San Diego, California, and Gulf of California; 10 to 22 fathoms (Rathbun). Bay of St. Elena, Ecuador (Nobili).

Genus *Heteractaea* Lockington

Similar in form to *Pilumnus* but lacking the palatal ridges which define the efferent branchial channels in that genus; fronto-orbital border half or more than half the greatest width of the carapace. Ambulatory legs armed above with a curiously shaped horned or lunate crest. Abdomen of male five-jointed.

Heteractaea lunata (Milne Edwards and Lucas)

Plate 37, figure 9

Pilumnus lunatus Milne Edwards and Lucas, in D'Orbigny's Voy. dans l'Amér. mérid., Crust., 6, pt. 1, p. 20, 1843, pl. 9, fig. 2, 1847.

Heteractaea pilosus Lockington, Proc. Calif. Acad. Sci., 7, 97, 1876 (1877).

Heteractaea lunata A. Milne Edwards, Crust. Rég. Mex., p. 301, pl. 52, fig. 2, 1879; Rathbun, H. A. E., 10, 185, 1904.

Characters.—Carapace quite thickly tomentose, with exception of the smooth, shining and naked anterior margin of the frontal lobes, upper and under margins of orbit, and a small tooth just external to the outer hiatus of the orbit; upper margin of orbit a thick, long, sinuate tubercle; anterolateral margin with three sharp teeth projecting beyond the tomentum. Chelipeds unequal, tomentose; carpus and hands covered with tubercles which are arranged in regular rows on the outer side of the hand.

Dimensions.—Specimens examined by Lockington: greatest length of male 19 mm., of female 15 mm., greatest width 27 and 20 mm. respectively.

Color.—In alcohol the teeth of front, upper and under margins of orbit, and a small tooth just external to the outer hiatus of the orbit are all red, smooth, shining and naked; remainder of upper surface of carapace thickly tomentose. Tubercles of manus and carpus red, the red predominating at distal end of merus (Lockington).

Type Locality.—Valparaiso, Chile.

Distribution.—San Diego, California (Faxon), to Chile.

Family GONEPLACIDAE

Carapace squarish, front quite broad, frequently with a median notch; orbits transversely elongated, eye-stalks long; anterolateral angles spiniform. Antennules fold back transversely or obliquely. Fingers of chelipeds practically straight longitudinally.

Genus *Speocarcinus* Stimpson

Carapace longitudinally convex, almost semi-cylindrical, transversely nearly flat, posteriorly narrowing very little, anteriorly margins arcuate and dentate; front less than half the width of the carapace; orbits marginal, oblong. Outer maxillipeds moderately separated from each other, merus subquadrate, with a notch at antero-internal angle for the insertion of palp. Abdomen of male with base much narrower than the last thoracic sternum; third, fourth, and fifth segments coalesced.

***Speocarcinus californiensis* (Lockington)**

Plate 34, figure 7

Eucrate? californiensis Lockington, Proc. Calif. Acad. Sci., 7, 33, 1876 (1877).

Speocarcinus californiensis Holmes, Occas. Papers Calif. Acad. Sci., 7, 77, 1900; Rathbun, H. A. E., 10, 190, pl. 9, fig. 1, 1904; Bull. U. S. Nat. Mus., 97, 42, text fig. 16, pl. 10, figs. 2-3, 1918.

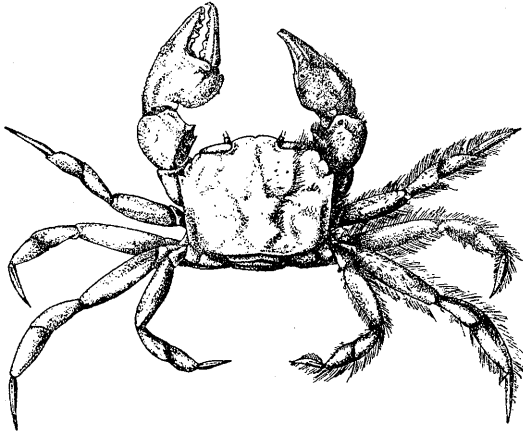


Fig. 148. *Speocarcinus californiensis*, ♂, $\times 1\frac{1}{2}$ (from Rathbun).

Characters.—Carapace nearly smooth above but minutely granulated toward the pubescent margins; front over one-fourth the width of the carapace, anterior margin nearly straight and emarginate in the center; anterolateral margin strongly curved and furnished with three teeth, including the postorbital; the first two teeth are thin-edged and lobate, second tooth broadly rounded, and the third acute. Outer maxillipeds diverging anteriorly, the merus distally truncated, with antero-external angle rounded and not produced. Chelipeds unequal; carpus with a spine at the antero-internal angle and a short, longitudinal granulated ridge at the distal end of the outer surface; hands wide, much compressed, outer surface nearly smooth, but granulated near the upper and lower margins, upper edge acute and sharply granulated; fingers ridged, immovable finger not deflexed. Last pair of ambulatory legs upturned, and to a less extent the preceding pair also.

Dimensions.—Type: length of carapace 20.8 mm., width 26.9 mm.

Type Locality.—San Diego, California.

Distribution.—San Pedro, Anaheim Creek, and Alamitos Bay to San Diego, California.

Remarks.—Lives in holes in muddy beaches (Holmes).

Family PINNOTHERIDAE

Carapace somewhat rectangular but frequently more or less rounded, usually more or less membranaceous; front, orbits, and eye-stalks usually very small, often rudimentary; anterolateral margin indistinct, entire. Antennules fold back transversely in an oblique direction. Small commensal or symbiotic crabs, living symbiotically or parasitically in the shells of bivalve molluses, corals, echinoderms, and worm tubes.

In case any difficulty is encountered in identifying any of the representatives of this usually puzzling family, the student should consult Miss Rathbun's very excellent monograph covering them (Bull. U. S. Nat. Mus., 97, 1918). The keys here given have been abstracted from it, as well as the original descriptions of recently discovered forms, several plates, a few notes, and remarks.

KEY TO THE CALIFORNIA GENERA OF THE PINNOTHERIDAE

- I. Ischium of external maxillipeds rudimentary or indistinguishably fused with merus, forming a single piece which sometimes lies transversely but usually obliquely across the buccal cavity; palp not more than half as large as merus-ischium.
- A. Carapace suborbicular or subquadrate, not strikingly wider than long. Ambulatory legs not successively diminishing in length from first to fourth.
1. Carapace without two longitudinal, impressed lines leading back from the middle of upper margin of orbit. Female larger than male and usually ill-calcified. *Pinnotheres*, p. 250.
 2. Carapace with two longitudinal, impressed lines leading back from middle of upper margin of orbit. Male unknown. *Fabia*, p. 253.
- B. Carapace much broader than long, anterior margin nearly straight. Ambulatory legs diminishing in length from first to last, last very small. (Known only from San Pedro.) *Parapinnixa*, p. 255.
- II. Ischium of external maxillipeds usually distinct from merus, though smaller and sometimes imperfectly united with it; palp of good size, usually about as large as merus-ischium. Carapace transverse, usually broadly so.
- A. Carapace much wider than long. Third pair of ambulatory legs the longest.
1. Third pair of ambulatory legs markedly larger and longer than the others. Carapace more or less membranaceous; lower, or true anterolateral margin forming an angle with posterolateral margin. *Pinnixa*, p. 255.
 2. Third pair of ambulatory legs not markedly longer than the others, legs more or less subequal. Carapace hard; lower, or true anterolateral margin curving gradually into posterolateral margin. *Scleroplax*, p. 267.
- B. Carapace very little wider than long; suborbicular. Ambulatory legs more or less subequal, second pair the longest. (Not known north of Monterey Bay.) *Opisthopus*, p. 268.

Genus *Pinnotheres* Latreille

Carapace smooth, more or less membranaceous, sometimes quite hard; suborbicular or pentagonal, scarcely wider than long; sometimes a little longer than wide, without longitudinal sulci behind the orbits. Outer maxillipeds oblique; ischium rudimentary; merus large and usually curved; palp three-jointed; last joint either articulated to inner margin of preceding one, or to its antero-external angle. Ambulatory legs subequal, of moderate length; third pair very little if any longer than the others.

KEY TO THE CALIFORNIA SPECIES OF PINNOTHERES

- I. Palp of outer maxillipeds small, much less than half as large as merus. Carapace wider than long. Dactyls of ambulatory legs falcate, terminating in slender, curved, corneous tips; dactyls of second pair of ambulatory legs the longest. Male unknown. (Known only from the type locality, Pacific Grove.)
holmesi, p. 251.
- II. Palp of outer maxillipeds large, nearly half as large as merus.
- A. Carapace wider than long, though nearly square; with rounded corners; naked. Dactyls of ambulatory legs nearly straight, those of fourth pair of ambulatory legs longer and more slender than the others. Male unknown. (From Monterey and Santa Cruz, not found since these two records were made by Holmes.)
nudus, p. 252.
- B. Carapace as long as or longer than wide. Dactyls of ambulatory legs falcate, terminating in slender, curved, corneous tips; dactyls similar.
concharum, p. 252.

***Pinnotheres holmesi* Rathbun**

Plate 39, figures 7 and 8

?*Pinnotheres nudus* Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 53, fig. 1, 1910; not *P. nudus* Holmes, 1895.

Pinnotheres holmesi Rathbun, Bull. U. S. Nat. Mus., 97, 68, text fig. 31, pl. 15, figs. 1-2, 1918.

Original Description of Female.—Carapace very soft and yielding, broader than long, the front and long antero-lateral margins forming a single arch; postero-lateral margins short, oblique, concave; posterior margin long, concave; greatest width in posterior half; carapace convex, thick, rounding gradually downward, except posteriorly; gastric region defined by a depression. . . . Front between orbits truncate, medially faintly emarginate, orbits partly visible from above.

Carpus of outer maxilliped suboblong; propodus no longer than carpus, and narrower, end obliquely rounded; dactylus linear, of nearly even width throughout, rounded at extremity, inserted near proximal end of propodus and not reaching its distal end.

Chelipeds stouter than [ambulatory] legs, but not very large; lower margin of propodus nearly straight, palmar portion widening rapidly to a point behind base of fingers; fingers stout, hooked at tips, prehensile edges uneven, an acute tooth near base of dactyl.

Relative length of [ambulatory] legs represented by 2, 3, 1, 4, the second longest; 2, 3, and 4 very slender; dactyl 2 much longer than 3 or 4 and curved on both margins, dactyl 3 less curved on anterior and nearly straight on posterior margin, dactyl 4 a trifle longer than 3, margins nearly straight; horny tips of all four very slender and hooked. First leg stout, especially propodus, not reaching middle of propodus of second; propodus widest distal to the middle and narrowest at distal extremity; dactyl shortest of all, conical except for tip.

Abdomen voluminous, much longer and wider than carapace (Rathbun).

Dimensions.—Type, female: length of carapace 7.2 mm.; width 8.7 mm.

Type Locality.—Probably Pacific Grove; known only from a single ovigerous female specimen.

***Pinnotheres nudus* Holmes**

Pinnotheres nudus Holmes, Proc. Calif. Acad. Sci., (2), 4, 563, figs. 1-5, 1894 (1895); Occas. Papers Calif. Acad. Sci., 7, 86, 1900; not *P. nudus* Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 53, fig. 1, except synonymy; Rathbun, Bull. U. S. Nat. Mus., 97, 83, fig. 40, 1918.

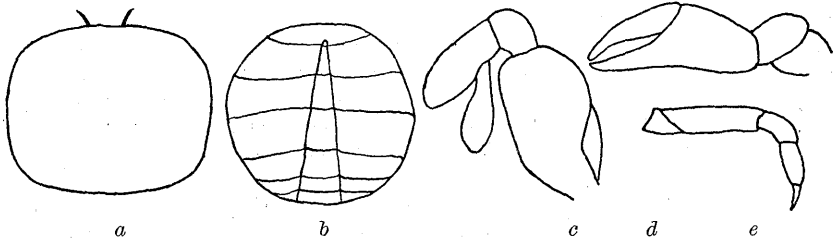


Fig. 149. *Pinnotheres nudus*, ♀, slightly enlarged; *a*, outline of carapace; *b*, outline of abdomen; *c*, outer maxilliped; *d*, left cheliped; *e*, first ambulatory leg (after Holmes, from Rathbun).

Characters.—Carapace a little broader than long, smooth, and naked; front rounded, deflexed, not protruding; orbits ovate. Antennules oblique. Palp of outer maxillipeds nearly half as large as merus. Three anterior pairs of ambulatory legs subequal, fourth pair smaller; dactyls acute, nearly straight, those of the fourth pair relatively longer and more slender than those of preceding legs. Abdomen of female nearly circular in outline, covers entire sternal surface.

Dimensions.—Types, two females: length of carapace 20 mm. and 15.5 mm., width 24 mm. and 19 mm., respectively.

Type Locality.—Santa Cruz, California.

Distribution.—Monterey and Santa Cruz, California (Holmes).

Remarks.—This species has not been found since the records, noted above, were made by Holmes.

***Pinnotheres concharum* (Rathbun)**

Plate 38, figures 1, 2, 3, and 4

Cryptophrys concharum Rathbun, Proc. U. S. Nat. Mus., 16, 250, 1893; Holmes, Occas. Papers Calif. Acad. Sci., 7, 96, 1900; Rathbun, H. A. E., 10, 188, pl. 7, fig. 6, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 60, 1910; Rathbun, Bull. U. S. Nat. Mus., 97, 86, text fig. 42, pl. 20, figs. 3-6, 1918.

Characters.—Carapace subpentagonal, slightly longer than broad, smooth, rigid, a faint sulcus behind the gastric region; anterior and anterolateral margins defined by a ridge of coarse setae, which are thickest and longest at the anterolateral angles; orbits circular. Antennules large, nearly transverse. Palp of outer maxillipeds nearly half as large as merus. Three anterior pairs of ambulatory legs subequal, the second the longest; the fourth pair the shortest, overreaching the carpal joint of the preceding pair; dactyli about as long as the propodi, terminating in slender, curved hooks. Abdomen of male broadest near proximal end of the second segment; first segment short; second, third, and fourth segments coalesced, first two of these fused segments convex on the margin and

separated by a faint line, the last one slightly concave on the margin; fifth and sixth abdominal segments broader than long; terminal segment subrectangular.

Dimensions.—Type, male: length 4.7 mm., width 4.2 mm.

Type Locality.—False Bay, San Diego County, California.

Distribution.—British Columbia to San Diego, California.

Remarks.—Commensal in bivalve mollusks: *Cardita*, *Kellia*, *Donax*, *Mya*, *Mytilus*, and ascidians: *Phallusia*; sometimes free-swimming (Rathbun).

Genus *Fabia* Dana

Carapace smooth, more or less membranaceous, not much wider than long, suborbicular or subquadrate, marked with a pair of longitudinal sulci enclosing the median area. Outer maxillipeds with ischium rudimentary and merus large; palp three-jointed, third joint articulated on the inner margin of the preceding one. Ambulatory legs subequal and rather slender; second pair longest.

KEY TO THE CALIFORNIA SPECIES OF *FABIA*

I. Legs of second ambulatory pair alike.

A. Turned-down front, with a shallow transverse sulcus which is covered with pubescence. Palm of chelipeds widened distally. (Not known south of Laguna Beach.)

subquadrata, p. 253.

B. Front naked, without trace of a transverse groove. Palm of chelipeds not widened distally. (Not known north of San Pedro.)

lowei, p. 254.

II. Legs of second ambulatory pair unlike, the right longer than the left. Front naked, with a short longitudinal median depression. Palm of chelipeds widened distally. (Known only from Monterey.)

canfieldi, p. 254.

Fabia subquadrata (Dana)

Plate 39, figures 1 and 2

Fabia subquadrata Dana, Proc. Acad. Nat. Sci. Phila., 5, 253, 1851; Crust.

U. S. Expl. Exped., 1, 382, 1852, pl. 24, fig. 5, 1915; Holmes, Occas.

Papers Calif. Acad. Sci., 7, 87, 1900 (part).

Raphonotus subquadratus Rathbun, H. A. E., 10, 186, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 55, fig. 2, 1910.

Fabia subquadrata Rathbun, Bull. U. S. Nat. Mus., 97, 102, fig. 53, pl. 24, figs. 1, 3, 1918.

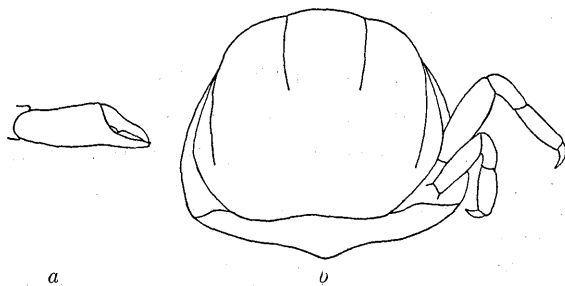


Fig. 150. *Fabia subquadrata*, ♀, $\times 1\frac{3}{4}$; a, chela; b, dorsal view of carapace (after Weymouth).

Characters.—Carapace smooth, glossy, membranaceous, subquadrate in outline, with the angles broadly rounded; the space between the longitudinal sulci is longer than wide and slightly narrowed behind; anterolateral margin rounded and marked by round cluster of pits; front abruptly turned down, with a shallow transverse sulcus covered with pubescence. Antennules obliquely plicated in very wide fossettes. Last joint of outer maxilliped reaches the end of the preceding joint. Palm of chela widens a little distally and is furnished with two rows of hair below, the inner one of which is continued to the end of the immovable finger.

Dimensions.—Type, female: length of carapace 12.2 mm., width 14.3 mm.

Type Locality.—Puget Sound.

Distribution.—Alaska to Laguna Beach, California (Rathbun).

Remarks.—Commensal in bivalve mollusks: *Mya* and *Mytilus* (Rathbun).

***Fabia lowei* Rathbun**

Plate 39, figures 3 and 4

Fabia subquadrata Holmes, Occas. Papers Calif. Acad. Sci., 7, 87, 1900 (part).

Raphonotus lowei Rathbun, H. A. E., 10, 186, text fig. 93, 1904.

Fabia lowei Rathbun, Bull. U. S. Nat. Mus., 97, 104, text fig. 55, pl. 24, figs. 2, 4, 1918.



Fig. 151. *Fabia lowei*, chela, ♀ × 4 (after Rathbun).

Characters.—Very similar to *F. subquadrata*, with carapace a little wider; turned-down front naked, with no trace of a transverse groove. Last joint of outer maxilliped does not reach the end of the preceding joint. Palm of chela, not widening distally, its margins subparallel or a little convex; lower surface with but one line of hair, which is continued to the end of the immovable finger; fingers less arched and less gaping than in *F. subquadrata*.

Dimensions.—Type, female: length of carapace 10 mm., width 12.5 mm.

Color.—In life whitish in color; carapace and abdomen largely orange color (Holmes, as *F. subquadrata*).

Type Locality.—San Pedro Bay, California.

Distribution.—Santa Monica Bay to San Diego, California (Rathbun).

Remarks.—Commensal in bivalve mollusks: *Pholas*, *Pachydesma*, *Modiola* and *Paphia* (Rathbun).

***Fabia canfieldi* Rathbun**

Plate 39, figures 5 and 6

Raphonotus subquadratus Rathbun, H. A. E., 10, 186, 1904 (part: specimen from Monterey).

Fabia canfieldi Rathbun, Bull. U. S. Nat. Mus., 97, 106, text fig. 57, pl. 24, figs. 5 and 7, 1918.

Original Description of Female.—Carapace of unique specimen very soft and so crushed as to be for the most part beyond description. Front devoid of hair and with a short, longitudinal median depression.

Second segment of palp of outer maxilliped very small, shorter, and narrower than first segment, and having the narrow terminal segment attached at about its middle.

As in *F. subquadrata* the palm increases in width to the distal end, the fingers are longer and inclined downward a little, the lower margin of the propodus being more markedly sinuous than in *subquadrata*; fingers not gaping, hairy along inner surface, a prehensile tooth at middle of dactyl and a smaller one at base of propodal finger.

[Ambulatory] legs subcylindrical, naked, relative lengths 2, 3, 1, 4, the second leg on right side one-third longer than on left; first leg stouter than the others; propodites slightly curved, but while having nearly parallel margins they are a trifle stouter at distal end; an exception is that of second right leg, which tapers to distal end; dactyli short, slender, conical, and a little curved up to the hooked, horny tip, except the second of the right side, which is quite straight up to the tip and is also the longest (Rathbun).

Dimensions.—Type, female: "Carapace about 7 mm. wide; approximate length of [ambulatory] legs of second pair, left $8\frac{1}{2}$, right 11 mm." (Rathbun).

Type Locality.—Monterey, California; only a single female specimen known.

Remarks.—Taken from the keyhole limpet, *Lucapina crenulata* (Rathbun).

Genus *Parapinnixa* Holmes

Carapace much broader than long, smooth, and shining; anterior margin nearly straight. Outer maxillipeds with ischium rudimentary, merus large and triangular; palp three-jointed, last joint attached to the tip of the preceding one. First pair of ambulatory legs the largest, the others diminishing successively in length, the last pair being quite small.

Parapinnixa affinis Holmes

Parapinnixa affinis, Holmes, Occas. Papers Calif. Acad. Sci., 7, 95, 1900.

Original Description of Female.—... the carapace is less than twice as wide as long...; the surface of the carapace is smooth and shining and the anterior margin straight. Front triangular, depressed, having a short median groove, Antennules oblique. Buccal area small, triangular, rounded in front, the posterior portion partly covered by a projection of the sternum. Chelipeds stout, smooth; hand thickened, smooth, rounded above and below; dactyl hooked at the tip and armed with a small tooth near the middle of the inner margin, the upper side smooth; pollex [immovable] finger, with two teeth at the tip. First pair of ambulatory legs larger than the others; dactyls short and stout. Next two pairs comparatively slender, having longer dactyls; last pair small, reaching about to the tip of the merus of the preceding pair; dactyls short and stout. Abdomen of the female widest at the third segment, behind which its shape is triangular, the tip broadly rounded (Holmes).

Type Locality.—Deadman Island, San Pedro, California.

Remarks.—This species has not been found since the original specimen was taken and described.

Genus *Pinnixa* White

Carapace much wider than long, more or less membranaceous. Outer maxillipeds with ischium small; merus large, distal portion of outer margin convex; palp three-jointed, jointed to summit of merus; third joint articulated on inner side of preceding one near the base. Third pair of ambulatory legs larger and longer than others, usually considerably so.

KEY TO THE CALIFORNIA SPECIES OF PINNIXA

- I. Dactylus of third ambulatory leg strongly falcate, the corneous tip bent at an angle to the general outline of the segment. Females much larger and softer than the males.
- A. Merus of third ambulatory leg of male more than twice as long as wide. Fingers of female not gaping; immovable finger of male horizontal. Carapace oblong, about one and one-half times as wide as long. (Not known south of San Pedro.)
faba, p. 259.
- B. Merus of third ambulatory leg of male twice as long as wide. Fingers of female gaping; immovable finger of male deflexed. Carapace pointed at sides, about twice as wide as long.
littoralis, p. 260.
- II. Dactylus of third ambulatory leg straight or slightly curved, the corneous tip continuing the general line of the segment.
- A. Fourth ambulatory leg when extended not reaching end of merus of third ambulatory leg; third ambulatory leg enormously large in proportion to body. Carapace very wide, nearly three times as wide as long.
1. Chela stout. Propodus of second ambulatory leg wide. (Not known south of Laguna Beach.)
longipes, p. 257.
2. Chela feeble. Propodus of second ambulatory leg narrow.
tubicola, young, p. 265.
- B. Fourth ambulatory leg when extended reaching end or beyond end of merus of third leg.
1. Propodus of third ambulatory leg about as wide as long.
- a. Carapace of female twice as wide as long. Propodus of last two legs squarish, much wider at distal end than proximal end of dactylus. Male not known. (Not known north of San Clemente Island.)
tomentosa, p. 258.
- b. Carapace of female two and one-half times as wide as long; of male twice as wide as long. Propodus of last two legs tapering at distal end almost to width of proximal end of dactylus.
tubicola, p. 265.
2. Propodus of third leg distinctly longer than wide.
- a. Carapace very convex, sloping from the middle in all directions; slightly more than one and one-half times as wide as long. Chela with immovable finger, thumb, strap-shaped; hand much widened toward distal end; fingers with wide triangular gape. (Not known north of Venice, California.)
barnharti, p. 261.
- b. Carapace more or less flattened, not sloping from the middle in all directions. Immovable finger not strap-shaped but diminishing from base.
- i. Chela with immovable finger markedly deflexed. Carapace about twice as wide as long.
occidentalis, p. 262.

- ii. Chela with immovable finger not deflexed.
 - a. Immovable finger straight or nearly so; lower margin of palm not convex. Carapace about twice as wide as long. (Known only from San Francisco Bay.)
franciscana, p. 263.
 - b. Immovable finger curved upward distally; lower margin of palm convex.
 - i. Carapace more than twice as wide as long; male not known. (Known only from off Catalina Island.)
hiatus, p. 265.
 - ii. Carapace less than twice as wide as long.
 - * Carapace laterally tapering, about one and three-fourths times, more or less, as wide as long. Sides of male abdomen more or less straight, not convex, first segment very wide at base. (Known only from south of San Francisco Bay.)
schmitti, p. 264.
 - ** Carapace laterally subtruncate; about one and two-thirds times as wide as long. Sides of male abdomen more or less straight, not convex, first segment very wide at base. (Known only from Monterey Bay.)
weymouthi, p. 266.

***Pinnixa longipes* (Lockington)**

Tubicola longipes Lockington, Proc. Calif. Acad. Sci., 7, 55, 1876 (1877).

Pinnixa longipes Holmes, Proc. Calif. Acad. Sci., (2), 4, 573, pl. 20, figs. 19-20, 1894 (1895); Occas. Papers Calif. Acad. Sci., 7, 92, 1900; Rathbun, H. A. E., 10, 188, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 58, text fig. 6, 1910; Rathbun, Bull. U. S. Nat. Mus., 97, 137, figs. 80, 81, 1918; Nininger, Jour. Ent. Zool., Pomona Coll., 10, 41, fig. 31, 1918.

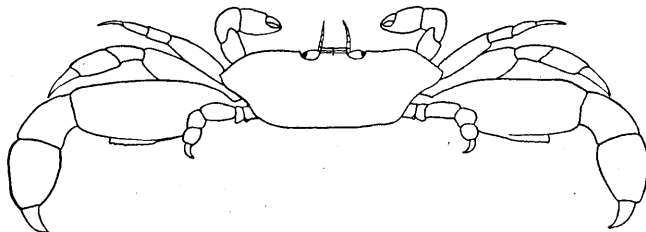


Fig. 152. *Pinnixa longipes* (after Holmes).

Characters.—Carapace considerably more than twice as wide as long, somewhat flattened above, and furnished with a transverse depression behind the gastric area. Chelipeds small, short, hairy; chelae stout, oblong, compressed. First two pairs of ambulatory legs slender, and furnished with slender, nearly straight dactyls which are about equal to the propodi in length; second pair slightly larger than the first; third pair of ambulatory legs enormously developed; merus with a kind of flange on the posterior margin, dactyl stout, somewhat curved, much

shorter than the propodus; last pair of legs small and stout, scarcely reaching beyond middle of merus of preceding pair; dactyl stout, shorter than propodus.

Dimensions.—Type: length of carapace 3.2 mm., width a little less than 6.3 mm., width from claw to claw at fourth pair 19.1 mm.

Type Locality.—Tomales Bay, in tube of annelid.

Distribution.—Tomales Bay to Laguna Beach, California (Rathbun).

Remarks.—The width of *Tubicola longipes* from end to end of the fourth pair of legs is eight [six?] times greater than its length from back to front (Lockington). There is probably no other crab of such great width relatively to its length, there is certainly no known species in which the fourth pair of ambulatory legs is so enormously enlarged, and I believe there is no Brachyuran which exceeds it in diminutiveness; commensal in the tube of an annelid worm, *Clymenella* (Holmes). This very odd looking little crab inhabits the sand tubes of *Clymenella*, which are abundant on the sand bars exposed at low tide near the outlet of Balboa Bay. One or two of the crabs were found in almost every tube examined which contained a worm (Nininger).

Pinnixa tomentosa Lockington

Pinnixa tomentosa Lockington, Proc. Calif. Acad. Sci., 7, 156 (12), 1876 (1877); Holmes, Proc. Calif. Acad. Sci. (2), 4, 568, pl. 20, figs. 11–13, 1894 (1895); Rathbun, Bull. U. S. Nat. Mus., 97, 141, text figs. 85, 86, pl. 30, fig. 8, 1918.

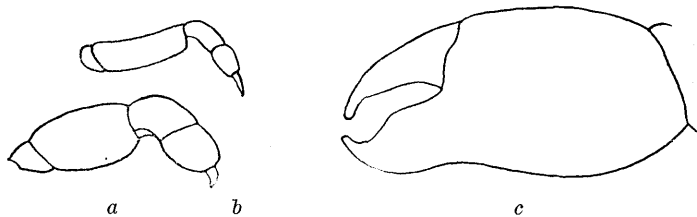


Fig. 153. *Pinnixa tomentosa*, ♀, enlarged; a, third ambulatory leg; b, first ambulatory leg; c, chela (after Holmes).

Characters.—Female (from Rathbun): Carapace and legs covered with a short pubescence. Carapace nearly twice as wide as long, smooth, and rounding down to margins; a shallow depression behind gastric region; cardiac region swollen but not ridged. A transverse depression just behind margin of front; antero-lateral margin marked by a granulated line on the branchial region.

Hand oblong, compressed, margins convex, the lower concave near the thumb. Fingers little over half length of palm, toothless; thumb wide, but abruptly narrowed near hooked tip; dactyl curved, subuncinate at apex, no longer than thumb. (Chela after Holmes.)

First [ambulatory] leg much more slender and shorter than second; second leg nearly as long as third and less stout, its propodus tapering distally; first and second dactyls slender, slightly curved, third and fourth dactyls stout, short, and more curved but not hooked; third [ambulatory] leg very wide, merus a little more than one and one-half times as long as wide, propodus nearly square; fourth [ambulatory] leg similar in shape but much smaller.

Dimensions.—Type, female: length of carapace 7.5 mm., width of same 14 mm.

Type Locality.—Angeles Bay, Gulf of California.

Distribution.—San Clemente Island, California, to Angeles Bay, Gulf of California (Rathbun).

***Pinnixa faba* (Dana)**

Plate 40, figures 1, 2, 3, and 4

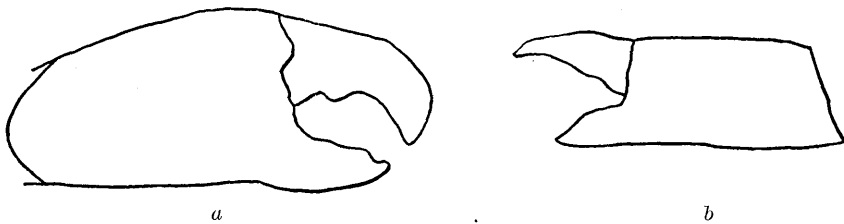
Pinnotheres faba Dana, Proc. Acad. Nat. Sci. Phila., 5, 253, 1851; Crust. U. S. Expl. Exped., 1, 381, 1852, pl. 24, fig. 4, 1855.*Pinnixa faba* Holmes, Occas. Papers Calif. Acad. Sci., 7, 93, 1900; Rathbun, H. A. E., 10, 188, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 59, text fig. 7, 1910 (part: specimen from Monterey Bay); Rathbun, Bull. U. S. Nat. Mus., 97, 142, text figs. 27, 88, pl. 31, figs. 1-4, 1918.

Fig. 154. *Pinnixa faba*, $\times 6$; a, right chela of σ ; b, left chela of ρ (after Rathbun).

Characters.—Carapace about one and a half times as wide as long, oblong, strongly convex, both longitudinally and transversely, truncated at the sides. In some males the anterolateral angle is vertically compressed and correspondingly thin, forming a laterally projecting lobe; no transverse ridge behind the gastric area; anterolateral margins marked by a low ridge, which disappears near the orbits; orbits oval. Hands of chelipeds flattened, widest just behind the articulation of dactyl; more or less pubescent on inner side between the fingers; fingers of female not gaping; immovable finger of male horizontal. Merus of third pair of ambulatory legs of male more than twice as long as wide.

Dimensions.—Type, female: length of carapace 11.7 mm., width 17 mm.

Color.—Dark or light brown, or brownish red, with hand coarsely dotted with color (Dana). Specimens in formalin: General color of females orange rufous with patches of scarlet on the gastric regions. Eggs orange chrome. Male, orange rufous, or dirty greenish-white, with orange rufous spots on carapace and a few of the same on chelipeds and legs. One female from Taylor Bay, British Columbia, was entirely white in life (Rathbun).

Type locality.—Puget Sound.

Distribution.—From Prince of Wales Island, Alaska, to Humboldt Bay, California (Rathbun). San Pedro, California (Holmes).

Remarks.—Commensal in bivalve mollusks: *Schizothaerus*, *Saxidomus*, *Mya*, *Paphia* (Rathbun); and cloaca of large holothurian, *Molpadia* (Holmes). Miss Rathbun, however, thinks Holmes's specimen may have been *P. barnharti*.

***Pinnixa littoralis* Holmes**

Plate 40, figures 5, 6, 7, and 8

Pinnixa littoralis Holmes, Proc. Calif. Acad. Sci., (2), 4, 571, pl. 20, figs. 14-16, 1894 (1895); Occas. Papers Calif. Acad. Sci., 7, 91, 1900; Rathbun, H. A. E., 10, 188, 1904; Weymouth, Stanford Univ. Publ. Univ. Ser., no. 4, 58, 1910 (part: except fig. 5 and specimens from Puget Sound); Way, Puget Sd. Mar. Sta. Publ., 1, 362, fig. 14, 1917; Rathbun, Bull. U. S. Nat. Mus., 97, 145, text figs. 89, 90, pl. 31, figs. 5-8, 1918; Nininger, Jour. Ent. Zool., Pomona Coll., 10, 41, fig. 32, 1918.

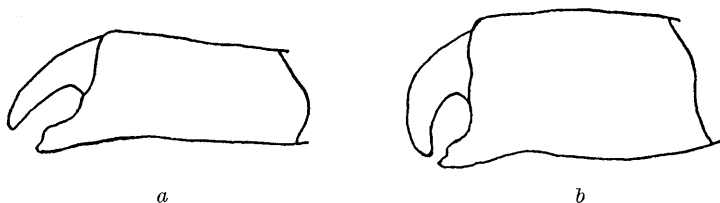


Fig. 155. *Pinnixa littoralis*, $\times 6$; a, left chela, ♀; b, left chela, ♂ (after Rathbun).

Characters.—Carapace about twice as long as wide, pointed at sides, flattened above; a transverse depression behind the median region followed by a transverse intumescence; orbits pointed at outer angle. Hands of chelipeds compressed, oblong but widening a little distally; fingers of female gaping; immovable finger of male deflexed. Immature females as well as immature males have chelae usually resembling those of adult males, that is, with the fingers widely gaping, thumb short, and dactyl strongly curved. Merus of third pair of ambulatory legs of male twice as long as wide.

Dimensions.—Type, length of carapace 4.5 mm., width 9.5 mm.

Color.—Regarding this species, Miss Rathbun remarks that it . . . can be distinguished from *P. faba* by the constantly different color. In formalin the carapace and appendages of female have a light greenish yellow ground, with large blotches of coral red on anterior half. Eggs orange-vermilion, sometimes chestnut. First three ambulatory legs with a rufous band which embraces the propodus and part of the carpus. Male light dirty greenish-white, with bands on legs like those of female.

A pair from near the station at Departure Bay [Vancouver Island] are said by Doctor Fraser to be yellow (in place of coral red), with a band of dull salmon on the legs.

Miss Way gives the color as grayish white, often with brownish-tipped walking legs.

Type Locality.—Bodega Bay, California.

Distribution.—Sitka, Alaska, to San Diego, California.

Remarks.—Some of the specimens were found in the holes of the common clam, *Mya*, others were picked up on the shore (Holmes). Of five hundred specimens taken by Fraser, the adults with few exceptions inhabited the giant clam, *Schizothaerus*, while all the young of both sexes were taken from the small clam, *Mya*. Has also been found in *Saxidomus*, *Macoma*, and *Paphia* (Rathbun). The only specimen recorded from Balboa Bay was found clinging to the outside of the slime tube of *Cerianthus* (Nininger).

Biological Survey of San Francisco Bay.—*Pinnixa littoralis* is represented in the collection by a single immature female specimen taken from a clam dredged at D 5709 (middle bay) in 10 to 12½ fathoms on "muddy sand." For this station the annual mean temperature is 13.05° C with an annual range of 7.8° to 18.0° C; the mean salinity 24.39, range 15.2 to 30.1. One specimen of *Pinnixa franciscana* was also taken at this station.

Pinnixa barnharti Rathbun

Plate 41

Pinnixa tumida Streets, Bull. U. S. Nat. Mus., 7, 115, 1877; not *P. tumida* Stimpson, 1858.

Pinnixa faba Rathbun, H. A. E., 10, 188, 1904 (part: specimen from San Pedro).

Pinnixa barnharti Rathbun, Bull. U. S. Nat. Mus., 97, 149, text fig. 91, pl. 32, 1918.

Original Description of Female.—Carapace hexagonal, very convex in both directions, sides truncate, antero-lateral margin a line of very fine granules not continued to hepatic region, side walls vertical, subhepatic region prominent, surface coarsely punctate toward the sides, furrow behind gastric region shallow, three deep pits on each side anteriorly, posterior margin very concave. Lobes of front prominent and arcuate, viewed from above. Orbits broadly oval, filled by the eyes. Antenna as long as width of front and one orbit.

Chelipeds large; chelae rhomboidal, increasing greatly toward fingers, a sinus in lower margin near base of thumb; thumb subhorizontal, a little curved or convex beneath, of nearly equal width throughout, tip obliquely truncate, lower corner armed with a short, sharp tooth, which is crossed by the sharp tip of the dactylus; dactylus oblique, making a large triangular gape with the thumb; a strong tooth at middle of dactylus, a fringe of hair above; a patch of long hair in the gape.

Merus of cheliped and [ambulatory] legs hairy above; merus and propodus of last two legs hairy below, carpus and propodus of last leg hairy above. [Ambulatory] legs thick, first nearly as long as second, but narrower, second reaching to dactylus of third, fourth to middle of carpus of third; merus of last 3 legs convex above, propodus of all tapering, dactylus short, nearly straight, broad at base, acuminate. (Rathbun.)

Dimensions.—Type, female: length of carapace 10.7 mm., width 16.2 mm.

Color.—The carapace in alcohol is largely a bluish purple; a few patches of same color on chelipeds and first three legs (Rathbun).

Type Locality.—Venice, California; from cloaca of "sea cucumber" (holothurian).

Distribution.—From Venice, California, to Ballenas Bay, Lower California (Rathbun).

Remarks.—"Chela of male very like that of female except palm a little shorter; in small but mature female, palm is still shorter.... Commensal with holothurians, *Molpadia*" (Rathbun).

***Pinnixa occidentalis* Rathbun**

Plate 42, figures 5 and 6

Pinnixa occidentalis Rathbun, Proc. U. S. Nat. Mus., 16, 248, 1893 (part: except specimen from San Diego); Holmes, Occas. Papers Calif. Acad. Sci., 7, 89, 1900; Rathbun, H. A. E., 10, 187, pl. 7, fig. 4, pl. 9, figs. 6, 6a, 1904 (part: except specimens from Cape Fox); Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, text fig. 3, 1910; Rathbun, Bull. U. S. Nat. Mus., 97, 155, text fig. 96, pl. 34, fig. 1, 1918.

Pinnixa californiensis Rathbun, Proc. U. S. Nat. Mus., 16, 249, 1893; Holmes, Occas. Papers Calif. Acad. Sci., 7, 90, 1900; Rathbun, H. A. E., 10, 187, pl. 7, fig. 3, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 56, 1910 (part: except young female from Pacific Grove).



Fig. 156. *Pinnixa occidentalis*, ♂; a, dorsal view, $\times 1\frac{1}{3}$; b, chela, $\times 3\frac{1}{2}$ (after Rathbun).

Characters.—Carapace more or less uneven, about twice as wide as long, occasionally a little more or a little less, with a single bilobed cardiac crest, anterolateral margin marked by a sharp, more or less granulated ridge running from the orbit diagonally outward and backward, crossing the hepatic region, and forming the anterolateral margin of the carapace. Chelipeds stout, setose; palm broad, flat, shining on outside, immovable finger short, markedly deflexed, prehensile edge with a stout tooth in the middle and a small one near the tip; movable finger much curved, sometimes with a tooth in the middle. Ambulatory legs setose; first pair shorter than the chelipeds, weak; second pair longer and stronger than the first; third pair very long and strong, especially the merus, propodus longer than wide; fourth pair intermediate in length between the first and second; dactyli as long as the propodi.

Dimensions.—Type, male: length of carapace 9.5 mm., width 19.5 mm.; female: length of carapace 10.5 mm., width 20.5 mm.

Type Locality.—South of Unimak Island, Alaska.

Distribution.—Unalaska to Magdalena Bay, Lower California. Shallow water to 238 fathoms.

Remarks.—Cardiac ridge blunter in female than in male, immovable finger longer, third ambulatory leg shorter and wider, about two and one-half times as long as wide. Specimens vary in the proportion of length to width of carapace, in the prominence of cardiac ridge, in the direction of the margins of the second abdominal segment of the male, in the length of the immovable finger of the male (Rathbun). Commensal in the burrows of the gephyrean worm *Echiurus* (Kincaid, from Rathbun).

Biological Survey of San Francisco Bay.—*Pinnixa occidentalis* was only taken outside the bay at three stations, D 5785, 5788, and 5789,

at depths between 33 and 68 fathoms. The bottom in all three cases was "very fine, green sand." The range of temperature (bottom) 9.3° to 9.8°C; range of salinity, 34.2 to 34.3.

Pinnixa franciscana Rathbun

Plate 42, figures 1, 2, 3, and 4

Pinnixa franciscana Rathbun, Bull. U. S. Nat. Mus., 97, 161, text fig. 100, pl. 35, figs. 1-4, 1918.

Original Description of Female.—Near *P. occidentalis*, but carapace smoother, cardiac ridge blunt and straight. Propodus of cheliped small, upper edge convex, densely granulate, lower margin straight from near the wrist to end of finger; outer surface with a granulate ridge just above lower edge, continued to end of finger and fringed above with hair, also a line of granules through the middle, and two lines of punctae and hairs on upper half. Fingers wide, not gaping, tips crossing, a wide triangular tooth at middle of dactylus, a similar tooth on distal half of fixed finger. First [ambulatory] leg reaches nearly to middle of dactylus of second, second nearly to end of third, fourth to middle of carpus of third; merus of third leg one and two-thirds times as long as wide, distally narrow (Rathbun).

Dimensions.—Type, female: length of carapace 5.7 mm.; width 11 mm.; length of third leg about 12 mm.

Type Locality.—San Francisco Bay, California, 10 to 12½ fathoms ("Albatross" station D 5709).

Distribution.—San Francisco Bay, California (see below, Biological Survey San Francisco Bay).

Remarks.—Male differs from female in sharpness of cardiac ridge. Cardiac ridge in female may be somewhat sharp, as in female, station [D] 5743. The merus of second [ambulatory] leg is very slender in the young female and increases proportionally more rapidly in width than the body in size. Cheliped of male not known (Rathbun).

Biological Survey of San Francisco Bay.—*Pinnixa franciscana* has been found only in San Francisco Bay, where it was taken at seven of the dredging stations (D 5709, 5715, 5723, 5743, 5772, 5824, 5825), from off Point San Pedro in the upper bay to off the Mission Rock in the lower bay, and ranging from 1¼ to 15½ fathoms in depth (see plate 9). One specimen was taken at all but one station (D 5825), located about halfway between Angel Island and the Southampton Shoal Light, where six were obtained. The bottom in all cases was more or less sandy mud accompanied in at least two cases with numerous worm tubes, the probable habitat of this species. The lowest and highest annual mean temperatures and salinities for the stations at which *P. franciscana* was taken, given here in view of its apparently sedentary habits, range respectively from 12.0° to 13.3° C, and from 24.4 to 31.0.

***Pinnixa schmitti* Rathbun**

Plate 42, figures 7, 8, and 9

Pinnixa occidentalis Rathbun, H. A. E., 10, 187, 1904 (part: specimens from Cape Fox).*Pinnixa schmitti* Rathbun, Bull. U. S. Nat. Mus., 97, 162, text fig. 101, pl. 35, figs. 6, 7 and 9, 1918.Fig. 157. *Pinnixa schmitti*, chela, ♂, × 7 (after Rathbun).

Original Description of Female.—Like *franciscana* but carapace more oblong, as sides are less pointed and anterolateral marginate crest is more prominent. Cardiac ridge obsolescent, broad and smoothly rounded; from a point behind each extremity, a smooth ridge curves forward to the anterior branchial angle, widening distally. Palm swollen, upper and lower margins convex, the latter becoming slightly concave under base of finger, which last inclines upward distally; outer and upper surfaces granulate, granules thinnest in middle, forming a line near lower edge, especially of finger, but very different from sharp, raised line in *franciscana*, prehensile edges of fingers meeting, sinuous. Relative lengths of [ambulatory] legs as much as in *franciscana*, but merus of third [ambulatory] leg less dilated, twice as long as wide, margins granulate, as also of the propodus (Rathbun).

Dimensions.—Type, female: length of carapace 5 mm., width 8.5 mm., length of third ambulatory leg about 9.7 mm. A male specimen: length of carapace 5 mm., width 9.2 mm., length of third ambulatory leg about 10 mm.

Type Locality.—San Francisco Bay, California, 9½ to 11 fathoms ("Albatross" station D 5723).

Distribution.—Port Levasheff, Unalaska, Alaska, to San Francisco Bay, California; 7 to 80 fathoms (Rathbun).

Remarks.—In the fully developed male the chela is much higher in proportion to its length than in the female, its margins straighter, surface non-granulate, the thumb very short, the dactylus bent in an obliquely vertical direction, prehensile edges each obscurely bidentate. Abdomen suboblong, its sides slightly convex.

There are males in which the chelae are similar to those of the female, that is, swollen, granulate, thumb only a little shorter than dactylus; they differ from those of the female in being more swollen and dactylus shorter.

There is some variation (1) in the width of the legs, but as they are of the same general shape I am disposed to think that the specimens listed below are all of one species; (2) in the length and prominence of the granulate, anterolateral ridge; (3) in the inequalities of the dorsal surface of the carapace (Rathbun).

Biological Survey of San Francisco Bay.—This species was taken only within the bay at five stations (D 5706, 5715, 5718, 5723, 5825), having approximately the same range as those at which *P. franciscana* was taken: from off Point San Pedro in the upper bay, to off Mission Rock in the lower bay (see plate 9). Although only one specimen was taken at each station, the center of greatest abundance like that

of the preceding species, is about halfway between Angel Island and the Southampton Shoal light, where three of the hauls lie in close proximity to one another (D 5706, 5718, 5825). At one of these (D 5825) as well as at its only upper (D 5715) and lower bay (D 5723) stations, it was taken in company with *P. franciscana* and like it was found on bottom of the same general character; and it apparently has the same habits, for at two of the stations numerous worm tubes were brought up. The annual mean temperature and salinities, which range respectively from 12.7° to 13.3° C, and from 25.3 to 29.6, correspond very closely to those given for *P. franciscana*.

Pinnixa hiatus Rathbun

Plate 43, figures 1, 2, 3, and 4

Pinnixa hiatus Rathbun, Bull. U. S. Nat. Mus., 97, 164, text fig. 102, pl. 36, figs. 1-4, 1918.

Original Description of Female.—Carapace very wide, narrowed at sides, anterolateral margin arcuate without a definite angle and marked by a raised and finely granulate edge up to hepatic region; posterior margin very long and straight; front advanced, widely emarginate in dorsal view. Surface smooth, sparingly punctate, a groove behind gastric region. Subhepatic region prominent. Orbits oval, filled by eyes.

Palm suboblong, upper margin convex, lower margin of palm and thumb sinuous, a granulated ridge on distal half just above lower edge. A corresponding ridge on dactylus. Thumb definitely shorter than dactylus and curving up toward it, extremity obliquely notched by means of a tuberculiform tooth. Dactylus curved, a tooth just behind middle; a wide gape when fingers are closed.

Merus of first [ambulatory] leg slender, of other legs narrowed at distal end; carpus of all legs longer than propodus; propodus tapering distally, but wider at end than adjoining end of dactyl; dactyls styliform, more slender in first and second pairs; in third pair, the anterior edge of merus and posterior edge of propodus is finely saw-toothed, posterior edge of merus more coarsely granulate, anterior edge of dactylus spinulose. Posterior margin of merus of second leg finely granulate. Posterior margin of third leg and both margins of last leg fringed with hair (Rathbun).

Dimensions.—Type, female: length of carapace 3.6 mm., width 7.7 mm.

Type Locality.—Off Santa Catalina Island, California; 50 fathoms; known only from a single female specimen.

Pinnixa tubicola Holmes

Plate 43, figures 5, 6, 7, and 8

Pinnixa tubicola Holmes, Proc. Calif. Acad. Sci., (2), 4, 569, pl. 20, figs. 17-18, 1894 (1895); Occas. Papers Calif. Acad. Sci., 7, 91, 1900; Rathbun, H. A. E., 10, 187, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 57, text fig. 4, 1910; Way, Puget Sd. Mar. Sta. Publ., 1, 361, fig. 13, 1917; Rathbun, Bull. U. S. Nat. Mus., 97, 165, fig. 103, pl. 36, figs. 5-8, 1918.

Characters.—General form subcylindrical. Carapace about two and one-half times as wide as long in the female, and twice as broad as long in the male; a shallow, transverse depression behind the gastric region which is a convex

(not crested) transverse intumescence, from which the carapace curves sharply downward toward the broad, slightly concave posterior margin; outer portion of anterolateral margin defined by a ridge. Chelipeds rather small; hand oblong, longer than the preceding joints combined, fingers hooked at the tips, their inner margins meeting when closed; immovable finger not deflexed, but curved upward distally; lower margin of palm convex. First pair of ambulatory legs slender with slender dactyls about equaling propodi in length; second pair much longer and stouter than first pair with relatively stouter dactyls, slightly shorter than their propodi; third pair stouter and a little longer than the second and furnished with shorter and stouter dactyls, dactyls markedly shorter than propodi, propodi about as long as wide; fourth pair of ambulatory legs similar to but much shorter than third, reaching, however, but not exceeding the end of the merus of the third pair.

Dimensions.—Type: length of carapace 4 mm., width 10 mm.

Color.—Golden brown with spots of bluish gray on dorsal surface; much lighter and of uniform color on ventral surface (Way).

Type Locality.—Trinidad, Cape Mendocino, California.

Distribution.—From Puget Sound to San Diego, California (Rathbun).

Remarks.—In calcareous tube of worm, Trinidad, California (Holmes), and in tubes of *Amphitrite* (Way, from Rathbun).

Pinnixa weymouthi Rathbun

Plate 43, figures 9 and 10

Pinnixa californiensis Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 56, 1910 (part: young female from Pacific Grove).

Pinnixa faba Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 59, fig. 7 (part: not synonymy).

Pinnixa weymouthi Rathbun, Bull. U. S. Nat. Mus., 97, 166, text fig. 104, pl. 36, figs. 9 and 10, 1918.

Original Description of Male.—Carapace smooth; cardiac region a transverse rounded elevation; sides subtruncate, anterolateral angles rather prominent; front deflexed, advanced; anterolateral margin sharp, from hepatic region backward; posterior margin little wider than base of abdomen.

Chelae pubescent; upper and lower margins of manus convex; fingers subconical, horizontal, curving toward each other near tips, edges sinuous, meeting, tips crossing.

[Ambulatory] legs pubescent, especially last two segments, propodi convex on both margins; first leg narrow, propodus no longer than wide, dactylus long and nearly straight; second leg wider, but similar, reaching end of propodus of third leg; third leg wide, dactylus slightly curved; fourth leg similar but smaller, reaching middle of carpus of third.

Abdomen with first segment very wide at base, its sides very oblique; second to sixth segment gradually diminishing, sixth constricted at middle; seventh short, margin broadly rounded (Rathbun).

Description of Female.—The female referred to here is about the same size as the male but has a thin shell, so that its shape is not well defined. Front less advanced and anterolateral margin less sharply marked than in male. Chelae not pubescent outside, similar in shape to those of male, except that the thumb is a little shorter. [Ambulatory] legs are as in male (Rathbun).

Dimensions.—Type, male: length of carapace 3.3 mm.; width 5.3 mm.

Type Locality.—Monterey Bay, California; 5 fathoms.

Distribution.—Monterey Bay, California; beach to 5 fathoms (1 male, off Monterey Wharf, 5 fathoms; 1 ovigerous female, Third Beach, Pacific Grove, free on the beach) (Rathbun).

Remarks.—

Related to *P. tubicola*, *schmitti*, and *hiatus*, all of which have smooth carapaces, swollen palms, and nearly straight dactyli of the legs; *weymouthi* is narrower, its sides truncated, and antero-lateral angle more prominent. The male abdomen of *tubicola* is more triangular, that of *schmitti* has more convex margins than in *weymouthi* (Rathbun).

Genus **Scleroplax** Rathbun

Carapace transverse, hard. Outer maxillipeds with ischium rudimentary; merus longer than broad, oblique, not curved, winged on the margins; palp three-jointed; last joint articulated near the proximal end of the inner margin of the preceding one. Ambulatory legs similar in character, slender; third pair the longest, but slightly exceeding the others.

Scleroplax granulata Rathbun

Plate 44, figures 1, 2, and 3

Scleroplax granulata Rathbun, Proc. U. S. Nat. Mus., 16, 251, 1893.

Pinnixa (Scleroplax) granulata Holmes, Occas. Papers Calif. Acad. Sci., 7, 94, 1900.

Scleroplax granulata Rathbun, H. A. E., 10, 188, pl. 7, fig. 5, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 59, text fig. 8, 1910; Way, Puget Sd. Mar. Sta. Publ., 1, 362, fig. 15, 1917; Rathbun, Bull. U. S. Nat. Mus., 97, 171, text fig. 109, pl. 37, figs. 1-3, 1918.

Characters.—Carapace subpentagonal, hard, granulate anteriorly and near the margins, punctate elsewhere; a granulated ridge defines the lateral margin; front narrow, produced, slightly convex as seen from above; orbits nearly circular, eye-stalks very short and thick; antennules almost transverse. Ambulatory legs slender, granulate, the third pair longest, the second longer than the first, the first pair weakest; the joints narrow, flattened; the dactyls very slender, almost straight, and equal the propodal joints in length. Abdomen of male narrow, tapering very gradually to the broad terminal segment; third, fourth, and fifth segments partially anchylosed; abdomen of female very smooth and shining, fringed with hair, not reaching beyond the sternum.

Dimensions.—Type, female: length of carapace 6 mm., width 8 mm.

Color.—Grayish white, very much darker after moultings (Way).

Type Locality.—Ensenada, Lower California.

Distribution.—Puget Sound, to Ensenada, Lower California (Rathbun).

Remarks.—Has been taken from the shell of *Mya* (Rathbun).

Biological Survey of San Francisco Bay.—Only one specimen of *Scleroplax granulata* was taken and that in the middle bay (D 5775) in company with *Crago munitella*, in 4 to 7 fathoms. The bottom was composed of "large and small angular rock fragments;" annual mean temperature 12.01° C, range 8.7° to 14.3° C; salinity, mean 31.04, range 26.6 to 33.3.

Genus *Opisthopus* Rathbun

Carapace usually firm and unyielding, smooth, subquadrilateral or suborbicular; regions not defined, lateral margins regularly arcuated. Outer maxillipeds with ischium well developed, merus broad; palp three-jointed, last joint articulated on the inner side of the preceding one. Ambulatory legs subequal in length, joints flattened.

Opisthopus transversus Rathbun

Plate 44, figures 4 and 5

Opisthopus transversus Rathbun, Proc. U. S. Nat. Mus., 16, 252, 1893; Holmes, Occas. Papers Calif. Acad. Sci., 7, 97, 1900; Rathbun, H. A. E., 10, 188, text fig. 95, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 61, text fig. 9, 1910; Rathbun, Bull. U. S. Nat. Mus., 97, 173, text fig. 110, pl. 37, figs. 4, 5, 1918; Nininger, Jour. Ent. Zool., Pomona Coll., 10, 36, fig. 8, 1918.

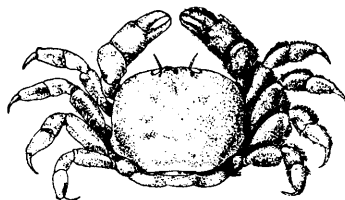


Fig. 158. *Opisthopus transversus*, ♀, dorsal view, $\times 1\frac{1}{2}$ (from Rathbun, U. S. N. M.).

Characters.—Carapace transverse, convex, thin but not soft and yielding; angles rounded; front deflexed, almost straight when seen from above, with a slight median sulcus; antennules well developed, lodged in deep, diagonal fossae. Ambulatory legs similar in character; joints rather broad, except the dactyls, which are curved and small, a little more than half the length of the propodal joints; second pair of legs the longest, fourth pair the shortest, reaching midway of the propodal joint of the preceding pair. Abdomen of male narrow at base, tapering regularly from the third to the terminal joint or telson, which is subquadrilateral; abdomen of female very wide and long, almost covering the maxillipeds. The female may reach maturity while its abdomen is still as narrow as that of the male.

Dimensions.—Type, female: length of carapace 14 mm., width 18 mm.; male: length of carapace 8.5 mm., width 9.8 mm.

Color.—Carapace richly spotted with vermilion to deep red, polished almost to pearly smoothness (Nininger).

Type Locality.—Monterey, California.

Distribution.—Monterey to San Diego, California (Rathbun).

Remarks.—Found in *Lucapina crenulata*, the large keyhole limpet; in siphon of *Pholas*, the rock-boring mollusk; in mantle cavity of the mussel, *Mytilus edulis*; and in the common holothurian, *Stichopus californicus* (Rathbun). Mr. E. P. Chace, of Los Angeles, recently took a female specimen from the gill chamber of a univalve mollusk, *Astraea undosa*, and numerous others of both sexes from the shells of *Schizothaerus*.

Family GRAPSIDAE

Carapace quadrate, flattened, or moderately convex; lateral margins straight and parallel or slightly arcuate, frequently toothed; front never very narrow, in general decidedly broad; orbits and eye-stalks of moderate size. Antennules folding back transversely or obliquely. Third maxillipeds with more or less of a gape left between them.

KEY TO THE CALIFORNIA GENERA OF THE GRAPSIDAE

- I. Carapace as long as or longer than broad, suborbicular, smooth. Anterior edges of ambulatory legs with a thick, dense fringe of hair. Pelagic crabs, usually found on floating seaweed in the open ocean.
Planes, p. 272.
- II. Carapace considerably broader than long. Anterior edges of ambulatory legs if hairy only sparsely so, never with a dense fringe. Littoral crabs found on mud flats or among rocks along shore.
- A. Carapace transversely striated. External maxillipeds with a wide rhomboidal gape between them.
1. Orbits normal, deep, and concave.
Pachygrapsus, p. 269.
2. Orbits not normal, with posterior surface bulging outward, convex instead of concave. (Only one specimen known, from San Diego.)
Grapsodius, p. 276.
- B. Carapace more or less smooth. External maxillipeds only moderately gaping.
Hemigrapsus, p. 272.

Genus *Pachygrapsus* Randall

Carapace marked with transverse striae; anterolateral margins entire, or with one or two teeth. Outer maxillipeds with a wide rhomboidal gape between them; merus as broad as or broader than long, distally truncated, and bearing the palp at its summit. Abdomen of male covers the sternum at its base.

KEY TO THE CALIFORNIA SPECIES OF *PACHYGRAPSUS*

- I. Merus of last pair of ambulatory legs with two or three sharply distinct teeth at posterodistal angle. Frontal (interorbital) margin distinctly sinuous in frontal aspect. Lateral margins of carapace converging posteriorly from the lateral tooth.
transversus, p. 271.
- II. Merus of last pair of ambulatory legs with posterodistal angle inconspicuously denticulate or entire. Frontal (interorbital) margin practically straight in frontal aspect. Lateral margins of carapace strongly arcuate.
crassipes, p. 270.

Pachygrapsus crassipes Randall

Plate 45

Pachygrapsus crassipes Randall, Jour. Acad. Nat. Sci. Phila., 8, 126, pl. 5, fig. 4, 1839; deMan, Notes Leyden Mus., 12, 86, pl. 5, fig. 11, 1890; Holmes, Occas. Papers Calif. Acad. Sci., 7, 79, 1900; Rathbun, H. A. E., 10, 189, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 61, pl. 13, fig. 41, 1910; Baker, Rept. Laguna Mar. Lab., 1, 102, 1912; Rathbun, Bull. U. S. Nat. Mus., 97, 241, pl. 59, 1918.

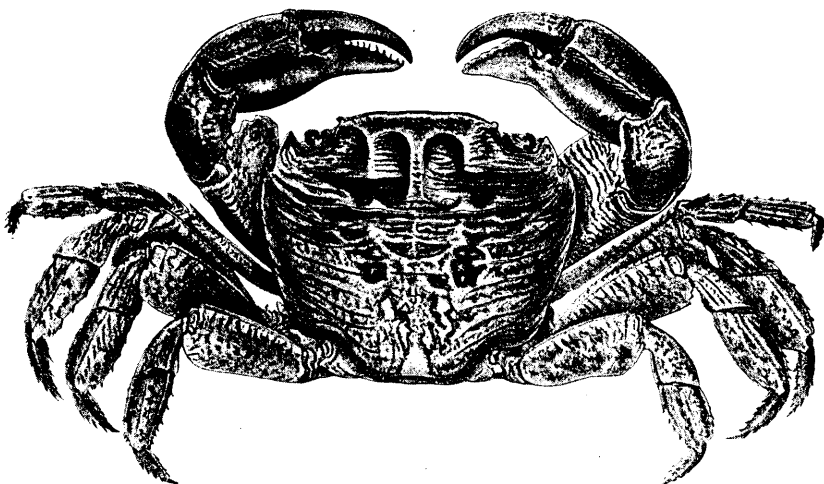


Fig. 159. *Pachygrapsus crassipes* (after deMan).

Characters.—Carapace nearly square, moderately convex; lateral margins strongly arcuate; entire upper surface except cardiac and intestinal regions transversely striated; frontal (interorbital) margin practically straight in frontal aspect; sides with a single tooth behind the prominent postorbital. Outer maxillipeds with merus quite strongly produced at antero-internal angle. Hand of adult male larger than all the preceding joints combined, a raised line usually present on the upper side of the palm and a delicate line on the lower portion of the outer surface. Merus of last pair of ambulatory legs with postero-distal angle entire.

Dimensions.—Type, male: length of carapace about 40.6 mm., width between 43.2 and 45.7 mm. Carapace of Bay specimens ranged from 7 to 38 mm. in width, the greater number measuring about 25 mm. across.

Color.—General color in life a very dark red with a variable amount of whitish color, which is sometimes almost entirely absent and again gives to the whole a light shade. A line of the light color is usually present in front of each of the striae of the carapace, and spots of it in the intestinal and cardiac regions. The ambulatory legs are similar in color to the carapace, the chelipeds are generally tan colored, veined with red. The thin cuticle at the joints is a livid green (Weymouth).

Type Locality.—Sandwich Islands (doubtful).

Distribution.—From Oregon to Gulf of California; Japan; Korea. The locality given by Randall, the Sandwich Islands, is too doubtful to be relied upon (Rathbun).

Remarks.—This is the very abundant shore crab which is so common scuttling over the stones of the higher beach. It sometimes contains a large parasitic isopod in its branchial cavities (Baker).

Biological Survey of San Francisco Bay.—*Pachygrapsus crassipes* also proved to be a strictly littoral species, apparently less abundant and less widely distributed than *Hemigrapsus nudus*. Seven specimens were collected among the rocks at Point Bonita, and one each, on the Presidio shore, at Sausalito, and on Red Rock.

Pachygrapsus transversus (Gibbes)

Grapsus transversus Gibbes, Proc. Amer. Assoc. Adv. Sci., 3, 181, 1850.

Goniograpsus innotatus Dana, Crust. U. S. Expl. Exped., pt. 1, p. 345, 1852, pl. 21, fig. 9, 1855.

Pachygrapsus transversus Rathbun, H. A. E., 10, 189, 1904; Proc. U. S. Nat. Mus., 28, 548, pl. 46, fig. 3, 1910; Bull. U. S. Nat. Mus., 97, 244, pl. 61, figs. 2, 3, 1918.

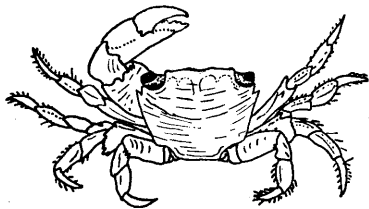


Fig. 160. *Pachygrapsus transversus*, ♂, $\times \frac{1}{2}$, right cheliped omitted (after Dana).

Characters.—Carapace about one-third broader than long, lateral margins quite strongly convergent posteriorly from the last lateral tooth; upper surface transversely striated, most distinctly so anteriorly, becoming obsolete posteriorly; several of the striae converge toward the lateral tooth on each side; sides with a well marked tooth behind the postorbital; frontal (interorbital) margin distinctly sinuous in frontal aspect. Hands smooth or finely granulate, with a raised, sometimes obsolete line on the upper margin, and another on the outer surface, near the lower edge, running to the tip of the immovable finger. Merus of last pair of ambulatory legs with two or three sharply distinct teeth at the posterodistal angle.

Dimensions.—Length of carapace 15 mm., width 20 mm. (Dana).

Type Locality.—Key West, Florida.

Distribution.—California (Kingsley) to Peru; Galapagos Islands; Oriental region; West Africa; Bermudas; Bahamas and Florida Keys to Rio de Janeiro (Rathbun).

Genus **Planes** Bowdich, Leach

Carapace smooth, convex, subquadrate or more or less suborbicular; with a slight notch or tooth behind the acute orbital angle. Anterior edges of ambulatory legs with a dense fringe of hair. Pelagic crabs, usually found on floating seaweed in the open ocean.

Planes minutus (Linnaeus)

Plate 46

Cancer minutus Linnaeus, Syst. Nat., ed. 10, 1, 625, 1758.

Planes minutus Rathbun, H. A. E., 10, 189, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 63, pl. 14, fig. 44, 1910; Rathbun, Bull. U. S. Nat. Mus., 97, 253, pl. 63, 1918.

Characters.—Carapace as long as or longer than broad, suborbicular, practically smooth, a few faint lines toward anterior and lateral portions of carapace; the single blunt tooth behind the postorbital sometimes obsolete. Hand with several oblique lines above and below, and a somewhat obscure longitudinal line on the lower portion of the palm running out on the immovable finger. Anterior edges of ambulatory legs with a dense fringe of hair.

Dimensions.—Two specimens from off Point Loma, collected by the "Albatross," measure, male: length of carapace 15 mm., width 14 mm.; female: length of carapace 20 mm., width 19 mm.

Color.—Color varies from light cream with pinkish tinge and light brown mottled to a very dark nut-brown, occasionally with a bluish cast on carapace and yellowish legs, sometimes with whitish blotches and markings on upper surface. (Murray and Hjort, 1912, pl. 6.)

Type Locality.—"In Pelagi Fuco natante" (Linnaeus).

Distribution.—Temperate and tropical seas. Taken at sea, west of Humboldt Bay, in Avalon Bay, Santa Catalina Island, and off Point Loma and San Diego, California (Rathbun). During the month of August, 1918, two small specimens, averaging about a half inch in width, were picked up from the beach at the Scripps Institution, La Jolla, California, by Messrs. P. L. Barnhart and H. J. Snook.

Genus **Hemigrapsus** Dana

Carapace not markedly striated; with two teeth behind the orbital angle. Outer maxillipeds without a wide rhomboidal gape, only moderately gaping; merus large and not produced at the antero-external angle; palp joined in a notch at about the middle of the distal margin. Abdomen of male does not cover the sternum at its base.

KEY TO THE CALIFORNIA SPECIES OF HEMIGRAPSUS

- I. Ambulatory legs hairy. Front with a deep sinus in the middle. Hands of chelipeds not spotted with red. *oregonensis*, p. 274.
- II. Ambulatory legs smooth. Front arcuate, very slightly sinuous. Hands of chelipeds spotted with red. *nudus*, p. 273.

Hemigrapsus nudus (Dana)

Plate 47

Pseudograpsus nudus Dana, Proc. Acad. Nat. Sci. Phila., 5, 249, 1851;
Crust. U. S. Expl. Exped., 1, 335, 1852, pl. 20, fig. 7, 1855.

Heterograpsus nudus Rathbun, R., The Fisheries and Fishery Industries of
the U. S., sec. 1, p. 765, 1884.

Brachynotus nudus Holmes, Occas. Papers Calif. Acad. Sci., 7, 81, 1900.

Hemigrapsus nudus Rathbun, H. A. E., 10, 189, 1904; Weymouth, Stanford
Univ. Publ., Univ. Ser., no. 4, 62, pl. 14, fig. 42, 1910; Rathbun, Bull.
U. S. Nat. Mus., 97, 267, pl. 69, 1918.

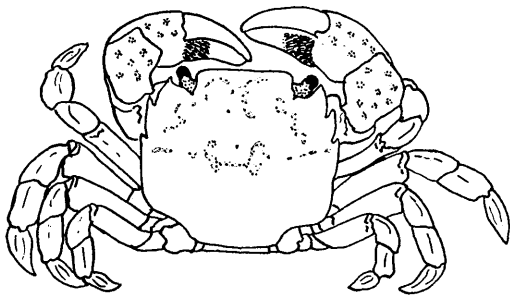


Fig. 161. *Hemigrapsus nudus*, $\times \frac{4}{5}$ (after Dana).

Characters.—Carapace posteriorly flat, smooth, and punctate, anteriorly convex, undulated, and furnished with small, scattered granules; front arcuate, very slightly sinuous (front bilobed, median emargination shallow but comparatively broad). Chelipeds smooth, mottled above with small, round, red spots; in the adult male there is a rounded lobe on the antero-internal angle of the merus, and a patch of long hair on the inner surface of the hand. Ambulatory legs naked, rather short; dactyls short, stout, scabrous, those of last pair less than two and one-half times, often less than twice as long as wide, and up-turned at the tip.

Dimensions.—Type, female: length of carapace 22.3 mm., width 26.5 mm.; male: length of carapace 22.6 mm., width 26.1 mm. Width of carapace of the Bay specimens ranged from 9 to 39 mm., the greater number being about 25 mm. wide.

Color.—Quite variable. It is generally of a mahogany red, but may be a purplish tone, dark red, or red marbled with white. I have seen some specimens with the upper side almost entirely white (Holmes). Ambulatory legs similar to carapace; chelipeds lighter, marked with numerous small spots of darker red (Weymouth). But amid all the variations of color the red spots on the chelipeds remain an absolutely constant character so far as I can determine. Young specimens present greater color variation than older ones (Holmes).

Type Locality.—Puget Sound.

Distribution.—From Sitka, Alaska, to Gulf of California (Rathbun).

Biological Survey of San Francisco Bay.—*Hemigrapsus nudus* is a strictly littoral species, recorded only from the middle bay, doubtless because all shore collecting was confined to that section. Specimens from one to a dozen or more were obtained at Point Bonita, along the Presidio shore, at Sausalito, north of the Key Route pier, on Red Rock, and in tide pools along the Richmond shore, north of the Standard Oil pier.

Hemigrapsus oregonensis (Dana)

Plate 48

Pseudograpsus oregonensis Dana, Proc. Acad. Nat. Sci. Phila., 5, 248, 1851; Crust. U. S. Expl. Exped., 1, 334, 1852, pl. 20, fig. 6, 1855.

Heterograpsus nudus Rathbun, R., The Fisheries and Fishery Industries of the U. S., sec. 1, p. 765, 1884.

Brachynotus oregonensis Holmes, Occas. Papers Calif. Acad. Sci., 7, 82, 1900.

Hemigrapsus oregonensis Rathbun, H. A. E., 10, 189, 1900; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 63, pl. 14, fig. 43, 1910; Rathbun, Bull. U. S. Nat. Mus., 97, 270, pl. 70, 1918.



Fig. 162. *Hemigrapsus oregonensis*, outline of front, $\times \frac{1}{2}$ (after Dana).

Characters.—Carapace more strongly undulated in front than in *H. nudus*, but not so much flattened behind; posterior portion not punctate, and anterior portion may be sparsely granulate; front with a deep sinus in the middle, front four-lobed, the median lobes the most prominent. Chelipeds smooth, not spotted with red; in the adult male there is a rounded lobe on the antero-internal angle of the merus, and a patch of long hair on the inner surface of the hand. Ambulatory legs hairy; dactyls narrower than in *H. nudus*, those of the last pair upturned.

Dimensions.—Type: length of carapace 21.2 mm., width 24.4 mm. The Bay specimens ranged from 3 to 29 mm. in width of carapace, the greater number being about 20 mm. wide.

Color.—In life a light grey, with minute blackish or dark blue spots, which are more numerous in some regions than in others. Legs lighter, marked with similar spots; hands of chelipeds whitish in tone, without spots (Weymouth).

Type Locality.—Puget Sound.

Distribution.—From Prince William Sound, Alaska, to Gulf of California (Rathbun).

Remarks.—This species may be readily distinguished from the preceding by its dull color, hairiness of the legs, the four-lobed front, and absence of round red spots on the chelipeds so characteristic of that closely related species (Holmes).

Biological Survey of San Francisco Bay.—Regarding the occurrence of this species Dr. Rathbun (1884, p. 765) says, “*H. oregonensis* is especially abundant in muddy sloughs of salt or brackish water where it literally swarms. Hundreds of uplifted threatening claws welcome the intruder who ventures near the mud flats when the tide is out.”

In view of these remarks our shore collections, which were confined to the middle bay, constitute a very imperfect littoral distribution picture. Four specimens were taken among the rocks at Point Bonita between tide marks, thirty at Sausalito, one at Tiburon in a 150-foot seine, twelve from the piles of the Key Route pier, eighty-three on the mud flats north of the Key Route pier, thirty-four along the Richmond shore north of the Standard Oil pier, and twenty-five among rocks on Red Rock.

However, when the dredging records are consulted we find that *Hemigrapsus oregonensis* was taken very much more frequently in the lower than in the other divisions of the bay (see plate 10). It is in the lower bay that the muddy bottom preferred by this species predominates. Here it was taken at sixteen stations (80%), of which the greater number, eleven, were recorded as more or less shelly as they were principally in oyster-beds; but it must be remembered that in the lower bay these shelly bottoms are primarily mud bottoms (Townsend, 1893, p. 348, 350). The other five stations from the lower bay were on a pure mud bottom in three cases, on muddy sand in another, and on an uncharacterized bottom at the remaining one.

In the upper bay this species was taken at but two (10.4%) of the stations, both of which (D 5817, 5819) were made with the sledge trawl off Point Pinole on a somewhat gritty mud bottom; for the middle bay we likewise have only two records (10%), dredged in-shore with the launch off Point San Quentin on an uncharacterized bottom (D 5750), and along the south side of Golden Gate, inside of Fort Point (D 5778), on a bottom largely made up of “fine, clean, gray sand and medium sized rounded stones.”

The average number of specimens per haul in the lower bay was sixteen and eight-tenths as compared with one and five-tenths specimens per haul for the upper and middle bays. The greatest number of specimens taken at any station was one hundred and two dredged in $1\frac{1}{4}$ to $3\frac{1}{2}$ fathoms (D 5768) off Alameda, in the upper part of the lower bay. Seven (35%) of the total number of dredging stations made in the bay were in less than 2 fathoms of water, only five (25%)

exceeded 5 fathoms, while the remaining eight (40%) were of intermediate depth. One specimen was secured while making hydrographic observations in the No. 2 Dumbarton oyster bed (H 5256).

The extremes of temperature and salinity for this species as observed at the hydrographic stations, correlated with the dredging stations from which it was obtained are, respectively, 11.0° to 16.6° C, and 17.5 to 31.6.

A complete list of stations includes: D 5730, 5750, 5766-5768, 5778, 5781, 5782, 5784, 5803, 5810-5814, 5817, 5819, 5847, 5848, 5849; H 5256; Sausalito, Jan. 18, Feb. 14 and 17, Mar. 14, 1913; Point Bonita, Aug. 1, 1912; Key Route pier, piles, Aug. 2, 1912; north of Key Route pier, Aug. 2, 1912; Red Rock, Aug. 3, 1912; Richmond shore, Standard Oil pier, Aug. 3, 1912; Tiburon, Apr. 29, 1913.

Genus *Grapsodius* Holmes

Carapace striated above, with the sides converging behind, and armed with a single tooth behind the postorbital. Front broad, not deflexed, but with the median portion depressed. Eye-peduncles short. Orbits with the posterior surface bulging outwards instead of concave. Maxillipeds narrow, widely gaping, and devoid of an oblique piliferous ridge; merus subcordate, shorter than the ischium, the antero-internal angle produced; palp joined near the middle of the distal margin of the merus. Dactyls spinulose. Abdomen of the male seven-jointed.

Grapsodius eximius Holmes

Grapsodius eximius Holmes, *Occas. Papers Calif. Acad. Sci.*, 7, 84, 1900.

Original Description.—Carapace undulated in front and flattened behind, where it is more strongly striated; sides strongly converging posteriorly. The front is over one-half the width of the carapace and has the outer angles more or less projecting and rounded; the anterior edge is thin and minutely granulated; viewed from above it is nearly straight, being slightly convex on either side of the middle where it is a little concave; viewed from in front it sags downward in the center. The orbits are remarkable in being swollen outward so that there is no hollow receptacle, as is usually the case, for the reception of the eyes; the superior orbital margin is marked by a fine ridge extending from the outer side of the front to the postorbital tooth; the inferior orbital margin is marked by a line of granules extending from the lower side of the postorbital tooth to the buccal area. Maxillipeds slender and wide apart. The ischium is much longer than the merus but not so wide; merus with the outer margin convex and the antero-external angle broadly rounded; the inner margin is straight and the antero-internal angle is produced into a prominent narrow lobe; first joint of the palp strongly convex near the middle of the inner margin; exognath at the base about one-half as wide as the ischium and tapering regularly to the tip which reaches slightly beyond the middle of the merus. Chelipeds subequal; merus short, trigonal, the outer surface transversely striated, the inner margin produced into a laminate expansion which is distally truncated and dentate; carpus with a spine near the middle of the upper margin; hands smooth

and inflated; the upper margin of the palm is broadly rounded, but bears a fine ridge; a very fine ridge on the lower side of the outer surface extending upon the pollex; fingers subcylindrical, not ridged or grooved, and armed within with small teeth. Merus of the ambulatory legs dilated and compressed much as in *Pachygrapsus crassipes*, with the upper margins acute and ending in a tooth a little behind the supero-distal angle; the infero-distal angle, in all but the last pair, is dentate; carpal joints with a few small spines near the distal end of the upper margin; propodi with the sides strongly convex and the upper and lower margins spiny; dactyls rather narrow, shorter than the propodi, strongly spinose above and below, and terminating in slender claws. The abdomen in the male is widest at the third segment, behind which it tapers to the tip, the sides converging more rapidly towards the posterior end; first segment much longer than the second; third segment about as long as the fourth, the sides strongly convex; fifth segment scarcely longer than the fourth and shorter than the sixth; last segment triangular, acute (Holmes).

Type Locality.—San Diego, California.

Remarks.—This species is described from a single dried and somewhat imperfect specimen contained in the Museum of the University of California. The form and arrangement of the antennae and antennules could not be determined nor could I make out whether or not the inferior orbital lobe was in contact with the front. The front, legs, maxillipeds, and striations on the carapace are similar to those of *Pachygrapsus*, but the character of the orbits separates it from that genus as well as all the other genera of the Grapsidae (Holmes).

This species has not been found since original specimen was taken and described. No measurements were given.

Family OCYPODIDAE

Carapace square or rounded, more or less convex; lateral margins generally without teeth; front moderately or very narrow, more or less depressed or bent downward; orbits transversely lengthened, eye-stalks usually very long. Third maxillipeds almost or quite close the mouth.

KEY TO THE CALIFORNIA GENERA OF THE OCYPODIDAE

- I. Eye-stalks moderately stout; corneae elongate, subterminal, eye-stalk projecting beyond them in a short process. Chelipeds in male subequal; fingers with truncate ends. (Only California record, a doubtful one, is from San Francisco Bay.)
Ocypode, p. 277.
- II. Eye-stalks slender; corneae terminal. Chelipeds in male extremely unequal; fingers with pointed tips.
Uca, p. 278.

Genus *Ocypode* Fabricius

Carapace squarish; antennules folded longitudinally. Eye-stalks large, moderately stout; cornea large, covering much of lower surface of eye-stalk, usually subterminal and reaching toward base of eye-stalk. No flagellum on exopodite of outer maxilliped. Chelipeds well developed, unequal but not noticeably different on either side or in either sex.

Ocypode gaudichaudii Milne Edwards and Lucas

Plate 38, figures 5 and 6

Ocypoda gaudichaudii Milne Edwards and Lucas, in D'Orbigny's Voy. dans l'Amér. MÉR., 6, pt. 1, p. 26, 1843, pl. 11, figs. 4-4b, 1847.

Ocypode gaudichaudii Rathbun, H. A. E., 10, 190, 1904; Proc. U. S. Nat. Mus., 38, 550, pl. 43, fig. 2, 1910; Bull. U. S. Nat. Mus., 97, 373, pl. 63, 1918.

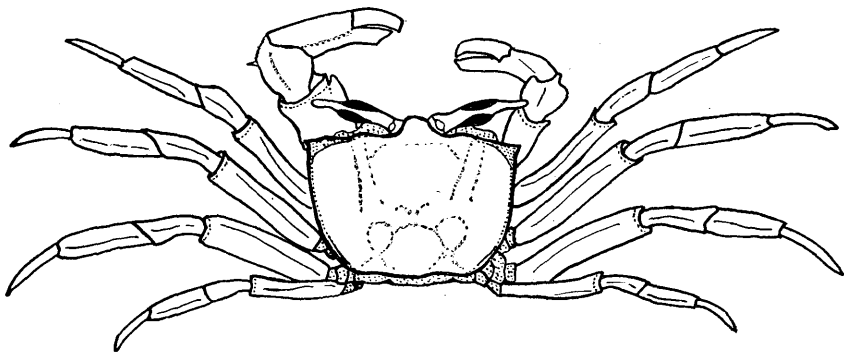


Fig. 163. *Ocypode gaudichaudii*, $\times \frac{4}{5}$ (from Milne Edwards and Lucas, after Rathbun).

Characters.—Carapace squarish, broader than long, anterior corners flattened; front between the eyes narrow, bent down. Eye-stalks large, elongated, prolonged beyond the corneae in a slender style. Chelipeds stout, somewhat unequal, rough; fingers with truncate ends. Ambulatory legs long, finely roughened.

Dimensions.—Of specimens from Peru, examined by Miss Rathbun: width about 40 mm.

Type Locality.—Chile.

Distribution.—From Lower California to Chile; Galapagos Islands; Honolulu. Three young specimens from San Pablo, California, are in the Museum of Comparative Zoology; determined by Dr. Faxon (Rathbun). In view of the tropical distribution of this species, it is very probable that the label on this lot is either incorrect or the result of an exchange.

Genus **Uca** Leach

Carapace transverse-quadrate; antennules folded longitudinally. Eye-stalks long and slender; cornea short, terminal, confined to distal end of eye-stalk. Exopodite of outer maxillipeds with flagellum. Chelipeds of male strikingly unequal, hand of larger one very large, fingers longer than the palm, hand of smaller feeble; both chelipeds in female feeble.

KEY TO THE CALIFORNIA SPECIES OF *UCA*

I. Carapace very convex, semi-cylindrical. Male with an oblique stridulating ridge near proximal lower corner of inner surface of large hand; abdomen of male with third to sixth segments fused.

musica, p. 280.

II. Carapace moderately convex, not semi-cylindrical. Male without stridulating apparatus; abdomen of male, inclusive of telson, seven-jointed. (Not known north of False Bay.)

crenulata, p. 279.

***Uca crenulata* (Lockington)**

Plate 49

Gelasimus crenulatus Lockington, Proc. Calif. Acad. Sci., 7, 149, 1876 (1877).

Gelasimus gracilis Rathbun, Proc. U. S. Nat. Mus., 16, 244, 1893.

Uca crenulata Holmes, Occas. Papers Calif. Acad. Sci., 7, 75, pl. 1, figs. 7-9, 1900; Rathbun, H. A. E., 10, 190, 1904; Rathbun, Bull. U. S. Nat. Mus., 97, 409, pl. 146, 1918.

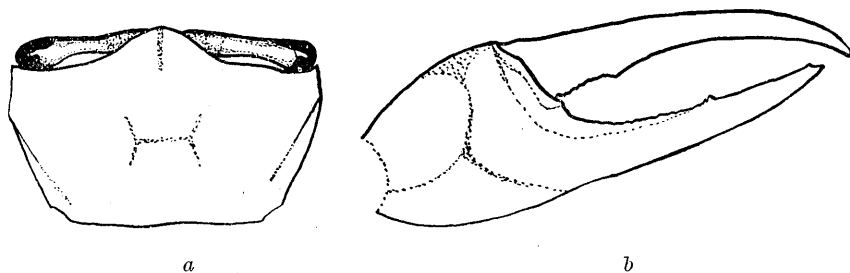


Fig. 164. *Uca crenulata*; a, carapace; b, inner side of large hand (after Holmes).

Characters.—Carapace smooth, moderately convex; lateral margins nearly parallel for a short distance behind the prominent, somewhat forwardly directed, acute anterolateral angles, then converging; front nearly one-third the width of the carapace. Hand of large cheliped of male finely granulated on outer surface, inner surface with an oblique granulated or tuberculated ridge which makes an obtuse angled turn in running from the lower to the upper margin. Ambulatory legs pubescent; merus transversely rugose. Abdomen of male, inclusive of telson, seven-jointed.

Dimensions.—Length 10 mm., width 15 mm. (Rathbun).

Type Locality.—Todos Santos Bay, near San Diego, California.

Distribution.—From False Bay, San Diego County, California, to Gulf of California (Rathbun).

Uca musica Rathbun

Plate 50

Uca musica Rathbun, Proc. U. S. Nat. Mus., 47, 127, text fig. 5, pl. 10, 1914; Bull. U. S. Nat. Mus., 97, 417, text fig. 171, pl. 154, 1918.

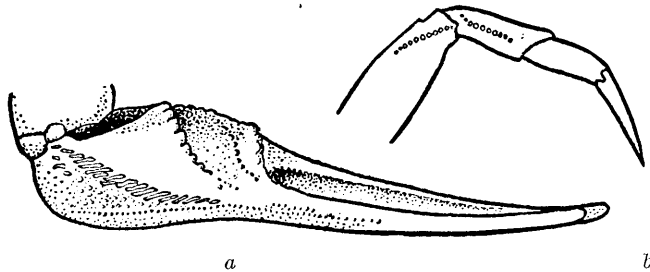


Fig. 165. *Uca musica*, ♂, $\times 3\frac{1}{4}$; a, lower view of large (left) chela, showing stridulating ridge; b, anterior (lower) view of portion of first left ambulatory leg, showing granules which play against stridulating ridge (after Rathbun).

Characters.—Carapace smooth, strongly convex, subcylindrical; anterolateral angles subrectangular; front less than one-fourth the width of the carapace. Hand of large cheliped granulated; with a very prominent ridge across inner surface of palm, bent at an obtuse and rounded angle, and armed for nearly its whole length with a row of large tubercles. Near the proximal lower corner of the inner surface is a longitudinally oblique stridulating ridge, extending from the articulation with the carpus to the lower marginal line of the palm almost below the angle of the transverse ridge. The stridulating ridge is made up of closely placed parallel lines, oblique to the axis of the ridge and subparallel to the lower margin of the palm. When the cheliped is flexed the ridge plays against a line of granules on the lower or anterior surface of the first ambulatory leg; this line extends nearly the whole length of the carpal segment and part way along the merus. Abdomen of male with third to sixth segments fused.

Dimensions.—Type, male: length of carapace 8 mm., width 12.9 mm.

Color.—Prevailing tint of carapace and limbs (in spirit) blue, of varying intensity, shading in parts into greenish and on the fingers of the chelipeds into white (Lockington, from Rathbun).

Type Locality.—Pichilique Bay, Gulf of California.

Distribution.—Vancouver Island, British Columbia, to Guaymas, Mexico (Rathbun).

IV. DISTRIBUTION

*Geographical.*¹—Of the one hundred and eighty-one marine decapods known to occur within the 100 fathom line off the coast of California, forty-two (23%) are found on the west coast of North America only within that area, fifty-nine (33%) range from California northward, fifty-three (29%) range southward, and twenty-seven (15%) range both north and south.

The species confined to California waters on the North American coast are:

<i>Palaeomonetes hiltoni</i> †	<i>Cyclodorippe plana</i>
<i>Pontonia californiensis</i> †	<i>Loxorhynchus grandis</i> *
<i>Pandalus gurneyi</i>	<i>Loxorhynchus crispatus</i> *
<i>Hippolysmata californica</i> †	<i>Cyclozanthops rugosus</i> †
<i>Spirontocaris affinis</i> °	<i>Lophopanopeus frontalis</i> †
<i>Spirontocaris lagunae</i> †	<i>Lophopanopeus heathii</i>
Spirontocaris franciscana	<i>Lophopanopeus leucomanus</i>
<i>Spirontocaris carinata</i>	<i>Lophopanopeus diegensis</i>
<i>Spirontocaris picta</i>	<i>Xanthias latimanus</i> †
<i>Crangon barbara</i> †	<i>Speocarcinus californiensis</i> †
<i>Crangon equidactylus</i>	<i>Pinnotheres nudus</i> °
<i>Betaeus harfordi</i>	<i>Pinnotheres holmesi</i> °
<i>Betaeus longidactylus</i> †	<i>Fabia lowei</i> †
<i>Nectocrangon californiensis</i> †	<i>Fabia canfieldi</i> °
<i>Axiopsis spinulicauda</i> °	<i>Parapinnixa affinis</i> †
<i>Callianassa affinis</i> †	<i>Pinnixa longipes</i>
<i>Paguristes parvus</i> †	Pinnixa franciscana °
Holopagurus pilosus	<i>Pinnixa hiatus</i> †
Pagurus samuelis	<i>Pinnixa weymouthi</i> °
<i>Pachycheles holosericus</i>	<i>Opisthopus transversus</i>
<i>Petrolisthes rathbunae</i> †	<i>Grapsodius eximius</i> †

Except *Pagurus samuelis*, all of the above are peculiar to California.

More than one-half, thirty-three (56%), of the fifty-nine species ranging northward find their northern limits along the Alaska coast,

¹ As noted in the Introduction this discussion deals only with the littoral fauna. The forms which have been included and which possibly do not properly belong here are the seven cited as "pelagic" or "with a bathymetric range of more than 500 fathoms," (p. 285) all or in part.

The species taken in connection with the Biological Survey of San Francisco Bay are printed in **bold face** type; those reported from the region covered by the survey but not taken during it are marked with an *; those found only north of Point Conception are indicated by a °; and those found only south of that point on the west coast of America are marked with a †. The species lacking either of these last two signs naturally range both north and south of Point Conception.

The northern limits of seven species are somewhat doubtful, but owing to the fact that they are so few in number (4%) and in order to avoid unnecessary

at or south of the Aleutian Islands; only nine (15%), *Spirontocaris prionota*,^o *S. flexa*,^{o*} **Crago communis**, *Haplogaster grebnitzkii*,^o *Pagurus beringanus*,^o **P. hirsutiusculus**, **Oregonia gracilis**,^o *Chionocetes tanncri*,^{*} *Telmessus cheiragonus*,^o go beyond into the Bering Sea, while none of the remaining seventeen (29%) are known to occur north of British Columbia, in fact, the ranges of six of these, *Spirontocaris decora*, *S. kincaidi*, **Crago munitella**, *Callianassa gigas*,^{o*} *Pachycheles pubescens*,^{o*} *Pinnixa tubicola*, end in Puget Sound or the Straits of San Juan de Fuca. Another, **Crago spinosissima**, does not go north of Oregon, and only ten, *Spirontocaris layi*,^o **S. paludicola**, **Crago alaskensis elongata**, **C. alba**, *Lopholithodes foraminatus*,^{*} **Paguristes turgidus**, *Pagurus hemphilli*,^o **Pylopagurus minimus**, *Pugettia richii*, *Pinnotheres concharum*, run up into British Columbia. The thirty-three species ranging northward, whose northern limits are found along the Alaskan coast, at or south of the Aleutian Islands, are:

Pandalus jordani	<i>Haplogaster cavicauda</i>
<i>Pandalus platyceros</i> [*]	Oedignathus inermis ^o
Pandalus danae ^o	Acantholithodes hispidus ^o
<i>Hippolyte californiensis</i>	<i>Phyllolithodes papillosus</i> ^o
<i>Spirontocaris lamellicornis</i> ^o	<i>Cryptolithodes typicus</i> ^o
<i>Spirontocaris bispinosa</i> [*]	<i>Cryptolithodes sitchensis</i> ^o
Spirontocaris gracilis	<i>Lopholithodes mandtii</i> ^{o*}
Spirontocaris brevis ^o	<i>Rhinolithodes wosnessenskii</i> ^o
Spirontocaris cristata	<i>Munida quadrispina</i>
Crago stylirostris	<i>Pugettia gracilis</i> [*]
Crago franciscorum	<i>Chorilia longipes</i> [*]
<i>Crago acclivis</i>	<i>Scyra acutifrons</i> [*]
<i>Crago munita</i>	<i>Fabia subquadrata</i>
<i>Paracrangon echinata</i>	Pinnixa littoralis
<i>Callianassa californiensis</i> [*]	<i>Pinnixa faba</i>
Pagurus ochotensis	Pinnixa schmitti ^o
<i>Parapagurus mertensii</i>	

explanations, they have, for the purposes of discussion, been accepted as unquestioned. These seven species with their ranges, including both doubtful and present known northern limits (in parentheses), are:

Pagurus californiensis, Monterey Bay? (Santa Catalina Island)—Gulf of California.

Panulirus interruptus, Monterey Bay? (San Luis Obispo)—Rosalia Bay, Lower California.

Cyclodorippe plana, Monterey Bay? (San Pedro Bay)—Santa Catalina Island.

Anasimus spinosus, Monterey Bay? (San Pedro Bay)—Cerro Island, Lower California.

Epialtus bituberculatus, Monterey Bay? (Laguna Beach)—Chile.

Portunus xantusii, Puget Sound? (Santa Monica Bay)—Chile.

Ocypode gaudichaudii^{*}, San Francisco Bay? (Lower California)—Chile.

Three new species, *Dardanus jordani*, *Pylopagurus holmesii*, and *Homola faxoni*, have been added to this paper since this section on "Distribution" was written. Had they been included here the total number of species of littoral record would have been one hundred and eighty-four.

Similarly, more than half of the twenty-seven "north and south" species, fourteen (52%), also find their northern limits along the Alaska coast from the Aleutians southward; none reach the Bering Sea, the above nine forms ranging northward being the only (5%) California species recorded so far north; of the other thirteen (48%) north and south forms, seven, **Crago nigricauda**, **Callianassa longimana**, **Petrolisthes cinctipes**, *P. eriomerus*,* **Epialtus productus**, **Cancer antennarius**, *Uca musica*, reach British Columbia; three, *Spirontocaris snyderi*, *Portunus xantusii*, **Scleroplax granulata**, reach Puget Sound; one, *Munidopsis quadrata*, the coast of Washington; and two, **Emerita analoga**, **Pachygrapsus crassipes**, only go as far as the Oregon coast. The fourteen species reaching the Alaska coast but not found north of the Aleutians are:

<i>Pasiphaea pacifica</i>	Cancer magister
Upogebia pugettensis	Cancer gracilis
<i>Pagurus granosimanus</i>	<i>Cancer oregonensis</i> *
<i>Pachycheles rudis</i> *	<i>Lophopanopeus bellus</i>
<i>Mimulus foliatus</i>	Pinnixa occidentalis
Cancer productus	Hemigrapsus nudus
Cancer gibbosulus	Hemigrapsus oregonensis

The southern limits of eighteen (67%) of the twenty-seven north and south species are found along the Lower California coast either at Magdalena Bay or at points intermediate between it and Todos Santos Bay; only nine (33%) range south of Magdalena Bay; six, *Pasiphaea pacifica*, **Petrolisthes cinctipes**, **Pachygrapsus crassipes**, **Hemigrapsus nudus**, **H. oregonensis**, *Uca musica*, into the Gulf of California; one, *Mimulus foliatus*, to Mazatlan; one, *Munidopsis quadrata*, in deep water to off the Tres Marias Islands, Mexico; and one, *Portunus xantusii*, to Chile. The eighteen north and south species not recorded south of Magdalena Bay are:

<i>Spirontocaris snyderi</i>	Cancer productus
Crago nigricauda	Cancer antennarius
Upogebia pugettensis	Cancer gibbosulus
Callianassa longimana	Cancer magister
<i>Pagurus granosimanus</i>	Cancer gracilis
Emerita analoga	<i>Cancer oregonensis</i> *
<i>Pachycheles rudis</i> *	<i>Lophopanopeus bellus</i>
<i>Petrolisthes eriomerus</i> *	Pinnixa occidentalis
Epialtus productus	Scleroplax granulata

Of the fifty-three species ranging southward from California, twenty-three (43%) have not been recorded south of the Coronados-Magdalena Bay stretch, while thirty (57%) run farther south; sixteen, *Palaemon ritteri*,† *Urocaris infraspinis*,† *Periclimenes tenuipes*,†

Synalpheus lockingtoni,† **Paguristes bakeri**, *Pagurus californiensis*, *Lepidopa myops*† (only to Cape St. Lucas), *Petrolisthes gracilis*, *Podochela hemphillii*, *Pelia clausa*,† *Cancer amphioetus*,† *Callinectes bellicosus*,† *Lophopanopeus lockingtoni*,† *Pilumnus spinohirsutus*,† *Pinnixa tomentosa*, *Uca crenulata*,† run to the Gulf of California; two, *Pleuroncodes planipes*, *Herbstia parvifrons*, to off the west coast of Mexico; two, *Processa canaliculata*,† *Inachoides tuberculatus*, to Panama; three, *Peneus brevirostris*,* *Dromidia larraburei*, *Pachygrapsus transversus*,† to Peru; five, *Crangon bellimanus*, *Mursia gaudichaudii*,* *Epialtus bituberculatus*, *Heteractea lunata*,† *Ocypode gaudichaudii*,* to Chile; and one, *Munidopsis aspera*†, in deep water to the Straits of Magellan and also in the Atlantic off Brazil; still another, *Planes minutus*, is cosmopolitan, pelagic in temperate and tropical seas. The twenty-three species ranging southward not found south of the Coronados-Magdalena Bay stretch, include:

<i>Spirontocaris palpator</i> *	Randallia ornata
Spirontocaris taylori	<i>Randallia bulligera</i> †
<i>Crangon dentipes</i> *	<i>Anasimus spinosus</i>
<i>Crangon californiensis</i> †	<i>Epialtus nuttalli</i> †
Crago nigromaculata	<i>Pugettia dalli</i> †
<i>Crago holmesi</i> †	<i>Pelia tumida</i> †
Crago resima	<i>Cancer anthonyi</i> †
<i>Panulirus interruptus</i>	<i>Cancer jordani</i>
<i>Paguristes ulreyi</i>	<i>Cyclozanthops novemdentatus</i>
<i>Galathea californiensis</i> †	<i>Xanthias taylori</i>
<i>Blepharipoda occidentalis</i> *	<i>Pinnixa barnharti</i> †
<i>Heterocrypta occidentalis</i> *	

Seventeen (9%) of all the above species have also been reported from the western north Pacific, chiefly from Japan and Kamchatka as follows:

<i>Pandalus platyceros</i> *	Japan
<i>Spirontocaris prionota</i> °	Japan
<i>Processa canaliculata</i> †	Japan; Amboina (also Europe, Madeira, Bermudas, North Carolina to Trinidad, Gulf of Mexico, West Indies).
Crago nigricauda	Japan
Crago communis	Kamchatka
<i>Paracrangon echinata</i>	Japan
Pagurus ochotensis	Japan; Okhotsk Sea
Pagurus hirsutiusculus	Japan; Kamchatka; Siberia
Pagurus samuelis	Japan
<i>Parapagurus mertensii</i>	Kamchatka
Oedignathus inermis °	Japan
<i>Pachycheles pubescens</i> °	Japan
Oregonia gracilis °	Japan

<i>Cancer amphioctus</i> †	Japan; Korea
Cancer gibbosulus	Japan
<i>Telmessus cheiragonus</i> °	Kamchatka; Siberia; Kurile Islands
Pachygrapsus crassipes	Japan; Korea

Only four (2%) species, one of which has already been listed as occurring in Japanese waters, are also recorded from the Atlantic littoral regions, principally from the Bermudas, West Indies and the Gulf of Mexico:

<i>Crangon dentipes</i> *	Bermudas, West Indies, Key West, Mediterranean, Cape Verde Islands.
<i>Processa canaliculata</i> †	North Carolina to Trinidad, Bermudas, West Indies, Gulf of Mexico; Europe (also Japan and Amboina).
<i>Epialtus bituberculatus</i>	Bermudas; Indian River, Florida, to Brazil (also Chile).
<i>Pachygrapsus transversus</i> †	Bermudas; Bahamas and Florida Keys to Rio de Janeiro, Brazil; West Africa (also Oriental region and Galapagos Islands).

Of these the second and fourth are cosmopolitan with respect to their distribution.

Two species are pelagic, *Pleuroncodes planipes* and *Planes minutus*. The first is known only from the Pacific shores of America ranging "90 miles S.W. of San Francisco to 150 miles S.W. of Cape St. Lucas"; while the second is a more or less cosmopolitan form found in temperate and tropical seas throughout the world. The latter might properly be included in both the preceding lists.

Five (3%) species have a bathymetric range exceeding 500 fathoms, and even two of these have been taken in over 1000 fathoms, as follows:

<i>Munida quadrispina</i> °	50- 559 fathoms
<i>Munidopsis quadrata</i>	47- 859 fathoms
<i>Munidopsis aspera</i> †	69-1500 fathoms
<i>Chorilia longipes</i> *	27- 603 fathoms
<i>Chionoecetes tanneri</i> °*	29-1625 fathoms

All of these are confined to the Pacific except *Munidopsis aspera*, which has also been taken in the Atlantic off Brazil (type locality) and which, except for its strictly abyssal record there, 1500 fathoms, might well be included among the Atlantic forms above. It can, however, be called a cosmopolitan form for all primary abyssal forms as a rule are cosmopolitan, or would prove to be more or less so were the deep sea thoroughly explored.

Summarized, the foregoing gives:

Species peculiar to California	41 (23%)
Species which on the west coast of North America are confined to California waters	42 (23%)
Species found in California and the region north of it	101 (55%)
Species found in California and the region south of it	95 (52%)
Species common to California and the regions both north and south	27 (15%)
Species finding the northern limit of their range in the Bering Sea	9 (5%)
Species finding the northern limit of their range in the Aleutian- Southeastern Alaska stretch.....	47 (27%)
Species finding the northern limit of their range in the British Columbia-Oregon stretch	40 (22%)
Species finding the southern limit of their range in the Coronados- Magdalena Bay stretch	41 (23%)
Species finding the southern limit of their range in the Gulf of California or beyond	39 (21%)
Species found at Panama or farther south	12 (7%)
Species occurring only in the stretch between the Aleutian Islands and Magdalena Bay	133 (73%)
Species also reported from the western north Pacific, chiefly from Japan	17 (9%)
Species also reported from the eastern littoral Atlantic	4 (2%)
Cosmopolitan species	4 (2%)
Pelagic species	2 (1%)
Species having a bathymetric range exceeding 500 fathoms	5 (3%)

The California littoral decapod fauna is almost wholly confined to the west coast of North America; in fact, forty-one (23%) of the forms represented in it are peculiar to California waters alone. Exclusive of cosmopolitan and near cosmopolitan species only sixteen (9%) have been reported from the western North Pacific, chiefly from Japan, and only twelve (7%) from as far south as Panama or farther. If we consider *Crangon dentipes*, which occurs also in the Mediterranean and the Cape Verde Islands, as near cosmopolitan, only one non-cosmopolitan California species is common to the Atlantic littoral, viz., *Epialtus bituberculatus*.

That nearly three-fourths (73%) of the species systematically treated in this paper, range, on the west coast of America, only within the stretch lying between the Aleutian Islands and Magdalena Bay seems indicative of the existence of a more or less uniform and continuous faunal area of like extent,² within which these species are so

² North of California there are (based on Rathbun, 1904a, pp. 6, 7, and accompanying table) but seventy-seven species occurring within the 100 fathom line which have not been reported from California. Of these twenty (26%) do not range north of the Aleutians, being confined to the stretch lying between those islands and the coast of Oregon; fifty-seven (74%), however, find their northern limits either in the waters of Arctic Alaska or the Bering Sea. But of the latter

distributed as to preclude subdivision into smaller regions or districts (cf. appendix I, p. 310).

Arguing from the distribution of the hydroids of the west coast of North America, Dr. C. McLean Fraser asserts (1911, p. 6) that, "The more the group is studied and the greater the number of locations for examination included, the more reason there is for believing that there are no sudden, nor comparatively sudden breaks in distribution along the entire West Coast, though naturally certain species disappear and others as gradually come in."

In an earlier paper on the same group of organisms (hydroids) Dr. Torrey noticed (1902, pp. 6, 7) that "from Alaska Peninsula to San Diego there are no abrupt transitions in the fauna." Although thinking "it possible, for purposes of comparison, to divide this great region into four subregions," viz., (1) Alaska Peninsula to Sitka, (2) Puget Sound, Vancouver Island and vicinity, (3) San Francisco Bay and vicinity, including Monterey Bay, (4) Southern California, south of Point Conception, he expressed the feeling, later justified by Dr. Fraser, that, "future exploration will doubtless reduce these differences."

In a recent monograph on the shallow water starfishes of the north Pacific coast from the Arctic Ocean to California, Professor A. E.

very few are to be found south of the Aleutians in less than 100 fathoms; only seven range as far south as Puget Sound, although some "are often found out of their normal region in the cold glacier-fed bays and sounds of southeastern Alaska."

Unalaska is probably the western limit of the faunal region suggested, as approximately 20% of the northwardly ranging California and 40% of the "north of California" decapods occurring in the Aleutian-Oregon stretch, find there their northern limit.

South of California comparatively little is known of the Lower Californian and Gulf of California faunae other than what has been listed in this paper, or in Miss Rathbun's "Descriptions of New Genera and Species of Crabs from the West Coast of North America" (1893); "Brachyura of the 'Albatross' Voyage, 1887-1888" (1898), and "Stalk-eyed Crustacea of Peru" (1910). An approximate tabulation of Miss Rathbun's lists gives a total of one hundred and twenty-four species from the Gulf of California and the west coast of Lower California. Irrespective of their southern ranges, forty-three species are not found north of the Gulf; thirty are reported from Cape St. Lucas; and twenty-five reach Magdalena Bay; only fifteen go beyond, of which only four are found north of Abrejos Point, two at San Bartolomé (or Turtle) Bay, and two off Cerros Island. The eleven unaccounted for bear the indefinite locality label "Lower California." Miss Rathbun, in her Peruvian lists, so designated twenty-six species, but reference to original sources reduced that number to eleven.

The papers of Faxon (1895) and Bouvier (1895a and 1898) were consulted, but barring species already cited practically none of Faxon's come within the 100 fathom limit, while Bouvier described about fifteen new species, all of which seem to be confined to the Gulf of California.

The fauna of the Gulf of California is largely peculiar to it alone, and is more related to that of the Panama region than to any further north.

Verrill (1914, p. 18) undertakes to divide the region with which we are here concerned into three "faunal districts":

"*The Columbia-Alaskan*," including "the coasts and islands of Alaska, south of the Aleutian Islands, and the entire coast of British Columbia, with Vancouver Island; Puget Sound, and the northwestern coast of Washington; the Gulf of Georgia; and the Straits of Fuca"; "*The Californian*," including "the middle and southern parts of the coast of Washington; all of the Oregon coast; and the coast of California to Point Conception, or the north end of the Santa Barbara Channel"; and "*The South Californian*," including "the coast of southern California, from the Santa Barbara Channel, Santa Rosa Island, and Santa Cruz Island to the middle part of the Lower California coast."

His districts, however, in the light of the remarks he makes concerning them, do not seem to be very well founded and can without difficulty be merged into the one large area of which they are but arbitrary subdivisions. For example, regarding his *Columbia-Alaskan* and *Californian* faunae he says (1914, p. 348):

The former includes a total of eighty-five species and named varieties; the latter includes forty altogether. *For my present purpose these may best be considered collectively, as they have many species in common.*³ The two lists include ninety-nine species, subspecies and varieties. Of these, only sixteen species and varieties are not known to occur in the Columbia-Alaskan fauna, while twenty-four are common to both. Of the ninety-nine forms, only eight are of Arctic origin...leaving nine[ty]-one that may be considered as characteristic of the region.

And, with respect to the *South California* fauna (1894, pp. 345 and 349):

So far as known, this fauna has few species peculiar to it. The species are largely members of the more northern faunae that extend far south, and partly species of the more southern fauna of Lower California and the Gulf of California that range northward beyond the normal limits of that fauna...The list given...includes twenty-nine species and varieties. Of these, *twenty-two occur farther north.*³ Of the remaining six species, three are known to occur in the Panamic fauna, and probably find here their northern limits...The remaining three, at present, seem to belong particularly to this fauna...This faunal district, as now known, does not show any special peculiarities of its own. It is a meeting ground, so to speak, between the Panamic and Californian faunae.

According to Dr. Wesley R. Coe, the "Nemerteans of the Pacific Coast" (1910, p. 118), also exhibit considerable continuity in their distribution. Of the thirty-two species enumerated from Alaska nearly one half, fourteen, "were found also on the California coast during a single summer.

Eleven of these forms, which are common both to the California coast and to Alaska, were found at Monterey Bay, ten at San Pedro or in the deep water in the vicinity, while only two were collected at

³ Italics inserted by the author.

San Diego, and these two were both common to the other two localities. At San Diego, however, the opportunities for collecting were comparatively limited, and but a short time was spent at that place."

That neither Fraser, Torrey, nor Coe considered the region south of San Diego, and that thirty-three of the California decapods at present find the southern limit of their range at San Diego is no doubt due to the extreme dearth of material from the west coast of Lower California. Except for the explorations of the elder Anthony (A. W.) and a number of scattered stations of the "Albatross" the littoral portion of this region remains today almost as much a "terra incognita" as it was before the expeditions of the California Academy of Sciences to Magdalena Bay and the "Cape." It still offers an extremely fertile field for the ambitious collector.

But Dr. A. E. Ortmann (1896*a*) was the first to point out the continuity of the faunal region under discussion, with whose "Pacific Boreal (Littoral) Subregion," lying south of the Aleutian Islands it closely corresponds.

Unlike almost all other students of zoogeography who seem to have followed the inductive method and constructed their zoogeographical divisions according to the actual distribution of animals, Dr. Ortmann followed the deductive method and constructed his divisions according to the differences in the physical conditions influencing the distribution of animals. Of these "probably no single factor is a more effective barrier to the extensive geographical range of marine animals than is that of temperature" (Mayer, 1914, p. 3), for, to use the words of Doflein (1904, p. 269), "Alle Erfahrungen der letzten Zeit haben uns mehr und mehr gelehrt, dass die Verbreitung der Meeres-tiere am meisten von den Wassertemperaturen beeinflusst wird."

Torrey, Coe, and Verrill all realized the importance of the influence of temperature on the distribution of the forms upon which their studies were based.

Though Dr. Torrey spoke of his faunal differences as being correlated with certain geographical differences, he said (1902, p. 7):

North of the [Alaska] peninsula is a region whose waters are largely covered with ice for more than half of each year. South of the peninsula begins a vast stretch of coast which is washed by the comparatively warm waters of the Japan Current. This current is probably accountable for the absence of abrupt transitions between the faunal area which I have tried to schematize above [quoted on p. 287 of this paper], and the exceedingly long distances to which some of the northern species have been distributed southward. The temperature of the current varies gradually with latitude, however, and that offers some explanation for the small faunal differences that exist.

Coe said (1910, p. 118) :

There can be no doubt that future collections will add materially to the number of... [nemerteans], whose range extends at least as far southward as Monterey Bay or even to Point Conception. And while this is a considerable range geographically, yet the environmental conditions of marine forms are not greatly different between Monterey Bay, Puget Sound, Sitka and the Eastern Aleutian Islands. The temperature of the water is but a few degrees different and in some seasons of the year is actually warmer on the coast in portions of Alaska than it is in Puget Sound, or even in the deeper water off the California coast.

Furthermore, although his faunal districts do not seem to have been founded on any such basis, Verrill said of his west coast starfishes (1914, p. 19) :

The limits of distribution on that coast seem to be determined entirely by the temperature of the water, especially in the breeding season, due probably to the greater sensitiveness of the free-swimming larval forms. The adults can regulate their temperatures by migrating into deeper or shallower water as occasions require.

As Ortmann anticipated, and Torrey and Coe more or less successfully demonstrated, there exists a comparative uniformity of temperature along a considerable part of the west coast, which permits the great latitudinal and intricately overlapping distribution of the marine organisms with which we are here concerned, and which is necessary to the establishment of our faunal area.

North of California to the Aleutians is a vast stretch of coast which with the exception of isolated glacier fed bays is warmed much above the temperature normal to such latitudes by the Kuro Siwo, the Japan current. This strikes the American coast in the neighborhood of Sitka where it separates into two streams, a northern, running up into the Gulf of Alaska and thence southeastward along the Alaska Peninsula into the eastern Aleutians, and a southern one which "broadens out and drifts slowly toward the equator, curving away from the coast."

South of Puget Sound to about Magdalena Bay is a region of almost equal extent which is cooled by an upwelling of cold abyssal water to a degree considerably below the normal expectation for its latitude.⁴ The surface water along this section of the coast also exhibits a southward drift, and though it is known as the California

⁴ "Between the latitudes 45°... and 25°... the mean annual surface temperature is progressively lower as the coast is approached. This fall in mean annual temperature is clearly indicated at every depth from 250 fathoms up to the surface, where there is an inshore temperature averaging 5° less than that found 1,000 miles off-shore.... The [appended] tables show that the off-shore surface temperatures at latitude 30° are much below the normal (the temperature given in the first column), while those at latitude 40° are somewhat greater, at least in

Current "it really is the part of the Japan Stream bordering the Pacific Coast, and doubtless would not have been given a different name were it not for its low temperature and relatively greater velocity." (McEwen, 1915, p. 133.)

It is these two great, as it were compensating influences, the one warming a northern, normally cold region, and the other cooling a southern, normally warm region, which tend to equalize the temperatures along the greater part of the west coast and to make possible the large faunal area which extends from about the eastern Aleutian Islands to near Magdalena Bay, Lower California.

These conditions are graphically portrayed, in a general way, in Berghaus's *Physical Atlas* (1892, pls. 21 and 22, "Seeströmungen"), but our present detailed knowledge concerning them is almost entirely due to the researches conducted by Dr. G. F. McEwen under the auspices of the Scripps Institution (1910, 1912, 1915, 1916).

A number of students of the west coast fauna, chiefly conchologists (Dall, 1899, 1909, 1916, and Bartsch, 1912, also Torrey and Verrill above), attach great importance to Point Conception as a faunal barrier. Possibly their conclusions are influenced by a predominance of littoral (*sensu strictu*), or shallow-water forms. These, especially in the case of mollusks, always reflect extremely localized environments, and were they excluded and only those of less restricted (bathymetric) range considered, i.e., 25 to 50 to 100 fathoms, no doubt Point Conception as an apparent faunal barrier would cease to be significant. Of the California decapods, only twenty-eight (15%) are at present restricted to the region north of Point Conception and

winter. Also, it appears that the annual range of off-shore temperatures agrees with the normal range for the same latitude. But the inshore temperatures are notably less than the others for the same latitude, especially during the warmest part of the year, and consequently have less than the annual normal range. Again, the maximum and minimum temperatures occur in-shore some months after the corresponding normal times; and the variation of in-shore temperatures with respect to the latitude is scarcely half the normal amount." (McEwen, 1915, p. 134.)

SURFACE TEMPERATURES AT LATITUDE 30, 150 MILES SOUTH OF SAN DIEGO

	Average ocean temperatures for the whole circle having the given latitude.		Temperature of the Pacific at the boundary of the California and Japan currents.		Temperature of the inshore water along the Pacific coast.	
	Temp.	Time of occurrence	Temp.	Time of occurrence	Temp.	Time of occurrence
Maximum	77°	August	72°	Aug., Sept.	65°	September
Minimum	64°	February	61°	April	59°	May
Annual range	13°		11°		6°	

SURFACE TEMPERATURES AT LATITUDE 40°, OFF CAPE MENDOCINO

Maximum	66°	August	66°	September	57°	October
Minimum	48°	February	51°	April	52°	March
Annual range	18°		15°		5°	

forty-three (23%) to the region south of it, while one hundred and ten (61%) range both north and south.

Biological Survey of San Francisco Bay.—Geographically the species taken in connection with the survey (**bold face** type in the preceding lists) fit very well into the scheme outlined above. This also holds true if the species reported from the region covered by the survey (the bay and that portion of the Gulf of the Farallones lying south of the Farallon Islands) but not taken in course of it (marked with an * in the preceding lists) are included, as shown in the following summary:

SUMMARY OF GEOGRAPHICAL DISTRIBUTION OF THE BIOLOGICAL SURVEY SPECIES⁵

	Only, = 46	Plus those reported from region but not taken during Survey, = 70
Species peculiar to San Francisco Bay (<i>Pinnixa franciscana</i>)	1 (2%)	1 (1%)
Species which on west coast of North America are confined to California waters	4 (9%)	6 (8%)
Species ranging north of survey region	40 (87%)	57 (81%)
Species ranging south of survey region	42 (91%)	65 (93%)
Species ranging both north and south	37 (80%)	53 (76%)
Species finding the northern limit of their range in the Bering Sea	3 (6%)	5 (7%)
Species finding the northern limit of their range in the Aleutian-S.E. Alaska stretch	19 (41%)	28 (40%)
Species finding the northern limit of their range in the British Columbia-Oregon stretch	15 (33%)	19 (27%)
Species finding the southern limit of their range in the Coronados-Magdalena Bay stretch	15 (33%)	22 (31%)
Species finding the southern limit of their range in the Gulf of California or beyond	5 (11%)	8 (11%)
Species occurring only in the stretch between the Aleutian Islands and Magdalena Bay	38 (83%)	57 (81%)
Species also reported from the western North Pacific chiefly from Japan	8 (17%)	9 (13%)
Species also reported from the Atlantic littoral (<i>Crangon dentipes</i>)		1 (1%)
Species having a bathymetric range exceeding 500 fathoms		2 (3%)

Ecologically only the species taken in the course of the survey operations will be considered, and then only in a very general way. Future collecting will unquestionably considerably alter the local distribution patterns, as at present known, for a number of the species; for aside from the fact that only forty-six⁵ (66%) of the total seventy

⁵ Through an unfortunate oversight *Cancer gibbosulus* was omitted from this discussion. Of this species three specimens were taken, outside, at station D 5790, 33 to 35 fathoms, bottom "very coarse variegated sand, with a small proportion of fine sand."

species known or reported from the region investigated were found, all shore collecting, including seine hauls, was unfortunately confined to the middle bay. No doubt many, if not all the forms so taken are to be found along the ocean beaches outside. At least one of the dredged species, *Pandalus danae*, is known to be plentiful outside though taken by us only in the bay. Moreover, nearly a fourth, eleven (24%), of the species were taken but once during the survey:

<i>Crago resima</i>	<i>Acantholithodes hispidus</i>
<i>Crago alba</i>	<i>Randallia ornata</i>
<i>Crago communis</i>	<i>Oregonia gracilis</i>
<i>Pagurus samuelis</i>	<i>Pinnixa littoralis</i>
<i>Pylopagurus minimus</i>	<i>Scleroplax granulata</i>
<i>Holopagurus pilosus</i>	

Those taken at more than ten stations are in no greater number, comprising, likewise, less than a fourth (24%) of the species. Only the first five of these were obtained from about one fourth of the total number of dredging stations. Arranged in order of the number of stations, dredging and hydrographic, at which each was taken, they are as follows:

	Number of stations		
	D.	H.	Total
<i>Crago franciscorum</i>	94	137	231
<i>Crago nigricauda</i>	103	69	172
<i>Spirontocaris cristata</i>	35	28	63
<i>Cancer magister</i>	57	1	58
<i>Crago stylirostris</i>	40	3	43
<i>Hemigrapsus oregonensis</i>	19	1	20
<i>Crago nigromaculata</i>	19	---	19
<i>Callinassa longimana</i>	16	2	18
<i>Cancer productus</i>	16	---	16
<i>Cancer gracilis</i>	14	---	14
<i>Pagurus hirsutiunculus</i>	13	---	13

However, with respect to their local distribution the survey species belong to three groups: (1) those taken only outside; (2) those taken only in the bay; and (3) those taken both in the bay and outside.

1. The species taken only outside are sixteen (35%) in number, as follows:

<i>Pandalus jordani</i>	<i>Paguristes bakeri</i>
<i>Spirontocaris gracilis</i>	<i>Holopagurus pilosus</i>
<i>Crago alaskensis elongata</i>	<i>Pagurus ochotensis</i>
<i>Crago communis</i>	<i>Pylopagurus minimus</i>
<i>Crago alba</i>	<i>Acantholithodes hispidus</i>
<i>Crago resima</i>	<i>Randallia ornata</i>
<i>Crago spinosissima</i>	<i>Oregonia gracilis</i>
<i>Paguristes turgidus</i>	<i>Pinnixa occidentalis</i>

All these are bottom dwellers, and almost without exception all returns for each were from depths of about 30 fathoms or more. Of the species taken at the regular series of stations, specimens of three only were found in shoaler water; *Crago alaskensis elongata* at one of eight stations, in 19 to 26 fathoms (D 5792); *Paguristes turgidus* at one of three stations, in 13 to 14 fathoms (D 5806); and *Pagurus ochotensis* at two of eight stations, corresponding one with each of the preceding. On the other hand, all but two, *Crago alba* and *Pylopagurus minimus*, each of which was taken but once in 33 to 35 fathoms at the same station (D 5790), ranged into 40 or more fathoms of water. Seven, *Pandalus jordani*, *Crago alaskensis elongata*, *C. communis*, *C. resima*, *C. spinosissima*, *Paguristes turgidus* and *Pinnixa occidentalis*, were even taken in 60 to 68 fathoms in the deepest haul made (D 5788). Of these the first and second were also found at each of the other six outside stations lying beyond the 30 fathom line, the second, in addition, as mentioned above, being also obtained from one station inside that line; the third and fourth species were only taken at the deepest station, and the fifth only at the deepest station and one other; the last two were taken at three stations each. The only species recorded from more than one outside station and not taken at the deepest is *Pagurus ochotensis*.

In nearly every case the bottom was composed of fine, more or less greenish sand, which at one station (D 5791) was marked by "refuse and garbage" and at only one other (D 5790) replaced by a "very coarse variegated sand, with a small proportion of fine sand." At this last, of the six species recorded from it, *Pandalus jordani*, *Crago alaskensis elongata*, *C. alba*, *Pagurus ochotensis*, *Pylopagurus minimus* and *Paguristes bakeri*, two, the third and fifth, were not found elsewhere.

So far as shown by the hydrographic observations made outside, none of the outside species was obtained from water having a salinity less than 33.9 (bottom reading, D 5790); the highest salinity recorded was 34.3 (bottom, D 5789). The corresponding (bottom) temperatures ranged from 9.3° (D 5788) to 11.1° C (D 5806).

Owing to the lack of any very definite data regarding their occurrence *Acantholithodes hispidus*, *Randallia ornata*, and *Oregonia gracilis* are not included in the above discussion.

2. Of the twenty-three (50%) species taken only in the bay, seven are represented only in the shore collections, and for reasons already given will here be considered apart. Two of these seven are

burrowing forms, which, though not found in company, were taken only from sandy beaches:

Emerita analoga was dug out of the beach skirting the Presidio, west of Fort Point, and brought up in the seine both at Fort Baker and on Angel Island.

Upogebia pugettensis was obtained both at Sausalito and at Tiburon; at the latter place by means of the seine.

The other five are all primarily inhabitants of rocky beaches:

Oedignathus inermis, at Point Bonita.

Petrolisthes cinctipes, at Sausalito, and along the Richmond shore.

Pagurus samuelis, along the Richmond shore.

Pachygrapsus crassipes, on the Presidio shore near Fort Point, at Point Bonita, at Sausalito, and on Red Rock.

Hemigrapsus nudus, on the Presidio shore near Fort Point, at Point Bonita, at Sausalito, north of the Key Route Pier, along the Richmond shore, and on Red Rock.

The other sixteen bay species grouped on the basis of their distribution within the bay, arrange themselves as follows:

a. Ten, restricted to the middle bay:

Pandalus danae

Spirontocaris franciscana

Spirontocaris paludicola

Spirontocaris brevirostris

Spirontocaris taylora

Crago munitella

Epialtus productus

Cancer antennarius

Pinnixa littoralis

Scleroplax granulata

b. One, found only in the middle and the lower bay.

Cancer productus.

c. Five, common to all three divisions of the bay:

Callinassa longimana

Pagurus hirsutiuseculus

Pinnixa franciscana

Pinnixa schmitti

Hemigrapsus oregonensis

a. Excepting the first, third and ninth, seven of the ten species found only in the middle bay, inclusive of shore stations, are restricted wholly to that portion lying west of a line drawn across the head of Raceoon Strait, and from Blunt Point on Angel Island to the nearest point on the San Francisco shore.

This limitation of range seems to be closely correlated with the character of the bottom, which within that area is more or less hard, rocky, gravelly, or sandy with very little if any admixture of mud, exclusive, of course, of the muddy portion of Richardson Bay, where only two hauls of the boat dredge were made and none of the strictly middle bay species was found.

In addition to being found only on a rocky substratum, *Epialtus productus* was always in patches of kelp, or in their immediate vicinity: at Point Bonita, Sausalito, and east of Fort Point. *Spirontocaris taylori*, another "hard bottom" species, was also taken only at localities characterized by an abundant growth of algae along both shores of Golden Gate and in bunches of seaweed stripped from the piles of the Sausalito Ferry building. So far as our observations go, the only other middle bay species, excepting *Spirontocaris paludicola* mentioned below, the distribution of which may be similarly conditioned, is *Spirontocaris brevirostris*, for although taken near the head of Raccoon Strait on a bottom characterized simply as "stones," it was also taken at the south side of Golden Gate in company with *Spirontocaris taylori*.

Though no doubt exercising a considerable influence on the distribution of the bay species, the effect of temperature and salinity on these bottom dwelling forms is much more difficult of demonstration and probably less important, at least within this section, than that exerted by the character of bottom. Of the species found exclusively in the bay only three were taken with the tow-net, *Callinassa longimana*, *Cancer antennarius* and *Hemigrapsus oregonensis*, respectively two, three, and one specimen each, the latter obviously an accident.

Of the three middle bay species, *Pandalus danae*, *Spirontocaris paludicola*, and *Pinnixa littoralis*, not wholly restricted to the portion lying west of the line drawn above, the third was found only in the predominantly muddy eastern portion of the middle bay; the first, *Pandalus danae*, was returned but once from a "variegated mud . . . sand and fine gravel" bottom in this eastern portion, as compared with thirty-two specimens from a principally coarse sand gravel and stone bottom in the western portion of the middle bay; while the second, *Spirontocaris paludicola*, was taken but twice in the middle bay, once in its western portion, in the eel grass along the northern shore of Angel Island, and once in its eastern portion, from the algal growth in tide pools north of the Standard Oil pier, Richmond.

b. In lacking a straining apparatus "for removing fine particles of foreign matter from its respiratory stream of water," *Cancer productus* is ill adapted for life on more or less muddy or purely sand bottoms, and although recorded from the lower bay and the easterly sections of the middle bay, it was taken most frequently and abundantly in the western middle bay, as is to be expected. Here

twenty-two specimens were taken at ten stations, all on primarily gravel or rock bottoms, as compared with twelve at seven stations in the easterly parts of the middle and lower bay, of which several had more or less hard bottoms, composed largely of shells, shell fragments, or clinkers. Aside from the scarcity of favorable bottom, it is possible that the great fluctuations of salinity obtaining in the upper bay may tend to exclude *Cancer productus* from that division.

c. As the bottom of the greater part of the bay is predominantly muddy, it is to be expected that the five bay species listed as occurring in all three divisions will show some preference for bottoms of that character.

Callinassa longimana in view of its burrowing habits would naturally be restricted to the softer bottoms, and it is not surprising that no specimens of this species were taken in the western middle bay. In the eastern middle bay it was dredged at nine stations, in the lower bay at five, and in the upper at three.

Pagurus hirsutiunculus, although only taken in the course of shore collecting, from rocky shores around the middle bay, was dredged from more or less shelly bottoms in the predominantly muddy sections of the bay; once in the upper bay, four times in the lower bay and seven in the eastern middle bay. Of the other six stations at which this species was taken four were on the more or less hard sandy or rocky bottom of the western middle bay, and two in the eel grass patches around Angel Island, one in the western, the other in the eastern middle bay.

Pinnixa franciscana and *P. schmitti* have practically the same range within the bay, in fact, coincide at three stations. In nearly every case the bottom from which they were dredged was a more or less sandy mud, accompanied in at least two instances by numerous worm tubes, the probable habitat of both species. With the exception of one specimen of *P. franciscana* taken from a bottom of "soft mud, with numerous worm tubes," off Belvedere Point, in Richardson Bay, neither species was found in the western middle bay.

Hemigrapsus oregonensis, as is well known, shows a marked preference for muddy bottoms, being especially abundant on mud flats at low tide though taken at times in more or less rocky situations in company with *Hemigrapsus nudus*. In the predominantly muddy lower bay an average of sixteen and eight-tenths specimens per haul was taken at each of sixteen stations, while in the middle and upper bay only one and five-tenths specimens were returned from each of the two hauls made in both of those divisions.

3. Seven (15%) of the survey species were found both in the bay and outside:

<i>Spirontocaris cristata</i>	<i>Crago franciscorum</i>
<i>Crago nigricauda</i>	<i>Cancer magister</i>
<i>Crago nigromaculata</i>	<i>Cancer gracilis</i>
<i>Crago stylirostris</i>	

These seven are really bay species which range outside as far as the environmental conditions correspond in general to those obtaining in the portions of the bay in which they range inside. With the exception of *Spirontocaris cristata* and *Cancer gracilis* none of these species was taken outside the 30 fathom line, nor, so far as our records indicate, in water of (bottom) salinity exceeding 34.0. Comprising, on the other hand, nearly two-thirds (63%) of the eleven species taken at more than ten stations, and all of the five taken at about one-fourth of the dredging stations, they should be, and in fact are, fairly well distributed throughout the bay. *Crago nigromaculata* is the only one of them failing of record in the upper bay.

Spirontocaris cristata was taken only three times outside, two specimens at each of two stations, and one at a third, in 8½ to 9 fathoms (bottom not characterized), in 9½ to 11¾ fathoms (bottom, "coarse sand and gravel"), and 29 to 36 fathoms (bottom, "refuse and garbage"). In the upper bay, however, *Spirontocaris cristata* was taken at two stations (1 D and 1 H), in the middle bay at thirty-three (21 D and 12 H), and in the lower bay at twenty-five (10 D and 15 H). The lower bay with its predominantly muddy bottom seemed to be the more favored habitat of this species. Here fourteen and four-tenths specimens per dredge haul were returned as compared with two and two-tenths for the middle bay and two for the upper bay. The average per catch with tow-net was, lower bay, four and eight-tenths, middle bay, three and five-tenths, and upper bay, one.

Cancer gracilis, the only other species found in the bay which ranged beyond the 30 fathom line was taken but twice outside, one specimen in 8 to 9 fathoms, on a bottom of "fine, dark, very clean sand," and two specimens in 39 to 40 fathoms, on "very fine dark-green sand." Although taken in the bay at but one upper, eight middle and three lower bay stations, its distribution was very closely related to that of the preceding species, *Spirontocaris cristata*, coinciding with it at five of the stations from which it was recorded and very nearly at the other nine. Similarly, too, the greater number of specimens per haul was in favor of the stations made on more or less muddy bottoms.

Crago nigromaculata though lacking in the upper bay, in common with other fairly well distributed bay species, seemed to a certain extent also to prefer more or less muddy bottoms. Of the nineteen stations returning it only two were located on the harder bottom of the western middle bay, and only three on sandy bottoms outside.

Crago stylirostris, however, although exceeding the range of *Crago nigromaculata* both within and outside the bay, in direct contrast to that species was found most frequently as well as most abundantly on more or less hard, sand or sandy bottoms. In the western middle bay *Crago stylirostris* was taken at twenty-eight dredging stations, in the eastern middle bay at seven, and in the upper and lower bay at only two each. Outside it was returned at eight stations from fine, grey, or coarse sand and pebble bottom. At the more or less muddy eastern middle, upper, and lower bay stations less than eleven specimens per haul were obtained, with one exception at which thirty-three were taken. But of the outside and western middle bay stations thirty returned more than twelve specimens each; of these eight returned more than thirty-three, and five more than fifty specimens. Only three specimens were taken in the tow-net, one at each of three hydrographic stations, one middle, and two lower bay.

Crago nigricauda and *Crago franciscorum* are the two most widely distributed decapods in the bay and outside within the 30 fathom line. Both were taken abundantly in all three divisions of the bay, and the latter was also abundant outside. More or less muddy bottoms returned the greater number of specimens per haul, though otherwise their distribution seemed little affected by the character of the bottom. Of the two *Crago nigricauda* is apparently more of a "bottom dweller," for even though taken at seven more dredging stations it appeared only about half as often (sixty-nine out of one hundred and thirty-seven times) in the catches of the tow-net. *C. franciscorum* was the only decapod found in Suisun Bay, as well as Napa Creek, and probably, therefore, can endure water of a lower salinity than any other species listed in connection with the survey.

Cancer magister, in spite of the fact that it is adapted primarily for living on sandy bottoms, was found well distributed throughout the region covered by the survey though not so abundantly as either of the preceding species. Within the bay it was actually taken more often on more or less muddy bottoms, but with very few exceptions

all the specimens were very much undersized. Together with *Crago nigricauda* and *C. franciscorum* this species is one of the only three that were taken at more than three stations in the upper bay, and together with these two and *Hemigrapsus oregonensis* is one of the only four taken at any of the upper bay stations lying north of Pinole Point.

In general *salinity* seems to be the controlling factor in the separation of the strictly outside species from those found in or "in and out" of the bay, and *character of bottom* that in the distribution of species within the bay. Though so important geographically, the effect of *temperature* on the local distribution of species is not at all evident. *Depth*, likewise, apparently exerts little or no influence on the distribution of the survey species: certain species were taken only beyond the 30 fathom line and others only in the course of shore collecting, but the relation of the former to the salinity outside, and the latter to their substratum is too intimate to permit any other explanation. That only four decapods are known to occur in the upper bay north of Pinole Point is probably due to the low salinity there obtaining, for although the annual range of temperature in this division is considerable it is almost equally great in the more populous but much more saline lower bay.

V. POSTSCRIPT

It is of more than passing interest to be able to notice, and compare here, the rather close correspondence between the conclusions set forth immediately above regarding the local distribution of the decapods of the Survey, and those independently arrived at by Packard (1918*a*, 1918*b*) as a result of his studies of the "Molluscan Fauna from San Francisco Bay," and published after the present paper had gone to press, viz:

"The character of the bottom appears to have the greatest significance in determining the local distribution of the mollusca" (1918*b*, p. 245). "Depth has little significance in determining the distribution of local forms...the significance of the temperature factor is obscure" (1918*a*, p. 331). "The salinity factor is considered to be the major one in accounting for the meagerness of the fauna of the upper in contrast to that of the other divisions of the bay" (1918*b*, p. 245).

Recently in *The factors controlling the distribution of the Polynoidae of the Pacific coast of North America*, Miss Essenberg (1918) has adduced what appears to be further evidence in favor of Point Conception as a faunal barrier, marking a dividing line between a north temperate zone (extending north to Cape Flattery) and a north subtropical zone (extending south to Cape San Lucas).

But if we treat the species listed by Miss Essenberg in the same manner that the California decapods were dealt with under their *Geographical Distribution* above (pp. 281 to 286), we find of the twenty-eight species of littoral record (from 100 fathoms or less) from off California, that seven (25%), so far as known at present, are restricted to the region north of Point Conception, and nine (32%) to the region south of it, while twelve (43%) range both north and south.

Of these twenty-eight polynoids of littoral record, the bathymetric range of twelve (43%) reaches beyond the 100-fathom line. It does not, therefore, seem unreasonable to expect that with more intensive collecting and dredging a considerable number of species at present only found south, will be found north of Point Conception as well, and vice versa, especially in view of Miss Essenberg's warning that, "the distribution of some of the species is as yet inadequately known" (1918, p. 175).

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VII. APPENDIX I

DISTRIBUTIONAL LIST OF THE MARINE DECAPOD CRUSTACEA OF CALIFORNIA

This list is almost wholly based on the one given by Miss Rathbun in her *Harriman Alaska Expedition Report* (1904a, pp. 8-17), with some additions from the U. S. National Museum collections, and several of the more recent authors. The species are in systematic order in the first column of the table. All of those dealt with in the section on "Distribution" (p. 281) are in roman type. Those taken in connection with the biological survey of San Francisco Bay are printed in **bold face** type, while species from depths exceeding 100 fathoms are *italicized*.

Since drawing up this table it has been found desirable to distinguish between the species whose bathymetric range is not known to exceed 30 fathoms and those which, though found within the 100-fathom line have not been taken, at least off the California coast, in 30 fathoms or less. The names of the former are followed by a black spot ●, the latter by a ○.

In the second column the northern limits of the ranges of the various species are given. In the case of Alaskan forms these as a matter of convenience, have been reduced to one of several generalized limits, i.e., Sitka, for all species whose range terminated there or between that point and the northern boundary of British Columbia; Kadiak, for the Sitka to Kadiak species; and the Aleutian Islands, for those reaching, but not running into the Bering Sea. As a matter of interest the northern limits of all species reported from the Straits of Fuca or Puget Sound have been marked with an asterisk.*

The southern limits given in the next to the last column have been similarly grouped in the case of Lower Californian species under Todos Santos Bay, San Geronimo Island, Point San Eugenio (Cerros Island), Magdalena Bay, and the Gulf of California, respectively.

The last column gives records of exceptional occurrence and of world distribution.

The remaining nine columns cover the distribution along the coast of California. Records of species from 100 fathoms or less are indicated by circular black spots, ●; those between 100 and 500 fathoms by a circle with a dot at the center, ○; and over 500 fathoms by a ○.

In a number of instances these symbols are accompanied by one or more index figures. When standing alone, an index figure signifies that the species in question has been found only at the locality referred to within the region delimited by the heading of the column in which it occurs; a plus sign (+) preceding the figure indicates that the species has also been found at the locality for which the index figure stands. Obviously where the stated northern and southern limit of a species restricts it to a particular locality the use of an index figure is unnecessary, yet they have been employed in all cases where one has been available.

The index figures and the localities for which they stand are:

- | | |
|--------------------------|-------------------------|
| 1. Pigeon Point | 7. San Clemente Island |
| 2. Point Conception | 8. San Nicolas Island |
| 3. Santa Barbara Channel | 9. Santa Barbara Island |
| 4. Laguna Beach | 10. Half Moon Bay |
| 5. San Francisco Bay | 11. Humboldt Bay |
| 6. Santa Barbara | 12. Farallon Islands |

The heading Santa Barbara Islands includes only San Miguel, Santa Rosa, Santa Cruz, and Anacapa. San Nicolas and Santa Barbara Island are separately indicated in the same column (index numbers 8 and 9), while San Clemente (index number 7) is included in the third column following, headed Santa Catalina Island.

DISTRIBUTIONAL LIST OF THE MARINE DECAPOD CRUSTACEA OF CALIFORNIA

Species	Northern limit	California Boundary— Cape Mendocino	Cape Mendocino— Point Reyes	Point Reyes— Monterey Bay	Monterey Bay— Point Conception	Santa Barbara Islands (Pt. Conception—Pt. Dume)	Santa Monica Bay (Pt. Dume—Pt. Vincente)	San Pedro Bay (Pt. Vincente—La Jolla)	Santa Catalina Island	San Diego (La Jolla—Mexican Boundary)	Southern limit	Addenda
<i>Sergestes similis</i>	Washington		○	○	○	○		○	○	○	Gulf of California	Japan
<i>Peneus brevis</i> ●	San Francisco			●				●		●	Peru	Galapagos Isls.
<i>Benthescymus albus</i>	San Clemente Isl.							○			South Pacific	Philippines; Japan; South Atlantic; off Tristan da Cunha; Gulf of Panama; Galapagos Isls.
<i>Benthescymus tanneri</i>	San Diego									○	Gulf of California	Ecuador; Galapagos Isls.
<i>Gennadas borealis</i>	Aleutian Isls.					○ ⁺⁸			○		Todos Santos Bay	
<i>Gennadas pectinatus</i>	Santa Catalina Isl.										Santa Catalina Isl.	
<i>Pasiphaea magna</i>	Point Arena		○	○					○	○	Panama	
<i>Pasiphaea pacifica</i> ●	Aleutian Isls.*		○	○	○	○				○	Gulf of California	
<i>Pasiphaea emarginata</i>	Santa Barbara Chan.					○ ³					Gulf of California	
<i>Pasiphaea corticata</i>	Cortez Bank									○	Cortez Bank	
<i>Pasiphaea affinis</i>	Cortez Bank									○	Cortez Bank	
<i>Parapasiphaea serrata</i>	Cortez Bank									○	Cortez Bank	
<i>Acanthephyra curtirostris</i>	San Clemente Isl.									○	Panama	Arabian Sea; Bay of Bengal; Andaman Sea
<i>Hymenodora frontalis</i>	Bering Sea								○		San Clemente Isl.	Kamohatka
<i>Palaemon Ritteri</i> ●	San Diego										Gulf of California	Ecuador
<i>Palaemonetes hiltoni</i> ●	San Pedro										San Pedro	
<i>Urocaris infraspinis</i> ●	San Diego										Gulf of California	
<i>Pontonia californiensis</i> ●	Santa Cruz Isl.										Santa Cruz Isl.	

DISTRIBUTIONAL LIST OF THE MARINE DECAPOD CRUSTACEA OF CALIFORNIA—(Continued)

Species	Northern limit	California Boundary— Cape Mendocino	Cape Mendocino— Point Reyes	Point Reyes— Point Reyes	Point Reyes— Monterey Bay	Monterey Bay— Point Conception	Santa Barbara Islands (Pt. Conception—Pt. Dume)	Santa Monica Bay (Pt. Dume—Pt. Vincente)	San Pedro Bay (Pt. Vincente—La Jolla)	Santa Catalina Islands	San Diego (La Jolla—Mexican Boundary)	Southern limit	Addenda
<i>Spirontocaris cristata</i>	Sitka, Alaska*			● ⁵	●	○	○	●	●	●	●	San Diego	
<i>Spirontocaris brachydactyla</i>	Santa Cruz Isl.				○						○	San Diego	
<i>Spirontocaris macrophthalmica</i>	Aleutian Isls.			● ¹²	●	● ⁶	● ⁶	●	● ⁺	●	●	Point Sur	
<i>Chargon dentipes</i> ●	Farallon Isls.				●	● ⁶	● ⁶	●	●	●	●	Magdalena Bay, Lower Cal.	Mediterranean; Cape Verde Isls.; Bermudas; West Indies; Key West
<i>Chargon bellimanus</i> ●	Monterey Bay				●	● ⁶	● ⁶	●	●	●	●	Chile	
<i>Chargon barbara</i> ●	Santa Barbara				●	● ⁶	● ⁶	●	●	●	●	Santa Barbara	
<i>Chargon californiensis</i> ●	San Pedro				●	● ⁶	● ⁶	●	●	●	●	Magdalena Bay, Lower Cal.	
<i>Chargon equidactylus</i> ●	Monterey Bay				●	● ⁶	● ⁶	●	●	●	●	Santa Barbara	
<i>Synalpheus lockingtoni</i>	San Nicolas Isl.				●	○ ⁸	● ⁶	●	●	●	●	Gulf of California	
<i>Betaeus harfordi</i>	Pt. Arena		●		●	● ⁶	● ⁶	●	● ⁺	●	●	Santa Catalina Isl.	
<i>Betaeus longidactylus</i>	San Pedro				●	● ⁶	● ⁶	●	● ⁺	●	●	San Diego	
<i>Processa canaliculata</i>	San Diego							●	● ⁺	●	●	Panama	
<i>Crango nigricauda</i>	British Columbia*	●	●	● ⁵	●			●	● ⁺	●	●	San Geronimo Isl., Lower Cal.	Europe; Madeira; Bermudas; North Carolina to Trini- dad; Gulf of Mexico; West Indies; Japan; Ambuina Japan
<i>Crango nigromaculata</i>	Bodega Bay		●	● ⁵	●			●	● ⁺	●	●	Magdalena Bay, Lower Cal.	
<i>Crango alaskensis elongata</i>	British Columbia*		●	●	●			●	●	●	●	U.S.—Mexican Boundary line	
<i>Crango alba</i>	British Columbia		●	●	●	● ⁸	● ⁸	●	● ⁺	●	●	San Diego	
<i>Crango holmesi</i>	San Pedro		●	●	●	● ⁸	● ⁸	●	● ⁺	●	●	Pt. San Eugenio, Lower Cal.	

DISTRIBUTIONAL LIST OF THE MARINE DECAPOD CRUSTACEA OF CALIFORNIA—(Continued)

Species	Northern limit	California Boundary— Cape Mendocino	Cape Mendocino— Point Reyes	Point Reyes— Monterey Bay	Monterey Bay— Point Conception	Santa Barbara Islands (Pt. Conception—Pt. Dume)	Santa Monica Bay (Pt. Dume—Pt. Vincente)	San Pedro Bay (Pt. Vincente—La Jolla)	Santa Catalina Island	San Diego (La Jolla—Mexican Boundary)	Southern limit	Addenda
<i>Holopagurus pilosus</i> ●	San Francisco	●	●	●	●			● ⁺⁴		●	San Diego	
<i>Pagurus ochotensis</i>	Aleutian Isls.*	●	●	●	●		●	●		●	San Diego	Okhotsk Sea; Japan
<i>Pagurus capillatus</i>	Arctic Alaska*										Monterey Bay	Kamchatka
<i>Pagurus lanneri</i>	Aleutian Isls.		○	○	○						San Simeon Bay	
<i>Pagurus beringanus</i> ●	Bering Sea*										Monterey Bay	
<i>Pagurus setosus</i>	Sitka, Alaska*					○					Santa Cruz Isl.	
<i>Pagurus hirsutiusculus</i> ●	Bering Sea*	● ¹¹		● ⁵⁺¹⁰	●			● ⁺⁴		●	San Diego	Siberia; Kamchatka; Japan
<i>Pagurus samuelis</i> ●	Humboldt County	●		● ⁵⁺¹⁰	●			● ⁺⁴		●	San Diego	Japan
<i>Pagurus granosimanus</i> ●	Aleutian Isls.*	●	●	● ¹⁰	●			●		●	Todos Santos Bay, Lower Cal.	
<i>Pagurus hemphilli</i> ●	British Columbia	●			●						Monterey Bay	
<i>Pagurus californiensis</i>	Monterey Bay?	●			?						Gulf of California	
<i>Pylopagurus minimus</i>	British Columbia			●	●		●	● ⁺⁴		●	San Diego	
<i>Pylopagurus holmesi</i> ●	San Pedro							●		●	San Diego	
<i>Parapagurus niertensii</i> ○	Kadiak, Alaska					● ^{○+8}		●		●	San Nicolas Isl.	Kamchatka
<i>Hapalogaster cavicauda</i> ●	Kadiak, Alaska					● ⁸					San Clemente Isl.	
<i>Hapalogaster grebnitzkii</i> ●	Bering Sea	● ¹¹									Humboldt Bay	
<i>Oedignathus inermis</i> ●	Aleutian Isls.*	●		● ⁵	●						Monterey Bay	Japan
<i>Acantholithodes hispidus</i>	Aleutian Isls.			●	●						Monterey Bay	
<i>Phylloolithodes papillosum</i>	Aleutian Isls.*				●						Monterey Bay	

<i>Cryptolithodes typicus</i> ●	Aleutian Isls.*	●								Monterey Bay
<i>Cryptolithodes sitchensis</i> ●	Sitka, Alaska*	●								Monterey Bay
<i>Lopholithodes mandtii</i>	Sitka, Alaska	●								Monterey Bay
<i>Lopholithodes foraminatus</i>	British Columbia*	●							○	San Diego
<i>Rhinolithodes wosnes-senski</i> ●	Kadiak, Alaska	●	●	●	●	●	●	●		Crescent City
<i>Paralomis multispina</i>	Aleutian Isls.		○							San Diego
<i>Paralomis verrilli</i>	Bering Sea		○							Cortez Bank
<i>Parolithodes rathbuni</i>	San Simeon Bay		○							San Diego
<i>Parolithodes californiensis</i>	Santa Cruz Isl.		○							San Diego
<i>Litholetes couesi</i>	Bering Sea								○	San Diego
<i>Pleuroncodes planipes</i> ●	90 miles S. W. San Francisco	●							○	150 miles S. W. Cape St. Lucas, Lower Cal.
<i>Galathea californiensis</i> ●	Monterey Bay	●	○						○	Pt. San Eugenio, Lower Cal.
<i>Munida quadrispina</i> ●	Sitka, Alaska*	●	○	○	○	○	○	○	○	Pt. San Eugenio, Todos Santos Bay, Lower Cal.
<i>Maniza hispidula</i>	Santa Catalina Isls.		○	○	○	○	○	○	○	Pt. San Eugenio, Lower Cal.
<i>Manidopsis hystrix</i>	Anacapa Isl.		○	○	○	○	○	○	○	Acapulco, Mexico
<i>Manidopsis verrilli</i>	Monterey Bay		○	○	○	○	○	○	○	Pt. San Eugenio, Lower Cal.
<i>Munidopsis quadrata</i> ●	Washington								○	Tres Marias Isls., Mexico
<i>Munidopsis aspera</i> ●	San Clemente Isl.								○	Straits of Magellan
<i>Blepharipoda occidentalis</i> ●	San Francisco	●								Galapagos Isls.; Brazil
<i>Lepidopa myops</i> ●	San Pedro	●								Pt. San Eugenio, Lower Cal.
<i>Emerita analoga</i>	Oregon	●	●	●	●	●	●	●	●	Cape St. Lucas, Magdalena Bay, Lower Cal.
<i>Pachycheles rudis</i> ●	Kadiak, Alaska*	●	●	●	●	●	●	●	●	Lower California
<i>Pachycheles holosericus</i> ●	Santa Monica Bay	●	●	●	●	●	●	●	●	San Diego
<i>Pachycheles pubescens</i> ●	Puget Sound*	●	●	●	●	●	●	●	●	Monterey Bay
<i>Petrolisthes cincipes</i> ●	British Columbia*	●	●	●	●	●	●	●	●	Gulf of California
<i>Petrolisthes eriomerus</i> ●	British Columbia*	●	●	●	●	●	●	●	●	Magdalena Bay, Lower Cal.
<i>Petrolisthes gracilis</i> ●	Monterey Bay								○	Gulf of California
<i>Petrolisthes rathbunae</i> ●	Monterey Bay								○	San Clemente Isl.

DISTRIBUTIONAL LIST OF THE MARINE DECAPOD CRUSTACEA OF CALIFORNIA—(Continued)

Species	Northern limit	California Boundary— Cape Mendocino	Cape Mendocino— Point Reyes	Point Reyes— Monterey Bay	Monterey Bay— Point Conception	Santa Barbara Islands (Pt. Conception—Pt. Dume)	Santa Monica Bay (Pt. Dume—Pt. Vincente)	San Pedro Bay (Pt. Vincente—La Jolla)	Santa Catalina Island	San Diego (La Jolla—Mexican Boundary)	Southern limit	Addenda
<i>Dromidia larraburei</i> ●	Monterey Bay				●			●		○	Peru	Galapagos Isls.
<i>Homola faxonii</i> ○	San Diego				●					○	San Diego	
<i>Cyclodorippe plana</i> ●	Monterey Bay ?				●			● ⁴	●	●	Santa Catalina Isl.	
<i>Randallia ornata</i>	Mendocino County				●			● ⁴	●	●	Magdalena Bay, Lower Cal.	
<i>Randallia bulligera</i> ●	San Diego										Magdalena Bay, Lower Cal.	
<i>Mursia gaudichaudii</i>	Farallon Isls.			⁺¹⁰⁺¹²	○	● ⁶		●	●	○	Chile	
<i>Heterocrypta occidentalis</i>	Gulf of the Farallones			●	●			● ⁴	●	●	Coronados Isls., Lower Cal.	
<i>Podochela hemphillii</i>	Monterey Bay			●	●			● ⁴	●	●	Gulf of California	
<i>Anasimus spinosus</i>	Monterey Bay?				●			●	●	●	Pt. San Eugenio, Lower Cal.	
<i>Oregonia gracilis</i>	Bering Sea*	●		●	●			●	●	●	Monterey Bay	Japan
<i>Inachoides tuberculatus</i>	Monterey Bay			●	●			● ⁴		●	Panama	
<i>Epialtus productus</i> ●	British Columbia*			● ⁺⁵⁺¹⁰	●	● ⁵		● ⁴	● ⁷	●	Pt. San Eugenio, Lower Cal.	
<i>Epialtus nuttallii</i> ●	Santa Barbara				●	● ⁵		● ⁴	●	●	Magdalena Bay, Lower Cal.	
<i>Epialtus bituberculatus</i> ●	Monterey Bay?				●			● ⁴	●?		Chile.	Indian River, Florida to Rio de Janeiro, Brazil, Bermudas.
<i>Mimulus foliatus</i> ●	Aleutian Isls.*				●						Mazatlan, Mexico	
<i>Pugettia gracilis</i>	Aleutian Isls.*	●		● ¹²							South'n California?	
<i>Pugettia richii</i> ●	British Columbia*				●			● ⁴	●	●	San Diego	
<i>Pugettia dalli</i> ●	San Pedro				●			● ⁴	● ⁷	●	San Geronimo Isl., Lower Cal.	

DISTRIBUTIONAL LIST OF THE MARINE DECAPOD CRUSTACEA OF CALIFORNIA—(Concluded)

Species	Northern limit	California Boundary— Cape Mendocino	Point Reyes	Point Reyes— Monterey Bay	Monterey Bay— Point Conception	Santa Barbara Islands (Pt. Conception—Pt. Dume)	Santa Monica Bay (Pt. Dume—Pt. Vincente)	San Pedro Bay (Pt. Vincente—La Jolla)	Santa Catalina Island	San Diego (La Jolla—Mexican Boundary)	Southern limit	Addenda
<i>Xanthias taylora</i>	Monterey Bay				●	● ⁸	●	● ⁴	● ⁷	●	Magdalena Bay, Lower Cal. San Diego	
<i>Xanthias latimanus</i> ●	San Diego									●		
<i>Pilumnus spinohirsutus</i> ●	Santa Monica Bay						●			●		
<i>Heteractaea lunata</i> ●	San Diego									●		
<i>Speocarcinus californiensis</i>	San Pedro									●		
<i>Pinnotheres holmesi</i> ●	Pacific Grove				●					●		
<i>Pinnotheres nudus</i> ●	Monterey Bay				●					●		
<i>Pinnotheres concharum</i> ●	British Columbia*				●					●		
<i>Fabia subquadrata</i>	Aleutian Isls.*									●		
<i>Fabia lowei</i> ●	Santa Monica Bay									●		
<i>Fabia canfieldi</i> ●	Monterey Bay				●					●		
<i>Parapinnixa affinis</i> ●	San Pedro									●		
<i>Pinnixa longipes</i> ●	Tomales Bay									●		
<i>Pinnixa tomentosa</i> ●	San Clemente Isl.									●		
<i>Pinnixa faba</i> ●	Sitka, Alaska*	● ¹¹										
<i>Pinnixa littoralis</i> ●	Sitka, Alaska*	● ¹¹										
<i>Pinnixa barnharti</i> ●	Santa Monica Bay		● ⁵							●		
<i>Pinnixa occidentalis</i>	Aleutian Isls.*									●		
<i>Pinnixa franciscana</i> ●	San Francisco		● ⁵							●		

VIII. APPENDIX II A

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING STATIONS DURING THE YEARS
1912 AND 1913

Only such data are reproduced here as have been used in the discussion of the distribution of the species listed. All other dredging data are to be found in the *Report on the Physical Conditions in San Francisco Bay* (Summer, 1914).

Unless obtained at more than three stations the species and number of specimens taken at the various stations are entered in the column of "Addenda." *Cancer antennarius* is the only exception to this rule.

Fifty or more specimens are represented by the letter "m" (many). The actual count of lesser numbers is given in full.

The positions of these stations are plotted on plates 2 and 3, and in order that they might be readily located they are referred to the "upper," "middle" or "lower" regions of the bay or to the region "outside."

The "upper" bay is taken as the section lying north of a line connecting Point San Pedro and Point San Pablo, including the region usually designated as San Pablo Bay. The "middle" bay extends from this line to one drawn from the San Francisco Ferry Building through the Goat Island Light, and separating it from the "lower" bay, the section below this latter line. The "middle" bay is separated from the region "outside" by a line passing from the Bonita Point Light through Mile Rock to the San Francisco shore.

As a rule hydrographic observations were not made in the course of dredging operations, and in order that such data obtained at the regular hydrographic stations might be used in connection with the dredging stations a table correlating the two has been drawn up as Appendix III (p. 354) of this report.

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
MIDDLE	1912	fms.									
D 5700	Jan. 30	19-17	Sand, coarse and fine gravel, broken shells.		2		8			24	7
D 5702	"	13-12½	Trawl contained chiefly shells with a few fair-sized stones.			2	5			12	7
D 5705	Feb. 6	9-9	Soft, gray mud, filled with worm tubes and ophiurans, very evident grit.			1	15	1			9
D 5706	"	9-7	Fine, semi-liquid mud, brownish gray, with black sticky lumps, very little grit, fewer worm tubes than 5705.								2
D 5707	"	8-9½	Bottom not accurately determined.				3			2	4
D 5708	"	10½-12½	Sandy mud.				3			1	1
D 5709	"	12½-10	Muddy sand.				3				3
D 5710	Feb. 16	16-9	Shell fragments, cinders, lumps of hard mud, finest ingredients washed out.							11	41
D 5711	"	8½-9½	Somewhat muddy, coarse sand and shell fragments.				2			24	6
D 5712	"	10½-14½	Coarse gray sand and shell fragments.				5			29	m
D 5713	"	17-10	Medium, coarse, gray sand with few pebbles.				2			16	8
D 5714	Feb. 28	15-9	Black, sandy mud (sand very fine) and dead shells (mostly <i>Macoma</i>).				2				2
UPPER											
D 5715	"	9½-13½	Fine, gray, dark sand, followed by soft gray mud almost free from grit.			2	15			4	19
D 5716	"	6-9	Soft, very smooth mud.				5				2
D 5717	"	7-6½	" " " "				3				
MIDDLE											
D 5718	"	7½-9	Soft, gray mud with great quantities of worm tubes and ophiurans.								
UPPER											
D 5719	Mar. 1	6½-6	Soft mud, with lumps of hard sticky mud, almost free from grit.				m				m
D 5720	"	14½-11	Soft mud and muddy sand, apparently taken separately.				5				m
D 5721	"	8½-8	Soft mud, partly black, partly brown, with coarse sand, clinkers and some large stones, abundant rotten drift-wood and vegetable debris. Animal life scarce except for crabs, shrimps and barnacles.				11				16

STATIONS DURING THE YEARS 1912 AND 1913

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutiusculus</i>	<i>Cancer productus</i>	<i>Cancer antonmaris</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).
D 5700				5							9-foot Agassiz trawl; net torn.
D 5702				3		2	1				9-foot Agassiz trawl.
D 5705			1			1					5-foot Tanner trawl.
D 5706									1		" " "
D 5707											" " "
D 5708	2		10	1		1					9-foot Agassiz trawl.
D 5709	3							1			<i>Pinnixa littoralis</i> 1. 5-foot Tanner trawl.
D 5710						1					5-foot Tanner trawl.
D 5711											" " "
D 5712						1					" " "
D 5713						1					" " "
D 5714	1					14					" " "
D 5715						4	1	1			" " "
D 5716	2					10	1				" " "
D 5717	2					10					" " "
D 5718				1		18			1		" " "
D 5719						10					" " "
D 5720						15					" " "
D 5721						40					9-foot Agassiz trawl.

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
UPPER	1912	fms.									
D 5722	Mar. 1	5½-1½	Soft, sticky mud, black and brown, without grit, containing shells of <i>Mya</i> .				2				
LOWER											
D 5723	Mar. 6	9½-11	Black, sticky mud, streaked with brown, many shells, clinkers. Fish probably lost, as none were taken. Abundant ophiurans.			20	2				1
D 5724	"	8½-9½	Soft, dark mud, somewhat gritty, with very few shell fragments.								
D 5725	"	7½-7	Soft, dark, somewhat gritty mud.								8
D 5726	Mar. 8	6½-7½	Soft, black, slightly sandy mud.			1					2
D 5727	"	6½-5½	Soft, black, sticky mud.				8				
D 5729	"	4½-4½	Sticky, nearly black mud, comparatively small quantities of shells and shell fragments.				18			1	3
D 5730	"	5-5½	Sticky, black mud, with very little grit.			3	18				6
OUTSIDE											
D 5731	Mar. 11	16-9½	Coarse sand with pebbles and shell fragments.				1			m	m
D 5732	"	11½-9½	Coarse sand and gravel, ranging up to about 2 cm. Most of sand sifted out, leaving coarse gravel. Thus, bottom sample not representative.			1	1			m	16
D 5733	"	9-8	Fine, dark, very clean sand.				2			m	9
D 5734	"	7½-9½	" " "								
D 5735	"	9½-10	" " "				4			38	40
D 5736	"	9½-10	" " "				1	1		23	7
D 5737	"	10½-13	" " "				10			34	m
MIDDLE											
D 5738	Mar. 13	60-23	Large rocks with very little coarse shelly sand.		3		2				
D 5739	"	18-22	Sand, followed by sandy mud.			1	4				9
D 5740	"	7-5	Fine, gray sand, followed by smooth gray-green mud.								
D 5741	Mar. 18	19½-18	Clean, dark-gray medium coarse sand and fine shell fragments, with a few fragments of stone. Little life; no perfect shells.							2	2
D 5742	"	20½-20	Bottom similar to last, but containing occasional small compact masses of black mud.				3			16	35

STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutipectus</i>	<i>Cancer productus</i>	<i>Cancer antennarius</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).
D 5722						9					9-foot Agassiz trawl
D 5723			1	6				1	1		5-foot Tanner trawl.
D 5724	1										9-foot Agassiz trawl; beam trawl carried away; too much mud.
D 5725						2					5-foot Tanner trawl.
D 5726											9-foot Agassiz trawl.
D 5727	3										9-foot Agassiz trawl; trawl net carried away but most of contents saved.
D 5729											9-foot Agassiz trawl.
D 5730	1									1	" " "
D 5731						1					" " "
D 5732						3					" " "
D 5733							1				" " "
D 5734						2					" " "
D 5735						2					" " "
D 5736											" " "
D 5737											" " "
D 5738											9-foot Agassiz trawl; net badly torn.
D 5739						14					5-foot Tanner trawl.
D 5740	1										5-foot Tanner trawl; net badly torn.
D 5741						1					9-foot Agassiz trawl.
D 5742						3	8				" " "

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago elaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
MIDDLE	1912	fms.									
D 5743	Mar. 18	10-15½	Muddy sand (latter so fine as to pass through finest screen of table sieve). Large amount of bottom material landed and an unusually large quantity of living worms, molluscs and brittle stars.			2	m				m
D 5744	"	5½-5	Soft, slightly sandy mud, with great quantities of worm tubes.			1	48				10
D 5745	"	14½-12½	Dark-gray sand which did not pass through finest screen of table-sieve, with small masses of black mud and considerable vegetable debris and shells.			1	m			7	m
D 5746	"	18-18	Dark-gray sand which did not pass through the finest screen of table sieve, pebbles, shell fragments, a little mud.			1	7			4	47
D 5747	Mar. 19	ft. 4- fms. 5	Dark, sticky mud, slightly gritty streaked with yellowish.			2	8				41
D 5748	"	ft. 4- fms. 5	Bottom much as in 5747.			3	1				2
D 5749	"	ft. 5- fms. 5	Very dark, sticky mud, slightly gritty, with many dead shells and shell fragments.				4				12
D 5750	Mar. 20	ft. 5- fms. 5					5				4
D 5751	"	ft. 4½- fms. 5					2				43
UPPER											
D 5752	"	ft. 5- fms. 5½	Very liquid yellow or brown-gray mud, slightly gritty, with numerous particles of vegetable debris.								1
MIDDLE											
D 5753	"	ft. 6- fms. 5	A little mud of character of that in 5752.								6
D 5754	Mar. 25	fms. 4½- ft. 3½	Brown mud, slightly gritty and not very sticky.			1	37				45
D 5755	"	fms. 3½- ft. 5	Fine, dark-gray, slightly muddy sand with shell fragments.			2	35				32

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
MIDDLE	1912	fms.									
D 5756	Mar. 26	4½-2	Soft gray mud, with abundant vegetable debris.								4
UPPER											
D 5757	"	fms. 4- ft. 4½	Fine, grayish-black, very muddy sand.				8				4
D 5758	"	fms. 2- ft. 4	Bottom as in 5756.				4				15
D 5759	April 1	fms. 4-3½	Dark gray, sticky mud, without grit or much vegetable debris.								11
D 5760	April 2	fms. 2½- ft. 3	Hard, clean, dark-gray sand, with mica flakes.								1
D 5761	"	fms. 3-5	Soft, muddy sand, or sandy mud, with driftwood fragments and other vegetable debris.								4
MIDDLE											
D 5762	April 3	3½-3¼	Rock fragments, little or no sand.			1	1				
D 5763	"	2-5½	No bottom sample taken, as eel grass did not permit dredge to scrape bottom.				20				1
D 5764	"	4¼-2¼	Bottom as in 5763.				17				3
D 5765	"	1¼-2½	Sand.				4			1	
LOWER											
D 5766	April 8	3-4	Fine, gray, non-gritty, liquid mud.			2	47				m
D 5767	April 9	3-1¼	Muddy sand.			4	m				m
D 5768	"	3½-1¼	Hard shelly bottom; living and dead <i>Mytilus</i> and <i>Monia</i> very numerous.			17	30				5
MIDDLE											
D 5769	April 15	3¼-3	Hard sand? (No bottom sample taken).							m	
D 5770	"	5-7½	Rough, rocky bottom. (No bottom sample taken).				4				

STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutioculus</i>	<i>Cancer productus</i>	<i>Cancer antennarius</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).	
D 5756	1		1								Dredged with launch in both directions, using 19-inch boat dredge and 3-foot Tanner trawl.	
D 5757			1								" " "	
D 5758											" " "	
D 5759											" " "	
D 5760											" " "	
D 5761											" " "	
D 5762						3					" " "	
D 5763			7	1		5					<i>Spirontocaris paludicola</i> 1. Dredged with launch 19-inch boat dredge and 3-foot beam trawl. (Bottoms dredged are indicated on chart by black lines, the remainder of the run by the dotted lines).	
D 5764			3			2					Launch used as in 5763. (Continuous and dotted line have same significance as above).	
D 5765			1								Launch used as in 5763 and 5764. (See note under preceding station).	
D 5766	1		3			2				11	Dredged with launch in both directions, using 19-inch boat dredge, and 3-foot Tanner trawl, (Dredged up San Antonio Creek, Oakland, with boat dredge; came back with trawl).	
D 5767				1							2	Dredged with launch in both directions, using 19-inch boat dredge and 3-foot Tanner trawl.
D 5768			1								m	Dredged with launch in both directions, using 19-inch boat dredge.
D 5769												Dredged with launch in both directions, using 19-inch boat dredge and 3-foot Tanner trawl.
D 5770												<i>Spirontocaris franciscana</i> 3. <i>Spirontocaris taylora</i> 2. Apparatus as before.

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
MIDDLE	1912	fms.									
D 5771	April 15	3½- ft. 3	Thin, dark-colored mud, not sticky and not gritty.				7				2
D 5772	"	fms. 1¼-4½	Soft mud, with numerous worm tubes. No sample saved.			1	22				1
D 5773	"	3½-2½	Rocky, the sample consisting of angular stones of various sizes.			2	7				4
D 5774	April 16	4½-4¾	Large, angular stones, covered with barnacles and bryozoa, interspersed with rounded gravel.				1				
D 5775	"	7-4	Large and small angular rock fragments.								
D 5776	April 17	3½-3¾	Fine, clean gray sand, between rocks.				29			m	
D 5777	"	3½-2½	Large, rounded weedy rocks.				28			16	1
D 5778	"	3½-2½	Fine, clean, gray sand and medium sized rounded stones.			1	m	1		28	
D 5779	May 8	3-3	Dark gray sand, rounded stones and small boulders			16	m	1			27
UPPER											
D 5780	May 13	5-1	Sticky, dark gray mud, without sand, mixed in latter part of course with abundantly broken shells (mud samples taken at both ends.)				7				m
LOWER											
D 5781	May 27	fms. 2½- ft. 3	Mud first, then shelly, after entering oyster beds.				11				
D 5782	"	4-4	Shelly.				2				
D 5783	May 28	fms. 2-2					3				
D 5784	"	1½-1¾					13				2
OUTSIDE											
D 5785	Oct. 15	39-40	Little bottom material taken, most of it having passed through meshes of net (that taken was very fine, dark-green sand).	5					22		
D 5786	"	40-40	Very fine, dark-green sand.	m					m		
D 5787	"	40-41	" " "	7					m		

STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutiusculus</i>	<i>Cancer productus</i>	<i>Cancer antennarius</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).
D 5771											Apparatus as before.
D 5772								1			" " "
D 5773			2	4							<i>Crago munitella</i> 2. Apparatus as before.
D 5774											Apparatus as before.
D 5775											<i>Crago munitella</i> 1. <i>Scleroplax granulata</i> 1. Apparatus as before.
D 5776						4					Apparatus as before.
D 5777											<i>Spirontocaris taylora</i> 2. Apparatus as before.
D 5778			1	1	1	3				2	<i>Spirontocaris franciscana</i> 1. <i>Spirontocaris brevirostris</i> 1. <i>Spirontocaris taylora</i> 6. <i>Epialtus productus</i> 1. Apparatus as before.
D 5779			1	1		3					Apparatus as before.
D 5780						3					" " "
D 5781			1							29	19-inch boat dredge. (In an unused oyster bed).
D 5782										33	19-inch boat dredge. (Made a circle in oyster bed and finished at starting point).
D 5783											19-inch boat dredge.
D 5784						1				2	" " "
D 5785		32					2				<i>Spirontocaris gracilis</i> 16. <i>Pinnixa occidentalis</i> 1. 12-foot Agassiz trawl. (On fishing grounds).
D 5786		13									<i>Spirontocaris gracilis</i> 1. Apparatus as before.
D 5787		24									<i>Paguristes bakeri</i> 1. Apparatus as before.

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
OUTSIDE D 5788	1912 Oct. 21	fms. 68-60	Very fine, green sand.	m					2		
D 5789	"	46-33	" " "	18					35		
D 5790	Oct. 22	35-33	Very coarse variegated sand, with a small proportion of fine sand.	1					m		
D 5791	"	36-29	Refuse and garbage, but little bottom material.	m		2			32		
D 5792	"	26-19	Fine, dark gray, somewhat greenish sand.				1	15	20	1	
UPPER D 5793	Oct. 28	10-14	Black, sticky mud, with grayish brown sand.				4				3
D 5794	"	14½-11	Dark gray sticky mud, with brown sand.				24				8
MIDDLE D 5795	Oct. 29	13-19	Stones (one measuring 8 inches).			2	42	1		19	14
D 5796	"	19-13½	Sand, with abundant shells and shell fragments.				9			28	18
D 5797	"	8½-7½	Sand.				m	3			m
D 5798	"	8-7½	Mud.				m			1	m
D 5799	"	8½-12½	Very fine, very muddy sand.			1	m	20		1	m
D 5800	"	16½-16½	Coarse sand and stones.				1			4	2
D 5801	"	16½-17	Gravel, stones, sand.				16			9	
LOWER D 5802	Oct. 30	10-10¼	Sandy, shelly mud.			43	m			1	m
D 5803	"	9½-8	Soft mud.			3	m	10			m
D 5804	"	7½-6¾	Soft mud and worm tubes.				m	3			m
D 5805	"	5¼-5	" " "				m	1			m
OUTSIDE D 5806	Nov. 4	14¼-13	Fine, dark gray, fairly clean sand.				6	4		3	m
D 5807	"	8½-9	.....			2	3			46	4
MIDDLE D 5808	"	43-27	Coarse sand, gravel and stones ranging up to 14 inches in length.		23		m			3	2

STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutiusculus</i>	<i>Cancer productus</i>	<i>Cancer antennarius</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).
D 5788											<i>Crago communis</i> 25. <i>Crago resima</i> 3. <i>Crago spinosissima</i> 2. <i>Paguristes turgidus</i> 2. <i>Pinnixa occidentalis</i> 1. 12-foot Agassiz trawl.
D 5789		31									<i>Crago spinosissima</i> 3. <i>Paguristes turgidus</i> 1. <i>Paguristes bakeri</i> 2. <i>Pinnixa occidentalis</i> 1. Apparatus as before.
D 5790		21									<i>Crago alba</i> 8. <i>Fylopagurus minimus</i> 1. <i>Paguristes bakeri</i> 1. <i>Cancer gibbosulus</i> 3. Apparatus as before.
D 5791		8									<i>Spirontocaris gracilis</i> 3. Apparatus as before.
D 5792		40									Apparatus as before.
D 5793											Heavy oyster dredge.
D 5794											" " "
D 5795				3		2					<i>Spirontocaris brevirostris</i> 1. Apparatus as before.
D 5796						3					Apparatus as before.
D 5797							3				5-foot sledge trawl.
D 5798						1	3				" " "
D 5799						1	7				" " "
D 5800											Heavy oyster dredge.
D 5801				1		13					" " "
D 5802				1		5	5				5-foot sledge trawl.
D 5803									1		" " "
D 5804						1					" " "
D 5805											" " "
D 5806		2				8					<i>Paguristes turgidus</i> 2. 12-foot Agassiz trawl.
D 5807						7					Apparatus as before.
D 5808				3	1	13					Oyster dredge.

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
MIDDLE	1912	fms.									
D 5809	Nov. 4	53-21½	Coarse sand, gravel and stones.	.....	3	1	48	.....	.....	2	.....
LOWER											
D 5810	Nov. 11	1¼-1½	Mud and shells.	.....	.....	.....	.....	.....	.....	.....	.....
D 5811 A, B + C	"	1-½	" " "	.....	.....	.....	.....	.....	.....	.....	.....
D 5812 A and B	Nov. 27	1	" " "	.....	.....	.....	.....	.....	.....	.....	.....
D 5813	"	1½	" " "	.....	.....	.....	.....	.....	.....	.....	.....
D 5814 A and B	"	1-1½	" " "	.....	.....	.....	.....	.....	.....	.....	.....
UPPER											
D 5815	Dec. 9	7-13	Somewhat sandy mud, vegetable fragments and fine flakes of mica, at beginning and fine, muddy sand, vegetable debris and shell fragments, at end of haul.	.....	.....	.....	34	.....	.....	.....	m
D 5816	"	9½-10½	Tenacious mud, mainly free from sand, black with yellow layer on top, and streaked throughout; many large shells of <i>Mya</i> with surface stained black, at beginning and tenacious mud, mainly dark, with yellow coating at surface, streaked throughout and containing flakes of mica, at end of haul.	.....	.....	.....	m	.....	.....	.....	m
D 5817	"	5½	Clear and sandy mud, at beginning and stiff mud, yellow at surface and streaked with sand, at end of haul.	.....	.....	.....	m	.....	.....	.....	m
D 5818	Dec. 10	5½-4½	Somewhat gritty black mud, slightly micaceous, with yellow surface layer; practically no life, at beginning and very sandy, gray and black micaceous mud, at end of haul.	.....	.....	.....	m	.....	.....	.....	m
D 5819	"	7-6	Bottom much like preceding, but semi-fluid and somewhat less sandy.	.....	.....	.....	m	.....	.....	.....	m
D 5820	"	12½-8	Bottom as before, but more sandy than at preceding stations.	.....	.....	.....	m	.....	.....	33	m
MIDDLE											
D 5821	Dec. 17	8-9½	Sandy mud and muddy sand with little tenacity, a few broken shells and many shell fragments. Very little life.	.....	.....	.....	m	4	.....	.....	m

STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutiuseculus</i>	<i>Cancer productus</i>	<i>Cancer antennarius</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).
D 5822	1					2					Orange peel bucket used at each end, sledge trawl through intervening distance.
D 5823	2										" " "
D 5824	28							1			" " "
D 5825	11					2	1	6	1		" " "
D 5826			1	1		10	8				" " "
D 5827											" " "
D 5828						1	1				" " "
D 5829											" " "
D 5830											" " "
D 5833											Orange peel bucket.
D 5835	1										" " "
D 5845					1						Heavy oyster dredge, without lining.

LIST OF SPECIES TAKEN AT "ALBATROSS" DREDGING

Station No.	Date	Depth	Character of Bottom	<i>Pandalus jordani</i>	<i>Pandalus danae</i>	<i>Spirontocaris cristata</i>	<i>Crago nigricauda</i>	<i>Crago nigromaculata</i>	<i>Crago alaskensis elongata</i>	<i>Crago stylirostris</i>	<i>Crago franciscorum</i>
LOWER	1913	fms.									
D 5847	April 22	8½-9	Dark, very tenacious mud, with scarcely any perceptible grit, and of uniform color and consistency, at beginning and black muddy sand, or sandy mud, with a large proportion of shells, at end of haul.	.....	.....	6	m	.....	.....	.....	m
D 5848	"	9-9½	Dark, very tenacious mud, except for thin layer of paler, softer mud at surface, very few shells, at beginning and dark, tenacious, clear mud, with a few patches of sand or fine gravel, a few shells and shell fragments, at end of haul.	.....	.....	45	m	.....	.....	.....	m
D 5849	"	10-9	Mud softer than last, nearly free from sand or shells, at beginning and clear, tenacious dark mud, with a few entire <i>Macoma</i> shells and fragments, at end of haul.	.....	.....	.....	6	.....	.....	.....	.....

STATIONS DURING THE YEARS 1912 AND 1913—(Concluded)

Station No.	<i>Callinassa longimana</i>	<i>Pagurus ochotensis</i>	<i>Pagurus hirsutiusculus</i>	<i>Cancer productus</i>	<i>Cancer antennarius</i>	<i>Cancer magister</i>	<i>Cancer gracilis</i>	<i>Pinnixa franciscana</i>	<i>Pinnixa schmitti</i>	<i>Hemigrapsus oregonensis</i>	Addenda (Inclusive of apparatus used).
D 5847							1			1	Orange peel bucket used at each end, sledge trawl through intervening distance.
D 5848										10	" " "
D 5849							1			4	" " "

APPENDIX II B

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913

In order to present the physical data (temperature, salinity, and phase of tide) obtained at such hydrographic stations as are correlated with the dredging stations given in appendix III (p. 354), a number of stations at which no specimens were taken have been included in this table.

The methods and apparatus employed in obtaining these data are fully explained in the report on the physical conditions (Sumner, 1914). Unless otherwise specified, the collecting apparatus consisted of three tow-nets, used simultaneously from the ship's dredging cable and towed just below or within a few feet of the surface. The three nets were a large intermediate (4-foot diameter) net made of No. 000 grit gauze, and two smaller wing-nets with 14-inch diameter hoops covered respectively with No. 12 and No. 20 bolting silk.

The positions of these stations can be readily ascertained by means of the "Reference Station" given in the second column of the table: the H stations there cited are the so-called primary hydrographic stations plotted on plate 4; the D (dredging) stations are plotted on plates 2 and 3. A summary of the hydrographic stations having approximately the same position is given below. The mean depth of all stations whose positions thus approximate has been included in this summary as a matter of record, as the depths of hydrographic stations are not otherwise given in this paper.

Only the four returns most frequent with the tow-nets (*Spirontocaris cristata*, *Crango nigricauda*, *C. franciscorum*, and the "crab megalopa") are given in the vertical columns of occurrences; all others, the species more rarely taken, are given in the column of "Addenda." Fifty or more specimens are represented by the letter "m" (many).

SUMMARY OF HYDROGRAPHIC STATIONS HAVING APPROXIMATELY
THE SAME POSITION.

Primary hydrographic station	Mean depth (all stations)	Hydrographic stations having approximately the same positions as the primary stations.
MIDDLE	fms.	
4967	11.7	5000, 5097, 5120, 5130, 5188, 5218, 5240, 5277, 5297, 5328.
4968	19.5	4999, 5098, 5121, 5131, 5156, 5298, 5327.
4969	19.2	4998, 5099, 5122, 5155, 5190, 5216, 5299, 5326.
4970	8.0	4997, 5133, 5191, 5215, 5237, 5280.
4971	9.9	4996, 5101, 5124, 5134, 5192, 5214, 5236.
4972	8.3	4995, 5102, 5125, 5135, 5193, 5235, 5282.
4973	7.1	4994, 5103, 5126, 5136, 5234, 5283.
4974	7.7	4993, 5104, 5127, 5137, 5150, 5233, 5284.
UPPER		
4975	12.5	4986, 5088, 5111, 5149, 5166, 5179, 5196, 5268, 5291.
4976	8.7	4987, 5087, 5110, 5167, 5178, 5242, 5267.
4977	6.2	4988, 5086, 5109, 5168, 5243, 5266.
4978	5.1	4989, 5085, 5169, 5176, 5199, 5244, 5265, 5288.
4979	6.6	4990, 5084, 5107, 5200, 5264.
4980	6.5	4991, 5083, 5103, 5171, 5246, 5263.
4981	12.5	4992, 5082, 5105, 5146, 5172, 5262, 5330.
LOWER		
5001	6.0	5017, 5096, 5119, 5158, 5187, 5248, 5276, 5313.
5002	5.0	5016, 5095, 5118, 5144, 5159, 5186, 5275, 5311.
5003	4.8	5015, 5117, 5143, 5160, 5185, 5274, 5315.
5004	5.5	5014, 5116, 5161, 5184, 5207, 5251, 5273, 5316.
5005	5.9	5013, 5115, 5162, 5183, 5206, 5252, 5272, 5308, 5317.
5006	8.2	5012, 5114, 5163, 5182, 5205, 5253, 5271.
5007	9.9	5010, 5090, 5113, 5164, 5181, 5204, 5254, 5270, 5306, 5319.
5008	11.5	5009, 5089, 5112, 5138, 5165, 5255, 5269, 5320.

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crago nigricauda	Crago franciscorum	Crab megalopa	Addenda
				Sur- face	Bot- tom	Sur- face	Bot- tom					
MIDDLE		1912		C.	C.	‰	‰					
H 4967		Feb. 13	Strong ebb	12.1	12.2	29.53	31.01					
H 4968		"	"	12.1	12.2	27.59	26.10					
H 4969		"	"	12.2	13.1	26.49	28.40					
H 4970		"	"	12.1	12.1	26.96	28.46					
H 4971		"	"	12.1	12.0	26.16	26.32					
H 4972		"	Ebb	12.0	12.1	23.91	25.39					
H 4973		"	"	12.0	12.0	18.23	22.76					
H 4974		"	"	12.0	11.9	17.47	21.74					
UPPER												
H 4975		Feb. 15	Strong ebb	12.1	12.0	13.91	18.56					
H 4976		"	"	12.1	12.0	13.94	17.68					
H 4977		"	"	12.0	12.1	15.10	19.85					
H 4978		"	"	12.0	12.2	14.19	21.47					
H 4979		"	"	12.2	12.2	21.54	22.11					
H 4980		"	"	12.1	12.2	19.02	21.28					
H 4981		"	"	11.8	12.2	21.41	22.51					
MIDDLE												
H 4982	D 5710	Feb. 16	Flood	11.0								
H 4983	D 5711	"	"	11.0								
H 4984	D 5712	"	"	11.0								
UPPER												
H 4986	H 4975	Feb. 20	Flood	12.2	12.2	7.01	12.67			43		
H 4987	H 4976	"	"	12.3	12.5	13.33	17.40		4	38		Net touched bottom.
H 4988	H 4977	"	"	12.9	12.6	11.35	19.57					Full of mud.
H 4989	H 4978	"	Slight flood	12.9	12.7	21.42	21.12		5	m		
H 4990	H 4979	"	"	12.8	12.6	24.22	24.19					
H 4991	H 4980	"	*Slack water	12.7	12.7	24.03	24.77					*Changing to fairly strong ebb.
H 4992	H 4981	Feb. 21	Flood, stream slow	12.3	12.6	18.95	23.95					
MIDDLE												
H 4993	H 4974	"	Flood	12.4	12.6	22.35	24.49			m		
H 4994	H 4973	"	"	12.6	12.4	23.77	25.35		3	2		
H 4995	H 4972	"	"	12.6	12.3	25.20	27.59		3	5		
H 4996	H 4971	"	Slow stream		12.7	26.78	29.14	1	m	m		<i>Spirontocaris</i> young 1. <i>Crago stylirostris</i> 1. <i>Callinassa longimana</i> 1.

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Squilla cristata	Crago nigricaula	Crago franciscorum	Crab megalopa	Addenda
				Surface	Bottom	Surface	Bottom					
MIDDLE												
		1912		C.	C.	‰	‰					
H 4997	H 4970	Feb. 21	Slow stream	12.9	12.3	28.74					1	
H 4998	H 4969	"	"	12.5	12.2	28.40	28.92	1	13		2	
H 4999	H 4968	"	"	12.5	12.2	28.23	28.14			19	1	
H 5000	H 4967	"	Slack	12.2	12.2	31.00	31.18					
LOWER												
H 5001		Feb. 23	*Flood	12.3	12.4	28.53	27.30					*Moderate current.
H 5002		"	"	12.6	12.6	28.56	28.40			40		
H 5003		"	"	12.7	12.6	28.29	28.33			38		
H 5004		"	"	12.7	12.6	28.14	28.02	1	23			
H 5005		"	"	12.7	12.6	27.87	27.83	1	4			<i>Crago stylirostris</i> 1.
H 5006		"	Flood, slow stream	12.5	12.8	27.48	27.52			1		Mud haul.
H 5007		"	"	12.4	12.2	26.94	27.17			12		
H 5008		"	"	12.6	12.0	27.68	27.85			2		
H 5009	H 5008	Feb. 27	Swift ebb (at outset)	11.4	10.8	27.37	28.84					
H 5010	H 5007	"	Ebb	11.6	11.4	27.01	27.72	2	m			
H 5012	H 5006	"	"	11.8	11.6	27.81	27.65			15		
H 5013	H 5005	"	"	11.7	11.7	27.79	27.75	9	m			
H 5014	H 5004	"	"	11.6	11.6	28.11	28.12	2	46			
H 5015	H 5003	"	"	11.7	11.6	28.23	28.28	1	4			<i>Crago stylirostris</i> 1.
H 5016	H 5002	"	"	11.6	11.6	28.28	28.25			3		
H 5017	H 5001	"	"	11.3	11.5	28.38	28.33			4		
UPPER												
H 5082	H 4981	April 23	"	13.2	12.2	13.83	22.68	6	20			
H 5083	H 4980	"	"	13.0	12.7	16.17		5	49			
H 5084	H 4979	"	"	13.4	13.2	13.13		m	m	14		
H 5085	H 4978	"	"	13.4	13.3		8.09		m			
H 5086	H 4977	"	"	13.4	13.7	4.15	7.79		11			
H 5087	H 4976	"	Flood	13.3	13.3	3.75	9.71		46			
H 5088	H 4975	"	"	13.4	13.4	3.25	9.03		16			
LOWER												
H 5089	H 5008	April 26	Ebb	12.9	11.6	25.85	29.06			1		
H 5090	H 5007	"	"	12.6	12.0	26.55	27.79			3		
H 5091	H 5006	"	"	13.2	12.7	26.21	26.39	2	1	m		
H 5092	H 5005	"	"	13.2	12.9	24.85		1	19			

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crago nigricauda	Crago franciscorum	Crab megalopa	Addenda
				Surface	Bottom	Surface	Bottom					
LOWER		1912		C.	C.	‰	‰					
H 5093	H 5004	April 26	Ebb	13.2	13.8		27.01			m		
H 5094	H 5003	"	"	14.2	13.9	27.17	27.08	1	3	49	1	
H 5095	H 5002	"	"	14.0	13.9	27.17				m		
H 5096	H 5001	"	"	14.2	13.9	26.87	27.31			m		
MIDDLE												
H 5097	H 4967	April 29	"	11.1	11.0	31.36	31.61				1	
H 5098	H 4968	"	"	11.8	11.0	30.02	31.16	3	2	3	1	
H 5099	H 4969	"	"	12.0	11.1	29.95	30.79	1				
H 5101	H 4971	"	"	12.3	11.6	26.71	29.89	1	12	7	2	
H 5102	H 4972	"	"	12.7	12.1	25.30	27.48	1		5	1	
H 5103	H 4973	"	"	13.0	12.3	23.31	26.39		1	47		
H 5104	H 4974	"	"	13.0	12.9	22.29	23.64		9	m	1	
UPPER												
H 5105	H 4981	April 30	Flood	13.1	12.7	19.75	23.29		2	m	1	
H 5106	H 4980	"	"	13.1	12.8	19.96	22.05		5	m	3	
H 5107	H 4979	"	"	13.3	12.8	18.95	21.89		6	m		
H 5109	H 4977	"	"	13.8	13.7	14.00	14.00		7	m	1	
H 5110	H 4976	"	"	13.7	13.8	12.45	14.29		1	m		
H 5111	H 4975	"	"	14.2	13.9	9.96	13.35		3	m		
LOWER												
H 5112	H 5008	May 1	"	12.6	12.6	26.58	27.89	2	7	m	9	
H 5113	H 5007	"	"	12.7	12.7	27.33	27.85		2	26		
H 5114	H 5006	"	"	13.0	13.1	27.26	27.79		4	20	1	
H 5115	H 5005	"	"	13.2	13.3	27.01	27.01	1	3	m	9	
H 5116	H 5004	"	"	13.6	13.8	27.17	27.01		8	9		
H 5117	H 5003	"	"	14.2	14.3	27.01	27.01	1	1	3	1	
H 5118	H 5002	"	"	14.2	14.3	26.87	27.01		1			
H 5119	H 5001	"	"	14.0	13.9	26.87	26.78					
MIDDLE												
H 5120	H 4967	May 6	"	13.5	12.9	26.55	27.79	1	2	6		
H 5121	H 4968	"	"	13.4	12.6	22.99						
H 5122	H 4969	"	"	14.6	12.3	20.82	28.88		2	11	4	<i>Spirontocaris</i> young 1.
H 5123	H 4970	"	"	14.8	12.6	19.70	28.88	1		27	2	
H 5124	H 4971	"	"	13.9	13.0	18.34	27.33		2	39	1	<i>Callinassa longimana</i> 1.
H 5125	H 4972	"	"	14.4	13.1	21.60	27.21		1	3	1	

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crago nigricauda	Crago franciscorum	Crab megalopa	Addenda
				Surface	Bottom	Surface	Bottom					
MIDDLE		1912		C.	C.	‰	‰					
H 5126	H 4973	May 6	Flood	13.9	13.2	23.08	27.33			7	1	
H 5127	H 4974	"	"	14.3	13.2	20.66	26.55		5	14	1	
H 5128	*	May 14	"	12.2	12.2	28.79	29.34	1		1	28+	*Between Alcatraz Isl. and H 4967.
H 5130	H 4967	July 22	Ebb	14.3	14.3	31.05	31.36				20+	
H 5131	H 4968	"	"	15.9	14.4	29.47	31.10			3		
H 5133	H 4970	"	"	17.0	14.8	27.54	30.98				10	
H 5134	H 4971	"	"	18.1	14.8	24.39	30.33	1		m	25+	
H 5135	H 4972	"	"	18.2	15.8	28.07	28.88				15+	<i>Cancer antennarius</i> 2.
H 5136	H 4973	"	"	17.8	16.0	27.21	28.79				2	
H 5137	H 4974	"	"	17.6	16.0	25.49	28.56			19		<i>Cancer antennarius</i> 1.
LOWER												
H 5138	H 5008	July 23	"	17.0	15.0	28.14	30.37	43	9	31		
H 5143	H 5003	"	"	18.4	18.3	27.70	27.59		1	31		
H 5144	H 5002	"	"	18.5	18.3	27.74	27.68		4	40		
UPPER												
H 5146	H 4981	July 24	"	17.3		26.39	28.79		3	29		
H 5149	H 4975	"	"	19.3	18.9	15.16	18.63			m		
MIDDLE												
H 5150	H 4974	July 29	Flood	17.9	17.2	22.32	26.49			48		
H 5155	H 4969	"	"	15.8	14.9	28.95	30.50			10		
H 5156	H 4968	"	"	14.6	14.4	30.96	30.98			11		
LOWER												
H 5158	H 5001	July 30	"	19.3	19.4	27.85	27.87		9	42		
H 5159	H 5002	"	"	19.2	19.3	27.91	27.82			m		
H 5160	H 5003	"	"	18.7	18.8	27.94	27.87			m		
H 5161	H 5004	"	"	17.8	17.7	28.33	28.33		1	m		
H 5162	H 5005	"	"	17.7	17.0	28.49	28.79			19		
H 5163	H 5006	"	"	17.4	17.4	28.51	28.64	1	29	m		
H 5164	H 5007	"	"	16.5	16.4	29.10	29.18		9	m		
H 5165	H 5008	"	"	15.9	14.9	30.11	30.83	2	6	22		
UPPER												
H 5166	H 4975	July 31	"	18.3	18.7	9.96	12.89			m		
H 5167	H 4976	"	"	18.4	18.6	11.35	16.11			m		
H 5168	H 4977	"	"	18.6	18.7	16.63	16.94		1	48		<i>Cancer magister</i> 2.
H 5169	H 4978	"	"	18.3	18.3	21.91	22.05		2	10		
H 5171	H 4980	"	"	17.2	16.9	26.47	27.01			7		

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crango nigricauda	Crango franciscorum	Crab megalopa	Addenda
				Sur-face	Bot-tom	Sur-face	Bot-tom					
UPPER		1912		C.	C.	‰	‰					
H 5172	H 4981	July 31	Flood	17.0	15.9	28.25	29.23	.....	2	9	.....
H 5173	H 4981	Oct. 7	Ebb	16.3	15.4	30.20	31.09	.....	.....	1	.....
H 5176	H 4978	"	"	16.9	16.4	21.24	26.99	.....	.....	6	.....	No. 20 came up muddy.
H 5178	H 4976	"	"	17.1	16.9	18.02	18.34	.....	.....	4	.....
H 5179	H 4977	"	"	17.1	16.6	20.78	21.21	.....	.....	m	.....
LOWER												
H 5180	H 5008	Oct. 8	"	14.3	14.0	32.21	32.60	.....	.....	16	.....
H 5181	H 5007	"	"	15.4	14.2	31.89	32.45	.....	.....	9	.....
H 5182	H 5006	"	"	15.5	15.4	31.36	31.66	.....	.....	1	.....
H 5183	H 5005	"	"	16.6	16.0	31.27	31.36	.....	.....	2	.....
H 5184	H 5004	"	"	17.2	17.2	31.29	31.27	.....	.....	.....	.....
H 5185	H 5003	"	"	17.4	17.2	31.60	31.36	.....	.....	7	.....
H 5186	H 5002	"	"	17.2	17.0	31.27	31.33	1	20	40	.....	As grit gauze lining ripped, outer bag was used as an inter. tow-net (1 in. mesh) at this station.
H 5187	H 5001	"	"	17.0	16.6	31.44	31.36	.....	2	26	.....
MIDDLE												
H 5188	H 4967	Oct. 9	"	13.2	12.7	33.22	33.27	1	.....	6	.....
H 5190	H 4969	"	"	14.4	13.7	32.80	32.60	.....	.....	1	.....
H 5191	H 4970	"	"	14.4	13.9	32.83	32.60	.....	.....	.....	.....
H 5192	H 4971	"	"	14.8	13.9	32.28	32.67	.....	.....	.....	.....
H 5193	H 4972	"	"	14.9	14.3	31.90	32.27	.....	1	41	.....
UPPER												
H 5196	H 4975	Oct. 10	Flood	16.2	16.1	14.03	17.08	.....	1	8	.....
H 5199	H 4978	"	"	16.0	16.0	24.77	25.16	.....	1	m	.....
H 5200	H 4979	"	"	15.8	15.4	28.26	28.95	.....	.....	4	.....
LOWER												
H 5204	H 5007	Oct. 11	"	16.0	15.9	31.51	31.51	.....	.....	.....	.....
H 5205	H 5006	"	"	16.6	16.6	31.36	31.36	.....	.....	.....	.....
H 5206	H 5005	"	"	16.6	16.6	30.89	31.05	.....	.....	.....	.....
H 5207	H 5004	"	"	16.7	16.6	31.18	30.91	.....	.....	.....	.....
MIDDLE												
H 5214	H 4971	Oct. 12	"	14.4	14.2	31.53	31.66	.....	.....	.....	.....
H 5215	H 4970	"	"	14.7	14.3	31.12	31.66	.....	.....	.....	.....
H 5216	H 4969	"	"	19.4	13.6	32.08	32.18	3	.....	.....	.....
H 5217	H 4968	"	"	13.8	13.4	32.29	31.99	.....	.....	.....	.....	Spirontocaris young 1.
H 5218	H 4967	"	"	13.2	13.4	33.06	52.33	.....	.....	1	.....

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crango nigricauda	Crango franciscorum	Crab megalopa	Addenda
				Surface	Bottom	Surface	Bottom					
OUTSIDE				1912		C.	C.	‰	‰			
H 5219	D 5785	Oct. 15	Ebb	12.0	9.8	33.81	34.14					
H 5220	D 5787	"	Flood	12.2	11.8							
H 5221	D 5788	Oct. 21	Ebb	11.3	9.3	34.16	33.99					
H 5222	D 5789	"	"	11.4	9.4	34.16	34.31					
H 5223	D 5790	Oct. 22	Ebb	11.5		33.89						
H 5224	D 5791	"	"	11.3	9.8	33.87	34.27					
H 5225	D 5792	"	"	11.0		34.08						
H 5226	D 5806	Nov. 4	"	12.2	11.0	33.09	34.03					Vertical tow-net haul.
H 5227	D 5807	"	"	12.2	11.9	32.81	32.93					"
MIDDLE												
H 5228	D 5808	"	"							2		"
LOWER												
H 5229	D 5810	Nov. 11		13.9- 14.3	13.4- 13.8	31.40- 31.42	31.21- 31.36					
H 5231 A,B+C	D 5811 A,B+C	"	Ebb	14.2- 14.3	14.0- 14.4	31.50- 31.51	31.44- 31.60					
MIDDLE												
H 5233	H 4974	Nov. 25	Flood	12.2	12.4	27.26	28.60					
H 5234	H 4973	"	"	12.1	12.4	26.66	29.82					
H 5235	H 4972	"	"	12.2	12.2	29.10	31.07					
H 5236	H 4971	"	"	12.0	12.2	28.60						
H 5237	H 4970	"	"	12.2	12.2	26.68	30.98					
H 5240	H 4967	"	"	12.0	12.0	32.14	32.28					
UPPER												
H 5241	H 4975	Nov. 26	"	11.8	12.2	14.29	20.38					
H 5242	H 4976	"	"	11.9	12.0	14.62	21.35					
H 5243	H 4977	"	"	12.6	12.3	17.40	22.92					
H 5244	H 4978	"	"	12.4	12.4	22.83	25.62					
H 5246	H 4980	"	Slack	12.6	12.2	25.85	28.26					
LOWER												
H 5248	H 5001	Nov. 27	Flood	13.0	12.9	29.60	30.11					
H 5250	H 5003	"	"	12.9	12.9	28.28	29.16		1	1		
H 5251	H 5004	"	"	12.8	12.8	28.77	28.40		3	m		
H 5252	H 5005	"	"	12.5	12.4	28.72	29.16		4	m		
H 5253	H 5006	"	"	12.5	12.2	29.56	30.11			3		
H 5254	H 5007	"	" (nearly slack)	12.5	12.2	29.43	30.43			4		

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Continued)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crago nigricauda	Crago franciscorum	Crab megalopa	Addenda
				Surface	Bottom	Surface ‰	Bottom ‰					
LOWER												
H 5255	H 5008	Nov. 27	Ebb (beginning)	12.6	12.2	30.35	30.82			2		
H 5256 A and B	D 5812 A and B	"	Flood	12.3	12.4	30.89- 31.36	31.27					<i>Hemigrapsus oregonensis</i> 1.
H 5257		"	"							21		Tow-net haul between H5256 A, and B.
H 5258	D 5813	"	"	12.7	12.7	31.05	31.18					
H 5260 A and B	D 5814 A and B	"	Ebb	12.8- 12.9	12.9	30.11- 30.79	30.11- 30.74					
UPPER												
H 5262	H 4981	Dec. 3	"	11.5	11.7	26.71	28.95			9		
H 5263	H 4980	"	"	11.5	11.7	25.97	28.02					
H 5264	H 4979	"	"	11.5	11.7	24.03	26.32	1				
H 5265	H 4978	"	"	11.5	11.7	17.33	24.52					
H 5266	H 4977	"	"	11.4	11.6	17.47	22.13			9		
H 5267	H 4976	"	"	10.9	11.2	13.75	14.29			44		
H 5268	H 4975	"	"	11.3	11.2	13.37	17.40					
LOWER												
H 5269	H 5008	Dec. 4	"	11.3	11.1	29.04	31.12			40		
H 5270	H 5007	"	"	11.6	11.7	29.50	28.88			3		
H 5271	H 5006	"	"	11.8	11.8	29.50	28.56			17		
H 5272	H 5005	"	"	11.8	11.8	29.50	29.50		2	m		
H 5273	H 5004	"	"	12.0	12.1	29.95	29.95			2		
H 5274	H 5003	"	"	12.0	12.0	30.50	29.89		1	15		
H 5275	H 5002	"	"	12.5	11.6	30.20	30.28			9		
H 5276	H 5001	"	"	11.9	12.0	30.43	30.43		1	m		
MIDDLE												
H 5277	H 4967	Dec. 5	"	11.0	11.1	32.28	32.37					
H 5280	H 4970	"	"	11.4	11.3	31.66	31.66					
H 5282	H 4972	"	"	11.4	11.5	30.66	31.21					
H 5283	H 4973	"	"	11.4	11.4	28.40	30.35					
H 5284	H 4974	"	"	11.1	11.4	27.33	29.04					
UPPER												
H 5288	H 4978	Jan. 13	"	7.0	6.8	18.56	22.83			2		
MIDDLE												
H 5297	H 4967	Jan. 20	"	8.7	8.8	28.97	29.82					
H 5298	H 4968	"	"	8.7	9.0	29.06	30.74	21	37	m		

LIST OF SPECIES TAKEN AT "ALBATROSS" HYDROGRAPHIC STATIONS DURING THE YEARS 1912 AND 1913—(Concluded)

Station No.	Reference Station	Date	Phase of Tide	Temperature		Salinity		Spirontocaris cristata	Crago nigricauda	Crago franciscorum	Crab megalopa	Addenda
				Surface	Bottom	Surface	Bottom					
MIDDLE		1913		C.	C.	‰	‰					
H 5299	H 4969	Jan. 20	Ebb	8.7	8.8	28.56	29.50	7	34	23		
H 5302	H 4972	"	"	8.2	8.3	24.30	25.31		8	m		
LOWER												
H 5306	H 5007	"	"	8.7	8.8	28.02	29.50			1		
H 5308	H 5005	Jan. 21	"	8.1	8.2	27.79	27.94		2	9		
H 5311	H 5002	"	"	7.6	7.7	28.84	29.08	8	1	m		
H 5313	H 5001	Jan. 27	Flood	8.0	8.2	28.56	28.84			16		
H 5315	H 5003	"	"	8.3	10.6	28.02	27.94			12		
H 5316	H 5004	"	"	8.6	8.6	27.33	27.40			6		
H 5317	H 5005	"	"	8.8	8.4	26.62	27.01	2				
H 5319	H 5007	"	"	8.7	8.8	26.10	26.73	4	10	m		
H 5320	H 5008	"	"	9.0	9.0	26.39	28.33		2	9		
MIDDLE												
H 5326	H 4969	Jan. 28	"	8.9	9.4	25.70	28.55					
H 5327	H 4968	"	"	9.0	9.4	26.62	29.50					
H 5328	H 4967	"	"	9.3	9.4	29.04	29.95					
UPPER												
H 5330	H 4981	July 21	"	17.3	16.6	23.80	26.74			4		

APPENDIX II C

1. SHORE COLLECTIONS DURING THE YEAR 1912

- March 1; Sausalito
Cancer gracilis, 1.
- March 15; Sausalito; crab-net over ship's side
Cancer antennarius, 1.
- March 19; Sausalito Ferry building
Spirontocaris taylora, 5.
Spirontocaris cristata, 3.
Hemigrapsus nudus, 2.
- March 23; Sausalito; 150-foot seine
Epialtus productus, 1.
Cancer productus, 1.
Cancer antennarius, 1.
Cancer magister, 3.
Cancer gracilis, 1.
- March 30; Sausalito; 150-foot seine —
Cancer productus, 1.
Cancer gracilis, 1.
Hemigrapsus nudus, 1.
- August 1; Point Bonita, between tide marks
Pagurus hirsutiusculus, 2.
Oedignathus inermis, 1.
Epialtus productus, 4.
Cancer antennarius, 1.
Cancer gracilis, 1.
Pachygrapsus crassipes, 7.
Hemigrapsus nudus, 11.
Hemigrapsus oregonensis, 4.
- August 1; Presidio shore, west of Fort Point
Emerita analoga, 1.
Pachygrapsus crassipes, 1.
Hemigrapsus nudus, 1.
- August 2; Key Route pier, piles
Hemigrapsus oregonensis, 12.
- August 2; north of Key Route pier
Crago franciscorum, 2.
Cancer magister, 3.
Hemigrapsus nudus, 4.
Hemigrapsus oregonensis, many.
- August 3; Red Rock
Pagurus hirsutiusculus, 22.
Pachygrapsus crassipes, 1.
Hemigrapsus nudus, 18.
Hemigrapsus oregonensis, 25.
- August 3; Richmond shore, north of Standard Oil pier
Spirontocaris paludicola, 1.
Pagurus hirsutiusculus, 25.
Pagurus samuelis, 1.
Petrolisthes cinctipes, 4.
Cancer magister, 1.
Hemigrapsus nudus, 10.
Hemigrapsus oregonensis, 34.
- November 23; Sausalito, near landing
Petrolisthes cinctipes, 1.

2. SHORE COLLECTIONS DURING THE YEAR 1913

- January 18; Sausalito
Pagurus hirsutiusculus, 1.
Hemigrapsus oregonensis, 3.
- February 8; Sausalito
Upogebia pugettensis, 1.
- February 14; Sausalito
Hemigrapsus oregonensis, 1.
- February 17; Sausalito
Hemigrapsus nudus, 5.
Hemigrapsus oregonensis, 20.
- March 4; Sausalito
Pagurus hirsutiusculus, 3.
Epialtus productus, 9.
Pachygrapsus crassipes, 1.
- March 14; Sausalito
Hemigrapsus oregonensis, 6.
- March 21; Sausalito
Pagurus hirsutiusculus, 2.
- March 27; Angel Island, west of Blunt Point, 250-foot seine
Crago nigricauda, 22.
Crago stylirostris, 1.
Emerita analoga, 1.
- April 3; Sausalito, electric light, ship's side
Crago franciscorum, 16.
- April 19; Fort Baker, seine
Crago nigricauda, 16.
Crago nigromaculata, 11.
Crago franciscorum, 1.
Emerita analoga, 1.
Cancer magister, 1.

April 29; Tiburon, 150-foot seine
Crago nigricauda, many.
Crago franciscorum, 4.
Upogebia pugettensis, 2.
Cancer magister, 1.
Hemigrapsus oregonensis, 1.

May 13; Fort Baker beach, 250-foot
 seine
Crago nigricauda, 18.
Crago nigromaculata, 7.
Cancer magister, 7.
 October 5; Sausalito
Cancer antennarius, 1.
 October; Sausalito
Epialtus productus, 1.

APPENDIX II D

MISCELLANEOUS COLLECTIONS

“Fishing grounds,” off Golden
 Gate, July, 1912.
Crago nigricauda, 7.
Crago stylirostris, 1.
Pagurus ochotensis, 3.
Paguristes bakeri, 7.
Oregonia gracilis, 1.
Cancer magister, 35.
Cancer gracilis, 2.

“Experimental trial of otter-trawl,”
 off Golden Gate, April 6, 1914
Randallia ornata, 1.

“No label”
Holopagurus pilosus, 1.
Oedignathus inermis, 1.
Acantholithodes hispidus, 1.

IX. APPENDIX III

LIST OF CORRELATED "ALBATROSS" DREDGING AND HYDROGRAPHIC STATIONS
OF THE YEARS 1912 AND 1913

For the purpose of rendering the hydrographic data obtained at hydrographic stations available for use in connection with the dredging stations, at which no such observations were made, this table correlating the two was drawn up at my suggestion by Mr. R. A. Coleman, clerk on the "Albatross."

Following the various dredging stations, the hydrographic stations most nearly related to them in point of time and position are given. These in turn are followed by the primary hydrographic station of the group to which each belongs (see Appendix II B, p. 340), together with their annual mean and the range of both temperature and salinity. These figures are, in a degree, applicable to the dredging stations with which they approximately correspond.

The actual observations for any particular hydrographic station may be ascertained by reference to Appendix II B (p. 342).

As to the method and procedure pursued in obtaining these data, the reader is referred to the *Report on the Physical Conditions in San Francisco Bay* (Summer, 1914).

LIST OF CORRELATED "ALBATROSS" DREDGING AND HYDROGRAPHIC STATIONS OF
THE YEARS 1912 AND 1913

Dredging station (for position see plates 2 and 3).		Nearest hydrographic station with respect to time and position (for position see corresponding primary station).				Primary hydrographic station (for position see plate 4).				
No.	Date	Flood		Ebb		No.	Temperature		Salinity	
		No.	Date	No.	Date		Mean	Range	Mean	Range
			1912		1912		C.	C.	‰	‰
MIDDLE	1912									
5700	Jan. 30	5000	Feb. 21	4967	Feb. 13	4967	12.01	8.7-14.3	31.04	26.6-33.3
5702	"	"	"	"	"	"	"	"	"	"
5705	Feb. 6	4997	Feb. 21	4970	Feb. 13	4970	12.69	8.5-17.1	28.52	19.7-32.8
5706	"	"	"	"	"	"	"	"	"	"
5707	Feb. 6	4993	Feb. 21	4974	Feb. 13	4974	13.05	7.8-18.0	24.39	15.2-30.1
5708	"	"	"	"	"	"	"	"	"	"
5709	"	"	"	"	"	"	"	"	"	"
5710	Feb. 16	5000	Feb. 21	4967	Feb. 13	4967	12.01	8.7-14.3	31.04	26.6-33.3
5711	"	"	"	"	"	"	"	"	"	"
5712	"	"	"	"	"	"	"	"	"	"
5713	"	"	"	"	"	"	"	"	"	"
5714	Feb. 28	4993	Feb. 21	4974	Feb. 13	4974	13.05	7.8-18.0	24.39	15.2-30.1
UPPER										
5715	Feb. 28	4992	Feb. 21	4981	Feb. 15	4981	13.29	7.1-17.3	25.33	13.8-32.5
5716	Feb. 28	4991	Feb. 20	4980	Feb. 15	4980	12.44	7.1-17.2	24.98	16.2-30.1
5717	"	"	"	"	"	"	"	"	"	"
MIDDLE										
5718	Feb. 28	4998	Feb. 21	4969	Feb. 1	4969	12.72	8.7-19.5	29.61	20.8-32.8
UPPER										
5719	Mar. 1	4990	Feb. 20	4979	Feb. 15	4979	13.06	7.1-18.1	24.46	13.1-28.9
5720	Mar. 1	4986	Feb. 20	4975	Feb. 15	4975	13.14	6.0-19.3	15.24	3.3-21.2
5721	Mar. 1	4987	Feb. 20	4976	Feb. 15	4976	13.06	6.0-18.5	15.69	3.8-21.4
5722	Mar. 1	4988	Feb. 20	4977	Feb. 15	4977	13.29	6.2-19.6	17.35	4.2-23.3
LOWER										
5723	Mar. 6	5007	Feb. 23	5010	Feb. 27	5007	12.85	8.7-17.1	28.76	26.1-32.5
5724	Mar. 6	5006	Feb. 23	5012	Feb. 27	5006	13.17	8.2-17.4	28.50	25.6-31.7
5725	"	"	"	"	"	"	"	"	"	"
5726	Mar. 8	5005	Feb. 23	5013	Feb. 27	5005	13.28	8.1-18.2	28.47	24.9-31.4
5727	"	"	"	"	"	"	"	"	"	"
5729	Mar. 8	5003	Feb. 23	5015	Feb. 27	5003	13.81	7.7-18.8	28.68	27.0-31.6
5730	Mar. 8	5002	Feb. 23	5016	Feb. 27	5002	13.75	7.6-19.3	28.90	26.9-31.3

LIST OF CORRELATED "ALBATROSS" DREDGING AND HYDROGRAPHIC STATIONS OF THE YEARS 1912 AND 1913—(Continued)

Dredging station (for position see plates 2 and 3).		Nearest hydrographic station with respect to time and position (for position see corresponding primary station).				Primary hydrographic station (for position see plate 4).				
No.	Date	Flood		Ebb		No.	Temperature		Salinity	
		No.	Date	No.	Date		Mean	Range	Mean	Range
	1912		1912		1912		C.	C.	‰	‰
OUTSIDE						Outside				
5731	Mar. 11	No hydrographic stations near enough with respect to time.				"				
5732	"	The outside hydrographic stations are H 5219-5227, inclusive, see dredging stations D 5785-5792, 5806, and 5807 in this table.				"				
5733	"					"				
5734	"					"				
5735	"					"				
5736	"					"				
5737	"					"				
MIDDLE										
5738	Mar. 13	5000	Feb. 21	4967	Feb. 13	4967	12.01	8.7-14.3	31.04	26.6-33.3
5739	Mar. 13	4999	Feb. 21	4968	Feb. 13	4968	12.26	8.7-16.0	30.07	23.0-33.2
5740	"	"	"	"	"	"	"	"	"	"
5741	Mar. 18	4997	Feb. 21	4970	Feb. 13	4970	12.69	8.5-17.1	28.52	19.7-32.8
5742	"	"	"	"	"	"	"	"	"	"
5743	Mar. 18	4999	Feb. 21	4968	Feb. 13	4968	12.26	8.7-16.0	30.07	23.0-33.2
5744	"	"	"	"	"	"	"	"	"	"
5745	Mar. 18	5008	Feb. 23	5009	Feb. 27	5008	12.64	8.5-17.0	29.14	25.9-32.7
5746	Mar. 18	5000	Feb. 21	4967	Feb. 13	4967	12.01	8.7-14.3	31.04	26.6-33.3
5747	Mar. 19	4995	Feb. 21	4972	Feb. 13	4972	12.88	8.2-18.2	26.96	18.0-32.3
5748	Mar. 19	4994	Feb. 21	4973	Feb. 13	4973	12.99	7.9-17.8	25.49	14.9-30.4
5749	"	"	"	"	"	"	"	"	"	"
5750	Mar. 20	4993	Feb. 21	4974	Feb. 13	4974	13.05	7.8-18.0	24.39	15.2-30.1
5751	"	"	"	"	"	"	"	"	"	"
UPPER										
5752	Mar. 20	5105	April 30	5082	April 23	4981	13.29	7.1-17.3	25.33	13.8-32.5
MIDDLE										
5753	Mar. 20	4993	Feb. 21	4974	Feb. 13	4974	13.05	7.8-18.0	24.39	15.2-30.1
5754	Mar. 25	4998	Feb. 21	4969	Feb. 13	4969	12.72	8.7-19.5	29.61	20.8-32.8
5755	Mar. 25	5008	Feb. 23	5009	Feb. 27	5008	12.64	8.5-17.0	29.14	25.9-32.7
5756	Mar. 26	4995	Feb. 21	5102	April 29	4972	12.88	8.2-18.2	26.96	18.0-32.3
UPPER										
5757	Mar. 26	5105	April 30	5082	April 23	4981	13.29	7.1-17.3	25.33	13.8-32.5
5758	"	"	"	"	"	"	"	"	"	"
5759	April 1	5087	April 23	.....	.....	4976	13.06	6.0-18.5	15.69	3.8-21.4
5760	April 2	5088	April 23	.....	.....	4975	13.14	6.0-19.3	15.24	3.3-21.2
5761	"	"	"	.....	.....	"	"	"	"	"

LIST OF CORRELATED "ALBATROSS" DREDGING AND HYDROGRAPHIC STATIONS OF THE YEARS 1912 AND 1913—(Continued)

Dredging station (for position see plates 2 and 3).		Nearest hydrographic station with respect to time and position (for position see corresponding primary station).				Primary hydrographic station (for position see plate 4).				
No.	Date	Flood		Ebb		No.	Temperature		Salinity	
		No.	Date	No.	Date		Mean	Range	Mean	Range
	1912		1912		1912		C.	C.	‰	‰
MIDDLE										
5762	April 3	5120	May 6	5097	April 29	4967	12.01	8.7-14.3	31.04	26.6-33.3
5763	"	"	"	"	"	"	"	"	"	"
5764	April 3	5122	May 6	5099	April 29	4969	12.72	8.7-19.5	29.61	20.8-32.8
5765	April 3	5121	May 6	5098	April 29	4968	12.26	8.7-16.0	30.07	23.0-33.2
LOWER										
5766	April 8	5112	May 1	5089	April 26	5008	12.64	8.5-17.0	29.14	25.9-32.7
5767	April 9	5113	May 1	5090	April 26	5007	12.85	8.7-17.1	28.76	26.1-32.5
5768	"	"	"	"	"	"	"	"	"	"
MIDDLE										
5769	April 15	5120	May 6	5097	April 29	4967	12.01	8.7-14.3	31.04	26.6-33.3
5770	"	"	"	"	"	"	"	"	"	"
5771	"	"	"	"	"	"	"	"	"	"
5772	"	"	"	"	"	"	"	"	"	"
5773	"	"	"	"	"	"	"	"	"	"
5774	April 16	"	"	"	"	"	"	"	"	"
5775	"	"	"	"	"	"	"	"	"	"
5776	April 17	"	"	"	"	"	"	"	"	"
5777	"	"	"	"	"	"	"	"	"	"
5778	"	"	"	"	"	"	"	"	"	"
5779	May 8	"	"	"	"	"	"	"	"	"
UPPER										
5780	May 13	5107	April 30	5084	April 23	4979	13.06	7.1-18.1	24.46	13.1-28.9
LOWER										
5781	May 27	5119	May 1	5096	April 26	5001	13.69	7.6-19.4	28.80	26.8-31.5
5782	"	"	"	"	"	"	"	"	"	"
5783	May 28	"	"	"	"	"	"	"	"	"
5784	"	"	"	"	"	"	"	"	"	"
OUTSIDE										
5785	Oct. 15	5220	Oct. 15	5219	Oct. 15	Outside	11.06	9.8-12.1	34.04	33.8-34.2
5786	"	"	"	"	"	"	11.67	11.0-12.2	34.08	34.1-34.1
5787	"	"	"	"	"	"	11.67	11.0-12.3	34.08	34.1-34.1
5788	Oct. 21	"	"	5221	Oct. 21	"	10.17	9.3-11.3	34.05	34.0-34.2
5789	"	"	"	5222	"	"	10.72	9.4-11.4	34.10	33.8-34.3
5790	Oct. 22	"	"	5223	Oct. 22	"	10.61	9.7-11.5	33.90	33.9-33.9
5791	"	"	"	5224	"	"	10.22	9.6-11.3	34.05	33.9-34.3
5792	"	"	"	5225	"	"	11.06	11.0-11.1	34.05	34.0-34.1

LIST OF CORRELATED "ALBATROSS" DREDGING AND HYDROGRAPHIC STATIONS OF THE YEARS 1912 AND 1913—(Continued)

Dredging station (for position see plates 2 and 3).		Nearest hydrographic station with respect to time and position (for position see corresponding primary station).				Primary hydrographic station (for position see plate 4).				
No.	Date	Flood		Ebb		No.	Temperature		Salinity	
		No.	Date	No.	Date		Mean	Range	Mean	Range
			1912		1912		C.	C.	‰	‰
UPPER	1912									
5793	Oct. 28	5196	Oct. 10	5179	Oct. 7	4975	13.14	6.0-19.3	15.24	3.3-21.2
5794	"	"	"	"	"	"	"	"	"	"
MIDDLE										
5795	Oct. 29	5215	Oct. 12	5191	Oct. 9	4970	12.69	8.5-17.1	28.52	19.7-32.8
5796	"	"	"	"	"	"	"	"	"	"
5797	"	"	"	"	"	"	"	"	"	"
5798	Oct. 29	5214	Oct. 12	5192	Oct. 9	4971	12.71	8.3-18.1	28.13	18.3-32.7
5799	"	"	"	"	"	"	"	"	"	"
5800	Oct. 29	5218	Oct. 12	5188	Oct. 9	4967	12.01	8.7-14.3	31.04	26.6-33.3
5801	"	"	"	"	"	"	"	"	"	"
LOWER										
5802	Oct. 30	5204	Oct. 11	5181	Oct. 8	5007	12.85	8.7-17.1	28.76	26.1-32.5
5803	Oct. 30	5205	Oct. 11	5182	Oct. 8	5006	13.17	8.2-17.4	28.50	25.6-31.7
5804	Oct. 30	5206	Oct. 11	5183	Oct. 8	5005	13.28	8.1-18.2	28.47	24.9-31.4
5805	Oct. 30	5207	Oct. 11	5184	Oct. 8	5004	13.53	7.7-18.6	28.67	27.0-31.3
OUTSIDE										
5806	Nov. 4	.....	.....	5226	Nov. 4	Outside	11.61	11.1-12.2	33.49	33.1-34.0
5807	"	.....	.....	5227	"	"	12.06	11.9-12.3	32.87	32.8-32.9
MIDDLE										
5808	Nov. 4	5240	Nov. 25	5277	Dec. 5	4967	12.01	8.7-14.3	31.04	26.6-33.3
5809	"	"	"	"	"	"	"	"	"	"
LOWER										
5810	Nov. 11	5248	Nov. 27	5229	Nov. 11	5001	13.69	7.6-19.4	28.80	26.8-31.5
5811	"	"	"	5231	"	"	"	"	"	"
5812	Nov. 27	"	"	5260	Nov. 22	"	"	"	"	"
5813	"	5256	"	"	"	"	"	"	"	"
5814	"	5258	"	"	"	"	"	"	"	"
UPPER										
5815	Dec. 9	5241	Nov. 26	5268	Dec. 3	4975	13.14	6.0-19.3	15.24	3.3-21.2
5816	Dec. 9	5242	Nov. 26	5267	Dec. 3	4976	13.06	6.0-18.5	15.69	3.3-21.4
5817	Dec. 9	5243	Nov. 26	5266	Dec. 3	4977	13.29	6.2-19.6	17.35	4.2-23.3
5818	Dec. 10	5244	Nov. 26	5265	Dec. 3	4978	12.68	6.5-18.3	19.62	8.1-27.0
5819	Dec. 10	5246	Nov. 26	5263	Dec. 3	4980	12.44	7.1-17.2	24.98	16.2-30.1
5820	Dec. 10	.....	.....	5262	Dec. 3	4981	13.29	7.1-17.3	25.33	13.8-32.5

X. EXPLANATION OF PLATES

All specimens figured are contained in the collections of the United States National Museum, except *Pinnixa barnharti*, male (pl. 41, figs. 1 and 4), which is in the Museum of Comparative Zoology at Cambridge, Massachusetts. Only where suitable California material of a particular species was unobtainable has that from other localities been utilized for photographing. Unless otherwise stated all localities are Californian, and before the numbers designating the "Albatross" stations D, signifying dredging, is to be understood.

Page references to the text are given below under the names of the species figured on the plates.

PLATE I

COAST OF CALIFORNIA

A. Northern boundary of the state of California to San Francisco.

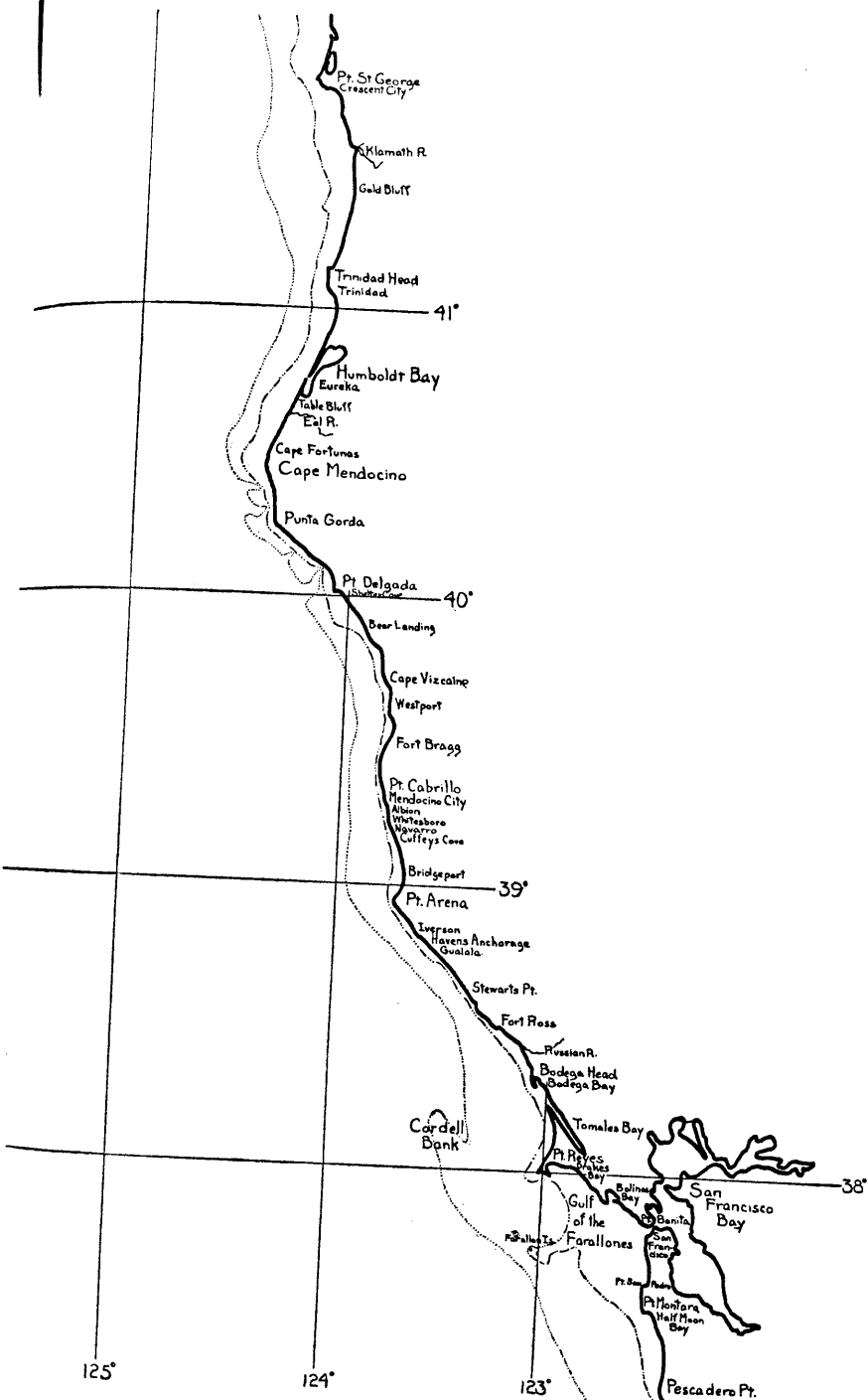
B. San Francisco to Point Conception.

C. Point Conception to southern boundary of the state of California.

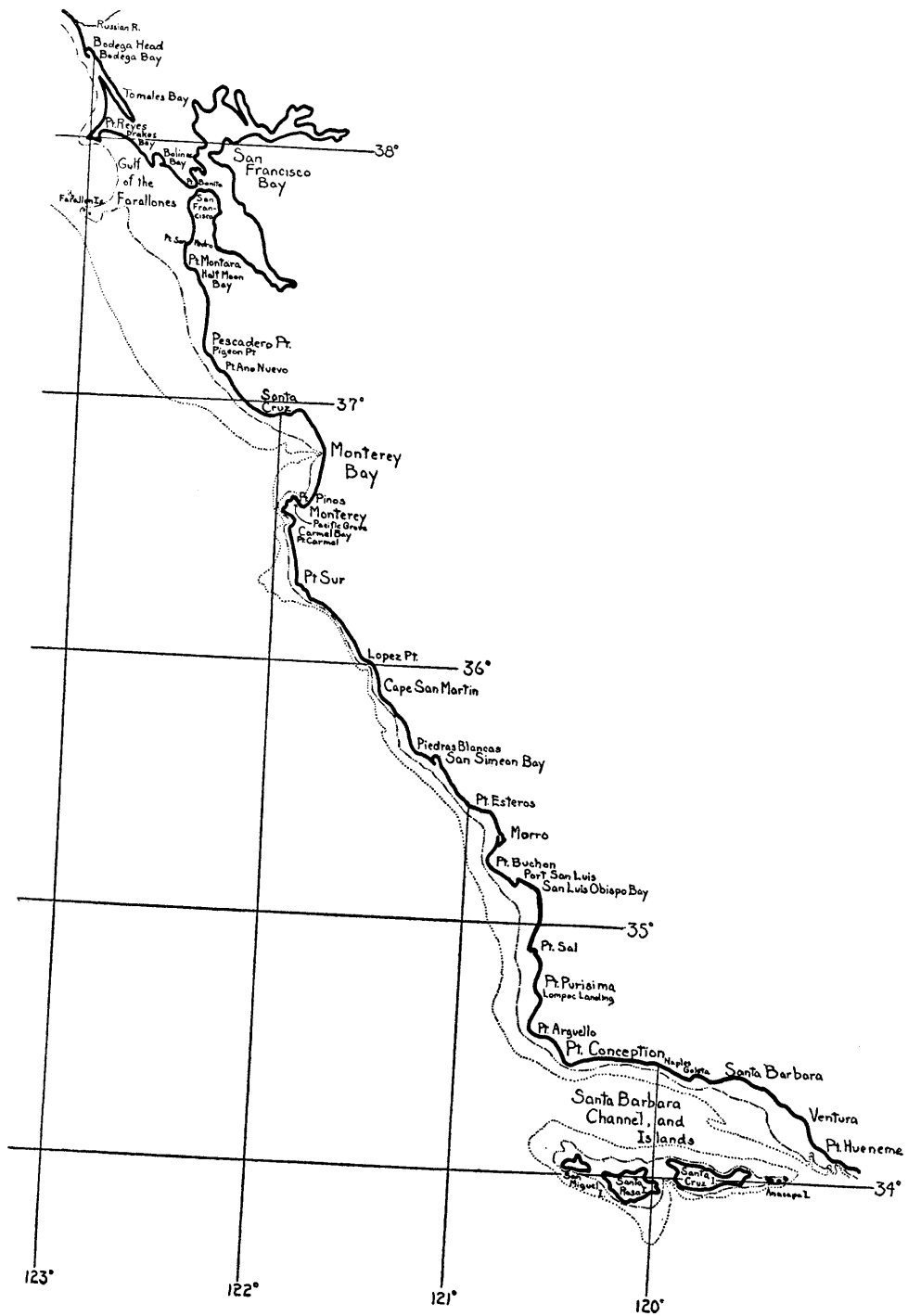
The 100-fathom line is represented by the dotted line (.....); the 30-fathom line by dots and dashes (...—...—).

Each degree of latitude equals 60 nautical miles (one nautical mile equals 6086.7 feet, or 1.15 statute miles).

These outline maps are based on the U. S. Coast and Geodetic Survey's Chart No. 5200.



A.



B.

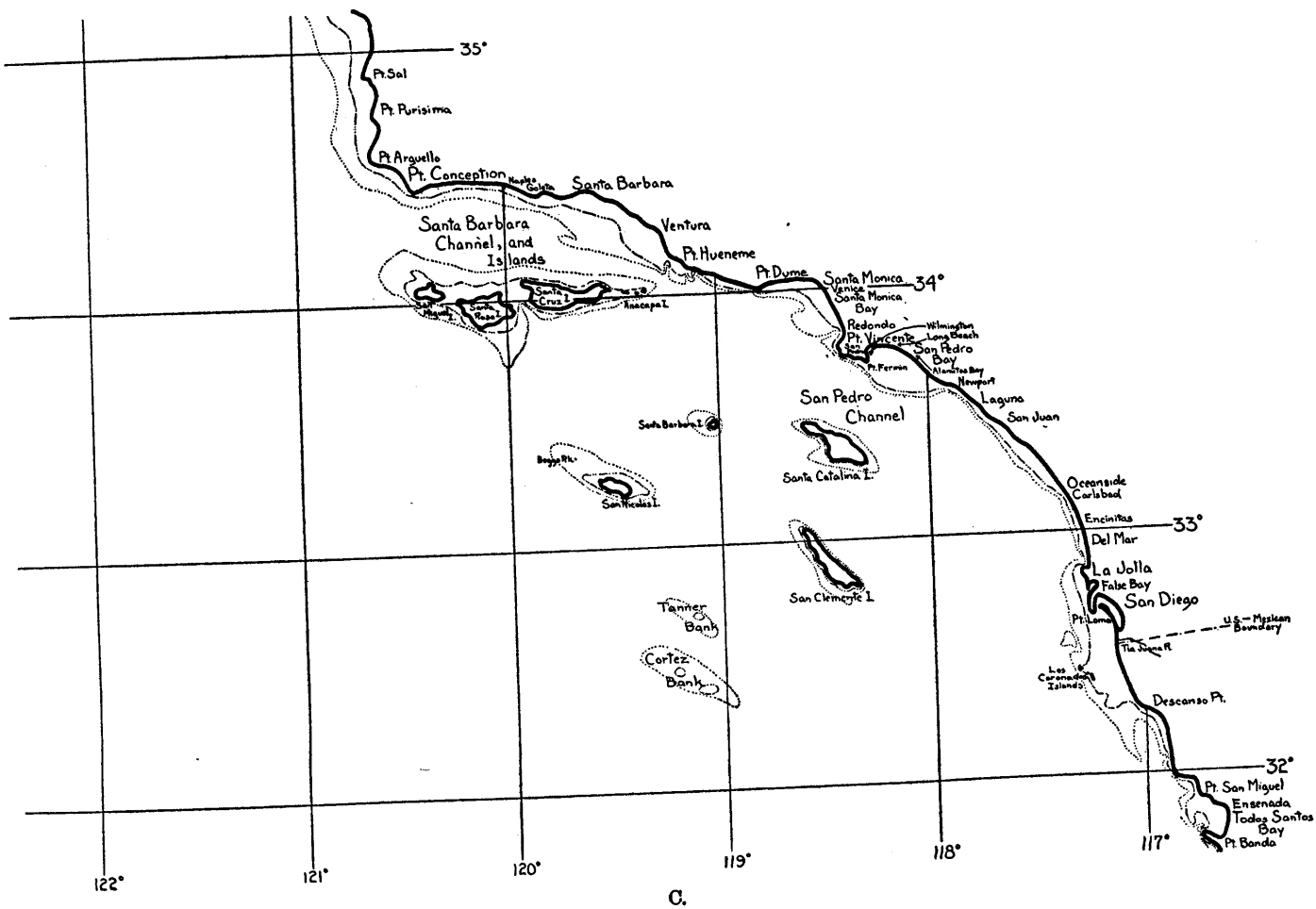


PLATE 2

Dredging stations of the "Albatross" in San Francisco Bay during 1912 and 1913 (from Sumner, *et al.*, Univ. Calif. Publ. Zool., 1914, pl. 1).

ADDENDA ET CORRIGENDA

Complete parenthesis after station 5814 (A), in insert carrying extreme lower end of bay.

Station 5732 east of Pt. San Mateo should be 5782.

The Standard Oil pier is the pier paralleling the number designating station 5756.

Red Rock is the island below station 5753 and west of the number designating it.

Bluff Point is the large point of land at the extreme northern end of Raccoon Strait near the number designating station 5795.

Mission Rock is the island off the San Francisco shore west of stations 5723 and 5802.

Potrero Point (San Francisco side of bay) is the most prominent one on the line of 37° 45' N.

Potrero Point (east side of bay near extreme lower end) is the prominent point of land north of the number designating station 5812 (A).

PLATE 3

Dredging stations of the "Albatross" outside of San Francisco Bay during 1912 (from Sumner, *et al.*, 1914, pl. 2).

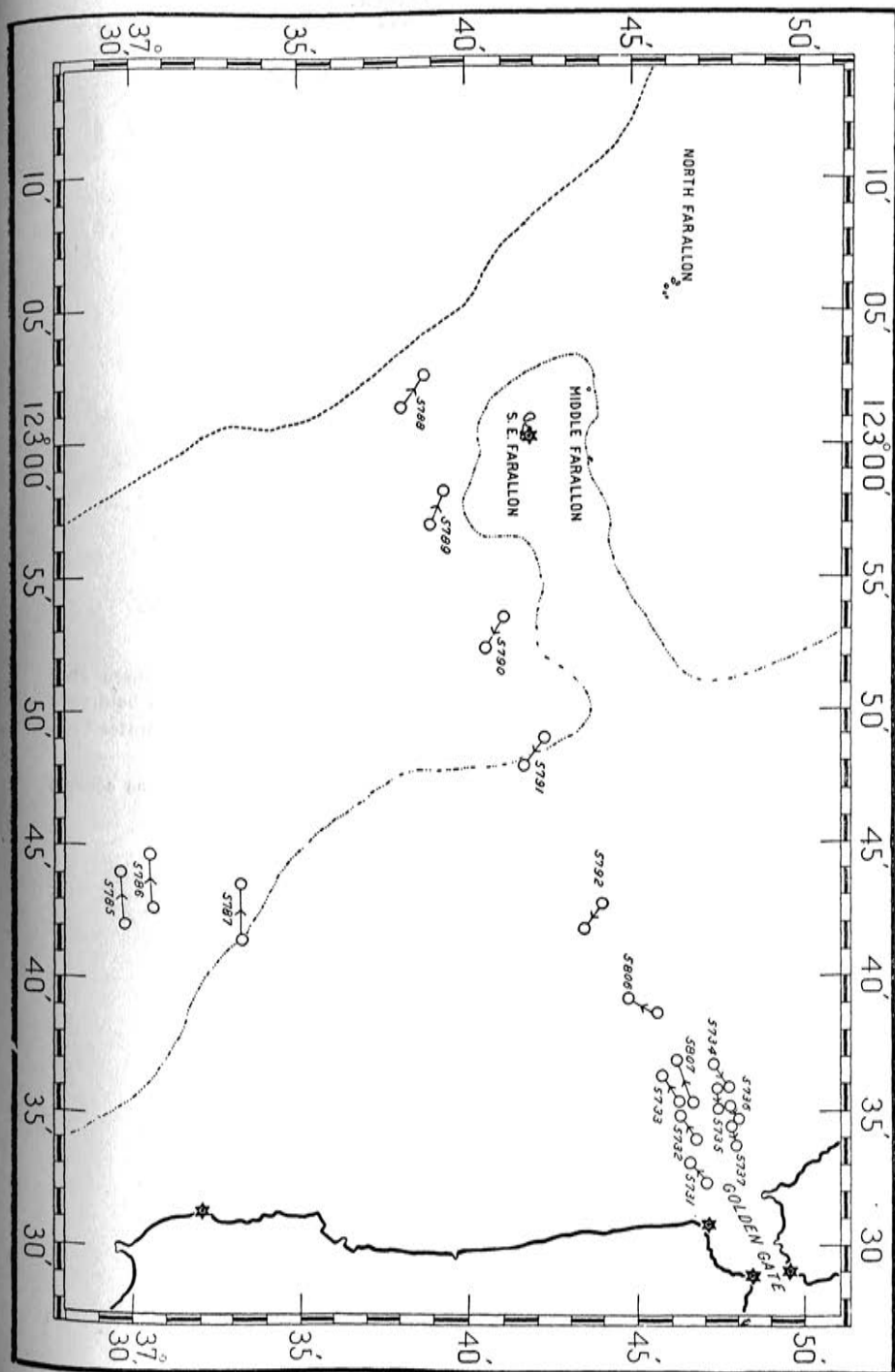


PLATE 4

Primary hydrographic stations of the "Albatross" in San Francisco Bay during 1912 and 1913 (from Sumner, *et al*, 1914, pl. 3). The figures in bold face type accompanying each of the primary stations give the mean annual water temperature at that station in degrees Centigrade.

In order to ascertain the position of other than "primary" stations consult Appendix II B (p. 342).



PLATE 5

Distribution of *Pandalus danae* (p. 45) ○ and *Cancer productus* (p. 222) ●
in San Francisco Bay.



PLATE 6

Distribution of *Spirontocaris cristata* (p. 70) ● and *Cancer gracilis* (p. 232) ○
in San Francisco Bay. (Dotted symbols represent hydrographic stations.)



PLATE 7

Distribution of *Crago stylirostris* (p. 91) ● and *C. nigromaculata* (p. 87) ○ in San Francisco Bay. (Dotted symbols represent hydrographic stations. Of these the one in the lower bay represents two stations having approximately the same position.)



PLATE 8

Distribution of *Callianassa longimana* (p. 118) ● and *Pagurus hirsutiusculus* (p. 138) ○ in San Francisco Bay. (Dotted symbol represents in this case two hydrographic stations having approximately the same position.)



PLATE 9

Distribution of *Pinnixa franciscana* (p. 263) ● and *P. schmitti* (p. 264) ○ in San Francisco Bay.



PLATE 10

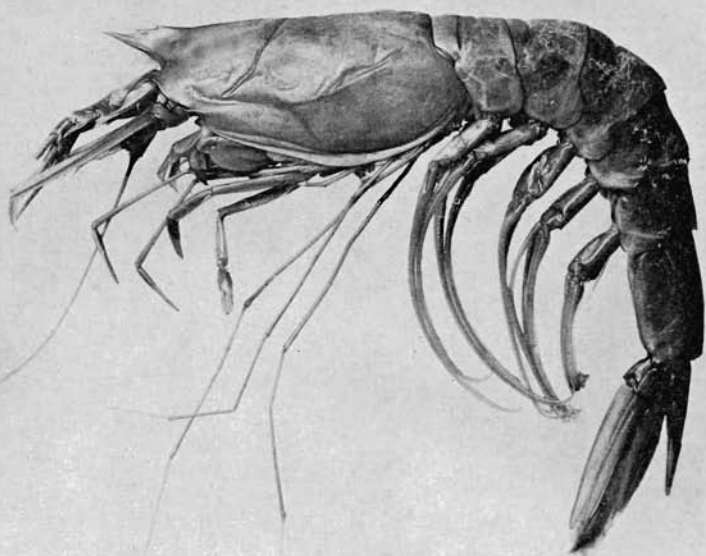
Distribution of *Cancer magister* (p. 229) ● and *Hemigrapsus oregonensis* (p. 274) ○ in San Francisco Bay. (Dotted symbols represent hydrographic stations.)



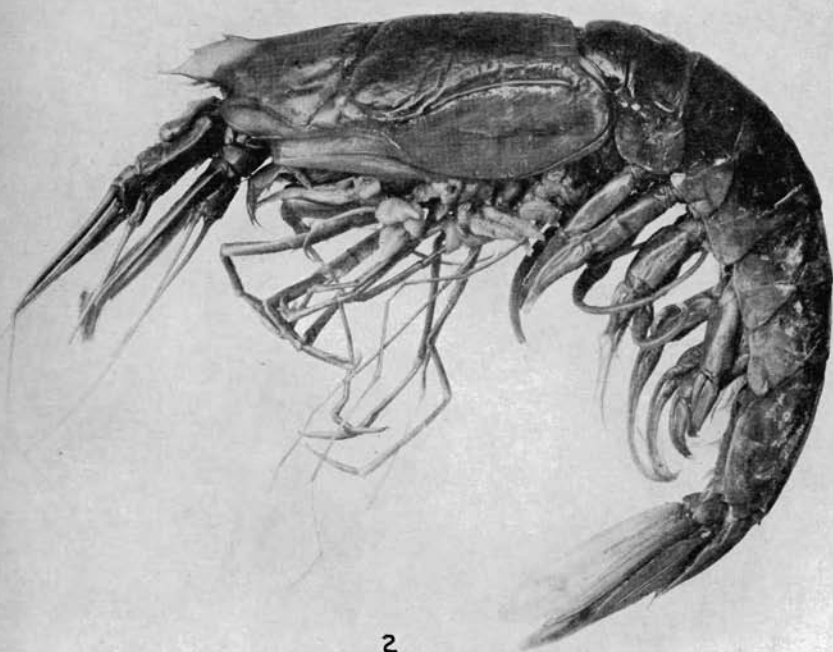
PLATE 11

Fig. 1. *Gennadas pectinatus*, female holotype; lateral view, \times about $1\frac{1}{10}$. Off San Nicolas Island, 2182-1350 fathoms. ("Albatross" station 4390.) (Page 25.)

Fig. 2. *Benthesicymus altus*, female; lateral view, \times about $1\frac{1}{10}$. Off San Nicolas Island, 2182-1350 fathoms. ("Albatross" station 4390.) (Page 22.)



1



2

PLATE 12

Fig. 1. *Synalpheus lockingtoni*, female; dorsal view, $\times 1\frac{1}{5}$. Beach at Venice, in roots of *Neriocystis*. (Page 77.)

Fig. 2. *Betaeus longidactylus*, female; lateral view, $\times 1\frac{1}{5}$. Rocky Point, San Pedro. (Page 80.)

Fig. 3. *Crago lomae*, male holotype; lateral view, $\times 1\frac{1}{5}$. Off Point Loma, 525-541-514 fathoms. ("Albatross" station 4334.) (Page 100.)

Fig. 4. *Crago lomae*, female paratype; dorsal view, $\times 1\frac{1}{5}$. Off Point Loma, 639-628-640 fathoms. ("Albatross" station 4353.) (Page 100.)

Fig. 5. *Palaemonetes hiltoni*, female holotype; lateral view, $\times 2\frac{3}{5}$. San Pedro. (Page 36.)

Fig. 6. *Processa canaliculata*, male; lateral view, $\times 1\frac{1}{5}$. Off San Joseph Island, Gulf of California, 40 fathoms. ("Albatross" station 2998.) (Page 81.)

Fig. 7. *Sergestes similis*, female; lateral view, $\times 1\frac{1}{5}$. Santa Barbara Channel, 322 fathoms. ("Albatross" station 2903.) (Page 19.)

Fig. 8. *Spirontocaris franciscana*, female holotype; dorsal view, $\times 1\frac{1}{5}$. San Francisco Bay, 5-7 $\frac{1}{2}$ fathoms. ("Albatross" station 5770.) (Page 60.)

Fig. 9. Same specimen as fig. 8; lateral view.

Fig. 10. *Spirontocaris lagunae*, female; dorsal view, $\times 2$. Laguna Beach. (Page 57.)

Fig. 11. Same specimen as fig. 10; lateral view.

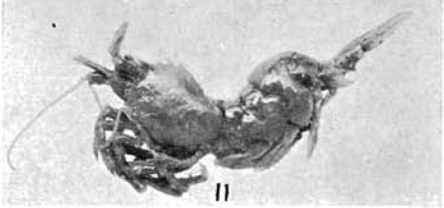
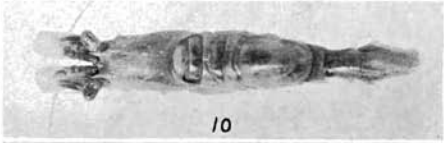
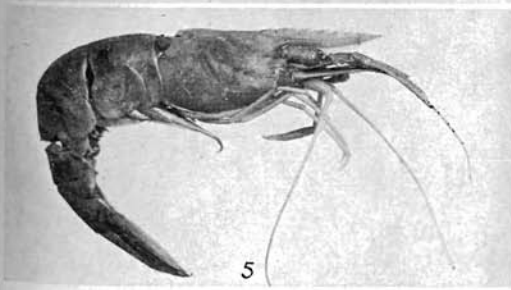
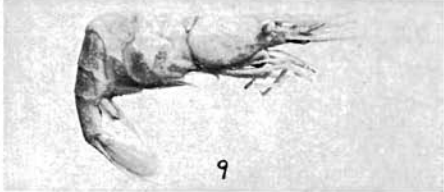
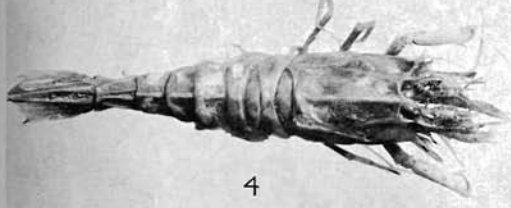
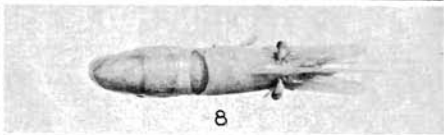
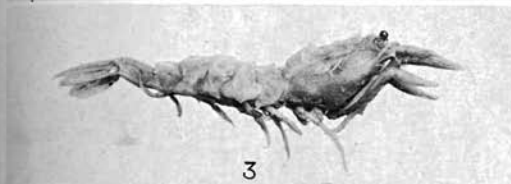
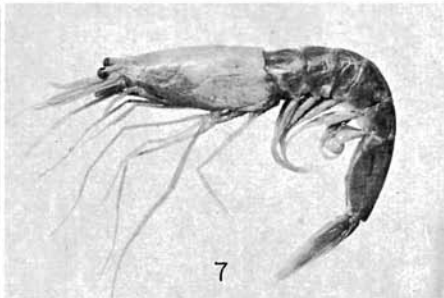
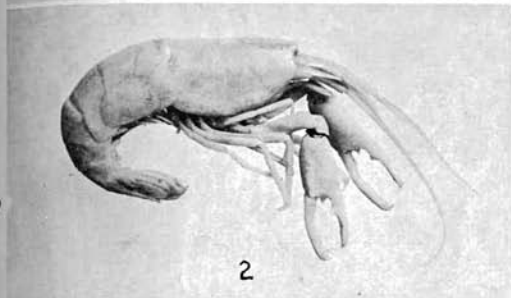
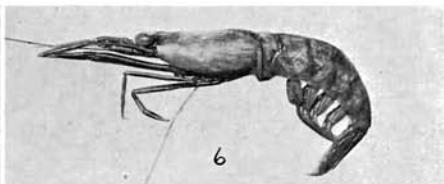
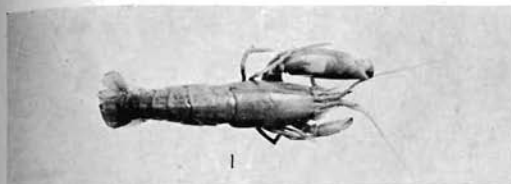
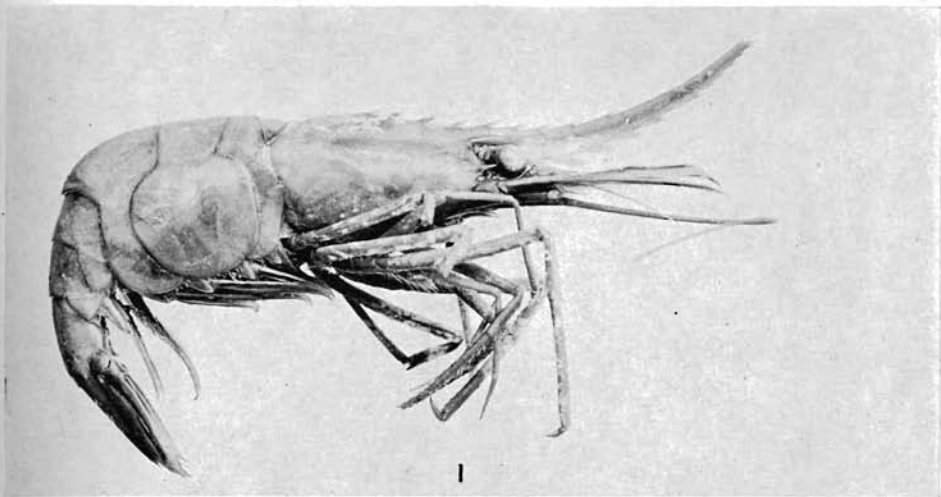


PLATE 13

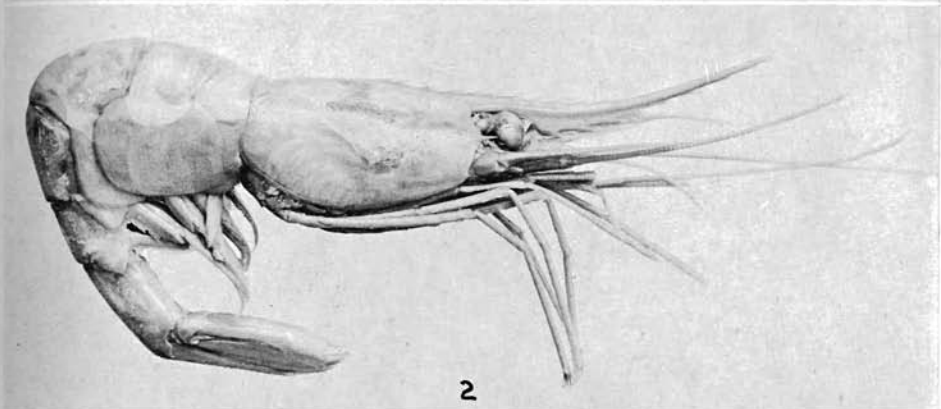
Fig. 1. *Pandalus gurneyi*, female; lateral view, $\times 1\frac{2}{3}$. Off Santa Barbara, 21 fathoms. ("Albatross" station 2961.) (Page 46.)

Fig. 2. *Pandalus montagui tridens*, female holotype; lateral view, $\times 1\frac{3}{10}$. Off North Head, Akutan Island, Alaska, 72 fathoms. ("Albatross" station 2842.) (Page 42.)

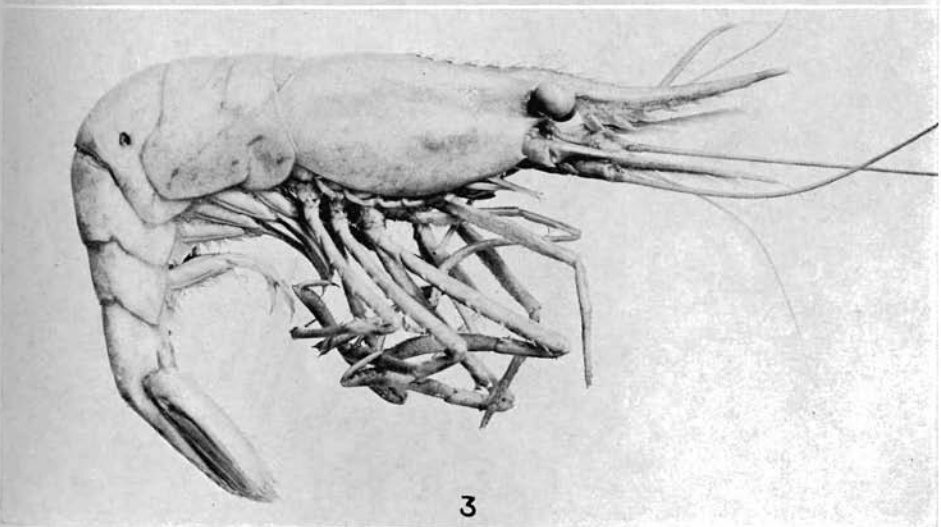
Fig. 3. *Pandalus danae*, male; lateral view, $\times 1\frac{3}{8}$. San Francisco Bay, $10\frac{1}{4}$ - $16\frac{1}{2}$ fathoms. ("Albatross" station 5828.) (Page 44.)



1



2



3

PLATE 14

Fig. 1. *Pandalus jordani*, male; lateral view, $\times 2\frac{1}{10}$. Off San Francisco, 40 fathoms. ("Albatross" station 5786.) (Page 41.)

Fig. 2. *Pandalopsis ampla*, male; lateral view, $\times 1\frac{1}{10}$. Near Cortez Bank, 776 fathoms. ("Albatross" station 3627.) (Page 46.)

Fig. 3. *Pandalus platyceros*, male; lateral view, $\times \frac{9}{10}$. Off Farallon Islands, 191 fathoms. ("Albatross" station 3161.) (Page 43.)

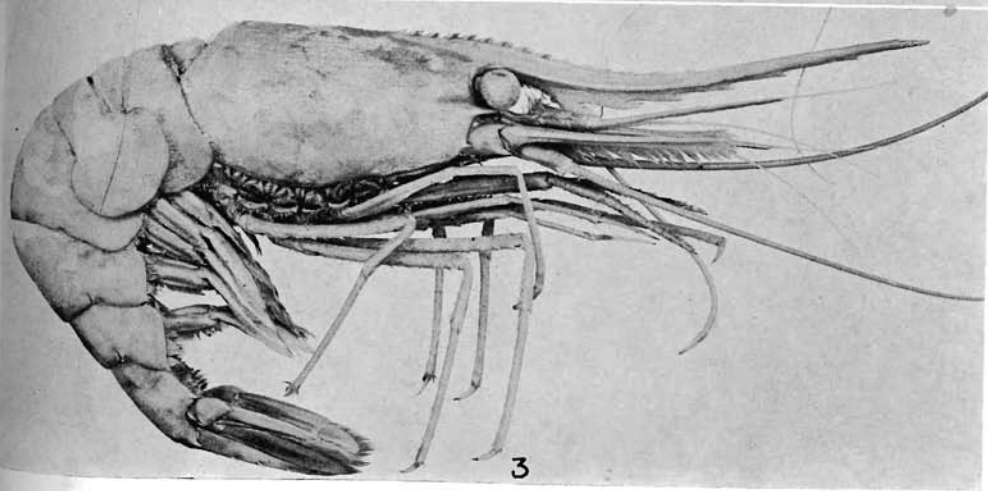
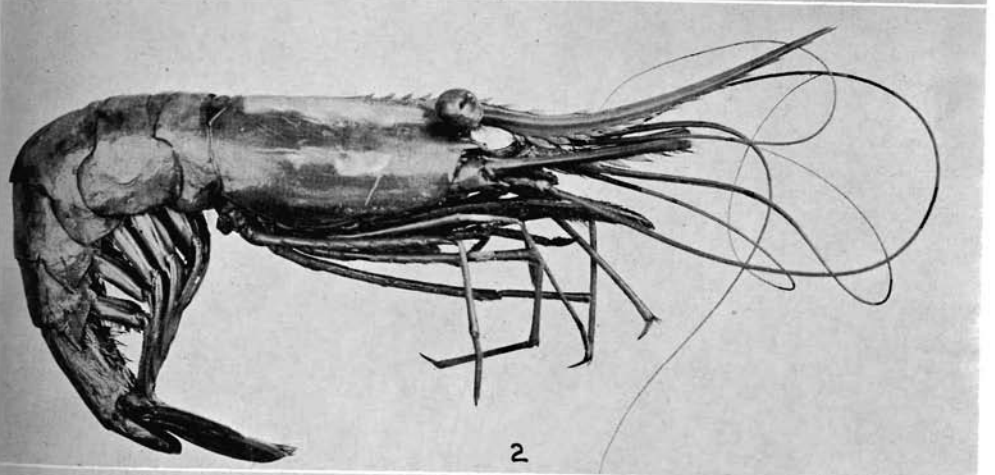
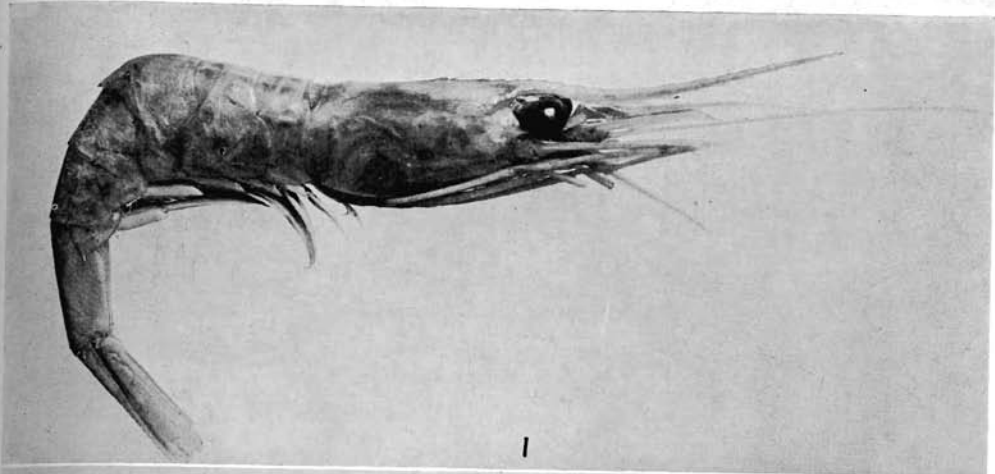
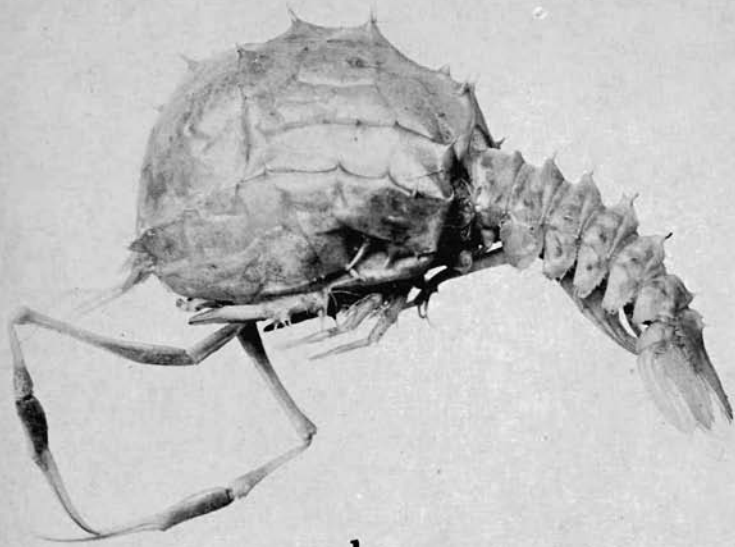


PLATE 15

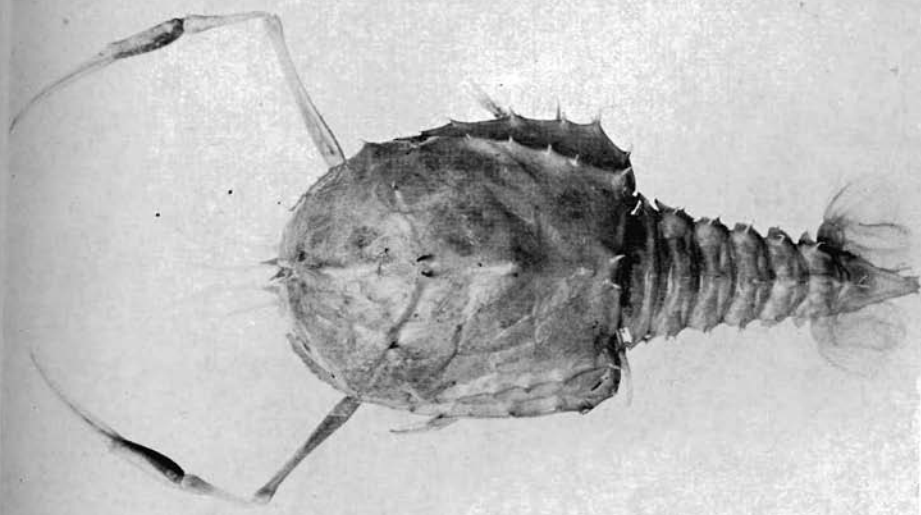
Eryonicus agassizi, female, \times about $1\frac{1}{4}$. Off San Clemente Island, 654-704 fathoms. ("Albatross" station 4405.) (Page 105.)

Fig. 1. Lateral view.

Fig. 2. Dorsal view.



1



2

PLATE 16

Fig. 1a. *Pylopagurus minimus*, male; dorsal view, $\times 4\frac{1}{10}$. Off Farallon Islands, 33-35 fathoms. ("Albatross" station 5790.) (Page 144.)

Fig. 1b. Same specimen as 1a; large hand, $\times 4\frac{1}{10}$.

Fig. 1c. Shell of *Dentalium indianorum* Carpenter, encrusted with much worn, indeterminate bryozoa, from which above *P. minimus* was taken, $\times 4\frac{1}{10}$.

Fig. 2. *Pagurus samuelis*, series of hands, $\times 1\frac{1}{2}$. All from males except fifth and last, the smallest. Pacific Grove. (Page 139.)

Fig. 3. *Pagurus samuelis*, female; dorsal view, $\times 1\frac{1}{2}$. Pacific Grove. (Page 139.)

Fig. 4. *Pagurus hirsutiusculus*, male; dorsal view, $\times 1\frac{1}{2}$. Bonita Point, between tide marks. (Page 137.)

Fig. 5. *Parapagurus mertensii*, male; dorsal view, $\times 1\frac{1}{2}$. Off Santa Cruz Island, 266 fathoms. ("Albatross" station 2948.) (Page 146.)

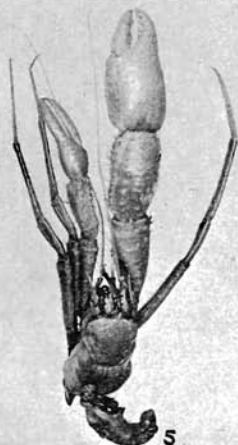
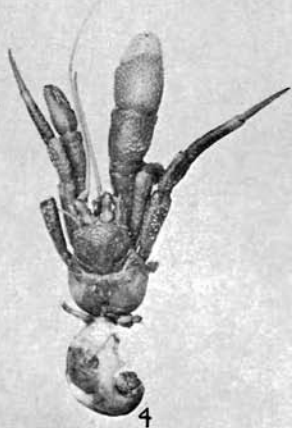
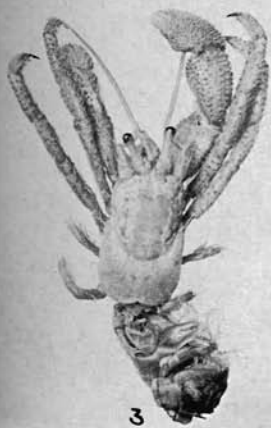
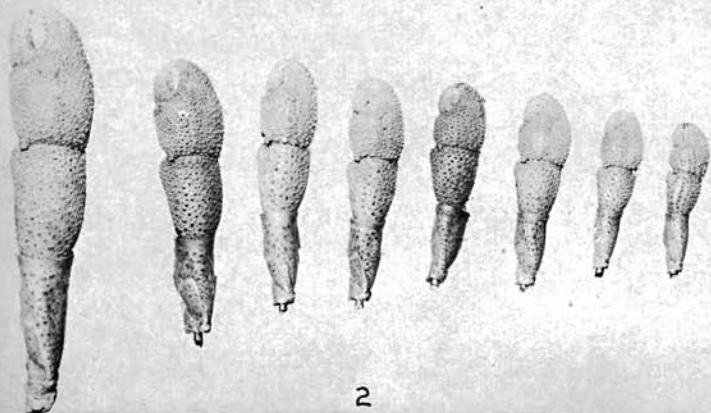
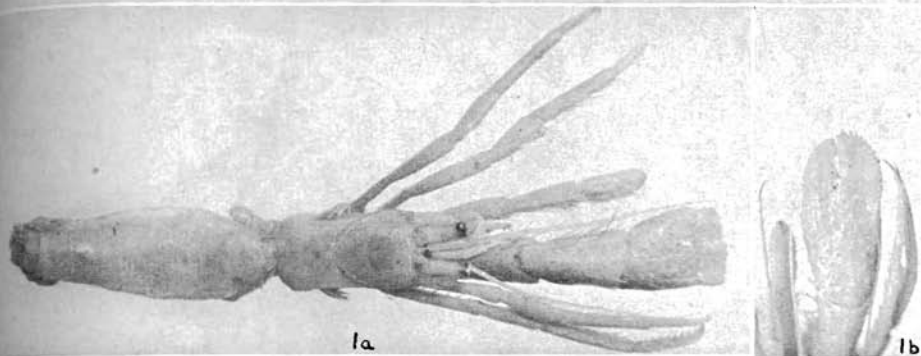


PLATE 17

Fig. 1. *Paguristes parvus*, female cotype; dorsal view, $\times 3\frac{2}{5}$. White's Point, near San Pedro. (Page 124.)

Fig. 2. *Holopagurus pilosus*; dorsal view, natural size. (Page 127.)

Fig. 3. *Dardanus jordani*, male holotype; dorsal view, $\times 1\frac{1}{5}$. San Francisco Bay. (Page 126.)

Fig. 4. Same specimen as fig. 3; anterodorsal view, to show large hand.

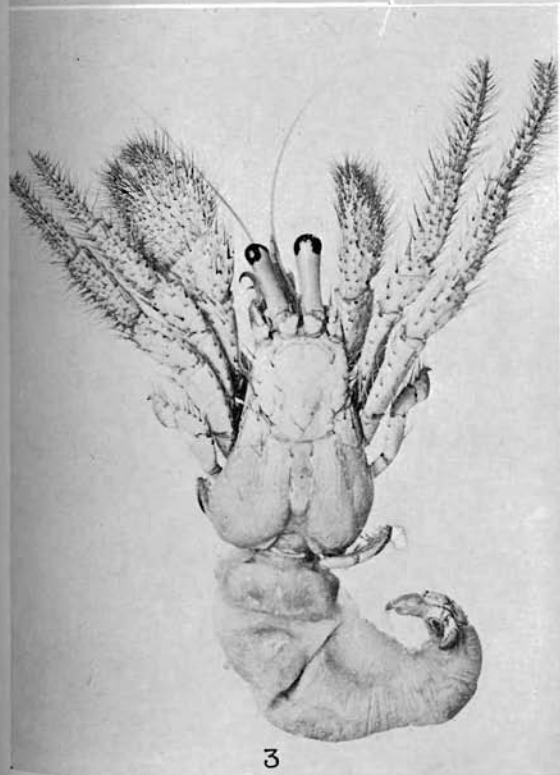
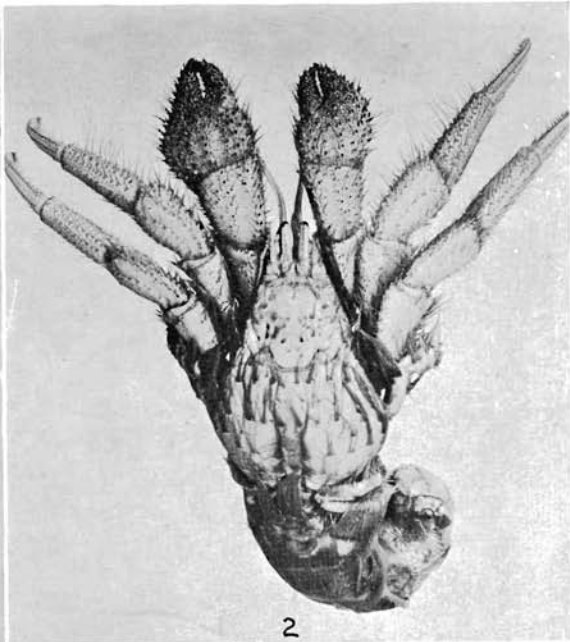


PLATE 18

Fig. 1. *Paguristes turgidus*, male; dorsal view, $\times 95/100$. Off San Francisco, 13-14 $\frac{1}{4}$ fathoms. ("Albatross" station 5806.) (Page 123.)

Fig. 2. *Paguristes bakeri*, male; dorsal view, $\times 74/100$. Off Santa Barbara, 29 fathoms. ("Albatross" station 2971.) (Page 124.)

Fig. 3. *Paguristes ulreyi*, male; dorsal view, $\times 94/100$. Santa Monica Bay. (Page 125.)

Fig. 4. *Paguristes ulreyi*, female paratype; dorsal view, without abdomen, $\times 1\frac{1}{4}$. Off San Diego, 25 fathoms. ("Albatross" station 4304.) (Page 125.)

Fig. 5. Same species as fig. 4; male holotype.

Fig. 6. *Paguristes bakeri*, young female; dorsal view of anterior portion of carapace to show comparative length of eyestalks, $\times 4\frac{2}{5}$. Portuguese Bend, near San Pedro. (Page 124.)

Fig. 7. *Paguristes ulreyi*, young female; dorsal view of anterior portion of carapace to show comparative length of eyestalks, $\times 4$. La Jolla. (Page 125.)

Fig. 8. *Paguristes turgidus*, young female; dorsal view of anterior portion of carapace to show comparative length of eyestalks, $\times 4\frac{1}{10}$. Off Farallon Islands, 68 fathoms. ("Albatross" station 3672.) (Page 123.)