

## 8.

Eastern Pacific Expeditions of the New York Zoological Society. XXXV.  
Mollusks from the West Coast of Mexico and Central America. Part IV.<sup>1</sup>LEO GEORGE HERTLEIN & A. M. STRONG.  
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(Plate I).

[This is the thirty-fifth of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Templeton Crocker Expedition (1936) and the Eastern Pacific Zaca Expedition (1937-1938). For data on localities, dates, dredges, etc., refer to *Zoologica*, Vol. XXII, No. 2, pp. 33-46, and Vol. XXIII, No. 14, pp. 287-298.]

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<sup>1</sup>Contribution No. 743, Department of Tropical Research, New York Zoological Society.

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## INTRODUCTION

This is the fourth of a series of papers dealing with collections of mollusks taken on the Templeton Crocker Expedition (1936) and the Eastern Pacific *Zaca* Expedition (1937-1938). The general plan of presentation followed in the present contribution is that mentioned in Part II of this series of papers<sup>2</sup>. Formal headings and keys are given only for the species collected by the Expeditions of 1936 and 1937-1938.

Acknowledgment is due Dr. G. D. Hanna, Curator, department of Paleontology of the California Academy of Sciences, for assistance and suggestions. Acknowledgment is also due Mr. A. G. Smith of Berkeley, California, Dr. A. Myra Keen of Stanford University and Mr. George Willett of the Los Angeles Museum of History, Science and Art for assistance in various ways. The preparation of most of the photographs by Mr. Frank L. Rogers is here acknowledged; his work was accomplished during the course of Federal Works Progress Administration Project Number 8569. We also wish to express our appreciation to Mr. Cecil Tose for the photographs of the new species of *Periploma*.

## CLASS PELECYPODA.

## Order Anomalodesmacea.

## Superfamily Laternulacea.

## FAMILY PERIPLOMATIDAE.

Genus *Periploma* Schumacher.Key to the species of *Periploma*.

- A. Beaks central or nearer the posterior end
  - a. Beaks nearly central..... *discus*
  - aa. Beaks nearer the posterior end
    - b. Shell orbicular ..... *stearnsii*
    - bb. Shell elongately oval ..... *teevani*
- B. Beaks nearer the anterior end; rostrum only slightly marked off from the disk ..... *carpenteri*

*Periploma carpenteri* Dall.

*Periploma carpenteri* Dall, *Proc. U. S. Nat. Mus.*, Vol. 18, April 23, 1896, p. 20. Dredged "in 210 fathoms, mud, in the Gulf of Panama."—Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, No. 6, October, 1908, p. 426, pl. 16, fig. 8. Same locality record as originally cited.

*Type Locality*: Gulf of Panama, in 210 fathoms, mud.

<sup>2</sup> Hertlein, L. G., and Strong, A. M. Eastern Pacific Expeditions of the New York Zoological Society. XXXII. Mollusks from the West Coast of Mexico and Central America. Part II. *Zoologica*, New York Zool. Soc., Vol. 28, Pt. 3, December 6, 1943, pp. 149-169, pl. 1.

*Range*: La Union, El Salvador, to Panama.

*Collecting Station*: El Salvador: La Union, Gulf of Fonseca (199-D-22), 3 fathoms, mud, mangrove leaves on bottom.

*Description*: Shell suborbicular, thin, pearly, beaks slightly nearer the anterior end; surface ornamented by fine crowded granules which on some parts of the shell are arranged in extremely fine radial rows. The present specimen measures 21.5 mm. in length and 19 mm. in height.

The more anteriorly situated beaks, the lack of or very fine radial arrangement of the crowded granules, larger pallial sinus and the fact that the rostrum is less distinctly marked off from the arch of the base, all serve to separate *Periploma carpenteri* from *P. stearnsii* Dall.

It is possible that the specimen here referred to *Periploma carpenteri* may be a young form of *Periploma alta* Adams,<sup>3</sup> a species originally described from Panama, the type specimen of which has not been illustrated. Adams' species is said to be similar to *Periploma discus* but differing in the outline of the posterior portion of the shell.

*Distribution*: A single right valve of *Periploma carpenteri* was dredged in the Gulf of Fonseca. This furnishes an extension northward of the known range of the species.

*Periploma discus* Stearns.

*Periploma discus* Stearns, *Proc. U. S. Nat. Mus.*, Vol. 13, September 16, 1890, p. 222, pl. 16, figs. 1 and 2. "San Pedro, Long Beach, etc., Los Angeles County, California."—I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 82, pl. 43, figs. 1 and 3. San Pedro to San Diego, California.

*Type Locality*: Long Beach, California (cited as type locality by I. S. Oldroyd and accepted as such by the present authors).

*Range*: Monterey Bay, California, to La Union, El Salvador.

*Collecting Station*: El Salvador: La Union, Gulf of Fonseca (199-D-11), 5 fathoms, mud.

*Description*: One small specimen measuring approximately 16 mm. from beak to base is in general features similar to *Periploma discus*. It is slightly less circular in outline than adult specimens but this feature seems to be characteristic of young forms of this species. A narrow and well marked rostrum is present. The valves are ornamented by fine granular sculpture which on some parts of the shell is arranged in fine radial rows. Pallial sinus short and rather narrow.

<sup>3</sup> *Anatina alta* C. B. Adams, *Ann. Lyceum Nat. Hist. New York*, Vol. 5, July, 1852, pp. 518, 547 (separate pp. 294, 323). "Panama".

*Periploma alta* C. B. Adams, Pilsbry & Lowe, *Nautilus*, Vol. 47, No. 3, 1934, p. 85.



*Distribution*: The present record of *Periploma discus* from the Gulf of Fonseca is an extension southward in the known range. Pilsbry and Lowe have cited the species from La Paz, Lower California, Mexico. It is known to occur north to Monterey Bay, California.

*Periploma stearnsii* Dall.

*Periploma stearnsii* Dall, *Proc. U. S. Nat. Mus.*, Vol. 18, April 23, 1896, p. 19. Dredged "in 24 fathoms, mud; off Point Fermin, at the head of the Gulf of California."—Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, No. 6, 1908, p. 426, pl. 16, fig. 5. Original locality cited.

*Type Locality*: Off Point Fermin, head of the Gulf of California, in 24 fathoms, mud.

*Range*: Head of the Gulf of California to San Lucas Bay, Lower California.

*Collecting Station*: Mexico: San Lucas Bay (135-D-2), 8-16 fathoms, sand.

*Description*: Shell orbicular, thin, pearly, beaks nearer the posterior end; rostrum rather wide and well marked off by a groove; surface ornamented by fine radial rows of granules separated from each other by a clear space. A right valve in the present collection measures approximately 34.8 mm. in length and 29.6 mm. in height.

The shell of *Periploma stearnsii* differs from that of *P. discus* in the more compressed form, wider rostrum, wider pallial sinus, and in that the beaks are more posteriorly situated.

*Distribution*: *Periploma stearnsii* heretofore has been known only from the head of the Gulf of California and the present record extends the known range south to Cape San Lucas Bay at the southern end of the Gulf of California.

*Periploma teevani* Hertlein & Strong, sp. nov.

Plate I, Figures 2 and 6.

Shell elongately roundly oval, thin, fragile, pearly, valves gently convex and gaping posteriorly; beaks nearer the posterior end, opisthogyrate, acutely pointed, fissured; anterior dorsal margin gently rounded, sloping and merging into the rounded anterior end, ventral margin gently rounded, posterior dorsal margin nearly straight sloping gently down to the subtruncated and nearly straight steeply sloping posterior end of the shell; surface of shell covered by fine concentric lines of growth, the basal half sculptured by fine, weak, radial rows of pustules; on the rostrum these are developed into fine but strong dense closely spaced radial rows; a narrow shallow groove runs from the beak to the anterior basal margin; internally the chondrophore is directed slightly anteriorly, and posteriorly is supported by a thin rounded buttress; a lithodesma is present anterior to the chondrophore; faint radial lines show through on the interior of the shell; pallial sinus short

(about one-fourth the length of the shell) not reaching a vertical with the hinge. Length, 23 mm.; height, 19 mm.; convexity (both valves), 10 mm.

Holotype, from Station 196-D-19, Lat. 15°44'N., Long. 96°05'W., Tangola-Tangola Bay, Oaxaca, Mexico, dredged in 30 fathoms (55 meters), mud.

Compared to *Periploma planiuscula* Sowerby<sup>4</sup>, a species which ranges from Point Concepcion, California, to Negritos, Peru, the new species is comparatively higher in proportion to the length, the rostrum is shorter and wider and the shell is ornamented by radial rows of pustules which in Sowerby's species are irregularly arranged. These same characters serve to separate it from *Periploma venezuelana wiedenmayeri* H. K. Hodson<sup>5</sup> from the Miocene of Venezuela.

This species is named for Mr. John Teevan, a member of the scientific staff on the *Zaca* during the eastern Pacific Expeditions.

FAMILY THRACIIDAE.

Key to the genera of the Thraciidae.

- A. Shell ornamented by prominent oblique concentric undulations ..... *Cyathodonta*  
 B. Shell ornamented only by concentric lines of growth ..... *Thracia*

Genus *Thracia* Leach in Blainville.

*Thracia curta* Conrad.

*Thracia curta* Conrad, *Jour. Acad. Nat. Sci. Philadelphia*, Vol. 7, 1837, p. 248, pl. 19, fig. 8. "Inhabits the coast of California, near Sta. Barbara."—I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 84, pl. 43, fig. 6. Icy Cape, Arctic Ocean, Bering Sea, to San Diego, California.

*Type Locality*: Near Santa Barbara, California.

*Range*: Icy Cape, Alaska, to Punta Penasco, Sonora, Mexico, in the Gulf of California, Mexico. To Ecuador (E. K. Jordan).

*Collecting Station*: Mexico: SE. of Cedros Island, in channel (126-D-19), 25 fathoms, rocks, algae.

*Description*: Shell roundly quadrate, anterior and ventral margins rounded, posterior end truncated; on large specimens a distinct carina marks off the rostrum from the remainder of the shell. A specimen collected at San Diego, California, by Henry Hemphill measures 42 mm. in length.

<sup>4</sup> *Periploma planiuscula* Sowerby, *Proc. Zool. Soc. London*, October 25, 1834, p. 87. "Hab. ad Sanctam Elenam."—Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 255, pl. 13, figs. 1a, 1b. [Not all of the synonymy.] Pliocene to Recent.

<sup>5</sup> *Periploma venezuelana wiedenmayeri* H. K. Hodson, *Bull. Amer. Paleol.*, Vol. 16, No. 59, October 1, 1931, p. 7, pl. 1, figs. 3, 5, 7. From "2 kilometers south and 600 meters east of La Compana, District of Democracia, State of Falcón. (La Compana is 11.5 kilometers east and 2 kilometers south of Urumaco)." Venezuela. Lower middle Miocene.

The shell of this species is more roundly quadrate in outline and the rostrum is much less expanded in comparison to that of *Thracia trapezoides* Conrad.

**Distribution:** A single right valve of this species was dredged in the channel southeast of Cedros Island, Lower California. It has been recorded as occurring from Alaska to the Gulf of California and south to Ecuador. We have not seen specimens from south of Cape Lucas, Lower California.

#### Genus *Cyathodonta* Conrad.

Key to the species of *Cyathodonta*.

- A. Shell ornamented by radiating rows of granules.....*undulata*
- B. Shell ornamented by granules arranged in irregular concentric lines
  - a. Shell elongately ovate; beaks decidedly nearer the posterior end .....*lucasana*
  - aa. Shell higher; beaks only slightly nearer the posterior end.....*dubiosa*

#### *Cyathodonta dubiosa* Dall.

*Cyathodonta dubiosa* Dall, *Proc. U. S. Nat. Mus.*, Vol. 49, November 27, 1915, p. 445. "Type locality, off La Paz." Range: San Pedro to San Diego, California, and to La Paz, Lower California.—I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 86, pl. 9, fig. 5. Original locality records cited.

**Type Locality:** Off La Paz, Lower California, Mexico.

**Range:** San Pedro, California, to Champerico, Guatemala.

**Collecting Station:** Guatemala: 7 miles W. of Champerico (197-D-2), 14 fathoms, mud.

**Description:** The specimen which is here referred to *Cyathodonta dubiosa* differs from *C. undulata* in the character of ornamentation pointed out by Dall, "the granulation is in somewhat irregular concentric lines and not radially distributed." It measures 19.8 mm. in length and 16 mm. in height.

**Distribution:** A single left valve of *Cyathodonta dubiosa* was dredged off Champerico, Guatemala, in 14 fathoms. The species has also been reported as occurring in the Pleistocene of Lower California and Panama.

#### *Cyathodonta lucasana* Dall.

Plate I, Figures 4 and 9.

*Cyathodonta lucasana* Dall, *Proc. U. S. Nat. Mus.*, Vol. 49, November 27, 1915, p. 445. "Type locality, Cape St. Lucas, Lower California, Xantus."

**Type Locality:** Cape San Lucas, Lower California, Mexico.

**Range:** La Paz, Lower California, to Port Guatulco, Mexico,

**Collecting Station:** Mexico: Port Guatulco (195-D-9), 7 fathoms, green sand, crushed shell.

**Description:** A single left valve in the present collection dredged off Port Guatulco, Mexico, is identified as *Cyathodonta lucasana* Dall. It is elongately ovate in shape, the anterior end the longer. The plications are few and sparse. In the original description of the species Dall stated that no granulation was perceptible on the type specimen which was 7.5 mm. long and 5 mm. high. The present specimen shows only fine granulation toward the base at that size but after attaining a height of 8 mm. shows well developed irregular concentric granulations. It measures: length, 21 mm.; height, 14 mm.; convexity (one valve), 3.4 mm.

**Distribution:** The discovery of the occurrence of this species at Port Guatulco, Mexico, is an extension southward of the known range.

#### *Cyathodonta undulata* Conrad.

*Cyathodonta undulata* Conrad, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 4, 1849, p. 156. [Title of article states "Shells from the coasts of Lower California and Peru"].

*Thracia plicata* Deshayes, Reeve, *Conch. Icon.*, Vol. 12, *Thracia*, November, 1859, species 7, pl. 2, figs. 7b, 7c. California. [Not *Thracia plicata* Deshayes, Reeve, pl. 2, fig. 7a].

**Type Locality:** East coast of Lower California, (here designated as type locality). Peru also cited originally.

**Range:** Gulf of California to Peru.

**Collecting Stations:** Mexico: Arena Bank (136-D-15), 40 fathoms, mud, crushed shell; Santa Inez Bay (145-D-1, 3), 4-13 fathoms, sand; anchorage 1 mile south of San Domingo Point, Concepcion Bay; Nicaragua: Corinto (200-D-4, 7), 1/2-2 fathoms, mangrove leaves; Costa Rica: Golfito, Gulf of Dulce.

**Description:** Shell elongate, ornamented by concentric ripples and by fine rows of granules radiating from the umbos. It attains a length of 50 mm. or more.

*Cyathodonta magnifica* Jonas, from the east coast of Honduras, is a similar species.

**Distribution:** *Cyathodonta undulata* has been recorded from a number of localities from the Gulf of California to Peru. It also has been reported from the Pliocene and Pleistocene of Lower California, and from the Pleistocene of southern California and Panama.

#### FAMILY PANDORIDAE.

Genus *Pandora* Hwass in Chemnitz.

Winckworth<sup>6</sup> has recently presented reasons for abandoning the genus name *Pandora* in favor of *Calpodium* Bolten<sup>7</sup>. The

<sup>6</sup> Winckworth, R., *Jour. Conch.*, Vol. 20, No. 2, 1934, pp. 52-53.

<sup>7</sup> Bolten, J. F., *Mus. Bolt.*, Pt. 2, 1798, p. 166.



latter name was proposed for *C. albidum* Bolten, in the synonymy of which was included *Tellina inaequivalvis* with a reference to Chemnitz, *Conchyl.-Cab.*, Vol. 6, pl. 11, figs. 106a, b, c, d [= *Tellina inaequivalvis* Gmelin]. *Calpodium* is thus certainly available if *Pandora* is considered to be invalid. We have hesitated to make this change until it is certain that the well known name *Pandora* must be abandoned.

Key to the subgenera of *Pandora*.

- A. Right valve with 2 cardinal teeth  
 a. Left valve with 1 tooth or none  
   b. Lithodesma present ..... *Kennerlia*  
   bb. Lithodesma absent... *Pandora s.s.*  
 aa. Left valve with 3 cardinal teeth ..... *Foveadens*  
 B. Right valve with 3 cardinal teeth ..... *Clidiophora*

Subgenus *Pandora s. s.*

*Pandora (Pandora) uncifera* Pilsbry & Lowe.

*Pandora uncifera* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 104, pl. 17, figs. 17, 18, 19. "Acapulco, 20 fathoms, type loc.," also from Manzanillo, Mexico, in 20 fathoms.

*Type Locality*: Acapulco, Mexico, in 20 fathoms.

*Range*: Gorda Banks off Cape San Lucas, Lower California, to Port Parker, Costa Rica.

*Collecting Stations*: Mexico: Gorda Banks (150-D-?); Port Guatulco (195-D-9), 7 fathoms, green sand, crushed shell; Tangola-Tangola Bay (196-D-6, 7, 14, 15) 5-7 fathoms, sand, crushed shell; Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud.

*Description*: Shell elongate, small, of about the same size and general features of *Pandora brevifrons* Sowerby<sup>8</sup> but proportionately shorter. Furthermore the anterior dorsal margin of the shell is hooked, a feature entirely lacking in the species described by Sowerby. Length about 12.5 mm.

*Distribution*: *Pandora uncifera* was dredged abundantly off Port Guatulco, Mexico, in 7 fathoms. The present records of the species north to Gorda Banks in the Gulf of California and south to Port Parker, Costa Rica, are extensions of the known range.

Subgenus *Kennerlia* Carpenter.

Key to the species of *Kennerlia*.

- A. Outline elongated; anterior area of left valve set off by an impressed line ..... *bilirata*

<sup>8</sup> *Pandora brevifrons* Sowerby, *Proc. Zool. Soc. London*, September 25, 1835, p. 93. "Hab. apud Panamam." "Obtained from a sandy bottom, at the depth of ten fathoms."—Sowerby, *Spec. Conch.*, Vol. 1, Pt. 2, 1855, *Pandora*, pl. [not numbered], figs. 25, 26. —Sowerby, *Conch. Icon.*, Vol. 19, *Pandora*, 1874, species 12, pl. 2, fig. 12, "Hab.—?"

- B. Outline semicircular; anterior area of left valve not, or only weakly, set off by an impressed line..... *convexa*

*Pandora (Kennerlia) bilirata* Conrad.

*Pandora bilirata* Conrad, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 7, 1855, p. 267. California.—Conrad, *U. S. Pac. R. R. Repts.*, Vol. 6, 1857, *Geol. Rept.*, p. 73, pl. 5, fig. 25. "Santa Barbara, Cal."

*Pandora (Kennerlia) bicarinata* Carpenter, Arnold, *Mem. Calif. Acad. Sci.*, Vol. 3, 1903, p. 123, pl. 18 fig. 2. Lower San Pedro series of Deadman Island, San Pedro, California, Pleistocene. Also Recent.

*Pandora (Kennerlia) bilirata* Conrad, I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, No. 1, 1924, p. 89, pl. 53, figs. 8 and 9. Range, Forrester Island, Alaska, to Point Abreojos, Lower California.

*Type Locality*: California.

*Range*: Drier Bay, Prince William Sound, Alaska, to Point Abreojos, Lower California.

*Collecting Station*: Mexico: East of Cedros Island (126-D-10, 12), 45-60 fathoms, crushed shell, eel grass, mud.

*Description*: Right valve concave, left convex; anterior margin contracted in the middle, base convex; posterior end truncated; left valve with two carinated ribs radiating dorsally from the beak to the posterior margin, also ornamented by a few very fine and rather widely spaced raised lines extending to the ventral margin posterior to the anterior contraction. Length about 16 mm.

*Distribution*: This species is often dredged on muddy or on fine sandy bottoms from Alaska to Lower California.

*Pandora (Kennerlia) convexa* Dall.

Plate I, Figure 5.

*Kennerlyia convexa* Dall, *Proc. U. S. Nat. Mus.*, Vol. 49, November 27, 1915, p. 449. "Type locality, Ballenas Lagoon, Lower California, in 48 fathoms."

*Type Locality*: Ballenas Lagoon, Lower California, in 48 fathoms.

*Range*: Ballenas Lagoon to Cape San Lucas, Lower California, Mexico.

*Collecting Station*: Mexico: Cape San Lucas, Lower California.

*Description*: The single specimen in the present collection referred to *Pandora convexa* is approximately 13.5 mm. in length as compared to the unfigured type of the species which was 21 mm. long. Compared to *P. bilirata* Conrad the shell of Dall's species is more semicircular in outline and the anterior area of the left valve is less distinctly set off by an impressed line.

*Distribution*: The present record of *Pandora convexa* at Cape San Lucas, Lower California, is an extension south of the known range of the species.

Subgenus *Clidiophora* Carpenter.*Pandora (Clidiophora) cristata* Carpenter.

*Clidiophora cristata* Carpenter, *Proc. Zool. Soc. London*, November 22, 1864, p. 597. "Hab. in sinu Californiensi."

*Pandora cristata* Carpenter, Sowerby, *Conch. Icon.*, Vol. 19, *Pandora*, 1874, species 1, pl. 1, fig. 1. "Hab.—?"

*Type Locality*: Gulf of California.

*Range*: Gulf of California to La Libertad, El Salvador.

*Collecting Stations*: Guatemala: 7 miles west of Champerico (197-D-1, 2), 13-14 fathoms, mud; El Salvador: La Libertad (198-D-1, 2), 13-14 fathoms, mud.

*Description*: The shell of this species may be distinguished from that of other similar forms of the genus by the presence of triangular serrations along the anterior dorsal margin. A large specimen measures approximately 26 mm. in length.

*Distribution*: The discovery of the occurrence of *Pandora cristata* as far south as La Libertad, El Salvador, is an extension of the known range of the species.

Subgenus *Foveadens* Dall.*Pandora (Foveadens) panamensis* Dall.

*Foveadens panamensis* Dall, *Proc. U. S. Nat. Mus.*, Vol. 49, November 27, 1915, p. 451. "Type locality, beach at Old Panama."

*Type Locality*: Old Panama, on beach.

*Range*: El Salvador to Panama.

*Collecting Station*: El Salvador: Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell.

*Description*: A single somewhat worn right valve dredged in the Gulf of Fonseca off El Salvador seems to fit the description given by Dall for *Pandora panamensis*. This flat, white, pearly valve is slightly concentrically undulated, and possesses two diverging teeth and a low ridge extending from the apex of the hinge to the anterior adductor scar. Length, 33.5 mm.

*Distribution*: The present record of this species in the Gulf of Fonseca is an extension north of the known range.

## FAMILY LYONSIIDAE.

Genus *Lyonsia* Turton.

Key to the subgenera of *Lyonsia*.

- A. Shell regular, not distorted;  
radial sculpture ..... *Lyonsia s.s.*  
B. Shell irregular, distorted;  
smooth ..... *Entodesma*

Subgenus *Lyonsia* s. s.

Key to the species of *Lyonsia s.s.*

- A. Umbos inflated; shell often  
arcuate ..... *californica*  
B. Umbos only slightly inflated; shell  
smaller, less arcuate ..... *gouldii*

*Lyonsia (Lyonsia) californica* Conrad.

*Lyonsia californica* Conrad, *Jour. Acad. Nat. Sci. Philadelphia*, Vol. 7, 1837, p. 248, pl. 19, fig. 20 [erroneously cited in text as fig. 21]. "Inhabits the coast of California, near Sta. Barbara."—I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 91, pl. 27, fig. 3. Type locality cited. Range, Puget Sound to Todos Santos Bay, Lower California.

*Type Locality*: Near Santa Barbara, California.

*Range*: Southeastern Alaska (Lat. 56°N.) to Lat. 24°S., Lower California.

*Collecting Station*: Mexico: East of Cedros Island (126-D-4), in 40 fathoms, mud.

*Description*: Shell elongate, thin, pearly, usually more or less arcuate, umbos inflated, ornamented by fine radial sculpture. Fresh specimens are always more or less covered with adhering sand grains.

The subspecies *Lyonsia californica haroldi* Dall, a generally larger shell from central California, is not arcuate and is nearly cylindrical in form. *Lyonsia californica nesioetes* Dall from southern California possesses a small, thin shell in which the beaks are much nearer the anterior end than in the typical species.

*Distribution*: A single specimen of *Lyonsia californica* was dredged in the channel east of Cedros Island, Lower California, in 40 fathoms. It is commonly found in the waters off California but is much less commonly found off Lower California.

*Lyonsia (Lyonsia) gouldii* Dall.

*Osteodesma nitidum* Gould, *Boston Jour. Nat. Hist.*, Vol. 6, April, 1852, p. 390, pl. 15, fig. 6. "Inhabits Santa Barbara."

*Lyonsia gouldii* Dall, *Proc. U. S. Nat. Mus.*, Vol. 49, November 27, 1915, p. 453. "San Francisco Bay, California, and south to Point Abrejos, Lower California." New name for *Osteodesma [Lyonsia] nitidum* Gould, 1851, not *Mya [=Lyonsia] nitida* Fabricus, 1798.

*Type Locality*: Santa Barbara, California.

*Range*: San Francisco Bay, California, to Acapulco, Mexico.

*Collecting Stations*: Mexico: Off Cedros Island; E. of Cedros Island (126-D-4), in 40 fathoms, mud; Santa Inez Bay, Gulf of California (145-D-1, 3), 4-13 fathoms, sand.

*Description*: Shell small, slender, pearly, umbos gently convex, ornamented by fine raised radial lines, posterior end truncated. Length about 16 mm.

The shell of *Lyonsia gouldii* is smaller, less arcuate in outline, and the umbos are much less inflated than those of *L. californica*.

*Distribution*: *Lyonsia gouldii* is said to range north to San Francisco Bay, California, but apparently it occurs more commonly



farther south off San Diego, California, and in west Mexican waters.

Subgenus *Entodesma* Philippi.

*Lyonsia* (*Entodesma*) *inflata* Conrad.

*L. [yonsia]. inflata* Conrad, *Jour. Acad. Nat. Sci. Philadelphia*, Vol. 7, 1837, p. 248, pl. 19, fig. 10. "Inhabits Guayaquil."—I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 93. Type locality cited. Range, in sponges from Vancouver Island, British Columbia, to Guayaquil, Ecuador.

*Type Locality*: Guayaquil, Ecuador.

*Range*: Vancouver Island, British Columbia, to Guayaquil, Ecuador (Dall).

*Collecting Station*: Mexico: Santa Inez Bay, Gulf of California (144-D-2), 2½ fathoms, mud, crushed shell.

*Description*: Shell irregularly oval in shape, smooth, attaining a length of about 20 mm.; anterior end short.

There is some doubt as to whether *inflata* is the correct specific name to apply to the present specimens. They agree quite well with the general features of *Lyonsia inflata* shown in the original figure, but possess a more angulated anterior margin. In comparing *Lyonsia* (*Entodesma*) *chilense* Philippi with *L. (E.) inflata*, Dall<sup>9</sup> stated that "these mollusks are nestlers" but in the discussion of *L. inflata* he stated that it is "usually found living in sponges or the mass of compound ascidians, and they differ from the rock nestlers in their polished smooth surface and normal shape."

*Lyonsia diaphana* Carpenter<sup>10</sup> was originally described from Mazatlan, Mexico. In an early paper Dall<sup>11</sup> stated that Carpenter's specimens appeared to be quite different from the original figure of *L. inflata* given by Conrad but in a later paper (1915) he considered *L. diaphana* to be a young form of Conrad's species. The illustration of "*Mytilimeria*" *diaphana* given by Sowerby<sup>12</sup> is similar in general characters to that of the original figure of *Lyonsia inflata* except that it is narrower and more elongated. We have not seen convincing evidence that the specimens from the Gulf of California really differ from the more southern forms, hence we have applied the earlier name proposed by Conrad.

*Distribution*: *Lyonsia inflata* has been recorded as occurring from Forrester Island, Alaska, to Ecuador. The more northern part of the range may perhaps be open to question but the present record from the Gulf

of California would appear to be well within the range of the species.

Superfamily Poromyacea.

FAMILY POROMYACIDAE.

Genus *Poromya* Forbes.

*Poromya* Forbes, 13th Rept. Brit. Assoc. Adv. Sci., (Cork, 1843), (issued 1844), pp. 143, 191. Sole species, *Poromya anatinoides* Forbes. "Asia Minor, Cyclades."

*Type* (by monotypy): *Poromya anatinoides* Forbes [= *Corbula granulata* Nyst & Westendorp. See illustration by Chenu, *Man. de Conchyl.*, Vol. 2, 1862, p. 49, fig. 206].

Shell small, ovate, subequilateral; sculpture of fine granules in radial series; hinge of right valve with a strong cardinal tooth in front of a wide chondrophore; hinge of the left valve with a small cardinal tooth behind and above the chondrophore.

*Questimya* Iredale<sup>13</sup> is a similar genus.

Subgenus *Dermatomya* Dall.

*Dermatomya* Dall, *Bull. Mus. Comp. Zool.*, Vol. 18, May 20, 1889, pp. 448, 452. Sole species, *Poromya (Dermatomya) mactroides* Dall.

*Type* (by original designation): *Poromya (Dermatomya) mactroides* Dall. Illustrated in *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 291, pl. 8, fig. 8. West coast of Patagonia, in 122, 348 and 449 fathoms. Also off the coast of Ecuador.

The shell of *Dermatomya* differs from typical *Poromya* in the absence of superficial granulations, in the presence of a deep and strong pallial sinus, and in that the hinge is very coarse and strong.

*Poromya (Dermatomya) tenuiconcha* Dall.

*Poromya (Dermatomya) tenuiconcha* Dall, *Proc. U. S. Nat. Mus.*, Vol. 45, June 11, 1913, p. 596. "In deep water off Monterey Bay, California."

*Dermatomya tenuiconcha* Dall, *U. S. Nat. Mus.*, *Bull.* 112, 1921, p. 27, pl. 3, fig. 10. Alaska Peninsula to Coronado Islands, in deep water [*Dermatomya* used as a subgenus of *Poromya*].

*Type Locality*: Off Monterey, California, in deep water.

*Range*: Alaska Peninsula to off San Jose Point, Lower California (Lat. 31° 25' N.).

*Collecting Station*: Mexico: 5 miles W. of San Jose Point, Lower California (175-D-1), 45 fathoms, slabs of slaty rock.

*Description*: Shell small, thin, smooth, subtrigonal, umbos inflated, anterior end rounded, posterior end roundly truncated,

<sup>9</sup> Dall, W. H., *Proc. U. S. Nat. Mus.*, Vol. 49, 1915, p. 455.

<sup>10</sup> *Lyonsia (Osteodesma) diaphana* Carpenter, *Proc. Zool. Soc. London*, February 5, 1856, p. 228. "Hab. Mazatlan."

<sup>11</sup> Dall, W. H., *Amer. Jour. Conch.*, Vol. 7, Pt. 2, 1871, p. 143.

<sup>12</sup> Sowerby, G. B., *Conch. Icon.*, Vol. 20, *Mytilimeria*, 1875, species 2, pl. 1, fig. 2. "California."

<sup>13</sup> *Questimya* Iredale, *Rec. Austral Mus.*, Vol. 17, No. 9, June 27, 1930, pp. 389, 406. "Type *Poromya undosa* Hedley and Petter," *Rec. Austral Mus.*, Vol. 6, No. 3, June 19, 1906, p. 224, pl. 38, figs. 16, 17. "Two odd valves from two hundred and fifty fathoms, and fragments of larger specimens from three hundred fathoms," off Sydney, Australia.

the area set off by a low angulation anterior to which is a shallow groove; interior pearly; hinge of left valve with a small internal resilium on an inconspicuous oblique chondrophore, and immediately in front of this a small notch; fitting into this is a projecting denticle on the opposite valve. The present specimen measures approximately: length, 11.9 mm.; width, 9.8 mm.; convexity (both valves), 7.6 mm.

The shell of *Poromya tenuiconcha* differs from that of *P. trosti* Strong & Hertlein, in the more trigonal form and in that the posterior margin is more distinctly truncated.

*Distribution*: A single specimen of this species was dredged in 45 fathoms west of San Jose Point, Lower California.

#### FAMILY CUSPIDARIIDAE.

Key to the genera and subgenera of the Cuspidariidae.

- A. Hinge with a posterior lateral tooth in right valve
- a. Surface smooth or with faint concentric sculpture... *Cuspidaria s. s.*
  - aa. Surface with radial ribs... *Cardiomya*
- B. Hinge with both posterior and anterior lateral tooth in right valve
- a. Surface granulated ..... *Plectodon*
  - aa. Surface smooth (or with concentric growth lines only) ..... *Leiomya*

Genus *Cuspidaria* Nardo.

Subgenus *Cuspidaria s. s.*

#### *Cuspidaria (Cuspidaria) apodema* Dall.

*Cuspidaria apodema* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, No. 2183, December 27, 1916, p. 407. "Station 2859, southwest of Sitka Bay, Alaska, in 1,569 fathoms."—Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 28. Off Sitka, Alaska, and south to Panama Bay, in deep water.

*Type Locality*: Southwest of Sitka, Alaska, in 1,569 fathoms.

*Range*: Sitka, Alaska, to Panama Bay, in deep water.

*Collecting Station*: Mexico: Cape San Lucas, Lower California.

*Description*: Shell small, white, umbos inflated, beaks about 5 mm. from the anterior end, hinge line nearly straight; anterior end rounding into the semicircular base which is suddenly constricted posteriorly at the rostrum; smooth except for incremental lines and wrinkles on the dorsal side of the rostrum.

A single worn specimen from Cape San Lucas, Lower California, in the present collection, approximately 12.6 mm. long and 7.5 mm. high, appears to be referable to *Cuspidaria apodema*. Dall stated that his species is similar to *C. obesa* Lovén, an At-

lantic species. Our specimen does resemble somewhat the illustration of that species given by Sars<sup>14</sup>.

Possibly the specimen from Cape San Lucas could be a worn valve of *Cuspidaria panamensis* Dall<sup>15</sup> but the smaller size and rather straight hinge line agree more nearly with Dall's description of *C. apodema*. Dall mentioned that the rostrum of *C. panamensis* is short and somewhat recurved and that the ligamentary nymph is very large and tooth like.

*Distribution*: Only a single valve of this species was taken by the expedition at Cape San Lucas, Lower California.

#### Subgenus *Cardiomya* A. Adams.

Key to the species of *Cardiomya*.

- A. Right valve with about 8 ribs, these are partly twinned on the left valve ..... *dulcis*
- B. Right and left valves with about 12 to 15 ribs ..... *pectinata*

#### *Cuspidaria (Cardiomya) dulcis* Pilsbry & Lowe.

*Cuspidaria (Cardiomya) dulcis* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 104, pl. 17, figs. 20, 21, 22. "Mexico: Acapulco, in about 20 fathoms," type. Also San Juan del Sur, Nicaragua.

*Type Locality*: Acapulco, Mexico, in about 20 fathoms.

*Range*: Punta Penasco, Sonora, Mexico, to Taboga Island, Panama.

*Collecting Stations*: Mexico: Cape San Lucas; Santa Inez Bay, Lower California (145-D-1,3), 4-13 fathoms, sand; Manzanillo (184-D-2), 30 fathoms, gravelly sand; Port Guatulco (195-D-19), 17 fathoms, green mud, crushed shell; Costa Rica: Port Parker (203-D-1,3), 12-15 fathoms, sandy mud, crushed shell.

*Description*: Shell small, right valve ornamented by about 8 radiating, high, narrow ribs; on the left valve these are partly twinned; two weak radial threads occur on the rostrum but are often lacking on empty shells. Length about 8 mm.

The shell of *Cuspidaria dulcis* appears to differ from that of *C. costata* Sowerby<sup>16</sup> in the twinning of the ribs on the left valve and in the possession of two radial threads on the rostrum. Neither of these features is

<sup>14</sup> See *Neaera obesa* Lovén, Sars, *Moll. Reg. Arct. Norvegiae*, 1878, p. 86, pl. 6, figs. 4a, b, c.

<sup>15</sup> *Cuspidaria panamensis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, No. 6, October, 1908, p. 432, pl. 16, fig. 2. "U. S. S. 'Albatross,' station 3394, in the Gulf of Panama, in 511 fathoms, mud, bottom temperature, 41° 8 F. U. S. N. M. 122,937."

<sup>16</sup> *Anatina costata* Sowerby, *Proc. Zool. Soc. London*, October 25, 1834, p. 87. "Hab. ad Sanctam Elenam." "A single specimen was found in sandy mud at a depth of six fathoms."



mentioned in the original description of Sowerby's species.

*Distribution*: This species occurs from the Gulf of California to Panama. In the present collection it is represented most abundantly by specimens from Port Parker, Costa Rica, in 14 fathoms. It is also known to occur in the Pleistocene of Magdalena Bay, Lower California.

***Cuspidaria (Cardiomya) pectinata* Carpenter.**

*Neaera pectinata* Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1863 (issued August, 1864), pp. 602, 637. Puget Sound; Santa Barbara, and Santa Barbara Islands, California. Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, pp. 88, 123.—Carpenter, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 17, 1865, p. 54. "Hab. In sinu Pugetiano." Also "apud insulam catalinam et Sanct. Barabaram adultam piscavit Cooper."—Arnold, *Mem. Calif. Acad. Sci.*, Vol. 3, 1903, p. 181, pl. 18, fig. 11. Lower San Pedro Series at Deadman Island, San Pedro, California, Pleistocene.

*Type Locality*: Puget Sound, Washington (cited as type locality by I. S. Oldroyd, 1924, and accepted as such by the present authors).

*Range*: Puget Sound to [?] Panama.

*Collecting Station*: Mexico: East of Cedros Island (126-D-12), 45 fathoms, crushed shell and mud.

*Description*: Shell with about 12 to 15 sharp radiating ribs which vary in size. The rostrum was originally described as lacking radial sculpture; this feature however, appears to be variable. Length about 8 to 11 mm.

The type of this species appears to have come from Puget Sound. Carpenter considered shells from Santa Catalina Island, California, to be identical with those from Puget Sound. Specimens from Puget Sound in the collection at Stanford University are fully twice as large as those from off California. Other than size there is no apparent difference. The ribs vary considerably, depending on the size of the shell.

*Cuspidaria californica* Dall,<sup>17</sup> described from Catalina Island, California, was described as differing from *C. pectinata* in possessing a smaller and proportionally longer and less inflated shell, with more numerous ribs, and straighter rostrum which is ornamented with two strong radiating lirae. In a series of specimens the characters enumerated seem variable and it seems likely that *C. californica* is hardly more than a subspecies of *C. pectinata*.

*Distribution*: *Cuspidaria pectinata* Carpenter has been reported as ranging from

Puget Sound to Panama. The specimens in the present collection, dredged east of Cedros Island, appear to be referable to Carpenter's species but we have not seen specimens from more southern localities.

Genus ***Leiomya*** A. Adams.

*Leiomya* A. Adams, *Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 13, 1864 [prior to April], p. 208. Sole species, *Leiomya adunca* Gould.

*Type* (by monotypy): *Leiomya adunca* Gould [= *Neaera adunca* Gould, *Proc. Boston Soc. Nat. Hist.*, Vol. 8, March, 1861, p. 24. "Inhabits Kagosima Bay, sandy mud, 12-15 fathoms."]

A posterior and an anterior lateral tooth are present in the right valve of *Leiomya*, whereas in *Cuspidaria* only a posterior lateral tooth is present.

Subgenus ***Plectodon*** Carpenter.

*Plectodon* Carpenter, *Rept. Brit. Assoc. Adv. Sci.*, for 1863 (issued August, 1864), pp. 611, 638. Sole species, *Plectodon scaber* Carpenter. Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, pp. 97, 124.—Dall, *Bull. Mus. Comp. Zool.*, Vol. 12, No. 6, 1886, p. 299.

*Type* (by monotypy): *Plectodon scaber* Carpenter.

Dall (1886) described the differences between *Plectodon* and *Leiomya* as follows: "It differs in the insertion of the cartilage behind and under the beaks, instead of on the hinge-margin or in a fossette; in having, rather than a true tooth upon the margin, a tooth-like prominence formed by the spiral twisting under the beaks of the hinge-margin itself, upon and over which, in *P. scaber*, there is a minute external ligament; lastly in *Plectodon* there is a granulated surface much as in *Poromya*."

Dall regarded *Plectodon* as "a mere section of *Leiomya*." We have not seen specimens of *Leiomya adunca*, the type of *Leiomya*, for comparison with *L. scabra*, but the differences in the hinge and exterior ornamentation described for the two has led us, at least for the present, to retain *Plectodon* as a subgenus of *Leiomya*.

***Leiomya (Plectodon) scabra* Carpenter.**

*Plectodon scaber* Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1863 (issued August, 1864), pp. 611, 638. "Cat. Is.; 2 similar valves, 40-60 fm." Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, pp. 97, 124.—Carpenter, *Proc. Calif. Acad. Sci.*, Vol. 3, 1865, p. 207. Hab. Catalina Island, California, in 40-60 fathoms.

*Leiomya scabra* Carpenter, I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 103, pl. 54, fig. 10 [not fig. 4 as cited]. "Type locality, Catalina Island in 40-60 fathoms." Range, Puget Sound to San Diego, California.

<sup>17</sup> *Cuspidaria (Cardiomya) californica* Dall, *Bull. Mus. Comp. Zool.*, Vol. 12, No. 6, September, 1886, p. 296 (footnote). "Habitat, Catalina Island, California, dredged in 16 fms., mud; Dall, and previously Cooper, who founded it, following Carpenter, with *pectinata*."

*Type Locality:* Catalina Island, California, in 40-60 fathoms.

*Range:* Catalina Island, California, to Santa Inez Bay, east coast of Lower California.

*Collecting Stations:* Mexico: East of Cedros Island (126-D-10, 12), 45-60 fathoms, crushed shell, eel grass, mud; Cape San Lucas; Arena Bank (136-D-22), 45 fathoms, mud; Santa Inez Bay (147-D-2), 60 fathoms, mud, crushed shell.

*Description:* Shell elongate, rostrate, covered by fine pustules giving the effect of a granular surface; color dingy white, umbonal area pink. Length about 24 mm.

*Leiomya (Plectodon) granulata* Dall<sup>18</sup> described from the Caribbean is a similar species. "*Cuspidaria (Plectodon) cf. granulata* Dall" has been cited by Gardner from the Shoal River formation, lower Miocene of Florida.

*Distribution:* The records of the occurrence of *Leiomya (Plectodon) scabra* in Mexican waters is an extension south of the known range of the species.

#### FAMILY VERTICORDIIDAE.

Genus *Verticordia* S. Wood.

Subgenus *Trigonulina* d'Orbigny.

*Verticordia (Trigonulina) ornata* d'Orbigny.

Plate 1, Figure 7.

*Trigonulina ornata* d'Orbigny, in Sagra, Hist. Phys. Polit. et Nat. Cuba, Moll., Vol. 2, 1846, p. 292, pl. 27, figs. 30-33. "Nous l'avons découverte dans le sable de la Jamaïque."—Chenu, Man. de Conchyl., Vol. 2, 1862, p. 169, fig. 843.

*Verticordia ornata* d'Orbigny, H. & A. Adams, Gen. Rec. Shells, Vol. 2, 1858, p. 532, pl. 124, figs. 2, 2a.—I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 103, pl. 54, figs. 15, 16, 17, 18. San Pedro, California. Range, Catalina Island, California, to Panama Bay. Also Japan and the Antilles.

*Type Locality:* Jamaica, in sand.

*Range:* Monterey Bay, California, to Panama. Also eastern America from Rhode Island to Jamaica and Barbados, Bermuda, and St. Helena.

*Collecting Stations:* Mexico: Manzanillo (184-D-2), 30 fathoms, gravelly sand; Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud.

*Description:* Shell small, nacreous, with about 8 or 9 prominent radial ribs on the anterior two-thirds of the shell. The average length is about 4 mm.

*Distribution:* This species occurs on both the Pacific and Atlantic coasts of America.

<sup>18</sup> *Leiomya (Plectodon) granulata* Dall, *Bull. Mus. Comp. Zool.*, Vol. 9, 1881, p. 111.—Dall, *Bull. Mus. Comp. Zool.*, Vol. 12, No. 6, 1886, p. 300, pl. 3, fig. 8. Off Sombrero, in 54 and 72 fathoms; off Barbados, in 76 and 100 fathoms; off Dominica, in 118 fathoms.

It is known from Monterey Bay, California, to Panama on the Pacific coast. It also has been reported from the Pleistocene of California.

#### Order Teleodesmacea.

Superfamily Astartacea.

#### FAMILY CRASSATELLITIDAE.

Key to the genera and subgenera of the Crassatellitidae.

- A. Shell large (over 10 mm. in height); thick  
 a. Margin crenulated. *Crassatellites* s.s.<sup>19</sup>  
 aa. Margin smooth ..... *Hybolophus*  
 B. Shell small (less than 10 mm. in height); thin ..... *Crassinella*

Genus *Crassatellites* Krüger.

Subgenus *Hybolophus* Stewart.

Key to the species of *Hybolophus*.

- A. Posterior end of shell pointed..... *gibbosa*  
 B. Posterior end of shell truncated.... *digueti*

#### *Crassatellites (Hybolophus) digueti* Lamy.

*Crassatella undulata* Sowerby, *Proc. Zool. Soc. London*, June 5, 1832, p. 56. "Hab. ad Puerto Portrero, Americae Centralis." "Dredged from sandy mud in eleven fathoms water."—Reeve, *Conch. Icon.*, Vol. 1, *Crassatella*, 1843, species 2, pl. 1, figs. 2a, 2b. Original locality cited.

Not *Crassatella undulata* Lamarck, *Ann. Mus. Hist. Nat.* (Paris), Vol. 6, 1805, p. 408. Not *Crassatella undulata* Say, *Jour. Acad. Nat. Sci. Philadelphia*, Vol. 4, 1842, p. 142, pl. 11, fig. 2(a, b).

*Crassatella digueti* Lamy, *Journ. de Conchyl.*, Vol. 62, No. 4, February 15, 1917, p. 217. "Ile Ceralbo," Gulf of California. New name for *Crassatella undulata* Sowerby, not *Crassatella undulata* Lamarck.

*Crassatellites laronus* E. K. Jordan, *Nautilus*, Vol. 46, No. 1, July, 1932, p. 9. "Near salt works at San José Island, Gulf of California."—E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, No. 4, 1936, p. 124, pl. 17, figs. 6, 7. Type locality cited. Also Angeles Bay, Lower California; Gulf of California and Central America. Also Magdalena Bay, Lower California, Pleistocene.

*Type Locality:* Puerto Potrero, Costa Rica, in 11 fathoms, sandy mud.

*Range:* Gulf of California to Gorgona Island, Colombia.

*Collecting Stations:* Mexico: Arena Bank (136-D-30), 35 fathoms, sand, weed; Port Guatulco (195-D-9), 7 fathoms, green sand, crushed shell; Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud.

*Description:* The shell of *Crassatellites digueti* may be easily separated from that of *C. gibbosa*, the only other species of the

<sup>19</sup> Not represented in the present collection.



genus living in west American waters, by the less rostrate form and by the truncated posterior end. A large specimen from the Gulf of California in the collections of the California Academy of Sciences measures 92 mm. in length.

*Distribution:* Shells of *Crassatellites digueti* were dredged at depths of 7, 12 and 35 fathoms. The species is known to occur from the Gulf of California to Colombia. It also occurs in the Pleistocene of Magdalena Bay, Lower California.

***Crassatellites (Hybolophus) gibbosus* Sowerby.**

*Crassatella gibbosa* Sowerby, *Proc. Zool. Soc. London*, June 5, 1832, p. 56. "Hab. ad oras Americae Meridionalis. (St. Elena and Xipixapi)." "Dredged from sandy mud in eleven fathoms water."—Reeve, *Conch. Icon.*, Vol. 1, *Crassatella*, 1843, species 1, pl. 1, figs. 1a, 1b. Original locality cited.

*Crassatellites rudis* Li, *Bull. Geol. Soc. China*, Vol. 9, No. 3, 1930 [received at library of California Academy of Sciences May 2, 1931], p. 257, pl. 3, fig. 16. Dredged in Panama Bay. "Horizon: Gatun formation." [= *Crassatellites gibbosus* Sowerby. See Pilsbry, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 83, 1931, p. 429, pl. 41, figs. 9, 10.]

*Type Locality:* Santa Elena and Xipixapi, Ecuador, in 11 fathoms, sandy mud.

*Range:* Gulf of California to Paita, Peru.

*Collecting Stations:* Mexico: Arena Bank (136-D-30), 35 fathoms, sand, weed; Santa Inez Bay (143-D-1, 3), 29-35 fathoms, mud, crushed shell, weeds; Gorda Banks (150-D-23), 45 fathoms, sand, calcareous algae; Chamela Bay (182-D-2), 12 fathoms, sand, algae; Tangola-Tangola Bay (196-D-17), 23 fathoms, mud; El Salvador: La Libertad (198-D-1, 2), 13-14 fathoms, mud; Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud; 14 mi. S. × E. of Judas Point (214-D-1, 4), 42-61 fathoms, mud, rocks.

*Description:* Shell elongately trigonal, the posterior end rostrate and pointed; early part of shell flattened and ornamented by concentric wrinkles. The posterior end of the shell of this species is narrower and more pointed than that of *C. digueti*. Specimens dredged off western Mexico measure 51 mm. in length.

*Distribution:* *Crassatellites gibbosus* was dredged at several localities from depths of 12 to 61 fathoms, mostly on sandy or shelly mud bottoms. It is known to occur from the Gulf of California to Peru and is also known to occur in the Pliocene of Costa Rica, and in the Pleistocene of Panama and Magdalena Bay, Lower California.

**Genus *Crassinella* Guppy.**

Key to the species of *Crassinella*.

A. Shell with usually 8-12 concentric ribs

- a. Anterior dorsal margin strongly concave ..... *pacifica*
- aa. Anterior dorsal margin weakly concave ..... *mexicana*

B. Shell with usually more than 12 concentric ribs which are finer and closer; shell smaller ..... *varians*

***Crassinella pacifica* C. B. Adams.**

*Gouldia pacifica* C. B. Adams, *Ann. Lyceum Nat. Hist. New York*, Vol. 5, July, 1852, pp. 499, 545, (separate pp. 275, 321). "Panama."—H. & A. Adams, *Gen. Rec. Shells*, Vol. 2, 1858, p. 484, pl. 115, figs. 7a, 7b.

*Type Locality:* Panama.

*Range:* Gulf of California to Panama.

*Collecting Stations:* Mexico: Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell; El Salvador: Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell; Nicaragua: Corinto, beach drift; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, shelly mud, crushed shell.

*Description:* Shell subtriangular, but with the ventral margin well excurved: the color varying in different specimens from dingy white to pale brown, often tinged with red about the beaks, with some narrow rays of brown, and rarely with short irregular lines of brown; with eight to twelve stout subequal concentric ridges; sometimes radially striated; beaks very acute and closely approximate; posterior area moderately depressed; lunule defined by a well impressed line, rising at the margin of the valves; margin of the interior not crenulate. It is closely allied to *G. parva* Ad. Length, .22 inch; height, .19 inch; breadth, .09 inch (C. B. Adams).

The type specimens of *Crassinella pacifica* have never been illustrated. H. & A. Adams give figures of the species but whether the specimen represented was from the type lot is not known. Specimens from the Gulf of California to Panama seem to agree with Adams' description. They also bear out Carpenter's conclusion that the West Indian *C. guadalupensis* d'Orbigny,<sup>20</sup> which species according to Lamy is identical with *C. parva* C. B. Adams (1845), is "the exact analogue of *Gouldia pacifica*." He also added that *C. martinicensis* d'Orbigny is intermediate between *C. pacifica* and *C. varians*.

The specific name *pacifica* is the earliest name available for specimens of the genus *Crassinella* found at Panama and it appears applicable to shells north to the Gulf of California. When a large series is examined it is apparent that there is so much variation in the size, shape, and amount of ribbing,

<sup>20</sup> *Crassatella guadalupensis* d'Orbigny, in Sagra, *Hist. Cuba, Moll.*, Vol. 2, 1845, p. 289, Atlas, pl. 27, figs. 24, 25, 26.

that we are inclined to question whether more than one species, or at most one species and a subspecies, occurs in this region.

*Distribution*: Specimens of *Crassinella pacifica* were collected on the beach and dredged abundantly at depths of 7 to 16 fathoms, from Port Guatulco, Mexico, to Port Parker, Costa Rica. This species has also been reported as occurring in the Pliocene of Ecuador.

***Crassinella pacifica mexicana* Pilsbry & Lowe.**

*Crassinella mexicana* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 103, pl. 14, figs. 8, 9. "Mexico: Guaymas, in about 20 fathoms (Lowe)."

*Type Locality*: Guaymas, Mexico, in about 20 fathoms.

*Range*: Cedros Island to the Gulf of California.

*Collecting Station*: Mexico: East of Cedros Island, Lower California (126-D-12), 45 fathoms, crushed shell and mud.

*Description*: According to Pilsbry & Lowe *Crassinella mexicana* is very similar to *C. pacifica* C. B. Adams but "it differs chiefly by being relatively high and short, the posterior and anterior dorsal margins meeting in a smaller angle." Externally there are about 12 concentric ribs. The measurements given for the type were: length, 3.4 mm.; height, 3.3 mm.; diameter, 1.8 mm.

There appears to be but few if any constant characters by which this form differs from the variable *C. pacifica*. The large size and less concave anterior dorsal margin may be distinguishing characters but it is not at all certain that these can be relied upon to separate the form *mexicana* as a distinct species or subspecies.

Specimens dredged by the expedition east of Cedros Island resemble so closely the illustrations of *Crassinella mexicana* given by Pilsbry & Lowe that we have assigned the shells to that form which we consider to be a subspecies of *C. pacifica*, at least until more is known regarding the relationship between it and the type specimens of *C. pacifica*.

*Distribution*: The discovery of the presence of this form off Cedros Island in 45 fathoms is an extension north of the known range.

***Crassinella varians* Carpenter.**

*Gouldia varians* Carpenter, *Cat. Mazatlan Shells*, October, 1855, p. 83. "Mazatlan." See also pp. 86 (footnote), 549.

*Crassatella pacifica* C. B. Adams, var. *varians* Carpenter, Lamy, *Journ. de Conchyl.*, Vol. 62, No. 4, 1917, p. 248. Bay of La Paz, Lower California, and Panama.

*Type Locality*: Mazatlan, Mexico.

*Range*: Gulf of California to Panama.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (145-D-1, 3), 4-13 fathoms, sand; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves.

*Description*: "It has the general size and appearance of *Astarte triangularis*." "It has concentric ribs either near the umbo, all over the shell, or not at all." "Even in its most ribbed form, it differs from *G. pacifica* in being very much smaller, not so flat, with umbos more spirally projecting, and with the anterior dorsal margin less concave, as well as in having the ribs smaller, and closer." (Carpenter).

As indicated by the specific name *varians* and by Carpenter's discussion, this is a very variable form. Specimens from the Gulf of California and south to Panama show great variation and certain ones could be picked out which could be assigned to *C. varians*, *C. pacifica* or *C. pacifica mexicana*. In the absence of any illustration of Carpenter's type and in view of the known variation of specimens of *Crassinella* from Mazatlan, the type locality of *C. varians*, and from Panama, the type locality of *C. pacifica*, the present authors question whether two distinct species exist in that region.

Apparently the chief characters which Carpenter relied upon to separate *C. varians* from *C. pacifica* were: the smaller size, more numerous and more closely spaced ribs and less concave anterior dorsal margin. Some specimens from Santa Inez Bay in the Gulf of California and others from Corinto, Nicaragua, seem to answer that description and have been referred to *C. varians*. They bear some resemblance to *C. goldbaumi* E. K. Jordan<sup>21</sup> from the Pleistocene of Magdalena Bay, Lower California, but we are inclined to refer them to Carpenter's species. *Crassinella haylocki* Pilsbry & Olsson<sup>22</sup> from the Pliocene of Ecuador appears to be a similar form, as does *Crassinella quintinensis* Manger<sup>23</sup> from the Pleistocene of San Quintin Bay, Lower California.

*Distribution*: The distribution of this species appears to be the same as that of *Crassinella pacifica*; that is, the Gulf of California to Panama.

Superfamily Carditacea.

FAMILY CARDITIDAE.

Genus *Cardita* Bruguière.

Key to the species of *Cardita*.

<sup>21</sup> *Crassinella goldbaumi* E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, No. 4, November 13, 1936, p. 126, pl. 18, figs. 4, 5. Magdalena Bay, Lower California, Pleistocene.

<sup>22</sup> *Crassinella haylocki* Pilsbry & Olsson, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 93, September 9, 1941, p. 57, pl. 18, figs. 7, 8. "Canoa formation, Punta Blanca." Ecuador, Pliocene.

<sup>23</sup> *Crassinella quintinensis* Manger, *Johns Hopkins Studies in Geol.*, No. 11, 1934, p. 298, pl. 21, figs. 1, 2. "San Quintin Bay, Lower California." Pleistocene.



- A. Shell high, quadrate or trigonal; hinge without distinct anterior lateral tooth..... (genus) *Cardita*
- a. Shell roundly trigonal in outline
- b. Shell large, very thick, ribs broad and rounded... *megastropa*
- bb. Shell small (15-20 mm. long), ribs narrow and bearing a row of pustules..... *spurca*
- aa. Shell subquadrate in outline
- c. Posterior end broadly rounded ..... *grayi*
- cc. Posterior end obliquely truncated
- d. Dorsal area offset: interspaces between ribs narrow ..... *cuvieri*
- dd. Dorsal area not offset; dorsal slope steep; interspaces two-thirds to three-fourths as wide as the ribs ..... *tricolor*
- B. Shell laterally elongated; hinge with a distinct anterior lateral tooth ..... (subgenus) *Carditamera*
- a. Posterior ventral and dorsal margins nearly parallel; spines on early portion of posterior ribs ..... *affinis*
- aa. Posterior ventral and dorsal margins not parallel; spines only on rib next to posterior dorsal margin ..... *radiata*

***Cardita cuvieri* Broderip.**

*Venericardia crassicostata* Sowerby, Cat. Shells Tankerville, Ap., 1825, p. IV. [No locality cited].—Hanley, Cat. Rec. Bivalve Shells, 1856, p. 129, pl. 17, fig. 56.

Not *Cardita crassicostata* Lamarck, 1819.

*Cardita cuvieri* Broderip, *Proc. Zool. Soc. London*, June 5, 1832, p. 55. "Hab. in Sinu Fonseca, Americae Centralis." "Dredged from sandy mud in eleven fathoms water, about seven miles from the shore."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 24, pl. 5, fig. 24. Original locality cited. Also "Acapulco."

*Cardita varia* Broderip, Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, pl. 5, fig. 25b [not 25a].

*Cardita michelini* Valenciennes, *Voy. Venus*, Zool., 1846, pl. 22, fig. 5 [two figs.]. [No locality cited.]

*Type Locality*: Gulf of Fonseca, Central America, in 11 fathoms, sandy mud.

*Range*: Gulf of California to Zorritos, Peru.

*Collecting Stations*: Mexico: Cerralbo Island, Gulf of California; Port Angeles; Port Guatulco; Colombia: Gorgona Island.

*Description*: Shell large (attaining a length of 66 mm.), subquadrate in outline,

thick, dorsal area strongly set off from remainder of valve; ornamented by about 14 broad, square, nodulous ribs which are separated by very narrow channelled interspaces; about a half dozen smaller ribs occur on the dorsal area; color reddish or orange brown.

The subquadrate shape and square ribs easily serve to separate this species from *C. megastropa* which possesses a rounded trigonal shell with rounded ribs. The closer set ribs and offset dorsal area are characters which assist in separating *Cardita cuvieri* from *C. tricolor*. *Venericardia hadra* Dall, the type of *Glyptactis* Stewart, and *Venericardia himerta* Dall, described from the lower Miocene of Florida, are somewhat similar to *C. cuvieri*. *Cardita umbonata* Sowerby, described from Sierra Leone, West Africa, is said to be similar in form to *C. cuvieri*.

*Distribution*: Specimens of *Cardita cuvieri* in the present collection were collected on the beaches in the Gulf of California, along the mainland of western Mexico, and at Gorgona Island, Colombia. The species is known to occur from the Gulf of California to Peru. It also is known to occur in the Pleistocene of Oaxaca, Mexico, and Ecuador.

***Cardita grayi* Dall.**

*Cardita crassa* G. B. Sowerby I, *Zool. Beechey's Voy.*, 1839, p. 152, pl. 42, fig. 4 [two figures]. "Inhab. Found at Acapulco."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 34, pl. 7, fig. 34. Original locality cited.

Not *Cardita crassa* Lamarck, 1819.

*Cardita grayi* Dall, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 54, January 20, 1903, p. 706. "Cape St. Lucas, the Gulf of California and south to Panama and the Galapagos Islands." New name for *Cardita crassa* Gray," not *C. crassa* Lamarck.

*Type Locality*: Acapulco, Mexico.

*Range*: Gulf of California to Guayaquil, Ecuador, and the Galápagos Islands.

*Collecting Stations*: Mexico: Chamela Bay, beach; Port Guatulco, beach; Tangola-Tangola Bay, beach.

*Description*: Shell trapezoidal, inflated, posterior dorsal margin broadly rounded; a broad shallow depression occurs from the beak to the base slightly anterior to the center; ornamented by 15 or 16 fairly broad rounded ribs which are separated by much narrower interspaces. A large specimen measures 33 mm. in length and 28 mm. in height.

The rounded posterior portion of the shell, rounded ribs, broad sulcus and less strongly developed central cardinal tooth, easily separate *Cardita grayi* from *C. tricolor* Sowerby.

A. M. Keen has pointed out that in so far as the hinge is concerned this species might well be referred to the genus *Beguina* Bolten (see Min. Conch. Club South. Calif., No. 39, September, 1944, p. 12).

*Distribution*: A few specimens of this species were collected on the beaches of Mexico. It ranges south to Ecuador.

***Cardita megastrophia* Gray.**

*Venericardia megastrophia* Gray, *Ann. Phil., New Ser.*, Vol. 25, February, 1825, p. 137, two figs. p. 138. [Not the locality "New Holland?"]—Lamy, *Journ. de Conchyl.*, Vol. 66, No. 4, 1922, p. 294, two text figs. p. 296. Lower California; Acapulco, Mexico.

*Venericardia flammea* Michelin, *Mag. de Zool.*, Vol. 1, 1831, Moll., pl. 6. [Locality unknown].

*Cardita tumida* Broderip, *Proc. Zool. Soc. London*, June 5, 1832, p. 56. "Hab. ad Americae Centralis et Meridionalis oras." "Found in a young state at Puerto Portrero, at a depth of eleven fathoms, in fine sand and gravel; and in a full-grown state at the Isle of Plata, in coral sand, at the depth of seventeen fathoms."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 26, pl. 5, fig. 26. Original locality cited.

*Cardita varia* Broderip, *Proc. Zool. Soc. London*, June 5, 1832, p. 56. "Hab. ad insulas Gallapagos." "Dredged in fine sand at the depth of six fathoms."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 25, pl. 5, fig. 25a [not 25b]. Original locality cited.

*Type Locality*: La Plata Island, Ecuador, in 17 fathoms, coral sand (here designated as type locality). ["New Holland?" originally cited].

*Range*: Gulf of California to La Plata Island, Ecuador, and the Galápagos Islands.

*Collecting Stations*: Mexico: Arena Bank (136-D-30), 35 fathoms, sand, weed; Ceralbo channel, Gulf of California (137-D-3), 46 fathoms, rock; Ceralbo Island, beach; 3 mi. off Pyramid Rock, Clarion Island (163-D-2), 55 fathoms, rock, coral; Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell; Santa Cruz Bay; Costa Rica: Port Parker, beach; Colombia: Gorgona Island, beach.

*Description*: Shell roundly trigonal with prominent curved beaks, ornamented by about 12 broad, rounded, often somewhat nodulous ribs, and additional finer ones which occur along the gently offset dorsal area; the ribs nearly merge one into the other at their bases but often they are separated by a shallow incised line; color usually brownish-red flecked with white or yellowish spots. A large specimen from Gorgona Island, Colombia, measures 54 mm. in altitude.

The shell of *Cardita megastrophia* is easily separated from that of *C. cuvieri* by the more trigonal form, more projecting beaks, and broad rounded ribs. *Venericardia terryi* Olsson from the Miocene of Costa Rica and *V. terryi brassica* Maury from the Miocene of Trinidad are similar forms.

*Distribution*: Specimens of *Cardita megastrophia* in the present collection were dredged from depths of 7 to 55 fathoms, and empty shells were found on beaches. The species is known to occur from the Gulf of California to Ecuador and the Galápagos Islands. It is also known to occur in the Pliocene and Pleistocene of Lower California.

***Cardita spurca* Sowerby.**

*Cardita spurca* Sowerby, *Proc. Zool. Soc. London*, for 1832 (issued March 13, 1833), p. 195. "Hab. ad oras Peruviae." "Dredged among coarse sand and gravel, in from six to ten fathoms, at Iquiqui, in Peru."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 32, pl. 7, fig. 32. Original locality cited.

*Type Locality*: Iquique, Chile, in 6 to 10 fathoms, sand and gravel.

*Range*: Mazatlan, Mexico, to Chile and Straits of Magellan.

*Collecting Station*: Mexico: Manzanillo (184-D-2), 30 fathoms, gravelly sand.

*Description*: Shell small, ovately oblong, anterior margin rounded, posterior dorsal area subangulated; ornamented by about 18 nodulous, radiating ribs; shell white or with brown spots, covered by an olivaceous periostracum; interiorly the dorsal area just beneath the beaks is often colored pink.

The specimens in the present collection agree so perfectly with the descriptions and illustrations of *Cardita spurca* that we have assigned them to that species. One of the largest specimens measures approximately 18 mm. in length and 16 mm. in height.

*Cardita velutina* E. A. Smith from Chile and the Strait of Magellan is a somewhat similar species.

*Distribution*: *Cardita spurca* is here recorded for the first time from west Mexican waters. It has previously been reported from Peru, Chile, and south to the Straits of Magellan. If our specimens are really *C. spurca* it has a long range. We have not seen specimens of the species from Chile and hence some doubt exists as to the identity of the present specimens from off Mexico.

***Cardita tricolor* Sowerby.**

*Cardita tricolor* Sowerby, *Proc. Zool. Soc. London*, for 1832 (issued March 13, 1833), p. 194. "Hab. Americâ Centrali." "Found among sand and mud, at a depth of ten fathoms, in the Bay of Guayaquil."—Lamy, *Journ. de Conchyl.*, Vol. 66, No. 3, 1922, p.



248. [Lower] California; Guaymas; Acapulco; Panama.

*Cardita laticostata* Sowerby, *Proc. Zool. Soc. London*, for 1832 (issued March 13, 1833), p. 195. "Hab. Americâ Centrali (Guacomayo)." "Found in sand, at a depth of from six to twelve fathoms, at St. Elena, Panama, and Real Llejos."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 36, pl. 7, figs. 36a, 36b, 36c.

*Cardita laticostata* Sowerby var. B, Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 36, pl. 7, fig. 36d. [Ref. to *Cardita tricolor*]. Original locality records of *C. tricolor* cited.

*Cardita arcella* Valenciennes, *Voy. Venus*, *Zool.*, Atlas, 1846, pl. 22, fig. 1 (two figures).

*Cardita reeveana* Clessin, Martini-Chemnitz *Conchyl.-Cab.*, Bd. 10, Abt. 1, *Carditacea*, 1888, p. 37, pl. 13, figs. 1 and 2 [not pl. 15, figs. 6 and 7].

*Type Locality*: Bay of Guayaquil, Ecuador, in 10 fathoms, sand and mud.

*Range*: Gulf of California, to Paita, Peru, and the Galápagos Islands.

*Collecting Stations*: Mexico: Port Guatulco (195-D-15), 1.5 fathoms, coral; Santa Cruz Bay, beach; Guatemala: 7 miles west of Champerico (197-D-1, 2), 14 fathoms, mud; Nicaragua: Potosi and Monypenny Point, beach; Costa Rica: Port Parker, beach; Piedra Blanca Bay (200-D-1, 10), 2-6 fathoms, rocks, sand, algae; Panama: Isla Parida, beach; Bahía Honda, beach.

*Description*: Shell fairly large, thick, subquadrate, ornamented by about 22 or 23 high, square ribs, of these 5 or 6 on the steeply sloping posterior margin are much smaller; ribs crossed by strong raised lines; periostracum black or brownish colored with raised concentric lines, sometimes with bands of bluish-white. The color varies, the anterior and posterior portions or in some cases concentric bands may be orange colored. A large specimen in the collection from Port Parker, Costa Rica, measures approximately 60 mm. in length and 52 mm. in height.

A study of a series of specimens reveals that there are no constant characters which can be relied upon to separate *Cardita tricolor* from *C. laticostata*. The specific name *tricolor* has page priority over that of *laticostata* and for that reason we have accepted Lamy's choice of that name for the species.

Large shells of *Cardita tricolor* are somewhat similar to those of *C. cuvieri* but can be easily separated from that species by the narrower ribs, wider interspaces, flatter umbos, and by the steeply sloping posterior area. Heilprin compared *Cardita serricosta* from the Tampa Silex beds of Florida with *C. laticostata*. *Cardita tricolor* bears some resemblance to *C. floridana* Conrad of the Caribbean region, but the posterior area

of the west American form slopes more steeply and it lacks the strong lateral teeth of the Floridan species. Other than the cardinals, the hinge of *C. tricolor* has only what Dall referred to as a lunular pustule.

*Distribution*: Specimens of *Cardita tricolor* in the present collection were found on beaches and dredged at depths of 1.5 to 14 fathoms. The species is known to occur from the Gulf of California to Peru. It also has been recorded as occurring in the Pliocene of Costa Rica and in the Pleistocene of the Tres Marias Islands.

#### Subgenus *Carditamera* Conrad.

##### *Cardita (Carditamera) affinis* Sowerby.

*Cardita affinis* Sowerby, *Proc. Zool. Soc. London*, for 1832 (issued March 13, 1833), p. 195. "Hab. in Americâ Meridionali." "Dredged from sandy mud, at a depth of from six to twelve fathoms, in the Bay of Montejo and Gulf of Nocoia."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 6, pl. 1, fig. 6. [No locality cited].

*Type Locality*: Bay of Montijo, Panama, in 6 to 12 fathoms, sandy mud, (here selected as type locality). Gulf of Nicoya, Costa Rica, also cited originally.

*Range*: Pequeña Bay, Lower California, to the Gulf of California and south to Santa Elena, Ecuador.

*Collecting Stations*: Mexico: Santa Inez Bay, east coast of Lower California; Cape San Lucas, Lower California; Chamela Bay; Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell; Guatemala: 7 mi. W. of Champerico (197-D-2), 14 fathoms, mud; El Salvador: La Union, Gulf of Fonseca (199-D-22), 3 fathoms, mud, mangrove leaves; Nicaragua: Potosi and Monypenny Point, beach; Corinto (200-D-2), 5.3 fathoms, mangrove leaves; San Juan del Sur, beach; Costa Rica: Port Parker (203-D-1), 15 fathoms, sandy mud, crushed shell; Port Culebra, beach; Culebra Bay, beach; Piedra Blanca, beach; Golfito, Gulf of Dulce, beach.

*Description*: Shell elongately rectangular in shape, anterior end projecting and rounded, basal margin and posterior dorsal margin nearly parallel, posterior end rounded or obliquely truncated, posterior umbonal area angulated or rounded; ornamented by about 15 ribs, the anterior ones flattened and lacking scales and in some cases more crowded, while those on the posterior portion of the valves are convex, squamose on young specimens but later become smooth or bear a varying number of scattered scales. The shell is colored brownish-white anteriorly and olive brown posteriorly; interiorly the posterior dorsal area is brown as is the anterior dorsal margin; the remainder is white. Length often less than 50 mm.

The smaller size, more scaly and spinose character of the posterior ribs and often

more contracted anterior end, seem to be about the only differences between *Cardita affinis* and its subspecies *californica*.<sup>24</sup> The subspecies attains a much larger size (a large specimen from the Gulf of California measures 82 mm. in length), the anterior end is broader with the ribs less crowded, and the posterior ribs almost or entirely lack spines, but in a large series there appears to be complete gradation between this form and *C. affinis*. The subspecies *C. affinis californica* is restricted to a more northern range and is particularly abundant in the Gulf of California. This appears to be the form illustrated by Reeve<sup>25</sup> as *Cardita pectunculus*.

*Cardita gracilis* Shuttleworth of the Caribbean region is similar to *C. affinis*.

*Distribution*: *Cardita affinis* was collected at many localities from the Gulf of California to Costa Rica, on beaches and dredged at depths of 3 to 15 fathoms. It is also known to occur in the Pleistocene of San Ignacio Lagoon and Magdalena Bay, Lower California, and of Oaxaca, Mexico.

***Cardita (Carditamera) radiata* Sowerby.**

*Cardita radiata* Sowerby, *Proc. Zool. Soc. London*, for 1832 (issued March 13, 1833), p. 195. "Hab. ad Salango, Columbiae Occidentalis, et ad Panamam." "Found in muddy sand at from six to twelve fathoms."—Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, 1843, species 5, pl. 1, fig. 5a [not fig. 5b]. Original locality cited.

*Lazaria radiata* Sowerby, H. & A. Adams, *Gen. Rec. Shells*, Vol. 2, 1858, p. 489, pl. 116, figs. 4, 4a.

*Lazaria observa* Mörch, *Malakozool. Blätter*, Bd. 7, 1861, p. 199. (Proposed for Reeve's pl. 1, fig. 5a). "Puntarenas." Costa Rica.

*Type Locality*: Salango, Ecuador, in 6 to 12 fathoms, sandy mud (here selected as type locality). Panama also cited originally.

*Range*: San Juanico, Lower California (Stearns); Petatlan Bay, Mexico, to Negritos, Peru.

*Collecting Stations*: Nicaragua: Potosi and Monypenny Point, beach; Corinto (200-D-10, 16, 19), 4-13 fathoms, mangrove leaves; Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud.

*Description*: The shell of *Cardita radiata* is somewhat similar to that of *C. affinis* but the ribs numbering about 17 are but little reduced anteriorly and scales occur only on the rib just below the posterior dorsal mar-

gin. The posterior end of *C. radiata* is more elongated, becomes gradually narrower and is usually somewhat pointed, and the two ribs at the posterior ventral margin are often projecting somewhat farther than the others. The color pattern of *C. radiata* is more spotted in effect, the ground color is yellowish-brown and on this are dark spots or narrow bands. The hinge of *C. radiata* is weaker and the left anterior cardinal tooth slopes much less steeply anteriorly than does that of *C. affinis*.

*Distribution*: Specimens of *Cardita radiata* in the present collection were found on beaches and dredged at depths of 4-13 fathoms, but not as abundantly as *C. affinis*.

Superfamily Chamacea.

FAMILY CHAMIDAE.

Key to the genera of the Chamidae.

- A. Nearly equivalve; with lunule; regular radial rows of long spines....*Echinochama*
- B. Usually not equivalve; without lunule; concentric scaly laminae or spines
  - a. Beaks turned to the right..... *Chama*
  - aa. Beaks turned to the left *Pseudochama*

Genus *Chama* Linnaeus.

Key to the species of *Chama*.

- A. Interior of adult shell entirely white
  - a. Shell with concentric lamellae or dense spines
    - b. Shell large; concentric scaly lamellae; exterior white and rose ..... *pellucida*
    - bb. Shell small, rounded; dense short white spines... *squamuligera*
  - aa. Shell with irregularly scattered spines; color pink..... *sordida*
- B. Interior of adult shell dark red, purple or partly white
  - a. Hinge bright coral red..... *echinata*
  - aa. Hinge white; exterior with radially striated, expanded, frondose lamellae ..... *frondosa*

***Chama echinata* Broderip.**

*Chama echinata* Broderip, *Proc. Zool. Soc. London*, for 1834 (issued April 3, 1835), p. 150. "Hab. in Americâ Centrali. (Puerto Portrero)." "Found at low water attached to rocks."—Broderip, *Trans. Zool. Soc. London*, Vol. 1, 1835, p. 305, pl. 39, figs. 5-7.—Reeve, *Conch. Icon.*, Vol. 4, *Chama*, 1847, species 35, pl. 7, fig. 35. Original locality cited.

*Chama coralloides* Reeve, *Conch. Icon.*, Vol. 4, *Chama*, December, 1846, species 18, pl. 4, fig. 18. "Hab. Porto Portrero, Central America (found attached to rocks at low water); Cuming."

<sup>24</sup> *Cardita californica* Deshayes, *Proc. Zool. Soc. London*, 1852 (issued May 23, 1854), p. 100. "Hab. Gulf of California."

<sup>25</sup> *Cardita pectunculus* Reeve, *Conch. Icon.*, Vol. 1, *Cardita*, June, 1843, species 4, pl. 1, fig. 4. [Not the record "Madagascar".]—Mabille, *Bull. Soc. Philomath. Paris*, Ser 8, Vol. 7, 1895, p. 74. Gulf of California; Lower California; coasts of Central America.



*Type Locality:* Puerto Potrero, Costa Rica, attached to rocks at low water.

*Range:* Magdalena Bay, Lower California, and the Gulf of California to Paita, Peru, and the Galápagos Islands.

*Collecting Stations:* Mexico: Gallito Point at entrance to Concepcion Bay, E. coast of Lower California; Port Guatulco; Nicaragua: Isla Cardon, Corinto.

*Description:* The purple interior and the bright coral red color of the hinge are characteristic features of the shell of this species.

*Distribution:* *Chama echinata* is commonly found attached to rocks at low tide along the west Mexican coast. It ranges south to Peru and the Galápagos Islands. It has also been reported from the Pleistocene of Oaxaca, Mexico.

#### *Chama frondosa* Broderip.

*Chama frondosa* Broderip, *Proc. Zool. Soc. London*, for 1834 (issued April 3, 1835), p. 148. "Hab. ad Insulam Platam Columbiae Occidentalis." "Dredged up from a rock of coral, to which it was adhering, at a depth of seventeen fathoms."—Broderip, *Trans. Zool. Soc. London*, Vol. 1, 1835, p. 302, pl. 38, figs. 1, 2.—Reeve, *Conch. Icon.*, Vol. 4, *Chama*, 1846, species 1, pl. 1, fig. 1a. Original locality cited.

*Type Locality:* Island of La Plata, Ecuador, in 17 fathoms, attached to coral.

*Range:* Gulf of California to Guayaquil, Ecuador, and the Galápagos Islands.

*Collecting Station:* Mexico: Santa Inez Bay, Gulf of California (143-D-1), 29 fathoms, mud, crushed shell, weeds.

*Description:* The shell of *Chama frondosa* is ornamented by striated frondose laminae each of which, when perfect, is shaped like a broad fan-shaped leaf. The exterior is usually of a beautiful saffron color while most of the interior is white with purplish colored finely denticulated margins.

A single specimen in the present collection from Santa Inez Bay in the Gulf of California appears to have grown without attachment of any kind.

The subspecies *Chama frondosa mexicana* Carpenter has shorter, less frondose, more numerous and irregularly distributed lamellae and the exterior is colored purplish-red as is the margin of the interior. It is the form represented on Reeve's plate 1, figure 1b. It occurs commonly along the west coast of Mexico and ranges from Magdalena Bay, Lower California, and the Gulf of California to Panama and the Galápagos Islands. This subspecies attains a large size and is often so covered by marine growths that the original sculpture is not visible.

*Distribution:* *Chama frondosa* occurs from the Gulf of California to Ecuador but

it appears to be much less commonly found in the northern part of its range. We have not seen specimens from the west coast of Lower California north of Cape San Lucas. It also occurs in the Pliocene of Lower California.

#### *Chama pellucida* Sowerby.

*Chama pellucida* Sowerby, *Proc. Zool. Soc. London*, for 1834 (issued April 3, 1835), p. 149. "Hab. ad Peruviam. (Iquiqui)." "Dredged up attached to stones, *Mytili*, and turbinated shells, at a depth varying from nine to eleven fathoms, from a bottom of coarse sand, and also found under stones at low water mark."—Broderip, *Trans. Zool. Soc. London*, Vol. 1, 1835, p. 302, pl. 38, fig. 3.—Reeve, *Conch. Icon.*, Vol. 4, *Chama*, 1847, species 32, pl. 6, fig. 32. Original locality cited.

*Type Locality:* Iquique, Chile, in 9 to 11 fathoms, attached to stones and *Mytili*; also under stones at low water mark.

*Range:* Oregon (Lat. 44° N.), to Mejillones and Cobija, Chile, and Juan Fernandez Island.

*Collecting Station:* Mexico: Off Cedros Island, Lower California.

*Description:* Shell translucent, exteriorly white or waxy white rayed with rosy streaks; spines irregular in size; interior white, margin very finely denticulated.

The spines of *Chama pellucida* are not expanded, frondose and striated as are those of *C. frondosa*.

*Distribution:* *Chama pellucida* was dredged by the expedition off Cedros Island, Lower California. It has been recorded as occurring from Oregon to Chile but we have not seen specimens from south of Cedros Island. It occurs fairly commonly along the coast of southern California. It has also been recorded as occurring from upper Miocene to Recent in California.

#### *Chama sordida* Broderip.

*Chama sordida* Broderip, *Proc. Zool. Soc. London*, for 1834 (issued April 3, 1835), p. 151. "Hab. in America Centrali. (Isle of Cuña)." "Dredged up from a depth of eighteen fathoms, attached to rocks."—Broderip, *Trans. Zool. Soc. London*, Vol. 1, 1835, p. 309, pl. 39, figs. 8 and 9. Original locality cited.—Reeve, *Conch. Icon.*, Vol. 4, *Chama*, 1847, species 23, pl. 5 fig. 23. Original locality cited.

*Type Locality:* Island of Cuña, Central America, in 18 fathoms, attached to rocks. [We have not noticed any South American island of this name in the atlases which we have consulted. There is, however, an island of "Caño" in the Gulf of Nicoya and another island of the same name in the Gulf of Dulce.]

*Range:* Carmen Island, Gulf of California, to Gorgona Island, Colombia.

*Collecting Station:* Mexico: Arena Bank (136-D-13), 45 fathoms, mud, *Arca* conglomerate.

*Description:* Shell of moderate size, lower valve deeply concave, upper valve gently convex, ornamented by short, sparse, irregularly scattered spines and by fine radial sculpture, color pale coral-red; interior white with finely crenulated margins. The short sharp rugosity in the hinge is finely serrated on some specimens. The original description mentions that the shell of this species varies much according to its age. The present specimen measures approximately 36.5 mm. from beak to base, and the convexity (both valves), 25.5 mm.

Apparently the record of *Chama iostoma* Conrad cited by Tomlin<sup>26</sup> from Gorgona Island, Colombia, can be referred to *Chama sordida*. Conrad's species was originally described from Hawaii.

*Distribution:* The present record is the second of *Chama sordida* from the Gulf of California. It occurs south to Colombia but is not a common species.

#### *Chama squamuligera* Pilsbry & Lowe.

*Chama spinosa* Broderip cited by authors from West American waters.

*Not Chama spinosa* Broderip, 1835.

*Chama squamuligera* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 103, pl. 14, fig. 10. "Nicaragua: San Juan del Sur," type. Also, Manzanillo, Tres Marias, Cape San Lucas, and Mazatlan, Mexico.

*Type Locality:* San Juan del Sur, Nicaragua.

*Range:* San Martin Island, Lower California, to San Juan del Sur, Nicaragua, and the Galápagos Islands.

*Collecting Stations:* Mexico: Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell; also on beach; Tangola-Tangola Bay.

*Description:* Shell small, round, both valves moderately arched, the lower more so, attached by nearly one half of the surface of the lower valve; whitish colored; sculpture consisting of dense, small, projecting scales which are more or less united into irregularly concentric frills. Interior white, margin fringed with scales, extremely finely crenulated and on large specimens granulose. Usually not over 20 mm. in altitude but sometimes specimens attain a height of 30 mm. from beak to base.

The shell of *Chama squamuligera* is very similar to that of the species described by Broderip as *Chama spinosa* from Lord

Hood's Island, a species referred by Lamy to *C. asperella* Lamarck. The white interior makes it possible to easily separate *Chama squamuligera* from the young of *C. echinata* in which the interior is brightly colored purple and the hinge red. Young specimens of *Chama pellucida* are more strongly and less densely spinose, often colored some shade of rose, and the margin has not the same granulose character as that of *C. squamuligera*.

*Distribution:* A few specimens of *Chama squamuligera* in the present collection were dredged in 7 fathoms at Port Guatulco, Mexico, and others were collected on the beach at Tangola-Tangola Bay, Mexico. It occurs south to the Galápagos Islands and has been recorded from the Pleistocene of Maria Magdalena Island, Tres Marias group.

#### Genus *Pseudochama* Odhner.

*Pseudochama saavedrai* Hertlein & Strong, sp. nov.

Plate I, Figures 1, 3, 8 and 10.

Shell ovately circular; color light yellowish-brown exteriorly; lower valve gently convex, beaks turned to the left, ornamented by rather appressed lamellae, which develop one strong and one weak row of scales toward the posterior margin; interior white, margin denticulate, one tooth on hinge; upper valve moderately inflated, ornamented similar to lower valve but with two well developed rows of scales; posterior to the scales the shell is ornamented only by the edges of close-set concentric lamellae; the concentric lamellae and scales on both valves are ornamented by radiating striae; interior white, margin denticulated. Length, 40.5 mm.; height, 46 mm.; convexity (both valves), approximately 30 mm. Holotype, from Station 184-D-1, dredged in 25 fathoms (45 meters), Lat. 19° 03' 45" N., Long. 104° 20' 45" W., off Manzanillo, Mexico. A paratype was collected by Fred Baker in 1921 at Puerto Ballandra, Carmen Island, in the Gulf of California.

*Pseudochama saavedrai* n. sp. seems to possess characters which separate it from all described west American species. The white interior of the shell, denticulate margin, and two radial rows of scales on the upper valve are characteristic features. The new species resembles *Pseudochama panamensis* Reeve<sup>27</sup> but the upper valve is more inflated and is ornamented by stronger concentric sculpture as well as by two radial

<sup>27</sup> *Chama panamensis* Reeve, *Conch. Icon.*, Vol. 4, *Chama*, January, 1847, species 45, pl. 8, fig. 45. "Hab. Panama (attached to stones); Cuming."—Clessin, Martini-Chernnitz *Conchyl.-Cab.*, Bd. 10, Abt. 1, *Chama*, 1889, p. 32, pl. 13, fig. 5.—Lamy, *Journ. de Conchyl.*, Vol. 71, No. 4, 1928, p. 330. Panama and La Paz.

*Pseudochama panamensis* Reeve, Pilsbry & Lowe, *Nautilus*, Vol. 47, No. 3, 1934 p. 84. Panama.

<sup>26</sup> Tomlin, J. R. leB., *Jour. Conch.*, Vol. 18, No. 7, May, 1928, p. 193. "Gorgona Is. on shore, common living; dead shells from Albemarle Is."



rows of lamellae on the posterior half of the shell in comparison to the rudely fimbriated sculpture of Reeve's species. Furthermore Reeve stated that the margin of *P. panamensis* is smooth while in the new species it is denticulated.

This species is named for Alvaro de Saavedra Cerón<sup>28</sup> who had charge of the first ship built on the west American coast and sailed from a west American port across the Pacific Ocean.

#### Genus *Echinochama* Fischer.

##### *Echinochama californica* Dall.

*Echinochama californica* Dall, *Proc. U. S. Nat. Mus.*, Vol. 26, July 10, 1903, p. 950, pl. 62, fig. 5. "From off Cerros Island, Lower California, in 25 fathoms."—Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, Pt. 6, October, 1903, p. 1404, 1406 (in text). Lower California.

*Type Locality*: Off Cedros Island, Lower California, Mexico, in 25 fathoms.

*Range*: Cedros Island, Lower California, to Coiba Island, Panama.

*Collecting Station*: Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud.

*Description*: Shell roundly trigonal, beaks turned to the left; a depressed lunular area present; color yellowish-white; about 20 to 21 ribs ornamented by long hollow spines; between the ribs there is a criss-cross granular sculpture; interior white, border finely crenulated; hinge rugosity serrated. Specimens attain an altitude of at least 40 mm. from beak to base.

*Echinochama californica* is similar to *E. arcinella* Linnaeus, a Caribbean species, but has larger, flatter and more quadrate valves, the beaks are less prominent, the lunule is less depressed and the ribs are more numerous and the spines are longer. According to Dall & Simpson the east American species is usually detached before it becomes adult. The same appears to be true of *E. californica*.

*Distribution*: Two specimens of *Echinochama californica* were collected by the expedition. One was dredged in 12 fathoms at Port Parker, Costa Rica, and the other was without locality information. The species is known to occur from Cedros Island and the Gulf of California to Panama.

#### Superfamily Lucinacea.

##### FAMILY THYASIRIDAE.

#### Genus *Thyasira* Leach in Lamarck.

##### *Thyasira excavata* Dall.

*Thyasira excavata* Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, August 22, 1901, pp. 790, 818, pl. 39, figs. 12, 15. "Dredged by the U. S.

Fish Commission in the Gulf of California, between San Marcos Island and Guaymas, in 1,005 fathoms; bottom temperature, 37°. 6 F. Also off Tillamook, on the coast of Oregon, in 786 fathoms, mud; bottom temperature, 37.3 F."

*Type Locality*: Between San Marcos Island and Guaymas, in the Gulf of California, in 1,005 fathoms.

*Range*: Tillamook, Oregon, to the Gulf of California, in 43 to 1,005 fathoms.

*Collecting Station*: Mexico: Arena Bank, Gulf of California (136-D-20, 22), 43-45 fathoms, mud.

*Description*: This species is markedly characterized by the deeply excavated and sharply bounded escutcheon and lunule, in which respect it is not closely approached by any other (Dall). In each valve there are three sharp and two or three obscure radial ridges.

Two specimens in the collection from Arena Bank show the rather deeply excavated lunule and escutcheon and radial ridges mentioned as characteristic of *Thyasira excavata*. The larger of the two measures approximately 9.3 mm. in altitude.

Wilckens<sup>29</sup> mentioned that *Thyasira townsendi* White from the Cretaceous of the Antarctic region possesses a lunule similar to that of *T. excavata*.

*Thyasira tomeana* Dall described from Chile bears some resemblance to *T. excavata* but differs somewhat in shape, is not as deeply furrowed posteriorly, and lacks strong radial ridges.

*Distribution*: The present specimens of *Thyasira excavata* from the Gulf of California appear to be the first found since those mentioned in the original description. According to Dall the species occurs to depths of 1,005 fathoms in the Gulf of California and ranges north to Oregon.

#### FAMILY LUCINIDAE.

Key to the genera and subgenera of the Lucinidae.

- A. Hinge with teeth
  - a. Sculpture divaricate ..... *Divaricella*
  - aa. Sculpture not divaricate
    - b. Hinge with cardinal teeth, laterals absent
      - c. Valves equally convex; strong concentric lamellae... *Lucinoma*
      - cc. Valves unequally convex; concentric sculpture of growth lines only..... *Miltha*
    - bb. Hinge with both cardinal and lateral teeth

<sup>28</sup> Regarding this voyage by Alvaro de Saavedra Cerón, see I. S. Wright, *Geogr. Rev.*, Vol. 29, No. 3, July, 1939, pp. 472-482, 1 fig. [map].

<sup>29</sup> *Thyasira townsendi* White, Wilckens, *Wiss. Ergeb. Schwed. Südpolar Exped. 1901-1903*, Bd. 3, Lief. 12, 1910, p. 53, pl. 2, figs. 31a-c; pl. 3, fig. 1. Snow Hill, Seymour Island, Antarctica, Cretaceous.

- d. Surface with concentric sculpture only
- e. Shell globose; lunule deeply impressed ..... *Here*
- ee. Shell compressed, obliquely elongate ..... *Cavilinga*
- dd. Surface with concentric and radial sculpture
- f. Radiating ribs divaricate ..... *Ctena*
- ff. Radiating ribs not divaricate
- g. Shell large, thick, anterior lateral close to cardinals ..... *Codakia*
- gg. Shell smaller, thinner, anterior lateral not close to cardinals
- h. Radial sculpture of 1 to 3 very broad ribs ..... *PleuroLucina*
- hh. Radial sculpture of 10 or more ribs
- i. Radial and concentric sculpture about equal, strong
- j. Sculpture with spines; many radial ribs  
*Lucinisca*
- jj. Sculpture without spines; usually 10 to 12 ribs  
*Bellucina*
- ii. Radial and concentric sculpture unequal, feeble  
*Parvilucina*
- B. Hinge without teeth ..... *Anodontia*

Genus *Lucina* Bruguière.

Subgenus *Bellucina* Dall.

*Lucina* (*Bellucina*) *cancellaris* Philippi.

*Lucina cancellaris* Philippi, *Zeit. f. Malakozool.*, February, 1846, p. 21. "Patria: Mazatlan". Mexico.

*Phacoides* (*Bellucina*) *cancellaris* Philippi, Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, 1901, pp. 814, 829, pl. 39 fig. 11. "Cerro Island, west of Lower California, and south to the Gulf and to Panama, in 5 to 30 fathoms."

*Type Locality*: Mazatlan, Mexico.

*Range*: Cedros Island, Lower California, and the Gulf of California to Panama, in 4 to 40 fathoms.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (145-D-1, 3), 4-13

fathoms, sand; Tenacatita Bay (183-D-3), 40 fathoms, sandy mud; Manzanillo (184-D-2), 30 fathoms, gravelly sand; El Salvador: Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

*Description*: Shell small, obliquely roundly trigonal, number of ribs variable, but usually there are from 10 to 12 fairly broad, radial ribs which are wider than the interspaces and are crossed by weaker concentric sculpture forming a cancellated pattern. Large specimens attain a height of 6 mm.

*Lucina amianta* Dall, which occurs from North Carolina to Brazil, and *L. tuomeyi* Dall from the upper Miocene of Florida, are similar species.

*Distribution*: *Lucina cancellaris* was dredged at a number of localities from depths of 4 to 40 fathoms, from Santa Inez Bay in the Gulf of California, where it was quite abundant, to Port Parker, Costa Rica. It also occurs in the Pleistocene of Magdalena Bay, Lower California, Maria Magdalena Island of the Tres Marias group and in the Pliocene of Ecuador.

Subgenus *Cavilinga* Chavan.

Key to the species of *Cavilinga*.

- A. Shell longer than high ..... *lampra*  
B. Shell with length and height about equal ..... *lingualis*

*Lucina* (*Cavilinga*) *lampra* Dall.

*Phacoides* (*Cavilucina*) *lamprus* Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, August 22, 1901, pp. 811, 827, pl. 39, fig. 9. Type locality, "La Paz, Lower California."

*Lucina lampra* Dall, E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1. No. 4, 1936, p. 130. Magdalena Bay, Lower California, Pleistocene. Also Gulf of California, Recent.

*Type Locality*: La Paz, Lower California.

*Range*: Gulf of California, to Santa Cruz Bay, Mexico.

*Collecting Stations*: Mexico: Cape San Lucas, beach; Manzanillo (184-D-2), 30 fathoms, gravelly sand; Port Guatulco (195-D-2, 6), 3 fathoms, sand, algae, crushed shell, also on beach; Santa Cruz Bay, beach.

*Description*: Shell of Dosinioid form, nearly orbicular, rather thick; beaks subcentral, lunule small, excavated, and nearly equally divided between the two valves; a broad shallow flexuosity is present along the posterior dorsal area but is sometimes nearly obsolete; sculpture of fine, low, rather sharp, concentric threads with occasional well marked sulci; microscopic radial striations sometimes present; internal margins



very finely crenulated in perfect specimens; color of shell white, yellow or pink. The largest specimens in the collection are about 21 mm. in length.

E. K. Jordan pointed out that the lunule in *Lucina lampra* is usually equally divided between the two valves, while in *L. californica* it is chiefly in the right valve. *Lucina lampra* is more circular in outline than the similar species *L. prolongata* Carpenter or *L. lingualis* Carpenter. Jordan also pointed out that the shell of *L. lampra* is longer than high, in *L. lingualis* the two dimensions are about equal, while that of *L. prolongata* is higher than long and pronouncedly oblique. The color of *Lucina lampra* varies from white to yellow or pink. All other species of the genus from the west coast are usually pure white.

*Distribution*: Specimens of *Lucina lampra*, most of them empty shells, were collected by the expedition at several localities from Cape San Lucas to Santa Cruz Bay, Mexico, on the beach and dredged to a depth of 30 fathoms. The discovery of the occurrence of this species at Santa Cruz Bay, Mexico, is an extension south of the known range. It also has been recorded as occurring in the Pleistocene of Magdalena Bay, Lower California.

#### *Lucina (Cavilinga) lingualis* Carpenter.

*Lucina lingualis* Carpenter, *Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 13, April, 1864, p. 313. Cape St. Lucas. Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, p. 211.—E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, 1936, p. 131. Magdalena Bay, Lower California, Pleistocene. Gulf of California to Acapulco, Mexico, Recent.

*Phacoides (Cavilucina) lingualis* Carpenter, Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, 1901, p. 827, pl. 39, fig. 7. Gulf of California.

*Type Locality*: Cape San Lucas, Lower California.

*Range*: Magdalena Bay to the Gulf of California and south to Acapulco, Mexico.

*Collecting Stations*: Mexico: Cape San Lucas, beach; San Lucas Bay (135-D-25), 7 fathoms, sand; Santa Inez Bay (145-D-1, 3), 4-13 fathoms, sand.

*Description*: The shell of this species resembles that of *Lucina lampra* but is higher and somewhat produced below; the height and length are about equal. A large right valve of this species from Magdalena Bay, Lower California, in the collections of the California Academy of Sciences, measures 13 mm. in height.

*Distribution*: Specimens of *Lucina lingualis* were collected by the expedition on the beach at Cape San Lucas and dredged at depths of 4-13 fathoms in the Gulf of California. It has been reported to range south to Acapulco and as occurring in the

Pleistocene at Magdalena Bay, Lower California.

#### Subgenus *Here* Gabb.

##### *Lucina (Here) excavata* Carpenter.

*Lucina excavata* Carpenter, *Cat. Mazatlan Shells*, November, 1855, p. 98. "Mazatlan."

*Phacoides (Here) richthofeni* Gabb, Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, 1901, pp. 810, 827, pl. 40, figs. 7 and 9. Catalina Island to the Gulf of California, in 16 to 66 fathoms.

*Type Locality*: Mazatlan, Mexico.

*Range*: San Pedro, California, to Mazatlan, Mexico, in 16 to 66 fathoms.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (142-D-3, 4), 40-50 fathoms, sand, weed, (146-D-1), 35 fathoms, mud, crushed shell; Gorda Banks (150-D-6) 60 fathoms, muddy sand, rocks.

*Description*: Shell globose, inflated; ornamented by concentric ridges and a deeply depressed lunule. A specimen from Santa Inez Bay in the Gulf of California measures approximately 23.5 mm. in altitude.

*Lucina (Here) iduna* Olsson from the Miocene of Peru has been compared to *L. excavata*.

*Distribution*: A few specimens of *Lucina excavata* were dredged at depths of 35 to 60 fathoms, from Cape San Lucas to Santa Inez Bay in the Gulf of California. It has also been recorded occurring as a fossil in California as far back as the middle Miocene.

#### Subgenus *Lucinisca* Dall.

Key to the species of *Lucinisca*.

- A. About 18 major ribs ..... *liana*
- B. More than 18 major ribs
  - a. Ribs equal, regularly spaced. . . . . *nuttalli*
  - aa. Ribs unequal, not regularly spaced, shell flatter ..... *fenestrata*

##### *Lucina (Lucinisca) fenestrata* Hinds.

*Lucina fenestrata* Hinds, *Zool. Voy. Sulphur*, Moll., Pt. 3, 1844 [January, 1845, on cover of Pt. 3], p. 66, pl. 19, fig. 2. "Inhab. Monte Christi; San Blas. In seven to fourteen fathoms."

*Lucina (Lucinisca) fenestrata* Hinds, Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, 1901, p. 811. Lower California to Panama (and Tumbes, Peru?). [Not *Lucina muricata* mentioned in the text].

*Type Locality*: Montechristi, Ecuador, in 7 to 14 fathoms (here designated as type locality). San Blas, Mexico, also cited originally.

*Range*: Cedros Island, Lower California, and the Gulf of California, to Salinas, Ecuador. Peru (Dall; Carpenter).

*Collecting Stations*: Mexico: East of

Cedros Island (126-D-2), 38 fathoms, mud; Arena Bank (136-D-15), 40 fathoms, mud, crushed shell; Santa Inez Bay (143-D-1, 2, 3, 4), 25-35 fathoms sand, weed, rocks.

*Description*: Shell resembling that of *Lucina nuttalli* but much larger. One valve in the present collection measures 44 mm. in altitude. The narrow elongate lunule appears to be about equally divided between the two valves. The sculpture is coarser and more rasp-like, the radial ribs are more unequal, smaller, and wider spaced in proportion to the size of the shell than are those of *L. nuttalli*. The major ribs of *L. fenestrata* are greater in number, finer, and more closely spaced than are those of *L. liana* Pilsbry. *Lucina (Luciniscia) fausta* Pilsbry & Olsson<sup>30</sup> from the Pliocene of Ecuador is a similar species.

*Distribution*: A number of specimens of *Lucina fenestrata* were dredged east of Cedros Island, on Arena Bank and in Santa Inez Bay at depths of 25 to 40 fathoms. It is much less commonly taken than the somewhat similar species *L. nuttalli*.

***Lucina (Luciniscia) liana* Pilsbry.**

*Lucina muricata* Chemnitz, Reeve, Conch. Icon., Vol. 6, *Lucina*, June, 1850, species 46, pl. 8, fig. 46. "Hab. Tumbez, Peru (in soft mud at a depth of eleven fathoms); Cuming."

Not *Lucina muricata* Chemnitz, 1795. An east American species.

*Phacoides (Luciniscia) hispaniolana* Maury, Li, *Bull. Geol. Soc. China*, Vol. 9, No. 3, 1930 [received at the library of the California Academy of Sciences May 2, 1931], p. 258, pl. 3, fig. 20. "Gatun Stage, Port Limon, Costa Rica." "Gatun formation." Dredged in the Bay of Panama.

Not *Phacoides (Luciniscia) hispaniolana* Maury 1917. Santo Domingo, Miocene.

*Phacoides (Luciniscia) liana* Pilsbry, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 83, November 13, 1931, p. 435, pl. 41, fig. 3. "Panama Bay, a mile out in 10-40 ft." [Rectification of the record cited by Li].

*Type Locality*: Panama Bay, 1 mile out, in 10-40 feet.

*Range*: Santa Inez Bay, east coast of Lower California, to Tumbez, Peru.

*Collecting Stations*: Mexico: Arena Bank (136-D-15, 22), 40-45 fathoms, mud, crushed shell; Santa Inez Bay (143-D-1), 29 fathoms, mud, crushed shell, weed; Port Guatulco (195-D-2), 3 fathoms, sand; Guatemala: 7 mi. W. of Champerico (197-D-1, 2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1, 2), 13-14 fathoms, mud; Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell;

Panama: Gulf of Chiriqui (221-D-1), 35 fathoms, sandy mud.

*Description*: Shell rounded, white; the upper anterior area ornamented by a few irregular ribs, the upper posterior area with 3 or 4 radial ribs followed by about the same number in a shallow groove, the remainder of the shell ornamented by about 18 major slightly wavy ribs between which there are smaller riblets, usually one or two toward the anterior end and 3 along the ventral margin; ribs and riblets ornamented by projecting points or scales where the ribs are crossed by rather widely spaced, thin concentric ridges. Hinge similar to *L. muricata*. Large specimens attain a length of 19.5 mm.

The unequal size between the major and minor ribs is a character which easily serves to separate *Lucina liana* from *L. nuttalli centrifuga* Dall. The major ribs of *L. liana* are much less numerous than those of *L. fenestrata* Hinds. *Lucina roigi* Maury from the Pliocene of Trinidad is another species of the *L. muricata* group to which *L. liana* belongs.

*Distribution*: The discovery of the occurrence of *Lucina liana* in the Gulf of California is an extension north of the known range of the species. It also has been recorded as occurring in the Pliocene of Panama and Ecuador.

***Lucina (Luciniscia) nuttalli* Conrad.**

*Lucina nuttalli* Conrad, *Journ. Acad. Nat. Sci. Philadelphia*, Vol. 7, 1837, p. 255, pl. 20, fig. 2. "Inhabits California."

*Lucina (Myrtea) nuttalli* Conrad, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 288, pl. 14, figs. 4a, 4b, 18. Earlier records cited. Upper Miocene to Recent.

*Type Locality*: California.

*Range*: Santa Barbara, California, to Manzanillo, and the Tres Marias Islands, Mexico.

*Collecting Stations*: Mexico: Arena Bank (136-D-22), 45 fathoms, mud; Santa Inez Bay (145-D-1, 3), 4-13 fathoms, sand; Tenacatita Bay (183-D-3), 15 fathoms, sand; Manzanillo (184-D-2), 30 fathoms, gravelly sand.

*Description*: Shell orbicular, ornamented by even, strong, cancellate sculpture; the ribs are nearly equal in strength but there are some finer ones interspersed; ribs more widely spaced toward the anterior and posterior margins. The lunule usually lies chiefly in the left valve. Large specimens attain a height of 25 mm.

The subspecies *Lucina nuttalli centrifuga* Dall, a form with widely spaced concentric lamellae described from the Gulf of California, intergrades completely with specimens of *L. nuttalli* from that region. The sub-

<sup>30</sup> *Lucina (Luciniscia) fausta* Pilsbry & Olsson, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 93, September 9, 1941, p. 58, pl. 17, figs. 3, 6. "Canoa formation, Punta Blanca." Ecuador, Pliocene.



species has not been reported outside the Gulf of California except as a fossil in southern California.

*Distribution*: *Lucina nuttalli* occurs commonly from southern California to the Gulf of California. The present record of the species from Manzanillo, Mexico, is an extension south of the known range. It is also known to occur from upper Miocene to Recent in California.

#### Subgenus *Lucinoma* Dall.

##### *Lucina (Lucinoma) annulata* Reeve.

*Lucina annulata* Reeve, Conch. Icon., Vol. 6, *Lucina*, May, 1850, species 17, pl. 4, fig. 17. "Hab. California?"

*Phacoides annulatus* Reeve, I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 126, pl. 33, figs. 5a, 5b. Port Althorp, Alaska, to the Coronado Islands, Lower California. Also upper Miocene, Pliocene and Pleistocene of California.

*Type Locality*: California.

*Range*: Port Althorp, Alaska, to Santa Inez Bay, east coast of Lower California.

*Collecting Stations*: Mexico: East of Cedros Island (126-D-2, 9, 12), 38-56 fathoms, crushed shell, eel grass, mud; Santa Inez Bay (142-D-4), 40-50 fathoms, sand.

*Description*: Shell suborbicular, often large, posterior dorsal margin straight; posterior sulcus slight; ornamented by fairly regular, sharp, raised concentric lamellae between which there are a number of low concentric threads; cardinal teeth well developed, lateral teeth weak.

The largest specimen in the present collection is about 26 mm. in altitude and appears to be typical of the species. Large specimens of *Lucina annulata* attain an altitude of 55 mm.

*Distribution*: The present records of *Lucina annulata* from off Cedros Island and from Santa Inez Bay in the Gulf of California furnish an extension south of the known range of the species. It is also known to occur in the Pliocene and Pleistocene of California.

#### Subgenus *Miltha* H. & A. Adams.

##### *Lucina (Miltha) xantusi* Dall.

Plate I, Figure 13.

*Phacoides (Miltha) xantusi* Dall, *Nautilus*, Vol. 18, No. 10, February, 1905, p. 111. "Cape St. Lucas." Lower California.

*Type Locality*: Cape San Lucas, Lower California.

*Range*: Gulf of California.

*Collecting Stations*: Mexico: Cape San Lucas; Arena Bank (136-D-5), 33 fathoms, sand, weed.

*Description*: Shell large, ovately rounded, produced ventrally, rather flat, right valve more convex than the left; ornamentation

consists of concentric lines of growth and radial striae; posterior sulcus present, ornamented by one radial ridge; lunule chiefly in the right valve, depressed; two cardinal teeth, the right anterior and left posterior tooth bifid; ligamental groove, long, posterior; muscle scars, especially the anterior one, large; inner surface of valve scatteringly pitted; margin smooth.

The specimen from Arena Bank measures 68 mm. in length, 71.2 mm. in height, and convexity (both valves), 23 mm. This is almost the same size as the type specimen described by Dall. Young specimens are rounder in outline. This species is very close to *Lucina (Miltha) joannis* Dall described from the Pliocene of Lower California. According to Dall the margin of the lunule of *L. joannis* is more deeply infolded, the shell heavier, more elongately oval and about one-fourth smaller than that of *L. xantusi*. The measurements given for *L. xantusi* are 71 mm. in height and 65 mm. in width as compared to 55 mm. in height and 51 mm. in width for *L. joannis*. These measurements do not indicate that the shell of *L. joannis* is more elongate in proportion to the width as compared to that of *L. xantusi*. The illustration given by Hanna<sup>31</sup> of a fossil shell from Imperial County, California, which he referred to *L. xantusi*, represents a rather round form which may perhaps be referable to *L. joannis*.

*Lucina (Miltha) childreni* Gray from Brazil is a similar species and there are other similar forms which occur in the late Tertiary of the Caribbean region.

*Distribution*: *Lucina (Miltha) xantusi* is a rare species. The two specimens taken on the expedition from the southern part of the Gulf of California from Cape San Lucas and Arena Bank are from the same region where it has been found previously by collectors.

#### Subgenus *Parvilucina* Dall.

Key to the species of *Parvilucina*.

- A. Concentric lamellae strong and dense;  
lunule deep ..... *mazatlanica*  
B. Concentric lamellae weaker;  
lunule shallower ..... *approximata*

##### *Lucina (Parvilucina) approximata* Dall.

*Phacoides (Parvilucina) approximatus* Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, August 22, 1901, pp. 813, 828, pl. 39 fig. 4. "From the Gulf of California, in 26 fathoms, sand." Also cited from Catalina Island, California, and south to Panama, in 5 to 40 fathoms.

*Lucina (Myrtea) tenuisculpta* Carpenter

<sup>31</sup> *Phacoides xantusi* Dall, Hanna, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 14, No. 18, 1926, p. 475, pl. 23, fig. 7, pl. 29, fig. 1. Coyote Mountain, Imperial County, California, Pliocene.

var. *approximata* Dall, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 289, pl. 14, figs. 8a, 8b. Earlier records cited. Pleistocene and Recent.

*Type Locality*: Gulf of California, in 26 fathoms, sand.

*Range*: Monterey, California, to Panama.

*Collecting Stations*: Mexico: East of Cedros Island (126-D-12), 45 fathoms, crushed shell, mud; Nicaragua: Corinto (200-D-19, also beach), 12-13 fathoms, mangrove leaves; Costa Rica: Port Parker (203-D-1, 3, also beach), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

*Description*: Shell small, usually not exceeding 6 mm. in length, nearly equilateral, tumid, lunule lanceolate in shape and depressed; sculpture of numerous fine radial ribs separated by narrow interspaces, radial sculpture absent on the dorsal areas, ribs crossed by distant elevated concentric lines which are feebly lamellose on the dorsal areas; margin crenulated. The measurements given for the type specimen of this species were, length, 6.3 mm.; height, 6.5 mm.

The shell of *Lucina approximata* is very similar to that of the generally more northern *L. tenuisculpta* but is smaller, more delicate, has stronger radial sculpture and lacks the right anterior cardinal tooth of the northern form. The radial ribbing tends to become obsolete in the northern part of its range and the two species are scarcely separable in southern California.

*Lucina crenella* Dall from the Atlantic coast is a similar species.

*Distribution*: *Lucina approximata* occurs fairly abundantly from southern California to Panama. It was dredged abundantly off Cedros Island and was taken by the expedition as far south as Costa Rica. It is also known to occur in the Pleistocene of southern California and Lower California.

#### *Lucina (Parvilucina) mazatlanica* Carpenter.

*Lucina mazatlanica* Carpenter, *Cat. Mazatlan Shells*, November, 1855, p. 99. "Mazatlan," Mexico.—E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, No. 4, 1936, p. 130. Magdalena Bay, Lower California, Pleistocene. Recent in the Gulf of California.

*Phacoides (Here) mazatlanicus* Carpenter, Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, 1901, p. 811. Mazatlan.

*Type Locality*: Mazatlan, Mexico.

*Range*: Gulf of California to Panama.

*Collecting Station*: Mexico: Santa Inez Bay, E. coast of Lower California (145-D-1, 3), 4-13 fathoms, sand.

*Description*: Shell small, tumid, nearly equilateral; lunule rather large and depressed; sculpture of numerous fine,

rounded riblets separated by narrow interspaces, weak or absent on the early part of the shell; concentric sculpture of elevated laminae which are very dense on the early part of the shell but are less pronounced on later stages; basal margin crenulated.

*Lucina mazatlanica* resembles *L. approximata* Dall and *L. tenuisculpta* Dall but average specimens (about 4.5 mm. in length) are smaller than either of these species. The lunule appears to be deeper and the concentric lamellae stronger and denser in comparison to young forms of *L. approximata*.

There is doubt regarding the exact identification of *Lucina mazatlanica* because, as mentioned by Dall (1901) "Carpenter's specimens are so small that it is difficult to be certain about them," furthermore, no illustrations of them have been published. Dall thought the species might be allied to *L. sombreroensis*, a Caribbean species. In the original description of *Lucina sombreroensis*<sup>32</sup> no mention was made of any radial sculpture on that species. Carpenter definitely mentioned radial sculpture on *L. mazatlanica* which would seem to place it near *L. approximata* Dall.

*Distribution*: Specimens referred to *Lucina mazatlanica* were dredged in 4 to 13 fathoms in Santa Inez Bay, in the Gulf of California. It also has been reported as occurring in the Pleistocene of Magdalena Bay, Lower California.

#### Subgenus *Pleurolucina* Dall.

##### *Lucina (Pleurolucina) leucocymoides* Lowe.

*Phacoides (Pleurolucina) leucocymoides* Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, No. 6, March 21, 1935, p. 17 pl. 1, fig. 4. "Tres Marias" Islands, (type). Also from Carmen Island in 20 fathoms, and Angel de la Guardia, in 20 fathoms, Gulf of California.

*Type Locality*: Tres Marias Islands, Mexico.

*Range*: Angel de la Guardia Island, Gulf of California, to Manzanillo, and Tres Marias Islands, Mexico.

*Collecting Stations*: Mexico: Arena Bank (136-D-15, 22, 23), 40-45 fathoms, mud, crushed shell, sand; Santa Inez Bay (142-D-3, 4), 40-50 fathoms, sand, weed, also (147-D-2), 60 fathoms, mud crushed shell; Gorda Banks (150-D-9), 50-60 fathoms, muddy sand; Manzanillo (184-D-2), 30 fathoms, gravelly sand.

*Description*: Shell with a single wide costa which occupies the entire middle half

<sup>32</sup> *Lucina sombreroensis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 12, No. 6, September, 1886, p. 264. "Off Sombrero in 72 fms., two valves; West Florida, 50 fms., one small valve."—Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 263, pl. 14, fig. 13. Off Cape Florida, in 84 to 85 fathoms, sand and mud. "Also in the Gulf of Mexico and off Sombrero Island, West Indies, by the Blake, in 50 to 72 fathoms."



of the shell and is bounded on either side by a channeled groove; concentric sculpture of reflexed concentric lirae; lunule large, heart-shaped, equally divided between each valve, shallowly depressed. The shell of adult specimens is quite thick. Hinge with two cardinals and divided laterals. Inner margin finely crenulated. The shell of this species attains a height of 20 mm.

*Lucina leucocyma* Dall of the Atlantic coast is a similar species.

*Lucina undatoides* Hertlein & Strong (*Lucina undata* Carpenter<sup>33</sup>, not *L. undata* Lamarck) is ornamented by three or four broad costae, and by finer concentric sculpture, and the shell is longer and less convex than that of *L. leucocymoides*.

*Distribution*: The present record of the occurrence of *Lucina leucocymoides* at Manzanillo, Mexico, is an extension south of the known range of the species. It is also known to occur in the Pleistocene of Albemarle Island, Galápagos group, where it was found by Professor Nicolas Reformatzky.

#### Genus *Anodontia* Link.

##### *Anodontia edentuloides* Verrill.

*Loripes edentuloides* Verrill, *Amer. Jour. Sci.*, Ser. 2, Vol. 49 (whole No. 99), No. 146, March, 1870, p. 226. "La Paz,—J. Pedersen. One specimen."

*Lucina edentuloides* Verrill, Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, 1901, p. 802. Magdalena Bay, Lower California and the Gulf of California.

*Anodontia edentuloides* Verrill, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 292. Earlier records cited. Pliocene and Recent.

*Type Locality*: La Paz, Lower California.

*Range*: San Clemente Island, California (Dall), and Cedros Island, Lower California, to the Gulf of California, and south to Tenacatita Bay, Mexico.

*Collecting Stations*: Mexico: East of Cedros Island (126-D-2), 38 fathoms, mud; Arena Bank (136-D-4, 13, 14, 20, 22), 43-55 fathoms, mud, *Arca* conglomerate; Santa Inez Bay (143-D-1, 2, 3, 4, 5), 18-35 fathoms, mud, crushed shell, weed, sand; Tenacatita Bay (183-D-3), 40 fathoms, sandy mud.

*Description*: Shell subglobose, beaks subcentral, ornamented by irregular lines of growth and submicroscopic radial striae; hinge without teeth. The largest specimen taken by the expedition measures approximately 43 mm. in length but the species attains a larger size.

<sup>33</sup> *Lucina undata* Carpenter, *Proc. Zool. Soc. London*, 1865, p. 279. "Hab. Gulf of California (teste Rowell)." Not *Lucina undata* Lamarck, 1819. Due to the fact that the combination of names *Lucina undata* proposed by Carpenter had already been used by Lamarck, the name *Lucina undatoides* was proposed by Hertlein & Strong for the species described by Carpenter (*Nautilus*, Vol. 58, No. 3, January, 1945, p. 105).

Young shells about 10 mm. in length, from Arena Bank, have two cardinals and one lateral tooth in the left valve and one cardinal and one lateral in the right valve. Apparently these teeth become covered as growth proceeds. Exteriorly these young shells are sculptured by concentric lines of growth and fine radial striation exactly as in large specimens of *Anodontia edentuloides*. These features as well as the exact shape of that species have led us to refer these young shells to Verrill's species.

The shell of *Anodontia edentuloides* is very similar to *A. chrysostoma* (Meuschen) Philippi, a Caribbean species, but the beaks are more centrally located on the west American shell which also appears to be slightly more elongated in proportion to the height.

*Distribution*: Specimens of this species were found off Cedros Island, in the southern part of the Gulf of California, and at Tenacatita Bay. The present record of the occurrence of the species at Tenacatita Bay, Mexico, is an extension south of the known range. It has also been recorded from the Pliocene of Imperial County, California.

#### Genus *Codakia* Scopoli.

##### *Codakia distinguenda* Tryon.

*Lucina (Codakia) distinguenda* Tryon, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 24, September 3, 1872, p. 130, pl. 6, fig. 3. "Gulf of California."

*Codakia colpoica* Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, August 22, 1901, pp. 801, 821, pl. 41, fig. 4. "Gulf of California."

*Type Locality*: Gulf of California.

*Range*: Magdalena Bay, Lower California, and the Gulf of California to Panama.

*Collecting Stations*: Mexico: Ceralbo Island, beach; Port Guatulco (195-D-10, also beach), 4 fathoms, gravelly sand, crushed shell, coral; Costa Rica: Port Parker, beach; Panama: Bahia Honda, beach.

*Description*: Shell large, orbicular, thick, white exteriorly, interiorly reddish colored around the margin and hinge and cream colored in the central part of the valve; ornamented exteriorly by many narrow fairly regular, radial ribs; lunule small, depressed, mostly confined to the right valve. A large specimen from the Gulf of California measures 140 mm. in length.

The shell of this species is very similar to that of the east American *Codakia orbicularis* Linnaeus, but the valves of the west American species are more depressed, the posterior dorsal area is straighter and longer, the inner margin of the hinge is usually reddish colored and the exterior is usually tinted faintly pinkish-white rather than the usually pure white of *C. orbicularis*.

A study of a series of specimens suggests that there is little to separate the form

described as *C. pinchoti* Pilsbry & Lowe<sup>34</sup> from *C. distinguenda* or from *C. recta* Dall & Ochsner which was originally described from the Pliocene of the Galápagos Islands.

*Distribution*: *Codakia distinguenda* occurs fairly commonly in the Gulf of California and 15 valves were taken by the expedition at Ceralbo Island. It was also collected at Costa Rica and Panama. It is also known to occur from Pliocene to Recent in the Gulf of California region.

#### Genus *Ctena* Mörch.

Key to the species of *Ctena*.

- A. Radial sculpture present on dorsal areas
- a. Radial sculpture much heavier than the concentric
    - b. Ribs fine, numerous.....*mexicana*
    - bb. Ribs coarse, less numerous .....*galapagana*<sup>35</sup>
  - aa. Radial sculpture only slightly heavier than or equal with the concentric
    - c. Transversely oval or sub-circular; anterior end broadly rounded .....*clippertonensis*
    - cc. Obliquely transversely ovate; anterior end narrower .....*clarionensis*
- B. Radial sculpture not present on dorsal areas .....*chiquita*

#### *Ctena chiquita* Dall.

*Codakia (Jagonia) chiquita* Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, August 22, 1901, pp. 801, 823, pl. 39, fig. 1. "On the west side of the lower end of the peninsula of Lower California, nearly abreast of La Paz, in 66 fathoms."

*Type Locality*: Off the west coast of Lower California, nearly abreast of La Paz, in 66 fathoms.

*Range*: West coast of Lower California in about Lat. 24°18'N., and the Gulf of California to La Libertad, El Salvador.

*Collecting Stations*: Mexico: Manzanillo (184-D-2), 30 fathoms, gravelly sand; Santa Cruz Bay, beach; Tangola-Tangola Bay (196-D-6, 7), 6-7 fathoms, sand, crushed shell; El Salvador: La Libertad (198-D-2), 14 fathoms, mud.

*Description*: Shell small, suborbicular, flattish, color yellowish-white, sculpture of fine nearly obsolete radial threads which often bifurcate toward the ventral margin, less prominent on the middle of the valves and absent along the dorsal margin, radials crossed by regular, concentric, crowded threads; lunule small, depressed, nearly

equally divided between the two valves. A large specimen from off Lower California measures 13.5 mm. in length.

The shell of *Ctena chiquita* is less elongate, and the radial sculpture is finer than that of *C. mexicana* Dall and is lacking on the dorsal areas.

*Distribution*: The present record of *Ctena chiquita* from La Libertad, El Salvador, is an extension southward of the known range of the species. It has not been recorded previously from south of the Gulf of California.

#### *Ctena clarionensis* Hertlein & Strong, sp. nov.

Plate I, Figures 11, 12 and 14.

Shell small, solid, plump, obliquely ovately quadrate, with the beaks nearer the posterior end; without posterior or anterior areas; sculptured with many, fine, close, rounded threads which are notched by somewhat wider spaced radial lines, giving the whole surface a finely beaded appearance; lunule narrow, moderately long, well impressed, equally divided between the two valves; growth stages distinctly marked, particularly the last three; interior with the muscle scars distinct, about equal in size; interior basal margin with fine radial ridges extending to the pallial line; cardinal teeth small, the right valve with a strong, distant anterior lateral and a smaller, closer, posterior lateral tooth; left valve with a weak posterior cardinal and a low projection which may represent a broken anterior cardinal, one small anterior lateral and socket and one posterior lateral and socket present; above each socket there is a faint lateral. The type measures: longitudinal diameter, 13.8 mm.; vertical diameter, 12.5 mm.; convexity (both valves), 8.2 mm.

Holotype, from Sulphur Bay, Clarion Island, collected by the Templeton Crocker Expedition of the New York Zoological Society.

The unique type is white with the anterior end and posterior edge dark reddish-brown but this color may be a stain. The new species resembles *Ctena clippertonensis* Bartsch & Rehder<sup>36</sup> described from Clipperton Island, but the present species is more oblique in outline, the anterior end is narrower and the sculpture is coarser. The new species has much finer sculpture than *C. mexicana* Dall.

#### *Ctena clippertonensis* Bartsch & Rehder.

*Ctena clippertonensis* Bartsch & Rehder, *Smithson. Miscell. Coll.*, Vol. 98, No. 10, (Publ. 3535), June 13, 1939, p. 13, pl. 3, figs.

<sup>34</sup> *Codakia pinchoti* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 103, pl. 14, figs. 1 and 2. "Panama City, on the reef off 'French Plaza'."

<sup>35</sup> Not represented in the present collection.

<sup>36</sup> *Ctena clippertonensis* Bartsch & Rehder, *Smithson. Miscell. Coll.*, Vol. 98, No. 10, (Publ. 3535), June 13, 1939, p. 13, pl. 3, figs. 1, 2, 3, 4, 5. "It was collected on Clipperton Island, on rocks to the south of the landing place."



1-5. "It was collected on Clipperton Island, on rocks to the south of the landing place."

*Type Locality*: Clipperton Island, on rocks.

*Range*: Maria Madre Island, Mexico, to Hannibal Bank, Panama, and Clipperton Island.

*Collecting Station*: Panama: Hannibal Bank (Sta. 224), 35-40 fathoms, rocks, dead coral, mud, sand, shells, algae.

*Description*: Left valve, white, transversely oval to subcircular, moderately inflated, beaks back of the center; ends broadly rounded; ornamented by fine radial riblets crossed by concentric lamellae of nearly equal strength which give the ribs a nodulose character; lunule, well defined, narrow, elongately lanceolate; hinge with an anterior cardinal and a smaller grooved posterior cardinal tooth, lateral teeth paired, the larger pointed one of each pair occurs on the inside and the smaller one near the margin.

The present specimen measures: length, 15.2 mm.; height, 13.8 mm.; convexity (one valve), 3.8 mm.

The broadly rounded anterior end of the present specimen as well as its other characters appear to be those of *Ctena clippertonensis* Bartsch & Rehder.

*Distribution*: A single left valve of this species was dredged by the expedition on Hannibal Bank, Panama, in 35-40 fathoms. This is an extension south of the known range of the species.

#### *Ctena mexicana* Dall.

*Codakia (Jagonia) mexicana* Dall, *Proc. U. S. Nat. Mus.*, Vol. 23, August 22, 1901, pp. 801, 822, pl. 40, fig. 6. "Gulf of California" (figured specimen). Range cited as Gulf of California to Panama and Guacomaayo.

*Lucina (Jagonia) mexicana* Dall, Lamy, *Journ. de Conchyl.*, Vol. 65, No. 3, 1921, p. 253. Colombia; Lower California.

*Type Locality*: Gulf of California.

*Range*: Gulf of California, to Santa Elena, Ecuador. Galápagos Islands (Tomlin).

*Collecting Stations*: Mexico: Arena Bank (136-D-1), 45 fathoms, mud, *Arca* conglomerates; Santa Inez Bay (143-D-1), 29 fathoms, mud, crushed shell, weed; also (145-D-1, 3), 4-13 fathoms, sand; also beach; Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell; Nicaragua: Corinto (200-D-11, 19), 8-13 fathoms, mangrove leaves; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, crushed shell.

*Description*: Shell small, usually somewhat elongated, ornamented by numerous well developed but fairly fine radial ribs which usually bifurcate toward the ventral margin; these are decussated by fine fairly regular concentric threads; lunule lanceolate moderately depressed. A large specimen

measures 22 mm. in length and 19.4 mm. in height.

The shell of *Ctena mexicana* is quite similar to that of the east American *C. imbricatula* C. B. Adams but the sculpture of the west American form is generally a little finer and more regular and the lunule is a little longer and less deeply impressed. The ribbing of the species in this group is variable.

*Distribution*: This species was collected by the expedition at various localities from the Gulf of California to Costa Rica. It occurs South to Panama and Ecuador. It has been cited as occurring in the Pleistocene of Magdalena Bay and the Tres Marias Islands.

Genus *Divaricella* von Martens.

#### *Divaricella lucasana* Dall & Ochsner.

*Lucina eburnea* Reeve, *Conch. Icon.*, Vol. 6, *Lucina*, June, 1850, species 49, pl. 8, fig. 49. "St. Elena, West Columbia and Panama (in sandy mud at a depth of eleven fathoms); Cuming."

Not *Lucina eburnea* Andrzejowski, Deshayes, *Bull. Soc. Geol. France*, Ser. 1, Vol. 6, 1835, p. 321. Miocene of Poland. [*Nomen nudum*].

*Divaricella lucasana* Dall & Ochsner, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 17, No. 4, June 22, 1928, p. 122, pl. 2, figs. 17, 21, 24. "1½ miles northeast of Vilamil, Albemarle Island, Galapagos Group. Probably Pleistocene." New name for *Lucina eburnea* Reeve, not *L. eburnea* Deshayes, 1835.

*Divaricella columbiensis* Lamy, *Bull. Mus. Nat. Hist. Nat. Paris*, Ser. 2, Vol. 6, No. 5, October, 1934, p. 433. Colombia. New name for *Lucina eburnea* Reeve, not *Venus eburnea* Gmelin, 1790 (which = *Codakia (Jagonia) jagon* Adanson); not *Lucina eburnea* Andrzejowski, Deshayes, 1835; not *Loripes eburnea* Conrad, 1847.

*Type Locality*: 1½ miles northeast of Vilamil, Albemarle Island, Galápagos Islands, Pleistocene. Of *Lucina eburnea* Reeve, Santa Elena, Ecuador, in 11 fathoms, sandy mud (here designated as type locality). Panama also cited originally.

*Range*: Magdalena Bay, and the Gulf of California, to Mancora, Peru.

*Collecting Stations*: Mexico: Cape San Lucas, beach; Arena Point area, beach; Santa Inez Bay (143-D-1), 29 fathoms, mud, crushed shell, weed, also (144-D-2), 2½ fathoms, sand, weed, rocks, also (145-D-1, 3), 4-13 fathoms, sand; Manzanillo (184-D-2), 30 fathoms, gravelly sand; Port Guatulco (195-D-2), 3 fathoms, sand; Nicaragua: Corinto (200-D-17, 19), 7-13 fathoms, sand, mangrove leaves, also beach.

*Description*: Shell round, nearly equilateral, inflated, with divaricate sculpture.

Shells of the species attain a height of 25 mm.

The name *Divaricella lucasana* was proposed by Dall & Ochsner because of the citation of *Lucina eburnea* Andrzejowski by Deshayes. So far as we have been able to ascertain the name cited by Deshayes is a *nomen nudum* and if the species was not formally described it does not invalidate the use of the same combination of names by Reeve. However, Lamy (1931) also considered Reeve's species to be nomenclatorially invalid and proposed a new name for it. Whether or not Reeve's name must be abandoned appears to be open to question. We have, at least for the present, used the name applied to the species by Dall & Ochsner.

Dall proposed the name *Divaricella parvula* for *Lucina pisum* Philippi, 1850, not *L. pisum* Sowerby, 1837. According to Dall *Divaricella parvula* differs from *D. eburnea* [= *lucasana*] in that it possesses a smaller shell which is ornamented by weaker external sculpture. There is variation in the size of the shell and in the sculpture of *Divaricella lucasana* and it seems doubtful whether two distinct species of *Divaricella* occur in this region.

*Divaricella quadrisulcata* d'Orbigny, which occurs in the Caribbean region, is a similar species.

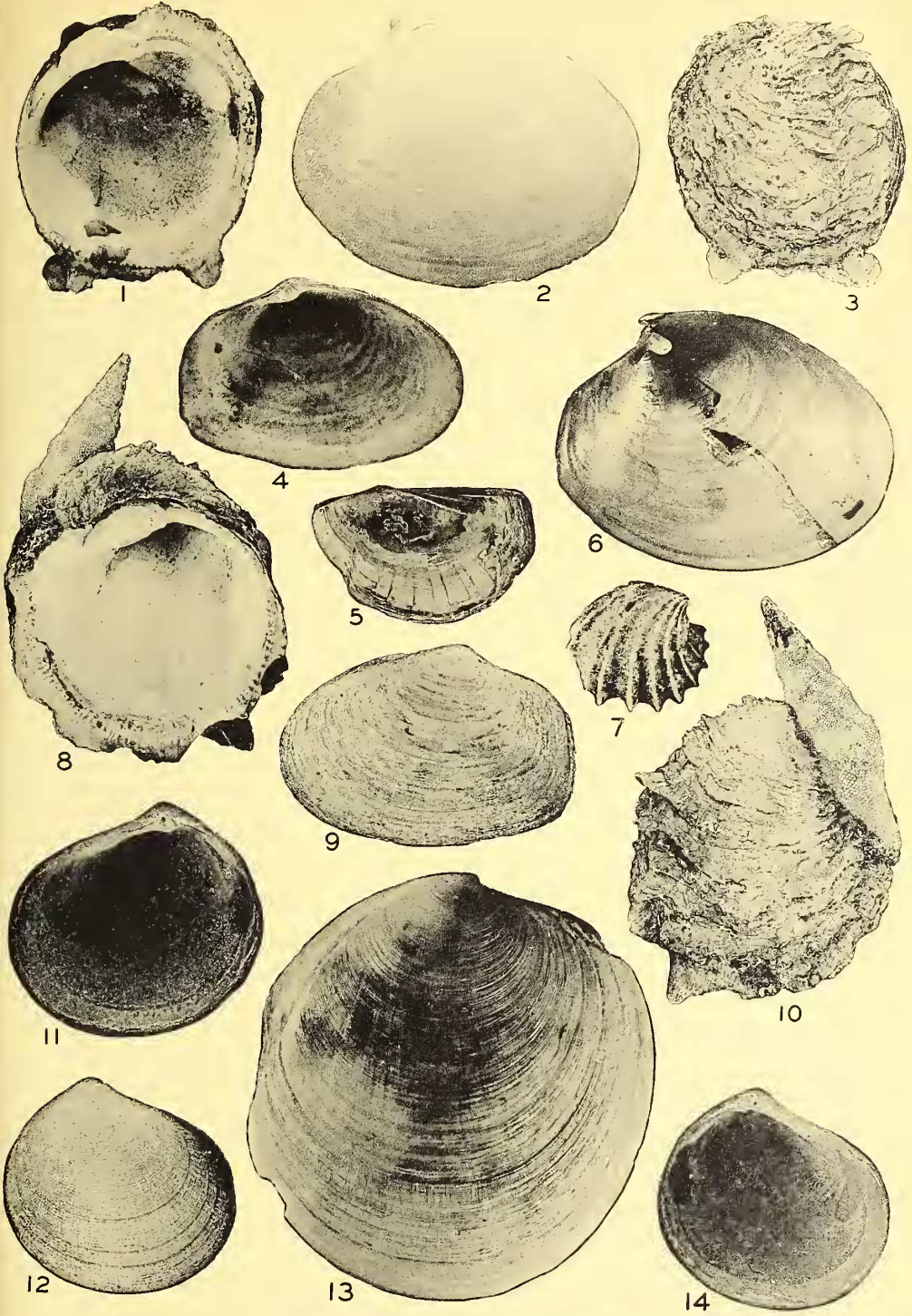
*Distribution:* *Divaricella lucasana* was taken by the expedition at various localities from Santa Inez Bay in the Gulf of California to Nicaragua, on the beach and at depths of 2½ to 30 fathoms. It was found abundantly on the beach at Cape San Lucas and at Corinto, Nicaragua. It is also known to occur in the Pliocene and Pleistocene of the Gulf of California region and in the Pleistocene of Oaxaca, Mexico, and the Galapagos Islands.

#### EXPLANATION OF THE PLATE.

- Fig. 1. *Pseudochama saavedrai* Hertlein & Strong, sp. nov. Holotype, left valve, from Station 184-D-1, dredged in Lat. 19° 03' 45" N., Long. 104° 20' 45" W., off Manzanillo, Mexico, in 25 fathoms (45 meters). Approximately natural size. View of the interior. P. 110.
- Fig. 2. *Periploma teevani* Hertlein & Strong, sp. nov. Holotype, right valve, from Station 196-D-19, dredged in Lat. 15° 44' N., Lon. 96° 05' W., Tangola-Tangola Bay, Oaxaca, Mexico, in 30 fathoms (55 meters). Length, 23 mm.; height, 19 mm. View of the exterior. P. 95.
- Fig. 3. *Pseudochama saavedrai* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the specimen shown in Fig. 1.
- Fig. 4. *Cyathodonta lucasana* Dall. Hypotype, left valve, from Station 195-D-9, dredged in Lat. 15° 44' 28" N., Long. 96° 07' 51" W., Port Guatulco, Mexico, in 7 fathoms (12.6 meters). Length, 21 mm.; height, 14 mm.; convexity (one valve), 3.4 mm. P. 96.
- Fig. 5. *Pandora (Kennerlia) convexa* Dall. Hypotype, left valve, from Cape San Lucas, Lower California, Mexico. Length, approximately 13.4 mm., height, 8.2 mm.; convexity (both valves), 2.5 mm. P. 97.
- Fig. 6. *Periploma teevani* Hertlein & Strong, sp. nov. Holotype. View of the interior of the left valve of the specimen shown in Fig. 2.
- Fig. 7. *Verticordia ornata* d'Orbigny. Hypotype, right valve, from Station 203-D-3, dredged in Lat. 10° 55' 45" N., Long. 85° 49' 05" W., Port Parker, Costa Rica, in 12 fathoms (22 meters). Length, approximately 3.2 mm.; height, approximately 3 mm. P. 102.
- Fig. 8. *Pseudochama saavedrai* Hertlein & Strong, sp. nov. Holotype. View of the interior of the right valve of the specimen shown in Fig. 1. Length, 40.5 mm.; height, 46 mm.  
This specimen is attached to the shell of a gastropod shown in the upper left part of the figure.
- Fig. 9. *Cyathodonta lucasana* Dall. Hypotype. View of the exterior of the specimen shown in Fig. 4.
- Fig. 10. *Pseudochama saavedrai* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the specimen shown in Fig. 8.
- Fig. 11. *Ctena clarionensis* Hertlein & Strong, sp. nov. Holotype, right valve, from Sulphur Bay, Clarion Island, Revillagigedo Islands, Mexico. Length, 13.8 mm., height, 12.5 mm. P. 118.
- Fig. 12. *Ctena clarionensis* Hertlein & Strong, sp. nov. Holotype, right valve. View of the exterior of the specimen shown in Fig. 11.
- Fig. 13. *Lucina (Miltha) xantusi* Dall. Hypotype, right valve, from Station 136-D-5, dredged in Lat. 23° 31' N., Long. 109° 27' 30" W., Arena Bank, southern part of the Gulf of California, in 33 fathoms (60 meters). Length, 68 mm.; height, 71.2; convexity (both valves), 23 mm. P. 115.
- Fig. 14. *Ctena clarionensis* Hertlein & Strong, sp. nov. Holotype. View of the interior of the left valve of the specimen shown in Figs. 11 and 12.

All the specimens illustrated on this plate are in the type collection of the Department of Paleontology of the California Academy of Sciences.





MOLLUSKS FROM THE WEST COAST OF MEXICO AND CENTRAL AMERICA.