

28898

TRANSACTIONS

OF THE

SAN DIEGO SOCIETY OF NATURAL HISTORY

VOLUME VII, No. 37, pp. 429-452, plates 28-31

WEST AMERICAN SPECIES OF THE GENUS LIOTIA

BY

A. M. STRONG

Los Angeles, California

SAN DIEGO, CALIFORNIA

PRINTED FOR THE SOCIETY

MAY 31, 1934

41
H

COMMITTEE ON PUBLICATION

U. S. GRANT, IV, *Chairman*

FRED BAKER

CLINTON G. ABBOTT, *Editor*

WEST AMERICAN SPECIES OF THE GENUS LIOTIA

BY

A. M. STRONG

Los Angeles, California

In identifying the Mollusca from the Gulf of California and adjacent islands collected by the expeditions sponsored by the California Academy of Sciences, it was found the species in the genus *Liotia* had received but little attention in the literature of west coast shells. Thirteen species and three varieties have been described from the west coast of North and South America, one by Gray, five by Carpenter, one by Baker and the remainder by Dall.¹

The descriptions are scattered through several publications, few of which are easily accessible. Only four of the species have been figured and seven are reported only by the types. Numerous specimens of some of the species are now available in the various California collections and two species and one variety that appear to be undescribed were found in the collection of the California Academy of Sciences. For these reasons it seemed advisable to review the available data on the west coast species, figuring the types or authentic specimens where such could be secured, and add the descriptions of the new forms. The writer wishes to acknowledge his indebtedness to Dr. Fred Baker of San Diego for the loan of specimens and other aid, to Dr. Alexander Wetmore of the U. S. National Museum for the photographs of the types on deposit there, and to Dr. G. Dallas Hanna of the California Academy of Sciences for photographs and assistance in the preparation of the plates and manuscript.

The genus *Liotia* Gray, 1847², (type by original designation *Delphinula cancellata* Gray, 1828, recent, Peru and Chile) contains small, turbate or depressed, umbilicated shells with a nacreous inner layer

¹ Since the preparation of the manuscript for this paper two species have been added to the list, both fully described and figured. They are as follows: *Arene winslowae* Pilsbry and Lowe, Proc. Acad. Nat. Sci., Phila., vol. 84, 1932, p. 86, pl. 9, figs. 1, 2, 2a; and *Arene hindiana* Pilsbry and Lowe, loc. cit., pp. 86-87, pl. 9, figs. 4, 5. The first is from San Juan del Sur, Nicaragua, and the second from Manzanillo, Mexico. They thus validate *Arene* as of generic rank and, in a later paper, loc. cit., vol. 85, 1933, p. 380, Pilsbry confirms this, defining *Arene* fully, but adds "The limits of *Arene* seem very nebulous."

² *Liotia* Gray, Proc. Zool. Soc. Lond., 1847, p. 145.

and a thickened, continuous lip which is attached to the body whorl for only a short distance. In the original description of the genus it was said that the operculum is corneous and multispiral, with a calcareous layer formed of spirally arranged pearly particles. However, the opercula are known only in a few of the species placed in the genus and in some of these it is said that the calcareous layer hardly shows. Carpenter expressed doubt in placing the three species he described from Mazatlan in the genus as the opercula were unknown, but the shell characters would seem to be sufficient. In the systematic arrangement the family *Liotiidae* is placed between *Turbinidae* and *Trochidae*. In many ways the shells resemble those of the genus *Leptothyra* in the first family but differ by the absence of any sign of a denticle on the columella, in the thicker and more continuous outer lip, and in many species by the wide umbilicus. From the genus *Margarites* in the second family they differ in the heavier shell and thickened lip. Nothing seems to be known of the ecology of the species in the genus, which is widely distributed and contains a number of fossil forms.

A single subgenus, *Arene* H. & A. Adams, is recognized, which, though named in 1854, was not defined by a type until 1928, when Woodring³ designated *Turbo cruentatus* Megerle von Mühlfeld, recent, West Indies. Woodring stated that the subgenus differs from the typical form in having "a higher turreted spire and a scaly sculpture." Dall had previously described three species from the west coast which he placed in this subgenus, evidently with a different idea of its characters. The first of these, *L. cookeana*, proves to be the young of a well known California shell quite similar to the type of the genus. The other two, *L. californica* and *L. pacis*, seem to be subgenerically distinct from the rest of the west coast species. They are much larger shells with the axial sculpture projecting beyond the margin of the whorls, giving them a stellate form. As this paper reviews the species from a limited fauna only no attempt to determine the proper subgeneric grouping is made.

The following key gives the principal differences in the species reviewed or described in the paper and this in turn is followed by detailed descriptions and references. It is believed that all species described from the west coast are included.

³ Miocene Mollusks from Bowden, Jamaica: Carnegie Inst. of Washington, Publ. 385, pt. 2, 1928, p. 422.

KEY TO THE WEST COAST SPECIES OF LIOTIA

- A¹. Axial ribs and spiral cords of about equal strength.
- B¹. Shell turbinate, spire elevated.
- C¹. Shell thick, solid; diam., 5 mm., Peru and Chile.....*cancellata*
- C². Shell thin, translucent; diam., 0.6 mm. (young).
Mazatlan*c-b-adamsii*
- B². Shell flattened, spire depressed; diam., 5 mm. Monterey
to Gulf of California*fenestrata*
- A². Spiral cords strong, axial ribs faint or absent.
- B¹. Body whorl with a peripheral and a second minor cord;
diam., 2 mm. Galapagos Islands*scitula*
- B². Body whorl with 2 or 3 major cords and many spiral threads;
diam., 4.7 mm. Magdalena Bay to
Tres Marias Islands*rammata*
- B³. Body whorl with 3 cords and faint axial striae; diam.,
0.9 mm. Mazatlan.....*striulata*
- B⁴. Body whorl with about 6 equal spiral cords.
- C¹. Axial ribs absent; diam., 3 mm. Monterey to Tres
Marias Islands*acuticostata*
- D¹. Spiral cords finer, shell smaller; diam., 2.3 mm.
Gulf of Californiavar. *stearnsi*
- C². Axial riblets showing between the spiral cords; diam.,
3 mm. San Pedro to San Martin Island.....var. *bristolae*
- C³. Axial ribs heavy, producing nodes at crossing of spiral
cords; diam., 3.7 mm. San Diego.....var. *supranodosa*
- B⁵. Body whorl with about 8 unequal spiral cords; diam., 6 mm.
Socorro Island*socorroensis*
- B⁶. Body whorl with about 11 spiral cords.
- C¹. Umbilicus bounded by 2 strong, nodulous cords; diam.,
5.5 mm. Gulf of California*carinata*
- C². Umbilicus bounded by 3 close-set, beaded cords; diam.,
6.2 mm. Panama*olivacea*
- C³. All cords beaded. Panamavar. *litharia*
- B⁷. Body whorl with about 20 spiral cords; diam., 1.7 mm.
Cape San Lucas*lucasensis*
- A³. Axial ribs strong, spiral sculpture fine or absent.
- B¹. Axial ribs 6, ending in blunt tubercles at periphery; diam.,
23 mm. Lower California*californica*
- B². Axial ribs 8, ending in spines at the periphery; diam., 15 mm.
La Paz*pacis*

1. *Liotia cancellata* (Gray)

Plate 30, figures 10, 11.

Delphinula cancellata GRAY, Spicil. Zool., pt. 1, 1828, p. 3, pl. 6, fig. 8. Arica (Chili).

Delphinula cobijensis REEVE, Conch. Icon., vol. 1, *Delphinula*, October, 1843, pl. 5, figs. 22, a, b.

Liotia cancellata GRAY, Tryon, Man. Conch., vol. 10, 1887, p. 109, pl. 36, fig. 2.—Dall, Proc. U. S. Nat. Mus., vol. 37, 1910, p. 239.

Not *Delphinula cancellata* Kiener or Reeve.

This species is described by Reeve as *D. cobijensis* as follows:

"Shell turbinated, very small, ribs convex, regularly latticed with equidistant, transverse and longitudinal ribs; umbilicus middling; lip simple." Tryon gives the diameter as 5 mm. and says of it: "Has the sculpture and umbilicus of *L. fenestrata* Cpr. but is more elevated."

The shell described and figured by Kiener as *Delphinula cancellata* comes from the Philippines and is quite distinct. Gray's species is cited as the type of the genus and Dall gives the range as Peru and Chile. As no specimens are available, Reeve's figure of *Delphinula cobijensis* is reproduced.

2. *Liotia c-b-adamsii* Carpenter

??*Liotia c-b-adamsii* CARPENTER, Mazatlan Catalogue, 1857, p. 249, no. 315.

A free translation of Carpenter's description is as follows:

"Shell very thin, diaphanous, white, turreted; whorls three, swollen, subangular above, elegantly cancellated with radiating lirae (on the last whorl 22) nodulous at the intersection with about 8 spiral lirae; first whorl and a half smooth; radiating lirae vanishing on the base; umbilicus small; aperture subcircular, lip continuous, scarcely interrupted by the penultimate whorl. Long. 0.6, lat. 0.55 mm. Div. 70°." To this is added the note in English, "Although this is clearly a young shell, its characters are well marked. It has the texture of *Vitrimella*, but is distinguished by the turreted form, and by the large size and short length of the apical portion. The rest of the shell is beautifully decussated by radiating lirae, obsolete on the base, knotted by revolving lirae, three of which appear on the base."

It was described from a single specimen collected at Mazatlan. No further reference to the unfigured species was found in the literature and no specimens answering to the description have been seen by the writer in collections.

3. *Liotia fenestrata* Carpenter

Plate 28, figures 10, 11, 12; plate 30, figures 7, 8, 9.

Liotia fenestrata CARPENTER, Suppl. Rep. Brit. Assoc., 1864, pp. 612, 652. Proc. Calif. Acad. Nat. Sci., vol. 3, 1865, p. 158.—Tryon, Man. Conch., vol. 10, 1887, p. 109.—Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 3, 1927, p. 170.

Liotia cookeana DALL, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 8.—Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 3, 1927, p. 171, pl. 91, figs. 12, 13, 13a.—Strong and Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 19, p. 5.

A free translation of Carpenter's description is as follows:

"Shell small, at first subdiscoidal, later variable, brownish white; nuclear whorls smooth, flat, apex depressed; normal whorls two and a half, convex, clathrate by about 15 equidistant radiating and 7 spiral ribs, with deep pitted interspaces; aperture circular, frequently slightly sloping, slightly attached to the parietal wall; umbilicus large, showing the whorls within; inner lip sinuated in the umbilical region."

Carpenter's type was collected by Cooper at Catalina Island, "beach to 40 fms., dead." A series of young specimens from San Martin Island, Lower California, in the collection of the California Academy of Sciences shows that the top of the first, often the second, and sometimes the third whorl is flat and sculptured only with microscopic spiral striae. Beginning on the second whorl, axial ribs develop and extend from the sharply angulated shoulder, over the rounded base to a spiral cord bounding the umbilical region. A little later spiral ribs begin to show in the interspaces and gradually increase in strength. The type of *Liotia cookeana* Dall, figured by Mrs. Oldroyd, is a specimen of three whorls at this stage of the development of the sculpture. As the shell increases in size, the spiral ribs become stronger until they equal the axial ribs and both gradually extend over the more rounding upper surface of the whorl until they reach the suture, forming the characteristic pitted surface of the adult. In the adult shell the flattened surface of the early whorls has the appearance of an eroded apex.

Dall gives the range of the species as from Monterey to San Martin Island and of *Liotia cookeana* as from South Coronado Island to the Gulf of California. Specimens are not uncommon along the coast of southern California in beach drift or inhabited by hermit crabs. It would seem to be an off-shore species in comparatively shallow water. The flattened form and deeply pitted surface easily distinguish it from the other

local species of the genus. The specimen figured was collected at Isthmus Cove, Catalina Island, and measures, height, 2; diameter, 4 mm.

4. *Liotia scitula* Dall

Plate 28, figures 7, 8, 9.

Liotia scitula DALL, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 358.

Dall's description of this species is as follows:

"Shell minute, white, with flecks of brown, of about four whorls, including a very minute smooth nucleus; spire flattened, suture distinct; axial sculpture of fine incremental lines, somewhat wrinkled in front of the suture, and on the last whorl developing a narrow row of beads at the suture and crenulating on the base the margin of the umbilicus; spiral sculpture of a very prominent, minutely crenulated keel at the periphery and a smaller one on which the suture is laid; the margin of the narrow umbilicus is also thread-like; aperture rounded except where modified by the external sculpture; the body with a glaze of enamel, the pillar lip somewhat thickened; height of shell 1, maximum diameter 2 mm."

The type specimen was dredged among the Galapagos Islands in 40 fms. No further reference to the species was found.

5. *Liotia rammata* Dall

Plate 29, figures 4, 5, 6; plate 30, figures 1, 2, 3.

Liotia rammata DALL, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 7. Proc. Calif. Acad. Sci., ser. 4, vol. 19, 1930, p. 19.

Dall's description of this species is as follows:

"Shell depressed-turbinate, of four whorls, the first two and two-thirds whorls and the base of the last whorl white, the upper surface of the last whorl and one-third reddish purple; the suture distinct, not appressed; spiral sculpture on the spire of two prominent threads, the posterior angulating the shoulder, the anterior growing more feeble on the last whorl; the rest of the surface is uniformly covered with fine, equal, close-set, smaller threads, slightly roughened by fine incremental lines; the only axial sculpture consists of feeble more or less obsolete plications in front of the suture; base rounded, with a small perforate umbilicus of which the margin is not crenate; aperture circular, thickened below. Breadth of shell, 4.7; height, 4.0 mm."

Dall's specimens came from Magdalena Bay on the outer coast of Lower California. Specimens in the California Academy of Sciences collection from the Tres Marias Islands off the west coast of Mexico seem to fit the description in every way. The only difference observed is that some of them have three instead of two major spiral cords and in the color pattern which is quite variable. Most of them are marked with alternating white and reddish or brownish radiating stripes. The specimen figured came from the Tres Marias Islands and measures, height, 4 mm.; maximum diameter, 4.5 mm.

6. *Liotia striulata* Carpenter

?*Liotia striulata* CARPENTER, Mazatlan Catalogue, 1857, p. 248, no. 314.

A free translation of Carpenter's description is as follows:

"Shell turban-shaped, spire subelevated, white, solid; whorls three, rounded, radiately feebly and closely striate, with three slightly prominent spiral carinae; umbilicus large, the edge somewhat radiately wrinkled; aperture slanting, solid, the interior rounded, scarcely touching the penultimate whorl. Long. .675, lat. .925 by .75 mm., div. 130°." To this is added the note in English: "The thickness of this little shell is extraordinary, being at the posterior portion of the aperture nearly .005 inches. The whorls are rounded, obscurely carinated, and most minutely and closely striated in the direction of growth."

No further reference to this unfigured species, of which a single specimen was collected at Mazatlan, was found in the literature and no specimens have been seen in the collections which would answer to the description.

7. *Liotia acuticostata* Carpenter

Plate 29, figures 7, 8, 9.

Liotia acuticostata CARPENTER, Suppl. Rept. Brit. Assoc., 1864, pp. 612, 652.

Proc. Calif. Acad. Nat. Sci., vol. 3, 1865, p. 159.—Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 3, 1927, p. 170.—Strong and Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 19, 1930, pp. 5, 19.

A free translation of Carpenter's description is as follows:

"Shell small, subglobose, white; nuclear whorls two, smooth, apex elevated; normal whorls three, with two raised carinae on the spire and six on the last whorl; sutures subrectangular; aperture circular; lip little contracted, conspicuous; umbilicus not large."

Carpenter listed it from Monterey and Catalina Island. Dead shells are not uncommon in the dredgings from shallow water near the kelp fields along the southern California coast. The California Academy of Sciences collection contains specimens from Guadalupe Island, Magdalena Bay, Cape San Lucas, and the Tres Marias Islands. These are of the typical form which is a glossy, almost translucent, white shell with sharp spiral ridges and no axial sculpture other than lines of growth. The specimen figured measures, height, 2.5; maximum diameter, 3 mm. It was collected at Isthmus Cove, Catalina Island.

8. *Liotia acuticostata stearnsi* Dall

Liotia acuticostata stearnsi DALL, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 8.

Dall's description of this variety is as follows:

"Resembling *acuticostata* but smaller, with more numerous and less prominent spiral cords. Height, 2.3; width, 2.3 mm."

Dall gives the range as the Gulf of California. No specimens answering to this description were found in the collections.

9. *Liotia acuticostata bristolae* Baker

Plate 29, figures 13, 14, 15.

Liotia acuticostata radiata DALL, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 8.—Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 3, 1927, p. 170.

Liotia acuticostata bristolae BAKER, The Nautilus, vol. 43, 1929, p. 72.⁴

Dall's description of this variety is as follows:

"Shell resembling the type but with numerous radiating riblets in the interspaces between the revolving costae."

This seems to be the normal form of the species, the absence of the fine radiating riblets in the interspaces being the result, at least in many cases, of a worn surface. Specimens of the variety are more common than the typical form along the southern California coast, and the California Academy of Sciences has specimens from La Paz, Amortajada Bay of San José Island, and Coyote Bay in Concepción Bay, all in the Gulf of California. The specimen figured was dredged off South Coronado Island, near San Diego, California, by Dr. Fred Baker, and measures, height, 2; diameter, 3 mm.

10. ?*Liotia acuticostata supranodosa* Strong, new subspecies

Plate 30, figures 4, 5, 6.

?*Liotia acuticostata* CARPENTER, Tryon, Man. Conch., vol. 10, 1889, p. 109, pl. 36, fig. 1.

This form differs from the typical in having heavy axial ribs which cross the stronger spiral cords, thus producing a series of nodes at the intersections, similar to those in *L. fenestrata*. The spiral cords are less acute than in *L. acuticostata*, the umbilicus is nearly or quite closed and there is a faint indication of a tubercle on the columella. The size, shape and general appearance of the two forms are very similar. Height, 3.6; diameter, 3.7 mm.

Holotype.—No. 5472, Mus. Calif. Acad. Sci.; collected at San Diego, California, by Henry Hemphill.

The type specimen is one of a lot of four found in the Hemphill collection at the California Academy of Sciences and marked: "Types.

⁴ Dall's name, *Liotia acuticostata radiata*, was preoccupied by *Delphinula radiata* Kiener (a *Liotia*) in Icon. Coq. Viv., vol. 10, 1838-1839, p. 7, pl. 4, fig. 9.

Liotia acuticostata variety *supranodosa*. Identified by P. P. Carpenter." I cannot find that Carpenter ever described the form in print. In a recent letter Dr. Pilsbry states that the specimen figured in Tryon's Manual of Conchology as *Liotia acuticostata* Carpenter seems to be a *Leptothyra*. A comparison of Hemphill's specimens with this figure shows that they might well be the same form. Examination of other specimens dredged off the coast of southern California having the same characters as Hemphill's specimens shows that many of them have a distinct tinge of red, something not seen in any of the specimens of *L. acuticostata* or variety *bristolae*. In order to avoid confusion it seems best to validate the name with a description and illustrations. An examination of the operculum may show that in spite of the close similarity this should be considered a distinct species and placed in *Leptothyra*. Material for such a determination is not now available.

11. *Liotia socorroensis* Strong, new species

Plate 31, figures 4, 5, 6.

Shell of about four shouldered whorls and a minute flattened nucleus of a little over one whorl; spiral sculpture of three strong, more or less nodulous spiral cords on the periphery, of which the upper forms the angle to the shoulder of the whorls; between this and the suture are two smaller, distinctly nodulous cords with a third developing on the last quarter turn; base flattened, with three nodulous spiral cords, of which the first is the smallest and the last forms a sharp carina around the deep, funnel shaped umbilicus; axial sculpture consisting of numerous, sharp, close-set, waved riblets which are faint on the nodules of the spiral cords; aperture circular, with a thick, continuous lip, the outer edge of which is crenulated by the spiral sculpture. The type (which is one of 12 specimens from Socorro Island, off the west coast of Mexico), measures, height, 5; maximum diameter, 6 mm. It is of a reddish cast with a few small, irregularly placed, lighter spots. The other specimens show much variation in color and color pattern. The operculum is multispiral with a central nucleus and a concave calcareous outer surface, showing the pearly grains very distinctly. The species was collected in the inter-tidal zone.

Holotype.—No. 5478, Mus. Calif. Acad. Sci.; from Socorro Island, Mexico; collected by G. D. Hanna and E. K. Jordan, June, 1925.

In many ways this species resembles *Liotia carinata* Carpenter, from the Gulf of California, but differs in the flatter shell, fewer spiral cords

and much larger umbilicus. In this latter feature it resembles *Liotia fenestrata* Carpenter from California.

12. *Liotia carinata* Carpenter

Plate 28, figures 1, 2, 3; plate 31, figures 1, 2, 3.

?*Liotia carinata* CARPENTER, Mazatlan Catalogue, 1857, p. 248, no. 313.

Liotia lurida DALL, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 590; vol. 66, pl. 36, fig. 3.

Dall's description of this species is as follows:

"Shell small, dull red or purplish brown, more or less reticulated on the ridges, of about four and a half whorls; nucleus minute, flattish; last whorl with four strong, beaded, spiral cords with subequal interspaces, peripherally; between these and the suture, three slightly smaller similar cords, the space at the suture giving a channeled effect; on the base two less prominent cords and two wider nodulous ridges around the deep, rather narrow umbilicus; aperture circular, the outer lip thick, fringed by the ends of the spiral cords; axial sculpture of numerous fine radial threads, most obvious in the channels between the cords. Height of shell, 4.5; max. diam., 5.5 mm."

Carpenter described from a single young specimen, long. 0.75, lat. 1.1 by 1.0 mm., which was ash colored, reddish tinted. The description of the sculpture is almost identical with that of Dall.

Examination of a large number of specimens of all sizes collected by Captain Porter in the Gulf of California (probably from drift to Espiritu Santo Island) and now in the collection of Dr. Fred Baker, leaves little room for doubt that the two species are identical. The California Academy of Sciences also has specimens from La Paz, Isla Raza, and Concepción Bay, in the Gulf of California. Most of these specimens have the upper portion of the spire whitish, while the remainder of the shell is reddish or brownish, more or less mottled. In some of the specimens the cords are nearly equal with only two or three on the periphery, but in all cases the presence of the two strong, nodulous cords bounding the umbilicus is a distinguishing character. The specimen figured comes from Isla Raza, in the Gulf of California, and measures, height, 3.5; maximum diameter, 5 mm.

13. *Liotia olivacea* Dall

Plate 29, figures 1, 2, 3.

Liotia olivacea DALL, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 7.—Zetek, Los Mol. de la Republica de Panama, Revista Nueva, nos. 1, 2, 1918, p. 34.

Dall's description of this species is as follows:

"Shell of five depressed-turbinate whorls; suture narrow but not appressed, the color very dark olivaceous, the prominent sculpture paler; nucleus minute, decorated, but apparently smooth; spiral sculpture of, on the upper part of the last whorl, four strong elevated cords with wider, almost channeled interspaces, the two posterior cords more adjacent; on the spire, only three cords are visible, the anterior more or less undulated; on the base are a single cord, a wide interval, then three more adjacent smaller plain cords, the three close-set beaded cords at the verge of the small perforate umbilicus; aperture circular, upper lip produced on the body, the interior pearly white; breadth of shell, 6.2; height, 5.5 mm."

The species has been reported only from Panama.

14. *Liotia olivacea litharia* Dall

Liotia olivacea litharia DALL, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 8.—Zetek, Los Mol. de la Republica de Panama, Revista Nueva, nos. 1, 2, 1918, p. 34.

Dall's description of this variety is as follows:

"Another specimen, long in the collection from Panama, but with no collector's name, has all the spiral sculpture strongly beaded, and may be called variety *litharia*. I have no doubt it is an extreme variety of the same species."

15. *Liotia lucasensis* Strong, new species

Plate 29, figures 10, 11, 12.

Shell minute, globose, shining white, of about three and a half slightly shouldered whorls and a very minute flattened nucleus of a little over one whorl; sutures not excavated; spiral sculpture of fine, raised, smooth, spiral threads, of which four appear on the first whorl, eight on the second and about twenty on the body whorl; axial sculpture absent; aperture circular, with a thick, continuous lip; umbilicus small. The type, which is one of about 200 more or less beach worn specimens, comes from Cape San Lucas and measures: height, 1.7; maximum diameter, 1.6 mm.

Holotype.—No. 5477, Mus. Calif. Acad. Sci.; from Cape San Lucas, Lower California, Mexico; collected by G. D. Hanna and E. K. Jordan, June, 1925.

This minute species would seem to be entirely distinct from any of the other west coast species placed in the genus.

16. *Liotia californica* Dall

Plate 28, figures 4, 5, 6.

Liotia californica, DALL, Bull. Mus. Comp. Zool., vol. 43, 1908, pp. 344-345.

Dall's description of this species is as follows:

"Shell large for the genus, rude, yellowish-white, depressed, with about six whorls, carrying at the shoulder six blunt, large, projecting tubercles; nucleus small, the nepionic whorls reticulate, flattened; the later whorls keeled bluntly at the shoulder, behind which they are flattened; on the flat area are two strong, elevated, spiral threads (which later disappear) close together, with the channels on either side reticulated by subequal and subequally spaced radial threads; on the last whorl all the sculpture on the upper part of the whorl, except the keel connecting the tubercles at the shoulder, has disappeared; the surface of the shell is of a spongy nature and all the sculpture is obscure as if deliquescent; the base is rounded with a large spiral, deep umbilicus, having one entering spiral keel which ends at a projection of the pillar lip; the verge of the umbilicus is rounded and spongy, outside of this ridge in the young it is constricted by a row of pits between which and the periphery are some obscure spirals in some specimens; aperture circular within, and when fresh brilliantly pearly, but the pearly coating is very thin and seems to disappear in dead shells; the outer margin of the aperture, which is very thick, is modified by the umbilical keel and other sculpture; operculum multispiral, with the external edges of the whorls fringed, very concave, and showing hardly any calcareous deposit. Alt. of adult, 15.0; of aperture, 9.0; max. diam., 23.0 mm."

The specimens were dredged from a sand bottom in 113 fms. at Albatross station 2984, off Lower California. No further reference to the species was found. It was placed in the subgenus *Arene* by Dall.

17. *Liotia pacis* Dall

Plate 28, figures 13, 14, 15.

Liotia pacis DALL, Bull. Mus. Comp. Zool., vol. 43, 1908, p. 345.

Dall's description of this species is as follows:

"This species is so similar to the preceding that it is best described by a comparative diagnosis. Than *L. californica* it is smaller, flatter, and more distinctly sculptured; the specimens examined have three and a half whorls besides the (lost) nucleus; it has eight peripheral projections instead of six, and they are flat, triangular, and spinose instead of bluntly tubercular; each projection is at the distal end of a distinct radial rib; the base is flatter, the umbilical ridge lower, and broken up into obliquely radial tubercles without any row of pits outside of it; the aperture is subcircular and the discrepancy between the inner and outer margins much less than in *californica*. Alt. of shell, 10.0; of aperture, 6.0; max. diam. of base, 15.0 mm."

The specimens were dredged from a mud bottom in 112 fms. off La Paz in the Gulf of California. No further mention of the species was found nor any specimens answering to the description. Dall placed it in the subgenus *Arene*.