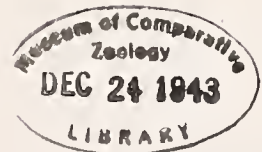


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FISSURELLIDAE

NUMBER 11

THE GENUS *DIODORA* IN THE WESTERN ATLANTIC

BY

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Guggenheim Fellow, Cuba, 1942-44

The genus *Diodora* is found in all tropical and temperate waters, being particularly rich in species along the Western Atlantic coast where it is found from New England south to Patagonia. Many of the species live in the inter-tidal area or just below. A few, however, occur in the deeper waters down to at least 800 fathoms.

All species in this genus are highly sculptured, most of them possessing a fine and intricate pattern. Color and color-pattern, however, though present in many species, are not highly developed and are limited to dark colored rays. Very little is known about the ecology and habits of our species. Members of *Diodora* as well as *Fissurella* are known as key-hole limpets.

I am deeply indebted to Miss Marion Bills for the beautiful photographs on plates 1 and 2; plate 3, fig. 1-8; plate 5, fig. 1-9. The remainder are by Mr. Fred Orchard of the Peabody Museum to whom I am also indebted for his skill in preparing the illustrations for this paper and the one on *Fissurella*.

Diodora Gray

Diodora J. E. Gray 1821, London Medical Repository, **15**, p. 233.

Fissuridea Swainson 1840, Treat. on Malacology, p. 356.

Diadora J. E. Gray 1847, Proc. Zool. Soc. London, **15**, p. 147.

Glyphis Carpenter 1857 (*non* Agassiz 1843), Catalogue Mazatlan Shells, p. 220.

Capiluna Gray 1857, Guide Syst. Moll. British Museum, p. 166.

Genotype (monotypic) *Patella Fissurella apertura* Montagu (= *Diodora graeca* Linné)

Shell conical, elevated or depressed, the size varying between wide limits. Apex in front of the shell center: in young specimens curved and slightly twisted, inclined backward and with a fissure in front of it. In the adult, this small and slightly twisted portion is totally lacking. Orifice at the summit or immediately anterior to it, variable in shape. Surface of the shell sculptured by conspicuous radiating ribs and concentric threads or laminae. Basal margin of the shell resting upon a plane or slightly elevated in the middle part of the sides; never raised at the ends. Margin strongly crenulated. Muscle impression frequently indistinct, but when distinct, not uniform in width and with the anterior part incurved at the ends. A small and narrow connecting ridge bridges the area between the incurved ends. A few species have the muscle scar completely oval and of a uniform width. The orifice is bounded by a callus which is truncated posteriorly and sometimes excavated at this region forming a deep pit. Shell completely external, not covered by the mantle and capable of containing all the soft parts.

The animal possesses one pair of tentacles with the eyes on little projections on their outer bases. Snout short, oval and disc-shaped with the mouth in the middle of the disc.

Pilsbry states "epipodium consisting of a fringe of short filamentous processes, alternately larger and smaller, becoming more obsolete posteriorly where it is marked by little tubercles in place of the filaments. Mantle-edge smooth or papillose, usually broad" (1891, *Man. of Conch.* (1) 12, p. 203). The central tooth of the radula in *Diodora* is large, while in *Fissurella* it is very small.

Key to the genera *Fissurella* and *Diodora*

- Shell with the internal callus of the orifice the same width throughout; sometimes with its basal margin raised at the ends. Central tooth of the radula narrow *Fissurella*
 Shell with the internal callus of the orifice truncated and frequently excavated posteriorly; with its basal margin never raised at the ends. Central tooth of the radula wide. *Diodora*.

Key to Western Atlantic *Fissurella*

1. Shell with the entire margin resting flat in a plane 2
 Shell with basal margin not flat, but with the extremities raised, so that it rests only upon the middle of each side 8
2. Shell very heavy and elevated; sculptured with smooth riblets *F. nimbose* 3
 Shell moderately heavy or thin, sculptured with more or less nodulose or scaly ribs
3. Ribs strongly nodulose; shell inside white, with radiating grooves *F. nodosa* 4
 Ribs with small nodules or scales; shell inside colored, not white, smooth
4. Internal callus of the orifice from buff to brown 5
 Internal callus of the orifice green 6
5. Orifice long and trilobated; from 15 to 20 primary ribs; basal margin the same width at both ends (elliptical) *F. barbouri*
 Orifice short and oval; 9 to 10 primary ribs; basal margin narrowed anteriorly (ovate). *F. angusta*
6. Orifice almost circular, without teeth; color arranged in lines or blotches *F. barbadensis*
 Orifice elongated, sometimes with two small teeth on each side; color arranged in rays 7
7. Internal callus of the orifice bounded by a black line *F. clenchi*
 Internal callus of the orifice bounded by a red line *F. rosea*
8. Orifice elliptical; ribs separated *F. subrostrata*
 [Johnsonia, No. 11, p. 20] 9
 Orifice long, narrow and with a mid-horizontal widening; ribs close-set
9. Shell with the anterior extremity truncated; about 55 radiating ribs *F. punctata*
 Shell with the anterior extremity rounded, not truncated; 46 or 47 radiating ribs *F. fascicularis*

Key to Western Atlantic *Diodora*

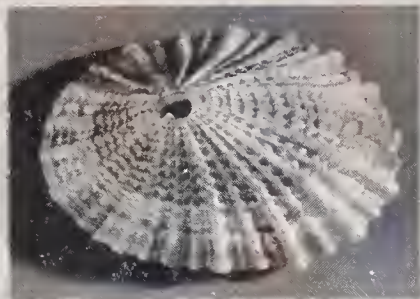
1. Shell sculptured with numerous radiating equal or subequal ribs 2
 Shell sculptured with larger and smaller radiating ribs, not necessarily alternating 5
2. Shell with a trilobated orifice; ribs crossed by raised concentric threads 3
 Shell with the orifice oblong-ovate, with a tooth each side, ribs crossed by concentric striae *D. patagonica*
3. Surface shiny and beaded; shell colored with black or brown lines, generally arranged in rays *D. mimda*
 Surface dull and reticulated; shell unicolored, or, if with rays, these are solid in color and placed anteriorly and laterally, not posteriorly 4
4. Orifice placed completely anteriorly; radiating ribs close-set *D. sayi*
 Orifice placed a little in front of the middle; radiating ribs, rather widely separated *D. bermadensis*
5. Ribs alternately larger and smaller 6
 Ribs every fourth a little larger 12
6. Orifice circular 7
 Orifice not circular 8
7. Shell elevated and reaching a great length (50 mm.); sculpture consisting of fine close-set ribs and concentric threads *D. lameri*
 Shell depressed and small, not exceeding 25 mm. in length; sculpture consisting of strong and widely separated ribs and laminae *D. meta*
8. Radiating sculpture consisting of rather widely separated erect ribs crossed by coarse laminae 9
 Radiating sculpture consisting of fine close-set ribs crossed by threads 11
9. Orifice key-hole shaped; sculpture very heavy *D. listeri*
 Orifice not key-hole shaped; sculpture pronounced, but delicate 10

10. Orifice oblong with a tooth each side; shell unicolored or with solid rays, not freckled *D. aguayo*
Orifice ovate, toothless; shell freckled with brown spots *D. jannei*
11. Orifice trilobated; shell with the apex completely curved anteriorly; front slopes very short and steep; posterior slope very convex *D. arcuata*
Orifice oblong; apex a little in front of the middle, not curved forward; slopes straight *D. harrassoitzii*
12. Orifice triangular; shell with black rays, solid, spotted, or dotted *D. alysoni*
Orifice not triangular; no black coloration 13
13. Shell thin and very small; sculpture exceedingly fine; orifice circular *D. fluriana*
Shell heavy; reaching a fairly large size; orifice not circular 14
14. Orifice trilobated; color of principal ribs oyster white, sharply contrasting with the greenish or bluish gray rays *D. viridula*
Orifice key-hole shaped; color of principal ribs does not contrast with rest of shell; no definite color pattern *D. cayenensis*

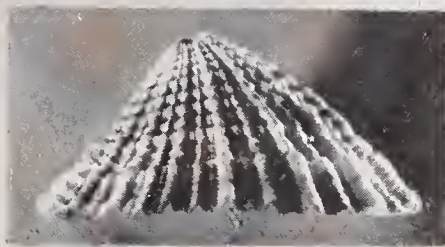
Diodora listeri d'Orbigny, Plate 1, fig. 1-10

Fissurella listeri d'Orbigny 1850-1853, [in] R. de la Sagra, Hist. Phys. Pol. Nat. Cuba, Moll., 2, p. 197, pl. 24, fig. 37-39 (Cuba, Saint Lucia and Martinique).

Description. Shell heavy, large, from 30 to 45 mm. in length, conical and elevated. Base ovate. Anterior slope generally straight, sometimes slightly concave; posterior slope convex. Summit in front of the middle, pierced by a key-hole shaped orifice with the rear wall thickened. It is rather small, its length being from one-seventh to one-eleventh that of the shell. Sculpture consists of 38 or 40 strong, rounded ribs, alternately larger



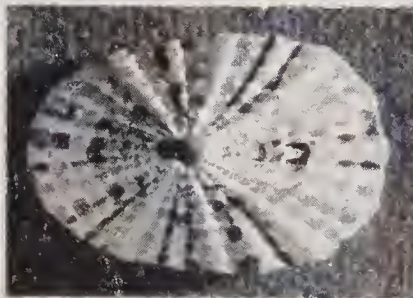
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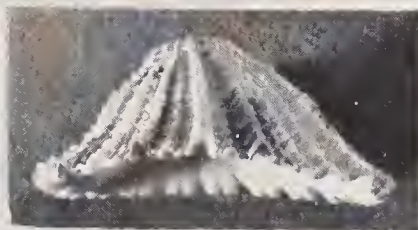
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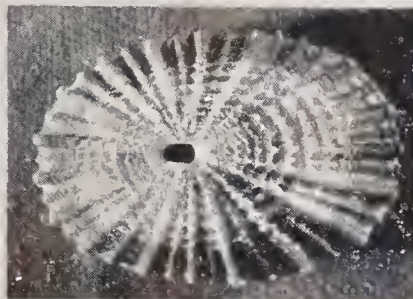
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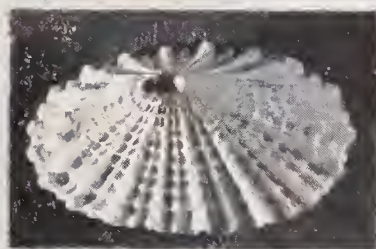
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10

Plate 1. *Diodora listeri* d'Orbigny. Fig. 1-4. Garden Key, Tortugas, Florida (fig. 1-3, nat. size; fig. 4, 5 ×). Fig. 5-6. Missouri Key, Lower Florida Keys (nat. size). Fig. 7. Biscayne Bay, Florida (nat. size). Fig. 8. Lake Worth, Florida (nat. size). Fig. 9. Virgin Gorda, Virgin Islands (nat. size). Fig. 10. Cienfuegos, Cuba (nat. size).

and smaller, the interspaces being deeply excavated and separated by rather broad deep grooves which bear an intermediate riblet. Crossing the shell there are from 9 to 12 concentric laminae which, where they intercept the ribs, form large nodules or scales and cut the interstices into square pits. Between these laminae are a variable number of fine threads. Color very variable: it may be unicolored in white, cream or gray: it may have black, gray or brown rays; or it may have a similar ground with a wide dark gray basal band. The orifice externally is sharply outlined or stained in blue black. Margin strongly crenulated with paired denticulations, each paired group widely and deeply separated from its neighbors. The inside color is milky white, light gray or green, the colors of the outside showing through, while the ribs and concentric ridges are seen in the form of white lines. Internal callus of the orifice the same color as the interior, sometimes stained at the sides and front with blue-black. Muscle impression hardly discernible, continuous and of a uniform width.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-------------------------------|
| (large) | 43 | 32 | 23 | 4 mm. | Eight Mile Rock, Grand Bahama |
| (average) | 34 | 24 | 14 | 4 | Dry Tortugas Keys, Florida |

Types. The type specimens of *D. listeri* may be at the British Museum. I here select Habana, Cuba to be the type locality, as d'Orbigny gave only island designations in his original description.

Remarks. This species is very common throughout its area. It lives generally attached to rocks, but has been found on coral reefs, on wooden and even on iron pilings. The typical sculpture is constant in character and is quite different from that of *D. cayenensis*, a species which appears to be rather closely related to it. *D. listeri* has much stronger and more widely spaced radiating ribs and concentric laminae than those occurring in *D. cayenensis*. The difference in coarseness is so great that when they are compared the two species are very easily separated.

Range. Eastern and southwestern Florida, Bermuda, the West Indies and south to British Guiana.

Records. FLORIDA: St. Augustine; South Lake Worth; Cape Florida (6 fathoms) (all T. Van Hyning); Biscayne Bay; Sanibel Id. (both MCZ); Key Largo (E. M. Davis); Indian Key (Yale); Lower Matecumbe Key; Sandy Key (both B. R. Bales); Missouri Key (T. McGinty); Pelican Shoals (J.S. Schwengel); Stock Id. (T. Van Hyning); Key West (MCZ); Sand Key (AMNH); Boca Grande; Marquesas Key; Dry Tortugas (all T. Van Hyning). BAHAMAS: Eight Mile Rock, Grand Bahama; Strangers Key, Great Abaco; Alicetown, Bimini Ids.; South Beach, New Providence; Governors Harbour, Eleuthera; Little San Salvador Id.; Arhurstown, Cat Id.; Simms, Long Id.; Watling Id.; Samana Cay; Matthewtown, Great Inagua (all MCZ). BERMUDA: (MCZ). CUBA: Vedado; Matanzas City (both MCZ); Varadero (H. Sarasúa); Playa de Jibacoa (J.L. Mayor); Cabo Roteño; Caibarién (both P.J. Bermúdez); Guantánamo Naval Base; Punta de los Colorados, Cienfuegos; Bahía de Cochinos, *Atlantis*, station 3328 (260–275 fathoms) [dead specimen] (all MCZ). HISPANIOLA: Monte Cristi; Puerto Plata; Puerto Sosúa; Santa Bárbara de Samaná; El Canal, Cabo Macorís; Miragoane; Cap Haitien; Gonave Id. (all MCZ). JAMAICA: Montego Bay (AMNH). PUERTO RICO: San Juan; Arecibo (both MCZ); Boca de Cangrejos; Laiza Vieja (both Univ. of Mich.). VIRGIN ISLANDS: St. Thomas (AMNH); St. John; Marina Cay and Guana Id., Tortola (all M. W. Dewey); Virgin Gorda (MCZ). LESSER ANTILLES: Barbados;

Trinidad (both MCZ); Fontenay Beach, Grenada (H. G. Kugler); Tobago (AMNH). CARIBBEAN IDS.: Swan Id. (MCZ). PANAMA: Colón (MCZ). BRITISH GUIANA: Corentyne River (H. G. Kugler).

***Diodora cayenensis* Lamarek, Plate 2, fig. 1-6**

Fissurella cayenensis Lamarek 1822, An. s. Vert., **6**, pt. 2, p. 12 (mers de la Guyane).

Fissurella alternata Say 1822, Journ. Acad. Nat. Sci. Philadelphia, **2**, pt. 2, p. 224 (coast of the United States).

Fissurella funata Reeve 1850, Conch. Icon., **6**, *Fissurella*, pl. 9, fig. 63 (locality unknown).

Fissurella larva Reeve 1850, Conch. Icon., **6**, *Fissurella*, pl. 13, fig. 98 (Island of St. John's, West Indies).

Fissurella viminea Reeve 1850, Conch. Icon., **6**, *Fissurella*, pl. 14, fig. 105 (locality unknown).

Description. Shell moderately heavy, from 25 to 40 mm. in length, conical, elevated and narrower anteriorly. Front slope straight or concave, posterior convex. Base ovate or sub-oblong. Apex anterior to shell center, more or less curved forward, and with the orifice placed immediately before it. The latter is key-hole shaped, the rear wall thickened and sometimes excavated obliquely, the sides frequently projecting upwards to form one prominent tooth which sometimes divides into two, while frontally and laterally it may sometimes have a very fine black line on the outside. Its length is from one-sixth to one-ninth that of the shell. Surface sculptured with numerous close set radiating sharp ribs, every fourth one larger. Concentric overlapping growth laminae cross the shell forming small scales where the ribs are intercepted. Color very variable: may be unicolored milky white, cream, buff, light pink or dark gray. With any of these colors as a ground, there may be eight or nine gray or brown rays which are solid, in broken lines, or in scattered spots; with the same ground color there may be a broad basal band of dark gray or black. Margin sharply and finely crenulated. Interior color white or bluish gray, the color pattern and sculpture of the outside showing through. The internal callus of the orifice is of the same color as the rest of the inside. It is sharply truncated and excavated obliquely, forming a deep pit behind; sometimes it is encircled by a black line. Muscle scar slightly impressed, narrower anteriorly.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|------------------------------|
| (large) | 39 | 24 | 15 | 5 mm. | Simms, Long Id., Bahamas |
| (average) | 30 | 19 | 13 | 4 | Biscayne Bay, Miami, Florida |

Types. Probably in the Geneva Museum. The type figures are those of B. Delessert 1841, Recueil Coquilles Décrites par Lamarek, Paris, pl. 24, fig. 5a-c. The type locality is French Guiana.

Remarks. This is an exceedingly variable species, the most variable characters being the general shape of the shell and the coloration. The color pattern has probably been chiefly responsible for the variety of names applied to this species. The very large collection of material at hand indicates that it is impossible to draw any line among these different forms. Certain specimens possess two sets of color characteristics each one of which has had a name applied to it.

It is exceedingly unfortunate that the well known name of *alternata* Say must be replaced by an earlier one proposed by Lamarek; both appeared in 1822, but that of Lamarek was published in May while that of Say was published in June.

D. cayenensis is found from the intertidal realm to depths of about 20 fathoms. It occurs mainly on rocks.

Range. Maryland and south, including the Gulf of Mexico, the West Indies and South America, to Brasil.

Records. MARYLAND: (AMNH). VIRGINIA: Hog Id. (MCZ). NORTH CAROLINA: Beaufort (MCZ). SOUTH CAROLINA: Charleston; Sullivan Id. (both MCZ). FLORIDA: Fernandina (T. Van Hyning); St. Augustine (MCZ); Melbourne (T. Van Hyning); Fort Pierce (T. McGinty); off Fort Walton (13-19 fathoms) (L. A. Burry); Palm Beach (J. S. Schwengel); off Lantana (10 fathoms) (T. Van Hyning); Boynton Beach (T. McGinty); Ft. Lauderdale; Hollywood (both L. A. Burry); Biscayne Bay (R. Humes):

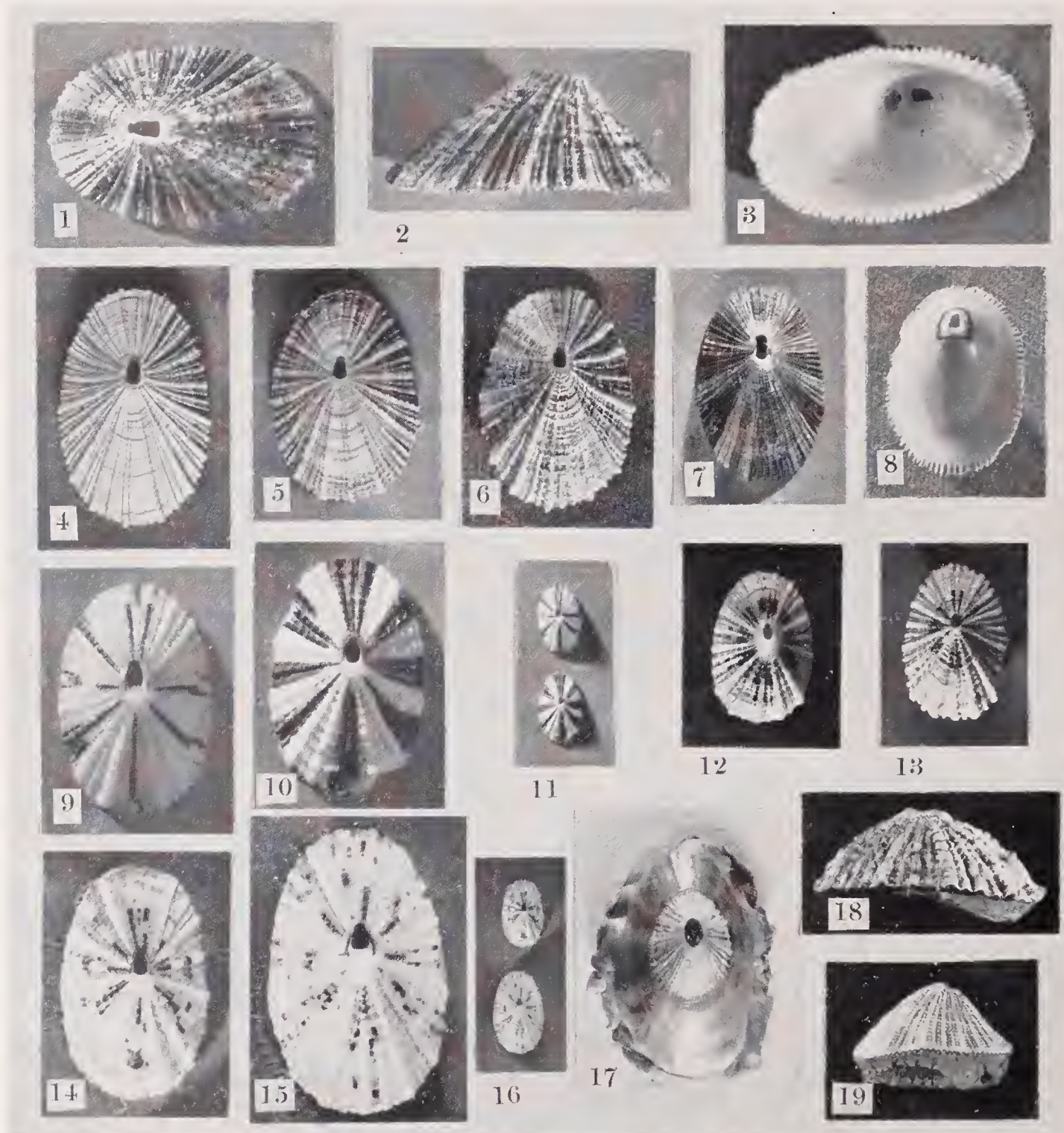


Plate 2. Fig. 1-3. *Diodora cayenensis* Lamarck, Tortugas, Florida (nat. size). Fig. 4. *Diodora cayenensis* Lamarck, Puerto Esperanza, Pinar del Río, Cuba (nat. size). Fig. 5. *Diodora cayenensis* Lamarck, Charleston, South Carolina (nat. size). Fig. 6. *Diodora cayenensis* Lamarck, Bonita Springs, Florida (nat. size). Fig. 7-8. *Diodora patagonica* d'Orbigny, Nova Almeida, Espirito Santo, Brasil (nat. size). Fig. 9-11. *Diodora dysoni* Reeve, Sarasota Bay, Florida (fig. 8-9, $3\times$; fig. 10, nat. size). Fig. 12-13. *Diodora dysoni* Reeve, Adelaide, New Providence, Bahamas (nat. size). Fig. 14-16. *Diodora dysoni* Reeve, Bermuda (fig. 14-15, $3\times$; fig. 16, nat. size). Fig. 17. *Lucapina*. Fig. 18. *Fissurella*. Fig. 19. *Diodora*. The last three figures are to show the position of the soft parts in the three genera (all nat. size).

Key West, *Blake*; Pavilion Key; Bonita Springs; off Sanibel Id. (6-15 fathoms) (all MCZ); Sarasota Bay (AMNH); Boca Grande (H. Dodge); off Big Sarasota Pass (7-8 fathoms) (T. Van Hyning); Pass-à-Grille (E. M. Davis); Gulfport (MCZ); Tampa Bay; St. Petersburg; off Tarpon Springs; St. Joseph's Bay; Camp Walton (all T. Van Hyning); off Destin (T. McGinty); Cedar Keys (AMNH); Upper Matecumbe Key; Sugarloaf Key; Bonefish Key (all B. R. Bales); Fort Jefferson, Dry Tortugas (T. Van Hyning). BERMUDA: Agar's Id.; Shelly Bay; Hemington Sound (all MCZ). BAHAMAS: Nassau, New Providence (P. D. Ford); Hatchet Bay, Eleuthera (MCZ); Cape St. Maria, Long Id.; Samana Cay (all MCZ). CUBA: Puerto Esperanza, Pinar del Río (Belén Rogés); Playa de Baracoa, Habana (J. L. Mayor); Cayo Francés, Caibarién (P. J. Bermúdez). HISPANIOLA: Monte Cristi; Puerta Plata (both MCZ). JAMAICA: Montego Bay (MCZ). PUERTO RICO: Humacao Beach; Mayagüez (both MCZ). VIRGIN ISLANDS: St. Thomas; St. John (both MCZ); Guana Id., Tortola (M. W. Dewey). LESSER ANTILLES: Ft. James Beach, Antigua (B. Baker); Pigeon Point, Tobago; Stables Bay and Scotland Bay, Trinidad (MCZ). MEXICO: Veracruz: Chalalacas; off Isla Mujeres (all MCZ). HONDURAS: Puerto Cortés (MCZ). PANAMA: Colón (MCZ). COLOMBIA: Cartagena (MCZ). VENEZUELA: off Curaçao (MCZ). FRENCH GUIANA: Cayenne (MCZ). BRASIL: Manginhos, Ilha de Itaparica; Pituba (both P. de Oliveira).

***Diodora dysoni* Reeve, Plate 2, fig. 9-16**

Fissurella dysoni Reeve 1850, Conch. Icon., 6, *Fissurella*, pl. 12, fig. 86 (Honduras).

Diodora microsticta Dall 1927, Proc. United States Nat. Mus., 70, Art. 19, p. 9 (South Florida to Cape San Roque, Brasil).

Description. Shell small, seldom exceeding 20 mm. in length, depressedly conical and with straight slopes. Base ovate. Apex slightly in front of the middle and characterized by a blunt knob situated behind the posterior wall of the small, almost triangular orifice. Sculpture consists of 18 strong ribs, between which there are three intercallary riblets. Numerous concentric laminae cross the shell, forming a rather heavy lattice-like appearance. Color milky white or cream with eight solid, broken or dotted black rays. The orifice is bounded laterally and anteriorly by a black line. Margin sharply crenulated with the denticles arranged in groups of four. Inside color white. Internal callus of the orifice broad, sharply truncated and excavated behind. It has the same color as the rest of the inside. Muscle scar faint.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|---------------------------------|
| (large) | 22 | 15 | 11 | 3 mm. | Sanibel Id., Florida |
| (average) | 17 | 11 | 6 | 2 | Nassau, New Providence, Bahamas |

Types. The types of this species are in the British Museum, the type locality being Honduras, Dyson collector.

Remarks. The sculpture of *D. dysoni* and *D. cayenensis* is quite similar, but in shells of equal size, the sculpture of *D. dysoni* is much stronger and the laminae are more widely spaced. In *dysoni* the orifice is triangular, while in *cayenensis* it is key-hole shaped. Color rays or spots are never colored black in *cayenensis*. When Dall described *D. microsticta*, he considered the specimens in which the black rays were broken or dotted, as well as those in which they are terminated at some distance from the margin, to be different from *D. dysoni*. However, I believe *D. microsticta* to be the same species. Variation is extensive in color pattern and a long series shows all connecting links between them. All other characters other than the color pattern are identical.

Range. Florida, the Bahamas and south to Brasil.

Records. FLORIDA: Sanibel (MCZ); Hollywood (35-60 fathoms) (L. A. Burry); Sarasota Bay (AMNH). BERMUDA: Gibbet Id.; Long Bird Id. (both MCZ). BAHAMAS: Arthurstown, Cat Id. (MCZ); Adelaide, New Providence (P. D. Ford). VIRGIN ISLANDS: St. Thomas (MCZ); Guana Id., Tortola (M. W. Dewey). LESSER ANTILLES: Guadeloupe (AMNH); Barbados (T. McGinty). HONDURAS: (AMNH).

Diodora patagonica d'Orbigny, Plate 2, fig. 7-8

Fissurella patagonica d'Orbigny 1847, Voyage dans l'Amérique Méridionale, 5, p. 476, pl. 64, fig. 1-3 (Rio de Janeiro [Brasil]; Rio Negro [Argentina]).

Diodora metcalffi Reeve, Conch. Icon., 6, *Fissurella*, pl. 11, fig. 75 (locality unknown).

Description. Shell medium in size, about 30 mm. in length, depressed conical. Anterior slope straight, posterior slope convex. Base oblong-ovate. Apex directed forward, situated at the beginning of the second third and pierced by the orifice. The orifice has the same shape as the basal margin and is slightly contracted in the middle, its length being from one-eighth to one-tenth that of the shell. The surface is sculptured with numerous close-set, rather sharp, radiating ridges which are closely decussated throughout with concentric striae. Shell is alternately rayed in buff and a greenish brown. The orifice is always outlined by a fine black line. Margin of shell thin, very sharply crenulated. Inside color grayish white. Internal callus of the orifice thick and outlined by an indenture. It has the same color as the rest of the inside and is surrounded by a dark gray streak. Muscle scar deeply impressed.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|--------------------------------------|
| (large) | 30 | 20 | 11 | 4.5 mm. | Trinidad |
| (average) | 27 | 17 | 11 | 4 | Nova Almeida, Espirito Santo, Brasil |

Types. The type of this species is probably in the British Museum. As d'Orbigny gave two widely separated localities, I here select as type locality, Rio de Janeiro.

Remarks. *D. patagonica* is a fairly abundant species from Trinidad south along the east coast of South America. It is not found in the rest of the West Indies. *D. metcalffi* Reeve has been constantly considered a synonym of *D. cayenensis*, but the specimens that we have seen agree exactly with Reeve's figure and description. These in turn agree with d'Orbigny's. This species is related to *D. cayenensis*, but the obvious differences in the sculpture, the shape of the orifice and the basal margin make it impossible to confuse them.

Range. Trinidad south through Brasil to Argentina.

Records. TRINIDAD: Magueripe Bay (MCZ). BRASIL: Nova Almeida, Espirito Santo, *Thayer* Expedition (MCZ); Rio de Janeiro (d'Orbigny 1847, p. 476). ARGENTINA: Rio Negro (d'Orbigny 1847, p. 477).

Diodora sayi Dall, Plate 3, fig. 1-8

Fissurella alternata Say, var. *sayi* Dall 1899, Bull. Mus. Comp. Zoöl., 18, p. 407 (off Habana, Cuba).

Description. Shell depressedly conical with the apex completely directed forward, medium in size, generally not exceeding 30 mm., narrower in front and from thin to moderately heavy. Anterior slope short, straight or concave; posterior, long and convex. Base oblong-ovate. Orifice placed in the anteriorly directed apex; it is long, narrow and tends to be trilobated, its length being from one fourth to one sixth that of the shell. Surface dull; sculpture consists of fine close set, nearly equal, radiating ribs which are crossed by numerous concentric threads. Color uniformly white, cream or faintly olive. In the lat-

ter case there are seven slightly darker rays, placed three on each side and one at the front. Margin finely crenulated, the denticulations tending to be arranged in pairs. Interior color the same as the outside; when rays are present, they show through. Internal callus of the orifice sharply truncated behind, of the same color as the inside and sometimes bounded by an olive-green, interrupted streak.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-----------------------------|
| (large) | 29 | 27 | 11 | 5.5 mm. | off Delray, Florida |
| (average) | 15 | 9 | 5 | 4 | off Pelican Shoals, Florida |

Types. Holotype, Museum Comparative Zoölogy, No. 125767, *Blake*, station 62, from off Habana, Cuba (N. Lat. $23^{\circ}9'$; W. Long. $82^{\circ}1'$) in 30 fathoms. Paratypes from the same station as well as from the following *Blake* stations: station 2, off Habana in 805 fathoms; station 32, off Yucatan (N. Lat. $23^{\circ}32'$; W. Long. $88^{\circ}5'$) in 95 fathoms; off Yucatan in 640 fathoms.

Remarks. Dall considered this form as a variety of *D. alternata* (= *cayenensis*) but its characteristics are strikingly different from those of that species. *D. sayi* possesses another shape, having the apex nearer to the anterior end. The sculpture of *D. sayi* consists of nearly equal ribs, while the sculpture of *D. cayenensis* has every fourth rib noticeably larger. The orifice of *D. sayi* is longer and is trilobated in outline; that of *D. cayenensis* being key-hole shaped.

D. sayi exists only below low water in depths ranging from 12 to 95 fathoms. Records from much greater depths, are based upon dead shells. Live material may not exist at such depths.

Range. Shallow to deep water from southeast Florida, Greater Antilles, along the Central American coast to Brasil.

Records. FLORIDA: Palm Beach (12–14 fathoms); Pelican Shoals (45 fathoms); off Destin (all J. S. Schwengel); off Hollywood (35–60 fathoms) (L. A. Burry); off Delray (80 fathoms) (T. Bayer). CUBA: off Habana, *Blake*, station 2 (805 fathoms); off Habana, *Blake*, station 62 (80 fathoms) (all MCZ). MEXICO: off Yucatan, *Blake*, station 32 (95 fathoms); off Yucatan, *Blake* (640 fathoms) (both MCZ). BRASIL: Recife; off Bahía, *Hassler* (40 fathoms) (both MCZ).

Diodora harrassowitzi v. *Ihering*, Plate 3, fig. 9–12

Lucapina harrassowitzi v. *Ihering* 1927, Archiv. für Molluskenkunde, 59, p. 97, pl. 6, fig. 9–12, 15–16 (Itapema, Sta. Catharina, Brasil).

Description. Shell small, about 12 mm. in length, moderately heavy, conical and elevated. Base oblong-ovate. Slopes straight. Apex a little in front of the middle, pierced by a long-oblong, almost parallel-sided orifice, about 1.5 mm. in length. Sculpture consists of alternately larger and smaller radiating ribs crossed by concentric raised threads which form small nodules where they intercept the ribs. Shell unicolored a light orange-buff. Margin strongly crenulated, the denticulations being in pairs. Inside color white or cream, the sculpture of the outside showing through. Internal callus of the orifice sharply truncated behind, the same color as the rest of the inside. Muscle scar rather deeply impressed.

| | length | width | height | orifice length | |
|---------|--------|-------|--------|----------------|-------------|
| (large) | 12 | 8 | 4 | 1.5 mm. | Holotype |
| (small) | 9 | 6 | 3 | 1.3 | West Indies |

Types. Holotype, Senckenberg Museum, Frankfurt, a. M., Germany, no. 3277, Itapema, Sta. Catharina, Brasil, H. von Ihering collector.

Remarks. This is an exceedingly rare species; the only specimens seen are four without data and included with specimens of *D. cayenensis*.

Range and Records. Known only from the type locality.

***Diodora bermudensis* Dall and Bartsch, Plate 3, fig. 13**

Fissuridea bermudensis Dall and Bartsch 1911, Proc. United States Nat. Mus., 40, p. 286 (Bermuda).

Description. "Shell small, white, elevated, reticulately sculptured: apex a little in advance of the middle of the shell, rather pointed: the anal perforation long-oval, the margins excavated in the middle, internally with a thickened margin, subtruncated behind: sculpture of radiating threads with wider deep interspaces, crossed between the apex and the base by about a dozen concentric lines, representing old margins, nodulating the radials and forming deep pits between the intersections; interior of the shell white, the margin forming a regular oval, and often internally radially grooved in harmony with the external ribs."

length width height
5 3.5 3 mm. Cotype

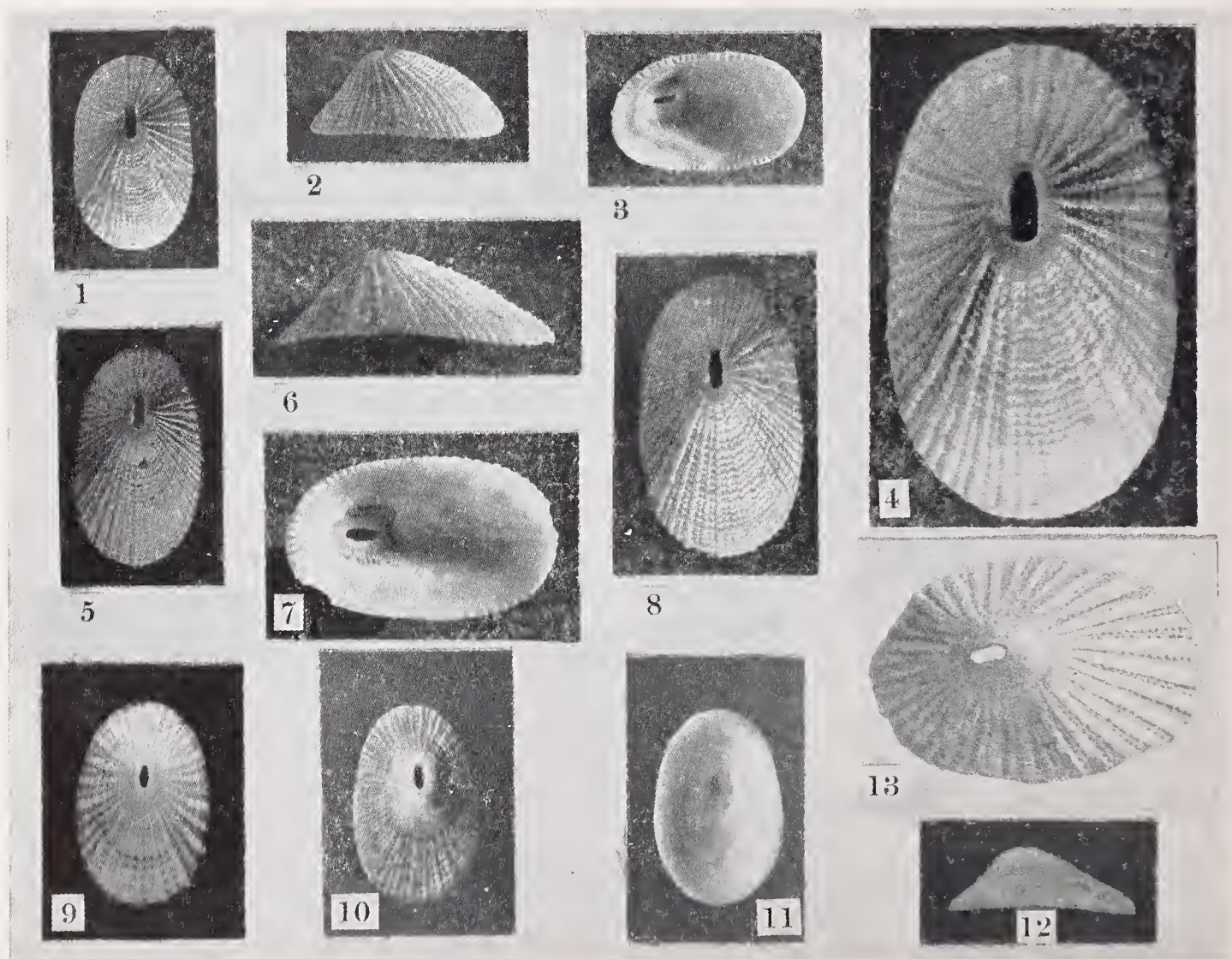


Plate 3. Fig. 1-4. *Diodora sayi* Dall, off Pelican Shoals, Florida (1-3, 2×; 4, 5×). Fig. 5. *Diodora sayi* Dall, off Pelican Shoals, Florida (2×). Fig. 6-8. *Diodora sayi* Dall, off Palm Beach, Florida (3×). Fig. 9. *Diodora harrassowitzi* von Ihering, West Indies (2×). Fig. 10-12. *Diodora harrassowitzi* von Ihering, Itapema, Sta. Catharina, Brasil (after von Ihering) (2×). Fig. 13. *Diodora bermudensis* Dall and Bartsch, Bermuda (after Dall and Bartsch) (8×).

Types. Cotypes, United States National Museum, no. 221618, Bermuda. Arthur Haycock collector.

Range and Records. Known only from Bermuda.

Remarks. I have not seen any specimens of this very distinctive *Diodora*. The above description and figure are copied from the report of Dall and Bartsch.

Diodora aguayoi, new species, Plate 4, fig. 1-3

Description. Shell thin, small, about 15 mm. in length, conical, elevated and somewhat narrower anteriorly. Front slope straight, posterior and lateral slopes slightly concave at the orifice and below continuing straight to the border. Apex a little in front of the middle, pierced by a small oblong anteriorly directed orifice which has a rounded tooth on each side. Its length is from one sixth to one seventh that of the shell. Sculpture consists of numerous, fine alternately larger and smaller radiating ribs, decussated by numerous concentric threads which form nodules or small scales where they intercept the ribs. Shell uniformly colored grayish white, cream or pale olive and sometimes with 4 or 8 irregularly placed darker rays. Margin finely crenulated, with paired denticles. Inside color the same as the outside, with the sculpture showing through as fine radiating and concentric white lines. Internal callus of the orifice sharply truncated and excavated behind, colored the same as the rest of the interior.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-----------|
| (large) | 14 | 10 | 11 | 2 mm | Holotype |
| (average) | 12 | 9 | 10 | 1.5 | Paratypes |

Types. Holotype, Museum of Comparative Zoölogy no. 125768, off Sandy Bay, Barbados, in 100 fathoms, *Hassler*, 1871. Paratypes from the same locality.

Remarks. This species would appear to be near to the *D. cayenensis* complex, but actually it is not at all related. *D. aguayoi* is a thinner species and smaller than *D. cayenensis*. Its shape is different, having the posterior and lateral slopes concave near the apex and becoming straight toward the margin, a condition quite different from that found in *D. cayenensis*. The sculpture of *D. aguayoi* consists of alternately larger and smaller ribs which are separated by a narrow groove while in *D. cayenensis* the ribs are close set with every fourth larger than the three in between. Also, in *D. aguayoi* the orifice is in part flat on top and strongly angled on the anterior slope, a condition not occurring in any other *Diodora* existing in the Western Atlantic area. This species is only known from fairly deep water in depths between 80 and 450 fathoms.

Range. Bermuda and south through the West Indies in fairly deep water.

Records. BERMUDA: off Castle Rock (80-100 fathoms). CUBA: off Habana, *Blake*, station 51 (450 fathoms). LESSER ANTILLES: off Sandy Bay, Barbados, *Hassler*, (100 fathoms) (all records are MCZ).

Named for Dr. C. G. Aguayo of the University of Habana, who was responsible for my first interest in mollusks.

Diodora jaumei *Aguayo and Rehder*, Plate 4, fig. 4-8

Diodora jaumei Aguayo and Rehder 1936, Mem. Soc. Cubana Hist. Nat., 9, No. 4, p. 236, pl. 24, fig. 6 (Varadero, Matanzas and La Chorrera, Habana, Cuba).

Description. Shell 15 to 21 mm. in length, conical, rather elevated, with the apex a little in front of the middle. Base ovate. Slopes straight or very slightly convex, particularly the posterior. Orifice small, ovate, extending anteriorly from the apex, its narrower

end being frontally placed. Surface lusterless, sculptured with rounded, strong, alternately large and smaller ribs crossed by concentric laminae which form squamous nodules where they intercept the ribs, cutting the interstices into rectangular pits. Between the laminae are intercalated two or three threads. Color from white to buff, freckled all over

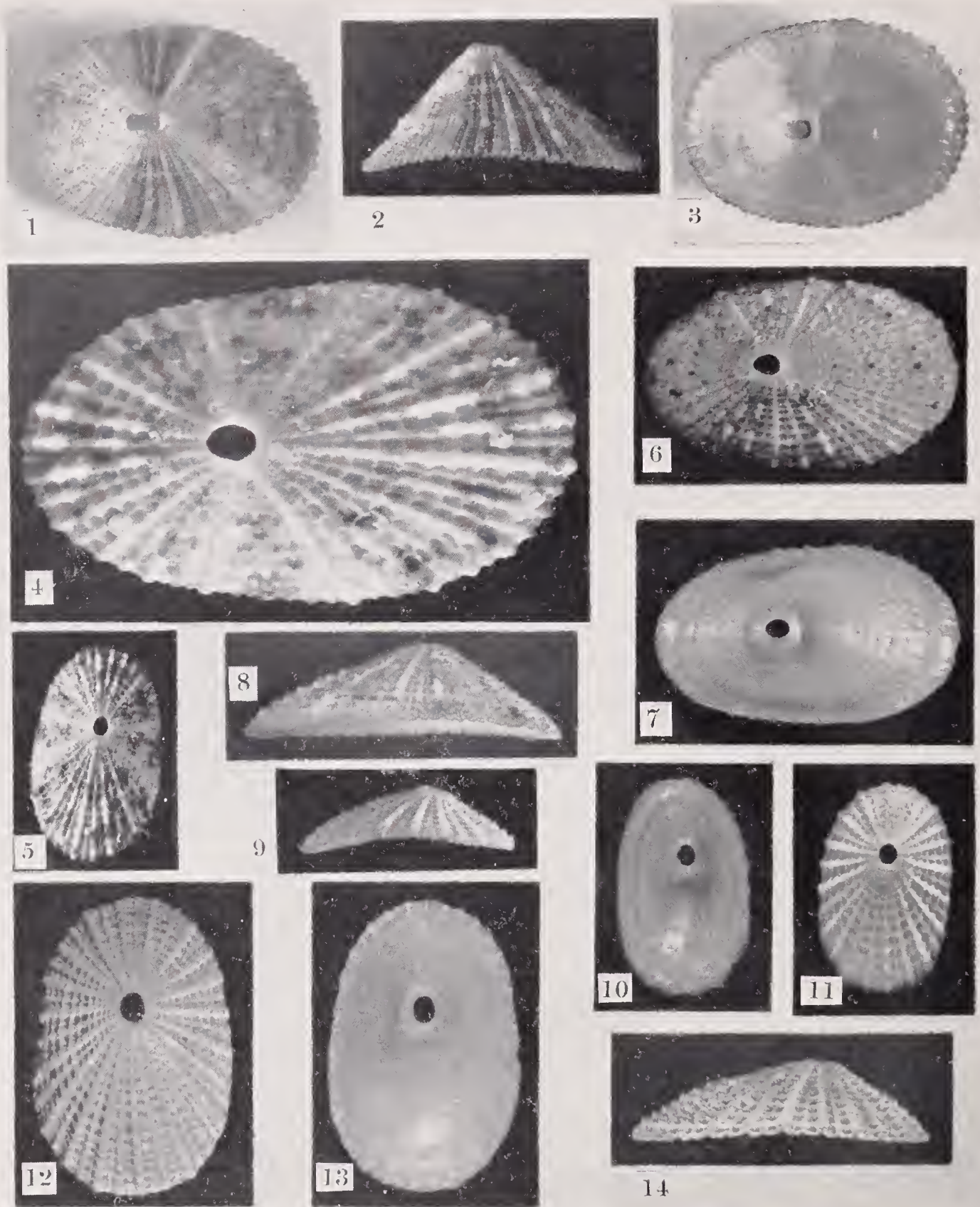


Plate 4. Fig. 1-3. *Diodora aguayoi* P. Farfante (Holotype), off Sandy Bay, Barbados, Lesser Antilles (3×). Fig. 4-5. *Diodora jaumei* Aguayo and Rehder, Bird Key Reef, Tortugas (5×). Fig. 6-8. *Diodora jaumei* Aguayo and Rehder, Pirates Cove, Key West, Florida (3×). Fig. 9-11. *Diodora meta* von Ihering, off Sanibel Id., Florida (3×). Fig. 12-14. *Diodora meta* von Ihering, off Sanibel Id., Florida (3×).

with elongated brown spots. When the specimens are worn the spots turn pinkish. Sometimes there are present light brown rays varying in number from 5 to 7 over which the spots are clearly visible. Margin finely crenulated, the denticulations arranged in pairs. Inside color white with the sculpture of the outside showing through as fine radiating and concentric white lines. Internal callus of the orifice white, oval, truncated posteriorly.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-----------------------|
| (large) | 21 | 13 | 7 | 3.5 mm. | Varadero, Cuba |
| (average) | 16 | 9 | 5 | 1.5 | Dry Tortugas, Florida |

Types. Holotype, United States National Museum no. 420974 Varadero, Matanzas Province, Cuba, M. L. Jaume collector. Paratypes from the same locality and from La Chorrera, Habana, Cuba.

Remarks. This delicate and beautiful species is rather rare although widely distributed. It has usually been collected in depths of 10 to 60 fathoms, though G. W. Van Hyning found live specimens on rocks at low water at Tortugas, Florida. A few specimens have been obtained in beach drift. From young specimens of *D. listeri*, which it approximates, it differs by having a less pronounced sculpture, with the ribs more closely set. The orifice of *D. jaumei* is ovate and not key-hole shaped as it is in *D. listeri* and also the orifice is not outlined or stained with black as it is in this latter species.

Range. Florida, from Lake Worth south to Tortugas and north along the Gulf coast to Camp Walton, Cuba and south to Trinidad.

Records. FLORIDA: Lake Worth; off Lantana (10 fathoms) (both T. Van Hyning); off Palm Beach (100 fathoms) (J. S. Schwengel); off Hollywood (20-60 fathoms); Pirates Cove, Key West (both L. A. Burry); Biscayne Bay (R. Humes); Camp Walton (T. Van Hyning); Pelican Shoals (45 fathoms) (J. S. Schwengel); Sand Key (T. Van Hyning); Dry Tortugas (B. R. Bales). CUBA: La Chorrera, Habana (C. G. Aguayo and M. L. Jaume); Varadero, Matanzas (MCZ). LESSER ANTILLES: Chaguaramas Bay, Trinidad (H. G. Kugler).

Diodora meta v. *Ihering*, Plate 4, fig. 9-14

Lucapina meta v. *Ihering* 1927, Archv. für Molluskenkunde, 59, p. 98, pl. 1-4, 13-14 (Itapema, Sta. Catharina, Brasil).

Description. Shell thin, small, about 15 mm. in length and depressedly conical. Base oval or ovate. Anterior slope straight, posterior slope convex. Apex a little in front of the middle. Orifice small, about 1 mm. long, circular in shape and situated slightly in front of the apex. Sculpture consists of 37 or 38 strong, radiating and widely separated ribs, between which there are alternated fine riblets. Concentric, separated laminae give a lattice-like appearance to the shell surface, forming nodules or scales where these laminae intercept the ribs. It is typically unicolored a milky white. Margin finely crenulated. Interior color polished white, the outside sculpture showing through in the form of radiating and concentric white lines. Internal callus of the orifice the same color as the rest of the inside; it is round, truncated and slightly excavated behind.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|---------------------------------|
| (large) | 16 | 11 | 4 | 1.4 mm. | Itapema, Sta. Catharina, Brasil |
| (average) | 14 | 9 | 4 | 1.3 | Sanibel Id., Florida |

Types. Holotype, Senckenberg Museum, Frankfurt a.M., no. 3279, Itapema, Sta. Catharina, Brasil.

Remarks. This beautifully sculptured species is exceedingly rare. It occurs in shallow water, living apparently below the low-water line though occasionally washed up on the beaches. At this writing only the two extremes in its distribution are known, namely Florida and Brasil. Shallow water dredging in the West Indies and along the coasts of Central and northern South America should indicate its presence.

Range. Southern Florida and Brasil.

Records. FLORIDA: off Palm Beach (12-14 fathoms) (J. S. Schwengel); off Hollywood (35-60 fathoms) (L. A. Burry); off Sanibel Id. (5 fathoms) (MCZ); off Sanibel Id. (4-6 fathoms) (J. S. Schwengel); Garden Key, Dry Tortugas (T. Van Hyning). BRASIL: Itapema, Sta. Catharina (H. v. Ihering, 1927).

Diodora viridula Lamarck, Plate 6, fig. 1-4

Fissurella viridula Lamarck 1822, An. s. Vert., 6, pt. 2, p. 13 (locality unknown); B. Delessert 1841, Recueil de Coquilles Décrites par Lamarck, Paris, pl. 24, fig. 1a-d (mers de Chine).

Fissurella bicolor "C. B. Adams" Pilsbry 1891, Man. of Conch. (1), 12, p. 226 (West Indies).

Description. Shell medium in size, from 20 to 30 mm. in length, elevated, conical and narrower anteriorly. Front slope straight or slightly concave, posterior slope more or less convex. Apex in front of the middle, the orifice being situated immediately before it. The orifice is long, narrow and trilobated, sometimes having two small teeth on each side. Externally it is outlined or stained with black; its length is from one-sixth to one-eighth that of the shell. Sculpture consists of from 18 to 20 principal radiating ribs colored oyster-white or light gray, between which there are three smaller ribs, the middle one generally larger and all three colored dark greenish or bluish gray. Numerous growth lines cross the shell, forming nodules, sometimes strong, sometimes very fine. Margin strongly crenulated, the indentations of the principal ribs being deeper than those of the intermediates, thus causing the indentations of the latter to appear in groups of three. Color pattern of the outside is seen in the crenulations. Inside color polished bluish or greenish gray, the sculpture of the outside showing through as white lines. Internal callus of the orifice narrow, long-oval, truncated and excavated behind. Its color is the same as on the inside and it is surrounded by a black line which is irregularly rayed anteriorly and laterally. Muscle impression distinct.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|------------------------------|
| (large) | 32 | 23 | 15 | 4 mm. | Virgin Gorda, Virgin Islands |
| (average) | 26 | 19 | 11 | 3.5 | Barbados, Lesser Antilles |

Types. The type of *D. viridula* is in Lamarck's collection at the Geneva Museum. As Lamarck gave no locality and Delessert gave "mers de Chine," the seas of China, for this species in error, I select that of Cienfuegos, Cuba, to be the type locality.

Remarks. This well marked species is not closely related to any others in the Western Atlantic. It is characterized by the prominent radial ribs being oyster-white, the intermediate ribs being colored a greenish or bluish grey. It is rather widely distributed but not at all common, living attached to rocks in the lower inter-tidal zone.

Range. Florida, the Bahama Islands and south through the Antilles and Gulf of Mexico to Trinidad.

Records. FLORIDA: Ragged Keys, Biscayne Bay (L. A. Burry). BAHAMAS: Eight Mile Rock, Grand Bahama (MCZ); Nassau, New Providence (P. D. Ford); Little San Salvador Id.; Arhurstown, Cat Id.; Simms, Long Id.; Matthewtown, Great Inagua (all

MCZ). CUBA: Varadero; Guantánamo Naval Base; Puerto Escondido; Cienfuegos (all MCZ). HISPANIOLA: Puerta Plata (T. McGinty); El Canal, Cabo Macorís; Puerto Sosúa; Santa Bárbara de Samaná; Jérémie (all MCZ). JAMAICA: (MCZ). PUERTO RICO: Boca de Cangrejos (Univ. of Mich.); Arecibo (MCZ). VIRGIN ISLANDS: St. Thomas (MCZ); Virgin Gorda (M. W. Dewey). LESSER ANTILLES: Barbados; Trinidad (both MCZ). CARIBBEAN ISLANDS: Swan Id. (MCZ).

***Diodora minuta* Lamarek**, Plate 5, fig. 1-4

Fissurella minuta Lamarek 1822, An. s. Vert., 6, pt. 2, p. 15 (locality unknown).

Fissurella elongata C. B. Adams 1845, Proc. Boston Soc. Nat. Hist., 2, p. 8 (Jamaica).

Fissurella gemmulata Reeve 1850, Conch. Icon., 6, *Fissurella*, pl. 16, fig. 12 a-b (locality unknown).

Description. Shell rather thin, small, generally not exceeding 15 mm. in length, depressedly conical. Apex situated at the anterior third of the shell. Basal margin the same width at both ends, elliptical, the sides subparallel and a little raised in the middle so that the shell rests upon its ends. Front slope slightly concave, back slope convex. Orifice

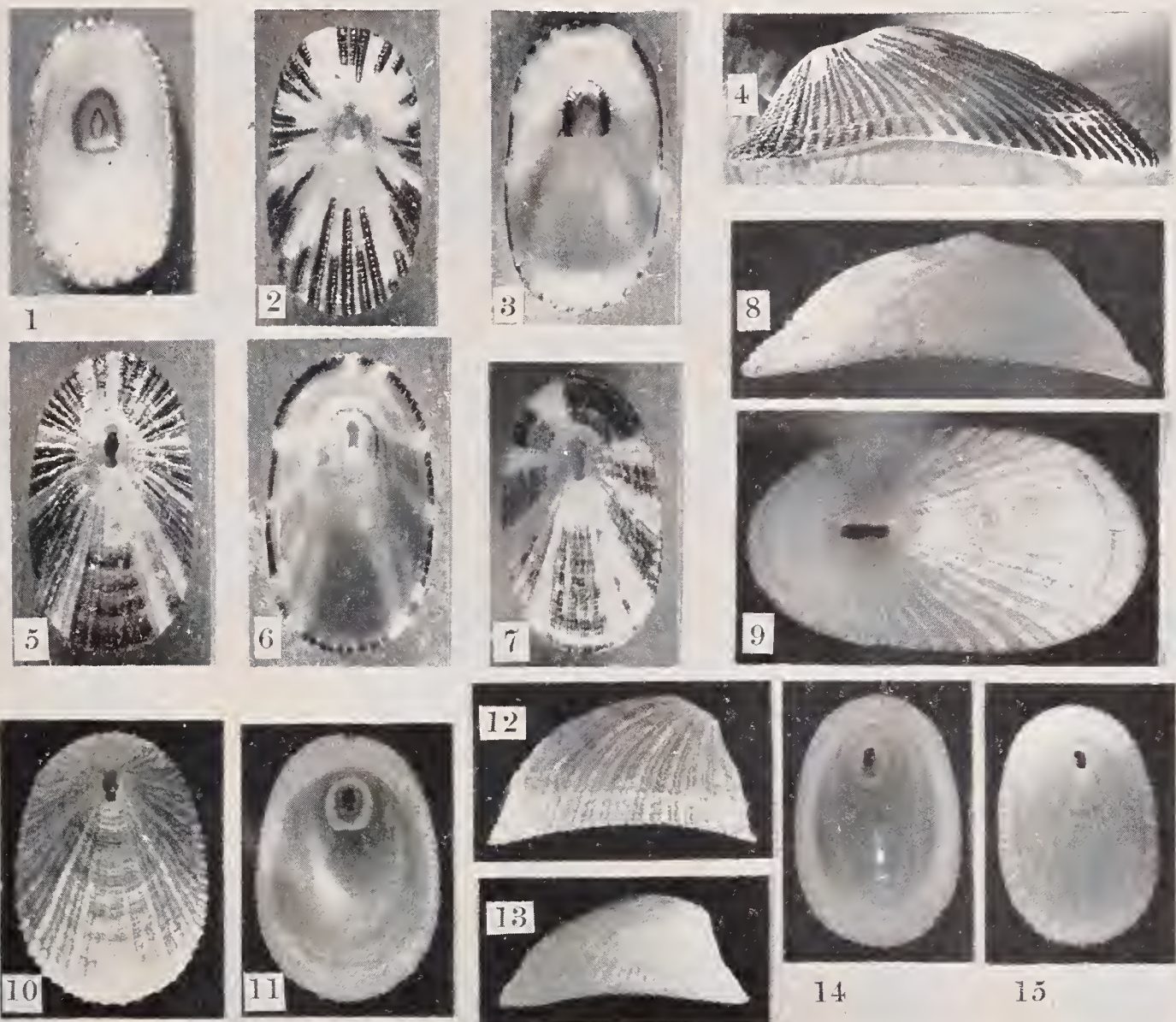


Plate 5. Fig. 1. *Diodora minuta* Lamarek, Athol Id., Bahamas (3×). Fig. 2-3. *Diodora minuta* Lamarek, Little San Salvador Id., Bahamas (3×). Fig. 4. *Diodora minuta* Lamarek, Arthurs-town, Cat Id., Bahamas (3×). Fig. 5-6. *Diodora minuta variegata* Sowerby, Athol Id., Bahamas (3×). Fig. 7. *Diodora minuta variegata* Sowerby, Guana Id., Tortola, Virgin Islands (3×). Fig. 8-9. *Diodora minuta variegata* Sowerby, Andros Id., Bahamas (3×). Fig. 10-12. *Diodora arcuata* Sowerby, Toco, Trinidad (3×). Fig. 13-15. *Diodora arcuata* Sowerby, Tobago, Lesser Antilles.

narrow and trilobated, with its posterior wall at the apex. Sometimes it is stained with black. Surface of shell shiny, sculptured with numerous rounded, subequal, radiating ribs, crossed by concentric raised threads which produce a beaded surface. Color oyster-white with numerous black or dark brown lines, generally arranged in seven or eight streaked rays, which form triangles in shape. Margin very finely crenulated. Interior color of shell a polished oyster-white, the color rays of the outside showing through. Internal callus of the orifice the same color as the inside, frequently bounded by a black streak.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-------------------------------|
| (large) | 16.5 | 9 | 5 | 2 mm. | Arthurstown, Cat Id., Bahamas |
| (average) | 11 | 6 | 3 | 1.5 | Pelican Shoals, Florida |

Types. The type of this species is in Lamarck's collection at the Geneva Museum. That of *F. elongata* C. B. Adams, is at the Museum of Comparative Zoölogy no. 155533 (Holotype). The type figures are those of *B. Delessert* 1841, *Recueil Coquilles Décrites par Lamarck*, Paris, pl. 24, fig. 3a-d. As Lamarck gave no locality, I select Arthurstown, Cat Id., Bahamas, as the type locality.

Remarks. This small, pretty species is rare and so far as known rather restricted in its range. As the records indicate below, the specimens from Florida occur mainly in fairly deep water. Bahama specimens were found under rocks in rather exposed places and washed up on the beaches.

Range. Florida, the Bahamas and south through the Greater and to the northern Lesser Antilles.

Records. FLORIDA: off Lantana (32 fathoms) (T. Van Hyning); Boynton Beach (T. McGinty); off Ft. Lauderdale (20-60 fathoms) (L. A. Burry); off Cape Florida (6 fathoms) (T. Van Hyning); Pelican Shoals (B. R. Bales); off Sand Key, *Blake*, (80 fathoms) (MCZ); Dry Tortugas (T. Van Hyning). BAHAMAS: Alicetown, Bimini Ids.; Nassau, New Providence; Little San Salvador Id.; Matthewtown, Great Inagua; Arthurstown, Cat Id.; Seymours, Long Id. (all MCZ); Atholl Id., New Providence (P. D. Ford). CUBA: Habana (C. G. Aguayo); Guantánamo Naval Base (MCZ). JAMAICA: (MCZ). PUERTO RICO: Boca de Cangrejos (Univ. of Mich.); Arecibo (MCZ). VIRGIN ISLANDS: St. Thomas (MCZ); Guana Id., Tortola; Virgin Gorda (both M. W. Dewey). LESSER ANTILLES: off Sombrero Id., *Blake* (72 fathoms) (MCZ).

***Diodora minuta variegata* Sowerby, Plate 5, fig. 5-9**

Fissurella variegata Sowerby 1862, *Thes. Conch.*, 3, p. 200, *Fissurellidae*, pl. 7, fig. 172, 173 (Isle of St. Thomas).

Description. The orifice and general shape are similar to those of *D. minuta*, the color and color pattern being the determining characteristics. *D. minuta variegata* may be unicolorated or with a secondary color in addition. When unicolorated, it is white or cream. When the secondary color is present, it is in the form of color triangles which are generally brownish or olivaceous. The color triangles in this subspecies are solid, the color appearing on both the ribs and in the spaces between, while in *D. minuta* the color triangles have only the radiating ribs pigmented. The sculpture may be the same, but occasional examples of *D. minuta variegata* show a reticulated pattern rather than the usual one of fairly strong radiating ribs crossed by fine concentric threads.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-------------------------------------|
| (large) | 15 | 9 | 5 | 2 mm. | Staniard Creek, Andros Id., Bahamas |
| (average) | 12 | 7 | 4 | 1.5 | Guana Id., Tortola, Virgin Islands |

Types. The types of *D. minuta variegata* are probably at the British Museum. The type locality is St. Thomas, Virgin Islands.

Remarks. In my opinion, *variegata* is only a subspecies of *D. minuta*, as the differences between the two, though rather constant, are not at all great. It is fairly rare and so far has not been found in Florida.

Range. The Bahama Islands and south to the northern Lesser Antilles.

Records. BAHAMAS: Fox Hill, New Providence (MCZ); Staniard Creek, Andros Id.; Atholl Id., New Providence (all P. D. Ford); Arthurstown, Cat Id. (MCZ). CUBA: Punta de los Colorados, Cienfuegos (MCZ). HISPANIOLA: Monte Cristi; Puerto Sosúa; Santa Bárbara de Samaná (all MCZ). JAMAICA: (AMNH). PUERTO RICO: Boca de Cangrejos (Univ. of Mich.). VIRGIN ISLANDS: St. Thomas (MCZ); Guana Id., Tortola (M. W. Dewey).

Diodora arcuata Sowerby, Plate 5, fig. 10-15

Fissurella arcuata Sowerby 1862, Thes. Conchy. 3, p. 199, *Fissurellidae*, pl. 7, fig. 163, 164 (Island of St. Thomas).

Description. Shell rather small, about 10 mm. in length, conical, elevated, sometimes to a considerable degree and slightly narrower in front. Summit completely curved forward, situated in the first third. Anterior slope short and steep; posterior slope very convex. Orifice situated at the apex, very small and trilobated, the central portion broader than the ends. Surface dull, sculptured with numerous alternating larger and smaller radiating ribs. These are crossed by many fine concentric threads which form very minute scales where they intercept the ribs; both ribs and threads are so close-set that the whole shell has a scaly appearance. Basal margin narrowed anteriorly, ovate, with the sides arched so that the shell rests upon the two ends alone. Color white or cream, with 8-10 tan or light brown, solid or broken rays. Margin very finely and sharply crenulated. Interior color a polished white. Internal callus of the orifice also white, oval and very slightly truncated behind.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|-----------------------------|
| (large) | 12 | 8 | 5 | 2 mm. | Palm Beach, Florida |
| (average) | 10 | 7 | 5 | 1.5 | Tobago Id., Lesser Antilles |

Types. The type of this species is probably in the British Museum. The type locality is St. Thomas, Virgin Islands.

Remarks. *D. arcuata* is apparently related to *D. minuta variegata* but differs by being higher, the apex definitely curved forward, the anterior slope shorter and the posterior slope more pronouncedly convex. The sculpture also is different, being scaly in *D. arcuata*, and beaded or reticulated in *D. minuta variegata*; finally, the color rays in *D. arcuata* are a lighter brown.

This is an exceedingly rare species and although it probably extends through the arc of the Greater and Lesser Antilles, we know of its occurrence from only five localities. It occurs in shallow water attached to rocks.

Range. Florida, Bahamas, Greater and Lesser Antilles south to Trinidad.

Records. FLORIDA: Palm Beach (12-14 fathoms) (J. S. Schwengel). BAHAMAS: Arthurstown, Cat Id. (MCZ). PUERTO RICO: Boca de Cangrejos (Univ. of Mich.). VIRGIN ISLANDS: St. Thomas (Sowerby 1862, in explanation of figures). LESSER ANTILLES: Tobago; Toco, Trinidad (both MCZ).

Diodora fluviana Dall, Plate 6, fig. 5-8

Glyphis fluviana Dall 1889, Bull. Mus. Comp. Zoöl. 18, p. 408, pl. 14, fig. 6, 6a (off Bahía Honda, Cuba).

Description. Shell very thin and small, about 9 mm. in length, conical and elevated. Slopes concave near the apex, becoming later straight or slightly convex. Summit anterior to shell center, a little curved forward and pierced by the orifice. The latter is about 1 mm. long and circular in shape. Sculpture consists of 17 or 18 principal ribs between which are intercalated 3 riblets, the central one being stronger than the other two. The shell is crossed by close-set concentric threads which form small nodules or scales where they intercept both ribs and riblets. Shell dull, may be unicolored either white or olive-green; or may be white with the green color forming an interrupted band at the margin. Some of the principal anterior ribs are colored orange. The shell is translucent.

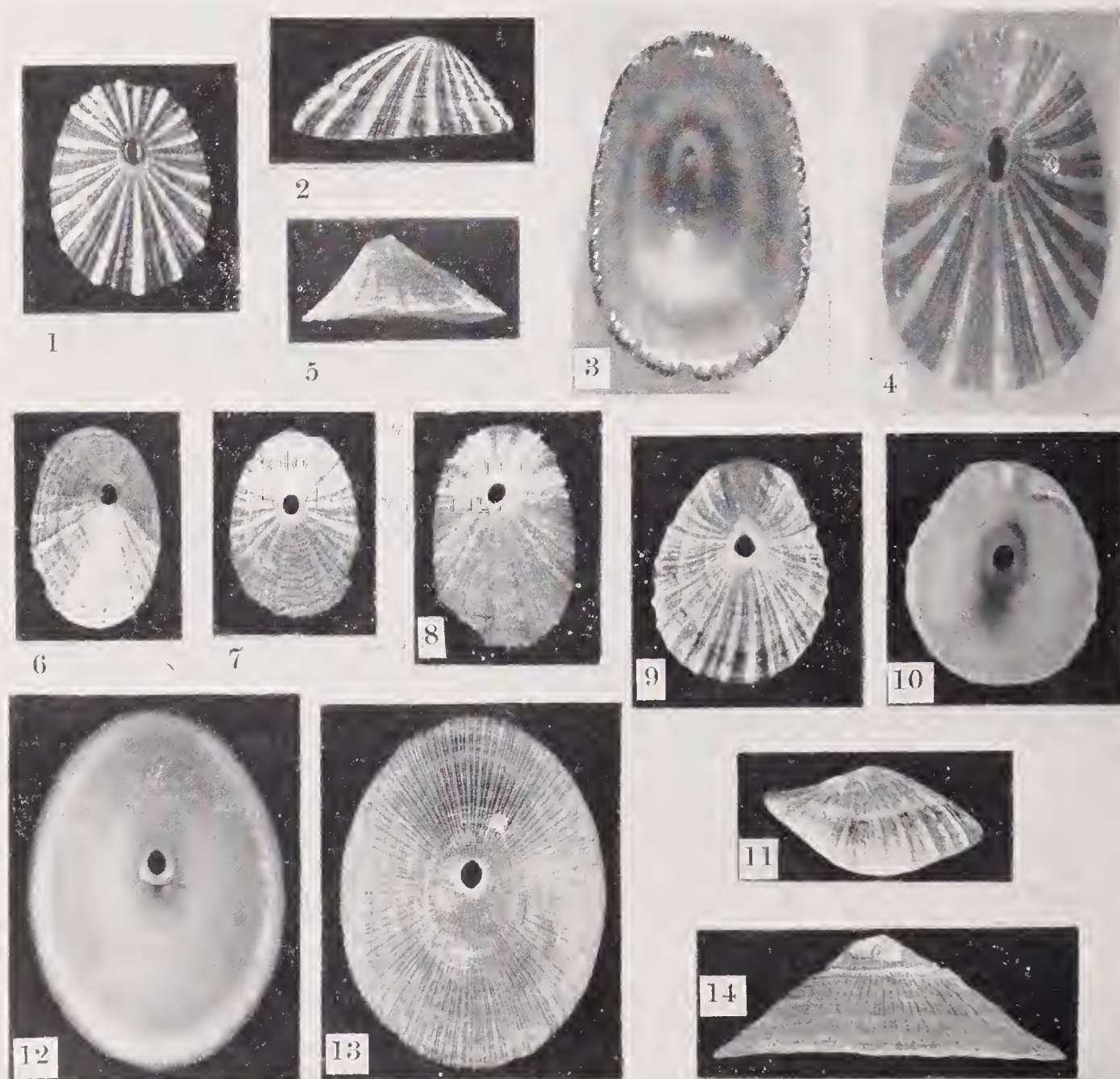


Plate 6. Fig. 1-2. *Diodora viridula* Lamarek, Barbados, Lesser Antilles (nat. size). Fig. 3-4. *Diodora viridula* Lamarek, Cienfuegos, Cuba ($3\times$). Fig. 5-6. *Diodora fluviana* Dall, off Grenada Id., Lesser Antilles (Paratype, $3\times$). Fig. 7. *Diodora fluviana* Dall, off Palm Beach, Florida ($3\times$). Fig. 8. *Diodora fluviana* Dall, off Lower Keys, Florida ($3\times$). Fig. 9-11. *Fissurella subrostrata* Sowerby, West Indies (nat. size). Fig. 12-14. *Diodora tumeri* Verrill, off Sagua la Grande, Cuba (nat. size).

the color of the exterior being visible on the inside; the stronger sculpture of the outside showing through in the form of shallow grooves, while the riblets are seen as fine lines. Interior surface glossy. Internal callus of the orifice truncated-oval, the same color as the rest of the inside.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|------------------------------|
| (large) | 10 | 6 | 4 | 0.75 mm. | off Lower Keys, Florida |
| (average) | 8 | 5 | 3.5 | 0.5 | Grenada Id., Lesser Antilles |

Types. Holotype, Museum of Comparative Zoölogy no. 7632, off Bahía Honda, Cuba (N. Lat. 23°02'30"; W. Long. 83°11') *Blake*, station 21 in 287 fathoms. Paratypes from off Grenada, Lesser Antilles, *Blake*, station 247 in 170 fathoms.

Remarks. This is a well marked species, not particularly close in its relationships to other Western Atlantic *Diodora*. It is rare and only a few specimens have been obtained in fairly deep water (100 to 805 fathoms).

Range. Southern Florida and south through the Greater and Lesser Antilles, probably to Trinidad.

Records. FLORIDA: off Palm Beach (100 fathoms) (J. S. Schwengel): off Lower Keys (L. A. Burry). CUBA: off Bahía Honda, *Blake*, station 21 (287 fathoms): off Habana, *Blake*, station 247 (170 fathoms) (both MCZ). LESSER ANTILLES: off Grenada, *Blake*, station 247 (170 fathoms) (MCZ).

Diodora tanneri Verrill, Plate 6, fig. 12-14

Diodora tanneri Verrill 1883, Proc. United States Nat. Mus. (for 1882), 5, p. 333 (off Delaware Bay): Verrill 1884, Trans. Connecticut Acad., 6, p. 255, pl. 19, fig. 13, 13a.

Description. Shell rather thin, large, reaching a length of 50 mm., conical and moderately elevated. Slopes straight, the posterior sometimes slightly convex. Base broadly ovate. Apex in front of the middle, pierced by a circular orifice. The latter is small, from one-tenth to one-twelfth the length of the shell. Sculpture consists of numerous, very fine, close-set radiating ribs, some beginning at the orifice, while the remaining interstitial ribs commence progressively below. The long ribs become increasingly stronger near the base of the shell. These ribs are crossed by numerous raised concentric threads which form nodules or small scales where they intercept the radial ribs. Color uniform oyster-white or yellowish gray. Margin very finely crenulated. Inside color a lustrous oyster-white. The internal callus of the orifice the same color as the interior, rounded and truncated behind. Muscle impression hardly visible.

| | length | width | height | orifice length | |
|-----------|--------|-------|--------|----------------|--------------|
| (large) | 50 | 33 | 15 | 4 mm. | off Virginia |
| (average) | 40 | 28 | 16 | 3 | off Barbados |

Types. Holotype, United States National Museum, off Delaware Bay, *Fish Hawk*, 1881, station 1046 in 104 fathoms.

Remarks. This is one of the most beautiful species in the genus. It is quite different from the other Western Atlantic species and not closely related to any of our forms. It is very rare and has been found only in depths of 100 to 400 fathoms.

Range. From Delaware Bay south through the Greater and Lesser Antilles to Barbados.

Records. DELAWARE: off Delaware Bay, *Fish Hawk*, station 1046 (104 fathoms)

(Verrill 1883, p. 333). VIRGINIA: off Virginia (N. Lat. $37^{\circ}46'$; W. Long. $74^{\circ}10'$), *Atlantis*, station 3986 (106 fathoms) (MCZ); off Virginia, *Albatross*, station 2264 (167 fathoms) (Yale). GEORGIA: off Brunswick, *Atlantis*, station 3781 (265–290 fathoms) (MCZ). CUBA: off Sagua la Grande, Sta. Clara (N. Lat. $23^{\circ}21'30''$; W. Long. $79^{\circ}54'$), *Atlantis*, station 3446 (360 fathoms). LESSER ANTILLES: off Barbados, *Blake*, station 288 (399 fathoms) and *Hassler* (100 fathoms) (both MCZ).

* * * *

I add the following *Fissurella* omitted from my report in *Johnsonia*, no. 10. Additional study, particularly of *Diodora*, indicates that this species is a true *Fissurella*.

***Fissurella subrostrata* Sowerby, Plate 6, fig. 9–11**

Fissurella subrostrata "Gray" Sowerby 1835, Conch. Illust., *Fissurella*, pt. 73, fig. 35 [with name in explanation of plates and p. 6 of Catalogue of the species] (St. Vincents [Lesser Antilles]).

Description. Shell heavy, elevated, about 30 mm. in length, compressed and attenuated anteriorly and broadly rounded posteriorly. Both extremities raised, the anterior much more so, to such a degree that the front slope is almost parallel to the plane upon which the shell rests. Outline ovate. Anterior and lateral slopes straight; posterior, convex. Orifice situated on the anterior portion of the second third, elliptical in form, its length being about one-seventh that of the shell. Surface sculptured with about 26 strong, very widely separated radiating ribs; those situated anteriorly are less pronounced. The interspaces between the ribs have several striae. Laminae, which are low and rather separated, cross the shell forming small scales over the ribs. Ground color buff, the ribs being of a lighter shade, with several brown striae between the ribs. Margin crenulations rather widely spaced. Inside color polished cream. Internal callus of the orifice the same color as the rest of the inside. Muscle scar wide and deeply impressed, lying near the margin.

| length | width | height | orifice length | |
|--------|-------|--------|----------------|-------------|
| 30 | 24 | 13 | 4.5 mm. | West Indies |

Types. The type of *F. subrostrata* is in the British Museum, the type locality being St. Vincent, Lesser Antilles.

Remarks. This is an exceedingly rare species. It has been considered a *Diodora* but it has all the characteristics of a *Fissurella*. The internal callus of the orifice is the same width throughout, not truncated; the extremities of the shell are raised, a characteristic never present in the genus *Diodora*. *F. subrostrata* is related to *F. punctata* and *F. fascicularis* from which it differs by its elliptical orifice which is quite different from the cross-shaped orifice of the latter species. Its sculpture consists of rather widely separated ribs, while in that of the others, the ribs are close-set. Finally, although the ground color is buff, there is absent the more or less extensive red color found in *F. punctata* and *F. fascicularis*.

This species probably lives well below the low-water line. Nothing is known about its life history nor, for that matter, its habits. I have seen only one specimen and this agrees perfectly with the figure and description of Sowerby.

Range and Records. Known only from the type locality.