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LIOTIIDAE

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## THE GENUS *CYCLOSTREMA* IN THE WESTERN ATLANTIC

BY

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There are only three known recent species of *Cyclostrema* in the Western Atlantic, but they are among the most attractive of our small, rare mollusks. Although one species, *C. cancellatum*<sup>2</sup> Marryat, is infrequently washed ashore, most specimens are usually obtained only by dredging over rocky bottom in waters between ten and fifty fathoms in depth. Their relatively inaccessible habitat explains the rarity of these shells in collections. Recently, Cuban malacologists have been obtaining handsome examples from piles of dredged sand which have been brought into Habana. No living specimens of Western Atlantic species have been brought to our attention. It is not uncommon in members of the Liotiidae for the operculum to be retained in the aperture long after the death of the individual. We owe our knowledge of the opercular characters of the type species of *Cyclostrema* to such a specimen presented to the United States National Museum by Mr. Thomas L. McGinty. Nothing is known of the reproduction or habits of this genus, but in all likelihood its members are herbivorous, as is the case with most trochid-like marine gastropods.

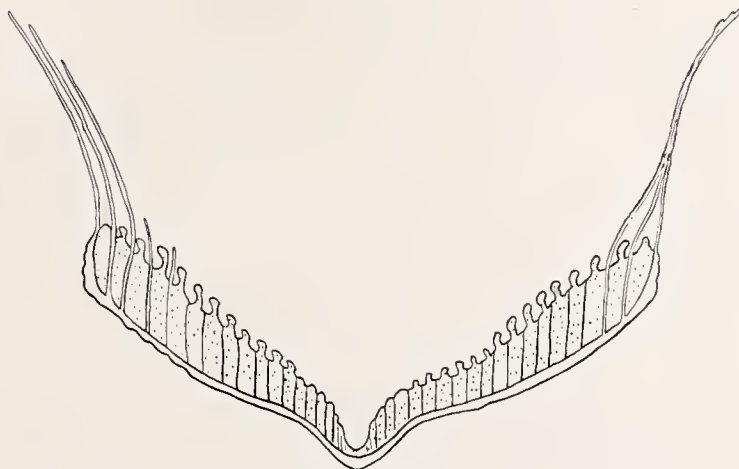


Plate 86. A cross-section diagram of the operculum of *Cyclostrema discoideum* Reeve (Philippines), showing the rows of beads and chitinous bristles (greatly enlarged).

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<sup>2</sup>Marryat was in error in treating *Cyclostrema* as of feminine gender, indicated by his spelling of *cancellata*. The Greek word "trema," meaning hole or aperture, is neuter in gender and should have had the associated specific name spelled *cancellatum*.

This genus is world-wide in distribution in tropical and semitropical seas. It is represented in the Indo-Pacific region by perhaps a dozen or more species, several of which are undescribed, and in New Zealand waters (as *Munditia* Finlay 1926) by nine species (Powell 1946). It appears that only one species exists in the Eastern Pacific which was described from Lower California by W. H. Dall (1918). We have included this species in this monograph to complete the American account. A species closely resembling our living forms has been described by Vidal (1921) from the Upper Cretaceous of Europe (Maestrichtien). Aguayo (Revista Soc. Malac., Cuba 6, no. 2, p. 59, pl. 1, figs. 7-8, 1948) has described *Cyclostrema cubanum* from Baire, Oriente, Cuba which he believes is from the Middle Oligocene.

The genus *Cyclostrema* is exceedingly close in generic characters to other Liotid genera, such as *Liotia* Gray 1847, *Liotina* P. Fischer 1885, *Dentarene* Iredale 1929, *Arene* H. and A. Adams 1854. Integration exists among such characters as degree of extension of the spire, prominence of peripheral nodules and spines and shape of umbilicus. There seems to be a fruitful field of investigation in the shape and relative size of calcareous beads found on the operculum, but these, also, after thorough study, may prove to be of rather nebulous generic value. At present, we feel it is wise to consider *Cyclostrema* and the other Liotids, such as *Liotia*, as distinct genera in order to maintain nomenclatorial simplicity and to avoid several confusing homonyms.

Young *Astraea* are likely to be confused with the more stellate forms of *Cyclostrema*, but the former may be distinguished by the nacreous interior of the aperture and absence of crowded, axial threads of opaque white material.

### Genus *Cyclostrema* Marryat

*Cyclostrema* Marryat 1818, Trans. Linn. Soc., London 12, p. 338, 2 figs.

*Cyclotrema* Gray 1840, Synoptical Contents British Museum, ed. 42, p. 148 [nude name, error for *Cyclostrema* Marryat].

*Pseudoliotina* Cossmann 1925, Essais de Paléoconch. Comp., pt. 13, p. 287 (as a section of *Eucycloscala* Cossmann) (Sectional type, *Liotia sensnyi* Vidal, original designation).

*Munditia* Finlay 1926, Trans. New Zealand Inst. 57, p. 363 (genotype, *Liotina tryphenensis* Powell, original designation).

Genotype, *Cyclostrema cancellata* Marryat, monotypic.

The shells of this genus are small, solid, planorboid in shape with flattened or slightly depressed spires; adults range in maximum diameter from 2 to 11 mm., are usually twice as wide as high, and are deeply and widely umbilicated. Whorls 2 to 4 in number. Nuclear whorl of  $\frac{1}{2}$  turn, glassy white, minutely creased with one or more fine spiral lines on the top surface. In fresh specimens, the old peristome of the last nuclear whorl flares, so that its remnant may be seen as a minute, raised scale projecting slightly over the beginning of the first postnuclear whorl. In adults, the spiral sculpturing consists of several moderately developed carinae. Axial sculpture either very weak or of quite strong ribs which often become nodular as they cross the spiral carinae. Frosted appearance over the outer shell is due to many, closely packed, axial, laminated threads. Peristome continuous, round internally, and often thickened externally into a heavy varix. Operculum multispiral, concave externally, with a chitinous base on the inside, and with many revolving rows of tiny, raised, calcareous beads on the external side. Often between the rows of beads, and always on the outer rim of the operculum, there are many

small, hair-like bristles forming a sparse or sometimes dense matting. The radula is rhipidoglossate<sup>1</sup> as shown from examination of specimens of *Cyclostrema discoidem* Reeve.

The identity and phylogenetic position of *Cyclostrema* have been in dispute since 1818, when Marryat first described the genus and its monotype, *C. cancellata*. The type specimen is apparently lost. Marryat had obtained a single specimen from "a collection of chiefly West Indian shells": and his illustrations of the type are not particularly good. A great number of species have been described under *Cyclostrema*, particularly from the Indo-Pacific region, which obviously belong to the Vitrinellidae. Iredale (1915), E. A. Smith (in Bush, 1897), Bush (1897), White (1942), and Pilsbry and McGinty (1945) have speculated on the identity of *C. cancellatum*. We are inclined to favor the view of the latter two authors that Kiener's *Delphinula cancellata* is the same as Marryat's species. There is little doubt in our mind that Dall's *Liotia (Lippistes) acrilla* is synonymous with *cancellata* of Kiener, and, in fact, is Marryat's long-lost species.

The original figures and description of *C. cancellatum* Marryat have been reproduced by Bush (1897) and Pilsbry and McGinty (1945). The latter authors have also reproduced the original figures of *Delphinula cancellata* Kiener.

Adding to the confusion have been two Indo-Pacific species which have been called *Cyclostrema cancellatum* and figured by Reeve, Sowerby and others. One of these was finally named *kieneri* by Philippi in 1853, the other named *pseudocancellata* by Bush in 1897. The former is a true *Cyclostrema*, the latter probably a *Pseudoliotia* Tate. A complete synonymy of these two species is appended at the end of this paper to clarify their rather unfortunate histories.

An attempt was made by K. M. White (1942) to define the genus *Cyclostrema* with an anatomical study of "*Cyclostrema*" *bushi* Dautzenberg and Fischer from India. The operculum is wholly chitinous and the radula taenioglossate.<sup>2</sup> These features exclude this species from the family Liotiidae. This species is close to *Pseudoliotia micans* A. Adams 1850 and *P. pseudocancellata* Bush 1897.

In connection with the close relationship of *Cyclostrema* to *Liotia* as shown by opercular characters, it may be pointed out that Gray's original description of the genotype species of *Liotia*, *Delphinula cancellata* Gray 1828, did not take note of the character of calcareous beads but merely described the operculum as "horny." Pilsbry (1934) has discussed this in detail and we have arrived independently at the same conclusion, after looking at Pilsbry's specimens of *L. cancellata* Gray, that Gray must have overlooked these calcareous beads. The operculum which Pilsbry figured (1934) is worn and, no doubt, had lost its chitinous bristles which are characteristically present in this family. Iredale's (1915) confusion arises from his belief that the operculum of *cancellata* Gray is wholly chitinous; this prompted him erroneously to consider *Pseudoliotia* Tate as a synonym of *Liotia* Gray.

Two additional Western Atlantic species may possibly be included in *Cyclostrema*, one being *Cyclostrema schrammii* Fischer 1857 from Guadeloupe Island, Lesser Antilles and *Cyclostrema canimarensis* Aguayo and Borro 1946 from the Upper Tertiary of Cuba. Neither quite meets the definition of *Cyclostrema* in that they have comparatively higher spires. They are both less than 1 mm. in maximum diameter. Reference has already been made to the nebulous characters of Liotid genera.

<sup>1</sup> Possessing a radula with numerous teeth in each transverse row.

<sup>2</sup> Possessing a radula with seven teeth in each transverse row.

The genus *Lippistes* Montfort 1810, a member of the Trichotropidae, was erroneously used by Dall in his original descriptions of *Cyclostrema*. We have examined Dall's type of *Lippistes? planorbis* (Proc. USNM 70, no. 2667, p. 131, 1927), and find that it does not belong to the genus *Cyclostrema*, but in all likelihood belongs to the Vitrinellidae.

### *Cyclostrema cancellatum* Marryat, Plate 87, figs. 1-3

*Cyclostrema cancellata* Marryat 1818, Trans. Linnean Soc., London 12, p. 338, pl. 10, figs. 3, 4 (West Indies).

*Delphinula cancellata* Kiener 1839, Icon. Coquilles Vivantes 10, Genre Delphinula, no. 7, p. 10, pl. 4, fig. 10 (Mers de l'Inde) (*non Delphinula cancellata* Gray 1828).

*Liotia (Lippistes) acrilla* Dall 1889, Bull. Mus. Comp. Zoöl. 18, p. 391, pl. 32, fig. 6, 11 (Garden Key, Tortugas, Florida).

*Cyclostrema cancellata* Marryat, Pilsbry and McGinty 1945, Nautilus 59, p. 52, pl. 6, figs. 10-11.

*Description.* Adult shell large for the genus, maximum diameter 12 mm., planorboid, widely and deeply umbilicate. Axial sculpture consists of 15 to 17 strong, rounded cords which encircle the entire whorl. Each cord becomes swollen or nodulose at the point of intersection with each of the 12 spiral, much smaller, rounded cords. The fourth, fifth and sixth spiral cords are almost as large as the axial cords and are situated respectively at the top, middle and bottom of the periphery of the whorl. Within the umbilicus, the axial cords narrow down and line up into a strongly serrated, rather prominent umbilical, spiral cord. Peristome circular, moderately thickened and bearing the slightly nodulate ends of the axial cords. In fresh material, the entire outer surface of the shell is covered with fine, axial striae or "frosting." Operculum circular, concave from the outside, with a chitinous base on the inner surface and on the outer surface with about 20 multispiral rows of rather widely-spaced calcareous, round beads.

	height	max. diam.	min. diam.	
	2.1	4.2	3.5 mm.	Holotype USNM 61095
(large)	5.9	11.4	9.0	Florida
(average)	2.9	6.0	5.1	Off Lake Worth, Florida

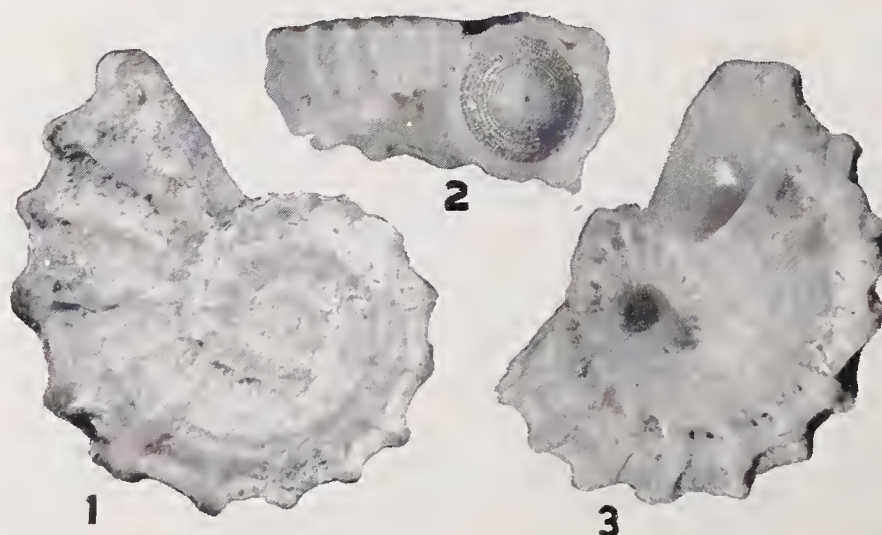


Plate 87. Figs. 1 and 3. *Cyclostrema cancellatum* Marryat, off Fowey Light, Florida. Fig. 2. Off Lake Worth, Florida (all 6x).

*Types.* Marryat's type "from the West Indies" is not in the British Museum according to W. J. Rees in a letter of September 1949. Most workers believe the type specimen is lost. The holotype of *aerillum* Dall is in USNM no. 61095. We hereby designate it as the neoholotype of *C. cancellatum* Marryat. Dall's type is from Garden Key, Tortugas, Florida, C. T. Simpson, leg. 1888. We hereby restrict the type locality to Garden Key.

*Common name.* Cancellate Cyclostreme.

*Remarks.* This is the largest member of *Cyclostrema* in the Western Atlantic. Although an inhabitant of moderately deep water where the bottom is rocky, beach-drift specimens have been collected on several occasions in Florida, Jamaica and the Bahamas. From the *Blake* and *Eolis* dredging records, it would appear that this species lives in waters ranging from 6 to 100 fathoms in depth. It has not been taken alive, although Mr. T. L. McGinty has dredged a specimen from off Lake Worth, Florida with the operculum still in place.

Pilsbry and McGinty (1945) have remarked on the similarity of the figures of Marryat and Kiener. An even closer comparison can be made between Dall's figure 6 (1889) and that of Marryat's type; so much so that we feel confident that future workers will agree that Marryat's species has been re-discovered.

For comparison with other species, see the key on p. 200.

*Range.* Off Lake Worth, Florida, south through the Bahamas to Cuba and Jamaica.

*Records.* FLORIDA: Off Pompano Beach; off Carysfort Light, Key Largo in 117 fms. (both L. Burry, MCZ); Miami, 18-25 fms.; off Fowey Light, 6 fms.; Garden Key, Tortugas; off Key West, 55 fms. (all USNM.); off Lake Worth, Florida, 50 fms., rocky bottom (T. McGinty). BAHAMAS: Rock Point, N.E. end of Crooked Island (USNM); north coast of New Providence Id., 2 fms. (J. Schwengel); Little San Salvadore Id., Cat Island (MCZ). CUBA: off Habana, 15 fms. (Museo Poey and MCZ); off Bahía Honda, 1-12 fms. (USNM). JAMAICA: Jack's Bay, St. Mary, Jamaica (USNM).

### *Cyclostrema amabile* Dall, Plate 88, fig. 4-6

*Liotia* (*Lippistes*) *amabilis* Dall 1889, Bull. Mus. Comp. Zoöl. **18**, p. 392, pl. 32, figs. 9, 12 (off Habana).

*Description.* Adult shell strong, planorboid, white, with a maximum diameter of 6 mm., widely and deeply umbilicate. Axial sculpture weak, with 9 to 10 indistinct cords. Spiral sculpture of about 14 small threads which are more distinct on the underside of the shell. The top and bottom of the periphery of the shell bear 9 to 11 rather large, rounded, fimbriated tubercles. In some specimens, including the holotype, there are axial, slightly amalgamated, rows of 4 large tubercles. The tubercles are swollen at their distal end and often pointing backwards towards the apex of the shell. Peristome circular, greatly thickened externally by a heavy, rounded varix which is finely laminated on its surface and crenulated on its posterior margin. The "frosted" axial sculpture is very prominent. Operculum unknown.

height	max. diam.	min. diam.	
2.0	5.0	3.8 mm.	Holotype, USNM 95046
2.5	5.5	4.3	Barbados, USNM 500306

*Types.* Holotype, United States National Museum no. 95046, *Blake*, station 62, off Habana, Cuba in 80 fathoms.

*Records.* CUBA: Blake, station 62, off Habana in 80 fathoms. PUERTO RICO: off Punta Salinas in 80–120 fathoms. LESSER ANTILLES: off Needham Point, Barbados in 25–40 fathoms; off Telegraph Station, Barbados in 30–70 fathoms (all USNM).

*Remarks.* This is a rather uncommonly collected species which, like other members of this genus, seems to prefer moderately deep water where the bottom is rocky. *C. amabile* is probably the rarest species of *Cyclostrema* in the Western Atlantic, and certainly the most attractive in appearance.

### *Cyclostrema tortuganum* Dall, Plate 88, figs. 1–3

*Liota* (*Lippistes*) *tortugana* Dall 1927, Proc. U.S. Nat. Mus. 70, no. 2668, p. 3.

*Description.* Shell strong, white, planorboid in shape, with a maximum diameter of 5.5 mm. ( $\frac{1}{4}$  inch), widely and deeply umbilicate. Number of whorls 3. Spire flat with slightly depressed apex and with slightly rounded whorls. Periphery of shell squarish. Axial sculpture in earlier whorls consists of closely spaced, rather sharp, raised ribs which are more developed on the periphery of the whorl than on the top of the whorls. These ribs become obsolete on the last half of the last whorl. Spiral sculpture consists of 3 strong cords on the periphery of the whorls. Wherever they cross one of the axial ribs, a large rounded tubercle is produced. The center cord on the middle of the periphery becomes obsolete, or nearly so in the last whorl. Umbilicus widely open, very deep, and bearing fine, sharp, axial ribs which are especially well-developed in the earlier whorls. There is a weak, crenulated, spiral cord running into the umbilicus. Interior of aperture circular, opaque white. Peristome round with the peripheral edges at the top and bottom produced into a tubercle. Suture well-indented, partially obscured by the tubercle of the former whorls. These tubercles are often hollowed out on their anterior surface. The en-

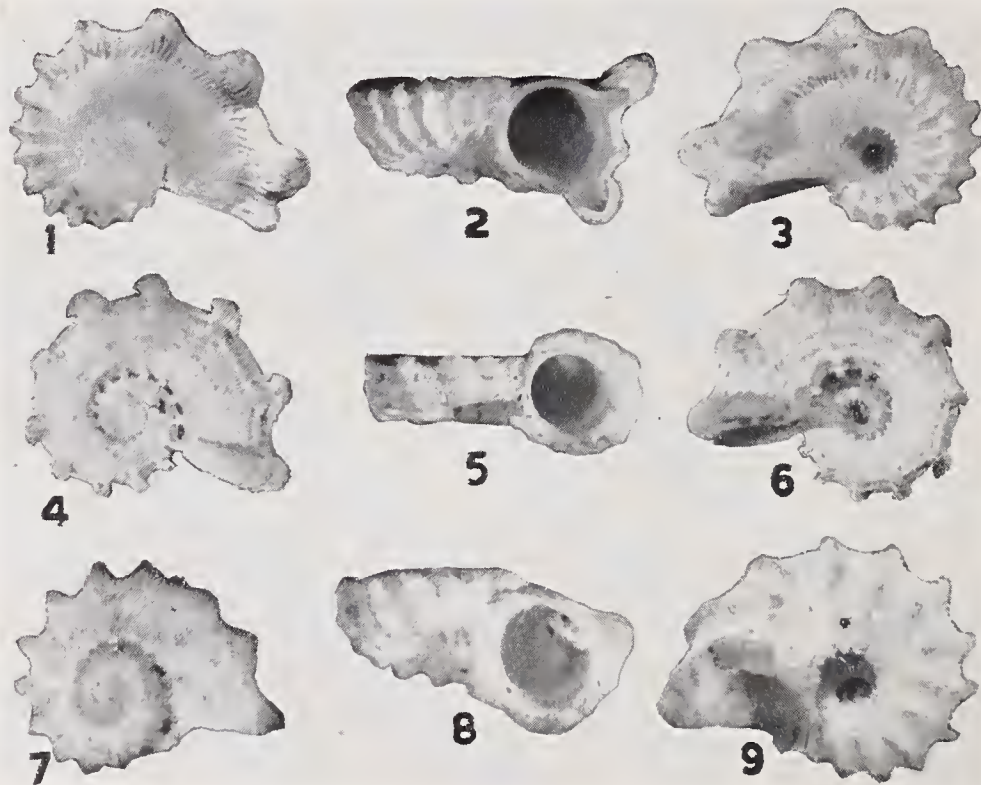


Plate 88. Figs. 1–3. *Cyclostrema tortuganum* Dall, holotype, off Tortugas, Florida (6x). Figs. 4–6. *Cyclostrema amabile* Dall, holotype, off Habana, Cuba (6x). Figs. 7–9. *Cyclostrema cookeanum* Dall, holotype, off South Coronado Island, Lower California (10x).

tire exterior shell is covered with minute, axial, crowded threads which give a "frosted" appearance. Operculum and animal unknown.

height	max. diam.	min. diam.	
2.5	5.0	4.0 mm.	Holotype
2.9	5.5	4.5	Paratype
4.0	10.0	7.0	off Boynton Beach, Florida

*Types.* Holotype in the United States National Museum no. 333708 from off Tortugas, Florida, 16 fathoms, *Eolis*, station 33, 1911. Paratype in the USNM no. 333709 from off Government Cut, Miami, Florida, 35 fathoms, *Eolis*, station no. 141, 1914.

*Remarks.* This is a very distinct species, even though the only three specimens which have been collected do not appear to be quite adult. It is surprising that it has not been collected more often since 1914, considering the extensive dredging activities in Florida by such ardent collectors as the McGintys, Lyman and Burry. This is the first time this species has been figured.

*Range.* Off Palm Beach and south to Tortugas, Florida.

*Records.* FLORIDA: off Palm Beach (J. Schwengel); off Boynton Beach (F. Lyman, ANSP); *Eolis*, station 33, off Tortugas in 16 fathoms; *Eolis*, station 141, off Miami in 35 fathoms (both USNM).

#### EASTERN PACIFIC *CYCLOSTREMA*

Since only one species appears to be present in the Eastern Pacific, and since it has been inadvisably synonymized recently, we are including a full treatment of *Cyclostrema cookeanum* Dall.

#### *Cyclostrema cookeanum* Dall, Plate 88, figs. 7-9

*Liotia (Arene) cookeana* Dall 1918, Proc. Biol. Soc. Washington 31, p. 8.

*Liotia (Arene) cookeana* Dall, Oldroyd 1927, Stanford Univ. Publ., Univ. Geol. Ser. Sci. 2, pt. 3, p. 171, pl. 91, figs. 12, 13, 13a.

*Liotia fenestrata* Carpenter, Strong 1934, Trans. San Diego Soc. Nat. Hist. 7, no. 37, p. 435, pl. 28, figs. 10-12 (in part).

*Description.* Adult shell 3 mm. in maximum diameter, solid, white, planorboid in shape, deeply and rather widely umbilicate. Number of whorls  $2\frac{1}{2}$ . Apex and top of whorls flattened, the last whorl slightly descending. Interior of aperture circular. Outer peristome quadrate in shape. Columella swollen at the base by a strong tubercle. Axial sculpture consists of 14 axial ribs which are strong on the base and sides of the whorls but absent on the top of the whorls. These ribs are made nodulose where the faint spiral cords cross them. The top row of tubercles is large and pointed and gives the shell a stellate appearance. The entire shell is covered with numerous, fine, opaque axial threads which lend a "frosted" appearance. Suture well-indented and slightly crenulate. The center of the whorls in the umbilicus bears a single revolving row of strong, sharp erenulations.

height	max. diam.	min. diam.	
1.4	3	2.3 mm.	Holotype

*Types.* Holotype, USNM no. 223290 from off South Coronado Island, Lower California, 7-10 fathoms, Fred Baker, collector.

*Remarks.* This appears to be the only true *Cyclostrema* in the Eastern Pacific. It is easily confused with the young of *Liotia fenestrata* Carpenter, especially when viewed

from the underside. However, the flat spire, the absence of square pits, the absence of any spiral sculpture on the top side of the whorls, the strong crenulated revolving line in the umbilicus, and the straighter columella will readily separate this *Cyclostrema* from *Liotia fenestrata* Carpenter.

*Range and Records.* Known only from the type locality.

#### Key to the American *Cyclostrema*

Base of periphery with a strong spiral cord	
Axial cords on top of last $\frac{1}{2}$ whorl	<i>cancellatum</i> p. 196
Axial cords absent from top of last $\frac{1}{2}$ whorl	<i>tortuganum</i> p. 198
Base of periphery without a strong spiral cord	
Peristome circular	<i>amabile</i> p. 197
Peristome not circular	<i>cookeanum</i> p. 199

#### Notes

The following synonymies concern two species of Indo-Pacific mollusks which have been involved with the name "*Cyclostrema cancellata*." The first, *C. kieneri* Philippi, is a true *Cyclostrema*, and from Reeve's original figure, appears to be very similar to the Western Atlantic species, *C. cancellatum* Marryat. The second, *Pseudoliotia pseudocancellata* Bush, is a very small, non-Liotid mollusk which closely resembles *P. micans* A. Adams, which is the type of *Pseudoliotia* Tate.

#### *Cyclostrema kieneri* Philippi

*Delphinula cancellata* Kiener, Reeve 1843, *Conchologia Iconica* **1**, Genus *Delphinula*, sp. 25, pl. 5, figs. 25 a-b. (Sibonga, Island of Zebu, Philippines) (*non* Gray 1828, *non* Kiener 1839, *non* Klipstein 1845).

*Delphinula kieneri* Philippi 1853, *Conchylien-Cabinet* **2**, no. 4, p. 22, pl. 5, fig. 19 (in part, by reference to Reeve 1843, sp. 25, and a copy of Reeve's figure and type locality).

#### ? *Pseudoliotia pseudocancellata* Bush

*Cyclostrema cancellata* Marryat, A. Adams 1850, *Proc. Zool. Soc. London* for 1850, p. 41 (Baszay = Basey, Island of Samar).

*Cyclostrema cancellata* Marryat, H. and A. Adams 1854, *Genera Recent Mollusca* **1**, p. 405, pl. 45, fig. 6a.

*Cyclostrema cancellata* Marryat, A. Adams 1863, *Thesaurus Conchyl.* **3**, pt. 22, p. 249, pl. 255, figs. 5 and 6.

*Cyclostrema cancellata* Marryat, Sowerby 1874, *Conchologia Iconica* **19**, pl. 1, figs. 6a-6b, sp. 6.

*Cyclostrema cancellata* Marryat, Pilsbry 1888, *Manual Conch.* (1) **10**, p. 89, pl. 31, figs. 27-28.

*Cyclostrema pseudocancellata* Bush 1897, *Trans. Connecticut Academy* **10**, p. 98.

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