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EPITONIIDAE

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THE GENERA *STHENORYTIS*, *CIRSOTREMA*, *ACIRSA*, *OPALIA* AND *AMAEA* IN THE WESTERN ATLANTIC

BY

WILLIAM J. CLENCH AND RUTH D. TURNER

Representatives of the family Epitoniidae are to be found in nearly all seas, from the Arctic to the Antarctic. In general, individual specimens of any one species appear to be rather rare and colonies are seldom found.

Little is known regarding the life histories of species within this family. Many species are to be found in the lower portions of the intertidal zone. They occur mainly, however, in deeper water and certain species are known only from profound depths. One of



Plate 96. *Amaea retifera* Dall

From off Sombrero Light, Marathon, Florida.
Enlarged to show sculpture (15x).

the deepest known records is that of *Epitonium polygyrella* Locard which was obtained from a depth of 2326 fathoms¹ between the Azores and Europe by the *Talisman* in 1883.

Many species produce a purple dye, perhaps all do. This may be similar to that secreted by species of *Thais* and *Purpura* and may possibly be an anesthetizing agent used to immobilize their prey. In shell structure this group probably exhibits some of the most outstanding sculptural features among the gastropods. The coil of the shell may be tightly wound and "attached" or open and "free coiled" so that only the axial blades impinge on the whorl above and below. This latter character thus provides for structural strength which would be entirely lacking in an absolutely free or unattached coil. It is quite astonishing that the sculptural characters in this family are based mainly upon the elaboration of the simple axial blade. These blades may be single, thin and erect or grouped, recurved or wavy. In others, the blades may be flattened and ridged or they may exist as rounded costae. The most elaborate sculpture is developed in the genus *Cirsotrema* (see Plate 98, figs. 1-3). Here the axial blades are grouped as exfoliated costae which, in addition, are wavy, the corresponding waves or crests in parallel costae touching one another. The hollows are thus left as pits between the costae. This develops two outer surfaces to the shell, the tops of the closely packed costae and the true surface of the shell which is at the base of the pits. When both the axial and spiral sculpture are more or less equal in development and more densely packed, the pits are more evenly spaced and are even formed in linear arrangement as that occurring in certain species of *Opalia* (see *O. burryi*, Plate 102, fig. 3). In addition, there may be spiral sculpture consisting of incised thread-like lines or definite low ridges or even blade-like structures. However, with few exceptions, the axial sculpture is usually the more highly developed.

Many species and genera possess a basal ridge, usually subperipheral, which is seen only on the body whorl. The sculpture changes below this ridge, generally being much less developed on the base of the shell (see Plate 106, fig. 1). In many species there is no basal ridge produced and as a consequence the body whorl sculpture is more or less uniform throughout.

In all species we have seen, the nuclear whorls are smooth and generally amber brown in color. Many species exhibit one or more varices, some are very pronounced but in others they exist only as slightly thickened blades or ridges.

The opercula are chitinous, thin, usually dark brown in color and circular to subcircular in shape. In general, the subcircular forms have fewer whorls than those that are circular. The few species we have seen with opercula show a transition from a paucispiral operculum in *Opalia* to a submultispiral operculum in *Sthenorytis*. The surface of the operculum is roughened by growth lines and in the case of *Opalia pumilio* Mörch, the surface is very minutely-beaded. See Plate 107, figs. 1-4.

The eggs of Epitoniidae are produced in strings, similar to a string of beads. Each egg is encased in a capsule composed of agglutinated sand grains and the shape of these egg cases appears to be different in the very few species in which the egg laying process has been observed. The difference in shape, however, may be due to the various kinds of sand grains used and the different angles at which they are cemented. The egg string and veliger of *Epitonium turtonis* Turton, a European species, has been observed and

¹ 4255 meters; 13,956 feet, or a little over two and one-half miles.

figured by Gunnar Thorson¹. We have been fortunate in obtaining the loan of a string of egg capsules and the specimen which produced them from Dr. Jeanne Schwengel. These will be figured when the species is considered in the number to follow.

The fossil history of this family is rather extensive, dating from the Triassic at the beginning of the Mesozoic. It reached its greatest development during the Tertiary, particularly in the Eocene and Miocene Periods when many of the recent genera and subgenera first appeared. To judge by the number of living species existing today, the family is still an exceedingly vigorous one. The range of many different species in all seas as well as the great range in depth shows a remarkable adaptability equalled by but few families among the gastropods.

The standard monographs, such as Sowerby, Reeve and Tryon have done little for this family other than describe briefly and figure the species known to exist at the time they were published.

O. E. Mörch, a Danish scientist, developed a considerable interest in this family. He described many Western Atlantic species, several unfortunately with inadequate descriptions and no figures. E. de Boury, a French engineer, became interested in this family as a hobby and devoted much time to its study. Unfortunately much of his published work was only preliminary. That is, from time to time, he published exceedingly brief accounts of subgenera and new species, with the idea that the details would be covered in subsequent monographs. Only two such completed studies ever appeared.

Wenz² has given an excellent detailed outline of this family. His classification extends to the subgenus and includes both recent and fossil groups with an illustration for each, generally the genotype or subgenotype. His use of many of the names, generally those of de Boury, are not always in agreement with those of other workers and the relationships of many of the genera and subgenera in his outline are open to question. This work is, however, the most complete and extensive that has appeared and it is the only work that has attempted to bring together, in some semblance of order, the long series of generic and subgeneric names that have been proposed in this family.

The study of this family has been exceedingly difficult for two reasons. In the first place, few species are at all clear cut; they have a tendency to merge into one another. The several species that show this type of relationship are not necessarily related *inter se*, but perhaps are only convergent in their characters. The extremes of two species may be very well defined but both may possess within their range of variation a similar pattern, particularly when this pattern is based upon the modification of axial blades and other sculptural details. The second difficulty has been the complex nomenclatorial tangle, not only concerning many specific names, but particularly regarding groups of generic and subgeneric rank. As stated above, de Boury has left behind a long list of generic and subgeneric names with only the type designations to give them standing. Even when the type species can be examined it is not always possible to decide what de Boury had in mind or why he considered the species to represent a higher category. It would seem that de Boury, perhaps becoming confused by the overlapping characters of the many

¹Thorson, Gunnar 1946, Reproduction and Larval Development of Danish Marine Bottom Invertebrates. Medd. Fra Kommissionen for Danmarks Fiskeri- og Havundersogelser, Series: Plankton 4, no. 1, p. 194.

²W. Wenz 1940, in Schindewolf, Handbuch der Paläozoologie 6, Gastropoda Teil 4, Prosobranchia, pp. 787-815.

species, found it much easier to create new categories than decide which established genera or subgenera were adequate for their inclusion. It must be realized that many of the species selected as types for his genera and subgenera are themselves questionable. There has been, however, a conscientious endeavor on the part of contemporary and subsequent workers to utilize these names of de Boury but unfortunately in many cases different interpretations have been placed upon them.

ACKNOWLEDGMENTS

We are deeply indebted to several institutions and many individuals for the loan of specimens in this family. The records in this report as well as in the number which is to follow, completing the monograph of the family, attest to how much we have used this material in our studies. All records are based only on material that we have seen and studied.

Genus *Sthenorytis* Conrad

Sthenorytis Conrad 1862, Proc. Acad. Natural Sciences, Philadelphia, p. 565.

Pseudosthenorytis Sacco 1891 [in] Bellardi and Sacco, Molluschi dei Terreni Terziarii del Piemonte e della Liguria Part 9, p. 43 (subgenotype, *Cirsotrema stenorytoides* Sacco, monotypic).

Stenorhyscala de Boury 1912, Nouv. Arch. Mus. Hist. Nat., Paris (5) 4, p. 227 [emendation for *Sthenorytis* Conrad].

Stenorhytis Cossmann 1912, Essais Paleonconch. Comp. 9, p. 44 [emendation for *Sthenorytis* Conrad]; de Boury 1912, Nouv. Arch. Mus. Hist. Nat. Paris (5) 4, p. 227.

Pseudostenorhytis Cossmann 1912, Essais Paleonconch. Comp. p. 49 (error for *Pseudosthenorytis* Sacco 1891).

Stenorhytis de Boury 1912, Nouv. Arch. Mus. Hist. Nat., Paris (5) 4, p. 227 [emendation for *Sthenorytis* Conrad].

Genotype, *Scalaria expansa* Conrad, subsequent designation, de Boury, 1889.

Shell solid, imperforate, strongly costate axially and with or without spiral striae. Axial costae may occur as broad and somewhat flattened ridges or elevated and blade-like. Aperture circular. The face of the aperture is not parallel to the axis but is offset at an angle generally of about 40°. Operculum corneous, circular, and with 5-6 whorls.

De Boury in a very able report (1912, pp. 209-266) has monographed the species both fossil and recent in this genus. Various species of *Sthenorytis* have existed since the Eocene, the greatest specific development occurring during Miocene times. Recent species are few and are known from the West Indies, the west coast of Central and South America and the Galápagos Islands.

Sthenorytis pernobilis Fischer and Bernardi, Plate 97, figs. 1-7; Plate 107, fig. 1

Scalaria pernobilis Fischer and Bernardi 1857, Journal de Conchyliologie 5, p. 293, pl. 8, figs. 2-3 (Marie Galente, Lesser Antilles).

Scala (*Sthenorytis*) *belaurita* Dall 1889, Bull. Museum of Comparative Zoölogy 18, pt. 2, p. 316, pl. 18, fig. 11b (*Blake*, station 290, from off Barbados, Lesser Antilles, in 73 fathoms).

Sthenorytis cubana Bartsch 1940, Memorias de la Sociedad Cubana de Historia Natural 14, no. 4, p. 264, pl. 47, fig. 1 (*Blake*, station 2, off Morro Light, Cuba, in 805 fathoms); *non* de Boury 1912.

Sthenorytis hendersoni Bartsch 1940, Memorias de la Sociedad Cubana de Historia Natural 14, no. 4, p. 264, pl. 47, fig. 2 (*Eolis*, station 330, off Sambo Reef [Lower Keys] Florida, in 120 fathoms).

Sthenorytis epae Bartsch 1940, Memorias de la Sociedad Cubana de Historia Natural 14, no. 4, p. 265, pl. 47, fig. 4 (*Albatross*, station 2601, about 36 miles off Cape Hatteras, North Carolina, N. Lat. 34°39'15"; W. Long. 75°33'30", in 107 fathoms).

Description. Shell reaching about 40 mm. ($1\frac{1}{2}$ inches) in length, solid, imperforate, and strongly costate. Whorls about 10, rapidly increasing in size and strongly convex. Color generally white to light gray. Suture recessed between the costae as the whorls are partially free and visibly attached only by the costae. Aperture circular and holostomatous. Columella not defined. Outer lip greatly reflected, each successive lip becoming a costa. Axial sculpture consisting of numerous, heavy, blade-like costae which are thickened at their bases and taper to a rather thin and backwardly reflected outer margin. There are twelve costae on the body whorl which become flattened at the parietal area. Spiral sculpture consisting of rather indistinct flattened ridges which are defined by very fine incised lines visible only between the costae. These may or may not be present even on different portions of the same specimen. In young specimens there is a well developed basal ridge which gradually disappears as the shell reaches maturity. Nuclear whorls two, exceedingly small and smooth. Operculum chitinous, circular and consisting of 5–6 whorls with an approximately central nucleus.

length	width	aperture	
41.5	30.5	12.5x11.5 mm.	off Cape Hatteras, N.C. (Holotype of <i>epae</i> B.)
32.5	22.5	9x8.5	off Sambo Reef, Florida (Holotype of <i>hendersoni</i> Bartsch)
36	26.5	11x10.6	off Great Isaac, Bimini Islands, Bahamas

Types. The holotype of *S. pernobilis* Fischer and Bernardi is probably in the Paris Museum; the type locality being Marie Galante, Lesser Antilles. The following holotype specimens are all in the United States National Museum: *S. belaurita* Dall, no. 106917, *Blake*, station 290, off Barbados, Lesser Antilles in 73 fathoms; *S. cubana*

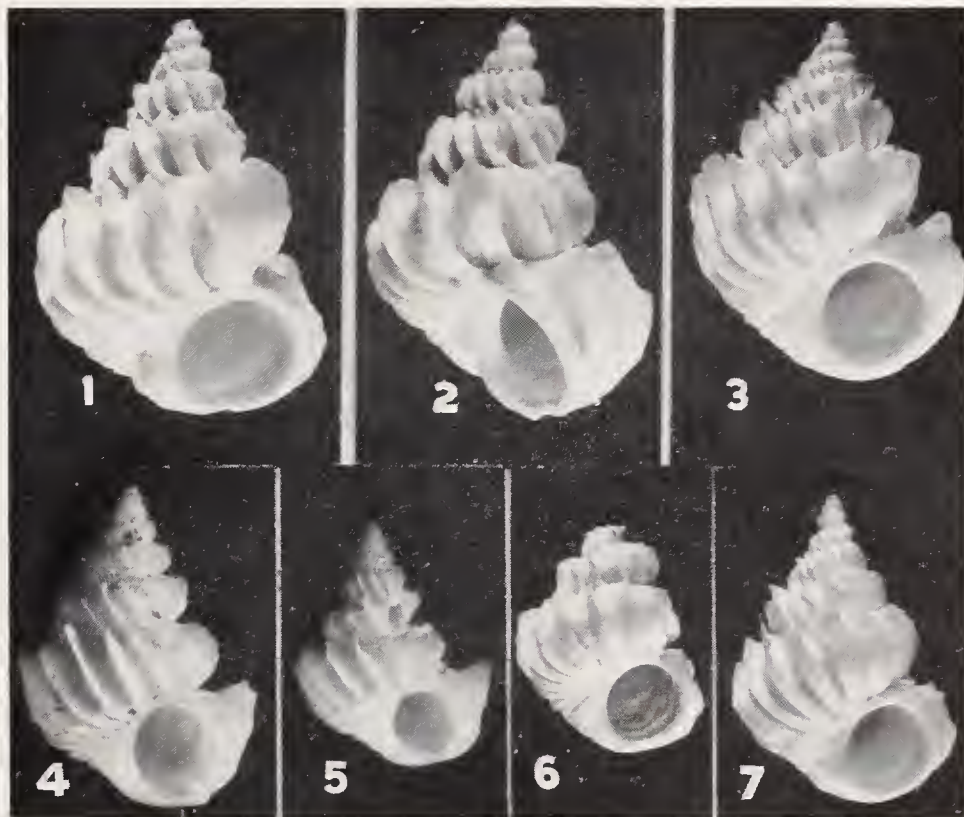


Plate 97. *Sthenorytis pernobilis* Fischer and Bernardi

Figs. 1–2. *Sthenorytis epae* Bartsch, holotype. Fig. 3. From off the Barbados. Fig. 4. From off Hillsboro Light, Florida. Fig. 5. *Sthenorytis belaurita* Dall, holotype. Fig. 6. *Sthenorytis cubana* Bartsch, holotype. Fig. 7. *Sthenorytis hendersoni* Bartsch, holotype (all natural size except figs. 4 and 5 which are 3x).

Bartsch, no. 126825, *Blake*, station 2, off Morro Light, Habana, Cuba, in 805 fathoms; *S. epae* Bartsch, no. 83724, *Albatross*, station 2601, 36 miles off Cape Hatteras, North Carolina in 107 fathoms; *S. hendersoni* Bartsch, no. 417101, *Eolis*, station 330, off Sambo Reef, Lower Keys, Florida, in 120 fathoms.

Remarks. We have examined personally all of the type specimens of Dall and Bartsch for the names listed in the synonymy above. It has been utterly impossible to separate any of these from *S. pernobilis* Fisher and Bernardi. The characters separating these species mentioned by Bartsch are to be found to a greater or lesser degree on all specimens regardless of names. The development of the angle on the costae at the shoulder of the whorl is very variable, some costae being well rounded while others are rather sharply angled. The incised spiral lines are also variable. They are present, though often exceedingly fine, on all specimens examined except on the early post-embryonic whorls. The type specimen of *S. belaurita* Dall in our opinion is only a young specimen of *S. pernobilis* Fisher and Bernardi.

Known specimens of this rather noble species are still very rare. They have been recorded in depths ranging from 73 to 805 fathoms, the latter depth record being based upon a dead and broken specimen from off Habana, Cuba, which may well have been adventitious at this locality. All other depth records fall between 73 and 155 fathoms.

Range. From North Carolina south through the Lesser Antilles.

Records. NORTH CAROLINA: *Albatross*, station 2601, about 36 miles off Cape Hatteras (N. Lat. $34^{\circ}39'15''$; W. Long. $75^{\circ}33'30''$) in 107 fathoms. FLORIDA: off Key West in 85 fathoms; off Sambo Reef in 120 fathoms; off Western Dry Rocks in 144 fathoms; off Sand Key in 110 fathoms (all USNM); $4\frac{1}{2}$ miles off Hillsboro Light in 80 fathoms; off American Shoals in 60–80 fathoms (fragment) (both L. A. Burry). BAHAMAS: *Atlantis*, station 2951, off Great Isaacs, Bimini Islands (N. Lat. $26^{\circ}08'$; W. Long. $79^{\circ}02'$) in 155 fathoms (MCZ). CUBA: *Blake*, station 2, off Morro Light, Habana in 805 fathoms (USNM). LESSER ANTILLES: *Blake*, station 290, off Barbados in 73 fathoms (USNM).

Genus *Cirsotrema* Mörch

Cirsotrema Mörch 1852, *Catalogus Conchyliorum Comes de Yoldi* p. 49.

Caloscala Tate 1885, *Southern Science Record* **2**, p. 3. [We have not seen this paper.]

Cirsostrema 'Mörch' Conrad 1865, *American Journal of Conchology* **1**, p. 211 [error for *Cirsotrema* Mörch].

Cirostrema 'Mörch' Dall 1907, *Nautilus* **22**, p. 128 [error for *Cirsotrema* Mörch].

Cirsotremopsis Thiele 1928, *Zeitschrift für Wissenschaftliche Zoologie* **132**, p. 92 (genotype, *Scalaria cochlea* Sowerby, monotypic).

Genotype, *Scalaria varicosa* Lamarck 1822, monotypic.

Shells white to gray with very elaborate sculpture consisting of fine spiral striae crossed by axial costae which are generally laminated. All possess a basal ridge.

The sculpture on the species composing the genus *Cirsotrema* is exceedingly complicated. Actually two surfaces may be involved, the regular shell surface and a secondary surface which is produced by the laminated costae. These costae may be erect, laminated and expanded on their outer margins. Occasionally the expanded edges of the opposing costae meet, leaving only small openings through which the regular shell surface can be seen. The greatest development of this character is expressed by *Cirsotrema dalli* Rehder. In other species these foliated costae do not meet so that a complete secondary shell

surface is not produced. However, it is almost necessary to have live material for a proper understanding of the several species involved in this genus. Beach-rolled shells have generally lost much of the delicate sculpture, a character upon which all of the species have been defined.

Cirsotrema pilsbryi McGinty, Plate 98, fig. 2

Epitomium (Cirsotrema) pilsbryi McGinty 1940, *Nautilus* **54**, p. 62, pl. 3, fig. 13 (off Palm Beach, Florida in 75 fathoms).

Description. Shell reaching 17 mm. (about $\frac{3}{4}$ inch) in length, attenuated, imperforate and elaborately sculptured. Whorls $8\frac{1}{2}$ to 9, strongly convex, slightly shouldered and joined. Color a uniform chalky grayish-white. Suture deep and not readily seen as it is covered by the sculpture. Aperture subcircular. Lip margined by a well-thickened varix. Columella short and arched. Axial sculpture consisting of numerous elevated blade-like structures which are grouped to form sinuous costae. These occasionally touch one another leaving openings to the shell surface below. These costae are nearly uniform in height with only a slight indication of a ridge above at the whorl shoulder. Below, the costae thicken somewhat and are slightly elevated to form a basal ridge. Operculum corneous, subcircular and paucispiral.

length	width	
19.2	7.1 mm.	Holotype
16.8	7	Paratype
16.5	7	off Hillsboro Light, Florida

Types. Holotype, Academy of Natural Sciences Philadelphia no. 176448¹, rocky reef, off Palm Beach, Florida in 75 fathoms.

Range. Southeastern Florida.

Records. FLORIDA: off Palm Beach in 50 to 75 fathoms; off Lake Worth in 90 to 100 fathoms (both ANSP and T. McGinty); off Hillsboro Light in 40 to 85 fathoms; off Sombrero Light in 90 to 100 fathoms (both L. A. Burry).

Remarks. See under *C. dalli*.

Cirsotrema dalli Rehder, Plate 98, figs. 1, 3; Plate 107, fig. 2

Scalaria (Cirsotrema) joubini deBoury 1911, *Revista Chilena de Historia Natural* **15**, p. 34 [nude name] (Rio de Janeiro, Brasil).

Cirsotrema (Cirsotremopsis) dalli Rehder 1945, *Proc. Biological Society Washington* **58**, p. 128 (Gulf of Mexico, off Cape San Blas, Florida, in 25 fathoms).

Cirsotrema (Cirsotremopsis) arcella Rehder 1945, *Proc. Biological Society Washington* **58**, p. 128 (36 miles S.W. of Cape Hatteras, North Carolina, in 124 fathoms).

Description. Shell reaching 41 mm. (about $1\frac{1}{2}$ inches) in length, attenuated, imperforate and elaborately sculptured. Whorls 9–10, strongly convex, strongly shouldered and joined. Color a uniform chalky grayish-white. Suture deep and not readily seen as it is covered by the sculpture. Aperture subcircular. Lip margined by a well-thickened varix. Columella short and arched. Axial sculpture consisting of numerous elevated

¹The holotype specimen has a catalogue number of 178622 and not the number given above from the published record.

blade-like structures which are grouped to form foliated costae. The costae are sinuous with the waves alternating so that each succeeding costa touches the one behind in places, leaving small holes which lead to the shell surface below. On the upper portion of the whorl the costae are higher and terminate in a ridge behind which there is a depression forming a canal. Here the costae are narrower and smaller leaving rather wide gaps between them. The surface of the shell below is finely and evenly reticulated. On the lower portion of the whorl the costae are reduced and are somewhat thinner, leaving much wider gaps which expose the reticulated shell surface below. Several varices are produced at irregular intervals. The basal ridge is moderately developed and the costae are much flatter over the basal area. Operculum corneous, subcircular and paucispiral.

length	width	
41	14.5 mm.	Holotype
23.5	9.5	off Destin, Florida
20.5	8	off Cape San Blas, Florida
15.5	6.3	La Chorrera, Habana, Cuba

Types. Holotype, *Cirsotrema dalli* Rehder, United States National Museum no. 515,240, *Albatross*, station 2373, N. Lat. 29°14'; W. Long. 85°29', off Cape San Blas, Florida in 25 fathoms (type locality). Holotype, *Cirsotrema arcella* Rehder, United States National Museum no. 83725, *Albatross*, station 2602, N. Lat. 34°38'30"; W. Long. 75°33'30" in 124 fathoms, 36 miles S.W. of Cape Hatteras, North Carolina.

Remarks. The present species is exceedingly close to or may be identical with *C. cochlea* Sowerby, originally described from Loanda, Angola, on the west coast of Africa. Lack of critical material makes it impossible to indicate the exact relationship. In our opinion *C. arcella* Rehder is only a small and perfect specimen of *C. dalli* Rehder. *Cirsotrema dalli* differs from *C. pilsbryi* in having a nearly complete secondary surface sculpture and by having a strongly developed whorl shoulder with a definite canal behind it.

This species occurs in moderately shallow water in depths ranging from 18 to 75 fathoms. Rarely this species may be washed up on the shore.

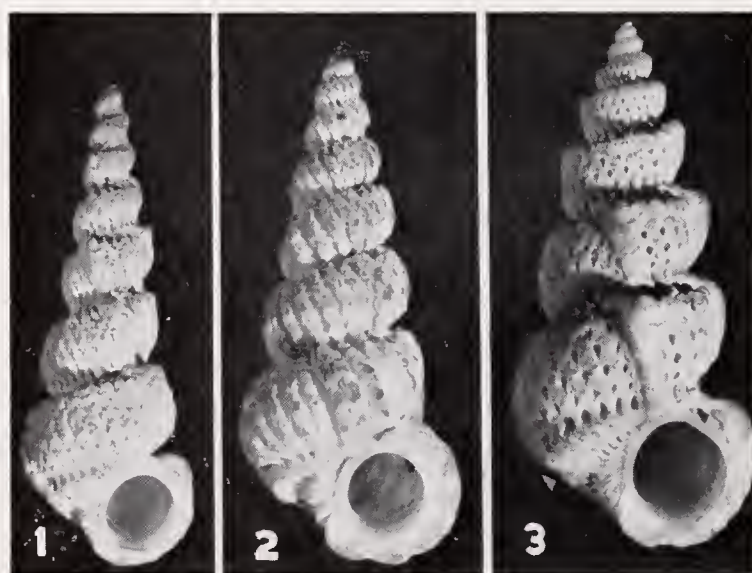


Plate 98. Fig. 1. *Cirsotrema dalli* Rehder, holotype (slightly enlarged). Fig. 2. *Cirsotrema pilsbryi* McGinty, holotype (about $3\frac{1}{2}x$). Fig. 3. *Cirsotrema arcella* Rehder, holotype (about $3\frac{1}{2}x$).

Range. North Carolina and south to the West Indies and Brasil (de Boury 1911).

Records. NORTH CAROLINA: 36 miles south of Cape Hatteras (USNM). FLORIDA: off Hillsboro Light in 20 to 33 fathoms; off Hollywood in 45 fathoms (both L. A. Burry); Lake Worth (T. McGinty); off Palm Beach in 60 fathoms (J. Schwengel); off Fort Lauderdale in 75 fathoms (L. A. Burry); off Miami in 20 fathoms; off Fowey Light in 25 fathoms; off Key West in 20–25 fathoms; off Loggerhead Key, Tortugas (all USNM); off Destin in 18–20 fathoms (T. McGinty); off Cape San Blas in 25 fathoms (USNM). CUBA: Arenas de la Chorrera¹, Habana (Museo Poey); off Habana (M. Jaume).

Genus *Acirsa* Mörch

Scalaria (*Acirsa*) Mörch 1857, Fortegnelse over Grönlands Blöddyr [in] Rink, Prodrömus Faunae Molluscorum Grönlandiae 2, Nat. bidr. 4, p. 77 [page 5 of the separate].

Genotype, *Scalaria borealis* Beck = *Turritella costulata* Mighels and Adams, monotypic.

Shells turreted and rather thin in structure. Whorls united and with only a moderately impressed suture. Varices are obsolete and the lip is simple. The sculpture is much reduced though both axial costae and spiral striae may be present. The basal area may be defined by a subperipheral ridge.

Acirsa costulata Mighels and Adams, Plate 99, figs. 1–3

Turritella costulata Mighels and Adams, January 1842, Boston Journal of Natural History 4, p. 50, pl. 4, fig. 20; *non Scalaria costulata* Kiener 1839, Dall 1889, Bulletin Museum Comparative Zoölogy 18, p. 307.

Scalaria borealis Beck 1842, Proc. Geological Society London 3, p. 120 [nude name].

Scalaria eschrichti 'Hölböll' Möller 1842, Nathurhistorisk Tidsskrift 4, p. 83.

Scalaria undulata 1844, Thesaurus Conchyliorum 1, **Scalaria**, p. 104, pl. 35, fig. 136 (no locality given).

Scalaria arctica 'Möller' Posselt 1898, Conspectus Faunae Groenlandicae Medd. on Grönland, Kjöbenhavn 23, p. 233.

Description. Shell reaching about 33 mm. (about 1¼ inches) in length, attenuated, chalky, and imperforate. Whorls 8–9, moderately convex. Color generally a light straw-yellow, occasionally having the incised spiral lines brownish. This color is invested in the periostracum which appears to be deciduous. Spire extended. Sutures moderately impressed. Aperture subcircular. Lip simple. Columella short and arched. Axial sculpture consisting of numerous and inconspicuous costae, more apparent on the earlier whorls. Spiral sculpture consisting of numerous incised lines more or less evenly disposed over each whorl as well as on the base of the shell. Basal ridge rather low but well defined. Nuclear whorls two and smooth. Operculum chitinous and paucispiral.

length	width	aperture	
19.5	6.2	4.5x3.1 mm.	Idiotype, Massachusetts
19	6	3.5x4.5	Eastport, Maine
20.5	6.6	4.0x4.8	“ “
30	9	5.0x6.6	“ “
33	9.5	7.0x4.5	“ “

¹Cascading or streaming sands. This is a sand pile located near the mouth of the Almendares River. This sand is brought to Habana for building purposes and is dredged from a few fathoms off the Cuban coast a few miles west of Habana. It is an excellent collecting spot, as many shells, dredged alive, occur in this sand pile. The sand is piled up while wet and upon drying cascades down.

Types. Idiotype, Museum of Comparative Zoölogy no. 165598 from Massachusetts, collected by J. W. Mighels. Cotypes of "*Sealaria borealis*" Beck, Museum of Comparative Zoölogy no. 187118, from Greenland, ex Museum Copenhagen.

Remarks. This is a rather rare species. It occurs from near low water to depths of about 50 fathoms. Specimens would appear to be isolated on the ocean floor as most of our dredged records are based upon only one or two individuals at any one station.

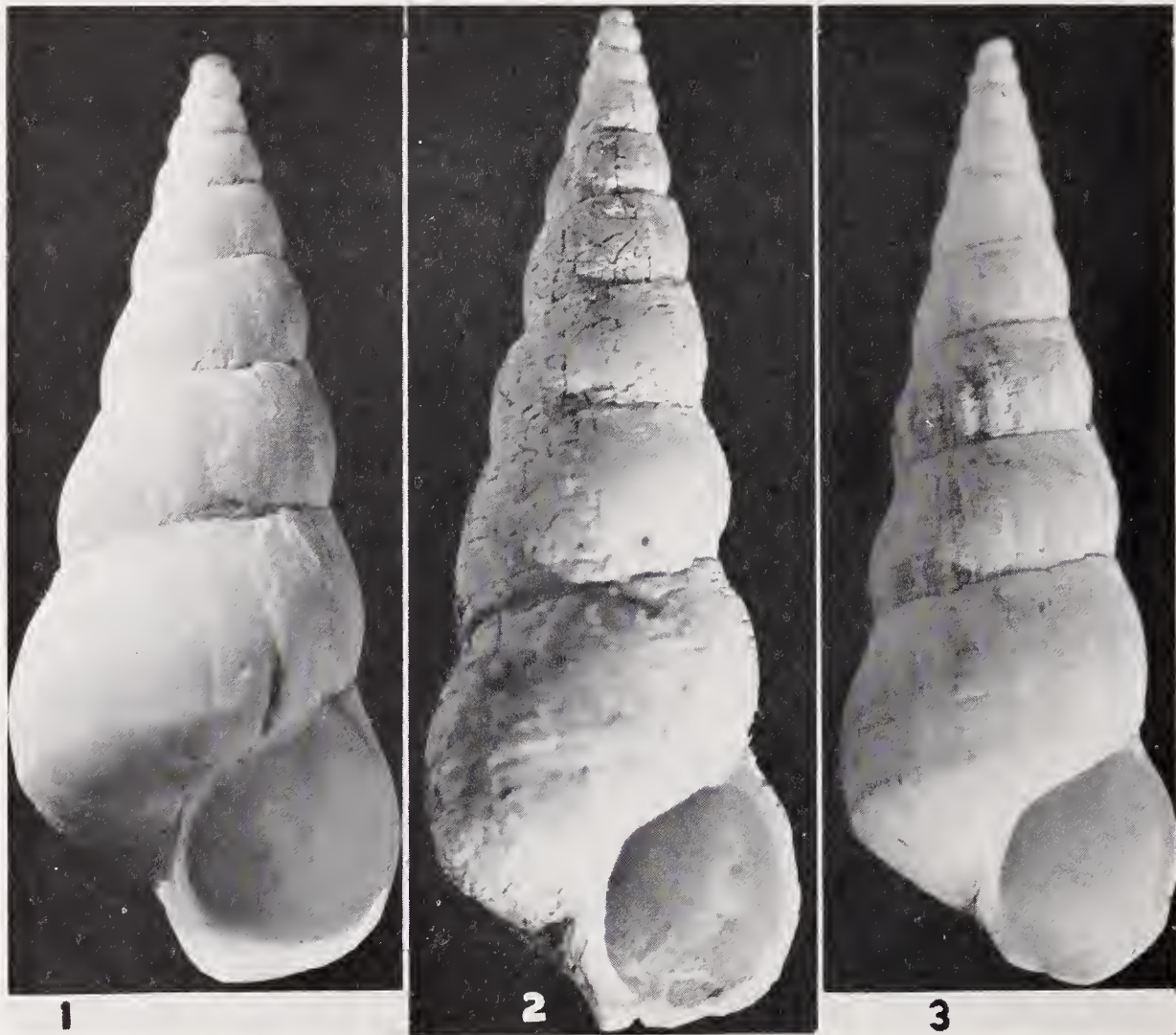


Plate 99. *Acirsa costulata* Mighels and Adams

Fig. 1. *Sealaria borealis* Beck, cotype (6x). Fig. 2. *Acirsa costulata* Mighels and Adams, idiotype (6x). Fig. 3. From Georges Bank, off Massachusetts (6x).

The original type specimen was lost in the Portland, Maine fire¹. Subsequently an additional specimen was found by Mighels and sent to the Boston Society of Natural History. It is now in the Museum of Comparative Zoölogy.

Range. Hudson Bay (fossil), West Greenland south to Massachusetts.

Records. GREENLAND (MCZ). NOVA SCOTIA: Bay of Fundy (USNM); N. Lat. 46° 04'; W. Long. 53° 20' (J. Miller). NEW BRUNSWICK: off Whitehead, Grand Manan in 28-50 fathoms (USNM). MAINE: Eastport (MCZ); Perry in 10 fathoms (J. Miller); Harrington Bay and off Cutler in 40 fathoms (both USNM). NEW HAMPSHIRE: off Isle

¹Johnson, R. I. 1949, Occasional Papers On Mollusks 1, pp. 214-216.

of Shoals in 35 fathoms (MCZ). MASSACHUSETTS: Georges Bank, N. Lat. $40^{\circ}23'$; W. Long. $68^{\circ}45'$ in 50 fathoms and N. Lat. $41^{\circ}20'$; W. Long. $66^{\circ}50'$ (both USNM).

Genus *Opalia* H. and A. Adams

Opalia H. and A. Adams 1853, Genera of Recent Mollusca **1**, p. 222.

Genotype, *Scalaria australis* Lamarck, subsequent designation, E. de Boury 1886.

Shell solid, white to light ivory in color and imperforate. Axial sculpture usually of strong ribs, but in some groups these may be reduced to small crenulations at the suture. Species in certain groups may be angulated or nodulose. Basal ridge present or absent depending on the group. Spiral sculpture usually of exceedingly fine incised threads which may or may not be finely pitted. This microscopic sculpture appears to be invested in a very thin outer layer of softer lime which is quickly lost in worn specimens. Operculum thin, corneous, paucispiral and littorinoid in shape.

Subgenus *Opalia* H. and A. Adams

Opalia H. and A. Adams 1853, Genera of Recent Mollusca **1**, p. 222.

Psychrosoma Tapparone-Canefri 1876, Journal de Conchyliologie **24**, p. 154 [subgenotype here selected, *Scalaria gouldi* T-C 1876 (= *Opalia borealis* Gould; = *Opalia wroblewskyi* Mörch)].

Subgenotype, *Scalaria australis* Lamarck, subsequent designation, E. de Boury 1886.

Shells solid, white and imperforate. Axial sculpture consisting of strong ribs. Basal ridge well developed. Spiral sculpture of exceedingly fine pitted threads. These small pits vary in number and size and are present only in fresh and unworn specimens.

Opalia (*Opalia*) *watsoni* de Boury, Plate 100, figs. 1-2

Scalaria funiculata Watson 1883, Journal Linnean Society **16**, p. 608; *ibid.* 1886, Voyage of the Challenger, Zoology **15**, p. 141, pl. 9, fig. 4 (off Pernambuco, Brasil, South Latitude $9^{\circ}5'$; West Longitude $34^{\circ}50'$; in 350 fathoms) *non S. funiculata* Carpenter 1857.

Scalaria watsoni de Boury 1911, Revista Chilena de Historia Natural **15**, p. 34 (new name for *S. funiculata* Watson *non* Carpenter 1857).

Description. Adult shell reaching about 5 to 6 mm. ($\frac{1}{4}$ inch) in length, attenuated, imperforate and sculptured. Whorls 10, moderately convex. Nuclear whorls $3\frac{1}{2}$ to 4, smooth and amber in color. Color a dirty white. Suture well impressed and not crenulated. Aperture subcircular. Outer lip much thickened and in the few specimens we have seen, consisting of the last costae. Columella short and arched. Axial sculpture consisting of strong costae which terminate below on the basal ridge. There are about 12 costae on the body whorl. Microscopic sculpture consisting of numerous exceedingly fine spiral threads which are minutely pitted. Operculum unknown.

length	width	
5.5	1.6 mm.	Holotype (after Watson)
4.3	1.5	off Puerto Tanamo, Cuba
2.7	1 (young)	off Bahia de Matanzas, Cuba

Types. British Museum, *Challenger*, station 122, off Pernambuco [Recife], Brasil (S. Lat. $9^{\circ}5'$; W. Long. $34^{\circ}5'$) in 350 fathoms.

Remarks. We know very little regarding this species. We have seen but four specimens and these agree in all details with the description and figure published by Watson in the Challenger Report, other than the possession of the exceedingly fine pitting. These fine pits may have been overlooked or they may have been filled in on the original specimen described by Watson.

The nuclear whorls appear to be more numerous than in most species of this genus. The spiral pitted threads are exceedingly fine and can only be detected under relatively high magnification (30x). The species is rather small but the development of the costae which ends at the basal ridge and the fine pitting place it in the subgenus *Opalia*.

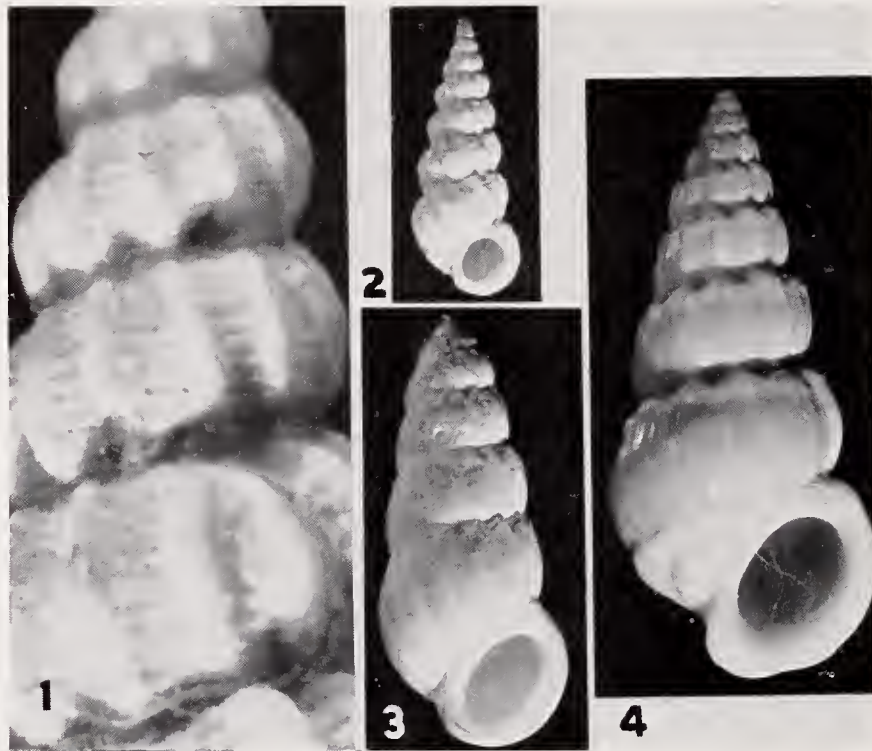


Plate 100. Fig. 1. *Opalia watsoni* de Boury, enlarged to show sculpture (about 42x). Fig. 2. *Opalia watsoni* de Boury, from off Puerto Tanamo, Oriente, Cuba (about 8x). Fig. 3. *Scalaria (Opalia) scaeva* Mörch (= *Opalia hotessieriana* d'Orbigny) St. Thomas, Virgin Islands, lectotype (5x). Fig. 4. *Opalia crenata* Linné, Cadiz, Spain (3½x).

Range. From southern Florida to Brasil.

Records. FLORIDA: *Eolis*, station 355, off Fowey Light in 70 fathoms (USNM). CUBA: *Atlantis*, station 3485, off Bahía de Matanzas (N. Lat. 23°13'; W. Long. 81°22') in 385 fathoms (MCZ and Museo Poey). *Atlantis*, station 3374, off Puerto Tanamo, Oriente (N. Lat. 20°45'; W. Long. 75°19') in 300 fathoms (MCZ). BRASIL: *Challenger*, station 122, off Pernambuco (S. Lat. 90°5'; W. Long. 34°5') in 350 fathoms (ex the Challenger Report).

Subgenus *Dentiscala* de Boury

Dentiscala de Boury 1886, Monographie des Scalidae Vivantes et Fossiles Partie I—Sous-genre *Crisposcala* p. xxi.

Granuliscala de Boury 1909, Journal de Conchyliologie 57, p. 256 (subgenotype, *S. granulosa* Quoy and Gaimard).

Subgenotype, *Turbo crenatus* Linné, original designation, E. de Boury 1886.

Shell solid, white to light ivory in color and imperforate. Axial sculpture consisting of rather low costae which may become obsolete other than as crenulations at the suture. Basal ridge may be present, absent or weak. Spiral sculpture of very fine incised lines which are very minutely pitted.

Opalia (Dentiscala) crenata Linné Plate 100, fig. 4; Plate 101, figs. 1-3

Turbo crenatus Linné, 1758, Systema Naturae ed. 10, p. 765 (locality unknown); C. Linné 1764, Museum Ludovicae Ulricaе Reginae p. 659.

Scalaria crenulata Kiener 1839, Coquilles Vivantes **10**, *Scalaria*, p. 17, pl. 6, fig. 18 (on the coast of Sicily).
Non Scalaria crenulata Pease 1867.

Description. Shell reaching 18-20 mm. (about $\frac{3}{4}$ inch) in length, attenuated, imperforate and moderately sculptured. Whorls 10, moderately convex, well shouldered and joined. Color a uniform grayish-white. Suture deep, aperture subcircular to ovate and oblique. Lip thickened. Columella short and arched. Axial sculpture consisting of rather numerous costae (11 on the body whorl) which may be strongly developed or nearly absent. These terminate above as a series of rounded points which rise above the suture and are generally impressed upon the whorl above. The canal thus formed consists of a series of rather deep pits between these pointed costae. There is generally a very well developed rounded basal ridge. Generally the costae are not formed below the basal ridge and there may be a fairly deep channel below the ridge which outlines the umbilical area. Occasionally the axial costae persist beyond the basal ridge. Microscopic sculpture consists of an exceedingly fine pitted surface. It appears to be equally well developed both on the costae and in the spaces between them. This sculptured layer is quickly lost in worn specimens. Operculum unknown.

length	width	
18.2	8	Cadiz, Spain
17	7.5	Jamaica, West Indies
12	5.9	off The Elbow, Key Largo, Florida

Types. According to S. Hanley, the type specimen of *Turbo crenatus* Linné is in the Museum of the Linnean Society London, England (*Ipsa Linnaei Conchyliæ* 1855, p. 341). Hanley further refers to Sowerby 1844, *Thesaurus Conchyliorum* **1**, *Scalaria*, pl. 35, fig. 123. The type of *S. crenulata* Kiener was figured from a specimen in the collection of the Prince of Massena.

Remarks. We can detect no differences in the characters exhibited by specimens from the West Indies and those from Europe and Africa. Most of the characters possessed by this species are quite variable, particularly in the development of the axial costae and the basal ridge. The basal ridge may exist as a mere terminating point for the costae or as a rather deep spiral groove below which is defined a well rounded ridge. The costae may be produced as low flattened ribs terminating as sutural crenulations or exist only as crenulations at the suture. Very occasionally a varix is produced.

Opalia crenata differs from *O. hotesseriana* by being larger and, most important, by having the whorls shouldered. In *hotesseriana* the whorls are not shouldered and the crenulations merge evenly into the whorl above. (See Plate 101, figs. 1-3, *crenata* and figs. 4-8, *hotesseriana*.)

Range. EASTERN ATLANTIC: France, the western Mediterranean and south at least to the Gold Coast. WESTERN ATLANTIC: Lower Florida, the West Indies south to Trinidad.

Records. WESTERN ATLANTIC: FLORIDA, *Eolis*, station 68, off Miami in 45 fathoms (USNM); off The Elbow, Key Largo (L. A. Burry); *Eolis*, station 61, off Turtle Harbor, Key Largo in 40 fathoms (USNM). CUBA: Arenas de la Chorrera, Habana (Museo Poey); Tarará (M. Jaume); Camacho Beach, Matanzas (C. J. Finley). HISPANIOLA: Baie Anglaise, near Aquin, Haiti (USNM). PUERTO RICO: Arecibo (MCZ); Tortugera, north of Monati (Matton). JAMAICA: (MCZ). LESSER ANTILLES: Anguilla (Naturhistoriska Riksmuseet, Stockholm). VENEZUELA: Curaçao (AMNH).

EASTERN ATLANTIC: SPAIN: Cadiz (MCZ). ALGERIA (MCZ). SENEGAL (M. Jaume). GOLD COAST: Accra (MCZ). LIBERIA: Monrovia (MCZ).

Opalia (Dentiscala) hotessieriana d'Orbigny, Plate 100, fig. 3; Plate 101, figs. 4-8

Scalaria hotessieriana d'Orbigny 1842 [in] de la Sagra, Histoire L'Ile de Cuba 2, p. 16, pl. 10, figs. 22-23 [*S. hotessieriana*, on plate] (Guadeloupe).

Scalaria crassicostata Sowerby 1844, Thesaurus Conchyliorum 1, Scalaria, p. 104, pl. 35, fig. 119 (no locality given), non Deshayes 1839.

Scalaria crassicosta 'Sowerby' Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 267 (Guadeloupe, St. Martin and St. Thomas, West Indies) [error for *Scalaria crassicostata* Sowerby].

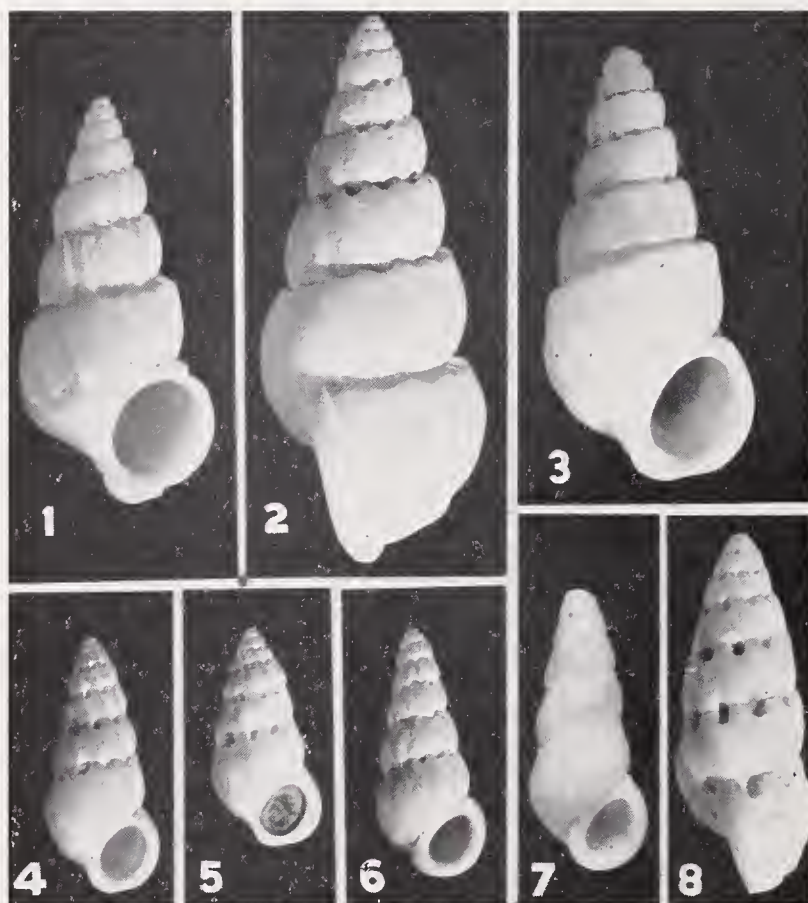


Plate 101. Figs. 1-3. *Opalia crenata* Linné. Figs. 4-8. *Opalia hotessieriana* d'Orbigny

Fig. 1. Off The Elbow, Key Largo, Florida. Fig. 2. Jamaica. Fig. 3. Arecibo, Puerto Rico (all about $3\frac{1}{2}x$). Fig. 4. Boynton Beach, Florida ($3\frac{1}{2}x$). Fig. 5. Boynton Beach, Florida (about $3x$). Fig. 6. St. Thomas, Virgin Islands (about $3x$). Fig. 7. *Rissoa crassicosta* C. B. Adams (= *Opalia hotessieriana* d'Orb.), lectotype ($1x$). Fig. 8. Uvilla Island, Bay Islands (about $3\frac{1}{2}x$).

Scalaria grossicostata Nyst 1871, Ann. Soc. Malacologique de Belgique **6**, p. 112 (new name for *crassicostata* Sowerby *non* Deshayes).

Rissoa crassicosta C. B. Adams 1845, Proc. Boston Soc. Nat. Hist. **2**, p. 6 (Jamaica); Clench and Turner 1950, Occasional Papers on Mollusks, Harvard University **1**, no. 15, p. 269, pl. 34, fig. 6.

Scala (Opalia) scaeva Mörch 1874 Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 267; *ibid.* 1876, Journal Academy Nat. Sciences Philadelphia (2) **8**, p. 204 (St. Thomas, Virgin Islands).

Description. Shell reaching about 12 mm. ($\frac{1}{2}$ inch) in length, similar in most respects to *Opalia crenata*, but differing by being somewhat smaller and in having the axial costae generally persisting below the basal ridge. There are 10–14 costae on the body whorl. Microscopic sculpture consisting of a very fine pitted surface, the little pits being arranged in fine spiral lines. This pitted surface is quickly lost when the shell is beach-rolled as the sculptured layer is very thin and readily suffers from abrasion. The shell appears a little more tapering with less tendency to develop a shoulder than does *Opalia crenata*. Operculum corneous, subcircular and paucispiral.

length	width	
12.5	5.3 mm.	Middle Sambo Shoal, near Key West, Florida
10.8	4	Tobago, Lesser Antilles
7	3.2	Boynton Beach, Florida
6.8	3.2	Port Royal, Jamaica

Types. According to J. E. Gray (1854, p. 18) the type of *Scalaria hotessieriana* d'Orbigny is in the British Museum. The type locality is Guadeloupe Island, Lesser Antilles. The lectotype of *Rissoa crassicosta* C. B. Adams from Jamaica is in the Museum of Comparative Zoölogy no. 186174. The type of *Scala (Opalia) scaeva* Mörch from St. Thomas, Virgin Islands is in the Universitetets Zoologiske Museum, Köbenhavn, Denmark.

Remarks. See remarks under *Opalia crenata* Linné.

Range. Southern Florida and south through the West Indies to Trinidad.

Records. FLORIDA: Boynton Beach; off Lake Worth in 90 fathoms; off Palm Beach in 50 fathoms; Middle Sambo Shoals near Key West (all T. McGinty); Loggerhead Key, Tortugas (USNM). BAHAMA ISLANDS: near Gambia, New Providence (ANSP); Arthurstown, Cat Island (MCZ). CUBA: Arenas de la Chorrera, Habana (Museo Poey); Camacho Beach, Matanzas (C. J. Finley). HISPANIOLA: Bariadèle, Dept. du Sud, Haiti; Baie Anglaise, near Aquin, Haiti; Aquin, Dept. du Sud, Haiti (all USNM). JAMAICA: Robins Bay, St. Mary's; Port Royal (both USNM). VIRGIN ISLANDS: St. Thomas (MCZ and the Zoologiske Museum, Köbenhavn, Denmark). LESSER ANTILLES: Tobago Island (T. McGinty). CARIBBEAN ISLANDS: Uvilla Island, Bay Islands (USNM).

***Opalia (Dentiscalia) burryi*, new species, Plate 102, figs. 1–3**

Description. Shell reaching 15 mm. (about $\frac{1}{2}$ inch) in length, attenuated, imperforate and sculptured. Whorls 9 to 11, moderately convex and moderately shouldered. Color a uniform white to dull gray. Suture deep. Aperture oblique and subcircular to ovate. Lip rounded and much thickened. Columella short. Axial sculpture consisting of numerous flattened ridges which terminate above as strong sutural crenulations. There are 14 costae on the body whorl (holotype). No basal ridge. Microscopic sculpture consisting of exceedingly fine punctate or pitted spiral lines which are just as strong on the

costae as they are in the valleys between them. These lines of pits may be straight or slightly wavy. One or more varices may occur. Nuclear whorls $1\frac{1}{2}$ to 2, a clear amber in color. Operculum unknown.

length	width	
15.2	5.1 mm.	Paratype
14	5	Holotype
8.6	3.2	Paratype (young)

Types. Holotype, Museum of Comparative Zoölogy no. 187107, $4\frac{1}{2}$ miles off Carysfort Light, Key Largo, Florida in 92 to 100 fathoms. L. A. Burry collector 1944. A paratype from the same locality and additional paratypes from off Palm Beach, Florida, in from 50 to 75 fathoms, collected by T. McGinty.

Remarks. Similar to that of other members of *Opalia*, the microscopical sculpture of *O. burryi* is invested in a very thin outer layer. From *O. crenata* it differs in being more attenuated, lacking a basal ridge, having the shoulder much less developed and in having a much thicker lip. The microscopical sculpture appears to be about the same in both species. From *O. hotessieriana* it differs by being much larger, having a slightly developed whorl shoulder and by not having a basal ridge.

Range. Palm Beach and south to Key Largo, Florida in 50 to 100 fathoms.

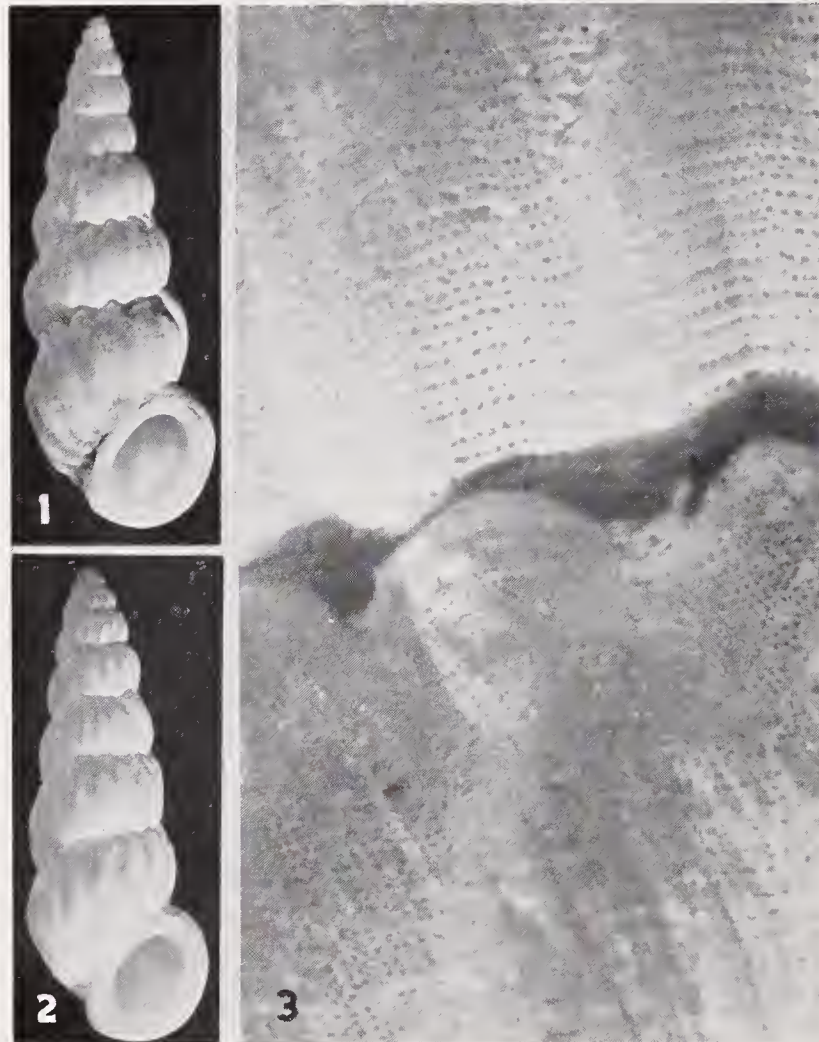


Plate 102. *Opalia (Dentiscalia) burryi* Clench and Turner

Fig. 1. Holotype (4x) from off Carysfort Light, Key Largo, Florida. Fig. 2. Paratype from same locality (3x). Fig. 3. Greatly enlarged to show sculpture (about 60x).

Records. FLORIDA: Palm Beach in 50 to 75 fathoms (T. McGinty): $4\frac{1}{2}$ miles off Carysfort Light, Key Largo, in 92 to 100 fathoms (L. A. Burry).

Subgenus *Nodiscala* de Boury

Nodiscala de Boury 1889, Bullettino della Società Malacologica Italiana **14**, p. 168.

Punctiscala de Boury 1889, Bullettino della Società Malacologica Italiana **14**, p. 175 (subgenotype, *Scalaria plicosa* Philippi, original designation).

Subgenotype, *Nodiscala* [*Scalaria*] *bicarinata* Sowerby, original designation, E. de Boury 1889.

Shell rather solid, attenuate, white to gray in color, and imperforate. Axial sculpture usually of rather strong ribs which terminate as crenulations at the suture. Occasionally these crenulations are almost obsolete. Whorls rounded or slightly angulate and occasionally nodulose at the angulation. Basal ridge absent. Spiral sculpture consisting of fine numerous incised lines which are generally finely pitted.

Opalia (*Nodiscala*) *pumilio* Mörch, Plate 103, figs. 1-6; Plate 107, fig. 3

Scala (*Opalia*) *subvaricosa* 'Dunker' Mörch 1874, Vidensk Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 267 (St. Thomas; Anguila; Bahamas); Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 204; *non Scalaria subvaricosa* Contraine 1842.

Scala subvaricosa var. *pumilio* Mörch 1874, Vidensk Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 268 (St. Thomas; Bahamas); Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 205; *non Scala eburnea pumilio* Mörch 1874, p. 261 (nude name).

Scala (*Dentiscala*) *hellenica nodosocarinata* Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, p. 321 (no locality given, but on the label of the type specimen it is given as 5 miles off Cape Florida, Florida in 8 fathoms).

Nodiscala dunkeri de Boury 1889, Bullettino della Società Malacologica Italiana **14**, p. 170 (new name for *Scala* (*Opalia*) *subvaricosa* 'Dunker' Mörch 1874 *non* Contraine 1842).

Nodiscala semivaricosa de Boury 1889, Bullettino della Società Malacologica Italiana **14**, p. 326. [New name for *Nodiscala dunkeri* de Boury 1889, *non Scala dunkeriana* Dall 1889. This name was not needed as *dunkeri* and *dunkeriana* are not homonyms].

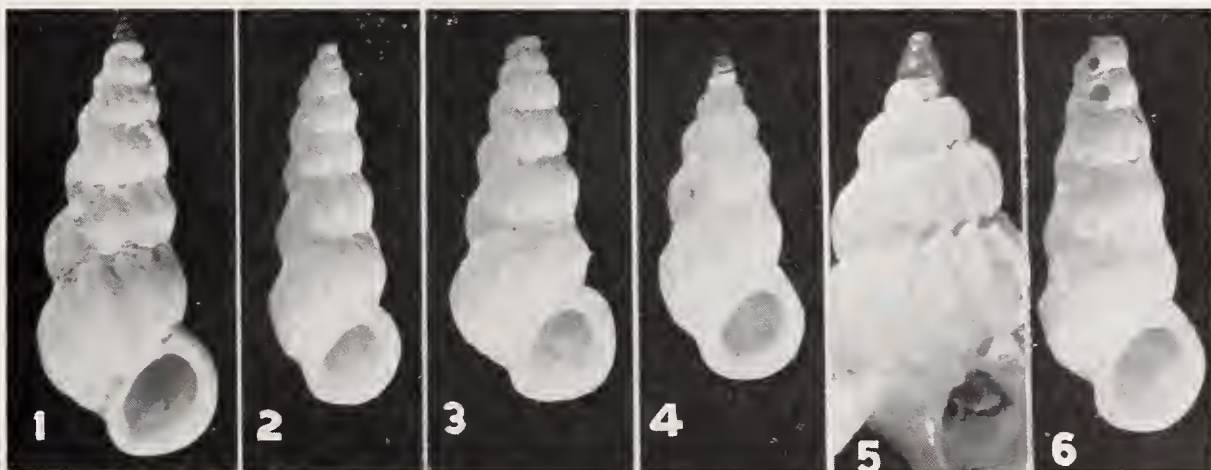


Plate 103. *Opalia pumilio* Mörch

Fig. 1. *Opalia pumilio* Mörch, off Miami, Florida in 30 fathoms ($8\frac{1}{2}x$). Fig. 2. *Opalia subvaricosa pumilio* Mörch, lectotype ($7x$). Fig. 3. *Opalia linteatum* Schwengel, holotype ($7x$). Fig. 4. *Opalia nodosocarinata* Dall, holotype ($9x$). Fig. 5. *Opalia pumilio* Mörch, off Pelican Island, Barbados. Enlarged to show nuclear whorls and sculpture ($15x$). Fig. 6. *Opalia subvaricosa* Mörch, lectotype ($4x$).

Epitonium (Cirsostroma) linteatum Schwengel 1943, *Nautilus* **56**, p. 77, pl. 7, fig. 6 (from off Palm Beach, Florida in 75 fathoms).

Description. Adult reaching about 10 mm. ($\frac{1}{2}$ inch) in length, attenuated, imperforate, and sculptured. Whorls 10–12, moderately convex. Nuclear whorls $2\frac{1}{2}$, smooth, amber in color. Color a uniform grayish-white. Suture finely crenulated and not deeply impressed. Aperture oblique, subcircular to ovate. Outer lip much thickened and rounded. Columella short and arched. Axial sculpture consisting of numerous costae each of which ends as a crenulation in the suture above. There are 14–16 costae on the body whorl. These costae are rounded over the convex whorl. There may be 2 or 3 varices on the adult shell. Microscopic sculpture consisting of exceedingly fine punctated or pitted spiral lines. No basal ridge defined. Opereulum unknown.

length	width	
10	3.4 mm.	<i>Eolis</i> , station 137, off Ajax Reef, Florida
8.7	3.7	Lectotype, <i>O. subvaricosa</i> Bahamas
5.6	2.4 (young)	Holotype, <i>E. linteatum</i> Palm Beach, Florida
5.5	2 (young)	Lectotype, <i>S. pumilio</i> St. Thomas, Virgin Islands
3.9	1.8 (young)	Holotype, <i>S. nodosocarinata</i> off Cape Florida, Florida

Types. Lectotypes of *Scala subvaricosa* 'Dunker' Mörch from the Bahamas and *S. subvaricosa* var. *pumilio* Mörch from St. Thomas are in the Universitetets Zoologiske Museum, København, Denmark. The holotype of *Scalaria hellenia nodosocarinata* Dall is in the United States National Museum no. 82955 from 5 miles off Cape Florida, Florida in 8 fathoms. The holotype of *Epitonium (Cirsostroma) linteatum* Schwengel is in the Academy of Natural Sciences Philadelphia no. 178787, from off Palm Beach, Florida in 75 fathoms. We here restrict the type locality to St. Thomas, Virgin Islands.

Remarks. This is an exceedingly variable species, particularly in the contour of the shell, the costae and the whorl angulation. Dall considered these West Indian forms to be varieties of *Opalia hellenia* Forbes from the Mediterranean. This certainly may be so but the lack of critical material and some differences in the description of that species make it advisable to keep these forms separated at least for the time being. Certain of the above synonyms have been based upon young specimens. This is easily done as *Opalia* produces a well defined lip during its early period and as the shell advances in age a new growth proceeds until another or even a third varix is produced.

Opalia pumilio differs from *morehiana* by having rounded instead of angulated whorls and having, in general, smaller and more numerous costae.

Range. North Carolina, the Gulf of Mexico and south through the West Indies.

Records. NORTH CAROLINA: 10 $\frac{1}{2}$ miles off Frying Pan Shoals in 12 $\frac{1}{2}$ fathoms (ANSP). FLORIDA: *Albatross*, station 2370 off Cape San Blas (N. Lat. 29°18'; W. Long. 85°32') in 25 fathoms (USNM); off Palm Beach in 75 fathoms; Lake Worth in shallow water (both T. McGinty); off Hillsboro Light in 30 to 60 fathoms (L. A. Burry); *Eolis*, station 117, off Miami in 35–38 fathoms; *Eolis*, station 372, off Fowey Light in 100 fathoms; *Eolis*, station 137, off Elliott Key in 40 fathoms; *Eolis*, station 368, off Ajax Reef in 80–100 fathoms; *Eolis*, station 301, off Sand Key in 95 fathoms; *Eolis*, stations 43 and 75, off Key West in 63 and 5 fathoms (all USNM). BAHAMA ISLANDS: North end, South Bimini Island; Mangrove Key, Andros Island (both USNM). CUBA: *Barrera*,

station 211, off Punta del Cajón (USNM); Arenas de la Chorrera, Habana (M. Jaume). VIRGIN ISLANDS: St. Thomas (Univ. Zoologiske Museum, København). JAMAICA: Port Royal (USNM). LESSER ANTILLES: off Pelican Island, Barbados in 100 fathoms (USNM).

Opalia pumilio var. **morchiana** Dall, Plate 104, figs. 1-2

Scala (Dentiscala) hellenica morchiana Dall 1889, Bulletin Museum of Comparative Zoölogy 18, p. 322, pl. 18, fig. 1 (Barbados, 100 fathoms).

Description. Adult shell reaching about 10 mm. ($\frac{3}{8}$ inch) in length, attenuated, imperforate and sculptured. Whorls 10-12 moderately to sharply angled at the periphery of the whorl. Nuclear whorls $2\frac{1}{2}$, smooth, amber in color. Color uniform grayish-white. Suture not deeply impressed; finely crenulated. Aperture oblique, subcircular to ovate. Outer lip much thickened and rounded. Columella short and arched. Axial sculpture consisting of 9 to 15 rather strong, axial costae which are angulated and even nodulose at the whorl periphery. Occasionally there may be two angles on the body whorl and there may be two or three varices on an adult shell. Microscopic sculpture consisting of exceedingly fine punctated or pitted spiral lines. No basal ridge defined. Operculum chitinous and paueispiral.

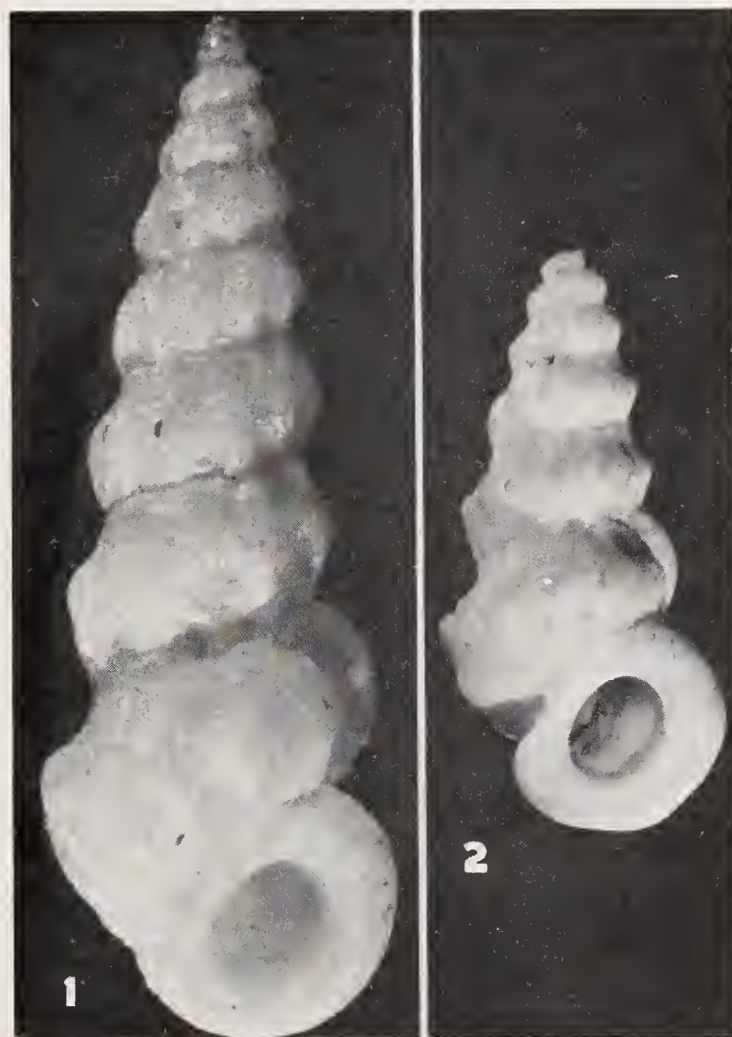


Plate 104. Fig. 1. *Opalia morchiana* Dall, from off the Barbados, holotype (15x). Fig. 2. From off Miami, Florida (7x).

length	width	
11.5	2.1 mm. (including nuclear whorls)	Holotype, <i>S. morchiana</i> , Barbados
10	3.5	off Palm Beach, Florida, 70 fathoms
9.6	4.3	Miami, Florida, 40 fathoms
5.2	1.8 (young)	<i>Eolis</i> , station 57, off Sand Key, Florida, 4 fms.
4.5	2 (young)	<i>Eolis</i> , station 33, Tortugas, Florida

Types. The holotype of *Scala hellenica morchiana* Dall is in the United States National Museum no. 126828, from Barbados, Lesser Antilles in 100 fathoms, *Hassler* Voyage.

Remarks. See under *Opalia pumilio* Mörch.

Range. North Carolina and south through Florida and the West Indies to the Barbados.

Records. NORTH CAROLINA: 10½ miles off Frying Pan Shoals in 12½ fathoms (ANSP); 31 miles off Cape Lookout in 52 fathoms (USNM). FLORIDA: off Hillsboro Light in 30 fathoms; off Hollywood in 45 fathoms; off Fort Lauderdale in 40–75 fathoms (all L. A. Burry); Lake Worth; Boynton Beach; off Palm Beach in 20 fathoms (all T. McGinty); *Eolis*, station 48 in 60 fathoms; *Eolis*, station 62 in 20 fathoms; *Eolis*, station 67 in 50 fathoms, all off Miami (all USNM); *Eolis*, station 147 in 35 fathoms; *Eolis*, station 177 in 60 fathoms both off Fowey Light; *Eolis*, station 160, off Sand Key in 62 fathoms; *Eolis*, station 33, off Tortugas in 16 fathoms (all USNM); off Sombrero Light in 90–100 fathoms; off American Shoals in 50 fathoms (both L. A. Burry); off Destin in 14 fathoms (T. McGinty). BAHAMAS: South Bight, Andros Island (USNM). CUBA: off Gibara in 35 fathoms (Museo Poey); off Habana in 119 fathoms; Cabañas Harbor in 25 fathoms (both USNM); Arenas de la Chorrera, Habana (M. Jaume). HISPANIOLA: Samaná Bay (USNM). VIRGIN ISLANDS: St. Thomas (ANSP). LESSER ANTILLES: Martinique (AMNH); off Pelican Island, in 80–90 fathoms; off Lazaretto in 94 fathoms, both Barbados (both USNM).

Opalia (Nodiscala) aurifila Dall, Plate 105, figs. 4–6

Scala (Dentiscala) aurifila Dall 1889, Bull. Museum of Comparative Zoölogy **18**, p. 322, pl. 18, fig. 4 (*Blake*, station 206, off Martinique in 270¹ fathoms).

Description. Shell about 11 mm. (½ inch) in length, elongate, imperforate and strongly sculptured. Whorls 13, slightly convex. Nuclear whorls 3, smooth, pale amber in color. Color a light and dull brown to a dirty gray. Suture moderately impressed. Aperture subcircular. Outer lip much thickened and rounded. Columella short and arched. Axial sculpture consisting of 12 strong costae, the ends of which produce crenulations at the suture. Spiral sculpture consisting of 6 to 7 cords which are strong but much less so than the axial costae. Slight nodules are produced where the spiral cords pass over the axial costae. In addition there is an exceedingly fine reticulated sculpture between these costae and cords which, under 30x magnification, has the appearance of coarsely woven cloth. This latter character is invested in the superficial layer and may be lost in worn specimens. Basal area defined by a low and rather inconspicuous ridge beyond which the axial costae do not extend. The basal area, however, does have the fine reticulated pattern. Operculum corneous and paucispiral.

¹This should be 170 fathoms as this is the figure given on the original label and it is also published in the *Blake* station list for station 206.

length	width	
10.8	2.9 mm.	Holotype, off Martinique, 170 fathoms
10.5	2.8	off Fowey Light, Florida

Types. Holotype, United States National Museum no. 106915, *Blake*, station 206, off Martinique, Lesser Antilles in 170 fathoms.

Remarks. *Opalia aurifila* differs from *O. eolis* by being far more attenuated, having much less globose whorls and having fewer axial costae. The microscopic sculpture is similar in both species. In *Opalia eolis* the whorls are more shouldered and the crenulations do not always abut upon the whorl above. So far as the present records go the range in depth for *O. aurifila* is 55 to 170 fathoms and that for *O. eolis* is 25 to 94 fathoms.

Range. From Hillsboro Inlet, Florida and south through the West Indies to Martinique.

Records. FLORIDA: off Hillsboro Light in 30 to 50 fathoms (L. A. Burry); *Eolis* (numerous stations) off Fowey Light in 40 to 78 fathoms; *Eolis*, station 43, off Key West in 63 fathoms; 16 miles off Tortugas in 90 fathoms (all USNM); off Looe Key in 70 to 90 fathoms; off American Shoals in 50 to 80 fathoms; off Sombrero Light in 90 to 100 fathoms (all L. A. Burry). LESSER ANTILLES: *Blake*, station 206, off Martinique in 170 fathoms (USNM).

***Opalia (Nodiscala) eolis*¹ new species, Plate 105, figs. 1-3; Plate 107, fig. 4**

Description. Shell about 9 mm. ($\frac{3}{8}$ inch) in length, elongate, imperforate, and strongly sculptured. Whorls 11, rather strongly convex. Nuclear whorls 3, smooth and pale amber in color. Color a pale and dull brown. Suture deeply impressed. Aperture subcircular. Outer lip much thickened and rounded. Columella short and arched. Axial sculpture consisting of 16 strong costae, the ends of which produce crenulations at the suture. Spiral sculpture consisting of 8 or 9 cords which are strong but much less so than the axial costae. Slight nodules are produced where the spiral cords pass over the axial costae. In addition there is an exceedingly fine reticulated sculpture between these costae and cords which, under 30x magnification, has the appearance of a coarsely woven cloth. This latter character is invested in the superficial layer and may be lost in worn specimens. Basal areas defined by a low, rather inconspicuous ridge beyond which the axial costae do not extend. The basal area, however, does have the fine reticulated pattern. Operculum corneous and paucispiral.

length	width	
8.3	3 mm.	Holotype, off Looe Key, Florida, 70-90 fathoms.
8.1	3.2	off Palm Beach, Florida

Types. Holotype, Museum of Comparative Zoölogy no. 187110, from off Looe Key, Lower Florida Keys in 70 to 90 fathoms, L. A. Burry collector. Paratypes from off Fowey Light (USNM); from off Sand Key (USNM); from off Palm Beach, Florida (T. McGinty).

Remarks. See under *O. aurifila* Dall.

Range. From off Palm Beach, Florida south to Barbados.

¹ Named for J. B. Henderson's yacht, the *Eolis*.

Records. FLORIDA: off Palm Beach in 42 fathoms (T. McGinty); *Eolis*, station 68, off Miami in 45 fathoms; *Eolis*, station 154, off Fowey Light in 42 fathoms; *Eolis*, station 180, off Fowey Light in 76 fathoms; *Eolis*, station 319, off Western Dry Rocks in 90 fathoms; *Eolis*, station 160, off Sand Key in 62 fathoms (all USNM); off Looe Key in 70 to 90 fathoms; off Sombrero Light in 30 to 50 fathoms (both L. A. Burry). LESSER ANTILLES: off Lazaretto in 94 fathoms; off Pelican Island in 75 fathoms; both Barbados (both USNM).

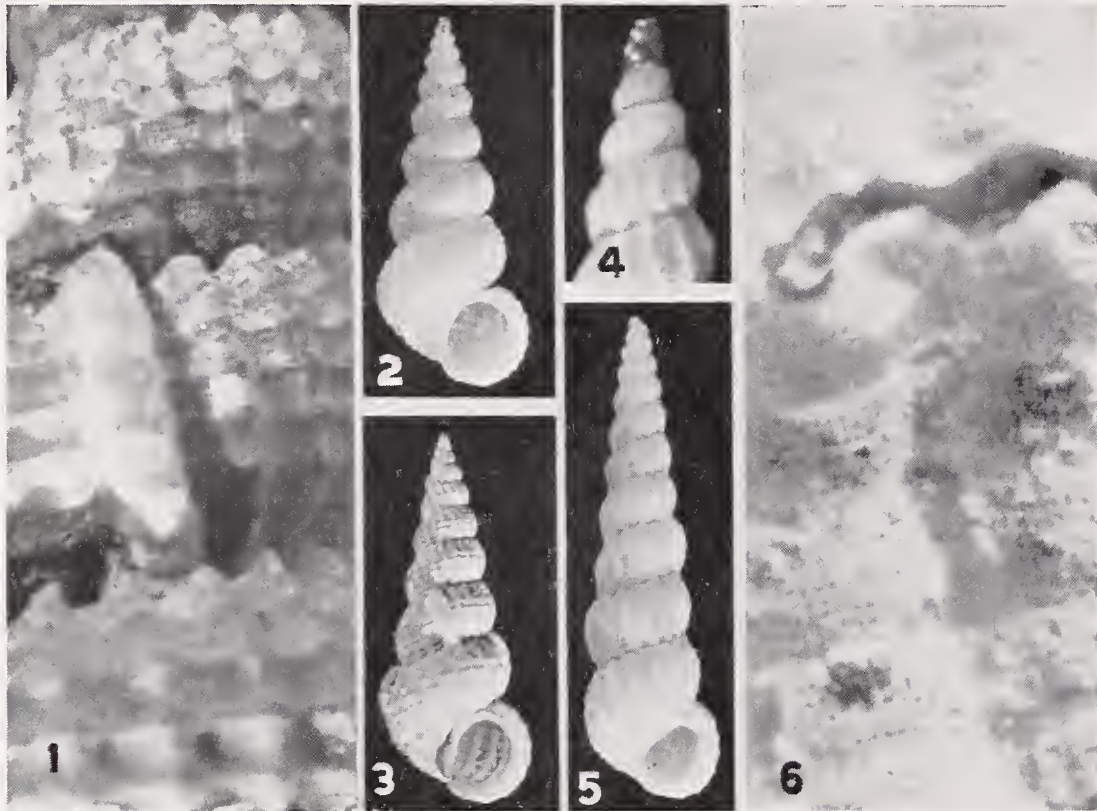


Plate 105. Figs. 1-3. *Opalia eolis* Clench and Turner. Figs. 4-6, *Opalia aurifila* Dall
 Fig. 1. Detail of sculpture (25x). Fig. 2. From off Palm Beach, Florida, paratype (5x). Fig. 3. From off Looe Key, Florida, holotype (5x). Fig. 4. From off Fowey Light, Florida (18x). Fig. 5. Off Martinique, Lesser Antilles, holotype ($4\frac{1}{2}$ x). Fig. 6. Detail of sculpture (about 70x).

Genus *Amaea* H. and A. Adams

Amaea H. and A. Adams 1853, *Genera of Recent Mollusca* 1, p. 233.

Genotype, *Scalaria magnifica* Sowerby, subsequent designation de Boury 1909.

Shells imperforate and with the whorls joined. Sculpture complex, consisting of both weak and strong axial costae and crossed by either equally weak or strong spiral ridges. Microscopic sculpture, when present, of both spiral and axial threads. The suture is generally very deeply impressed. Outer lip simple or thickened only by one of the axial costae. Basal ridge present.

Subgenus *Amaea* H. and A. Adams

Amaea H. and A. Adams 1853, *Genera of Recent Mollusca* 1, p. 233.

Subgenotype, *Scalaria magnifica* Sowerby, subsequent designation, de Boury 1909.

Shell imperforate and with the whorls joined. Sculpture consisting of low axial costae and equally low spiral ridges. Microscopic sculpture consisting of both axial and spiral threads. Basal ridge present separating two types of sculpture on the body whorl.

Amaea (Amaea) mitchelli Dall, Plate 106, figs. 5-7

Scala mitchelli Dall 1896, Nautilus **9**, p. 112 (Matagorda Island, Texas).

Description. Shell reaching about 60 mm. ($2\frac{1}{2}$ inches) in length, attenuated, thin but strong, imperforate, and with whorls attached. Whorls 15 and rather strongly convex. Color a pale ivory with a dark brownish band at the periphery and a solid brownish area below the basal ridge. Suture deeply impressed. Aperture subcircular and with a slightly thickened but non-reflected lip. Columella short and arched. Axial sculpture consisting of numerous low, irregular costae with about 22 on the whorl. These costae may appear as low and rather broad flat ridges or may be reduced to very fine threads. Spiral sculpture consisting of numerous irregular ridges which equal in size the finer axial costae. This produces a well defined reticulated pattern. In addition there are much finer spiral threads in between the spiral ridges. Basal area defined by a somewhat thickened ridge and an area of brownish color. Early whorls appear to be slightly angulated. Nuclear whorls not seen. Operculum unknown.

length	width	aperture	
56*	19	10.5x9.5 mm.	Matagorda Island, Texas (broken)
49	18.5	10.0x9.9	Galveston, Texas
36.5*	14.5	8.0x6.0	Matagorda Island, Texas (holotype)

* Nuclear whorls missing.

Types. Holotype, United States National Museum no. 187792, from Gulf Beach, Matagorda Island, Texas, J. G. Mitchell, collector.

Remarks. *Amaea mitchelli* Dall appears to be quite closely related to the genotype *Amaea magnifica* Sowerby. We know nothing about this species other than its existence along the Texas coast. It probably has a more extended range, possibly throughout the northern gulf coast area. All specimens seen were collected dead and all are somewhat beach rolled.

Range. From Matagorda Island to Padre Island, Texas.

Records. TEXAS: Matagorda Island (USNM and T. E. Pulley); Padre Island (J. Hedgpeth); Galveston (ANSP).

Subgenus **Ferminoscala** Dall

Ferminoscala Dall 1908, Bull. Museum Comparative Zoölogy, Cambridge, Mass. **43**, p. 315.

Elegantiscala de Boury 1911, Journ. de Conchyliologie **58**, p. 216 (subgenotype, *S. elegantissima* Deshayes).

Subgenotype, *Epitonium* (*Ferminoscala*) *ferminoscala* Dall, original designation.

Shells imperforate and with the whorls joined. Species in this subgenus possess an exceedingly complex sculpture of both axial costae and spiral ridges. Superficially, the sculpture in general is reticulated. A basal ridge is present and in general set off by a different type of sculpture between the ridge and the base of the shell than that existing between the basal ridge and the portion of the whorl above.

Amaea (Ferminoscala) retifera Dall, Plate 96; Plate 106, figs. 1-4

Scala (Acrilla) retifera Dall 1889, Bull. Museum Comparative Zoölogy, Cambridge, Mass. **18**, pt. 2, p. 312 (17 to 25 miles off the coast of North Carolina at *Albatross* stations 2595 and 2596 in 49 to 63 fathoms).

Description. Shell reaching about 30 mm. ($1\frac{1}{4}$ inches) in length, attenuated, thin but strong, imperforate, and with whorls attached. Whorls 16, strongly convex, with a moderately well defined shoulder angle. Color a dull straw yellow to pale brown with two light and narrow brownish bands, one above and one below the periphery. Suture deeply impressed. Aperture subcircular to ovate with a slightly thickened but non-reflected lip. Columella short and arched terminating below in a very shallow and relatively inconspicuous siphonal canal. Axial sculpture consisting of numerous and fairly high blade-like costae which rise well above the spiral ridges. There are about thirty-two costae on the body whorl. In profile these costae are somewhat scalloped, the low areas being between the spiral ridges. At the point of the whorl shoulder the costae produce rather sharpened points which in turn are responsible for the moderate whorl shoulder. Spiral sculpture consisting of seven or eight ridges which are a little lower than the axial costae. The reticulated pattern thus formed is quite regular and is found on all the whorls below the nuclear whorls. In the little reticulated areas there are both axial and spiral threads which are clearly visible under a 10x magnification. Basal area defined by the lower and basal spiral ridge. In this area the axial costae are low but well defined; spiral ridges though present are rather indistinct, with the fine thread-like sculpture persisting. Early whorls very slightly angulated. Nuclear whorls two, amber in coloration

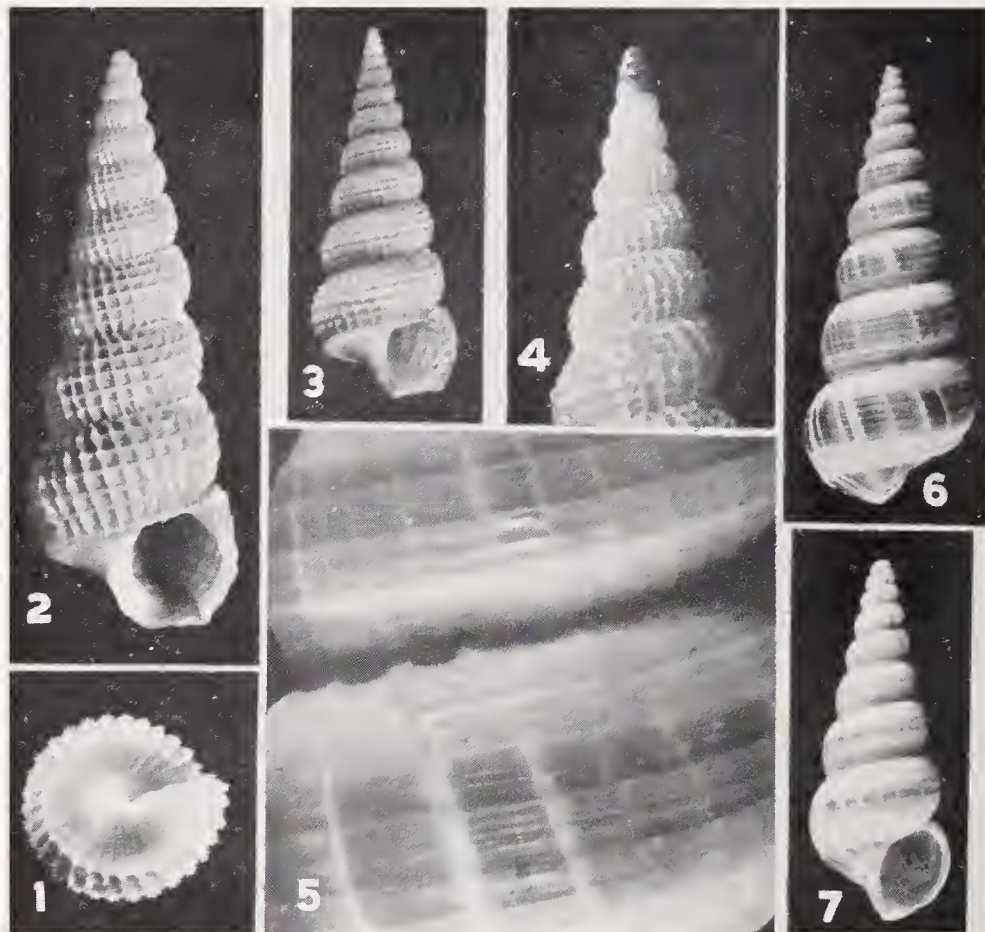


Plate 106. Figs. 1-4. *Amaea retifera* Dall. Figs. 5-7. *Amaea mitchelli* Dall.

Fig. 1. Basal view to show sculpture. From off Carysfort Light, Key Largo, Florida (3x). Fig. 2. Off Sombrero Light, Marathon, Florida (3x). Fig. 3. Off Cape Hatteras, North Carolina, holotype (3x). Fig. 4. Apex to show nuclear whorls (10x). Fig. 5. Enlargement to show sculpture (4x). Fig. 6. Texas (natural size). Fig. 7. From Gulf Beach, Matagorda Island, Texas, holotype (natural size).

and devoid of sculpture. Operculum chitinous, subcircular, paucispiral and with a slightly excentric nucleus.

length	width	aperture	
29	9.3	5.0x4.5 mm.	Hollywood, Florida
26.5	8	4.8x4.0	off Fowey Light, Florida
23	8.5	4.0x3.5	off Key West, Florida

Types. Holotype, United States National Museum no. 83733, *Albatross*, station 2596 (N. Lat. $35^{\circ}08'30''$; W. Long. $75^{\circ}10'00''$) about 17 miles off Cape Hatteras, North Carolina in 49 fathoms.

Remarks. This is a very distinctive species and can be distinguished readily from all others in this family found in the Western Atlantic. On Plate 96 we figure an enlarged photograph which shows the remarkable and complex sculpture. In relationship this species appears to be nearest to *Amaca decussata* Lamarck from the East Indies. However, *Amaca retifera* is a much smaller shell and has somewhat less convex whorls. It appears to be a relatively abundant species throughout its range as the number of our records indicate. It occurs in depths ranging from 13 to 120 fathoms.

Range. North Carolina to Florida, the Gulf of Mexico and south to the Barbados.

Records. NORTH CAROLINA: *Albatross*, station 2595, about 22 miles off Cape Hatteras (N. Lat. $35^{\circ}08'00''$; W. Long. $75^{\circ}05'30''$) in 63 fathoms; *Albatross*, station 2596, 17 miles off Cape Hatteras (N. Lat. $35^{\circ}08'30''$; W. Long. $75^{\circ}10'00''$) in 49 fathoms; *Albatross*, station 2617, 25 miles southeast of Cape Fear (N. Lat. $33^{\circ}37'30''$; W. Long. $77^{\circ}36'30''$) in 14 fathoms (all USNM). FLORIDA: Palm Beach in 70 fathoms (J. Schwengel and T. McGinty); off Hillsboro Light in 40–60 fathoms; off Pompano Beach in 60–70 fathoms; off Hollywood in 45 fathoms; off Fort Lauderdale in 75 fathoms (all L. A. Burry); off Miami (USNM); *Eolis*, station 130, off Fowey Light in 25 fathoms; *Eolis*, station 145, off Long Reef, Elliott Key in 40 fathoms; *Eolis*, station 368, off Ajax Reef, Elliott Key in 80–100 fathoms; *Eolis*, station 166, off Ragged Key, Elliott Key in 65 fathoms (all USNM); 4 miles east of Carysfort Light, Key Largo in 66 fathoms; off The Elbow, Key Largo in 66 fathoms; $3\frac{1}{2}$ miles N.E. of Pacific Reef, Key Largo in 66 fathoms (all L. A. Burry); *Eolis*, station 61, off Turtle Harbor, Key Largo in 40 fathoms (USNM); South of Looe Key in 70–90 fathoms; S.W. of American Shoals in 40–100 fathoms; off Sombrero Light, Marathon in 50–66 fathoms (all L. A. Burry); *Eolis*, station 101, off Sand Key in 101 fathoms; *Eolis*, station 43, off Key West in 63 fathoms; *Eolis*, station 33, off Tortugas in 16 fathoms (all USNM); off Destin, Okaloosa Co. in 14 fathoms (T. McGinty); 15–35 miles off Fort Walton in 13–19 fathoms (L. A. Burry). PUERTO RICO: off Mayagüez (USNM). LESSER ANTILLES: Antigua, English Harbour in 120 fathoms (USNM); Anguilla; St. Barthelemy (both Naturhistoriska Riksmuseet, Stockholm); Barbados, off Telegraph Station and off Lazaretto in 30 to 94 fathoms (both USNM).

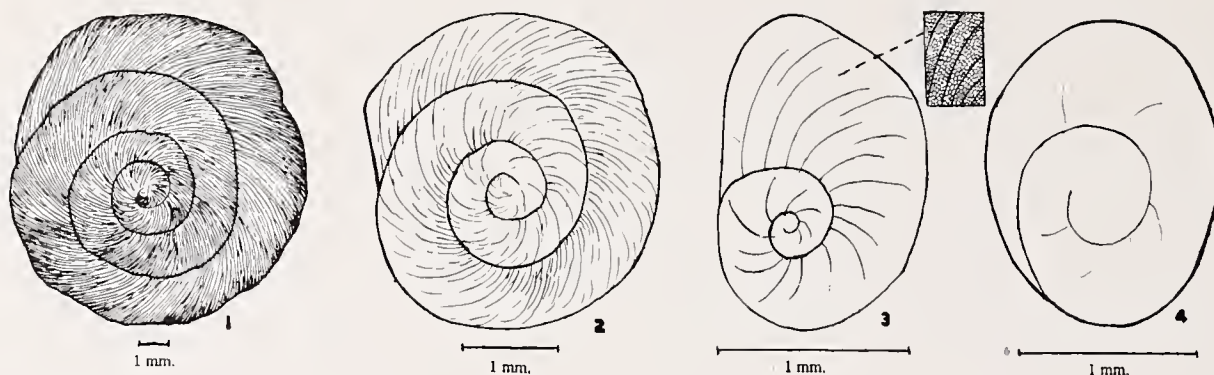


Plate 107. Opercula

Fig. 1. *Sthenorytis pernobilis* Fischer and Bernardi (USNM 459804) very dark brown in color and with rather coarse growth lines. Fig. 2. *Cirsotrema dalli* Rehder (McGinty Collection) dark brown in color with moderate to strong growth lines. Fig. 3. *Opalia pumilio* Mörch (USNM 417378) rather light brown in color and with the entire surface very minutely beaded as shown in the inset. Fig. 4. *Opalia eolis* Clench and Turner (USNM 417292) light horn colored, exceedingly thin, and with the growth and sutural lines barely visible.

Notes

The radula in the few species examined in this family is exceedingly small and rather simplified. Both the rachidian and marginal teeth have been lost. The remaining lateral teeth are somewhat numerous, rather elongate, pointed, and in certain species, possess a small hook on one side and a little above the mid-area of the tooth. Troschel¹ figures two species, *Epitonium greenlandicum* Perry and *Clathrus communis* Lamarck (= *C. clathrus* Linné).

* * * *

At the time this report was in press, Mr. J. L. Chamberlin returned from an expedition to Hudson Bay. At two localities he collected a series of Quaternary fossils including *Acirsa costulata* M. and A. Though still unreported as recent, this species may exist in this little explored area. These deposits were found south of Hazard, Richmond Gulf, Quebec and at Moosonee, James Bay, Ontario.

¹Troschel, F. H. 1875, Das Gebiss der Schnecken, Berlin 2, p. 154, pl. 15, figs. 2-3.

Book Reviews

Thorson, Gunnar 1946: *Reproduction and Larval Development of Danish Marine Bottom Invertebrates*. Meddelelser Fra Kommissionen For Danmarks Fiskeri-OG Havundersogelser, series: Plankton 4, no. 1, pp. 1-573 (pp. 160-317 on mollusks), text figures 1-199. This is one of the most important publications of its kind, dealing with reproduction, eggs and larval stages of many marine invertebrates. Though it is concerned with the northern European fauna, many of the species dealt with also occur in the Western Atlantic and, of course, many genera are common to both sides of the Atlantic even though the species are different.

Much detailed information is given, not only of previously published data but also on the original work of Thorson and C. B. Jørgensen, the latter responsible for the chapter on the Lamellibranchia (pp. 277-311). This work is illustrated with numerous line cuts showing eggs, larval stages and in the case of mollusks, the nuclear whorls of several species. It is unfortunate, however, that the adult specimen was not figured in each case for this is the only way that other workers can be certain as to exactly which species or subspecies produced the eggs. Future name changes or the splitting of a group could make it very difficult to associate the larval stage with the correct species.

Besides the descriptive portion devoted to these marine invertebrates there are important chapters on methods and techniques employed in this study, general remarks on reproduction and larval occurrence and upon the ecology of reproduction and larval development.

A very extensive bibliography is given which covers a wide range of subject matter in this field.—W. J. CLENCH.

Kuroda, T. and T. Habe 1949— : *Illustrated Catalogue of Japanese Shells*. Edited by Tokubei Kuroda, Zoological Institute, Science College, Kyoto University, Kyoto, Japan. This serial publication deals with the mollusks of Japan in a brief monographic style and is written in English. To date, five numbers have appeared, the first on November 1949 and the fifth on May 15, 1950, with a total of 38 [41] pages. All species are figured either with excellent line-cuts or with halftones. So far, each number deals with one or more families and all presently considered are on marine mollusks.

The five numbers published to date contain the following:

No. 1. November 15, 1949	Erodonidae	11 species, 6 pages
No. 2. January 15, 1950	Ringiculidae, Retusidae	19 species, 10 pages
No. 3. February 15, 1950	Hydatinidae, Bullidae, Akeridae	15 species, 8 pages
No. 4. May 10, 1950	Myochamidae	6 species, 6 pages
No. 5. May 15, 1950	Volutidae	17 species, 11 pages

The last number on the Volutidae has a very fine colored plate figuring eleven of the Japanese species.

New species are described rather fully. Known species have synonymies, measurements, type locality and general distribution. Figures are given, but no descriptions, as the illustrations are usually adequate in this category for all diagnostic purposes. The lack of critical remarks regarding the various species and their relationships is, however, a serious omission. In many cases, particularly regarding closely related forms, remarks

that point out characters that differentiate these forms, is the key to their determination.—W. J. CLENCH.

Sullivan, M. Charlotte 1948: Bivalve Larvae of Malpeque Bay, Prince Edward Island Bulletin 77, Fisheries Research Board of Canada, pp. 1-36, 22 plates. In recent years there has been evidenced an increasing interest in the larval forms of marine invertebrates and the means of identifying them. This has been especially true in the case of mollusks and particularly those species of economic importance. Miss Sullivan's paper is an important contribution to the study of bivalve larvae of the Western Atlantic. This work is limited in its scope to the means of securing, identifying and preserving these bivalve larvae. This study was carried on during the summers over a period of four years so that average dates of appearance and relative abundance were obtained. An interesting chart shows the seasonal occurrence and changing abundance of the larvae of different species relative to water temperature. This is an important aid in deciding what larvae might logically be expected to be present in any given plankton tow once the threshold temperature for the spawning of the various species is known. Six principal types of larval shells are recognized and illustrated by line cuts, a definite aid in limiting the number of possibilities when endeavoring to identify a specimen. The larval shells of each of the twenty-two species of bivalves found in Malpeque Bay are fully treated with descriptive and comparative remarks and numerous microphotographs. The original plates were not well executed and a new set was issued and sent to those who had received copies of the paper. Unfortunately, however, the plate captions were not reprinted on these new plates.—R. D. TURNER.