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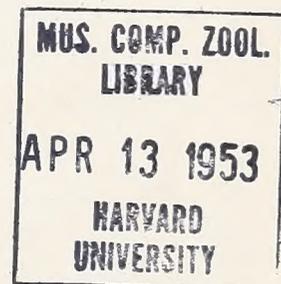
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MONOGRAPHS OF THE MARINE MOLLUSKS OF THE WESTERN ATLANTIC

VOLUME II
Numbers 19-32

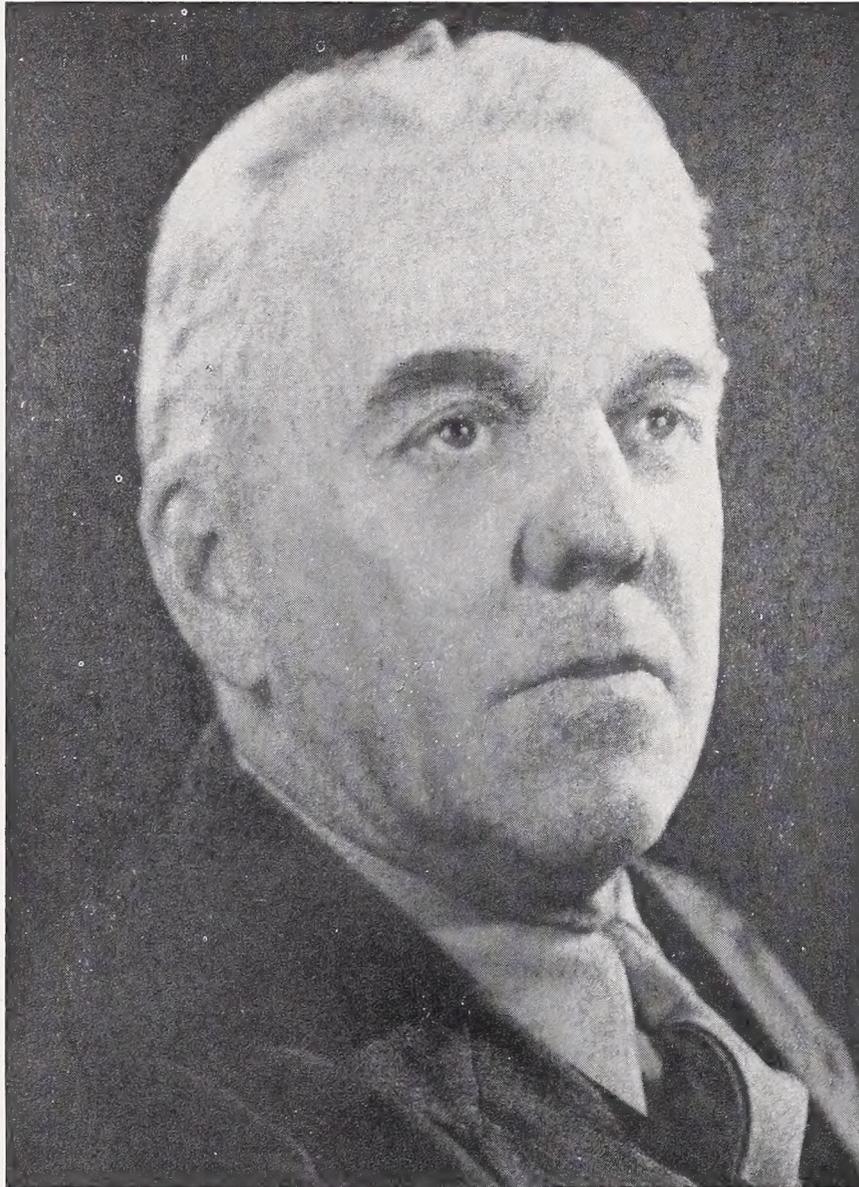
Edited by
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WILLIAM FREDERICK CLAPP
1880-1951

Assistant, Museum of Comparative Zoölogy
1911-1923

Lecturer, Massachusetts Institute of Technology
1923-1933

Founder and President, W. F. Clapp Laboratories, Inc.
Duxbury, Massachusetts
1933-1951

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WILLIAM F. CLAPP

IT is a pleasure to dedicate this second volume of *Johnsonia* to William F. Clapp who was for so long a teacher, friend and colleague.

My first acquaintance with Dr. Clapp dates from the early days of 1914. At that time he was an assistant in the Museum of Comparative Zoölogy, in charge of the Mollusk Department. This position he had held since 1911 and he continued in charge of the mollusk collection until 1923 when he left to take up his work with the National Research Council at the Massachusetts Institute of Technology. Dr. Clapp was a close friend of Mr. C. W. Johnson and both men had a wonderful spirit of interest in others who were at all fond of Natural History. It is little wonder that many young men continued to keep through life the love of natural history which first started under the early stimulation of these men.

Later, in 1933, Dr. Clapp established his own laboratory at Duxbury, Massachusetts, his boyhood home. Here near the sea, where he had the ideal place to continue his research on marine biology, experimental work was possible. From small beginnings—the schooner *M. M. Hamilton*, a house and barn—his laboratory was developed. His was an approach to the control of marine organisms that destroy or disrupt the use of many kinds of installations pertaining to the sea, such as boats, wharves, buoys, intake tunnels, and so forth. Private companies as well as government agencies utilized his knowledge and sought his counsel before a bridge or wharf was constructed. In brief, when any costly installation was planned, his laboratory ran the necessary tests in the area to determine just what procedure and construction was advisable for that place. With the engineers, as with his students of earlier days, he had a happy faculty of making biology vital. As a result of his enthusiastic approach and interest in every problem, engineers and paint chemists who knew him had a far better idea of what happened to water-front installations.

In August 1928, Dr. Clapp made a gift of his Teredo collection which numbered some 2000 lots to the Museum of Comparative Zoölogy. At that time this was by far the most extensive alcoholic collection of this important family ever brought together. He had donated much material before this date and continued to send shells to the museum up to the time of his death. In addition to the Teredo and pholad collection, he had donated 2036 lots of mollusks which he had collected himself or received from others.

The early training which Dr. Clapp had in pure science under Alexander Agassiz and others was manifest throughout his life. He kept alive these interests even in his own industrial laboratory. Though he had very limited time for such work, he saved and preserved many hundreds of specimens of all kinds of boring and fouling organisms for others to study. Certainly without his material our report on *Bankia* could never have been written. In addition, this scientific interest was expressed by his maintaining a museum, exhibiting wood borers and fouling organisms for their educational value and to show the practical results of the treatments employed.—WILLIAM J. CLENCH

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* * * *

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Our grateful thanks are extended to the many persons responsible for the specimens we have had to study in this present volume. Their aid has been invaluable and their interest stimulating. As in the past we are indebted to Marion Bills, Frederick Orchard and Frank White for the many illustrations that grace these pages. All photographs, without acknowledgement, were produced by Frank White, staff photographer in the Biological Laboratories of Harvard University, other than the photographs which appear in numbers 27 and 28 which were sent with Mr. Abbott's paper from Washington.

* * * *

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INTRODUCTION

WE are still at the threshold of knowledge regarding our Western Atlantic mollusks. The descriptive phase of new forms has not as yet ended and will not end, probably for many years to come as more and more areas of our off shore waters are investigated. Even the intertidal realm, the most accessible part of our shore line, is yielding new forms. This descriptive phase, exceedingly important as it is, plays but a part in the vast field of biology that is associated with each species with which we attempt to deal. Basic studies on life histories, particularly in embryology and breeding habits, are most necessary. Studies such as these yield facts that are needed for a better understanding of geographical distribution, methods of dispersal, ecological and faunistic problems.

With the exception of a few pelagic forms, nearly all mollusks are more or less sedentary for the greater portion of their lives. They must become adapted to the many vicissitudes of their environment. Even in the free swimming stage they are subject to the whims of both wind and wave, as their ability to swim is probably only of value in the final stages of their development and then limited to only a few feet or yards if chance has lead them into quiet waters. The young of many species are prodigious in number; chance and fate allow a few to reach the sanctuary of their proper station and they may survive. Many others, such as most of the prosobranch gastropods, have far fewer offspring, but these mollusks have given greater protection to their young by producing egg capsules in which the eggs are laid. Upon hatching, the young with but comparatively few exceptions emerge into their own environment.

If the prosobranch young emerge from the capsules as veligers, they may well be carried beyond their ecological station and perish. It is curious that one of our earlier known deep sea mollusks turned out to be the young stage of an intertidal species in the genus *Thais*. In 1841, d'Orbigny¹ described the genus *Sinusigera* which had been collected by M. de Cande in deep water off the coast of Jamaica. In 1882, Jousseauime worked out the larval stages of a west African *Thais* and found the embryonic shell to be identical with d'Orbigny's *Sinusigera*. Thus *Sinusigera cancellata* d'Orbigny is the young stage of some West Indian species of *Thais* which had been carried out to sea where it perished when the larval stage was over.

Others emerge from the egg capsule as young-shelled gastropods, the veliger stage having been passed within the capsule. Food in the form of nurse eggs is provided for many species, while others are each provided with a large yolk sac which is sufficient for their growth and development until they leave the capsule. In many genera the eggs are laid in gelatinous masses or gelatinous strings, and in others, such as in the Epitoniidae, the eggs are produced in strings, each egg or perhaps aggregation of eggs covered with agglutinated sand grains. However, information of this sort is completely lacking for most of our mollusks.

This introduction is not meant to be a discussion of larval development, but only to point out some types of information that are known for only a limited few of our species and the kind of data that are most needed to aid in solving the many problems that confront the marine biologist.

¹See *Johnsonia* 2, pp. 68-69 for references to d'Orbigny and Jousseauime.

Preserved material is sadly needed in many genera. This is particularly true of the rarer species about which we know so little. We would be grateful to any of our readers who might be interested in collecting and preserving the less common species for us. It is best to use grain alcohol if possible, wood alcohol if the other is not available. If neither can be obtained, specimens can be preserved for an extensive period of time in ordinary table salt. Avoid the use of formaldehyde as it eventually destroys the shell, and, in addition, it is far more difficult to soften the tissues by soaking the animal in trisodium phosphate.

Notes

In *Johnsonia* 2, no. 25 (Truncatellidae), page 159, we erected the subgenus *Tomlinella*. As this name was preoccupied by *Tomlinella* Viader 1938, Bulletin of the Mauritius Institute 1, page 6, we changed our name to *Tomlinitella* Clench and Turner, *Occasional Papers on Mollusks* 1, no. 13, page 159, 1948.

* * * *

In our earlier studies on the family Epitoniidae we placed *Depressiscula* de Boury in the synonymy of *Gyroscala* de Boury (*Johnsonia* 2, p; 281). Later when we had more material for consideration, we gave *Depressiscula* the rank of a genus (*Johnsonia* 2, p. 327). This change was the result of our having received specimens of *Scala aurita* Sowerby, the genotype of *Depressiscula*.

* * * *

After the last number of *Johnsonia* was in press, we received a paper by Mr. W. K. Ford on a biographical sketch of Frederick P. Marrat. His name is associated with that of the Rev. Higgins, co-author of *Murex imbricatus* (= *M. argo* Clench and Farfante), see *Johnsonia* 2, p. 360. Mr. Ford's paper appeared in the Liverpool Bulletin of the Libraries, Museums and Arts Committee 2, pp. 30-36, Feb. 1953.

* * * *

ERRATA

No. 22, page 5, plate 28, caption should read *Scaphella* (*Scaphella*) *junonia* Shaw.

No. 23, page 65, plate 33, figs. 3-4, add *Purpura patula* Linné.

No. 23, page 75, plate 36, fig. 7, read *Thais haemastoma forbesii* Dunker.

No. 28, page 220, the correct spelling is *Tomas Barrera*.

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APRIL 27, 1946

TEREDINIDAE

VOL. 2, NO. 19*

THE GENUS *BANKIA* IN THE WESTERN ATLANTIC¹

BY

WILLIAM J. CLENCH AND RUTH D. TURNER²

Boring mollusks present some of the most important biological problems in the Mollusca. Their life histories are extremely complicated and economically they are a factor of tremendous importance in the deterioration and destruction of marine structures such as wharves and boats, particularly those built of wood and concrete. The two most important families which contain species that bore into stone, inferior grades of concrete, wood and rope are the Pholadidae and Teredinidae. The former are known to bore into

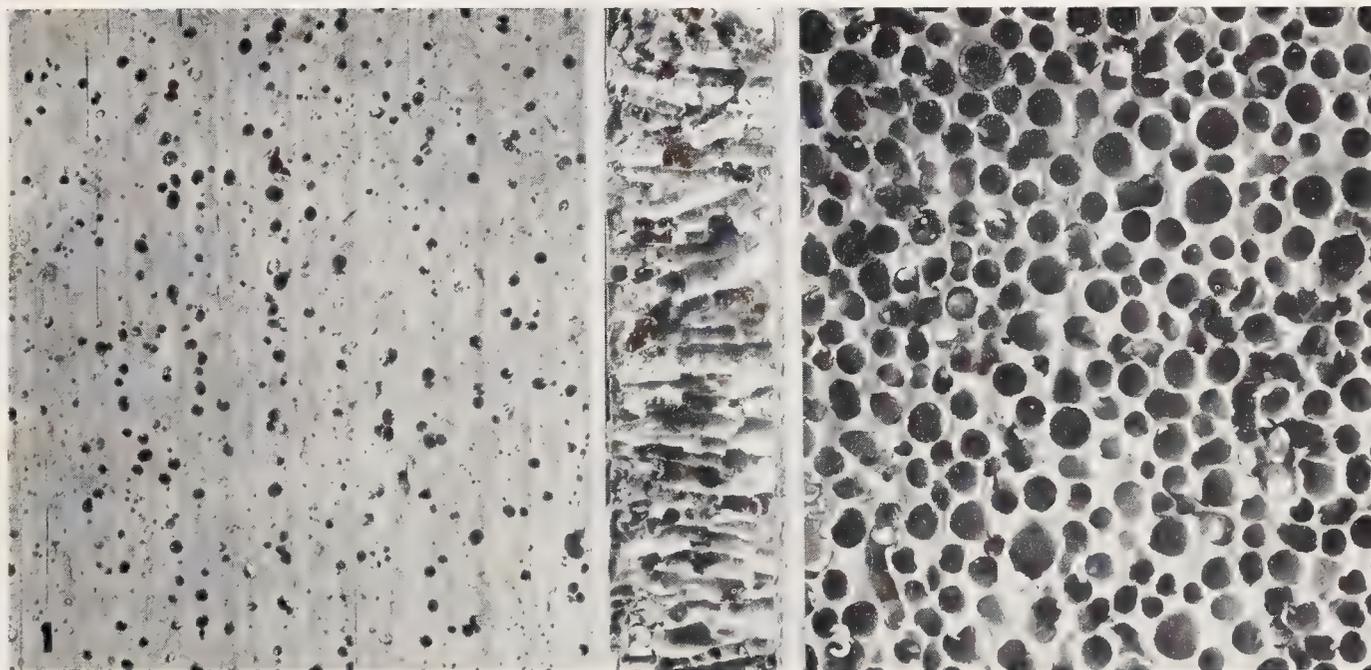


Fig. 1

Fig. 2

Fig. 3

Plate 1. Damage by *Bankia gouldi* Bartsch

First layer of a laminated test-board from Pensacola, Florida. (Submerged December 22, 1944, removed from water August 22, 1945. Board examined monthly, no apparent damage until May.)

Fig. 1. Outside of board showing minute entrance holes. Smaller holes are those of *Bankia* that were living at time of removal; larger holes are those of *Bankia* that were dead at time of removal. Fig. 2 Cross-section through one-half inch board. Fig. 3 Inside of board showing tunnels after one-half inch of growth. All enlarged $1\frac{1}{2}\times$. Specimen from the William F. Clapp Laboratories.

Photographs by F. P. Orchard

**Johnsonia*, Volume 2, starts with number 19.

¹ Published with the aid of a Milton grant.

² Ruth Dixon Turner, Research Assistant, Department of Mollusks, Museum of Comparative Zoölogy. Formerly, Biologist, W. F. Clapp Laboratories.

all these substances, even into the covering of marine telegraph cables, while the various members of the Teredinidae are limited to boring into wood, rope and asphalt.

The Teredinidae are probably the most important economically among all families of Mollusca. The amount of damage caused by the many species in this family probably exceeds by far the total income from the sale of mollusks that are used for food, art work and all other purposes. The destruction caused by this group in recent years is clearly evidenced by the exhaustive reports which have been published on marine piling investigations. During the years 1919 to 1921 there were sudden and severe invasions of borers in San Francisco Bay. This was due to a decline in rain fall and an intensified program of irrigation. The resultant lowering of the river waters allowed the salt water of the bay to advance up the tidal areas of these rivers. This created conditions favorable to the spread of *Teredo* and *Bankia*. The damage caused at this time resulted in the complete collapse of almost every wooden structure in San Pablo Bay with a loss of \$25,000,000. Following this catastrophe the committee on Marine Piling Investigation was organized by the National Research Council and their report was published in 1924. In 1927, the San Francisco Bay Piling Committee published a complete study of the marine borers in that locality. In 1933 the situation became serious in New England, and as a consequence, a New England Committee was formed. The Australians likewise have been faced with this problem and from their researches two reports have appeared: one for the Port of Sydney and the other for the Port of Brisbane. All of these papers are of great importance to students in this group as considerable space in each is devoted to the biology and taxonomy of the Teredinidae. These reports are, of course, only a fraction of the very large body of literature that has been written about these animals from both a taxonomic and an economic point of view.

The present study concerns the taxonomy of the genus *Bankia*, one of the genera in the family Teredinidae. All members of this family are commonly referred to as shipworms, as pileworms and in Australia as "cobras."

We are under great obligation to Dr. William F. Clapp¹ of the Clapp Laboratories, Duxbury, Massachusetts for the very large collection of Teredinidae which he donated to this museum in 1928. Since that time he has more than doubled the original collection and today it numbers more than 5,000 specimens. All of this material was obtained from test-boards, wharves, bridges and other permanent structures in ports throughout the world. The majority of the specimens, however, are from the Western Atlantic.

The pallets and shells of each specimen in this collection are preserved together in glycerine-alcohol for permanency. It is necessary to keep the pallets moist because they consist in part of a chitinous periostracum. In drying out this generally scales off and consequently the differential characteristics contained in this covering are lost. The best method, to our knowledge, is to preserve them in a mixture of four parts alcohol (70%) and one part glycerine. The glycerine keeps the periostracum soft and pliable, and if the alcohol evaporates the pallets will remain moist for a considerable period of time. Permanent slides can be made by mounting the pallets in diaphane or euparal directly from the specimens that have been preserved for some time in glycerine-alcohol or from fresh

¹ Biologist, National Research Council, Committee on Marine Piling Investigation in the Western Atlantic (1922 to 1924).

specimens that have been placed in 75% alcohol for 24 hours. Magnifications of 10 to 24 diameters will allow ready identification in all cases. It is to be borne in mind, however, that the pallets must be in excellent condition for proper identification. Dried pallets or those that have started to decompose lose much if not all of the periostracum. Many species in this family remain unknown, other than by name, as the original diagnosis was based upon incomplete or poorly preserved specimens.



Fig.
1

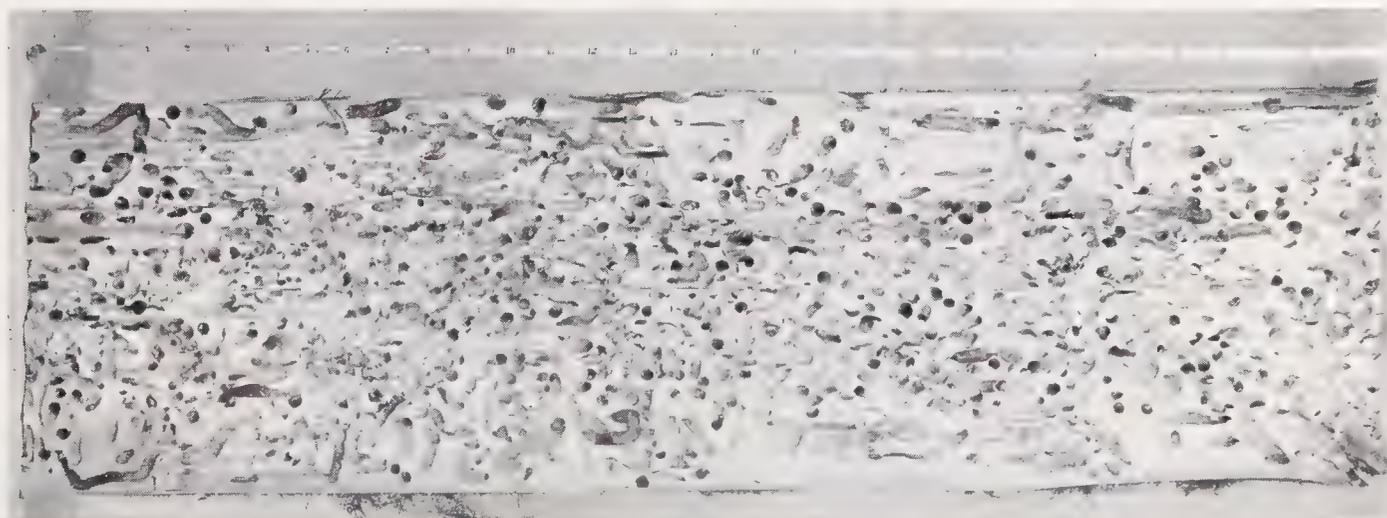


Fig.
2

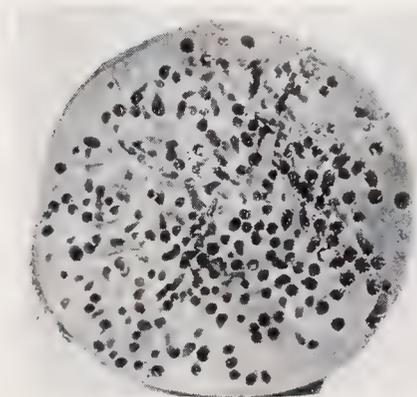


Fig.
3

Plate 2. Damage by *Bankia gouldi* Bartsch

Cypress dolphin piling from near channel, Cape Fear River, Wilmington, North Carolina. Driven August 1, 1944, pulled May 5, 1945.)

Fig. 1. Outside of piling showing almost no evidence of damage other than at the $2\frac{1}{2}$ -inch exposed area, Upper half cleaned of marine growth. Fig. 2. Inside of piling (split midway) showing the extent of destruction. Fig. 3. Cross-section of piling. (All greatly reduced. Actual size 2 feet, 10 inches in length and 10 inches in diameter.) Specimen from the William F. Clapp Laboratories. Photographs by F. P. Orchard

NOTES ON THE LIFE HISTORY OF *Bankia gouldi* BARTSCH

The following notes on the life history of *Bankia gouldi* Bartsch fit all species in this genus so far as now known. These notes have been obtained mainly from the paper on this species by C. P. Sigerfoos.

Though shipworms begin life in a typical molluscan fashion, the adults are probably among the most specialized and striking of all pelecypods. The eggs of *Bankia gouldi* are extruded from the exhalant siphon and are fertilized in the water. Development of

the egg is very rapid and on warm days the embryo may become free-swimming within three hours, reaching the typical veliger stage within a day. During the free-swimming stage, which probably lasts about a month, the shipworm closely resembles a typical minute bivalve except for the possession of a velum or swimming organ. At this stage the young may also crawl about rapidly, but once a point of attachment has been selected they fasten themselves by a single byssus thread and immediately scrape a shallow depression in the surface of the wood. By cementing these scrapings together, they build a small conical covering for protection. Once within this protective covering a metamorphosis takes place. The velum is lost, the foot becomes pestle-shaped for aid in boring, and the shell becomes specialized, gaping anteriorly for the projection of the foot and posteriorly for the extension of the long body. Under favorable conditions this change requires about two days and after this time the young *Bankia* begins to bore and develop rapidly into an elongate animal, enlarging its burrow as it increases in size. According to Sigerfoos, a newly attached larva is less than 0.25 mm. in length; within twelve days it is 3 mm., and in 36 days 100 mm. (about 4 inches). The rate of growth is dependent upon the salinity and temperature of the water, the food supply and the crowding of the animals. When extreme crowding prevails stunted or stenomorphic individuals result.

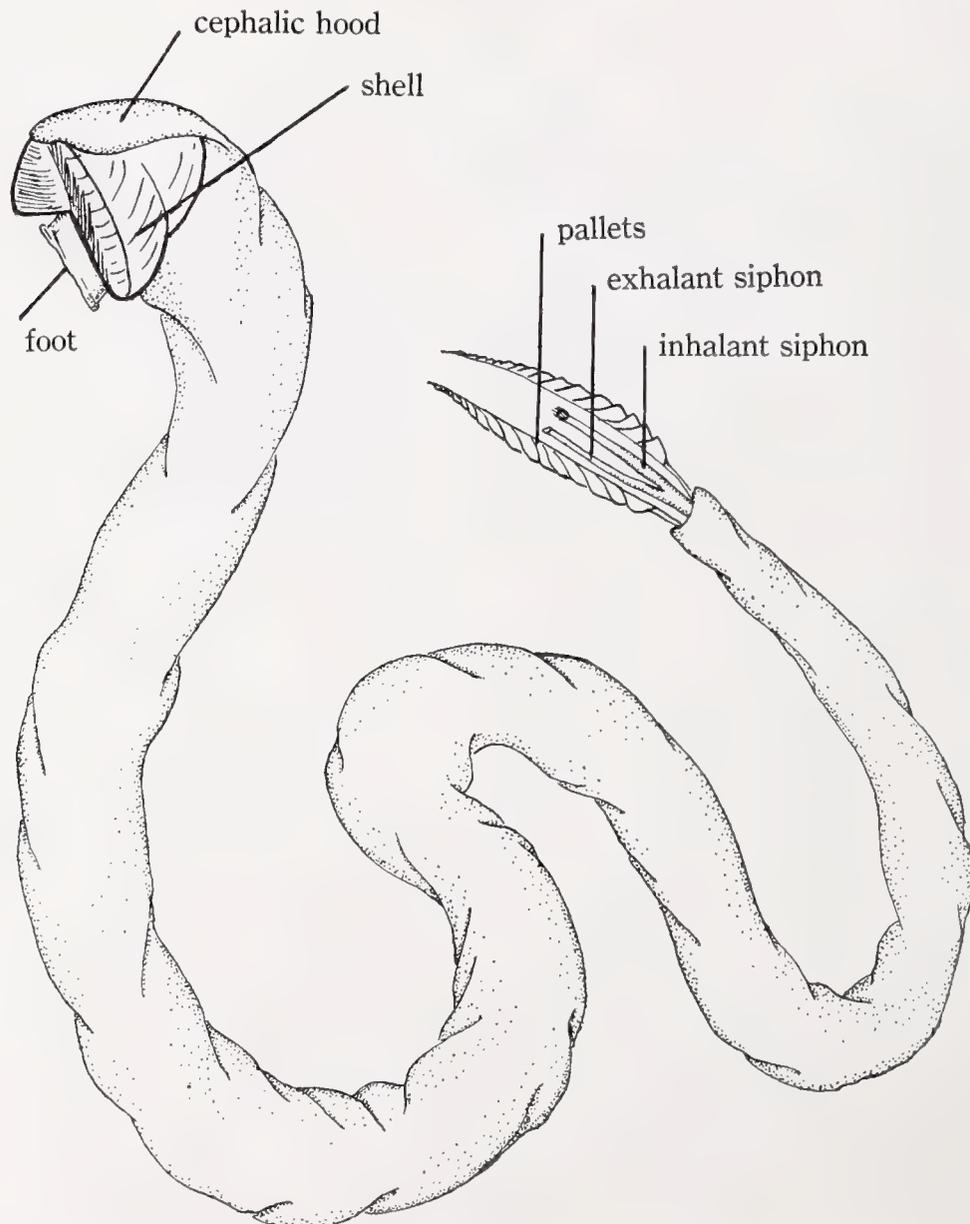


Plate 3. Diagrammatic drawing of an entire *Bankia*, showing relative position of shell and pallets (lateral view).

Under general conditions the shell of an adult specimen is about 1/40 of the total length of the animal, the remainder of the body being protected by the wood in which it bores. The mantle secretes a thin, smooth calcareous lining for the burrow as an added protection to the soft body. The pallets which are located at the posterior end of the animal can be pushed forcibly into the minute opening at the end of the burrow as a plug, thus giving protection from enemies, changes in salinity or other adverse conditions. When the shipworm is undisturbed the pallets are withdrawn and the siphons are extended into the water for breathing and feeding.

DESCRIPTIVE CHARACTERS OF SHELLS AND PALLETS OF THE TEREDINIDAE

External view of shell. The shell consists of three main parts, the lobe, the disc,¹ and the auricle. The lobe, the anterior part of the shell, is covered with rows of denticulations which run parallel to the ventral margin. The number of rows and spacing between them vary with the age and rate of growth of the specimen. On the dorsal part of the lobe there is a smooth non-denticulated area, the umbo, from which the rows of teeth radiate. The ventral margin of the lobe meets the anterior margin of the disc at about a right angle. The disc is divided into three parts, anterior, median and posterior. The anterior portion of the disc is armed with rows of denticulated ridges which run parallel to the anterior margin. These rows of denticles are coarser and more crowded than those on the lobe, the spaces between the rows being very narrow. The median portion of the

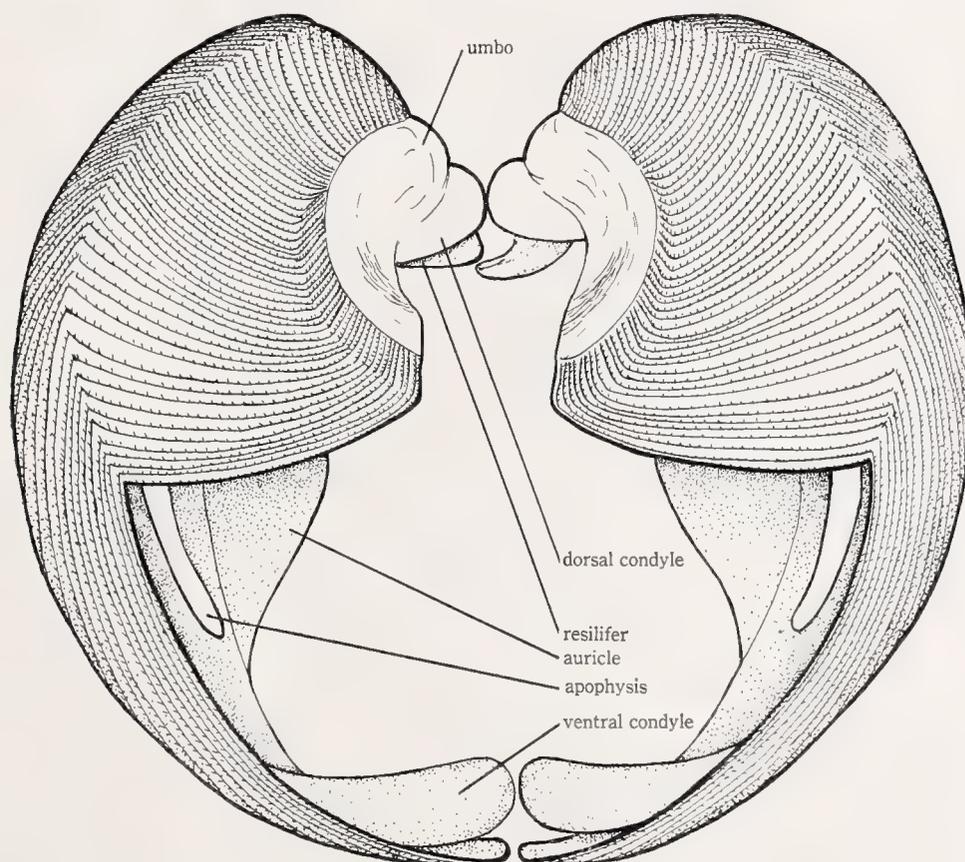


Plate 4. Anterior view (pedal gape) of teredinid shell showing various structures and the apposition of the condyles upon which the two valves rotate.

¹The disc is also known as the median area and the three portions of the disc as anterior median area, middle median area, and posterior median area. To be consistent with the terminology employed in the descriptions of other bivalve shells, we have retained the term *disc* when referring to the central portion of the valves.

disc is without denticles, is usually much narrower than the anterior and posterior portions, and sometimes may be slightly elevated. The posterior portion of the disc is broad and marked with concentric lines of growth. The auricle is posterior to the disc. This part of the shell is largely imbedded in the mantle of living specimens. The line of fusion between the auricle and the disc may be almost invisible or, again, so marked that a distinct shelf is formed on the internal side where the two overlap.

Internal view of shell. The main portions of the shell discussed for the external view can readily be distinguished internally, and in addition there are four more parts to be seen, namely the dorsal and ventral condyles, the shelf, and the apophysis. On the internal edge of the umbo may be seen the dorsal condyle. The ventral condyle is located at the ventral margin of the median portion of the disc. In boring, the two valves rotate

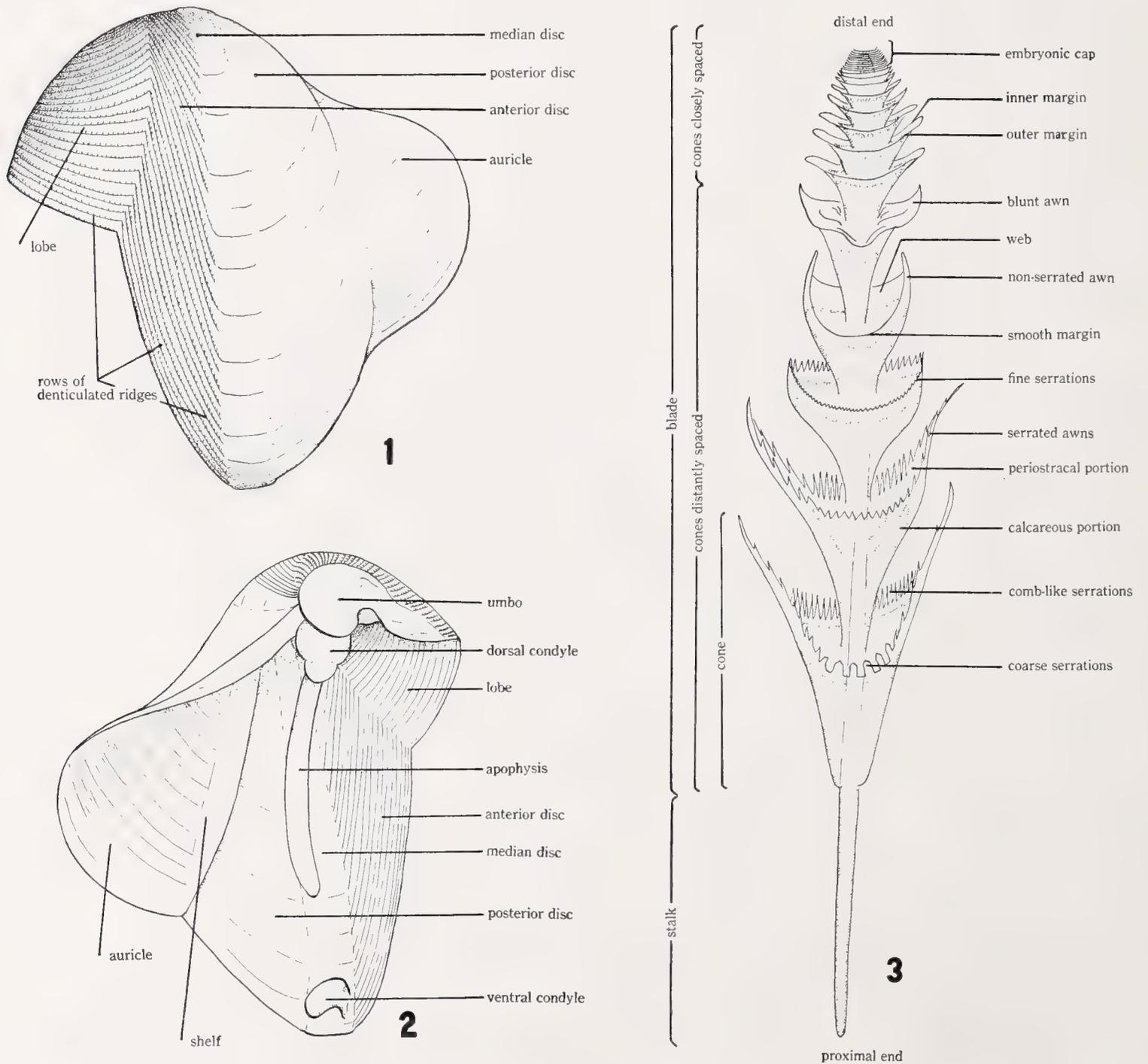


Plate 5. Diagrammatic drawing of shell and pallets, to show various parts and to indicate descriptive terms. Fig. 1. External view of shell. Fig. 2. Internal view of shell. Fig. 3. Hypothetical pallet to show the forms of cone structure and modification of the periostracum.

on these processes. The apophyses, to which the muscles of the foot are attached, originate on the under side of the dorsal condyles and extend to about one-half the distance between this and the ventral condyles. The shelf which is formed by the overlapping of the auricle and the disc may be almost invisible or quite marked, its width and depth varying with the species and the age of the specimen.

The denticulated ridges of the shell are the cutting tools of the boring mechanism. As the two valves rotate back and forth, pivoting on the dorsal and ventral condyles, the denticles scrape away minute particles of wet wood. The foot plays an important part in boring, for by means of suction, it holds the animal in one position during the cutting operation. The position of the valves, of course, is changed from time to time as the burrow is lengthened. The backward rotation does the cutting and as a consequence the posterior adductor muscle which is attached to the auricle has become greatly enlarged to aid in this work. The anterior adductor muscle remains small and its function is to bring the valves forward again. The muscles of the foot are attached to the apophyses.

Pallets. The pallets of all teredinids are made up of two parts, the blade and the stalk. The blade, which is the broad flat portion, is made up of one piece in the genus *Teredo*, but composed of several cone-like elements in the genus *Bankia*. The stalk is usually nearly circular in cross-section and in some species is clearly visible through the cones. In cross-section the blade of the pallet is flattened on the inner surface and convex on the outer surface, the degree of convexity varying greatly with the species and individually within any one species. The cone-like elements which make up the pallets are most distinctive and are of great importance taxonomically. They are made up of a calcareous base and are covered with a thin chitinous periostracum. The amount of periostracum varies with the species. Its upper margin may be smooth or serrate and in many species it is produced laterally to form awns. The spacing of the cones is generally consistent within the species though much depends upon the rate of growth of the individual.

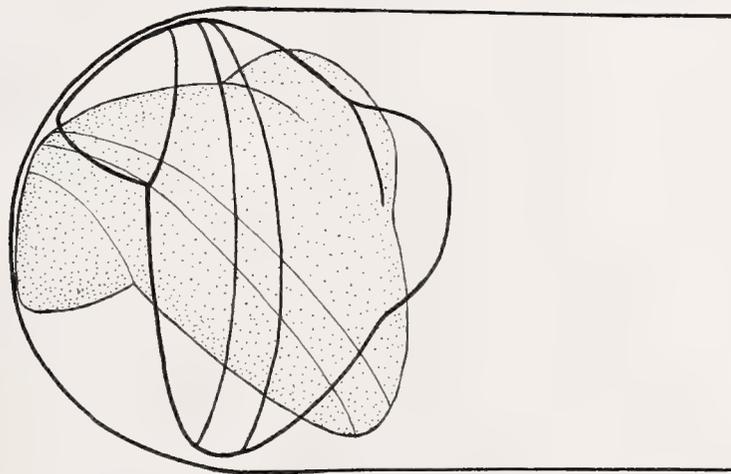


Plate 6. Diagrammatic drawing of a teredinid shell in the burrow, to show two positions in boring (lateral view).

Genus *Bankia* Gray 1842

Bankia Gray 1842, Synopsis of the Contents of the British Museum, ed. 44, p. 76; 1847, Proc. Zool. Soc. London, p. 188: *non Bankia* Guenée 1852.

Xylotrya Leach of authors, *non* Menke 1830, Synopsis Methodica Molluscorum, Pyrmont, p. 121.

Genotype, *Teredo bipalmulata* Lamarck (original designation, Gray 1842).

The shell is small, seldom exceeding 15 mm. in height. When the two opposing valves are in normal position it is nearly spherical in shape. The shell gapes widely both anteriorly for the foot and posteriorly for the body, the shell being only a small fraction of the length of the animal. Each valve is composed of three main parts, the lobe, the disc and the auricle. The lobe and the anterior portion of the disc are armed with closely set rows of denticulated ridges. It is extremely difficult, if not impossible, to separate with any degree of certainty the shells of this genus from those of the genus *Teredo*. The pallets are elongate and consist of a series of cone-like sections which are composed of lime and are covered with periostracum. The margin of the periostracum may vary from being non-serrated and without awns to being deeply serrated and possessing long awns. The cone elements are built on a central stalk: the individual elements, however, are free from each other (not fused) and can be easily separated. This character differentiates the genus *Bankia* from the genus *Nausitora*, the latter having the multiple cone elements fused together.

The name *Xylotrya* 'Leach' Menke 1830 has been the cause of considerable confusion. The name did not appear officially until 1830 when Menke listed it as a synonym under *Pholas*. Whatever Leach had intended in manuscript for this genus is, of course, of no moment now. Its use by Menke, however, was valid and the name must date from his Synopsis Methodica Molluscorum. Gray, in 1847, synonymized his own genus *Bankia*, which he had proposed in 1842, under *Xylotrya* and for the genera *Xylotrya* and *Bankia* he gave as type *Teredo bipalmulata* Lamarck. Unfortunately, this type selection cannot be used for *Xylotrya* as Menke's use, even as a synonym, was under the genus *Pholas*. In order to avoid confusion for future workers, we here select *Pholas dactylus* Linné as the type of *Xylotrya* Menke, thus making the latter an absolute synonym of *Pholas* Linné which possesses the same type, designated by Children in 1823.

Subgenus *Bankia* Gray

Bankia Gray 1842, Synopsis of the Contents of the British Museum, ed. 44, p. 76.

Subgenotype, *Teredo bipalmulata* Lamarck (original designation, Gray 1842).

The species of this subgenus have a serrated margin of periostracum on the inner surface and a narrower and smooth-edged margin on the outer surface. The lateral portions extend as long awns. The awns are not of equal length on the same cone, one being nearly twice as long as the other. The two pallets of a specimen are really mirror images of one another, so that when the pallets are in normal position, the long awns are opposite each other and the short awns are also opposite each other.

The characters of *B. bipalmulata* Lamarck, the genotype, were never clearly outlined until the re-examination of the type material by E. Lamy (1927, pp. 267-268). We quote a translation from Lamy's report:

"The alcoholic collection of mollusks in the Museum of Paris includes a specimen,

no. 81, in a very bad state of preservation (except the pallets) labelled *T. palmulatus* Lk. with this indication of origin: 'Pondichery-Adanson.' This is probably the specimen which Lamarck described and which, moreover, is perhaps the specimen examined by Adanson.

"This Indian form ought to keep the oldest name of *T. bipalmulata* Lk. Its pallets are formed of about twenty triangular cups, the outer angles of which are extended, forming two heavy projecting spines, of which the upper is longer than the lower."

No species in the subgenus *Bankia* is known to occur in the Western Atlantic. However, we include a synonymy and description and figures of *Bankia bipalmulata* Lamarck to aid in a better understanding of this group. Our studies are based upon material from the New Hebrides and Hawaiian Islands.

Bankia (Bankia) bipalmulata Lamarck, Plate 7, fig. 1-5

Teredo bipalmulata Lamarck 1801, *Système des Animaux Sans Vertèbres*, p. 129 (no locality); Lamy 1926, *Jour. de Conch.*, **70**, p. 266.

Teredo palmulatus Lamarck 1818, *Animaux sans Vertèbres*, **5**, p. 440 (Indian Ocean [Pondichéry, India]); non *T. palmulata* Forbes and Hanley 1853.

Bankia rubra Sivickis 1928, *Philippine Jour. Sci.*, **37**, p. 288, pl. 1, fig. 6 (living mangrove stems, Puerto Galera, Mindoro Island, Philippines).

Bankia kingyokuensis Roch 1931, *Mitt. Zool. Staatsinstitut Zool. Mus. Hamburg*, **44**, p. 20, pl. 2, fig. 21 (Kinyoku, Takanoshima, Japan).

Bankia (Neobankia) konaensis Edmondson 1942, *Occasional Papers B. P. Bishop Museum*, **17**, no. 10, p. 134, fig. 10a-c (Kealakekua Bay, Kona, Hawaii).

Bankia (Neobankia) hawaiiensis Edmondson 1942, *Occasional Papers B. P. Bishop Museum*, **17**, no. 10, p. 136, text fig. 11a-e (Oahu, Hawaiian Islands).

Description. Shells similar to those of *B. gouldi*, and adults under favorable conditions are quite large. Old specimens generally produce a very distinct shelf on the inside of the shell where the disc and auricle overlap. The apophysis is long, and in adults, it is fairly wide and minutely and irregularly serrated on its inner edge. Pallets consisting of a series of widely spaced cones with the blade rather narrow in proportion to its length. Both the calcareous part and the periostracum rather strong and heavy. Outer margin of periostracum smooth and broadly U-shaped, inner margin nearly straight and rather coarsely serrated. Lateral processes extending as long awns, one being twice the length of the other. Each pallet is a mirror image of the other so that in a normal condition of apposition the long awns fit together and the short awns also fit and oppose one another. In plate 7, if the inner pallet (fig. 2) was placed underneath the other pallet (fig. 1), which would be the natural position, the long and short awns of each cone would be opposite each other. In very young specimens, the awns are of nearly equal length (fig. 3).

height	length	pallet (length)	
11.5	11	48.5 mm.	New Hebrides
7	7.5	28	Pearl Harbor, Oahu

Types. Lamarck's type of *bipalmulata* is no. 81 in the National Museum in Paris. The holotypes of *B. hawaiiensis* Edmondson and *B. konaensis* Edmondson are in the B. P. Bishop Museum, Honolulu and the holotype of *B. kingyokuensis* is in the Berlin Museum. The holotype of *B. rubra* Sivickis was probably destroyed when the Japanese burned

the Philippine Bureau of Science during the recent war. The type locality is Pondichéry, India as given by Lamy from Lamarck's label in the Paris Museum.

Common name. Oriental Shipworm.

Remarks. This species would never have been understood had it not been for the re-examination of Lamarck's type specimen by Lamy. The great confusion that existed in the early literature, particularly among the English malacologists, was due to the fact that Lamarck described the pallets so briefly, merely indicating that they were those of the present genus *Bankia*. As a consequence about all of the various species now considered in the genus *Bankia* that were described prior to 1875 were called *bipalmulata* and *palmulata* at one time or another.

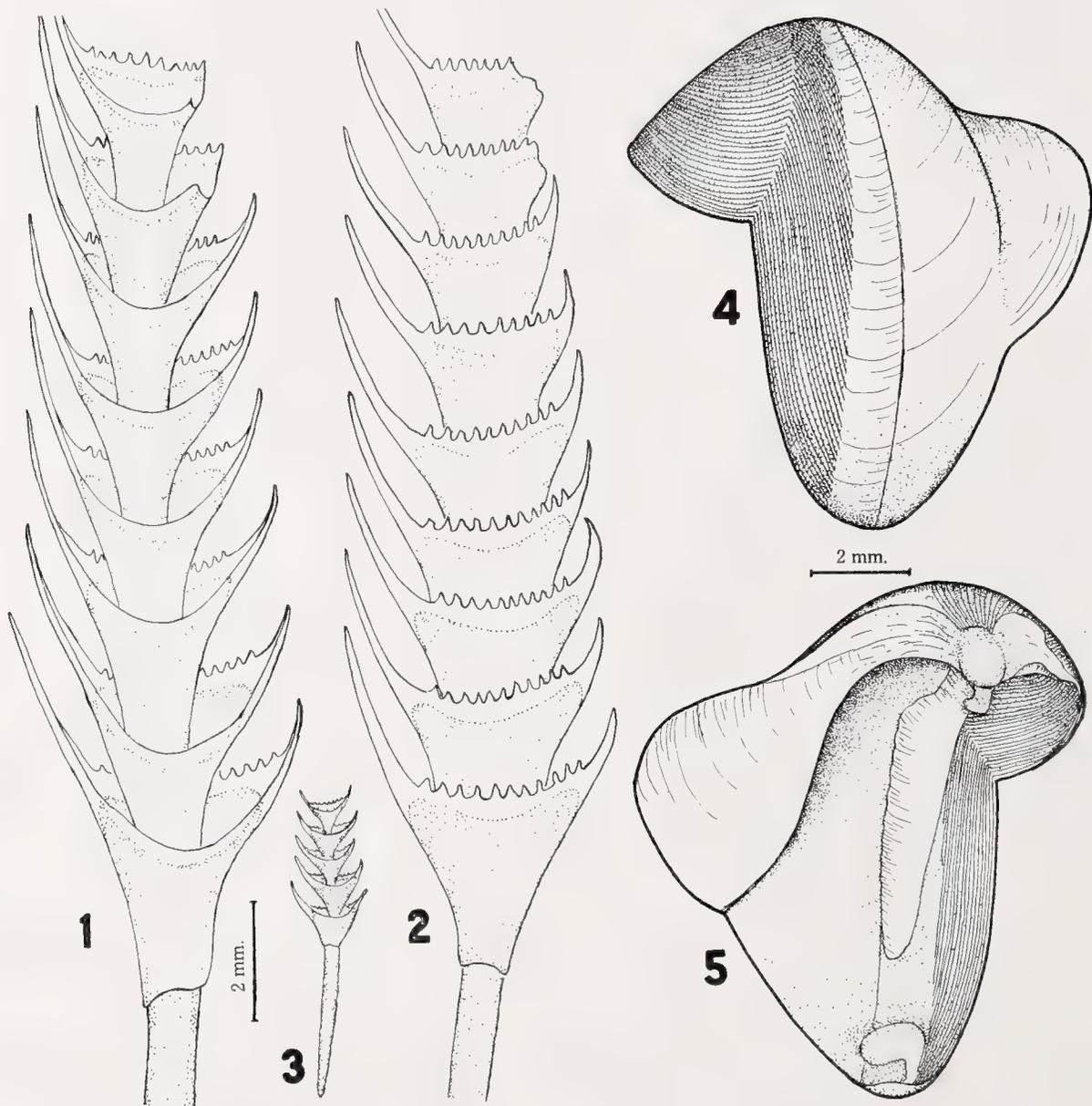


Plate 7. *B. bipalmulata* Lamareck¹

Espiritu Santo Island, New Hebrides. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of opposite pallet. Fig. 3. Pallet of young specimen showing nearly equal awns (same magnification). Fig. 4. External view of shell. Fig. 5. Internal view of same shell.

¹ All drawings of pallets and shells were made by the junior author with the aid of a standard camera-lucida and enlargements of these drawings by means of a Berville camera-lucida.

We have given above in our synonymy a few names which refer to this widespread Indo-Pacific form. There are unquestionably several more which will eventually prove to be the same as *bipalmulata* Lamarck.

This species very probably extends throughout the Indo-Pacific area. It is extremely destructive wherever found due to its large size and rapid growth. Edmondson (1942, p. 183) records the largest specimen as 175 mm. (7 inches) after a growth period of only 65 days. Test boards from the New Hebrides (W. F. Clapp Laboratories) were completely riddled in a matter of 90 days. These boards measured 12×6×2 inches.

Edmondson's statement (1942, p. 137) that the growth in *B. hawaiiensis* takes place at the *distal* end of the pallet is most peculiar to say the least—in fact he uses this character to separate this species from his new *B. konaensis* which he states adds new cones to the pallet on the *proximal* end. All pallets of *Bankia* are added to on the proximal end. Edmondson was apparently misled by the peculiar compact embryonic terminations that he had observed in an extremely young specimen of *B. hawaiiensis*. The young pallet figured by Edmondson may not even belong to his *B. hawaiiensis*. A very clear description of the pallet growth is given by Sigerfoos (1908, p. 206).

Range. Hawaiian Islands and west to Japan (Roch and Moll), the Philippines (Sivickis) and probably south to New Caledonia and west at least to India (Lamarck).

Records. HAWAIIAN ISLANDS: Pearl Harbor, Oahu. NEW HEBRIDES: Espiritu Santo Id. (both MCZ).

Key to the Western Atlantic subgenera of *Bankia*

- | | |
|---|--------------------|
| 1. Periostracal margin of the cones non-serrated | 2 |
| Periostracal margin of the cones serrated | 4 |
| 2. Awns rather broad, projected away from the cone above | 3 |
| Awns narrow and fine, projected upwardly against the cone above | <i>Bankiella</i> |
| 3. Embryonic cones plate-like and compact | <i>Bankiopsis</i> |
| Embryonic cone similar to later cones, not compact | <i>Liliobankia</i> |
| 4. Cones with long and serrated awns | <i>Plumulella</i> |
| Cones without awns | <i>Neobankia</i> |

Key to *Bankia* of the Western Atlantic (pallets only)

- | | | |
|--|---|------------------------------------|
| 1. Margin of cone periostracum non-serrated | 2 | |
| Margin of cone periostracum serrated | 4 | |
| 2. Awns short and fine, connected by a wide margin of periostracum on the inner surface | | <i>gouldi</i> |
| Awns short and broad | 3 | <i>B. gouldi</i> |
| 3. Cones funnel-shaped, moderately spaced, embryonic cones crowded forming compact tip | | <i>caribbea</i> |
| | | <i>B. caribbea</i> |
| Cones funnel-shaped, distantly spaced, embryonic cones not crowded | | <i>katherinae</i> |
| | | <i>B. katherinae</i> |
| 4. Cones without awns
(cones closely spaced, <i>destructa</i> ; cones distantly spaced, <i>zeteki</i>) | | <i>destructa</i> and <i>zeteki</i> |
| Cones with awns | 5 | <i>B. zeteki</i> |
| 5. Cones closely packed, periostracal margin with fine serrations, awns moderately long and serrate | | <i>cieba</i> |
| Cones distantly spaced, awns large and serrated | 6 | <i>B. cieba</i> |
| 6. Periostracal margin wide, calcareous portion V-shaped | | <i>fimbriatula</i> |
| Periostracal margin rather narrow, with coarse serrations, calcareous portion broadly U-shaped | | <i>fosteri</i> |
| | | <i>B. fimbriatula</i> |
| | | <i>B. fosteri</i> |

Stippled areas indicate the calcareous portion of the cones.

As stated elsewhere we have found the shells in this genus to be nearly useless for purposes of identification. This same observation has been frequently made by nearly all students of this genus and upon other genera in this complex family. Dr. W. F. Clapp, during the course of several years study, made every attempt possible to differentiate the shells of one species from those of another by all the observable characters possessed by the various structures of the valves. Cross sections were made to obtain profiles of the denticulated ridges, countless measurements made and other usual taxonomic procedures followed to determine if any of these unit observations would be of value. These studies were all based upon a very large collection of material. The results were all negative as far as any one character or even the summation of several characters was concerned. Extreme variation and very marked differentiation are brought about by the individual nature of the local conditions under which each specimen lives. In addition, there is a marked change in the shell outline and the morphology of the various structures during the life of the individual.

We have given a full description of the shell of *Bankia gouldi*. General statements of a comparative nature are based on some slight differential characters that we have noticed. It must be clearly understood, however, that the apparent differences existing in the shells of the various species we have seen and figured are due mainly to the particular stage in growth that our various specimens had reached. A few more weeks or even days of growth would have resulted in a marked difference in the shells that we have figured.

Subgenus **Bankiella** *Bartsch*

Bankiella Bartsch 1921, Proc. Biol. Soc. Washington, **34**, p. 26.

Subgenotype, *Bankia mexicana* Bartsch = *B. gouldi* Btsh. (original designation, 1921).

Shells similar to those in other subgenera in the genus *Bankia*. Pallets consisting of cones that possess a non-serrated margin of the periostracum (both inner and outer face) and have the lateral portions of the periostracum extended to form rather short and inconspicuous awns. The periostracal margin on the inner face is wider than on the outer face. This appears as a "web" between the two lateral awns.

Bankia setacea Tryon of the west coast (Alaska south to southern California) is a member of *Bankiella* and not *Bankia* s.s. as given by Bartsch (1922, p. 7). Tryon (1863, p. 144) states "sides of the joints fringed," a reference to the lateral awns only and not meant to convey the idea of any periostracal serrations. His figure, plate 1, fig. 3, shows no serrations at all.

Bankia (Bankiella) gouldi *Bartsch*, Plate 9, figs. 1-4

Xylotrya gouldi Bartsch 1908, Proc. Biol. Soc. Washington, **21**, p. 211 (Norfolk harbor, Virginia).

Bankia (Bankiella) mexicana Bartsch 1921, Proc. Biol. Soc. Washington, **34**, p. 27 (Sinaloa [west coast] Mexico); Bartsch 1922, United States Nat. Mus. Bull. 122, p. 10, pl. 30, fig. 2.

Bankia schrencki Moll 1935, Sitz. Akad. Wissen. Wien (Math.-natur. Klasse), **144**, p. 275, pl. 2, fig. 7 (Sao Francisco do Sul, Brasil).

Description. Shells equivalve, strongly convex, gaping widely anteriorly for the protrusion of the body. Shell very small in proportion to the size of the animal, thin, whitish and very finely sculptured. Outer surface: Lobe consisting of numerous very fine concentric ridges which are finely denticulate. Anterior disc possesses an equal number of denticulated ridges. The ridges of the anterior disc are much finer and the denticles much

coarser than those existing on the lobe. The ridges of the lobe and the anterior disc connect at an angle of about 125° . These ridges exist on the median disc, posterior disc and the auricle as exceedingly fine non-denticulated growth lines. Median disc exists as a dorso-ventral area which is somewhat elevated. The posterior disc is nearly smooth, as stated above, with the growth lines running obliquely. The auricle is somewhat ear-shaped in outline, smooth, and slightly depressed dorso-ventrally through its center; its posterior margin flares outwardly. Inner surface: The three main portions, the lobe, the disc, and the auricle are clearly indicated, not only by the marginal contour but also by sculptured growths such as ridges and even incised lines. Below the margin of the umbo on the inner side of the valve there is developed a rounded knob, the dorsal condyle, and on the ventral margin of the median disc there is a similar knob, the ventral condyle. From beneath the umbo there extends downward a scimitar-shaped process, the apophysis, which is flattened antero-posteriorly. The overlapping of the auricle and the disc is materially thickened and forms a shelf-like area. The auricle, posterior disc and median

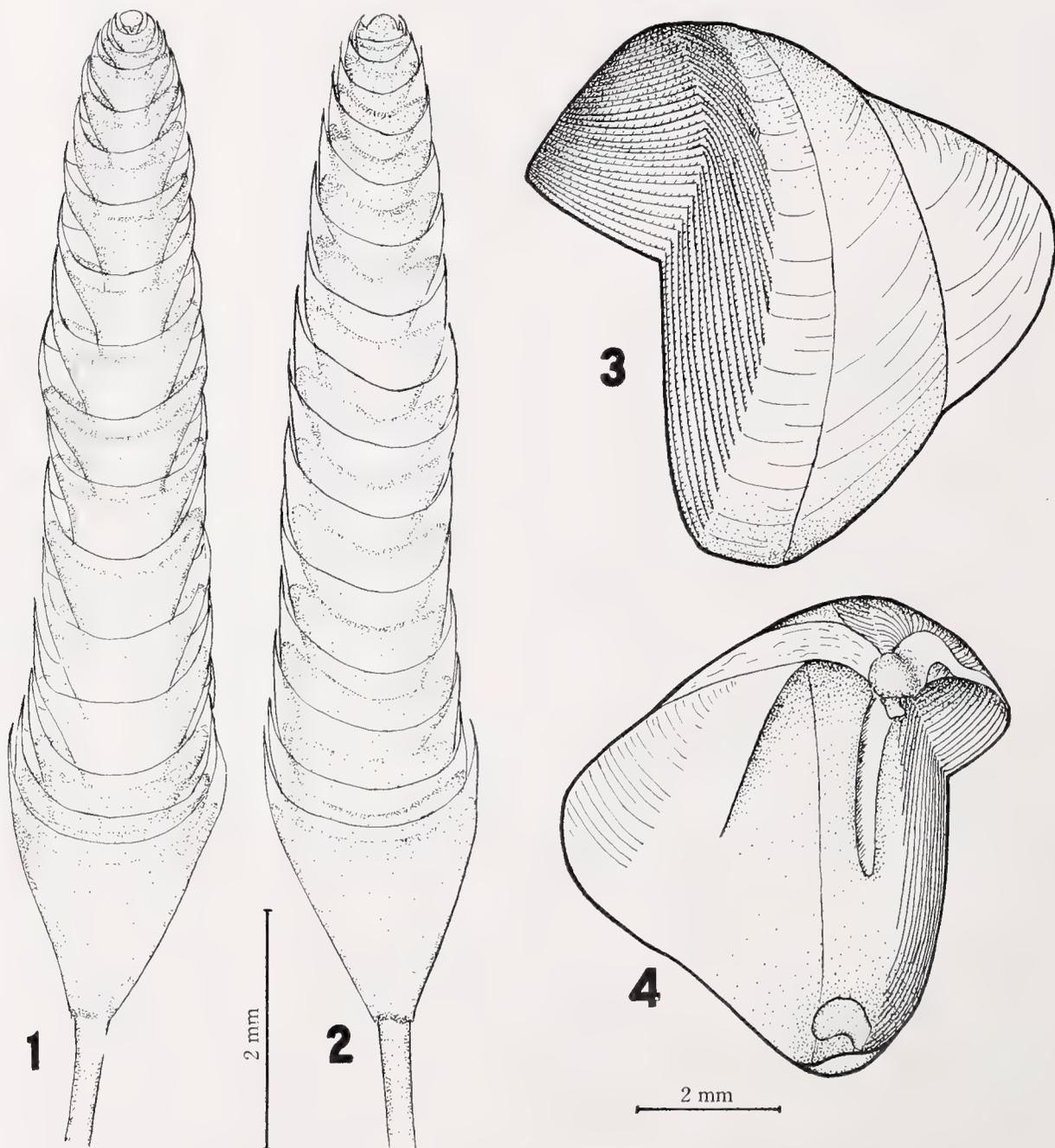


Plate 9. *B. gouldi* Bartsch

Norfolk, Virginia. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell.

disc are covered with a fine yellowish periostracum. Pallets consisting of a series of closely-spaced cones, calcareous portion of each cone funnel-shaped and with the inner margin wider than the outer. Periostracal margin of the outer surface broadly U-shaped, wide and smooth, forming a "web" between the awns which are short and fine.

	height	length	pallet (length)	
	8.6	8.5	9.7 mm.	Holotype (<i>B. gouldi</i>)
(average)	7	7.2	13.6	Norfolk, Virginia
	6.5	7	fragment	Holotype (<i>B. mexicana</i>)

Types. Holotype, United States National Museum, no. 27415, Norfolk, Virginia (dried specimen). Holotype of *B. mexicana* Bartsch, United States National Museum, no. 194176a, Sinaloa, Mexico (dried specimen). Holotype of *B. schrencki* Moll is probably in the Berlin Museum.

Common name. Gould's Shipworm.

Remarks. *B. gouldi* is the most widespread and abundant species in this genus on the Atlantic coast and also the most destructive. Bartsch, in his Monograph (1922) has shown photographs of "Ravages by Gould's Shipworm" on three plates. Damage done on these wharf pilings in all three cases was accomplished largely by *Limnoria*, a crustacean. On plate 11, the "hour-glass" shape of the piling is a typical characteristic feature of *Limnoria* work. *Teredo* and *Bankia* bore into the wood forming only internal tunnels and do not destroy the wood by cutting it away from the outside. Plates 14 and 15 are hand-lettered on the photograph as "destroyed by *Limnoria*" and are not entirely the work of *Bankia* as the printed caption by Bartsch would indicate. There is no question that *Teredo* or *Bankia* may have aided in the destruction of these pilings, but the obvious damage was done by *Limnoria*. On our plate 2 the damage done by *Bankia gouldi* is clearly indicated by the numerous tunnels made in the wood, but the original width of the piling remains the same.

Bankia gouldi also occurs on the west coast of Central America and is the one named *mexicana* by Bartsch. We have been privileged to examine the type specimen. The very small pallet (less than 2 mm. in length) certainly does not belong to the two large shells associated with it. The embryonic portion as figured by Bartsch (1922) is not on the small pallet fragment we have examined. The figures given by Bartsch on plate 30, fig. 2, may well be overdrawn as his statement on page 11 would indicate. "The pallets are all fragmentary, and hence it is impossible to give their measurements." His key is valueless in separating *gouldi* from *mexicana* as the terms are purely relative and all characters fall well within the variations of *gouldi* that we have seen from many localities in the Western Atlantic. Specimens we have received from the Pacific side of Panama from Mr. J. Zetek are definitely *B. gouldi*.

Bankia schrencki Moll described from São Francisco do Sul, Brasil also appears to be *gouldi*. The figured specimens were dried and almost nothing remains of the periostracum. The "segments bear on all sides a narrow membrane with short fringes." This statement in the original description may well define a condition of the periostracum in dried specimens where it splits lengthwise and produces an artificial serration.

Range. New Jersey, the West Indies, Central America, and probably as far south as Brasil. Also in the Eastern Pacific at Panama.

Records. NEW JERSEY: Barnegat Bay (T. C. Nelson). DELAWARE: Lewis. MARYLAND: Baltimore. VIRGINIA: Great Bridge and Norfolk, Norfolk Co.; Newport News; Hampton Roads. NORTH CAROLINA: Washington; Beaufort. SOUTH CAROLINA: Charleston. GEORGIA: Cockspur Id., Savannah; Brunswick. FLORIDA: Fernandina; Mayport; Daytona Beach; Tampa; St. Petersburg; Pensacola. ALABAMA: Fort Morgan; Mobile. MISSISSIPPI: Pascagoula; Gulfport; Port Eads. TEXAS: Sabine Pass; Port Bolivar; Galveston; Rockport; Port Aransas; Corpus Christi; Pt. Isabel. HISPANIOLA: Port au Prince. PUERTO RICO: San Juan. JAMAICA: Kingston. HONDURAS: Puerto Cortes; Puerto Castilla. PANAMA: Coco Solo; Almirante. COLOMBIA: Santa Marta (all MCZ). EASTERN PACIFIC: Balboa, Canal Zone, Panama (J. Zetek).

Subgenus **Bankiopsis**, new subgenus

Subgenotype, *Bankia caribbea* Clench and Turner.

Species in this subgenus have a narrow and smooth margin of periostracum which is produced laterally into short and rather wide awns. The embryonic cones are crowded at the tip of the pallet and are covered with a cap of periostracum.

This subgenus differs from *Liliobankia* in having a narrow margin of periostracum and particularly in having the early or embryonic cones pushed together to form a compact and close-set series.

Bankia (Bankiopsis) caribbea, new species, Plate 10, figs. 1-4

Description. Shell exceedingly variable and similar in all of the characteristics to that of *B. gouldi*. We figure a comparatively young shell which shows the auricle to be formed fairly high on the margin of the posterior disc. Pallets consisting of a series of closely-spaced cones. Calcareous portion of each cone funnel-shaped with the inner margin higher than the outer margin. Periostracal margin of the inner and outer surfaces shallowly U-shaped, narrow and smooth. Awns short and broad.

height	length	pallet (length)	
4.5	4.9	10 mm.	Paratype
3.8	3.5	8	Holotype

Types. Holotype, Museum of Comparative Zoölogy no. 121065, Fort Pickens, Pensacola, Florida. Paratypes from the same locality.

Common name. The Caribbean Shipworm.

Remarks. This is not a common species. As a rule, this species is quite small. The compact and flattened cones of the embryonic cap of the pallet are very different from the early cones of any other known species in the Western Atlantic. *B. caribbea* can be readily differentiated from other species with non-serrated cones by the embryonic cap, the nearly horizontal margin of the distal portion of the cone, and the narrow margin of periostracum on both the inner and outer surfaces.

Range. Gulf of Mexico, the West Indies and south to Bahía, Brasil.

Records. FLORIDA: Pensacola. MISSISSIPPI: Gulfport. TEXAS: Gulfport. PUERTO RICO: Fajardo. HONDURAS: Puerto Castilla. COSTA RICA: Port Limón. PANAMA: Coco Solo. COLOMBIA: Santa Marta. BRASIL: Bahía (all MCZ).

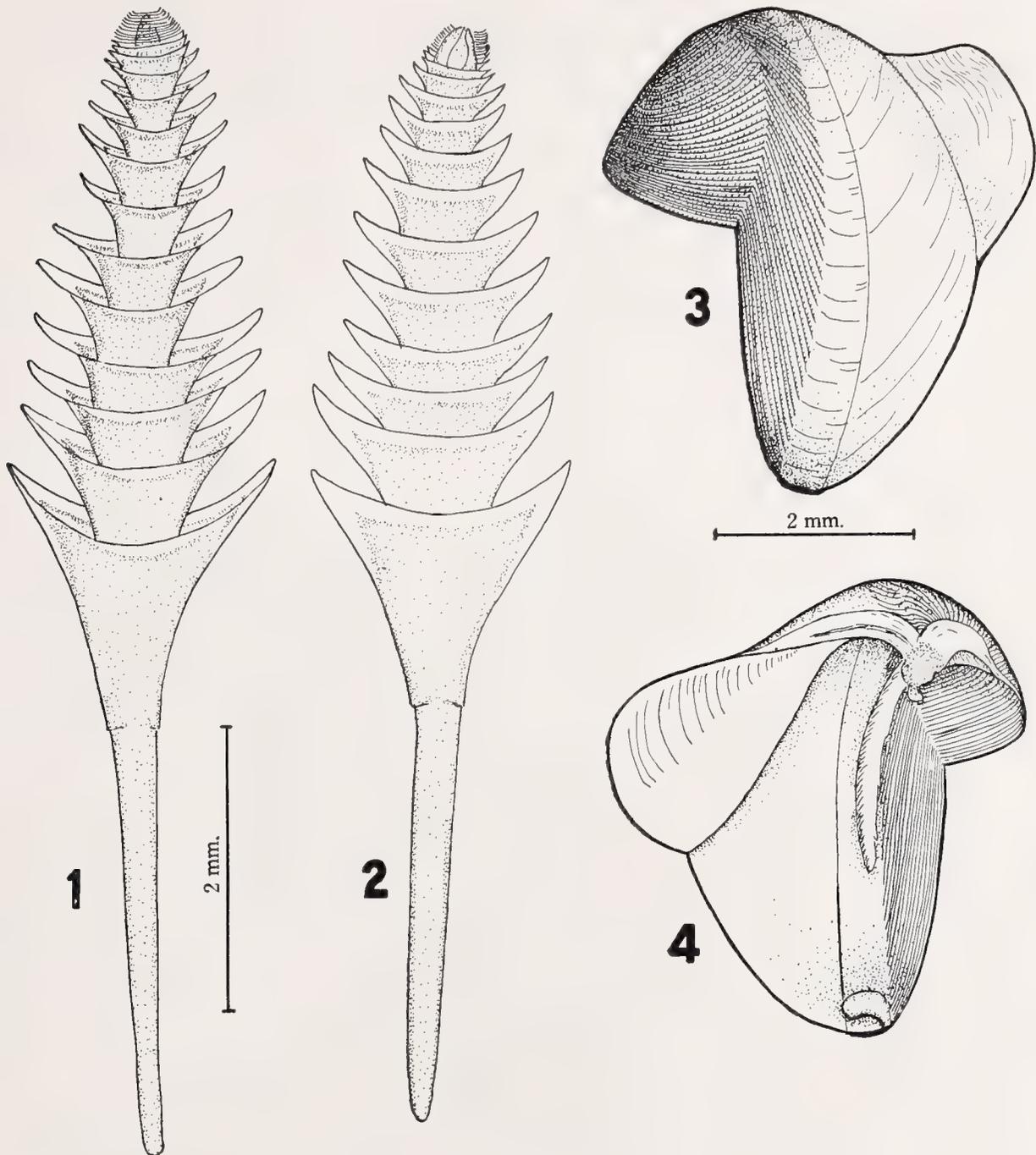


Plate 10. *B. caribbea* Clench and Turner

Holotype MCZ 121065, Fort Pickens, Pensacola, Florida. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell.

Subgenus **Liliobankia**, new subgenus

Subgenotype, *Bankia katherinae* Clench and Turner.

The pallets of *Liliobankia* have a moderately wide and smooth margin of periostracum which is produced laterally to form wide, blunt awns. The embryonic cones are not crowded at the tip of the pallet but are distantly spaced. This subgenus differs from other subgenera of *Bankia* by having broad and non-serrated awns and distantly spaced embryonic cones.

Bankia (Liliobankia) katherinae,¹ new species, Plate 11, figs. 1-6

Description. Shells essentially the same as those of *B. gouldi* and show just as wide a growth variation. We have drawn two stages (Plate 11, figs. 3-5) to indicate the variation in the relative size and position of the auricle. Figures 3 and 4 are those of a shell 4 months old, and figures 5 and 6 are those of a shell 1 month old. Pallets consisting of a series of widely-spaced cones. Calcareous portion of each cone funnel-shaped with the inner and outer margin of equal height. Periostracal margin of the outer surface shallowly U-shaped, smooth and with a broad notch near the center. Inner margin similar but without the notch. Periostracal margin of the cones wide, flattened and bell-shaped with

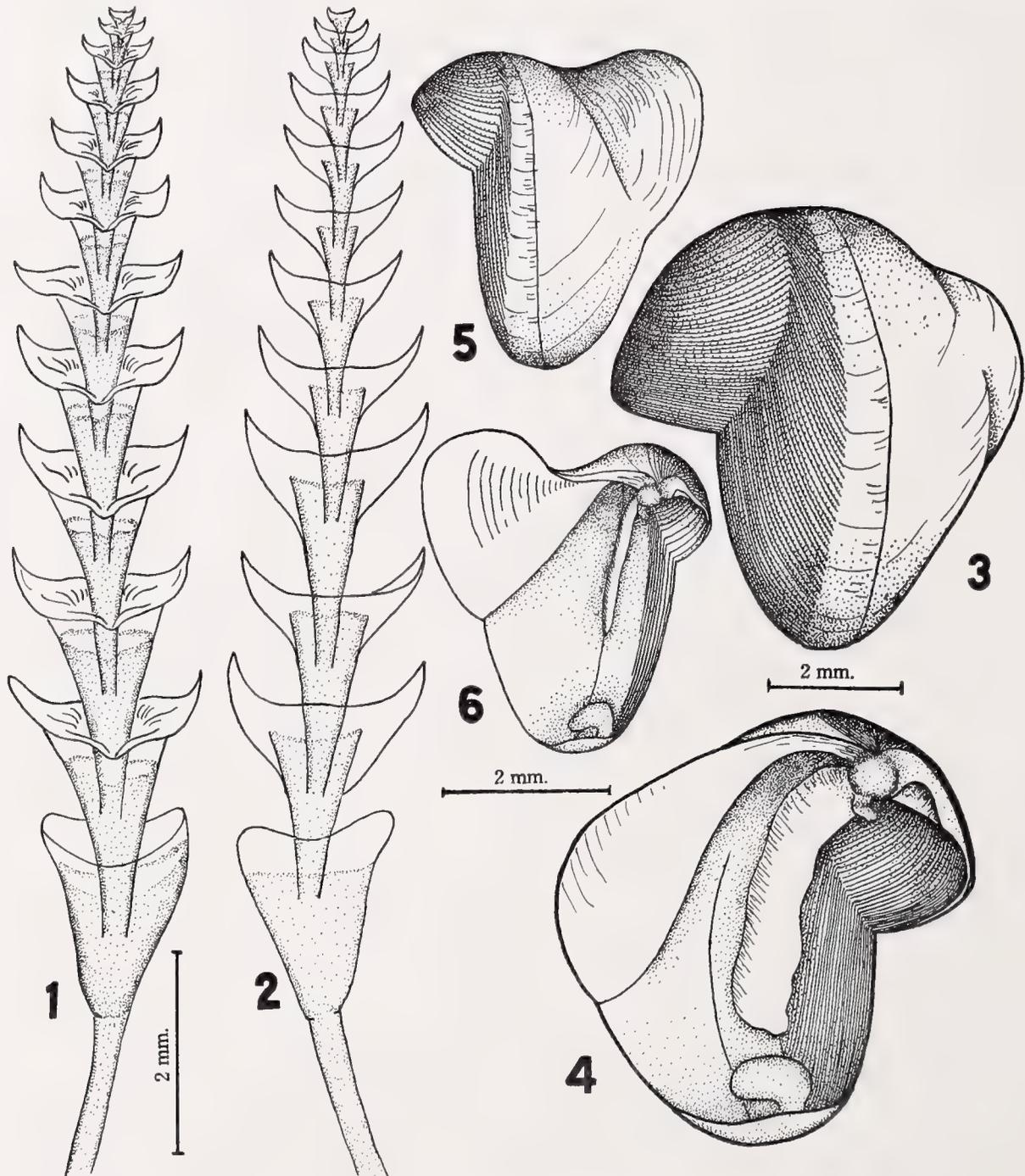


Plate 11. *Bankia katherinae* Clench and Turner

Holotype MCZ 168023, Bahía, Brasil. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell (4 months). Fig. 4. Internal view of same shell. Fig. 5. External view of shell (1 month). Fig. 6. Internal view of same shell.

¹ Named for Katherine Tucker, to whom we are indebted for considerable material.

a small central notch on the margin of the outer face. Lateral portions broadened and somewhat upwardly curved forming wide, blunt awns. Outer surface of the periostracum that covers the calcareous portion of the cone is minutely papillose.

	height	length	pallets (length)	
(average)	5.3	5	16 mm.	Holotype
(large)	7.5	8	40	Trinidad

Types. Holotype, Museum of Comparative Zoölogy, no. 168023, Bahía, Brasil. Paratypes from the same locality.

Common name. The Lily Shipworm.

Remarks. We still know but little concerning this species. The pallets are very different from those of any other species in the Western Atlantic and can be readily told by the flattened and bell-shaped margin of the cones. The entire blade is very long and narrow and the cones very distantly spaced.

Range. Caribbean Sea and south to Bahía, Brasil.

Records. LESSER ANTILLES: Trinidad. PANAMA: Almirante. COLOMBIA: Santa Marta. BRASIL: Bahía (all MCZ).

Subgenus *Neobankia* Bartsch

Neobankia Bartsch 1921, Proc. Biol. Soc. Washington, 34, p. 26.

Deviobankia Iredale 1932, [in] Destruction of Timber by Marine Organisms in the Port of Sydney, Sydney Harbour Trust, p. 33. [Subgenotype, *Bankia debenhami* Iredale, original designation.]

Subgenotype, *Bankia zeteki* Bartsch (original designation, Bartsch 1921).

In this subgenus, the species have a moderately wide margin of periostracum which is serrated on both the inner and outer margins but is not produced laterally to form definite awns.

The subgenus, *Deviobankia* Iredale appears to us to be an absolute synonym of *Neobankia* Bartsch. We have a paratype specimen of the subgenotype (*B. debenhami* Iredale) received from Dr. W. F. Clapp.

Bankia (*Neobankia*) *zeteki* Bartsch; Plate 12, figs. 1-4

Description. Shells similar to *B. gouldi*. We have figured a rather young specimen so that the rows of denticulated ridges are widely spaced and the auricle is placed high on the posterior margin of the disc. Pallets consisting of a series of distantly-spaced cones. Calcareous portion of each cone funnel-shaped and semicircular in cross-section, with the inner margin higher than the outer margin. The periostracal margin of the outer surface is shallowly U-shaped, with a finely serrated margin. The inner margin straight, with moderate comb-like serrations. With wear, these serrations may become more and more truncated and finally leave the cone with a nearly or quite smooth margin. Awns absent.

height	length	pallets (length)	
4.5	5	9 mm.	Coco Solo, Canal Zone
9	8.5	35	Balboa, Canal Zone
9.5	10.2	12 (broken)	Holotype

Types. Holotype, United States National Museum, no. 341128, Canal Locks, Balboa, Canal Zone. From greenheart timber. James Zetek, collector (dried specimen).

Common name. Zetek's Shipworm.

Remarks. This is probably an Eastern Pacific species that has reached the Western

Atlantic by means of commerce. We have records from two localities on the Atlantic side of Central America.

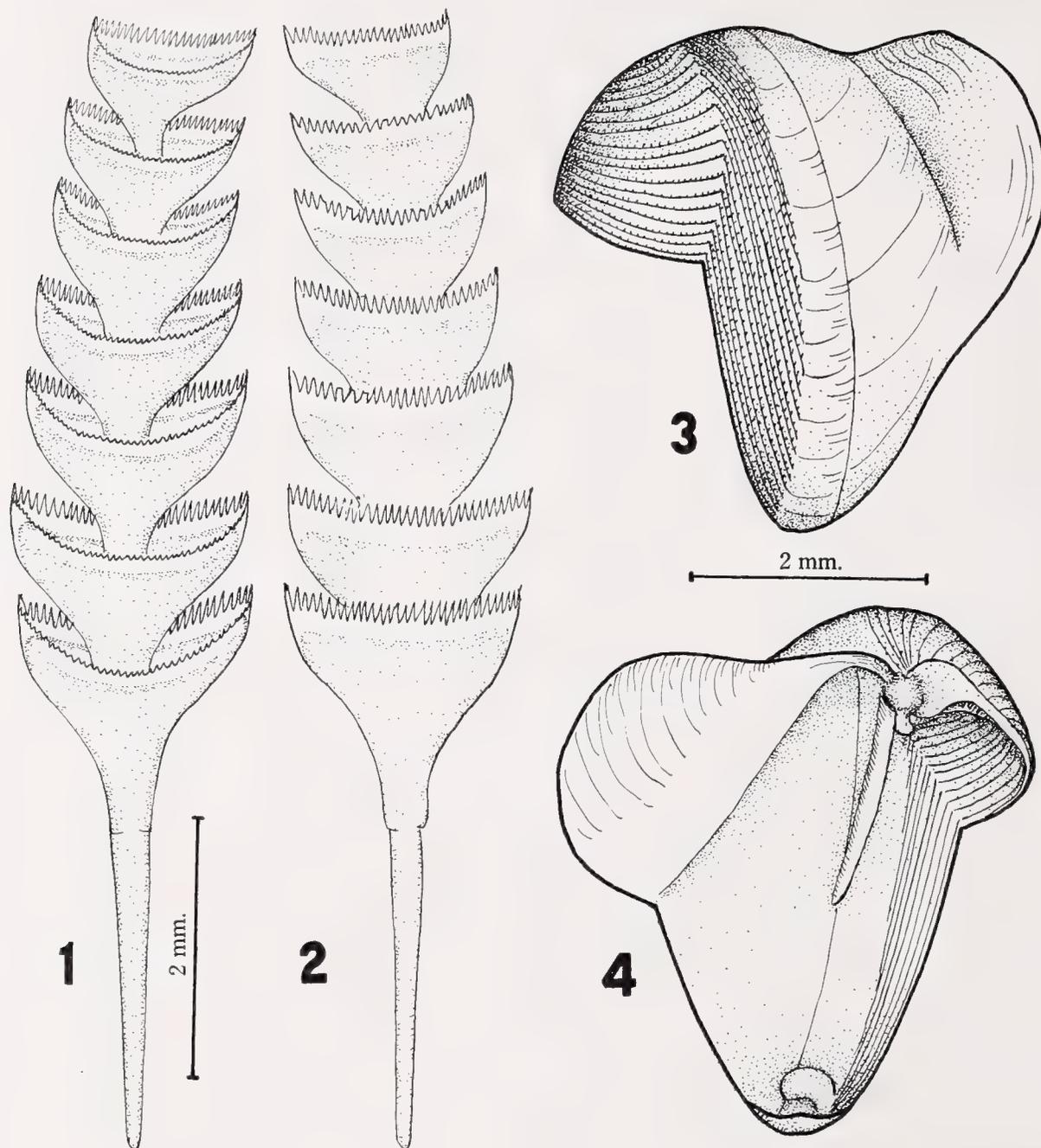


Plate 12. *Bankia zeteki* Bartsch

Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell (a rather young specimen).

Bankia zeteki is quite close in its relationship to *B. destructa*. The cones of *zeteki* are more goblet-shaped and more distantly spaced than in *destructa*.

Range. Both sides of the Isthmus of Panama.

Records. PANAMA: Cristobal and Coco Solo. EASTERN PACIFIC: Balboa and Puerto Armuelles, Panama (all MCZ).

Bankia (*Neobankia*) *destructa*, new species, Plate 13, figs. 1-4

Description. Shell similar to *B. gouldi*. We figure a moderately matured specimen which is average for the species. Pallets with the cones rather closely-set on a narrow stalk. Calcareous portion widely U-shaped on the outer surface and slightly curved on the inner surface. Periostracal margins narrow, very finely serrated on the outer margin

and rather coarsely serrated on the inner margin. Lateral areas not extended as awns though slightly broadened out.

height	length	pallet (length)	
4	4.1	13.5 mm.	Holotype
8	7.5	40	Almirante, Panama

Types. Holotype, Museum of Comparative Zoölogy, no. 123303, La Cieba, Honduras.

Common name. The Destructive Shipworm.

Remarks. This species appears closely related to *B. zeteki*. The significant differences are in the possession of closely-set and broadly U-shaped inner margins of the cones in *B. destructa* and the widely-spaced and straight inner margins of the cones in *B. zeteki*.

It is quite possible that these two species originated from common stock, similar to other closely related marine mollusks that exist on both sides of the Isthmus of Panama. Their common origin would date from the time when the connection existed between

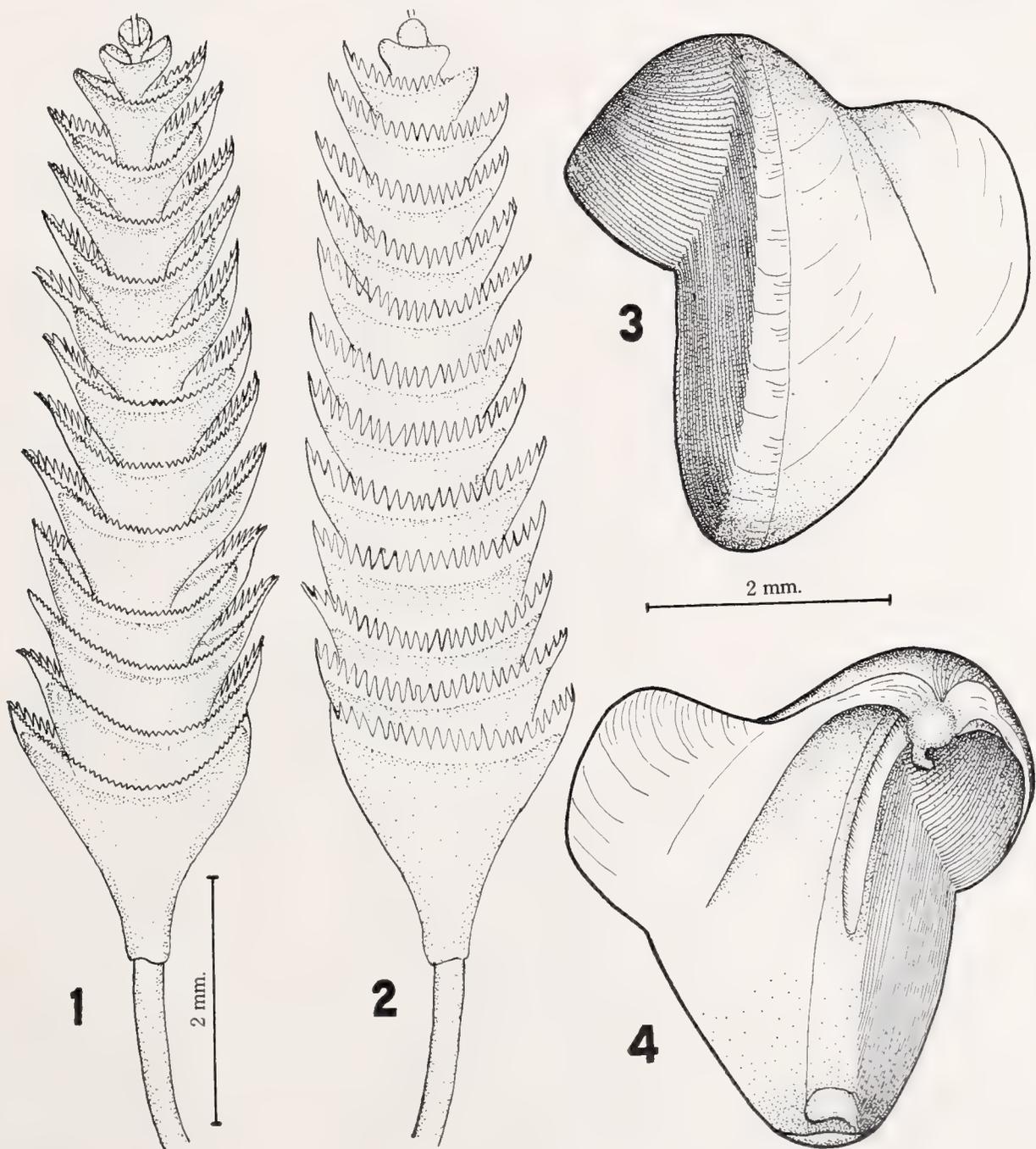


Plate 13. *Bankia destructa* Clench and Turner

Holotype MCZ 123303, La Cieba, Honduras. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of the same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell.

the Atlantic and Pacific Oceans in this region. Subsequent isolation since that time has brought about sufficient differentiation so that they exist as distinct subspecies and species. In the case of *Bankia* and very probably several other genera capable of mechanical transport, they have become re-established on the opposite sides of the canal region. This is not at all difficult for members of the Teredinidae as there are ample records of many species being able to withstand several days in fresh water.

Range. Atlantic and Pacific sides of Central America.

Records. HONDURAS: Puerto Castilla, La Cieba, Puerto Cortes. PANAMA: Almirante. COLOMBIA: Santa Marta. VENEZUELA: Puerto Cabello. EASTERN PACIFIC: Puerto Armuelles, Panama (all MCZ).

Plumulella, new subgenus

Subgenotype, *Teredo fimbriata* Jeffreys (= *Bankia fimbriatula* Moll and Roch).

This subgenus has species possessing pallets that have long, serrated awns. The periostracal margins on both the inner and outer surfaces of each cone are finely to coarsely serrated. The three species herein considered members of this subgenus have the inner margins of the cones with deep, comb-like serrations.

Bankia (*Plumulella*) *fimbriatula* Moll and Roch, Plate 14, figs. 1-4

Teredo bipalmulata 'Lamarck' Forbes and Hanley 1853, History of British Mollusca, London, **1**, p. 86, pl. 2, figs. 9-11 (Ireland from the timbers of a vessel returning from a foreign voyage); non Lamarck 1801; Philippi 1836.

Teredo fimbriata Jeffreys 1860, Ann. Mag. Nat. Hist. (3) **6**, p. 126 (Leith [Scotland]); non *T. fimbriata* Defrance 1828.

Bankia fimbriatula Moll and Roch 1931, Proc. Malac. Soc. London, **19**, p. 213; new name for *fimbriata* Jeffreys 1860, non Defrance 1828. [The name only applies to this species. The remarks in the text and the plate refer to a totally different species, very possibly *B. gouldi* Bartsch. Moll and Roch did not see the Jeffreys type material which is now located in the National Museum, Washington, D.C.]

Bankia (*Bankia*) *canalis* Bartsch 1944, Smithsonian Misc. Collections, **104**, no. 8, pp. 1-3, pl. 1, (Balboa and Cristobal, Canal Zone).

Description. Shells similar to *B. gouldi*. The specimen figured (plate 14, figs. 3-4) is a young but mature individual. Pallets consisting of a series of moderately-spaced cones. Calcareous portion of each cone deeply notched or V-shaped. Periostracal margin of the outer surface deeply U-shaped, wide, with a finely serrated margin and with faint indications of vertical ribs extending below the union of the serrations. Inner margin deeply U-shaped and possessing long comb-like serrations. Awns greatly extended and deeply serrated.

	height	length	pallets (length)	
(average)	4.5	4.5	16 mm.	Port au Prince, Haiti
(large)	6.8	6.5	39	Port au Prince, Haiti
(large)	6.3	6.2	18.4 (fragment)	Balboa, Canal Zone

Types. Cotypes of *B. fimbriata* Jeffreys are in the United States National Museum from Leith, Scotland. The holotype of *B. canalis*, USNM, no. 568817 is from Balboa, Canal Zone (measurements above). As the actual origin of the specimens of both Forbes and Hanley and of Jeffreys is unknown, we here select Balboa, Canal Zone to be the type locality, based upon the types of *B. canalis* Bartsch.

Common name. Jeffreys' Shipworm.

Remarks. Most species of *Bankia* that have been described from British waters are admitted by Forbes and Hanley, and J. G. Jeffreys to be of drift origin. The confusion of names that has surrounded these species is rather appalling. Many of the names have been used interchangeably and Lamarck's *B. palmulata* and *bipalmulata* also have been included in this complex.

The origin then of these species is of considerable interest, as one quite certainly and others possibly may be of West Indian origin. Just what *B. bipennata* Turton may be, is still uncertain; at least we have seen nothing from the West Indies that would appear to be this species. However, *B. fimbriatula* is more or less widespread in the Gulf of Mexico and the West Indian region and exists also on the Pacific coast of Panama.

Bankia canalis Bartsch is unquestionably *fimbriatula* Moll and Roch. The deep V-notch of the calcareous portion of the cones is a very important and characteristic feature. Through the kindness of Dr. Paul Bartsch we were privileged to see the types of both of these forms. Both type lots are based on dried specimens and little periostracum remains, but the calcareous portions are identical.

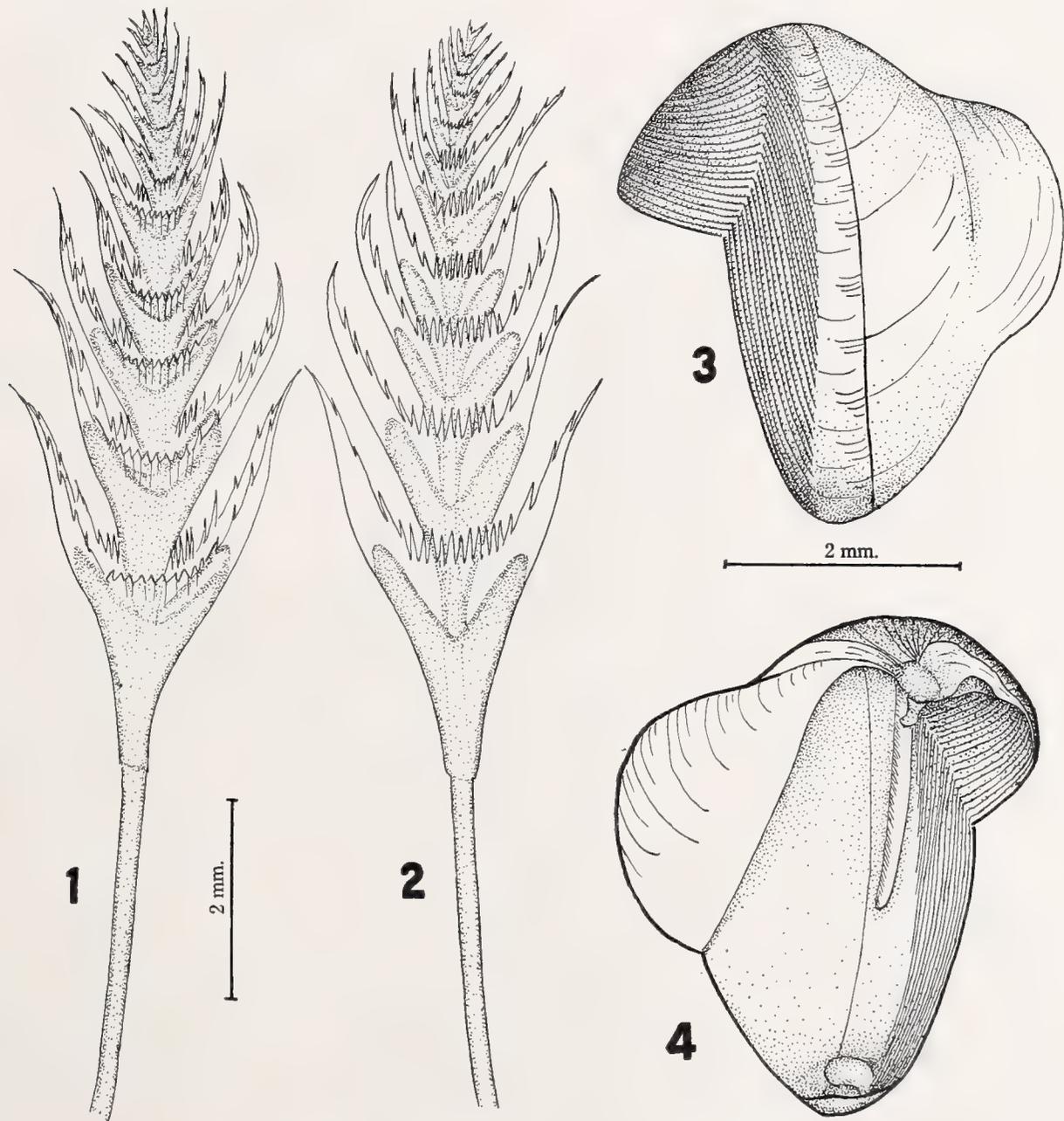


Plate 14. *Bankia fimbriatula* Roch and Moll

Port au Prince, Haiti. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell.

Range. East and West Florida, the West Indies and south to Bahía, Brasil. Also the Eastern Pacific at Panama.

Records. FLORIDA: Jupiter Inlet; Tampa; Pensacola. CUBA: Banes Bay; Guantánamo. HISPANIOLA: Port au Prince; Santo Domingo City; San Pedro de Macorís. PUERTO RICO: San Juan. JAMAICA: Kingston. LESSER ANTILLES: Trinidad. HONDURAS: Puerto Cortes; Puerto Castilla. COSTA RICA: Port Limón. NICARAGUA: Bluefields. PANAMA: Coco Solo; Cristobal; Almirante. BRASIL: Bahía (all MCZ). EASTERN PACIFIC: Balboa, Canal Zone (J. Zetek).

Bankia (Plumulella) fosteri, new species, Plate 15, figs. 1-4

Description. Shells similar to *B. gouldi*. All shells so far examined show the same range of variation seen throughout the entire genus. Pallets consisting of a series of moderately-spaced cones. The calcareous portion of each cone funnel-shaped with the inner margin higher than the outer margin. The periostracal margin of the outer surface deeply

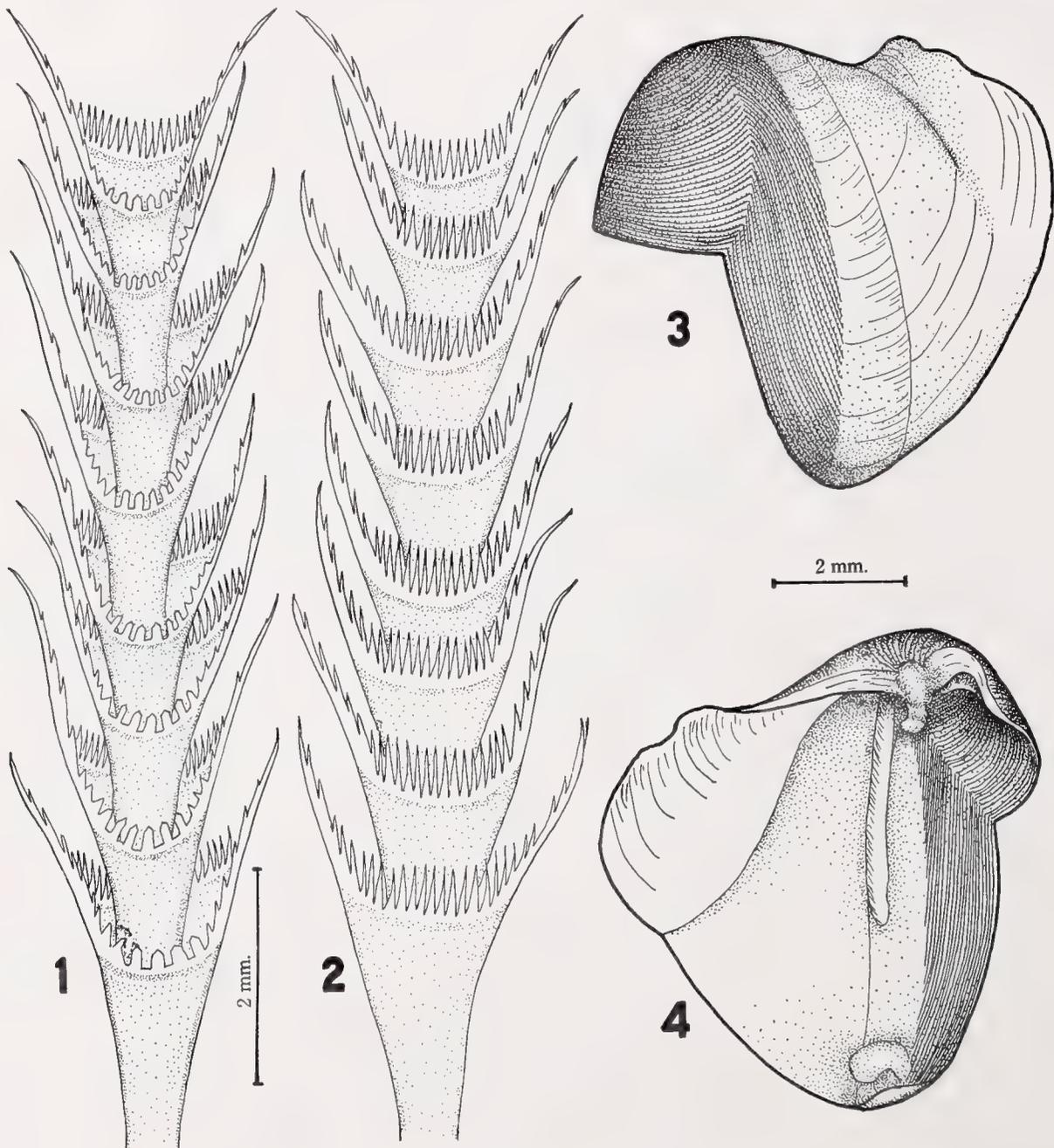


Plate 15. *Bankia fosteri* Clench and Turner

Holotype MCZ 122536, Santa Marta, Colombia. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell.

U-shaped, rather narrow and with coarse serrations. Inner margin deeply U-shaped with long comb-like serrations. Awns greatly extended and deeply serrated.

height	length	pallets (length)	
6.8	7	12 mm. (fragment)	Holotype
7.5	7	15 (fragment)	Santa Marta, Colombia

Types. Holotype, Museum of Comparative Zoölogy, no. 122536, Santa Marta, Colombia.

Common name. Foster's Shipworm.

Remarks. In all fifteen lots we have seen of this species, the pallets have been fragmentary. A 10 mm. fragment was used in drawing the plate. It is a comparatively rare species and, so far as we now know, possesses but a limited range in the Caribbean Sea.

It is readily differentiated from both *fimbriatula* and *cieba* by having very coarse and almost square serrations on the outer margin of the periostracum. The calcareous portion of the cone is very dense and solid.

Range. Mainland bordering the Caribbean Sea from Honduras to Colombia.

Records. HONDURAS: Puerto Castilla. COLOMBIA: Santa Marta (both MCZ).

Bankia (Plumulella) cieba, new species, Plate 16, figs. 1-4

Description. Shells similar to *B. gouldi*. A few shells we have seen are more arcuate over the top of the disc than generally exists among other species in this genus. Pallets consisting of a series of closely-spaced cones. Calcareous portion of each cone funnel-shaped. Periostracal margin of the outer surface deeply U-shaped, wide, very finely serrated, and with faint indications of vertical ribs extending below the union of the serrations. Inner margin broadly U-shaped with long, comb-like serrations. Awns greatly extended and deeply serrated.

height	length	pallets (length)	
5.5	5.2	10 mm.	Holotype
4.5	4.5	10	Santa Marta, Colombia

Types. Holotype, Museum of Comparative Zoölogy, no. 168097, Balboa, Canal Zone.

Common name. The Cieba Shipworm.

Remarks. In this species the cones are closely-set and it is necessary to float the pallets in glycerine-alcohol so that the awns will separate from the cone above. Dissection of the pallet to separate a single cone will aid greatly in identification.

Bankia cieba is a relatively small species and very delicate in structure. The specimen figured is among the largest we have seen. This species can be separated from *B. fosteri* by its very wide margin of periostracum and the extremely fine serrations on the outer surface. From *B. fimbriatula* it is readily separated by the relatively small calcareous portion which has a straight upper margin. In *fimbriatula* the calcareous portion is very deeply V-shaped. Our largest and most perfect series of specimens came from Balboa, from which station we received the best test-board material.

Range. Greater Antilles and south to Colombia. Also on the Pacific side of Panama.

Records. CUBA: Banes Bay. HISPANIOLA: Port au Prince. LESSER ANTILLES: Trinidad. HONDURAS: Puerto Castilla; Puerto Cortes. COLOMBIA: Santa Marta. EASTERN PACIFIC: Balboa, Canal Zone (all MCZ).

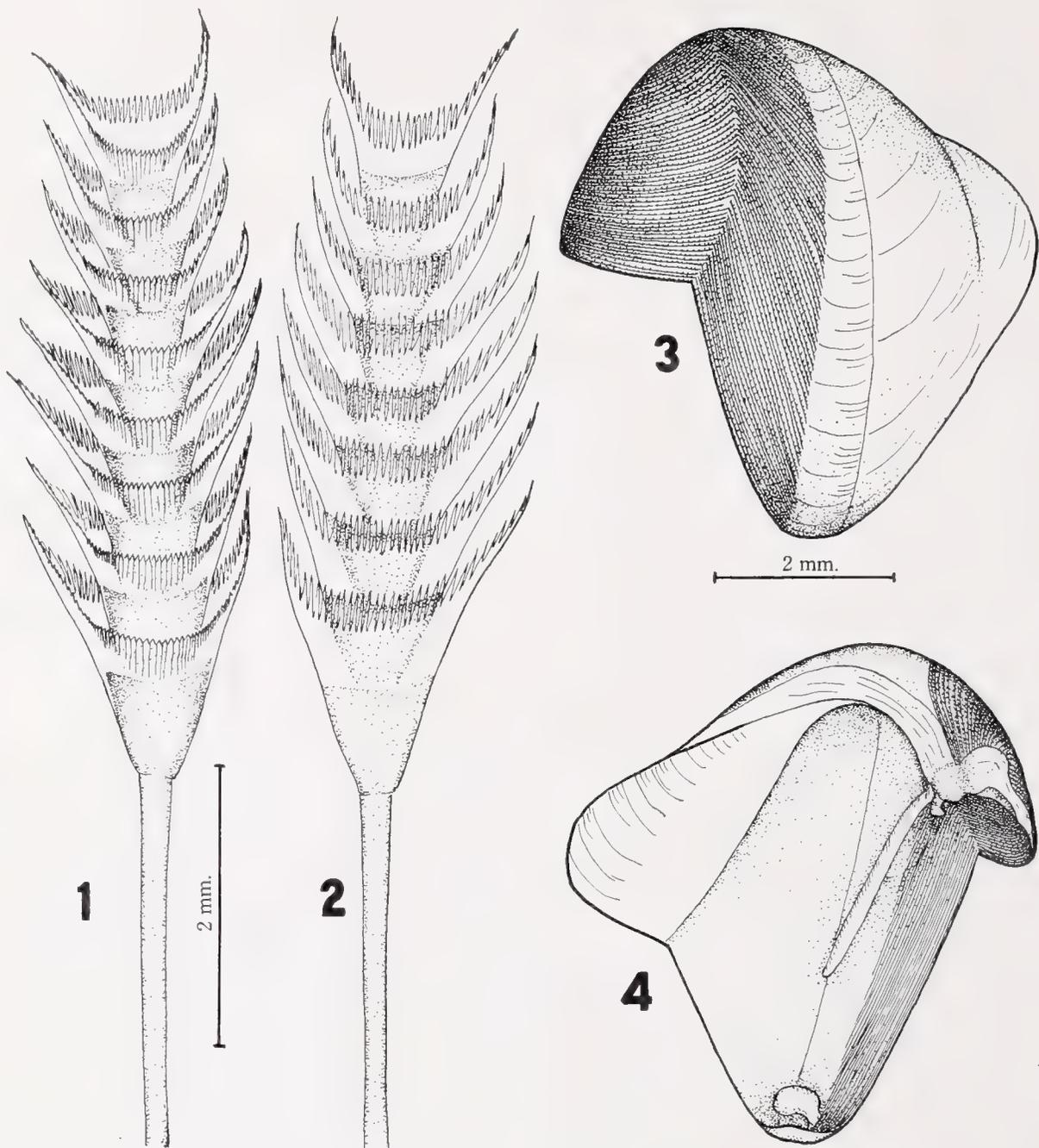


Plate 16. *Bankia cieba* Clench and Turner

Holotype MCZ 168097, Balboa, Canal Zone. Fig. 1. Outer surface of pallet. Fig. 2. Inner surface of same pallet. Fig. 3. External view of shell. Fig. 4. Internal view of same shell.

Bankia (Plumulella) argentinica Moll

Bankia argentinica Moll 1935, Sitz. Akad. Wissen. Wien (Math.-natur. Klasse), 144, p. 274, pl. 2, fig. 5 (Buenos Aires, Argentina).

Description. (Translation of the original description from the German by Joseph Bequaert). "Pallets: About 25 elongate funnel-shaped segments whose distal extremity is semi-circularly curved inward. Segments with lateral long spines and provided on the outer side with a finely denticulated membranous margin.

"Shell: Anterior piece large and broad, covered with very fine, closely-placed rows of teeth. Auricle narrow and elongate. The shells as a whole are very large and strong."

Types. The whereabouts of the holotype of this species was not given by Moll. It is possibly in the Berlin Museum. The type locality is Buenos Aires, Argentina.

Common name. Argentina Shipworm.

Remarks. This species is unknown to us. The limited description and the small and indistinct figures given by Moll leave much to be desired in the way of a proper diagnosis of this species. However, the few characters outlined would indicate that it is a member of the subgenus *Plumulella*. The published figures were so small and dark that they could not be reproduced.

Range and Records. Known only from Buenos Aires, Argentina, the type locality.

Spurious species

Teredo campanulata was named by Deshayes in the British Museum collection but was never described by him. Jeffreys listed the name as a synonym under *B. stutchburyi* De Blainville and later, Sowerby described this form from the same specimens examined by Jeffreys. Moll and Roch have considered this form distinct from *B. stutchburyi*, validating its use by Sowerby and proposing a new name, as *campanulata* Sowerby had thus become a homonym of *campanulata* Jeffreys.¹ However, neither the description nor the figures of Sowerby are recognizable; in fact it is very questionable whether the single pallet and the shells figured are from the same specimen. The shells figured for *campanulata* by Sowerby are quite characteristic of *Psiloteredo*, a subgenus of *Teredo*, which possesses auricles that are broad and high and have a notch at the dorsal union with the posterior disc. The pallets of *Psiloteredo* consist of a single blade and not the compound cone elements of a *Bankia* as figured by Sowerby. Furthermore, Moll and Roch state that the type has been lost and there is no known locality. This leaves us with about as many uncertainties as could exist for any sort of an understanding regarding this species. It may, of course, be our *Bankia katherinae*, but with the type material lost, the poor description and the possible mixed original material of Sowerby, *campanulata* will be questionable for all time. We give below a synopsis of its published history.

Bankia campanellata Moll and Roch

Teredo campanulata 'Deshayes' Sowerby 1875, *Conchologica Iconica*, **20**, *Teredo*, pl. 2, fig. 9a-c (locality unknown); *non T. campanulata* 'Deshayes' Jeffreys 1860 [a manuscript name given as a synonym under *T. stutchburyi* DeBlainville].

Bankia campanellata Moll and Roch 1931, *Proc. Malac. Soc. London*, **19**, p. 215, plate 25 [new name for *campanulata* Sowerby 1875, *non* Jeffreys 1860, *Ann. Mag. Nat. Hist.* (3), **6**, p. 127.

* * * *

The genus *Bankia* in the Western Atlantic extends from southern New England and south to the Straits of Magellan. In the Eastern Atlantic, though records for *Bankia* are known from latitudes far north of those reported for the Western Atlantic, its ex-

¹ A nude name, once listed as a synonym of a described species, automatically takes the description of that species.

istence there is probably fortuitous. If *Bankia* actually breed in the northern waters they probably live but a short time and are then winter-killed. In a very comprehensive study of the molluscan fauna of the Netherlands, Dr. Jutting credits no records of *Bankia*, though the companion genus, *Teredo* is quite abundant. It would appear to us that most if not all of the many English records are due to chance introductions of *Bankia* by commerce in wooden ships and probably quite frequently by driftwood of West Indian origin by way of the Gulf Stream. *Bankia* does exist, however, in the Mediterranean Sea and may extend well up along the French coast in the open Atlantic and, of course, south along the African coast. This genus is widely distributed in the Indo-Pacific and Eastern Pacific areas.

* * * *

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MYIDAE

VOL. 2. NO. 20

THE GENUS *MYA* IN THE WESTERN ATLANTIC

BY
RICHARD W. FOSTER

The members of the genus *Mya* are widespread and abundant in northern waters. This genus is remarkable in that all its species are used for food by man. Of the few forms which have been described, both recent and fossil, all are very closely related to the two species found in the Western Atlantic.

Mya Linné

Mya Linné 1758, Syst. Nat., ed. 10, p. 670.

Arenomya Winckworth 1930, Proc. Malac. Soc. London, **19**, p. 15 (Genotype, *M. arenaria* Linné).

Genotype, *Mya truncata* Linné (subsequent designation, Children 1823, Quart. Journ. Sci., Lit. and Arts, **14**, p. 85. Placed on the Official List of Generic Names by Opinion 94 of the International Commission on Zoological Nomenclature).

Shell inequivalve, the right valve being slightly larger than the left, variable in shape, rounded anteriorly, gaping posteriorly. Sculpture restricted to concentric growth lines and radial irregularities. Ligament extending on either side of the depressed umbones. Left valve provided with a well-developed projecting chondrophore which bears a broad, heavy resilium or internal ligament. The right valve has a corresponding excavated chondrophore under the beak. Teeth obsolete; hinge strengthened by nymphs or rounded lamellae. Pallial sinus extends to the middle of the shell. Long siphons united and covered by a tough epidermal layer which is contiguous with the mantle. Mantle edges fused except for an anterior slit for the extension of the foot.



Plate 17. *Mya truncata* Linné
Belgium. Siphons extended (natural size).

Mya truncata Linné, Plates 17–19

Mya truncata Linné 1758, Syst. Nat., ed. 10, p. 670 (O. Europaeo).

Mya ovalis Turton 1822, Shells of the British Islands, p. 33, pl. 3, fig. 1–2 (Dublin Bay, at Clontarf [Ireland]).

Sphenia swainsoni Turton 1822, Shells of the British Islands, p. 37, pl. 19, fig. 2 (rocks in Torbay [England]).

Mya pullus Sowerby 1826, Mineral Conch. Great Britain, 6, p. 58, pl. 531, fig. 6–8 (Crag at Butley, Suffolk [England]).

Mya truncata var. *Uddevalensis* Forbes 1846, Mem. Geol. Survey of Great Britain, 1, p. 407 (fossil: Clyde Beds [England], Scandinavia, Russia, Canada; living: Gulf of St. Lawrence [Canada]).

Mya praecisa Gould 1850, Proc. Boston Soc. Nat. Hist., 3, p. 215; 1852, United States Exploring Expedition, 12, p. 384, fig. 498–498b (Puget Sound [Washington]).

Mya truncata var. *abbreviata* Jeffreys 1865, British Conchology, 3, p. 67 (no locality cited [Great Britain]).

Description. Shell 25 to 75 mm. (1 to 3 inches) in length, valves widely gaping at the truncated posterior end, chalky white with traces of cream and flesh color on the inner surface. Umbones subcentral. Sculpture consists of coarse concentric growth lines. Ligament well-developed. Chondrophore of the left valve short, broad, trigonal, and connected anteriorly to the hinge line by a broad ledge. Anterior ridge uniformly elevated and recurved. Distal margin straight to slightly curved. The evenly worn posterior tooth never projects beyond the edge. Behind this is a shallow sulcus and the deep, symmetrically-excavated pit. Right valve chondrophore deeply excavated, its lower margin free. The surmounting tooth is often poorly developed. Subcircular posterior adductor muscle scar situated in the upper sixth of the shell near the umbo; swollen base of the lanceolate anterior muscle scar lies near the lower third. Depth of the pallial sinus equal to its width or much less. The upper margin slopes sharply downward while the lower edge may be parallel to the hinge line. Periostracum heavy, ranging from straw yellow to chocolate brown.

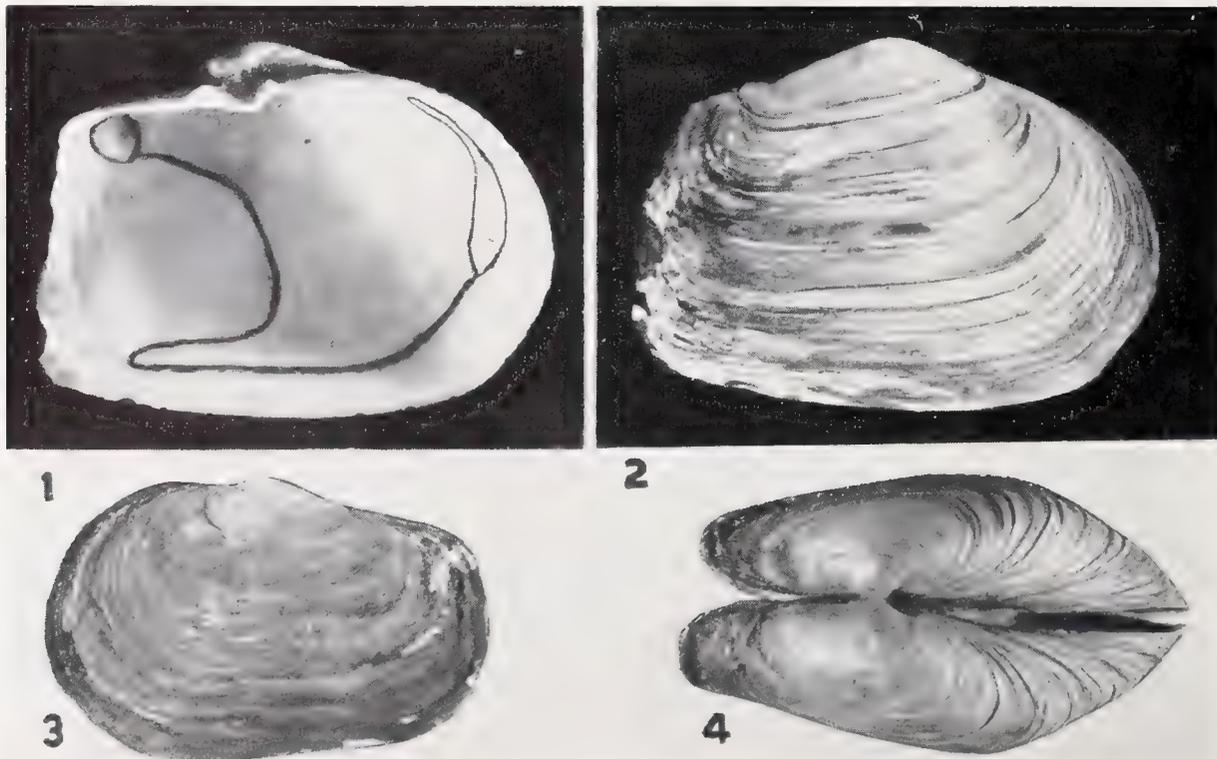


Plate 18. *Mya truncata* Linné

Figs. 1–2, 4. Boone Island, Maine. Fig. 3. Perry, Maine (all natural size).

In figure 1 the pallial complex has been inked in.

	length	height	width	maximum gape	
(large)	70.2	49.7	31.8	18.5 mm.	Eastport, Maine
(average)	52.8	39.5	29	17	Boone Id., Maine
	38.3	26.4	18.3	10.2	Revere, Massachusetts
	26	19.7	11.2	7.3	Grand Manan, New Brunswick
	28.5	23.6	17 est.	—	Hebron, Labrador (form <i>uddevalensis</i> Forbes)

Types. We here select Linné's reference to Lister 1678, *Hist. Anim. Angliae*, pl. 5, fig. 36, as the type figure and Liverpool, England as the type locality.

Common name. Gaper.

Remarks. *M. truncata* Linné is quite variable in the degree of truncation and the angle which the posterior margin forms with the axis. Forbes applied the name *uddevalensis* (= *abbreviata* Jeffreys) to a shell that he considered to be a variety of this species characterized by having a very obliquely truncated posterior margin which sloped anteriorly toward the base to a point almost under the umbones. Naturally the pallial sinus was much reduced. Our largest series, collected by Captain von Paulson, USCG, at Dove Bay, Danmark Haven, northeast Greenland, shows a nearly complete intergradation between typical and shortened forms. To our knowledge, the examples from the Gulf of St. Lawrence cited by Forbes constitute the southernmost living record for the form *uddevalensis*. We believe it to be only an extreme variant of the typical *truncata*.

Jeffreys (1865, p. 69) states that this species is eaten by the king eider duck of Greenland and the arctic fox and that large quantities have been obtained from the stomachs of Spitzbergen walrus which presumably rake them out of the mud with their long tusks, crush the shells with their molars and spit out the fragments and siphonal cuticles. He gives the vernacular names (all apparently derived from the Danish "smör," meaning

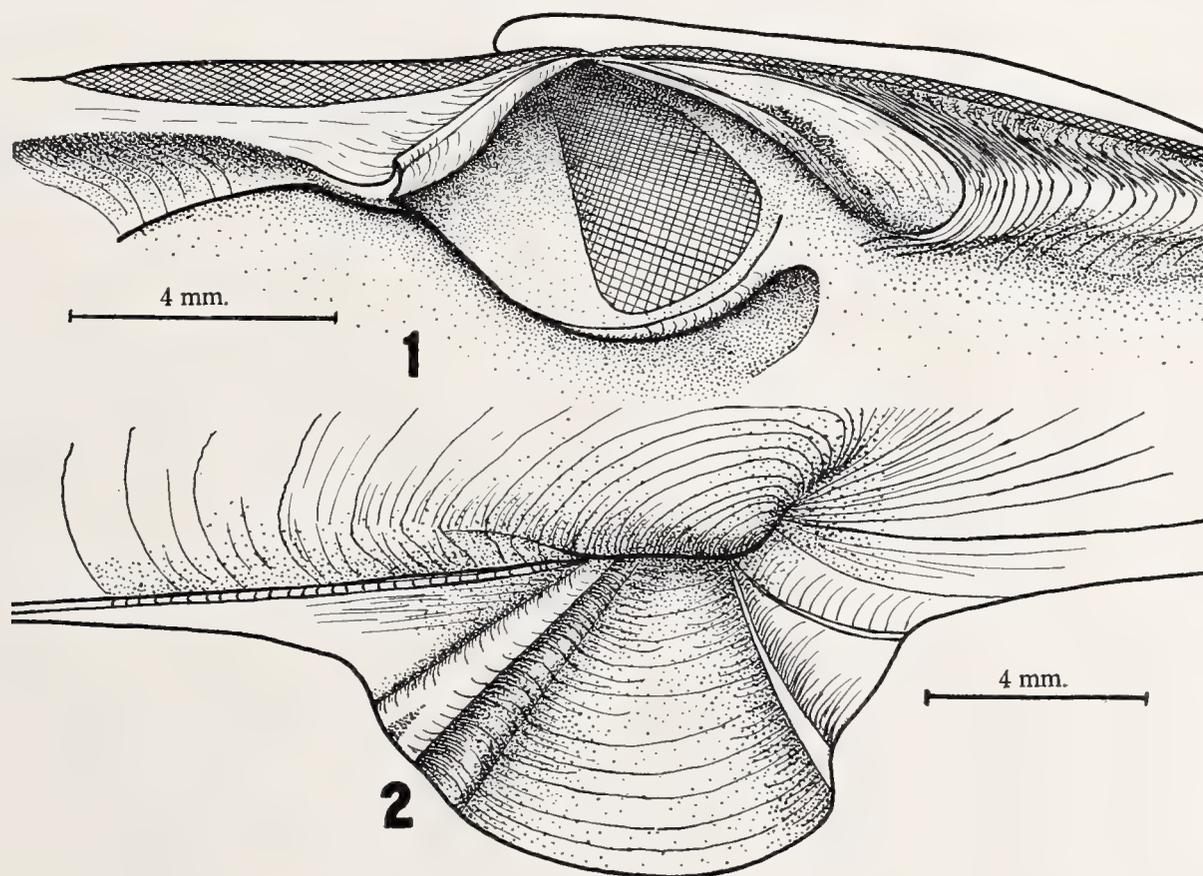


Plate 19. *Mya truncata* Linné

Fig. 1. Chondrophore of right valve. Fig. 2. Chondrophore of left valve.

Ruth D. Turner del.

butter) which are used for this clam in Iceland, the Faroe Islands, Shetland and western Scotland where it is considered quite a delicacy. Ganong (1889, p. 104) states that it forms an important source of food for the cod on the Newfoundland Banks.

Range. Circumpolar in Arctic waters. EASTERN ATLANTIC: south to La Rochelle, France, (Lamy 1927, p. 167). WESTERN PACIFIC: south to Hakodate, Japan (Lamy 1927, p. 166). EASTERN PACIFIC: south to Port Orchard, Washington (MCZ). WESTERN ATLANTIC: south to Nahant, Massachusetts.

Records. LABRADOR: Cape Mumford to Hebron (60 fathoms); Nain (7 fathoms)*. NEWFOUNDLAND: St. Lawrence Harbor (53 fathoms);* St. Anthony.* QUEBEC: Little Metis. NOVA SCOTIA: Banquereau (35-40 fathoms). NEW BRUNSWICK: Grand Manan. MAINE: Eastport; Boone Island. MASSACHUSETTS: Middle Bank (35 fathoms); Nahant; Revere Beach; Plymouth* (all MCZ); Nantucket* (USNM).

Mya arenaria Linné, Plates 20-21

Mya arenaria Linné 1758, Systema Naturae, ed. 10, p. 670 (O. Europae septentrionalis).

Mya communis Megerlé v. Mühlfeld 1811, Mag. Ges. naturf. Fr. Berlin, 5, p. 46 (based on Chemnitz 1782, Conch. Cab. (1) 6, pl. 1, fig. 3-4).

Mya lata Sowerby 1815, Mineral Conch. Great Britain, 1, p. 185, pl. 81 (the Crags of Norfolk and Suffolk Counties [England]); Smith 1816, Strata Identified by Organized Fossils, London, pl. 2, fig. 9 [typical *M. arenaria* chondrophore].

Mya acuta Say 1822, Journ. Acad. Nat. Sci. Philadelphia, 2, p. 313 (southern coast [United States]).

Mya mercenaria Say 1822, Journ. Acad. Nat. Sci. Philadelphia, 2, p. 313 (the coast of the United States).

Mya alba Agassiz 1839, Mém. Soc. Sc. Nat. Neuchâtel, 2: Mém. Moules de Mollusques, p. 40, pl. 3, fig. 1-6 and Notice sur le *Mya alba*, p. 1, pl. 1, fig. 2-8 (Porto Rico) [locality data erroneous].

Mya corpulenta Conrad 1845, Fossils of the Medial Tertiary, Philadelphia, p. 68, pl. 39, fig. 1 (Petersburg, Virginia [Tertiary]).

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Mya hemphilli Newcomb 1874, Proc. Acad. Nat. Sci. Philadelphia, 5, p. 415 (Bay of San Francisco [California]).

Mya elongata Locard 1886, Prodrome de Malac. française, pp. 383 and 586 (Dunkerque, La Rochelle, Arcachon [France]).

Description. Shell 25-150 mm. (1 to 6 inches) in length, elongately to roundly ovate, valves slightly gaping at the acute to rounded posterior. Color chalky-white with traces of cream and flesh color on inner surface. Umbones subcentral to central. Sculpture consists of concentric growth lines and obscure radiating surface irregularities. Ligament poorly developed. Chondrophore of the left valve long, spoon-shaped and shallow. Its anterior edge projecting sharply from the hinge line at an angle of 90-100° has an elevated recurved ridge particularly well-developed at the extremity. The figured chondrophore shows an unusually pronounced connecting ledge. Distal margin broadly rounded. Projecting end of posterior tooth prominent, its proximal portion often badly worn. Margin sulcate on either side of tooth. The adjacent narrow ledge is flat and the pit slopes gradually anteriorly. Chondrophore right valve shallow, unevenly excavated, its lower portion flattened where ventral margin fuses with shell. Surmounting tooth never well-developed. Subcircular posterior adductor muscle scar situated in upper third of shell. Swollen base of lanceolate anterior scar lies about on the midline. Pallial sinus long

* Dead valves with periostracum badly worn.

and narrow, its length usually about twice its width. Upper and lower margins slope at the same angle. Periostracum thin, light gray to straw-yellow.

	length	height	width	
(large)	140	85.4	53.5 mm.	Chelsea Beach, Massachusetts
	98.3	58.5	37	Brooklyn, New York
(average)	60	34.3	21.2	Little Choptank River, Maryland
	64.8	48.8	35.2	Cohasset, Massachusetts (distorted, living among rocks)

Types. We here select Baster 1762, *Opuscula Subseciva*, 2, pl. 7, fig. 1 as the type figure. Linné gave this reference in his 12th edition of the *Systema Naturae*. We designate the mouth of the Scheldt River, Netherlands as the type locality since this was mentioned by Baster.

Common names. Soft-shelled clam, soft clam, long-necked clam, nanny nose (derived from the Indian name "maninose").

Remarks. *Mya arenaria* is so variable in shape that this character alone is often of little value in distinguishing badly distorted specimens of this species from *M. truncata* and more particularly the arctic and West Coast forms. The least inconsistent characters are

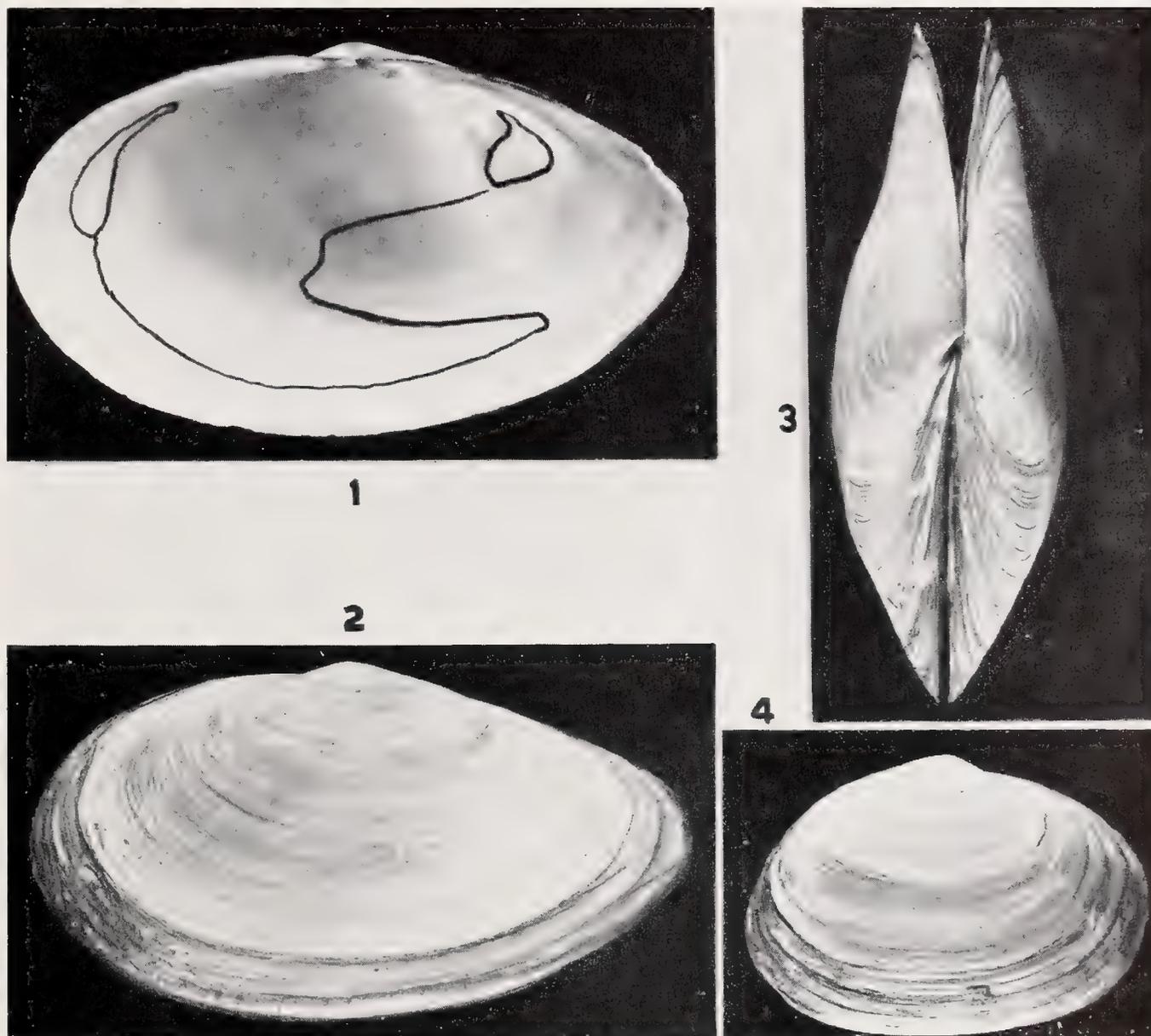


Plate 20. *Mya arenaria* Linné

Figs. 1-3. Little Choptank River, Dorchester Co., Maryland. Fig. 4. Nantasket Beach, Massachusetts (all natural size). In figure 1 the pallial complex has been inked in.

the form of the pallial sinus and the proportions of the chondrophores. Rocky and gravelly bottoms as well as waters of low salinity produce a large quota of deformed and dwarfed individuals. As one advances up the St. Lawrence River, the clams become progressively smaller.

About 1870 young clams were accidentally introduced into San Francisco Bay, California with shipments of seed oysters and spread rapidly northward to Puget Sound and south to Monterey (Stearns 1881). Just prior to this time the coasts of northern California and Washington were unique among all North Temperate shores in supporting no representatives of this species.

For a long time it has been generally thought that *M. arenaria* was circumpolar in the Arctic. However, such is not the case. The arctic counterpart of this species in Greenland, Iceland, Spitzbergen and northern Siberia is *Mya pseudoarenaria* Schlesch (1931, p. 136, syn.: *M. truncata ovata* Jensen 1900, p. 139; *non ovata* Donovan 1802). Hesseland (1946) in his very complete account of the geological history and spread of *M. arenaria* in European waters shows that, unlike the cold water *M. truncata*, it was exterminated there during the Pleistocene Ice Age. It was evidently reintroduced some time during the 16th or 17th century from our American coast and has only recently spread to northern Scandinavia. It was probably either imported for food or bait or the larvae were accidentally transported in the leaky bilges of ships.

Economy. In 1935, 11,635,000 pounds of soft-shelled clams valued at \$704,000 were harvested on the East Coast (Fiedler 1938, p. 42). In New England the quantities of

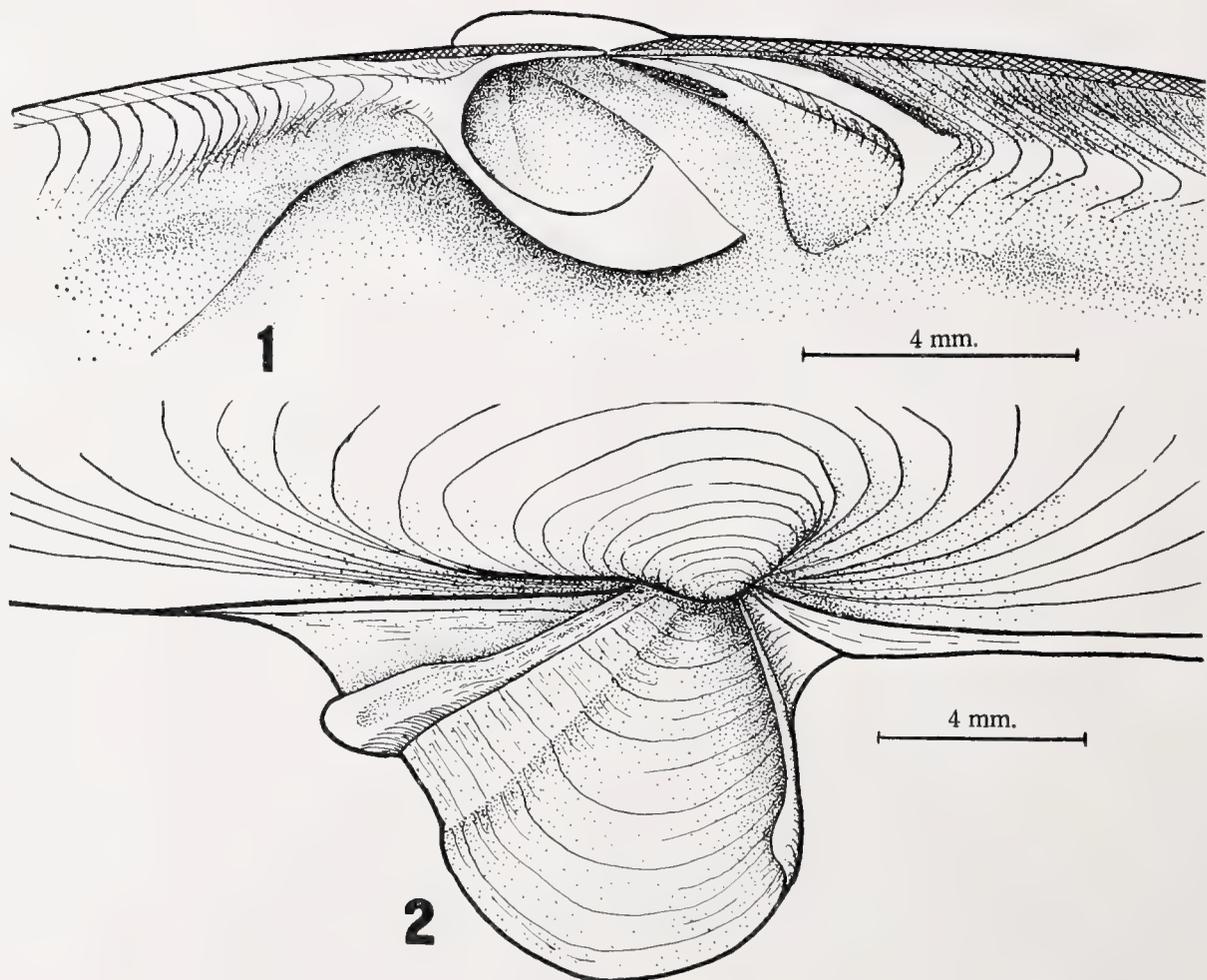


Plate 21. *Mya arenaria* Linné

Fig. 1. Chondrophore of the right valve. Fig. 2. Chondrophore of the left valve.

Ruth D. Turner del.

clams and oysters produced were about equal. Living as they do on readily accessible flats, it is natural that they should have been overfished. Attempts at seeding barren but well-situated areas with young clams sifted from overpopulated flats have been very successful. The "farmers'" investments have been protected by state legislation. The interest derived from an undertaking involving so little work is quite large when one considers that an acre may produce over a million clams in about two years. Furthermore, a hundred pounds of clams furnishes thirty-five pounds of food while the equivalent weight of oysters would give only thirteen pounds.

In the past, several outbreaks of typhoid fever have been traced to the consumption of polluted clams from sewage-contaminated waters. Nowadays clams from such areas cannot be sold unless they are first cleansed in tanks of chlorinated seawater.

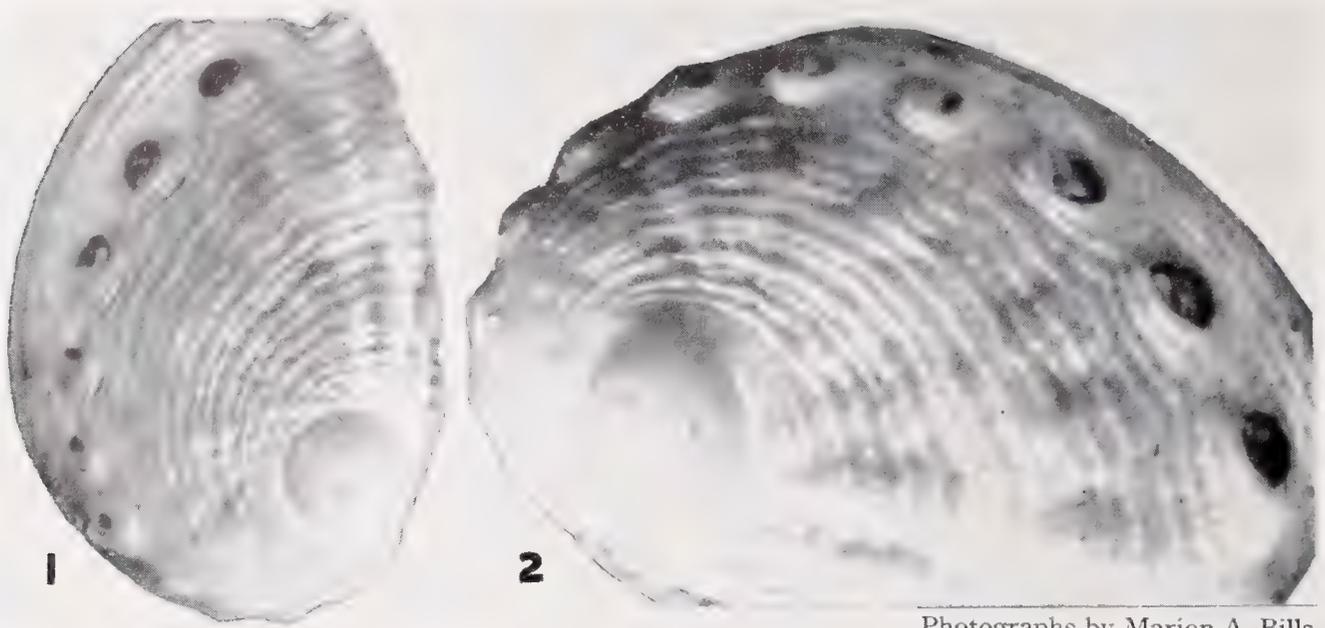
Range. EASTERN ATLANTIC: Northern Norway (Hessland 1946, p. 1) to Arcachon, France (Lamy 1927, p. 162). WESTERN PACIFIC: Kamchatka Peninsula¹ to Iyo, Japan (MCZ). EASTERN PACIFIC: Akutan Id., Alaska and Puget Sound, Washington (both MCZ) to Monterey, California (Stearns 1881, p. 366). WESTERN ATLANTIC: Labrador to Cape Hatteras, North Carolina. The southernmost living examples we have seen were from Virginia Beach. The National Museum has three worn valves from Beaufort, N.C., which may be Pleistocene. Neither Jacot (1921, p. 137) nor any of the papers on the Beaufort fauna to which he refers record finding living *arenaria*. All records south of Cape Hatteras may well be based on fossil material.

Records. LABRADOR: Nain. NEWFOUNDLAND: Cape Norman; Pilley's Id.; St. Pierre (5 fathoms). QUEBEC: Seven Islands, Saguenay Co.; Little Metis (all MCZ). PRINCE EDWARD ISLAND: Ellerslie (J. C. Medcof). NEW BRUNSWICK: St. John; Grand Manan. MAINE: Eastport; Isle au Haut; Kennebunkport. NEW HAMPSHIRE: Hampton Beach. MASSACHUSETTS: Ipswich; Atlantic; Duxbury; Provincetown; Dennisport; Nantucket. RHODE ISLAND: Westerly. CONNECTICUT: Stonington; Branford. NEW YORK: Glen-cove; Staten Island. NEW JERSEY: Atlantic City. MARYLAND: Little Choptank River, Dorchester Co. VIRGINIA: Virginia Beach (all MCZ). NORTH CAROLINA: Beaufort (USNM, dead valves).

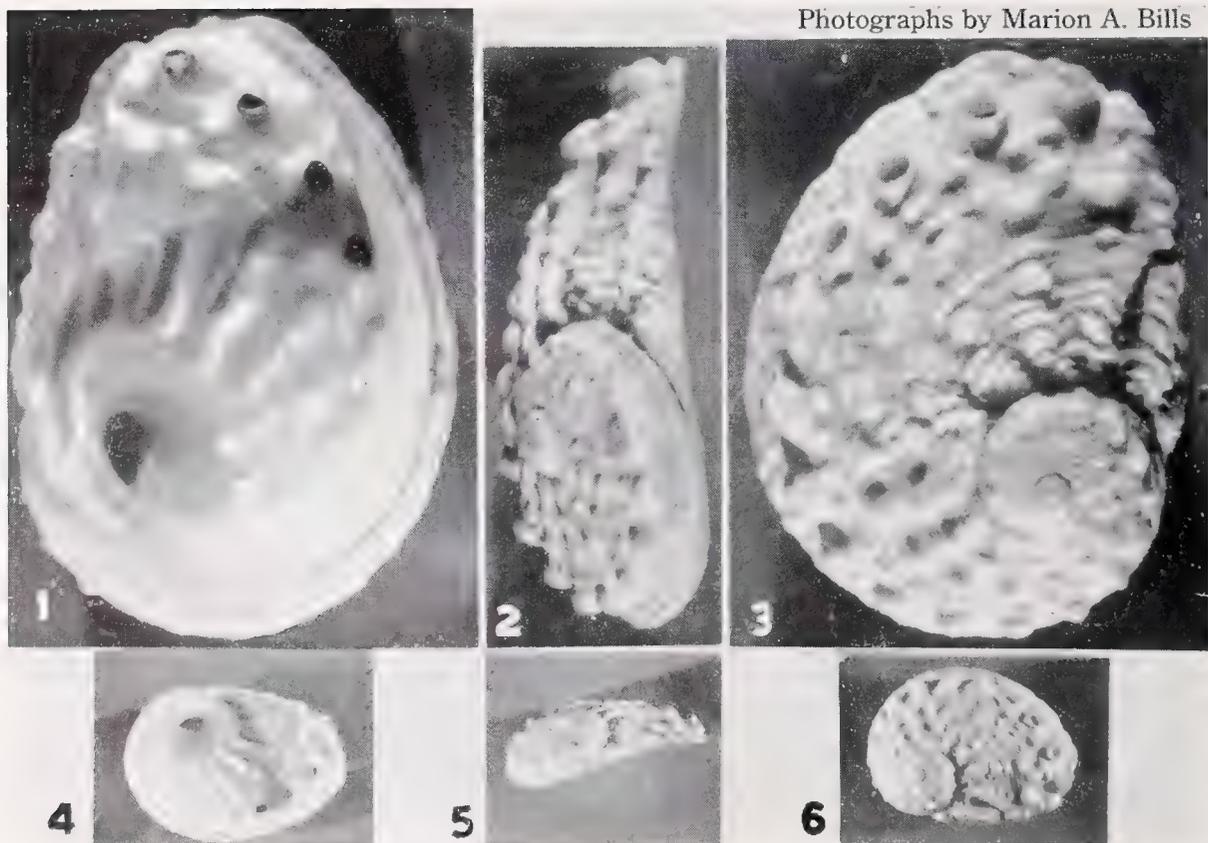
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¹ Lamy 1927, p. 162; possibly *M. profundior* Grant and Gale.



Photographs by Marion A. Bills

Plate 22. *Haliotis pourtalesii* DallOff the Elbow, Key Largo, Florida, in 90-100 fathoms (fig. 1, 7 \times ; fig. 2, 10 \times).

Photographs by Marion A. Bills

Plate 23. *Haliotis barbouri* FosterPraia de Copacabana, Brasil, Holotype (figs. 1-3, about 3 \times ; figs. 4-6, natural size).



JOHNSONIA

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HALIOTIDAE

VOL. 2, NO. 21

THE FAMILY HALIOTIDAE IN THE WESTERN ATLANTIC

BY
RICHARD W. FOSTER

Representatives of the family Haliotidae, commonly known as abalones, are found in most of the tropical and temperate seas of the world. They even reach up into the colder waters of the English Channel, Alaska, and northern Japan. The vast majority of the more than eighty recognized species live on the reefs and rocky ledges just off shore in depths of less than ten fathoms.

This family has followed a biological trend common to many other molluscan groups in achieving its greatest diversification into species complexes in Australian and East Indian seas and in producing a smaller number of species characterized by large size and abundance of individuals in the temperate portions of the Northern Pacific. Some of these northern forms have proved to be of considerable economic value. For example, in 1935 the catch of abalone in the waters of California yielded some 774,200 pounds of steaks valued at \$115,319.¹ In Europe, the people of the Channel Islands harvest *Haliotis tuberculata* Linné, or "ormer," for use not only as food but also in the manufacture of buttons. The iridescent, nacreous shells of the larger abalones lend themselves well to the fabrication of various kinds of jewelry.

Haliotis Linné

Haliotis Linné 1758, Syst. Nat. ed. 10, p. 779.

Genotype; *H. asinina* Linné (subsequent designation, Denys de Montfort 1810, Conch. Syst., 2, p. 119).

Shell nacreous, subcircular to elongate, depressed, with a small spire and a very large body whorl having a row of pores along the left side for the escape of waste products. As the new pores are formed the old ones are closed by the formation of a callus. Aperture occupying nearly the whole under surface of the shell. Muscle impression truncately ovate in form and very large, often equivalent in area to two-thirds the size of the aperture. Operculum lacking.

The anatomy of this group has been worked out in great detail by D. R. Crofts (1929 Trans. Liverpool Biol. Soc., 43, pt. 2, pp. 1-174, pl. 1-8).

¹ R. H. Fiedler 1937; Fishery Industries of the United States, 1936. Bureau of Fisheries Administrative Report no. 27, p. 222.

Haliotis pourtalesii, Dall, Plate 22

Haliotis (Padollus) pourtalesii Dall 1881, Bull. Mus. Comparative Zoölogy, **9**, p. 79 (off Florida Reefs, 200 fathoms [Florida]).

Haliotis (Padollus) pourtalesii Dall, Henderson 1915, Proc. United States National Mus., **48**, p. 660, pl. 45-46 (upper figures).

Haliotis pourtalesii Dall, Smith 1937, East Coast Marine Shells, Lantana, Florida, p. 78, pl. 29, fig. 3.

Description. Shell fairly thin, sub-elliptical, 10 to 25 mm. (two-fifths to one inch) in length. Whorls two and three-quarters. Color ranges from wax yellow to light brown with an occasional irregular patch of reddish orange on the body whorl. A uniform light orange band runs from each hole to the columella. On one specimen this lateral portion is speckled with dark orange pin-point maculations. Spire small, low, submarginal, and situated on the posterior fifth of the shell. Aperture subelliptical, nacreous. Base of the shell concave with some lateral torsion. Columella with a sulcus inside the raised parietal margin of the aperture. An 11 mm. specimen has five oval shell pores with elevated margins preceded by twelve moderately prominent tubercles representing perforations in the earlier growth stages. Spiral sculpture consists of sharp rather widely-spaced wavy cords between which finer threads are occasionally intercalated. The area adjacent to the terminal margin of the body whorl and bounded by the suture and the pores contains from 22 to 27 of these cords and threads. The lateral portion of the body whorl has three cords followed by a strong, angular, peripheral ridge or carina. Immediately below this are three more cords. The axial sculpture consists of radiating lamellae which roughly correspond to the pores in their position. They may occur as continuous folds across the whorl; as two distinct rows of lamellae (one next to the suture, the other midway between this and the rows of holes); or they may be present only near the suture. A single specimen often shows several of these stages. It is unfortunate that the figure of the neotype did not show its somewhat poorly developed lamellae. Surface with very fine growth lines. No periostracum apparent.

length	width	height ¹
10.2-3	6.9	3 mm. Key Largo, Florida
11	8	— neotype, off Sand Key, Florida

According to Dall, Pourtalès' shell was "about an inch and a half in diameter." We have a large fragment dredged off Key Largo which must have come from a specimen at least 1 inch in length.

Types. Neotype, United States National Museum no. 271601, 3 miles off Sand Key, Florida, in 90 fathoms, J. B. Henderson, collector, 1913.

Common name. Pourtalès' Abalone.

Remarks. The history of this species is so remarkable that we feel this paper would be incomplete without a brief summary of the background of its original discovery, loss, and rediscovery.

Count Louis François de Pourtalès while engaged in dredging operations for the U.S. Fish Commission aboard the "Bibb" during March of 1869, collected a single live speci-

¹The height given here was determined by placing the shell on a plane surface and measuring the altitude, which, in this case, is actually the greatest distance from the base to a point on the body whorl.

men in 200 fathoms off the Florida Reefs. The collections made on that expedition were deposited for a short time in the National Museum in Washington before being sent to Dr. William Stimpson at the Chicago Academy of Sciences. Stimpson, at that time Director of the Academy, was laboring on the manuscript for his monumental work on the marine invertebrates of the eastern coast of North America from Maine to Georgia which was to be published by the Smithsonian Institution. For his researches he had assembled within the supposedly fireproof walls of the new building what was probably the finest array of marine animals and related literature which had ever been gathered together in one place up to that time. The museums of Europe and this country had been unusually generous in the loan of study material. In fact, Dall (Proc. Biol. Soc. Washington, 4, p. 132, 1888) states that the National Museum had shipped him all of their alcoholic collections of crustaceans and mollusks. In the fall of 1871, a great fire swept through Chicago, leaving nothing but charred embers in its wake. The wealth of marine invertebrates, including Pourtalès' abalone, accumulated by half a dozen museums and scores of individuals was destroyed in a few hours together with all of Stimpson's notes, manuscripts and engravings. The shock of the catastrophe was too great a blow for Stimpson's already weakened condition. He died seven months after the conflagration.

No specimens of Pourtalès' Abalone were to be seen again for forty-two years.

Dall had examined the shells collected by the "Bibb" while they were still in Washington and was so amazed to find a *Haliotis* from the Western Atlantic that he was able to briefly describe the species from memory ten years later in his preliminary report on the mollusca of the "Blake" Expedition. The dredgings of the "Albatross" off the Galápagos Islands brought forth several specimens of a *Haliotis* which Dall believed to be identical with his *H. pourtalesii* from the Western Atlantic. In the report on the mollusca obtained on the cruise (Dall 1889, Proc. United States National Mus., 12, p. 355, pl. 12, figs. 1, 3) he figured and redescribed the species in considerable detail. The interest associated with the supposed rediscovery of the species was further enhanced by the fact that no representatives of this family had previously been known to exist in the Eastern Pacific south of the Gulf of California.

A quarter of a century elapsed. In the course of his very extensive dredging operations aboard the yacht "Eolis," John B. Henderson secured another specimen of the Western Atlantic form in 90 fathoms off Sand Key, Florida. It is interesting to note that it was found on Pourtalès' Plateau, that great shelf so suitably named by Alexander Agassiz, which extends the entire length of the Lower Florida Keys. Dall certified that the specimen belonged to the species he had described from memory. It is evident that he probably was in error when he characterized Pourtalès' shell as ". . . ., above smoothish except for two strong spiral ribs," A critical comparison of the Atlantic and Galápagos specimens resulted in the discovery that the latter was a distinct species. In 1915 Henderson finally clarified the picture and gave the "Galápagos" shells (USNM Cat. no. 96392) the name *Haliotis (Padollus) dalli*. Unlike *H. pourtalesii*, it was a true *Padollus* by virtue of the fact that it possessed a spiral ridge centrally located on the upper surface with a corresponding sulcus on the ventral side.

In 1916 Henderson collected five more imperfect shells in the Key West Region and in 1944 L. A. Burry dredged several fragments and one nearly perfect specimen off Key Largo and Sombrero Light.

Range. Off the Lower Florida Keys.

Records. FLORIDA: 5½ miles S.E. of the Elbow, Key Largo, in 92–100 fathoms; 6 miles S.E. of Sombrero Light in 66 fathoms (all L. A. Burry and MCZ); 3 miles off Sand Key in 90 fathoms; off Sand Key in 85 fathoms; off Western Dry Rocks in 65 fathoms (all USNM).

Haliotis barbouri, new species, Plate 23

Description. Shell moderately heavy, roundly ovate, 22.6 mm. (0.9 inches) in length. Whorls 2.75 to 3, convex. Nuclear whorl indistinct. Base color white with radiating flame-shaped patches of orange, gold, and light yellow which blend from dark to light in a postero-anterior direction. These bands correspond to the position of the holes and are particularly well defined in the region of the carina. Spire somewhat elevated and situated on the posterior third of the shell. Aperture ovate, nacreous. Base of shell concave in the long axis with some lateral torsion. Columella smooth with a sulcus inside the parietal margin of the aperture. The four active shell pores are oval to round in shape with elevated margins. These are preceded by twenty-four quite prominent tubercles representing perforations in the earlier growth stages. The spiral sculpture consists of from 16 to 18 closely packed cords. Up to about 2.5 whorls every fifth or sixth cord is much more pronounced. Nodules develop at the intersections of major cords and low axial lamellae. These radiating lamellae are coincident with the pores. At 2.5 whorls quite an abrupt change in the sculpture takes place. At this point the relatively indistinct lamellae become very prominent and the individual nodules are absorbed into these heavy, occasionally bifurcated, coarsely granose ridges. The cords become even more crowded together and irregular in size. The lateral portion of the body whorl has three cords followed by a strong, angular peripheral ridge or carina. Below the carina two broad spiral ribs overlap the margin of the columella so that the sulci appear to be diagonally impressed. Growth lines fine. Periostracum straw colored.

length	width	height
22.6	16.9	7.4 mm. Holotype

Types. Holotype, Museum of Comparative Zoölogy, no. 152469, collected on the beach at Praia de Copacabana, Distrito Federal, Brasil, by J. Modesto dos Santos and sent to us by Dr. Mathias de Oliveira Roxo. Only this single specimen is known.

Common name. Barbour's Abalone.

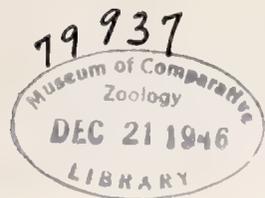
Remarks. This species can be readily distinguished from *H. pourtalesii* Dall by its greater convexity, the broader, more oval shape, the more anteriorly placed spire, and the radial sculpture consisting of individual nodules on poorly defined lamellae in the earlier portion of the shell. These develop into prominent, sometimes bifurcated, lamellae on the body whorl.

Named for the late Dr. Thomas Barbour, distinguished director of the Museum of Comparative Zoölogy for the past eighteen years.

Range and Records. Known only from the type locality.

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DECEMBER 21, 1946

VOLUTIDAE

VOL. 2, NO. 22

THE GENERA BATHYAURINIA, REHDERIA AND SCAPHELLA IN THE WESTERN ATLANTIC

BY
WILLIAM J. CLENCH

The three genera considered in this report are worthy members of the family Volutidae, a family noted for the remarkable beauty of many of its species.

Scaphella, as now restricted, *Bathyaaurinia* and *Rehderia* are known only from the temperate and tropical portions of the Western Atlantic. All species occur in moderate depths.

Nothing as yet is known regarding their life histories, and their distribution is based upon but few records. A few species are known only from single examples; the remainder from a few specimens, many of which were dead and occupied by hermit crabs.

Various genera in this family are remarkably diversified as regards sculpture, color, production of periostracum, the degree to which the mantle fold envelops the shell and other characteristics. Within any one genus, however, these characters are fairly constant.

The young are produced in membranous capsules, singly in some species or multiple in others. According to Dall, in *Scaphella* the early embryonic portion of the shell is membranous and sloughs off and this is probably true of *Bathyaaurinia* and *Rehderia* as well. The calcareous portion starts as a minute papilliform point, the calcarella, which enlarges rapidly and may spiral immediately or coil in a single plane for an additional whorl, depending upon the species.

Various members of the three genera considered in this report show a rather wide range of depth tolerance. *Scaphella junonia* occurs in 2 to 45 fathoms while other mem-

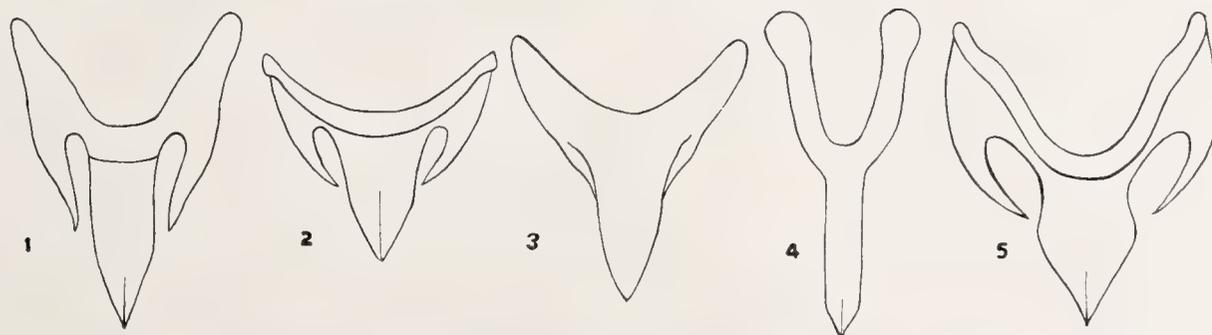


Plate 24. Radulae. Fig. 1. *Bathyaaurinia torrei* Pilsbry. Fig. 2. *Bathyaaurinia aguayoi* Clench. Fig. 3. *Scaphella (Aurinia) florida* Clench and Aguayo. Fig. 4. *Scaphella (Aurinia) junonia* Shaw. Fig. 5. *Rehderia georgiana* Clench.

bers of this genus extend to depths of 509 fathoms. The limits of the known depth range of *Rehderia* are from 40 to 125 fathoms and those of *Bathyaurlinia* are from 10 to 440 fathoms.

I am deeply indebted to Dr. Harald Rehder for the loan of the entire series of *Scaphella* and *Rehderia* contained in the collections of the United States National Museum.

Genus *Bathyaurlinia* Clench and Aguayo

Bathyaurlinia Clench and Aguayo 1940, Memorias de la Sociedad Cubana de Historia Natural 14, p. 92.

Genotype, *Aurinia torrei* Pilsbry (original designation, Clench and Aguayo 1940).

The shells are elongate, polished, fairly light in structure and possessing a moderately well developed whorl shoulder which may be smooth or axially ridged. Columella without plicae. A very small radula is present (2 mm. in length for a shell measuring 54 mm.). Only a single longitudinal row of teeth remains, the rachidian or central row. Reduction or loss of parts has been less, however, than in *Aurinia*, as a strong and well developed lateral denticle flanks each side of the large and robust central denticle (see plate 24, fig. 1-2).

Very little is known about the habits of this genus. *Bathyaurlinia torrei* was first obtained in a fish trap. This would indicate that this species and possibly others in the genus are scavengers, at least partially, in their procurement of food.

All of the dredged material that we possess in this genus came from fair depths: *Bathyaurlinia torrei* from 150 to 265 fathoms (900 to 1590 feet); *B. piratica* from 210 fathoms (1260 feet); *B. aguayoi* from 425 to 440 fathoms (2550 to 2640 feet). The original specimens of *B. torrei* were obtained in comparatively shallow water, 10 fathoms (60 feet).

Bathyaurlinia piratica Clench and Aguayo, Plate 25

Bathyaurlinia piratica Clench and Aguayo 1940, Memorias de la Sociedad Cubana de Historia Natural 14, p. 93, pl. 15, fig. 2 (off Punta Alegre, Camagüey, Cuba).

Description. Shell probably reaching 100 mm. (about 4 inches) in length, fusiform, rather light in structure, shining and faintly ridged axially on the upper whorls. Whorls 6, convex and shouldered, the last whorl much enlarged. Color probably yellowish to salmon in live specimens. Spire extended. Suture impressed and glazed smooth with the whorls shingled upon one another. Aperture sub-elliptical and rather elongate. Outer lip thin. Parietal lip not indicated by a reflected area. Siphonal canal broken. Columella nearly straight and without plicae. No spiral striae on the first post-nuclear whorl. Later whorls sculptured with very fine axial ridges which disappear on the body whorl. Sculpture on the body whorl consisting of exceedingly fine spiral threads which are a little more strongly developed near the base of the shell. No periostracum as the shell is highly glazed and is enveloped in the mantle. Operculum probably absent.

	length	width	aperture	
large	93.5+	41.8	55+ × 21 mm.	Holotype

Types. Holotype, Museum of Comparative Zoölogy no. 135235, *Atlantis*, station no. 2982A (N. Lat. 22°48'; W. Long. 78°50') off Punta Alegre, Camagüey, Cuba, March 11, 1938, in 210 fathoms.

Remarks. (See also under *B. torrei*). Unfortunately the only specimen known is a dead and rather badly broken shell. However, sufficient characters remain so that it is readily differentiated from the other two species in the genus.

Range and Records. See under Types.



Photograph by F. P. Orchard

Plate 25. *Bathyaurinia piratica* Clench and Aguayo (Holotype), off Punta Alegre, Camagüey, Cuba (natural size).

***Bathyaurinia torrei* Pilsbry, Plate 26, fig. 1-2**

Aurinia torrei Pilsbry 1937, *Nautilus* 51, p. 37, pl. 4, fig. 1 (off Cayo Francés, Caibarién, Cuba).

Description. Shell reaching at least 116 mm. (about $4\frac{1}{2}$ inches) in length, fusiform, rather light in structure, shining, and rather strongly ridged axially. Whorls six, convex and shouldered. Color of the first two whorls white, the remaining whorls a diffused salmon pink, with a series of small dark reddish brown spots in a spiral line just below the suture on the third and fourth whorls. These spots may start as a solid line on the first post-embryonic whorl; rarely do these spots continue to the fifth whorl. A second row of spots in spiral arrangement is located on the parietal area. Spire extended. Suture impressed and glazed smooth with the whorls shingled upon one another. Aperture sub-elliptical and rather elongate. Outer lip rather thin. Parietal lip not indicated by a reflected area. Siphonal canal rather broad and reflected backward. Columella nearly straight and without plicae. Sculpture consisting of a few very fine spiral striae on the first post-nuclear whorl. Later whorls with rather strong axial ridges which are most

prominent on the whorl shoulder. On the body whorl these ridges become irregular and rather indistinct. No periostracum as the shell is highly glazed and is enveloped entirely by the mantle. Operculum probably absent.

	length	width	aperture	
(large)	113	38	$75.5 \times \pm 18$ mm.	Holotype
(large)	116	40	77×17	off Cayo Coco, Camagüey, Cuba
(average)	94	33	62×15	off Sagua la Grande, Las Villas, Cuba

Types. Holotype, Academy of Natural Sciences, Philadelphia, no. 168804, from a fish trap off Cayo Francés, Caibarién, Cuba, in 10 fathoms. A paratype in the collection of Carlos de la Torre.

Remarks. This species differs from *piratica* by having a less swollen body whorl, much more pronounced axial ridges and having no trace of spiral sculpture on the body whorl. *B. torrei* differs from *B. aguayoi* in being much larger, possessing smaller nuclear whorls, lacking the fine axial striations, having the columella straight rather than arched and in possessing subsutural spots rather than a solidly colored band.

Range. North and south coasts of Cuba.

Records. All station numbers are those obtained by the *Atlantis*. CUBA: off Sagua la Grande, station 3438, (265 fathoms); off Caibarién, station 3434, (255 fathoms); off Punta Alegre, station 2980, (220–260 fathoms); off Cayo Coco, station 3405, (235 fathoms); off Cayo Romano, station 3388, (255 fathoms); off Bahía de Cochinos, station 3332, (220 fathoms); (all MCZ and Museo Poey).

Bathyaurlnia aguayoi *Clench*, Plate 26, fig. 3

Bathyaurlnia aguayoi Clench 1940, Memorias de la Sociedad Cubana de Historia Natural **14**, p. 241, pl. 42, fig. 4 (about 164 miles east of St. Augustine, Florida).

Description. Shell reaching about 75 mm. (about 3 inches) in length, fusiform, rather light in structure, shining and faintly ridged axially on the upper whorls. Whorls six, convex and only moderately shouldered. Color of the first two whorls white, the remaining whorls a diffused light brownish orange with a deeper brownish subsutural band below a whitish band at the suture. Spire moderately extended. Suture impressed and glazed smooth with the whorls shingled upon one another. Aperture sub-elliptical and rather elongate. Outer lip rather thin. Parietal lip not indicated by a reflected area. Siphonal canal rather broad and reflected backward. Columella strongly arched and without plicae. No spiral striae on the first post-nuclear whorl. Later whorls sculptured with very small axial ridges which disappear on the penultimate and body whorls. Spiral sculpture on the body whorl consisting of numerous and exceedingly fine threads which are a little coarser toward the base. No periostracum as the shell is highly glazed and is enveloped entirely by the mantle. Operculum probably absent.

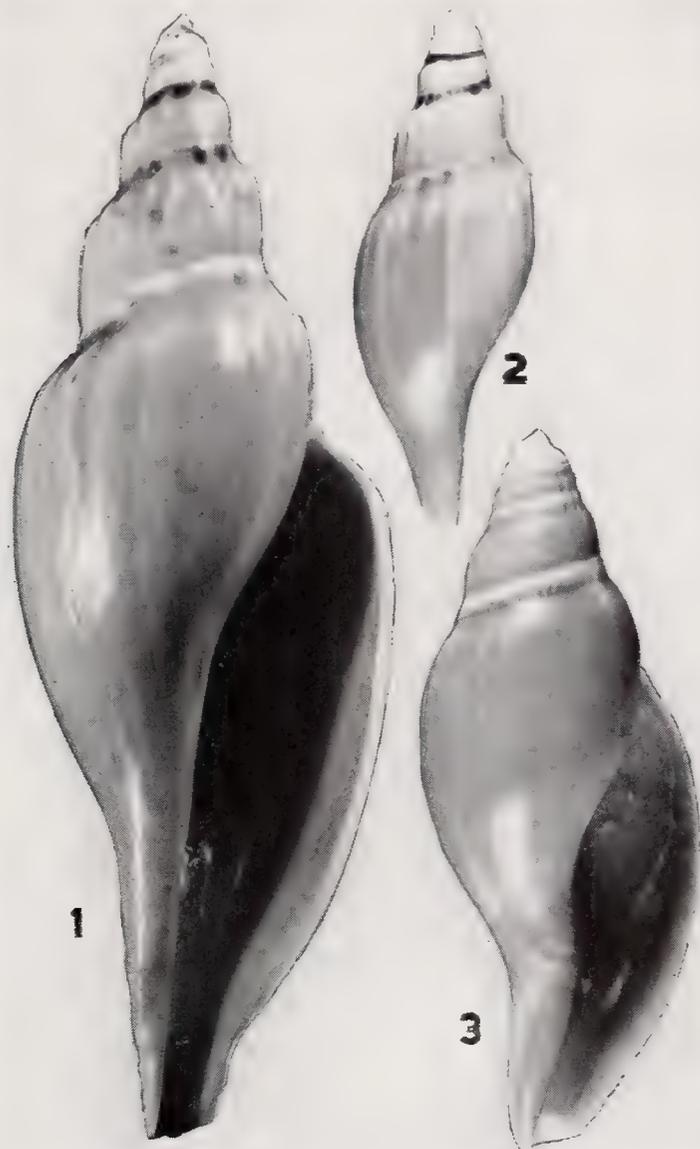
	length	width	aperture	
(large)	75	27.5	52×12.5 mm.	Holotype
(large)	77.1	32.5	57×13.5	Paratype

Types. Holotype, Museum of Comparative Zoölogy no. 111858, *Atlantis*, station 3783 (N. Lat. $30^{\circ}03'$; W. Long. $78^{\circ}37'$) about 164 miles east of St. Augustine, Florida

in 425 to 430 fathoms. A single dead paratype from station no. 3782 (N. Lat. $30^{\circ}10'$; W. Long. $78^{\circ}34'$) about 158 miles east of St. Augustine, Florida in 435 to 440 fathoms.

Remarks. (See also under *B. torrei*). This species, though congeneric with both *B. torrei* and *B. piratica*, differs rather sharply from them both in having less shouldered whorls, less pronounced axial ridges and in possessing a rather strongly arched columella.

Range and Records. See under Types.



Photographs by F. P. Orchard

Plate 26. Fig. 1 and 2. *Bathyaurnia torrei* Pilsbry. Fig. 1, off Cayo Coco. Fig. 2, off Cayo Romano, Camagüey, Cuba. Fig. 3. *Bathyaurnia aguayoi* Clench (Holotype), off St. Augustine, Florida (all natural size).

Rehderia, new genus

Shells are characterized by having large nuclear whorls with the calcarella smooth and hardly extending above the first whorl. This may be regularly coiled into the post embryonic whorl or may be somewhat offset to the main axis. Whorls are shouldered and the shell possesses a very heavy periostracum. The mantle envelops the ventral portion of the body whorl and most of the spire. Columellar plicae present.

A radula is present and an operculum absent in all members of this genus. On the basis of the radula the genus *Rehderia* is closely related to *Bathyaurnia* (plate 24, fig. 1, 5).

Genotype, *Aurinia schmitti* Bartsch

Rehderia schmitti Bartsch, Plate 27, fig. 1-2

Aurinia schmitti Bartsch 1931, Journal Washington Academy of Science 21, pp. 539-540, fig. 1 (off Tortugas, Florida); M. Smith 1942, A Review of the Volutidae, Lantana, Florida, p. 66, pl. 7, fig. 58.

Description. Shell fusiform, large, reaching about 130 mm. (5 inches) in length, rather light in structure. Whorls six, slightly convex. Color, when periostracum is present, a yellowish to dark brown. Underneath the periostracum the shell is a very pale pinkish salmon with 4 or 5 spiral rows of dark brown, square spots. These are somewhat indistinct and can be seen only where the periostracum has been removed from the shell. Aperture lengthened and sub-elliptical. Outer lip thin. Parietal region with a yellowish gray glaze, its area taking in most of the lower surface whorl, and, in addition, including most of the ventral surface of the spire. This glaze actually overlays the periostracum from the inner margin of the aperture to nearly half way around the body whorl. However, within the aperture both this overlay and the periostracum are absorbed. Upper end of the aperture rather wide and somewhat ear-shaped which produces a high shoulder on the body whorl. Lower portion of the aperture rather wide and extending into the siphonal canal. Columella nearly straight and supporting two well-developed plicae. Spire extended, acute and produced at an angle of about 45°. Sculpture consisting of very fine spiral threads crossed by numerous irregular, coarse, arched growth lines. Nuclear whorls straw yellow and smooth. First two post-embryonic whorls sculptured with fine spiral threads and crossed by axial ridges. Operculum absent. The radula consists of a single row of rachidian teeth, 10½ mm. in length for a shell 129 mm. long. The individual teeth are almost exactly like the one figured for *R. georgiana* (plate 24, fig. 5).

length	width	aperture	
129	41	93 × 15 mm.	off Tortugas, Florida
114	35	75 × 14	Holotype
97	33	71 × 13	Paratype

Types. Holotype, United States National Museum no. 382779, from south of the Tortugas Islands, Florida in 80 fathoms. A single paratype from the same locality and depth. An additional specimen from the same locality but collected in 125 to 65 fathoms.

Remarks. A remarkable feature of this species is that it has produced a very heavy protective periostracum and at the same time has the mantle so developed that it envelops most of the shell. I cannot recall any other species of mollusk in which this occurs, at least to the extent exhibited by *R. schmitti*. In the matter of mantle envelopment, the genus *Rehderia* is intermediate between *Scaphella*, in which the mantle does not envelop the shell, and *Bathyaurnia*, in which, so far as known, the mantle completely envelops the shell.

The irregularity of the embryonic whorl appears to be variable in this species, as two specimens have the post-nuclear whorls continued evenly in spiral development, while the third (the holotype) has the axis of the nuclear whorl offset by at least 45°.

Range and Records. See under Types.

Rehderia georgiana, new species, Plate 27, fig. 3

Description. Shell fusiform, medium in size, reaching 82 mm. ($3\frac{1}{4}$ inches) in length, rather light in structure. Whorls six, slightly convex with a moderately strong shoulder on the body whorl. Color, when periostracum is present, a yellowish straw. Underneath the periostracum the shell is chalky white with a slight pinkish tinge. There are five spiral rows of rather large, dark brown, square spots. These are distinct only in transmitted light through the palatal area. Aperture lengthened and sub-elliptical. Outer lip thin. Parietal region with a heavy grayish glaze overlying the periostracum. This area extends to about the nuclear whorls and covers much of the lower half of the body whorl. Upper end of the aperture fairly wide, lower end of the aperture broad and extending into the siphonal canal. Columella rather strongly arched to the right and supporting two weak plicae. Spire extended, acute and produced at an angle of about 45° . Sculpture consisting of very fine spiral threads crossed by numerous and very fine growth lines. Nuclear whorl yellowish brown and smooth, the calcarella small and worn. The



Photographs by F. P. Orchard

Plate 27. Fig. 1-2. *Rehderia schmitti* Bartsch, south of Tortugas Islands, Florida. Fig. 1, Paratype; Fig. 2, Holotype). Fig. 3. *Rehderia georgiana* Clench (Holotype), about 100 miles off Darien, Georgia (all natural size).

post-embryonic whorls with rather well developed axial costae which disappear on the body whorl. Periostracum rather heavy.

The sides of the foot are granulose and mottled with both yellow and black. The radula is 7 mm. long (shell 82 mm., holotype) and consists of only a single row of rachidian teeth. These possess a well developed central denticle with two narrow lateral denticles (plate 24, fig. 5).

length	width	aperture	
82	28	55 × 12 mm.	Holotype
102	34	64 × 13	Paratype
85	30	57 × 11	Paratype

Types. Holotype, United States National Museum no. 543509, *Pelican*, station 179-5, from about 100 miles off Darien, Georgia (N. Lat. 31°29.5'; W. Long. 79°41.5') in 45 fathoms. A paratype from the same station in the Museum of Comparative Zoölogy.

Remarks. This species differs from *R. schmitti* by being smaller, having the columella strongly arched and in having the mantle covering a smaller portion of the parietal area.

Range. North Carolina south to Florida.

Records. NORTH CAROLINA: about 100 miles east of Cape Fear, *Pelican*, station no. 187-4 (N. Lat. 34°05'; W. Long. 76°10') in 80 to 100 fathoms. GEORGIA: about 100 miles east of Darien, *Pelican*, station no. 179-5 (N. Lat. 31°29.5'; W. Long. 79°41.5') in 45 fathoms. FLORIDA: about 40 miles east of Cape Canaveral, *Pelican*, station no. 169-8 (N. Lat. 28°25'; W. Long. 79°58') in 50-100 fathoms.

Genus *Scaphella* Swainson

Scaphella Swainson 1832, Zoological Illustrations (2) 2, p. 87; Swainson 1840, A Treatise on Malacology, p. 318; J. E. Gray 1847, Proc. Zoological Society of London, p. 141; W. H. Dall 1890, Trans. Wagner Free Institute of Science, Philadelphia 3, p. 79; *non Scaphella* 'Gray' H. and A. Adams 1858; M. Smith 1942, A Review of the Volutidae, Lantana, Florida, p. 55.

Amoria 'Gray' H. and A. Adams 1858, The Genera of Recent Mollusca 2, p. 619; *non Amoria* Gray 1855. *Maculoplum* Dall 1906, Nautilus 19, p. 143.

Genotype, *Voluta junonia* Shaw (subsequent designation, Gray 1847).

The shells are characterized by being rather solid in structure, generally spindle-shaped, the columella with or without plicae and possessing a color pattern of numerous spiral rows of spots or bands. The protoconch is membranous and is lost. The nuclear whorls consist of a papilliform nucleus, the calcarella, which enlarges rapidly into a normal whorl. The nuclear whorls are generally smooth, the post-nuclear whorls finely sculptured. Radula exceedingly small and short and consisting only of a single row of rachidian teeth in all of the species so far examined. Operculum absent so far as known.

The history of this genus and its type designations has not been a fortunate one. Swainson included four "typical species" in his genus *Scaphella*, namely *undulata*, *junonia*, *maculata* and *zebra*. J. E. Gray in 1847 listed *Scaphella* of Swainson with two type designations: his first, *Voluta fusiformis*, based on Swainson 1840, was invalid since this species was not listed by Swainson in 1832 in his original diagnosis of the genus. Gray's second choice was that of *Voluta junonia*, a species included by Swainson in 1832. So far as I can trace, this was the first type designation of this genus. This selection was followed by Dall who in 1890 indicated the same type. Unfortunately, Dall in 1906 completely overlooked his early designation and that of Gray by introducing the genus

Maculopeplum and gave *Voluta junonia* as its type. This latter type selection, of course, makes *Maculopeplum* an absolute synonym of *Scaphella*.

Smith (1942, p. 55) in a footnote states "*Scaphella* having been discarded" and proceeds to erect a new subfamily, *Auriniinae*, to replace *Scaphellinae*. I can find no valid grounds at all to discard *Scaphella*, nor does Smith give any reasons whatsoever for his stand. His name *Auriniinae* becomes an absolute synonym of *Scaphellinae*.

Dall states (1907, p. 366) that both *Aurinia* and *Scaphella* s.s. (*Maculopeplum*) represent two divergent lines of development from the Eocene genus, *Caricella*. *Aurinia* is also related to the recent Eastern Atlantic genus *Halia*. In this latter genus the shell has become very thin and rather broad, structurally a very different appearing genus. The persistence of the spiral rows of color spots is rather remarkable, considering the rather striking modifications that have taken place in the morphological structures of the shells.

Subgenus *Scaphella* Swainson

Scaphella Swainson 1832, Zoological Illustrations (2) 2, p. 87.

Maculopeplum Dall 1906, Nautilus 19, p. 143 [genotype, *Voluta junonia* Lamarck].

Subgenotype, *Voluta junonia* Shaw (subsequent designation, Gray 1847).

The typical subgenus is characterized by possessing shells that are a little more massive, and particularly by the shape of the rachidian teeth. These are almost wish-bone in shape with the denticle rather long and narrow, and the lateral shanks extending behind rather than to the side. No lateral denticles seen in the single specimen we have examined (plate 24, fig. 4). The nuclear whorls are extended and as a consequence the calcarella is generally worn away. Mantle extending only over the parietal area. Periostracum consisting of a very thin yellowish covering.

Scaphella (*Scaphella*) *junonia* Shaw, Plate 28, fig. 1-3

Voluta junonia G. Shaw 1808, The Naturalist's Miscellany 19, p. 815, pl. 5 (Southern Pacific?); Kuster 1840, Conchy.-Cab. (2) 5, pt. 2, p. 161, pl. 27, fig. 1-2; Reeve 1849, Conchologia Iconica 6, *Voluta*, pl. 20, fig. 50.

Scaphella junonia Hwass, Dall 1889, Bull. Museum of Comparative Zoölogy 18, p. 148, pl. 34, fig. 5b-e.

Maculopeplum junonia Lam., Dall 1906, Nautilus 19, p. 143; Dall 1907, Smithsonian Misc. Collections 48, p. 370; Perry 1940, Bull. American Paleontology No. 95, p. 155, pl. 36, fig. 241.

Aurinia junonia Hwass, M. Smith 1942, A Review of the Volutidae, Lantana, Florida, p. 65, pl. 6, fig. 53.

Description. Shell fusiform, reaching about 115 mm. ($4\frac{1}{2}$ inches) in length, solid and strong. Whorls 5 to 6, shouldered and moderately convex. Color old ivory to cream with a series of mahogany brown spots in spiral rows. These spots are somewhat irregular in shape and size, as they may be subcircular to almost square, the subsutural row being the largest. Aperture long and somewhat elliptical, ending below in an oblique and slightly upturned siphonal canal. Outer lip generally thin on its margin though thickened immediately below. Parietal area very thinly glazed. Columella nearly straight and margined on the parietal side by a low ridge which is formed by the successive growth stages of the siphonal canal. Parietal area supporting four strongly developed plicae. Sculpture consisting of spiral incised lines on the first two early whorls, in addition to very fine axial ridges. Last two whorls smooth except for a few fine cords near the base. Nuclear whorl smooth and brown in color. Calcarella generally worn away. Periostracum brownish and exceedingly thin. No operculum.

	length	width	aperture	
(large)	114	47	90 × 18 mm.	West Coast, Florida
(average)	93	42	73 × 17	West Coast, Florida
(average)	82	37.5	65 × 15	Neoholotype

Types. Nothing is known apparently about the disposition of Shaw's types. They have probably been lost and as a consequence it appears wise to select a neoholotype, (Mus. Comp. Zoöl. no. 178048), the restricted type locality being off Sanibel Island, Lee County, Florida.

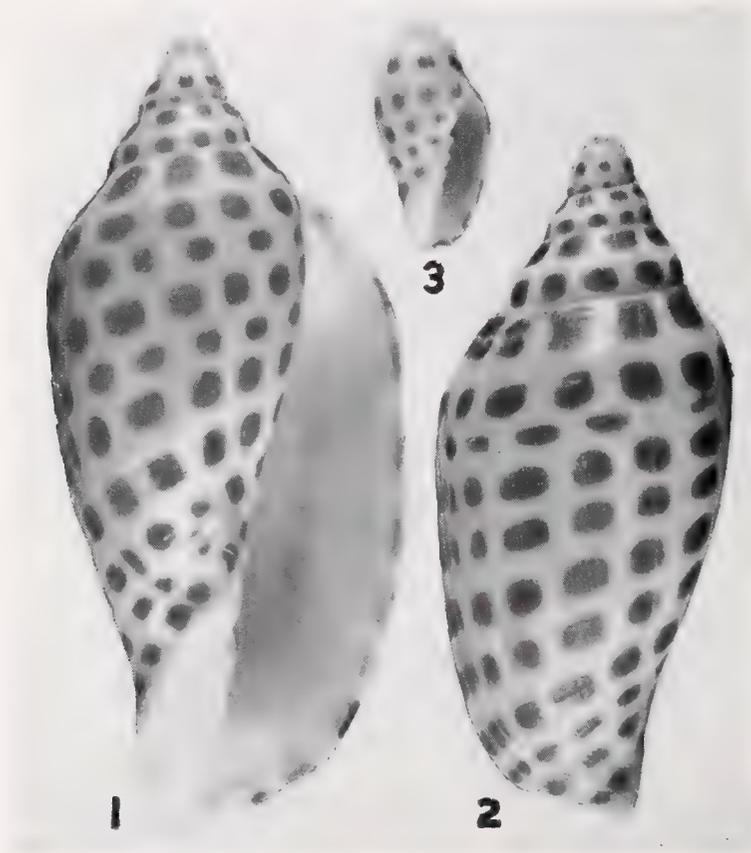
Common name. Juno's Volute; Junonia Shell.

Remarks. This is a rather rare species though of late years specimens have been dredged off the west coast of Florida in fair numbers.

Contrary to Dall's statement (1907, p. 370), this species, as well as others in the genus *Scaphella*, possesses a radula. This is remarkably small for the size of the animal and is thus very easily overlooked. The rachidian teeth of *S. junonia* are remarkably similar to those of *Volutomitra typica* Strebel as figured by Thiele (1929, p. 351, fig. 421). So far as we can determine, there are no traces of any lateral teeth in *junonia*, though a remnant of these teeth occur in *Volutomitra*. However, our observations are based upon but a single small specimen of *S. junonia* which was dredged in shallow water off Sanibel Island, Florida (plate 24, fig. 4).

The soft parts are colored much like the shell except that the spots are much larger and far more irregular in shape. The surface of the sides of the foot is finely granulose.

Range. North Carolina and south to both coasts of Florida.



Photographs by F. P. Orchard
 Plate 28. *Scaphella (Aurinia) junonia* Shaw. Fig. 1. (Neoholotype) off Sanibel Island, Florida. Fig. 2. Off Clearwater, Florida. Fig. 3. Off Tortugas, Florida (all natural size).

Records. NORTH CAROLINA: *Albatross*, station 2608 (a fragment), 17 miles off Cape Lookout (N. Lat. 34°32'; W. Long, 76°12') in 22 fathoms (USNM). FLORIDA: off Miami in 45 fathoms; off Tortugas in 15 fathoms; *Albatross*, station 2414, 30 miles north of Tortugas (N. Lat. 25°04'; W. Long. 82°59') in 26 fathoms (all USNM); Marco (P. T. Jackson); Pavilion Key; Naples; Sanibel Island; Boca Ciega; Passagrille; off Clearwater (all MCZ).

Subgenus *Aurinia* H. and A. Adams

Aurinia H. and A. Adams 1853, The Genera of Recent Mollusca **1**, p. 166.

Livonia 'Gray' H. and A. Adams 1858, The Genera of Recent Mollusca **2**, p. 617; *non Livona* Gray 1842.

Volutifusus Conrad 1863, Proc. Academy Natural Sciences Philadelphia for 1862, p. 563 (genotype, *Fasciolaria mutabilis* Conrad, monotypic).

Genotype, *Voluta dubia* Broderip (monotypic).

This subgenus is characterized by having shells strong but not massive; nuclear whorls with a strongly developed calcarella; and rachidian teeth of the radula with a very strong denticle with the shanks above extending almost at right angles. At the base of the denticles there are two very small lateral teeth which appear to be fused to the central denticle (plate 24, fig. 3). Extended mantle covering only the parietal area. Periostracum consisting of a very thin yellowish covering. Operculum probably absent.

Smith's substitute designation (Smith 1942, p. 63) of *Aurinia dohrni dohrni* Sowerby as the genotype of *Aurinia* is invalid. His statement "The validity of that species [i.e. *Voluta dubia* Broderip] is now questionable" is certainly in error. Broderip's species is not only well described but is very well figured. Actually, Sowerby's *dohrni* is poorly figured and the few remarks given in the original citation hardly constitute a description.

Scaphella (*Aurinia*) *dohrni* Sowerby, Plate 29, fig. 1-2

Voluta dohrni Sowerby 1903, Jour. Malacology **10**, p. 74, pl. 5, fig. 8 (locality not given).

Aurinia dohrni Sowerby, Clench and Aguayo 1940, Memorias de la Sociedad Cubana de Historia Natural **14**, p. 88, pl. 16, fig. 2.

Aurinia dohrni dohrni Sowerby, M. Smith 1942, A Review of the Volutidae, Lantana, Florida, p. 63, pl. 6, fig. 61.

Description. Shell large, reaching about 100 mm. (4 inches) in length, fusiform and fairly solid. Whorls 7, strongly convex. Color a more or less uniform yellowish orange with nine or ten spiral rows of square dark brown spots. Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin; parietal wall thinly glazed. Columella moderately arched with three to four rather well developed plicae. Siphonal canal rather broad and arched dorsally. Sculpture: nuclear whorl smooth, remaining whorls with exceedingly fine incised spiral lines which persist to the body whorl; these are somewhat coarser toward the base. No axial costae developed. Nuclear whorl and calcarella very small and moderately extended.

	length	width	aperture	
(large)	81	30	49×11 mm.	off Sandy Key, Florida
(average)	65	25.5	42×10.5	off Key West, Florida

Types. The type of this species may possibly be in the British Museum. The type locality is here restricted to off the Lower Florida Keys.

Remarks. (See also under *S. dubia*). This species is also close to *S. florida* and this latter may be possibly only a form of the present one. However, differentiation between the two is readily made and there is a difference in their ranges. The young of many of these

several forms are difficult if not impossible to separate, as the diagnostic characters are mainly invested in the adult, the early whorls being quite similar.

This species differs from *S. florida* by possessing smoothly rounded whorls, not angled as in *florida*, and in lacking completely the axial costae, so pronounced in this other species. From *S. bermudezi*, which appears to resemble *dohrni*, it differs by possessing only three or four well spaced, low and smoothly rounded columellar plicae. There are four rail-like (cross-section) plicae in *bermudezi*. From *S. atlantis* it differs in being smaller, heavier and far more yellowish in color and having far fewer axial rows of spots (9 or 10 rows in *dohrni* and 15 in *atlantis*).

Scaphella dohrni is known to occur in depths of from 75 to 144 fathoms (450 to 864 feet).

Range. Known only from off the Lower Florida Keys in the vicinity of Key West and Tortugas, Florida.

Records. FLORIDA: off Sambo Reef (110 fathoms); off Key West (75 to 109 fathoms); off Western Dry Rocks (80 to 144 fathoms); off Sand Key (75 to 120 fathoms); (all USNM); off Lower Florida Keys (MCZ); off Tortugas (J. Miller); off Key West in 100 fathoms (Mrs. John Wentworth). Most of the above records from the United States National Museum were obtained by the *Eolis*.

Scaphella (Aurinia) florida Clench and Aguayo, Plate 29, fig. 3-4

Voluta dubia 'Broderip' Dohrn 1879, Jahrbücher Deutschen Malakozologischen Gesell. **6**, p. 150, pl. 4, fig. 1-3 (shores of the Caribbean on the Florida Peninsula); *non V. dubia* Broderip 1827.

Voluta (Aulica) dubia 'Broderip' Tryon 1882 (in part) Manual of Conchology (1) **4**, p. 90, pl. 27, fig. 77 (Caribbean Sea off Florida).

Aurinia dohrni florida Clench and Aguayo 1940, Memorias de la Sociedad Cubana de Historia Natural **14**, p. 88, pl. 16, fig. 1, text fig. 1.

Description. Shell large, reaching about 100 mm. (4 inches) in length, fusiform and fairly solid. Whorls seven and moderately convex. Color a more or less uniform yellowish ivory with nine to ten spiral rows of square dark brown spots. Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin; parietal wall thinly glazed. Columella moderately arched with three to four rather well developed plicae. Siphonal canal rather broad and arched dorsally. Sculpture: nuclear whorls smooth, remaining whorls with exceedingly fine incised spiral lines which persist more or less to the body whorl; these become somewhat coarser toward the base. From the third to the fifth whorls there is a series of rather fine axial costae at the whorl shoulder. Nuclear whorl and calcarella small and somewhat extended.

length	width	aperture	
90	31	57 × 14 mm.	Holotype
63	26	43 × 12	Paratype
77.5	27.5	49 × 13	off Key West, Florida
97.5	33.5	61 × 16	off Lower Keys, Florida

Types. The holotype of *S. florida* is based upon Dohrn's fig. 1, pl. 4, Jahr. Deut. Malak. Gesell. **6**, 1879. The type locality, here restricted, is off the Lower Florida Keys.

Remarks. (See also under *S. dohrni* and *S. dubia*). This species is readily differentiated from *dohrni* by its angled whorls and numerous axial costae on the mid-whorls. From *S. gouldiana*, which also possesses strongly developed axial costae, it differs in having spiral rows of spots rather than a uniform straw-yellow color or rarely with bands of color.

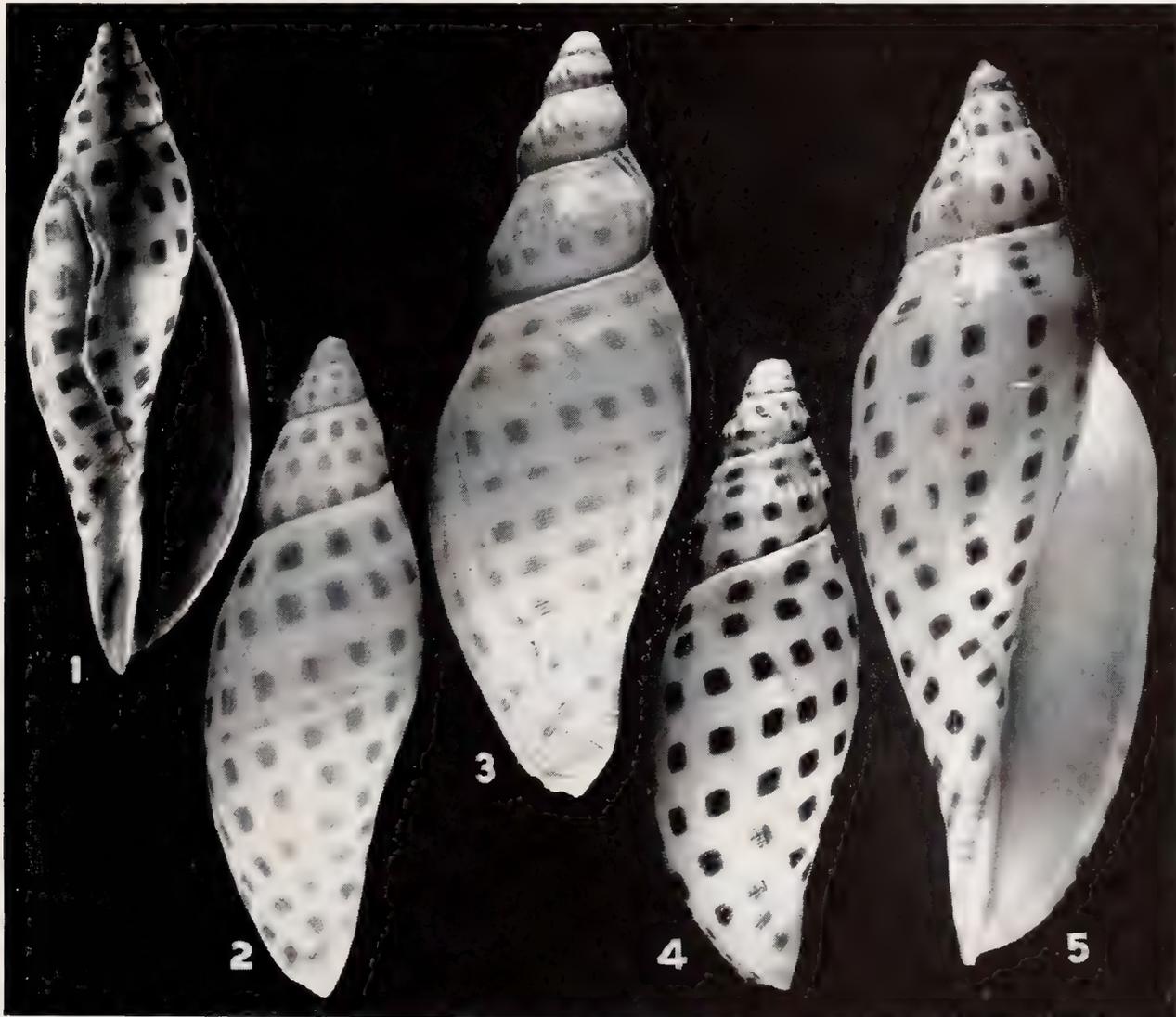
This species is known to occur in depths of from 67 to 122 fathoms (402 to 732 feet).

Range. Found off the Lower Florida Keys from Miami to Key West.

Records. FLORIDA: off Cape Florida (67 fathoms); off Ragged Keys (80 fathoms); off Sambo Reef (118 fathoms); off Key West (87 to 122 fathoms); off Sand Key (75 to 110 fathoms); off Western Dry Rocks (80 fathoms) (all USNM); off Lower Florida Keys (MCZ); off Miami in 100 fathoms (Mrs. John Wentworth). The above records from the United States National Museum were obtained mainly by the *Eolis*.

Scaphella (Aurinia) atlantis, new species, Plate 29, fig. 5

Description. Shell large, reaching about 100 mm. (4 inches) in length, fusiform and rather thin. Whorls seven and moderately convex. Color a more or less uniform yellowish ivory with 15 spiral rows of square dark brown spots (holotype). Aperture elliptical and somewhat lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella straight with three very strongly developed plicae. Siphonal canal rather broad and straight. Sculpture: nuclear whorl smooth, remaining whorls displaying a fine reticulated pattern with the spiral lines the stronger. This sculpture becomes obsolete on the body whorl. No axial costae on the mid-whorls though the shoulder is



Photographs by F. P. Orchard

Plate 29. Fig. 1-2. *Scaphella (Aurinia) dohrni* Sowerby, off Lower Florida Keys. Fig. 3. *Scaphella (Aurinia) florida* Clench and Aguayo, off Lower Florida Keys. Fig. 4. *S. florida* Clench and Aguayo, off Western Dry Rocks, Florida. Fig. 5. *Scaphella (Aurinia) atlantis* Clench (Holotype), off Punta Alegre, Camagüey, Cuba (all natural size).

slightly angled at this point. Nuclear whorl and calcarella small and partially submerged within the second whorl.

length	width	aperture
97.5	34.5	67 × 14.5 mm. Holotype

Types. Holotype, Museum of Comparative Zoölogy no. 135263, off Punta Alegre, Camagüey, Cuba. *Atlantis*, station 3415 (N. Lat. 22°51'30"; W. Long. 78°55'30") in 210 fathoms.

Remarks. (See also under *S. dohrni*). This species differs from *dohrni* by being pale yellowish ivory in color, rather than a deep yellowish orange. In addition, it has 15 spiral rows of spots, while in *dohrni* there are nine to ten rows. It is also lighter in structure, a little larger in size with the mid-whorls slightly angled at the periphery and is moderately shouldered on the body whorl. No axial costae present. Only a single adult specimen is known, though we possess a few young specimens which may possibly be this species.

Range and Records. See under Types.

Scaphella (Aurinia) dubia Broderip, Plate 30, fig. 1-2

Voluta dubia Broderip 1827, Zoological Journal 3, p. 81, pl. 3, fig. 1 (locality unknown); Reeve 1849, Conchologia Iconica 6, *Voluta*, p. 22, fig. 59.

Fulguraria (Aurinia) dubia Broderip, H. and A. Adams 1853, The Genera of Recent Mollusca 1, p. 166.

Scapha (Aurinia) dubia Broderip, H. and A. Adams 1858, The Genera of Recent Mollusca 2, p. 617.

Description. Shell large, reaching 100 mm. (4 inches) in length, fusiform and rather thin. Whorls six and slightly convex. Color a more or less uniform yellowish ivory to pinkish with six to seven spiral rows of square dark brown spots. Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella straight, with or without one or two fairly well developed plicae. Siphonal canal rather narrow and straight. Sculpture: nuclear whorl smooth, remaining whorls with five raised spiral threads. From the third to the last whorl there may be a series of fine or rather strong axial costae at the whorl shoulder. Nuclear whorl and calcarella large and extended, sometimes being larger than the first post-nuclear whorl.

The following is the original description of Broderip:

“Shell fusiform, slightly ribbed, longitudinally and transversely striated, yellowish, with many bands of interrupted, somewhat square fulvous spots; spire short, apex rude, with the papilla terminating almost acutely; the pillar very slightly marked with two plaits, and the base entire. Length 2½ inches.”

length	width	aperture
70	21.5	49.5 × 10 mm. Neoholotype
57.5	18.5	40.5 × 9 Neoparatype
98	broken	66 × ? (broken) off Key West, Florida

Types. According to Dall (1907, p. 367) the original type specimen has been lost. We here designate a neoholotype, United States National Museum no. 54544, Gulf of Mexico, about 75 miles south of Cape San Blas, Florida. *Albatross*, station 2402 (N. Lat. 28°36'; W. Long. 85°33'30"). A neoparatype from the same locality in the Museum of Comparative Zoölogy.

Remarks. (See also under *S. kieneri*). This species has had a peculiar history so far as the name is concerned. It was originally described by Broderip in 1827 from a specimen without a locality. It remained practically unknown until 1853 when the Adams brothers created the subgenus *Aurinia* for its reception. In 1879, Dohrn received some specimens from Agassiz that had been collected by Pourtalès off the Lower Florida Keys. He thought these specimens to be the same as *dubia*, and described and figured them under this name. However, they were quite different. This fact was noted by Sowerby, and in a review of the question (1903, p. 74) he described and figured still another species which he called *dohrni*. This still left the specimens of Dohrn without a name until 1940 when the name *florida* was given by Clench and Aguayo.

Range. Gulf of Mexico from northern Florida south to Key West.

Records. FLORIDA: *Albatross*, station 2402, about 75 miles south of Cape San Blas (N. Lat. $28^{\circ}36'$; W. Long. $85^{\circ}33'30''$) in 111 fathoms; *Eolis*, off Key West in 90 and 95 fathoms (all USNM).

Scaphella (Aurinia) gouldiana Dall, Plate 30, fig. 3-5

Voluta gouldiana Dall 1887, The Conchologists' Exchange [Nautilus] **2**, p. 10 (West Indies); *ibid.* 1889, Bull. Museum of Comp. Zoölogy **18**, p. 154, pl. 19, fig. 3 (many localities between Georgia and Key West).

Description. Shell moderate in size reaching about 70 mm. ($2\frac{3}{4}$ inches) in length, fusiform and rather solid. Whorls six and rather strongly convex. Color a straw yellow with a tinge of pink along the margin of the columella. Occasionally specimens possess a series of rather dark brown, spiral bands, about seven or eight in number. Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella arched and supporting two or three weak plicae. Siphonal canal rather broad and arched dorsally. Sculpture: nuclear whorl smooth, remaining whorls with numerous and exceedingly fine spiral incised lines. On the body whorl these lines become quite strong toward the base. From the third to the last whorl there is a series of strong axial costae at the whorl shoulder. Nuclear whorl small with the calcarella and first whorl extended.

length	width	aperture	
69	25	45 × 11 mm.	Holotype
52.5	21.5	35 × 9.5	off Cape Canaveral, Florida
53	22.5	33 × 8.5	off Ragged Keys, Florida

Types. Holotype, United States National Museum no. 83873, *Albatross*, station no. 2625, about 75 miles off Cape Fear, North Carolina (N. Lat. $32^{\circ}35'$; W. Long. $77^{\circ}30'$) in 247 fathoms.

Remarks. (See also under *S. florida*). This species is superficially like *S. florida*, but differs by being smaller, lacking the spiral rows of spots and having only two rather weak columellar plicae. Occasional specimens of *S. gouldiana* may be white or a very pale straw-yellow. Three specimens in the United States National Museum possesses rather indistinct spiral bands of brown. This is a persistence of a character which is remarkably consistent for the entire genus *Scaphella*. In most cases the bands have become broken into series of spots; in others they remain as bands or broken bands of color. The occurrence of nearly white forms shows a variability of color in this species not shared by other members of this genus. It is to be remembered, however, that what little knowledge we possess of this entire genus is based upon but very few specimens.

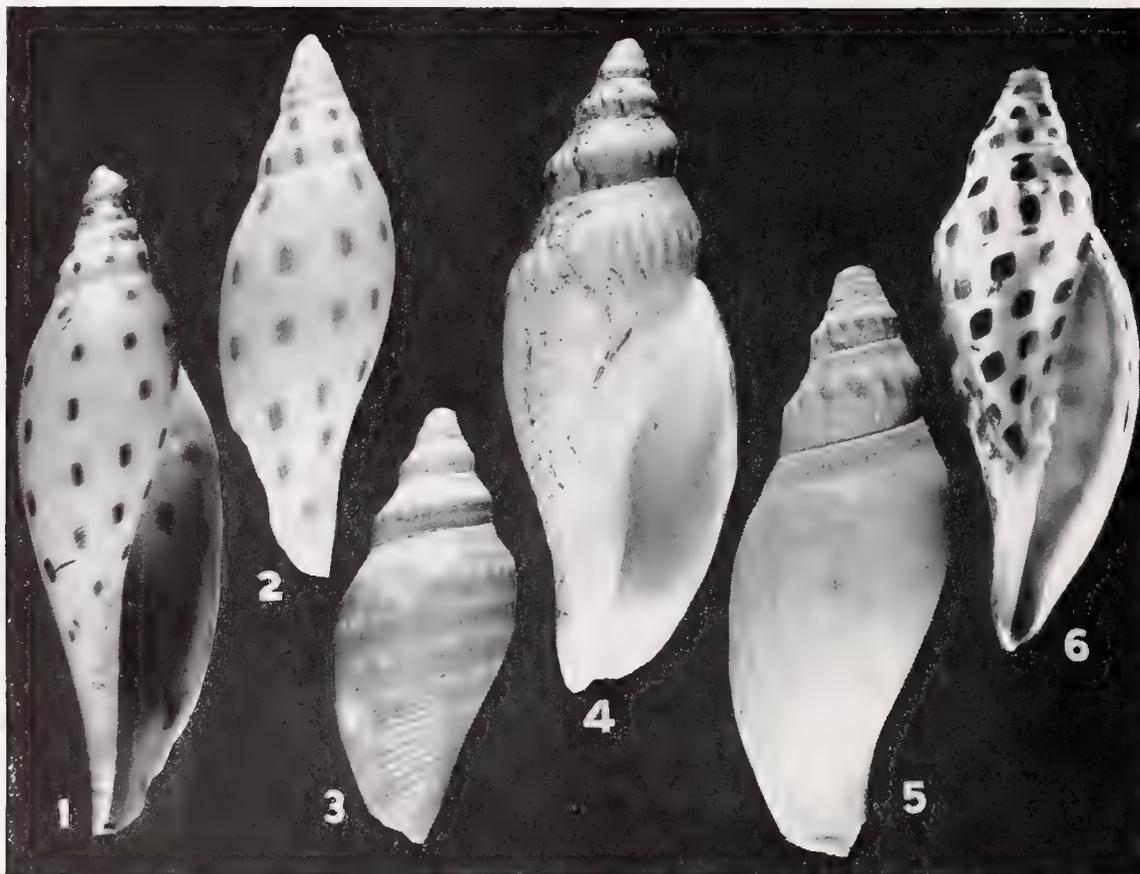
This species occurs in depths of 78 to 509 fathoms (468 to 3054 feet).

Range. North Carolina south to the Florida Keys, the western Bahamas and the northern coast of Cuba.

Records. NORTH CAROLINA: about 75 miles off Cape Fear, *Albatross*, station no. 2624 (N. Lat. $32^{\circ}36'$; W. Long. $77^{\circ}29'15''$) in 258 fathoms; station 2625 (N. Lat. $32^{\circ}35'$; W. Long. $77^{\circ}30'$) in 247 fathoms. SOUTH CAROLINA: *Albatross*, station 2314, about 130 miles east of Charleston (N. Lat. $32^{\circ}43'$; W. Long. $77^{\circ}51'$) in 159 fathoms. FLORIDA: *Albatross*, station 2666, about 110 miles east of Fernandina (N. Lat. $30^{\circ}47'$; W. Long. $79^{\circ}49'$) in 270 fathoms; *Albatross*, station 2661, about 80 miles east of Daytona (N. Lat. $29^{\circ}16'30''$; W. Long. $79^{\circ}36'30''$) in 438 fathoms; *Albatross*, station 2659, about 120 miles east of Cape Canaveral (N. Lat. $28^{\circ}32'$; W. Long. $78^{\circ}42'$) in 509 fathoms; *Eolis*, station 194, off Ragged Keys, in 85 fathoms; *Eolis*, station 165, off Fowery Light in 78 fathoms (all USNM). BAHAMA ISLANDS: *Atlantis*, station 2951, off Great Isaac, Bimini Ids. (N. Lat. $26^{\circ}08'$; W. Long. $79^{\circ}02'$) in 155 fathoms. CUBA: *Atlantis*, station 3437, off Caibarién, Las Villas (N. Lat. $23^{\circ}05'$; W. Long. $79^{\circ}37'$) in 260 fathoms; *Atlantis*, station 2980A, off Punta Alegre, Camagüey, (N. Lat. $22^{\circ}48'$; W. Long. $78^{\circ}41'$) in 260 fathoms (all MCZ).

Scaphella (Aurinia) bermudezi *Clench and Aguayo*, Plate 30, fig. 6

Aurinia bermudezi Clench and Aguayo 1940, *Memorias de la Sociedad Cubana de Historia Natural* 14, p. 89, pl. 16, fig. 2 (Bahía de Cochinos, Cuba).



Photographs by F. P. Orchard

Plate 30. Fig. 1-2. *Scaphella (Aurinia) dubia* Broderip, 75 miles south of Cape San Blas, Florida. (Fig. 1, Neoholotype; Fig. 2, Neoparatype). Fig. 3. *Scaphella (Aurinia) gouldiana* Dall, off Fowey Light, Florida. Fig. 4. *S. gouldiana* Dall, off Fernandina, Florida. Fig. 5. *S. gouldiana* Dall (Holotype), about 75 miles off Cape Fear, North Carolina. Fig. 6. *Scaphella (Aurinia) bermudezi* Clench and Aguayo (Holotype), off Bahía de Cochinos, Las Villas, Cuba (all natural size).

Description. Shell medium in size, about 60 mm. ($2\frac{1}{4}$ inches) in length, fusiform and rather solid. Whorls six, slightly convex. Color a more or less uniform yellowish ivory with eight spiral rows of dark brown spots (holotype). Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella slightly arched and supporting five strong plicae. Siphonal canal rather broad and slightly arched dorsally. Sculpture: nuclear whorl smooth, succeeding whorls with a very fine reticulated pattern, the spiral lines being the stronger, the sculpture becoming more or less obsolete on the body whorl. From the fourth to the last whorl there is a series of small and fine axial costae at the whorl shoulder. Nuclear whorl small with the calcarella and the first whorl partially submerged in the second whorl.

length	width	aperture
59.2	20.4	42.2 × 9.1 mm. Holotype

Types. Holotype, Museum of Comparative Zoölogy no. 135245, *Atlantis*, station no. 2962 (N. Lat. $22^{\circ}07'$; W. Long. $81^{\circ}08'$), Bahía de Cochinos, Las Villas, Cuba, in 180–190 fathoms.

Remarks. (See also under *S. dohrni*). Little can be added about this species as only a single specimen is known. It differs from *dohrni* by being lighter in color and particularly by possessing four closely set rail-like (cross section) and strongly developed columellar plicae and an additional rather weak one near the base. It is somewhat lighter in structure and lacks the spiral threads of *dohrni*.

Range and Records. See under Types.

Scaphella (Aurinia) neptunia *Clench and Aguayo*, Plate 31, fig. 3–4

Aurinia neptunia Clench and Aguayo 1940, *Memorias de la Sociedad Cubana de Historia Natural* 14, p. 90, pl. 16, fig. 5 (off Banner Reef, Pedro Bank, 75 miles south of Jamaica).

Description. Shell medium, about 50 mm. (2 inches) in length, fusiform and rather thin. Whorls five, slightly convex (specimen probably only partially grown). Color a straw yellow with five (holotype) brownish bands which may be solid or broken up into lengthened bars. Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella nearly straight and supporting two or three rather weak plicae. Siphonal canal rather broad and straight. Sculpture: nuclear whorls smooth, remaining whorls with numerous and very fine incised spiral grooves. These are cut by irregular and fine axial growth lines. Nuclear whorls large with the calcarella and first whorl extended above the second whorl.

length	width	aperture
50.5	18.1	35 × 8.5 mm. Holotype

Types. Holotype, Museum of Comparative Zoölogy no. 119025, *Blake*, station no. 8, off Banner Reef, Pedro Bank, 75 miles south of Jamaica (N. Lat. $17^{\circ}45'$; W. Long. $77^{\circ}58'40''$) in 322 fathoms.

Remarks. This species is known from only a single young specimen. It is characterized by a very large nuclear whorl and having but five spiral bands which are broken into lengthened bars of color rather than spots.

Range and Records. See under Types.

Scaphella (Aurinia) cuba, new species, Plate 31, fig. 2

Description. Shell medium to small, about 60 mm. ($2\frac{1}{2}$ inches) in length, fusiform and rather solid. Whorls six, slightly convex. Color a straw yellow with seven spiral rows of square to rectangular dark brown spots which may be lengthened axially (holotype). Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella arched and supporting four moderately developed plicae. Siphonal canal rather narrow and moderately arched dorsally. Sculpture: nuclear whorl smooth, remaining whorls with numerous and fine incised grooves which persist to the body whorl. These are a little coarser toward the base of the shell. From the third to the fifth whorl there is a series of fine axial costae at the whorl shoulder. Nuclear whorl small with the calcarella and first whorl partially submerged in the second whorl.

length	width	aperture	
56	24.5	40 × 11 mm.	Holotype

Types. Holotype, Museum of Comparative Zoölogy no. 135229, *Atlantis*, station 2988, off Sagua la Grande, Las Villas, Cuba (N. Lat. $23^{\circ}15'$; W. Long. $79^{\circ}57'$) in 380 fathoms.

Remarks. This species is based upon a single specimen. It is proportionately wider than all known species except *S. robusta*. It differs from *robusta* in having the spiral rows of spots lengthened axially and in having four rather well developed columellar plicae, whereas *robusta* possesses only three weakly developed plicae. In addition, the columella is only slightly arched and the siphonal canal is nearly straight rather than definitely up-turned or recurved as it is in *robusta*.

Range and Records. See under Types.

Scaphella (Aurinia) kieneri, new name, Plate 31, fig. 1

Fusus tessellatus 'Schubert and Wagner' Kiener 1840, Icon. Coquilles Vivantes 5, p. 38, pl. 29, fig. 1 (locality unknown); *non F. tessellatus* Schubert and Wagner 1829.

Description. "Shell thin, elongate, fusiform, with a conical spire; composed of six slightly convex whorls, of which the first form at the apex a smooth rounded nipple; the succeeding, except for the last, are provided with small, narrow, longitudinal ribs; the last whorl is attenuate, scarcely globose, ending at the base in a rather broad canal, with a slight notch; the entire surface of the shell is covered with very fine and close-set transverse striae. The aperture is elongate, violaceous-white inside; the right edge [outer lip] is thin, sharp, marked inside with cloudy spots which correspond to those on the outside; the columella is feebly curved, rounded, smooth, and non-spotted. This shell is pale fulvous, covered with a large number of russet sub-elongate or rectangular, well separated spots. Length 5 inches 6 lines."

Types. The type specimen, originally in the collection of Prince Massena, is now in the Museum at Geneva, Switzerland (Dall 1907, p. 368). The type locality is still unknown.

Remarks. The above quotation is a translation of Kiener's description by J. Bequaert. Kiener's specimen still remains the only known example of this beautiful species.

It would be exceedingly interesting to know just how Prince Massena and Broderip came into possession of *S. kieneri* and *S. dubia*. Both were obtained prior to 1829. All

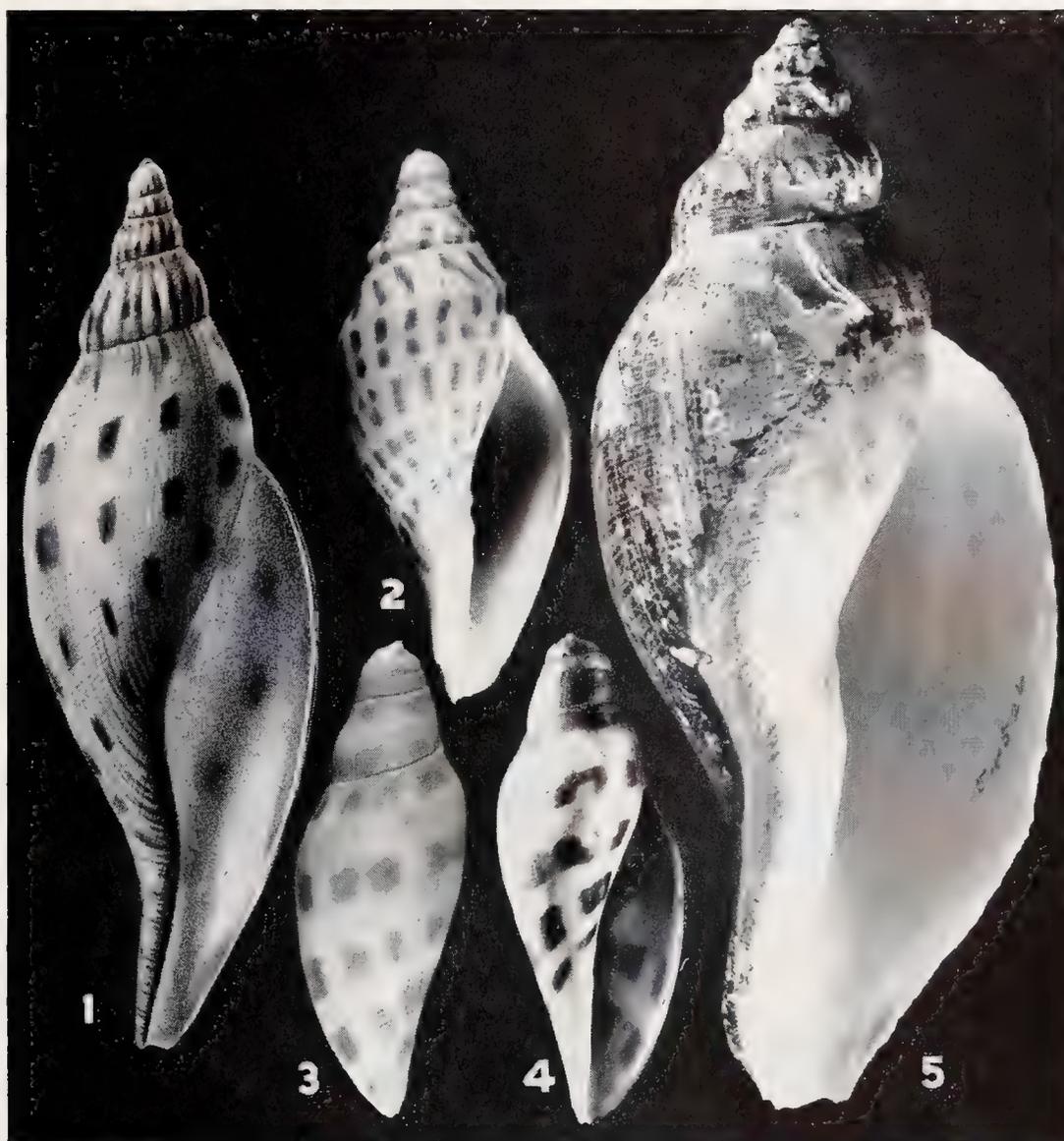
known species in *Scaphella* are deep water forms other than *S. junonia* which lives just below low water, and this latter form was known to Favanne sometime prior to 1780. It is possible, of course, that both these species were obtained in fish traps off the French islands that compose a part of the Lesser Antilles, a source of rare deep water forms that furnished Fischer and Bernardi, years later, with several fine species. *Bathyaaurinia torrei* was first discovered by this means. This method is still used to collect some of the finest deep water species off the Japanese coast, many of which are in the *Volutidae*.

Range and Records. See under Types.

***Scaphella (Aurinia) robusta* Dall, Plate 31, fig. 5**

Aurinia robusta Dall 1889, Bull. Museum of Comparative Zoölogy **18**, p. 153, pl. 35, fig. 2. Gulf of Mexico [about 80 miles southwest of Cape San Blas, Florida].

Description. Shell large, reaching about 112 mm. ($4\frac{3}{4}$ inches) in length, fusiform and



Photographs by F. P Orchard

Plate 31. Fig. 1. *Scaphella (Aurinia) kieneri* Clench (after Kiener pl. 29, fig. 1). Fig. 2. *Scaphella (Aurinia) cuba* Clench (Holotype), off Sagua la Grande, Las Villas, Cuba. Fig. 3-4. *Scaphella (Aurinia) neptunia* Clench and Aguayo (Holotype), off Banner Reef, Pedro Bank, 75 miles south of Jamaica. Fig. 5. *Scaphella (Aurinia) robusta* Dall (Holotype), about 80 miles S.W. of Cape San Blas, Florida (all natural size).

rather solid. Whorls seven and rather strongly convex. Color a straw yellow with about ten spiral rows of square dark brown spots (holotype). Aperture elliptical and somewhat lengthened. Spire acute and moderately lengthened. Suture slightly indented. Outer lip thin, parietal wall thinly glazed. Columella strongly arched and supporting three weak plicae. Siphonal canal broad and strongly arched dorsally. Sculpture: nuclear whorl smooth, remaining whorls with numerous fine incised lines which persist to the body whorl. From the fourth to the sixth whorl there is a series of rather strong axial costae at the whorl shoulder. Nuclear whorl small with the calcarella and first whorl somewhat extended.

length	width	aperture
119	52	88 × 24.5 mm. Holotype

Types. Holotype, United States National Museum no. 54526, *Albatross*, station no. 2397, Gulf of Mexico, about 80 miles southwest of Cape San Blas, Florida (N. Lat. 28°42'; W. Long. 86°36') in 280 fathoms.

Remarks. (See also under *S. cuba*). A large species which does not appear to be very close in its relationships with the other members of this genus. The records of Dall (1889, p. 153) and our own (1940, p. 88) are open to question as all were based upon immature specimens.

Range and Records. See under *Types*.

Scaphella (Aurinia) tessellata *Schubert and Wagner*

Fusus tessellatus Schubert and Wagner 1829, Conchy.-Cab. (1) 12, p. 24, pl. 219, fig. 3048-3049 (locality unknown); *non Voluta tessellata* Lamarek 1811; Wood 1828; *non Fusus tessellatus*, Kiener 1840.

Voluta (Aulica) dubia 'Broderip' Tryon 1882 (in part) Manual of Conchology (1) 4, p. 90, pl. 27, fig. 81 (Caribbean Sea off Florida).

This species may or may not exist. As the name was validly introduced it must be considered, and as such, will remain as a questionable species, probably for all time. Schubert and Wagner based their name on an anonymous drawing; two views of the shell are given. Though only one specimen is supposed to be involved, the figures are obviously different. It is quite possible that these drawings are a poor attempt to copy the figure of Broderip (see under *S. dubia*), the dorsal view being pure guess work on the part of the artist. However, sufficient difference in these figures exist so that *dubia* and *tessellata* should be held separate, and the latter one considered among the spurious forms.

It is equally possible that this was an attempt to portray *S. kieneri*, a very different species from *S. dubia*. It is interesting to note that both of these species existed in European collections (one specimen only of each) at the time this painting was submitted to Schubert and Wagner for publication.

* * * *

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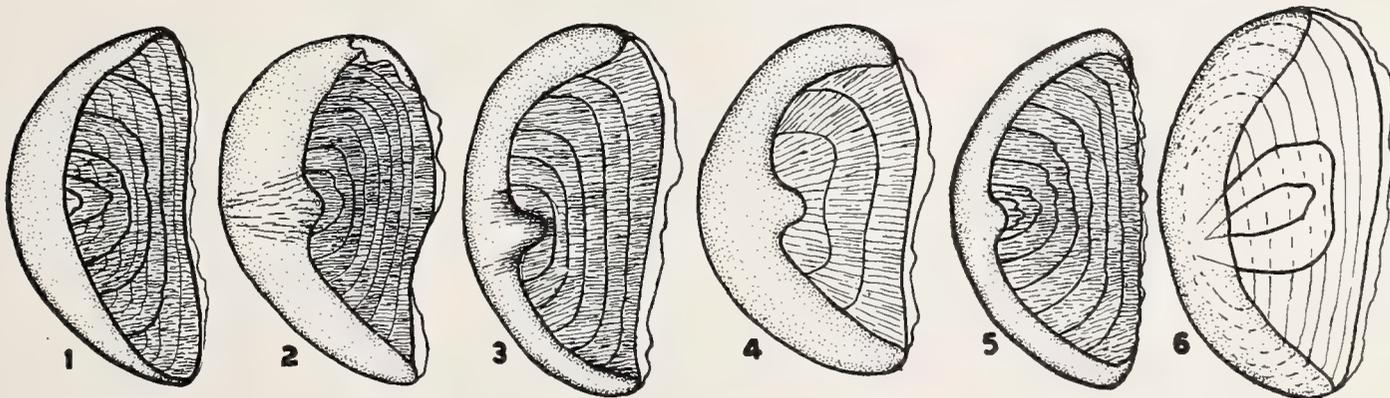
VOL. 2, NO. 23

THE GENERA PURPURA AND THAIS IN THE WESTERN ATLANTIC

BY
 WILLIAM J. CLENCH

So far as known, all species contained in these two genera are carnivorous, generally preying upon other members of their own phylum. Most species occur in the intertidal zone, usually on rocks, though a few frequent oyster bars. These latter are referred to as "drills" and become important economically when their depredations occur on commercial oyster grounds such as the coastal areas of Alabama, Mississippi, Louisiana and Texas. Generally, however, they feed upon non-economic forms, such as various species of chitons, *Mytilus*, *Balanus* and probably a host of other genera.

Very probably all species in *Purpura* and *Thais* produce some sort of secretion which turns purple on exposure to air and light though the quantity varies considerably with the species. The color is purely incidental, however, to the poisonous effects of this secretion which is used to immobilize the animal's prey. Its production and use may be in proportion to the type of food the creature generally feeds upon. *Thais lapillus* Linné would hardly have to use this poison while feeding upon either young *Mytilus* or *Balanus*, sessile animals to which *T. lapillus* gains access by drilling through their shells. On the other hand, *Purpura patula* Linné produces a quantity of this secretion and apparently



Drawings by R. D. Turner

Plate 32. Under side of the opercula of *Purpura* and *Thais*. Fig. 1. *Purpura patula* Linné. Gun Cay, Bimini Islands, Bahamas. Fig. 2. *Thais trinitatensis* Guppy, Rio Mucury, Espirito Santo, Brasil. Fig. 3. *Thais haemastoma floridana* Conrad, Cutler Point, Biscayne Bay, Florida. Fig. 4. *Thais rustica* Lamarck, Natal, Brasil. Fig. 5. *Thais deltoidea* Lamarck, Porto Seguro, Brasil. Fig. 6. *Thais lapillus* Linné, Broad Cove, Cushing, Maine (all approximately 2×).

uses it to immobilize chitons, not resorting to drilling through their rather thick plates of shell material. The poisonous qualities of this secretion have been reported upon by Dubois as well as others.

Various species of trematode parasites are reported to occur in *Thais haemastoma haysae* Clench (V. Schechter 1943, Journ. Parasitology **29**, p. 362) and in *Thais (Polytropa) lapillus* Linné (M. V. Labour 1907, Annals and Magazine of Natural History (7) **19**, pp. 102–106, 2 plates; H. W. Stunkard and R. M. Cable 1932, Biological Bulletin **62**, pp. 328–338, 1 plate). The adults of certain of these trematode worms are known to occur as parasites in gulls; for others, the primary host still remains unknown.

Variation among the many species is very extensive and has given rise to a host of names, many of which are rather useless and in general almost impossible to define. We have attempted to figure some of the extremes of variation exhibited by the species with which we are concerned. It is to be understood, of course, that these figures represent only certain variation limits and that in any extensive series, completely intergrading forms will occur. The nomenclature has become highly complicated and much uncertainty still exists as to just what name should be applied to some of the species.

The opercula of *Purpura* and *Thais* are unguiculate, chitinous and rather thin. The underside has the outer margin somewhat thickened and shining. The remaining portion consists of a series of rather pronounced concentric ridges which may be fairly regular to very irregular in arrangement. Very fine sculpture may be present and it is usually in the form of minute discontinuous threads that are set at right angles to the coarse ridges mentioned above.

There appears to be a fair degree of differentiation among the opercula of the species we have figured (Plate 32, fig. 1–6), and there are indications that certain of these differences may be of subgeneric value. This is particularly true of *Thais (Polytropa) lapillus* Linné which differs by having the ridges more or less oval in pattern. This same type of operculum is possessed by *Thais (Polytropa) lamellosa* Gmelin of the American northwest coast. However, far more species should be examined to determine the extent of variation both within and between species.

The eggs of *Thais (lapillus; lamellosa and haemastoma haysae)* are produced in capsules which are clustered together, sometimes in considerable numbers. There are several eggs in each capsule, and it has been reported that in the case of *T. lapillus* Linné, many more young are produced than eventually emerge, as the first few to hatch feed upon the yolk mass formed by the other eggs. According to Pelseneer (1905, pp. 343–345) the original number of eggs in each capsule may be as great as 600, though only from 6 to 40 snails may eventually leave the capsule. The average number of snails is about 12. This does not seem to be true of *T. haemastoma haysae* Clench whose young emerge as larvae in the veliger stage. Almost nothing is known about the egg laying habits of most of our other species of *Thais* and *Purpura*. It is a problem that is in need of study.

Genus *Purpura* Bruguière

Purpura Bruguière 1789, Encyclopédie Méthodique **1**, pt. 1, p. xv; non *Purpura* Bruguière 1792, Journal d'Histoire Naturelle **1**, p. 29, pl. 2, fig. 3–4 [= *Typhis* Denys de Montfort 1810]; non Röding 1798; non Martyn 1784.

Haustrum Perry 1811, Conchology, London, text with plate 44.

Microtoma Swainson 1840, A Treatise on Malacology, London, p. 301; *non Microtoma* Laporte 1833 (*Microstoma* Cossmann 1903, lapsus).

Purpurella Dall 1871, American Journal of Conchology **7**, p. 110 (genotype, *Purpura columellaris* Lamarck); *non* Des Voidy 1853; Bellardi 1882.

Lepsia Hutton 1883, Trans. New Zealand Institute **16**, p. 222 (type, *Purpura haustum* Martyn = *Buccinum haustorium* Gmelin).

Plicopurpura Cossmann 1903, Essais Paléoconchologie Comparée Livr. 5, p. 69; new name for *Purpurella* Dall, *non* Des Voidy.

Patellapurpura Dall 1909, United States Geological Survey, Professional Paper 59, p. 50 (*T. patula* Lamarck = *Buccinum patulum* Linné, monotypic).

Genotype, *Buccinum persicum* Linné (subsequent designation, Denys de Montfort 1810).

The species constituting this genus possess rather large and capacious apertures. The siphonal canal is small and recurved, the anal notch small or absent and the margin of the outer lip very strongly crenulated. The columella is broad and distinctly depressed in the mid-parietal area. The parietal shield is generally partially absorbed and smooth above on the body whorl showing the old and inner shell material. The spire is rather depressed. Sculpture generally consists of spiral incised lines, spiral ridges or strong nodules, the nodules being in spiral arrangement.

Winckworth (1945, p. 143) in a very able report on the types of the Boltenian genera, gives a clear and concise account of the name *Purpura* Bruguière and its history. Bruguière briefly described *Purpura* first in 1789 (p. xv) without mentioning any species. On page 241 in the same report he states that the genus *Buccinum* Linné has been considered by him to constitute four genera, one of which is "Pourpre." By inference and elimination alone, subsequent authors have attempted to group into the genus *Purpura* the several species of Linné that form the assemblage of species headed by *Buccinum persicum* Linné. The first accepted type designation was that of Denys de Montfort (1810) who selected *Buccinum persicum* Linné as the type of *Purpura*. In 1792 (p. 29) Bruguière again defined the genus *Purpura* and described *Purpura tubifer*, a totally different shell, which was subsequently made the type of the genus *Typhis* by Denys de Montfort in 1810. This of course is the type of *Purpura* Bruguière 1792 by monotypy. It is difficult to understand why contemporary and later authors completely overlooked this second definition of *Purpura*. Perhaps Lamarck, as co-author of the Encyclopédie Méthodique, attempted to follow what he believed to be the original understanding of this genus by Bruguière.

In 1915, Apstein submitted to the International Commission a list of 156 molluscan names to be retained as *nomina conservanda*¹; among these names was *Purpura* Bruguière 1789 with *B. persicum* Linné as the type. The Commission ruled² that these names could not be accepted in toto but must be ruled upon separately at a later date with the acceptance of each genus based upon its own merits. Unfortunately, Thiele (1929, p. 295) overlooked this ruling and listed *Purpura* as a *nomen conservandum* and

¹C. Apstein 1915: Sitzungsbericht der Gesellschaft Naturforschender Freunde zu Berlin **11**, no. 5, pp. 181-184.

²Opinions Rendered by the International Commission on Zoölogical Nomenclature 1922, Smithsonian Miscellaneous Collections **73**, no. 1, Opinion 74, pp. 32-34.

gave, by error, the date of Bruguière as 1792. His error is quite apparent as he proceeds to consider the species under *Purpura* Bruguière 1789 (of authors), and not under the group now known as *Typhis* or *Purpura* Bruguière 1792.

I am in full agreement with Winckworth that *Purpura* Bruguière 1789, with its type, *Buccinum persicum* Linné, should be accepted, and that it should be added to the list of names included in the *nomina conservanda* at an early date by the Commission. To do this will avoid much confusion of name changes and the generic name *Typhis* Denys de Montfort 1810, so long known and understood in the literature, will then be retained.

Winckworth has shown that Martyn's work, *The Universal Conchologist* 1784, cannot be accepted under our present rules as being binomial and consequently his use of the name *Purpura* cannot be considered valid¹.

If, however, *Purpura* Bruguière 1789 be rejected as inadequately described, the next available name is *Haustrum* Perry 1811 with the type, *Haustrum zealandicum* Perry (= *Buccinum haustorium* Gmelin)².

The family name Thaididae has been retained, even though Purpuridae is much older. This seems best in the light of the fact that the generic name *Purpura* is still of questionable validity so far as its use in this report is concerned. A future ruling may invalidate such use whereas Thaididae, even as a synonym, will be clearly understood for the genera and species it contains.

***Purpura patula* Linné, Plate 33, fig. 3-4**

Buccinum patulum Linné 1758, *Systema Naturae*, ed. 10, p. 739 (America). [Refers to Gualtieri 1742, *Index Testarum Conchyliorum*, pl. 51, fig. D, E, A].

Haustrum tuberculatum Perry 1811, *Conchology*, London, text and plate 44, fig. 4 (South Seas); *non Purpura tuberculata* de Blainville 1832.

Description. Adult shell 50 to 85 mm. (2 to 3½ inches) in length, imperforate, the larger size, however, not frequently found. Whorls 4½ to 5½ and rapidly increasing in size, the last or body whorl exceedingly capacious. Color a dull and faintly rusty gray with the columellar area a salmon-brown which is also suffused along the inner margin of the outer lip. Blotches of a deep blackish brown also irregularly disposed along the inner margin of the outer lip and on the parietal wall on its outer margin. Columella short and broad, its inner edge smoothly arched into the parietal wall margin. Aperture broadly elliptical. Outer lip simple and strongly crenulated. A very short and nearly inconspicuous siphonal canal at the base, its left side margined by the columella. Inner lip broad and smooth, its outer edge crenulated at the columellar region. Spire moderately depressed. Suture not well differentiated though indicated by the strongly shouldered

¹ R. Winckworth 1929; *Proceedings Malacological Society of London* 18, pp. 228-229.

² The following will outline the relationships of the names involved if *Purpura* Bruguière 1789 is not followed.

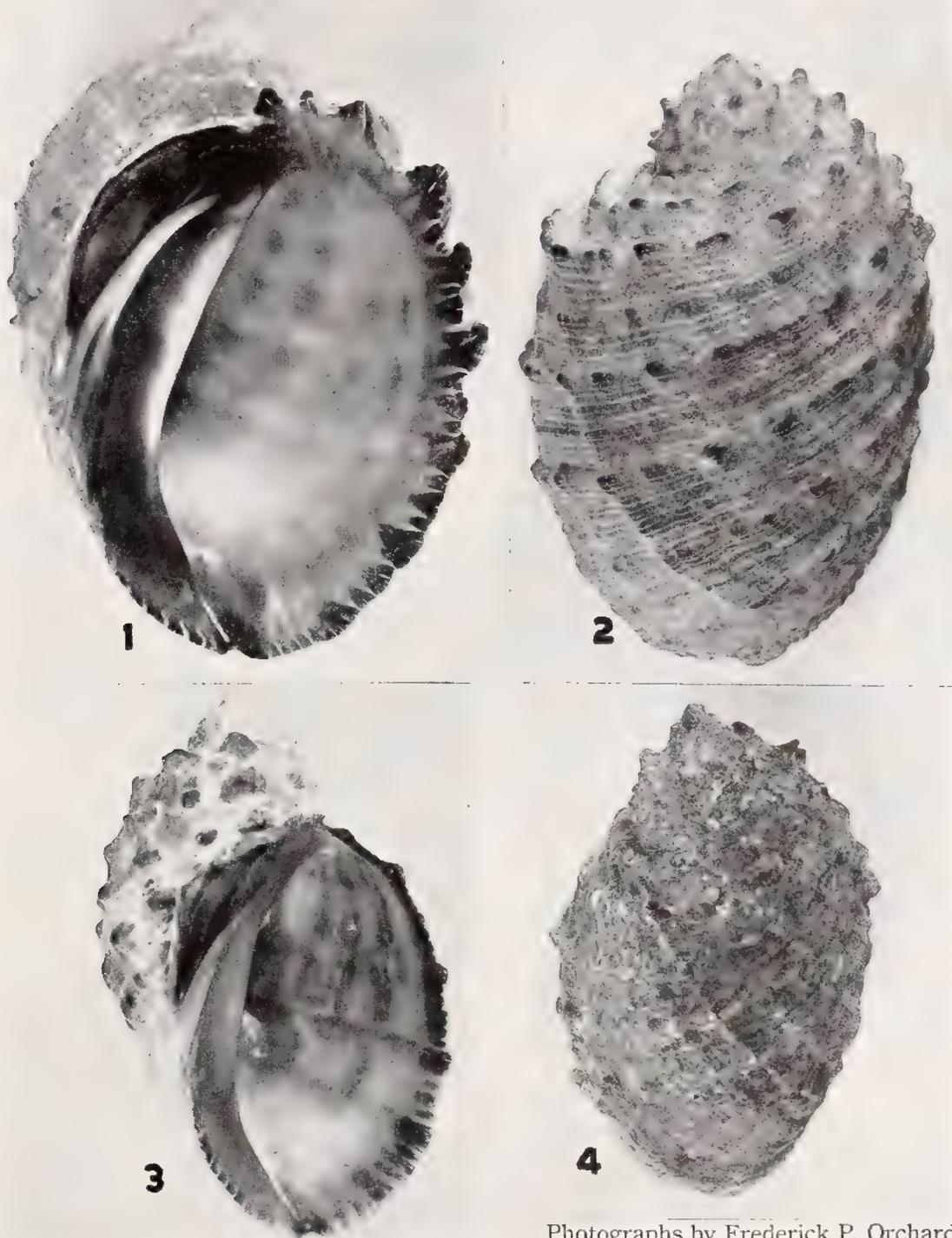
Genus *Haustrum* Perry

Haustrum Perry 1811, *Conchology*, London, text with plate 44, genotype, *Buccinum haustrum* Martyn = *Buccinum haustorium* Gmelin (subsequent designation, Iredale 1915).

All of the synonyms given above under *Purpura*, other than the original reference of *Purpura* by Bruguière 1789, also belong here.

whorls. Nuclear whorls smooth, succeeding whorls nodulose, consisting of 6 or 7 spiral rows of short and rather sharp nodules. Young shells are proportionately more nodulose. A few adults are occasionally found with the body whorl nearly smooth. In addition to the rows of nodules, there are rather numerous and fine incised lines, generally about 4 lines between two rows of nodules. No periostracum. Operculum nearly semicircular, inner side with a series of strong growth ridges about a marginal nucleus which is located on the palatal side. Under side of the operculum sculptured with concentric thread-like ridges. Operculum smaller than the aperture, but capable of closing the latter when the animal recedes well within the opening.

	length	width	aperture	
(large)	85	56	70×35 mm.	Key West, Florida
(average)	61	40	52×28	Navassa Island, Caribbean Sea



Photographs by Frederick P. Orchard

Plate 33. Fig. 1-2. *Purpura patula pansa* Gould, Charles Island, Galápagos Islands. Fig. 3-4. Governors Harbour, Eleuthera Island, Bahamas. (All natural size.)

Types. Figure E on plate 51 in Gualtieri is here selected as the type figure. We limit the type locality to Puerto Sosúa, Hispaniola.

Common name. Wide Mouthed Rock Shell.

Remarks. This species is rather common throughout its range though individuals are not particularly abundant at any one locality. It grips the rocks very firmly and is difficult to remove by hand. It is intertidal though most commonly found near the low water line.

A remarkable use of the dye produced by *P. patula pansa* Gould is given in considerable detail by Z. Nuttall.¹ On the Pacific coast of the Isthmus of Tehuantepec, Mexico, fishermen, by means of boats at low water, search the rocks for *Purpura patula pansa* Gould. Carrying skeins of loosely twisted cotton thread, the natives collect individual specimens of *Purpura*, "blow" upon them, and, as the mollusk recedes into the shell exuding a "milky froth," they dab this froth upon the cotton thread. The shell is then placed back on the rock or in a tide pool and used again upon the return journey. The "milky froth" turns purple and the threads are thus dyed. Skirts made from this hand-dyed cotton thread are called "de caracolillo" and sell for \$10.00 gold. This is a case of real native conservation. This same method of primitive dyeing was commonly practiced along much of the west coast of Central America.

I have seen the exuding of this dye many times. It appears as a milky fluid, always associated with an exceedingly disagreeable odor. It soon turns purple on contact with the air, probably by oxidation, the salt water acting as a mordant. This dye is very difficult to remove from the hands; on cotton bags, it will remain indefinitely even when the bags have been in alcohol for several years.

I suspect that this exudate may possibly be a narcotizing agent used by *Purpura* to paralyze its prey. I have found, several times, four to six *Purpura* feeding upon a large overturned chiton. Generally this species is found singly other than at such meal times when several are grouped around the "kill." The odor may possibly be a means of bringing them to the feast or stimulating several to work together on the victim. Complete observations on this procedure are certainly needed but may prove rather difficult to obtain, as this species inhabits rocks exposed to the open sea and its movements appear to be made during the high water stage of the tide. Exposed, they continue to feed but isolated specimens at low water stage are generally immobile. It would seem almost impossible for a single or even several *Purpura* to have the power to remove a large chiton from the rocks unless possessing something in addition to mere physical force.

Purpura patula Linné is very easily separated from the Eastern Pacific subspecies, *pansa* Gould, by the uniform salmon-brown coloration on *patula* and the lengthened white area on the parietal margin of *pansa*. Confusion existed in the mind of Carpenter as to the validity of this west coast form, probably as he was working with some material that was itself of indefinite locality. It is to be remembered that much early material came into the hands of students, either without locality or with only general locality data. Specimens from different localities were "lumped" together, so that the overall picture of a species, and its limitations as to characters, were often confused. Thus, the

¹ A Curious Survival in Mexico of the Use of the Purpura Shell-Fish for Dyeing. Putnam Anniversary Volume Anthropological Essays. G. E. Stechert Co., New York, 1909, pp. 368-384, pl. 1-2.

white parietal area in *pansa* Gould and the salmon-brown of the parietal area in *patula* Linné were "lost." Specimens accurately localized indicate that these characters are exceedingly constant for the two different regions.

Carpenter included the Philippines as a record based upon shells contained in the Cuming collection. This is certainly an error and again due to a wrong assignment of locality, not at all infrequent in Cuming's material.

Records of *P. patula* from West Africa are open to question. Mr. J. R. leB. Tomlin has written to me that he has seen no authentic specimens from this area and believes none are in the British Museum. The only published record known to me is that of Adanson who included in his *Histoire Naturelle du Sénégal* many species now known to be found in other portions of the world and not known to occupy the coastal area of West Africa. In relationship, however, *P. patula* is close to *P. eudeli* Sowerby from Gorée Island, Sénégal (1903, *Journal of Malacology*, 10, p. 74, plate 5, fig. 3).

Recently Fischer-Piette (*Jour. de Conch.* 85, p. 202, pl. 5, fig. 3 a-b) has written upon the mollusks of Adanson and has figured specimens of *P. patula* from the Adanson collection. These certainly are of this species, but as stated above, Adanson's collection contains many species not of West African origin. In his catalogue, Adanson referred to it as "the Purple of Panama."

The relationship of *patula* and *pansa* is similar to that of many other mollusks that are to be found on both coasts of Central America. When the isthmus was submerged many species probably migrated both ways and later became differentiated when the isthmus again separated the Atlantic and the Pacific Oceans.

Range. Palm Beach, Florida south to Trinidad. (? Brasil, Dall 1889, p. 122). A record from Bermuda by Dall in the same publication is open to question. It is not listed by Piele.

Records. FLORIDA: Palm Beach (MCZ); Boca Raton (B. R. Bales); Miami Beach (A. H. Patterson); Key West; Tortugas (both MCZ). BAHAMAS: Eight Mile Rock, Grand Bahama; Sweetings Village, Great Abaco; Gun Key, Bimini Ids.; Andros Id.; Nassau, New Providence; Governors Harbour, Eleuthera; Arthurstown, Cat Id.; Clarendetown, Long Id.; Watlings Id.; Matthewtown, Great Inagua Id. (all MCZ); Elbow Cay, Cay Sal Bank (R. Humes). CUBA: Cabo San Antonio (USNM); Mariel (MCZ); Habana (R. W. Jackson); Peninsula de Hicacos, Cárdenas (C. J. Finlay); Cayo Francés; Caibarién (both P. J. Bermúdez); Gibara; Baracoa; Guantánamo Naval Base; Cienfuegos Harbor (all MCZ); Levisa Bay, Mayari (A. Queñones). HISPANIOLA: Gonave Id.; Cap Haitien (both W. J. Eyerdam); Puerto Sosúa; Cabo Macorís; Santa Bárbara de Samaná (all MCZ). PUERTO RICO: San Juan (MCZ); Borinquen (D. Thomas). Aguadilla; Cayo de Muertos; Hucares (all MCZ). VIRGIN ISLANDS: Virgin Gorda; Guana Id., Tortola; St. John (all M. W. Dewey); Saint Croix (H. A. Beatty); St. Thomas (USNM). JAMAICA: Port Henderson; Runaway Bay, St. Ann (both MCZ). LESSER ANTILLES: Fort James, Antigua; Barbados (both C. M. Pomerat); Martinique (USNM); Grenada (H. G. Kugler); Toco; Balata Bay, Trinidad (both MCZ). CARIBBEAN ISLANDS: Navassa Id.; Swan Id.; Utilia Id., Bay Ids. (all MCZ). MEXICO: Veracruz (USNM). PANAMA: Isle of Pines, San Blas; Porto Bello (both J. Zetek); Colón (USNM). COLOMBIA: Cartagena; Santa Marta (both MCZ). VENEZUELA: La Guaira (MCZ).

Purpura patula pansa Gould, Plate 33, fig. 1-2

Purpura pansa Gould 1853, Boston Journal of Natural History **6**, p. 406 [p. 33 of separate]. (West coast of Central America).

Purpura patula 'Linné' Gould and Carpenter 1856 [1857] Proc. Zoological Society of London, p. 208.

Purpura patula 'Linné' Carpenter 1857, Catalogue of Mazatlan Shells, British Museum, London, p. 474 (Mazatlan, Mexico).

Description. General characters quite similar to those of *P. patula* Linné other than the white coloration on the inner margin of the parietal area. In the case of *pansa*, the inner margin of the parietal area is white throughout most of its length. This color shades evenly into the salmon-brown of the parietal shield about one-fourth to one-half inch behind the edge. Young specimens of *P. p. pansa* appear to be a little more strongly nodulose than those of *P. patula*.

	length	width	aperture	
(large)	94	69	85 × 46 mm.	Mazatlan, Mexico
(average)	64	41	54 × 21	Acapulco, Mexico

Types. The type specimens are probably in the New York State Museum, Albany, New York. Gould and Carpenter (1856, p. 208, above) cite Mazatlan, Mexico for this subspecies which is here selected to be the type locality.

Remarks. A. A. Gould (1853, p. 406, above) apparently intended to institute the name *Purpura pansa* for the West Coast specimens of *Purpura patula* auct. His description, however, is a curious mixture of the characteristics of both East and West Coast forms and a muddle of geographic localities. Gould and Carpenter used the name *pansa* for the West Coast forms but considered it synonymous with *patula*. Carpenter's use of the name can be accepted as applying to this subspecies that occurs from Lower California south to Colombia. (See remarks under *P. patula*).

This subspecies has been included to aid in clarifying the differences that exist between these two forms.

Range. West Coast of Mexico south to Colombia (possibly Ecuador) and the Galápagos Islands.

Records. MEXICO: Magdalena Bay; Cape San Lucas; Mazatlan; Acapulco (all MCZ); Tres Marias Ids. (USNM). SAN SALVADOR: Libertad (Yale University). COSTA RICA: Golfo Dulce (M. Valerio). PANAMA: Pacheca Id., Pearl Ids. (J. Zetek); Flamingo Id., Panama Bay (W.D. Clark). COLOMBIA: Malpelo Id.; Village Ardito (both AMNH). EASTERN PACIFIC ISLANDS: Cocos Id. (MCZ); Clarion Id.; Socorro Id. (both USNM). Charles Id. and Indefatigable Id., Galápagos Ids. (both MCZ); Chatham Id. and James Id., Galápagos Ids. (both USNM).

Genus *Thais* Röding

Thais Röding 1798, Museum Boltenianum (2) p. 54. [*T. lena* Röding = *Murex fuscus* Gmelin 1790. Röding refers to Martini 1777, Conchy.-Cab. (1), **3**, pl. 100, fig. 959-960]; *non Thais* Fabricius 1807; Holiday 1838.

Sinusigera d'Orbigny 1842, [in] Ramon de la Sagra, Histoire de L'Ile de Cuba, Mollusques **2**, p. 149 (monotypic, *Sinusigera cancellata* d'Orbigny 1842, *l. c.* above) p. 150, pl. 23, fig. 7-9, off Jamaica). [This genus was based upon the embryonic shell of some West Indian species of *Thais*. The shell is very different from that

of an adult *Thais*. The outer lip of the shell is thrust forward in the center, forming two embayments for the reception of the paired velar lobes. These embayments disappear when the velum is absorbed and the shell assumes the adult form. See Pelseneer 1906, *A Treatise on Zoology* **5**, Mollusca, London, p. 140, fig. 122.]

Sinugigera 'd'Orbigny' Jousseume 1882, *Le Naturaliste* **4**, p. 183 (error for *Sinusigera* d'Orbigny 1842). Jousseume was the first to point out that *Sinusigera* was the embryonic shell of *Thais*.

Genotype, *Thais lena* Röding = *Murex fuscus* Gmelin = *Nerita nodosa* Linné (subsequent designation, Stewart 1926).¹

The shells are usually solid and strong, occasionally smooth, but generally with spiral ridges which may be imbricated or nodulose. The aperture is moderately large, and the parietal wall narrow or broad and either straight or somewhat inwardly arched. The siphonal canal is rather short and slightly oblique; the anal canal may be indicated by a parietal ridge and a small palatal sinus or these characters may be lacking entirely. The spire may be short or moderately extended.

Subgenus **Thais** Röding

(See synonymy under the genus *Thais*).

Subgenotype, *Nerita nodosa* Linné

Shells in the subgenus are solid, strongly nodulose with a well developed anal canal. The parietal wall is inwardly arched and broad. The spire is very short.

No members of the subgenus *Thais* exist in the Western Atlantic. A subspecies, *Thais nodosa ascensionis* Quoy and Gaimard, of the west African *T. nodosa* Linné occurs on Ascension Island in the South Atlantic Ocean. It has not been reported west of this small island.

Subgenus **Thaisella**, new subgenus

Shells subglobose to moderately elongate with both anal notch and siphonal canal well developed. Spiral sculpture of fine threads or cords and generally spirally nodulose. Old margins of the anal canal remain as a series of flutings or scales at the union of the whorls. The various species may be nearly smooth to strongly nodulose.

Subgenotype, *Purpura trinitatensis* Guppy

Thais (Thaisella) trinitatensis Guppy, Plate 34, fig. 1-4

Purpura trinitatensis Guppy 1869, *Proc. Scientific Association Trinidad* **1**, p. 366; *ibid.* 1875, *Annals and Magazine of Natural History* (4) **15**, p. 50 (Gulf of Paria, Trinidad); *ibid.* 1878, *Proc. Scientific Association of Trinidad* **2**, p. 179, pl. 7, fig. 17; G. D. Harris 1921, *Bull. American Paleontology* **8**, no. 35, p. 100, pl. 5, fig. 17. [This is a reprint of Guppy's 1878 paper.]

Purpura haemastoma trinidadensis 'Guppy' Dall 1889, *Bull. Museum Comparative Zoölogy* **18**, pt. 2, p. 217.

Purpura coronata 'Lamarck' Pilsbry 1900, *Nautilus* **13**, p. 130.

Thais floridana trinidadensis 'Guppy' M. Smith 1939, *An Illustrated Catalogue of the Recent Rock Shells, Lantana, Florida*, p. 25.

Thais coronata brujensis M. Smith 1946, *Nautilus* **60**, p. 61 (Bruja Point (Caribbean) Canal Zone).

¹Dall's type designation of "*T. neritoides* Lamarck" is completely invalid as no species by this name is cited by Röding under his genus *Thais*. The subject of a type designation for *Thais* has been carefully studied by Stewart (1926, *Proc. Academy Natural Sciences, Philadelphia*, **78**, p. 386).

Description. Shell 35 to 45 mm. $1\frac{1}{2}$ to $1\frac{3}{4}$ inches) in length, rather heavy, solid and coarsely sculptured. Whorls convex, angular at the shoulder and six to seven in number. Color a dull brown to gray, occasional specimens possessing a few spiral and interrupted lines of white. Aperture pinkish (Guppy) to rather dark salmon brown, often with numerous lines which are continuous from the margin to within the aperture. Occasionally these lines exist as dark spots at the crenulations and become faint or entirely absent within. Spire moderately extended, and produced at an angle of 72° to 82° . Suture indistinct. Aperture subcircular to elliptical. Posterior canal or anal notch well developed, occasionally margined on the parietal wall with a well defined ridge which follows back within the aperture. Anterior (siphonal) canal deep and recurved, its successive growth stages producing a broad umbilical area with the small opening rimate or evenly circular, but only extending a short distance within. Outer lip slightly thickened and finely crenulated. Parietal wall heavily glazed, sometimes ridged over the basal margin. Columella nearly straight and rounded in contour. Sculpture consisting of from one to four nodulose spiral ridges, the shoulder ridge being the most prominent. In addition, there are numerous spiral threads. Axial sculpture consists of very fine imbricated growth lines which cross the nodules and fine spiral threads. At the suture the successive margins of the posterior canal remain as a series of large imbrications.

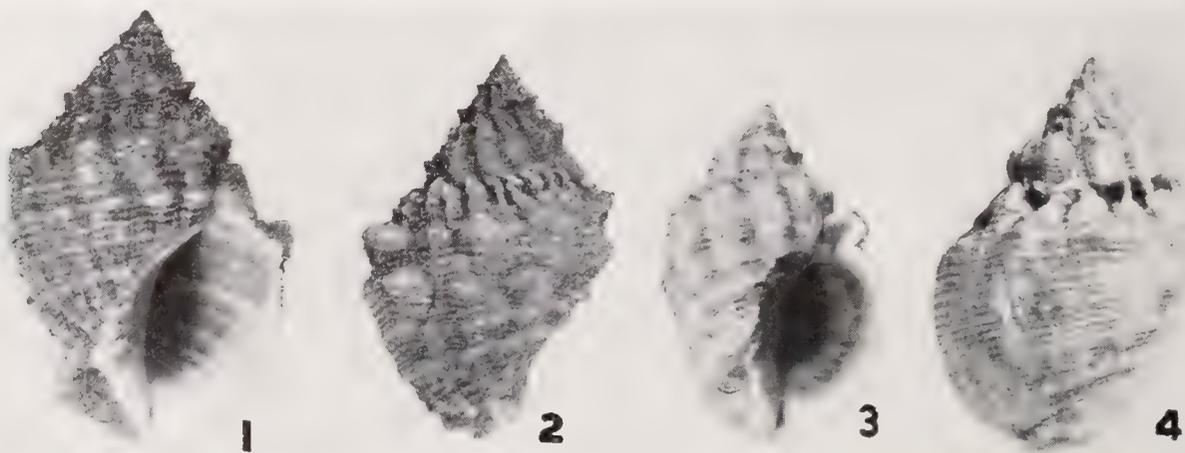
	length	width	aperture	
(large)	43.5	29	24 × 13 mm.	Claxton Bay, Trinidad
(average)	34	20.5	19 × 8.5	Punta Brujas, Panama
(small)	31	21.5	18 × 9	Río Mucury, Espirito Santo, Brasil

Types. Neoholotype, Museum of Comparative Zoölogy no. 177755, Claxton Bay, Trinidad, Lesser Antilles, H. G. Kugler collector.

Neoparatype in the Kugler Collection. So far as we can determine, Guppy's collection was destroyed when the Victoria Institute was burned in Port of Spain, Trinidad.

Common name. Trinidad Rock Shell.

Remarks. This is a rather distinctive species though rather closely related to *Thais coronata* Lamarck of the West African and Brazilian coasts. Under this name it has been



Photographs by F. P. Orchard

Plate 34. *Thais trinitatensis* Guppy. Fig. 1-2. Claxton Bay, Trinidad (Fig. 1. Neoholotype). Fig. 3-4. Brujas Point, Canal Zone, Panama (Atlantic). (All natural size.)

recorded from the Western Atlantic. It differs from *coronata* by being far more attenuated and having finer sculpture. This species is not to be confused with *T. coronata* A. Adams (= *adamsi* Dall) a Western Pacific species which is the subgenotype of *Pinaxia* A. Adams.

The Pacific analogue of this form at Panama is *Thais* (*Thaisella*) *kiosquiformis* Duclou. In this species the spire has become very much attenuated and the whorl shoulder angled and tuberculated. The strongly imbricated scales of the previous anal canal growth stages are well developed (Plate 34, fig. 3-4).

The recently described subspecies (of *coronata*), *T. c. brujensis* Smith, is an absolute synonym of *T. trinitatensis*. Specimens submitted by W. D. Clark from Punta Brujas, Panama are slightly more attenuated than specimens of *trinitatensis* from Trinidad, the type locality, but in all other respects they are similar.

Thais trinitatensis appears to be a rather rare species and perhaps only locally abundant. From the limited series we have seen, this species becomes smaller and the spire more attenuated at the northern end of its range.

Thais santodomingensis Pilsbry and Johnson 1917 (Proc. Acad. Nat. Sci., Philadelphia 69, p. 169; Pilsbry 1922, *ibid.* 73, p. 354, pl. 28, fig. 8-9) from the Oligocene of Hispaniola, belongs in the subgenus *Thaisella*. It is possibly an ancestral form of *T. trinitatensis*.

Range. Guatemala and south to Brasil.

Records. GUATEMALA: Puerto Barrios (H. Vander Schalie). PANAMA: Punta Brujas; west shore of Limón Bay, Canal Zone (both W. D. Clark). TRINIDAD: Claxton Bay (H. G. Kugler). BRITISH GUIANA: Georgetown (S. T. Brooks). SURINAM: Courantyne River (H. G. Kugler). BRASIL: Río Mucury, Espirito Santo (Thayer Expedition); São Luiz do Marantão (both MCZ).

Thais (Thaisella) coronata Lamarck, Plate 35, fig. 1-2

Purpura coronata Lamarck 1822, Animaux sans Vertèbres 7, p. 241 (Seas of Sénégal); Kiener 1836, Icon. Coquilles Vivantes 8, p. 70, pl. 18, fig. 53-53a.

Purpura callifera Lamarck 1822, Animaux sans Vertèbres 7, p. 240 (locality unknown).

Purpura guinensis Schubert and Wagner 1829, Conchy.-Cab. (1) 12, p. 144, pl. 232, fig. 4083-4084 (Guinea [Africa]).

Cuma coronata Lamarck, Tryon 1880, Manual of Conchology (1) 2, p. 201, pl. 62, fig. 326.

Description. Shell 36 to 44 mm. (about $1\frac{1}{2}$ to $1\frac{3}{4}$ inches) in length, very heavy, solid and coarsely sculptured. Whorls six, strongly convex and generally with a strongly angled shoulder. Color old ivory to dull white, occasionally mottled with light reddish brown. Interior of aperture yellowish salmon. Spire depressed with the base sometimes sunken below the shoulder of the body whorl. Spire produced at an angle of 75° which does not include the shoulder on the body whorl. Aperture subcircular with the inner edge of the outer or palatal lip finely crenulated. Posterior or anal canal greatly developed and margined within by an inconspicuous anal ridge. Previous growth stages of the canal occasionally form a series of closely packed scales at the union of the whorls thus forming the very high and sharply angled shoulder. This is particularly true of certain adult specimens. In others, however, these scales are not so large nor so closely

packed and as a consequence leave rather deep depressions between the scales. Siphonal canal rather deep and recurved, previous growth stages leaving a broad ridge around the shallow umbilicus. Columella nearly straight and thickened. Parietal area glazed and somewhat thickened. Sculpture consisting of a strongly marked anal canal ridge and in addition a series of two or more spiral rows of nodules; there are also numerous and rather fine, imbricated, spiral cords. Axial sculpture consists of fine and irregular growth lines.

	length	width	aperture	
(large)	44	35	23 × 14 mm.	Curuçá, Brasil
(average)	35	31	20 × 10	Curuçá, Brasil

Types. The type figures and the specimens upon which they were based are here selected to be those in Kiener's *Icon. Coquilles Vivantes* 8, pl. 18, fig. 53–53a. These figures are based upon specimens of Lamarck. The type locality is Sénégal, West Africa.

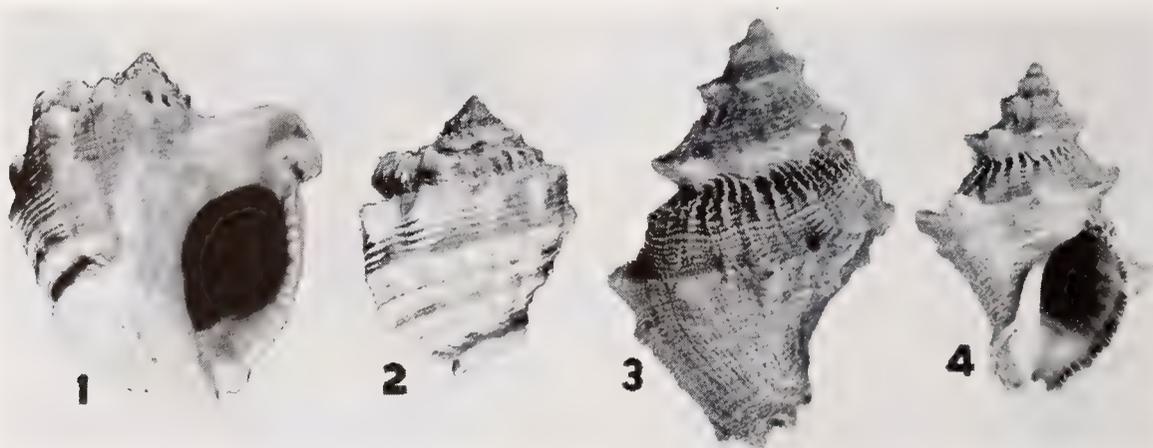
Common name. Crown Rock Shell.

Remarks. We possess but a single lot of this species from the Western Atlantic collected by L. Agassiz during the Thayer expedition to Brasil at Curuçá in the state of Pará. These specimens all possess the closely packed imbricated scales that form the past growth stages of the anal canal.

This record of Agassiz appears to be authentic, particularly as the specimens were associated with the characteristic printed labels of the Thayer Expedition. However, the species should be searched for along the Brazilian coast to establish definitely its occurrence in the Western Atlantic.

We owe to Kiener the indication of the relationships of *Thais callifera* Lamarck. Kiener states that it is but a "variety" of *T. coronata* Lamarck, and also that it is the same as *T. guinensis* S. and W. This latter is well figured and is certainly the same species as *T. coronata*.

Range. EASTERN ATLANTIC: Cape Verde Islands south to the Belgian Congo. WESTERN ATLANTIC: Brasil.



Photographs by F. P. Orchard

Plate 35. Fig. 1–2. *Thais coronata* Lamarek, Curuçá, Pará, Brasil. Fig. 3–4. *Thais kiosquiformis* Duclos, Panama City, Panama.

Records. WESTERN ATLANTIC: BRASIL: Curuçá, Pará. EASTERN ATLANTIC: CAPE VERDE ISLANDS (MCZ). SENEGAL: (MCZ). LIBERIA: Monrovia; Cape Mount, Fisherman's Lake (both MCZ); Marshal (M. Brisco). CAMEROON: Kribi (G. Schwab). RIO MUNI: Benito; Adjé (both S. T. Brooks). GABOON: (MCZ). BELGIAN CONGO: Malela, near Banana (MCZ).

Subgenus **Stramonita** *Schumacher*

Stramonita Schumacher 1817, Essai Nouveau Système, Copenhagen, p. 226.

Subgenotype, *Buccinum haemastoma* Linné (subsequent designation, Gray 1847).

Shells moderate to large in size, rather strong, smooth to moderately nodulose and generally having the spire extended. Anal canal generally indicated with a rather strongly developed anal ridge.

Thais (Stramonita) haemastoma *Linné*, Plate 36, fig. 1-6

Buccinum haemastoma Linné 1767, Systema Naturae, ed. 12, p. 1202 (European Ocean) [Refers to Gualtieri 1742, pl. 51, fig. A].

Thais grisea Röding 1798, Museum Boltenianum (2), p. 54 [Refers to Martini 1777, Conchy.-Cab. (1) 3, pl. 101, fig. 964. This figure is here selected as the type figure].

Thais metallica Röding 1798, Museum Boltenianum (2), p. 54 [Refers to Martini 1777, Conchy.-Cab. (1) 3, pl. 101, fig. 965-966. Figure 965 is here selected as the type figure. This is the apertural view of the same specimen which Röding called *grisea* above].

Thais nebulosa Röding 1798, Museum Boltenianum (2), p. 54 [Refers only to *Buccinum haemastoma* Linné]; *non* Conrad 1867.

Thais panama Röding 1798, Museum Boltenianum (2) p. 54 [Refers to *Buccinum haemastoma* Gmelin, Chemnitz 1788, Conchy.-Cab. (1) 10, pl. 154, fig. 1467-1468].

Thais stellata Röding 1798, Museum Boltenianum (2), p. 54 [Refers to D. D'Argenville 1757, La Conchyliologie, pl. 17, fig. H. This is an unrecognizable figure. It could be any of several species of *Thais*, even species in other genera. However, as Röding associated *stellata* with *haemastoma*, it can be considered an absolute synonym of *haemastoma*].

Buccinum lineatum Lamarck 1822, Animaux sans Vertèbres 7, p. 268 (locality unknown); *non* *P. lineata* 'Lamarck' de St. Vincent 1827.

Buccinum cingulatum Lamarck 1822, Animaux sans Vertèbres 7, p. 268. [Listed as a synonym of *B. lineatum* by Lamarck with reference to pl. 400, fig. 6a-b, Tableau Encyclopédique et Méthodique 3, 1816]; *non* *Buccinum cingulatum* Linné 1771; Röding 1798; Reeve 1846.

Purpura unifascialis Lamarck 1822, Animaux sans Vertèbres 7, p. 247 (locality unknown); B. de St. Vincent 1827, in Lamarck's Tableau Encyclopédique et Méthodique 3, pl. 397, fig. 6.

Purpura biserialis de Blainville 1832, Nouvelles Annales du Muséum d'Histoire Naturelle (Paris) (3) 1, p. 238, pl. 11, fig. 11 (Mazatlan [Mexico]).

Purpura callaoensis Kiener 1836, Icon. Coquilles Vivantes 8, p. 99, pl. 26, fig. 71 (Coast of Callao [Peru]); *non* Gray 1828.

Purpura lineata Kiener 1836, Icon. Coquilles Vivantes 8, p. 115, pl. 33, fig. 80 (locality unknown); *non* *lineata* 'Lamarck' de St. Vincent 1827 [Kiener's reference is to fig. 6a-b in the Tableau Encyclopédique et Méthodique, the same figures named *Buccinum cingulatum* by Lamarck in 1822 and de St. Vincent in 1827. Kiener's figures were based apparently on the same specimens in the collection of Lamarck].

Purpura nuttalli Conrad 1837, Journal Academy Natural Sciences Philadelphia 7, p. 265, pl. 20, fig. 19 (Fayal [Azores]).

Purpura gigantea Calcara 1840, Monografiedi generi Clausilia e Bulimo, p. 53, Palermo, Sicily; *non* de Blainville 1832. [We have not seen this paper, but Dautzenberg reports it to be the same as *gigantea* Reeve.]

Purpura blainvillei Deshayes 1844, Animaux sans Vertèbres (2) **10**, pl. 93 (Coast of Peru); new name for *P. callaoensis* Kiener 1836, *non* Gray 1828.

Purpura cornuta 'Menke' Reeve 1846, Conchologia Iconica **3**, **Purpura**, under species 21 [Listed as a synonym of *T. haemastoma* Linné. This is probably a manuscript name of Menke].

Purpura gigantea Reeve 1846, Conchologia Iconica **3**, **Purpura**, pl. 4, fig. 17 (locality unknown); *non* de Blainville 1832.

Purpura fasciata Dunker 1857, Proc. Zoological Society London 1856 [1857], p. 357 (locality unknown); *non* Reeve 1846.

Purpura floridana Conrad 1867, American Journal of Conchology **3**, p. 270 [Refers to Dunker 1853, Index Molluscorum, supplement 2, Novitates Conchologicae, pl. 3, fig. 14; *non* Conrad 1837].

Purpura nebulosa Conrad 1867, American Journal of Conchology **3**, p. 270 [Refers to figure 15, in Dunker, cited above, which, however, is the obverse view of the specimen he called *floridana!*]; *non nebulosa* Röding 1798.

Purpura barcinonensis Hidalgo 1867, Journ. de Conchy. **15**, p. 357, pl. 12, fig. 1 (Barcelona, Spain).

Purpura oceanica Locard 1886, Prodrome de Malacologie Française, Paris, p. 145 and 555 (Atlantic coast of France [Cap Breton]. The types of Locard are in the Paris Museum). [This is the same as *gigantea* Reeve.]

Purpura haemastoma minima Pallary 1900, Journ. de Conchy. **48**, p. 291 (Oran, Algeria).

Purpura haemastoma costellata Pallary 1900, Journ. de Conchy. **48**, p. 292 (Oran, Algeria).

Purpura haemastoma striata Pallary 1900, Journ. de Conchy. **48**, p. 292 (Oran, Algeria); *non* Quoy and Gaimard 1832.

Description. Adult shell reaching about 80 mm. in length ($3\frac{1}{4}$ inches), solid, occasionally smooth, but generally nodulose. Whorls 6 to 7, slightly convex and occasionally angled. Color dirty gray to dark brown, occasional specimens showing darker color areas generally arranged in an axial pattern. Interior of aperture usually colored a salmon pink, though many specimens are found in which the color is yellowish and even approaching white. Aperture sub-ovate to sub-oval. Outer lip moderately thickened and generally strongly crenulated, the crenulations formed by the ends of low and small ridges which generally run back well within the aperture. Inner lip glazed, smooth and thickened by the callus. At its upper margin there is a strong ridge which runs back within the aperture. This is opposite the small anal canal. Some specimens have a few faint plicae on the base of the columella. Umbilicus generally closed, occasionally very slightly rimate. Columella nearly straight and moderately thickened. Siphonal canal oblique and short. Previous growth stages of the canal leave behind a small ridge which surrounds the umbilical area. Anal canal short and margined within by a narrow ridge on the parietal wall. There is a small subsutural depression occasionally present on the outer whorl. Spire moderately extended. Suture fine and irregular. Sculpture is exceedingly variable, consisting of very fine incised spiral lines, and frequently with two or more rows of nodules which are arranged in spiral pattern. Axial striae consisting mainly of fine growth lines. Periostracum deciduous and rarely present.

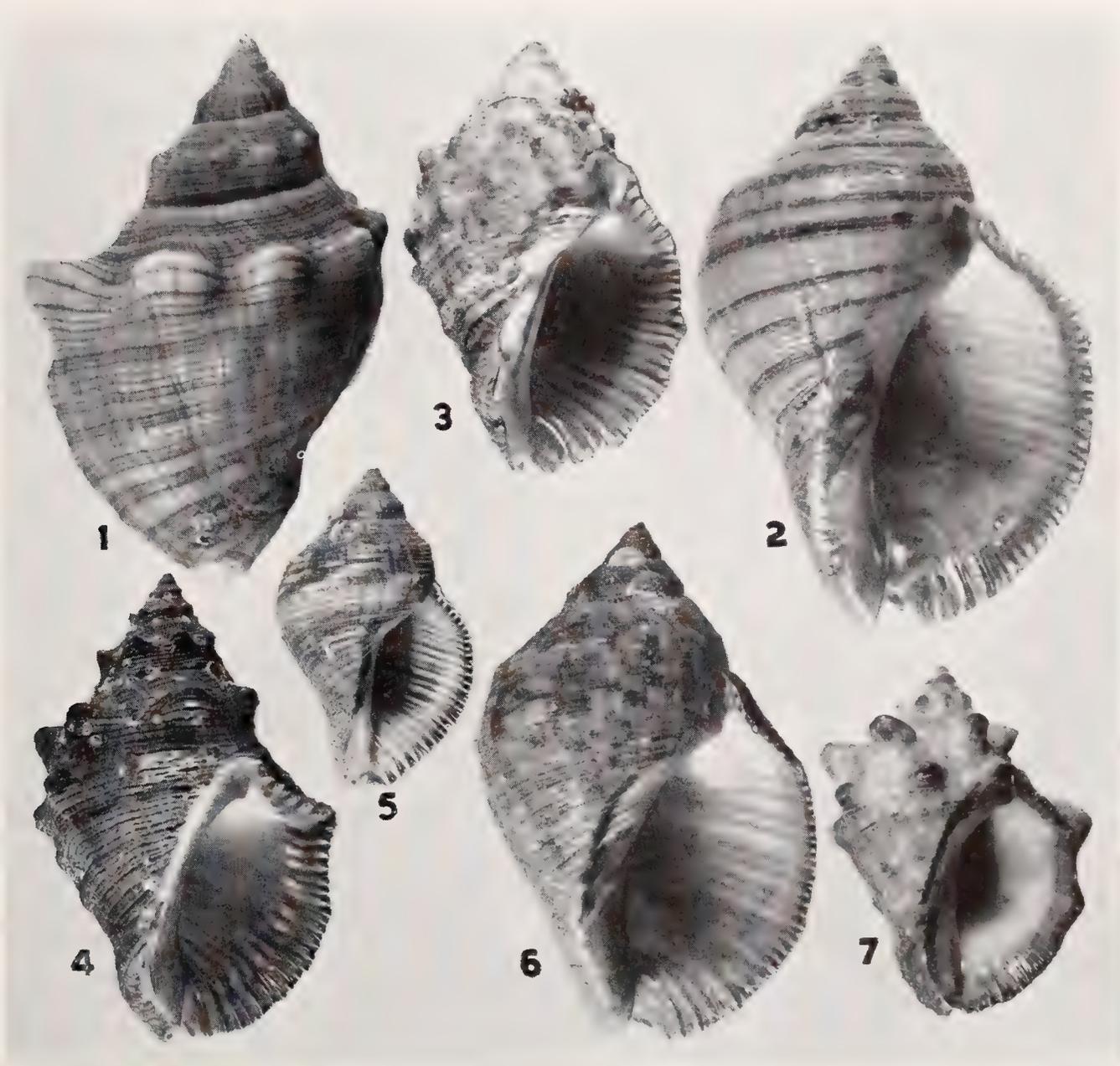
	length	width	aperture	
(large)	121	77	80 × 40 mm.	(from figure of Reeve's <i>gigantea</i>)
(large)	80	47	51 × 35	Río de Janeiro, Brasil
(average)	60	36	38 × 36	Galicia, Spain
(average)	62	38	40 × 20	Taboga Island, Panama

Types. The type figure of this species is that published by Gualtieri 1742, pl. 51, fig. A. This is the only reference given by Linné. We here select the type locality to be Teneriffe, Canary Islands, as the specimens which we have seen from this place agree very well with Gualtieri's figure.

Common name. Red-mouthed Rock Shell; Red-lipped Scoop.

Remarks. This species is probably as variable as any in the genus. European writers have proposed a host of names for the many forms as the above synonymy indicates. According to our present understanding of this species most of the names do not appear at all necessary as they are applied mainly to individual variations, in many cases to groups of individuals of unit ecologic populations (Pallary 1900, Journ. de Conchy. 48, p. 290). One Eastern Atlantic subspecies seems to be fairly well differentiated, *T. haemastoma forbesi* Dunker, from the West African coast, but even this subspecies merges into the typical form (Plate 36, fig. 7).

On the southern end of its range in Brasil and Uruguay individuals become quite large and somewhat strongly nodulose.



Photographs by F. P. Orchard

Plate 36. *Thais haemastoma haemastoma* Linné. Fig. 1-2. Jura Juba Bay, Rio de Janeiro, Brasil. Fig. 3. Teneriffe, Canary Islands. Fig. 4. Taboga Island, off Panama. Fig. 5. Panama. Fig. 6. Rio de Janeiro, Brasil. Fig. 7. *Thais haemastoma forbesii* Dunker, Benito, Spanish Guinea, West Africa. (All natural size.)

Reeve's *T. gigantea* is but an exceedingly large example of *haemastoma*. Pallary (*l.c.* above) cites examples of equal size that occur at Oran, Algeria.

In a large series it seems to be impossible to differentiate specimens from the Eastern Atlantic, Western Atlantic and Eastern Pacific. Certain extreme individual variations do appear to be somewhat different but the majority of specimens from these geographic regions are quite similar. In common with many intertidal species it is capable of mechanical transport, even in the adult stage. We possess a specimen collected by the United States Exploring Expedition on a floating log (North Latitude 36°, West Longitude 22°). This is some 300 miles northwest of the Madeira Islands. Drift of this sort could certainly carry specimens a considerable distance under favorable conditions. This may indicate a possible origin of the species in the Western Atlantic. A westward distribution may have occurred early enough to have reached the Eastern Pacific at the time when passage was possible through the region of Central America. The strong South Equatorial Current (westward) is probably a factor of considerable import in such mechanical dispersal. There are many cases of similar or very closely related forms that occur in the Western Atlantic and the Eastern Atlantic regions, particularly in the tropical portions of both areas that may have had advantage of such transport.

Range. EASTERN ATLANTIC: France, Western Mediterranean and south along the African coast to Sénégal. (*T. h. Forbesi* Dunker continues south along the African coast at least to the French Congo.) WESTERN ATLANTIC: from Trinidad south to Uruguay. EASTERN PACIFIC: from Mexico south to central Chile.

Records. EASTERN ATLANTIC: SPAIN: Asturias; Galicia (both MCZ). ALGERIA: Mers-el-Kebir, Oran; Algiers (both MCZ). MADEIRA ISLANDS: Fayal (MCZ). CANARY ISLANDS: Teneriffe (MCZ). CAPE VERDE ISLANDS: (MCZ). SENEGAL: Gorée Id. (MCZ).

WESTERN ATLANTIC: TRINIDAD: Otaheite Bay (MCZ); Magueripe Bay (H. G. Kugler). BRASIL: Praia de Camocim, Estado do Ceará; Praia do Chega Negro, Bahía; Río Mucury, Estado Espirito Santo; Praia de Itaipú, São Gonçalo, Río de Janeiro; Praia das Conchas, Itanhaen, Estado de São Paulo (all M. J. de Oliveira). URUGUAY: Cabo Santa María (A. Carcelles).

EASTERN PACIFIC: MEXICO: Acapulco; Magdalena Bay; Lower California; Mazatlan; Loreto; Cabo San Lucas; Guaymas (all MCZ). COSTA RICA: Golfo de Nicoya (MCZ). PANAMA: near Panama City (J. Zetek); Taboga Id.; Venado Beach (both C. M. Dumbauld). ECUADOR: Santa Elena (MCZ). PERU: Payta; Callao; Bahía de Paracas (all MCZ). CHILE: Valparaiso (MCZ). EASTERN PACIFIC ISLANDS: Cedros Id.; Juan Fernandez (both MCZ).

***Thais haemastoma floridana* Conrad, Plate 37, fig. 1-4**

Purpura floridana Conrad 1837, Journal Academy of Natural Sciences, Philadelphia 7, p. 265, pl. 20, fig. 21 (Florida and Mobile Point, Alabama); *non floridana* Conrad 1867.

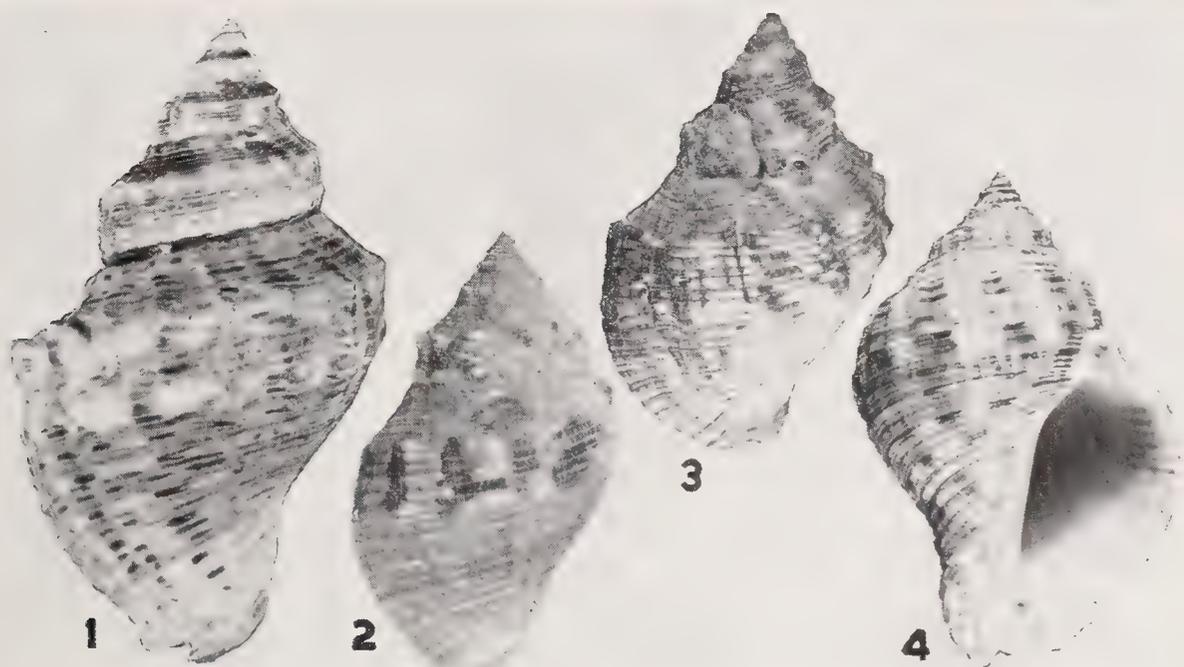
Purpura haemastoma 'Linné' Dall 1889, Bull. United States National Museum no. 37, p. 122, pl. 46, fig. 1a-2b.

Purpura gundlachi 'Dunker' Arango 1880, Fauna Malacologia Cubana, Habana, p. 202 (Habana, Cuba); [nude name]. This name so far as we can trace was never published until it appeared as a synonym under *P. floridana* Conrad by Arango.

Description. Adult shell reaching about 75 mm. in length (3 inches), solid, smooth to generally and finely nodulose. Whorls 6 to 7, slightly convex and occasionally angled. Color light gray to yellowish with a mottling of a darker color which generally appears in an axial pattern. Interior of aperture with a well diffused color of salmon pink, many specimens showing brown between the denticulations of the outer lip. Aperture sub-ovate to sub-oval. Outer lip moderately thickened and generally strongly crenulated, the crenulations formed by the ends of low and small ridges which generally run back well within the aperture. Inner lip glazed, smooth and thickened by a callus. At its upper margin there is a strong ridge which runs back within the aperture. Some specimens have a faint plica on the base of the columella. Umbilicus generally closed, occasionally very slightly rimate. Columella nearly straight and moderately thickened. Siphonal canal oblique and short. Previous growth stages of the canal leave behind a small ridge which surrounds the umbilical area. Anal canal short and margined within by a narrow ridge on the parietal wall. There is a small subsutural depression occasionally present on the outer whorl. Spire moderately extended. Suture irregular and generally fine, occasionally indented. Sculpture is exceedingly variable, consisting of very fine incised spiral lines and frequently with two or more rows of small nodules which are in spiral pattern. Axial striae consist mainly of fine growth lines.

	length	width	aperture	
(large)	75	44	41 × 19 mm.	Charleston, South Carolina
(average)	56	33	32 × 15	Galveston, Texas
(average)	67	39	38 × 18	Hypoluxo Island, Lantana, Florida

Types. Neoholotype, Museum of Comparative Zoölogy, no. 125382, Hypoluxo Island, Lantana, Florida. F. Lyman, collector. Dr. Pilsbry reports that Conrad's original



Photographs by F. P. Orchard

Plate 37. *Thais haemastoma floridana* Conrad. Fig. 1. Hypoluxo Island, Lantana, Florida (Neoholotype). Fig. 2-3. Daytona Beach, Florida. Fig. 4. Fernandina, Florida. (All natural size.)

type is not at the Academy of Natural Sciences, Philadelphia and is presumably lost. We have selected a new specimen to represent this subspecies.

Common name. Florida Rock Shell.

Remarks. This subspecies is exceedingly close in its relationships to the typical form. Segregated geographically, specimens do appear to be a little different. They are not as nodulose as *haemastoma*, are generally lighter in color and possess more pinkish rather than salmon-brown color within the aperture. Many examples of both forms are difficult and sometimes impossible to separate. In the main, however, West Indian specimens bear a closer relationship to *floridana* than they do to *haemastoma*. Krebs (1864, p. 26) reports only *floridana* from the West Indies though he states that *haemastoma* is "often found at the bottom of vessels which arrive from the coast of Africa at the port of St. Thomas." I have seen but a single example from the west coast of Florida south of the Cedar Keys, found by Mr. S. L. Porter on the outer coast of Sanibel Island on a small patch of rocks.

Range. North Carolina, south through the West Indies and along the Central American coast to Trinidad.

Records. NORTH CAROLINA: Roanoke Id.; Beaufort (both MCZ). SOUTH CAROLINA: Sullivan's Id., Charleston (Charleston Museum). FLORIDA: Fernandina; Fort Walton; Tortugas (all L. A. Burry); Lantana (F. Lyman); Daytona Beach (G. Quelch); Cutler Point (R. Humes); Lake Worth; Lower Matecumbe Key; Plantation Key; Conch Key (all B. R. Bales); St. Augustine; Cape Canaveral; West Palm Beach; Fort Lauderdale; Miami Beach; Key Largo; Key West; Cedar Keys; Pensacola (all MCZ); Sanibel Id. (S. L. Porter); Panama City (A. B. Koto). TEXAS: Galveston (MCZ); Port O'Connor (Charleston Museum). BAHAMAS: North Bimini Id., Bimini Ids. (MCZ). CUBA: Varadero, Matanzas (C. J. Finley); off Cayo Conuco, Caibarién (R. Humes); Punta de la Sabanilla, Cienfuegos (MCZ). HISPANIOLA: Monte Cristi; Puerto Plata; Santa Bárbara de Samaná; Jérémie (all MCZ). JAMAICA: (MCZ). VIRGIN ISLANDS: Tortola (M. W. Dewey); St. John; St. Thomas (both MCZ). LESSER ANTILLES: Antigua (M. L. Howland); Guadaloupe (MCZ); Soldado Rock, Trinidad (H. G. Kugler). MEXICO: Veracruz; Isla del Carmen, Campeche (both M. E. Bourgeois). NICARAGUA: Waunta Haulover (W. H. Fluck). VENEZUELA: Cubagua Id. (MCZ).

***Thais haemastoma haysae* Clench, Plate 38, fig. 1-3**

Thais floridana haysae Clench 1927, *Nautilus* 41, p. 6; 1930, *Nautilus* 44, p. 68, pl. 2, fig. 11 (Grand Bayou, Mississippi delta, Louisiana).

Thais haemastoma 'Linné' Burkenroad 1931, *Ecology* 12, pp. 656-664, fig. 1.

Description. Adult shell reaching about 105 mm. in length ($4\frac{1}{2}$ inches), solid and possessing a double row of strong nodules at the shoulder. Whorls 7 to 8, convex, the last whorl strongly angled. Color dull gray with occasional specimens showing an irregular mottling of a darker color which may be in a spiral or axial pattern. Interior of aperture a light brownish to pinkish orange. Aperture sub-ovate to sub-oval. The outer lip moderately thickened and generally strongly crenulated; the crenulations generally run well

back within the aperture. Inner or parietal lip glazed, smooth and thickened by the callosity. At its upper margin there is a strong ridge which runs back within the aperture. Occasional specimens will have a few faint plicae on the base of the columella. Umbilicus generally closed, occasionally very slightly rimate. Columella nearly straight and moderately thickened. Siphonal canal oblique and short. Previous growth stages of the canal leave behind a small ridge which surrounds the umbilical area. Anal canal short and margined within by a narrow ridge on the parietal wall. There is a small to pronounced subsutural depression generally present on the outer whorl. Spire moderately to well extended, occasionally equaling the length of the aperture. Suture usually indented. Sculpture generally quite constant, consisting of numerous, rather coarse, spiral incised lines with two rows of very large nodules in spiral arrangement at the whorl shoulder. Young specimens under 5 or 6 whorls show only traces of tubercles. Periostracum deciduous and rarely present.

	length	width	aperture	
(large)	90	50	51×22 mm.	Holotype
(large)	103	53	56×21	Grand Bayou, Louisiana
(average)	80	42	44×18	25 miles south of Port Arthur, Texas

Types. Holotype, Museum of Comparative Zoölogy no. 52203, Grand Bayou, Mississippi delta, Louisiana. M. L. Hays collector, 1926.



Photographs by F. P. Orchard

Plate 38. *Thais haemastoma haysae* Clench. Fig. 1. Grand Bayou, Louisiana (Holotype). Fig. 2. Bastian Bay, Louisiana. Fig. 3. Horn Island, Louisiana. (All natural size.)

Common name. Hays' Rock Shell; Louisiana Conch; Louisiana Drill.

Remarks. This subspecies, in common with other members of the *haemastoma* complex, possesses specimens that are rather difficult to separate under a given name. In general, however, *haysae* appears to be a well marked subspecies. Specimens occur that are much larger than *floridana*, the subspecies with which it is most closely allied. In addition, it is differentiated by the two large rows of nodules, much coarser spiral, incised lines and the deeply channeled suture.

M. D. Burkenroad (*l.c.* above) in an able report has given considerable data on the biology of this subspecies. It is a serious pest, destroying large numbers of oysters in Louisiana waters and elsewhere along the northern Gulf Coast. The eggs are imbedded in a gelatinous matrix and enclosed in horny capsules about 10 mm. in length. Each capsule contains about 100 eggs; each female is capable of producing more than 100 capsules. The larvae are liberated as veligers and escape from the capsule after the small cap has been broken open. In this free swimming stage they are widely dispersed by currents over new territory. This is in direct contrast to the condition existing in *T. lapillus*; here the veliger or free swimming stage must be passed over very rapidly while the young are in the capsule, as these emerge as minute snails with the shells well formed.

Range. Gulf of Mexico from Florida west to Texas and possibly along the northern Mexican coast.

Records. FLORIDA: Pensacola (L. A. Burry). LOUISIANA: Grand Bayou, Bastian Bay; Horn Island (all MCZ). TEXAS: 25 miles south of Port Arthur; 10 miles S.W. of Sabine; Carancahua Bay, Calhoun Co. (all MCZ).

Thais (Stramonita) rustica Lamarck, Plate 39, fig. 4-6, 8, 10

Thais undata of authors, not of Lamarck 1822.

Purpura rustica Lamarck 1822, Animaux sans Vertèbres 7, p. 246 (locality unknown). [Kiener has figured these specimens of Lamarck under *Purpura undata* (1836, Icon. Coquilles Vivantes 8, pl. 34, fig. 81c)].

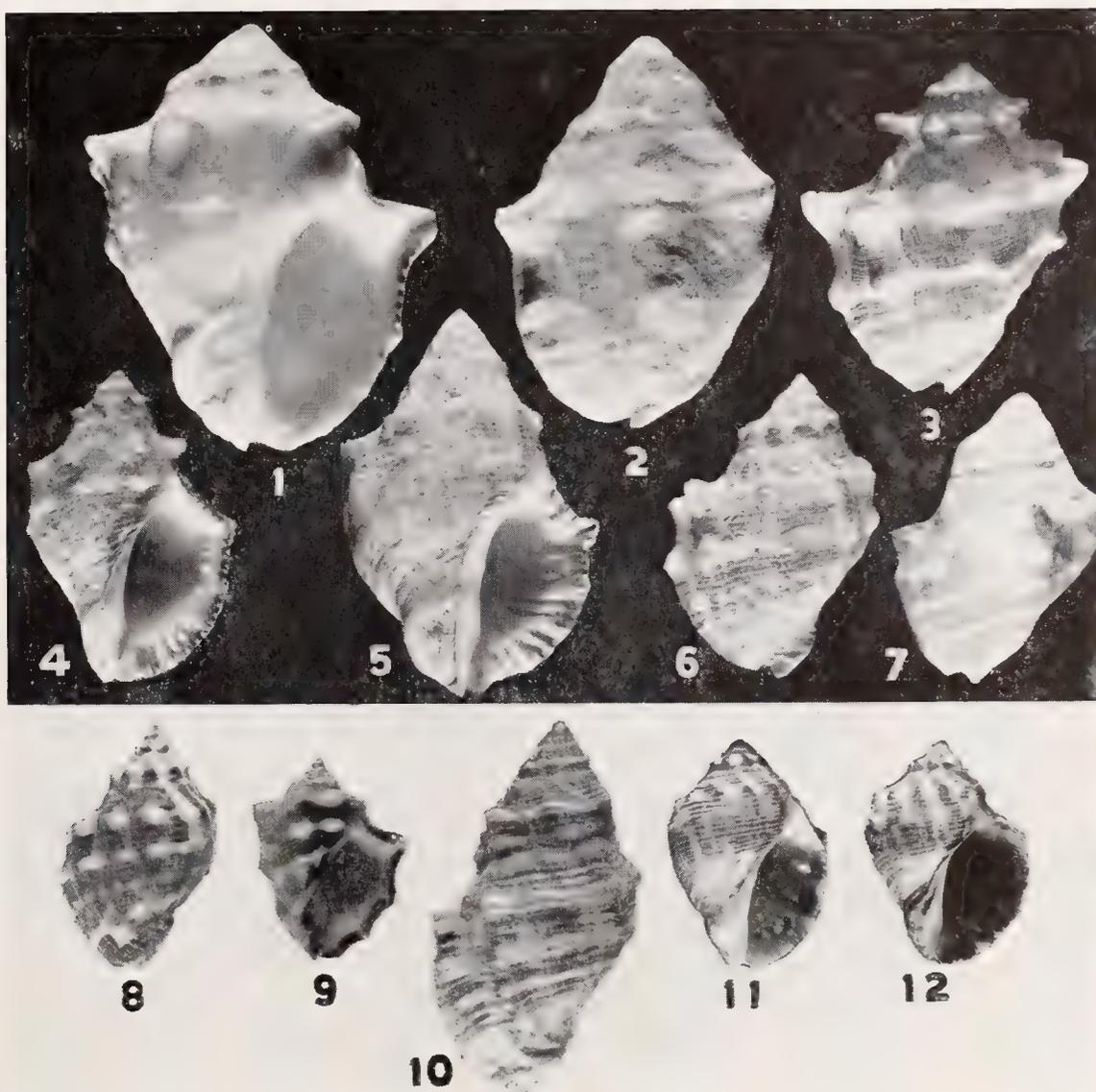
Purpura bicostalis 'Lamarck' de St. Vincent 1827, Tableau Encyclopédique et Méthodique 3, pl. 398, fig. 5 a-b (locality not given).

Purpura kienerii Deshayes 1844, Animaux sans Vertèbres ed. 2. 10, p. 64, 101 (Martinique). [Based on the figures of *P. bitubercularis* Kiener, non Lamarck (Kiener 1836, Icon. Coquilles Vivantes 8, pl. 11, fig. 32)].

Purpura fasciata Reeve 1846, Conchologia Iconica 3, **Purpura**, species no. 45, pl. 9 (locality unknown); non *P. fasciata* Dunker 1857.

Description. Adult shell reaching about 50 mm. (2 inches) in length, solid and generally sculptured. Whorls five to six, slightly convex and angled at the shoulder. Color a dirty gray to a dull mottled brown, particularly in old specimens. Young specimens are mottled dark chocolate brown and cream with occasional specimens showing reddish, particularly on the nodules and along the spiral line of their development. Interior of aperture white, but generally margined with dark brown along the outer lip. The dark coloration generally confined to the ends of the small ridges and these usually grouped into bands. This is particularly pronounced in young specimens before the thicker white overlay limits this color to near the margin. Parietal wall usually glazed and showing fine threads of color in spiral pattern. Aperture sub-ovate to sub-oval. Outer lip moder-

ately thickened and generally strongly crenulated, the crenulations formed by the ends of the low, small ridges which generally run back well into the aperture. In addition to the marginal ridges there is usually a second series below. These lower ridges are few in number and generally white in color and are usually stronger than the marginal series. Rarely these secondary ridges form little knobs on their outer extremities. Inner lip glazed and smooth. At its upper margin there is a strong ridge, the anal ridge, which runs back into the aperture. This is opposite the small and relatively inconspicuous anal canal. Some specimens have a few faint plicae on the base of the columella. Umbilicus closed. Columella nearly straight and moderately thickened. Siphonal canal oblique and short. Previous growth stages of the canal leave behind a small ridge which surrounds the umbilical area. Anal canal short and inconspicuous. There is a small subsutural depression occasionally present on the outer whorl. Spire generally extended. Suture fine and irregular and usually difficult to observe, particularly in older specimens. Sculpture varia-



Photographs by F. P. Orchard

Plate 39. *Thais deltoidea* Lamarck. Fig. 1. Channel Rocks, Miami, Florida. Fig. 2-3. Eight Mile Rock, Grand Bahama Island, Bahamas. Fig. 9. Arthurs-town, Cat Island, Bahamas. *Thais rustica* Lamarck. Fig. 4 and 6. Guana Island, Tortola, Virgin Islands. Fig. 5. Puerto Plata, Santo Domingo. Fig. 8. Gambia, New Providence, Bahamas. Fig. 10. Monte Cristi, Santo Domingo. *Thais rustica bicarinata* de Blainville, Fig. 7, 11 and 12. Ascension Island, South Atlantic Ocean. (All natural size.)

ble but generally with one or more rows of rather well developed nodules on the shoulder and mid area of the whorl. In addition there are many small spiral threads. Axial sculpture consisting of very fine growth lines. Periostracum deciduous and rarely present.

	length	width	aperture	
(large)	48	37	27.5 × 11 mm.	Puerto Plata, Hispaniola
(average)	34	19	21.5 × 9.5	Key West, Florida

Types. Lamarck's types were figured by Kiener 1836, Icon. Coquilles Vivantes 8, pl. 34, fig. 81c. As the locality was unknown to Lamarck we here limit the type locality to Puerto Plata, Hispaniola.

Common name. The Rustic Rock Shell.

Remarks. This species has long been known under the name of *T. undata* Lamarck. However, a re-examination of the monographs of both de Blainville and Kiener who have figured specimens from Lamarck's collection, indicates that Lamarck's *undata* is an Indo-Pacific species and not a member of our Western Atlantic fauna.

Thais rustica is a well defined species though closely related to the *T. haemastoma* complex. It differs from *T. haemastoma* by having the mouth of the aperture white, not yellow or orange, and by possessing, with few exceptions, a secondary series of ridges within the aperture. It is more nodulose and generally a smaller shell.

This species occurs on the rocks exposed to the open sea. It is intertidal and though not rare it never occurs in any great numbers. It produces a small amount of purple dye.

Range. Southern Florida, the West Indies and south to Brasil.

Records. FLORIDA: Palm Beach; Soldiers Key, Miami; Key West (all MCZ); Hillsboro Reef; Looe Key (both L. A. Burry); Boca Chica Bay (B. R. Bales); Miami (R. Humes); Boca Raton (P. P. McGinty); Tortugas (J. Miller); Missouri Key (A. B. Koto). BERMUDA: Hamilton; Coney Id. (both MCZ). BAHAMA ISLANDS: West End, Grand Bahama Id.; Bimini Ids.; East Point, New Providence; Savannah Sound, Eleuthera; Millerton, Long Island; Arthurstown, Cat Id.; Abraham's Bay, Mariguana; Mathewtown, Great Inagua (all MCZ). CUBA: Habana (MCZ); Kawama Beach, Matanzas (C. J. Finley); Cayo Francés Caibarién (P. J. Bermúdez); Levisa Bay, Mayarí (A. Queñones). Guantánamo Naval Base; Punta de los Colorados, Cienfuegos (both MCZ). HISPANIOLA: Cap Haitien (W. J. Eyerdam); Monte Cristi; Puerto Plata; Santa Bárbara de Samaná; Jérémie (all MCZ). JAMAICA: Port Antonio; mouth of Dunn's River (both MCZ). MONA ISLAND: (H. A. Beatty). PUERTO RICO: Miramar, San Juan (MCZ). VIRGIN ISLANDS: Tortola; Virgin Gorda (both M. W. Dewey); Saint Thomas (MCZ). LESSER ANTILLES: Dominica (Yale Univ.); Antigua; St. Pierre, Martinique; Barbados; Toco and Salybia, Trinidad (all MCZ). CARIBBEAN ISLANDS: Navassa Id. (MCZ). PANAMA: Colón (MCZ); Isla de Pinos, San Blas (J. Zetek). COLOMBIA: Santa Marta; Cartagena (both MCZ). BRASIL: Natal (MCZ); Praia do Chega Negro, Bahía (M. de Oliveira).

Thais rustica bicarinata de Blainville, Plate 39, fig. 7, 11-12

Purpura bicarinata de Blainville 1832, Nouvelles Annales du Muséum d'Histoire Naturelle (Paris) (3) 1, p.

215 (St. Helena) [See also under *P. helena* Quoy and Gaimard]; Lamy 1918, Bull. Muséum d'Histoire Naturelle **24**, p. 354.

Purpura helena Quoy and Gaimard 1833, Voyage L'Astrolabe **2**, p. 573, pl. 39, fig. 7-10 (St. Helena). [According to Fischer-Piette and Beigbeder 1943, p. 429 and 430, the type specimens of this species were also the type specimens selected by de Blainville for his *P. bicarinata*].

Purpura undata 'Lamarck' Kiener 1836, Icon. Coquilles Vivantes **8**, p. 116, pl. 34, fig. 81 a-b [not fig. 81] (The South Seas [South Atlantic?] and St. Helena). [Figures 81 a-b are those collected by Quoy and Gaimard and described by deBlainville as *P. bicarinata*].

Purpura fasciata minor Hidalgo 1893, Mem. Real Academia Ciencias, Madrid **19**, p. 336; *non minor* Jeffreys 1867. [Hidalgo refers only to Kiener's figures (Icon. Coquilles Vivantes **8**, pl. 34, fig. 81 a-b, 1836); see notes under *Purpura undata* 'Lamarck' Kiener above]. Hidalgo's records of Bahía and Pernambuco, Brasil no doubt refer to specimens of *Thais rustica* Lamarck.

Description. Adult shell reaching about 33 mm. (1¼ inches) in length, solid and with five to six sculptured whorls, convex and angled at the shoulder. Color a dirty gray to dull mottled brown. In young specimens the color is more pronounced. Interior of aperture white with brownish color marks showing near the margin. Parietal wall glazed. Aperture ovate. Outer lip thickened and finely crenulated. Within there are four low ridges which may be discontinuous, their outer ends terminating in nodules. Sculpture consisting of two or more spiral ridges on which there are numerous nodules in young specimens. In adult specimens these nodules become much fewer and much larger.

	length	width	aperture	
(large)	33	21	20 × 9.5 mm.	Ascension Id., South Atlantic
(young)	24	16.5	18.5 × 9	Ascension Id., South Atlantic

Types. The type specimens of *bicarinata* de Blainville, *helena* Quoy and Gaimard, and *undata* 'Lamarck' Kiener are in the Paris Museum. The type locality is the Island of St. Helena in the South Atlantic [see notes after these names in the synonymy].

Common name. St. Helena Rock Shell.

Remarks. This subspecies is close in most of its characters to the typical form. It differs in possessing much stronger nodules, being broader in proportion to its length, and in having the apertural ridges more strongly developed.

Range and Records. Known only from the islands of St. Helena and Ascension in the South Atlantic. We are indebted to Mr. A. H. Patterson for specimens from Ascension Island.

Subgenus *Mancinella* Link

Mancinella Link 1807, Beschreibung der Naturalien-Sammlung zu Universität zu Rostock, p. 115.

Thalessa H. and A. Adams 1853, Genera of Recent Mollusca, London **1**, p. 127.

Subgenotype, *Murex mancinella* of authors, not of Linné or Gmelin = *Purpura gemmulata* Lamarck (subsequent designation, Iredale 1915). See E. A. Smith 1913, Proc. Malac. Society, London **10**, pp. 287-289.

Shells are moderate in size, generally strong and solid usually strongly nodulose with most species having a rather short spire. Anal canal rather short and sometimes hardly indicated at all. Anal ridge small and relatively inconspicuous.

Thais (Mancinella) deltoidea Lamarck, Plate 39, fig. 1-3, 9

Purpura deltoidea Lamarck 1822, Animaux sans Vertèbres 7, p. 247 (locality unknown); Kiener 1836, Icon. Coquilles Vivantes 8, p. 54, pl. 13, fig. 37 (Seas of Martinique); Deshayes and Edwards 1844, Animaux sans Vertèbres (2) 10, p. 85.

Purpura subdeltoidea de Blainville 1832, Nouvelles Annales du Muséum d'Histoire Naturelle (2) 1, p. 214, pl. 9, fig. 11 (Martinique).

Purpura albocinta Küster 1860, Conchy.-Cab. (2) 3, pt. 1a, p. 180, pl. 30, fig. 8-9 (locality unknown).

Purpura trapa 'Röding' Guppy 1877, Proc. Scientific Association of Trinidad 2, p. 144; *non* Röding 1798.

Description. Shell 30 to 50 mm. (about 1 to 2 inches) in length, heavy, solid and coarsely nodulous. Whorls convex, 6 to 8. Color generally grayish white, irregularly mottled with dull brown to black in young specimens and occasionally with dark purple to black color patches near outer lip on old specimens. Parietal wall tinted with lavender to rose. Spire moderately extended, produced at an angle from 85° to 90°. Suture indistinct. Aperture rather elongate and nearly semicircular, its interior a porcelaneous white. At the union of the outer lip and the parietal wall there is a moderately deep groove which corresponds to the anal notch. At this point, however, the outer lip is not cut back to form a sinus. Outer lip thickened within and its edge finely crenulated below the shoulder spine. Parietal lip reflected over the body whorl in the form of a broad callus, highly polished and colored irregularly with pink, salmon and brown. Siphonal canal short, but cut back deeply under the columella, its apex terminating in a ridge. This ridge follows back and disappears under the smooth parietal shield. Columella nearly straight and rounded, with a small but distinct ridge at the base which forms the margin of the siphonal canal, its upper end following back within the whorl as a small plication. Slightly above this ridge there are from 1 to 3 very indistinct teeth. Sculpture consisting of a series of large and blunt nodules at the shoulder of the whorl, occasionally producing a second row of nodules below the shoulder series. In young specimens a third row may be moderately developed. In addition to the nodules there are numerous and fine spiral incised lines each ending in one of the crenulations at the margin of the aperture. In old specimens these are obsolete except on the last half of the body whorl. No axial sculpture apparent. Periostracum absent. Operculum semicircular, corneous, rough, with strong axial growth lines, inner surface with a strong and thickened marginal callus, central scar area with small irregular ridges with the areas in between minutely scarred with incised lines.

	length	width	aperture	
(large)	51.5	39	35 × 14.5 mm.	Miami Beach, Florida
(average)	41	36.5	32 × 12	Eleuthera Id., Bahamas

Types. As Lamarck did not figure a specimen with his original description we here select as typical illustrations the two figures of Kiener which may possibly have been based upon Lamarck's material. Martinique, Lesser Antilles is here selected as the type locality.

Common name. The Deltoid Rock Shell.

Remarks. This is an abundant species, occurring throughout the West Indian region. It lives on rocky shores in both exposed and partially protected places though it seems to prefer situations where a fair amount of surf occurs. It can grip the rocks with considerable strength and it takes quite a pull to dislodge them.

Variation in the shell characters is considerable and young specimens appear to be very different from adults, particularly in their coloration and fine, distinct sculpture. Mature specimens, especially those found in exposed situations, are usually worn smooth except the large nodules and the color is usually an ashen gray while young examples obtained in more sheltered spots are darker in color, almost black, with the nodules tipped with dark red or rose. In addition this species appears to be particularly susceptible to the lodgment of coralline algae.

This species is not closely related to any other in the Western Atlantic though it is fairly close to *T. crassa* de Blainville of the Panamic province of the Eastern Pacific region.

Range. Jupiter Inlet, Florida, Bermuda, the Bahamas and south through the West Indies to Brasil.

Records. FLORIDA: St. Lucie Inlet (J. M. Cannon); Lake Worth (L. A. Burry); Boynton Beach (P. McGinty); Pompano (MCZ); Channel Rocks, Biscayne Bay (Ralph Humes); Molasses Reef, Key Largo (L. A. Burry); Lower Matecumbe Key; Pelican Shoals (both B. R. Bales); Key West (A. B. Koto); Tortugas (MCZ). BERMUDA: (Yale Univ.; MCZ). BAHAMAS: Eight Mile Rock, Grand Bahama Id.; Joe Cays, Little Abaco Id.; Sweetings Village, Great Abaco; Cat Cay, Bimini Ids.; Gambia, New Providence; Governors Harbour, Eleuthera Id.; Arthurstown, Cat Id.; Cape St. Maria, Long Id.; Watlings Id.; Fortune Id.; Matthewtown, Great Inagua (all MCZ); Cay Sal Bank (R. Humes). CUBA: Habana (MCZ); Punta Sabanilla, Matanzas; Cayo Francés, Caibarién (both P. J. Bermúdez); Cayo Santa Maria, Camagüey (R. Humes); Guantánamo Naval Base; Castillo de Jagua, Cienfuegos (both MCZ). HISPANIOLA: Gonave Id.; Miragoane; Cap Haitien (all W. J. Eyerdam); Monte Cristi; Puerto Plata; Santa Bárbara de Samaná (all MCZ). PUERTO RICO: San Juan (MCZ). VIRGIN ISLANDS: Guana Id., Tortola; Virgin Gorda (both M. W. Dewey); St. Thomas (MCZ). JAMAICA: Montego Bay (MCZ). LESSER ANTILLES: St. Lucia (Charleston Museum); Dominica (Yale Univ.); Guadaloupe; Barbados (both MCZ); Grenada (H. G. Kugler). CARIBBEAN ISLANDS: Roatan Id. (MCZ). MEXICO: Isla Mujeres, Yucatan (C. G. Aguayo). PANAMA: Colón (MCZ); Porto Bello (J. Zetek). BRASIL: Porto Seguro (MCZ); Praia de Chega Negro, Cidade de Bahía and Manguinhos, Ilha de Itaparica, Estado de Bahía (both Paulo de Oliveira).

Subgenus *Polytropa* Swainson

Nucella of authors, not of Röding 1798.

Polytropa Swainson 1840, A Treatise on Malacology, London, pp. 81 and 305.

Polytropicalicus Rovereto 1899, Atti Soc. Ligustica **10**, p. 105, new name for *Polytropa* Swainson non De-france 1826. [De-france instituted the name *Polytropes*. Under our present rules this name is not a homonym of *Polytropa* Swainson as stated by Rovereto and therefore this latter name is valid].

Subgenotype, *Buccinum lapillus* Linné (subsequent designation, J. E. Gray 1847).

The shells generally possess a sculpture of spiral ridges which may be crossed by axial imbrications or foliations. Anal canal generally not indicated though occasionally specimens show a slight groove within the aperture at its upper end. Siphonal canal moderately long, oblique, with the previous growth stages leaving behind a rather strongly developed umbilical ridge. Umbilical area depressed and may possess a small rimation.

Röding introduced the name *Nucella* listing several species, one of these being *Nucella lapillus* Röding. Iredale subsequently (1915) made this species the genotype of *Nucella* assuming that this was the species of Linné and Lamarck. Unfortunately this is not so. Röding refers his *Nucella lapillus* to *Buccinum rusticum* Gmelin and in addition gives a reference to Martini 1777, Conchy.-Cab. (1) 3, plate 120, fig. 1104–1105. As this reference is included also by Gmelin, these are here selected to be the type figures. They do not refer to any species of *Thais* as now understood but probably to a true buccinoid, some member of the genus *Cantharus*, possibly *undosa* Linné.

However, if the above statement is not accepted, it can be ruled that Iredale's type designation of 1915 was invalid as his type reference was to *Thais* [*Purpura*] *lapillus* Lamarck 1803, a name published five years after Röding's genus *Nucella* was introduced. The next type designation was that of Winckworth (1945, p. 141) who gives *N. theobroma* Röding = *Buccinum lapillus* Linné. Winckworth was in error, however, in giving credit to Dall for this type designation as Dall did not use the word "type" nor did he use the name *theobroma* Röding. I cannot, however, accept Winckworth's statement that *N. theobroma* Röding = *Buccinum lapillus* Linné. Röding refers his *theobroma* to *Buccinum filosum* Gmelin, and they both in turn refer to Martini 1777, Conchy.-Cab. (1) 3, pl. 121, figures 1113–1114, figures which appear to me to be unrecognizable. On the same plate in Martini (121) there are two excellent figures of *Buccinum lapillus* (fig. 1111, 1112) which Röding renamed *Nassa rudis* with a reference to *Buccinum lapillus* Gmelin. It is clear that Röding did not intend the species which is now commonly known as *Thais lapillus* to be included in his subgenus *Nucella*. This latter name should be either abandoned or else associated with *Cantharus* as indicated above.

Polytropa in all probability should be raised to a full genus. Though differences in shell characters appear to be somewhat minor, dissimilarity in operculum characters is evident as between *Polytropa* and the other species of *Thais* that we have examined. In this respect mention may be made of the ovate growth ridges and the lack of very fine sculpture as characteristic of *Polytropa*. Also, as mentioned in the introduction to this report, young *T. lapillus* Linné emerging as shelled snails from the egg capsule, differ quite sharply from the shell-less veligers of *T. haemastoma haysae* Clench in the subgenus *Stramonita*. However, far more knowledge of the biology for most of the species is needed before any significant conclusions can be drawn.

Thais (Polytropa) lapillus Linné, Plate 40, fig. 1–8

Buccinum lapillus Linné 1758, Systema Naturae ed. 10, p. 739 (European Ocean) [Among several references Linné gives Lister's *Historiae Animalium Angliae*, London, 1678, pl. 3, fig. 5–6]; *non Nucella lapillus* Röding 1798.

Nassa rudis Röding 1798, Museum Boltenianum (2) p. 132 [Refers to Gmelin 1790, Systema Naturae, ed. 13, p. 3484 (*Buccinum lapillus* Linné), and to Martini 1777, Conchy.-Cab. (1) 3, pl. 121, fig. 1111–1112].

Purpura imbricata Lamarck 1822, Animaux sans Vertèbres 7, p. 244 (Seas of Europe).

Purpura bizonalis Lamarck 1822, Animaux sans Vertèbres 7, p. 249 (locality unknown).

Purpura filosa Menke 1830, Synopsis Methodica Molluscorum, Pymont, p. 62 [Refers to *Buccinum filosum* Gmelin].

Purpura buccinoidea de Blainville 1829, Faune Française p. 148.

Purpura rugosa 'Lamarck' Kiener 1836, Icon. Coquilles Vivantes 8, p. 103, pl. 29, fig. 77a; *non P. rugosa* Lamarck 1822; Quoy and Gaimard 1833.

Purpura lapillus Linné varieties *major* and *minor* both of Jeffreys 1867, British Conchology 4, p. 277; *non minor* Hidalgo 1893.

Purpura lapillus Linné var. *ponderosa* Verkrüzen 1881, Jahrb. Deut. Malakozoologischen Gesell. 8, p. 95 (Notre Dame Bay, Newfoundland).

Purpura celtica Locard 1886, Prodrôme de Malacologie Française, p. 147 (several localities along the Atlantic coast of France) [Locard based his *celtica* on the same figure which Kiener had given for *P. rugosa* 'Lamarck.' The original *rugosa* of Lamarck is a species from New Zealand, and only superficially like *T. lapillus* or any of its several forms. Kiener apparently had selected a strongly spirally sculptured specimen of *lapillus* which he figured as *rugosa* 'Lamarck'].

Purpura lapillus Linné, varieties *crassissima*, *lactea*, *aurantia*, *castanea*, *lineolata*, *fauce-violaceo* all of Dautzenberg 1887, Bull. Soc. d'études scientifiques de Paris 9, pt. 2, p. 24.

Purpura lapillus Linné varieties *citrina*, *caerulescens*, *monozonalis*, *mixta* all of Dautzenberg 1920, Journal de Conchyliologie 65, p. 47.

Purpura lapillus fusco-apicata Dautzenberg and Fischer 1925, Travaux Station Biologique Roscoff, Part 3, p. 44.

Several fossil forms of *Thais lapillus* Linné are considered by F. W. Harmer in The Pliocene Mollusca of Great Britain 1, pp. 117 (1914) and 334 (1918), Palaeontographical Society, London. Many references are given to earlier works on this subject.

Description. Adult shell reaching about 40 mm. (1½ inches) in length in the Western Atlantic, and 65 mm. (2½ inches) in the Eastern Atlantic solid, occasionally smooth but generally sculptured. Whorls five, rather convex. Color a dull yellowish white with variations of yellow, orange or brown, diffused or in the form of bands on a white background. Aperture elliptical and colored white to brown. Outer lip generally smooth, rather thick and occasionally crenulated. Occasionally there are a few small, short ridges within the aperture that appear in one or more axial rows. Inner or parietal lip glazed, usually with a well defined callus. Anal canal hardly defined, siphonal canal rather narrow and slightly oblique, the older shell growth extending backward as a basal ridge. Suture moderately impressed and poorly defined. Columella arched and slightly angled at the beginning of the siphonal canal. Sculpture exceedingly variable, sometimes smooth but generally with numerous rounded spiral ridges. Frequently specimens exhibit a series of imbricated scales which are arranged in an axial pattern. These may appear over the entire surface of the shell or only over certain portions. Operculum small and thin. Periostracum absent.

Both the description and measurements for this species have been based upon material from the Western Atlantic. Certain European specimens are much larger than anything known to occur on our coast, and there is in addition a much wider range in form and sculpture.

	length	width	aperture	
(large)	40	22	28 × 12 mm.	Digby, Nova Scotia
(average)	36	21.5	22 × 10.5	Port Clyde, Knox County, Maine
(average)	27	17.5	20 × 8.5	Kennebunkport, Maine

Types. The type figure, here selected, is plate 3, fig. 5 in Lister's *Historiae Animalium Angliae*, London, 1678. If Linné's types are not in existence, a neoholotype should be chosen from some locality in southern England that approximates this figure in Lister.

Common names. Dog Whelk; Dog Periwinkle; Common Whelk.

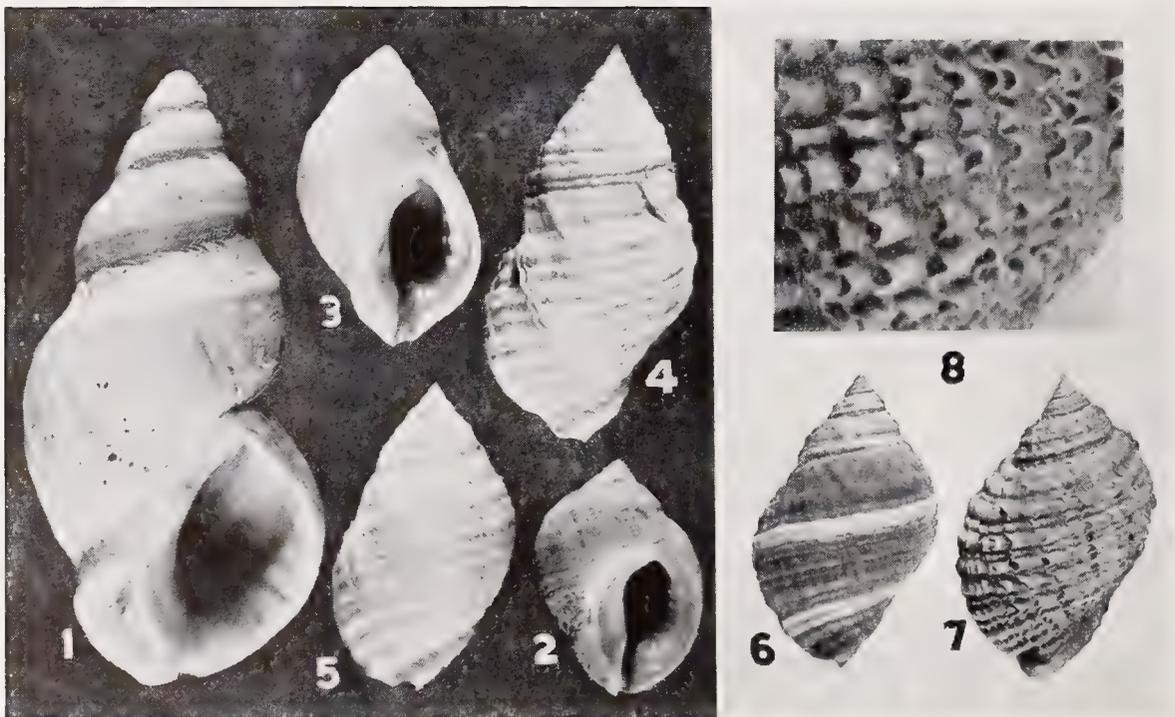
Remarks. I have made no attempt to complete the list of synonyms or accepted subspecies of all of the European forms in this variable species. Variation of this species in

European waters appears to be far more extensive than that existing anywhere along our Atlantic shores. Reference should be made to A. H. Cooke (1895, p. 91, fig. 35) where 19 figures are given, showing the many types of variation that are exhibited by this species. On our plate 40, fig. 1-2 are two extreme forms from England.

It is considered here that *T. imbricata* Lamarck is an absolute synonym of *T. lapillus* Linné. This is a name generally employed for specimens of *lapillus* that possess imbrications. These imbricated forms intergrade completely with the smooth forms of this species and many examples exist that possess both smooth and imbricated areas on the same specimen. From our own field observations it would appear that the imbricated specimens develop in protected areas. A protected spot can exist even on an exposed rocky coast. When this species is exposed at low tide it becomes quiescent, generally remaining fixed until the return of the tide. New shell growth is made when the animal is submerged and such a delicate structure as a thin scale or blade of shell material would be difficult and perhaps impossible to construct in water severely agitated.

Colton (1916, p. 453) claims that the various color patterns are hereditary and that natural selection has played an important part in their survival. That is, light colored forms are more numerous on the barnacle-covered (light colored) rocks and that the dark colored forms are more numerous on the darker colored rocks where *Mytilus* occurs. The data he submits on the imbricated forms to show that they are non-environmental, are anything but conclusive. The same can be said of the facts given in a later paper by Colton (1922, pp. 146-157) in which the evidence can certainly be interpreted as favoring environmental causes.

Moore (1936, p. 79) on the other hand presents considerable evidence that certain coloration is due to food; that is, *T. lapillus* feeding on *Mytilus* are dark colored while



Photographs by F. P. Orchard

Plate 40. *Thais lapillus* Linné. Fig. 1. Cornwall, England. Fig. 2. Teignmouth, England. Fig. 3. Kennebunkport, Maine. Fig. 4. Cushing, Maine. Fig. 5. Fishers Island off Stonington, Connecticut. Fig. 6. Casco Bay, Maine. Fig. 7-8. Grand Manan, New Brunswick. (Fig. 1-7, natural size; Fig. 8, 4 \times .)

those feeding on *Balanus* are white. When *Mytilus*-fed *Thais* were transferred to a diet of *Balanus*, a pigmentation change took place in the shells and when put back on a *Mytilus* diet the dark coloration reappeared. The orange pigmentation, however, did not seem to be influenced by diet. Moore (p. 83) also found that imbricated forms occurred mainly below low water mark which would again bear out our own contention that these forms are produced when there is protection from physical forces of the environment. In the same paper Moore reports that large examples of *T. lapillus* reach 63 mm. in length in England, though these giant forms exist mainly in the sub-littoral zone. We possess a single example from Cornwall, England that measures 65 mm. in length. *T. lapillus* is known to occur in depths as low as 10 fathoms. Additional biological data on *T. lapillus* is given by Moore in his 1936 paper and again in 1938 (see bibliography).

According to A. Labbé (1926, Bull. Biologique de France et Belgique 60, pp. 30-41, 2 text figures) shelled embryos of *T. lapillus* are imbricated in the egg capsule and retain or lose these imbrications after their escape from the capsule. That is, the development of imbrications is a normal condition for this species, and this sculpture is continuously developed only when the specimens occupy a protected situation after they have left the egg capsule.

Range. WESTERN ATLANTIC: Jacobshaven, eastern Greenland and southern Labrador south to central Connecticut and the eastern end of Long Island, New York. EASTERN ATLANTIC: Mathew Strait, Novaya Zemlya south to Villanova de Portimao, Algarve, Portugal.

The distribution of this species has been very carefully studied by A. H. Cooke (1915, pp. 192-209) who cites numerous localities in both Eastern and Western Atlantic waters and includes an extensive bibliography.

All records for *T. lapillus* in the Pacific from both the northern Asiatic and North American coasts are referable to other, though closely allied, species of *Thais*.

Records. NEWFOUNDLAND: Fogo Id.; mouth of Serpentine River, Bay of Islands. PRINCE EDWARD ISLAND: Carleton Head. NOVA SCOTIA: Digby; Halifax; Harborville; Mitchell Bay; South Joggins; White Island; Bird Island. NEW BRUNSWICK: Grand Harbor, Grand Manan. MAINE: Eastport; Jonesport; Seal Harbor, Mt. Desert Id.; Castine; Isle au Haut; Rockland; Tenants Harbor; Bremen; Brunswick; Portland; Biddeford Pool; Kennebunkport; Kittery. NEW HAMPSHIRE: Hampton Beach. MASSACHUSETTS: Plum Island; Rockport; Gloucester; Beverly Farms; Salem; Swampscott; Nahant; Castle Island and Squantum, Boston Harbor; Nantasket; Cohasset; Scituate; Duxbury; Plymouth; Provincetown; Falmouth. RHODE ISLAND: Newport; Newcastle; Quonochontaug. CONNECTICUT: Napa Tree Pt., New London County. NEW YORK: Fishers Island (all of the above localities are based on the collections in the MCZ); Orient and Montauk Point, Long Island (both R. Latham).

Notes

The following notes are based on names that have been referred to *Thais* and *Purpura* of the Western Atlantic that were misidentified or are now known to be in other genera. Of course, this list is not complete, but it does include most of the names that had to be considered for our studies on the Western Atlantic mollusks.

Coralliophila abbreviata Lamarck

Purula abbreviata Lamarck 1822, Animaux sans Vertèbres **7**, p. 146 (locality unknown).

This species has been referred to *Purpura* frequently. It is, however, in the genus *Coralliophila* in the family Magilidae. This same species has been called "*Purpura galea* Chemnitz," a name now considered invalid.

Tritonalia aberrans C. B. Adams

Purpura aberrans C. B. Adams 1850, Contributions to Conchology, New York, no. 4, p. 58 (Jamaica) [Holotype MCZ 177956].

Though described as a *Purpura* this species belongs in the genus *Tritonalia*.

Thais bitubercularis Lamarck

Purpura bitubercularis Lamarck 1822, Animaux sans Vertèbres **7**, p. 237 (locality unknown) [Lamarck refers to A. Seba 1758, Lecupletissimi Rerum Naturalium **3**, pl. 52, fig. 22-23]; H. de Blainville 1832, Nouvelles Annales du Muséum d'Histoire Naturelle (Paris) (3) **1**, p. 215 (Martinique); L. C. Kiener 1836, Icon. Coquilles Vivantes **8**, p. 49, pl. 11, fig. 32 (Martinique).

In a very large series of *Thais* at hand, there is nothing that closely approximates this species of Lamarck from the Western Atlantic. Both de Blainville and Kiener refer this species to Martinique, certainly in error. We possess specimens referable to *bitubercularis* from Bombay, India and from near Broome, Western Australia.

Thais (Mancinella) consul Gmelin

Murex consul Gmelin 1790, Systema Naturae 13 ed., **6**, p. 3540, no. 159 (Indian Ocean) [This name is based on Chemnitz 1788, Conchylien-Cabinet **10**, p. 160, fig. 1516-1517].

Purpura consul Gmelin, Lamarck 1822, Animaux sans Vertèbres **7**, p. 237 (Indian Ocean) [Based upon the same figure noted above in Chemnitz].

Purpura chocolatum Duclou 1832, Annales des Sciences Naturelles **26**, p. 108, pl. 2, fig. 7 (Peru).

It appears to me that *Thais consul* and *T. chocolata* are synonymous. The original figure of *consul* by Chemnitz is based upon a very old specimen. We have a few examples that approximate the figure of Chemnitz. The "chocolate" color is not always exhibited, many specimens being a rather dull gray.

Purpura dubia 'Stimpson' Kurtz

Purpura dubia 'Stimpson' Kurtz 1860, Catalogue of Recent Marine Shells Found on the Coasts of North and South Carolina, (Portland, Maine), p. 8 [nude name].

Buccinum filosum Gmelin

Buccinum filosum Gmelin 1790, Systema Naturae ed. 13, **1**, pt. 6 (locality unknown) [Refers to Martini 1777, Conchy.-Cab. (1), **3**, pl. 121, fig. 1113-1114].

This figure in Martini has been referred to as *Thais lapillus* Linné, but in my opinion it is unrecognizable.

Thais haemastoma forbesii *Dunker*

Purpura consul Reeve 1846, *Conchologia Iconica* **3**, *Purpura*, sp. 4, pl. 1 (Corregidor, Philippines); *non P. consul* Gmelin.

Purpura forbesii Dunker 1853, *Novitates Conchologicae*, Suppl. 2, p. 22, pl. 4, fig. 7-8, 13 (Loanda, Angola).

Reeve's figure is exactly similar to the large, spinose forms from the tropical West African coast. We have seen nothing similar to this form from the Indo-Pacific area.

Sistrum nodulosum *C. B. Adams*

Purpura nodulosa C. B. Adams 1845, *Proceedings of the Boston Society of Natural History* **2**, p. 2 (Jamaica) [Lectotype MCZ 177045].

Though described as a *Purpura* this species belongs to the genus *Sistrum*.

Purpura persica rudolphi *Lamarck*

Purpura rudolphi Lamarck 1822, *Animaux sans Vertèbres* **7**, p. 235 (East Indies); *non Buccinum rudolphi* Wood 1828 = *Purpura columellaris* Lamarck 1822 = *Haustrum dentex* Perry 1811.

Purpura inerma Reeve 1846, *Conchologia Iconica* **3**, *Purpura*, pl. 5, fig. 20 (locality unknown).

Dall (1893, p. 111) listed *inerma* Reeve as a variety of *haemastoma* Linné, but, in our opinion, it appears to be an absolute synonym of *rudolphi* Lamarck, a subspecies of *persica* from the Indo-Pacific region.

* * * *

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Book Reviews

Henderson, J. B. 1920: A Monograph of the East American Scaphopod Mollusks. Bulletin 111, United States National Museum, pp. vi-177, 20 plates. This is one of the best publications ever attempted on our Western Atlantic mollusks. Though limited in its scope to the class *Scaphopoda*, it presents the many genera and species in relatively complete form with clear descriptions, detailed locality records, excellent keys and with most of the species figured. In all, there are 110 species and subspecies considered, of which 50 are described as new. An excellent feature is that of a table which gives both geographic and bathymetric distribution. This enables one to determine quickly the number of species that are known to occur in a particular region, and, in most cases, the depth range at which any particular species has been dredged.

Material at Henderson's disposal was extensive and had been obtained through the years, mainly by the research vessels *Blake*, *Albatross*, *Fish Hawk*, and by his own yacht, the *Eolis*.

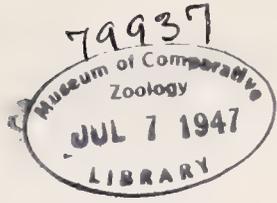
A history of the studies made on this group in the Western Atlantic is given along with notes on classification and geographic distribution.—W. J. CLENCH.

Johnson, Charles W. 1934: List of the Mollusca of the Atlantic Coast from Labrador to Texas. Proceedings of the Boston Society of Natural History 40, no. 1, pages 1-204. This is one of the important papers on the mollusks of the Atlantic coast. It is strictly a check-list, recording 2632 species, subspecies and varieties and their distribution. No descriptions, illustrations, or synonymies are given. This is the only published list covering the entire area from Labrador to Texas and to all depths of the ocean. It was published at a time when the nomenclature was in a confused state and it has been helpful in settling many problems in this field.

The faunal areas of the Atlantic coast and the bathymetrical zones of the sea are defined in the introduction. A brief but helpful account of the earlier workers in marine shells of the Atlantic coast is also given in the introduction, while at the end of the paper there is a 27 page bibliography of publications brought out since 1860.

Johnson was for many years Curator of Mollusks at the Boston Society of Natural History and it is in his honor that *Johnsonia* is named.—R. D. TURNER.

Johnson, Charles W. 1915: Fauna of New England, List of Mollusca: Occasional Papers of the Boston Society of Natural History 7, no. 13, pages 1-231. This check-list includes the land, fresh-water and marine mollusks of New England. For each species recorded the author gives a reference to the original description, selected references to other descriptions, and distribution data. There are no illustrations. Johnson regarded Gould and Binney's *Invertebrata of Massachusetts* as "the book on New England mollusca" and so made constant reference to it. In considering the distribution of the marine mollusks Johnson included the coast as far north as the Bay of Fundy, south to include Long Island Sound, and out to a depth of 200 fathoms. A map of this area is given in the introduction.—R. D. TURNER.



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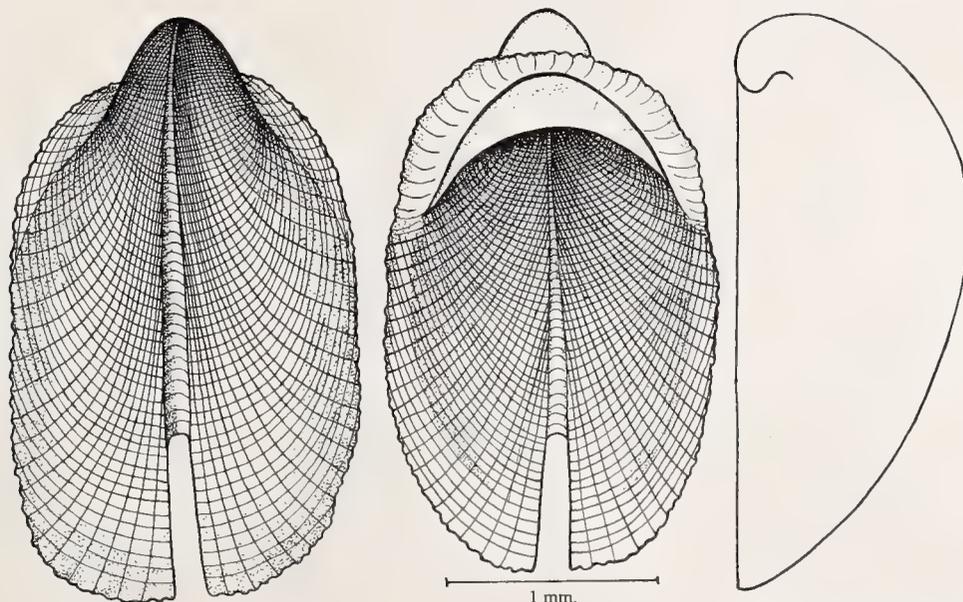
FISSURELLIDAE

VOL. 2, NO. 24

THE GENERA ZEIDORA, NESTA, EMARGINULA, RIMULA AND PUNCTURELLA IN THE WESTERN ATLANTIC

BY
 ISABEL PÉREZ FARFANTE

These genera belong to the same subfamily Emarginulinae. All possess an internal muscle scar with the ends incurved backwards, forming a hook on either side of the mid-line of the anterior slope. *Emarginula* and *Puncturella*, the two genera in which the soft anatomy is known, show similar types of crop and gill filaments. The several genera considered in this report form a remarkable series almost as though they represented progressive stages in the evolution of the family. *Zeidora*, *Nesta* and *Emarginula* have both the same type of fissure in the form of a deep slit, open in front, and a long anal fasciole. *Zeidora* is probably the most primitive. *Rimula* has the fissure closed in front and placed about at the middle of the anterior slope; in consequence the anal fasciole is much shorter. In the genus *Puncturella* there has been developed an internal septum at the fissure. Successive stages in the position of the fissure are expressed by the three subgenera in this genus. In the subgenus *Cranopsis*, which is nearest in its relationship to *Rimula*, some species have the fissure at about the middle of the anterior slope. In *Puncturella* s. s. the fissure has moved to the base of the apical whorls with



Drawing by R. D. Turner

Plate 41. *Zeidora bigelowi* Pérez Farfante.
 Bahía de Cochinos, Cuba. (Holotype.)

certain species still possessing a remnant of the anal fasciole. In the subgenus *Fissurisepta* the fissure is at the apex, causing the loss of the apical whorls.

Key to the genera and subgenera of Fissurellidae in the Western Atlantic

1. Shell with a conspicuous orifice or fissure at the apex, along the anterior slope, or forming a deep slit on the margin 2
 Shell with only a notch or a very small slit on the anterior margin *Hemitoma* *
2. Shell with the fissure forming a deep marginal slit 3
 Shell with the fissure not forming a marginal slit 5
3. Shell with the apex drawn backwards to the posterior end and placed immediately above the margin, at the margin, or below the margin 4
 Shell with the apex drawn backwards but placed higher on the shell *Emarginula*, p. 99
4. With a septum *Zeidora*, p. 95
 Without a septum *Nesta*, p. 97
5. Shell with an internal septum at the fissure 6
 Shell without an internal septum at the fissure 8
6. Apical whorls absent *Fissurisepta*, p. 144
 Apical whorls present 7
7. Anal fasciole long or moderately so, with a well marked groove from the fissure to the margin, showing both on the inside and on the outside *Cranopsis*, p. 118
 Anal fasciole absent or very short, with the groove from the fissure to the margin absent or only showing on the inside *Puncturella* s.s., p. 128
8. Shell with the fissure about at the middle of the anterior slope *Rimula*, p. 110
 Shell with the fissure at the summit or replacing the apex 9
9. Shell with the internal callus around the orifice the same width throughout 10
 Shell with the internal callus around the orifice truncated and sometimes excavated posteriorly 12
10. Margin of the shell entirely in one plane 11
 Shell with its two extremities raised so that when placed on a plane it rests on its sides *Clypidella*, **Johnsonia** 1, No. 10, p. 12
11. Margin very finely crenulated; sculpture consisting of radiating and practically smooth riblets *Fissurella* s.s., **Johnsonia** 1, No. 10, p. 2
 Margin strongly crenulated; sculpture consisting of strong radiating ribs which are nodulose or which have small scales *Cremides*, **Johnsonia** 1, No. 10, p. 3
12. Muscle impression circular. The mantle covering about one third of the outside of the shell or with narrow processes extending over the shell margin 13
 Muscle impression not circular but with the anterior ends incurved. Shell not covered by the mantle or by mantle processes at the margin *Diodora*, **Johnsonia** 1, No. 11
13. Internal margin of the shell thickened to form a callus *Lucapinella*, **Johnsonia** 1, No. 10, p. 18
 Internal margin of the shell not thickened *Lucapina*, **Johnsonia** 1, No. 10, p. 14

* To be published in a later number of Johnsonia.

Genus *Zeidora* A. Adams

Zeidora A. Adams 1860, Ann. Mag. Nat. Hist. (3) 5, p. 301; Pilsbry 1891, Man. of Conch. (1) 12, p. 246; Thiele 1913, Conchy.-Cab. (2), 2, pt. 4a, p. 41.

Crepimarginula Seguenza 1880, Atti. Royal Acc. Lincei, Memorie (3) 6, p. 273 (Genotype, *C. reticulata* Seguenza = *Zeidora seguenzae* Watson; non *Zeidora reticulata* A. Adams).

Legrandia Beddome 1883, Proc. Royal Soc. Tasmania for 1882, p. 169; non *Legrandia* Hanley 1872 (Genotype, *L. tasmanica* Beddome).

Zidora P. Fischer 1885, Manuel de Conchyliologie, p. 861.

Genotype, *Zeidora calceolina* A. Adams (monotypic, A. Adams 1860).

Shell small, convexly depressed, the apex drawn backwards and downwards over the extreme posterior end, so that the anterior slope occupies the whole length of the shell. The posterior slope is reduced to a small area around the apical whorl. The portion of the posterior slope nearest the margin generally bends outwards forming a narrow shelf upon which the apical whorl generally rests. The latter is very small and turned slightly to the right. The most striking character is the septum on the inside of the shell, extending forward from the shelf, or from above the anterior margin and surrounding the posterior part of the intestinal mass. It is considered similar to the margin of the columella in most spiral shells. A band, the anal fasciole, extends from the apex to the fissure along the middle of the anterior slope. It is formed as growth proceeds by the filling in of the posterior end of the fissure with shell material; each succeeding period of growth in the anal fasciole is marked by incremental semilunar lines or lamellae. The fissure forms a slit on the anterior margin and extends some distance back from it and is directed toward the left.

Zeidora seems to be the most primitive genus in the family Fissurellidae. Unfortunately the anatomy of the group is unknown.

***Zeidora bigelowi*, new species, Plate 41, fig. 1-3**

Description. Shell small, about 2.5 mm. in length, very delicate and semitransparent, glossy and depressed, the height being 40% of the length. Base oblong; the margin at the posterior end bends outwards forming a small shelf. Apical whorl turned to the right and resting on the shelf. Anal fasciole shallow, running from the apex to the fissure, with numerous, semilunar incremental lines. Fissure rather long, about one-third the length of the anterior slope, and conspicuously turned to the left. From the borders of the anal fasciole fine ribs start and continue to the margin. As the shell grows, new ribs are intercalated between the older ribs. The whole shell is crossed by numerous threads which divide the intercostal spaces into squares. These threads are not perfectly concentric: some originate in the posterior portion, the rest are intercalated between them nearer the anterior slope. Margin finely denticulated. The septum is attached at the base of the posterior margin, being slightly arched with its anterior edge concave.

length	width	height
2.5	1.5	1 mm. Holotype

Types. Holotype, Museum of Comparative Zoölogy, no. 179559, from Bahía de Cochinos, *Atlantis*, station 3332, in 175 to 225 fathoms. Paratype, at the Museo Poey, University of Habana, from the same locality.

Remarks. This species is very closely related to *Z. naufraga*, from which it differs in having a narrower septum. In *Z. bigelowi* it is about 10% of the shell length, while in *Z. naufraga* the septum is about 25% of the shell length. In addition, *Z. bigelowi* has a much deeper fissure and a different shape, being broader in front and having the anterior slope more strongly convex.

Zeidora bigelowi is a very rare species, since only two specimens were collected by the *Atlantis* at the many dredging stations along the south coast of Cuba.

This species is named for Dr. Henry Bryant Bigelow, Curator of Oceanography at the Museum of Comparative Zoölogy.

Zeidora naufraga Watson, Plate 42

Zeidora naufraga Watson 1883, Journ. Linn. Soc. London **17**, p. 27; Watson 1886, Challenger Report **15**, p. 36, pl. 4, fig. 3a-d (northwest of Culebra Island, West Indies); Dautzenberg and Fischer 1897, Mémoires Soc. Zool. France **10**, p. 179 (Azores).

Description. “*Shell.* White, delicate, depressed, oblong, pointed behind, with a minute short apex, rounded and cleft in front, with a broad flat keel bearing the old cleft-scar and extending the whole length of the shell: the enormous mouth is closed behind by a crepidula-like partition. *Sculpture.* Longitudinals—from the apex to the cleft across the middle of the back runs a broad raised keel, flat on the top, where it is scored by the minute delicate, sharp, prominent, close-set, but not contiguous scars of the old cleft; on either side it is bordered by a sharp marginal line: from these marginal lines branch off feeble irregular diverging threadlets, between which, as they go wider apart, others arise; the intervals between them are two to three times the breadth of the threadlets. Spirals—strictly speaking there are none, but the whole surface is scored at right angles to the longitudinals with a series of threadlets, very similar in form but rather more closely-set; these radiate from the apex and indicate the old mouth-edges. *Colour* porcellaneous white, which is dead on the threadlets, but almost translucent elsewhere from the extreme thinness of the shell. *Apex*—at the posterior end of the shell there is a narrow, rounded, prominent beak, within which, a little bent to the right and projecting slightly above the margin of the mouth, is the minute apex of one whorl. *Mouth* oblong. *Margin* minutely denticulated by the ends of the ribs; cleft in front by a strong, parallel-sided, blunt-ended fissure; behind, it is peculiarly patulous, being markedly bent outwards

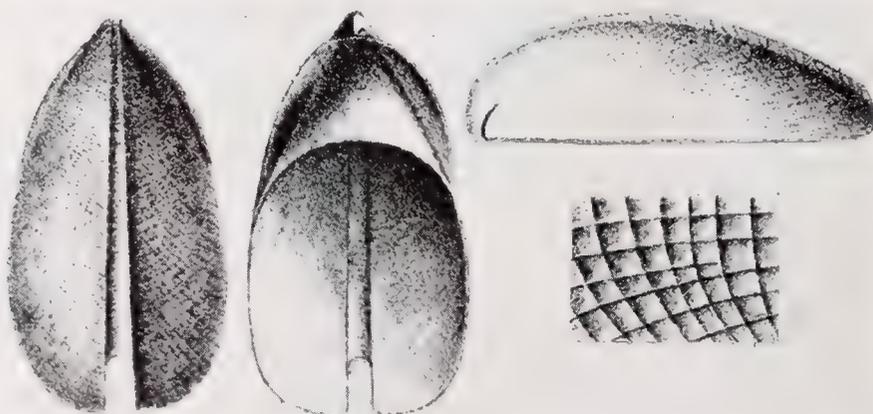


Plate 42. *Zeidora naufraga* Watson.

Off North of Culebra Island, Lesser Antilles, $4\frac{1}{2}\times$ (after Watson).

from the line of attachment of the septum, this bending being strongly shown on the outside of the shell. *Inside* glossy, smooth; a strong depression corresponding to the exterior keel extends from end to end of the shell. *Septum*—a little way within the margin and deepest at the end, is the short oblique septum, which is faintly arched, with a concave edge in front.

The present species, though somewhat chipped, is of great beauty. It differs from *Z. calceolina* A. Adams, which is rudely cancellated, and is also wider and more depressed. It is liker *Z. reticulata* A. Adams; but is larger, deeper, has the old cleft scar raised on a projecting ridge which forms a strong internal furrow, has the beak sharper and more projecting, the form is more oblong and more pinched-in at the sides; the sculpture-lines are much finer and less regular than in that species."

length	width	height
9.5	5	4 mm. Holotype

Types. The Holotype is in the British Museum, from N.W. of Culebra Island, West Indies, *Challenger*, station 24, N. Lat. $18^{\circ}38'30''$; W. Long. $65^{\circ}5'30''$, in 390 fathoms.

Remarks. We have not seen this species. The description above and the figures are taken from Watson. The lateral view is apparently incorrectly drawn since it shows the apical whorl curving below the posterior margin of the shell while Watson states in the text that the apical whorl projects above the margin. The interior view, which is another of the shell shown on Watson's plate shows the apical whorl resting on the posterior margin and projecting from it, but without any indication of curving below it.

Range and Records. Known only from the type locality, N.W. of Culebra Island, West Indies, in 390 fathoms and from the Azores, where it was collected by the *Princesse-Alice* (1896), station 90 in 874 fathoms.

Genus *Nesta* H. Adams

Nesta H. Adams 1870, Proc. Zool. Soc. London, pt. 1, p. 5, pl. 1, fig. 1, 1a.

Nesta (as a section of *Emarginula*), Pilsbry 1891, Manual of Conchology (1), 12, p. 269.

Genotype, *Nesta candida* H. Adams (monotypic, H. Adams 1870).

Shell low and elongated, with the apex drawn backwards to the posterior end and placed just above the margin, at the margin, or below it. Apical whorl very small and turned slightly to the right. Generally the portion of the posterior slope nearest the margin bends outwards forming a narrow shelf. There is no septum. The anal fasciole extends from the apex to the fissure. The latter forms a slit on the anterior margin, extending some distance back from it and is directed toward the left.

Nesta was considered by Pilsbry to be a section of *Emarginula*. The depressed-convex shape of the shell, the extremely low position of the retracted apex, and the almost constant formation of a shelf, places this group nearer to *Zeidora* than to *Emarginula*. However the lack of a septum separates it from *Zeidora*.

Nesta atlantica, new species, Plate 43, fig. 1-3

Description. Shell small, about 10 mm. in length, thin and convexly depressed. Base long ovate. Apical whorl very minute, turned a little to the right and placed at the extreme posterior end, generally resting on the margin. Anterior slope occupies the whole

length of the shell, the posterior slope being very reduced; the portion nearest the margin may bend outward forming a narrow shelf. Anal fasciole shallow, smooth to the naked eye but under a lens provided with numerous, incremental semilunar lines. Fissure short and inclined slightly to the left. Sculpture consists of close-set, very fine radiating ribs; some originate at the apex, the rest are intercalated farther down as growth proceeds. There is no true concentric sculpture, only the concentric incremental lines being present. Margin smooth. Interior glossy, smooth, the anal fasciole being marked by a very shallow depression. Muscular impression narrow and rather far from the margin. It turns sharply inward at the anterior end and extends backwards on each side of the anal fasciole to the apex.

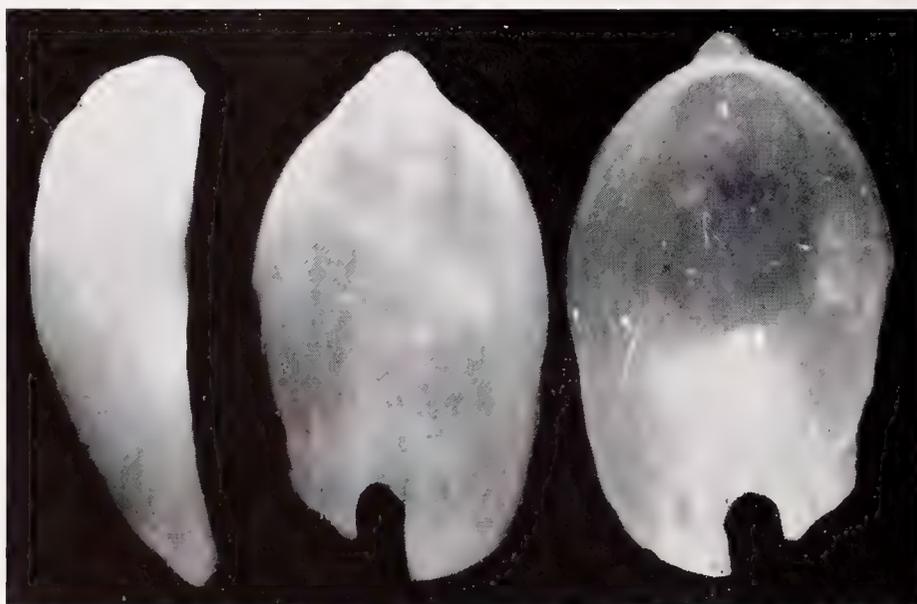
length	width	height	
9.5	4.75	2.8 mm.	off Palm Beach, Florida
8	4.5	2.5	Holotype

Types. Holotype is in the collection of T. McGinty, collected by him off Palm Beach, Florida. Paratypes from the same locality, in the Museum of Comparative Zoölogy, and from off Pelican Island, Barbados, State University of Iowa Expedition, station 456, in 80 fathoms, in the United States National Museum.

Remarks. This is the only known species of *Nesta* in the Western Atlantic and the second found in the world. Its nearest relative is *Nesta candida*¹ from the Red Sea. They differ quite sharply, *Nesta atlantica* having the apical whorl just above or resting on the margin while in *N. candida* it curves below the narrow shelf. In addition, *N. candida* is highly sculptured, possessing elevated radiating ribs and concentric cords, while in *atlantica* the radiating ribs are low and fine and there is no true concentric sculpture, only incremental lines being visible. Finally, in *candida* the anal fasciole shows very strong and widely-spaced incremental lines, while in *atlantica* these are almost inconspicuous.

Range. Palm Beach, and probably south along the eastern coast of Florida, Florida Keys and the West Indies to Barbados.

Records. See under *Types*.



Photographs by Marion Bills

Plate 43. *Nesta atlantica* Pérez Farfante.
Off Palm Beach, Florida (Holotype, 7×).

¹This is not to be confused with *Emarginula candida* A. Adams.

Genus **Emarginula** Lamarck

Emarginula Lamarck 1801, Syst. Animaux sans Vert., p. 69 (refers to Conchy.-Cab. (1), 1, pl. 12, fig. 109, 110).

Emarginulus Montfort 1810, Conchy. Syst. p. 74.

Imarginula Gray 1821, London Medical Repository 15, p. 233 (nude name).

Genotype, *Emarginula conica* Lamarck (monotypic, Lamarck 1801).

Shell from very small to moderately large, generally uniformly white or yellowish, but a few species have colored rays or freckles. Apex not removed, recurved backwards, its position varying along the posterior half of the shell. Apical whorls from one to two, very small and turned slightly to the right. Fissure forming a slit open in front and extending some distance up the middle of the anterior slope. A band, the anal fasciole, extends from the apex to the fissure. It is formed as growth proceeds, by the filling in of the posterior end of the fissure with shell material; each succeeding period of growth in the anal fasciole is marked by either incremental lines or lamellae. It may be depressed or raised above the shell surface. Sculpture varies from coarse to very fine and consists of numerous radiating ribs crossed by concentric threads or cords. In the interior of the shell there is a callus grooved in the middle, following the anal fasciole.

Subgenus **Emarginula** Lamarck

Shell moderately high, the fissure the same width throughout its length. Anal fasciole shallowly depressed or in the same plane as the rest of the shell, not keeled. Muscular impression rather wide, following the margin of the shell and turning inward at the fissure in the shape of a hook. There is no septum. The mantle border does not extend over the margin. Central tooth of the radula is wider than in *Fissurella* and a large bifid lateral tooth is found. Odhner (1932, Jena Z. Naturw. 67, p. 292-309, fig. 1-41) has made a very careful study of the anatomy of most genera of the family Fissurellidae. They show very striking anatomical differences that at the same time allowed him to establish the relationships. The following are extracts from his paper which Dr. J. Bequaert has been kind enough to translate. "In *Emarginula* the space of the mantle-border between the median and the lowermost fold is thickened, thus producing a wide zone, which is limited above and below by the corresponding folds; this mantle-border zone or mantle edging is covered with fine warts and is almost smooth at the margin. On the right tentacle, behind the eye tubercle, is found a long feeler, the sexual cirrus, and a small papilla. The shape of the gill filaments also provides a taxonomically important character. Each gill filament has the shape of a triangle drawn out to a point; the longer side of the filament bears a marginal supporting lamella and corresponds to the dorsal margin of the reversed ctenidium, while the shorter side corresponds to the ventral margin of the same. The tip between the two sides together with the supporting lamella, is noticeably lengthened and reaches beyond the ventral margin. In *Emarginula* the crop, a more or less wide pouch before the narrow hind oesophagus, is expanded posteriorly into a more spacious pouch which fills up the entire body cavity ventrally, and has inner walls bearing villi everywhere. On either side of the crop there are a right and a left oesophageal pocket which are separated from it by a median and a dorsal or ventral guide-pad. In *Emarginula* these guide-pads are surprisingly narrow, especially the median one which forms a band-like fold. This fold starts directly behind the tongue, deflects however at once and

directly to the right side, climbs onto the dorsal wall of the crop and runs on this, posteriorly, toward the narrow oesophagus. This course of the median fold indicates a high degree of torsion of the crop and this torsion influences the oesophageal pockets. The right pocket is much reduced in size; since it lies to the right side of the median fold, it is found in *Emarginula* only in the most anterior area and as a strip between the median and dorsal guide-pads. The dorsal guide-pad runs very obliquely, its hind portion lying dorsally above the left pocket. The left pocket is in proportion more strongly developed and expands at the left side of the median guide-pad into a spacious pouch which sends forth posteriorly, to the right of the narrow oesophagus, the long caecum extending to the hind extremity of the body cavity. Medially this caecum is split by an obliquely placed partition, a continuation of the ventral guide-pad. Upward also a widening of the left oesophageal pocket extends toward the right side as far as the dorsal fold."

Key to the Western Atlantic species of *Emarginula*

1. Apical whorls placed slightly in front, even with, or beyond the posterior shell margin 2
 Apical whorls varying in position from one immediately posterior to the shell center, to one at one fifth of the shell's length from the posterior end 3
2. Shell sculptured with 20 to 24 primary ribs; the square pits well defined *E. phrixodes*
 Shell sculptured with more than 30 primary ribs; the square pits very small *E. tuberculosa*
3. Radiating ribs very closely-set, about equal in size, and beaded by elongated nodules concentrically arranged but not linked to form concentric cords *E. nordica*
 Radiating ribs rather widely-spaced or closely-set; but if closely-set they are crossed by concentric cords 4
4. Shell with broadened radiating ribs *E. pumila*
 Shell without broadened radiating ribs 5
5. Anal fasciole formed by widely-spaced, raised lamellae. Radiating ribs and concentric threads rather widely-spaced, and raised so that the shell surface has a lattice-like appearance *E. sicula*
 Anal fasciole formed by very closely-set and fine lamellae. Radiating ribs and concentric threads closely-set so that the shell surface does not have a lattice-like appearance, but a granular one *E. crassa*

Emarginula tuberculosa Libassi, Plate 44, fig. 1-7

Emarginula tuberculosa Libassi 1859, Atti dell'Acca. Sci. Lett. Palermo (n.s.) **3**, p. 15, fig. 1 (fossil from Altavilla and Ficarazzi, Palermo); Monterosato 1892, Journ. de Conchy. **40**, p. 78.

Emarginula compressa Jeffreys 1883, Proc. Zool. Soc. London, pt. 4, p. 679 (off Portugal); Dall 1889, Bull. Mus. Comp. Zoöl. **18**, p. 406 (Yucatan Strait; off Havana; near Barbados); Dall 1889, Bull. United States Nat. Mus. **37**, p. 170 (off Georgia, Florida Keys, West Indies, Barbados); Pilsbry 1891, Man. of Conch. **12** (1), p. 250 (off Portugal, Georgia, Florida Strait to Barbados); Dall 1927, Proc. United States Nat. Mus. **70**, Art. 18, p. 113 (off Georgia, Portugal and the Mediterranean. Yucatan Strait to the Lesser Antilles); *non E. compressa* Cantraine 1835.

Emarginula guernei Dautzenberg and Fischer 1896, Mém. Soc. Zool. France **9**, p. 490, pl. 22, fig. 8, 9 (Azores).

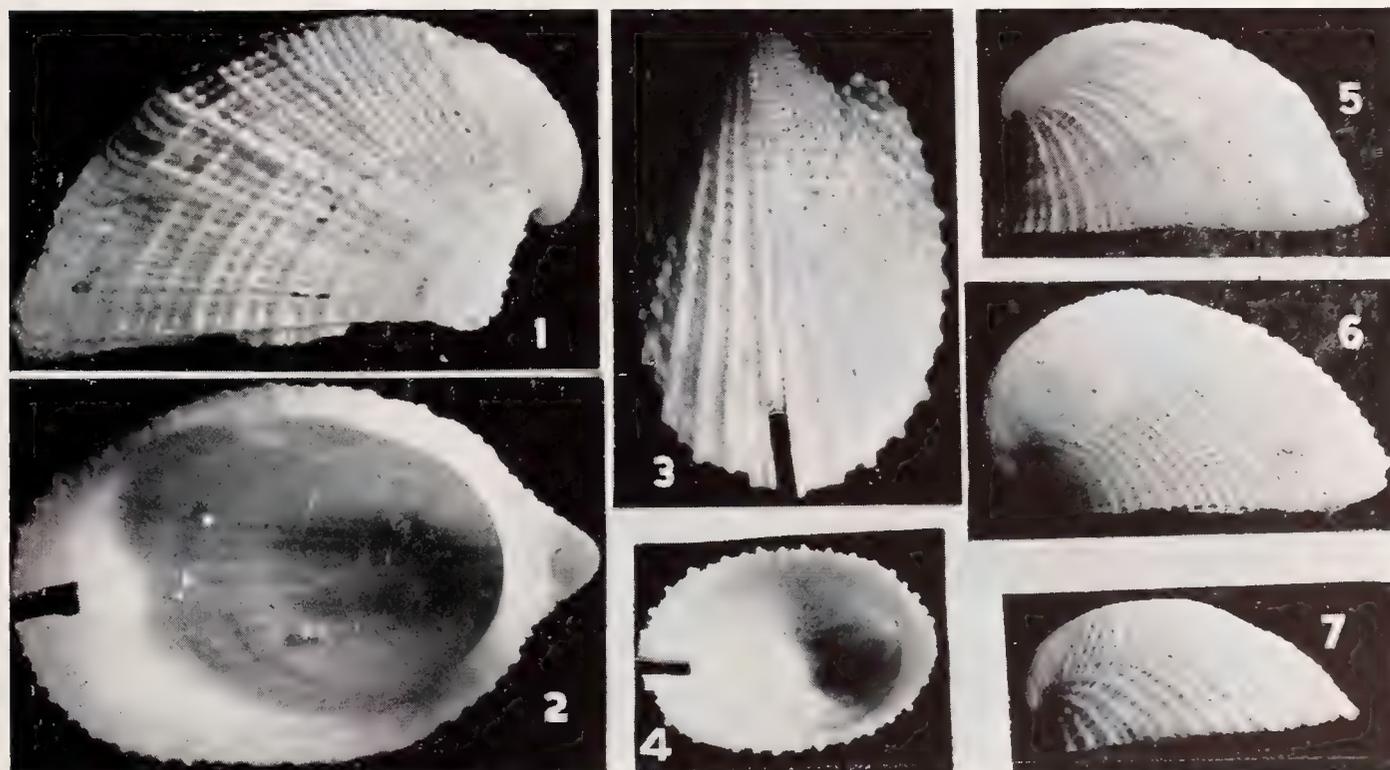
Description. This species reaches a large size, up to 18 mm. in length. The shell is highly sculptured, elevated, the height being about two thirds the length, with the anterior slope strongly convex and the posterior slope straight or concave. Apical whorls one and one half. These whorls are sometimes reduced to a small pointed hook (Plate 44, fig. 5). The position of the apical whorls varies from one high on the shell, close to but a little below the summit and immediately in front of the posterior end, to one near

the base and projecting beyond the posterior end. Anal fasciole with numerous, rather closely-set, arched lamellae which are frequently in greater numbers than the concentric cords that cross the shell. Fissure rather wide and about one-sixth the length of the anterior slope. Sculpture consists of numerous raised primary ribs radiating from the apex to the margin. Secondary ribs, which start some distance from the apex, alternate with them. Sometimes very fine riblets that originate lower down than the secondary ribs are intercalated between the primary and secondary ribs. Numerous concentric cords cross the surface of the shell forming thickened nodules where they intersect the ribs. These cords divide the spaces between the ribs into more or less square pits. Sometimes two very short chalky white lines are found in the square pits. Color opaque white or buff. Margin finely and strongly crenulated by the termination of the ribs. Interior of shell highly polished, the sculpture of the outside showing through as radiating and concentric translucent lines. The anal fasciole is marked inside by a grooved callus.

	length	width	height	
(large)	18	13	11 mm.	off Georgia
(average)	12	9	6	off Sand Key, Florida

Types. The disposition of the types is unknown to me. The type locality is given as two stations, in the Miocene of Altavilla and Ficarazzi, Palermo, Sicily.

Remarks. *Emarginula tuberculosa* is rather common throughout its range in the Western Atlantic, having been found in depths of from 33 to 450 fathoms. This species shows a variation in the thickness of the shell and in the strength of the sculpture. Specimens from some localities are much thinner and more delicate than those from other places. In the former the shell is sculptured by fine radiating and concentric threads while in heavy specimens there are raised ribs and strong cords. This variation has no



Photographs by Marion Bills (fig. 1-2); Frank White (fig. 3-7)

Plate 44. *Emarginula tuberculosa* Libassi.

Fig. 1, 2. Off Cumberland, Georgia ($3\frac{1}{2}\times$). Fig. 3, 4 and 7. Off Habana (fig. 3, $5\times$; fig. 4 and 7, $3\times$). Fig. 5. Off Cumberland, Georgia ($2\times$). Fig. 6. Yucatan Strait ($2\frac{1}{2}\times$).

geographical significance since all forms varying from thin to heavy are found in adjacent localities throughout the range of this species.

Monterosato in 1892, discussed Jeffreys' misidentification of *E. tuberculosa* Libassi as *E. compressa* Cantraine. He presents the characters that distinguish the true *compressa*, proposing for it a new genus, *Agariste*.

Range. EASTERN ATLANTIC: off Portugal and Azores. WESTERN ATLANTIC: Georgia, Florida and south through the West Indies to Brasil.

Records. WESTERN ATLANTIC: GEORGIA: off Cumberland Id., *Albatross*, station 2415, in 440 fathoms (USNM). FLORIDA: off Key West, *Eolis*, station 333, in 110 fathoms; off Sambo Reef, *Eolis*, station 329–331, in 118 to 135 fathoms; off Sand Key, *Eolis*, station 322, in 115 fathoms; off Western Dry Rocks, *Eolis*, station 321, in 65 fathoms; Pourtalés Plateau, in 200 fathoms. CUBA: off Bahía Honda, *Blake*, station 21, in 310 fathoms and 287 fathoms; off Morro Light, *Blake*, station 16, in 292 fathoms; off Habana, *Blake*, station 65, in 127 fathoms (all MCZ); off Sagua la Grande, *Atlantis*, station 3442, in 335 fathoms (Univ. of Habana); off Puerto Tánamo, *Atlantis*, station 3372, in 300 fathoms (MCZ); Bahía de Cochinos, *Atlantis*, station 2963-C, in 205 fathoms (Univ. of Habana); Yucatan Strait, *Blake* in 640 fathoms. LESSER ANTILLES: Barbados, *Blake*, station 282, in 154 fathoms and station 296, in 84 fathoms; and off Pelican Id., State University of Iowa Exp., station 413, in 33 fathoms; and off Lazaretto, State University of Iowa Exp., station 483, in 90–100 fathoms (all USNM). BRASIL: off Bahía, *Hassler* (Lat. 11°49'; W. Long. 37°10') in 450 fathoms (MCZ).

Emarginula sicula Gray, Plate 45, fig. 1–3

Emarginula sicula Gray 1825, Annals of Philosophy (n.s.) 9, p. 407; Potiez and Michaud 1838, Galerie des Mollusques 1, p. 518, pl. 36, fig. 11, 12 (Mediterranean); Monterosato 1884, Nomenclatura Generica Specifica Conchiglie Mediterranee, p. 35; Locard 1886, Prodr. Malac. Française, Moll. Mar., p. 336 (coast of Atlantic Ocean, Capbreton, Landes, France; after de Folin); Locard 1898, Exp. Scient. Travailleur et du Talisman, Moll. Test. 2, p. 83 (Madeira Islands and West of Morocco).

Emarginula reticulata Risso 1826, Hist. Nat. L'Europe Méridionale 4, p. 260; *non E. reticulata* Sowerby 1813.

Emarginula fissura Payraudeau 1826, Cat. Moll. de Corse, p. 92; *non Patella fissura* Linné 1758.

Emarginula cancellata Philippi 1836, Enumeratio Moll. Siciliae 1, p. 114, pl. 7, fig. 15 a, b, c; Jeffreys 1883, Proc. Zool. Soc. London, pt. 4, p. 679 (Guernsey, Channel Islands); Bucquoy, Dautzenberg and Dollfuss 1886, Moll. Mar. du Roussillon 1, p. 452, pl. 54, fig. 5, 6; Dall 1889, Bull. Mus. Comp. Zoöl. 18, p. 406 (off Cuba and off Barbados).

Emarginula squamulosa Aradas 1846, Atti. Acc. Gioenia Sci. Nat. Catania, p. 183, pl. 2, fig. 4a, b (Sicilia).

Emarginula squamosa Locard 1898, Exp. Scient. Travailleur et du Talisman, Moll. Test. 2, p. 83 (error for *squamulosa* Aradas).

Description. Shell reaching a comparatively large size, up to about 16 mm. in length, the height from one half to two thirds the length. Color oyster white or cream. Base ovate or subcircular; young specimens have almost circular bases. Anterior slope convex, posterior slope straight or slightly concave. Apex elevated, close to but a little below the summit, and at the posterior fourth of the shell. Nuclear whorls minute. Anal fasciole conspicuous, provided with elevated arched lamellae which generally stand out above the margins of the fasciole. These lamellae are less numerous and are farther apart than the concentric cords that cross the shell. Fissure narrow and long, its length being one fourth that of the anterior slope. Sculpture consists of about 26 rather strong ribs

radiating from the apex. A short distance from the apex a secondary rib appears between each two of the primary ribs; they are at first rather fine, increasing in diameter until they equal the size of the primary ribs. Finally a thread is intercalated between the primary and the secondary ribs. In some specimens the differentiation of these three types of ribs is not very clear. Numerous concentric threads cross the shell forming small nodules where they intersect the ribs. These threads divide the spaces between the ribs into small, more or less square, pits; this gives to the shell a very fine lattice-like appearance. The sculpture near the apex is very fine, becoming increasingly coarser as it approaches the margin in adult specimens. Margin crenulated by the termination of the ribs. Interior of shell glossy with the outside sculpture showing through in the form of radiating and concentric translucent lines. The primary ribs are marked by shallow grooves. On the interior, the anal fasciole is marked by a grooved callus.

	length	width	height	
(large)	17	12	8 mm.	off Sand Key, Florida
(average)	12	10	6	off Barbados, Lesser Antilles

Types. Probably in the British Museum. The type locality probably is Sicily, Italy, as indicated by the specific name.

Remarks. Comparison of specimens of *E. sicula* from the Mediterranean with those from the Western Atlantic, bring us to the same conclusion that Dall reached, that there are no differences which would make possible their separation. We adopt Gray's name *E. sicula* instead of the better known *E. cancellata* Philippi, because we agree with many European authors that Gray's description applies to Philippi's species.

E. sicula differs quite sharply from *E. tuberculosa*, the Western Atlantic species to which it appears nearest in relationship. In *E. sicula* the apex is subcentral and the apical whorls minute while in *E. tuberculosa* the apex is placed near the posterior margin and the whole upper portion of the shell is drawn out and extremely recurved. The lamellae of the anal fasciole in *E. sicula* are more prominent and more widely spaced than those of *E. tuberculosa*.

This species is found in depths of from 8 to 250 fathoms. In the Western Atlantic it has been dredged from 100 to 150 fathoms and seems to be quite rare.

Range. EASTERN ATLANTIC: Channel Islands, probably in the Cantabrig Sea, along the coast of Portugal and south to west of Morocco, and in the Mediterranean Sea. WESTERN ATLANTIC: Florida Keys and south all along the West Indies.

Records. WESTERN ATLANTIC: FLORIDA: off Sand Key, in 100 fathoms (MCZ). CUBA: off Habana, *Blake*, station 65, in 127 fathoms; Bahía de Cochinos, *Eolis*, station 232, in 100 to 150 fathoms (both USNM). LESSER ANTILLES: off Anegada Id., Johnson-Smithsonian Exp., in 140 fathoms; off Barbados, in 100 fathoms (MCZ): off Pelican Id., State University of Iowa Exp., station 400, in 100 fathoms (USNM).

Emarginula phrixodes *Dall*, Plate 45, fig. 4-6

Emarginula phrixodes Dall 1927, Proc. United States Nat. Mus. 70, Art. 19, p. 8 (off Sambo Reef, Florida).

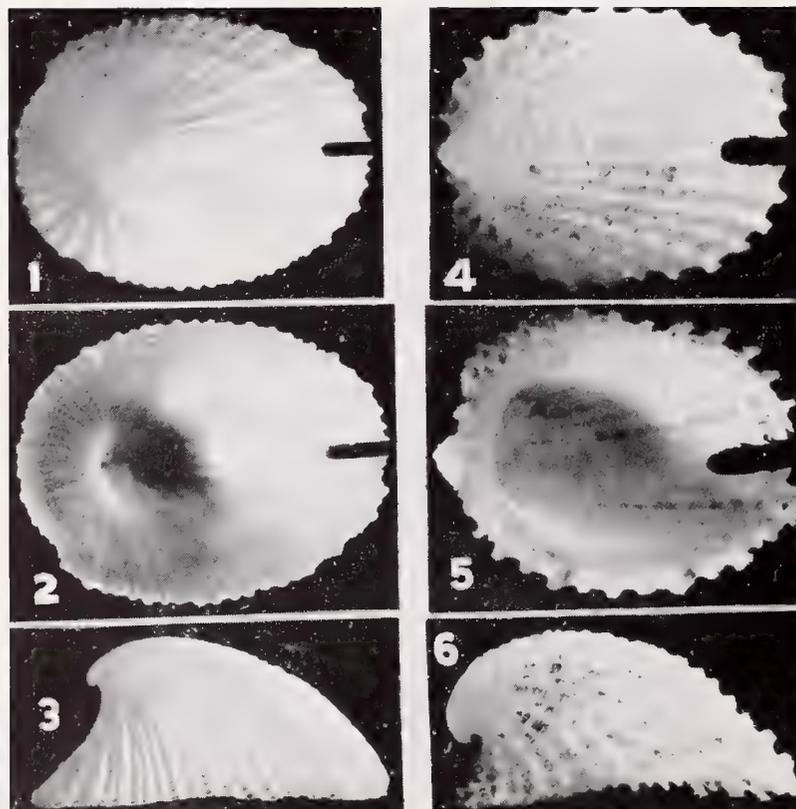
Description. Shell small, generally not exceeding 7 mm. in length, rather thin but strong, the height being 50% to 75% of the length. Base oval. Anterior slope convexly arched; posterior slope concave immediately below the apex, then extending downward

in a straight line. Apical whorls one and one half in number, very small, and placed about half way down the shell and at the posterior end or immediately in front of it. Anal fasciole with arcuate transverse lamellae, which are more numerous than the concentric cords that cross the shell; there may be as many as three lamellae to each cord. Radial sculpture consists of 20 to 24 widely-spaced ribs beginning at the apex, with a few finer intermediate ribs starting lower down the shell. Concentric sculpture consists of widely-separated cords which are knobbed at the points of intersection with the ribs and cut the interstices into deep square pits. Inside these pits there are series of minute chalky-white punctules or very small depressions, varying in number from two at the apex to four near the margin in adult specimens. In each series there are four or five of these punctules. Color translucent white. Interior of shell glossy with the sculpture of the outside showing through in the form of radiating and concentric very shallow grooves or lines. Anal fasciole is marked interiorly by a callus grooved in the middle.

	length	width	height	
(large)	6.5	5	4 mm.	New Providence, Bahamas
(average)	6	4.5	3.	Holotype

Types. Holotype, at the United States National Museum, no. 333734, the type locality being off Sambo Reef, Florida, *Eolis*, station 329, in 135 fathoms. Paratype, from off Sambo Reef, Florida, *Eolis*, station 330, in 120 fathoms. Both were collected in 1916.

Remarks. This beautiful little species has been found in moderate depths of 20 to 124 fathoms throughout its very wide distribution. Specimens of *E. phrixodes* can be separated from young specimens of *E. compressa* by their much stronger sculpture, consist-



Photographs by Frank White

Plate 45. Fig. 1-3. *Emarginula sicula* Gray. Cuba (3×). Fig. 4-6. *Emarginula phrixodes* Dall. Off Sambo Reef, Florida (Holotype, 7×).

ing of more prominent and widely-spaced radial ribs and concentric threads resulting in more marked interstitial pits. The minute depressions inside the pits are much less conspicuous and more numerous in *E. compressa*. Adult specimens of *E. phriaxodes* never reach the size of those of *E. compressa*.

Range. North Carolina, Florida, and probably along the gulf coast of the continent and throughout the West Indies to Barbados.

Records. NORTH CAROLINA: Cape Hatteras, *Albatross*, station 2602, in 124 fathoms (USNM). FLORIDA: off Lantana, in 90 fathoms (T. McGinty); off Hollywood, in 35-60 fathoms (L. A. Burry); off Miami, *Eolis*, station 49, in 60 fathoms; off Sambo Reef, *Eolis*, station 320, in 120 fathoms, and station 330, in 120 fathoms; off Key West, *Eolis*, station 42, in 60 fathoms and station 334, in 90 fathoms; off Sand Key, *Eolis*, station 302, in 100 fathoms (all USNM). BAHAMAS: Bastion Point, Mangrove Key, Andros Id. (USNM); New Providence Id. (D. Brown). CUBA: off Habana, in 6-10 fathoms (M. L. Jaume); La Chorrera (C. G. Aguayo); Matanzas Bay, in 25 fathoms (P. J. Bermúdez); *Eolis*, station 232, in 100-150 fathoms (USNM); *Atlantis*, station A2963 in 155-190 fathoms and *Atlantis*, station 3332 in 175-225 fathoms, all in Bahía de Cochinos; off Cienfuegos, *Atlantis*, station 3538, in 1075 fathoms (all Univ. of Habana). HISPANIOLA: Samaná Bay, Johnson Smithsonian Exp., station 56, in 165 fathoms. LESSER ANTILLES: Barbados, off Carlisle Bay, State University of Iowa Exp., station 466, in 12 fathoms; and off Pelican Id., station 453, in 100 fathoms. PANAMA: Colón (all USNM).

Emarginula crassa Sowerby, Plate 46

Emarginula crassa Sowerby 1812, Mineral Conchology of Great Britain **1**, p. 73, tab. 33 upper figures (the Crag near Ipswich, England); Forbes 1844, Ann. Mag. Nat. Hist. (1), **14**, p. 410, pl. 10, fig. 1 (Loch Fine, Scotland); Lovén 1846, Öfvers. K. Vet. Akad. Förhandlingar, Stockholm, Index Moll. Scandinaviae, p. 152; Forbes and Hanley 1850, British Mollusca **2**, p. 481, pl. 63, fig. 2 and plate CC, fig. 2; Jeffreys 1865, British Conchology **3**, p. 263, and 1869, *ibid.*, **5**, p. 200, pl. 59, fig. 4; G. O. Sars 1878, Mollusca Regionis Arcticae Norvegiae, p. 125; Dautzenberg and Fischer 1897, Mém. Soc. Zool. France **10**, p. 179 (La Coruña [Spain]); Jeffreys 1883, Proc. Zool. Soc. London, pt. 4, p. 678 (Donegal and Dingle Bay, Ireland, and off S.W. Norway); Hidalgo 1911, Revista de la Real Acad. Ciencias Madrid **9**, p. 976 (Santander); Thiele 1913, Conch.-Cab. (2) **2**, p. 4a, p. 47, pl. 5, fig. 19; Dautzenberg 1927, Result. Camp. Scient. Monaco, Fasc. **72**, p. 220 (La Coruña and off S. Miguel, Azores).

Emarginula magnifica Pilsbry 1891, Man. of Conch. (1), **12**, p. 251 (St. Croix, West Indies).

Description. Shell moderately heavy, large, reaching 27 mm. in length, conical, the height being only 40% to 50% of the length of the shell, although the elevated position of the apex gives to the shell the appearance of being quite high. Color opaque white or cream. Base broadly ovate. Anterior slope convex, posterior slope concave immediately below the apex, then extending downward in a straight line to the margin. Apical whorls one and one quarter in number, very small, close to but a little below the summit and at a point removed from the posterior end of the shell by about a third or a fourth of the length of the shell. Anal fasciole narrow and formed by very closely-set lamellae. Fissure small, one fifth to one sixth the length of the anterior slope. Sculpture compact, consisting of numerous, closely-set, slightly raised, radiating ribs. At the apex the primary ribs begin as fine threads, becoming stronger and broader as growth proceeds: lower down the shell, finer ribs are intercalated between them. Sometimes the primary

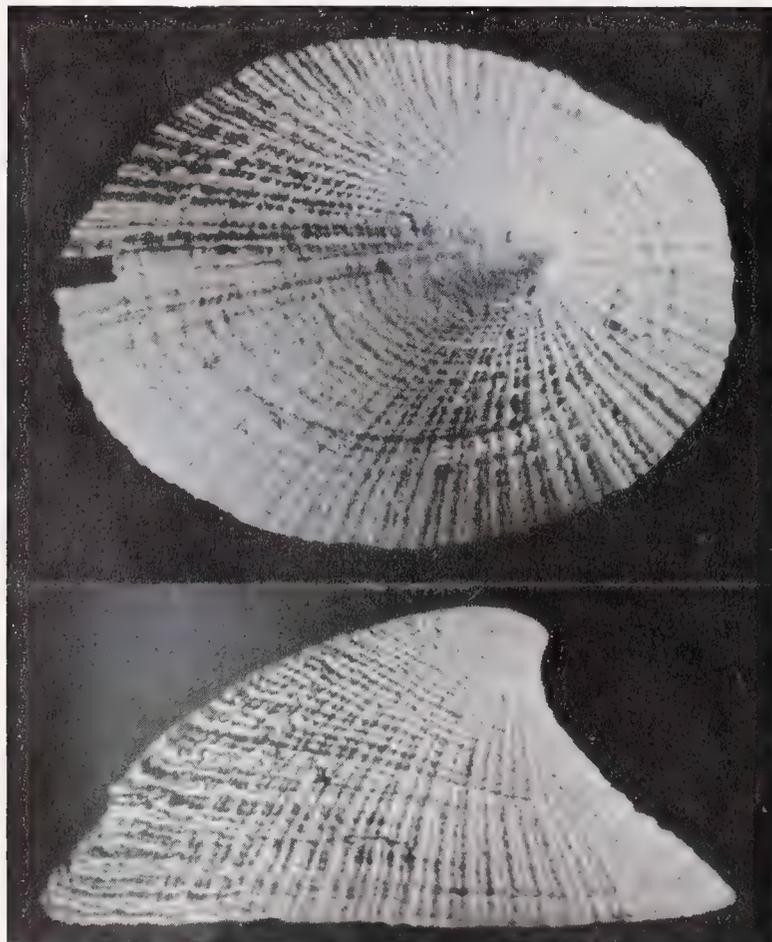
ribs divide into three or four while still maintaining their identity as rounded bundles. Numerous concentric coarse and wavy cords cross the shell giving rise to nodules where they intersect the ribs. Since ribs and cords are closely set the shell has a granular appearance. Margin finely crenulated by the terminations of the ribs. Interior of shell smooth and opalescent, the anal fasciole being marked by a thick grooved callus.

	length	width	height	
(large)	27	20	11 mm.	Thiele, 1913 (<i>l.c.</i>)
(average)	21	15	10	Saint Croix, Virgin Islands

Types. The type specimen of *Emarginula crassa* Sowerby is probably at the British Museum, and was collected by Mrs. Cobbold in the Crag near Ipswich, England. The types of *E. magnifica* are at the Academy of Natural Sciences of Philadelphia, no. 40913, from Saint Croix, Virgin Islands and were collected by R. E. Griffith.

Remarks. We have compared the types of *E. magnifica* with specimens of *E. crassa* from the British Isles and have come to the same conclusion as Thiele, that no differences can be found which would justify their separation. Some European specimens are fasciculated while others remain regularly ribbed. The latter is the case with the Saint Croix specimens.

Pilsbry's types appear to be fossil shells and not dead recent specimens. Though described as a fossil form, *E. crassa* is found alive in European waters. So far no live material has been collected anywhere in the Western Atlantic.



Photographs by Marion Bills

Plate 46. *Emarginula crassa* Sowerby.
Saint Croix, Virgin Islands ($3\frac{1}{4}\times$). (Holotype of
E. magnifica Pilsbry).

Range. EASTERN ATLANTIC: Norway and south to Spain and the Azores.

Records. WESTERN ATLANTIC: VIRGIN ISLANDS: Saint Croix (fossil?) (ANSP).

***Emarginula pumila* A. Adams, Plate 47, fig. 1-5**

Subemarginula pumila A. Adams 1851, Proc. Zool. Soc. London, pt. 19, p. 91 (locality unknown).

Emarginula rollandii P. Fischer 1856, Journ. de Conchy. 5, p. 356, pl. 12, fig. 10 (Guadeloupe).

Emarginula pumila A. Adams 1863, in Sowerby's Thesaurus Conchyliorum 3, p. 216, *Fissurellidae* pl. 12, fig. 80 (locality unknown); Sowerby 1873, in Reeve's Conchologia Iconica 19, *Emarginula*, pl. 7, fig. 46 (Honduras).

Emarginula dentigera Heilprin 1889, Proc. Acad. Nat. Sci. Philadelphia, p. 142, pl. 8, fig. 7, 7a (Bermuda).

Emarginula pileum Heilprin 1889, Proc. Acad. Nat. Sci. Philadelphia, p. 142, pl. 8, fig. 6, 6a (Bermuda).

Emarginula tumida Dall 1889, Proc. United States Nat. Mus. 12, p. 358 (Cape San Roque, Brasil); Simpson 1889, Proc. Davenport Acad. Nat. Sci. 5, p. 63 (Tortugas); *non E. tumida* Sowerby 1874.

Subemarginula rollandii Pilsbry 1891, Man. Conch. (1), 12, p. 274, pl. 29, fig. 36; pl. 64, fig. 36; pl. 41, fig. 18, 19, 26, 27 (Florida, Guadeloupe and St. Thomas, West Indies; Bermuda).

Description. Shell generally not exceeding 12 mm. in length, from thin to moderately heavy and translucent. It is extremely variable in shape, from depressed and broad to high and relatively narrow. In the first case the height is about 25% of the length, in the second it may reach as high as 70% of the length. All intermediate stages are found between these two extremes. Color a uniform white or greenish yellow; in the latter case all the primary ribs may be white or only the posterior laterals. The tip of the apical whorls may be of a dark flesh coloration. Base ovate, much narrower in front than behind. Apical whorls one to one and one half and very minute. They are turned to the right and lie against the uppermost part of the posterior slope. However, owing to variations in the shape of the shell, this may mean a location immediately posterior to the center of the shell, or, on the other hand, at the posterior fifth of the length. Anterior slope slightly concave, although sometimes it descends in a straight line or even convexly to the margin. Anal fasciole narrow and formed by thickened, raised, strongly arched lamellae. Fissure short, one seventh to one fifth the length of the anterior slope. Sculpture consisting of eleven to thirteen primary ribs. In addition to these, there occur secondary ribs and between primary and secondary a third series of still smaller and shorter ribs. The primary ribs are always stronger than the others but vary considerably in different specimens. All the ribs are broad, the primary particularly so, and vary from rather widely-spaced to closely-set; in the former case the interspaces are rather deep. Concentric and irregular cords cross the shell. These cords on specimens with open radiating ribs are more prominent when crossing the deep interspaces between the ribs, where they give rise to more or less square pits. In young individuals the ribs and cords stand out only slightly and the shell in consequence looks almost smooth. Numerous rows of punctules radiate from the apex, continuing to the margin of the shell between the ribs. Margin strongly crenulated by the terminations of the ribs, the crenulations caused by the primary ribs being particularly large. Interior of shell glossy, showing the same coloration as the outside, that is, a uniform white or greenish yellow; in the latter case the white ribs show as white rays. The anal fasciole is marked by a thick grooved callus.

	length	width	height	
(large)	12	9.5	3 mm.	La Chorrera, Habana
(average)	8.5	7.25	4.25	Cayo Jutía, Pinar del Río, Cuba

Types. The types of *E. pumila* are at the British Museum. As the locality was unknown to A. Adams, Honduras is here selected to be the type locality, based on a reference in the *Conchologia Iconica* by Sowerby (above) who as an aid in his diagnosis of this species had access to the original specimens of Adams.

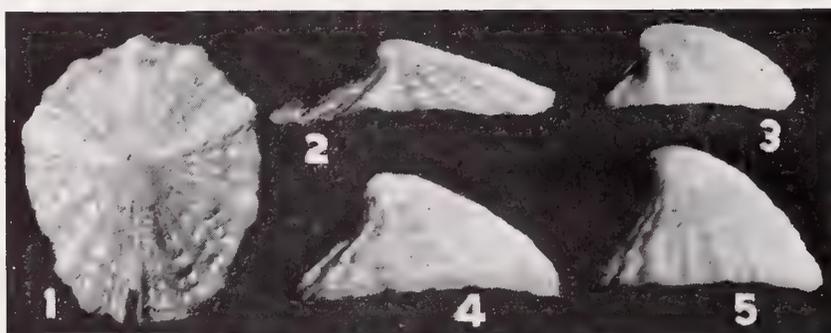
Heilprin's types are at the Academy of Natural Sciences of Philadelphia: those of *E. dentigera* under the no. 61940 and those of *E. pileum* under the no. 61971; both were collected in the Bermudas.

Remarks. This species shows such an extreme variation in shape, from almost flat to highly conical, that it is hard to realize that the two extremes belong to the same species. This variation is undoubtedly the reason for the several names applied to this species. We have been fortunate enough to have had for study a rather large series, and have been unable to consider as good species or varieties, the different forms which have received names from various authors, since all forms are found in the same or adjacent localities.

It is with some doubt that we include this and the following species in the genus *Emarginula*. We have been unable to secure the soft parts for the study of the radula. These two species show a very well differentiated anal fasciole and a fissure which forms a conspicuous marginal slit, as is typical of *Emarginula*; and do not show the longer rib in the place of the anal fasciole and the notch in place of the fissure as in the genus *Hemitoma*.

Range. South East Florida, Florida Keys and Bermudas through the West Indies to Brasil.

Records. FLORIDA: off Miami, *Eolis*, station 62 in 20 fathoms, station 70 in 10 fathoms, station 85 in 6 fathoms, station 93 in 18–25 fathoms, station 103 in 20 fathoms and station 114 in 20 fathoms; off Bear's Cut, *Eolis*, station 113 in 18–20 fathoms; off Fowey Light, *Eolis*, station 88 in 6 fathoms; Ajax Reef, *Eolis*, station 55 in 4 fathoms; Key West, *Eolis*, station 313 in 16 fathoms (all USNM). BERMUDAS: (ANSP). BAHAMAS: off South Bight, and Bastion Point, Mangrove Cay, Andros Id. (both USNM). CUBA: Cayo Jutía, *Tomás Barrera*, station 218; Cabañas, *Tomás Barrera*, station 202 in 25 fathoms; Bahía Honda, *Tomás Barrera*, station 208 in 1–12 fathoms (all USNM); La Chorrera, Habana; Matanzas (both C. G. Aguayo); Bahía de Cochinos, *Eolis*, sta-



Photographs by Frank White

Plate 47. *Emarginula pumila* A. Adams.

Fig. 1–3. La Chorrera, Habana, Cuba. Fig. 4. Cayo Jutía, Pinar del Río, Cuba. Fig. 5. Cotype of *E. pileum* Heilprin, Bermudas (all 4×).

tion 232 in 100–150 fathoms (USNM). HISPANIOLA: Jérémie; Samaná Bay, in 16 fathoms. JAMAICA: Black River. BRASIL: off Cabo São Roque, in 20 fathoms (all USNM).

Emarginula nordica, new species, Plate 48

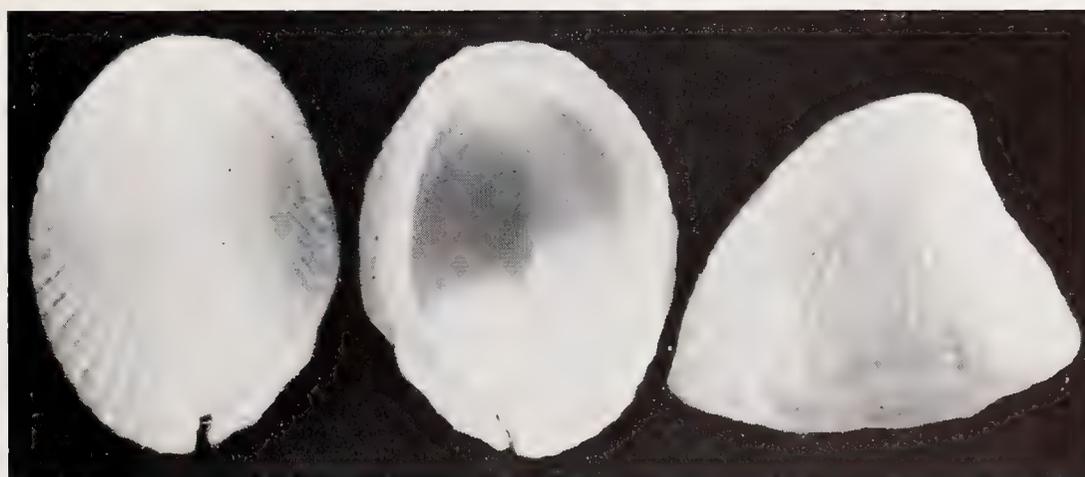
Description. Shell heavy, small, laterally compressed, elevated, the height being about 75% of the length. Base narrow ovate. Anterior slope convex, posterior slope slightly concave below the apex, then straight to the margin. Apex high and at about one fourth of the length of the shell from the posterior end. Anal fasciole very narrow, formed by numerous closely-set incremental lamellae. Fissure about one sixth the length of the anterior slope and turned to the left. Sculpture consists of very compact, almost equal radiating ribs, beaded by elongated and very closely-set nodules concentrically arranged but not linked to form concentric cords. Interior of shell polished, with the muscular impression strongly marked.

length	width	height	
5	3.5	3.75 mm.	Paratype
4.5	3.5	3.25	Holotype

Types. Holotype, Museum of Comparative Zoölogy, no. 179151, from south of Block Island, R. I., in 70 fathoms. Paratype from the same locality. Both were collected by J. Miller.

Remarks. This species is close to *E. solidula* from the Mediterranean Sea, both having the same type of sculpture. They differ quite sharply in shape, *E. nordica* being much compressed, with a narrow oval base, while *E. solidula* has the shape of a broadened cone, with a much wider base. In addition, *E. solidula* is lower, its height being half or less the length and has the apex placed farther from the posterior end.

Range and Records. See under *Types*.



Photographs by Marion Bills

Plate 48. *Emarginula nordica* Pérez Farfante.
South of Block Island, Rhode Island (Holotype, 10×).

Genus *Rimula* Defrance

Rimula Defrance 1827, in Dictionnaire des Sciences Naturelles **45**, p. 472.¹

Rimularia "Defrance" Gotthelf Fischer de Waldheim 1834, Bibliographia Palaeontologica p. 271; Bronn 1838, Lethaea Geognostica, 2nd. edition, **2**, p. 995 (Genotype by designation of Gray, 1847: *Rimula blainvillii*).

Genotype, *Rimula blainvillii* 'Defrance' de Blainville (subsequent designation, J. E. Gray 1847, Proc. Zool. Soc. London, pt. 15, p. 147).

Shell small, generally white, with the apex entire and recurved downwards toward the posterior extremity. Apical whorls small and inclined a little to the right. Anterior slope convex, posterior slope concave. Fissure narrow and elongated, about in the middle of the anterior slope, and closed at both ends. It has evolved as the result of the closing of the anterior end of the slit in *Emarginula*. The anal fasciole extends from the fissure to the apex. It is formed, as growth proceeds, by the filling in of the posterior end of the fissure with shell material, while the anterior margin of the fissure is absorbed by the animal. In this way the fissure retains its position on the anterior slope. Each succeeding period of growth in the anal fasciole is marked by either incremental lines or lamellae. Shell surface sculpture with numerous radiating ribs and concentric threads. There is no septum. Muscular impression slight with the anterior ends sharply incurved toward the posterior portion in the shape of a hook. In the interior of the shell sometimes a thin callus is found around the fissure, generally continuing on either side of the mid-line of the anterior slope to the margin. This callus is found in a little more developed form in some species of *Puncturella* and reaches its full development only around the fissure in *Diodora* and *Fissurella*.

Key to Western Atlantic species of *Rimula*

- | | |
|--|------------------------|
| 1. Apical whorls below the middle of the shell | 2 |
| Apical whorls above the middle of the shell | 3 |
| 2. Basal margin of shell long ovate; concentric cords about as strong as the primary ribs and forming squares with them | <i>R. frenulata</i> |
| Basal margin of shell broadly elliptical or ovate; concentric cords finer and much closer together than the radiating ribs | <i>R. pycnonema</i> |
| 3. Shell with small, inconspicuous, apical whorls; sculpture consisting of 36 to 40, rather fine, radiating primary ribs | <i>R. aequisculpta</i> |
| Shell with large and prominent apical whorls; sculpture consisting of about 25 very strong radiating primary ribs | <i>R. dorriae</i> |

¹ Defrance in 1824 (Tableau des Corps Organisés Fossiles, p. 111) uses only the vernacular name "Rimulaire" with no description or figures. De Blainville in 1824 (Dictionnaire des Sciences Naturelle **32**, p. 291) and 1825, (Manuel de Malacologie, p. 501, pl. 48 bis, fig. 1, 1a, 1b) also uses the vernacular names of "Rimule" (1824) and "Rimulaire" (1825) and refers *Emarginula blainvillii* "Defrance" to this group. This was a manuscript name of Defrance which de Blainville first published in Dict. Sci. Nat. with the definition of the genus "Rimule" and later in his Manual with reference to a figure. As such, this species must be credited to de Blainville and not to Defrance.

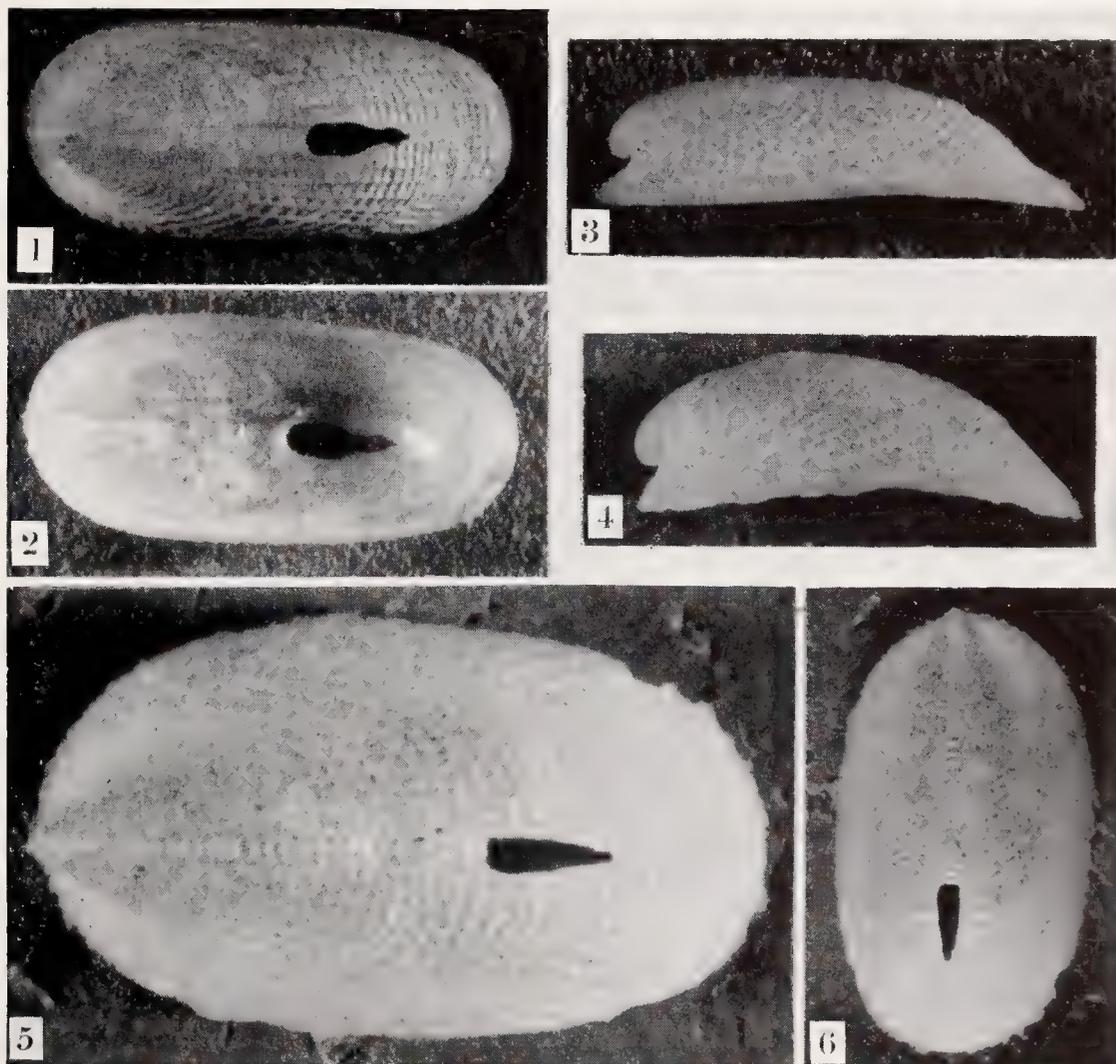
Thiele in 1912 (Conchy.-Cab. (2) **2**, pt. 4a, p. 137) cites *Rimulus* d'Orbigny 1841, in de la Sagra, Histoire Physique, Politique et Naturelle de Cuba, Moll. **1**, p. 199, in the synonymy of *Rimula* Defrance; but this is erroneous as d'Orbigny's genus belongs in the Pleurotomaridae. Moreover, d'Orbigny changed his name *Rimulus* to *Ditremaria*.

Rimula frenulata Dall, Plate 49, fig. 1-6

Emarginula (Rimula) frenulata Dall 1889, Bull. Mus. Comp. Zoöl. **18**, p. 406, pl. 28, fig. 4 (West Florida and the Keys); Pilsbry 1943, Nautilus **57**, pp. 38, 40, pl. 7, fig. 1 (Bonefish Key, Florida).

Rimula longa Pilsbry 1943, Nautilus **57**, p. 38, pl. 7, fig. 2 (off Destin, Florida).

Description. Shell thin, very delicate, small, generally not exceeding 7 mm. in length, the height and width being very variable. The height is from 20% to about 50% of the length; the width is from 33% to 60% of the length. Base long-ovate. Anterior slope convex, occupying most of the length; posterior slope very short, straight or slightly concave. Apical whorls small, one and one quarter, laterally compressed, located low on the shell near the posterior end or projecting a little beyond it. Anal fasciole with rather numerous incremental, semilunar threads. It is limited by two sharp ridges. Fissure small, placed on the anterior half of the front slope of the shell, rounded behind and narrowing in front to a point, with irregular contour. Sculpture consists of fine radiating ribs between each two of which there is a riblet. The whole shell is crossed by concentric cords which divide the intercostal interval into squares. The cords are not perfectly concentric. Since the posterior slope is shorter than the anterior and the sculpture is regular throughout, there are more cords on the latter than on the former. The additional cords



Photographs by Marion Bills

Plate 49. *Rimula frenulata* Dall.

Fig. 1-3. Off Destin, Florida (Holotype of *Rimula longa* Pilsbry, 8×). Fig. 4-6. Tortugas, Florida (fig. 4 and 6, 8×; fig. 5, 12×).

originate as a result of the bifurcation of a cord coming from the posterior slope, or from the intercalation of a new one. Color white, cream, or rust, generally a deeper shade at the apex and fading toward the margin which is finely crenulated. Interior of the shell glossy, the outside color and sculpture showing through; the anal fasciole is marked by two faint ridges extending from the fissure to the apex.

	length	width	height	
(large)	6.5	3	1.8 mm.	off Destin, Florida
(average)	5	2.5	1.75	Barbados

Types. Dall's original type-specimen of this species apparently has been lost, and, therefore, we have selected a neoholotype (USNM no. 61110) collected by Gregor in the Tortugas. The measurements of the neoholotype are exactly the same as those given by Dall for the lost holotype. The type of *R. longa* Pilsbry is at the Academy of Natural Sciences of Philadelphia, no. 178632, from off Destin, Florida, collected by T. McGinty. Dall's general locality of "West Florida and the Keys" is here restricted to Tortugas, Florida.

Remarks. *Rimula frenulata* is the most abundant species of *Rimula* in the Western Atlantic. This very delicate species is found in diverse situations: under rocks, on the sea-shore, and at depths up to 150 fathoms.

Rimula longa Pilsbry is but a variation of *R. frenulata*. Pilsbry's statement that *longa* is "higher and wider" than *frenulata* is not borne out by the series of measurements taken by us. The ratios of height to length and height to width vary considerably in this species, a circumstance probably brought about by local ecologic conditions. The index of height to length, based on material from several localities on the Florida coast is 2.20 to 4.95. The height-length index of the type specimen of *R. longa* is 3.61, almost intermediate between the two extremes of the several measurements taken of specimens of *R. frenulata*.

Range. North Carolina, south around eastern and western Florida including the Keys, and along the arc of the Greater and Lesser Antilles to Barbados.

Records. NORTH CAROLINA: off Cape Hatteras, *Albatross*, station 2596 in 49 fathoms; off Cape Lookout, *Albatross*, station 2612 in 52 fathoms. FLORIDA: Turtle Harbor (near Port Orange) in 5 fathoms (USNM); off Palm Beach in 50 fathoms (T. McGinty); off Hollywood in 35-60 fathoms (L. A. Burry); off Miami, *Eolis*, station 103 in 20 fathoms, station 68 in 45 fathoms, station 95 in 90 fathoms; off Bear's Cut, *Eolis*, station 122 in 30 fathoms; off Fowey Light, *Eolis*, station 8 in 25 fathoms, station 142 in 40 fathoms; inside Ajax Reef, *Eolis*, station 55 in 4 fathoms; off Sand Key, *Eolis*, station 57 in 40 fathoms; Boca Grande; Tortugas, *Eolis*, station 32 in 16 fathoms; off Anclote Light, near Sponge Harbor, *Fish Hawk*, station 7106 in 12.5 fathoms (all USNM); off Destin in 13 fathoms (ANSP). CUBA: Cabañas, *Tomás Barrera*, station 203 in 3-12 fathoms (USNM); La Chorrera, Habana; Bacuranao Beach (both MCZ); Bahía de Cochinos, *Eolis*, station 232 in 150 fathoms (USNM); Bahía de Cochinos, *Atlantis*, station 3332 in 175-225 fathoms (MCZ). BARBADOS: The following are from the State University of Iowa Expedition: Carlisle Bay, station 490 in 5 fathoms, station 509 in 80 fathoms; off Lazaretto, station 503 in 80-90 fathoms, station 483 in 90-100 fathoms; off Pelican Id., station 506 in 25-72 fathoms. ANTIGUA: off English Harbor, station 496 in 110 fathoms (all USNM).

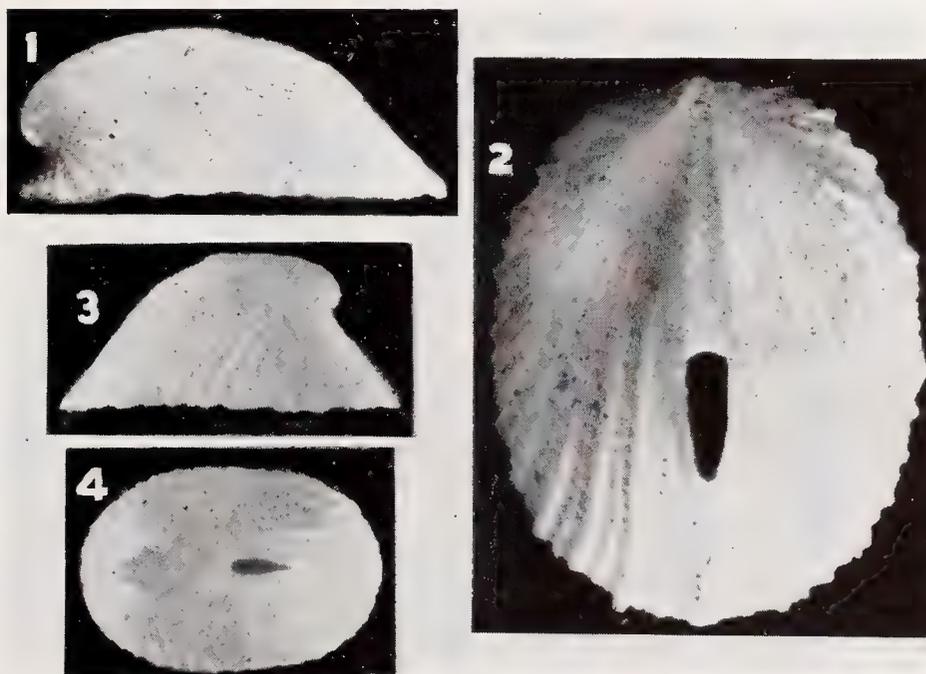
Rimula pycnonema Pilsbry, Plate 50, fig. 1, 2

Rimula pycnonema Pilsbry 1943, Nautilus 57, p. 38, 39, pl. 7, fig. 3 (off Palm Beach, Florida).

Description. Shell very small, from 3 to 4 mm. in length and relatively wide, the width being from 68% to 85% that of the length. Basal margin broadly elliptical, sometimes almost circular. Anterior slope long and convex, posterior slope short and concave. Apical whorls one and a quarter, smooth, placed at the posterior end just below the middle of the shell; they are turned a little toward the right side. The anal fasciole extends from the fissure to the apex, having very numerous, closely set, semilunar, incremental lines along its whole length. Fissure small, with the rounded and wider posterior end placed at the middle of the front slope, the anterior end acute and continuous with a double primary rib. Surface sculptured with about 34 narrow radiating ribs, extending from the apex to the margin, between each two of which there is generally a fine riblet. The whole of the shell is crossed by numerous, irregularly disposed, concentric threads which are arched from rib to rib giving a peculiar spider-web appearance. Color white. Margin finely crenulated. Interior of shell polished, the radiating ribs showing through in the form of fine and very shallow translucent grooves, the concentric threads as concentric lines. The anal fasciole is marked by a very shallow groove.

	length	width	height	
(large)	4.25	3	1.5 mm.	off Miami, Florida
(average)	3.7	2.5	1.5	off Palm Beach, Florida

Types. Holotype at the Academy of Natural Sciences of Philadelphia, no. 178633, from off Palm Beach, Florida, in about 33 to 50 fathoms. Thomas L. McGinty collector. Paratype in the collection of T. L. McGinty.



Photographs by Frank White (fig. 1-2); Marion Bills (fig. 3-4)

Plate 50. Fig. 1-2. *Rimula pycnonema* Pilsbry. Off Hollywood, Florida (fig. 1, 14×, fig. 2, 18×). Fig. 3-4. *Rimula aequisculpta* Dall. Off Ajax Reef, Florida (Holotype, 8×).

Remarks. *Rimula pycnonema* Pils. appears to be nearest in relationship to *R. aequisculpta* Dall. In *aequisculpta* the radiating ribs are more compact and the concentric threads straight, while in *pycnonema* the radiating ribs are more widely spaced and the concentric threads are arched from rib to rib. The apical whorls of *aequisculpta* are very small and are placed at the posterior fourth of the shell while in *pycnonema* the apical whorls are quite prominent and are located at the extreme posterior end of the shell.

Range. South Florida and through the West Indies to Barbados.

Records. FLORIDA: off Palm Beach, in 33–50 fathoms (ANSP and J. S. Schwengel); off Hollywood, in 35–60 fathoms (L. A. Burry); off Miami, *Eolis*, stations 48, 49, 93, 118 and 141, in 18–60 fathoms; off Bear's Cut, Burry-Foster Exp., station 112, in 25 fathoms; off Fowey Light, *Eolis*, station 8, in 25 fathoms and station 142, in 40 fathoms; off Turtle Harbor, *Eolis*, station 61, in 40 fathoms; off Conch Reef, *Eolis*, station 7, in 35 fathoms. CUBA: Bacuranao (M. L. Jaume); off Matanzas, *Atlantis*, station 2999, in 145–230 fathoms (University of Habana). BARBADOS: off Pelican Id., State University of Iowa Exp., station 413, in 33 fathoms (USNM).

Rimula aequisculpta Dall, Plate 50, fig. 3, 4

Rimula aequisculpta Dall 1927, Proc. United States Nat. Mus. 70, Art. 19, p. 9 (off Ajax Reef, Florida).

Description. Shell small, from 4–7 mm. in length, high, delicately sculptured. Base oval, the width only a little more than half the length. Anterior slope convex, comparatively short, extending only a little beyond the mid-portion of the shell. Posterior slope straight. Apical whorl very small, smooth, placed high on the shell just below the summit and at a distance from the posterior end of about one fourth the length of the shell. Anal fasciole short, having closely-set incremental semilunar threads. Fissure small, rounded behind, narrowing to a point in front, and placed about midway on the anterior slope. Sculpture consists of from 36 to about 40 radiating ribs, between each two of which there is an intercalated thread. Numerous concentric, closely-set threads cross the shell. Color white. Margin very finely crenulated. Interior of the shell glossy, the radiating ribs and the concentric threads showing through as translucent lines, the spaces between remaining opaque. The anal fasciole is hardly perceptible as a very shallow groove.

	length	width	height	
(large)	6.75	4.5	3 mm.	Bahía Honda, Cuba
(average)	4.5	3.25	2.25	off Pelican Island, Lesser Antilles

Types. Holotype at the United States National Museum, no. 333736, from off Ajax Reef, Florida. Collected by the *Eolis*, station 368, in 80–100 fathoms.

Remarks. See under *Rimula pycnonema* Pilsbry and *R. dorriae* Pérez Farfante.

Range. South Florida and through the West Indies to Barbados.

Records. FLORIDA: off Miami, *Eolis*, station 312, in 25 fathoms; off Fowey Light, *Eolis*, station 128, in 60 fathoms (both USNM); off Lake Worth in 50 fathoms (T. McGinty). CUBA: Cabañas, *Tomás Barrera*, station 203, in 3–12 fathoms and station

202, in 25 fathoms; Bahía Honda, *Tomás Barrera*, station 208, in 1-12 fathoms and station 202, in 25 fathoms (all USNM); Habana; Gibara (both C. G. Aguayo). BARBADOS: off Pelican Id., State University of Iowa Exp., station 438, in 90-100 fathoms and station 495, in 80 fathoms; off Lazaretto, State University of Iowa Exp., station 483, in 90-100 fathoms and station 500, in 75-80 fathoms (all USNM).

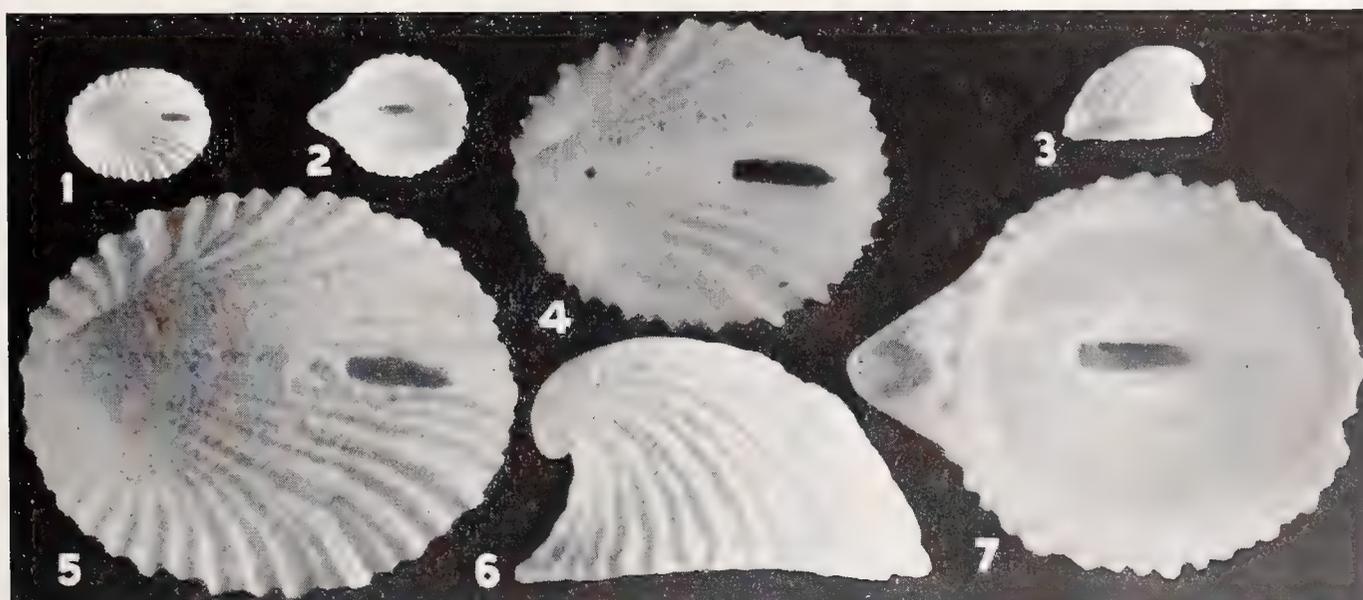
Rimula dorriae, new species, Plate 51, fig. 1-7

Description. Shell small, about 7 mm. in length, high, the height being about two thirds of the length. Base broadly ovate. Anterior slope convex, posterior slope concave. Apical whorls one and one half, prominent, placed high on the shell and just in front of the posterior end. Anal fasciole and fissure with the borders ridged. The fasciole with widely-spaced incremental lamellae. The fissure is rounded behind and tapers to a sharp point in front. Sculpture consists of about 25 radiating, very strong, ribs between each two of which there is a finer one. The shell is crossed by concentric threads which form elongated nodules where they intersect the ribs. Color white. Margin finely crenulated. In the interior of the shell the anal fasciole is rather heavily thickened.

	length	width	height	
(large)	6.25	5	4 mm.	Holotype
(average)	5.50	4.75	3.25	off Western Dry Rocks, Florida Keys

Types. Holotype, United States National Museum no. 454388, from off Western Dry Rocks, Florida, *Eolis*, station 319, in 90 fathoms. Paratypes, from off Western Dry Rocks, *Eolis*, station 320, in 80 fathoms, at the United States National Museum and at the Museum of Comparative Zoölogy, and from off Sambo Reef, Florida, *Eolis*, station 331, in 118 fathoms, at the USNM.

Remarks. This species, while quite different from any other in the Western Atlantic, appears to be nearer *R. aquisulpta* than to the rest of the species. It differs from *aquisulpta* in being higher, heavier, with coarser sculpture. In addition, its apex is much



Photographs by Marion Bills

Plate 51. *Rimula dorriae* Pérez Farfante.

Fig. 1-3 and 5-7. Off Sambo Reef, Florida (fig. 1-3, $2\frac{1}{2}\times$; fig. 5 and 7, $7\frac{1}{2}\times$; fig. 6, $7\times$).
Fig. 4. Off Western Dry Rocks, Florida (Holotype, $6\times$).

larger and more prominent, the anal fasciole is more conspicuous and its growth increase is shown by lamellae rather than by threads, such as occur in *R. aequisculpta*.

Range and Records. See under *Types*.

Named for Dorothea Slater, assistant in the Department of Mollusks at the Museum of Comparative Zoölogy.

Genus *Puncturella* Lowe

Puncturella Lowe 1827, Zool. Journ. 3, p. 77, 78.

Cemoria "Leach" Lowe 1827, Zool. Journ. 3, p. 77; Leach 1852, Synopsis Moll. Great Britain, p. 213; *non* Risso 1826.

Sipho Brown 1827, in part, Illust. Conch. Great Britain and Ireland, Index, p. 3, pl. 36, fig. 14-16; *non* *Sipho* Fabricius 1823; *non* "Klein" Mörch 1852.

Sypho Brown 1827, in part, Illust. Conch. Great Britain and Ireland, pl. 36, fig. 14-16 [this name appears in the explanation of the plates].

Rimula "Defrance" Couthouy 1838, Boston Journ. Nat. Hist. 2, p. 87; Lovén 1846, Öfvers. Vet. Akad. Förhandlingar, Stockholm, Index Moll. Scandinaviae, p. 153; *non* *Rimula* Defrance 1827.

Diodora Gray 1840, Synopsis of the Contents of the British Museum, p. 151 [name only]; *non* *Diodora* Gray 1821.

Cremoria Gray 1842, Synopsis Content British Museum, ed. 44, p. 63; 90 [I have not seen this paper].

Diadora "Gray 1821 de Blainville" Gray 1847, Proc. Zool. Soc. London, pt. 15, p. 147 [first reference, 155]; *non* *Diodora* Gray 1821.

Siphon "Brown" Gray 1847, Proc. Zool. Soc. London, pt. 15, p. 147.

Genotype, *Patella noachina* Linné (monotypic, Lowe 1827).

Much confusion has been created through Gray's use of the name *Diodora*. In 1821 he published his genus *Diodora*, mentioning *Patella apertura* Montagu in connection with it. Although many authors, who presumably had not seen Montagu's specimen, but his poor drawing only, have considered this species to be identical with *Patella noachina* Linné, other authors who did see this specimen, state that this was a young *Patella graeca* Linné. Accepting this latter view, we must include under Gray's *Diodora* the group of species which have the generic characters of *graeca*. This is what we have done in *Johnsonia* 1, no. 11.

In 1840, however, Gray again published the name *Diodora* without any description or reference, allowing it to be inferred that he was referring to his 1821 *Diodora*; but in 1847 he brought forward his *Diodora* 1840 in association with *P. noachina*. At the same time he erroneously ascribes to de Blainville 1825 (Manuel de Malacologie, p. 501) a reference to his (Gray's) 1821 "*Diadora*." De Blainville, however, did not spell the name "*Diadora*" but did refer to Gray's *Diodora* with the statement that this was based on *P. apertura* Montagu.

Risso in 1826 (Hist. Nat. L'Europe Méridionale, p. 258) used the name *Cemoria* for a genus he included in the family Fissurellidae and in a foot note indicated that this was a manuscript name of Leach. Risso's description however, does not apply at all to the genus *Cemoria* Leach (= *Puncturella* Lowe) but to *Patella equestris* Linné, his genotype (monotypic), which does not belong in the Fissurellidae.

Shell from a few millimeters to about 60 mm. in length; conical in form with top straight or recurved after the fashion of a Phrygian cap. Base very variable in shape: it may be narrow or broadly elliptical, narrow oval or more often broadly oval. Apex behind the middle of the shell center; it may be entire or absorbed. Apical whorls, when present, turned to the right and backwards, their position varying from one high on the shell and immediately posterior to the shell center, to one nearer the margin and beyond the posterior end. Fissure from lanceolate to circular. It varies in position along the anterior slope, from one near the middle of the slope to one at the summit of the shell. The most striking character is the interior septum which extends more or less obliquely downwards and forwards from the posterior end of the fissure: sometimes almost perpendicularly, when it divides the interior of the shell into two almost equal parts; at other times more obliquely, near the anterior slope, when it gives rise to a funnel-shaped formation. The septum in *Puncturella* is not related in anyway to the one in *Zeidora*. Anal fasciole present or absent: if the former is the case, it is rather deep and may be long or very short. It is formed by a series of erect, semilunar lamellae, which are the result of successive periods of growth. Sculpture very variable: it may be granular or may consist of radiating ribs which generally are crossed by concentric cords. If granular, the granules are arranged in one of the following three patterns: in rows radiating from the top of the shell to the margin; in diagonal and parallel lines; or, finally, in chevron formation. The radiating ribs also may be smooth or beaded; when concentric cords are present, they give rise to nodules where they intersect the ribs. Muscular impression with the ends turned backwards in the shape of a hook. The mantle protrudes through the fissure, forming a short tubular process.

In all genera of Fissurellidae, according to Odhner (*l.c.*, p. 99), "the border of the mantle forms folds of which the outermost (here better called the uppermost) lies close to the margin of the shell and remains small and thin. Then follow the median fold and the innermost fold (here better called the lowermost), both of which may become more complicated by the production of papillae. The flat space between the median and the innermost fold may become very large. The simplest condition of the mantle-border occurs in *Puncturella*, in which the border is divided as described above, but is as yet simple; the median and lower folds lie close together and are only slightly papillose. Since the folds mentioned above run around the shell, it follows that they occur also in the slit. In *Puncturella* all three may be traced distinctly along the margin of the slit. At the fissure the folds occur in reversed order, the uppermost fold forming a peripheral band; the median fold is folded back over the margins of the apical hole and produces here the papillae placed before and behind the fissure; the lowermost fold closes up siphon-like and protrudes through the fissure, but its margins remain free.

"In many genera of Fissurellidae the right tentacle bears behind the eye tubercle a long feeler, which has previously been called the penis in *Puncturella*. This structure is evidently connected with the sexual life since it is found only on the right side of the body, but cannot, however, be regarded as a penis in the strict sense, as it is not hollow and occurs moreover in all individuals, even the females. I call it therefore the sexual cirrus.

"In members of the Fissurellidae the lips surrounding the buccal opening bear erect and brush-like bristles. A circular brush of cuticular bristles is present, though weakly developed in *Puncturella*." In this genus the radula is not essentially different from that of *Emarginula*: the central or rachidian tooth is longer than wide, narrowing anteriorly,

and the outermost lateral tooth is bifid. The crop in *Puncturella* is like that of *Emarginula*, p. 99.

Subgenus **Cranopsis** *A. Adams*

Cranopsis A. Adams 1860, Ann. Mag. Nat. Hist. (3) 5, p. 302.

Rimulanax Iredale 1924, Proc. Linn. Soc. New South Wales 49, p. 218.

Subgenotype, *Cranopsis pelex* A. Adams (monotypic, A. Adams 1860).

Shell with the anal fasciole always present, rather deep, long or moderately so, depending on the position of the fissure. This is generally placed near the middle of the anterior slope but may move upwards to a position somewhat near the base of the apical whorls, which are always present. The fissure is rounded behind and narrowing in front. Internal septum convexly arched, generally narrow. From the anterior or lower end of the fissure, a fine groove extends to the anterior margin of the shell, visible on the inside as well as on the outside. In young shells the fissure is a slit open in front; this gives an *Emarginula*-like form. Later the margins of the slit partially unite, the union being marked by the groove described above.

Key to the species of *Cranopsis* in the Western Atlantic

- | | |
|--|--------------------------|
| 1. Shell sculptured with radiating ribs and concentric cords | 2 |
| Shell sculptured with radiating ribs, no concentric cords present | 5 |
| 2. Shell with apical whorls placed high on the shell, immediately below the summit, and behind the center | 3 |
| Shell with the apical whorls placed half way between the summit and the base, and near the posterior end | <i>P. (C.) antillana</i> |
| 3. Shell with the fissure at about the middle of the anterior slope | <i>P. (C.) asturiana</i> |
| Shell with the fissure higher on the anterior slope, near the base of the apical whorls | 4 |
| 4. Shell reticulated, strongly sculptured with raised radiating ribs and concentric cords | <i>P. (C.) erecta</i> |
| Shell not reticulated, finely sculptured with thin radiating riblets and concentric threads | <i>P. (C.) agger</i> |
| 5. Shell with radiating ribs showing elongated thickenings along their length | <i>P. (C.) billsae</i> |
| Shell with granulose radiating ribs | 6 |
| 6. Upper end of the fissure at about the middle of the anterior slope; radiating ribs fine and widely spaced | <i>P. (C.) larva</i> |
| Upper end of the fissure at the summit; radiating ribs rather strong and closely-set | <i>P. (C.) granulata</i> |

Puncturella (Cranopsis) asturiana *P. Fischer*, Plate 52, fig. 1-5

Rimula asturiana Jeffreys 1880, Ann. Mag. Nat. Hist. (5) 6, p. 317 [*nomen nudum*].

Rimula asturiana P. Fischer 1882, Journ. de Conchy. 30, p. 51 (Gulf of Gascony).

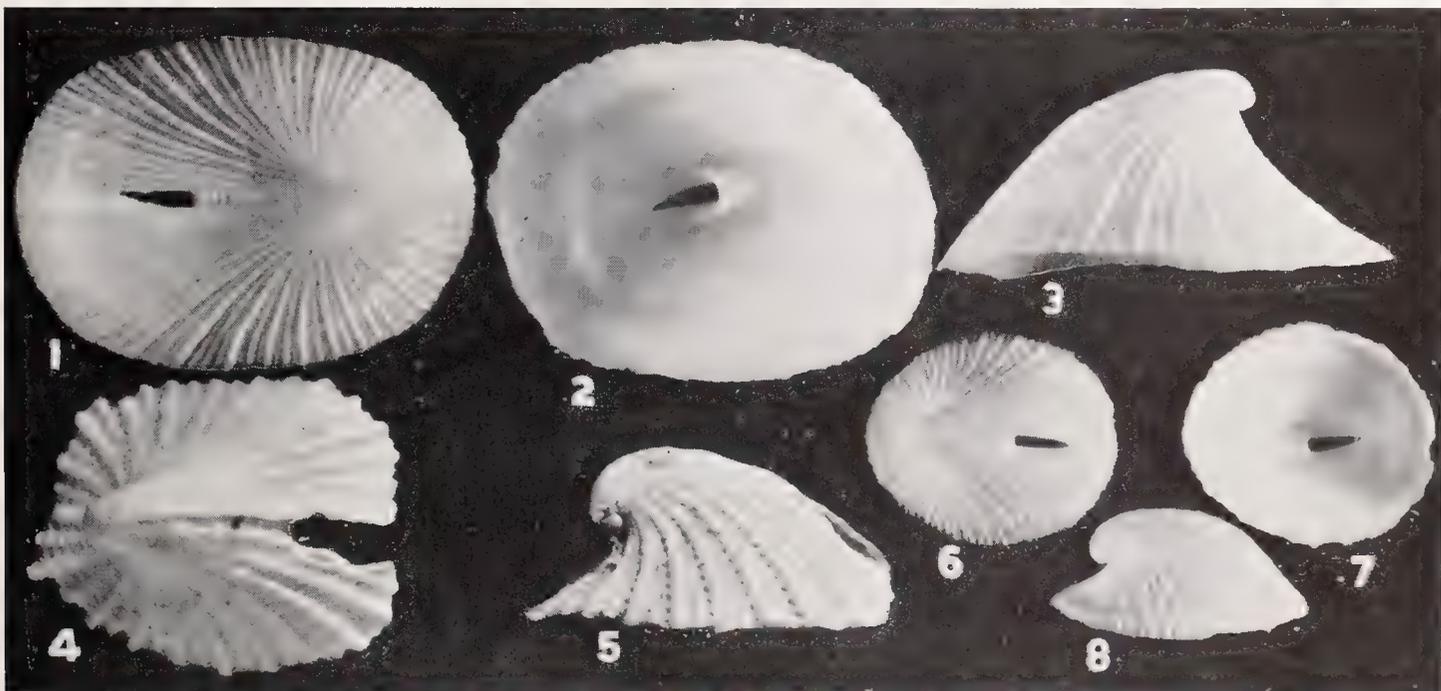
Puncturella (Cranopsis) asturiana Fischer, Watson 1883, Journ. Linn. Soc. 17, p. 29; Watson 1886, Challenger Report 15, p. 45, pl. 4, fig. 4 (off Saint Thomas, north of Culebra Island, West Indies); Dall 1889 [in part], Bull. Mus. Comp. Zoöl. 18, p. 404 (off Cape Florida); Dall 1889, Bull. United States Nat. Mus. 37, p. 170 (Cape Hatteras, Georgia, Florida Keys, West Indies to Saint Bartholomew); Dall 1890, Proc. United States Nat. Mus. 12, p. 358 (off Fernandina, Florida; off St. Bartholomew, West Indies).

Puncturella (Cranopsis) craticia Watson 1883, Journ. Linn. Soc. 17, p. 29 (off Saint Thomas, north of Culebra Island, West Indies).

Puncturella asturiana P. Fischer, Locard 1898, Exp. Scient. Travailleur et du Talisman, Moll. Test. 2, p. 77 (north of Spain, west of Cape Finesterre, west of Portugal, southwest of Spain).

Puncturella asturiana P. Fischer var. *alta* Locard 1898, Exp. Scient. Travailleur et du Talisman, Moll. Test. 2, p. 78.

Description. Shell highly sculptured, reaching a rather large size, about 21 mm. in length, and medium in height, the latter being about one half of the length. Color a pure or yellowish white. Base rather broadly elliptical or ovate. Anterior slope convex, posterior slope concave. Apical whorls prominent, from one and three quarters to two and one quarter, increasing rapidly in diameter, with the tip glossy, the rest opaque. They lie below but close to the summit on the right side and immediately behind the center of the shell. The anal fasciole starts near the base of the apical whorls; it is deep, bordered by sharp edges and formed by rather widely-spaced incremental lamellae, which are much less numerous than the concentric cords that cross the shell. Fissure at the middle of the anterior slope, rounded behind and narrowing in front to a point. In young individuals the fissure is a slit, open in front (Plate 52, fig. 4). When they approach maturity both sides of the fissure unite leaving a fine groove between them (Plate 52, fig. 1, 2). Sculpture consists of from 24 to 28 rather strong radiating ribs, starting at the base of the apical whorls. Lower down a secondary rib appears between each two of the primary ribs; they are at first rather fine, increasing in diameter until they equal the size of the primary ribs at the margin. Finally, a thread is intercalated between the primary and the secondary ribs. Two ribs, a little stronger than the rest, border the fine groove that extends from the lower end of the fissure to the margin. Numerous concentric cords cross the shell forming nodules where they intersect the ribs. The cords also divide the spaces between the ribs into more or less square and deep pits; this gives to the shell surface a lattice-like appearance. Margin finely denticulated. Interior of shell nacreous-white, and extending into the apical whorls. The primary ribs show through as shallow grooves which increase in depth as they approach the margin. The anal fasciole is marked by a thick callus. Internal septum convex, narrow and short, its length being less than half that of the fissure. A ridge is developed along each side of the fissure, continuous with the outer edge of the septum and extending to the margin. These ridges are separated beyond the fissure by the narrow groove mentioned above.



Photographs by Marion Bills

Plate 52. Fig. 1-3. *Puncturella (Cranopsis) asturiana* P. Fischer, off Brunswick, Georgia (2×). Fig. 4, 5. *Puncturella (Cranopsis) asturiana* P. Fischer [young], off Fernandina, Florida (8×). Fig. 6-8. *Puncturella (Cranopsis) antillana* Pérez Farfante, off Punta Alegre, Camagüey, Cuba (Holotype, 2×).

	length	width	height	
(large)	21	15	10 mm.	off Brunswick, Georgia
(average)	18	12	8	off Fernandina, Florida

Types. Lectotype, here selected, at the United States National Museum, no. 95108, from off Cape Finisterre, Spain, *Travailleur*, in 1103 fathoms (Jeffreys collection).

The lectotype is chosen from the original series of four specimens, collected by the *Travailleur*, on which Fischer based *P. (Cranopsis) asturiana* and has the same measurements as those given by him in his original description.

Remarks. *P. (Cranopsis) asturiana* is the largest species of the group occurring in the Western Atlantic. It lives in relatively deep waters, from 100 to 1103 fathoms.

See *Remarks* under *P. (Cranopsis) antillana* and *P. (Cranopsis) erecta*.

Range. EASTERN ATLANTIC: Gulf of Biscay along the north coast of Spain and off Portugal. WESTERN ATLANTIC: North Carolina and south to Saint Bartholomew, Lesser Antilles.

Smith (1896, *Ann. Mag. Nat. Hist.* (6) 18, p. 371; 1904, *Ann. Mag. Nat. Hist.* (7) 14, p. 5; and 1906, *Ann. Mag. Nat. Hist.* (7) 18, p. 247) has reported this species from the Indian Ocean.

Records. NORTH CAROLINA: off Cape Hatteras, *Albatross*, station 2601 in 107 fathoms (USNM). GEORGIA: off Brunswick, *Atlantis*, station 3781 in 265–290 fathoms (MCZ). FLORIDA: off Fernandina, *Albatross*, station 2668 in 294 fathoms, station 2666 in 270 fathoms, and station 2667 in 273 fathoms (all USNM); off Saint Augustine, *Atlantis*, station 3779 in 230–250 fathoms (MCZ). LESSER ANTILLES: off Saint Bartholomew, *Albatross*, station 2750 in 496 fathoms (USNM).

***Puncturella (Cranopsis) antillana*, new species, Plate 52, fig. 6–8**

Puncturella (Cranopsis) asturiana Dall 1889 [in part], *Bull. Mus. Comp. Zoöl.* 18, p. 404 (Yucatán Strait; off Habana, off Martinique); *non* P. Fischer 1882.

Description. Shell white, medium in size, generally not exceeding 13 mm. in length, thin and rather low, the height varying from 43% to 50% of the length. Base ovate. Anterior slope long and strongly convex, posterior slope short and strongly concave around the apical whorls, then slightly concave to the margin. Apical whorls very small, one and one half, inclined backwards and downwards to occupy a position halfway between the summit and the base and rather near the posterior end of the shell. They are also conspicuously turned to the right. Anal fasciole long, rather deep, bordered by sharp edges and with widely-spaced, raised, semilunar lamellae which are much less numerous than the concentric cords that cross the shell. Fissure at the middle of the anterior slope, rounded behind and narrowing in front to a point. Sculpture very compact, consisting of about 28 strong radiating ribs starting at the base of the apical whorls. Lower down a secondary rib appears between each two of the primary ribs; they are at first rather fine, increasing in diameter until they equal the size of the primary ribs at the margin. Finally a thread is intercalated between the primary and the secondary ribs. Two ribs, a little stronger than the rest, border the fine groove that extends from the lower end of

the fissure to the anterior margin. Numerous closely-set concentric cords cross the shell forming elongated and rather strong nodules where they intersect the ribs. Since ribs and cords are closely-set the shell has a granular appearance. Margin finely denticulated. Interior of shell nacreous-white, extending into the apical whorls. The radiating sculpture shows through as translucent fine grooves which increase in depth as they approach the margin. The anal fasciole is marked by a thick elongated callus. Internal septum convex, narrow and short, its length being less than half that of the fissure. A ridge is developed along each side of the fissure, starting from the outer edges of the septum and continuing to the margin. These are separated beyond the fissure by a fine groove.

	length	width	height	
(large)	13	11	6.5 mm.	off Saint Thomas, Virgin Islands
(average)	11.5	10	5	Holotype

Types. Holotype, Museum of Comparative Zoölogy, no. 160518, from off Punta Alegre, Camagüey, Cuba, *Atlantis*, station 2982A in 210 fathoms. Paratypes, from off Habana, *Blake*, station 100 in 250–400 fathoms (USNM and MCZ); from off Saint Thomas, Virgin Islands, Johnson Smithsonian Exp., station 94 in 300–400 fathoms (USNM); and from off Martinique, *Blake*, station 208 in 213 fathoms (MCZ).

Remarks. This species is very close to *P. (Cranopsis) asturiana*, but differs from it by having the apical whorls smaller, placed half way between the summit and the base and near the posterior end of the shell, while in *asturiana* they lie immediately below the summit and behind the center of the shell. In addition, *antillana* is thinner and smaller, probably not exceeding 14 mm. in length, and has a more compact sculpture, which gives a granular appearance to the surface of the shell.

Dall (*l.c.*) made reference to the differences shown by some specimens of *asturiana* from the Antilles, but considered them to be mere variations, stating that these specimens intergraded with the typical in a larger series. We have examined Dall's material and find that they do not intergrade, but show the differences given above.

Range. Along the West Indies.

Records. See under *Types*.

***Puncturella (Cranopsis) erecta* Dall, Plate 53, fig. 1–5**

Puncturella Cranopsis? erecta Dall 1889, Bull. Mus. Comp. Zoöl. **18**, p. 405 (off North Carolina).

Puncturella hendersoni Dall 1927 (February), Proc. United States Nat. Mus. **70**, Art. 19, p. 9 (off Sambo Reef, Florida and Maine).

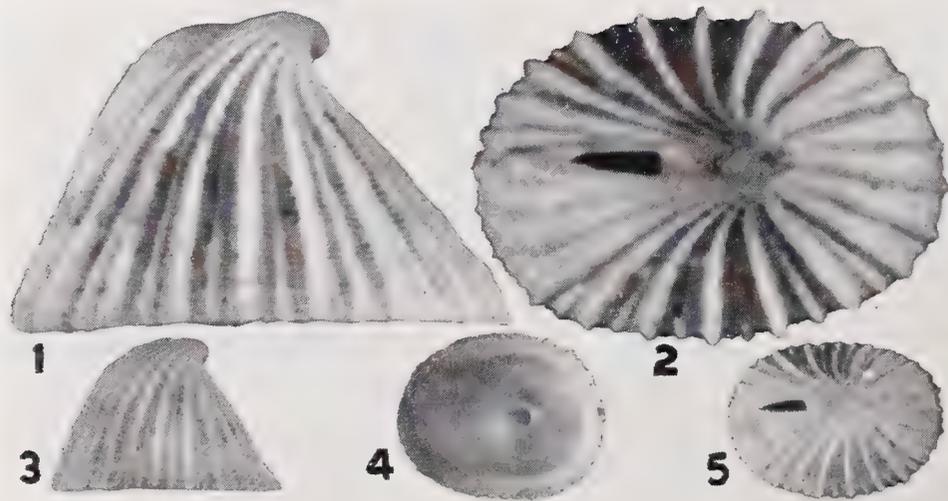
Puncturella hendersoni Dall 1927 (April), Proc. United States Nat. Mus. **70**, Art. 18, p. 111 (off Georgia; off Sambo Reef, Florida Strait).

Description. Shell conical, strong, beautifully sculptured and high, the height being from 65% to 80% that of the length. Base elliptical. Anterior slope extends at first almost horizontally forward, then turns down forming a rounded curve, and finally descends in almost a vertical line to the base. The posterior slope descends gradually to the base and it may be straight, slightly concave or even convex. Apical whorls one and one third or one and one half, small, though increasing rather rapidly in diameter. They lie immediately below the summit, a little behind the middle of the shell, being turned backwards and downwards against the posterior slope and towards the right. Fissure long

and narrow, high on the anterior slope, rounded at the upper end and produced in front to a point. The fissure is generally edged by two narrow extensions of the walls of the shell which merge at the lower end of the fissure with two closely-set ribs that run from the lower end of the fissure to the margin. These two ribs border the groove that extends from the lower end of the fissure to the margin of the shell. A moderately long anal fasciole occupies the summit of the shell; it is formed by several semilunar incremental lamellae. Sculpture consists of 23 strong, markedly raised, widely-spaced radiating ribs starting at the base of the apical whorls. Lower down, a secondary rib appears between each two of the primary ribs; these are at first very fine, increasing in diameter until they equal the size of the primary ribs at the shell margin. Finally a thread is intercalated between the primary and secondary ribs. Numerous concentric cords cross the shell, dividing the spaces between the ribs into rectangular pits, which are relatively deep; this gives to the shell surface a reticulated appearance. Margin strongly crenulated by the ends of the ribs which, near the margin, are marked in the inside by rather strong grooves. Interior of shell nacreous-white, the outside ribs showing through as translucent radiating fine lines. In this species the interior does not extend into the apical whorls, stopping short at their base. The internal septum is strongly convex, rather short, extending forward for about one third the length of the fissure. It continues as a ridge on each side of the fissure, and extends from the lower end of the latter to the margin of the shell. This ridge has a fine groove running down the middle of it.

	length	width	height	
(large)	15	11	10 mm.	off Western Dry Rocks, Florida Keys
(average)	10	7.5	7	Holotype

Types. The holotype of *P. erecta* is at the United States National Museum, no. 95147, the type locality being off Cape Hatteras, North Carolina, *Albatross*, station 2601 in 107 fathoms. The holotype of *P. hendersoni* is at the same institution, no. 333723, from off Sambo Reef, Florida Keys, *Eolis*, station 330 in 120 fathoms. Paratype from off Western Dry Rocks, Florida Keys. The other paratypes mentioned by Dall from Maine are actually specimens of *P. noachina*. Dall published *P. hendersoni* a second time, choosing



Photographs by Marion Bills

Plate 53. *Puncturella (Cranopsis) erecta* Dall

Fig. 1, 2. Off Cape Hatteras, North Carolina (Holotype, 5×). Fig. 3-5. Off Sambo Reef, Florida (Holotype of *P. hendersoni* Dall, 2½×).

then as type a different specimen, from off Georgia [off Cumberland Island] *Albatross*, station 2415 in 440 fathoms, which is also at the United States National Museum, no. 333491.

Remarks. In 1889 Dall published *P. erecta*. In 1927 he overlooked this species and published it again under the name of *P. hendersoni* and two months later it appeared still another time under the same name as a new species. Different type specimens were selected for all these descriptions.

P. (Cranopsis) erecta is one of the most beautiful species in the genus, being quite distinctive and readily separable from *P. (Cranopsis) asturiana*, its nearest relative in the Western Atlantic. *P. asturiana* is a broader shell, with larger apical whorls which stand out conspicuously on the posterior slope. The sculpture however, is much stronger in *erecta*, where the radiating ribs are more elevated and the concentric cords stronger. Finally, the fissure in the latter species is placed higher on the anterior slope.

P. erecta is included in the subgenus *Cranopsis* as it possesses a moderately long anal fasciole and a distinctive groove extending from the lower end of the fissure to the shell margin, visible both internally and externally. This species lives in moderate depths, occurring in 107 to 440 fathoms. It appears to be quite rare as only a few specimens have been obtained from the several dredging trips made along the coasts of North Carolina, Georgia and Florida.

Range. Cape Hatteras, North Carolina and south along the coast of Florida to the lower Florida Keys.

Records. See under *Types*. FLORIDA: off Florida Reefs (MCZ).

***Puncturella (Cranopsis) billsae*, new species, Plate 54, fig. 1-3**

Description. Shell very small, about 3.5 mm. in length, strongly compressed and high, the height being 70% to 85% of the length. Color white under a pale green periostracum. Base narrow ovate. Anterior slope strongly convex, posterior slope concave along its entire length. Apical whorls one and one half, the tip smooth and highly glossy, the rest rough. The apical whorls are turned backwards to such an extent that they project slightly beyond the posterior end. They lie on the right side of the shell. The anal fasciole runs from the fissure almost to the apex and it is provided with numerous incremental lamellae. Fissure at the summit of the shell, rounded at its upper end and narrowing down to a point. A groove extends from the fissure to the margin of the shell, along the mid-line of the anterior slope bordered by ribs a little stronger than the remaining ribs on the shell. Sculpture consists of numerous closely-set radiating ribs starting at the base of the apical whorls. There are no true cords, but the radiating ribs show all along their length elongated thickenings which are concentrically arranged. Between each two ribs there is a series of white punctules which alternate with these thickenings. Margin finely crenulated. Interior of shell glossy with the punctules of the outside showing through as white points. Internal septum long, extending down far beyond the lower end of the fissure. It is slightly convex and runs close to the anterior slope, thus giving rise to a funnel-like formation.

length	width	height	
3.5	2.25	2.75 mm.	off Carysfort Reef, Florida
3	2	2.25	Holotype

Types. Holotype, United States National Museum, no 333728, from off Sand Key, Florida, *Eolis*, station 164 in 92 fathoms. Paratypes, from off Carysfort Reef, Florida, *Albatross*, station 2641 in 60 fathoms, in the United States National Museum; from off Key West, Florida, *Eolis*, station 333 in 110 fathoms, in the Museum of Comparative Zoölogy; and from Bahía de Cochinos, *Atlantis*, station 3332 in 175–225 fathoms, at the University of Habana.

Remarks. This species seems to be related to *P. granulata* but they differ, however, quite sharply. In profile the apical whorls of *P. billsae* are produced beyond the posterior margin, while in *P. granulata* they are located in front of the posterior margin. In *P. billsae* the posterior slope is strongly concave throughout its entire length; in *P. granulata* the posterior slope is straight below the apical whorls. Finally, the sculpture of *P. billsae* consists of very compact radiating ribs which show elongated thickenings along their courses while in *P. granulata* the radiating ribs are not so closely set and show granules rather than thickenings.

Range and Records. See under *Types*.

This species is named for Miss Marion A. Bills.

Puncturella (Cranopsis) granulata Seguenza, Plate 54, fig. 4–7

Rimula granulata Seguenza 1863, Ann. Acc. Aspir. Natural. (3) 2, p. 88, pl. 5, fig. 6, 6a (from the Miocene of Rometta, Messina, Sicily).

Puncturella (Cranopsis) granulata Seguenza, Watson 1883, Journ. Linn. Soc. 17, p. 31; Watson 1886, Challenger Report 15, p. 46, pl. 4, fig. 5 (off St. Thomas, north of Culebra Island, West Indies); Dautzenberg and H. Fischer 1896, Mém. Soc. Zool. France 9, p. 491 and 1897, *ibid.* 10, p. 180 (Azores).

Puncturella (Cranopsis) tuberculata Watson 1883, Journ. Linn. Soc. 17, p. 31 (off St. Thomas, north of Culebra Island, West Indies).

Puncturella Watsoni Dall 1889, Bull. Mus. Comp. Zoöl. 18, p. 403 (Barbados; off Bahía Honda, Cuba; off Yucatán); Dall 1889, Bull. United States Nat. Mus. 37, p. 168 (Gulf of Mexico, West Indies to Barbados).

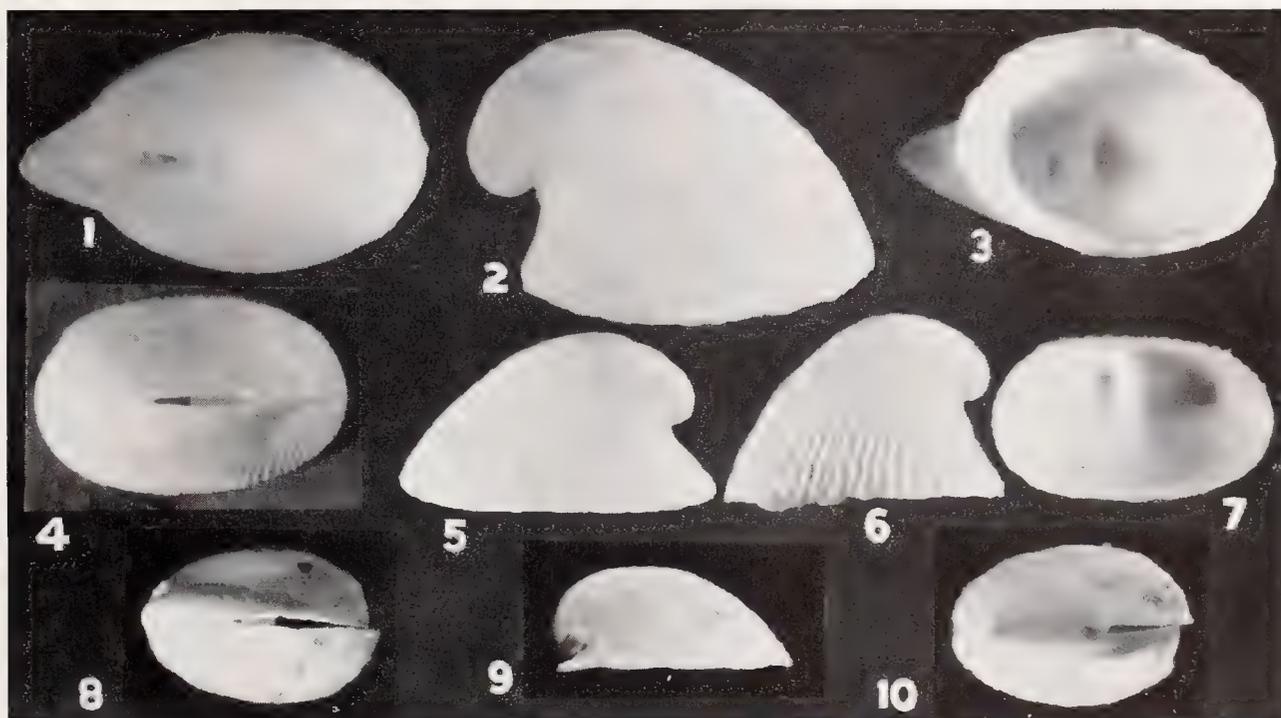
Description. Shell small, probably not exceeding 8 mm. in length, compressed, very variable in height, which may be from 45% to 75% of the length. Color oyster-white under a very thin yellowish periostracum, which is partially flaked off. Base a narrow elongated oval. Anterior slope long and rather strongly convex, posterior slope short, concave around the apical whorls, then straight to the margin. Apical whorls prominent, from one and three quarters to two and one half, increasing rapidly in diameter after the first whorl, smooth, the tip glossy and standing out with considerable distinctness. They lie on the right side of the shell, turned backwards and downwards, their position varying from one rather high on the posterior slope to one somewhat lower down. Anal fasciole with numerous closely-set incremental lamellae. Fissure narrow and elongated, rounded at the upper end and narrowing in front to a point. It lies high on the front slope, its upper end rising to the summit of the shell, but still remote from the apex. From the fissure a fine groove runs down the front slope bordered on each side by a small ridge. Sculpture consists of very numerous radiating granulose ribs. The granules are very fine at first, increasing progressively in size toward the margin where they are rather prominent. There is no true concentric sculpture. Margin finely denticulated. Interior of shell glossy. The internal septum extends down for about three quarters the length of the fissure. The groove that runs from the fissure to the margin is more conspicuous on the inside of the shell where it is edged by very thin calluses which are prolonged to include the fissure.

	length	width	height	
(large)	7.75	4.75	3.75 mm.	off Culebra Island, West Indies (Watson 1883)
(average)	4.5	3	2.75	Campeche Bank, Yucatán, Mexico

Types. The whereabouts of the type specimen of *Puncturella (Cranopsis) granulata* Seguenza is unknown to me. The type locality is the Miocene of Rometta, Messina, Sicily.

The lectotype of *Puncturella watsoni* Dall, here selected, is in the United States National Museum, no. 85146, from off Barbados, in 100 fathoms. It was collected by the *Blake*. Paratypes, in the same institution, from off Campeche Bank, and off Yucatán, Mexico; and in the Museum of Comparative Zoölogy, from off Bahía Honda, Cuba, and from off Barbados.

Remarks. I am unable to separate *P. watsoni* Dall from *P. granulata* Seguenza. A re-examination of Dall's types definitely places *watsoni* in *Cranopsis* and not in *Puncturella* s.s. as originally stated by Dall. *P. watsoni* agrees in all its characters with *P. granulata*: in having the fissure somewhat distant from the apex; in having a moderately long anal fasciole; and in possessing a well marked groove from the lower end of the fissure to the margin of the shell. Dall states that *watsoni* is higher than *granulata* but our studies indicate a wide range in the ratio of height to length, from 48% to 75%.¹ The ratio of height to length obtained from Seguenza's measurements is 66%, a figure well within



Photographs by Marion Bills (fig. 1-7); Frank White (8-10)

Plate 54. Fig. 1-3. *Puncturella (Cranopsis) billsae* Pérez Farfante, off Sand Key, Florida, Holotype (fig. 1, 3, 10×; fig. 2, 13×). Fig. 4, 5. *Puncturella (Cranopsis) granulata* Seguenza, Campeche Bank, Yucatán, Mexico (7×). Fig. 6, 7. *Puncturella (Cranopsis) granulata* Seguenza, off Barbados, Lesser Antilles (10×). Fig. 8-10. *Puncturella (Cranopsis) larva* Dall, off Fernandina, Florida (Holotype, 8×).

¹I have examined the type series of *watsoni* Dall. There is no specimen remaining whose measurements agree with those he published, which gave a ratio of height to length of 82%.

the range of the ratios for the Western Atlantic form. Again, the anterior and posterior slopes vary in different specimens, a factor of course responsible for the variation of the height-length ratios given above. This variation may be directly due to immediate factors in the environment, that is, the objects upon which these animals are attached. This condition is probably not different from that exhibited by various species in the genus *Crepidula*, in which the slope of the shell varies tremendously, depending upon the flatness or curvature of the place of attachment.

See *Remarks* under *P. (Cranopsis) billsae*.

Range. EASTERN ATLANTIC: AZORES. WESTERN ATLANTIC: Florida Keys and south along the coast of Mexico and through the West Indies.

Records. FLORIDA: off Sambo Reef, *Eolis*, station 331 in 118 fathoms (USNM). CUBA: off Bahía Honda, *Blake*, station 20 in 220 fathoms (MCZ); Bahía de Cochinos, *Atlantis*, station 3332 in 175–225 fathoms, station 3335 in 200 fathoms and station 3338 in 1075 fathoms (all Univ. of Habana). LESSER ANTILLES: off English Harbor, Antigua, State Univ. of Iowa Exp., station 496 in 120 fathoms (USNM); off Barbados, *Blake*, in 100 fathoms; off Lazaretto, State Univ. of Iowa Exp., station 483 in 90–100 fathoms; off Pelican Id., State Univ. of Iowa Exp., station 505 in 80–90 fathoms (both USNM).

***Puncturella (Cranopsis) larva* Dall, Plate 54, fig. 8–10**

Rimula larva Dall 1927, Proc. United States Nat. Mus. 70, Art. 18, p. 113 (off Fernandina, Florida).

Description. Shell delicate, low, the height being less than half the length. Basal margin oval. Anterior slope long and convex, posterior slope very short and concave. Apical whorls one and one quarter, glossy, almost terminal, located almost immediately behind the posterior margin and on the right side. Anal fasciole very narrow and depressed, starting rather far from the apex and extending only a short distance. Fissure lanceolate and narrow, continuing to the margin in the form of a very narrow slit. Sculpture consists of rather widely-spaced granulose radiating ribs, stronger on the posterior half of the shell. There is no true concentric sculpture, but the lines of growth are clearly seen. Interior of the shell highly polished. The anal fasciole marked by a slightly convex callus. The posterior end of the fissure is covered by a short septum. Muscular impression clearly marked.

length	width	height	
3	2	1.3 mm.	Holotype

Types. Holotype, United States National Museum, no. 108148, from off Fernandina, Florida, *Albatross*, station 2668 in 294 fathoms. Paratypes from the same locality, also in the USNM.

Remarks. Though originally described as a species in the genus *Rimula* by Dall, it is a *Puncturella* in the subgenus *Cranopsis*. It belongs here primarily because it possesses a septum; it has also a fissure continued as a slit to the margin, a condition found in young shells of *Cranopsis*. Dall's types are immature specimens; adults are as yet unknown.

Range and Records. See under *Types*.

Puncturella (Cranopsis) agger Watson, Plate 55, fig. 1-6

Puncturella agger Watson 1883, Journ. Linn. Soc., London, **17**, p. 32; Watson 1886, Challenger Report **15**, p. 40, pl. 4, fig. 6a-e (off St. Thomas, north of Culebra Island, West Indies); Dall 1889, Bull. United States National Museum **37**, p. 168 (Florida Strait, East Florida, West Indies).

Description. Shell small, generally not exceeding 6 mm. in length, conical, moderately high, with the top slightly flattened. Base elliptical, the same width at both ends. Color translucent-white under a thin brown periostracum which is partially flaked off. Anterior slope convex, posterior slope straight. Apical whorls one and three quarters (the whole shell consisting of two and one quarter whorls), increasing rather rapidly in diameter, the tip glossy and smooth, the rest rough in appearance. They are not set exactly on top of the shell, but are turned backwards and downwards against the posterior slope. The nuclear whorls lie to the right of the shell, but at the same time the axis about which they coil is not at right angles to the anterior-posterior axis of the shell, but is turned to the right. The orifice lies high on the anterior slope, its upper end at the summit of the shell but still not close to the apex. The fissure is long and narrow, rounded at the upper end and narrowing in front to a point. From the lower end two ridges extend to the margin of the shell, these ridges being separated by the groove that is produced along the middle of the anterior slope. Sculpture consisting of a series of fine primary riblets, radiating from the base of the apical whorls to the margin. Secondary riblets, which start lower down, alternate with the primary riblets. Finally, in the interspaces between the primary and secondary riblets there may be one to three threads. All the riblets and the threads are very slight but are made more distinct by the closely-set nodules formed at the intersection of the concentric threads and the radiating riblets. Sometimes all the riblets



Photographs by Marion Bills

Plate 55. *Puncturella (Cranopsis) agger* Watson

Fig. 1-3. Off Fowey Rocks, Florida Keys (10×). Fig. 4-6. Campeche Bank, Mexico (7×).

start near the base of the apical whorls thus giving rise to a rather compact sculpture (Plate 55, fig. 1-3). In the spaces between the riblets there is a row of punctules, alternating with the nodules. Margin thin and smooth. Interior of shell glossy, the punctules of the outside showing through as radiating rows of white points. A groove runs from the fissure to the margin, bordered on either side by a shallow callus which is prolonged to include the orifice. Septum glassy and short.

	length	width	height	
(large)	6	4.5	3.25 mm.	off Fowey Rocks, Florida Keys
(average)	5	4	2.5	Campeche Bank, off Yucatán, Mexico

Types. The types are in the British Museum, the type locality being off Saint Thomas, north of Culebra Island, West Indies, *Challenger*, station 24 (N. Lat. $18^{\circ}38'30''$; W. Long. $65^{\circ}5'30''$) in 390 fathoms.

Remarks. *Puncturella agger* is an intermediate form and consequently difficult to assign to a subgenus. The highly placed fissure and the short anal fasciole would tend to justify its inclusion in *Puncturella* s.s. However, the well marked groove from the lower end of the fissure to the margin of the shell is characteristic of the subgenus *Cranopsis*, in which I have provisionally placed this species.

Puncturella agger superficially resembles *P. profundus* Jeffreys. They differ, however, in the following characters: *P. agger* has the top of the shell flattened while this is not true of *P. profundus*. *P. agger* has a lanceolate fissure while *P. profundus* has one that is pear-shaped; in addition, the latter species does not have those characters which are responsible for the inclusion of *agger* in the subgenus *Cranopsis*: that is to say *P. profundus* has neither anal fasciole, nor groove, and so belongs to *Puncturella* s.s.

Range. Florida Keys and south, probably along the coast of Central America and the West Indies.

Records. FLORIDA: off Fowey Rocks, in 465 fathoms (USNM); off Sand Key, in 136 fathoms (ANSP); off Conch Reefs, *Bibb*, in 169 fathoms (MCZ). CUBA: Bahía de Cochinos, *Atlantis*, station 3338 in 1075 fathoms (Univ. of Habana). LESSER ANTILLES: north of Culebra Island, *Challenger*, station 24, in 390 fathoms (Watson 1883). MEXICO: off Yucatán, Campeche Bank, in 200 fathoms (USNM).

Subgenus *Puncturella* *Lowce*

Shell generally without anal fasciole, sometimes with a very small one. Fissure at or very near the base of the apical whorls, which are always present. Fissure from lanceolate to circular. Internal septum generally very well developed, long and wide, as a shelf extending from side to side; although in a few species it is short. There is no groove on the external surface from the lower end of the fissure to the anterior margin; this is also generally the case on the internal surface but here sometimes a fine groove may be present. Sculpture very variable: all the types described for the genus are found in *Puncturella* s.s.

***Puncturella (Puncturella) profunda* Jeffreys, Plate 56, fig. 1-5**

Puncturella profunda Jeffreys 1877, Ann. Mag. Nat. Hist. (4) **19**, p. 232 (off Cape Mondego, Portugal, and off Cape Farewell, Greenland); Jeffreys 1883, Proc. Zool. Soc. London, pt. 4, p. 675, pl. 50, fig. 10 (off Cape Mondego, Portugal; off Cape Farewell, Greenland; Bay of Biscay; and off Culebra Island, West Indies); Watson 1883, Journ. Linn. Soc., London, **17**, p. 35 (north of Culebra Island); Dautzenberg and Fischer 1896, Mém. Soc. Zool. France **9**, p. 491 (Azores); Locard 1898, Exp. Scient. Travailleuse et du Talisman, Moll. Test. **2**, p. 80 (west of Finesterre and west of Sahara); Dall 1889, Bull. United States Nat. Mus. **37**, p. 168 (off Fernandina, Georgia, East Florida, West Indies); Dall 1927, Proc. United States Nat. Mus. **70**, Art. 18, p. 111 (off Fernandina and Georgia).

Puncturella acuta Watson 1883, Journ. Linn. Soc., London, **17**, p. 35 (north of Culebra Island, West Indies).

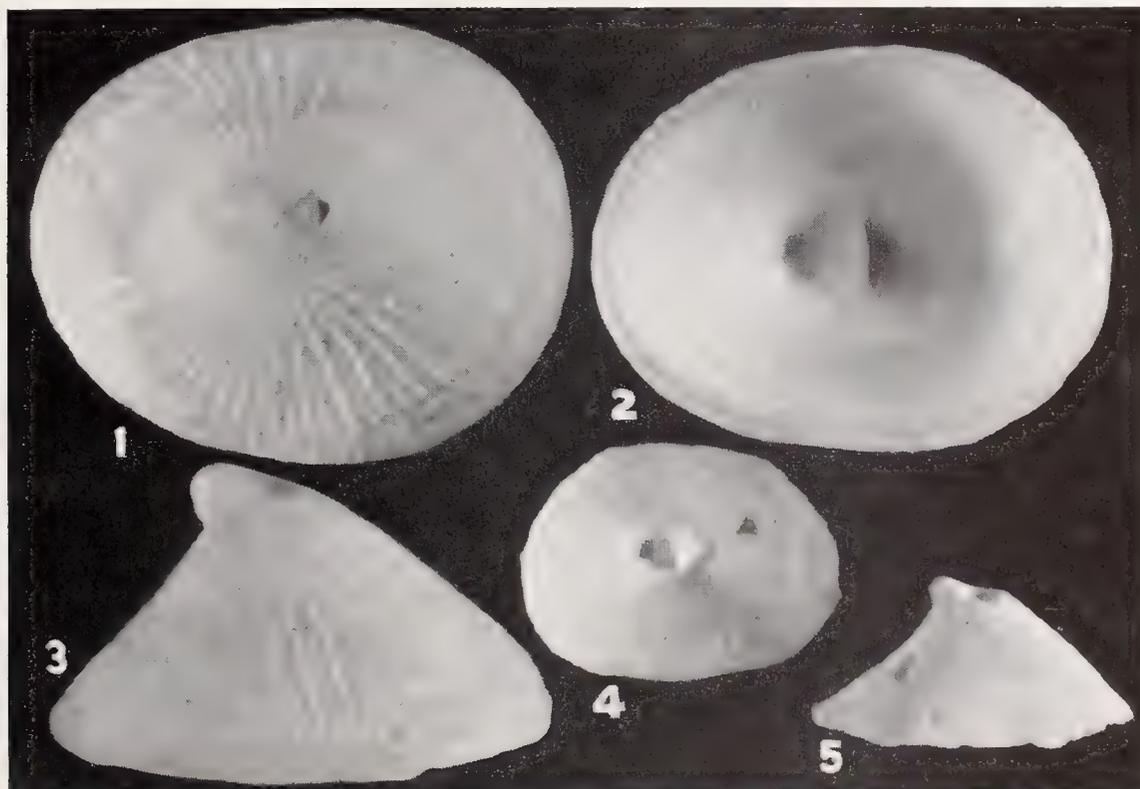
Puncturella (Cranopsis) profunda Jeffreys, Watson 1886, Challenger Report **15**, p. 47 (north of Culebra Island, West Indies).

Puncturella profunda 'Jeffreys' Locard 1886, Prodr. Malac. Franç., Moll. Mar., p. 336 (Gulf of Gascony).

Puncturella profunda 'Jeffreys' Locard 1899, Coq. mar. au large des côtes de France, p. 109.

Puncturella profunda var. *multifila* Dall 1927, Proc. United States Nat. Mus. **70**, Art. 18, p. 111.

Description. Shell small, about 6 mm. in length, thin but strong, conical, expanding gradually from the top to the margin, the height varying from 50% to 80% of the length. The anterior half of the shell has straight or slightly convex sides; the posterior half, slightly concave sides. Base broadly ovate. Apical whorls from one and one quarter to one and one half, smooth, glossy, slightly projecting upwards. They lie immediately behind the orifice, to the right of the shell, but since the axis about which they coil is not at right angles to the anterior-posterior axis of the shell, but is turned to the right, the whorls lie obliquely on the posterior slope. The orifice is rather short, pear shaped, sometimes occupying an almost horizontal position at the top of the shell. Sculpture very fine consisting of numerous radiating riblets starting around the orifice, intermediate ones



Photographs by Marion Bills

Plate 56. *Puncturella (Puncturella) profunda* Jeffreys

Fig. 1-3. Off Fernandina, Florida (12×). Fig. 4, 5. Off Cumberland Island, Georgia (6×).

being intercalated lower down. These riblets are beaded by numerous granules formed at the intersection of fine, closely-set threads with the riblets, giving the shell a granular appearance. Margin smooth in adults and very finely crenulated in young specimens. Interior of shell highly polished and glossy, extending deeply into the apical whorls. Internal septum is a flat shelf reaching from one side of the shell to the other and extending downwards for about a third of the distance from apex to base.

	length	width	height	
(large)	5	4	2.50 mm.	off Fernandina, Florida
(average)	4.25	3.25	3	Holotype ¹

Types. Holotype, United States National Museum, no. 178887, from off Cape Mondego, Portugal (N. Lat. 39°55'; W. Long. 9°56'), *Porcupine* (1870), station 16 in 994 fathoms. Paratypes, from the same locality, from off Cape Farewell, Greenland, *Valorous* station 12 (N. Lat. 56°11'; W. Long. 37°44') in 1450 fathoms, both series at the United States National Museum; and from off Cape Mondego, Portugal, *Porcupine*, stations 17 and 17a in depths from 740 to 1095 fathoms. The whereabouts of the last mentioned paratypes is unknown to me.

Remarks. *P. profundi* is a deep sea species, with a wide distribution. Dall (1927, p. 111) described *multifila* from the Western Atlantic as a variety of *profundi* on the following basis: "the radial sculpture alternates stronger and weaker and is more or less granulated by incremental lines." In the Western Atlantic we find typical specimens along with others which have the radiating ribs more widely spaced, the intermediate riblets proportionally finer and the concentric threads almost invisible in the spaces between the ribs and riblets, while the concentric lines of growth are very distinct. All other characters are the same in both forms, and having found intermediate forms that merge one into the other, we conclude that the specimens with a lighter and more widely-spaced sculpture can not possibly be considered to constitute a good variety. The differences referred to above are quite common among the species of *Puncturella*: *P. noachina* is a good case in point. See *Remarks* under *P. agger* and *P. circularis*.

Range. EASTERN ATLANTIC: from the Bay of Biscay to northwestern Africa and the Azores. WESTERN ATLANTIC: from Cape Farewell, Greenland, south along the West Indies and the coast of Mexico and Central America.

Records. WESTERN ATLANTIC: GREENLAND: off Cape Farewell, *Valorous*, station 12 in 1450 fathoms (Jeffreys 1877). GEORGIA: off Cumberland Id., *Albatross*, station 2668 in 294 fathoms. FLORIDA: off Fernandina, *Albatross*, station 2415 in 440 fathoms. LESSER ANTILLES: off Culebra Island, *Challenger*, station 24 in 390 fathoms (Jeffreys 1883 and Watson 1883).

***Puncturella (Puncturella) circularis* Dall, Plate 57, fig. 1-4**

Puncturella circularis Dall 1881, Bull. Mus. Comp. Zoöl. 9, p. 75; Dall 1889, Bull. Mus. Comp. Zoöl. 18, p. 403, pl. 26, fig. 7, 7b (off Dry Tortugas, Florida); Dall 1927, Proc. United States Nat. Mus. 70, Art. 18, p. 112 (off Fernandina, Florida).

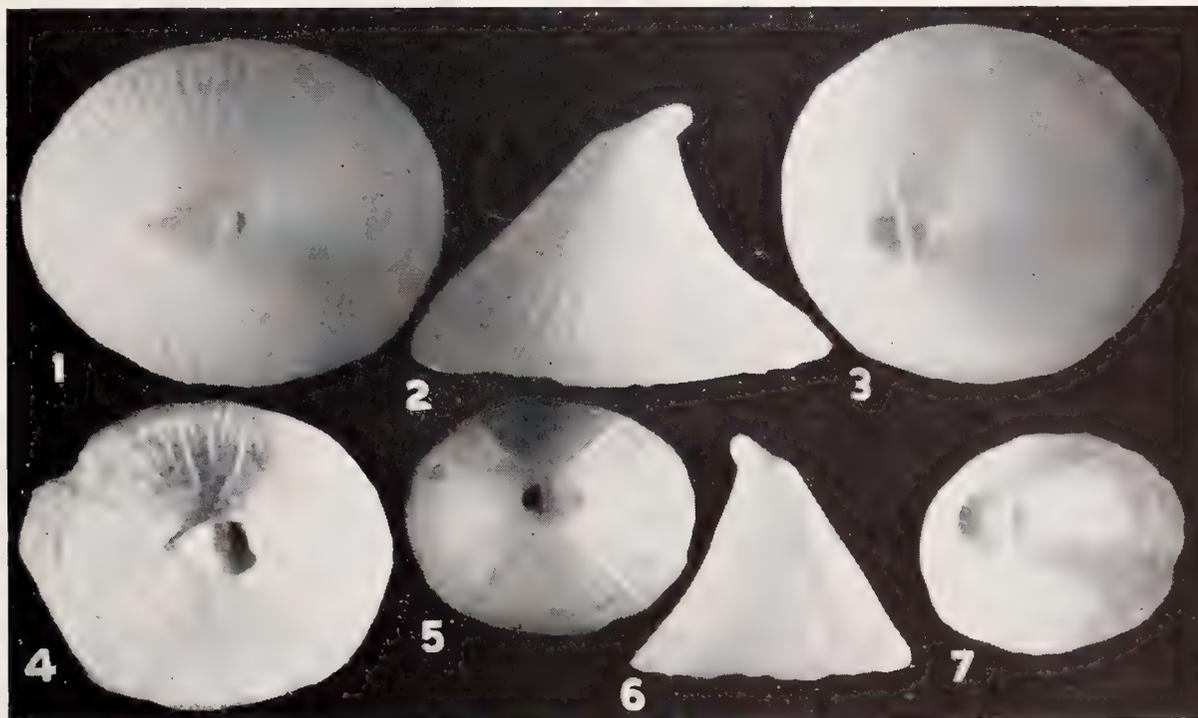
¹ Jeffreys (1877, p. 232) published measurements are in error as they do not agree with those of his holotype or with the length of the shell of his published figure.

Description. Shell thin, small, about 7 mm. in length, conical, expanding rather abruptly toward the margin, height very variable, from 60% to 85% of the length. Color a glossy oyster-white. Anterior half of the shell has straight sides, while the posterior half has concave sides. Apical whorls one and one half, smooth and highly polished. They lie at the summit of the shell, immediately behind the fissure and project markedly backwards instead of lying flat against the side of the shell as in certain other species. Fissure rounded in front and drawn backwards and upwards to a point in the shape of a tear drop. In very young specimens the surface of the shell is smooth. The same is true of adults so far as the area around the summit is concerned; the remainder of the adult shell however is sculptured with fine beaded radiating ribs. These, as they approach the margin, are augmented by finer intercalated ribs. Numerous extremely fine threads cross the shell, beading the ribs at the point of intersection and giving to the surface a peculiar delicately foliated appearance. Margin faintly crenulated. Interior of shell glossy. The radiating ribs of the outside are marked by translucent lines. Well down towards the margin a ridge is found, below which is the muscular scar. The septum is a shelf extending from side to side and down for a short distance. It divides the interior of the shell into two almost equal parts, the anterior being slightly smaller than the posterior.

	length	width	height	
(large)	6.5	5.25	4 mm.	off Bahía de Santa Clara, Cuba
(average)	5	4.25	4.25	off Sagua la Grande, Cuba

Types. Holotype, United States National Museum, no. 333724, off Dry Tortugas, Florida, *Blake*, station 44 (N. Lat. 25°33'; W. Long. 84°35') in 539 fathoms.

Remarks. This beautiful species is rather rare. It is a deep sea form, living in depths ranging from 380 to 580 fathoms.



Photographs by Marion Bills

Plate 57. Fig. 1-3. *Puncturella (Puncturella) circularis* Dall, off Bahía de Santa Clara, Matanzas, Cuba (7×). Fig. 4. *Puncturella (Puncturella) circularis* Dall, off Dry Tortugas, Florida (Holotype, 7×). Fig. 5-7. *Puncturella (Puncturella) borroi* Pérez Farfante, off Baracoa, Oriente, Cuba (Holotype, 7×).

P. circularis is very closely related to *P. borroi*. See *Remarks* under this latter species. It resembles superficially *P. profundi*, but they can easily be separated: *P. circularis* is narrower near the top and it expands rather abruptly toward the margin, while *P. profundi* expands gradually from the top to the margin. The apical whorls in *P. profundi* are a little larger and lie slightly flattened against the posterior slope, while in *P. circularis* the apical whorls project markedly backward. In addition, the sculpture of *P. profundi* is more compact and extends over the entire shell below the apical whorls while in *P. circularis* the compact sculpture is limited to the basal area of the shell.

Range. Eastern Florida, Florida Keys, Cuba and south to Tobago Island.

Records. FLORIDA: off Fernandina, *Albatross*, station 2668 in 294 fathoms; off Tortugas, *Blake*, station 44 in 539 fathoms (both USNM). CUBA: off Bahía de Cárdenas, *Atlantis*, station 2993 in 580 fathoms; off Bahía de Santa Clara, *Atlantis*, station 2991 in 575 fathoms and station 2988 in 380 fathoms (all MCZ); off Cienfuegos, *Atlantis*, station 3338 in 1075 fathoms (Univ. of Habana). LESSER ANTILLES: Tobago Island (Dall 1927, p. 112).

Puncturella (Puncturella) borroi, new species, Plate 57, fig. 5-7

Description. Shell very thin and small, about 4 mm. in length, acutely conical, high, the height being from 70% to 90% of the length, and with a few spaced radiating threads front and back but not on the sides. Shell translucent white, the anterior half with straight or slightly convex sides, the posterior half with concave sides. Apical whorls one and one half, smooth and glossy. They lie at the top of the shell, immediately behind the middle and project markedly backwards. Fissure rounded in front and drawn backwards and upwards to a point, in the shape of a tear drop. Shell highly polished with eight to ten radiating, fine, beaded threads in front and seven on the back. These threads begin at the top, while a few intermediate ones appear lower down. Both sets extend to the margin, which is thin and smooth. Interior glossy, with the threads on the exterior of the shell marked as fine radiating lines or grooves. The septum is a flat triangular shelf extending from side to side and down for a short distance. It divides the interior of the shell into two almost equal parts, the anterior being only slightly smaller than the posterior.

	length	width	height	
(large)	4.25	3	3.25 mm.	off Bahía de Cárdenas, Cuba
(average)	4	3	3	Bahía de Cochinos, Cuba

Types. Holotype, Museum of Comparative Zoölogy, no. 160519, from off Baracoa, Oriente, Cuba, *Atlantis*, station 3362 in 1020 fathoms. Paratypes, from off Bahía de Cárdenas, *Atlantis*, station 2993 in 580 fathoms; from off Nuevitas, *Atlantis*, station 3379 in 910 fathoms; from Bahía de Cochinos, *Atlantis*, station 3332 in 175-225 fathoms, all at the Univ. of Habana; and also from east of Tobago Island, Lesser Antilles, in 880 fathoms, and off Río de la Plata, in 11½ fathoms, both in the United States National Museum.

Remarks. *P. borroi* is a deep sea species, widely distributed in the Western Atlantic.

This species is closely related to *P. circularis* from which it differs by being thinner, and by not expanding abruptly toward the margin. Furthermore, *P. borroi* has radiating ribs only in front and back, while *P. circularis* has such ribs on the sides as well. Finally, *P. borroi* seems not to reach a length exceeding 4.5 mm.

Range. Cuba and south through the West Indies and along the coast of South America, as far south as Argentina.

Records. See under *Types*.

Named for Primitivo Borro who has contributed much to our knowledge of Cuban marine mollusks.

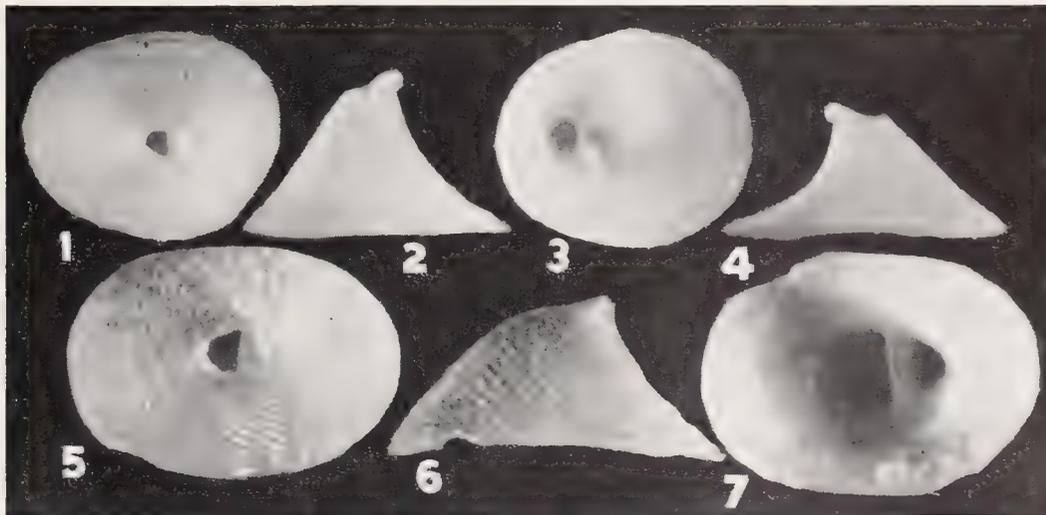
***Puncturella (Puncturella) sportella* Watson, Plate 58, fig. 1-4**

Puncturella sportella Watson 1883, Journ. Linn. Soc., London, **17**, p. 37; Watson 1886, Challenger Report **15**, p. 45, pl. 4, fig. 9 (off Saint Thomas, north of Culebra Island, West Indies).

Description. Shell very small, about 4 mm. in length, a dull white and highly sculptured. It is very variable in height, which may be from 50% to 85% of the length. Base broadly ovate. Anterior slope straight, posterior slope concave, expanding toward the margin. Apical whorls one and one half or one and three quarters, small, globose, and porcellaneous-white. They project backwards below the posterior end of the fissure and are turned to the right. Fissure roundish in front and drawn out and up behind, where it is closed by the septum, into a sharp point. The sculpture consists of numerous subequal, raised and somewhat irregular radiating ribs, crossed by concentric, raised threads which form nodules on crossing the ribs and divide the spaces between the ribs into squares. This gives rise to the basket-work appearance from which the name of the species was derived. Margin finely crenulated. Interior of shell glossy, with numerous, very fine, radiating riblets. The septum begins at the base of the apical whorls. At first it occupies an exterior position, then descends vertically, dividing the interior of the shell into two unequal parts, the posterior smaller than the anterior.

	length	width	height	
(large)	4.5	3	3.5 mm.	off Puerto Tánamo, Oriente, Cuba
(average)	3.5	2.5	3	off Sagua la Grande, Cuba

Types. The type specimen is in the British Museum, the type locality being off Saint



Photographs by Marion Bills

Plate 58. Fig. 1-3. *Puncturella (Puncturella) sportella* Watson, off Bahía de Cárdenas, Cuba (7×). Fig. 4. *Puncturella (Puncturella) sportella* Watson, off Bahía de Santa Clara, Matanzas, Cuba (7×). Fig. 5-7. *Puncturella (Puncturella) ovia* Watson, off Georgia (12×).

Thomas, north of Culebra Island, *Challenger*, station 24 (N. Lat. $18^{\circ}38'30''$; W. Long. $65^{\circ}5'30''$) in 390 fathoms.

Remarks. *P. sportella* resembles in general shape *P. circularis*, but its cancellated surface makes it readily separable from the latter.

Range. Georgia, Florida Keys and south through the West Indies.

Records. GEORGIA: off Cumberland Island, *Albatross*, station 2668 in 294 fathoms (USNM). FLORIDA: off Carysfort, Burry-Foster Exp., station 21 in 117 fathoms; off the Elbow, Key Largo, Burry-Foster Exp., station 14 in 92–100 fathoms (both L. A. Burry). CUBA: off Cabo San Antonio, *Atlantis*, station 3313, in 550 fathoms; off Matanzas, *Atlantis*, station 3485 in 385 fathoms; off Varadero, *Atlantis*, station 2998 in 355 fathoms; off Bahía de Cárdenas, *Atlantis*, station 2993 in 580 fathoms and station 3474 in 490 fathoms; off Bahía de Santa Clara, *Atlantis*, station 3459, in 500 fathoms, and station 2992 in 555 fathoms; off Sagua la Grande, *Atlantis*, station 2991, in 475 fathoms and station 2998 in 360 fathoms; off Puerto Tánamo, *Atlantis*, station 3369 in 600 fathoms; Bahía de Cochinos, *Atlantis*, station 3332 in 175–225 fathoms (all MCZ and Univ. of Habana).

Puncturella (Puncturella) oxia *Watson*, Plate 58, fig. 5–7

Puncturella oxia Watson 1883, Journ. Linn. Soc., London, **17**, p. 36; Watson 1886, Challenger Report **15**, p. 44, pl. 4, fig. 8a–e (off Saint Thomas, north of Culebra Island, West Indies); Dall 1927, Proc. United States Nat. Mus. **70**, Art. 18, p. 111 (off Fernandina [actually off Cumberland Island, Georgia] Florida and Georgia).

Description. Shell very small, from 3 to 4 mm. in length, thin and depressed conical, the height being from 50% to 55% of the length. Base elliptical. Anterior half of the shell has convex sides, posterior half has concave sides. Apical whorls two, lying behind the orifice and turned backwards. Fissure rounded in front, drawn out behind and upwards. The sculpture is very peculiar, consisting of rows of rough tubercles, the rows interrupted and irregular, in chevron formation. Border thin and smooth. Interior of shell glossy, with numerous radiating very fine white lines, extending from the orifice to the margin. In some specimens there is, below the muscular scar, a band of longitudinal, irregular wrinkles. The internal septum is a flat shelf extending from side to side, convexly arched at first but thereafter extending almost vertically downwards.

	length	width	height	
(large)	4	3	2.25 mm.	off Cumberland Island, Georgia
(average)	3.5	2.5	1.75	off Culebra Island, West Indies

Types. The types are in the British Museum. They are from off Saint Thomas, north of Culebra Island, West Indies, *Challenger*, station 24 (N. Lat. $18^{\circ}38'30''$; W. Long. $65^{\circ}5'30''$) in 390 fathoms.

Remarks. *Puncturella oxia* is readily differentiated from other species by its peculiar type of sculpture, that is, by the arrangement of the rough tubercles in chevron formation. All of the specimens studied have lost the apical whorls.

It is a deep sea species, having been found in depths ranging from 294 to 440 fathoms.

Range. Georgia and south, probably along the West Indies.

Records. GEORGIA: off Cumberland Island, *Albatross*, station 2415 in 440 fathoms and *Albatross*, station 2668 in 294 fathoms (both USNM). LESSER ANTILLES: off Culebra Island (Watson 1883).

Puncturella (Puncturella) plecta Watson, Plate 59, fig. 1-3

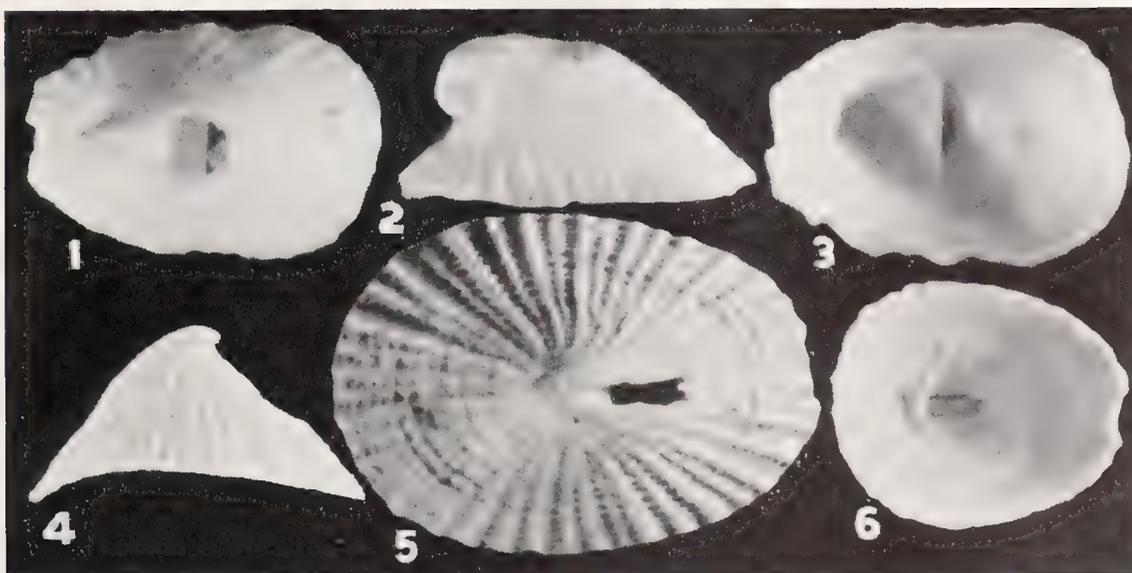
Puncturella plecta Watson 1883 (March), Journ. Linn. Soc. **17**, p. 34; Watson 1886, Challenger Report **15**, p. 39 (off Saint Thomas, north of Culebra Island, West Indies).

Puncturella clathrata Jeffreys 1883 (April), Proc. Zool. Soc. London, pt. 4, p. 676, pl. 50, fig. 11 (off Cape Mondego, Portugal and off Culebra Island, West Indies); Watson 1886, Challenger Report **15**, p. 39 (off Saint Thomas, north of Culebra Island, West Indies).

Description. Shell small, about 4 mm. in length, opaque, white, rather strong and low conical, the height being about 42% of the length. Base elongated oval. The top of the shell is wide and projects slightly backwards; the anterior half of the shell has slightly convex sides, the posterior half, concave sides. Fissure occupies an almost horizontal position; it is elongated, rounded in front and drawn out behind. Apical whorls one and one half, glassy and turned to the right. They lie in front of the posterior end, projecting backwards below the fissure. Sculpture consists of about 40 radiating riblets crossed by concentric threads which form small nodules where they intersect the riblets. Margin crenulated by the ends of the riblets. Interior of shell glossy. The septum is strongly curved; at first it runs very near the outer surface, closing the posterior part of the fissure, then descends obliquely, dividing the interior of the shell into two unequal parts, the anterior much smaller than the posterior.

length	width	height	
3.75	2.5		off Cape Mondego, Portugal
3	2	1.25 mm.	off Cumberland Island, Georgia

Types. The type of *plecta* Watson is in the British Museum, the type locality being off Saint Thomas, north of Culebra Island, West Indies, *Challenger*, station 24 (N. Lat. 18°38'30"; W. Long. 65°5'30") in 390 fathoms. The disposition of Jeffreys' type is un-



Photographs by Marion Bills

Plate 59. Fig. 1-3. *Puncturella (Puncturella) plecta* Watson, off Cumberland Island, Georgia (11×). Fig. 4-6. *Puncturella (Puncturella) pauper* Dall, off Guantánamo, Cuba, Holotype (fig. 4, 6, 7×; fig. 5, 10×).

known to me. The type locality is off Cape Mondego, Portugal, *Porcupine*, station 17a (N. Lat. $39^{\circ}39'$; W. Long. $9^{\circ}39'$) in 795 fathoms.

Remarks. Jeffreys' description of *P. clathrata* apparently was based upon one specimen from Cape Mondego, Portugal. In addition, he included the locality off Culebra Island, West Indies, *Challenger*, station 24, in his record, thus indicating that he had seen another specimen which he identified as belonging to his new species *clathrata*. This specimen seemingly was the one upon which Watson based his *P. plecta*. Furthermore, Watson stated that his species was the same as *P. clathrata* Jeffreys: "*P. plecta* Watson is *P. clathrata* Jeffreys, of which, however, as an unpublished species mine, must, to my regret (for this species has long been differentiated by Jeffreys), take precedence." Watson in 1896 places his species *plecta* in the synonymy of *clathrata*; in this he was in error (like subsequent authors), since in reality his species had antedated Jeffreys' *clathrata* by one month. Consequently the species *plecta* must stand, and *clathrata* be included in its synonymy. Thus we have Jeffreys and Watson agreeing that their specimens belong to the same species. However, a further complication enters into the picture in that Watson's description does not fit the description or figure of *P. clathrata*. He states that his specimen is porcellaneous-white, while *clathrata* is lusterless; that the fissure is short and broad while one of the most striking features of *clathrata* is its very elongated orifice; that the sculpture consists of 60 or 70 riblets, while as a matter of fact *clathrata* has only 40; that the inside of *plecta* is not hollowed into the apex, while *clathrata* is. Finally he makes the contradictory statements that the septum in *plecta* is "very curved" and later that it is "straight and is almost perpendicular." Since both Jeffreys and Watson seem to have seen each other's specimen, and since Jeffreys' description agrees with his figured specimen and also with one specimen I have examined from off Cumberland Island, Georgia, one can only infer that Watson's description must be in error and let the final determination rest upon an examination of Watson's specimen, which unfortunately has never been figured.

Range. EASTERN ATLANTIC: off Portugal. WESTERN ATLANTIC: south of Georgia, and south, probably along Florida and the West Indies.

Records. WESTERN ATLANTIC: GEORGIA: off Cumberland Island, *Albatross*, station 2668 in 294 fathoms. LESSER ANTILLES: off Culebra Island, *Challenger*, station 24 in 390 fathoms (Watson 1883 and 1886, and Jeffreys 1883).

Puncturella (Puncturella) brychia *Watson*, Plate 63, fig. 1-3

Puncturella brychia Watson 1883, Journ. Linn. Soc., London, **17**, p. 32; Watson 1886, Challenger Report **15**, p. 40, pl. 4, fig. 7a-e (off Halifax, Nova Scotia).

Description. "*Shell.* Very small, porcellaneous, translucent, oval, very slightly broader in front; its side slopes are slightly, its front slope extremely convex, its back slope is short and flattened and very much overhung by the protuberant apex; there are sparse and distinct riblets. The slit is short and coarse, though not large; and from it a broad round ridge trending to the right runs to the margin. *Sculpture.* The riblets are neither strong nor sharp; but they are distinct, rising as little round threads from the surface, and being parted by broad intervals, rather strongly pitted by the little specks of the genus; the ridge which runs down the front of the shell is the full breadth of the slit;

the concentric striae are mere slight irregular lines of growth. *Color* clouded, porcellaneous white under the brownish caducuous epidermis. *Apex* very much curled in and bent down, but not spread out on the backward slope; the minute extreme tip is exerted and projects; the whorls $2\frac{1}{4}$. *Slit*: the open part is short and narrowly oblong, and as broad in front as behind, from which point the old scar runs up the crest. *Margin* thin, patulous, especially behind, crenulated by the riblets. *Inside* porcellaneous, deeply hollowed into the apex; scored by the rib-furrows, of which the one in front is very strong, particularly near the slit, which is rather closely covered by the strong, slightly arched septum, which has a retracted edge and is unbuttressed.

In the animal the eye-peduncles are present; but no eyes are visible; the pedal papillae are very small, as is also the funnel-shaped process leading to the shell-slit."

length	width	height
4.5	3	2.5 mm. Holotype

Types. The type is probably in the British Museum; the type locality is off Halifax, Nova Scotia, *Challenger*, station 47 (N. Lat. $41^{\circ}15'$; W. Long. $65^{\circ}45'$) in 1340 fathoms.

Remarks. I have not seen this species. The description and the figures are taken from Watson. Although Watson in his description states that in *brychia* the old scars of the fissure run up to the crest, thus seeming to indicate that it possesses an anal fasciole, the figure shows a long septum running very near the surface and closing most of the fissure, very much as in *P. clathrata*. For this reason I include *brychia* in *Puncturella* s.s. and not in *Cranopsis* where it would belong if Watson's description alone were taken into consideration.

Range and Records. See under *Types*.

***Puncturella (Puncturella) pauper* Dall, Plate 59, fig. 4-6**

Puncturella pauper Dall 1927, Proc. United States Nat. Mus. **70**, Art. 19, p. 10 (south of Cuba).

Description. Shell very small, about 5 mm. in length, conical and moderately high, the height being 60% that of the length. Color a dark cream. Base ovate, narrower in front. Anterior slope gently convex, posterior slope very slightly concave, almost straight. Apex placed high on the shell immediately behind the middle. The apical whorls, so well developed in the majority of the species of this group, are reduced in this species to a very small beak at the summit of the shell. Fissure long, progressively narrowing to its upper end, and provided with a small sharp denticle at the middle of its lower end. It lies high on the anterior slope, its upper end being very near the apex. Sculpture consists of numerous radiating ribs between which intermediate riblets are intercalated. Strong cords cross the shell forming square pits with the radiating ribs and riblets. Margin slightly crenulated. Interior of shell glossy, the ribs of the outside marked as fine radiating grooves. The internal septum is triangular, very small and flat, covering only the extreme upper end of the fissure. The rest of the aperture is surrounded by a thin callus.

length	width	height
5	4	3 mm. Holotype

Types. Holotype, United States National Museum, no. 93906, from off Guantánamo, Cuba, *Albatross*, station 2135 in 250 fathoms.

Remarks. This species is very distinct. The denticle at the middle of the lower end of the fissure is very unusual. In addition, the much reduced flat septum is an unique character so far as the Western Atlantic species of *Puncturella* are concerned. This seems to indicate one of the last stages in the evolution of *Puncturella* s.s. The sculpture of *P. pauper* is very close to that of *P. abyssicola*, but they differ in all other characters, *P. abyssicola* having the apical whorls well developed, and at the same time placed farther backwards. The orifice is much shorter, of different shape and lacks the tooth at the lower end. In addition, the septum of *P. abyssicola* is long and strongly arched, giving rise to a funnel-like formation which covers the entire orifice.

P. pauper is a rare species, the only specimen known being Dall's type.

Range and Records. See under *Types*.

***Puncturella (Puncturella) noachina* Linné, Plate 60, fig. 1-3; Plate 61, fig. 1-6**

Patella noachina Linné 1771, Mantissa Plantarum, p. 551 (locality unknown).

Patella fissurella O.F.Muller 1776, Zoologiae Danicae Prodrromus, p. 237; O.F.Muller 1788, Zoologia Danica, p. 24, pl. 24, fig. 4, 5 (in finis Dröbachiensibus raro [Dröbak, Norway]).

Puncturella noachina Lowe 1827, Zool. Journ. 3, p. 77 (Oban [Scotland]); Forbes and Hanley 1853, Hist. British Mollusca 2, p. 474; Dautzenberg 1881, Feuille des Jeunes Naturalistes, p. 4 (Cannes); Locard 1898, Exp. Scient. Travailleleur et du Talisman, Moll. Test. 2, p. 80 (West of Cape Finisterre); Dautzenberg and Fischer 1912, Result. Camp. Scient., Prince de Monaco 37, Moll., p. 288.

Cemoria Flemingii 'Leach' Lowe 1827, Zool. Journ. 3, p. 77.

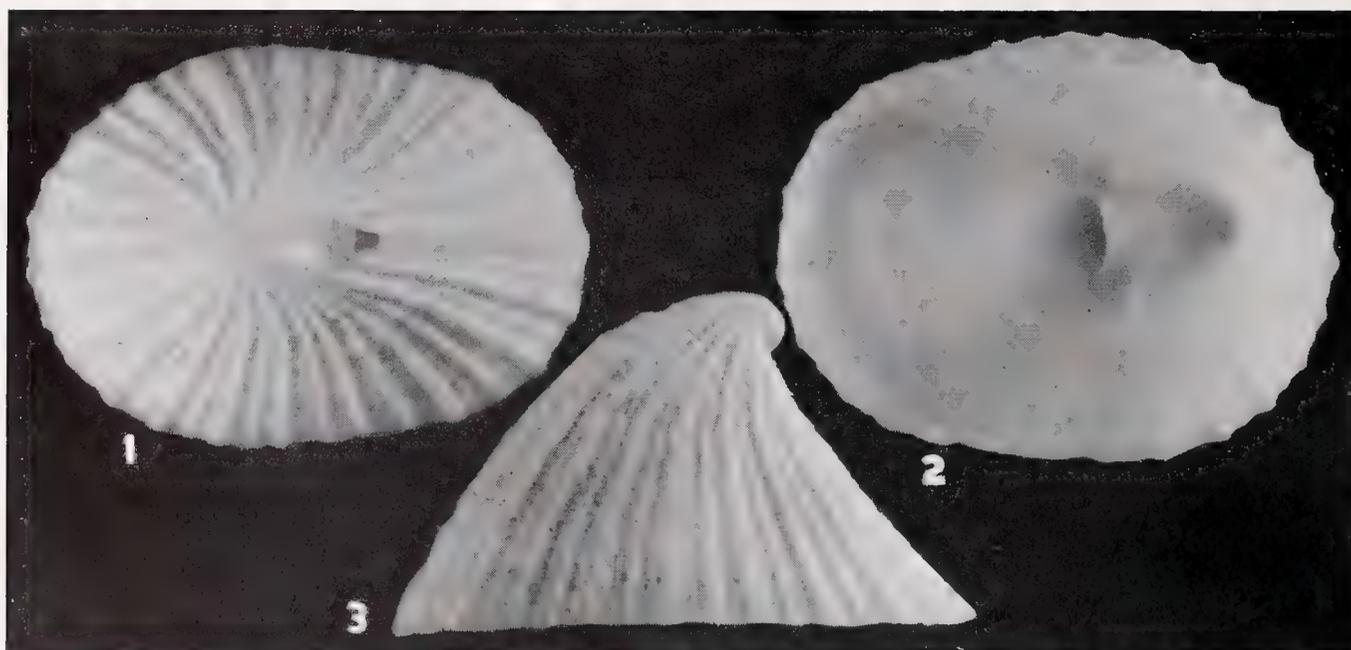
Sipho striatus Brown 1827, Illust. Conch. Great Britain and Ireland, Index, p. 3, pl. 36, fig. 14-16.

Sipho striata Brown 1827, Illust. Conch. Great Britain and Ireland, pl. 36, fig. 14-16 [this name in the explanation of the plate].

Cemoria princeps Mighels and Adams 1842, Boston Journal Nat. Hist. 4, p. 42, pl. 4, fig. 9; Mighels and Adams 1843, Proc. Boston Soc. Nat. Hist. 1, p. 49 (stomach of a haddock, 75 to 100 miles off the mouth of the Kennebec River, Maine).

Diodora noachina Gray 1847, Proc. Zool. Soc. London, pt. 15, p. 147.

Cemoria flemingiana Leach 1852, Synopsis Moll. Great Britain, p. 214, pl. 10, fig. 4, 5 (mari Orcadensi et Zetlandiensi [Orkney and Shetland Islands seas]).



Photographs by Marion Bills

Plate 60. *Puncturella (Puncturella) noachina* Linné
Fig. 1-3. Off Duxbury, Massachusetts (7×).

Description. Shell conical, laterally compressed, medium in size, generally not exceeding 12 mm. in length, usually high, but varying in height from 60% to 85% of the length in adult specimens. Color uniformly white, externally rather dull, internally glossy, the majority of the specimens being translucent. Base narrowly elliptical. Anterior slope slightly convex, posterior slope straight or very slightly concave. Apical whorls one and one-half, at the top and a little behind the middle of the shell, bent backwards and downwards against the posterior slope and turned toward the right. The surface of the apical whorls is slightly rough, without ribs but with several rows of punctules radiating from the apex and continuing to the margin over the rest of the shell where new rows also appear. Fissure high on the posterior slope immediately below the summit, tapering above, enlarging near its lower extremity to contract again at the end. The surface is sculptured with from 21 to 26 primary ribs, starting at the base of the apical whorls, between each two of which a secondary rib appears lower down; sometimes a third series of ribs appears between the other two. The strength of the sculpture varies a great deal, even among individuals in the same locality. This can be observed in the specimens figured in Plate 60 and Plate 61, fig. 1-3, both coming from the same locality. The ribs may be strong or weak, sometimes so weak that they hardly stand out from the surface; in the former case they may be slightly beaded. There is no true concentric sculpture, but some of the lines of growth decussate the surface. Between the primary and secondary ribs there are generally one, two or three rows of chalky-white punctules, some of these being a continuation from the apical whorls. Margin sharp, crenulated, the projections caused by the primary ribs being bolder than those caused by the intermediate ribs. Inside of the shell porcellaneous-white and glossy, sometimes nacreous. In strongly sculptured shells the primary ribs are marked by radiating translucent grooves. The rows of punctules on the outside show through as radiating series of points. Septum narrow, generally strongly convex, producing with the walls of the shell a funnel-like formation and extending a little beyond the end of the fissure. From the lower end of the fissure a shallow and fine groove extends to, or nearly to, the margin of the shell and is bounded on either side by a low ridge or callosity which is a continuation of the side of the septum at its point of attachment to the shell. The septum is sometimes buttressed on each side by a prop. A triangular shallow depression is formed on each side at the base of the septum, bounded by the septum, the prop and the sides of the shell. Forbes and Hanley (*l.c.*) described the animal as follows: "The animal is white. The head, which is tumid but short, bears two rather obtuse subulate stout tentacula, with the eyes, which are very large, on prominent bulgings, or short peduncles at their external bases. The mantle is simple-edged. The foot is oblong and not steep or high-sided; at its junction with the body there are on each side, six or seven short cirrhi, and an odd one, larger than the rest, and behind them on the left side. There are no cirrhi posteriorly. From the anal cleft projects a conspicuous truncated sheath-like membrane, open in front, where are three or more retractile papillae. The branchiae are distinctly visible in the cavity behind the head." Pelseneer (1899, *Mém. Cour. L'Acad. Roy. Belgique* 57) and Rammelmeyer (1925, *Zoologischer Anzeiger, Leipzig*, 64, p. 105) have made very careful anatomical studies of this species. The radula has been studied several times: for instance, by H. Friele (1877, *Archiv. Mathematik og Naturvidenskab* 2, p. 303, pl. 1, fig. 3).

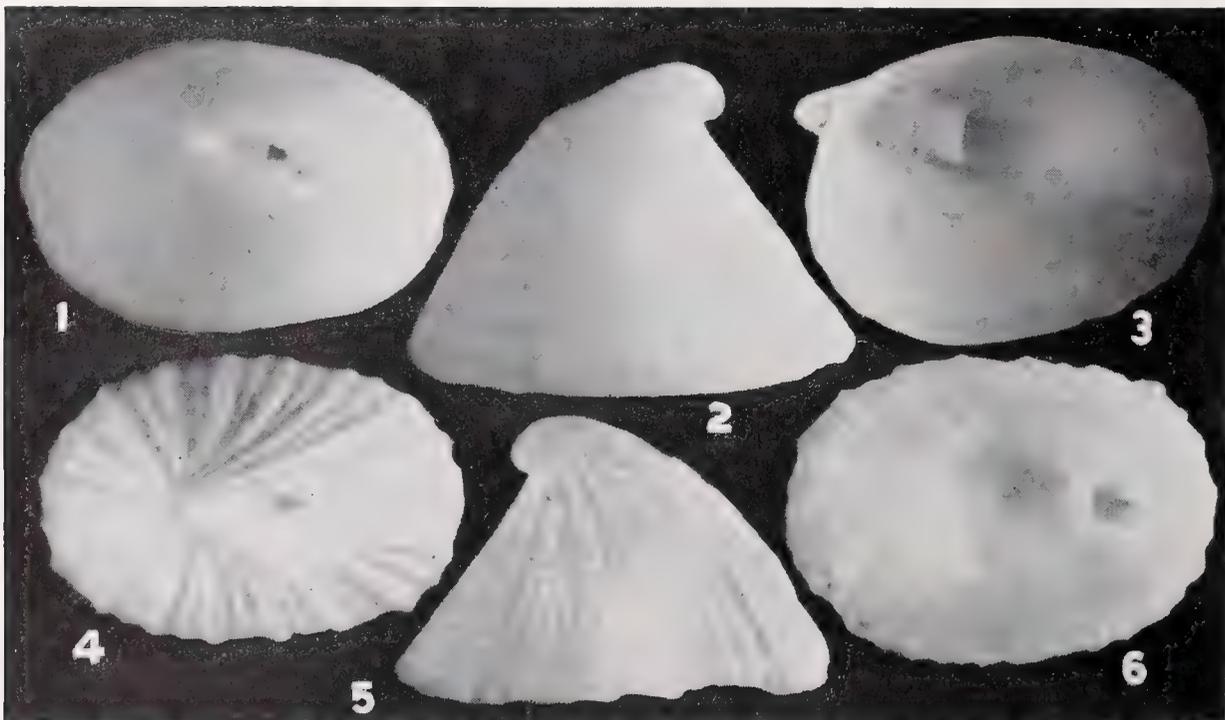
	length	width	height	
(large)	11.25	7.5	8 mm.	Maine
(average)	5	6.5	5.5	off Duxbury, Mass.

Types. The whereabouts of Linné's type is unknown to me. O. F. Müller was the first to give a specific locality for *P. noachina*, namely, Dröbak, Norway, and this is here selected to be the type locality.

Remarks. *Puncturella noachina* is a widely distributed species extending as it does from Franz Joseph Land in the Arctic Ocean, to off Spain in the Eastern Atlantic and west to the coast of North America from Greenland and North Canada to Cape Cod. It also occurs under various ecological conditions and in depths from near the low water line to 1105 fathoms.

As a consequence of its wide distribution and variation in shell characters, several names have been applied to this species. However, specimens from a single locality frequently show most of the variations that have been reported separately from various parts of its range. Hence the names that have been used for these several variations have to be considered as synonymous. The sculpture varies greatly, even on specimens from a single locality; for example, the ribs may be weak or well developed. There may be many or few rows of conspicuous punctules or these punctules may be relatively indistinct or even absent. The buttresses or props to the septum are generally, though not always, absent in young individuals and generally, though not invariably, present in adult forms. So far as I can determine, these variations exist wherever this species is known to occur. In particular, it has been held that the European and North American forms are distinct, either as species or subspecies, but in an examination of a large series of specimens from both sides of the Atlantic, no difference could be found which would permit such a separation.

Mighels and Adams in the original description of their *Cemoria* (= *Puncturella*) *princeps* stated that it differs from *P. noachina* in the following particulars: the ribs are more elevated in *P. noachina*, slight and obtuse in *P. princeps*; the interior sulci are much more obvious and the posterior slope strongly and regularly curved in *P. noachina*, while



Photographs by Marion Bills

Plate 61. *Puncturella* (*Puncturella*) *noachina* Linné

Fig. 1-3. Off Duxbury, Massachusetts (7×). Fig. 4-6. Maine (7×).

in *P. princeps* the slope is subrectilinear; the shell in *P. noachina* is smaller, proportionately longer, and not so high. All these are variable characters. In addition they stated that the septum in *P. princeps* is strengthened by props while *P. noachina* is without them. However, we possess a single specimen from Mighels in the C. B. Adams collection, determined by him as *P. noachina* (MCZ 156450) coming from Maine, and this specimen possesses "wings" or props to the septum contrary to their statement that this species is without them! Mighels and Adams described *P. princeps* from a small series of specimens (originally taken from the stomach of a haddock) which represent an extreme variation of *P. noachina*. Specimens like the one they figured in their description with a very weak sculpture and with almost straight sides, may be found along with others showing the more pronounced ribs and more marked slopes of typical *noachina*.

Dall (1927, Proc. United States Nat. Mus. 70, Art. 19, p. 10) considered the Western Atlantic species to be *P. princeps* and made reference to a variety. He stated: "Among our northern forms *P. princeps* is marked by distinct punctuation in the interspaces between the ribs and an obscure beading on the ribs. In the supposed variety [he does not give it a name or make any other reference to it] the ribs and the interspaces are smooth. The latter closely resembles the European *noachina* and may be conspecific." Here again I have examined an enormous amount of material from all along the range of distribution of this species in North America and have been unable to separate specimens either as varieties or as geographical subspecies.

Puncturella galeata Gould has been placed many times in the synonymy of *P. noachina*; however *galeata* is definitely a good species readily separable from *P. noachina* and found in a different area, western North America, from Unalashka, Aleutian Islands and south to Santa Barbara, California.

The Magellanic species *P. cognata* Gould, *P. falklandica* A. Adams and *P. conica* d'Orbigny and *P. analoga* v. Martens, have also been considered to be the same as *P. noachina*. However Dall (1914, The Nautilus 28, p. 62) states that "the northern species have thickish tentacles with the eyes on protuberances at their outer bases; the antarctic forms have long slender tentacles with the eyes about one third the length from the insertion of the tentacle." The matter being still open to discussion, I do not include these names in the synonymy of *noachina*.

De Kay's report of this species from New York was based on shells found in stomachs of fishes and this species never has been found elsewhere south of Cape Cod (1843, Zoology of New York, pt. 5, Mollusca, p. 156, pl. 9, fig. 195).

Range. EASTERN ATLANTIC: Franz Josef Land in the Arctic Ocean south to Scotland and northern England and on the continent along the coast of Norway and south to Spain. WESTERN ATLANTIC: from Greenland and Melville Peninsula, Hudson Bay, south to Cape Cod.

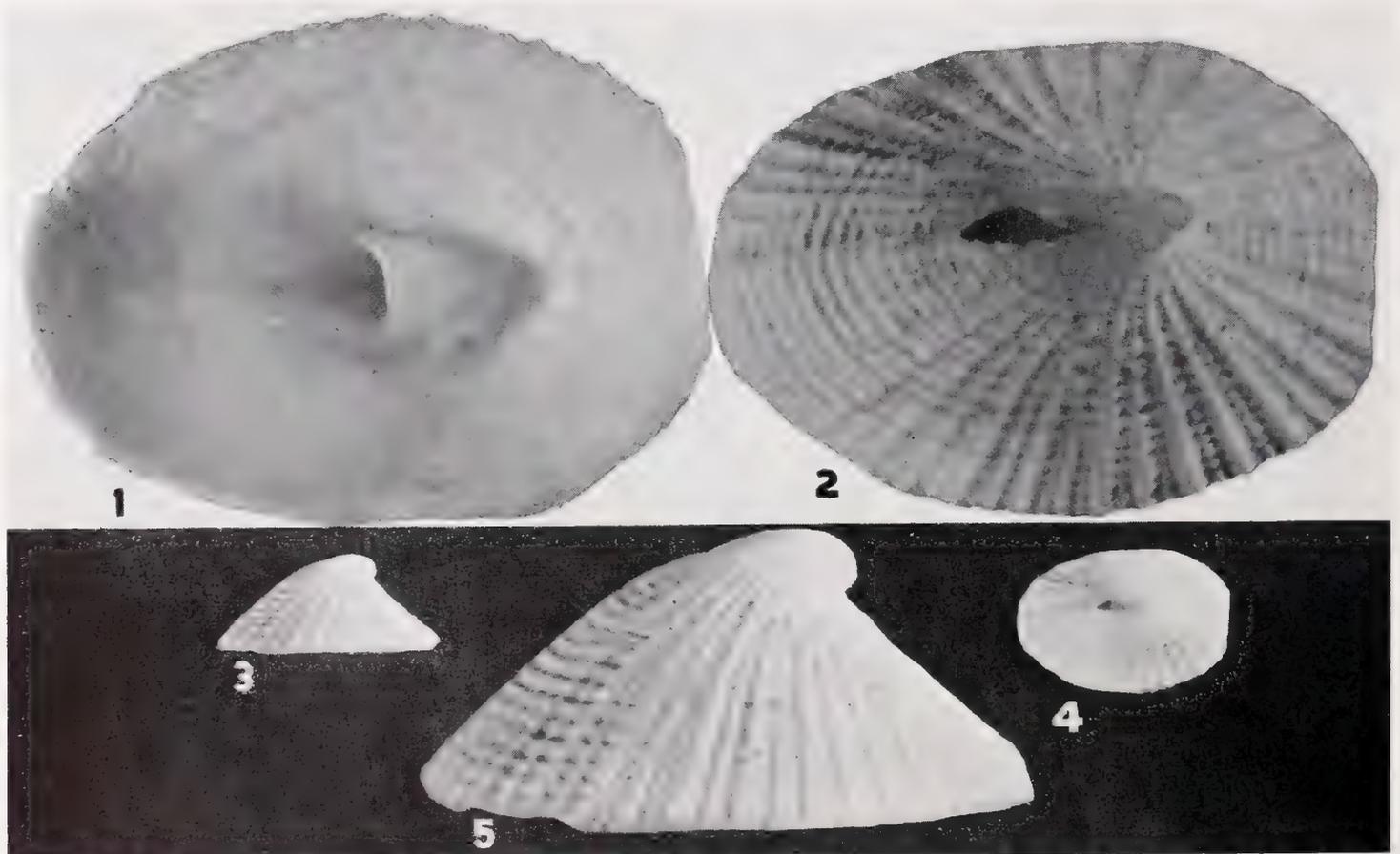
It has also been recorded from the south Indian Ocean. The records from western North America are definitely known to be based upon other species. Records from the Sea of Okhotsk, Korea and Japan should all be restudied to determine if they are *P. noachina* or a closely allied species.

Records. WESTERN ATLANTIC: GREENLAND: (MCZ). NORTHWEST TERRITORIES: S. end of Melville Peninsula in 7-25 fathoms (USNM). LABRADOR: Egg Harbor in 7 fathoms; Henley Harbor in 3 fathoms; Shoal Tickle, 20 miles S. E. of Nain (all MCZ).

NEWFOUNDLAND: St. Pierre Id. in 5 fathoms. QUEBEC: off Bonaventure Id. in 9 fathoms (both MCZ). NOVA SCOTIA: off Halifax, *Speedwell*, station 124 in 51 fathoms and station 103 in 92 fathoms (both USNM); Emerald Bank in 45–55 fathoms; S.W. of Cape Sable in 40 fathoms (both MCZ); between St. Pierre and Banquereau Banks, *Albatross*, station 2481 in 116 fathoms; Bay of Fundy (both USNM). CAPE BRETON ISLAND: off Cheticamp (USNM). NEW BRUNSWICK: E. of Grand Manan in 28–52 fathoms. MAINE: Perry; Eastport in 20 fathoms (both MCZ); off Little River, in 40 fathoms; Schoodie Id. (USNM); Frenchman's Bay in 1–35 fathoms; Bar Harbor in 15 fathoms; Egg Rock; Bartlett Id.; Blue Hill Bay, Bass Harbor; Baker Id.; Penobscot Bay (all USNM); Isle au Haute; Kimball Id.; 75 to 100 miles off mouth of the Kennebec River (all MCZ); Casco Bay, Portland Harbor; Platt Bank, *Bache*, station 69B in 32 fathoms; E. of Jeffreys Ledge, *Bache*, station 73B, in 102–105 fathoms (all USNM). NEW HAMPSHIRE: Cashe's Ledge, *Bache*, station 55 and 56B in 30–40 fathoms (both USNM). MASSACHUSETTS: off Duxbury in 10 fathoms (MCZ); off Race Point, *Fish Hawk*, station 1086 in 34 fathoms; Georges Bank, *Bache*, station 96 and 97B in 150 fathoms; E. of Georges Bank, *Albatross*, station 2525 in 72 fathoms and station 2526 in 121 fathoms; Buzzards Bay, *Fish Hawk*, station 1033 in 183 fathoms; off Martha's Vineyard, station 1095 in 321 fathoms and station 1096 in 317 fathoms; off Nantucket, *Albatross*, station 2262 in 250 fathoms (all USNM).

Puncturella (Puncturella) abyssicola Verrill, Plate 62, fig. 1–5

Puncturella abyssicola Verrill 1885, Trans. Connecticut Acad. 6, pt. 2, p. 425 (N. Lat. $39^{\circ}03'15''$; W. Long. $70^{\circ}50'45''$ [south of Martha's Vineyard]).



Photographs by Marion Bills

Plate 62. *Puncturella (Puncturella) abyssicola* Verrill

Fig. 1–5. South of Martha's Vineyard, Holotype (fig. 1, 2 and 5, $7\times$; fig. 3, 4, $2\frac{1}{2}\times$).

Description. Shell about 10 mm. in length, thin but strong, low conical, expanding toward the margin, its height being 45% of the length. Color a pure dull white. Base ovate, narrower in front. Anterior slope convex, posterior slope straight. Apical whorls one and one quarter, increasing very rapidly in diameter, with the surface punctulate. They are on top of the shell but at the same time are turned somewhat backwards and downwards and placed a little behind the middle. Fissure short, tear-shaped, the upper end being rounded. From this end of the fissure a short anal fasciole runs to the base of the apical whorls, being provided with only five incremental lamellae. From the anterior end of the fissure a shallow ridge runs down the middle of the front slope. The surface is sculptured with 32 rather strong, radiating ribs between each two of which a finer one is intercalated. Concentric cords cross the shell forming elongated nodules where they intersect the ribs and give to the shell surface a cancellated appearance. Margin finely crenulated by the ends of the ribs. Interior of shell a nacreous-white with the outer ribs showing through in the form of very fine radiating grooves. Internal septum strongly arched and long, extending down beyond the fissure. Below the septum there is a low ridge on each side of a shallow and fine groove which extends toward the anterior margin of the shell. The ridges are extensions of the sides of the septum where it is attached to the shell.

length	width	height
10	6.75	4.5 mm. Holotype

Types. Holotype; in the United States National Museum, no. 44837, from South of Martha's Vineyard, Massachusetts, *Albatross*, station 2222 (N. Lat. 39°03'15"; W. Long. 70°50'45") in 1537 fathoms.

Remarks. This species seems to be related to *P. noachina* but the two can readily be differentiated: *P. abyssicola* is much less elevated and is expanded instead of being compressed; the primary radiating ribs are more numerous, only up to 26 in number in *noachina* while in *abyssicola* there may be 32. Finally, strong concentric cords are very conspicuous in *abyssicola*, but are absent in *noachina*.

Range and Records. See under *Types*.

Key to the species of *Puncturella* s.s. in the Western Atlantic

- Interior of shell with two ridges continuous with the outer edges of the septum and extending along each side of the mid-line of the anterior slope 2
Interior of shell not having ridges along each side of the mid-line of the anterior slope 3
- Shell sculptured with 32 primary radiating ribs; with concentric cords *P. (P.) abyssicola*
Shell sculptured with no more than 26 primary radiating ribs; without concentric cords *P. (P.) noachina*
- Shell with a large and more or less convex septum, extending at least as far as the middle of the fissure 4
Shell with a small, flat septum covering only the extreme upper portion of the fissure *P. (P.) pauper*
- Shell sculptured with rows of tubercles arranged in chevron formation *P. (P.) oxia*
Shell with some other type of sculpture 5
- Shell with a few, very fine, radiating ribs front and back *P. (P.) borroi*
Shell with radiating ribs, fine or strong, all around 6
- Shell with the fissure much elongated; septum extending very obliquely near the anterior wall 7
Shell with the fissure not elongated; septum extending almost vertically or only slightly obliquely 8

7. Shell sculptured with radiating riblets and concentric threads; not having a ridge from the lower end of the fissure to the anterior margin *P. (P.) plecta*
 Shell sculptured with radiating riblets but without concentric threads; with a broad round ridge running on the outer surface from the lower end of the fissure to the anterior margin *P. (P.) brychia*
8. Shell with numerous radiating ribs starting at the summit; as the shell broadens, additional ribs appear so that all are equally spaced over the entire surface 9
 Shell with rather widely spaced radiating primary ribs; an additional series of fine ribs appearing somewhat near the margin. In this arrangement the ribs are widely spaced above and narrowly spaced below *P. (P.) circularis*
9. Shell with raised and moderately spaced radiating ribs and concentric cords which give to the shell a reticulated or basket-work appearance *P. (P.) sportella*
 Shell with fine close-set radiating riblets and concentric threads, with a granular rather than reticulated appearance *P. (P.) profundi*

Subgenus *Fissurisepta* Seguenza

Fissurisepta Seguenza 1863, Annali dell'Accademia degli Aspiranti Naturalisti (3) 2, p. 83.

Subgenotype, *Puncturella (Fissurisepta) papillosa* Seguenza (subsequent designation, Woodring 1928, Carnegie Institution of Washington, no. 385, Miocene Moll. Bowden, Jamaica, p. 454).

Shell conical and straight, with the apical whorls lost in the adult. Fissure at the summit, circular or ovate. There is no groove from the lower end of the fissure to the anterior margin, either on the outer or on the interior surface. Internal septum generally well developed as a wide shelf extending down beyond the middle, or reduced to a very small triangular lamina. The surface may be smooth or sculptured. If sculptured, there may be radiating ribs and concentric cords or there may be tubercles arranged in different patterns.

Puncturella (Fissurisepta) trifolium Dall, Plate 63, fig. 4-7

Puncturella trifolium Dall 1881, Bull. Mus. Comp. Zoöl. 9, p. 76; Dall 1889, Bull. Mus. Comp. Zoöl. 18, p. 403, pl. 26, fig. 8, 8b (Yucatán Strait).

Description. "Shell brownish white, acutely conical, with anterior and posterior walls nearly straight, except near the tip where they are slightly concave, especially the latter; tip erect, squarely truncated at the top, not twisted, inclined or recurved; surface ornamented with some twenty-four to thirty strongly elevated rounded ribs, smooth for the most part, but undulating a little as they pass over the concentric sculpture and rarely and irregularly spinous; these spines do not exceed two or three on any rib, occur only on the stronger ribs and are short, pointed, solid, and acutely triangular; between the primary radiating ribs are secondary ones about equal in number, but not spinous, and not raised above the concentric sculpture; the latter is not strictly concentric except in a general sense, and consists of stout spongy bands connecting the ribs, passing from base to base between each pair of primary ribs on a level with the secondaries, but not evenly continuous clear around the shell, and having a pumice-like texture, so that the bands are not defined sharply like the ribs; the spaces left vacant by this reticulation are rather deep, and have a worm-eaten appearance; shell inside smooth, with shallow grooves indicating the stronger external ribs and with a striated space over the head between the anterior horns of the scar of the great pedal muscles. Puncture externally circular, as in *Glyphis* [*Diodora*], internally trefoil-shaped from the projection of the middle of the

septum and two little shelly knobs on each side into the space; septum triangular, very small and short, inclined in about the same plane as the anterior wall of the shell, in the middle of its lower edge produced and thickened like a little short tongue; about half way between the base of the septum and the outer upper surface of the perforation inside the tube and at about equal distances from each other and from the median line of the septum, are two little shelly triangular projections, which give to the interior of the apex, when looked through, the trilobate outline referred to in the specific name; base of the shell ovate, the margin showing projections and indentations corresponding to the sculpture of the exterior."

length	width	height
14	10.5	7 mm. Holotype

Types. Holotype at the United States National Museum, no. 333725, from Yucatán Strait. It was collected by the *Blake* at 640 fathoms.

Remarks. Although we have examined the holotype of this species, we have quoted above Dall's excellent description. *P. trifolium* is quite different from any other species known in the genus: the peculiarities of the orifice and its types of sculpture readily differentiate it. The only specimen known is Dall's type.

Range and Records. See under *Types*.

***Puncturella (Fissurisepta) acuminata* Watson, Plate 64, fig. 1-3**

Puncturella (Fissurisepta) rostrata 'Seguenza' Watson 1883, Journ. Linn. Soc., London, **17**, p. 38; Watson 1886, Challenger Report **15**, p. 4 [description, not figure] (off Saint Thomas, north of Culebra Island, West Indies).

Puncturella (Fissurisepta) acuminata Watson 1883, Journ. Linn. Soc., London, **17**, p. 38 (off Saint Thomas, north of Culebra Island, West Indies).

Puncturella (Fissurisepta) triangulata Dall 1889, Bull. Mus. Comp. Zoöl. **18**, p. 404 (coast of Yucatán); Dall 1890, Proc. United States Nat. Mus. **12**, p. 357 (off Cozumel Island, coast of Yucatán; and off Fernandina, Florida [actually off Cumberland Island, Georgia]).

Fissurisepta triangulata Dall 1927, Proc. United States Nat. Mus. **70**, Art. 18, p. 112 (off Fernandina, Florida [actually off Cumberland Island, Georgia]; coast of Yucatán; Bay of Campeche).

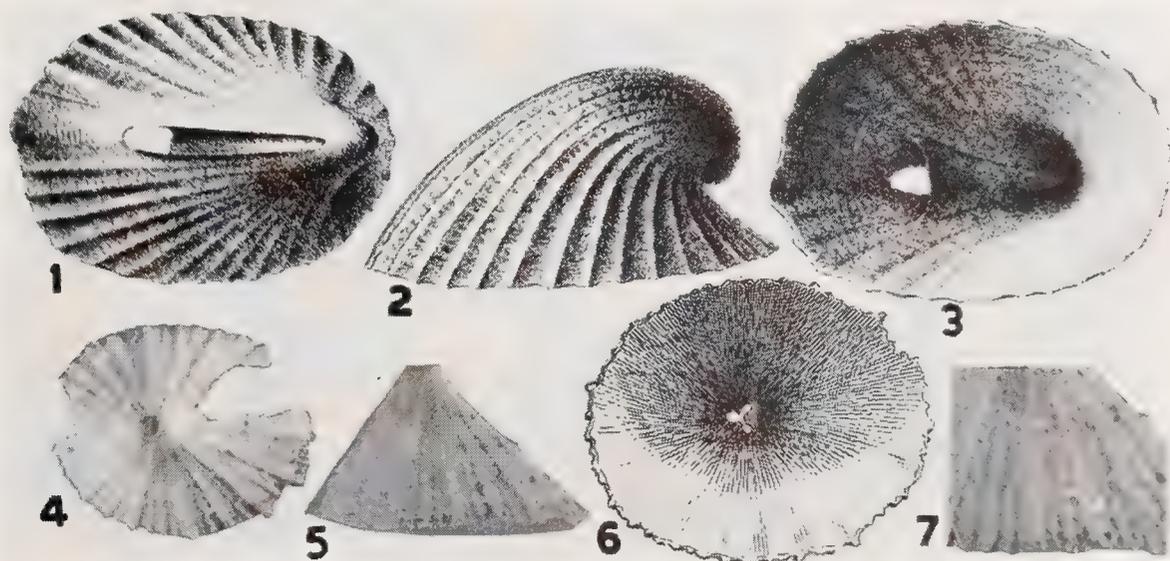


Plate 63. Fig. 1-3. *Puncturella (Puncturella) brychia* Watson, off Halifax, Nova Scotia, 8× (after Watson). Fig. 4-7. *Puncturella (Fissurisepta) trifolium* Dall, Yucatán Strait, Mexico, Holotype (fig. 4, 5, 2×; fig. 6, 2½×, after Dall; fig. 7, 4×).

Fissurisepta microphyma Dautzenberg and H. Fischer 1927, Resultats Camp. Scient. Albert 1^{er}, Fasc. 77, p. 224, pl. 7, fig. 16 (Azores).

Description. Shell very small, about 4 mm. in length, highly conical, the height being from 75% to 130% that of the length, laterally compressed, vitreous, and colored an oyster-white. Base narrow-ovate, slightly wider behind than in front, the sides arched so that when placed on a plane, the shell rests on the ends. Anterior slope slightly convex, posterior slope very slightly concave. Fissure elliptical, placed at the summit from immediately behind the center to the posterior fourth, set obliquely, higher at the posterior end. Sculpture consists of rounded, chalk-white, bluntly-prominent tubercles, generally widely-set in oblique parallel rows. Sometimes the tubercles may be rather closely-set. The two margins of the septum, which are attached to the sides of the shell, show through on the outside as two white lines. Sometimes there exist two sulci that correspond to these two white lines. Margin smooth. Interior of shell glossy. Internal septum a long, thin shelf extending down slightly below midway of the height, running obliquely very near the anterior wall. It divides the interior into two unequal portions, the anterior being much smaller.

	length	width	height	
(large)	5	3.5	4 mm.	off Cozumel Island, Yucatán, Mexico
(average)	4	3	3	off Cumberland Island, Georgia
	3.25	2.5	4.25	off Cumberland Island, Georgia

Types. The types of *acuminata* Watson are in the British Museum, the type locality being off Saint Thomas, north of Culebra Island, West Indies, *Challenger*, station 24 (N. Lat. 18°38'38"; W. Long. 65°5'30") in 390 fathoms. The types of *triangulata* Dall are in the United States National Museum, no. 61236, from off Cozumel Island, Yucatán, Mexico. I have chosen a lectotype from Dall's cotypes.

Remarks. I agree with Dall that this species is distinct from *rostrata* Seguenza. There are differences in the arrangement of the tubercles: those of *rostrata* being equally disposed both horizontally and vertically, while in *acuminata* the tubercles are disposed in horizontal rows, but alternate rows are offset to form oblique rows from the top to the base or a quincuncial pattern when groups of five tubercles are considered. The position of the fissure also differs in both species: in *rostrata* it is placed in the posterior fourth or beyond the posterior margin of the shell, while in *acuminata* it is placed immediately behind the center to the posterior fourth.

It is unfortunate that this species can not be attributed to Dall, who was first to consider it separate from *rostrata* Seguenza. Watson, following his usual procedure of giving new names to species already described, published the name *acuminata* with *rostrata* Seguenza. However, his description does not apply to the latter species but to *triangulata* Dall, therefore, the name *acuminata* Watson must be used as it was published six years before the name employed by Dall. So far Seguenza's species has not been found on this side of the Atlantic and may very well be strictly an Eastern Atlantic species.

P. (Fissurisepta) acuminata has in most cases a ratio of height to length of 75% to 100%, but a few specimens from off Cumberland Island have a ratio over 100%, even up to 130%. In this locality typical specimens are also found.

Range. South Carolina and south through the West Indies and along the coast of Mexico.

Records. SOUTH CAROLINA: *Albatross*, station 2314, N. Lat. $32^{\circ}43'$; W. Long. $77^{\circ}51'$, in 159 fathoms. GEORGIA: off Cumberland Island, *Albatross*, station 2668 in 294 fathoms (both USNM). LESSER ANTILLES: off Culebra Island, *Challenger*, station 24 in 390 fathoms (Watson 1883). MEXICO: Bay of Campeche in 200 fathoms (USNM and ANSP); off Cozumel Island, Yucatán (USNM).

***Puncturella (Fissurisepta) tenuicola* Dall, Plate 64, fig. 4-6**

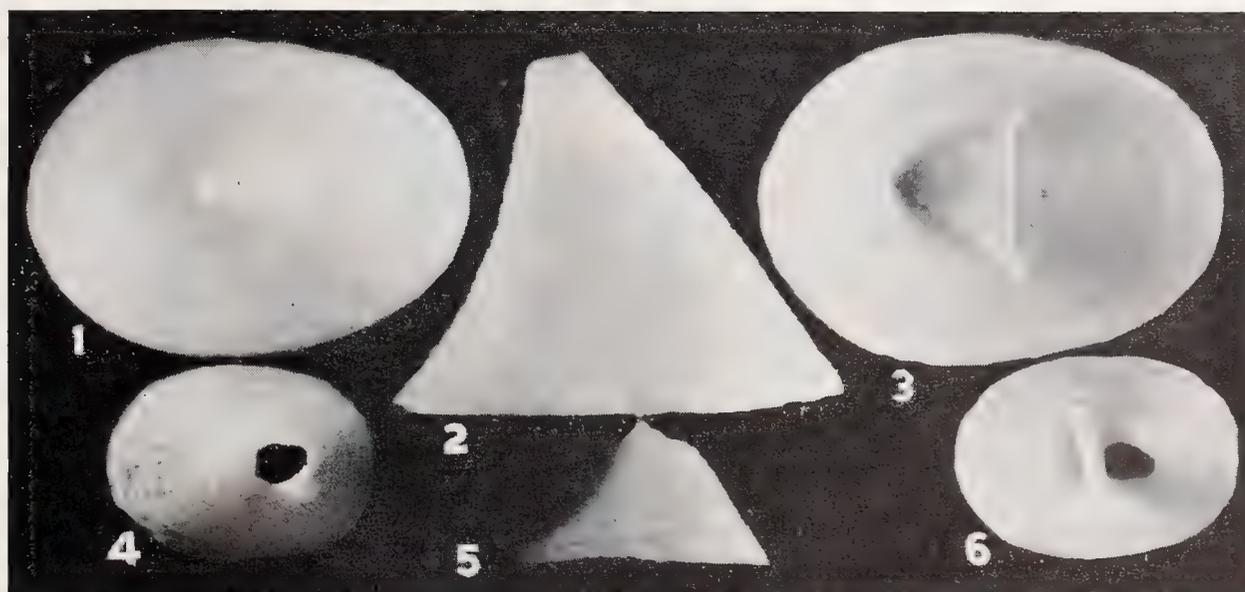
Puncturella tenuicola Dall 1927, Proc. United States Nat. Mus. **70**, Art. 18, p. 112 (off Fernandina, Florida [actually off Cumberland Island, Georgia]).

Description. Shell very small, about 3 mm. in length, thin, semitranslucent and white. Base ovate. Anterior slope straight, posterior slope slightly concave and longer. Apical whorls absent. Orifice ovate, large for the size of the shell. The outer surface has neither radiating ribs nor true concentric sculpture, only numerous concentric growth lines being visible. Interior surface possesses numerous, chalky-white striae radiating from the top to near the margin; lower down on the shell short striae are intercalated, and there is a smooth narrow band above the margin. The striae show on the outside as white lines. Internal septum a rather wide, convex shelf extending very near the posterior wall, forming with it a sheath-like process. The septum also has longitudinal chalky-white striae.

length	width	height
3	2	1.75 mm. Holotype

Types. Holotype, United States National Museum, no. 108151, the type locality being off Cumberland Island, Georgia, *Albatross*, station 2668 in 294 fathoms.

Remarks. This little species is readily differentiated from others in this subgenus by



Photographs by Marion Bills (fig. 1-3); Frank White (4-6)

Plate 64. Fig. 1-3. *Puncturella (Fissurisepta) acuminata* Watson, off Cozumel Island, Yucatán, Mexico (10×). Fig. 4-6. *Puncturella (Fissurisepta) tenuicola* Dall, off Cumberland Island, Georgia (Holotype, 10×).

possessing an almost smooth outer surface and by having the rather deeply-marked striae on the inside wall of the shell.

Range and Records. See under *Types*.

* * * *

Zeidora, *Nesta*, *Emarginula* and *Rimula* occur in tropical and temperate seas. Most species of *Puncturella* also occur in these waters; a limited few, however, reach the Arctic and Antarctic Oceans. A few species live at the low-water line and from there extend into moderate depths; others are known only from very deep water. *Puncturella profundum* Jeffreys, for example, has been obtained in 1640 fathoms by the *Porcupine* expedition. Little is known about their ecology though they are known to occur on most types of bottom, such as sand, mud and broken shells.

* * * *

I am deeply grateful to Miss Marion A. Bills for her splendid photographic work. Most of the species are only a few millimeters in length and lack color making it very difficult to bring out the sculpture most necessary for specific differentiation. I am also grateful to Miss Ruth Turner for the excellent drawing of *Zeidora bigelowi* and to Frank White for some fine photographs. I desire also to express my appreciation to Paul Bartsch, Harald Rehder and H. A. Pilsbry for their kindness in loaning their collections, without which this study would have been impossible. Particular thanks are extended to W. J. Clench and M. E. Champion for their invaluable aid and encouragement.

* * * *

ERRATA

Page 107 under the synonymy of *Emarginula pumila*, line eight should read: *Emarginula tumida* Dall 1890.

Page 110 the first line of the second paragraph of the footnote should read: Thiele in 1917.

Page 112 under *Remarks*, the second sentence of the second paragraph should read: Pilsbry's statement that *frenulata* is higher and wider than *longa* is not borne out by the series of measurements taken by us.

Page 113 under *Description*, the second sentence should read: Basal margin broadly elliptical, or ovate.

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TRUNCATELLIDAE

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THE GENUS TRUNCATELLA IN THE WESTERN ATLANTIC

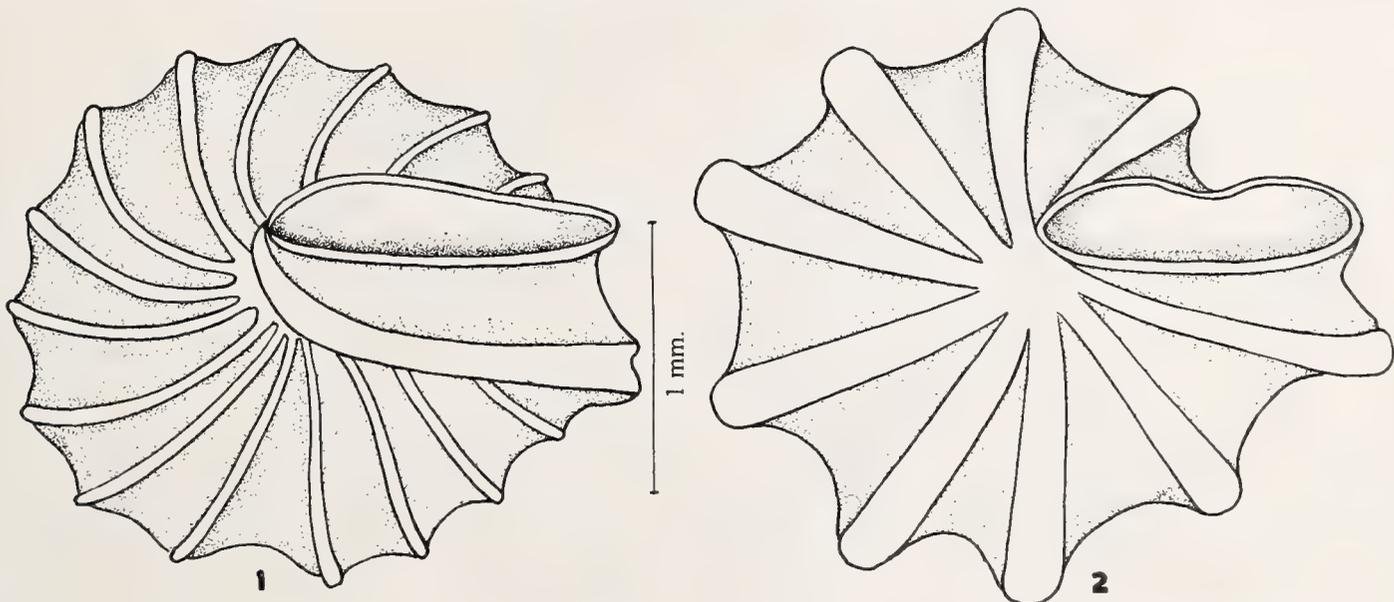
BY

WILLIAM J. CLENCH AND RUTH D. TURNER

The genus *Truncatella* occurs in nearly all tropical and in warmer portions of the temperate seas. A few species have managed to survive beyond these limits, notably *T. subcylindrica* Linné, in the British Isles and on the Central European coasts.

Most species in the genus *Truncatella*, as is the case with nearly all true halophytic mollusks, possess a rather wide distribution. All species probably can exist for a shorter or longer period of time submerged in salt water, though they are generally found at high tide line or a little above, usually under some protective material such as seaweed, boards or rocks. Local distribution can be surprisingly discontinuous. A colony may occupy only a few feet of rubble in the midst of a long stretch of beach where living conditions are presumably identical or at least, similar. The answer is possibly that they are more or less readily transported by flotsam, become established locally for varying periods of time and then eventually die out as subsequent conditions prove inimical to their existence. So far as we can find out, little is known about the life history of members of this genus and the problem is one that needs investigation.

The peculiar habits of *Truncatella* have resulted in inadequate treatment of this genus



Drawn by Ruth D. Turner

Plate 65. Fig. 1. *Truncatella scalaris piratica*, basal view, Holotype. Fig. 2. *Truncatella scalaris* Michaud, basal view, Neoholotype.

by writers whose studies have been limited to either the marine or the land shells of a given region. A writer on marine shells may consider the species of *Truncatella* to be land forms while a writer on terrestrial species may look upon them as belonging to the sea. Thus they may or may not receive attention, depending on the attitude of the individual author.

In the strict sense, the terms marine, land and freshwater refer only to habitat preference and are only lightly superimposed upon the much broader and more exact systematic arrangement of our mollusks. Border line families and genera and even species naturally overlap in the three major habitats so that their inclusion in any faunal study should be based upon their ecological preference rather than their systematic position. In the case of *Truncatella* however, both ecological considerations and systematic relationships justify calling it a marine genus.

It is notable, however, that some primitive members of the Truncatellidae have given rise on at least two occasions to land genera: *Geomelania* in Jamaica and elsewhere in the West Indies and *Taheitia* in Polynesia and other islands in the Western Pacific.

There are several species of *Truncatella* that appear to have two forms: smooth or nearly smooth and strongly costate. This does not seem to be a case of sex dimorphism, as in many instances colonies of one form or the other exist as "pure" races. In other colonies these two forms are mixed, usually with many intermediate individuals difficult to assign to either form. This naturally has given rise to many names applied locally to the species or species complex in which this ambiguous sculpture occurs. Size variation is also a common character which again has complicated the taxonomy of this genus, especially in Europe. We wish in particular to focus attention on the characters of smooth and costate forms for those who have access to fresh material and those living in a region where several different colonies can be studied in the field. Such a study should prove of considerable interest and value and may solve problems of the same sort that exist on many of the temperate and tropical coasts of the world.

All known species in the genus *Truncatella* are mechanically truncated; that is, at or near maturity a mid whorl is plugged by a rounded septum, usually between the fourth and fifth whorls, and the unoccupied whorls are broken off. The shell walls where the septum joins the whorls appears to be slightly weakened by the absorption of the lime so that the fracture is usually fairly clean, though this is not always the case. The actual break is probably never consciously attempted by the mollusk but is generally brought about by the stresses of the environment, such as wave action or other mechanical means. This condition exists in other genera, particularly in the Urocoptidae (terrestrial) in which most genera are mechanically truncated. We cannot recall any other marine genus in which this condition exists. Under purely aquatic conditions, of course, there would be a buoyancy factor of considerable importance which would render the amputation of the unoccupied whorls less necessary. In fact, cross sections of *Terebra* show that many of the early whorls are completely plugged with lime. We are unable to explain why certain genera or families of mollusks produce far more whorls than they eventually occupy.

Non-truncated specimens are occasionally found in the genera mentioned above, particularly in the field, though we have seen but comparatively few complete and mature examples of *Truncatella* in over 50,000 specimens that we have examined in this genus.

The young shell of *Truncatella* is quite typical of most multicoiled mollusks. The first

two or three whorls are generally smooth. Beyond these whorls sculpture appears and becomes heavier as the whorls increase in number and size. Normally smooth forms in the adult, of course, lack any kind of sculpture on any of their early whorls.

The operculum of *Truncatella* is paucispiral and may or may not develop a thin calcified plate on its outer surface. The amount of calcium deposited seems to vary exceedingly, even on specimens in a single locality series. Certain species from the Indo-Pacific have this character well developed; the outer surface is even ridged, the ridges curved and emanating from a common center more or less directly over the opercular nucleus.

A. Vayssière (1885, p. 253–288, pls. 12–13) gives a fine account of the anatomy of *Truncatella truncatula* Draparnaud, discussing in detail the digestive, respiratory, nervous and reproductive systems which are also well illustrated. As shown in this publication *Truncatella* are prosobranchiate mollusks closely related to the Rissoidae, the sexes being separate as is the case with most prosobranchs. He notes that the absence or presence of costae on the shells is in no way a sex character. Vayssière also gives an account of his observation on this species in the field as well as in aquaria in his laboratory and describes the method of creeping by using the proboscis as well as the foot. This “measuring worm” method of progression has been fully described by Pilsbry and Brown also (1914, p. 426–428, pl. 14).

In the Western Atlantic, *Truncatella* extends from the Bermudas, northern Florida and the West Indies as far south as Trinidad. The records from southern New England and North Carolina are based upon mechanical introduction by man or sporadic introductions by drift. Records from the northern Gulf of Mexico may also be chance introductions which in these areas may survive for only a short period of time.

The common name for members of this genus is “looping snails” in reference to the way they progress by means of both foot and proboscis.

We have had the use of the very large collections of *Truncatella* of the United States National Museum and the American Museum of Natural History. These two collections have added materially to our geographical records and our understanding of the several species involved. Our thanks are due to Dr. C. G. Aguayo for the gift of several lots of *Truncatella* from Cuba and for the loan of a type series of *Truncatella pulchella* Pfeiffer, a series collected originally by Gundlach.

Genus *Truncatella* Risso

Acmea Hartmann 1821,¹ *Neue Alpina* 1, p. 204–212. This use of *Acmea* was for a *Truncatella* but was published after his use of *Acmea* and *Acme* in Sturm's *Deutschlands Fauna* for a species which is not in the genus *Truncatella*.

¹There has been considerable confusion regarding the use of the name *Acmea* Hartmann 1821 in place of *Truncatella* Risso 1826. The confusion was originally initiated by Iredale (1915, p. 332) when he stated that *Acmea* Hartmann would have to replace *Truncatella* Risso. He based his conclusion on Hartmann's use of the name *Acmea* in *Neue Alpina* 1, p. 204–212, 1821. Iredale had overlooked an earlier use of *Acmea* by Hartmann in the *System der Erd-und Suesswasser Gastropoden Europa's* [in] Sturm's *Deutschlands Fauna*, Abth. 6, Heft 5, p. 48–49, 1821. According to Sherborn this work appeared before the *Neue Alpina* given above. In this earlier work Hartmann used the spelling *Acme* and *Acmea* (pp. 31, 37). Only a single species is mentioned, *Acmea lineata* Draparnaud, on page 49, and the diagnosis is not that of a *Truncatella*. Pilsbry (1926, p. 32) has clarified this entire situation and as first reviser has selected *Acme* Hartmann to stand for

Acmea of Authors, not of Hartmann in Sturm's Deutschlands Fauna; Iredale 1915, Proc. Malacological Soc., London **11**, p. 332; Pilsbry 1926, Nautilus **40**, p. 32; Keene 1946, Minutes of the Conchological Club of Southern California No. 56, p. 7.

Truncatella Risso 1826, Histoire Naturelle de l'Europe Méridionale **4**, p. 124; Gude 1921, Fauna of British India, Mollusca **3**, p. 360.

Fidelis Risso 1826, Histoire Naturelle de l'Europe Méridionale **4**, p. 121 (genotype, *Fidelis theresa* Risso, monotypic).

Truncatella Lowe 1832, Zoological Journal **5**, p. 300 (genotype, *Cyclostoma truncatulum* Draparnaud, monotypic).

Erpetometra Lowe 1832, Zoological Journal **5**, p. 300 (genotype *Cyclostoma truncatulum* Draparnaud, monotypic).

Choristoma J. de Cristophori and Jan 1832, Cat. Mus. (Mantissa Test.) p. 3, non Hartmann 1840. [We have not seen this publication.]

Truncatula Leach 1847, Annals and Magazine of Natural History (1) **20**, p. 271 (genotype, *Truncatula truncata* Montagu = *Turbo truncatus* Montagu) [= *Helix subcylindrica* Linné, here selected].

Zeanoë Leach 1852, Synopsis of the Mollusca of Great Britain, London, p. 198 (genotype, *Turbo nitida* Adams, monotypic).

Glaucothoë Leach 1852, Synopsis of the Mollusca of Great Britain, London, p. 199 (genotype, *Glaucothoë montaguana* Leach, monotypic).

Herpetometra 'Lowe' Gray 1856, Proc. Zool. Soc., London, p. 22 [error for *Erpetometra* Lowe].

Albertisia Issel 1880, Ann. del Museo Civico di Storia Nat. di Genova **15**, p. 275 (genotype, *Albertisia punica* Issel, monotypic).

Truncatula 'Risso' Caziot, 1910, Etude Moll. Princip. Monaco p. 450 (error for *Truncatella* Risso); non Leach 1847, non Hagenow 1851.

Genotype, *Truncatella laevigata* Risso, subsequent designation, Gude 1921 (= *Helix subcylindrica* Linné).

The shells are small, rarely exceeding 10 mm. in the adult truncated form. They possess a paucispiral operculum which may or may not have a thin accessory plate of calcium on its outer surface. The shell has many whorls but most of these are lost when the animal becomes adult. Sculpture, when present, consists of rather strong axial costae which may extend from suture to suture or disappear on the whorl periphery. In a few species or members of a single species this sculpture may be entirely absent.

Members of the genus *Truncatella* are prosobranchiate mollusks with the sexes separate, aquatic or semiaquatic and live in the vicinity of the high water line. They rarely occur where there is much brackish water. In relationship they are close to the Bulimidae and Rissoidae.

Key to the Western Atlantic *Truncatella*

1. Costae 17 or more on the body whorl	3
2. Costae 16 or less on the body whorl	7
3. Outer lip duplex	<i>bilabiata</i> and <i>bahamensis</i>
4. Outer lip simple	5
5. Costae well developed; lip thickened	<i>succinea</i>
6. Costae rather poorly developed; lip usually thin	<i>pulchella</i>
7. Costae 8 to 11 on the body whorl	<i>scalaris</i>
8. Costae 13 to 16 on the body whorl	<i>piratica</i>

the genus with *Acmea* Hartmann a synonym. This was accepted by Thiele 1929, Handbuch der Systematischen Weichtierkunde **1**, p. 136. Keene (1946, p. 7) has added to the confusion by accepting the dictum of Iredale, overlooking the clarification of this problem by Pilsbry.

Subgenus **Truncatella** *Risso*

Truncatella Risso 1826, Histoire Naturelle de l'Europe Méridionale 4, p. 124.

This subgenus is characterized by having shells which may be smooth or which may exhibit more or less numerous costae. However, costae are seldom completely absent. Operculum corneous, with or without a thin accessory calcified plate on its outer surface.

Subgenotype, *Truncatella laevigata* Risso, subsequent designation Gude 1921 (= *Helix subcylindrica* Linné).

Truncatella (Truncatella) bilabiata *Pfeiffer*, Plate 66, fig. 1-7

Truncatella bilabiata Pfeiffer 1840, Archiv. für Naturgeschichte (6) 1, p. 253 (Cuba).

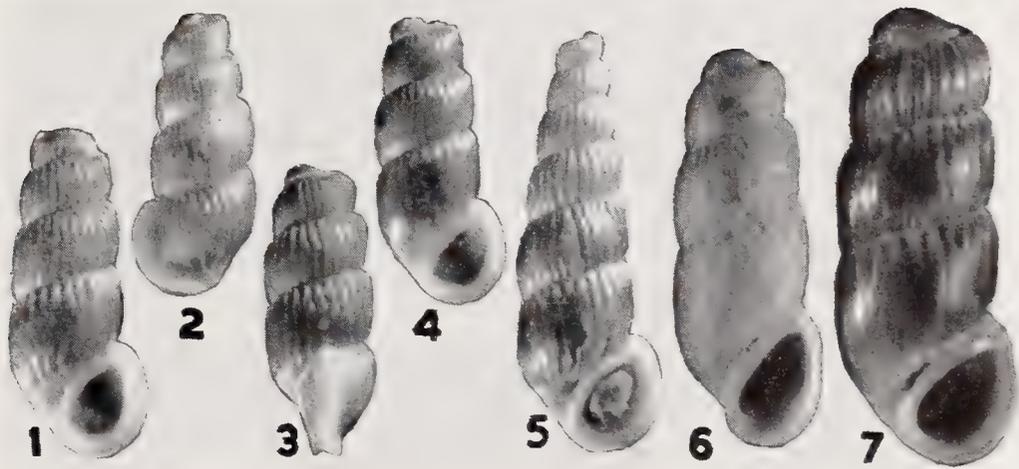
Truncatella bairdiana C.B. Adams 1852, Ann. Lyceum Nat. Hist. New York 5, p. 437 [p. 213 in separate] ([West] Panama [Lectotype, MCZ 177110]).

Truncatella barbadensis Pfeiffer 1856 [1857], Proc. Zool. Soc. London 24, p. 337 (Barbados, West Indies) [Heautotypes, MCZ 136008].

Truncatella debilis Mousson 1874, Jahrbücher Malakozoologischen Gesellschaft 1, p. 99, pl. 5, fig. 3 (Rabat, Morocco).

Truncatella capillacea 'Gundlach' Pfeiffer 1859, Malakozoologische Blätter 6, p. 77 (Caimanera [Guantánamo] Cuba) [Cotypes, MCZ 178982, 178983].

Description. Shell small, variable in size, from 3 to 6½ mm. in length. Costate to nearly smooth and rather solid. Whorls 3½ to 4½ and rather strongly convex. Color pale straw-yellow to red-brown with a white lip. Spire lengthened and truncated. Suture rather deeply impressed. Aperture holostomatous, subcircular to subovate. Parietal wall thickened with the inner lip extending above. Outer lip duplex with the lower lip very much thickened. Basal ridge short, thickened and merging into the lower lip. Shell imperforate or at best with a very minute rimation. Columella not apparent. Sculpture generally consisting of numerous well formed axial ribs which extend from suture to suture. Many specimens, however, have the sculpture much reduced, consisting only of



Photographs by F. P. Orchard

Plate 66. *Truncatella bilabiata* Pfeiffer

Fig. 1-5. Coconut Grove, Florida (all about 6½x). Fig. 6. Cotype of *T. capillacea* Pfeiffer (= *bilabiata* Pfeiffer) Caimanera, Cuba (about 9x). Fig. 7. Lectotype of *T. bairdiana* C.B. Adams (= *bilabiata* Pfeiffer) Panama (about 9x).

very short riblets which appear only above and below the suture, the peripheral area being quite smooth and shiny. All grades of sculpture from those that are nearly smooth to those that are strongly costate may exist in specimens from a single locality. Operculum paucispiral, corneous and generally with a thin calcified plate on the outer face. In young specimens the first two whorls are smooth, the third whorl finely costate and the remaining whorls increasingly so.

	length	width	
(large)	6.5	2.5 mm.	Barbados, Lesser Antilles
(average)	5.5	2.2	Key West, Florida
(small)	3	1.3	Punta Alegre, Camagüey, Cuba

Types. The type of this species is probably in the museum at Stettin, Germany. We here restrict the type locality to Matanzas, Cuba.

Remarks. It is quite possible that *T. bilabiata* is adventitious in the Eastern Atlantic. It is exceedingly common in the West Indian region and distribution from this area eastward to Madeira and the adjacent coast of Africa is not impossible.

We are unable to separate *Truncatella bairdiana* Adams, from the Pacific at Panama, from *T. bilabiata* Pfeiffer. Just why Adams compared his new form with *T. scalariformis* Reeve of Polynesia instead of *T. bilabiata* Pfeiffer of the West Indies is a little difficult to understand. *T. scalariformis* is a very different species and in no way related to the Panamanian form. *T. bilabiata* possesses a well developed duplex lip and a strongly developed basal ridge, characters which readily separate it from *T. pulchella*.

We have seen three cotype series of *T. capillacea* Pfeiffer. Two of these lots (MCZ) consist of depauperate specimens of *T. bilabiata* Pfeiffer while the third is made up (USNM) of depauperate specimens of both *T. bilabiata* Pfeiffer and *T. scalaris* Michaud. The type locality, Caimanera, Cuba, near the Guantánamo Naval Base is in Guantánamo Harbor and at a considerable distance from the harbor entrance. Habitat conditions at this place are probably not very favorable for their existence.

Range. Florida and the West Indies south to Trinidad, Lesser Antilles. Also the Eastern Atlantic at Morocco and the Madeira Islands and the Eastern Pacific at Panama.

Records. EASTERN ATLANTIC: MADEIRA IDS. (J. R. leB. Tomlin). WESTERN ATLANTIC: FLORIDA: New Smyrna (USNM); Mosquito Lagoon, Indian River; Palm Beach (both MCZ); Coconut Grove (R. Humes); Lignumvitae Key (MCZ); Big Pine Key (P. McGinty); Key West; Cape Sable; Marco; Sanibel Island (all MCZ); Boca Grande (H. Dodge); Sarasota; Gulfport; Cedar Keys (all MCZ). BERMUDA: Hungry Bay; Shelly Bay (both MCZ). BAHAMAS: Riding Point, Grand Bahama; Cave Cay, Little Abaco; Mores Island and Marsh Harbor, Great Abaco; Nassau, New Providence; Mangrove Cay, Andros Island; Upper Pimlico Id. and Rock Sound, Eleuthera; Arthurs-town, Cat Island; Matthewtown, Great Inagua (all MCZ); Booby Cay, Mariguana Id.; Plana Cays; Knife Cay, Ragged Ids.; Pinnacle Point and Mason Bay, Aclin Id.; Grand Caicos Id., Caicos Ids. (all USNM). CUBA: Punta del Cajon (USNM); Playa Manimani, Pinar del Río (A. del Valle); Jaimanitas, Habana; Playa de Bellamar, Matanzas (both P. J. Bermúdez); Cárdenas (MCZ); Cayo Santa Maria, Camagüey (R. Humes); Gibara (C. G. Aguayo); Peninsula del Ramon, Antilla (A. Quiñones); Cinco Reales,

Santiago (C. G. Aguayo); Batabano (J. T. Acosta); Bahía de Cochinos (USNM). ISLE OF PINES: Nueva Gerona (MCZ). PUERTO RICO: Fajardo (MCZ). VIRGIN ISLANDS: St. Thomas (MCZ). HISPANIOLA: Port au Prince; St. Louis; Port Salut; Bizonton; Aquin; Les Cayes; Gonave Id.; Ile à Vache (all USNM). JAMAICA: Kingston; Spanish Town Road (both MCZ); Rockfort (USNM). LESSER ANTILLES: St. Kitts; St. Bartholomew; Simson's Bay, St. Martins; Martinique; Barbados (all MCZ); Antigua; Trinidad (both USNM). CARIBBEAN ISLANDS: Roatan Island, Bay Islands (MCZ); Cayman Brac and Little Cayman, Cayman Ids. (both USNM).

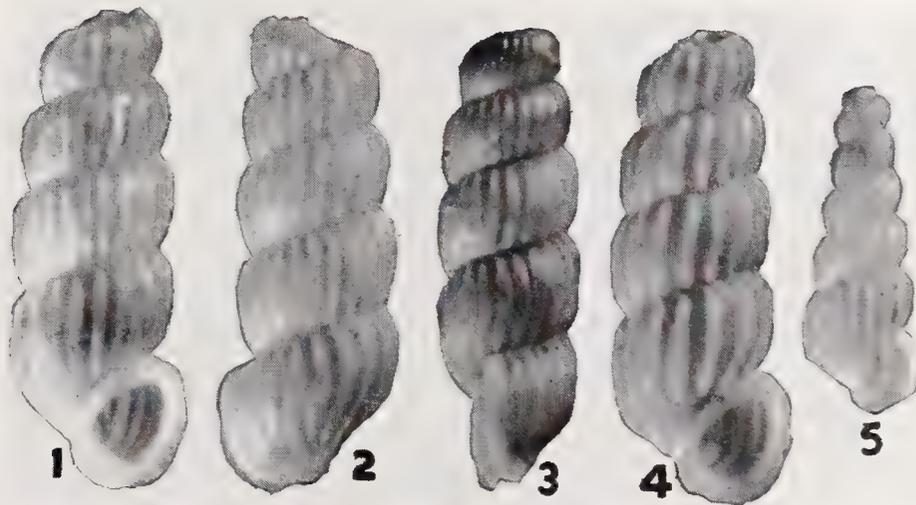
Truncatella bilabiata bahamensis, new subspecies, Plate 67, fig. 1-5

Description. Shell smaller, narrower and less robust than typical *bilabiata*. The costae are more blade-like and show a considerable variation in their spacing; they are of equal height and show no tendency to become smooth at the whorl periphery. The lip is bilabiate and the aperture is holostomatous, the inner lip not being attached to the parietal area.

length	width	
4.7	1.8 mm.	Holotype
4.4	1.8	Matthewtown, Great Inagua, Bahama Islands

Types. Holotype, Museum of Comparative Zoölogy no. 158794, Northwest Point, Little Inagua Island, Bahama Islands. R. A. McLean and B. Shreve collectors.

Remarks. This subspecies appears to be quite well marked. It differs from typical *bilabiata* by being smaller and narrower and is in general a far more delicate shell. As stated in the description, the costae are more blade-like, quite different from the more rounded and lower costae of *bilabiata*. All specimens so far seen have the costae strongly developed and of equal height throughout their length. In *bilabiata* there are many specimens that have the peripheral area smooth and others are almost entirely smooth. The whorls in *bahamensis* are nearly of equal size so that the sides of the shell are almost parallel. In *bilabiata*, successive whorls are slightly larger, resulting in a more tapering spire.



Photographs by F. P. Orchard

Plate 67. *Truncatella bilabiata bahamensis* Clench and Turner

Fig. 1. Holotype, Northwest Point, Little Inagua, Bahama Islands. Fig. 2-5. Paratypes from the same locality (all about 10x).

Range. Limited to the Bahama Islands.

Records. BAHAMAS: Sand Bank, Crossing Bay, Great Abaco; Canfield Bay and Matthewtown, Great Inagua; Northwest Point, Little Inagua (all MCZ). Lagoon, Watling Id.; East Caicos, Caicos Islands (both USNM).

Truncatella (Truncatella) pulchella Pfeiffer, Plate 68, fig. 1-6; Plate 69

Truncatella pulchella Pfeiffer 1839, Archiv. für Naturgeschichte von Wiegmann (5th year) **1**, p. 356 (Cuba); Küster 1855, Conchylien-Cabinet (2) **1**, pt. 23, p. 10, pl. 2, fig. 11-15.

Truncatella caribaeensis 'Sowerby' Reeve 1842, Conchologia Systematica **2**, p. 94, pl. 182, fig. 2 (no locality given).

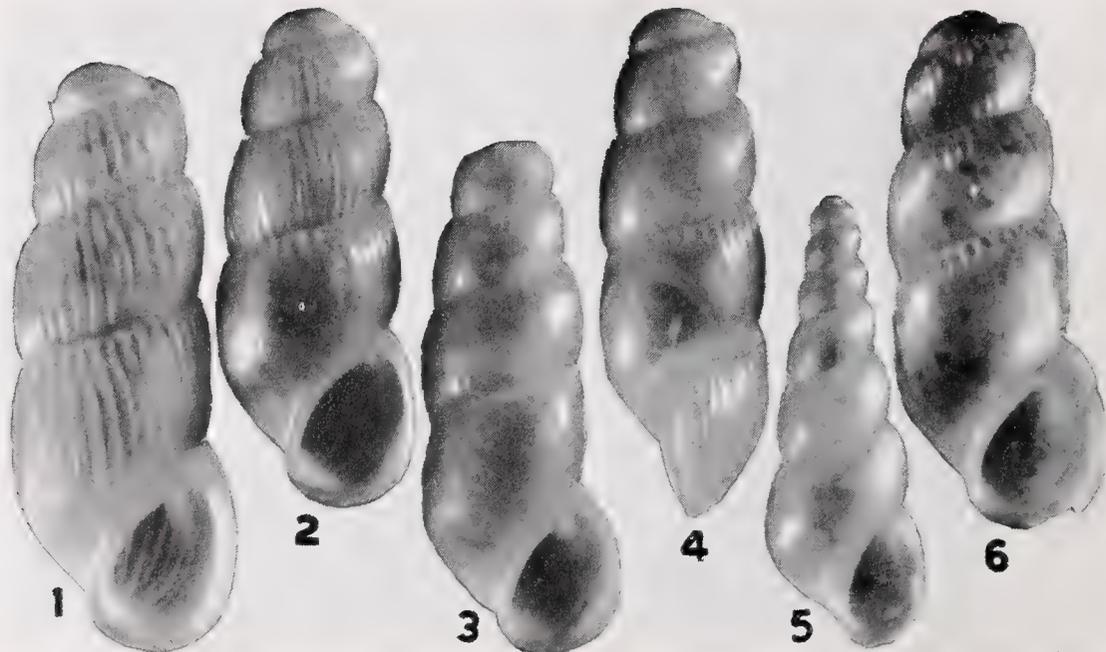
Truncatella variabilis Pfeiffer 1846, Zeitschrift für Malakozoologie **3**, p. 183 [nude name in the synonymy of *T. caribaeensis* Pfeiffer].

Truncatella caribaeus 'Sowerby' Petit 1856, Jour. de Conchy. **5**, p. 152 (Guadeloupe) [error for *caribaeensis* Sowerby].

Truncatella guerinii 'Parreyss' Pfeiffer 1856, Monographia Auriculaceorum Viventium, p. 185 [nude name included in the synonymy of *T. caribaeensis*]; non *T. guerinii* Villa 1841.

Truncatella turrita 'Pfeiffer' Dall 1885, Bull. United States Geological Survey no. 24, p. 314. [This was an error by Dall in which he misread the letter T. for *Truncatella* and not an abbreviation of the word Testa as originally meant by Pfeiffer.]

Description. Shell small, variable in size, from $5\frac{1}{2}$ to $7\frac{1}{2}$ mm. in length. Costate to nearly smooth, rather shining and somewhat solid. Whorls 4 to $4\frac{1}{2}$ and convex. Color straw-yellow to light amber with the aperture generally whitish. Spire lengthened and truncated. Suture rather deeply impressed. Aperture holostomatous, ovate and somewhat flaring, rounded below and angled above. Parietal wall margined by the thickened inner lip. Outer lip simple and noticeably thickened at its union with the body whorl above. Basal ridge absent or only slightly developed. Shell imperforate or at best with a very minute rimation. Columella not apparent. Sculpture consisting of numerous axial



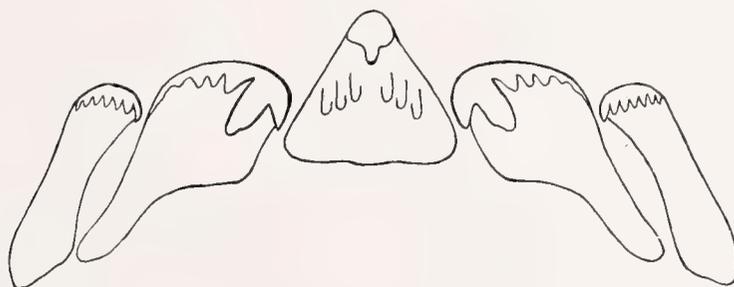
Photographs by F. P. Orchard

Plate 68. *Truncatella pulchella* Pfeiffer

Fig. 1. Coconut Grove, Florida. Fig. 2-5. Nueva Gerona, Isle of Pines, Cuba (all $9\frac{1}{2}x$). Fig. 6. Lectotype of *Truncatella pulchella* Pfeiffer, Cárdenas, Cuba (10x).

ribs; generally few specimens are completely costate. In moderately costate forms the ribs appear only on the upper portion of the whorls, leaving the peripheral and lower areas of the whorls smooth. Operculum paucispiral, corneous and generally with a thin calcareous plate on the outer surface. Young specimens have the first two whorls smooth with the remaining whorls moderately to rather fully costate.

	length	width	
(large)	7.3	2.8 mm.	Homosassa, Florida
(average)	6.1	2.5	Nueva Gerona, Isle of Pines
(small)	5.5	2.6	Simms, Long Island, Bahama Ids.



Drawn by Ruth D. Turner

Plate 69. Radula of *Truncatella pulchella* Pfeiffer

Types. Lectotype, here selected, Museo Poey, Habana, no. 181, Cárdenas, Cuba. Paratype, Museum of Comparative Zoölogy, no. 158170, from the same locality. Additional types are probably in the Museum of Stettin, Germany.

Remarks. Both *Truncatella pulchella* and *T. bilabiata* have approximately the same distribution in the Western Atlantic. Many times these two species will occur together at the same locality.

Truncatella pulchella is readily separated from *T. bilabiata* by being larger and having a simple lip. Considering the species as a whole there are probably far more specimens of *pulchella* than of *bilabiata* that lack strong costae. It is quite probable that certain of these smooth forms were erroneously considered to be *T. subcylindrica* Linné of Europe. In a reduction of the costae in *T. pulchella* they disappear over the peripheral area and the base of the whorl while in *T. bilabiata* the reduction takes place only in the peripheral area. This is, in addition, reflected in the weakened basal ridge in *T. pulchella* and the strong basal ridge in *T. bilabiata*.

Range. North Carolina, Florida and the West Indies south to Barbados, Lesser Antilles.

Records. NORTH CAROLINA: Beaufort (AMNH). FLORIDA: Coconut Grove (R. Humes); Key Largo; Lignumvitae Key (both MCZ); Key West (D. Thaanum); Cape Sable; Marco; Sanibel Island; Pass-à-grille (all MCZ); Sarasota Bay (D. Thaanum); St. Petersburg; Cedar Keys; Homosassa (all MCZ). TEXAS: Aransas Pass; Metagorda Co. (both USNM). BERMUDA: Shelly Bay (MCZ). BAHAMAS: Angel Fish Point and Sand Bank, Crossing Bay, Great Abaco; Culbert Point, Nassau, New Providence; North Bimini Id., Bimini Islands; Mangrove Cay, Andros Island; James Cistern and Rock Sound, Eleuthera; Arthurstown, Cat Island; Simms, Long Island; Matthew-

town, Great Inagua (all MCZ); Watling Id.; Mariguana Id.; Providenciales Id., Caicos Islands (all USNM). CUBA: Playa Manimani, Pinar del Río (A. del Valle); Cárdenas (C. G. Aguayo); Varadero (USNM); Punta Alegre, Camagüey (R. Humes); Punta de Piedra, Banes (A. Quiñones); Cabo Cruz (MCZ). ISLE OF PINES: Nueva Gerona (MCZ). PUERTO RICO: Ensenada Honda (USNM). VIRGIN ISLANDS: St. Thomas; St. Croix (MCZ). JAMAICA: St. Ann's Bay; Port Royal (both MCZ). HISPANIOLA: Gonave Id. (MCZ); Aquin; Ile à Vache; Cap Haitien; Port-au-Prince; Barahona; Santa Bárbara de Samaná (all USNM). LESSER ANTILLES: St. Bartholomew; Martinique; Guadeloupe; Barbados (all MCZ); Trinidad (USNM). CARIBBEAN ISLANDS: Curaçao (MCZ).

***Truncatella (Truncatella) succinea* C. B. Adams, Plate 70, fig. 1-6**

Truncatella succinea C. B. Adams 1845, Proc. Boston Society Natural History 2, p. 12 (Jamaica).

Truncatella gouldii 'C. B. Adams' Pfeiffer 1846, Zeitschrift für Malakozoologie 3, p. 183 [nude name in the synonymy of *caribaeensis* Reeve [Cotypes, MCZ 177133].

Truncatella gouldii 'Bronn' Pfeiffer 1856, Monographia Auriculaceorum Viventium, p. 185. [This was a nude name given in a price list of Bronn and included by Pfeiffer as a synonym of *caribaeensis*.]

Description. Shell rather large for the genus, reaching to about 9 mm. ($\frac{5}{8}$ of an inch) in length, rather solid and generally strongly sculptured. Color ranging from grayish-white to yellowish-brown. Whorls remaining, 4 to $4\frac{1}{2}$, moderately convex. Suture well defined. Aperture holostomatous, subcircular to subovate. Outer lip simple though occasionally thickened by the first costa behind. Parietal lip thickened and smoothly arched over the columellar area. Both outer and inner lip slightly reflected. Basal ridge well developed. Umbilical area minutely rimate or smooth. Columella short. Sculpture consisting of numerous (generally 30 to 40) axial costae which may be evenly developed throughout their length or so reduced that the peripheral area of the whorl is smooth, the costae being developed only at the suture. Operculum generally with a calcareous plate on a chitinized base.



Photographs by F. P. Orchard

Plate 70. *Truncatella succinea* C. B. Adams

Fig. 1. Lectotype, Jamaica. Fig. 2-5. Paratypes, Jamaica; fig. 5 shows the non-truncated adult shell. Fig. 6. Cotype of *Truncatella gouldii* 'C. B. Adams' Pfeiffer (= *succinea* C. B. Adams), Jamaica (all 6x).

	length	width	
(large)	8.4	3.5 mm.	Jamaica
(average)	8	3.3	Turks Island, Bahamas
(small)	7	2.9	Key Largo, Florida

Types. Lectotype, here selected, Museum of Comparative Zoölogy, no. 177154, Jamaica, C. B. Adams collector. Many paratypes from the same locality.

Remarks. For the time being, at least, it seems best to retain the name *succinea* C. B. Adams for this Western Atlantic species. However, it is impossible in most cases to separate this form from that of *guerinii* A. and J. B. Villa of the Indo-Pacific area. *T. succinea* is generally more amber in color and less grayish than is usually the case with *T. guerinii*. Also, the calcareous opercular plate is less well developed in *succinea*. Even in these minor qualifications, however, the two forms completely overlap.

The peculiar distributional pattern of *succinea* is rather difficult to explain unless we take into consideration the possibility of an early introduction of this form from the Indo-Pacific area. This may well be the case though we completely lack factual evidence. Ballast, seaweed for packing material, or any other means may have been responsible for its introduction during the nineteenth century and as a consequence, its spread from a possible Jamaican center has been erratic and discontinuous. It is also possible that *succinea* may hybridize with *T. pulchella* as these two species certainly do merge into one another and certain specimens cannot be separated with any certainty. It is also interesting to note that the largest examples, and those which duplicate exactly the characters of *guerinii* Villa of the Indo-Pacific, are the specimens of the type series of C. B. Adams which he obtained about 1845.

Range. The Bahamas, Cuba, Hispaniola, Jamaica and the Cayman Islands.

Records. BAHAMAS: Turks Island (USNM). CUBA: Cabo Cruz; Matanzas (both USNM). HISPANIOLA: Les Cayes; Ile à Vache; L'Acul River (all USNM). JAMAICA: Ackendown; Port Antonio (both MCZ). CAYMAN ISLANDS: Little Cayman Island (USNM).

Subgenus **Tomlinella**, new subgenus¹

This subgenus is characterized by possessing only a few, but exceedingly strong, axial costae. So far as known, the costae are always strongly developed with little tendency toward reduction at the periphery or complete loss. These costae seldom if ever group to form a basal ridge. Lip generally duplex, the outer being an enlargement of the last costa, the inner being a slightly forward development of the body whorl. Operculum paucispiral and corneous without any accessory calcified plate so far as known.

Tomlinella is known to occur only along the tropical and subtropical coasts of both sides of the Atlantic.

Subgenotype, *Truncatella scalaris* Michaud.

¹ Named for J. R. leB. Tomlin of St. Leonards-on-Sea, England.

Truncatella (Tomlinella) scalaris Michaud, Plate 65, fig. 2; Plate 71, fig. 1-6

Rissoa scalaris Michaud 1830, Descr. Genre Rissoa, p. 18 [this paper not seen by us] (locality unknown); 1832 Descriptions de Plusieurs Nouvelles Espèces de Coquilles du Genre Rissoa (Fremerville) 2nd Ed., p. 21, fig. 31-32.

Truncatella clathrus Lowe 1832, Zoological Journal 5, p. 303 (locality unknown); Reeve 1842, Conchologia Systematica 2, pl. 182, fig. 3 (locality unknown).

Truncatella costata Pfeiffer 1839, Archiv für Naturgeschichte von Weigmann (5th year) 1, p. 356 (Cuba); non Cossmann 1895.

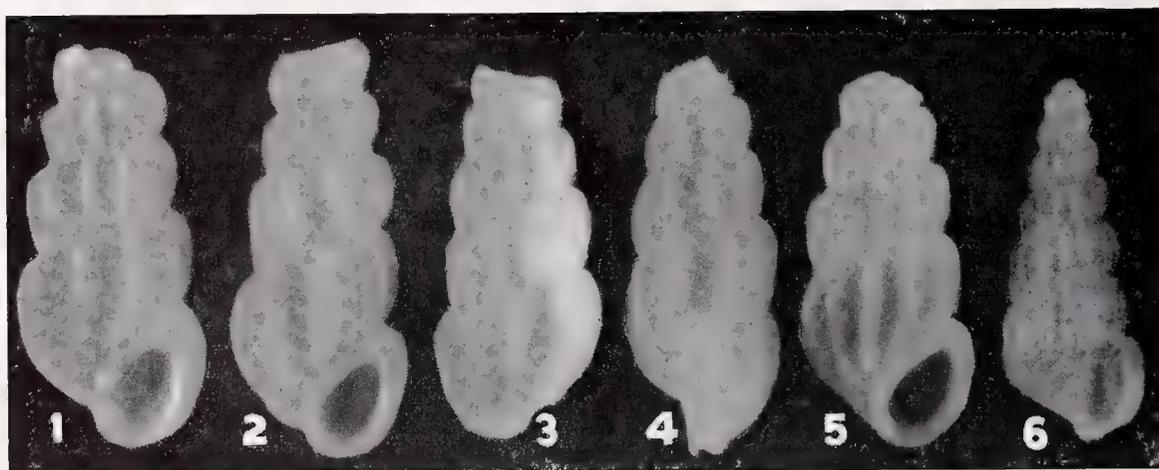
Truncatella cumingii C. B. Adams 1845, Proc. Boston Society of Nat. Hist. 2, p. 12 (Jamaica) [Lectotype, MCZ 177155].

Truncatella scalariformis C. B. Adams 1845, Proc. Boston Society Nat. Hist. 2, p. 12 (Jamaica); non Reeve 1842.

Truncatella adamsi Pfeiffer 1846, Zeitschrift für Malakozologie 3, p. 119, 189 [new name for *T. scalariformis* C. B. Adams, non Reeve 1842].

Description. Shell small, about $4\frac{1}{2}$ to 5 mm. in length, imperforate, solid, with strong axial costae. Whorls remaining, $3\frac{1}{2}$ to $4\frac{1}{2}$, moderately convex. Color generally a dull gray to light straw-brown. Spire extended and truncated. Suture deeply impressed. Aperture holostomatous and subovate. Outer lip double, its inner portion a thin ridge, the outer portion greatly thickened. Inner lip continuous, consisting of the inner margin only. Columella short and inconspicuous. Sculpture consisting of 8 to 11 very prominent axial costae (body whorl). These costae terminate at the sutures and seldom oppose evenly the costae on the whorl above. At the umbilical region of the body whorl these costae end without forming a basal ridge. There are very faint spiral threads between the costae ($45\times$). Operculum thin and corneous. In young specimens the first two whorls are smooth, the third whorl finely costate and the remaining whorls coarsely costate.

	length	width	
(large)	4.6	1.9 mm.	Guadeloupe
(large)	4.5	2	Jamaica
(small)	3.5	1.6	Matanzas, Cuba



Photographs by F. P. Orchard

Plate 71. *Truncatella scalaris* Michaud

Fig. 1. Neoholotype, Port Antonio, Jamaica. Fig. 2. Lectotype, of *T. cumingii* C.B.Adams (= *scalaris*), Jamaica. Fig. 3-4. Paratypes of *T. cumingii* C.B.Adams. Fig. 5-6. South Bight, Mangrove Cay, Andros Island, Bahamas (all $9\times$).

Types. As Michaud's type of this species is not known to exist, we here designate as a neoholotype, Museum of Comparative Zoölogy no. 165706, from Port Antonio, Jamaica, the latter to be the type locality.

Remarks. This species appears to be rather rare. We have seen but one large lot, from the United States National Museum, collected by C. R. Orcutt at Saltrou, Haiti.

Truncatella scalaris differs from *T. s. piratica* by having fewer and much stronger costae. In *scalaris* there are 8 to 11 costae while *piratica* possesses 13 to 16. In young *scalaris* the third whorl is very finely costate and the remainder coarsely so. In *piratica* the third to sixth whorls are generally very finely costate and the later whorls more strongly so. The duplex lip of *piratica* is much stronger and heavier than that of *scalaris*.

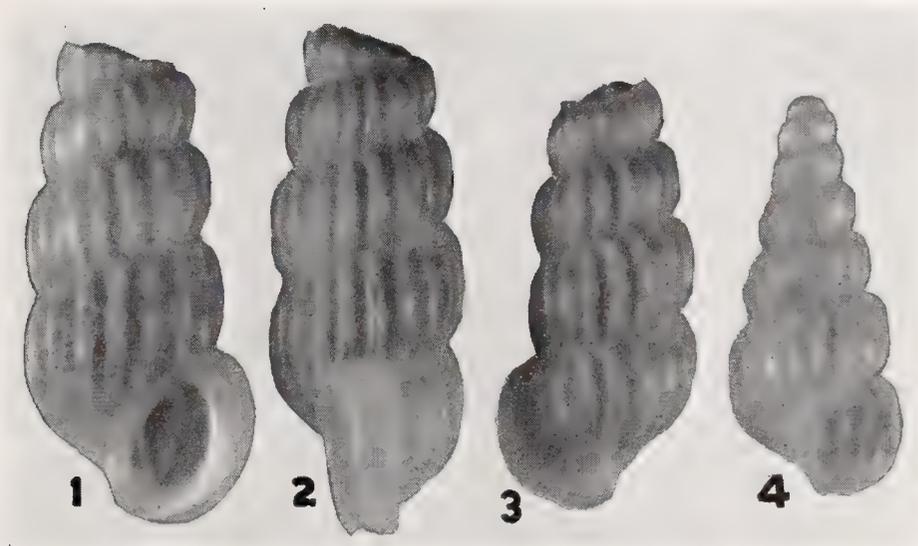
Variation in the number of costae is quite limited in specimens from any one locality. There appear, however, to be definitely more costae in specimens from the more northern localities.

Range. Florida, the Bahamas and south to the Lesser Antilles.

Records. FLORIDA: West Summerland Key (R. Humes). BAHAMAS: Sweetings Village, Great Abaco; Mangrove Cay, Andros Id. (both MCZ). CUBA: Matanzas (C. G. Aguayo); Punta de Piecha, Banes (A. Quiñones); Cinco Reales, Santiago (C. G. Aguayo). HISPANIOLA: Port Salut; Les Cayes; St. Louis: Saltrou; Bizonton; Baie Anglaise near Aquin (all USNM). JAMAICA: Port Antonio (MCZ); Montego Bay; Jacks Bay and Robins Bay, St. Mary's (all USNM). LESSER ANTILLES: Guadeloupe; St. Martins (both MCZ).

***Truncatella scalaris piratica*, new subspecies, Plate 65, fig. 1; Plate 72, fig. 1-4**

Truncatella clathra 'Lowe' Pilsbry 1900, Trans. Connecticut Academy 10, p. 506, pl. 62, fig. 13; *non* Lowe 1832.



Photographs by F. P. Orchard

Plate 72. *Truncatella scalaris piratica* Clench and Turner

Fig. 1. Holotype, St. George's Causeway, Bermuda. Fig. 2-4. Paratypes from the same locality (all about 10x).

Description. Shell small, about $4\frac{1}{2}$ to 5 mm. in length, imperforate, solid and with strong axial costae. Whorls remaining, $3\frac{1}{2}$ to $4\frac{1}{2}$, moderately convex. Color generally a straw-yellow to light reddish-brown sometimes with almost a golden tinge. Spire extended and truncated. Suture deeply impressed. Aperture holostomatous and subovate. Outer lip double, its inner portion a thin ridge, the outer portion greatly thickened. At the umbilical region of the body whorl the costae end without forming a basal ridge. Columella short and inconspicuous. Sculpture consisting of 13 to 16 very prominent axial ribs (body whorl). These ribs terminate at the sutures and seldom oppose evenly the ribs on the whorl above. Inner lip continuous, consisting of the inner margin only. Very faint spiral threads exist between the costae ($45\times$). Operculum thin and corneous. In young specimens the first two whorls are smooth, the third and fourth very finely, and the rest rather coarsely, costate.

length	width
4.7	2.2 mm. Bermuda

Types. Holotype, Museum of Comparative Zoölogy, no. 178985, from St. George's Causeway, Bermuda. Paratypes in the MCZ and USNM from the Bermudas.

Remarks. See under *Truncatella scalaris* Michaud.

Range. Known only from the Bermudas.

Records. BERMUDA: St. George's Causeway (MCZ); Gibbet Island; Eves Pond (both USNM).

Notes

The following notes and the description of *T. rostrata* Gould are included to complete our studies of *Truncatella* in the Western Atlantic. These are species erroneously assigned to the Western Atlantic or representing introductions that have been unable to survive. We give a description of *T. rostrata* Gould since this species was described as coming from Rio de Janeiro, Brasil, though actually from West Africa.

Truncatella aurea Prime

Truncatella aurea Prime 1853, List of Shells and Corals Collected at Bermuda by Temple Prince [sic] L.L.B. of New York. Bermuda Pocket Almanac for 1852, p. 55 [nude name].

Truncatella modesta C. B. Adams

Truncatella modesta C. B. Adams 1851, Ann. Lyceum Nat. Hist., New York 5, p. 48 (Jamaica).

We have the sole specimen of this species (holotype, MCZ no. 177159). It is not a *Truncatella* but a species of *Turbonilla*.

Truncatella (*Tomlinella*) *rostrata* Gould, Plate 73, fig. 1-2

Truncatella rostrata Gould 1847 [1848], Proc. Boston Society Nat. Hist. 2, p. 209; Gould 1852, United States Exploring Expedition 12, p. 111, pl. 8, fig. 128a-b (Rio de Janeiro [Brasil]).

Truncatella princeps Dohrn 1866, Malakozoologische Blätter 13, p. 134 (Ilha do Principe [Princes Island, Gulf of Guinea, Africa]); Pfeiffer 1867, Novitates Conchologicae 3, p. 317, pl. 76, fig. 10-11.

Description. Shell small, 5 to 6½ mm. in length, imperforate, solid, with strong axial costae. Whorls remaining, 4½, moderately convex. Color a rather dull brownish-yellow. Spire extended and truncated. Suture deeply impressed. Aperture subovate and nearly holostomatous. Outer lip double, its inner portion a rather thickened and somewhat flaring ridge, the outer portion greatly thickened. Inner lip continuous and much thickened but hardly extending vertically. Columella short and inconspicuous. Sculpture consisting of 14–15 very prominent axial costae (body whorl). These costae terminate at the sutures and seldom oppose evenly the ribs on the whorl above. The costae end at the umbilical region of the body whorl without forming a basal ridge. No spiral sculpture (45×). Operculum thin and corneous with no apparent calcified plate. In young specimens the first 2½ whorls are smooth; from the third whorl on they become increasingly costate.

length	width	
6	2.5 mm.	Princes Island, Gulf of Guinea, Africa
5	2.3	“Rio de Janeiro”

Types. Lectotype of *T. rostrata* Gould, here selected, New York State Museum no. G2541a, Rio de Janeiro, Brasil. Lectotype of *T. princeps* Dohrn, here selected, Museum of Comparative Zoölogy no. 104559, Princes Island, Gulf of Guinea, Africa.

Remarks. The locality, Rio de Janeiro, Brasil, for Gould's *T. rostrata* is open to question. We have been unable to trace any published record of *Truncatella*, other than Gould's, from south of Trinidad. Nor are there any records south of Trinidad in the large collections of this genus that we have studied. We have made a careful comparison of Gould's types of *T. rostrata* with types of Dohrn's *T. princeps* and can detect no differences.

Truncatella rostrata Gould differs from *T. scalaris* Michaud by being a larger and



Photographs by F. P. Orchard

Plate 73. *Truncatella rostrata* Gould

Fig. 1. Lectotype of *T. princeps* Dohrn (= *rostrata* Gould), Princes Island, Gulf of Guinea, Africa. Fig. 2. Lectotype of *T. rostrata* Gould, Rio de Janeiro, Brasil (both about 9x).

much heavier shell with more whorls, and much darker coloration. It is intermediate between *scalaris* and *scalaris piratica* in the number of costae on the body whorl.

Range. Princes Island and south to Gaboon, West Africa.

Records. EASTERN ATLANTIC: Princes Island (MCZ), Gaboon, West Africa (AMNH).

The Western Atlantic record from Rio de Janeiro is quite certainly in error. Gould received much material from Cape Palmas, Liberia and it is quite possible that the specimens he described from Rio de Janeiro came originally from this locality in Africa.

***Truncatella subcylindrica* Linné**

Helix subcylindrica Linné 1767, Systema Naturae 12 Ed., 1, p. 1248 (Northern Europe).

This European species has been referred to the West Indies in several reports, but unquestionably in error. These references were probably based upon certain forms of *Truncatella pulchella* Pfeiffer. (See Pilsbry 1902, Nautilus 15, p. 119.)

***Truncatella truncata* Montagu**

Turbo truncatus Montagu 1803, Testacea Britannica 2, p. 300, pl. 10, fig. 7 (Southampton and Plymouth, England).

Truncatella truncata Montagu, Johnson 1915, Occasional Papers, Boston Soc. Nat. Hist. 7, pt. 13, p. 111 (Newport, Rhode Island).

This reference is based entirely on Verrill's *T. truncatula* Draparnaud (see below).

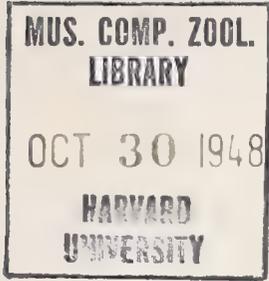
***Truncatella truncatula* Draparnaud**

Truncatella truncatula Draparnaud 1805, Histoire Naturelle des Mollusques Terrestres et Fluviales de la France, p. 40, pl. 1, fig. 28-31 (Coast of Mediterranean); Verrill 1880, American Journal Science 20, p. 250; Verrill 1882, Trans. Connecticut Acad. 5, p. 525, pl. 58, fig. 8a-b (all Newport, Rhode Island).

This European form occurred alive in seaweed at high water line in the dock area of Newport, Rhode Island. Verrill, who had collected the material at Newport, stated that he suspected this form was introduced from Europe. It has failed to survive. No records of this species have been obtained since from anywhere in New England or even south of this area.

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TONNIDAE

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THE FAMILY TONNIDAE IN THE WESTERN ATLANTIC

BY
RUTH D. TURNER

The family Tonnidae, as here considered, contains four genera, namely *Tonna*, *Malea*, *Eudolium* and *Oocorys*. *Tonna* is by far the largest genus both in the size of the shells and the number of species. It is found in the tropical and warmer portions of temperate seas throughout the world. *Malea*, which is entirely tropical, is represented by relatively few species, none of which is found in the Western Atlantic. However, we include a description of the genus and a figure of the type species to complete the family. *Eudolium* is a rather rare genus and is found mainly in deeper water, occurring in both tropical and temperate portions of the world. *Oocorys* is also rare and world-wide in distribution in temperate and tropical seas, but is usually found only at considerable depths. By far the largest number of species in the family occur in the Indo-Pacific.

According to our present knowledge, members of this family occur mainly in sandy areas, generally just below, to well below, the low-tide mark. Specimens of *Oocorys* have been dredged as deep as 2620 fathoms (almost 3 miles).

The Tonnacea includes the families Cassididae, Cymatiidae, Bursidae, Tonnidae and Ficidae. Even though the radula varies somewhat in the finer structures of the teeth, these variations appear to be just as great within a family as they do among these five families. The radulae of the various genera in all these families as figured by Thiele, Trochel and others are often so close that, on the basis of this character alone, a genus could be placed in any family of the Tonnacea. With a few exceptions, it now appears that the shells are far more diagnostic as a single character in the study of relationships

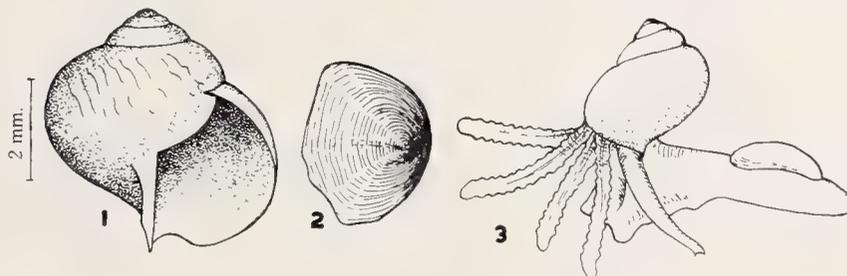


Plate 74

Fig. 1-2. Shell and operculum of pelagic young of *Tonna maculosa?* Dillwyn, from the Campeche Bank, Yucatan. For the radula from this specimen see Plate 75, fig. 3. Fig. 3. The pelagic young of some species of *Tonna*, showing the long velar lobes, the foot and the operculum (Fig. 3, after Fischer).

than are most of the morphological structures of the soft anatomy. However, it is by a consideration of all of the characters involved rather than any one character that a genus can be placed properly in this complex.

From general shell and anatomical characters the Tonnidæ appear to be most closely related to the Cassididae and the Ficidae and less so to the Cymatiidae and Bursidae. In the Tonnidæ, so far as now known, all species have an operculum in their young stage, but only in *Oocorys* does it persist in the adult.

Certain species in the genus *Tonna* reach a very large size and are among the largest gastropods known, exceeded in length and capaciousness only by *Megalotractus*, *Fasciolaria* and *Melo*. *Tonna melanostoma* Jay is the largest species in the Tonnidæ. Our largest specimen has a capacity of about 4 quarts (3170 cc). This specimen measures 280×240 mm. (11×9½ inches).¹

Very little is known of the life history of the various species of the Tonnidæ other than the fact that the sexes are separate and that they produce free-swimming, pelagic young. The embryonic shell of *Tonna* has 3 to 4 whorls, is smooth and has a golden-brown coloration. It consists mainly of periostracum overlaying a thin layer of lime. The aperture is closed with a well-developed, tightly fitting operculum (Plate 74, fig. 2). In adults the early whorls become much thickened by a lime deposit.

The genus *Macgillivrayia* was established by Forbes for the pelagic young of some species of *Tonna* that were found off the eastern coast of Australia. Macgillivray states that it is furnished with a float in the manner of *Ianthina*. Fischer (1885, p. 651) figured the animal of *Macgillivrayia pelagica* showing the four long velar lobes, the large foot, the operculum and the thin transparent shell (Plate 74, fig. 3). He concludes that the young of *Tonna* have the appearance of *Macgillivrayia*. He no doubt based this statement on the work of B. Cazenavette (1853, p. 62) who described the young shells of what he called *Dolium perdix*. However, Cazenavette failed to cite a locality and it may be assumed from the article that he was dealing with *T. galea*, the only species of *Tonna* found off the French coast. After the death of Cazenavette the specimens were sent to Fischer who (1863, page 147) described them fully and pointed out the relationship of *Tonna* and *Macgillivrayia*. These pelagic young possess an operculum which apparently is lost at the time the animal changes from the larval free-swimming stage to the post-larval and bottom-living form. It would be impossible to determine the species of *Tonna* from the embryonic shells as all are nearly uniform in size and coloration and all lack sculptural characters; however, specific differences may occur in the radulae.

In the catalogue of this family by Winckworth and Tomlin 96 names are listed and of these some 50% are considered synonyms. So far as can be determined from the large series available to us, all species appear to be exceedingly variable, not only as to size but also in coloration, sculpture and general shape of the shell. A series from any one locality is usually limited; many times to only a single specimen in a lot. As a consequence, these minor variations have given rise to many names so that it is impossible to separate them into valid categories.

One of the outstanding characters in this family is that of spiral ridges. These may be clear-cut as ridges only, or else associated with small spiral cords or threads between the

¹ A specimen of *Megalotractus aruanus* Linné measuring 560x260 mm. (20¼x10¼ inches) has a capacity of 3650 cc. and a specimen of *Melo aethiopica* Linné measuring 388x223 mm. (13½x8¾ inches) holds 3640 cc.

Radulae and Opercula of the Tonnidae

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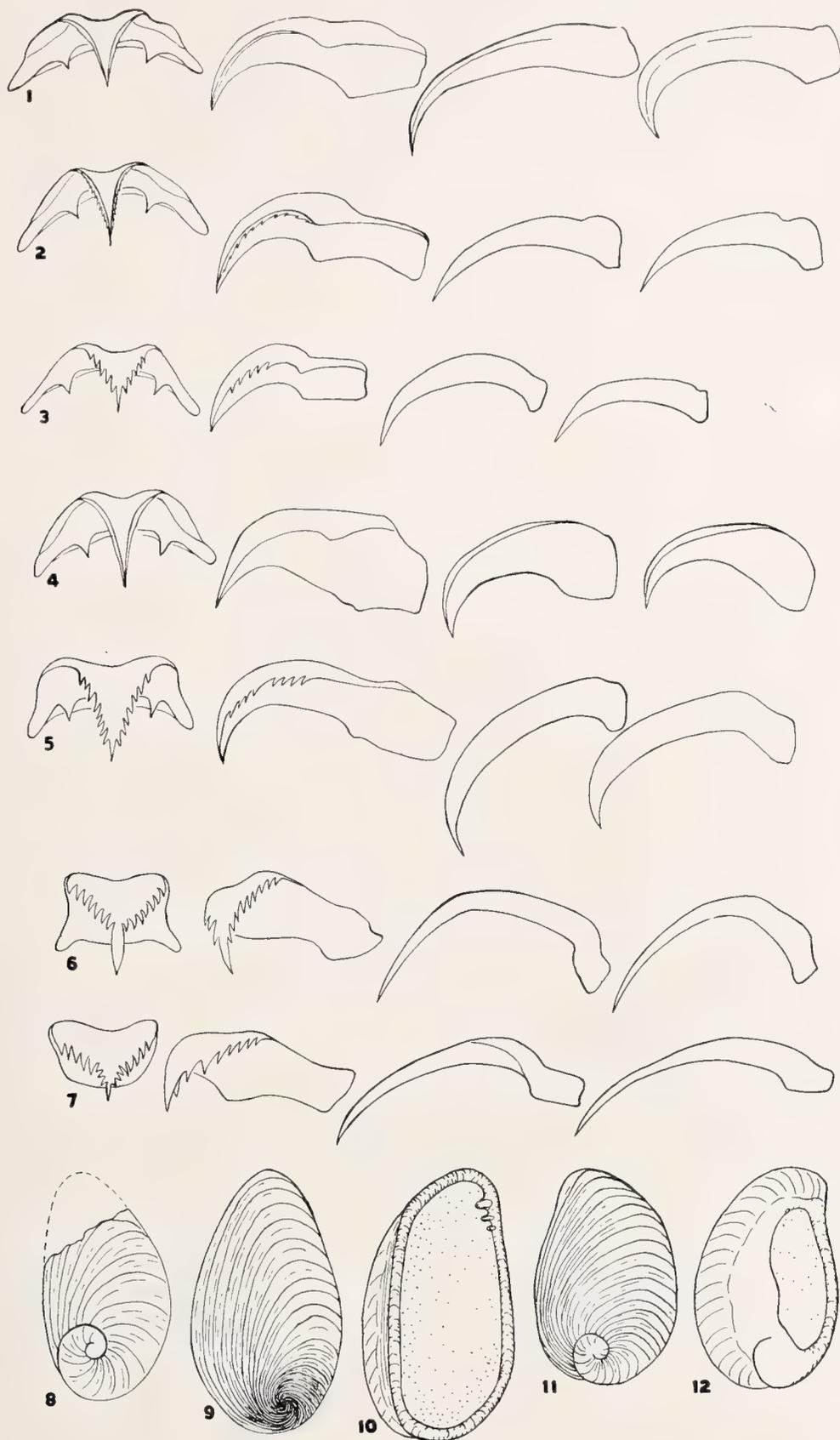


Fig. 1. *Tonna perdix* Linné.

Fig. 2. *Tonna maculosa* Dillwyn.

Fig. 3. Pelagic young of *Tonna*, apparently close to *Tonna maculosa* Dillwyn.

Fig. 4. *Tonna galea* Linné.

Fig. 5. *Eudolium crosseanum* Monterosato.

Fig. 6. *Oocorys (Benthodolium) abyssorum* Verrill and Smith.

Fig. 7. *Oocorys bartschi* Rehder.

Fig. 8. Operculum of *Oocorys sulcata* Fischer (young specimen).

Fig. 9-10. Operculum of *Oocorys bartschi* Rehder. Fig. 9. Outer side. Fig. 10. Inner side. Stippled area indicates the muscle scar.

Fig. 11-12. Operculum of *Oocorys (Benthodolium) abyssorum* Verrill and Smith. Fig. 11. Outer side. Fig. 12. Inner side. Stippled area indicates the muscle scar. (All radulae drawn with the aid of a camera lucida and greatly enlarged.)

Plate 75

The figures of the radulae shown are all from young specimens or from the least worn portions of the radulae so as to show as much dentition as possible. We have seen the radula of an adult specimen of *E. crosseanum* in which the denticles are worn almost completely smooth. Trochel has shown denticles on the rachidian and marginal teeth of *T. perdix* which were apparently drawn from a much younger specimen than the one we figure.

ridges. The number of ridges and cords has been used to separate different forms, yet many individual specimens show a decided change in the number of cords between the ridges as the animal advances in age. In other words, the early whorls show, for example, only one small cord between two well-developed ridges, yet on the body whorl three cords may exist between these ridges.

Tonna fasciata Bruguière from the Indo-Pacific appears to be the only species in this family that produces true varices though there is some indication that this also occurs in the genus *Oocorys*. Certain species such as *T. perdix* and *T. maculosa* have a simple, thin lip while in other species, such as *Tonna galea*, the degree of development of the lip, which is produced only at maturity, is exceedingly variable.

From the small amount of preserved material at our disposal it would appear that this family has an extremely simple reproductive system. The four males (2 *T. galea*, 1 *T. maculosa* and 1 *E. crosseanum*) which we were able to examine, possess a very large intromittent organ similar to that shown by Bergh in Semper (1904, pl. 8). This appears to be formed by the body wall and is filled with spongy tissue. The seminal groove, a continuation of the vas deferens, runs along the posterior edge of the intromittent organ and disappears on the copulatory papilla. It is the papilla which seems to vary in the few species examined. In *T. galea* it is digitiform, short and rather thick; in *T. perdix*, according to Bergh, it is somewhat longer and thinner and in *T. maculosa* it is extremely long and flagellate. The single male specimen of *Eudolium crosseanum* studied was completely lacking in any trace of a copulatory papilla, but the remainder of the intromittent organ was in all respects similar to that of the other species examined. Unfortunately no male specimens of *Oocorys* have been seen. Far more material must be studied before any complete account of the reproductive anatomy of this group can be given.

The nervous system of *Tonna galea* has been fully discussed and illustrated by B. Haller (1893, p. 563–577) and Hermann Weber (1927) has given a very complete, fully illustrated account of the anatomy, morphology and histology of the digestive tract of this species.

Subfamily Tonninae

Shell lacking the operculum in the adult, as far as now known, possessing basal denticles on the rachidian teeth of the radula and having a rather large protoconch.

Genus *Tonna* Brunnich¹

Tonna Brunnich 1772, *Zoologiae Fundamenta*, p. 248.

Cadus Röding 1798, *Museum Boltenianum*, p. 150 (genotype, *Buccinum perdix*, subsequent designation, Woodring 1928, p. 310).

Dolium Lamarck 1801, *Système des Animaux sans Vertèbres*, p. 79 (genotype, *Buccinum galea* Linné, monotypic).

Cadium Link 1807, *Beschreibung der Naturalien-Sammlung der Universität zu Rostock*, p. 113 (genotype, *Buccinum perdix* Linné, subsequent designation, Woodring 1928, p. 310).

Perdix Denys de Montfort 1810, *Conchyliologie Systématique* 2, p. 447 (genotype, *Perdix reticulatus* Denys de Montfort, original designation); *non* Brisson 1760.

¹Winckworth 1945, *Bulletin of Zoological Nomenclature* 1, pt. 5, pp. 113–116 has placed before the International Commission the problem of *Tonna* Brunnich. This genus was outlined by Brunnich though no species was listed. However, the name has been in general use since 1906 and we agree with Winckworth that this well known name should be placed on the official list of Generic Names in Zoology rather than discarded for *Cadus* Röding.

Macgillivrayia Forbes 1852, Voyage of the Rattlesnake **2**, p. 383, pl. 3, fig. 8a-b (genotype, *Macgillivrayia pelagica* Forbes, monotypic); Fischer 1863, Journal de Conchyliologie **11**, p. 147-149; Fischer 1884, Manuel de Conchyliologie, p. 651.

Macgillivraya Forbes 1852, Report British Association Advancement of Science for 1851, **21**, Appendix, p. 77.

Galea 'Klein' Mörch 1852, Catalogus Conchyliorum Comes de Yoldi, p. 110. [This pre-Linnean name of Klein was introduced by Mörch as a synonym of *Dolium*.]

Foratidolium Rovereto 1899, Atti Società Ligustica **10**, p. 107; new name for *Perdix* Denys de Montfort, non Brisson 1760.

Parvitonna Iredale 1931, Records of the Australian Museum **18**, p. 216 (genotype, *P. perselecta* Iredale, monotypic).

Genotype, *Buccinum galea* Linné, subsequent designation, Suter 1913.

Shell medium to very large in size, in shape from oval to globose, rather thin but strong and generally sculptured with strong spiral ridges. Axial sculpture consisting only of fine growth lines except on the early post-embryonic whorls where a minor reticulated sculpture is apparent in certain species. Parietal shield slightly, to well-developed and reflected over the umbilicus. Aperture large, with or without a reflected lip. Columella nearly straight or moderately twisted. Anal canal inconspicuous, siphonal canal short and broad. Periostracum thin, straw-yellow and deciduous. Embryonic whorls persistent, covered with a horny periostracum and devoid of sculpture.

The genus *Macgillivrayia* was described by Forbes from some small pelagic mollusks that were collected by Macgillivray some 15 miles off Cape Byron, New South Wales, Australia. These were subsequently considered by Fischer (1863, p. 349; 1884, p. 651) to be the young free-swimming larvae of *Tonna perdix*. There appears to be no question about *Macgillivrayia* being the young of *Tonna*, though it would be difficult to assign these young to any one species.

There appears to be no question that two species of the *perdix* complex exist, one in the Indo-Pacific region and one in the Western Atlantic. Adanson's assertion that it occurs in Sénégal is open to question (*Histoire Naturelle du Sénégal*, 1757, p. 107, pl. 7, fig. 5). Many species listed by Adanson for Sénégal were obtained from other sources.

Following, we consider both species in detail in order to aid in the clarification of this problem.

***Tonna maculosa* Dillwyn, Plate 75, fig. 2; Plate 76, fig. 1-2**

Buccinum maculosum Solander 1786, A Catalogue of the Portland Museum, p. 137, no. 3050 [nude name].

Buccinum maculosum 'Solander' Dillwyn 1817, Descriptive Catalogue of Recent Shells, London **2**, p. 583 (no specific locality given). [Dillwyn refers to A. Seba 1758, **3**, pl. 68, fig. 16 which appears to be quite definitely the Western Atlantic form.]

Helix sulphurea C. B. Adams 1849, Contributions to Conchology, New York, no. 3, p. 33 (Jamaica); C. B. Adams *ibid.*, 1850, p. 98.

Dolium pennatum Mörch 1852, Catalogus Conchyliorum Comes de Yoldi, pt. 1, p. 110 (Antilles).

Dolium album Conrad 1854, Proc. Acad. Nat. Sciences Philadelphia **7**, p. 31 (no locality given).

Dolium perdix β *brasiliana* Mörch 1877, Malakozoologische Blätter **24**, p. 43 [nude name]; non *Dolium antillarum* var. *brasiliana* Mörch, *ibid.*, p. 41 (Bahia, Brasil).

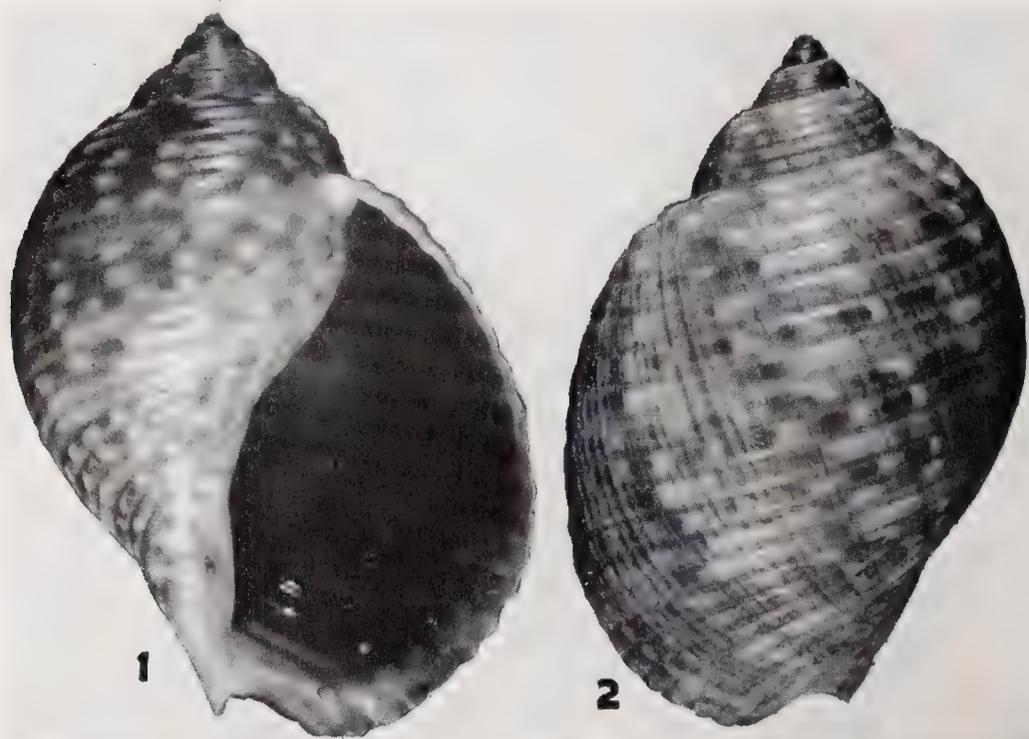
Dolium perdix occidentalis 'Mörch' v. Martens 1878, Zoological Record **14**, Mollusca, p. 35. [Mörch did not intend to use the word *occidentalis* in a subspecific sense but only as a geographic designation for the Western Atlantic area.]

Helix sulfurea 'Adams' Dall 1889, Bull. Museum Comp. Zoöl. **18**, p. 232 [error for *sulphurea* C.B. Adams].

Description. Shell varying in size from 47 to 134 mm. ($1\frac{3}{4}$ to $5\frac{1}{4}$ inches) in length, thin but rather strong and umbilicated. Whorls 6 to 7, strongly convex and rapidly increasing in size. Ground color white. The early post-embryonic whorls generally a light pinkish-brown, remaining whorls irregularly mottled. The brownish coloration is interrupted, mainly on the ribs, by long white bars of color. Two or more ribs may have the same color pattern and in many shells this grouping of the color pattern shows up as poorly defined bands. Nuclear whorls about 3, generally a golden brown. Spire moderately extended. Aperture subovate and large. Outer lip thin, slightly crenulate and occasionally edged with brown and in adults usually margined below by a very slight thickening. Parietal wall thinly glazed by a parietal shield. This shield folds over the rather deep but small umbilicus. Columella moderately arched and margined on its outer side by a ridge which terminates at the short siphonal canal. Spire moderately extended. Suture deeply impressed. Sculpture consisting of about 20 to 22 flattened, spiral ribs, which are separated by narrow and moderately deep grooves. Axial sculpture consisting of very fine and irregular growth lines. Nuclear whorls glass-like and smooth. The shell is generally covered with a thin periostracum which is deciduous.

	length	width	aperture	
(large)	134	96	106x56 mm.	Dunmore, Harbour Id., Eleuthera, Bahama Islands
(average)	97	67	64x38	Monte Cristi, Hispaniola
(small)	47	32	34x18	Barbados

Types. As the whereabouts of the specimen on which Seba's figure was based is not known and is probably not in existence, we here designate as neoholotype, Museum of Comparative Zoölogy, no. 113091, from Simms, Long Island, Bahama Islands (Plate 76, fig. 1).



Photographs by F. P. Orchard

Plate 76. *Tonna maculosa* Dillwyn

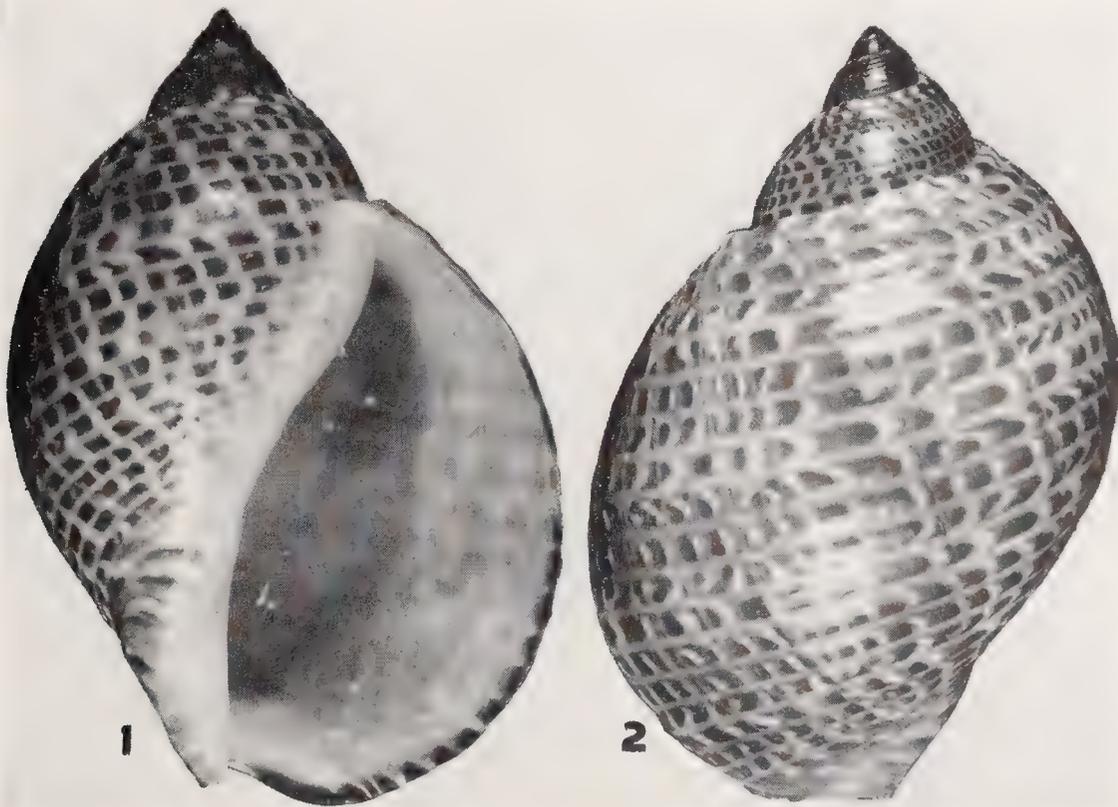
Fig. 1. Simms, Long Island, Bahama Islands (Neoholotype). Fig. 2. Near mouth of Yaqui River, Monte Cristi, Hispaniola; (both natural size).

Remarks. Dillwyn was the first to recognize the existence of two forms in the *perdix* complex. Under the title of "variety" he gives the name *Buccinum maculosum* Solander MSS. and a reference to Seba (3, pl. 68, fig. 16). The figure of Seba, a woodcut, is excellent, and shows the sharply defined grooves between the spiral ridges, and the less definite color markings of the Western Atlantic form. The name must date from Dillwyn as Solander's name was without description or reference to a previously published figure.

T. album Conrad appears to be nothing more than an albino specimen of *maculosa*. Albino specimens are not common but they exist apparently as sporadic examples throughout the range of this species.

Differences between the Western Atlantic and Indo-Pacific species, *maculosa* and *perdix*, have long been appreciated by several workers. Dillwyn was first and he was followed by Mörch, Hanley, Winckworth, Tomlin and Bayer. The question, however, has been as to which species the name *perdix* applies. We are in full agreement with Bayer that *perdix* should be employed for the Indo-Pacific species inasmuch as all of Linné's references are to this form, even though he cited "America" as the locality.

These two species though close can be readily separated. Typical *maculosa* differs from *perdix* by its type of mottling, by having a less produced spire, a more deeply arched parietal-columellar union, and more convex whorls. The ribs of *maculosa* are a little more numerous, narrower and more clearly defined as a sculptural character by the deeper inter-spaces, while in *perdix* the ribs are defined more clearly by the color pattern. In general, specimens of *maculosa* are not quite so large as those of *perdix*.



Photographs by F. P. Orchard

Plate 77. *Tonna perdix* Linné

Fig. 1. Tunuloa, Vanua Levu, Fiji Islands (natural size). Fig. 2. Calapan, Mindoro, Philippine Islands (reduced from $4\frac{1}{2}$ inches).

Range. From southern Florida south through the West Indies to Brasil.

Records. FLORIDA: Boynton (P. McGinty); Key Biscayne, Miami; Sand Key (both MCZ); Molasses Reef, Key Largo (L. A. Burry); Bahia Honda Key; Key West; Tortugas (all USNM). BERMUDA: Castle Harbour (fossil, dredged, H. Moore). BAHAMA ISLANDS: Hawksbill Creek, Grand Bahama Island; Strangers Cay, Little Abaco Island; North Bimini Island; Mangrove Cay, Andros Island; Nassau, New Providence; Dunmore, Eleuthera Island; Arthurstown, Cat Island; Clarendetown, Long Island; Abraham's Bay, Mariguana Island; Watling Island; Matthewtown, Great Inagua (all MCZ); Cay Sal, Cay Sal Bank (R. Humes). CUBA: Caibarién, Las Villas (P. J. Bermúdez); off Punta Alegre, Camagüey (R. Humes); Guarda la Vaca, Banes; Blue Beach, Guantánamo Naval Base, Bahía Honda (all MCZ). HISPANIOLA: Les Cayes; Port Salut (both USNM); Cap Haitien; Miragoane (both W. J. Eyerdam); Monte Cristi; Puerto Plata and Santa Bárbara de Samaná (all MCZ). PUERTO RICO: San Juan (MCZ); Port Real (USNM). JAMAICA: Kingston, Port Royal (both USNM); Montego Bay (MCZ). VIRGIN ISLANDS: Tortola (M. W. Dewey); St. Thomas; St. Croix (both MCZ). LESSER ANTILLES: St. Christopher; Antigua; St. Lucia (all MCZ). Carriacou Island, Grenadines; Tobago Island (both H. J. Kugler); Barbados (MCZ). CARIBBEAN ISLANDS: Grand Cayman Island; Swan Island (both MCZ); La Orchila Island (USNM). MEXICO: Veracruz (M. E. Bourgeois); Cabo Catoche, Yucatan (A. del Valle). BRITISH HONDURAS: Belize (MCZ). COSTA RICA: Limón (USNM). PANAMA: Colón (USNM). COLOMBIA: Mouth of Atrato River (USNM). VENEZUELA: La Guira (USNM). BRITISH GUIANA: Corentyne River (H. J. Kugler). BRASIL: Praia do Chega Negro, Est. Bahia; Ilha de Itaparica, Est. Bahia (both M. J. de Oliveira).

Tonna perdix Linné, Plate 75, fig. 1; Plate 77, fig. 1-2

Buccinum perdix Linné 1758, Systema Naturae ed. 10, p. 734 (America).

Cadus coturnix Röding 1798, Museum Boltenianum, p. 150.

Cadus meleagris Röding 1798, Museum Boltenianum, p. 150.

Perdix reticulatus Denys de Montfort 1810, Conchyliologie Systématique 2, p. 447, text fig. (Seas of America, in Ethiopia and the Indies).

Dolium perdix ventricosior Menke 1829, Catalog Malsburg, p. 35 [nude name].

Dolium rufum de Blainville 1829, Dictionnaire des Sciences Naturelles 54, p. 503 (Seas of Australasia).

Dolium plumatum Green 1830, Trans. of the Albany Institute, New York 1, p. 132 (South Sea Islands); Dunker 1868, Novitates Conchologicae, Abth. 2, p. 106.

Description. Shell varying in size from 75 to 163 mm. (3 to 6½ inches) in length, thin but rather strong. Whorls 5½, strongly convex and rapidly increasing in size. Ground color white. The early post-embryonic whorls generally a more or less uniform pinkish-brown; remaining whorls decidedly mottled. The mottling effect is brought about by the brown coloration which follows the ribs and which is in turn interrupted by axial bars or chevron-shaped white markings. Spaces between the ribs white, though in large adult shells the brownish coloration becomes somewhat suffused on the last half of the body whorl. Nuclear whorls 3 to 3½, generally a golden-brown. Aperture sub-ovate and large. Outer lip thin, edged with brown, somewhat crenulate and, in adults, usually margined below by a slight thickening. Parietal wall thinly glazed by a parietal shield. This shield folds over the rather deep but narrow umbilicus. Occasional specimens have

a large irregular callus of white on the body whorl at the upper insertion of the aperture. Columella slightly arched and margined on its outer side by a ridge which terminates at the short siphonal canal. Spire moderately extended. Suture deeply impressed. Sculpture consisting of about 19 to 20 flattened, spiral ribs which are separated by narrow and shallow grooves. Axial sculpture consisting of very fine and irregular growth lines. Nuclear whorls glass-like and smooth.

	length	width	aperture	
(large)	163	114	125 x 70 mm.	Amboyna, Molucca Islands
(average)	114	80	87 x 45	Calapan, Mindoro, Philippine Islands
(small)	75	48	51 x 25	Amouli, Tutuila Islands, Samoan Islands

Types. Plate 27, fig. C, in Rumphius, D'Amboinsche Rariteitkamer, Amsterdam, 1741 is here selected to represent this Indo-Pacific species. This reference is one of the several given by Linné. The type locality, here selected, to be Amboyna, Molucca Islands.

Remarks. (See under *T. maculosa*).

Range. Probably throughout the Indo-Pacific from the Hawaiian Islands to the east coast of Africa.

Records. HAWAIIAN ISLANDS: Kauai Island (AMNH); Hilo Bay, Hawaii; Laie, Oahu (both MCZ). SOCIETY ISLANDS: Raiatea (AMNH). SAMOAN ISLANDS: Massacre Bay, Tutuila; Tau Island (both R. T. Abbott). GILBERT ISLANDS: Apaiang (MCZ). MARSHALL ISLANDS: Bikini Island, Bikini Atoll (USNM); Ebon Island (MCZ). CAROLINE ISLANDS: Ponape (MCZ). FIJI ISLANDS: Levuka, Ovalau Island; Tunuloa, Vanua Levu (both R. T. Abbott). DUTCH NEW GUINEA: Wakde Island (R. T. Hatt). NEW HEBRIDES: Espiritu Santo Island (MCZ). LOO CHOO ISLANDS: Hirame Jima (F. Stearns). PHILIPPINE ISLANDS: Calapan, Mindoro; Cuyo Island; Lubang Island (all MCZ). MOLUCCA ISLANDS: Boeroe Island (Fairchild Garden Expedition); Amboyna (MCZ). AUSTRALIA: Moreton Bay, Queensland (MCZ). INDIAN OCEAN: Mauritius (MCZ).

Tonna galea Linné, Plate 75, fig. 4; Plate 78, fig. 1-2

Buccinum galea Linné 1758, Systema Naturae ed. 10, p. 734 (Mediterranean Sea).

Dolium tenue Menke 1830, Synopsis Methodica Molluscorum Pymont, p. 143 (near Alexandretta [Iskenderon] Turkey).

Dolium antillarum Mörch 1877, Malakozoologische Blätter 24, p. 41 (St. Thomas and Jamaica).

Dolium galea var. *epidermata* DeGregorio 1884, Bull. Società Malacologica Italiana 10, p. 115 (Palermo [Sicily]).

Dolium galea var. *spirintrorsum* DeGregorio 1884, Bull. Società Malacologica Italiana 10, p. 114 (Italy).

Dolium galea var. *tardina* DeGregorio 1884, Bull. Società Malacologica Italiana 10, p. 114 (Palermo [Sicily]).

Dolium galea var. *spirintrorsum* 'DeGregorio' Paetel 1887, Catalog der Conchylien-Sammlung 1, p. 221 [error for *spirintrorsum* DeGregorio].

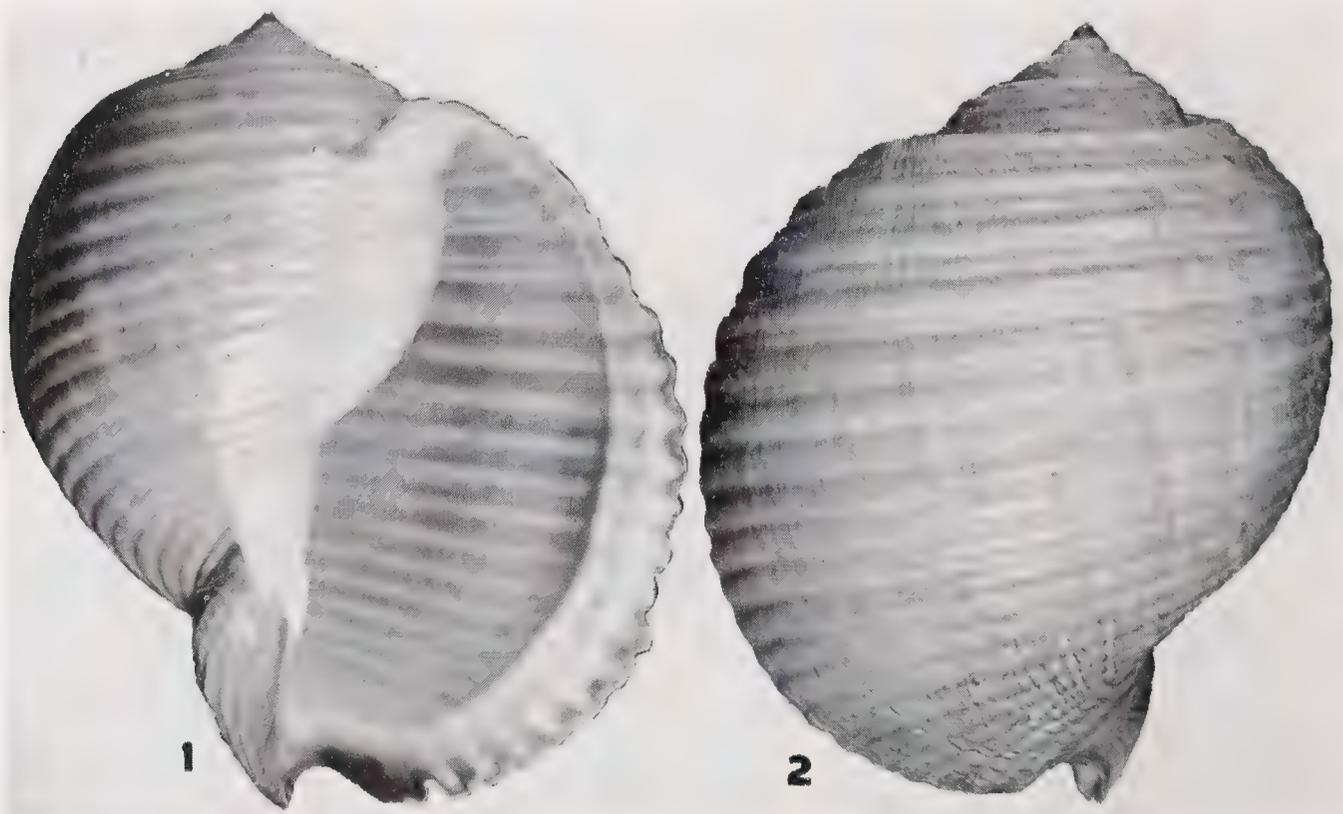
Description. Shells reaching to about 172 mm. ($6\frac{3}{4}$ inches) in length, thin but rather strong and umbilicated. Whorls 7 to $7\frac{1}{2}$, strongly convex and rapidly increasing in size. Ground color white to light coffee-brown, generally uniform but occasionally indistinctly

mottled. Nuclear whorls about $2\frac{1}{2}$, generally a deep golden-brown. Spire slightly extended. Aperture subovate and large. Outer lip rather thin, strongly crenulate in fully adult shells, and with a thickened ridge well below the lip margin. This lip area may also be slightly reflexed and is usually colored a somewhat darker brown. Parietal wall thinly glazed, older specimens forming a well-defined parietal shield. Columella short, twisted and margined on its outer side by a broad ridge which terminates at the siphonal canal. Suture deep, forming a definite channel. Sculpture consisting of 19 to 21 rather broad and somewhat flattened spiral ridges. In addition a narrow ridge may develop between two of the larger ones. These are usually found above the mid-whorl area. Nuclear whorls smooth, first 2 to $2\frac{1}{2}$ post-embryonic whorls finely reticulated. Remaining whorls with only the spiral ridges crossed by very fine axial growth lines. The shell is covered with a moderately strong yellowish to brown periostracum which is somewhat deciduous.

	length	width	aperture	
(large)	172	149	147 x 77 mm.	Amboyna, Molucca Islands
(large)	165	133	139 x 74	Great Abaco Island, Bahama Islands
(medium)	140	110	119 x 60	Naples, Italy

Types. Of the two references cited by Linné we select that of Gualtieri 1742, pl. 42, fig. A to represent the type. We restrict the type locality to Naples, Italy.

Remarks. This species has a very wide distribution, occurring as it does in the Eastern and Western Atlantic and the Indo-Pacific region. Except in specimens from Brasil there appears to be no character upon which geographic races can be instituted. Specimens from the Indo-Pacific are the same as those from the West Indies. Closely related



Photographs by F. P. Orchard

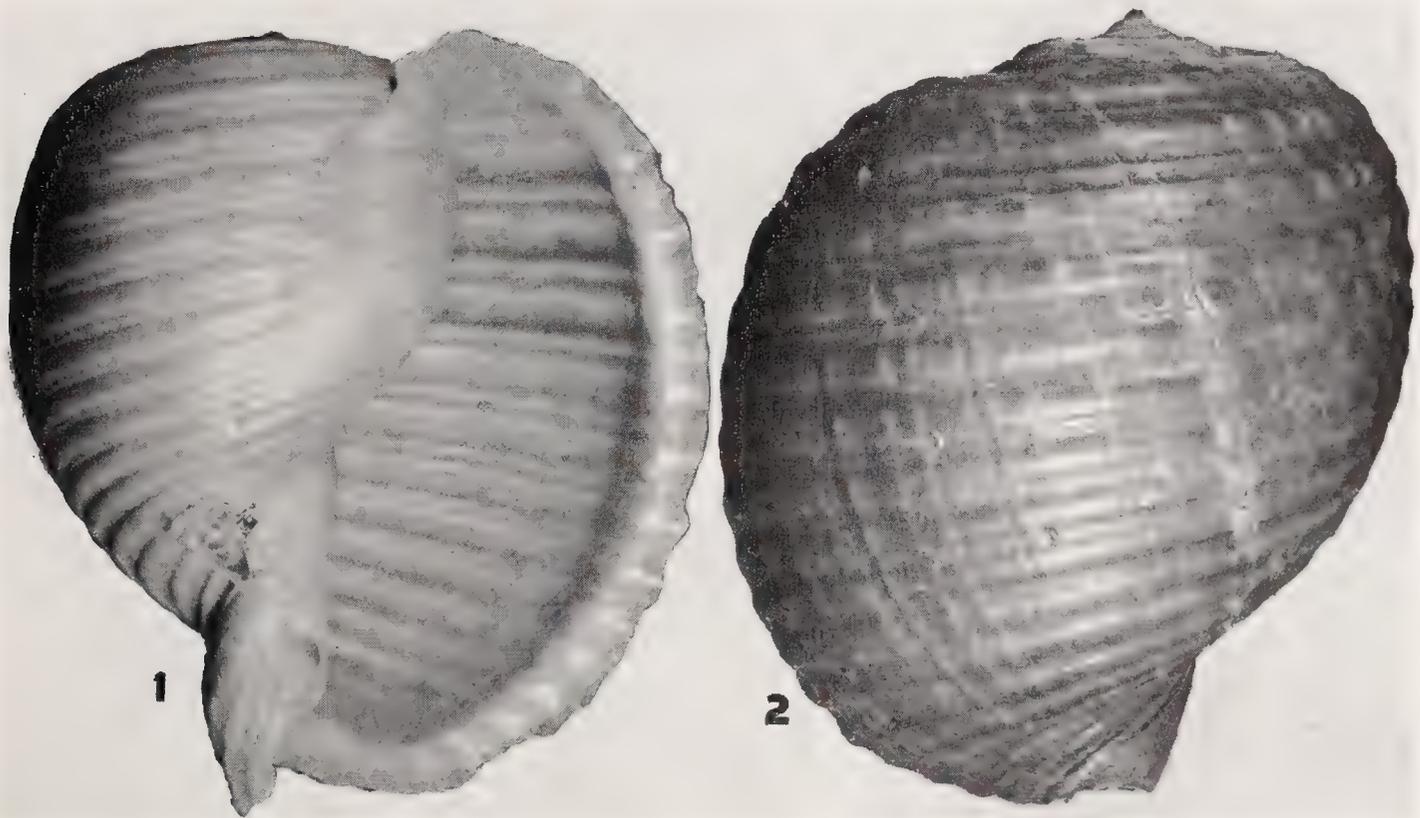
Plate 78. *Tonna galea* Linné

Fig. 1. South side of Great Abaco Island, Bahama Islands (reduced from $4\frac{1}{2}$ inches). Fig. 2. Port Antonio, Jamaica (reduced from $6\frac{1}{2}$ inches).

forms from the Indo-Pacific have been named *zonata* Green, *ampullacea* Philippi and *tenebrosa* Hanley. These may eventually prove to be only subspecies of *T. galea* Linné. However, much more material is needed for a fair comparison of the several named entities that are now believed to be separate species. The three varieties of *T. galea* Linné described by DeGregorio from southern Italy and Sicily are apparently only individual variations.

Range. EASTERN ATLANTIC: Mediterranean Sea and south along the African coast at least as far as Spanish Guinea. WESTERN ATLANTIC: North Carolina and south probably to Trinidad. INDO-PACIFIC: From the Hawaiian Islands to Japan and south through the East Indies and Indian Ocean.

Records. WESTERN ATLANTIC: NORTH CAROLINA: *Pelican*, station 189, about 12 miles off Ocracoke Inlet in 13 fathoms; Cape Lookout; Beaufort (all USNM). SOUTH CAROLINA: Myrtle Beach; St. Helena Island (both MCZ). FLORIDA: Cape Canaveral (MCZ); Lake Worth, Boynton (P. McGinty); Tortugas (USNM); 15–35 miles off Fort Walton (L. A. Burry); Port St. Joe (A. Merrill). LOUISIANA: Morgan City in 2 to 5 fathoms; off Timbalier Island in 2 to 5 fathoms (both USNM). TEXAS: St. Joseph Island (J. W. Hedgpeth); Matagorda Island (USNM). BAHAMA ISLANDS: Great Abaco Island; Nassau, New Providence (both MCZ); Cay Sal (USNM). CUBA: off Caibarién, Las Villas (P. J. Bermúdez). HISPANIOLA: Jérémie; Puerto Plata; Santa Bárbara de Samaná (all MCZ). PUERTO RICO: Caja de Muertes; Mayagüez (both USNM). JAMAICA: Port Antonio (MCZ); Kingston; Annotta Bay (both USNM). MEXICO: Tux-



Photographs by F. P. Orchard

Plate 79. *Tonna galea brasiliiana* Mörch

Fig. 1. Rio Grande do Sul, Brasil (reduced from $4\frac{3}{4}$ inches). Fig. 2. Ilha Guaiba, Est. do Rio de Janeiro, Brasil (reduced from $5\frac{1}{2}$ inches).

pan, Veracruz (M. E. Bourgeois); Cabo Catoche, Yucatan (USNM); COLOMBIA: Cartagena; Sabanilla (both USNM). EASTERN ATLANTIC: ITALY: Naples (MCZ). MALTA: (MCZ). SPANISH GUINEA: Corisco Island; near Benito (both MCZ). INDO-PACIFIC: MOLUCCA ISLANDS: Amboyna (MCZ). PHILIPPINES: Manila Bay, Luzon; Calapan, Mindoro (both MCZ). INDIAN OCEAN ISLANDS: Zanzibar (MCZ).

Tonna galea brasiliana Mörch, Plate 79, fig. 1-2

Dolium antillarum var. *brasiliana* Mörch 1877, Malakozoologische Blätter 24, p. 42 (Brasil); *non Dolium pernix brasiliana* Mörch, *ibid.*, p. 43.

Description. Shell essentially the same as typical *galea* except for the spire which in adult specimens hardly extends above the upper margin of the aperture. The degree of difference in the spire of this form from that of typical *galea* is sufficiently marked to retain the name for this Brazilian subspecies.

length	width	aperture	
155	130	144 x 66 mm.	Rio de Janeiro, Brasil
140	116	129 x 62	Ilha Guaiba, Est. do Rio de Janeiro, Brasil
116	105	110 x 59	Rio Grande do Sul, Brasil

Types. The whereabouts of Mörch's types is unknown to us. Some are in Denmark, others are in the British Museum and probably others are in various European museums. The type locality is Brasil and we here restrict the locality to Rio de Janeiro.

Remarks. The descriptive character of lirae becoming obsolete on the spire, as given by Mörch, does not characterize this subspecies. In fact most of the specimens we have seen from Brasil have well-developed intercostal lirae. However, the greatly depressed spire is present on all specimens that we have seen. Immature specimens, nevertheless, have the spire a little more extended, but as the shell advances in age the aperture becomes larger until eventually it is about as large as the body whorl. This depressed spire seems to be the only tangible character which separates *brasiliana* from typical *galea*.

Range. Known only from Brasil.

Records. BRASIL: Ilha Guaiba, Est. do Rio de Janeiro (M. deOliveira); Rio de Janeiro (MCZ); Rio Grande do Sul (MCZ; USNM); São Sebastião, São Paulo (USNM).

* * * *

Though the genus *Malea* is found only in the Eastern Pacific and Indo-Pacific we include a description of the genus and a figure of *Malea ringens* Swainson, the genotype, to complete the generic analysis of the family Tonnidae (Plate 80). In the Western Atlantic the genus *Malea* is known only from the Tertiary (cf. Woodring 1928, p. 311).

Genus **Malea Valenciennes**

Malea Valenciennes 1832 [in] Humboldt, Voy. Intér. Amér., Obs. Zool. **2**, p. 325 [we have not seen this paper].

Quimalea Iredale 1929, The Australian Zoologist **5**, p. 345 (genotype, *Buccinum pomum* Linné, original designation).

Genotype, *Malea latilabris* Valenciennes [= *Cassis ringens* Swainson], subsequent designation, Herrmannsen 1847, Indiciis Generum Malacozoorum **2**, p. 13.

Shell medium to very large in size, subglobose, rather heavy and sculptured with strong spiral ridges. Axial sculpture consisting of fine growth lines. Parietal shield slightly to well-developed and reflected over a small umbilicus. Aperture moderate in size. Outer lip strongly crenulated, reflected and usually with a definite sulcus behind. Parietal lip with moderate to very strong lamellae grouped on the parietal area and again on the columella.



Photograph by F. P. Orchard

Plate 80. *Malea ringens* Swainson
Panama, west coast (natural size).

Genus **Eudolium Dall**

Doliopsis Monterosato 1872, Notizie Intorno alle Conchiglie Mediterranee, Palermo, p. 49¹; non Vogt 1852, Conrad 1865.

Eudolium Dall 1889, Bulletin of the Museum of Comparative Zoölogy **18**, p. 20, 232.

Galeodolium Sacco 1891, Memorie Reale Accademia delle Scienze di Torino (2) **41**, p. 228.

Simplicodolium Sacco 1891, Memorie Reale Accademia delle Scienze di Torino (2) **41**, p. 237.

¹We have not seen this paper. Dr. Giovanni Giorgi of Rome has kindly sent us the full reference as it occurs in this paper: "*Doliopsis crosseana*, Allery [di Monterosato] Jour. de Conchyl. 1869, p. 228 (Dolium)." This genus along with several others was not described by Monterosato but only indicated as above.

Tuberculodolium Sacco 1891, Memorie Reale Accademia delle Scienze di Torino (2) **41**, pt. 233.

Endolium 'Dall' Preston 1924, Zoological Record **60**, Mollusca, p. 42 [error for *Eudolium*].

Simplicidolium 'Sacco' Wenz 1941 [in] Schindewolf, Handbuch der Palaozoologie, Gastropoda Lief. 7, Bd. 6, p. 1076 [error for *Simplicodolium* Sacco].

Genotype, *Dolium crosseanum* Monterosato, monotypic.

Shell small to medium in size, subglobose, imperforate, and sculptured with strong spiral ridges. Axial sculpture absent or consisting of fine axial ribs. Shell rather thin though strong. Parietal shield slightly to well-developed. Aperture large, outer lip reflected. Periostracum deciduous, thin and light straw-yellow in color. Embryonic whorls rather large, smooth and dark horn color. Operculum lacking in the adult.

Eudolium crosseanum Monterosato, Plate 75, fig. 5; Plate 81, fig. 1-2

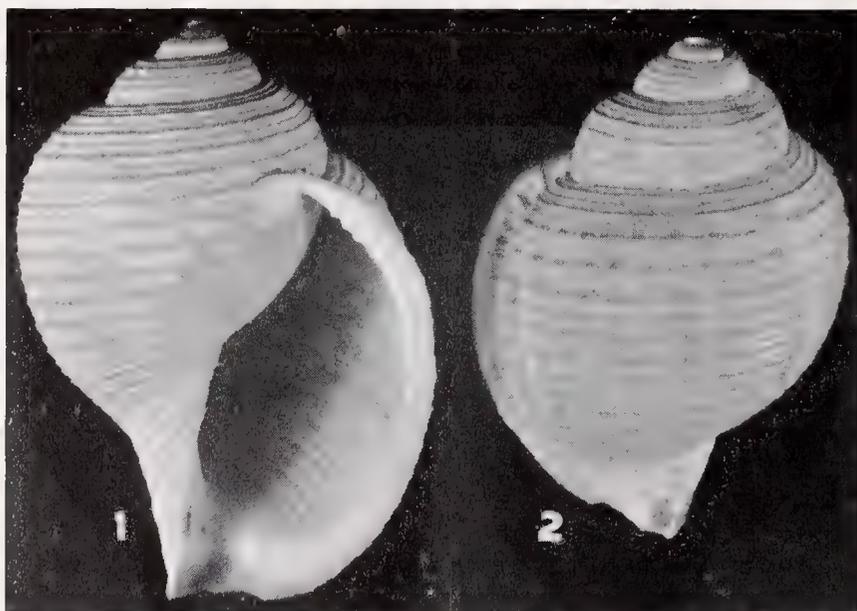
Dolium crosseanum Monterosato 1869, Journal de Conchyliologie **17**, p. 228, pl. 12, fig. 1.

Dolium bairdii Verrill and Smith 1881, American Journal of Science (3) **22**, p. 299 (*Fish Hawk*, station 945, N. Lat. $39^{\circ}58'00''$, W. Long. $71^{\circ}13'00''$, $84\frac{1}{2}$ miles SW of Marthas Vineyard in 207 fathoms); Verrill 1884, Transactions of the Connecticut Academy of Arts and Sciences **6**, p. 253, pl. 29, fig. 2a-b.

Dolium bayrardi 'Verrill' Paetel 1888, Catalog de Conchylien-Sammlung **1**, p. 221 [error for *bairdii* Verrill and Smith].

Eudolium testardi 'Montrouzier' Osima¹ 1943, Conchologia Asiatica **1**, p. 132, pl. 4, fig. 3.

? *Eudolium lineatum* 'Shepman' Osima² 1943, Conchologia Asiatica **1**, pl. 5, fig. 1.



Photographs by F. P. Orchard

Plate 81. *Eudolium crosseanum* Monterosato

Fig. 1. *Fish Hawk*, station 1113, about 168 miles off Barnegat, New Jersey, in 192 fathoms. Fig. 2. *Atlantis*, station 3447, off Sagua la Grande, Las Villas, Cuba, in 375 fathoms; (both natural size).

¹In the Manual of Conchology 1885 (1) **7**, p. 263 and 305, Tryon transposed his plate references to the figures of *Tonna testardi* Montrouzier and *Eudolium crosseanum* Monterosato. Osima, not aware of this error, figured *crosseanum* for *testardi* and placed it in the genus *Eudolium*.

²The specimen figured by Osima is not *lineatum* Shepman as figured in the Siboga-Expeditie Monograph **49**, 1 b, p. 124, pl. 10, fig. 5. Osima's figure compares very closely with *Eudolium crosseanum* and probably is that species. From the description and figure of *lineata* as given by Shepman it appears to be in the genus *Oocorys*.

Description. Shell moderately large, reaching about 81 mm. ($3\frac{1}{2}$ inches) in length, imperforate, thin but strong and with well-developed spiral ridges. Whorls 6, strongly convex and rather rapidly increasing in size. Color white to light cream with spiral ridges of straw-yellow. Aperture elliptical. Outer lip reflected and slightly thickened, its inner edge crenulated. Parietal area with a thin glaze through which the sculpture is visible. Spire moderately extended. Suture distinct. Anal canal slightly developed. Siphonal canal short, broad and a little recurved. Columella twisted and nearly vertical. Sculpture consisting of numerous coarse spiral ridges between which there may be from one to three fine thread-like cords. There are numerous very fine growth lines which cross the spiral ridges and cords. Periostracum thin and light yellow-brown in color. Embryonic whorls $2\frac{1}{2}$, smooth, large and with a dark horny periostracum.

	length	width	aperture	
(large)	81	56 [59]	62 x 28 mm.	Holotype, ¹ off Palermo, Sicily
(large)	68	51	51 x 25	Holotype of <i>E. bairdii</i> Verrill and Smith
(average)	53	35	35 x 14	off Sagua la Grande, Las Villas, Cuba
(small)	33	22.5	25 x 12	off Charleston, South Carolina

Types. The type of *croseanum* from off Palermo, Sicily is in the collection of T. Allery di Monterosato which is now in the University of Rome. The holotype of *D. bairdii* Verrill and Smith is in the United States National Museum no. 51385, from *Fish Hawk*, station 945 (N. Lat. $39^{\circ}58'$; W. Long. $71^{\circ}13'$) in 207 fathoms, $84\frac{1}{2}$ miles southwest of Marthas Vineyard [about 130 miles east of Barnegat, New Jersey].

Remarks. *Eudolium croseanum* Monterosato has a very wide range of distribution and is probably quite common in some localities to judge by the number of specimens dredged by the *Fish Hawk* off New Jersey.

E. croseanum is readily distinguished from others in the genus by its light weight, and characteristic sculpture which consists of spiral ridges alternating with thin spiral cords, both being crossed by very fine axial threads giving the shell a fine irregular reticulated appearance when examined with a 10x lens. Verrill and Smith in the original description of *D. bairdii* (*E. croseanum*) have given a detailed account of the external anatomy of this species.

See also *Remarks* under the genus *Oocorys*.

Range. EASTERN ATLANTIC: Mediterranean Sea, the Azores and south to South Africa. WESTERN ATLANTIC: From off New Jersey south through the West Indies to the Barbados.

Records. NEW JERSEY: about 190 miles off Barnegat in 180–190 fathoms (J. Miller); *Fish Hawk*, station 945, about 130 miles off Barnegat (N. Lat. $39^{\circ}58'$; W. Long. $71^{\circ}13'$) in 207 fathoms²; *Fish Hawk*, station 1036, about 220 miles off Barnegat (N. Lat. $39^{\circ}58'$; W. Long. $69^{\circ}30'$) in 94 fathoms; *Fish Hawk*, station 1113, about 168 miles off Barnegat (N. Lat. $39^{\circ}57'$; W. Long. $70^{\circ}37'$) in 192 fathoms; *Fish Hawk*, station 1097, about 200 miles off Barnegat (N. Lat. $39^{\circ}54'$; W. Long. $69^{\circ}44'$) in 158 fathoms (all USNM); *Fish*

¹ Measurements as given by Monterosato in the original description.

² Though the *Fish Hawk* station records were given as off Marthas Vineyard, they were always to the south. It has been the policy in *Johnsonia* to associate all off-shore dredging stations with a locality on the coast in approximately the same latitude.

Hazck, station 1046, about 85 miles off Cape May (N. Lat. $38^{\circ}33'$; W. Long. $73^{\circ}18'$) in 104 fathoms (Peabody Museum, Yale University). VIRGINIA: *Albatross*, station 2264, about 80 miles off Norfolk (N. Lat. $37^{\circ}07'50''$; W. Long. $74^{\circ}34'20''$) in 167 fathoms (USNM). NORTH CAROLINA: *Albatross*, station 2601, about 50 miles off Cape Lookout (N. Lat. $34^{\circ}39'15''$; W. Long. $75^{\circ}33'30''$) in 107 fathoms (USNM). SOUTH CAROLINA: *Albatross*, station 2314, about 100 miles off Charleston (N. Lat. $32^{\circ}43'$; W. Long. $77^{\circ}51'$) in 159 fathoms; *Albatross*, station 2676, about 145 miles off Charleston (N. Lat. $32^{\circ}39'$; W. Long. $77^{\circ}01'$) in 407 fathoms (both USNM). FLORIDA: *Atlantis*, station 3779, about 80 miles off Jacksonville (N. Lat. $30^{\circ}21'$; W. Long. $79^{\circ}55'$) in 230–250 fathoms (MCZ); *Albatross*, station 2665, about 65 miles off St. Augustine (N. Lat. $29^{\circ}47'$; W. Long. $80^{\circ}05'45''$) in 263 fathoms (USNM); about 5 miles east of Carysfort Light, Key Largo in 96–107 fathoms; about $7\frac{1}{2}$ miles N. E. of Sombrero Light, Key Largo in 20 fathoms [fragments] (both L. A. Burry). CUBA: *Blake*, station 16, off Habana (N. Lat. $23^{\circ}11'$; W. Long. $82^{\circ}23'$) in 292 fathoms; *Atlantis*, station 3447 and 3448, off Sagua la Grande, Las Villas (N. Lat. $23^{\circ}21'$; W. Long. $79^{\circ}55'$) in 375–380 fathoms; *Atlantis*, station 3376, off Puerto Tanamo, Oriente (N. Lat. $20^{\circ}47'$; W. Long. $75^{\circ}11'$) in 450 fathoms; *Atlantis*, station 3414, off Punta Alegre, Camagüey (N. Lat. $22^{\circ}50'31''$; W. Long. $78^{\circ}52'$) in 230 fathoms (all MCZ). LESSER ANTILLES: *Blake*, station 192, off Dominica (N. Lat. $15^{\circ}17'20''$; W. Long. $61^{\circ}24'22''$) in 138 fathoms; *Blake*, station 238, off the Grenadines (N. Lat. $12^{\circ}46'10''$; W. Long. $61^{\circ}23'35''$) in 127 fathoms; *Blake*, station 291, off Barbados (N. Lat. $13^{\circ}12'$; W. Long. $59^{\circ}41'$) in 210 fathoms; *Blake*, station 273, off Barbados (N. Lat. $13^{\circ}03'05''$; W. Long. $59^{\circ}36'18''$) in 103 fathoms (all MCZ).

* * * *

Frederico Sacco (1891, pp. 225–241) has described a number of species and subspecies from the Tertiary of Italy.

So far as we can trace, three other species of recent *Eudolium* have been described and two of these, namely *aulacodes* Tomlin and *solidior* Dautzenberg and Fischer may eventually be found in the Western Atlantic. We include references to all to complete the record. From the published description and figures *aulacodes* Tomlin and *solidior* Dautzenberg and Fischer appear to be very close in their relationship to each other and they may both eventually prove to be in the genus *Oocorys*.

***Eudolium solidior* Dautzenberg and Fischer**

Dolium (*Eudolium*) *croseanum* var. *solidior* Dautzenberg and Fischer 1906, Resultats des Campagnes Scientifiques de Monaco, Fasc. 32, p. 38, pl. 3, fig. 1 (Princesse Alice, station 866, Açores [Azores] in 599 meters).

***Eudolium aulacodes* Tomlin**

Eudolium aulacodes Tomlin 1927, Annals of the South African Museum 25, pt. 1, p. 83, fig. 4a (Cape Point, N. E. 40 miles in 560 to 700 fathoms).

***Eudolium pyriforme* Sowerby**

Dolium pyriforme Sowerby 1914, Annals and Magazine of Natural History (8) 14, p. 37, pl. 2, fig. 14 (Kii, Japan).

Subfamily **Oocorythinae**

Shell retaining the operculum in the adult, lacking basal denticles on the rachidian teeth of the radula and having a smaller protoconch.

Genus **Oocorys** *Fischer*

Oocorys Fischer 1883, Journal de Conchyliologie 31, p. 392.

Genotype, *Oocorys sulcata* Fischer, monotypic.

Shell small to medium in size, elliptical to globose, imperforate or perforate or, rarely, with a minute umbilicus formed by the non-adherence of the parietal shield to the columella. Sculpture consisting of well-developed spiral ridges with the axial sculpture absent or ranging from fine growth lines to fine ribs. Parietal shield slightly to well-developed. Aperture large, outer lip generally reflected. Periostracum thin, deciduous. Embryonic whorls or protoconch rather small and devoid of sculpture. Operculum chitinous and paucispiral.

There has been considerable controversy as to the relationship of the genus *Oocorys*. We agree with Watson (1886, p. 412) in placing this genus in the family Tonnidae and not in the Cassididae or in a separate family, the Oocorythidae,¹ as it appears to be most closely related to the genus *Eudolium*. When Fischer created the family Oocorythidae he stated that he was uncertain as to its affinities but thought it was most closely related to the Tritonidae [Cymatiidae]. Watson, however, included the genus in the family Doliidae [Tonnidae] and Tryon states that, considering the shell characters, it is essentially an operculated *Dolium* [*Tonna*]. Dall (1907, p. 67) places *Oocorys* in the family Cassididae close to *Galeodea* and *Sconsia* on the basis of the small protoconch, the presence of the operculum, and the lack of basal denticles on the rachidian teeth of the radula. However, the presence of an operculum in adult *Oocorys* is perhaps not so great a difference as it at first appears for it has been known for some time that the young of *Tonna* possess an operculum that is lost in the adult stage. From the information now available the presence of basal denticles on the rachidian teeth of the radula does not appear to be of family significance. According to Trochel (1856–1863, Pl. 19), there are several species of *Ranella* [*Bursa*] which possess basal denticles on the rachidian teeth and in all other respects so closely resemble the radula of *Dolium* [*Tonna*] *perdix* Linné that they would appear to belong to the same genus. Consequently, the lack of these basal denticles hardly seems sufficient to exclude *Oocorys* from the Tonnidae. Though the protoconch of *Oocorys* is small it is very similar to that of *Eudolium* from which the periostracum has been removed. We have in our collection two fine specimens of *Sconsia striata* Lamarck which have perfect protoconchs still covered with periostracum and resembling very closely those of *Tonna* and *Eudolium*. When more is known of the genera *Dolium* and *Sconsia* it may well be that they will be placed in the Tonnidae. The shell characters of *Oocorys* are much closer to those of *Eudolium* than to those of any other known genus. Until sufficient material is available for a complete anatomical study of the entire Tonnacea it seems best to place *Oocorys* in the Tonnidae.

The genus *Oocorys* differs from *Eudolium* by having smaller embryonic whorls, by possessing an operculum in the adult and by having a slightly heavier shell. The radula

¹ Not Oocoritidae as occasionally spelled.

of *Oocorys* lacks the two accessory denticles on the basal plate of the rachidian teeth which are present in *Eudolium* (Plate 75, fig. 6-7). *Oocorys* has been dredged in far greater depths than has *Eudolium*.

Subgenus *Oocorys* Fischer

Oocorys Fischer 1883, Journal de Conchyliologie 31, p. 392.

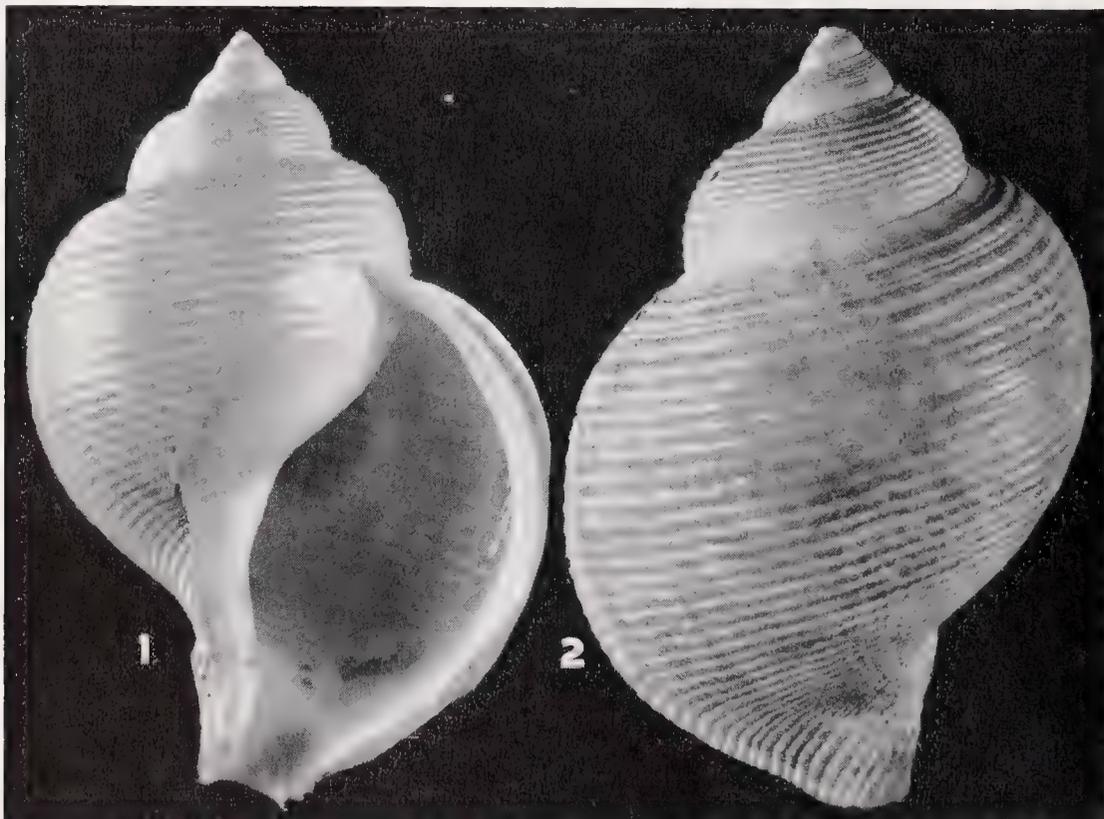
Subgenotype, *Oocorys sulcata* Fischer, monotypic.

Shell rather thin but strong, porcellaneous, imperforate or, rarely, with a slight indication of an umbilicus due to the non-adherence of the parietal shield to the columella. Sculpture consisting of well developed spiral ridges with the axial sculpture ranging from fine growth lines to rather coarse axial ribs. Parietal shield moderately to well-developed. Aperture elliptical to ovate. Outer lip reflected and generally thickened. Embryonic whorls small. Periostracum very thin, deciduous. Operculum paucispiral. The radula of only one species of *Oocorys* ss. (*O. bartschi* Rehder) is known but this differs from that of *Oocorys* (*Benthodolium*) *abyssorum* Verrill and Smith in lacking the two lobes on the basal plate of the rachidian tooth (Plate 75, fig. 7).

Oocorys (*Oocorys*) *bartschi* Rehder, Plate 75, fig. 7, 9-10; Plate 82, fig. 1-2

Oocorys bartschi Rehder 1943, Proceedings of the United States National Museum 93, no. 3161, p. 197, pl. 10, fig. 16 (off Tortugas, Florida).

Description. Shell large, reaching about 111 mm. (about 4½ inches) in length, thin but strong, imperforate and sculptured by rather coarse flattened spiral ridges. Whorls 7,



Photographs by F. P. Orchard

Plate 82. *Oocorys bartschi* Rehder

Fig. 1. From off Tortugas, Florida (Holotype). Fig. 2. Florida (both reduced from 4½ inches).

strongly convex and regularly increasing in size. Shell a pale flesh color. Aperture elliptical. Outer lip reflected, only slightly thickened and crenulated, these crenulations appearing more as gentle undulations. Parietal area with a thin glaze through which the sculpture is visible. Along the columella the inner lip becomes somewhat thickened. Spire moderately extended. Anal canal lacking. Siphonal canal short, broad and slightly recurved. Suture distinct but not indented. Sculpture consisting of rather broad, flattened spiral ridges which are crossed by numerous very fine axial growth lines. There are 37 broad ribs on the body whorl of the holotype. Whorls slightly shouldered, the first broad rib being set at some distance from the suture. Embryonic whorls smooth, white. Operculum chitinous, ovate, paucispiral and with a very large muscle scar covering most of the inner surface.

length	width	aperture	
111.7	71.7	75 x 33.5 mm.	Holotype

Types. Holotype, United States National Museum no. 535689, from off Tortugas, Florida in 79 to 140 fathoms, Dr. W. L. Schmitt, collector.

Remarks. *Oocorys bartschi* Rehder is by far the largest species so far known in the genus. It appears to be most closely related to *O. sulcata* and *O. barbouri*, and is readily distinguished from both these forms by being nearly three times as large and by having a slightly crenulated outer lip. From *O. sulcata* it is further differentiated by having broad flattened spiral ridges and flesh coloration. It differs from *O. barbouri* in being more globose, in having a uniform coloration and in lacking the beading on the whorl shoulder. The operculum of *O. bartschi* is much heavier than that of *O. sulcata* and has a very large padded muscle scar whereas the muscle attachment of *sulcata* is small and inconspicuous.

Range and Records. Known only from the type locality. See under *Types*. One additional paratype specimen in the collection of the National Museum is labeled only Florida.

***Oocorys (Oocorys) barbouri* Clench and Aguayo, Plate 83, fig. 1-2**

Oocorys barbouri Clench and Aguayo 1939, *Memorias de la Sociedad Cubana de Historia Natural* 13, no. 3, p. 193, pl. 29, fig. 2 (off Sagua la Grande, Las Villas, Cuba in 280-300 fathoms).

Description. Shell reaching about 50 mm. (2 inches) in length, strong, imperforate and sculptured with numerous well-marked spiral ridges. Whorls 7, moderately convex and regularly increasing in size. Color white with a broad pinkish-brown band extending from the suture to below the periphery. Aperture elliptical. Outer lip smooth, reflected and moderately thickened. Parietal shield well-developed, forming a fold over the columella. Spire extended. Anal canal lacking. Siphonal canal short, broad and slightly recurved. Suture distinct, whorls shingled. Sculpture consisting of flattened spiral ridges which are crossed by exceedingly fine growth lines. There are 28 flattened ridges on the body whorl of the holotype. Whorls slightly shouldered, the ridge margining the shoulder finely beaded. Embryonic whorls smooth. Operculum unknown.

length	width	aperture	
50	29	34 x 16 mm.	Holotype
48.5	29	32 x 15	Paratype

Types. Holotype, Museum of Comparative Zoölogy no. 135055, *Atlantis*, station no. 2987 (N. Lat. $23^{\circ}22'$; W. Long. $79^{\circ}53'$) off Sagua la Grande, Cuba in 280–300 fathoms. Two paratypes from the same region, *Atlantis*, stations 3451 and 3437, are in the Museum of Comparative Zoölogy and the Museo Poey, Habana, Cuba.

Remarks. This species differs from others in the genus by its more attenuated shape, by its pinkish-brown color band and by the beading on the shoulder of the whorls. See *Remarks* under *bartschi*.

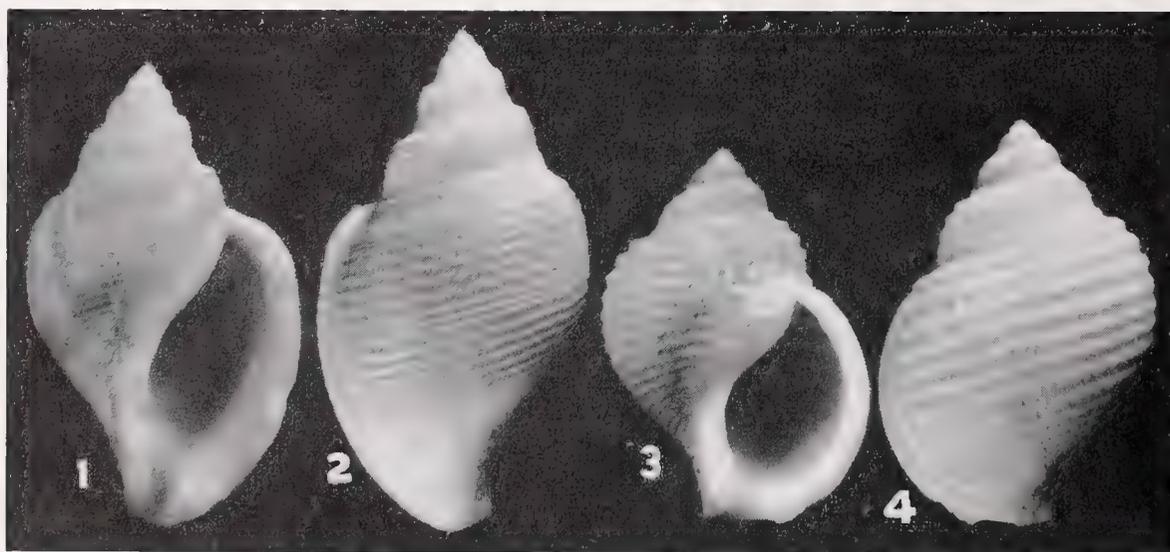
Range. Known only from off northern Cuba.

Records. The following station records are all from the dredgings of the *Atlantis*. CUBA: station 2987 (N. Lat. $23^{\circ}22'$; W. Long. $79^{\circ}53'$) in 280–300 fathoms; station 3541 (N. Lat. $23^{\circ}20'$; W. Long. $79^{\circ}59'$) in 405 fathoms; station 3437 (N. Lat. $23^{\circ}05'$; W. Long. $79^{\circ}32'$) in 260 fathoms—all off Sagua la Grande, Las Villas (all MCZ and Museo Poey); station 3359 (N. Lat. $20^{\circ}38'$; W. Long. $74^{\circ}32'$) from off Baracoa in 1000 fathoms (MCZ).

Oocorys (Oocorys) caribbaea Clench and Aguayo, Plate 83, fig. 3–4

Oocorys sulcata caribbaea Clench and Aguayo 1939, Memorias de la Sociedad Cubana de Historia Natural 13, no. 3, p. 192, pl. 29, fig. 3 (from off Bahía de Corrientes, Pinar del Río, Cuba in 615 fathoms).

Description. Shell reaching 35 to 40 mm. (about $1\frac{1}{2}$ inches) in length, rather thin but strong, imperforate and with coarsely sculptured beaded spiral ridges. Whorls 6, strongly convex and regularly increasing in size. Color ivory-yellow. Aperture elliptical and constricted toward the posterior end. Outer lip smooth, reflected, moderately thickened and with a slight sulcus behind. Parietal area with a thin glaze through which the sculpture is visible. Spire moderately extended. Anal canal lacking, siphonal canal short, broad and slightly recurved. Suture distinct but not indented. Sculpture consisting of coarse spiral ridges which are crossed by flattened axial threads giving the effect of a



Photographs by F. P. Orchard

Plate 83. Fig. 1–2. *Oocorys barbouri* Clench and Aguayo, from off Sagua la Grande, Las Villas, Cuba (Holotype). Fig. 3–4. *Oocorys caribbaea* Clench and Aguayo, from off Bahía de Corrientes, Pinar del Río, Cuba (Holotype; both natural size).

beaded, reticulated surface. There are 20 spiral ridges on the body whorl of the holotype. Whorls shouldered, the first ridge being set at some distance from the suture. Axial ribs showing rather distinctly over the shoulder. Embryonic whorls $2\frac{1}{2}$, small, smooth. Periostracum thin, a very light straw-yellow. Operculum unknown.

length	width	aperture	
41	29	21 x 12.5 mm.	Holotype
34	25.5	18 x 10.5	Paratype
47	34	25 x 15	"

Types. Holotype, Museum of Comparative Zoölogy no. 135072, from *Atlantis*, station 2953 (N. Lat. $21^{\circ}47'30''$; W. Long. $84^{\circ}32'30''$), from off Bahía de Corrientes, Pinar del Río, Cuba in 615 fathoms. Paratypes from this locality and from off southeastern Oriente Province, Cuba in 1600 to 1800 fathoms are in the Museum of Comparative Zoölogy and the Museo Poey.

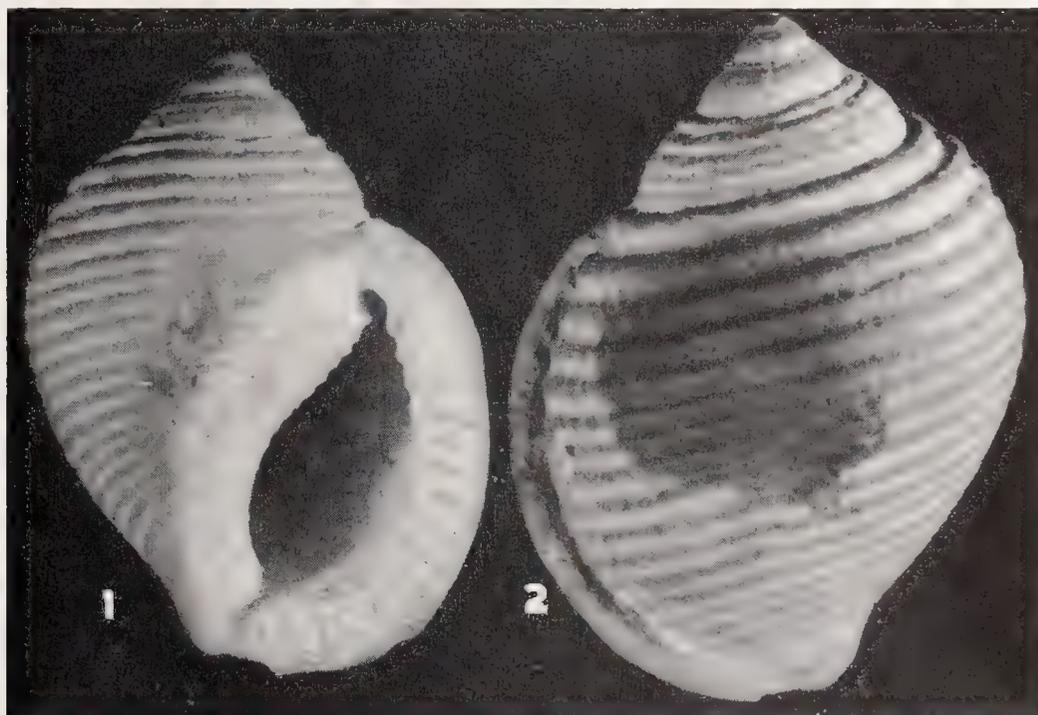
Remarks. *Oocorys caribbaea* is not closely related to any of the Western Atlantic species and can readily be differentiated by its strong reticulated sculpture. *O. sulcata cancellata* Dautzenberg and Fischer may be very close to this species but unfortunately was not figured.

Range. West Indies.

Records. CUBA: *Atlantis*, station no. 2953 from off Bahía Corrientes, Pinar del Río (N. Lat. $21^{\circ}47'30''$; W. Long. $84^{\circ}32'30''$) in 615 fathoms; *Atlantis*, station 2970 from off the southeastern coast of Oriente Province, about 40 miles east of Guantánamo (N. Lat. $19^{\circ}51'$; W. Long. $74^{\circ}26'$) in 1600 to 1800 fathoms. CARIBBEAN ISLANDS: *Blake*, station 111, off Navassa Island (N. Lat. $19^{\circ}05'55''$; W. Long. $74^{\circ}49'05''$) in 1200 fathoms.

Oocorys (Oocorys) verrillii Dall, Plate 84, fig. 1-2

Dolium (Eudolium) verrillii Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, p. 233, pl. 35, fig. 12 (*Albatross*, station 2120, from off Grenada in 73 fathoms).



Photographs by F. P. Orchard

Plate 84. *Oocorys verrillii* Dall
From off Grenada, Lesser Antilles (Holotype; 2x).

Description. Shell reaching about 33 mm. ($1\frac{1}{4}$ inches) in length, imperforate, heavy and solid, with coarsely sculptured spiral ribs. Whorls 5, moderately convex and regularly increasing in size. Color a dull grayish-white [dead specimen]. Aperture elliptical but constricted toward the posterior end. Outer lip greatly thickened, reflected backwards, with a deep sulcus behind. The inner edge of the outer lip with low ridges which run back a short distance within the aperture. Inner lip and parietal area thickened by a heavy callus or parietal shield which is marked with numerous ridges which run back within the aperture. Anal canal short but well defined. Siphonal canal narrow, deep and set obliquely. Spire moderately extended. Suture slightly indented. Columella arched to the left. Spiral sculpture consisting of coarse and rather evenly-spaced ridges, there being 19 on the body whorl. These ridges decrease in size and are more closely spaced near the base of the body whorl. Axial sculpture barely visible on the single worn specimen but apparently consisting of very fine growth lines. Embryonic whorls small and smooth.

length	width	aperture
32.5	23.6	17 x 8 mm. Holotype ¹

Types. Holotype, United States National Museum no. 87208, *Albatross*, station 2120, from off Grenada (N. Lat. $11^{\circ}07'$; W. Long. $62^{\circ}14'30''$) in 73 fathoms.

Remarks. We are including *verrillii* in the genus *Oocorys* because of its small protoconch, strongly developed parietal shield and its much heavier shell. It does not appear to be closely related to any species in the Western Atlantic and is readily differentiated by its heavy shell, very coarse spiral ridges, strongly crenulated and greatly thickened outer lip, thick, ridged parietal shield and marked anal canal.

After examining the single specimen of *verrillii* it does not appear that the suture is "deeply channelled" as stated by Dall in his original description. The suture is only slightly indented but as it is built on one of the spiral ridges it gives a false impression of depth to the suture. The transverse sculpture mentioned by Dall is barely visible in the holotype, though it may well be that in a fresh specimen this character would be more apparent.

Range and Records. Known only from the type locality, see under *Types*.

***Oocorys (Oocorys) sulcata* Fischer, Plate 75, fig. 8; Plate 85, fig. 1-2**

Oocorys sulcata Fischer 1883, Journal de Conchyliologie **31**, p. 392 (coast of Sahara; Sénégal; Azores in 1258 to 3655 meters); Watson 1886, Report of the Scientific Results of H. M. S. Challenger **15**, p. 412, pl. 17, fig. 11; Locard 1897, Expéditions Scientifiques du Travailleur et du Talisman, Mollusques Testacés **1**, p. 288.

Oocorys sulcata var. *minor* Locard 1897, Expéditions Scientifiques du Travailleur et du Talisman, Mollusques Testacés **1**, p. 290 (no definite locality given—from off the northwest coast of Africa and the Azores).

Oocorys sulcata var. *elongata* Locard 1897, Expéditions Scientifiques du Travailleur et du Talisman, Mollusques Testacés **1**, p. 291 (no definite locality given—off the northwest coast of Africa).

Description. Shell reaching about 51 mm. (2 inches) in length, thin but strong, imperforate or very rarely with a slight indication of an umbilicus due to the non-adherence of

¹ Dall's measurement of 22 mm. for the length of the aperture includes the thickness of the lip at both ends of the aperture.

the parietal shield to the columella, and sculptured with numerous fine spiral ridges. Whorls 5, convex and regularly increasing in size. Shell white with a light ivory-colored periostracum. Aperture ovate. Outer lip smooth, slightly to moderately reflected and, in adults, moderately thickened. Parietal area with a medium glaze through which the sculpture is visible. Along the columella the parietal shield is a little more thickened and, rarely, slightly free for a short distance over the columella. Anal canal lacking. Siphonal canal very short, broad and oblique. Suture distinct though not impressed. Sculpture consisting of rather fine but clearly defined spiral ridges which are crossed by numerous very fine growth lines. There are 26 to 30 spiral ridges on the body whorl. Whorls slightly shouldered, subglobose. Embryonic whorls $2\frac{1}{2}$, small and smooth. Periostracum a very light ivory and deciduous. Operculum chitinous, paucispiral.

length	width	aperture	
51	35	31 x 17 mm.	off Cape Hatteras, North Carolina
39	26	21 x 12	off Guadeloupe, Lesser Antilles
28.5	20	15 x 9.5	off Charleston, South Carolina

Types. The types of *Oocorys sulcata* are probably in the collection of the Paris Museum. As Fischer apparently had at least three lots in the original series we here restrict the type locality to off Sénégal.

Remarks. *Oocorys sulcata* Fischer is most closely related to *O. bartschi* Rehder from which it is readily distinguished by its much smaller size, its narrow rather than flattened spiral ridges, smooth outer lip, and by being white rather than flesh-colored.

From *O. abyssorum* with which it has been so often confused, it is differentiated by being less globose, imperforate, having a more reflected and thickened outer lip, much finer growth lines, a much thinner, lighter periostracum and a more porcellaneous shell.

Oocorys sulcata has been dredged in depths ranging from 88 to 2512 fathoms in the Western Atlantic.

Range. WESTERN ATLANTIC: from Cape Hatteras, North Carolina south through the West Indies to Grenada. EASTERN ATLANTIC: The Azores and off the northwest coast of Africa. J. R. le B. Tomlin has reported *O. sulcata watsoni* Locard from Cape Town, South Africa.

Records. NORTH CAROLINA: *Albatross*, station 2225, 280 miles off Cape Hatteras (N. Lat. $36^{\circ}05'30''$; W. Long. $69^{\circ}51'45''$) in 2512 fathoms (Peabody Museum, Yale University). SOUTH CAROLINA: *Albatross*, station 2678, about 165 miles off Charleston (N. Lat. $32^{\circ}40'$; W. Long. $76^{\circ}40'30''$) in 731 fathoms; *Albatross*, station 2677, about 155 miles off Charleston (N. Lat. $32^{\circ}39'$; W. Long. $76^{\circ}50'30''$) in 478 fathoms (both USNM). CUBA: *Atlantis*, station 3344, off Cienfuegos (N. Lat. $21^{\circ}38'$; W. Long. $80^{\circ}12'$) in 1440 fathoms (MCZ). LESSER ANTILLES: *Blake*, station 173, off Guadeloupe in 734 fathoms (MCZ); *Albatross*, station 2751, south of St. Kitts (N. Lat. $16^{\circ}54'$; W. Long. $63^{\circ}12'$) in 687 fathoms (USNM); *Blake*, station 227, off St. Vincent (N. Lat. $13^{\circ}10'10''$; W. Long. $61^{\circ}18'15''$) in 573 fathoms; *Blake*, station 232, off St. Vincent (N. Lat. $13^{\circ}06'45''$; W. Long. $61^{\circ}06'55''$) in 88 fathoms (both MCZ); *Blake*, station 268, off Grenada (N. Lat. $12^{\circ}07'15''$; W. Long. $61^{\circ}50'50''$) in 955 fathoms (USNM).

Subgenus **Benthodolium** *Verrill and Smith*

Benthodolium Verrill and Smith 1884, Transactions of the Connecticut Academy of Arts and Sciences **6**, pt. 1, p. 177.

Subgenotype, *Benthodolium abyssorum* Verrill and Smith, monotypic.

Shell thin, chalky and not very strong, umbilicated or, rarely, with the umbilicus nearly closed by the parietal shield. Sculpture consisting of numerous well-developed spiral ridges which are crossed by numerous fine growth lines. Embryonic whorls small, devoid of sculpture. Operculum chitinous, paucispiral. Periostracum thin, deciduous. Radula similar to that of *O. bartschi*, but with two lobes on the basal plate of the rachidian tooth (Plate 75, fig. 6).

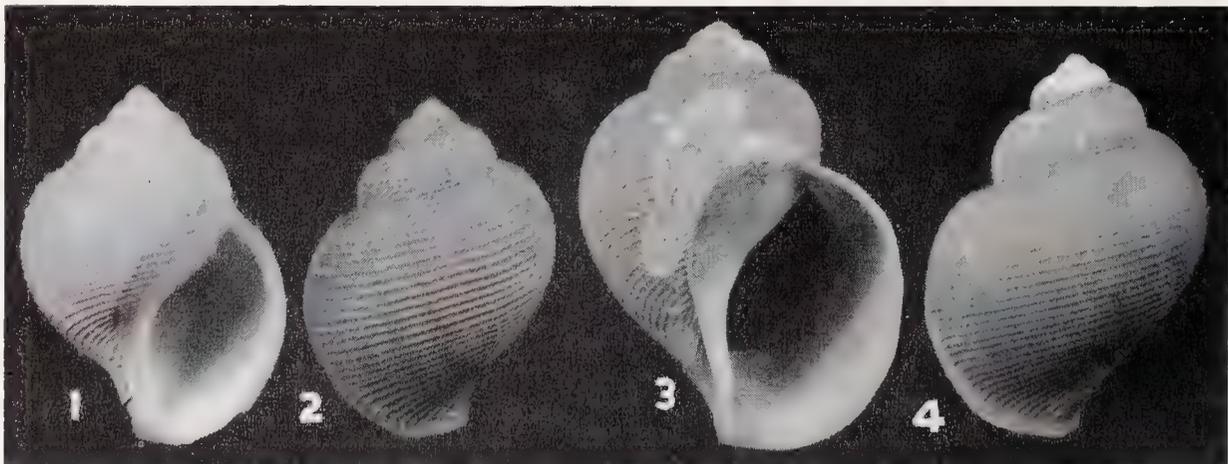
Verrill and Smith in the original description of the genus state that there is no umbilicus, but in the specific description of *abyssorum* it is mentioned and the type specimen is definitely umbilicated; only rarely does the parietal shield develop so as nearly to close the umbilicus.

Oocorys (Benthodolium) abyssorum *Verrill and Smith*

Plate 75, fig. 6, 11-12; Plate 85, fig. 3-4

Benthodolium abyssorum Verrill and Smith 1884, Transactions of the Connecticut Academy of Arts and Sciences **6**, pt. 1, p. 117, pl. 31, fig. 12a-b (*Albatross*, station 2098, from off Cape Charles, Virginia, in 2221 fathoms).

Description. Shell reaching about 45 mm. (about $1\frac{3}{4}$ inches) in length, thin and rather chalky, umbilicate and sculptured with numerous fine spiral ridges. Whorls 5, strongly convex and rather rapidly increasing in size. Shell white with a brownish-yellow periostracum which is deciduous. Aperture ovate. Outer lip smooth, thin and only very slightly reflected. Parietal area with a light to moderately heavy glaze through which the sculpture is barely visible in some specimens. In adults the parietal shield is somewhat thickened and extends as a free fold the length of the columella. Spire moderately extended. Anal canal lacking. Siphonal canal very short and broad. Suture impressed. Sculpture consisting of 30 to 35 very narrow but clearly defined spiral ridges which are crossed by numerous growth lines, giving the shell a fine reticulated appearance when ex-



Photographs by F. P. Orchard

Plate 85. Fig. 1-2. *Oocorys sulcata* Fischer. Fig. 1. From off Guadeloupe. Fig. 2. From off Grenada, Lesser Antilles. Fig. 3-4. *Oocorys (Benthodolium) abyssorum* Verrill and Smith. From off Cape Charles, Virginia. Fig. 3. Holotype (all natural size).

aminated with a 10x lens. Whorls shouldered and very globose. Embryonic whorls $2\frac{1}{2}$, small and devoid of sculpture. Operculum thin, chitinous and paucispiral.

length	width	aperture	
47	35	30 x 18 mm.	Holotype
40.5	31	25 x 16.5	off Cape Charles, Virginia
36.5	27.5	22 x 14	“ “ “ “

Types. Holotype, United States National Museum no. 35273, from *Albatross*, station 2098, from off Cape Charles, Virginia (N. Lat. $37^{\circ}40'30''$; W. Long. $70^{\circ}37'30''$) in 2221 fathoms.

Remarks. Though *Oocorys abyssorum* has often been confused with *O. sulcata* Fischer it is readily differentiated from it by being umbilicated and more globose, by having a thin and only very slightly reflected outer lip and by being a thinner, more fragile shell with a more conspicuous periostracum.

Range. From off New Jersey south through Virginia, with one specimen from the Gulf of Mexico off Pensacola, Florida.

Records. NEW JERSEY: *Albatross*, station 2196, about 220 miles off Atlantic City (N. Lat. $39^{\circ}35'$; W. Long. $69^{\circ}44'$) in 1230 fathoms (USNM); *Albatross*, station 2221, about 200 miles off Cape May (N. Lat. $39^{\circ}05'30''$; W. Long. $70^{\circ}44'30''$) in 1525 fathoms (Peabody Museum, Yale University). MARYLAND: *Albatross*, station 2714, about 220 miles off Ocean City (N. Lat. $38^{\circ}22'$; W. Long. $70^{\circ}17'30''$) in 1825 fathoms. VIRGINIA: *Albatross*, station 2098 (N. Lat. $37^{\circ}40'30''$; W. Long. $70^{\circ}37'30''$) in 2221 fathoms; *Albatross*, station 2229 (N. Lat. $37^{\circ}38'40''$; W. Long. $73^{\circ}16'30''$) in 1423 fathoms; *Albatross*, station 2566 (N. Lat. $37^{\circ}23'$; W. Long. $68^{\circ}08'$) in 2620 fathoms; *Albatross*, station 2226 (N. Lat. $37^{\circ}00'$; W. Long. $70^{\circ}54'$) in 2021 fathoms—all off Cape Charles (all USNM). FLORIDA: *Albatross*, station 2400, off Pensacola (N. Lat. $28^{\circ}41'$; W. Long. $86^{\circ}07'$) in 169 fathoms (USNM).

* * * *

The list given below includes the remaining species of recent *Oocorys*; species described as such or recognized as belonging to this genus. No attempt is made to allocate these species to subgenera.

Oocorys alcocki Smith

Morio alcocki Smith 1906, Annals and Magazine of Natural History (7) 18, p. 170 (*Investigator*, station 280, from off the Coromandel Coast [India]; N. Lat. $11^{\circ}29'45''$; E. Long. $80^{\circ}02'30''$ in 446 fathoms); Shepman 1909, Siboga-Expeditie Monograph 49b, Prosobranchia, pt. 2, p. 124, pl. 10, fig. 6.

Oocorys sulcata var. *cancellata* Dautzenberg and Fischer

Oocorys sulcata var. *cancellata* Dautzenberg and Fischer 1897, Memoire de la Société Zoologique de France 10, p. 162 (*Princesse Alice*, station 90, off the Azores in 1600 meters).

Oocorys elevata Dall

Oocorys elevata Dall 1908, Bulletin Museum of Comparative Zoölogy **43**, no. 6, p. 322, pl. 8, fig. 9 (*Albatross*, station 4649, between the Galápagos Islands and Sechura Bay, Peru, S. Lat. $5^{\circ}17'$; W. Long. $85^{\circ}20'$, in 2235 fathoms).

Oocorys fischeri Locard

Oocorys fischeri Locard 1897, Expéditions Scientifiques du Travailleur et du Talisman, Mollusques Testacés **1**, p. 291 (*Talisman*, 38, 76, 78 and 291 from off Morocco, Soudan and between Pico and St. George Islands, in the Azores).

Oocorys fischeri var. *minor* Locard 1897, Expéditions Scientifiques du Travailleur et du Talisman, Mollusques Testacés **1**, p. 292 (no definite locality given—from off the northeast coast of Africa and the Azores).

Oocorys granulosa Schepman

Morio granulosa Schepman 1909, Siboga-Expeditie Monograph 49b, Prosobranchia, pt. 2, p. 123, pl. 10, fig. 4 (*Siboga*, station 316 [Java Sea], S. Lat. $7^{\circ}19'$; E. Long. $116^{\circ}39'$, in 538 meters).

Oocorys sulcata var. *indica* Smith

Oocorys sulcata var. *indica* Smith 1906, Annals and Magazine of Natural History (7) **18**, p. 170–171 (*Investigator*, station 278, off the south of Ceylon in 1912 fathoms).

Oocorys lineata Schepman

Morio lineata Schepman 1909, Siboga-Expeditie Monograph 49b, Prosobranchia, pt. 2, p. 124, pl. 10, fig. 5 (*Siboga*, station 173, Ceram Sea, S. Lat. $3^{\circ}27'$; E. Long. $131^{\circ}05'$, in 567 meters).

Oocorys pacifica Dall

Benthodolium pacifica Dall 1895, Proc. United States National Museum **18**, p. 11 (*Albatross*, station 3375 from near Malpelo Island, Gulf of Panama in 1201 fathoms. Holotype, United States National Museum no. 123031); Dall 1908, Bulletin Museum of Comparative Zoölogy **43**, no. 6, p. 323, pl. 4, fig. 7.

Oocorys rotunda Dall

Oocorys rotunda Dall 1908, Bulletin Museum of Comparative Zoölogy **43**, no. 6, p. 322, pl. 4, fig. 9 (*Albatross*, station 3360, Gulf of Panama in 1672 fathoms. Holotype, United States National Museum no. 123029).

Oocorys schepmani, new name

Oocorys elongata Schepman 1909, Siboga-Expeditie Monograph 49b, Prosobranchia, pt. 2, p. 121, pl. 10, fig. 3 (*Siboga*, station 221, from the Banda Sea, S. Lat. $6^{\circ}24'$; E. Long. $124^{\circ}39'$, in 2798 meters); *non O. sulcata* var. *elongata* Locard 1897.

Oocorys watsoni Locard

Oocorys watsoni Locard 1897, Expéditions Scientifiques du Travailleur et du Talisman, Mollusques Testacés **1**, p. 290; Watson 1886, Voyage of H.M.S. Challenger **15**, pp. 412, pl. 17, fig. 11 (*Challenger*, station 106, Mid-Atlantic, N. Lat. $1^{\circ}47'$; W. Long. $24^{\circ}26'$, in 1850 fathoms).

This species was named by Locard from the description and figure of a specimen obtained by the *Challenger* and identified by Watson as *Oocorys sulcata* Fischer. More material is necessary before the species complex of the Eastern Atlantic can be clearly understood.

Oocorys weberi Schepman

Oocorys weberi Schepman 1909, Siboga-Expeditie, Monograph 49b, Prosobranchia, pt. 2, p. 120, pl. 10, fig. 2 (*Siboga*, station 175, from the Ceram Sea, S. Lat. $2^{\circ}37'$; E. Long. $130^{\circ}33'$, in 1914 meters).

Buccinum (?) *aquilarum* Watson 1882, Journ. Linnean Soc. London **16**, p. 359; Watson 1886, The Voyage of H.M.S. Challenger **15**, pp. 212-213, pl. 13, fig. 4 (*Challenger*, station 78, from off San Miguel, Azores; N. Lat. 39°26'; W. Long. 25°13', in 1000 fathoms).

This species has been referred to the genus *Oocorys* by Dautzenberg, Locard and Dall, but J. R. leB. Tomlin (1927, p. 81) who has examined the type in the British Museum agrees with E. A. Smith who has placed it in the family Cancellariidae and states that it probably belongs in the genus *Admete*.

* * * *

I am most grateful to Harald Rehder of the United States National Museum and Percy Morris of Peabody Museum, Yale University for the loan of their collections. I am particularly indebted to William J. Clench, under whose guidance this work was done, and to Merrill E. Champion who was so helpful in reading manuscript and proof.

* * * *

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* * * *

Book Reviews

*Conchologia Asiatica—A New Japanese Publication—*The first volume of this publication consists of four parts, each dealing with a separate genus or family, with a total of 136 pages, 22 plates and numerous text figures. These are as follows: Part 1. *Limidae* by K. Oyama; Part 2. Genus *Lepidodesma* Simpson by K. Suzuki; Part 3. Genus *Turricula* Dall by Y. Otuka; Part 4. *Tonnidae* by K. Osima. All were published in 1943. The text is entirely in Japanese with the standard latinized captions for genera and species and similarly for the references on the plates. Most of the synonymies are given as in the original; Japanese references are all in Japanese.

To judge by the species included, this work embraces the Japanese Empire, China, Korea, the Philippines and the East Indian Islands. Many genera and species are described as new.—W. J. CLENCH

Mazyck, W. G. 1913: *Catalogue of Mollusca of South Carolina. Contributions from the Charleston Museum no. 2*, pp. 14+39. A total of 534 species and subspecies are given in this very important list of the land, freshwater and marine forms occurring in South Carolina. Six species are described as new.

This is an exceedingly important work. It has been very carefully prepared and it is the result of many years of collecting and study. It embodies not only the material of W. G. Mazyck but also that of previous students such as Edmund Ravenel, Lewis R. Gibbes, J. D. Kurtz and others.—W. J. CLENCH



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LIOTIIDAE

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THE GENUS *CYCLOSTREMA* IN THE WESTERN ATLANTIC

BY

R. TUCKER ABBOTT¹

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*² 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.

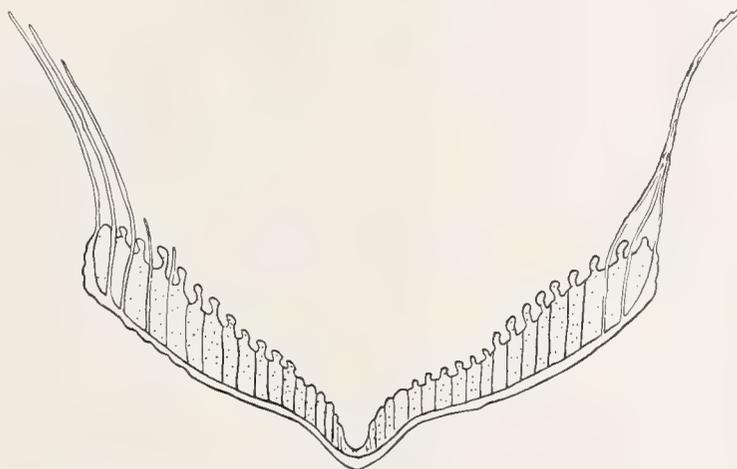


Plate 86. A cross-section diagram of the operculum of *Cyclostrema discoideum* Reeve (Philippines), showing the rows of beads and chitinous bristles (greatly enlarged).

¹Assistant Curator, Division of Mollusks, United States National Museum.

²Marryat 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 sensuyi* 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 rhipidoglossate¹ as shown from examination of specimens of *Cyclostrema discoideum* 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.² 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.

¹ Possessing a radula with numerous teeth in each transverse row.

² 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

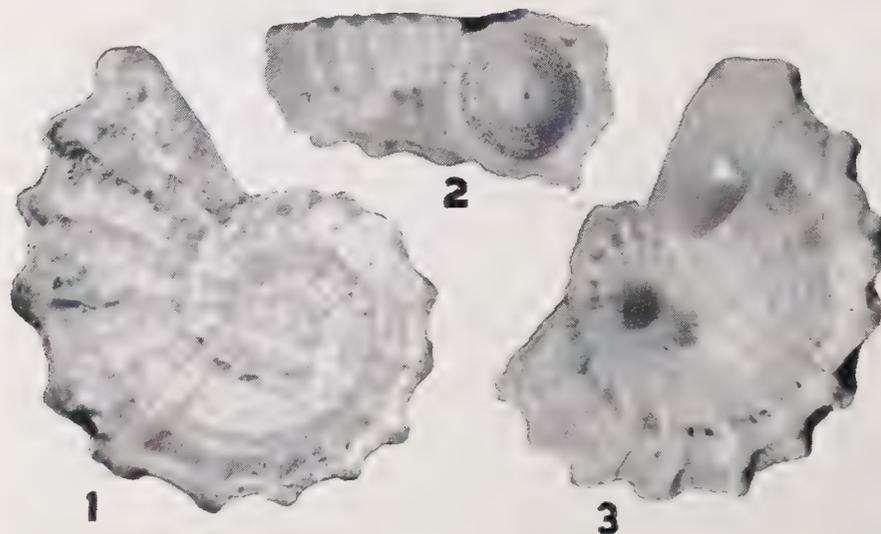


Plate 87. Figs. 1 and 3. *Cyclostrema cancellatum* Marryat, off Fowey Light, Florida. Fig. 2. Off Lake Worth, Florida (all 6x).

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

Liotia (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-

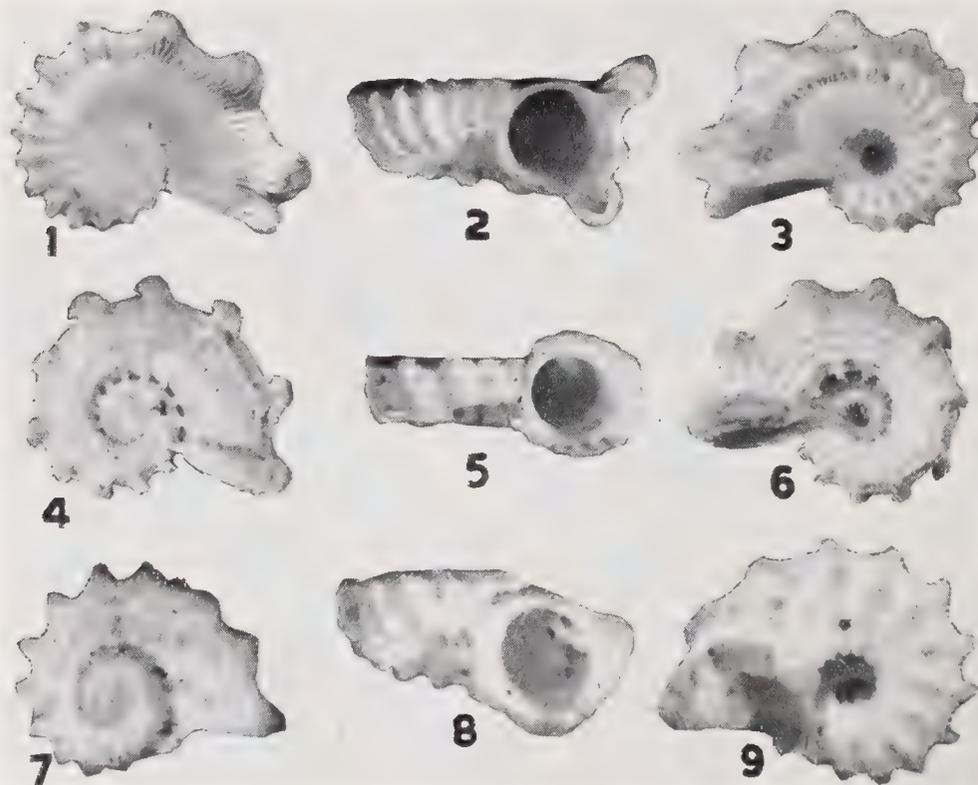


Plate 88. Figs. 1–3. *Cyclostrema tortuganum* Dall, holotype, off Tortugas, Florida (6x). Figs. 4–6. *Cyclostrema amabile* Dall, holotype, off Habana, Cuba (6x). Figs. 7–9. *Cyclostrema cookeanum* Dall, holotype, off South Coronado Island, Lower California (10x).

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 crenulations.

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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XANCIDAE

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THE GENERA XANCUS AND VASUM IN THE WESTERN ATLANTIC

BY

R. TUCKER ABBOTT

Although the chanks of the genus *Xancus* and the vase shells, of the genus *Vasum*, are often very common in many localities throughout the warm regions of the Western Atlantic, Indo-Pacific, and, to a lesser degree, the Eastern Pacific, they are represented by not many more than a dozen recent species in all. These genera extend back as far as Eocene times with no major morphological changes. Today's two genera are a curious mixture of common, moderately widespread species and uncommon, extremely localized species. For the most part, all inhabit shallow water and their main source of food appears to be bivalves and tube worms. The largest species is the West Indian chank, *Xancus angulatus* Solander, which is common in the Bahamas and is second in size in the Western Atlantic only to the horse conch, *Fasciolaria gigantea* Kiener. The second and smaller Atlantic species, *X. laevigatus* Anton, is less common and limited to a small area of Brasil's northeastern coast.

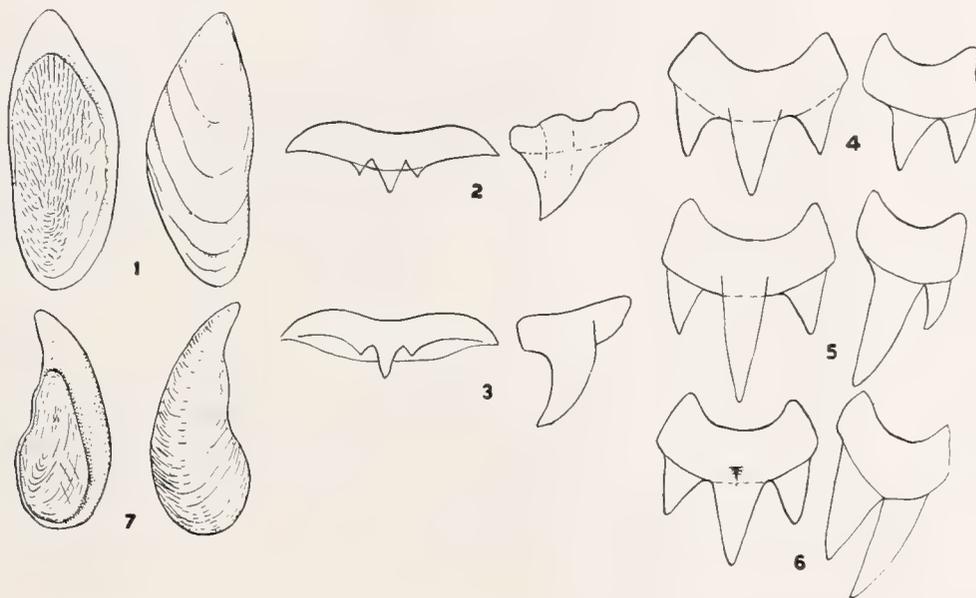


Plate 89. Fig. 1. Operculum of *Xancus angulatus* Solander from Eleuthera Island, Bahamas: *left*, inner side; *right*, outer side. $\times\frac{1}{2}$. Fig. 2. Radula (central and right lateral) of *X. fusus* Sowerby, Andaman Islands, Indian Ocean (after Dall 1885). Fig. 3. Radula of *X. laevigatus* Anton, Bahia, Brasil (after Thiele 1929). Fig. 4. Radula of *Vasum muricatum* Born, Key Largo, Florida. Fig. 5. Radula of *V. turbinellum* Linné, Lato-bach Island, Rongerik Atoll, Marshall Islands. Fig. 6. Radula of *V. ceramicum* Linné, Philippines. Fig. 7. Operculum of *V. muricatum* Born, Key Largo, Florida: *left*, inner side; *right*, outer side. $\times\frac{1}{2}$ (all radulae approx. $\times 200$).

Xancus is of considerable economical importance in the Indian Ocean where the sacred chank, *X. pyrum* Linné, is fished at an annual rate of over two million specimens. The most important market is in the province of Bengal, India, where the shells are sawed and carved into bangles for Hindu women of all castes. Larger specimens are used as trumpets in religious ceremonies. Hornell (1922, p. 130) says the meat is eaten by the families of the chank fishermen. The muscular part of the animal is boiled, cooled, and cut into thin slices for sun-drying. These molluscan "potato chips" keep indefinitely in this hard, dry condition. In cooking, the slices are fried in oil. The operculum is a valuable source of glue in the manufacture of incense sticks. Sinistral specimens of the sacred chank appear in about one out of every hundred thousand normally dextral shells. They are extremely valuable, and are held in high religious esteem by the Hindus and Buddhists. It is one of the emblems of Vishnu, the second god of the Hindu triad. A complete and extremely interesting account of the sacred chank fisheries, and of the innumerable superstitions connected with the shell, is given by J. Hornell (1914).

Nothing is known of the anatomy and little of the life history of the Western Atlantic species, *X. angulatus*. We have collected this species on the north coast of Cuba where it may be found in large, scattered colonies on the intertidal flats. *X. pyrum* in India is gregarious and beds of them are found on sandy bottom where tube worms serve as their main source of food. They are most abundant in waters of 8 to 10 fathoms in depth. The egg capsules are somewhat like those of *Busycon*. Hornell (1922) describes the ribbon as consisting of 25 or more discoidal capsules. Of the considerable number of fertilized eggs in each capsule, only half a dozen survive, the remainder being eaten by their stronger capsule-mates. The fully developed protoconch is very strong, cylindrical in shape, and consists of about 3 whorls. It persists, barring accidents, throughout the life of the snail. The breeding season, when the capsules are formed and are rooted at one end in the sand, occurs during the first three months of the year (see also Lamy 1928, p. 49).

Dall (1885) has described and figured the anatomy of *Xancus fusus* Sowerby from the Andaman Islands. He erroneously identified his specimen as *Turbinella pyrum* Lamarck (USNM specimen no. 41026).

The geographical distributions of the species of both genera in the Western Atlantic are unusual and a preliminary study of the Indo-Pacific species indicates a similarly unusual situation. *X. angulatus* is almost a dominant species in the Bahama area but becomes increasingly uncommon in its geographical extension southwestward through the Lower Florida Keys to Yucatan, Panama and Colombia. Although abundant in certain places along the north coast of Cuba, it has not been recorded eastward in the other Antillean islands. The only other Atlantic *Xancus* is found 3,000 miles to the south on a small portion of the Brazilian coast. In contrast, the commonest vase shell, *Vasum muricatum* Born, is apparently absent, or at least rare, in the Bahamas although it is common in southern Florida, nearby Cuba, and throughout the Caribbean area in general, except the Lesser Antilles. As in the case of *Xancus*, a somewhat similar species of *Vasum* is found far to the south in an extremely local Brazilian region. This is the rare *Vasum cassiforme* Kiener. As *V. muricatum* begins to become uncommon in Puerto Rico and absent southeastward in the Lesser Antilles, it is replaced by the quite different *V. capitellum* Linné. This latter species is uncommon throughout its odd range from Puerto Rico and the Virgin Islands south through the Lesser Antilles and then west-

ward along the north coast of South America to Colombia. A very distinct subspecies, *V. globulus nuttingi* Henderson, is known only from several small colonies in Antigua, Lesser Antilles.

Key to the Genera of *Xancidae*

Shell usually over 5 inches in length; most posterior (or upper) columellar plica is on the curvature of the body whorl; operculum very slightly curved; lateral radular tooth with one cusp. *Xancus*

Shell usually less than 4 inches in length; most posterior columellar plica below the curvature of the body whorl; operculum strongly curved at one end; lateral radular tooth with two cusps. *Vasum*

Genus *Xancus* Röding

Xancus Röding 1798, Museum Boltenianum (2), p. 134.

Turbinella Lamarck 1799, Mémoires Société Histoire Naturelle, Paris, ("Prodrôme"), p. 73, no. 25 (monotypic genotype, *Voluta pyrum* Linné); non Bory St. Vincent 1827.

Turbinellus Lamarck 1801, Animaux sans Vertèbres, p. 83 (monotypic genotype, *Voluta pyrum* Linné); non Oken 1815.

Turbinellarius Duméril 1806, Zoologie Analytique, p. 166. [Regarded as a substitute name for *Turbinella* Lamarck. See Woodring's 1928 discussion of Duméril].

Buccinella Perry 1811, Conchology, London, text with plate 27 (genotype here designated as *B. caerulea* Perry =? *X. pyrum* Linné. See Winckworth's 1945 discussion on the identity of this species).

Scolymus Deshayes 1843, Animaux sans Vertèbres, 2nd edition 9, p. 375. [A replacement for *Turbinella* Schumacher 1816 = *Turbinella* Lamarck.]

Mazza 'Klein' H. and A. Adams 1853, Genera of Recent Mollusca 1, p. 156 (genotype here selected as *M. pyrum* Linné).

Turbofusula Rovereto 1900, Atti Reale Università, Genova 15, p. 169 [not seen, *vide* Wenz 1946].

Genotype, *Voluta pyrum* Gmelin 1791 = *V. pyrum* Linné 1758 (subsequent designation, Dall 1906, Journal of Conchology 11, p. 296).

The species in this genus are large, heavy and massive, and of fusiform shape. There are 3 to 4 prominent columellar plicae which are set almost at right angles to the axis of the shell. The top or most posterior plica is on the curvature of the body whorl. In general, the shells are smooth although in some species there are well-developed nodules or blunt spines at the shoulder of the whorls. Spiral sculpture is often present in the form of rough, raised threads which may be located at the top and base of each whorl. Axial ribs are often present in very young specimens. The nucleus consists of about 3 or 4 strong, smooth whorls which do not expand in size, thus piling up on each other to give the apex in undamaged specimens a cylindrical, raised or mammiform shape. The parietal shield is often well-developed in adults. Siphonal canal open and moderately long, but not twisted at its very end as in *Vasum*. In some species there is very often an abnormal, raised cord on the middle of the body whorl on the inside of the shell. The periostracum is thin to moderately thick and often flakes off from dried specimens. The operculum is horny, hard, unguiculate (claw-like with the nucleus at one end), about 1/3 the area of the aperture, twice as long as wide, very slightly curved, and with a muscle scar covering 9/10 of the area of the inner surface.

Animal with a small, rather broad foot. No separately developed head. Tentacles short, cylindrical, and not joined at their bases. Eye small, located near the end of the tentacle, beyond which there is a small, short, thin feeler or fleshy extension. Mouth large and circular. Proboscis long, white, muscular, cylindrical, and capable of being

completely withdrawn into the body. No jaws present. Radula rachiglossate, with two lateral teeth in each row bearing a single cusp, and with a long, narrow central tooth which bears 3 small, pointed cusps (see plate 89, figs. 2, 3).

Although the genus *Xancus* resembles *Vasum* in shell structure and in many animal characters, it should be noted that the radula of *Vasum* is much closer to that of *Melongenina* than to that of *Xancus*. These two genera have been allied in the same family by most workers because of their strong columellar plicae, but the much more posterior position of those in *Xancus* may be of more phylogenetic significance than has been hitherto suspected. A careful anatomical review may in the future place this family between the Fascioliariidae and Melongenidae instead of in the Volutacea between the Mitridae and Harpidae as they are now placed by Thiele (1929), Wenz (1946) and others. In addition, the Xancidae may perhaps be separated by future workers into two sub-families.

Volema Röding 1798, associated loosely with *Xancus* by Dall's 1906 listing of *V. pyrurum* Gmelin as the first species, was defined and placed in the Melongenidae by Iredale's 1917 type designation for this genus of *V. paradisiaca* Röding (Proceedings of the Malacological Society of London 12, p. 323).

Xancus angulatus Solander, Plate 90, figs. 1-3

Voluta angulata Solander 1786, Portland Catalogue, p. 76, no. 1711. [Refers to Martini 1780, Conchy.-Cab. (1) 4, fig. 1325.]

Murex scolymus Gmelin 1791, Systema Naturæ, ed. 13, p. 3553, no. 101. [Refers to Martini 1780, Conchy.-Cab. (1) 4, fig. 1325.]

Turbinella scolymus Gmelin, Lamarek 1822, Animaux sans Vertèbres 7, p. 103, no. 1.

Tubularia clavata Esper 1830, Pflanzen-Thiere 3, p. 129, pl. 22 [egg case only].

Description. Adult shell varying from 180 to 360 mm. in length (7 to 14 inches). Solid, heavy, and fusiform in shape. Whorls 8 to 11, angulate at the shoulder and with prominent blunt tubercles at the top of the whorl. Color of shell cream-white, but often hidden by the thick, light-brown periostracum. Spire pointed, flat-sided, and of an angle of 50 to 60 degrees. Suture prominent, wavy, well-indented. Aperture large, elongate, with a porcelaneous finish and colored either a yellowish-white, pinkish-cream or a deep, brownish-orange. Parietal wall in adults developed into a thick, oval shield which has a glossy finish and is often more richly colored than the aperture. The shield continues anteriorly into the long, open siphonal canal. The length of the last whorl (aperture and siphonal canal) is generally 2/3 of the length of the entire shell. Outer lip strong, sharp, and often slightly crenulated at the edge on the lower third. Columella bears 3 strong, widely-spaced, rounded plicae or plaits which run back into the shell. They are situated opposite the widest part of the aperture and appear to be almost on a plane vertical to the axis of the shell. There is a thickened, spiral, indistinct, and sometimes absent, ridge on the center of the body whorl inside the aperture. This often accompanies a spiral, light color-streak on the outside of the shell. Umbilicus irregularly formed, deep, slit-like. Axial sculpture consists of 6 to 8 prominent, blunt tubercles on the top of each whorl. Spiral sculpture consists of numerous, small, raised threads which are coarsely beaded by the interruption of the fine axial threads. These spiral threads are usually absent on the center of the body whorl. Nucleus large, bulbous and rather smooth. Periostracum thick, persistent, light-brown in color. Operculum horny, hard, unguiculate,

dark-brown, $2\frac{1}{2}$ times long as wide, narrow at each end, and with a very large muscle scar (see plate 89, fig. 1). Animal unknown.

	length	width	
(large)	360	152 mm.	Bahamas
(average)	206	95	Cat Island, Bahamas

Types. The location of the type specimen once belonging to the Duchess of Portland and sold at auction is unknown to us. Should it prove to be lost, we select Martini 1780, Conchyl.-Cab. (1) 4, pl. 142, fig. 1325 as the type figure, and the type locality as Nassau,

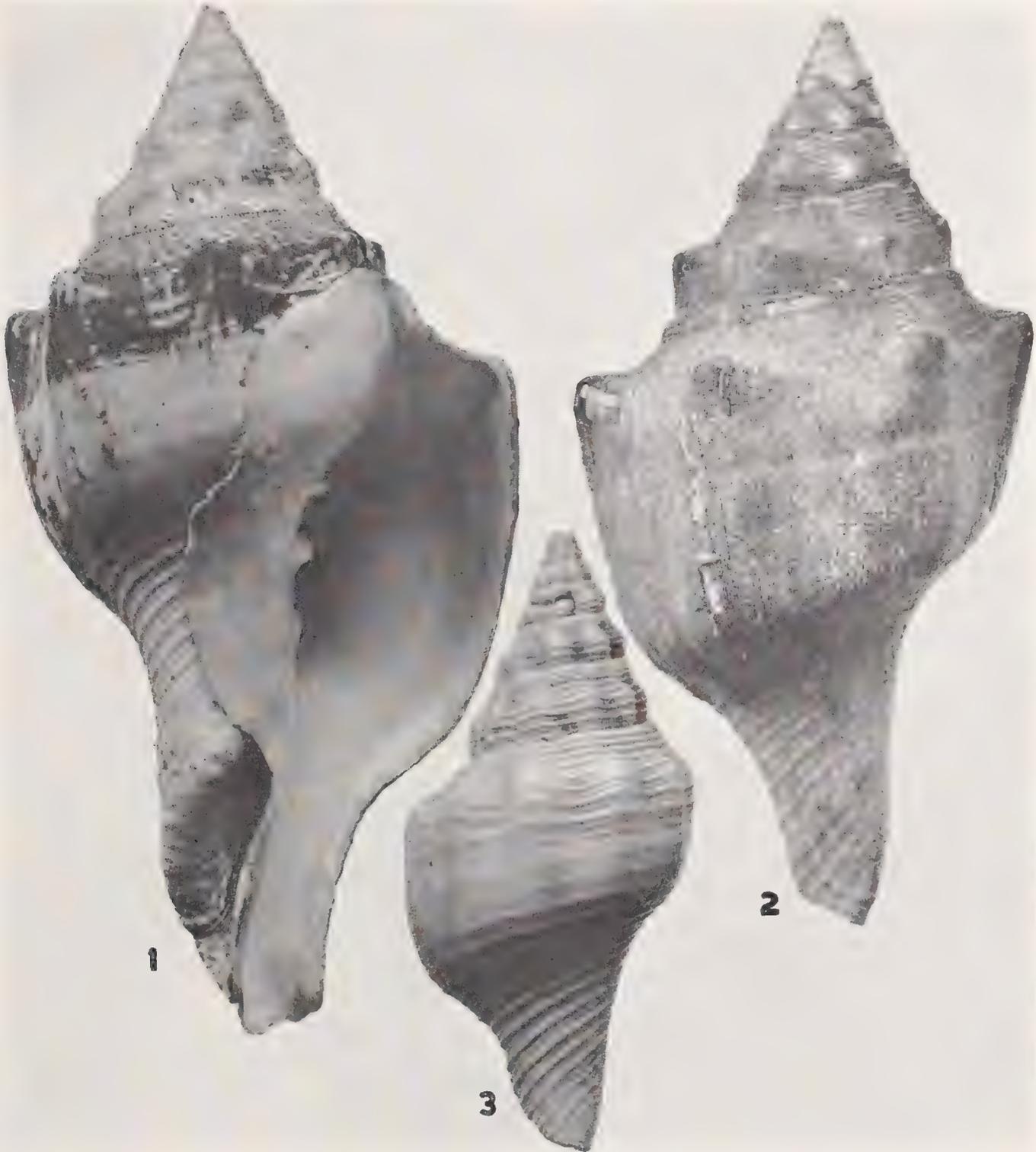


Plate 90. *Xancus angulatus* Solander

Fig. 1. Bahama Islands (reduced from 9 inches). Fig. 2. Yucatan, Mexico (reduced from $5\frac{3}{8}$ inches). Fig. 3. Alicetown, North Bimini Islands, Bahamas (reduced from $7\frac{3}{4}$ inches).

New Providence Island, Bahamas, since Solander (1786, p. 16) mentions "the Island of Providence" as its locality.

Common name. West Indian Chank.

Remarks. The West Indian Chank is common throughout the shallow waters of the Bahamas and the northern coast of Cuba and is found with less frequency along the Central American shores of the Gulf of Mexico. It is found in scattered colonies in relatively quiet waters from the intertidal zone down to a depth of a few fathoms. It is carnivorous and most likely feeds on bivalves and tube worms. In the collection of the Museum of Comparative Zoölogy there is an egg case collected by O. Bryant at Abaco Island, Bahamas, and labelled as coming from this species. It is very similar to that of *X. pyrum* Linné of the Indian Ocean. The horny, yellow-brown, translucent capsules are round discs $1\frac{1}{2}$ inches in diameter, each with a peripheral collar bearing three reinforced folds. The thin cord to which these capsules are closely attached is $\frac{3}{4}$ of an inch wide with a central, rope-like "umbilical" cord in the middle.

Variation in this species is common especially in the degree of development of the nodules on the shoulder of the whorls which may be low and rounded or pointed and triangular, and closely or distantly spaced. The umbilicus may be closed or open. The spiral threads on the whorls are prominent in some shells, especially two specimens from Yucatan, Mexico. It is not uncommon to find them with the spire leaning to one side. This is due to breakage of the siphonal canal in young examples.

A beautiful color photograph of a specimen cut to show the interior columellar plicae has been published in the National Geographic Magazine, Washington **96**, no. 1, p. 80, fig. 2, July 1949 by Rutherford Platt.

Woodring (1928, p. 251) has briefly reviewed the phylogenetic development of the fossil *Xancus* in the Western Atlantic area. There are two main stocks arising in the middle Oligocene Age, each of which is represented by a single living species. The *angulatus* stock includes such fossil species as *X. wilsoni* Conrad, *X. validus* Sowerby, *X. textilis* Guppy and *X. scolymoides* Dall. The distribution of the recent species has been reduced considerably to only the Bahama—Cuba—Western Caribbean area. The other major stock represented by *X. "praeovoideus"* Maury has probably given rise to the recent species, *X. laevigatus* Anton, which is now extremely local in its distribution on the coast of Brasil.

Range. Bahama Islands, Florida Keys, Cuba (north coast only?) and the coast of Central America from Yucatan to Colombia.

Records. FLORIDA: Tortugas. BAHAMAS: Settlement Point, Grand Bahama; Marsh Harbour, Great Abaco; Alice Town, North Bimini; Turtle Rocks, South Bimini (J. Schwengel); Cat Cay, South Bimini; Sandy Point, Savannah Sound, Eleuthera; Dunmore, Harbour Island, Eleuthera; Arthurstown, Cat Island; Berry Cay, Cat Island; Bullock Harbour, Great Harbour Island, Berry Islands; Clarence Town, Long Island. CUBA: Cayo Francés, Caibarién; Habana. HAITI: Saltrou, Dept. de l'Ouest—fossil? (USNM). MEXICO: Yucatan (USNM); Vera Cruz (M. E. Bourgeois, MCZ). BRITISH HONDURAS: Shoals near St. George Cay, Belize (USNM). NICARAGUA: Bluefields. PANAMA: Colón (L. D. Sayers, USNM). COLOMBIA: Puerto Colombia, Bolivar

(USNM); Cartagena, Bolivar—subfossil? (USNM). All records MCZ unless otherwise noted.

Xancus laevigatus Anton, Plate 91, figs. 1-2

Turbinella laevigata Anton 1839, Verzeichniss der Conchylien, Halle, p. 71, no. 2463 (no locality).

Turbinella ovoidea Kiener 1841, Icon. Coquilles Vivantes, Genre Turbinelle 6, p. 7, no. 4, pl. 17, fig. 4 (les côtés de Bahia).

Xancus laevigatus Anton, Winckworth 1939, Proceedings Malacological Society London 23, p. 347.

Description. Adult shell varying from 100 to 120 mm. in length (4 to 5 inches). Solid and heavy, somewhat turnip-shaped. Whorls 7 to 8, globose, smooth. Color of shell dull white, but often hidden by the moderately thick, brown periostracum. Spire pointed but not high, slightly to moderately concave, with the whorls becoming increasingly more rounded. Suture fairly even, deeply indented. Aperture relatively small, elongate, narrowing posteriorly into a narrow channel and produced anteriorly into a relatively short siphonal canal. Parietal wall, in adults, developed into a small, glazed shield which, at the spire end, possesses a low, rounded, thick callus. Length of last whorl (aperture and siphonal canal) equal to or slightly more than $\frac{2}{3}$ that of the entire shell. Outer lip heavy with a fairly sharp edge. Columella possesses on its center three well-developed plicae, the upper two being the largest. They protrude laterally and slightly downward from the columellar wall. Opposite these, and on the inside of the body whorl, there is a raised, spiral, irregular ridge in most specimens. Axial sculpture confined to the earlier whorls and consists of about 6 low, rounded, tubercles. Spiral sculpture consists of about 10 raised, even threads on the top third of each whorl and on the outside of the siphonal canal. Nuclear whorls unknown. Periostracum fairly thick, persistent, light to dark brown. Operculum corneous, heavy, unguiculate, dark brown, $2\frac{1}{2}$ times as long as wide, narrow at each end, and with a very large muscle scar. Animal unknown.



Plate 91. *Xancus laevigatus* Anton

Fig. 1. Maranhao, Brasil (reduced from $4\frac{3}{4}$ inches). Fig. 2. Recife, Pernambuco, Brasil (reduced from 4 inches).

	length	width	
(large)	176	88 mm.	Bahia, Brasil (ANSP)
(average)	122	64	Maranhao, Brasil (MCZ)
(small)	102	45	Recife, Brasil (USNM)

Types. The type is probably in Anton's collection, but we do not know if it has survived the last war. Bahia, Brasil is here selected as the type locality.

Common name. Brazilian Chank.

Remarks. So far as we know, this species is limited to the northeastern bulge of Brasil. It is apparently fairly common locally but it has been collected on less than a dozen occasions. *X. laevigatus* shows a closer resemblance to the Indian *X. pyrum* than it does to the only other Western Atlantic species, *X. angulatus*. It is possible that *Bucinella caerulea* Perry 1811 is this species, but, as Winckworth (1945) has said, the hideous illustration by Perry is equally applicable to *X. pyrum* Linné. Like so many of Perry's names, this one had best be relegated among the unknowns. *X. laevigatus* is heavier, smaller and more turnip-shaped than *X. angulatus*.

Range. The northeast coast of Brasil from the State of Maranhão to the State of Bahia.

Records. BRASIL: Guimarães, 50 miles north of Maranhão; Maranhão, both Estado da Maranhão; Recife, Estado da Pernambuco (all USNM); Bahia; Manguinhos; Mar Grande, Ilha de Itaparica, Estado da Bahia (A. Oliveira, all MCZ).

Genus *Vasum* Röding

Vasum Röding 1798, Museum Boltenianum (2), p. 56.

Volutella Perry 1810, Arcana or the Museum of Natural History, sign. B1 [genotype here designated as *V. divergens* Perry 1810 = *V. rhinoceros* Gmelin]; 1811, Conchology, London, text with plate 26; *non* Swainson 1820 and 1835. Arcana data obtained from Mathews and Iredale 1912, The Victorian Naturalist **29**, pp. 9-13.

Cynodonta Schumacher 1817, Essai Nouveau Système Habitations Vers Testacés, p. 73 [monotypic genotype: *Voluta ceramica* Linné]. *Cynodonta* on p. 241 is an error for *Cynodonta*.

Scolymus Swainson 1835, Elements of Modern Conchology, p. 21; 1840, Treatise Malacology, p. 304 [genotype here selected as *S. cornigerus* Chemnitz fig. 1725-6 = *Turbinella cornigera* Lamarck = *Voluta turbinellus* Linné]; *non* Deshayes 1843.

Cynodonta 'Schumacher' Fischer 1887, Manuel de Conchyliologie, p. 619 [an emendation for *Cynodonta*].

Genotype, *Vasum turbinellus* Röding 1798 = *Murex turbinellus* Linné 1758 (subsequent designation by Winckworth 1945. See discussion below).

The shells of *Vasum* are from 1 to 5 inches in length, very heavy and solid, and sculptured with strong nodules or blunt spines. The columella bears 3 to 5 strong plicae which are located just above the region of the siphonal canal. The siphonal canal is moderately to well-shortened and is slightly twisted up and to the left at its tip. The base of the shell usually bears 3 to 5 spiral rows of strong cords, nodules or blunt spines. When spines are present, they are hollowed out on their anterior faces. The animal is similar to that of *Xancus*. It is carnivorous and the radula is rachiglossate with about 150 transverse rows of teeth, each row possessing one central and two laterals. The central tooth is arched and bears on its anterior edge 3 prominent, pointed cusps. The lateral tooth bears 2 large, long, pointed and slightly curved cusps. The operculum is horny, hard,

dark-brown, unguiculate, rounded at one end, pointed at the other, and curved. The muscle scar occupies $\frac{1}{2}$ to $\frac{3}{4}$ of the inner surface. Periostracum either thick and matted or thin depending upon the species.

The subgenera employed in this genus are rather nebulous and it is possible that as other species are discovered, especially among the fossils, their recognition will be weakened. As a specific character, the number of columellar plicae is often useful, but in some species, such as *Vasum turbinellum* Linné from the Indo-Pacific and *V. muricatum coestus* Reeve from the Panamic province, there is a characteristic variation in number. The basic number throughout the group is 3, but a number of species, recent and fossil, have added two smaller plicae between these to give 5. Some fossil species have 4. There appear to be 3 types of periostraca, the thick, brown, matted form found in *V. muricatum* Born (Western Atlantic); the thin, yellowish, foliated type as in *V. capitellum* Linné (Western Atlantic); and the hard, varnish-like, black periostracum found in *V. turbinellum* Linné and *V. ceramicum* Linné (both Indo-Pacific). The group recurrently evolves towards spinosity, *V. horridum* Heilprin of the Florida Pliocene age being an outstanding example. The living *V. capitellum* Linné represents a recent development.

A genotype for *Vasum* Röding has been designated five times, but possibly only one of these stands as a clearly valid designation. In 1882, von Martens (Zoological Record, Mollusca, p. 43) designated *V. muricatum* Born. This species name is not included among Röding's originally listed six species in the genus *Vasum*. Even though *muricatum* Born and *urna* Röding (one of the six included species) are synonyms and based on the same figures in Martini 1777, Conchy.-Cab. 3, figs. 949 and 950, von Martens' designation cannot be considered valid because *urna* is not mentioned by name. A similar case exists in Cossmann's 1901 genotype designation (Essais Paleo. Comp. 4, p. 65) in which *Turbo cornigera* Lamarck is chosen. This species exists in Röding's list only as the synonym, *V. turbinellus* Röding. The first valid designation was inadvertently made by Winckworth in 1945 (Proceedings of the Malacological Society of London 26, p. 145) when he stated that Cossmann in 1901 designated as type "*V. turbinellus* Röding = *Voluta turbinellus* Linné 1767 = *Murex turbinellus* Linné 1758. *Turbinella cornigera* Lamarck 1822 is the same". Wenz (1946, p. 1300) claims that *Murex ceramicus* Linné was designated as genotype by Hermannsen in 1852, but I can find no such reference in the works of the latter author. Schumacher in 1817 made *V. ceramica* Linné the genotype of *Cynodona* which is a *subjective* synonym of *Vasum* and therefore cannot be transferred as genotype of *Vasum*. Dall (1885, p. 347) designated "types" for *Vasum* Link, but unfortunately gave two species, *Voluta ceramica* Linné and *V. cornigera* Lamarck. It might be argued by some, however, that, since *cornigera* does not appear among Röding's originally listed species, this species is eliminated from consideration, thus leaving *ceramica* Linné as the sole valid genotype. It should be noted that some genotype designations of "*Vasum*" Link 1807" are tantamount to designations for *Vasum* Röding, since Link accepted and quoted Röding as the author. Subsequent authors, including Dall in 1885, believed Röding invalid and therefore erroneously credited Link with many of Röding's generic names. If none of the above designations seems acceptable because of its dubious and complex history, we hereby designate *V. turbinellus* Röding 1798 = *Murex turbinellus* Linné 1758 as the genotype of *Vasum* Röding 1798.

Subgenus **Vasum** *Röding*

(See synonymy under the genus *Vasum*.)

Subgenotype, *Murex turbinellus* Linné 1758.

Shells in this subgenus are heavy, with moderately produced spires, and with spiral rows of blunt or sharp spines. There are no pronounced, fine, axial lamellations. Columella with 3 to 5 plicae. Included here are two Western Atlantic species; one Eastern Pacific subspecies, *V. muricatum coestus* Reeve; one South African species, *V. truncatum* Sowerby; and such Indo-Pacific species as *V. turbinellum* Linné, *V. ceramicum* Linné, *V. imperiale* Reeve and *V. rhinoceros* Gmelin.

Vasum (Vasum) muricatum *Born*, Plate 92, figs. 1-2

Voluta muricata Born 1778, Index Rerum Naturalium Musei Caesarea Vindobonensis, pt. 1, Testacea, p. 222. [Refers to Martini 1777, Conchyl.-Cab., (1) 3, pl. 99, figs. 949-950.]

Vasum urna Röding 1798, Museum Boltenianum (2), p. 56, no. 711. [Refers to Martini 1777, 3, pl. 99, figs. 949-950 (selected here as type figure) and Knorr 1773, (French edition) pt. 6, pl. 35, fig. 1.]

Turbinella capitellum Lamarek 1816 (in part), Encyclopédie Méthodique Vers, pl. 431 bis*, fig. 3 [not 4]. Liste, p. 7 [name and figure only].

Turbinella pugillaris Lamarek 1822, Animaux sans Vertèbres 7, p. 104, no. 5. [Refers to Martini 1777, Conchyl.-Cab. (1), 3, pl. 99, figs. 949-950; Knorr and Lister].

Vasum muricatum Born, Lyman 1949, Shell Notes 2, nos. 7-9, illust. on front cover, Dec. [Nov. 21, 1949].

Description. Adult shell varying from 60 to 125 mm. in length (2½ to 5 inches). Solid and heavy. Whorls 8 to 9, slightly concave on their sides and shouldered at the top with prominent, blunt spines. Color of shell chalk-white, but usually hidden by a very thick, blackish-brown periostracum. Spire low with the first few whorls protruding to a rather



Plate 92. *Vasum muricatum* Born

Fig. 1. Dry Tortugas, Florida (reduced from 3½ inches).

Fig. 2. Key West, Florida (reduced from 3 inches).

sharp point, sometimes concave but usually flat-sided. Suture well-indented, wavy. Aperture moderately large, elongate, with a white porcelaneous finish which is sometimes tinged with purple. Parietal wall, in adults, developed into a narrow, weak shield of white glaze. Siphonal canal short, thick-walled, upturned toward the left at its very end. The length of the last whorl (aperture and siphonal canal) is almost $\frac{3}{4}$ that of the entire shell. Outer lip strong, with 8 to 12 crenulations on the edge. Columella bears 5 well-developed plicae. The first and third plicae are twice as large as the second, fourth and fifth ones. Umbilicus is a shallow, slit-like indentation which is often obscured by the reflected edge of the columella. Axial sculpture consists of numerous, fine, raised threads. Spiral sculpture consists of 8 to 10 strong, raised, rounded cords on the middle of the body whorl, 1 or rarely 2 spiral rows of 9 to 10 blunt spines at the shoulder of the whorl, and 3 to 5 spiral rows of blunt spines at the base of the whorl. Large spines are hollowed out on their anterior faces. The umbilicus is bounded by a spiral, rugose, thick cord. Periostracum very thick, velvet-like in structure, axially foliated, dark-brown to blackish-brown in color and persistent. Operculum horny, thick, unguiculate, curved, narrow at one end, rounded at the other, with a muscle scar of about $\frac{1}{2}$ to $\frac{3}{4}$ the area of the inner side. The operculum fills most of the aperture.

The gross anatomy of the animal is typical of the genus. The radula is rachiglossate. The central tooth bears three anterior cusps, the center one being only $\frac{1}{3}$ longer than the two which flank it. The lateral bears two cusps of which the next one to the central tooth is very slightly larger than the outer one. We have not made notes on the living animal, nor seen egg cases.

	length	width	
(large)	100	80 mm.	Kingston, Jamaica
(small)	78	62	Key West, Florida

Types. Born (1778) cited no locality, but his sole figure reference is based on Martini's pl. 99, figs. 949-950 which was a specimen belonging to Spengler. The latter author stated that it "comes from St. Croix and Jamaica." We here restrict the type locality to Kingston, Jamaica.

Common name. Caribbean Vase.

Remarks. This is a handsome and well-known species which is not uncommon in certain localities in the Florida Lower Keys and abundant in certain areas in the Greater Antilles. It seems to prefer rather sheltered, shallow waters, but is sometimes found on relatively exposed reefs. Oddly enough, it has not been recorded from the Bahamas although it is well-established in southern Florida and the south coast of Cuba. Nor have we seen specimens from the Lesser Antilles.

There is considerable variation in the size and number of shoulder spines among individual specimens. The spire may be low in squat, wide specimens or rather high in elongate, narrower individuals. We have noted no specimens from the Western Atlantic which have not 5 plicae on the columella. This species is represented in the Panamic province by the subspecies *coestus* Reeve. Our series of Eastern Pacific specimens is small, but it appears that *coestus* may have 5 or 4 plicae on the columella at the same locality. Pacific specimens tend to have heavier spiral cords on the center of the body whorl. This species and its subspecies show many morphological similarities with *V.*

cassiforme Kiener (see next species) and *V. rhinoceros* Gmelin (Indo-Pacific, recent), and is especially close to *V. floridanum* McGinty 1940 (Nautilus 53, no. 3, p. 82, pl. 10, fig. 1 Caloosahatchee Marl, Florida, Pliocene). The latter has 4 columellar plicae only.

Tryon's reference (Manual of Conchology (1) 4, p. 71, 1882) of *Vasum crosseanum* Souverbie 1875 (Journal de Conchyliologie 23, no. 4, p. 297 and 24, pl. 13, fig. 1, no locality) to *V. muricatum* seems inadvisable.

Range. Southern Florida, through the Greater Antilles to the Virgin Islands and along the coast of the Caribbean Sea from Honduras to Venezuela. No Bahama records found.

Records. FLORIDA: near Miami; Key Largo; Ragged Key; Key Vaca (all USNM); Sanibel Island; Newfound Harbor (both MCZ); Big Pine Key (ANSP); Bahia Honda Key; Sugarloaf Key; Key West; Sand Key Reef; Dry Tortugas (all MCZ); Content Key, Key West (J. Schmidt). CUBA: Punta de los Colorados, Cienfuegos Bay; Fish Point, Guantánamo Bay, Oriente (both MCZ). HAITI: La Gonave (MCZ); Les Cayes; Torbeck (both USNM). JAMAICA: Gray's Inn, St. Mary; Hope Bay, Portland; Port Royal, Kingston; Port Henderson, St. Catherine (all USNM). HISPANIOLA: Monte Cristi; Santa Bárbara de Samaná; Puerto Plata (all MCZ). PUERTO RICO: Muertos Island (USNM). VIRGIN ISLANDS: St. Johns (MCZ); St. Thomas (USNM). HONDURAS: La Ceiba (USNM). PANAMA: Colón (MCZ). COLOMBIA: Cartagena, Bolivar; Pasa Nueva, Bolivar (both USNM). CARIBBEAN ISLANDS: Swan Island (MCZ).

Vasum (Vasum) cassiforme Kiener, Plate 93, figs. 1-2

Turbinella cassiformis 'Valencienne' Kiener 1841, Iconographie Coquilles Vivantes 6, Genre Turbinelle, p. 20, sp. 13, pl. 9, fig. 4 (. . . côtés de Bahia).

Turbinella cassidiformis Kiener, Deshayes 1845, Animaux sans Vertèbres, 2nd. edition 9, p. 395 [an emendation].

Description. Adult shell about 65 mm. in length (2½ inches). Solid and heavy. Whorls about 8, shouldered at the top with a row of prominent, blunt tubercles and straight to



Plate 93. *Vasum cassiforme* Kiener

Fig. 1. Manguinhos, Ilha de Itaparica, Bahia, Brasil (reduced from 2¾ inches). Fig. 2. "Bahia, Brasil" (reduced from 2½ inches).

slightly concave on their sides. The last whorl in adults flares at the aperture. Color a cream-white with heavy mottlings of reddish-brown. Spire moderately extended, flat-sided. Suture slightly indented and wavy. Aperture flaring and extended at the top, with a whitish interior and externally mottled with light purplish-brown. Parietal wall developed into a fairly wide, elongate shield which is glazed, purplish-brown in color and strongly concave or "dished out" in the area opposite the siphonal canal. Columella generally with 3 weak plicae. The lowest one is sometimes very weak. Siphonal canal short, slightly turned up at the very end. The length of the last whorl (aperture and siphonal canal) is greater than $\frac{3}{4}$ that of the entire shell. Outer lip strong, slightly rolled back and bears prominently raised, rounded, brown, crenulations. The anterior or lower end of the columella is stained a dark-brown. Umbilicus sealed over by the glazed parietal shield. Axial sculpture consists of numerous, fine, prominently raised threads which form fine foliations on the much larger, low spiral cords. Spiral sculpture on the body whorl consists of about a dozen round, foliated cords. At the top of the whorl at the shoulder there is a row of 8 or 9 large, blunt spines which are hollowed out on their anterior faces. At the base of the shell there are 3 to 5 spiral rows of prominent tubercles. Nuclear whorls appear to be smoothish and fairly large. Periostracum moderately thick, persistent, light- to dark-brown, and finely foliated on the spiral cords of the shell. Operculum and animal unknown.

	length	width	
(average)	68	50 mm.	Manguinhos, Ilha de Itaparica, Bahia, Brasil

Types. The type is presumably in the Muséum d'Histoire Naturelle in Paris. Bahia, Brasil is the type locality given by Kiener.

Common name. Helmet Vase.

Remarks. This species is apparently quite rare and limited in its distribution to the State of Bahia, Brasil. The outer lip flares considerably, especially at the top. The parietal wall and the lower portion of the columella are pressed in to form a dish-like depression, a feature which distinguishes it from *V. rhinoceros* Gmelin of the Indo-Pacific. The latter also differs in having 3 strong, white columellar plicae, while *cassiforme* has 3 weak, mauve-brown plicae of which the lower one is almost obsolete. The spiral cords on the body whorl of *cassiforme* are strongly fimbriated. We know of no fossil relatives of this species.

Range. Known only from the State of Bahia, Brasil. Reeve's (1847) record of "the West Indies" is open to question.

Records. BRASIL: "Bahia" (USNM); Manguinhos, Ilha de Itaparica, Estado da Bahia (A. Oliveira, MCZ).

Subgenus *Altivasum* Hedley

Altivasum Hedley 1914, Biological Results of the Fishing Experiments carried on by the F.I.S. "Endeavour" 1909-1914 2, pt. 2, p. 68, pl. 9 (genotype, *Latirus aurantiacus* Verco 1895; *non* Montfort 1810).

Altivasum Hedley, Verco 1914, Transactions and Proceedings Royal Society South Australia 38, p. 484.

Vasum (*Altivasum*) Hedley, Wenz 1946, Handbuch der Paläozoologie, Berlin 6, Gastropoda part 6, p. 1300.

Shell moderately elongate, moderately heavy, with the spire quite elevated. Sculpture spinose with the spines often quite delicate. Axial sculpture delicate, consisting of fine, crowded, sharp, raised foliations or lamellae. Columella with 3 plicae. Umbilicus funnel-shaped, sometimes partially filled by the enrollment of the non-glazed portion of the wall of the siphonal canal. Siphonal canal moderately to greatly shortened. Periostracum very thin, brownish-yellow in color.

Subgenotype, monotypic, *Latirus aurantiacus* Verco 1895 (*non* Montfort 1810) = *Altivasum flindersi* Verco 1914.

This subgenus includes those *Vasum* species which have evolved in the direction of delicate spinosity, elevated spire, shortened siphonal canal, fine, crowded axial lamellae and lightness in shell. The most extreme of these is the subgenotype, *V. (A.) flindersi* Verco, from 75 to 140 fathoms in the Great Australian Bight. Our Western Atlantic representative is *V. (A.) capitellum* Linné which, however, does not have as high a spire nor as short a siphonal canal. This species has changed little from its Lower Miocene ancestor, *V. (A.) subcapitellum* Heilprin, from the Silex beds of Ballast Point, Tampa, Florida. *Vasum horridum* Heilprin of Shell Creek, Florida (Chipola formation, Lower Miocene) appears to be an unusual departure from *Vasum s.s.*, and may doubtfully be placed in the subgenus *Altivasum*. It is unique in its production of many, equal-sized spines on the spire and in having 4 columellar plicae. There is no recent derivative of this species known. *Vasum (Vasum) ceramicum* Linné of the Indo-Pacific bears a superficial relationship with this subgenus in its possession of an elevated spire, but is excluded by its 5 columellar plicae, stoutness of shell, absence of delicate, axial foliations or lamellae in the shell and complete absence of an umbilicus.

Vasum (Altivasum) capitellum Linné, Plate 94, figs. 1-2

Murex capitellum Linné 1758, Systema Naturae, 10th edition, p. 750, no. 465 [refers to Argenville 1742, Histoire Naturelle Lithologie et Conchyliologie, Paris, pl. 18, fig. k].

Voluta capitellum Linné, Gmelin 1791, Systema Naturae, 13th edition, p. 3462, no. 100 (Oceano indico et americano).

Turbinella capitellum Lamarck 1816, Encyclopédie Méthodique Vers, pl. 431 bis*, fig. 4 [not fig. 3]; Liste, p. 7 [name and figure only].

Turbinella mitis Lamarck 1822, Animaux sans Vertèbres 7, p. 106, no. 10 (no locality).

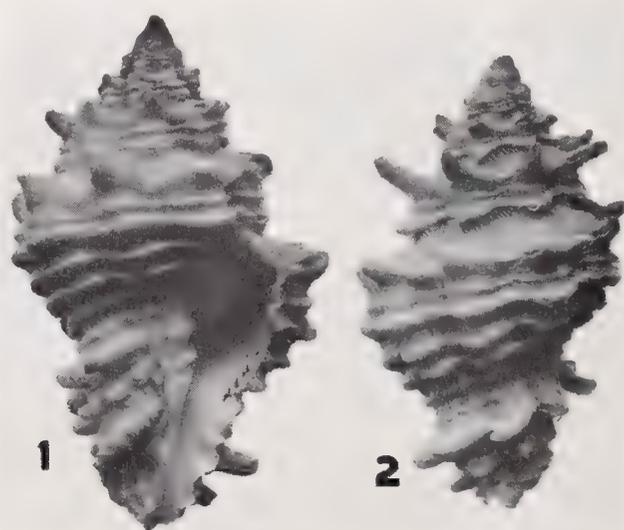


Plate 94. *Vasum capitellum* Linné
Figs. 1 and 2. Lesser Antilles (both natural size).

Description. Adult shell varying from 50 to 65 mm. in length (2 to 2½ inches). Solid, moderately heavy and spinose. Whorls 8 to 9, bearing prominent, sharp, though sometimes blunt, spines at the shoulder. Color of shell cream-white to yellowish-white, rarely with 2 or 3 chocolate-brown, spiral bands. Spire well-produced and pointed. Suture obscure and wavy and sometimes obscured by overlapping spines from the whorl above. Aperture relatively small, oval, continuous below with the siphonal canal, and colored a porcelaneous white. Parietal wall, in adults, developed opposite the columellar plicae into a thick, narrow, glazed shield. Siphonal canal moderately shortened, slightly turned up and to the left at its very end. The length of the last whorl (aperture and siphonal canal) is equal to or slightly greater than ½ the total length of the shell. Outer lip strong, with about 8 prominent, deep scallopings or crenulations. Columella bears 3 strong plicae of which the lowest is sometimes weak. Umbilicus small, funnel-shaped, partially filled by the reflected edge of the columella. Axial sculpture consists of numerous, crowded, raised lamellae which are very delicate in texture. Spiral sculpture consists of 1 or 2 rows of long and sharp or short and blunt spines at the shoulder of each whorl, and of 4 to 6 strong, wavy and rounded cords on the center of the whorl. At the base or lower third of the whorl there are 3 spiral rows of prominent spines. The lowest one is generally foliated and borders the umbilicus. All long spines, if present, are hollowed out on their anterior faces. Periostracum thin, persistent, axially foliated or lamellated and a light yellowish-brown in color. Operculum and animal unknown.

	length	width	
(large)	64	39 mm.	"Lesser Antilles"
(average)	50	32	Port Castries, St. Lucia, Lesser Antilles
(small)	38	25	St. Lucia, Lesser Antilles

Types. The figure given by Argenville 1742, pl. 18, fig. k (see reference above) is designated as the type figure. We restrict the type locality to St. Lucia, Lesser Antilles.

Common name. Spiny Vase.

Remarks. The spiny vase is an uncommon species which apparently lives in waters of moderate depth. The great variation in spinosity, which may in some cases be reduced to a simple nodulation, may be due to environmental conditions, although at present there are insufficient data to support this conjecture. Two young specimens from Villa, St. Vincent, Virgin Islands, have 3 spiral color bands of chocolate-brown.

Range. Puerto Rico, through the Lesser Antilles and thence westward along the northern coast of South America to Colombia.

Records. PUERTO RICO: Mayagüez (MCZ). VIRGIN ISLANDS: Villa, St. Vincent (USNM); St. Thomas (ANSP and MCZ). LESSER ANTILLES: Port Castries, St. Lucia; St. Lucia, 10 fathoms (both USNM); Carriacou Island, Grenadines; Fontenary Beach, Grenada; Barbados (all H. G. Kugler, MCZ). CARIBBEAN ISLANDS: Bonaire; Curaçao (both USNM). COLOMBIA: Cartagena, Bolivar (USNM).

Subgenus **Globivasum**, *new subgenus*

Shell globular in shape, solid, with a very short siphonal canal. Sculpture nodulose, not spinose, with low, rounded, axial ribs. Spiral sculpture of weak, wavy, rounded

cords which are more pronounced on the middle of the body whorl. Columella with 3 prominent plicae, the lowest of which is weakest in development. Umbilicus funnel-shaped, shallow, sometimes partially filled by the reflected, porcelaneous portion of the columella. Periostracum thin, light-brown in color. Operculum typical of the genus. Animal unknown.

Subgenotype, *Turbinella nuttingi* Henderson 1919 = *Vasum* (*Globivasum*) *globulum nuttingi*.

There appears to be no fossil representative described for this subgenus and the subgenotype, *V. (G.) globulum nuttingi* is the sole Western Atlantic member. This subgenus is an unusual development towards simplicity in sculpture and conservatism in shape. It shows an opposite trend from that displayed by members of the subgenus *Altivasum* which tend towards elongation, spinosity and delicateness in form. *V. (G.) globulum globulum* Lamarck is presumably limited to the West African coast.

***Vasum* (*Globivasum*) *globulum globulum* Lamarck**

Turbinella globulus Lamarck 1816, Encyclopédie Méthodique Vers, pl. 431 bis*, fig. 2; Liste, p. 7 [name and figure only].

Voluta globosa Dillwyn 1817, Descriptive Catalogue Recent Shells, London 1, p. 569 (no locality) [refers to Chemnitz 1795, Conchy.-Cab. (1) 11, pl. 178, figs. 1715, 1716].

Turbinella globulus Lamarck, Kiener 1841, Iconographie Coquilles Vivantes 6, Genre Turbinelle, p. 16, pl. 10, fig. 2 (Ocean Indien?).

Turbinella globulus Reeve 1847, Conchologia Iconica 4, Turbinella, no. 11 (Africa).

Description. In all respects, so far as we know, like that of *V. nuttingi* Henderson, except that the columella and interior of the aperture are always bright, rosy-pink in color.

	length	width	
(large?)	35	25 mm.	Cape of Good Hope, Union of South Africa [?]. USNM 124677.

Types. The type upon which Lamarck based his description is presumably in the Muséum d'Histoire Naturelle in Paris. We refrain from suggesting a specific type locality because of insufficient material.

Common name. The Little Globe Vase.

Remarks. This rare species has not been recorded from the Western Atlantic and it presumably comes from the west coast of Africa. It differs from its West Indian subspecies, *V. globulum nuttingi*, only in having a bright, rosy-pink aperture instead of a brownish-orange to dark chocolate-brown one. *Buccinella tuberculata* Perry 1811 (Conchology, London, pl. 27, fig. 7, "Amboyna") may be this species, but the unsatisfactory figure and locality place this name among Perry's doubtfuls.

Range and Records. We can find only three locality records for this species. Reeve (1847) gave "Africa" and added that it is a peculiar and well-known species, though not one of very common occurrence." A young specimen in the Academy of Natural Sciences of Philadelphia is labelled "West Africa." An adult in the U. S. National

Museum from the Turton collection is labelled "Cape of Good Hope," but the accuracy of this is open to question.

Vasum (Globivasum) globulum nuttingi Henderson, Plate 95, figs. 1-2

Turbinella nuttingi Henderson 1919, [in] C. C. Nutting, University Iowa Studies, Natural History, 1st series, no. 28, p. 201, pl. 11, fig. 1 (Falmouth Harbour, Antigua).

Description. Adult shell varying from 25 to 43 mm. in length (1 to 1 $\frac{3}{4}$ inch). Solid, heavy and globular in shape. Whorls 8 to 9, rounded and bearing 8 to 10 low, rounded, axial ribs. Color of shell, white to cream-white with chocolate-brown mottlings seen in young specimens. Spire moderately produced, slightly rounded. Suture well-indented and wavy. Aperture ovate, continuous with siphonal canal opening, colored a pinkish-brown to light, brownish-orange outside and a dark brown inside. Parietal wall, in adults, developed into a narrow, glazed shield which extends anteriorly into the siphonal canal. Siphonal canal short, slightly turned up at its very end. The length of the last whorl (aperture and siphonal canal) is slightly less than $\frac{2}{3}$ that of the entire shell. Outer lip strong, with heavy crenulations, each of which bears 2 spiral, raised, glazed cords. These are thickened into teeth just inside the edge of the outer lip. Columella bears 3 well-developed plicae, the most anterior one being generally smaller than the two above it. They are almost vertical to the axis of the shell. Umbilicus funnel-shaped, shallow, sometimes closed over by the reflected edge of the columella. Axial sculpture consists of 8 to 10 low, rounded, evenly-spaced ribs. Over the entire shell are numerous, fine, axial lamellae which are often fimbriated. Spiral sculpture consists of fairly prominent rounded cords which, when crossing the axial ribs, give the shell a nodulose sculpture. Periostracum thin, yellowish-brown in color. Operculum corneous, heavy, light-brown, unguiculate, curved, pointed at one end, rounded at the other, with a muscle scar covering half the inner surface. Animal unknown.

	length	width	
(large)	43	34 mm.	Falmouth Harbour, Antigua (paratype)
(average)	37	26	Falmouth Harbour, Antigua (holotype)
(small)	25	19	English Harbour, Antigua (paratype)

Types. Holotype, USNM no. 600532. The type locality is Falmouth Harbour, Antigua Island, Lesser Antilles, station 402, 7 fathoms, Smithsonian-Univ. Iowa Expedi-



Plate 95. *Vasum globulum nuttingi* Henderson

Fig. 1. Falmouth Harbour, Antigua Island, Lesser Antilles (holotype). Fig. 2. English Harbour, Antigua Island, Lesser Antilles (paratype) (both natural size).

tion, June 21, 1918, J. B. Henderson, leg. Paratypes in USNM 459370 from the above locality. Paratypes in USNM 459365, 459366, 459368 and 459369, all from minor, shore localities in English Harbour, Antigua. J. B. Henderson, leg. June 1918.

Common name. Nutting's Vase.

Remarks. This subspecies is very similar to *V. globulum globulum* Lamarek, but differs in having a light yellowish-brown to mauve-brown columella and outer lip and an inner aperture of chocolate-brown. Henderson appears to be the only one who has collected this species, having found over thirty specimens in Antigua. He says (1919, p. 201) that they are very difficult to see against the rocky shore background. "One of the chief enemies of these rock-loving mollusks is a fish of the grouper family that at high tide swims about the reefs examining every inch of their surface for little mollusks." Henderson must have changed his mind about giving a new name to this species after the appearance of Nutting's 1919 report in which he gave a description, locality, and figure. His series of specimens in the U. S. National Museum were labelled "*globulus* Lamarek" and bore no indication of having been described. The figured specimen has been separated from the paratypes, and is now set aside as the holotype in USNM 600532.

Range and Records. Known only from the above localities in Antigua, Lesser Antilles.

Key to the Western Atlantic species of *Vasum*

- | | |
|---|--------------------------|
| 1. Columella with 5 plicae | <i>muricatum</i> |
| Columella with 3 plicae | 2 |
| 2. Shell globose, without spines or tubercles | <i>globulum nuttingi</i> |
| Shell elongate, with spines or tubercles | 3 |
| 3. Aperture white; lip not flaring | <i>capitellum</i> |
| Aperture mauve-brown; lip flaring | <i>cassiforme</i> |

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All photographs by F. B. Kestner of the Smithsonian Institution.

Acknowledgements

In connection with the work on *Cyclostrema*, I am particularly indebted to C. G. Aguayo of the Museo Poey, Habana, Cuba, who first suggested this problem. I also wish to thank W. J. Clench, H. A. Pilsbry and J. S. Schwengel for the opportunity of examining their material used in *Johnsonia* numbers 27 and 28. I am most appreciative of the help on many technical matters given me by W. J. Clench, H. A. Rehder, R. Stewart and W. P. Woodring.

* * * *

Voyages of the "Eolis"

The motor yacht, "Eolis," was built in 1909 by Mr. John B. Henderson, Jr. for the purpose of dredging mollusks in Western Atlantic waters. The "Eolis" was 50 feet in length, 11 feet in width, and drew 5 feet of water. Her home port was Washington, D.C. Seven cruises were made from 1910 to 1915, five of which were in Florida and Bahama waters. During the summers of 1910 and 1912, Mr. Henderson took the "Eolis" to Bar Harbor and Frenchman's Bay, Maine, where a small amount of dredging was done. The most outstanding cruises were made along the coast of southern Florida, principally over the Pourtalès Plateau and Hawk Channel. During the five Florida cruises, over 31,400 lots of deep-sea mollusks were collected. These were later donated to the United States National Museum. A two week's trip was taken to the Bimini Islands during the third Florida cruise, but the dredging results were rather poor. Mr. George H. Clapp and Mr. Charles T. Simpson accompanied Mr. Henderson on most of these southern cruises. Interesting extracts of the log of the "Eolis" were published by Mr. Henderson in the *Nautilus* (1911, 25, no. 6, pp. 71-72, no. 7, pp. 81-83).

No extensive report has been made on the "Eolis" collections and it will be many years before it is thoroughly worked, probably by numerous authors as the various families are monographed. In 1915, Henderson published an account of the "Rediscovery of Pourtales' Haliotis" (see *Johnsonia* 2, no. 21, May 1946).

In 1918, Mr. Henderson carried out successful dredging operations in Antigua and Barbados, Lesser Antilles, during the Smithsonian-University of Iowa Expedition. Hauls from 6 to 120 fathoms were made from his 27-foot launch "Eolis, Jr." A fascinating account by Mr. Henderson appears in C. C. Nutting's "Barbados-Antigua Expedition" (Univ. Iowa Studies (1) 8, no. 3, pp. 88-96 and 199-203). *Turbinella nuttingi* Henderson, a synonym of *Vasum globulum* Lamarck, is inadvertently described as new.

Since no obituary of Mr. John Brooks Henderson, Jr. has ever appeared in malacological literature, we are including a few remarks, pending a more complete account. Mr. Henderson was born in Louisiana, Pike County, Missouri, on February 18, 1870. He graduated from Harvard University in 1891 and received his law degree in 1893 from Columbian (now the George Washington) University. He was author of "American Diplomatic Questions" and "The Cruise of the Tomas Barrera."

Henderson collected mollusks in Jamaica, Haiti, Cuba, the Lesser Antilles, Hawaii, United States, Europe, Japan and China. He published 43 articles on mollusks, most of which appeared in the *Nautilus* and the *Proceedings of the U.S. National Museum*, the most outstanding being "A Monograph of the East American Scaphopod Mollusks."

He was a regent of the Smithsonian Institution from 1910 until his untimely death on January 4, 1923, at the age of 52.—R. T. ABBOTT.

The Voyage of the "Tomas Berrera"

One of the many important expeditions in Cuban waters was that of the schooner *Tomas Berrera*, an expedition organized by J. B. Henderson and Dr. Carlos de la Torre. The *Tomas Berrera* cruised along the Colorado Reefs on the northwest coast of Cuba from La Esperanza to Cabo de San Antonio for six weeks during May and June of 1914. The purpose of the trip was to make as complete a collection as possible of the flora and fauna of the region, especially to collect marine mollusks and to take advantage of the unusual opportunities for collecting land and fresh-water mollusks on the northern slopes of the Sierra de los Organos, a region more or less inaccessible from the south.

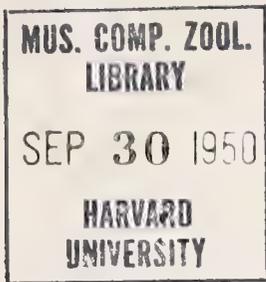
The party of naturalists included Paul Bartsch, George H. Clapp, John B. Henderson, J. Rodriguez, Charles T. Simpson, Carlos de la Torre and Manuel Lesmes, a fisheries expert for the Cuban government.

The *Tomas Berrera* was the prize member of a large Cuban fishing fleet. She was a "vivero," a ship possessing a large tank for keeping fish alive until delivered at the market. She was sixty-five feet long at the water line, had a twenty foot beam and carried a large set of sails but had no auxiliary engine. A twenty-five foot Gurnet dory equipped with a number of dredges of varying sizes and weights, and other special collecting apparatus had been brought from Miami. In addition to this, the expedition had at its disposal a small auxiliary sloop-rigged "vivero" the *Tarpon*, which served as a tug and was used for collecting trips into shallow waters.

Dredging began in the bay at La Esperanza and from then on collecting never ceased during daylight hours except when the *Tomas Berrera* was actually under way. Hauls were made in shallow depths along the entire length of the inner reef as the expedition was not equipped to make hauls in the deeper waters on the outside of the reef. Night collecting with the aid of a submarine light was most productive.

Collecting along the reef near Cayo Hutia was excellent and while half of the party were thus engaged the rest went inland to explore Pan de Azucar, a mountain noted for many fine land shells. From Cayo Hutia the schooner proceeded to Dimas, taking a route outside the reef, the inner waters being too shallow. From Dimas to Santa Rosia and thence to Los Arroyas the dredge was in constant use. Interesting hauls were made off Punta del Torete, but Cabo Colorado proved disappointing. Exploration of the Cayos de la Leña was interesting and varied. Dredging around Punta del Cajon and Cabo de San Antonio completed the main portion of the marine work of the expedition. The schooner put in at La Fé and from here a trip was made overland to Viñales and La Esperanza. Here the party joined the ship and the expedition proceeded eastward to explore the region about Mulata, Bahía Honda and Cabañas, while a land party made productive trips to Pan de Guajaibon and the hills about Cabañas.

Most of the material collected was deposited in the United States National Museum and records have appeared in many scattered reports, which include stations of the *Tomas Berrera* expedition. A popular account of this voyage appeared as "The Cruise of the *Tomas Berrera*" by John B. Henderson, 1916, 329 pages with 36 illustrations and maps, G. P. Putnam and Sons, New York.—RUTH D. TURNER.



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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

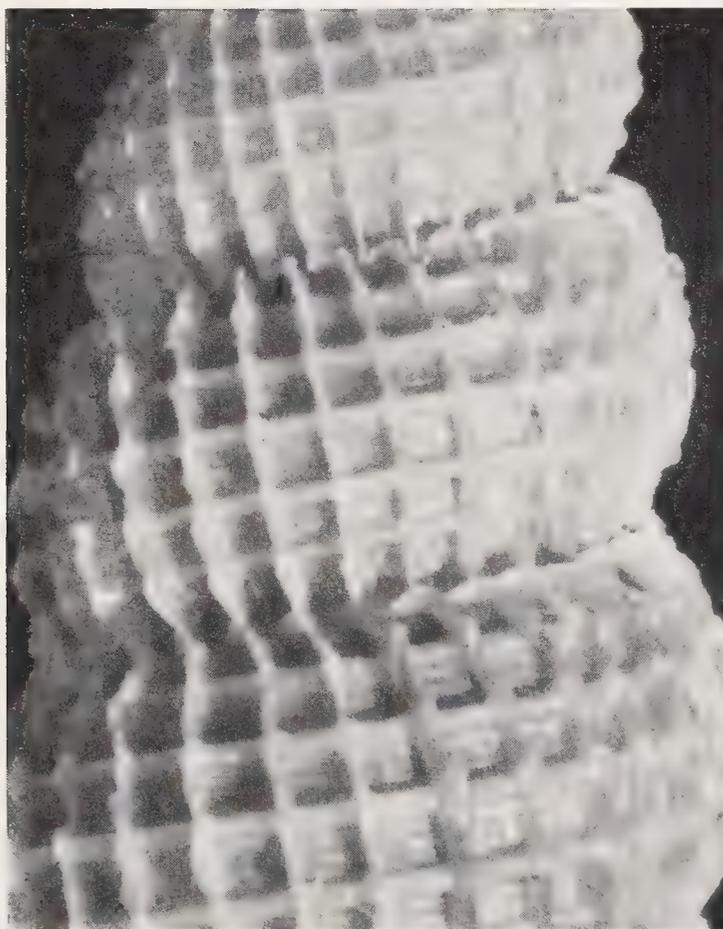


Plate 96. *Amaea retifera* Dall

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 deBoury 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).

StenorhytisScala 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*

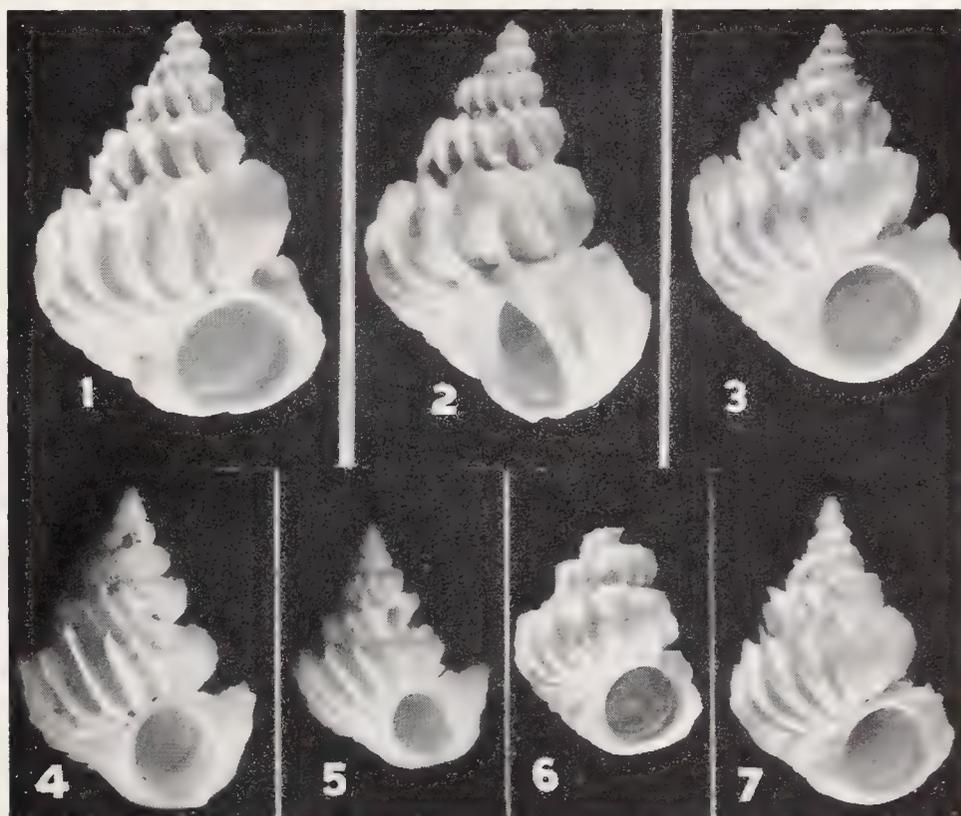


Plate 97. *Sthenorytis pernobilis* Fischer and Bernardi

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* Fischer 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* Fischer 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 Isaac, 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

Epitonium (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. $29^{\circ}14'$; W. Long. $85^{\circ}29'$, 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. $34^{\circ}38'30''$; W. Long. $75^{\circ}33'30''$ 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.

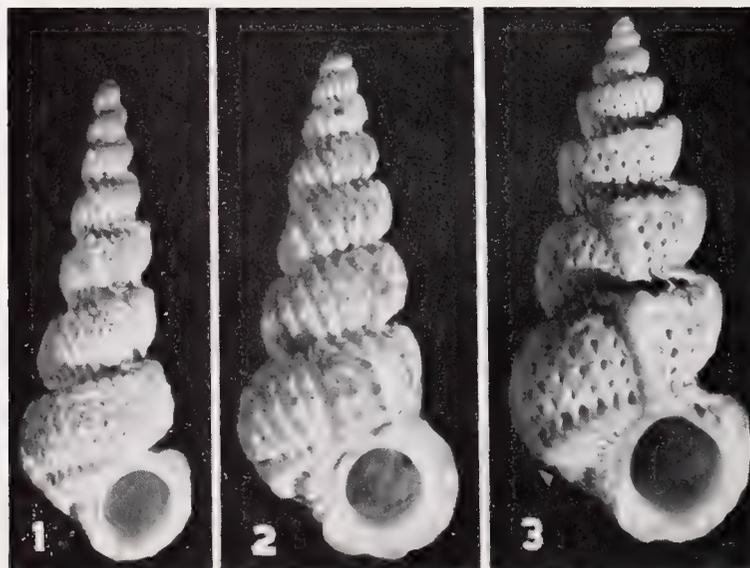


Plate 98. Fig. 1. *Cirsotrema dalli* Rehder, holotype (slightly enlarged). Fig. 2. *Cirsotrema pilsbryi* McGinty, holotype (about $3\frac{1}{2}x$). Fig. 3. *Cirsotrema arcella* Rehder, holotype (about $3\frac{1}{2}x$).

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 "*Scalaria 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.

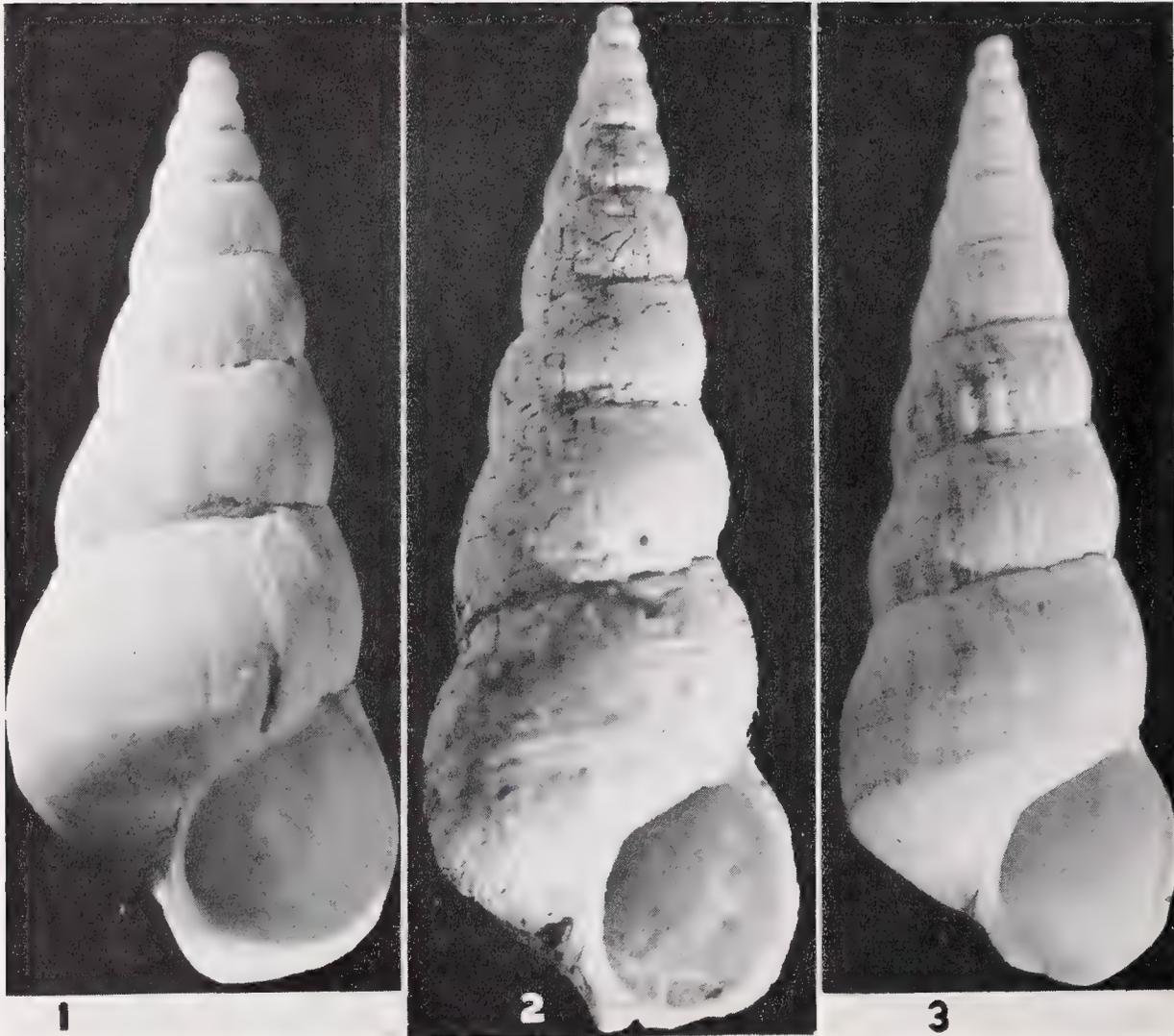


Plate 99. *Acirsa costulata* Mighels and Adams

Fig. 1. *Scalaria 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*.

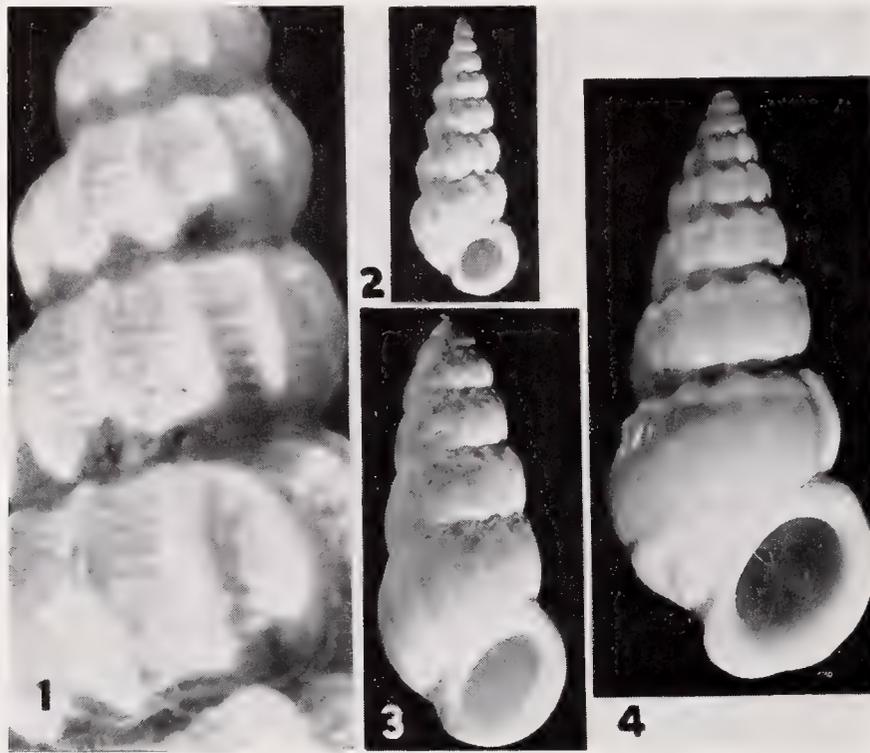


Plate 100. Fig. 1. *Opalia watsoni* de Boury, enlarged to show sculpture (about 42x). Fig. 2. *Opalia watsoni* de Boury, from off Puerto Tanamo, Oriente, Cuba (about 8x). Fig. 3. *Scalaria (Opalia) scaeva* Mörch (= *Opalia hotessieriana* d'Orbigny) St. Thomas, Virgin Islands, lectotype (5x). Fig. 4.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

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. $23^{\circ}13'$; W. Long. $81^{\circ}22'$) in 385 fathoms (MCZ and Museo Poey). *Atlantis*, station 3374, off Puerto Tanamo, Oriente (N. Lat. $20^{\circ}45'$; W. Long. $75^{\circ}19'$) in 300 fathoms (MCZ). BRASIL: *Challenger*, station 122, off Pernambuco (S. Lat. $90^{\circ}5'$; W. Long. $34^{\circ}5'$) 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 (Mattox). 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 (Dentiscalia) 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].

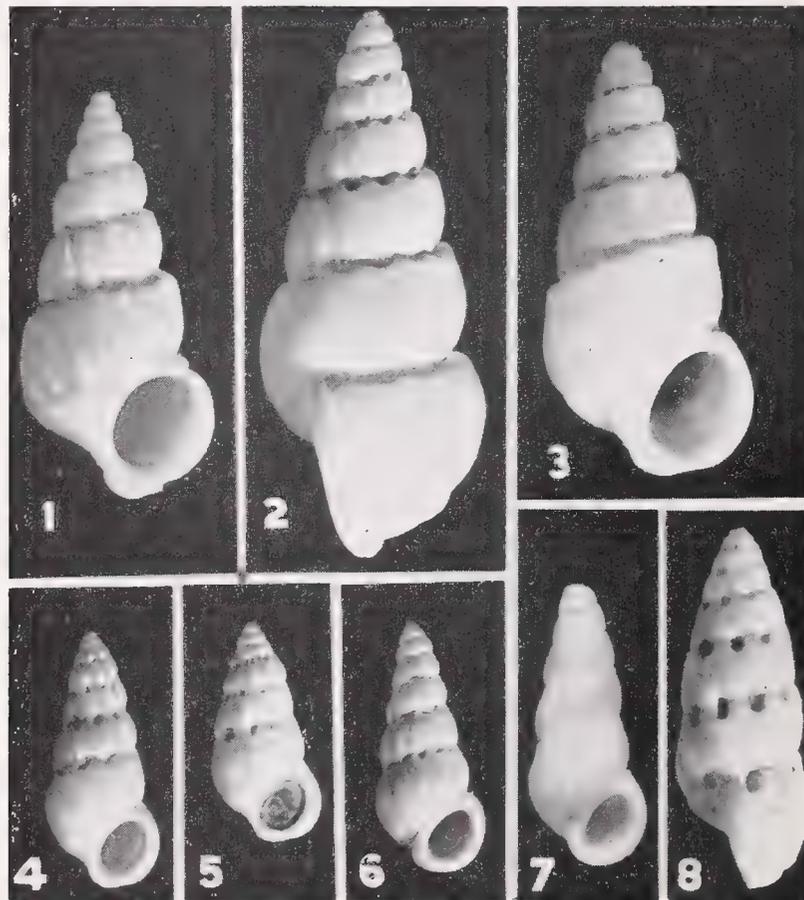


Plate 101. Figs. 1-3. *Opalia crenata* Linné. Figs. 4-8. *Opalia hotessieriana* d'Orbigny

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 ($4x$). Fig. 8. Utilia 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 crassicoستا 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 crassicoستا* 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: Bâriadèle, 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 (Dentiscala) 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.

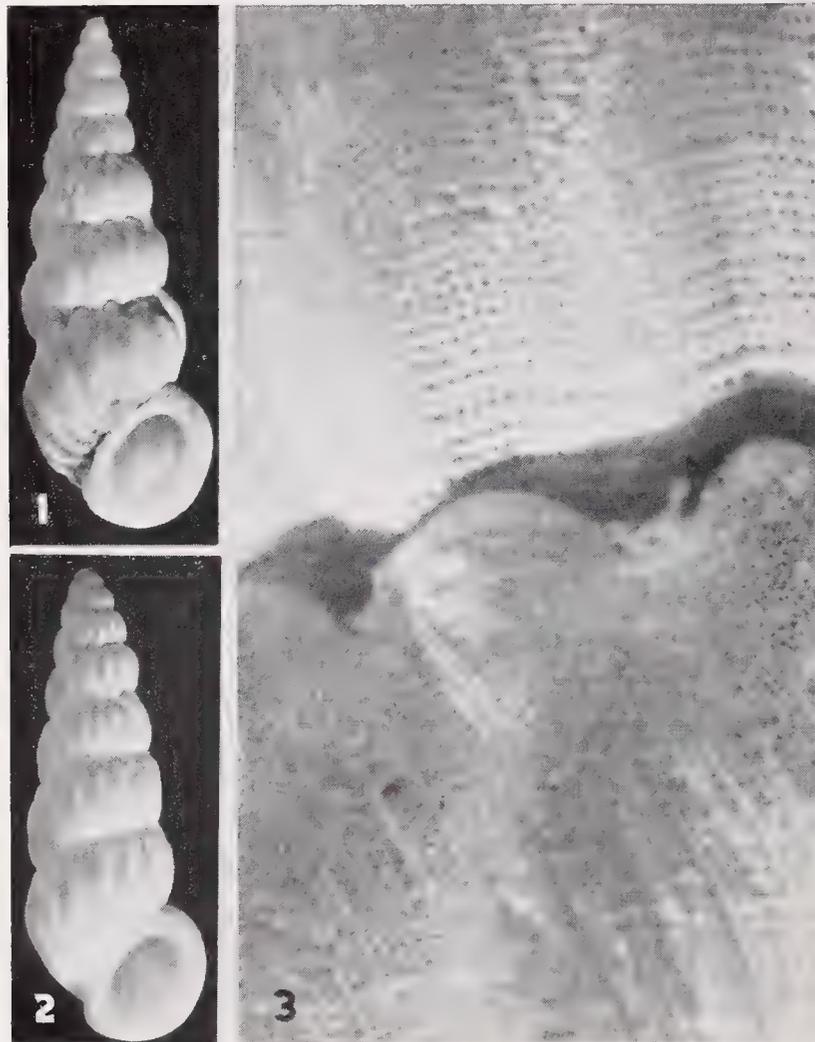


Plate 102. *Opalia (Dentiscalia) burryi* Clench and Turner

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* Conraine 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* Conraine 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].

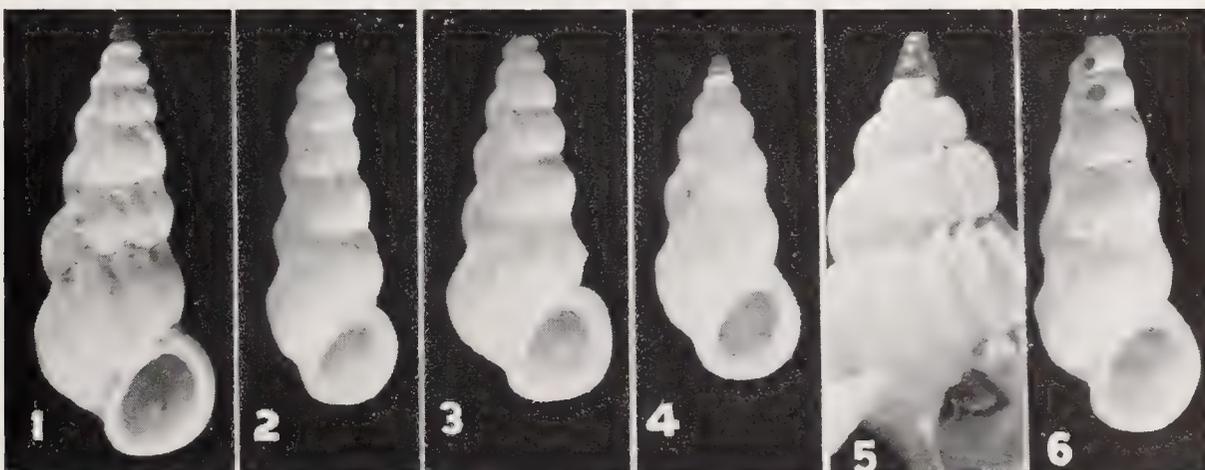


Plate 103. *Opalia pumilio* Mörch

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. Operculum 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 hellenica 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 hellenica* 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 *morchiana* 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 paucispiral.

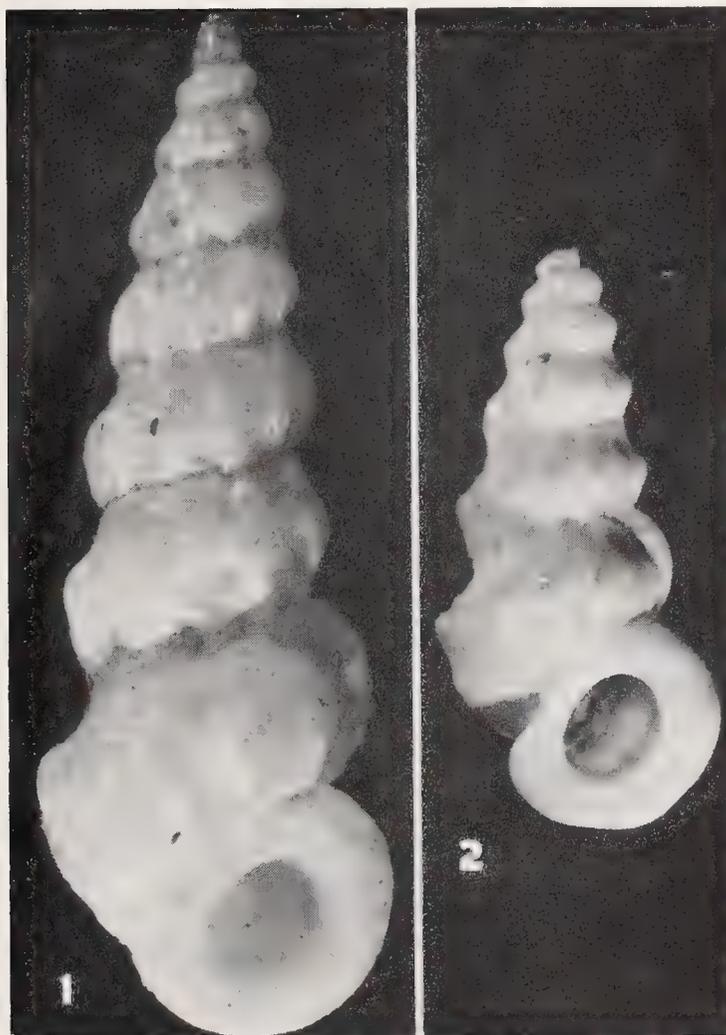


Plate 104. Fig. 1. *Opalia morchiana* Dall, from off the Barbados, holotype (15x). Fig. 2. From off Miami, Florida (7x).

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).

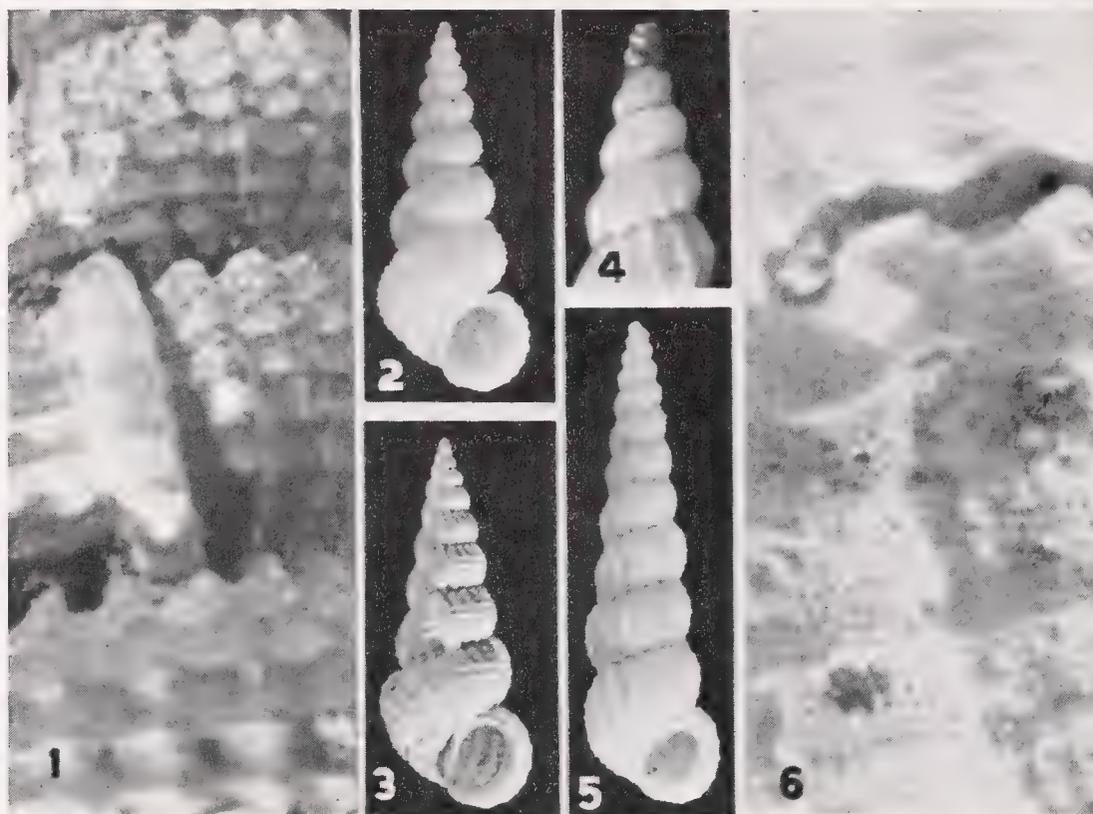


Plate 105. Figs. 1-3. *Opalia eolis* Clench and Turner. Figs. 4-6, *Opalia aurifila* Dall
 Fig. 1. Detail of sculpture (25x). Fig. 2. From off Palm Beach, Florida, paratype (5x). Fig. 3. From off Looe Key, Florida, holotype (5x). Fig. 4. From off Fowey Light, Florida (18x). Fig. 5. Off Martinique, Lesser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

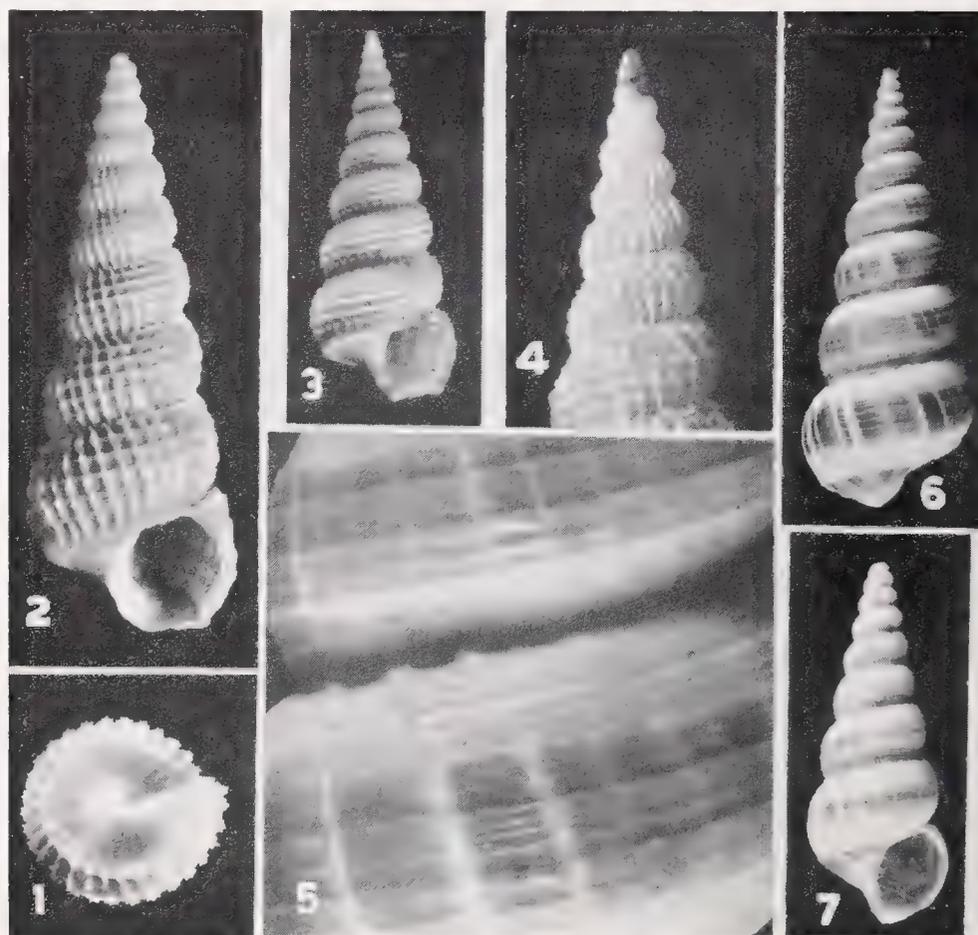


Plate 106. Figs. 1-4. *Amaea retifera* Dall. Figs. 5-7. *Amaea mitchelli* Dall.

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 *Amaea decussata* Lamarck from the East Indies. However, *Amaea 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).

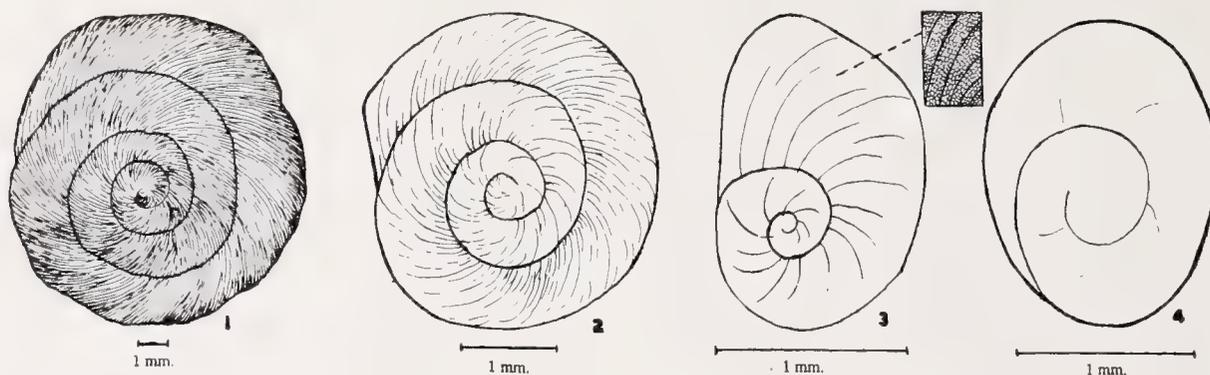


Plate 107. Opercula

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.

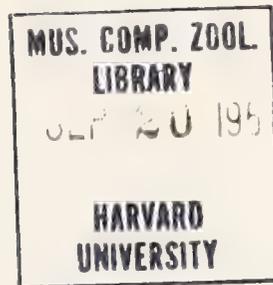
New species are described rather fully. Known species have synonymies, measurements, type locality and general distribution. Figures are given, but no descriptions, as the illustrations are usually adequate in this category for all diagnostic purposes. The lack of critical remarks regarding the various 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.

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EPITONIIDAE

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THE GENUS EPITONIUM IN THE WESTERN ATLANTIC

Part I

BY

WILLIAM J. CLENCH AND RUTH D. TURNER

This present number deals with three subgenera in the genus *Epitonium*. In these particular subgenera the axial costae completely dominate the sculpture of the shell. The spiral sculpture, other than the basal ridge which is present in a few species, is almost entirely absent. On purely taxonomic grounds, the present grouping of these species under these subgenera is artificial and they are to be considered as a convenience rather than an expression of understood or believed relationships. They are used tentatively, not only because of their lack of true value in a taxonomic sense but also on nomenclatorial grounds. As stated in our previous number, E. de Boury created a very large number of subgenera¹ which were never diagnosed but defined only by citing a type species.



Plate 108. *Epitonium scalare* Linné
China (natural size). This species is the genotype
of the genus *Epitonium*.

¹ E. de Boury 1909, *Journal de Conchyliologie* 57, pp. 255-258.

When more of these type species are better known and evaluated, many more names may be added to the synonymy.

There appears to be considerable parallel development in the shell characters that are used to separate species or indicate their close relationship. That is, the presence of a basal ridge may indicate a close relationship between two or more species, yet its absence may separate species which in all other characters approximate one another. An open umbilicus as opposed to one more or less closed by the parietal expansion of the inner lip may separate two species subgenerically. On purely mechanical grounds, a more widely coiled species will evolve the character of an open umbilicus, a more narrowly coiled species will not show it, the difference thus being far more apparent than real. Nevertheless these differences have their value in grouping the species in this genus, even if this grouping is considered to be somewhat artificial.

The axial costae are blade-like or cord-like and may be angled, pointed or hooked at the whorl shoulder. In the case of *E. echinaticostum*, from three to five such angles are produced on each costa giving it a fluted appearance. The costae of each whorl may be produced just below those of the whorl above so that in alignment they form a nearly straight and continuous ridge from the nuclear whorls to the base of the shell. Individual specimens, however, may produce these costae independent of those of the whorl above, though this character appears to be more constant in certain species than in others. In many species the whorls proper are produced as a free coil and are attached only by the opposing costae on the preceding whorl for structural strength. In a few species, the costae may be reflected backward as in *E. venosum* Sowerby or they may exhibit this character only in the early post-nuclear whorls. In general, however, the costae are usually developed at right angles to the axis of the shell.

The basal ridge may be well developed as is usually the case with most specimens of *E. lamellosum* Lamarck or poorly developed as in many specimens of *E. rupicolum* Kurtz. Between the costae the shell is generally highly polished and smooth, but occasional specimens may show a very faint trace of spiral sculpture when viewed under a magnification of 14x or more.

A peculiar character exhibited by many specimens is the changing of the direction of the axis of the shell after the production of the nuclear whorls. It is most frequently observed in specimens of *E. echinaticostum* d'Orbigny and *E. krebsii* Mörch or other species that produce a wide coil and are openly umbilicate. This is probably brought about by the change from a tightly coiled young stage to the wide and freely coiled shell of the adult.

The nuclear whorls are usually smooth, glass-like and devoid of sculpture. The post-nuclear whorls show sculpture as fine blade-like costae, usually a little more numerous on these early whorls than on the later whorls.

The operculum is generally thin, corneous, paucispiral and light brownish-yellow in color.

So far as known the eggs are laid on a string of chitinized material and covered by agglutinized sand grains. The egg mass appears as a minute string of beads. (Plate 120, fig. 1)

Pigmentation in the shell proper is rather rare in this family. In *E. rupicolum* Kurtz there is a diffused brownish pigment with darker areas indicating spiral bands of color. In a few other species the pigment may be limited to a single spiral band as in *E. uni-*

fasciatum Sowerby and rarely to spots as in the European *E. mirificum* Linné. A brilliant red species, *E. mirificum* Locard, has been figured by Filhol (La Vie au Fond des Mers, Paris 1885, plate 5). This species was obtained by both the *Travailleur* and the *Talisman* off the coast of Morocco as deep as 2075 meters (1134 fathoms). Vivid coloration of this sort is all the more remarkable as in general, mollusks living in waters of this depth are usually devoid of brilliant coloration. A complete description and excellent figures of this species are given by Locard 1897 (Expéditions Scientifiques du Travailleur et du Talisman, Mollusques 1, p. 399, pl. 18, figs. 27-30).

Wentle-trap shells have always been admired for their beauty of sculpture. A perfect specimen of *Epitonium lamellosum* is an exceedingly beautiful shell. Simple in design and perfect in its execution, it represents a form of beauty seldom exceeded by the far more elaborate sculpture in other genera and species.

Genus *Epitonium* Röding

Scala Bruguière 1792, Encyclopédie Méthodique 1, pt. 2, p. 532. [This is only a copy of J. T. Klein's work, a pre-Linnean author.]

Epitonium Röding 1798, Museum Boltenianum p. 91.

Cyclostoma Lamarck 1799, Mem. Soc. d'Hist. Nat. Paris, p. 74 (genotype, *Turbo scalaris* Linné, monotypic); non *Cyclostoma* Lamarck 1801.

Scalaria Lamarck 1801, Système des Animaux Sans Vertèbres, Paris, p. 88 (*Scalaria conica* Lamarck = *Turbo scalaris* Linné).

Scalatarius Duméril 1806, Zoologie Analytique, Paris, France, p. 164.

Aciona Leach 1815, Zoological Miscellany 2, p. 79, plate 87 (genotype, *Aciona scalaris* Linné, monotypic.)

Genotype, *Turbo scalaris* Linné, subsequent designation, Suter 1913.

The species composing the genus *Epitonium* are characterized by having the whorls either attached, or freely coiled with attachment by the costae only. Generally they possess rather strong axial costae or cords and between the costae they may be smooth or have spiral cords either strongly or weakly developed. The species may vary from widely umbilicate to imperforate. Most species are white; a limited few are colored with bands, spots or diffused pigmentation. Most species are attenuate, but a few are rather short and broad. The aperture is generally holostomatous; a few species have the lip appressed to the parietal wall. A basal ridge is developed in a few species.

Epitonium differs from *Sthenorytis* by being proportionately more attenuate and less massive in structure and in having the face of the aperture nearly parallel to the axis.

The synonymy involving this genus is exceedingly long and complicated. We give above the more important synonyms. For a more detailed account of the many names ascribed to this genus reference should be made to Dall.¹

The name *Scala* was first used by J. T. Klein, a pre-Linnean author, in 1753. In 1792 Bruguière copied the system of Klein in his Encyclopédie Méthodique 1, p. 532. However he made no additions or gave no indication as to what these various genera were (no species were given) so according to opinion 5 of the International Rules, Bruguière's use of the name *Scala* remains invalid. As a validly introduced name, though still a synonym, it can date from Herrmannsen 1848 (Indicis Generum Malacozoorum 2, p. 418) or from Mörch 1852 (Catalogus Conchyliorum Comes de Yoldi, p. 48) as these authors, by indication, associated this name with *Scalaria* Lamarck and *Epitonium* Röding.

¹ Dall, W. H. 1889, Bulletin Museum of Comparative Zoölogy 18, pp. 299-307.

The first available name is that proposed by Röding in the Museum Boltenianum where he established *Epitonium* for this group in 1798. This was a composite group containing many generic elements that are not even remotely related to *Epitonium* in its restricted use. However, the fixation of a genotype by Suter¹ limits the use of the name to the wentle-trap shells.

We include a description of *Epitonium scalare* Linné as it is the genotype of the genus *Epitonium*. In fact, it is the cornerstone of the entire family and the departure point for similarities and differences that exist between the many genera and species that compose this remarkable family of mollusks.

Epitonium (Epitonium) scalare Linné

Plate 108

Turbo scalaris Linné 1758, Systema Naturae, edition 10, p. 764.

Epitonium breve Röding 1798, Museum Boltenianum, p. 91.

Epitonium lineatum Röding 1798, Museum Boltenianum, p. 91; non *S. lineata* Say 1822.

Epitonium medium Röding 1798, Museum Boltenianum, p. 91.

Epitonium principale Röding 1798, Museum Boltenianum, p. 91.

Scalaria pretiosa Lamarck 1816, Encyclopédie Méthodique Vers 3, pl. 451, figs. 1a-b.

Under all of the above species by Röding reference is made to *Turbo scalaris* Linné.

Description. Shell reaching about 70 mm. ($2\frac{3}{4}$ inches) in length, openly umbilicate, axially costate and rather solid. Color white to pale ivory. Whorls 8 to 9, strongly convex and unattached other than by the costae. Spire extended. Aperture subcircular and holostomatous. Lip reflected, the lip being the last costa produced. Columella not defined. Umbilicus widely open, the early whorls being visible from within. Suture profound. Sculpture consisting of numerous axial costae which may be blade-like, occasionally thickened and usually somewhat recurved, at least on the last 2 whorls. There are 12 to 14 costae on the body whorl. Microscopic sculpture faint, consisting of very fine spiral threads. Nuclear whorls smooth, glass-like and opaque. Operculum not seen.

length	width	whorls	
67	42.5 mm.	7*	China
65.5	42	7*	Hongkong, China
58	32.3	7*	

* Broken, possibly a loss of two early whorls.

Types. Among the references of Linné is that of Gaultieri 1742, plate 10, fig. 22 which we here select to be the type figure. According to Hanley (1855, Ipsa Linnaei Conchylia, p. 339) Linné did not possess a specimen of this species at the time his description was written, but depended upon the figures of other authors.

Remarks. This is one of the largest species in the family Epitoniidae and certainly one of the best known. In the latter part of the eighteenth century perfect specimens were sold for as high as £40, a value which would be equal to \$500.00 today. It is still a very rare species and large examples are not easy to obtain.

Range. In distribution, it extends from southern Japan, China, the Philippine Islands, and south and east to Queensland, Australia. Specific localities such as Manila, Hong-

¹ Suter, H. 1913, Manual of the New Zealand Mollusca, Wellington, p. 319.

kong and Singapore really mean but little as these localities were markets and specimens sold at these places may have come from areas hundreds of miles away.

Subgenus *Cycloscala* Dall

Cycloscala Dall 1889, Bull. Museum Comparative Zoölogy **18**, p. 316 (no type designation); de Boury 1909, Journal de Conchyliologie **57**, p. 258.

Subgenotype, *Scala dunkeriana* Dall (= *E. echinaticostum* d'Orbigny), subsequent designation, de Boury 1909.

Shell with the body of the whorls free or unattached though connected to one another by the costae. Openly umbilicate, at least in mature examples, with the costae completely encircling the whorls. Costae scalloped or fluted, at least along the palatal side.

The single character, that of the fluted costae, alone differentiates this subgenus from all others in the genus *Epitonium*, and it is the only character other than size which separates it from *Epitonium* s. s.

Epitonium (*Cycloscala*) *echinaticostum* d'Orbigny

Plate 109, figs. 1-3

Scalaria echinaticosta d'Orbigny 1842 [in] Ramon de la Sagra, Histoire de l'Isle de Cuba, Mollusques **2**, p. 18, pl. 11, figs. 4-6 (St. Thomas [Virgin Islands]).

Scala soluta 'Dunker' Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn,¹ no. 17, p. 255 (St. Thomas and Smith Bay [Virgin Islands]); Mörch 1875, Malakozoologische Blätter **22**, p. 145; Mörch 1876, Jour. Acad. Nat. Sciences Philadelphia (2) **8**, p. 195, pl. 29, fig. 5.

Scala volubilis Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn, no. 17, p. 256; Mörch 1875, Malakozoologische Blätter **22**, p. 146; Mörch 1876, Jour. Acad. Nat. Sciences Philadelphia (2) **8**, p. 195 (St. Thomas [Virgin Islands]).

Scala blandii Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn, no. 17, p. 256 (St. Thomas [Virgin Islands]); Mörch 1875, Malakozoologische Blätter **22**, p. 145; Mörch 1876, Jour. Acad. Nat. Sciences Philadelphia (2) **8**, p. 195, pl. 29, fig. 8.

Scala (*Cycloscala*) *dunkeriana* Dall 1889, Bull. Museum Comparative Zoölogy **18**, p. 315, new name for *Scala soluta* Mörch; non A. Adams 1862; Tiberi 1863.

Scalaria inconstans de Boury 1913, Jour. de Conchyliologie **61**, p. 87, new name for *S. dunkeriana* Dall 1889; non *S. dunkeri* Nyst 1882. [This name was not necessary at all as *dunkeri* and *dunkeriana* are not homonyms.]

Description. Adult shell reaching about 9 mm. (about $\frac{3}{8}$ inch) in length, attenuated, widely umbilicate, with the whorls free and possessing numerous blade-like axial costae. Color white. Whorls 8, very strongly convex and solute. First three whorls generally narrowly coiled and attached, later whorls free and much more widely coiled; in addition, the axis of these early whorls may be set at a different angle from those that develop later. Spire extended, acute, and produced at an angle of about 30°. Aperture circular and holostomatous. Lip expanded to form a ring around the aperture, each succeeding lip becoming one of the costae. Suture and columella not defined. Sculpture consisting of axial costae which completely encircle the shell. The outer or palatal portion with from 3 to 5 small angulated lobes. Inner or parietal area smooth. Costae from 7 to 13 on the body whorl. These costae are generally very thin, lobed and may be slightly recurved

¹The present accepted spelling of this city is Köbenhavn. We adhere to the older spelling only in the references as originally cited.

backwards. Nuclear whorls two and one-half, opaque, glass-like and smooth. Operculum thin, corneous, sub-multispiral with an eccentric nucleus, light straw-yellow in color.

length	width	whorls	
9.5	4.9 mm.	8	Bermuda
7.1	4.5	6	Garden Key, Tortugas, Florida
6.7	3.3	8	Lake Worth, Florida
6.4	3.8	7	“ “ “

Types. The type specimen of *E. echinaticostum* d'Orbigny is probably in the British Museum. The holotype of *E. solutum* Dunker is in the Universitetets Zoologiske Museum, København, Denmark. Both of these specimens are from St. Thomas, Virgin Islands, the type locality. We do not know the present location of the type specimens of *volubile* Mörch and *blandii* Mörch. Both were described as coming from St. Thomas.

Remarks. This species is exceedingly variable in most of its characters. The several synonyms given above are based almost entirely on the many variants or upon immature stages in its growth. The earliest name available is that of d'Orbigny, *echinaticostum*, which was based upon a very young specimen. In his description d'Orbigny states that it was "imperforate." This is true only in part, as the first 2 or 3 whorls are usually narrowly spiral and the apertural costa, the last produced in his example, had covered the narrow umbilicus. He was dealing only with juvenile specimens. Beyond these, the whorls become free or unattached and proceed in this manner until the animal becomes adult. The coil expands and as a consequence, produces a widely open umbilicus in the adult stage. At the start of the free or solute stage of development the axis alignment

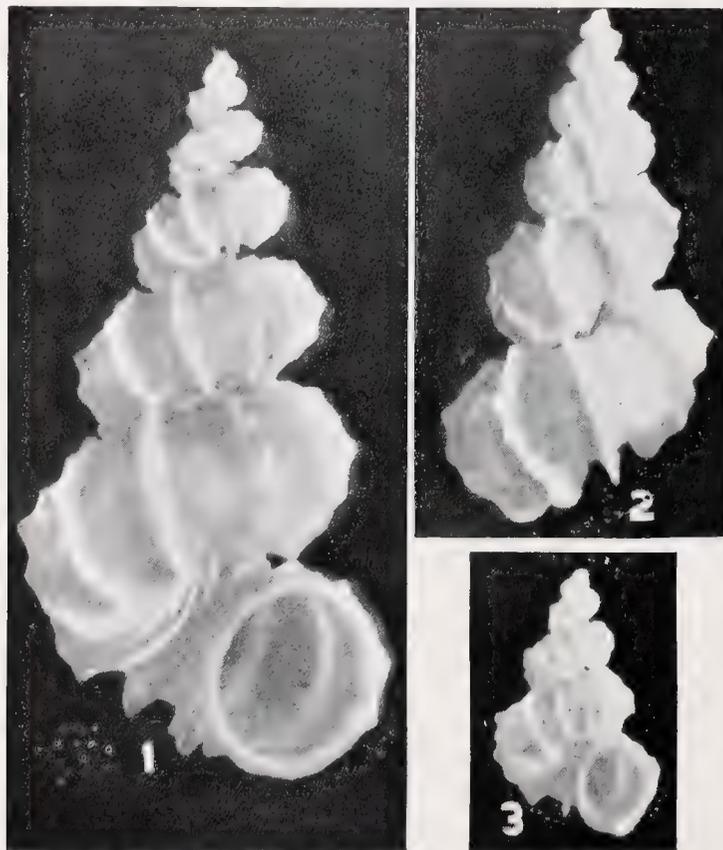


Plate 109. *Epitonium echinaticostum* d'Orbigny

Fig. 1. Boot Key Harbor, Key Vaca, Florida. Fig. 2. Caesars Creek, Biscayne Bay, Florida. Fig. 3. Holotype specimen of *Scalaria soluta* Dunker (= *Epitonium echinaticostum* d'Orbigny), St. Thomas, Virgin Islands (all about 7x).

may change, sometimes as much as 45° between the nuclear whorls and the post nuclear whorls. The degree of separation between the whorls is very variable, even in examples found in a single locality. Thus, two examples with the same number of whorls may differ as much as a millimeter in their total length, the only difference being the extent to which the whorls are separated. The costae also vary in number, possibly dependent upon the rate of growth. Specimens from deeper water usually possess fewer costae and are somewhat thinner in structure than those occurring in the low tidal areas or just below the low water line. The small wavy or fluted costae make possible a ready determination of this species, even in very young examples. It has been dredged as deep as 200 fathoms off Anguilla in the Lesser Antilles.

Range. Bermuda; Florida from Lake Worth south along the Lower Keys and north to Gulfport on the west coast; the West Indies and south to Barbados in the Lesser Antilles.

Records. FLORIDA: Lake Worth (T. McGinty); off Hollywood in 45 fathoms (L. A. Burry); *Eolis*, station 117 off Miami in 35–38 fathoms; Caesars Creek Bank in 2 fathoms (both USNM); Featherbed Bank off Ragged Key (H. Moore); Key Vaca; Duck Key; Bahía Honda Key; Bone Fish Key; Soldiers Key; Virginia Key (all J. Weber); Conch Key (T. McGinty); Tea Table Key (J. Schwengel); Boca Chica Key (E. Bates); No Name Key; *Eolis*, station 66 off Key West in 3–4 fathoms; Garden Key, Tortugas (all USNM); Fort Myers Beach (J. Weber); Boca Grande (USNM). GULFPORT (MCZ). BERMUDA: (Bermuda Government Museum); Fairyland (ANSP). BAHAMA ISLANDS: *Eolis*, station 50 off North Bimini Island in 20 fathoms; South Bight, Andros Island (both USNM); New Providence (J. Weber); Savannah Sound, Eleuthera Island (MCZ); Grand Caicos Island; East Caicos Island (both USNM). CUBA: *Tomas Barrera*, off Punta Colorado in 2–3 fathoms and off Cardenas in 1–3 fathoms (both USNM); Habana (M. Jaume); Guarda la Vaca, Banes (MCZ). HISPANIOLA: Saltrou, Dept. de l'Ouest, Haiti; Bahía de Samaná, Santo Domingo (both USNM). JAMAICA: Robins Bay, St. Mary (USNM). VIRGIN ISLANDS: St. Thomas (ANSP and Univ. Zool. Mus. København). LESSER ANTILLES: off Anguilla in 200 fathoms (B. Hubendick); Barbados (USNM).

Subgenus *Epitonium* Röding

Epitonium Röding 1798, Museum Boltenianum, p. 91.

Turbona 'Brown' Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 259; non *Turbona* Leach 1847.

Nitidiscala de Boury 1909, Jour. de Conchyliologie 57, p. 257 (subgenotype, *Scala unifasciata* Sowerby).

Eburniscala de Boury 1909, Jour. de Conchyliologie 57, p. 257 (subgenotype, *Scala venosa* Sowerby).

Acutiscala de Boury 1909, Journal de Conchyliologie 57, p. 257 (subgenotype, *S. philippinarum* Sowerby).

Anguliscala de Boury 1909, Jour. de Conchyliologie 57, p. 258 (subgenotype, *Scala angulata* Say).

Viciniscala de Boury 1909, Jour. de Conchyliologie 57, p. 258 (subgenotype, *Scala pallasii* Kiener).

Lamelliscala de Boury 1909, Journal de Conchyliologie 57, p. 258 (subgenotype, *S. fasciata* Sowerby).

Solvaclathrus Iredale 1936, Records of the Australian Museum 14, p. 299 (genotype, *Solvaclathrus jacobiscala* Iredale).

Subgenotype, *Turbo scalaris* Linné, subsequent designation, Suter 1913.

Species included in this subgenus possess blade-like or cord-like, axial costae with the interspaces smooth or with only a trace of spiral sculpture when seen under a 14x mag-

nification. The whorls may be appressed or unattached and the shell may be umbilicate or imperforate. There is no basal ridge. The aperture is usually holostomatous with the last costa forming the lip. The costae may possess angles or hooks at the whorl shoulder.

Epitonium (Epitonium) krebsii Mörch

Plates 110; 111

Scala krebsii Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 252 (St. Thomas in 60 ft.; St. Martin); Mörch 1875, Malakozologische Blätter **22**, p. 142; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 192, pl. 29, figs. 1, 2.

Scala swiftii Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 253 (St. Thomas [Virgin Islands]); Mörch 1875, Malakozologische Blätter **22**, p. 123; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 193, pl. 29, fig. 3.

Scaloria bulbulus 'Sowerby' Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 193 [a nude name included as a synonym of *S. swiftii* Mörch].

Scala contorquata Dall 1889, Bull. Museum Comparative Zoölogy **18**, p. 318, pl. 18, fig. 9 (*Blake*, station 248, off Grenada [Lesser Antilles] in 161 fathoms).

Scala electa Verrill and Bush 1900, Transactions Connecticut Academy of Science **10**, p. 536, pl. 64, fig. 11 (Bermuda Islands).

Description. Adult shell rather small, reaching about 18 mm. (about $\frac{3}{4}$ inch) in length, globose turbinate, thin but strong, narrowly to rather widely umbilicate and possessing numerous blade-like costae. Color generally a china-white; occasionally specimens occur in which there is a trace of brown to pinkish-brown more or less diffused on the body whorl. Whorls 7 to 8, strongly convex and attached by the costae only. Spire moderately extended and forming an angle of about 45° . Aperture subcircular and holostomatous. Lip reflected and slightly turned backward. Parietal area of the lip attached to the costae on the whorl above. Columella not definable. Umbilicus rather narrow to wide, exceedingly deep and but slightly covered by the reflection of the lip. Suture profound. Sculpture consisting of numerous blade-like costae which are slightly recurved

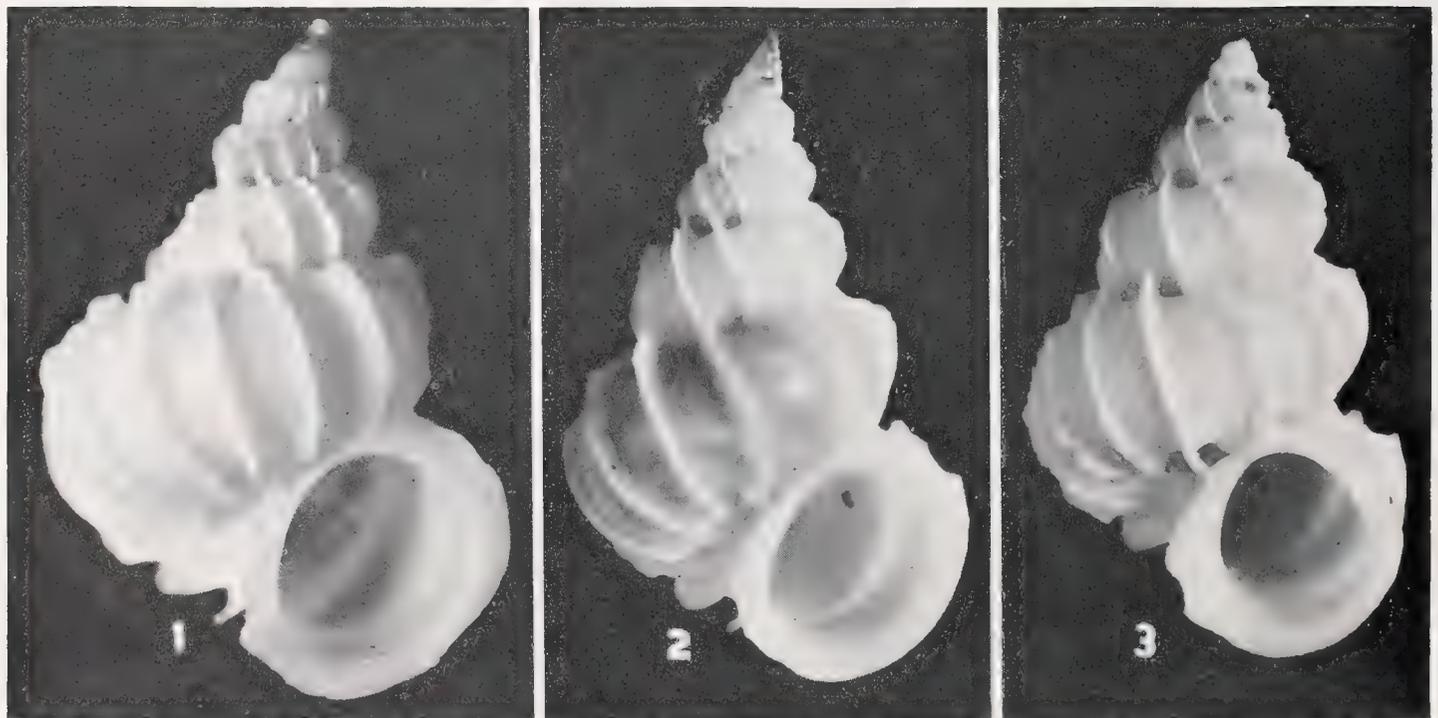


Plate 110. *Epitonium krebsii* Mörch

Fig. 1. Holotype specimen of *Scala contorquata* Dall (= *krebsii* Mörch) from off Grenada (11x).
Fig. 2. From off Key West, Florida (10x). Fig. 3. From off Destin, Florida ($3\frac{1}{2}x$).

backward and with a rather strong angulation at the shoulder of the whorl. There are 10 to 12 costae on the body whorl. The costae of one whorl are attached to the costae of the whorl above. There is no microscopic sculpture present. Nuclear whorls two, glass-like and smooth. Operculum dark mahogany-brown, paucispiral and corneous.

length	width	whorls	
18	11.5 mm.	7	off Destin, Florida
17	9	8	off Key Largo, Florida
16	9.5	7	off Tortugas, Florida

Types. The holotype of *Scala swiftii* Mörch is in the Academy of Natural Sciences Philadelphia no. 19715, from St. Thomas, Virgin Islands. We do not know the present location of the types of *Scala krebsii* Mörch from St. Thomas and St. Martin or those of *Scala electa* Verrill and Bush from Bermuda. We here limit the type locality to St. Thomas, Virgin Islands. The holotype of *Scala contorquata* Dall is in the United States National Museum no. 106913 from off Grenada, Lesser Antilles, *Blake*, station 248, in 161 fathoms.

Remarks. *Epitonium swiftii* Mörch is but a somewhat worn and narrowly umbilicate specimen of *E. krebsii* Mörch. Mörch based this name upon a unique example contained originally in the collection of Robert Swift which is now in the Academy of Natural Sciences, Philadelphia. *Epitonium contorquata* Dall is only a young specimen of *krebsii* Mörch. This species is easily recognized by its rather stout form and its open and deep umbilicus. The whorls are well separated though attached by the costae. The surface of

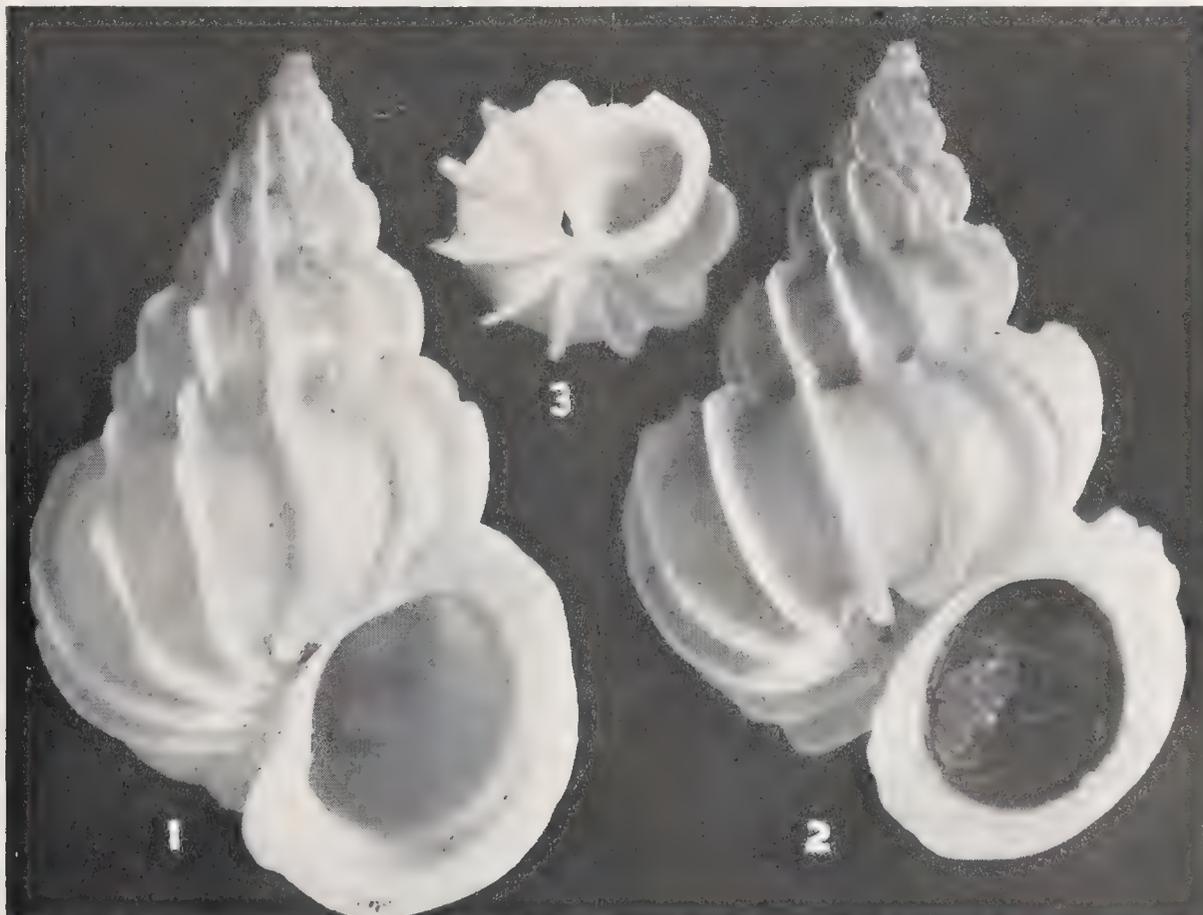


Plate 111. *Epitonium krebsii* Mörch

Fig. 1. Holotype specimens of *Scala swiftii* (= *krebsii* Mörch), St. Thomas, Virgin Islands (7x). Fig. 2. From off Sand Key, Florida (8x). Fig. 3. Basal view of specimen from Marathorn, Florida ($3\frac{1}{2}$ x).

the shell between the costae is highly polished. The angulations on the costae are small, though well developed, but these may be broken off on worn specimens.

Geographically the species though rare appears to be rather widely distributed, appearing as it does in the northern Gulf of Mexico and south to at least as far as the Barbados. The numerous records which we have given from the Lower Florida Keys are due mainly to the extensive dredging in this region by Leo A. Burry and J. B. Henderson. *Epitonium krebsii* lives from a little below the low water line to depths of 160 fathoms in rather fine coral sand.

Range. South Florida, the Gulf of Mexico, Bermuda and south through the West Indies to the Lesser Antilles.

Records. FLORIDA: off Palm Beach in 50–70 fathoms; off Lake Worth in 70–80 fathoms; Boynton Beach (all T. McGinty); off Hillsboro Light in 100 fathoms; off Pompano Beach in 60–70 fathoms; off Fort Lauderdale in 60 fathoms; off Hollywood in 45 fathoms (all L. A. Burry); *Eolis*, station 131, off Fowey Light in 25–60 fathoms; *Eolis*, station 77, off Miami in 8 fathoms; *Eolis*, station 69, off Miami in 38 fathoms (all USNM); off Molasses Reef, Key Largo in 75 fathoms; off The Elbow, Key Largo in 66–75 fathoms; off American Shoals in 40–100 fathoms; off Sombrero Light in 90–150 fathoms; off Looe Key in 100 fathoms (all L. A. Burry); *Eolis*, station 160, off Sand Key in 62 fathoms; *Eolis*, station 30, off Key West in 7 fathoms; *Eolis*, station 43, off Key West in 63 fathoms; off Tortugas in 16–35 fathoms; off Cape San Blas in 20 fathoms (all USNM); off Destin in 14 fathoms (T. McGinty). BERMUDA: (USNM). BAHAMA ISLANDS: *Eolis*, station 50, North Bimini Island, Bimini Islands in 20 fathoms; Rum Cay (both USNM). CUBA: off Habana (C. G. Aguayo). VIRGIN ISLANDS: St. Thomas (ANSP). JAMAICA: (MCZ). LESSER ANTILLES: Anguilla (B. Hubendick); off Falmouth, Antigua; *Blake*, station 248, off Grenada in 161 fathoms; off Pelican Island, Barbados in 100 fathoms (all USNM).

***Epitonium (Epitonium) occidentale* Nyst**

Plate 112

Scalaria tenuis Sowerby 1844, Thesaurus Conchyliorum **1**, pt. 4, p. 87, pl. 32, figs. 6–7 (West Indies); non *S. tenuis* Gray.

Scalaria occidentalis Nyst 1871, Annales Société Malacologique de Belgique **6**, p. 124; new name for *S. tenuis* Sowerby, non *S. tenuis* Gray.

Scala micromphala Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 258 (Vieques Island [Puerto Rico]), Riise collector; Mörch 1875, Malakozologische Blätter **22**, p. 147; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 197.

Scala occidentalis var. *aurita* Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 257; Mörch 1875, Malakozologische Blätter **22**, p. 146; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 196 (St. Thomas, Virgin Islands, A. H. Riise collector); non *S. aurita* Sowerby 1844.

Description. Adult shell reaching about 25 mm. (1 inch) in length, rather light in structure, imperforate or very nearly so and possessing numerous rather low, blade-like costae. Color white with the surface somewhat shining. Whorls up to 10, strongly convex, slightly separated and attached by the costae. Spire extended and forming an angle of 35°. Aperture subcircular and holostomatous. Outer lip reflected and thin. Parietal area appressed and attached to the costae. Columella not definable. Suture profound

owing to the unattached whorls. Sculpture consisting of numerous thin and occasionally slightly reflected costae which are generally acutely angled on the whorl shoulder. Sometimes, especially on young specimens, the shoulder angles of the costae are pointed enough to be called spines. Here the shoulder of the whorl is flattened so that each whorl above is decidedly inset. On the early whorls the costae are far more numerous, becoming less so as the shell advances toward maturity. There are 12 to 15 costae on the body whorl. There is no indication of spiral sculpture. Nuclear whorls smooth, glass-like and white. Operculum paucispiral, thin and corneous.

length	width	whorls	
24.3	10.2 mm.	10	Tortugas, Florida
15	6.4	10	St. Thomas, Virgin Islands
13	5.8	10	Bear Cut, Biscayne Bay, Florida

Types. The type of this species is probably in the British Museum under the name of *Scalaria tenuis* Sowerby. The holotype of *S. micromphala* Mörch is in the Universitetets Zoologiske Museum, København, Denmark. It is a young specimen from Vieques Island, Puerto Rico and was collected by Riise. We here limit the type locality to St. Thomas, Virgin Islands from which we have seen many fine examples of this species.

Remarks. Perhaps the most distinctive features of this species are the flattened whorl shoulder and the usually fine pointed shoulder angles on the costae. From *E. krebsii* with which this species may be confused it differs in being proportionately narrower and in being imperforate, or nearly so, and in having the whorls less solute. From *E. foliaceicostum* it differs by being proportionately wider, having far more globose whorls and much lower and more numerous costae.

This species is generally found below low water line though occasional specimens are

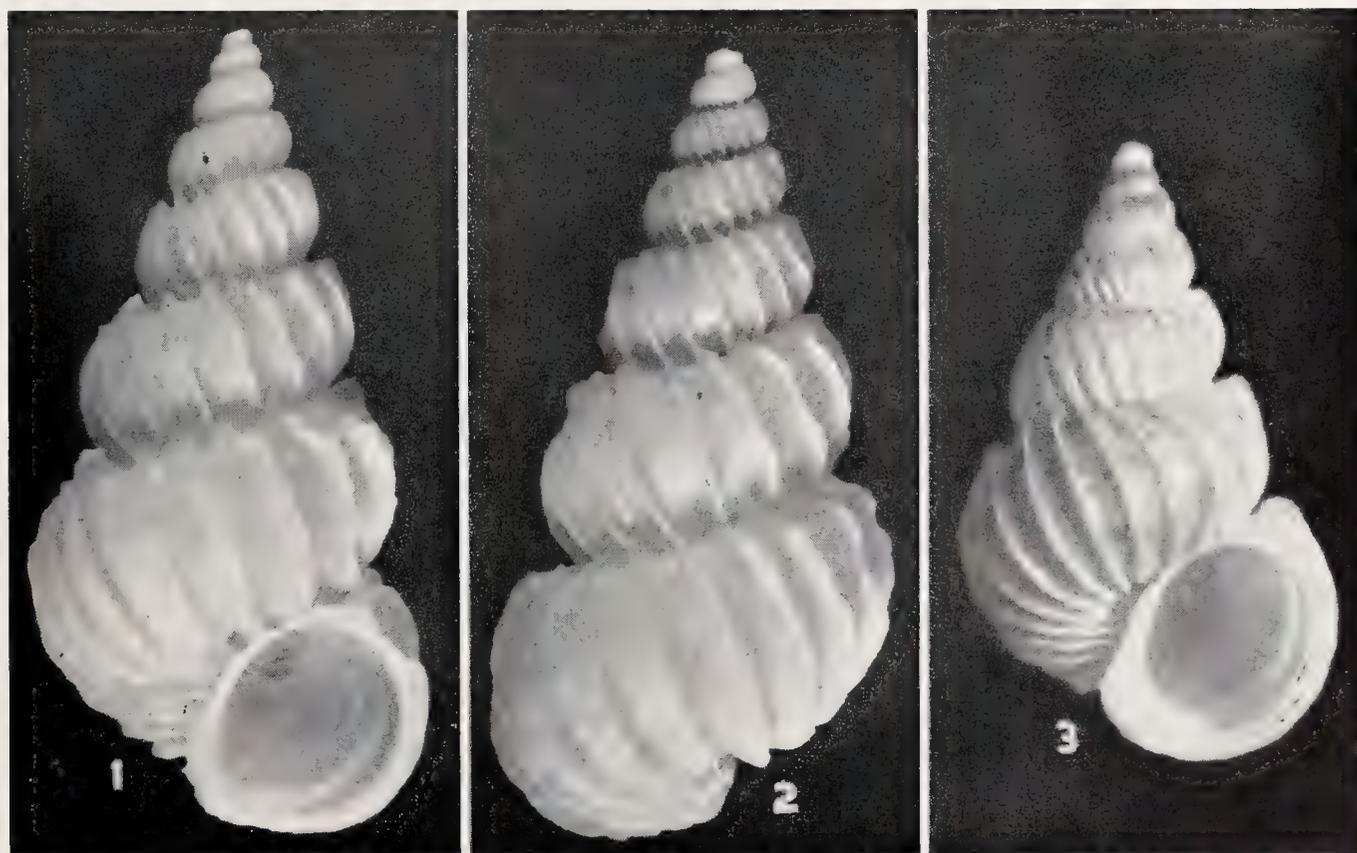


Plate 112. *Epitonium occidentale* Nyst

Figs. 1-2. St. Thomas, Virgin Islands (about 7x). Fig. 3. Holotype of *Scala micromphala* Mörch (= *E. occidentale* Nyst) Vieques Island (10x).

washed up on the shore after storms. Mr. L. A. Burry has dredged it off Sombrero Light in the Lower Florida Keys in about 150 fathoms.

The largest example which we have seen measured a little over 24 mm., though such large specimens are apparently exceedingly rare. Most of the adult specimens that we have studied measured about 12 to 15 mm. in length.

Range. Southern Florida from Miami to Tortugas, Bermuda and south through the West Indies to Barbados, Lesser Antilles.

Records. FLORIDA: Bear Cut, Biscayne Bay (H. Moore); off Sombrero Light in 150 fathoms (L. A. Burry); *Eolis*, station 32, off Sand Key in 61 fathoms (USNM); Key West; Tortugas (both Charleston Mus.). BERMUDA: (USNM). BAHAMAS: Great Abaco (USNM). CUBA: La Chorrera, Habana (M. Jaume); Cape Cajon, Pinar del Rio (USNM). HISPANIOLA: Bahía de Samaná, Santo Domingo (USNM); Saltrou, Dept. de l'Ouest; Port Salut, Dept. du Sud; Biziton, Dept. de l'Ouest; Baie Anglaise, near Aquin, Dept. du Sud; Les Cayes, Dept. du Sud, all Haiti (all USNM); Miragoane, Haiti (MCZ). PUERTO RICO: Vieques Island (Univ. Zool. Mus. Köbenhavn, Denmark). JAMAICA: Port Royal; Kingston (both USNM). VIRGIN ISLANDS: St. Thomas (MCZ; USNM; ANSP); Little Camanoe Island, Tortola (M. Dewey). BARBADOS: (MCZ; USNM).

Epitonium (Epitonium) albidum d'Orbigny

Plates 113; 114

Scalaria albida d'Orbigny 1842 [in] Sagra, Histoire Physique, Politique et Naturelle de l'Île de Cuba **2**, Mollusques, p. 17, pl. 10, figs. 24, 25 (Cuba, Auber collector).

Scalaria fragilis 'Hanley' Sowerby 1844, Thesaurus Conchyliorum **1**, pt. 4, p. 88, pl. 33, figs. 64-66 (St. Vincent [Lesser Antilles] Cuming Collection); non *S. fragilis* Hanley 1840.

Scalaria ligata C. B. Adams 1850, Contributions to Conchology no. 4, p. 67 (Jamaica); Clench and Turner 1950, Occasional Papers on Mollusks **1**, p. 304.

Scala quindecimcostata Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 258 (St. Thomas [Virgin Islands]); Mörch 1875, Malakozoologische Blätter **22**, p. 147; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 197.

Scala gradatella Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 259 (St. Thomas [Virgin Islands] H. Krebs collector); Mörch 1875, Malakozoologische Blätter **22**, p. 148; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 198, pl. 29, fig. 11.

Description. Adult shell reaching about 21.5 mm. (about $\frac{3}{4}$ inch) in length, rather light in structure, imperforate and possessing numerous blade-like costae. Color generally a shiny white with occasional specimens having a faint subsutural band of yellowish-brown. Whorls 9 to 11, moderately convex and attached by the costae only, particularly on the later whorls. Spire extended and forming an angle of 27° . Aperture sub-circular. Outer lip expanded and reflected, parietal area narrow, somewhat thickened and held away from the body whorl by the costae. In older specimens the costae fuse, forming a much thickened area at this point. Columella not readily definable as the aperture is nearly holostomatous. Suture very deep on the early whorls, profound on the later whorls. Sculpture consisting of numerous blade-like to narrow ridge-like costae which are rather low and generally fused with the costae on the whorl above. There are 12 to 14 costae on the body whorl which are not angled at the whorl shoulder. Micro-

scopic sculpture when present consisting of exceedingly fine spiral threads. There is no basal ridge. Operculum thin, corneous and paucispiral. Nuclear whorls smooth and glass-like and light amber in color.

length	width	whorls	
21.5	9 mm.	11	St. Thomas, Virgin Islands
16.8	7.5	10	Jamaica
17.2	7.6	10	Bathsheba, Barbados

Types. The type of *Scalaria albida* d'Orbigny is in the British Museum according to Gray 1854, p. 18, as is also the type of *S. fragilis* 'Hanley' Sowerby. The type of *S. ligata* C.B. Adams has been lost. The holotype of *S. quindecimcostata* Mörch is in the Universitetets Zoologiske Museum, København, Denmark. The whereabouts of the type of *S. gradatella* Mörch is unknown. We here limit the type locality to Habana, Cuba.

Remarks. This species appears to be widely distributed though not at all common. It has an extended range in the Western Atlantic occurring as it does from Bermuda and southern Florida south to northern Argentina. In addition, it is found in the Eastern Atlantic and the Atlantic Islands of St. Helena and the Cape Verde Islands.

This species may very well be the "*Scala eburnea*" Potiez and Michaud but this latter species is poorly described and figured so that no certainty can ever be given to it.

We have not seen the type of *E. gradatella*. This species was based upon a unique specimen collected by Henry Krebs on the island of St. Thomas in the Virgin Islands. In our opinion it is a rather narrow form of the variable *E. albidum*.

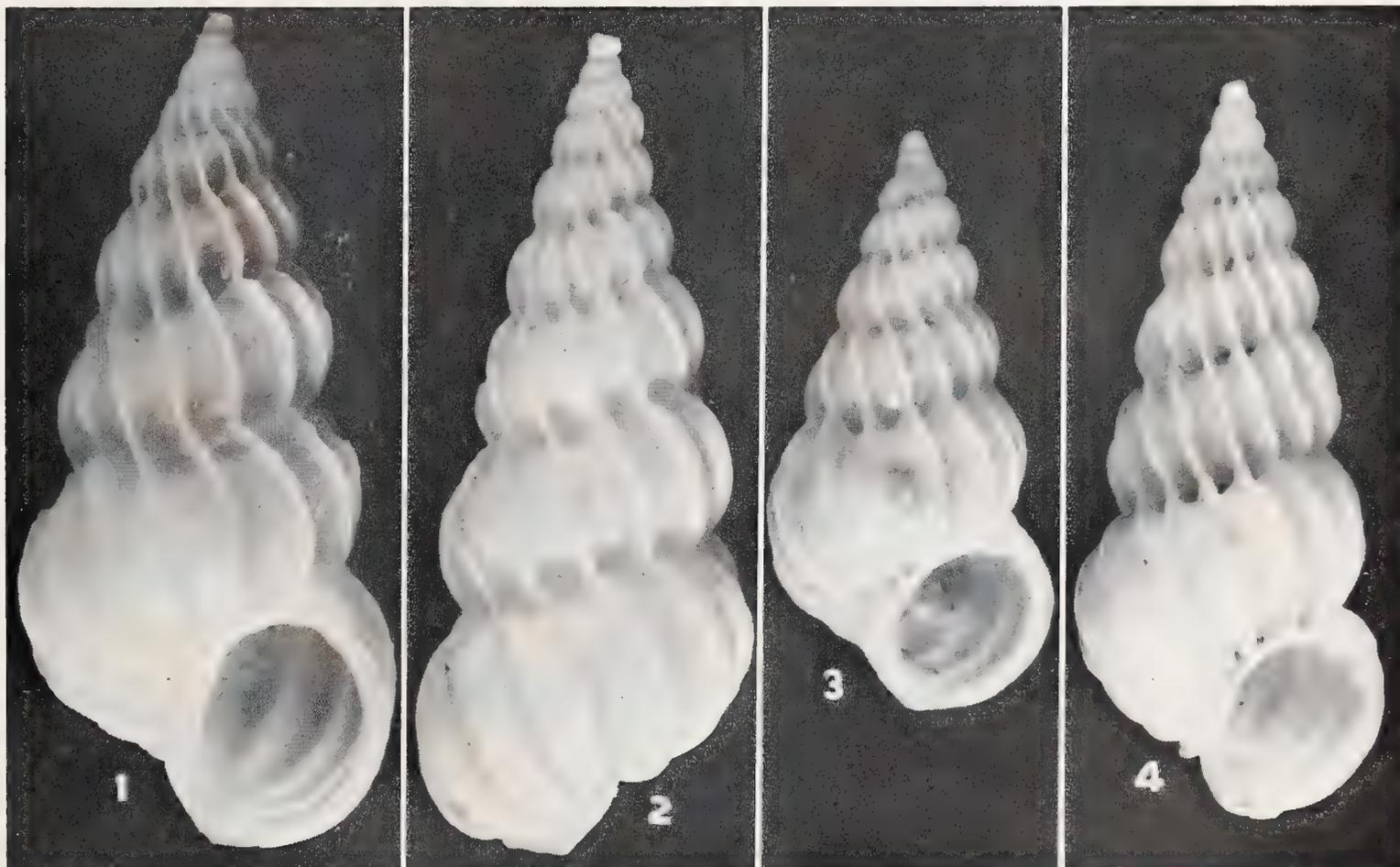


Plate 113. *Epitonium albidum* d'Orbigny

Figs. 1-3. Boynton Beach, Florida. Fig. 1. Form with brownish-yellow subsutural band ($10\frac{1}{2}x$). Fig. 2. ($8x$). Fig. 3. Young to show nuclear whorls ($15x$). Fig. 4. Holotype of *Scalaria quindecimcostata* Mörch (= *E. albidum* d'Orbigny), St. Thomas, Virgin Islands ($10\frac{1}{2}x$).

Epitonium albidum d'Orbigny may be considered the basic pattern in the subgenus *Epitonium* s.s. It is less elaborately developed than the other members of this group and as a consequence worn specimens of other closely related forms often resemble this species.

This species appears to be fairly close in its relationship to *venosum* Sowerby and *georgettina* Kiener. From *venosum* it differs by having the costae usually thin and erect and by its somewhat larger size. From *georgettina* it differs in being smaller and having the costae usually blade-like and not thickened as they are in this latter species.

This species is rather difficult to define though it appears to us to be distinct. The shell is rather thin, the costae are blade-like, low and show no tendency to develop angles on the whorl shoulder. Occasional specimens develop a yellowish-brown sub-sutural band. These specimens look superficially like *E. unifasciatum* Sowerby. They differ by having more numerous and thin costae whereas in *unifasciatum* the costae are not only fewer but they are somewhat thickened. In addition, the whorls of *unifasciatum* are attached while in *albidum* the later whorls are solute, being attached by the costae only, and are more globose. Worn specimens of *E. occidentale* may be confused with *E. albidum*.

Range. WESTERN ATLANTIC: Southern Florida, Bermuda, the West Indies and south to northern Argentina. EASTERN ATLANTIC: The west coast of Africa, probably in the latitude of the Cape Verde Islands and south to the Gold Coast.

Records. FLORIDA: Hillsboro Light in 65 fathoms (L. A. Burry); Boynton Beach; Lake Worth; Virginia Key (all T. McGinty); Tortugas (USNM). BERMUDA: (Bermuda Government Museum; MCZ). BAHAMA ISLANDS: West End, Grand Bahama

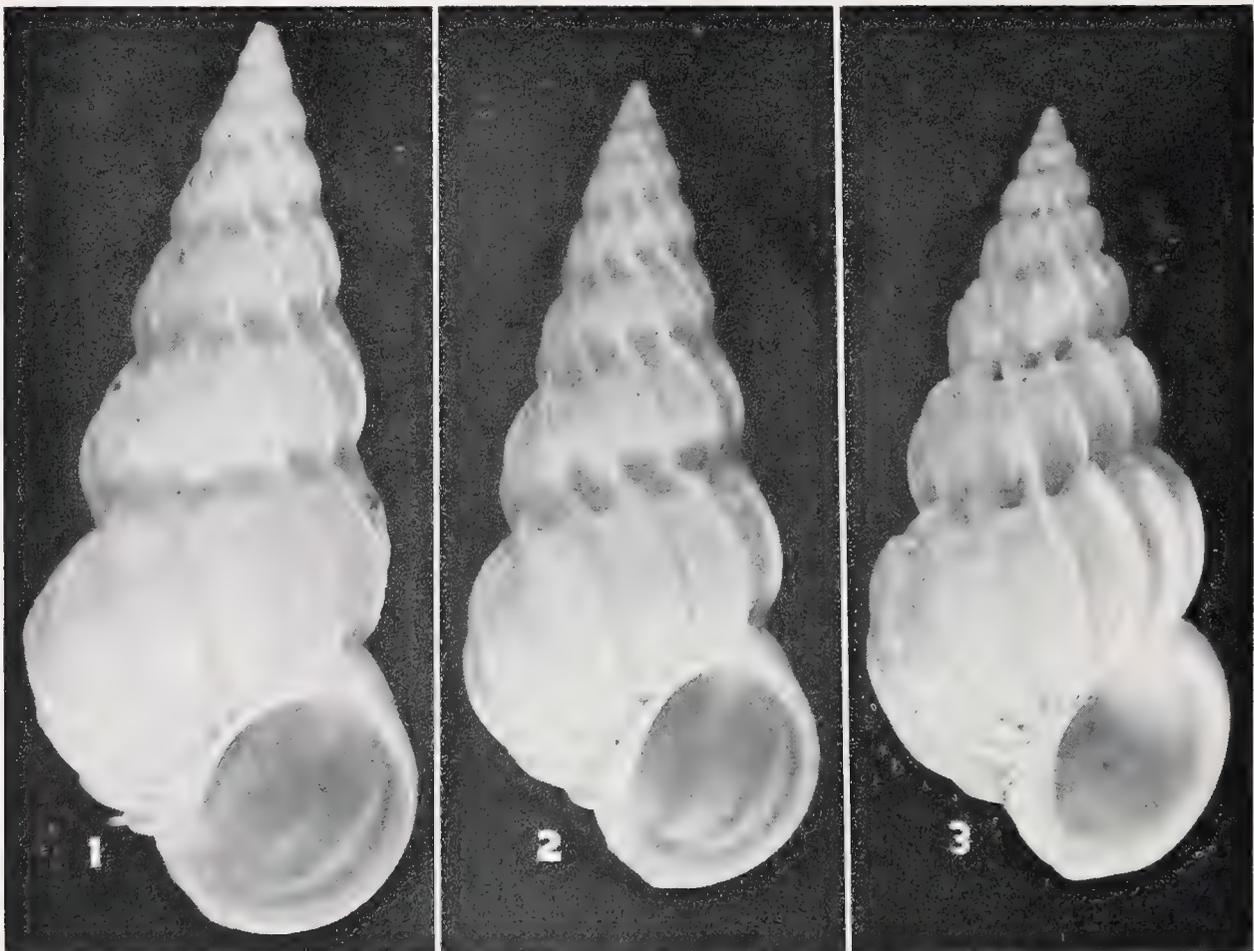


Plate 114. *Epitonium albidum* d'Orbigny

Fig. 1. From off Bathsheba, Barbados (6x). Fig. 2. La Chorrera, Habana, Cuba ($8\frac{1}{2}x$).
Fig. 3. Bahía San Blas, Buenos Aires, Argentina ($6\frac{1}{2}x$).

(MCZ); Great Abaco (USNM); New Providence (J. Weber); Arhurstown, Cat Island; Matthewtown, Great Inagua (both MCZ). CUBA: Cabo San Antonio (USNM); La Chorrera, Habana (C. G. Aguayo); Vedado, Habana; Boca Rio Quibu, Habana (both M. Jaume); Caibarién (P. J. Bermúdez). HISPANIOLA: Aquin, Dept. du Sud; Bariadele, Dept. du Sud; Les Cayes, Dept. du Sud; Saltrou, Dept. de l'Ouest; Les Trois Pavillons, Dept. du Nord-Ouest, all Haiti (all USNM). JAMAICA: Montego Bay (Charleston Museum); Port Royal; Runaway Bay; Port Morant; Robins Bay, St. Mary (all USNM). VIRGIN ISLANDS: Virgin Gorda (USNM); St. Thomas (USNM; ANSP). LESSER ANTILLES: Guadeloupe (MCZ); Barbados (MCZ; USNM). MEXICO: Vera Cruz (USNM; ANSP). BRASIL: São Sebastião, São Paulo (USNM). URUGUAY: Punta Coronilla (USNM). ARGENTINA: Bahía San Blas, Buenos Aires (A. Carcelles). EASTERN ATLANTIC: St. Helena (M. Jaume); São Vicente, Cape Verde Islands (Univ. of Michigan). GOLD COAST: Accra (MCZ). LIBERIA: Monrovia (MCZ).

Epitonium (Epitonium) venosum Sowerby

Plate 115; Plate 116, figs. 3-5

Scalaria venosa Sowerby April 1844, Thesaurus Conchyliorum **1**, p. 89, pl. 33, figs. 72, 73 (the West Indies); Sowerby July 1844, Proc. Zoological Society London, p. 13 (Nevis [Lesser Antilles]).

Scalaria modesta C. B. Adams 1845, Proc. Boston Society Natural History **2**, p. 7 (Jamaica); Jay 1850, A Catalogue of the Shells Contained in the Collection of J. C. Jay, Fourth edition, New York, p. 301; Clench and Turner 1950, Occasional Papers on Mollusks **1**, no. 15, p. 309, pl. 49, fig. 6.

Scala erectispina Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 258 (St. Thomas, A. H. Riise, collector); Mörch 1875, Malakozologische Blätter **22**, p. 146; Mörch 1876, Proceedings Academy Natural Sciences Philadelphia (2) **8**, p. 196.

Description. Adult shell reaching about 15 mm. ($\frac{5}{8}$ of an inch) in length, rather strong in structure, imperforate and possessing numerous blade-like costae. Color grayish-white with the costae china-white. Whorls 9 to 10, moderately convex and attached by the cos-



Plate 115. *Epitonium venosum* Sowerby

Holotype of *Scalaria erectispina* Mörch (= *E. venosum* Sowerby)
St. Thomas, Virgin Islands. A very young specimen (16x).

tae only. Spire extended and forming an angle of about 22° . Aperture subcircular. Outer lip expanded and reflected. Parietal area somewhat thickened and held away from the body whorl by the costae. Columella not readily definable as the aperture is nearly holostomatous. Suture profound. Sculpture consisting of numerous blade-like costae which are recurved backward, particularly on the earlier whorls. There are 11–13 costae on the body whorl. There is a slight to moderate angulation of the costae at the whorl shoulder and the costae of one whorl impinge on those of the whorl above. Microscopic sculpture, when present, consisting of exceedingly fine axial and spiral threads. These are generally very faint and can only be seen under a magnification of 10x or more. There is no basal ridge. Operculum unknown.

length	width	whorls	
13.7	4.8 mm.	$8\frac{1}{2}$	Puerto Cabello, Venezuela
12	4.5	8	“ “ “ “
10	4.2	$7\frac{1}{2}$	Jamaica

Types. The holotype of *Epitonium venosum* Sowerby is probably in the British Museum. The lectotype of *E. modestum* C. B. Adams from Jamaica is in the Museum of Comparative Zoölogy no. 186168. The type locality is the island of Nevis in the Lesser Antilles. The type of *Scala erectispina* Mörch is in the Universitetets Zoologiske Museum, Köbenhavn, Denmark from St. Thomas, Virgin Islands.

Remarks. This species is mainly characterized by having the axial costae reflected backward and in many cases the edge is bent downward giving the impression of thickness to the costae; occasionally succeeding costae nearly touch one another particularly on the earlier whorls. At the whorl shoulder the costae are built forward to a greater extent forming a definite angle at that point.

Dall was completely confused regarding this species as it appeared in the *Blake Report* (1889, *Bulletin Museum Comparative Zoölogy* 18, p. 311). He believed that he

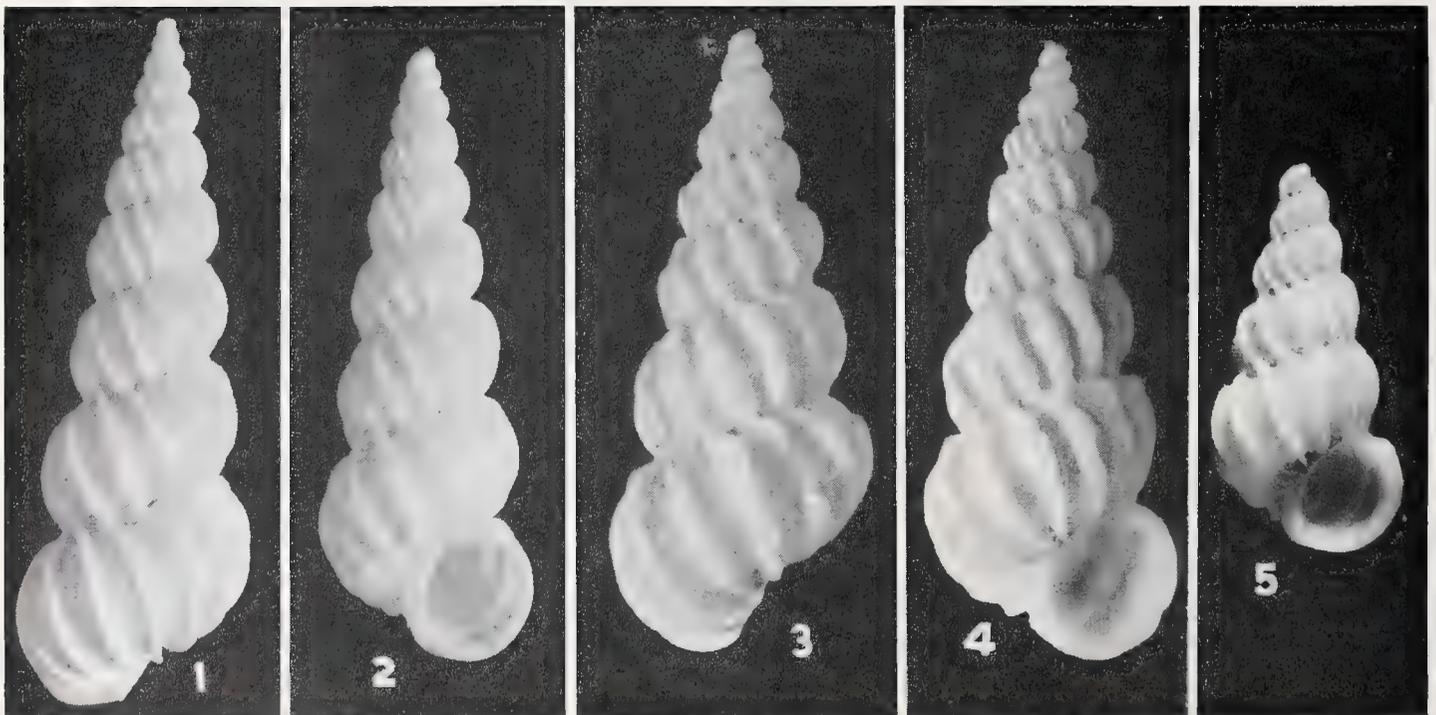


Plate 116

Epitonium georgettina Kiener. Fig. 1. Mar de Ojo, Buenos Aires, Argentina. Fig. 2. Puerto San Antonio, Rio Negro, Argentina (both $2\frac{1}{2}x$). *Epitonium venosum* Sowerby. Figs. 3–4. Puerto Cabello, Venezuela (both $5x$). Fig. 5. Holotype specimen of *Scalaria modesta* C. B. Adams (= *Epitonium venosum* Sowerby) Jamaica (about $8x$).

had specimens from the Adams type series, but the specimens which Dall had and which we have also examined are totally different from the types of Adams and from Adams' original description. Dall's specimens are *E. undecimcostatum* Mörch and the original type specimens of *E. modestum* C. B. Adams are typical *E. venosum* Sowerby.

In relationship *E. venosum* appears to be nearest to *E. albidum*, differing by being on the average a little smaller in size and by possessing large and recurved costae.

Range. Isle of Pines, Jamaica and the Virgin Islands south to Venezuela.

Records. ISLE OF PINES: (C. G. Aguayo). JAMAICA: (MCZ). VIRGIN ISLANDS: St. Thomas (Univ. Zool. Mus. København, Denmark); St. Croix (ANSP). LESSER ANTILLES: Nevis (type locality); Barbados (MCZ; USNM). PANAMA: Colón (ANSP). VENEZUELA: Puerto Cabello (MCZ).

Epitonium (Epitonium) georgettina Kiener

Plate 116, figs. 1, 2; Plate 117, fig. 1

Scalaria georgettina Kiener 1839, *Iconographie des Coquilles Vivantes* 10, p. 14, pl. 5, fig. 15 (Océan Atlantique).

Scalaria elegans d'Orbigny 1840, *Voyage dans l'Amérique Meridionale* 5, Mollusca, pt. 3, p. 389, pl. 54, figs. 1-3 (Patagonia, Baie de San Blas; Baie de Blanche and l'Embouchure de Rio Negro).

Scalaria d'orbignyi Nyst 1871, *Annales de la Société Malacologique de Belgique* 6, p. 124 (new name for *S. elegans* d'Orbigny; non Risso 1826; non Lea 1841).

Description. Adult shell reaching about 33 mm. (about 1¼ inches) in length, rather light in structure, imperforate or very slightly rimate and possessing numerous and rather low cord-like costae. Color white with the surface usually somewhat shining. Whorls up to 10½, strongly convex and slightly separated, being attached by the costae only. Spire extended forming an angle of 20°. Aperture subcircular and holostomatous. Outer lip

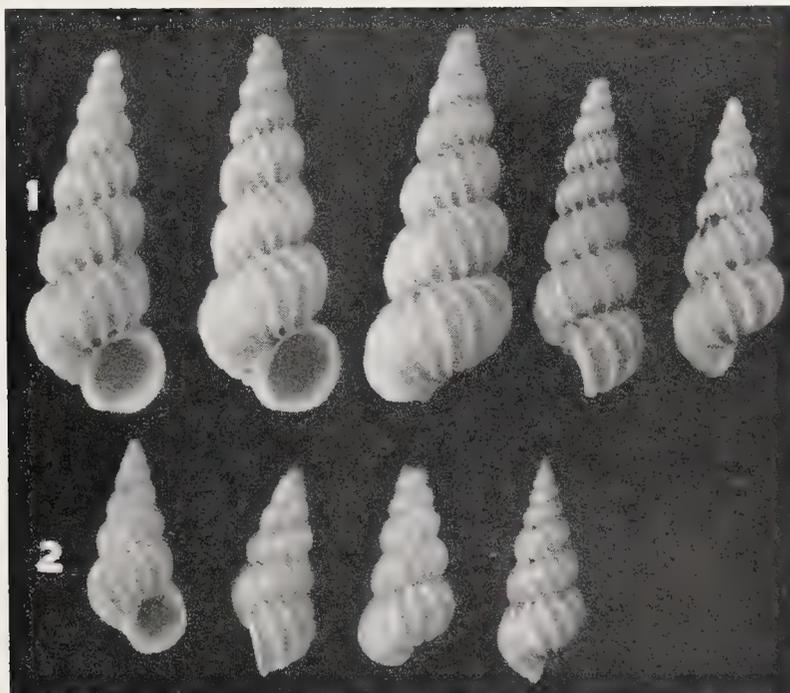


Plate 117

Fig. 1. (Upper row) *Epitonium georgettina* Kiener.

Fig. 2. (Lower row) *Epitonium humphreysii* Kiener.

These are the probable types of Kiener for these two species. Photographs by G. Mermod, Natural History Museum, Geneva, Switzerland.

slightly reflected, parietal area usually in the form of a slight shield which overlays the costae. Columella not definable as the aperture is holostomatous. Suture profound owing to the unattached whorls. Sculpture consisting of numerous, rather low, narrow, slightly reflected costae. This reflection adds to their apparent thickness. There are from 12 to 15 costae on the body whorl. There is no indication of spiral sculpture. Nuclear whorls $2\frac{1}{2}$, exceedingly small, glass-like and smooth. Operculum unknown.

length	width	whorls	
33	10.4 mm.	$10\frac{1}{2}$	Mar del Plata, Argentina
32	10.8	10	Puerto Madryn, Chubut, Argentina
31	10	$10\frac{1}{2}$	Rio Grande do Sul, Brasil

Types. The original specimens of *E. georgettina* Kiener were in the collection of Prince Massena, which was later acquired by Delessert, and are now in the Museum of Natural History at Geneva, Switzerland¹. According to Gray the types of *E. elegans* d'Orbigny are in the British Museum. We here limit the type locality to Bahía San Blas, Buenos Aires, Argentina which is one of the several localities listed by d'Orbigny.

Remarks. This species has been known mainly as *Epitonium d'orbigny* Nyst. Kiener's name, *E. georgettina*, for this species has been unrecognized mainly owing to the indefinite locality given (Océan Atlantique) in the original description. However, the excellent figure in Kiener leaves no doubt in our minds as to its identity.

This is one of the largest species of *Epitonium* in the Western Atlantic. It exists from low water to depths at least as deep as 55 fathoms. In relationship it appears to be nearest to *E. tollini* Bartsch. As in other members in this subgenus, there is a fair amount of variation in the proportion of length to width of the shell and in the number of costae.

Range. From southern Brasil south to the province of Chubut, Argentina.

Records. BRASIL: Rio Grande do Sul (USNM). URUGUAY: La Coronilla; off Cabo Polonio (S. Lat. $34^{\circ}40'$; W. Long. $52^{\circ}56'$ in 55 fathoms); Cabo Santa Maria (all Museo Argentino de Ciencias Naturales); Punta del Este, Maldonado (Univ. Michigan; ANSP; USNM). ARGENTINA: Mar del Ajo, Buenos Aires (M. Birabén); Monte Hermosa, Buenos Aires (USNM); Ostende; Mar del Plata; 20 miles south of Mar del Plata in 33 fathoms; Miramar; Bahía San Blas; Puerto San Antonio, Gulf of San Matias, all Buenos Aires (all Museo Argentino de Ciencias Naturales); off Punta Bermeja (S. Lat. $41^{\circ}17'$; W. Long. $63^{\circ}00'$) in 17 fathoms; off Promontorio Balen (S. Lat. $41^{\circ}15'$; W. Long. $63^{\circ}50'$) in 25 fathoms; off mouth of Río Negro (S. Lat. $41^{\circ}40'$; W. Long. $63^{\circ}13'$) in 30 fathoms (all *Hassler* voyage MCZ); Puerto Madryn, Golfo Nuevo, Chubut; Bahía Vera, Chubut (S. Lat. $44^{\circ}16'$; W. Long. $65^{\circ}12'$) in 27 fathoms (both Museo Argentino de Ciencias Naturales).

Epitonium (Epitonium) tollini Bartsch

Plate 118, figs. 1-4

Epitonium tollini 'Dall' Bartsch 1938, *Nautilus* 52, p. 34, pl. 1, fig. 7 (Sanibel Island, Florida, W. N. Souther, collector); Perry 1940, *Marine Shells of the Southwest Coast of Florida*, p. 107, pl. 22, fig. 148.

¹Through the kindness of Dr. G. Mermod of the Geneva Museum we have received photographs of the supposed types of *georgettina* (Plate 117, fig. 1).

Epitonium tolleni [sic] Dall, M. Smith 1941, East Coast Marine Shells, Ann Arbor, Michigan, p. 85 [error for *tollini* Bartsch].

Description. Adult shell reaching about 14 mm. (about $\frac{1}{2}$ inch) in length, rather light in structure, imperforate and possessing numerous blade-like costae. Color a china-white with the apical whorls on live specimens a very faint amber-brown. Whorls 9 to 10, strongly convex and appressed or slightly separated, being attached by the costae only. Spire extended and produced at an angle of 21° to 23° . Aperture subcircular. Outer lip generally thickened and reflected. Palatal lip fairly narrow and appressed tightly to the parietal wall. Columella short and arched. Suture profound. Sculpture consisting of numerous and generally blade-like costae which range in number from 11 to 16 on the body whorl. These costae are irregular in spacing and are not always produced so as to line up with the costae on the whorl above. These costae are not angled at the whorl shoulder, they are even in height throughout their length, generally thin and blade-like with an occasional thickened costa, especially on the body whorl of adult specimens. There appears to be no microscopic sculpture other than exceedingly fine growth lines. Operculum paucispiral, corneous and yellowish-brown in color.

length	width	whorls	
13.9	4.9 mm.	9	Sanibel Island, Florida
11.5	3.8	10	“ “ “
8.3	3	9	Holotype

Types. Holotype, United States National Museum no. 188931 and paratypes, Museum of Comparative Zoölogy nos. 16892, 132757 and 137356 from Sanibel Island, Florida, collected by W. N. Souther and W. F. Clapp.

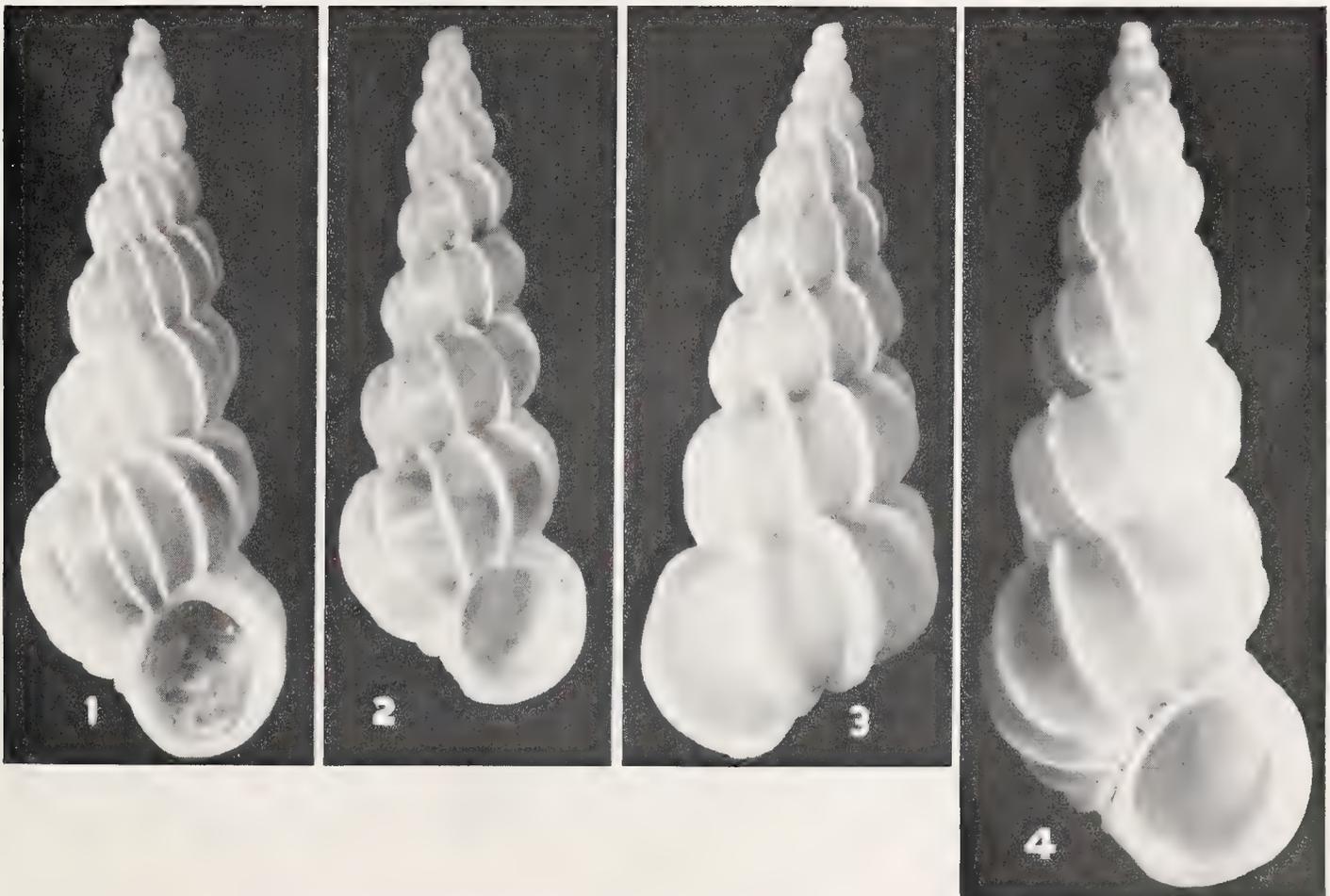


Plate 118. *Epitonium tolleni* Bartsch

Figs. 1-3. From Sanibel Island, Florida (about $7\frac{1}{2}x$). Fig. 4. Holotype from Sanibel Island, Florida ($11\frac{1}{2}x$).

Remarks. *Epitonium tollini* is nearest in its relationships to *E. georgettina* Kiener of Uruguay and Argentina, differing, however, by being much smaller. The largest specimens of *tollini* reach only 14 mm. in length while specimens of *georgettina* reach 33 mm. in length. In addition, the costae on the later whorls of *georgettina* are more widely spaced and somewhat recurved. From *E. humphreysii*, with which *tollini* is often confused, it differs in being a little narrower in proportion to its length, having the whorls globose, and most important by lacking any trace of angulation on the costae. In addition, the costae of *tollini* are usually blade-like and lower and do not always line up with the costae on the whorl above.

This species is only known from the west coast of Florida and there it is limited in its range, so far as is now known, from Marco Island north to Gasparilla Island, though it very probably will be found beyond those limits. So far as we can determine, this species lives off the outer beaches below the low water line.

Range. West Florida from Marco Island north to Gasparilla Island.

Records. FLORIDA: Sanibel Island (ANSP; USNM; MCZ); Boca Grande, Gasparilla Island (ANSP); Hickory Island, Hickory Pass (MCZ); Marco (USNM).

Epitonium (Epitonium) humphreysii Kiener

Plate 117, fig. 2; Plate 119; Plate 120

Scalaria humphreysii Kiener 1838, *Iconographie des Coquilles Vivantes* 10, p. 15, pl. 5, fig. 16 (Atlantic Ocean to the south of Carolina).

Scalaria humphreysiana 'Kiener' Sowerby 1873, *Conchologia Iconica* 19, species no. 14, synonymy only [error for *humphreysii* Kiener].

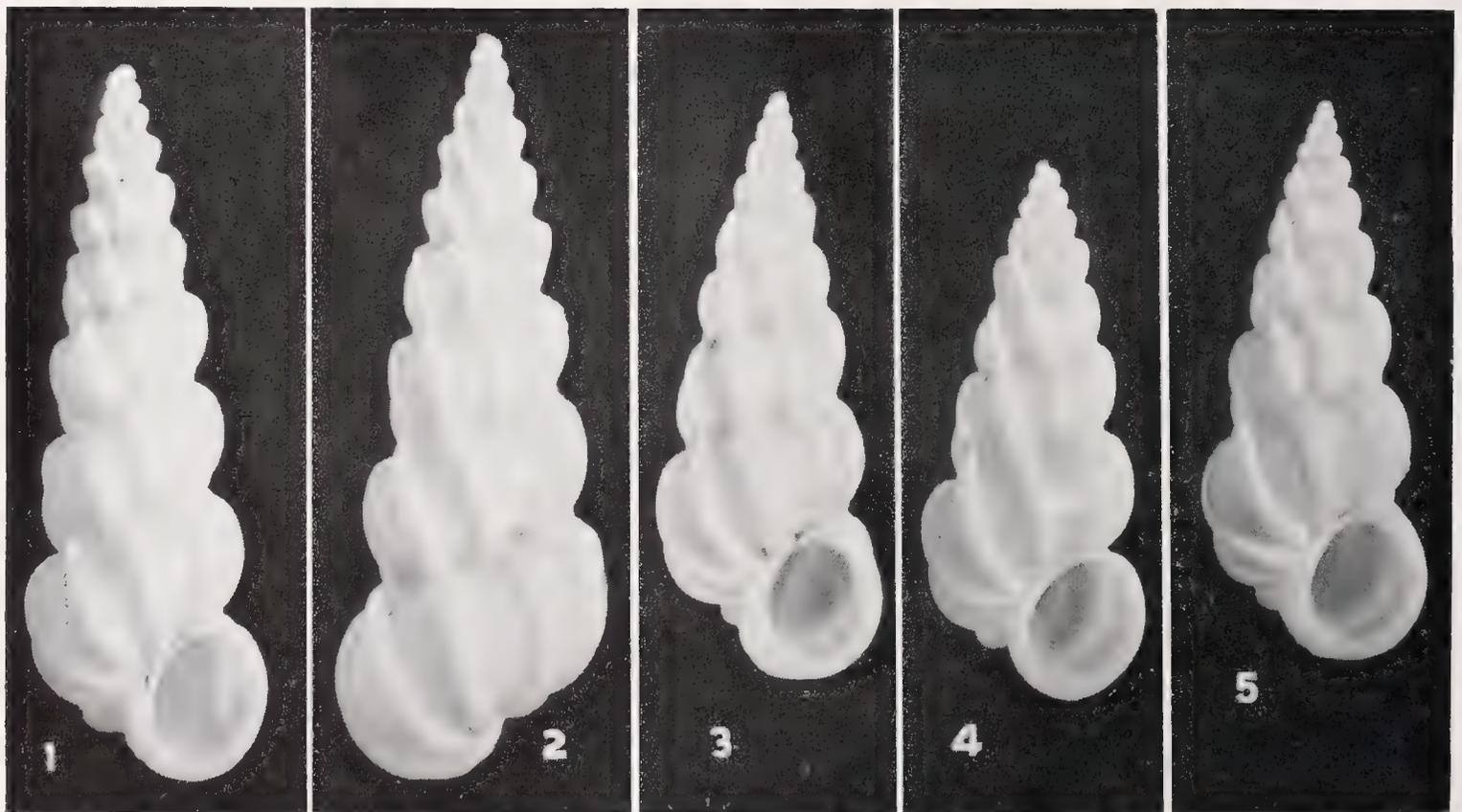


Plate 119. *Epitonium humphreysii* Kiener

Fig. 1. Isle of Palms, South Carolina. Fig. 2. Shackleford Island, North Carolina. Fig. 3. Sullivan's Island, Charleston, South Carolina. Figs. 4-5. Port St. Joseph, Florida [also called Port St. Joe] (all 4.4x).

Scala sayana Dall 1889, Bulletin Museum Comparative Zoölogy **18**, p. 309 (Virginia to Key West and Corpus Christi, Texas).

Scala humphreysii Kiener, Pilsbry 1890, Nautilus **3**, p. 106.

Description. Adult shell reaching about 18 mm. ($\frac{3}{4}$ inch) in length, rather strong in structure, imperforate and possessing numerous blade-like to rounded costae. Color a flat white. Whorls 9 to 10, rather strongly convex and attached to one another by the costae. Spire extended and produced at an angle of 25° to 27° . Aperture subcircular, outer lip expanded and usually thickened. Parietal lip thin and tightly appressed to the body whorl. Columella short and arched. Suture profound. Sculpture consisting of numerous costae which may be thin and blade-like or rounded and thickened. On the early whorls the costae are generally more blade-like and on the later whorls they become more rounded and thickened. Occasionally the costae may be slightly reflected backward. These costae may be somewhat angled at the whorl shoulder, especially on the early whorls. There are 8 to 9 costae on the body whorl. Microscopic sculpture absent. Operculum thin, paucispiral, corneous and dark mahogany-brown in color. Nuclear whorls two and one-half, opaque and smooth.

length	width	whorls	
18.2	7.5 mm.	10	St. Augustine, Florida
17.5	6.4	10	Shackleford Island, North Carolina
15.1	5.5	10	Charleston, South Carolina
14.1	6.0	10	Bradenton Beach, Florida
13.1	5.3	9	Port St. Joseph, Florida

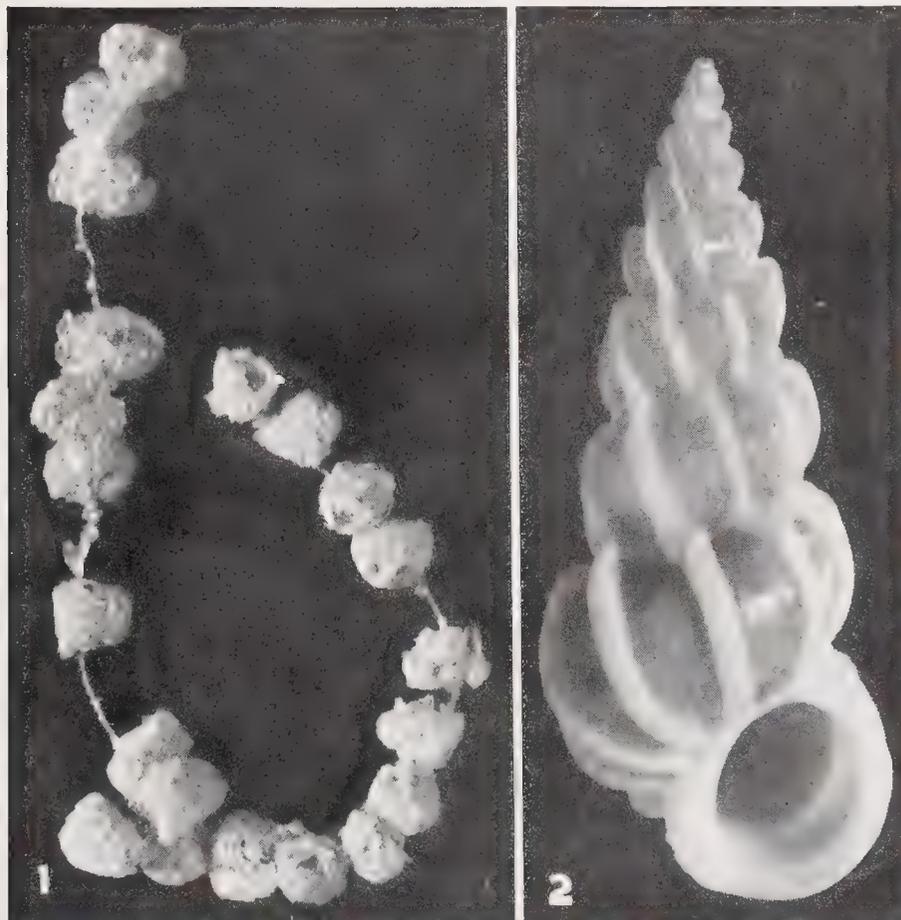


Plate 120. *Epitonium humphreysii* Kiener

Fig. 1. Egg cases showing their arrangement and construction (7x). Fig. 2. Specimen which produced the egg cases ($6\frac{1}{2}x$). From Pine Island Sound, Captiva Island, Florida, received from Dr. Schwengel. This specimen produced the egg cases in an aquarium.

Types. The original specimens of *E. humphreysii* Kiener¹ were in the collection of Prince Massena, which later was acquired by Delessert. These specimens are now in the collection of the Museum d'Histoire Naturelle de Genève, Switzerland².

We here limit the type locality to Sullivan's Island, Charleston, South Carolina.

Remarks. This is a difficult species to understand. Typical specimens are very different from *E. angulatum* but there are many examples, especially young specimens, that approach *angulatum* very closely. In many localities both species are known to occur and in others only one or the other species may exist.

Epitonium humphreysii Kiener is most closely related to *E. angulatum* Say. From typical examples of *angulatum* it differs by being proportionately narrower, having the costae generally more rounded rather than blade-like, and in having the angle at the whorl shoulder of the costae much less developed. For additional data on relationships see remarks under *angulatum* and *tollini*.

This species has a typical Carolinian Zone distribution, extending as it does from Cape Cod, Massachusetts south to near Lake Worth, Florida and in the Gulf of Mexico from the west coast of Florida at Cape Romano to Texas.

Range. From Cape Cod, Massachusetts south to Florida (excluding the Lower Florida Keys) and west to Texas.

Records. MASSACHUSETTS: Cotuit (J. Miller). RHODE ISLAND: Tiverton; off Point Judith (both J. Miller). CONNECTICUT: Branford (MCZ). NEW YORK: Three Mile Harbor, East Hampton, Long Island (R. Latham). NEW JERSEY: Atlantic City (USNM); Anglesea (USNM; ANSP); Reeds Beach, Wildwood (MCZ); off New England Creek, Delaware Bay (USNM). DELAWARE: Lewes, Delaware Bay (USNM). VIRGINIA: Hog Island (MCZ); Chincoteague Island; Smith's Island; Lynnhaven Bay, Chesapeake Bay; Magothy Bay, Chesapeake Bay; Virginia Beach (all USNM). NORTH CAROLINA: *Albatross*, station 2297, off Cape Hatteras (N. Lat. 35°38'; W. Long. 74°53') in 49 fathoms; *Albatross*, station 2290, off Cape Hatteras (N. Lat. 35°23'; W. Long. 75°24') in 10 fathoms; off Cape Lookout in 52 fathoms (all USNM); between Fort Macon and Beaufort; Shackleford Island (both MCZ). SOUTH CAROLINA: Pawley's Island; Cape Romain; Sullivan's Island, Charleston; Folly Island; Isle of Palms; Edisto Island (all Charleston Museum); Myrtle Beach (USNM); Fort Johnson (MCZ). FLORIDA: Mayport (USNM; T. McGinty); St. Augustine (USNM); Daytona (E. Bates); Cape Canaveral (Charleston Museum); Lake Worth (T. McGinty); off Hollywood in 45 fathoms (L. A. Burry); Port St. Joseph (A. Merrill); off Fort Walton in 16 fathoms (L. A. Burry); Dunedin; Point Pinellas, Tampa Bay; Shell Key, St. Petersburg; Egmont Key (all USNM); Cortez; Bradenton Beach; Siesta Key, Sarasota (all N. E. Schmidt); Englewood (ANSP; T. McGinty); Punta Gorda (A. Koto);

¹ Kiener states that the original material came from "M. Humphreys, de l'Academie des Sciences de Boston." In all probability this was D. Humphreys Storer who at that time was an officer in the Boston Society of Natural History, and an admirer of Kiener. He was, in fact, translating Kiener's work into English and in 1837 published privately one volume of these translations which including the genera *Tornatella*, *Pyramidella*, *Thracia*, *Harpa*, *Buccinum* and *Dolium*. No other translations were ever published.

² The photographs of the supposed types (Plate 117, fig. 2) were supplied through the kindness of Dr. G. Mermod of the Geneva Museum.

Captiva Island (J. Schwengel); Sanibel Island (ANSP; MCZ); Fort Myers Beach (ANSP; N. E. Schmidt); Bonita Springs (N. E. Schmidt); Marco (E. Bates; N. E. Schmidt); Cape Romano (USNM). LOUISIANA: Cameron (USNM). TEXAS: Galveston (USNM; T. Pulley); Corpus Christi (USNM).

Epitonium (Epitonium) angulatum Say

Plate 121, figs. 1-3; Plate 122, figs. 1-4

Scalaria clathrus angulata Say 1830, American Conchology no. 3, pl. 27, two upper figures (South coast of the United States).

Scalaria turbinata Conrad 1837, Journal Academy Natural Sciences Philadelphia 7, p. 263, pl. 20, fig. 26 (near Beaufort, North Carolina).

Scala angulata Say, Pilsbry 1890, Nautilus 3, p. 106.

Description. Adult shell reaching about 18.5 mm. (about $\frac{3}{4}$ inch) in length, rather strong in structure, imperforate and possessing numerous blade-like, axial costae. Color a china-white. Whorls eight, rather convex and attached to one another by the costae. Spire extended and produced at an angle of 28° to 30° . Aperture subcircular, outer lip expanded, thickened and reflected. Parietal area somewhat thickened and held away from the body whorl by the costae. Columella not defined. Suture profound. Sculpture consisting of numerous blade-like costae which are very slightly reflected backward. At the whorl shoulder these costae are generally expanded and form an angle. The angles are usually strong on all the early whorls, a little less so to almost absent on the later and body whorls. The costae of each whorl are usually formed in line with those on the

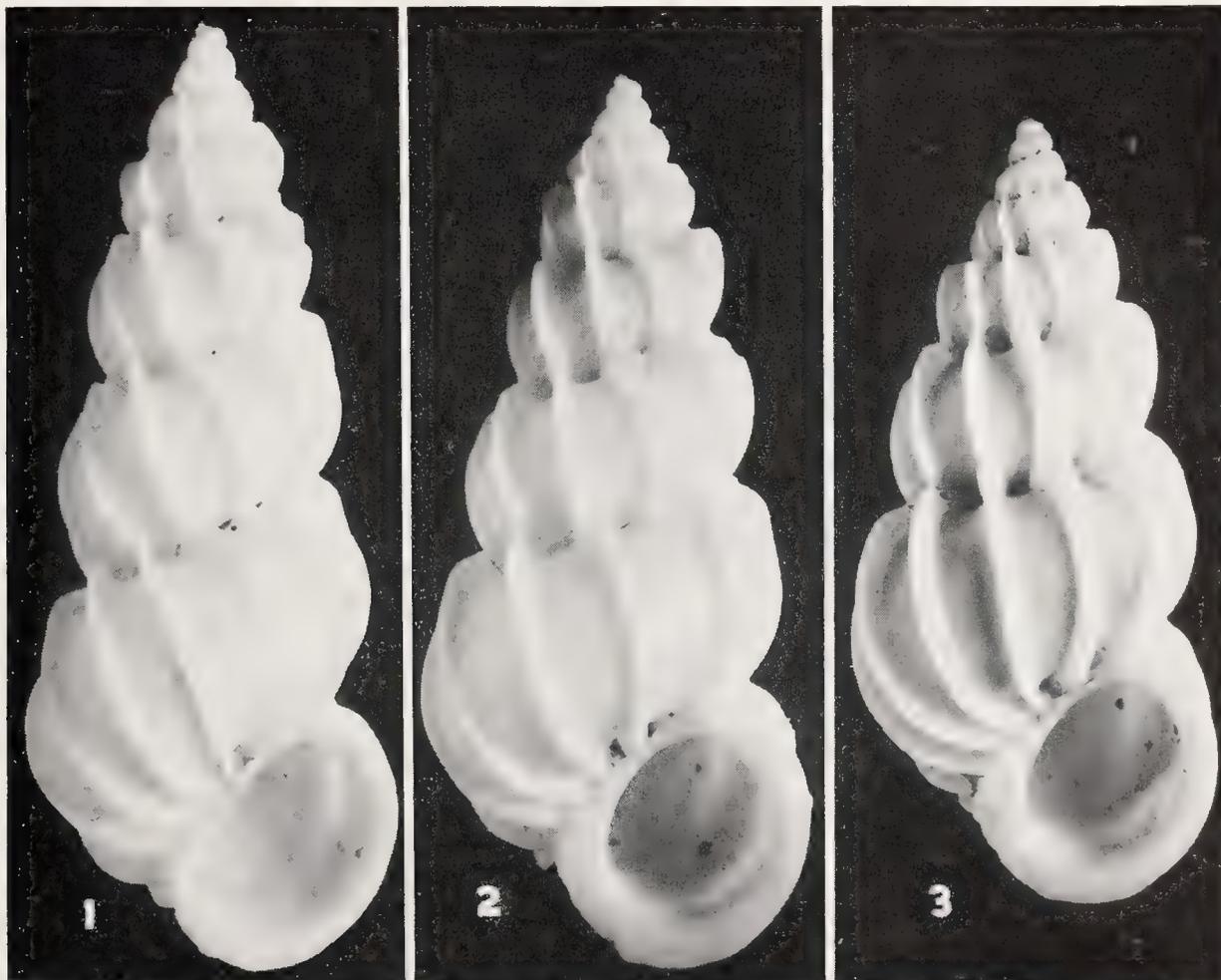


Plate 121. *Epitonium angulatum* Say

Figs. 1-3. Isle of Palms, South Carolina (all about $4\frac{1}{2}x$).

whorl above and are fused at their points of contact. Microscopic sculpture, when present, consisting of numerous and exceedingly fine spiral threads which are visible only under strong magnification. Operculum corneous, paucispiral and yellowish to dark-brown in color. Nuclear whorls are smooth, glass-like and opaque.

length	width	whorls	
24.5	9.0 mm.	9	Isle of Palms, South Carolina
18.5	8.2	9	Daytona Beach, Florida
17	6.9	7	Easthampton, Long Island, New York
16	6.5	8	Galveston, Texas
13	6.5	7½	Marco, Florida

Types. The present location of Say's type specimen is unknown. It is not in the Academy of Natural Sciences, Philadelphia where many of Say's types are preserved.¹ We restrict the type locality to Charleston, South Carolina, an area from which Say had received much material.

Remarks. This species extends throughout the Carolinian Zone and appears to be fairly abundant throughout its range.

Say derived the name of this species from the angle which is developed on the costae at the whorl shoulder. This is usually a well developed character in this species, though many specimens are found in which there is but a slight indication of angulation. These angles are best developed during the early stages of growth and as the animal approaches

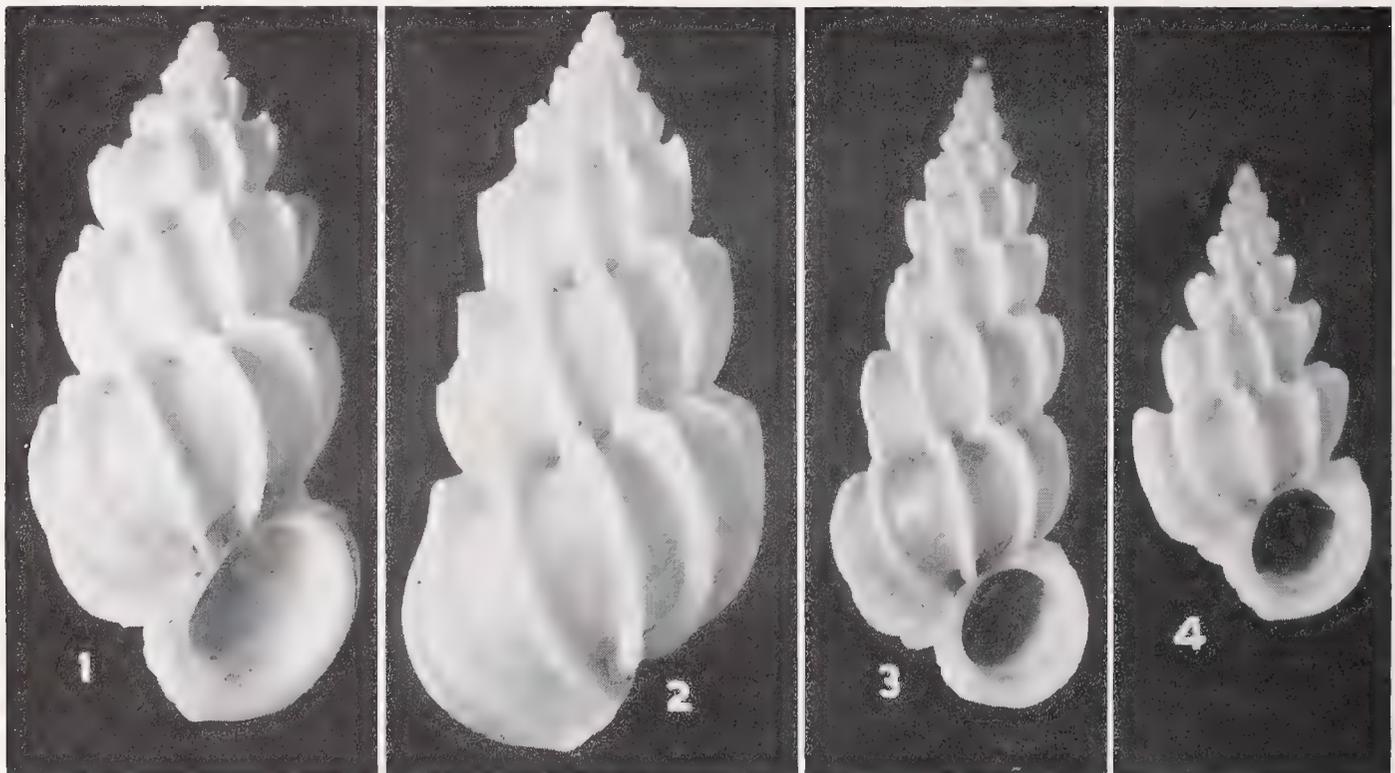


Plate 122. *Epitonium angulatum* Say

Figs. 1-2. Cape Lookout, North Carolina (about 4½x). Fig. 3. Bradenton Beach, Florida (4½x).
Fig. 4. Bradenton Beach, Florida (7½x).

¹ Thomas Say sent much of his original material to others who had become interested in his species. Thus many of his early types were distributed and their present location is unknown. We know that Mr. J. G. Anthony, after the death of Say, received many type lots of his freshwater species from Mrs. Say. These formed a part of Mr. Anthony's private collection which was later deposited in the Museum of Comparative Zoölogy.

maturity, the costae generally show a tendency to become more rounded and thickened.

There is considerable variation in size and proportion, many specimens, even from the same locality, being quite slender as compared with the wider and more typical forms. This variation has occasioned considerable difficulty in separating many of these narrow forms of *E. angulatum* from *E. humphreysii*. See also under remarks for *E. humphreysii* Kiener.

Range. From eastern end of Long Island, south to Florida (excluding the Lower Keys) and west to Texas.

Records. NEW YORK: East Hampton; Orient; Peconick Bay; Noyack Bay, all Long Island (all R. Latham). VIRGINIA: Lynnhaven Bay, off Cherrystone Light in 25 fathoms; off Horseshoe Light in 7½ fathoms; off Smith's Island, all Chesapeake Bay: off Cape Charles in 10 fathoms (all *Fish Hawk*, all USNM). NORTH CAROLINA: *Albatross*, station 2276, off Cape Hatteras (N. Lat. 35°21'; W. Long. 75°19') in 16 fathoms (USNM); Shackleford Island (Univ. of Michigan; MCZ); Beaufort (ANSP; USNM; Univ. of Michigan); Cape Lookout (MCZ). SOUTH CAROLINA: Cape Romain (Charleston Mus.); Sullivan's Island (MCZ; Charleston Mus.); Pawley's Island; Isle of Palms; Folly Island; Edisto Island; St. Helena's Sound in 3–6 fathoms (all Charleston Mus.). FLORIDA: Fernandina (USNM); Mayport (USNM; Charleston Mus.; Univ. of Michigan); Jacksonville Beach (ANSP); Titusville (USNM); Cape Canaveral (Charleston Mus.); Daytona (E. Bates); New Smyrna (A. Koto); Palm Beach Inlet (T. McGinty); off Fort Walton (L. A. Burry); Port St. Joseph (A. Merrill); Little Clearwater Pass (ANSP); Egmont Key (MCZ; Yale Univ.); Cortez; Bradenton Beach; Sarasota (all N. E. Schmidt); Punta Gorda (A. Koto); Sanibel Island (MCZ); Fort Myers Beach (ANSP; N. E. Schmidt); Naples (MCZ); Marco (USNM; N. E. Schmidt); Pavilion Key (ANSP). TEXAS: 25 miles south of Port Arthur (MCZ); Galveston Beach (USNM; MCZ; T. Pulley); Matagorda Bay (USNM).

***Epitonium (Epitonium) foliaceicostum* d'Orbigny**

Plate 123, figs. 1–3; Plate 124, figs. 1–2

Scalaria foliaceicosta d'Orbigny 1842 [in] Ramon de la Sagra, *Histoire de L'Ile de Cuba* 2, p. 17, pl. 10, figs. 26–28 (Martinique; Guadeloupe and St. Thomas). [Spelled *faliaceicosta* on plate.]

Scalaria muricata 'Kiener' Sowerby 1844, *Thesaurus Conchyliorum* 1, pt. 4, p. 86, pl. 32, figs. 29, 31–32 (a common West Indian species); non *S. muricata* Risso 1826.

Scalaria foliaceicostata 'd'Orbigny' Krebs 1864, *The West Indian Marine Shells, Denmark*, p. 64 [error for *foliaceicosta*].

Scala spuria Mörch 1874, *Vidensk. Medd. Naturhist. Forening i Kjöbenhavn* no. 17, p. 254; Mörch 1875, *Malakozoologische Blätter* 22, p. 144; Mörch 1876, *Journal Academy Natural Sciences Philadelphia* (2) 8, p. 194 (St. Thomas, Anguilla).

Scala spina-rosae Mörch 1874, *Vidensk. Medd. Naturhist. Forening i Kjöbenhavn* no. 17, p. 255 (St. Thomas).

Scala spinae-rosae Mörch 1875, *Malakozoologische Blätter* 22, p. 145 (St. Thomas [Virgin Islands]); Mörch 1876, *Journal Academy Natural Sciences Philadelphia* (2) 8, p. 194.

Scala novemcostata Mörch 1874, *Vidensk. Medd. Naturhist. Forening i Kjöbenhavn* no. 17, p. 254; Mörch 1875, *Malakozoologische Blätter* 22, p. 144; Mörch 1876, *Journal Academy Natural Sciences Philadelphia* (2) 8, p. 193 (St. Thomas [Virgin Islands]).

Scala pretiosula Mörch 1874, *Vidensk. Medd. Naturhist. Forening i Kjöbenhavn* no. 17, p. 252; Mörch 1875, *Malakozoologische Blätter* 22, p. 143; Mörch 1876, *Journal Academy Natural Sciences Philadelphia* (2) 8, p. 192 (St. Martin [Lesser Antilles] H. Krebs, collector).

Description. Shell reaching about 18 mm. (about $\frac{3}{4}$ inch) in length, rather light in structure, imperforate and possessing numerous blade-like costae. Color a flat white to pale ivory. Whorls 10–11, strongly convex and separated, being attached by the costae only. Spire extended and produced at an angle of 25° . Aperture subcircular and nearly holostomatous. Outer lip expanded, inner lip reflected and rolled over on top of the costae. Columella not definable. Suture profound. Sculpture consisting of numerous blade-like costae which are strongly angled at the whorl shoulder. There are 7 to 8 costae on the body whorl. The tips of these angles are high and acute and slope concavely toward the suture in profile view. Microscopic sculpture consisting of a few exceedingly fine spiral lines which are visible only under strong magnification. Nuclear whorls $1\frac{1}{2}$, opaque, white and devoid of sculpture. Operculum corneous, paucispiral, thin and a light brownish-yellow in color.

length	width	whorls	
17.2	6.5 mm.	11	Lake Worth, Florida
13	7	8	Hunt's Bay, St. Andrews, Jamaica
13	5.5	9	off Tortugas, Florida

Types. The type specimen of *E. foliaceicostum* is probably in the British Museum. We here restrict the type locality to St. Thomas, Virgin Islands. The lectotype, here chosen, of *S. spuria* Mörch from St. Thomas, Virgin Islands, and the holotype of *S. novemcostata* Mörch from St. Thomas, Virgin Islands, both A. H. Riise, collector, are in the Universitetets Zoologiske Museum, København, Denmark. The present whereabouts of the type specimens of *Scala spina-rosae* Mörch and *S. pretiosula* Mörch is unknown though they are probably in Denmark. Both were contained originally in the Krebs collection.

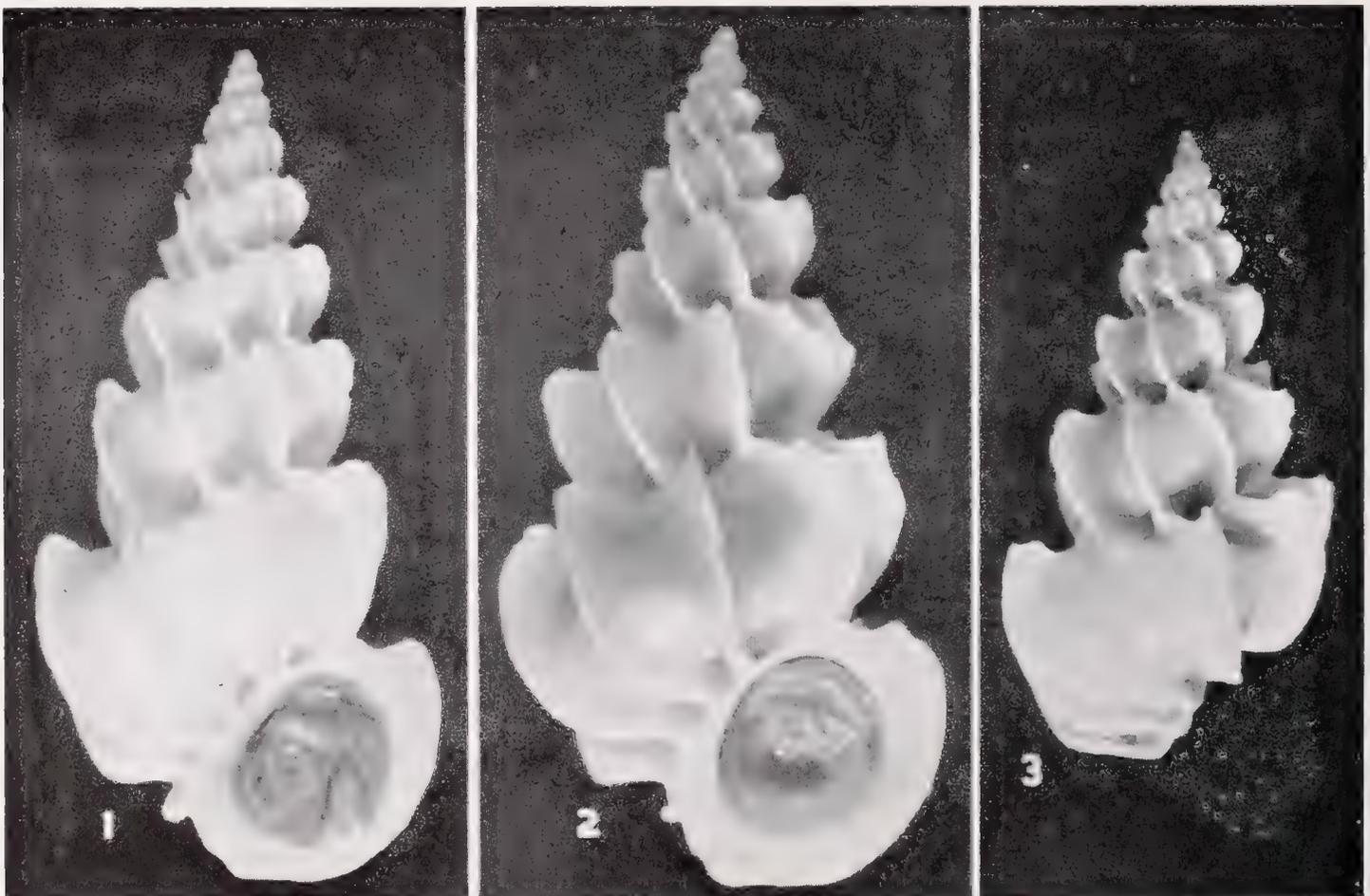


Plate 123. *Epitonium foliaceicostum* d'Orbigny

Fig. 1. Peanut Island, North Inlet, Lake Worth, Florida (7x). Figs. 2–3. *Eolis*, station 33, off Tortugas, Florida in 16 fathoms (7x).

Remarks. This species is the West Indian analogue of *E. angulatum* Say. It differs from *angulatum* by being somewhat smaller, lighter in structure and having the angle on the whorl shoulder greatly developed. The blade-like costae are thin and fairly high, the angles pointed and occasionally extending as high as the mid-portion of the whorl above. From *E. krebsii* Mörch, with which it may be confused, it differs by being narrower, imperforate and in having much more highly developed shoulder angles on the costae. Very young and worn specimens of this species may be confused with *E. echinaticostum* d'Orbigny. In the case of the latter species, however, the whorls are far more disjoined and the costae have a fluted appearance. Worn specimens of *E. foliaceicostum* have given rise to many of the synonyms named above. We have figured a few of the type specimens that were available.

This species occurs from low water to depths of at least 120 fathoms. It is rather widely distributed in the West Indian region though apparently it is never common at any one locality.

Range. Florida east coast from Lake Worth, south to Tortugas and north in the Gulf of Mexico to off Destin. In the West Indies from the Bahamas south and east to the Lesser Antilles.

Records. FLORIDA: Lake Worth, Boynton (T. McGinty); Hillsboro Light in 80 fathoms; Fort Lauderdale in 60 fathoms; off Hollywood in 45 fathoms (all L. A. Burry); off Lower Matecumbe Key; *Eolis*, station 62, off Miami in 20 fathoms (both USNM); off The Elbow, Key Largo in 90–100 fathoms; off Looe Key; off American Shoals, Lower Florida Keys in 55–70 fathoms (all L. A. Burry); off Key West (L. A.

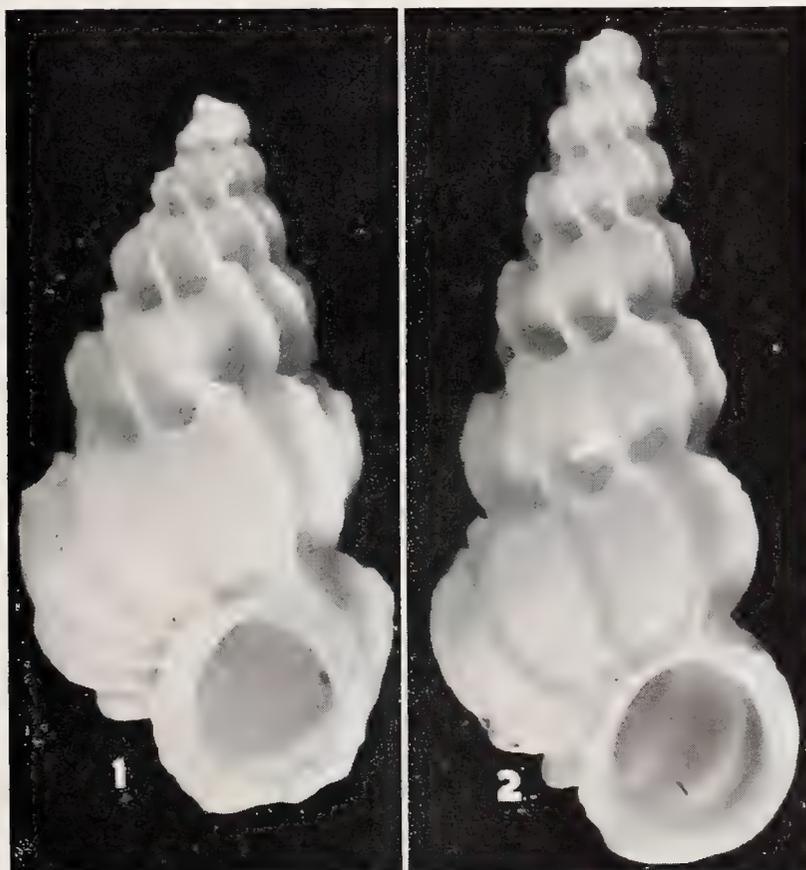


Plate 124. *Epitonium foliaceicostum* d'Orbigny

Fig. 1. Holotype of *Scalaria novemcostatum* Mörch (= *E. foliaceicostum* d'Orbigny) St. Thomas, Virgin Islands (10x). Fig. 2. Lectotype of *Scalaria spuria* Mörch (= *E. foliaceicostum* d'Orbigny) St. Thomas, Virgin Islands (6.8x).

Burry; USNM); Loggerhead Key, Tortugas; *Eolis*, station 330, off Sambo Reef in 120 fathoms; *Eolis*, station 33, off Tortugas in 16 fathoms; *Eolis*, station 4, off Cape Sable in 1½ fathoms (all USNM); off Destin in 18–20 fathoms (T. McGinty). BAHAMA ISLANDS: South Bight, Andros Island (USNM); New Providence (D. H. Brown; T. McGinty); Mangrove Cay, Andros Island; Arthurstown, Cat Island (both MCZ). CUBA: Vedado, Habana (M. Jaume); Arenas de la Chorrera, Habana (C. G. Aguayo); Cayo Levisa; Bahía Cochinos (both USNM). HISPANIOLA: Bahía de Samaná; Santo Domingo in 17 fathoms; Aquin, Dept. du Sud, Haiti (both USNM). JAMAICA: Hunt's Bay, St. Andrew; Kingston (both USNM). VIRGIN ISLANDS: St. Croix (ANSP); St. Thomas (MCZ; Univ. Zool. Mus. København, Denmark). LESSER ANTILLES: English Harbour, Antigua (USNM); Guadeloupe; Barbados (both MCZ).

Epitonium (Epitonium) fractum Dall

Plate 125

Epitonium fractum Dall 1927, Proceedings United States National Museum 70, Art. 18, p. 60 (off Fernandina [Florida] *Albatross*, station 2668 in 294 fathoms (N. Lat. 30°58'; W. Long. 79°38').

Description. Adult shell reaching 22 mm. (about $\frac{7}{8}$ inch) in length, rather light in structure, attenuated, minutely perforate and possessing numerous blade-like, axial costae. Color white with the nuclear whorls a light amber-brown. Whorls 16, strongly convex, free and attached by the costae only. Spire extended, forming an angle of 20°. Aperture subcircular and holostomatous. Outer lip reflected, formed by the last costa. Inner or parietal lip a little narrower and slightly appressed against the costae. Suture profound. Columella not definable. Umbilicus very small and partially hidden by the parietal lip. Sculpture consisting of numerous thin, blade-like costae which number 17 to 19 on the body whorl. At the whorl shoulder the costae have a very well developed angle; in the case of the present species, these angles form a series of sharply pointed hooks. There appears to be no trace of spiral sculpture. There is no basal ridge. However, there is a small rib which is formed by the costae as they coalesce on the outer edge of the umbilicus. Nuclear whorls 3½, glass-like and smooth. Operculum paucispiral, corneous and a light brownish-yellow.

length	width	whorls	
22.2	6.4 mm.	16	off Delray, Florida
15.8	5	10*	off Fowey Light, Florida
8.5	4.2	4½*	Holotype

* Early whorls lost.

Types. The holotype of *E. fractum* Dall is in the United States National Museum no. 108015 from *Albatross*, station 2668, off Fernandina, Florida in 294 fathoms (N. Lat. 30°58'; W. Long. 79°38').

Remarks. This species was based upon a unique and badly broken specimen. However, the species is so characteristic that even the broken fragment readily characterized it.

This species occurs in depths from 30 to 325 fathoms and it is rare throughout its range.

See *Remarks* under *E. dallianum* Verrill and Smith.

Range. East coast of Florida from off Fernandina south to Key West.

Records. FLORIDA: *Albatross*, station 2668, off Fernandina (N. Lat. $30^{\circ}58'$; W. Long. $79^{\circ}38'$) in 294 fathoms; *Eolis*, station 139, off Miami in 30 fathoms; *Eolis*, station 358, off Fowey Light in 125 fathoms; *Eolis*, station 332, off Sambo Reef in 115 fathoms; *Eolis*, station 334, off Key West in 90 fathoms (all USNM); 16 miles off Boynton in 275–285 fathoms; 18 miles E. of Delray in 300 to 325 fathoms; off Sombrero Light in 35 fathoms (all L. A. Burry).

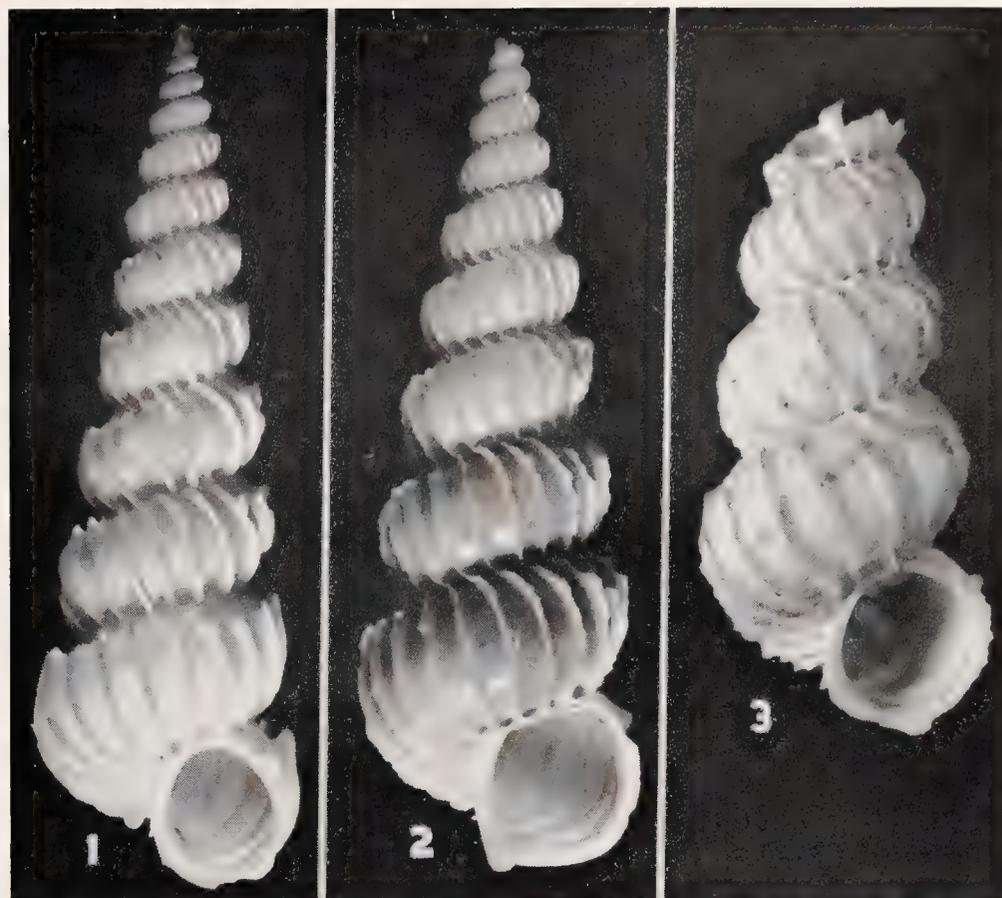


Plate 125. *Epitonium fractum* Dall

Fig. 1. Eighteen miles east of Delray, Florida in 300 to 325 fathoms (about 4x). Fig. 2. *Eolis*, station 358, off Fowey Light, Florida in 125 fathoms ($5\frac{1}{2}x$). Fig. 3. Holotype. *Albatross*, station 2668, off Fernandina, Florida in 294 fathoms (about $7\frac{1}{2}x$).

***Epitonium (Epitonium) dallianum* Verrill and Smith**

Plate 126

Scalaria dalliana Verrill and Smith 1880, American Journal of Science **20**, p. 395 (*Fish Hawk*, station 869 [about 175 miles off Asbury Park, New Jersey] about 85 miles S. of Martha's Vineyard (N. Lat. $40^{\circ}02'18''$; W. Long. $70^{\circ}23'06''$ in 192 fathoms)); Verrill and Smith 1882, Transactions Connecticut Academy **5**, p. 527, pl. 57, fig. 33; Verrill 1885, Annual Report of the Commissioner of Fish and Fisheries for 1883, p. 568, pl. 25, fig. 91.

Epitonium dallianum Verrill and Smith, Johnson 1915, Occasional Papers Boston Society of Natural History **7**, no. 13, p. 103.

Description. Adult shell reaching 12.5 mm. ($\frac{1}{2}$ inch) in length, rather light in structure, attenuate, nearly imperforate and possessing numerous, blade-like axial costae. Color a grayish-white with the nuclear whorls very pale amber. Whorls 10 and strongly convex. Early whorls attached, later whorls very slightly separated by the costae. Spire extended forming an angle of 17° . Aperture subcircular and holostomatous. Outer lip reflected, formed by the last costa. Inner or parietal lip a little narrow and appressed

against the costae on the whorl above. Columella not definable. Suture deep to profound. Umbilicus very minute and more or less covered by the reflection of the parietal lip. Sculpture consisting of numerous, thin, blade-like costae. There are 20 to 30 costae on the body whorl. At the whorl shoulder the costae have a small but well developed angle which is slightly hooked. When seen in profile the regularity of the position of these hooks gives a shouldered appearance to the whorls. There is no basal ridge. Nuclear whorls two, glass-like and smooth. Operculum paucispiral, corneous and light brownish-yellow in color.

length	width	whorls	
12.5	4.0 mm.	10	<i>Fish Hawk</i> , station 871, off Asbury Park, New Jersey
10.1	3.4	10	<i>Fish Hawk</i> , station 869, off Asbury Park, New Jersey, lectotype
15	4.8	10*	<i>Fish Hawk</i> , station 870, off Asbury Park, New Jersey

* Broken.

Types. The lectotype, here chosen, is in the United States National Museum no. 44795, *Fish Hawk*, station 869. Additional paratypes in the United States National Museum and the Academy of Natural Sciences, Philadelphia and the Peabody Museum, Yale University. The type locality is *Fish Hawk*, station 869, off Asbury Park, New Jersey (N. Lat. $40^{\circ}02'18''$); W. Long. $70^{\circ}23'06''$) in 192 fathoms.

Remarks. This is not a common species and there are comparatively few specimens available for study. In relationship it appears nearest to *Epitonium fractum* Dall. It differs from this species by being smaller, having lower costae and having the angles or hooks on the whorl shoulder much less developed.

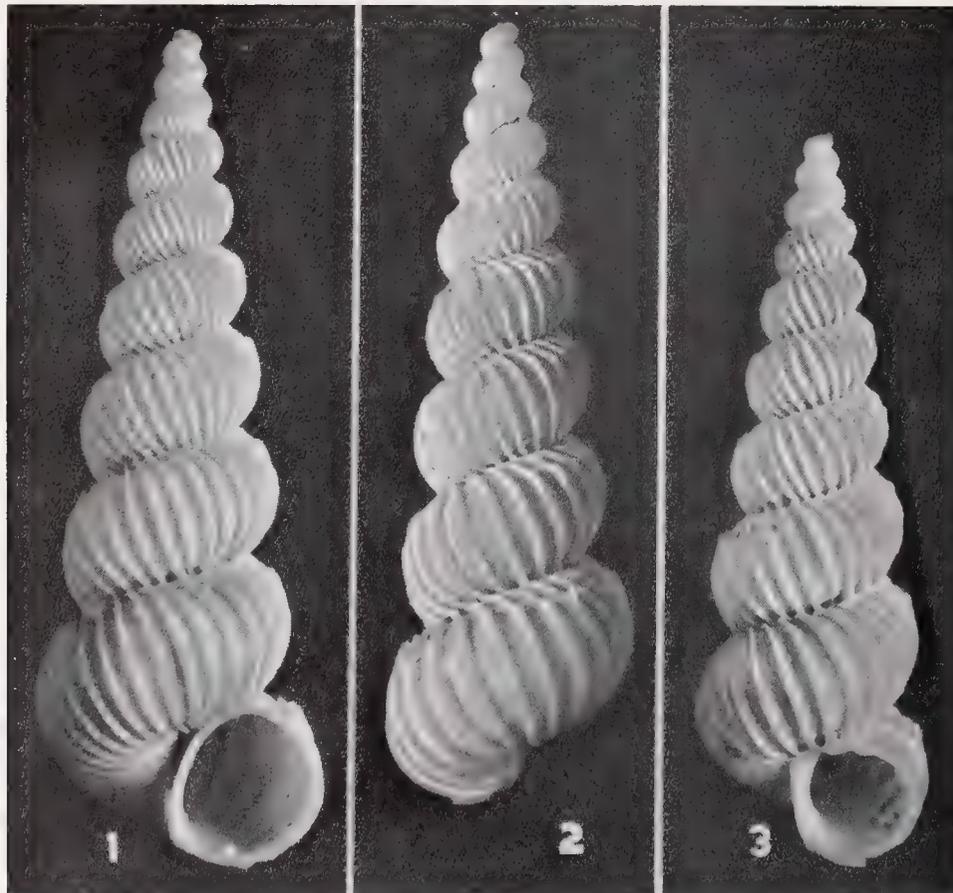


Plate 126. *Epitonium dallianum* Verrill and Smith

Fig. 1. *Fish Hawk*, station 871 in 115 fathoms. Fig. 2. *Fish Hawk*, station 874 in 85 fathoms. Fig. 3. Lectotype. *Fish Hawk*, station 869 in 192 fathoms. All off Asbury Park, New Jersey (all about 7x.)

Range. From the latitude of northern New Jersey south to North Carolina in depths ranging from 63 to 192 fathoms.

Records. NEW JERSEY: *Fish Hawk*, station 869 (N. Lat. $40^{\circ}02'18''$; W. Long. $70^{\circ}23'06''$) in 192 fathoms (USNM; Yale University); *Fish Hawk*, station 870 (N. Lat. $40^{\circ}02'36''$; W. Long. $70^{\circ}22'58''$) in 155 fathoms (USNM); *Fish Hawk*, station 871 (N. Lat. $40^{\circ}02'54''$; W. Long. $70^{\circ}23'40''$) in 115 fathoms (ANSP; Yale University); *Fish Hawk*, station 874 (N. Lat. $40^{\circ}00'$; W. Long. $70^{\circ}57'$) in 85 fathoms (USNM). (All of the above stations are about 150 to 175 miles east of Asbury Park, New Jersey and about 85 miles south of Martha's Vineyard.) *Atlantis*, station D6 (1935) about 130 miles east of Asbury Park in 67 fathoms (MCZ); *Fish Hawk*, station 1097, about 200 miles off Barnegat Bay (N. Lat. $39^{\circ}54'$; W. Long. $69^{\circ}44'$) in 158 fathoms (USNM). VIRGINIA: *Albatross*, station 2265, about 60 miles off Cape Charles (N. Lat. $37^{\circ}07'$; W. Long. $74^{\circ}35'$) in 70 fathoms (Yale University). NORTH CAROLINA: *Albatross*, station 5109, about 25 miles off Cape Hatteras (N. Lat. $35^{\circ}14'$; W. Long. $74^{\circ}59'$) in 142 fathoms (Yale Univ.); *Albatross*, station 2595, about 22 miles off Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}05'$) in 63 fathoms; *Albatross*, station 2602, about 36 miles off Cape Hatteras (N. Lat. $34^{\circ}38'$; W. Long. $75^{\circ}33'$) in 124 fathoms; *Albatross*, station 2614, about 36 miles off Cape Lookout (N. Lat. $34^{\circ}09'$; W. Long. $76^{\circ}02'$) in 168 fathoms (all USNM).

Epitonium (Epitonium) unifasciatum Sowerby

Plate 127

Scalaria unifasciata Sowerby 1844, Thesaurus Conchyliorum 1, p. 98, pl. 33, fig. 68 (West Indies).

Description. Adult shell reaching 13 mm. (about $\frac{1}{2}$ inch) in length, rather light in structure, imperforate and possessing numerous low rounded axial costae. Color white with an irregular spiral band of brown on the upper portion of the whorl near the suture. Occasional specimens with the coloration slightly diffused. Costae white. Whorls eleven, moderately convex and attached. Spire extended and forming an angle of 20° . Aperture subcircular. Outer lip generally slightly reflected and usually moderately to greatly thickened. Varices usually limited to the final one, the lip of the adult. Occasionally, however, more are produced and these are usually limited to a position on the last whorl. The parietal wall and columella are not definable as the aperture is holostomatous. Suture well defined and moderately deep. Sculpture consisting of many low, narrow and somewhat rounded axial costae. In general, the costae on one whorl are in line with those on the whorl above. There are from 7 to 9 costae on the body whorl. No basal ridge is developed. Nuclear whorls about two and devoid of sculpture. Operculum unknown.

length	width	whorls	
13	5.5 mm.	$9\frac{1}{2}$	Jamaica
12	5.5	10	St. Thomas, Virgin Islands
9.7	4.5	$9\frac{1}{2}$	Boynton Beach, Florida

Types. The type of this species is probably in the British Museum. The type locality given by Sowerby was only "the West Indies." We here restrict the type locality to Port Royal, Jamaica.

Remarks. This is a very distinct species. It is rare throughout its range and as a consequence not often seen. It can, however, be confused with a few other forms in the Western Atlantic. It superficially resembles worn specimens of *E. lamellosum* Lamarck, but can be easily distinguished from this species by the lack of a basal ridge. From *E. albidum* d'Orbigny it differs by being more attenuate, having the whorls attached and having fewer, more cord-like costae rather than blade-like costae. Usually the subsutural band of brown is present.

See remarks under *E. lamellosum* and *E. albidum*.

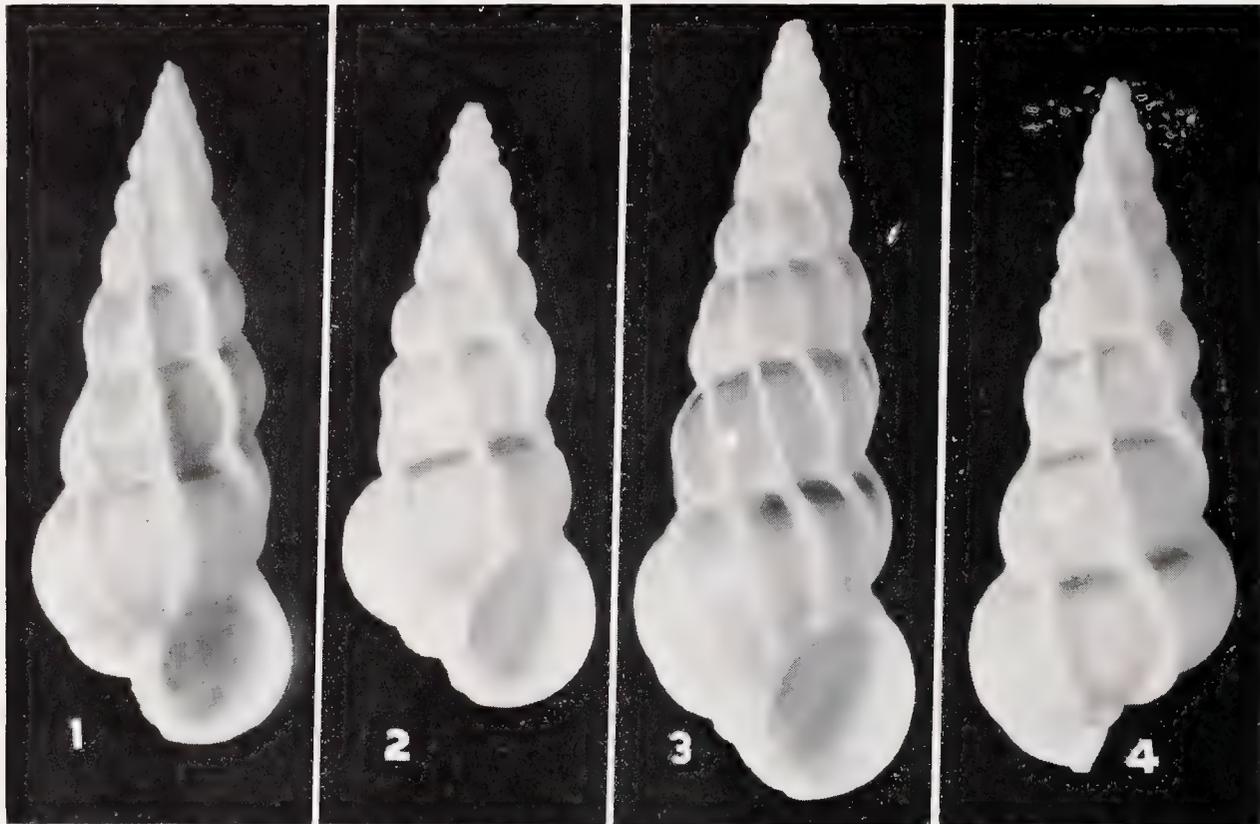


Plate 127. *Epitonium unifasciatum* Sowerby
Figs. 1-4. Jamaica (about 6x).

Range. South Florida, the Bahama Islands and south through the West Indies to the Lesser Antilles.

Records. FLORIDA: Lake Worth; Boynton Beach (both T. McGinty). BAHAMA ISLANDS: South Bimini Island, Bimini Islands; Great Abaco (both USNM). CUBA: Habana (M. Jaume). HISPANIOLA: Anse à Drick, Dept. du Sud, Haiti (USNM). PUERTO RICO: East of Boca de Congrejos (Univ. of Michigan). JAMAICA: Montego Bay (Charleston Mus.); Port Royal; Jacob's Bay, St. Mary (both USNM). VIRGIN ISLANDS: Prosperity Beach, St. Croix (H. A. Beatty); St. Thomas (USNM). LESSER ANTILLES: St. Vincent (ANSP); Barbados (MCZ).

Subgenus *Gyroscala* de Boury

Gyroscala de Boury 1887, Etude sur les sous genres de Scalidae du Bassins de Paris, p. 15, Thémécourt, Seine-et-Oise, France (subgenotype, *G. (Scalaria) commutata* Monterosato [= *Epitonium lamellosum* Lamarck]).

Turbona 'Brown' Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 259 [sectional type, *Scala lamellosa* Lamarck, here selected]; non *Turbona* Leach 1847.

Pictoscala Dall 1917, Bull. United States National Museum **53**, no. 2217, p. 477 [subgenotype, *S. lineata* Say, subsequent designation, de Boury 1919].

Depressiscula de Boury 1909, Journal de Conchyliologie **57**, p. 258 (subgenotype, *S. aurita* Sowerby, original designation).

Subgenotype, *Scalaria commutata* Monterosato [= *Epitonium lamellosum* Lamarck].

Species in this subgenus are imperforate, moderately to strongly axially costate, have convex whorls and possess a well developed basal ridge. Color may be present as spiral bands or somewhat diffused. The whorls are generally attached.

Epitonium (Gyroscale) lamellosum Lamarck

Plates 128–129

Turbo clathrus Linné 1758, Systema Naturae, edition 10, p. 765 [in part, reference to Gualtieri only].

Scalaria lamellosa Lamarck¹ 1822, Animaux Sans Vertèbres **6**, pt. 2, p. 227 (locality unknown); Kiener 1839, Iconographie Coquilles Vivantes **10**, Scalaria, p. 10, pl. 3, figs. 7, 7a, 7b (Corsica; Sicily; Teneriffe, Canary Islands and Martinique); Delessert 1841, Recueil de Coquilles Décrites par Lamarck, Paris, pl. 33, figs. 10a-b.

¹ *Turbo lamellosa* Brocchi 1814, Conchiologia Fossile Subapennina **2**, p. 379, pl. 7, fig. 2, is not a homonym of *Scalaria lamellosa* Lamarck. Both were described in different genera and both are in different genera at this time. E. de Boury places *Turbo lamellosa* Brocchi in the genus *Cirsotrema*.

Scalaria pseudoscalaris 'Risso' Philippi 1836, Enumeratio Molluscorum Siciliae **1**, p. 167, pl. 10, fig. 2 (Panormi, Messina, Sicily); non *pseudoscalaris* Brocchi 1814.

Scalaria monocycla 'Lamarck' Kiener 1839, Iconographie des Coquilles Vivantes **10**, Scalaria, p. 19, pl. 3, fig. 9; non Lamarck (locality unknown).

Scalaria commutata Monterosato 1877, Ann. Museo Civico di Storia Naturale di Genova **9**, p. 240 (Civitavecchia, Italy).

Description. Adult shell reaching 32 mm. (about 1¼ inch) in length, rather light in structure; imperforate and possessing numerous blade-like axial costae. Color whitish with irregular brownish markings which are generally stronger at the suture. Occasionally the color becomes diffused over all portions of the whorl and is usually darker on the later whorls. The costae are always white. Whorls eleven, strongly convex and attached. Spire extended, forming an angle of 40° to 50°. Aperture subcircular. Outer lip generally slightly reflected and usually moderately to greatly thickened. Varices usually limited to the final one, the lip of the adult; occasionally, however, more are produced and these are usually limited to a position on the last whorl. The parietal wall and columella are not definable as the aperture is nearly holostomatous. Suture well defined and moderately deep. Sculpture consisting of numerous thin, high, blade-like axial costae. The costae of each succeeding whorl are nearly in line with one another so that in general they appear continuous from the apex to the base of the shell. Rarely they may be offset or double. Basal ridge consisting of a well developed thread-like line. Nuclear whorls two and devoid of sculpture. Operculum dark mahogany-brown, thin, corneous and paucispiral.

length	width	whorls	
34	15 mm.	11*	Arthurstown, Cat Island, Bahama Islands
30.8	14	8*	Monte Cristi, Santo Domingo
28.8	12.5	11	Grassy Key, Florida
28.5	14.5	11	St. Thomas, Virgin Islands

* Broken — early whorls lost.

Types. Delessert in 1841 figured Lamarck's type specimen of this species. It is now probably in the museum at Geneva, Switzerland where Delessert's collection was deposited. The original locality was unknown to Lamarck. We here select Corsica to be the type locality. This is one of the several localities cited by Kiener in 1839, based upon the material contained in the Paris Museum.

Remarks. This species is one of the most beautiful in the entire family. Perfect specimens are not common as the thin blade-like costae are very quickly broken after the animal dies. It is not a rare species as it is found throughout the entire Caribbean area as well as portions of the Eastern Atlantic, though it is perhaps never abundant at any one locality.

So far as we can detect there appears to be no characters upon which the West Indian specimens of this species can be separated from those occurring along the shores of southern Europe and the west coast of Africa.

The name *lamellosum* appears to be the earliest that is available. According to Hanley (1855, *Ipsa Linnaei Conchylia*, London, p. 339) Linné had two species in the group

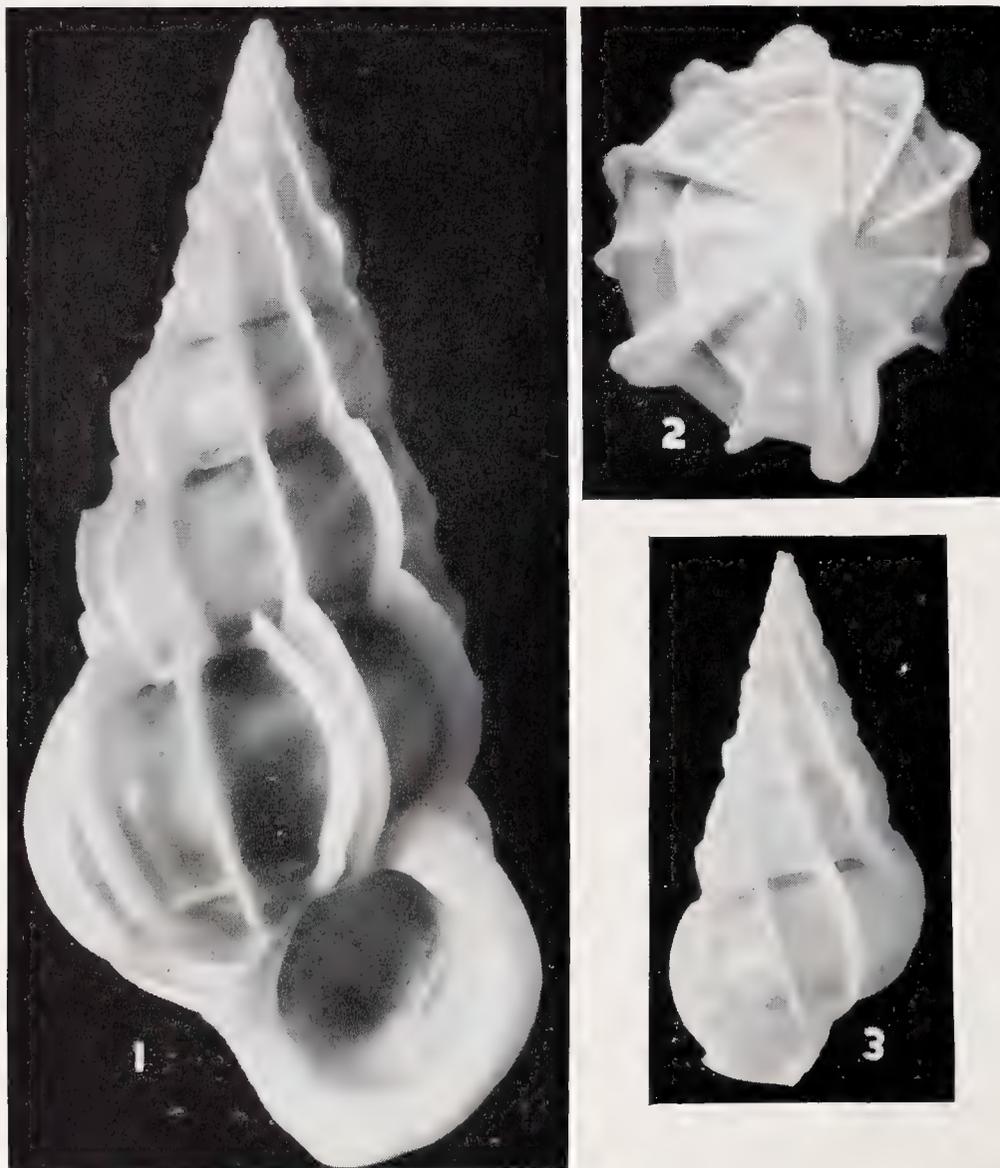


Plate 128. *Epitonium lamellosum* Lamarck

Fig. 1. Grassy Key, Lower Florida Keys, Florida (4x). Note double costae. Fig. 2. Bathsheba, Barbados (4x). Showing the well developed basal ridge. Fig. 3. Barbados (4.3x). A nearly pure white form with a faint brownish, subsutural line.

which he called *clathrus*. All references but one (Gaultieri) cited by Linné refer to a species without a basal ridge, or what is now understood to be *Epitonium clathrus* Linné. The figure cited by Gaultieri (1742, Index Testorum Conchyliorum, pl. 58, figure H) is that which was later named *lamellosum* by Lamarck.

This species is readily differentiated from *E. unifasciatum* by the presence of a well defined basal ridge, its much larger size and by its blade-like costae. In *unifasciatum* the costae are low and rounded and there is no basal ridge. In coloration there are generally two definable brown bands on each whorl of *lamellosum*, even when the color has become somewhat diffused, while in *unifasciatum* the color is limited to a single narrow and occasionally interrupted subsutural band.

From *E. rupicolum* this species differs in being larger, having the costae blade-like and uniform in height. In *E. rupicolum* the costae are occasionally very much thickened to form varices and those in-between are much reduced in height and thickness.

This species is found from low water to depths of about 33 fathoms.

Range. WESTERN ATLANTIC: From Lake Worth, Florida, Bermuda and the Gulf of Mexico, south through the West Indies to Tobago in the Lesser Antilles. EASTERN ATLANTIC: On the Atlantic coast of France from Finistere south; the western Mediterranean and the coast of Africa south to Liberia and the Gold Coast.

Records. EASTERN ATLANTIC: CORSICA: (AMNH; MCZ). SICILY: Palermo; Messina (both MCZ). ITALY: Porto Mourizio (MCZ). ALGERIA: Gulf of Oran (MCZ); Algiers (Bergens Museum). CANARY ISLANDS: Teneriffe (AMNH); Grand Canary Island (MCZ). GOLD COAST: Accra (MCZ). LIBERIA: Monrovia (MCZ).

WESTERN ATLANTIC: FLORIDA: Lake Worth; Boynton Beach (both T. McGinty); Biscayne Bay (J. Weber); Virginia Key (T. McGinty; J. Weber); Key Largo; Tea Table Key (both Univ. of Miami); Tavenier Key (USNM); Lower Matecumbe Key; Washerwoman Key (both J. Schwengel); Grassy Key; Boca Chica Key (both N. E. Schmidt); Bahía Honda Key (A. Soper); Missouri Key; Pelican Shoals; Middle Sambo Shoals (all T. McGinty); 5 mi. S.E. of Sombrero Light in 33 fathoms (L. A. Burry); Key West (ANSP); Garden Key and Loggerhead Key, Tortugas (USNM); Marco (J. Weber); Sanibel Island (MCZ); off Fort Walton in 13-19 fathoms (L. A. Burry). BERMUDA: (AMNH; USNM). BAHAMA ISLANDS: West End and Eight Mile Rock, Grand Bahama Island; North Bimini (all MCZ); Nassau, New Providence; South Bimini and Gun Cay, Bimini Islands (all T. McGinty); Arthurstown, Cat Island (MCZ); Cay Sal, Cay Sal Bank (R. Humes); Matthewtown, Great Inagua (MCZ); Rocky Point, Acklin Island (USNM). CUBA: Cape San Antonio (Univ. of Michigan); Cape Cajon, *Tomas Barrera*, station 211; Cardenas (both USNM); Vedado, Habana (C. G. Aguayo); Habana (ANSP; Univ. of Michigan); Cayo Francés, Caibarién (MCZ); Cayo Santa Maria, Camagüey (R. Humes); Guantánamo (MCZ); Aquadores, near Santiago, Oriente (M. Jaume); Punta de los Colorados, Cienfuegos (MCZ). HISPANIOLA: Les Cayes; Aquin, both Dept. du Sud, Haiti; Saltrou, Dept. de l'Ouest, Haiti (all USNM); Jérémie, Haiti (MCZ); Les Trois Pavillons, Dept. du Nord-Ouest, Haiti; Gonave Island, Haiti (both USNM); Monte Cristi; Puerto Plata; Puerto Sosua, all Santo Domingo (all MCZ); Bahía de Samaná, Santo Domingo (USNM). PUERTO RICO:

Arroyo (USNM); Mona Island (MCZ); Parguera (N. T. Mattox); San Juan (N. Athearn); E. of Boca de Congrejos (Univ. of Michigan); Cajo de Muertos, off Ponce (AMNH; N.T. Mattox). JAMAICA: Montego Bay (MCZ; Charleston Mus.); Robins Bay and Jacobs Bay, St. Mary; Port Royal (all USNM). VIRGIN ISLANDS: St. Croix (MCZ; ANSP); St. Thomas (MCZ; USNM); St. John (MCZ); Guana Island, Tortola (M. W. Dewey). LESSER ANTILLES: Antigua (MCZ; USNM); St. Bartholomew

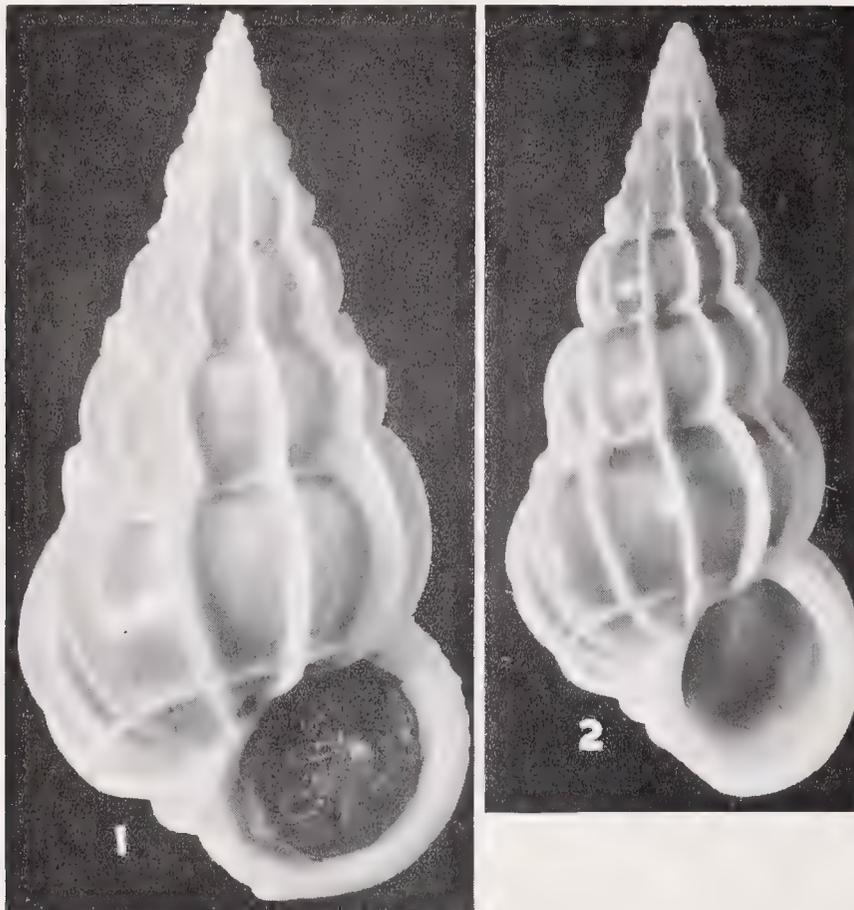


Plate 129. *Epitonium lamellosum* Lamarck

Fig. 1. Biscayne Bay, Florida (4.1x). Port Salut, Dept. du Sud, Haiti (4½x).

(B. Hubendick); St. Martin (MCZ; B. Hubendick); Martinique; Guadeloupe (both ANSP); Dominica (USNM); Barbados (MCZ; F. G. Kellett; USNM); Bucco Reef and Anse Fourmi, Tobago Island (both MCZ). CARIBBEAN ISLANDS: Swan Island (MCZ); St. Andrews Island (ANSP); Curaçao (AMNH); Ruatan Island, Bay Islands (USNM). MEXICO: Cabo Catoche, Yucatan (A. del Valle); Isla Mujeres, Yucatan (USNM). COLOMBIA: Santa Marta; near Cartagena (both USNM).

Epitonium (Gyroscale) rupicolum Kurtz

Plate 130

Scalaria lineata Say 1822, Journal Academy Natural Sciences, Philadelphia **2**, p. 242 (inhabits the southern coast [of the United States]); Say 1831, American Conchology No. 3, *Scalaria*, pl. 27, two lower left figures; Gould 1870, Invertebrata of Massachusetts, Boston, p. 312 [description only, not the figure]; non *Scalaria lineata* Kiener¹; non *E. lineatum* Röding 1798.

¹ Kiener (1839, Iconographie des Coquilles Vivantes **10**, p. 6, pl. 2, fig. 5; pl. 6, fig. 20) is completely wrong regarding this species of Say. Sowerby in 1844 referred Kiener's species to the Philippines and in addition he complicated the problem by calling the species *lineolata*. This was followed by de Boury who had

Scalaria rupicola Kurtz 1860, Catalogue of the Recent Marine Shells found on the Coast of North and South Carolina, Portland [Maine], p. 7 (Fort Johnson, South Carolina); Clench 1946, Nautilus **60**, p. 71.

Scalaria unicostata Sowerby 1873, Conchologia Iconica **19**, Scalaria, pl. 8, fig. 55 (America).

Scalaria fischeriana Tapparone-Canefri 1876, Journal de Conchyliologie **24**, p. 152 (new name for *unicostata* Sowerby non *uncinaticosta* d'Orbigny.) [The name *uncinaticosta* d'Orbigny is not, however, a homonym of *unicostata* Sowerby as considered by Tapparone-Canefri.]

Epitonium reynoldsi Sowerby 1916, Proc. Malacological Society London **12**, p. 74, pl. 3, fig. 4 (Florida).

Scalaria sublineata de Boury² 1918, Journal de Conchyliologie **64**, p. 38 [nomen nudum].

Description. Adult shell reaching about 20 mm. (about $\frac{3}{4}$ inch) in length, imperforate and possessing numerous blade-like or rounded, axial costae. Color whitish or light yellowish with two brownish, spiral bands at the suture. The brownish color may become somewhat diffused, though generally the spiral bands show up much darker. In very young specimens there may be but a single band and that at the lower margin of each whorl. Very rarely specimens occur which are very dark brown all over, the darker bands being barely visible. The costae are always white or slightly tinged with brown in the banded area. Whorls eleven, globose, strongly convex and attached. Spire extended forming an angle of 35° to 40°. Aperture subcircular. Outer lip generally slightly reflected and usually moderately thickened. The number of varices varies greatly, adult specimens possessing from one to as many as six. The parietal wall and columella are not definable as the aperture is nearly holostomatous. Suture well defined and very deep. Sculpture consisting of numerous and rather low, blade-like costae. The rounded costae are usually varices produced during the earlier stages in the animal's growth. The costae are variable both in number and height on the various specimens and occasionally they are hardly produced above the shell surface. The costae of one whorl are not necessarily lined up with those of the whorl above. There are from 12 to 18 costae on the body whorl. Basal ridge well developed but usually existing as a very thin, thread-like line. Nuclear whorls two and devoid of sculpture. Operculum thin, corneous, yellowish in color and paucispiral.

length	width	whorls	
25	11.5 mm.	$9\frac{3}{4}$	Tampa, Florida
20.5	8.5	$8\frac{1}{2}$	Smith's Island, Virginia
19.4	10	$9\frac{1}{2}$	Peconic Bay, Southold, New York
18.5	8	$10\frac{1}{2}$	Gulfport, Florida
15.5	6.8	$9\frac{1}{2}$	Marco Island, Florida

Types. Say's type of *S. lineata* is probably not in existence, at least it is not in the Academy of Natural Sciences, Philadelphia where many of his types are to be found. Say did not delimit his type locality other than "inhabits the southern coast." The

created a new subgenus (*Lineoscala*) with the type *S. lineolata* Kiener. All this resulted from the fact that Kiener never described the species but only gave figures for a species and variety, both of which were very different but were given under the name of *lineata*.

² It is utterly impossible to understand de Boury's reasoning in proposing this name along with others in this particular paper. There is no description and his reference to Dall (1890, Transactions Wagner Free Institution of Science, Philadelphia **3**, p. 158) is only to a series of localities and Dall's subsequent reference to a description of the living *E. lineatum* Say. In this particular paper de Boury created new names for several late tertiary specimens of this and other species without making any attempt whatsoever to examine the original material.

whereabouts of the type of *S. rupicola* Kurtz is unknown. The type locality is Fort Johnson, South Carolina.

Remarks. Except for lower Florida this species is well distributed from Cape Cod, Massachusetts to Texas and is fairly common throughout its range. This species occurs from just below low water to depths of about 20 fathoms.

It is exceedingly unfortunate that the well known name of *lineatum* Say must be relegated to the synonymy as a homonym because Röding used the same name many years before. The first available name is that of J. D. Kurtz who described a dark form of *Scalaria lineata* under the name of *S. rupicola*. His description is exceedingly brief, but the single character of brown coloration on the shell proper and the white ribs defines only this species among all known to us from this area of the Western Atlantic. The following is the entire original description as given by Kurtz.

“*Scalaria rupicola* Kurtz, n.s. length .5 in., divergence 48° whorls brown, ribs white; in the crevices of stones. Ft. Johnson, S.C.”

There is considerable color variation within this species, certain specimens becoming quite dark where the brownish color has become diffused throughout most of the shell. In general, the color is limited to the two spiral bands which margin the suture.

Range. Provincetown, Massachusetts south to Florida and west to Texas.

Records. MASSACHUSETTS: Provincetown (J. Weber); South Harwich Beach; Dennisport; Hyannis; Woods Hole (all MCZ); Wareham (J. Miller); Marion; New Bedford (both MCZ); off Gay Head, Martha's Vineyard in 10 fathoms (J. Miller); West Jetty, Nantucket (D. Taylor). RHODE ISLAND: Sakonnet in 2 fathoms (J. Miller). NEW YORK: Sag Harbor; Southold; Orient, all Long Island (all R. Latham); Bayville, Long Island (MCZ); Staten Island (USNM). NEW JERSEY: off New England Creek, Dela-

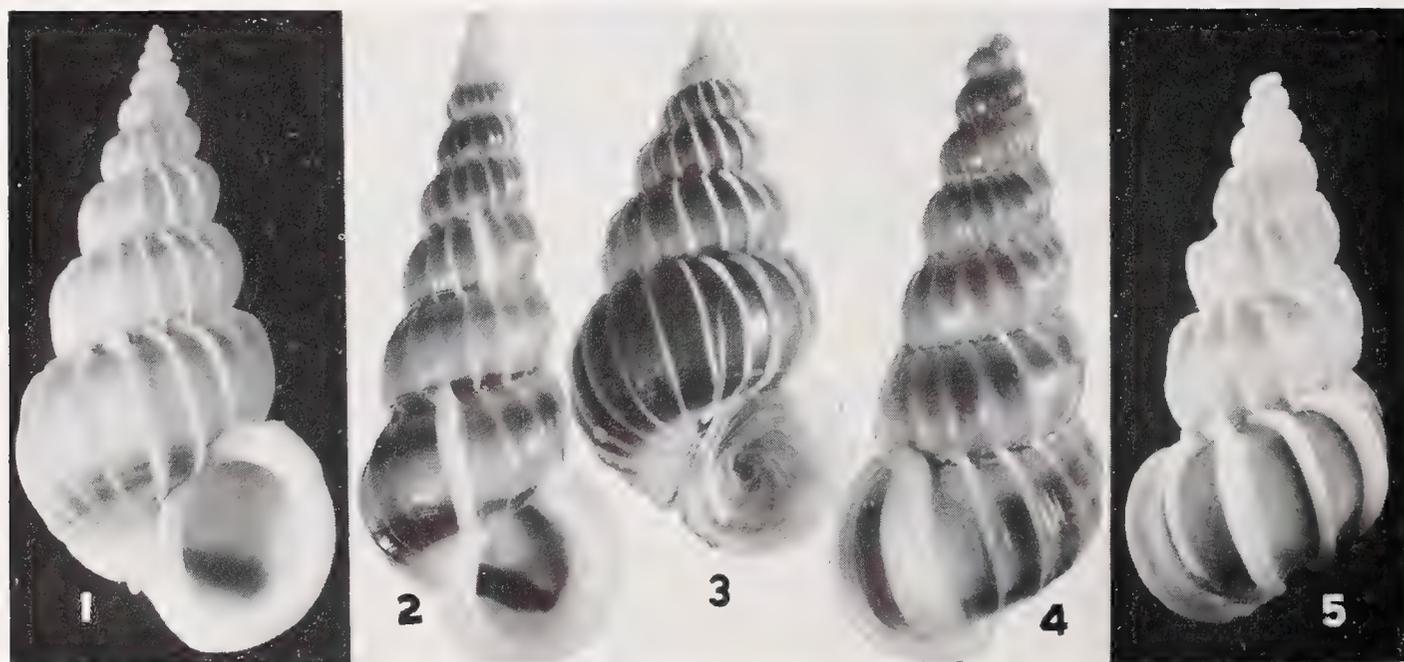


Plate 130. *Epitonium rupiculum* Kurtz

Fig. 1. Lake Worth, Boynton, Florida (4x). Fig. 2. Marco Island, Florida (about $4\frac{1}{2}x$). Fig. 3. Lake Worth, Boynton, Florida (4.2x). Fig. 4. Smith's Island, Virginia ($4\frac{1}{4}x$). Fig. 5. Sanibel Island, Florida ($4\frac{1}{2}x$).

ware Bay (USNM). DELAWARE: off Bowers (USNM). MARYLAND: Town Point, Little Choptank River (R. Jackson); Parkers Creek, Calvert Co., Chesapeake Bay; Benedict; Plum Point Wharf; off Gibson Island, *Fish Hawk*, station 8533 (N. Lat. $39^{\circ}02'$; W. Long. $76^{\circ}22'$) in 7 fathoms; off Cove Point, *Fish Hawk*, station 8524 (N. Lat. $38^{\circ}21'$; W. Long. $76^{\circ}22'$) in 4 fathoms (all USNM). VIRGINIA: Chincoteague Island; Magothy Bay, Chesapeake Bay; Smith's Island; off Smith's Point Light, Chesapeake Bay, *Fish Hawk*, station 8383, (N. Lat. $37^{\circ}53'$; W. Long. $76^{\circ}05'$) in 6 fathoms; off Cape Henry, *Fish Hawk*, station 8595 (N. Lat. $36^{\circ}57'$; W. Long. $76^{\circ}00'$) in 12 fathoms (all USNM). NORTH CAROLINA: off Cape Hatteras in 16 fathoms; off Cape Lookout Bight, *Eolis*, station 20 (both USNM); Beaufort (Univ. of Michigan; USNM); Shackleford Island (MCZ). SOUTH CAROLINA: Cape Romain; Pawley's Island; Mt. Pleasant; Isle of Palms; Sullivan's Island; Charleston Harbor; Folly Island; Edisto Island; off Edisto River in 3-7 fathoms; Eddingsville Beach (all Charleston Museum); May River (USNM). FLORIDA: St. Augustine (USNM); near Daytona (E. Bates); Cape Canaveral (Charleston Museum); Cocoa Beach (MCZ); Palm Beach Inlet (T. McGinty); South Lake Worth; Yamata, Palm Beach Co. (both Univ. Miami); Fort Lauderdale (L. A. Burry); Bird Key, Biscayne Bay, *Eolis*, station 13 (USNM); off Fort Walton (L. A. Burry); Clearwater (ANSP); Gulfport in 2 fathoms (MCZ); St. Petersburg (T. McGinty; J. Weber); Crescent Beach, Sarasota (N. E. Schmidt); Egmont Key, Tampa Bay (L. A. Burry); Useppa Island (MCZ); Punta Gorda (J. Weber); Sanibel Island (MCZ); Fort Myers Beach (N. E. Schmidt); Marco Island (E. Bates; N. E. Schmidt); Cape Romano (USNM). MISSISSIPPI: Gulfport (J. Weber). LOUISIANA: Cameron; Grand Lake; Cameron Co. (both USNM); Barataria Bay, Grand Isle (A. Walsh). TEXAS: Galveston (T. Pulley); Matagorda Bay and Keller Bay, Calhoun Co. (both USNM); Port Aransas (T. Pulley; J. Hedgpeth); Corpus Christi (USNM).

* * * *

Notes

In our previous number (*Johnsonia* no. 29, p. 243) we used *Ferminoscala* as a subgenus of *Amaea*. We unfortunately overlooked a paper by K. van Winkle Palmer in which it was shown that *Ferminoscala* Dall is a synonym of *Scalina* Conrad.

The following is the synonymy as we now understand it.

Genus *Amaea* H. and A. Adams

Subgenus *Scalina* Conrad

Scalina Conrad 1865, American Journal of Conchology **1**, p. 27.

Ferminoscala Dall 1908, Bull. Museum Comparative Zoölogy **43**, p. 315 (subgenotype, *Epitonium* (*Ferminoscala*) *ferminianum* Dall [not *ferminoscala* as we had it in error]).

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

Scalina Conrad, Palmer 1937, Bulletins American Paleontology **7**, no. 32, p. 102 (subgenotype, *Scalina staminea* Conrad, subsequent designation, Palmer 1937).

Epitonium eburneum Potiez and Michaud

Scalaria eburnea Potiez and Michaud 1838, Galerie des Mollusques 1, p. 344, pl. 31, figs. 1-2 (locality unknown).

It is impossible to tell just what this species may be as the poor figures could represent any of several forms. The few casual remarks given regarding the differences between this and *Epitonium lamellosum* Lamarck and *Opalia australis* Lamarck are far too superficial to be of any significant value. We suggest it should be dropped from the list of Western Atlantic species.

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Book Review

Dezallier D'Argenville 1742: *L'Historie Naturelle Eclaircie dans deux de ses parties principales: La Lithologie et La Conchyliologie*, Paris, 4to., pp. viii+492, 33 pls. The brilliant French Court of Louis XV lavishly and ostentatiously supported the arts and sciences, and it is not surprising that D'Argenville's work appeared in the midst of the War of the Austrian Succession. Plates 6-33 illustrate mollusks. They are well done and for the most part easily recognizable. It is because of the figures that the work still commands our attention, for many of these cuts were referred to by Linné and subsequent authors, and many are the type figures of our Western Atlantic mollusks. The work also contains a history of conchology and a report on the principal shell cabinets then to be found in Europe.

In 1757, a second edition of the conchological section was printed with 41 plates, 1-29, 1-3, 1-9. Two of these plates portray the soft parts of the mollusks. Both of these editions appeared anonymously, but it is evident from the dedication that very little concealment of identity was intended.

D'Argenville had a high opinion of his ability as a conchologist, bumptiously asserting that his works were "un monument eternal." Johnston (1850, Introduction to Conchology, London, p. 503) says however, "He was a mere amateur, and had no idea of a naturalist beyond his capacity for ticketing a cabinet."

The second edition was translated into German and appeared in Vienna in 1772 under the title, *Dezallier von Argenville's Conchyliologie oder Ubhandlung von den Schnecken Muscheln, &c.* It contains the same plates as the second edition but in a somewhat different order, plates 1-28, 1-9 (1-3 being numbered 10-12).

D'Argenville died in 1763, but in 1780 a third edition of the work appeared under the title, *La Conchyliologie ou Historie Naturelle des Coquilles* edited by De Favanne de Moncervelle, father and son. This greatly enlarged edition consists of two quarto volumes and an atlas of 80 plates, three engraved frontispieces, and a portrait of D'Argenville. The plates are not easily collated with the other editions. This edition was to have consisted of 5 volumes with an atlas of plates. Only two were published. Seventy-two pages of volume three were printed but were never distributed.

All of these various editions of D'Argenville have as a frontispiece an engraving done by the celebrated French artist of the period, Francois Boucher.—RICHARD I. JOHNSON

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EPITONIIDAE

VOL. 2, NO. 31

THE GENERA EPITONIUM (PART II), DEPRESSISCALA, CYLINDRISCALA, NYSTIELLA AND SOLUTISCALA IN THE WESTERN ATLANTIC

BY
WILLIAM J. CLENCH AND RUTH D. TURNER

This present number concludes our studies in the family Epitoniidae. It completes the genus *Epitonium* and covers several smaller genera usually considered in this family. The various species in the several subgenera of *Epitonium* which are covered in this report, possess weak to very strong spiral sculpture as well as the various types of axial sculpture found in all members of the genus. Again, we must state that the division of species into subgenera based on the presence or absence of spiral sculpture and the possession of a basal ridge is still arbitrary. It is a system of convenience rather than one expressing true relationships. When more data are available regarding the anatomy and ecology of the many species considered, a more natural classification can be attempted.

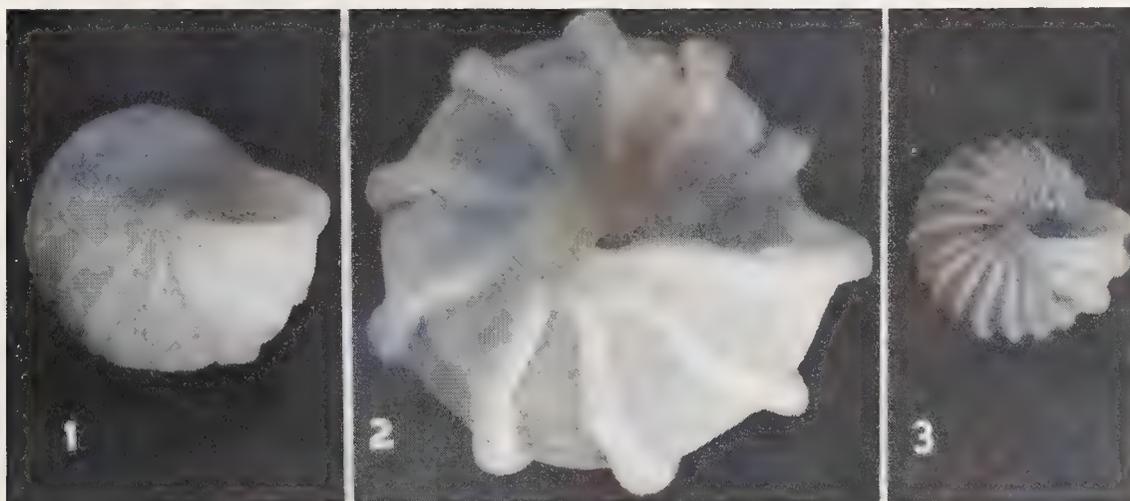


Plate 131. Basal views of *Epitonium*.

Fig. 1 *Epitonium championi* Clench and Turner, Lewis Bay, Hyannis, Massachusetts. Fig. 2. *Epitonium greenlandicum* Perry, Gotts Island, Blue Hill Bay, Maine. Fig. 3. *Epitonium candeanum* d'Orbigny, Lake Worth, Florida all (8x).

ACKNOWLEDGMENTS

We are exceedingly grateful to many friends for the loan and gift of specimens in this family. Curators in many institutions both here and abroad kindly loaned us their entire collections of Atlantic material for our studies. Without their substantial aid this study would have been impossible. We are indebted to the following for their interest and support.

C. G. Aguayo, Museo Poey, Universidad de la Habana, Habana, Cuba; J. Armstrong, American Museum of Natural History; F. Bruun, Universitetets Zoologiske Museum, København, Denmark; A. Carcelles, Museo Argentino de Ciencias Naturales, Buenos Aires; L. Forcart, Naturhistorisches Museum, Basel, Switzerland; B. Hubendick, Naturhistoriska Riksmuseet, Stockholm, Sweden; J. Kjennerud, Zoologiske Museum, Bergen, Norway; N. Knaben, Zoologiske Museum, Oslo, Norway; P. Morris, Peabody Museum, Yale University; H. A. Pilsbry, Academy of Natural Sciences Philadelphia; H. A. Rehder, United States Natural Museum; E. B. Richardson, Charleston Museum, Charleston, South Carolina; T. Soot-Ryen, Tromsø Museum, Tromsø, Norway; H. vander Schalie, Museum of Zoology, University of Michigan.

In addition to institutional loans, many private collectors have sent their entire collections of Western Atlantic Epitoniidae and without their aid many of the facts in this present study would have been unknown to us. Credit in all cases is given in the Records. However, we are particularly indebted to Ester Bates, Leo Burry, M. Jaume, Roy Latham, Tom McGinty, Nevada Schmidt, Jeanne Schwengel, and Jay Weber for extensive series of carefully localized specimens.

To David and Nevada Schmidt we are grateful for much new material especially collected at critical areas along the southwest coast of Florida, as well as live specimens for radula studies.

Genus *Epitonium* *Röding*

Part II

The genus *Epitonium* is continued here from *Johnsonia*, no. 30, p. 287. The subgenera covered in Part I of *Epitonium* were those lacking spiral sculpture.

Subgenus *Asperiscala* *de Boury*

Asperiscala de Boury 1909, Journal de Conchyliologie 57, p. 257.

Cinctiscala de Boury 1909, Journal de Conchyliologie 57, p. 257 (subgenotype, *S. antillarum* de Boury [= *E. candeanum* d'Orbigny]).

Decussiscala de Boury 1909, Journal de Conchyliologie 57, p. 257 (subgenotype, *S. denticulata* Sowerby).

Sodaliscala de Boury 1909, Journal de Conchyliologie 57, p. 257 (subgenotype, *S. multistriata* Say).

Subgenotype, *Scalaria bellastriata* Carpenter, original designation.

Shells axially costate with either cord or blade-like costae and possessing spiral sculpture ranging from low cords to very fine incised lines. The costae may be rounded or hooked at the whorl shoulder. Basal ridge absent. Nuclear whorls $2\frac{1}{2}$ to 3, white or light brown in color, glass-like and smooth.

Epitonium (*Asperiscala*) *apiculatum* *Dall*

Plate 132

Scala apiculata Dall 1889, Bulletin Museum Comparative Zoölogy 18, p. 310 (*Albatross*, station 2596, about 18 miles southeast of Cape Hatteras, North Carolina); non *Epitonium apiculatum* Dall 1917.

Description. Shell reaching 4.5 mm. (about $\frac{3}{8}$ of an inch) in length, attenuate and subimperforate. Whorls 9, convex and attached by the costae only. Aperture circular to subcircular and with a thickened, expanded lip. The umbilical area partially closed by a parietal thickening. Columella short and arched. Axial sculpture consisting of numer-

ous blade-like costae. There are 11 costae on the body whorl of the holotype. There are two stages in the development of these axial costae. The nuclear whorls (about the first three) are smooth, the first three postnuclear whorls possess costae which are low, cord-like and far more numerous than those on the remaining whorls. Beyond these first three postnuclear whorls the costae are reduced in number and become high and blade-like. Spiral sculpture consisting of numerous, thread-like cords which exist only on the first three postnuclear whorls. On the later whorls they are barely visible or entirely lacking. There is no basal ridge. Nuclear whorls three, white, smooth and glass-like. Color of entire shell a shining white. Operculum unknown.

length	width	whorls	
4.5	2.5 mm.	9	Holotype
4.5	2.5	9	From off Cape Lookout, N.C.
4.5	2.4	9	S.E. of Cape Fear, N.C.

Type. The holotype of *E. apiculatum* Dall is in the United States National Museum, no. 94890, from the *Albatross*, station 2596 (N. Lat. 35°08'; W. Long. 75°10') in 49 fathoms. This station is about 18 miles southeast of Cape Hatteras, North Carolina.

Remarks. This species differs rather strikingly from all others in this rather compact group. This difference is based upon the two forms taken by the axial costae, the low cord-like costae on the first three postnuclear whorls and the strong blade-like costae on the later whorls. In addition, the spiral sculpture is limited to the first three postnuclear whorls. This species appears to be related rather distantly to *E. candeanum* by the sim-

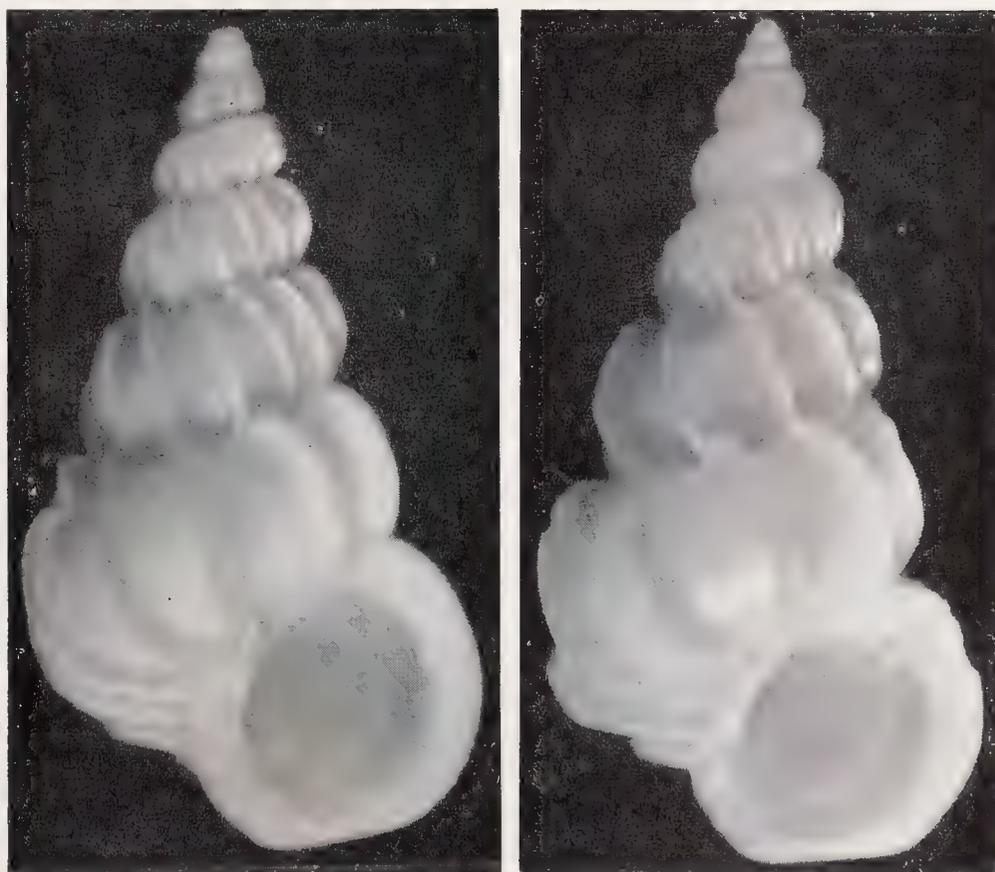


Fig. 1

Fig. 2

Plate 132. *Epitonium apiculatum* Dall

Fig. 1. From *Albatross*, station 2596, off Cape Hatteras, North Carolina. Holotype (19x). Fig. 2. From *Albatross*, station 2617, 25 miles southeast of Cape Fear, North Carolina (about 20x).

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ilar type of spiral sculpture on the early postnuclear whorls. This same sculptural character relates it to *E. multistriatum* Say, in addition to the numerous, low, cord-like costae which both possess. In *E. multistriatum* these cord-like costae persist throughout, while they are limited on *E. apiculatum* to the first three postnuclear whorls.

It is difficult to explain the limited distribution of this species. Certainly, the lack of collecting in the offshore waters to the immediate south of North Carolina may be part of the answer. At the same time this could be an aberrant form of some more widely distributed species. The two types of postnuclear sculpture exhibited by *E. apiculatum* are unique so far as our Western Atlantic species are concerned. Possibly this may be a southern species, larval stages of which are carried north by the Gulf Stream. On settling to the bottom they survive, at least for a short period of time. After the summer months have passed and the temperature gradient is on its downward swing, the colder waters of this northern area may in some way affect the sculpture. The three postnuclear whorls are almost identical to the early whorls of *E. candeanum*, the later whorls somewhat resemble *E. albidum* d'Orbigny. All specimens of *E. apiculatum* that we have examined appear to be only half grown.

Range. Known only from North Carolina.

Records. NORTH CAROLINA: *Albatross*, station 2596, 18 miles S.E. of Cape Hatteras (N. Lat. 35°08'; W. Long. 75°10') in 49 fathoms; *Albatross*, station 2616, off Cape Fear (N. Lat. 33°42'; W. Long. 77°31') in 17 fathoms; *Albatross*, station 2618, about 25 miles southeast of Cape Fear in 14 fathoms (N. Lat. 33°17'; W. Long. 77°35'); *Albatross*, station 2619, about 25 miles southeast of Cape Fear in 15 fathoms (N. Lat. 33°38'; W. Long. 77°36'); 12 miles east of Frying Pan Shoals in 12 fathoms; off Cape Lookout in 8 fathoms (all USNM).

Epitonium (Asperiscala) multistriatum Say

Plates 133, 134

Scalaria multistriata Say 1826, Journal Academy of Natural Sciences Philadelphia (1) 5, p. 208; Say 1830, American Conchology no. 3, pl. 27, lower right figure and the enlarged figure above (east coast of Florida and Charleston, South Carolina).

Scala multilirata 'Say' H. and A. Adams 1853, The Genera of Recent Mollusca 1, p. 221 [nude name, probably error for *multistriata* Say].

Scalaria leptalea Bush 1885, Transactions Connecticut Academy 6, pt. 2, p. 465; Bush 1893, Bulletin Museum Comparative Zoölogy 23, no. 6, p. 240, pl. 1, fig. 17 (off Cape Hatteras, North Carolina).

Epitonium elliotti Mazyck 1913, Catalog of Mollusca of South Carolina. Contributions from the Charleston Museum no. 2, p. 12 (Pawley's Island, South Carolina).

Epitonium virginicum Henderson and Bartsch 1914, Proceedings United States National Museum 47, no. 2055, p. 414, pl. 13, fig. 1 (Chincoteague Island, Virginia).

Description. Shell reaching about 15 mm. (about ½ inch) in length, attenuate, imperforate, rather light in structure and having axial costae and spiral threads. Whorls 8 to 10, rather strongly convex, having the later whorls unattached. Color a uniform dull-white. Suture rather deeply impressed to profound. Aperture subcircular to ovate and with a narrowly expanded lip. Parietal lip moderately developed and appressed tightly to the parietal area. Columella not defined. Axial sculpture consisting of very numerous, cord-like to low blade-like costae which do not form angles at the whorl shoulder. There

are 16 to 19 costae on the body whorl. Spiral sculpture consisting of exceedingly numerous and fine incised lines or threads which do not pass over the costae. Nuclear whorls 3 to 4, smooth and glass-like, the apical whorls being exceedingly small. There is no basal ridge. Operculum unknown.

length	width	whorls	
14.8	5.5 mm.	8½*	Holotype, <i>leptaleum</i> Bush
14.2	5.2	9½	Sullivan's Island, Charleston, South Carolina
13.7	5.2	9	Charleston, South Carolina
7.0	3.4	8	Holotype, <i>elliotti</i> Mazyck
3.0	1.5	5	Holotype, <i>virginicum</i> Henderson and Bartsch

* 1 or 2 early whorls lost

Types. Say's type of *E. multistriatum* has been lost. The type locality is Charleston, South Carolina, Stephen Elliott, collector. The holotype of *E. leptaleum* Bush is in the United States National Museum, no. 44845, from the *Albatross*, station 2277 (N. Lat. 35°20'; W. Long. 75°19') from off Cape Hatteras, North Carolina in 16 fathoms. The holotype of *E. virginicum* Henderson and Bartsch is in the United States National Museum no. 252568, from Chincoteague Island, Virginia. The holotype of *E. elliotti* Mazyck is in the Charleston Museum, no. 43.28.9831 from Pawleys Island, South Carolina.

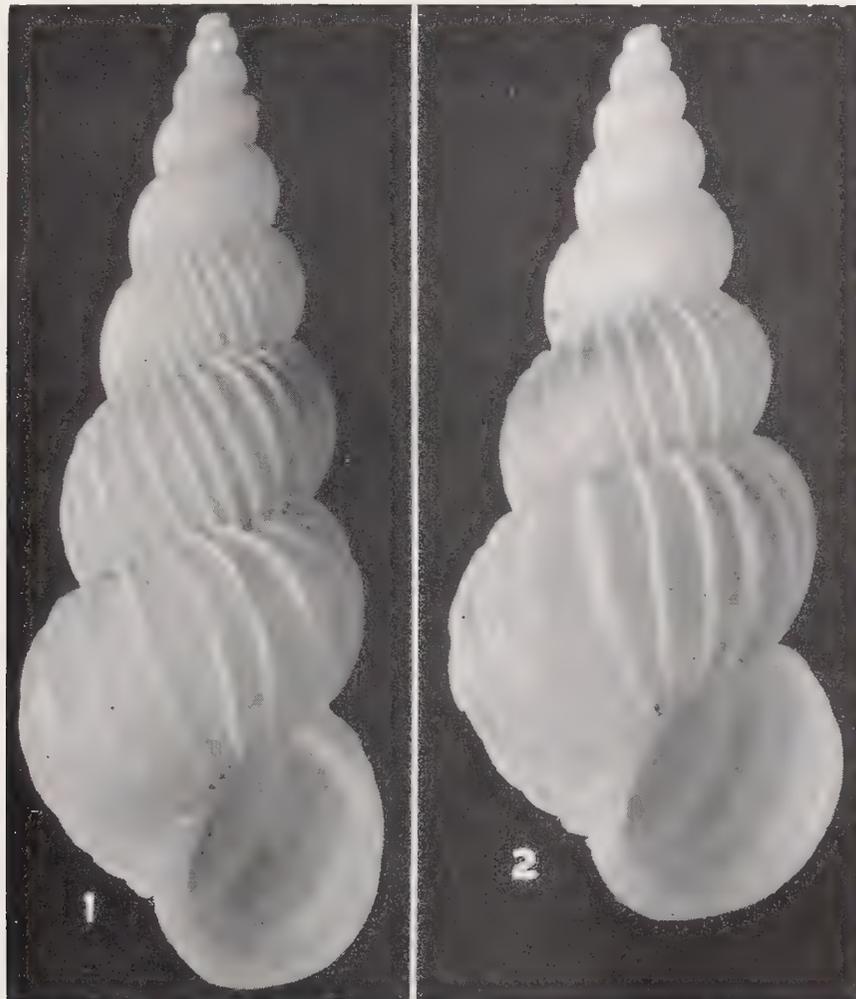


Plate 133. *Epitonium multistriatum* Say

Fig. 1. *Epitonium leptaleum* Bush (= *E. multistriatum* Say) from *Albatross*, station 2277, off Cape Hatteras, North Carolina. Holotype (7x). Fig. 2. Isle of Palms, South Carolina (about 9x).

Remarks. *Epitonium leptaleum* Bush appears to us to be an absolute synonym of *E. multistriatum* Say. It exactly duplicates specimens of *E. multistriatum* we have seen from Sullivans Island, Charleston, South Carolina. Though Say's original description is brief, it is clear and the species is well figured in his *American Conchology*. *E. virginicum* Henderson and Bartsch is a very young specimen of this species. In older specimens the nuclear whorls are generally lost and unless this is understood there may appear to be a disproportionate number of whorls to the size of the shell. *E. ellioti* Mazyck is also a young specimen and it appears to us to be an absolute synonym of *E. multistriatum* Say.

There is considerable variation in the number and spacing of the costae, a factor which probably has been responsible for the large number of synonyms. The costae are very numerous on the early postembryonic whorls. As the animal increases in size, the costae become more widely spaced and fewer in number on the last or body whorl. Fully adult specimens of 9 to 9½ whorls possess 16 to 18 costae on the body whorl, while a specimen of only 5 to 6 whorls may have as many as 46 costae on the body whorl.

This species is not particularly common to judge by the comparatively few specimens we have seen. It occurs in depths from a little below low water to 120 fathoms and is found mainly on sandy bottoms.

Epitonium multistriatum is readily separated from others in this complex by the very large number of costae which are particularly numerous on the early whorls. It also differs from *E. novangliae* and *E. denticulatum* by lacking the hooks or angles on the costae at the whorl shoulder. From *E. candeanum* it differs by having more numerous and much finer costae, by having finer spiral sculpture, by being somewhat larger in size and having less globose whorls.

Range. From Buzzards Bay, Massachusetts south to Cape Canaveral, Florida and probably along the north coast of the Gulf of Mexico from Florida to Texas.

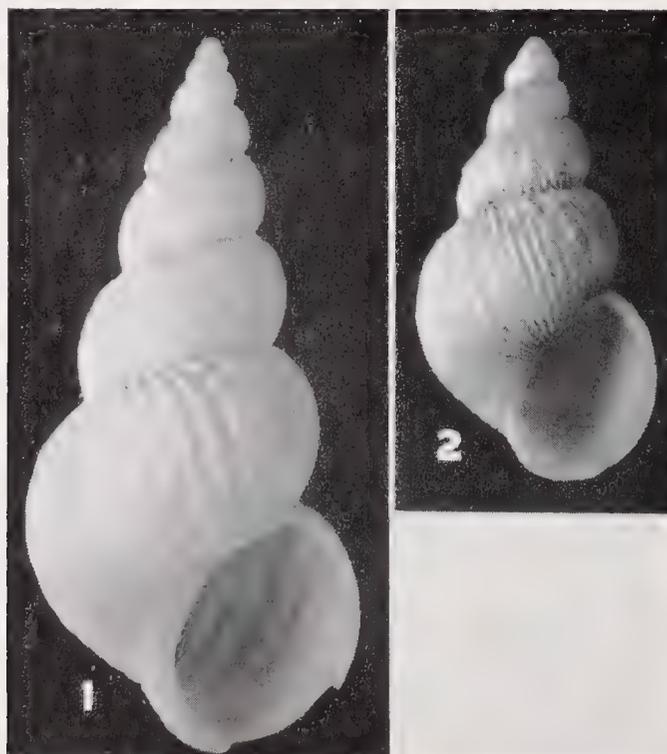


Plate 134. *Epitonium multistriatum* Say

Fig. 1. *Epitonium ellioti* Mazyck (= *E. multistriatum* Say) Pawleys Island, South Carolina. Holotype (10.7x). Fig. 2. *Epitonium virginicum* Henderson and Bartsch (= *E. multistriatum* Say) Chincoteague Island, Virginia. Holotype (15.5x).

Records. MASSACHUSETTS: Mattapoisett; Vineyard Sound (both MCZ); *Fish Hawk*, station 863, off Cuttyhunk Light, Vineyard Sound (USNM). RHODE ISLAND: Sakonnet Point (MCZ); Block Island (MCZ; USNM). NEW JERSEY: Atlantic City; Ocean City (both ANSP). VIRGINIA: Chincoteague Island; Smith's Island; Lynnhaven Bay, Chesapeake Bay (all USNM). NORTH CAROLINA: *Albatross*, station 2278, off Cape Hatteras (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}20'$) in 16 fathoms (ANSP; Peabody Museum, Yale Univ.); *Albatross*, station 2277, off Cape Hatteras (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}19'$) in 16 fathoms; *Albatross*, station 2595, 22 miles S.E. of Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}05'$) in 63 fathoms; *Albatross*, station 2592, off Cape Hatteras (N. Lat. $35^{\circ}02'$; W. Long. $75^{\circ}12'$) in 120 fathoms; off Cape Lookout in 8 fathoms (all USNM); Shackleford Island (MCZ); Beaufort; off Cape Fear (N. Lat. $33^{\circ}35'$; W. Long. $77^{\circ}36'$) in $12\frac{1}{2}$ fathoms (both ANSP); 12 miles E. of Frying Pan Shoals (USNM). SOUTH CAROLINA: Pawleys Island; Isle of Palms; Folly Island (all Charleston Museum); Sullivans Island (MCZ). FLORIDA: St. Augustine (USNM); Ponce de Leon Inlet, Daytona (E. Bates); Cape Canaveral (Charleston Museum). TEXAS: Galveston; Port Aransas (both T. Pulley).

***Epitonium multistriatum matthewsae*, new subspecies**

Plate 135

Description. Shell reaching 13 mm. (about $\frac{1}{2}$ inch) in length, rather light in structure, imperforate and possessing both axial costae and spiral threads. Color a china-white. Whorls 9 to 10, moderately convex and attached well down in the suture. Spire extended



Plate 135

Epitonium multistriatum matthewsae
Clench and Turner, Sanibel Island,
Florida. Holotype (8.4x).

and produced at an angle of 23° . Aperture elliptical with the outer lip slightly reflected. Parietal lip rather tightly appressed against the lower costae. Columella not defined. Suture profound. Sculpture consisting of numerous blade-like costae which are low and slightly reflected backward. There are 13 to 18 costae on the body whorl. These axial

costae are far more numerous on the early whorls than they are on the later whorls. There is no indication of any shoulder angles. Spiral sculpture consisting of numerous fine threads which do not pass over the costae. Nuclear whorls about $2\frac{1}{2}$, white, glass-like and smooth. There is no basal ridge. Operculum unknown.

length	width	whorls	
11	4 mm.	10	Holotype
10.5	3.5	9	off Fort Walton, Florida
12	3.9	9.5	Sanibel Island, Florida
13.5	4.5	8 *	“ “ “

* early whorls lost

Types. Holotype, Museum of Comparative Zoölogy, no. 197134, from Sanibel Island, Florida. Paratypes from the same locality in the Museum of Comparative Zoölogy, the United States National Museum, the collections of Jay Weber and N. E. Schmidt.

Remarks. This subspecies can be readily differentiated from the typical form by being smaller in proportion to the number of whorls as well as being more attenuate. The whorls are attached at the base of a deep suture whereas in *E. multistriatum* the whorls are very close together but are actually attached only by the costae, at least on the later whorls. The costae are exceedingly numerous on the early whorls as in the typical form.

This subspecies, along with several others, indicates that there is a slightly different faunistic element along the west coast of Florida. It is here that *Epitonium tollini* Bartsch and *Dinocardium robustum vanhyningi* Clench and Smith also occur, additional forms not known elsewhere in the Western Atlantic.

We take pleasure in naming this subspecies for Charlotta Matthews of Sanibel Island, Florida, whose interest and aid have meant much to a generation of malacologists.

Range. West coast of Florida from off Fort Walton south to Marco, Florida.

Records. FLORIDA: 15 to 35 miles off Fort Walton (L. A. Burry); Egmont Key (USNM); Sanibel Island (MCZ; USNM; Jay Weber; N. E. Schmidt); Marco Island (USNM).

Epitonium (Asperiscala) rushii Dall

Plate 136

Scala rushii Dall 1889, Bulletin Museum Comparative Zoölogy **18**, pt. 2, p. 313 (off Cape Hatteras, North Carolina in 49-63 fathoms, *Albatross*, stations 2595 and 2596).

Description. Shell reaching 9 mm. (about $\frac{3}{8}$ inch) in length, attenuate, imperforate and rather light in structure. Whorls 12, moderately convex and attached. Color a very pale straw-yellow with occasional specimens showing irregular bands or patches of reddish-brown. Spire extended and formed at an angle of about 25° . Suture deep but not profound. Aperture subcircular to subovate with little or no development of a parietal shield. Columella rather short and arched. Axial sculpture consisting of numerous low, blade-like costae which become a little higher at the sutures. There are 25 to 27 costae on the body whorl. Spiral sculpture consisting of numerous threads which do not cross over the costae. There is no basal ridge. Nuclear whorls 3 to 4, glass-like and smooth. Operculum thin, yellow and paucispiral.

length	width	whorls	
9	3.1 mm.	12	off Key West, Florida
8	2.8	12	“ “ “ “
5.5	2.2	10 (broken)	Holotype

Types. Holotype, United States National Museum, no. 83698, from *Albatross*, station 2596, 17 miles off Cape Hatteras, North Carolina (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}10'$) in 49 fathoms. Paratypes from the same locality and from *Albatross*, station 2595, 22 miles off Cape Hatteras, North Carolina (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}05'$) in 63 fathoms.

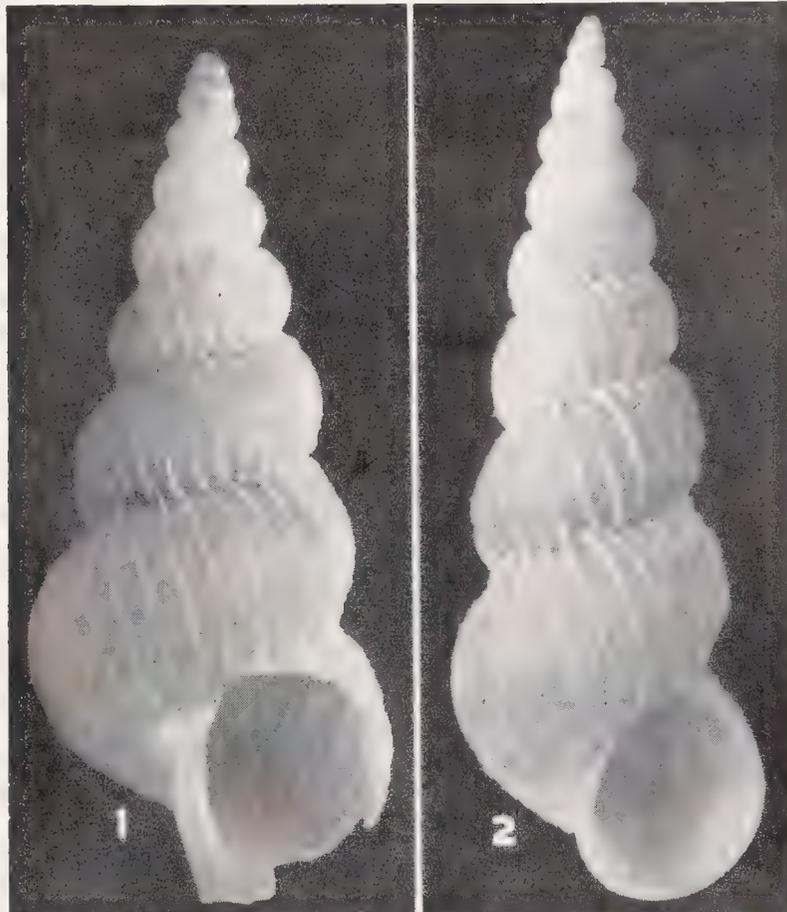


Plate 136. *Epitonium rushii* Dall

Fig. 1. From *Albatross*, station 2596, about 17 miles off Cape Hatteras, North Carolina in 49 fathoms. Holotype (15.5x). Fig. 2. From off Key West, Florida in 63 fathoms (about 10x).

Remarks. This appears to be a rare species. It occurs in fairly deep water ranging from 38 to 100 fathoms. In relationship it appears to be nearest to *E. polaceum* Dall differing by having much stronger spiral threads and a more uniform cone to the spire. It is also related to *E. turritellulum* Mörch, but *E. rushii* is much larger and is proportionately wider and has more convex whorls. Both have a very similar sculpture.

Range. North Carolina south through the Florida Keys.

Records. NORTH CAROLINA: *Albatross*, station 2595, 22 miles off Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}05'$) in 63 fathoms; *Albatross*, station 2596, 17 miles off Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}10'$) in 49 fathoms (both USNM). FLORIDA: off Boynton (Gilbert Voss); *Eolis*, station 160, off Sand Key in 62 fathoms; *Eolis*, station 1, off Key West in 55 fathoms; *Eolis*, station 42, off Key West in 60 fathoms;

Eolis, station 183, off Fowey Light in 80 fathoms; *Eolis*, station 69, off Miami in 38 fathoms (all USNM); off Looe Key, Marathon in 70 to 90 fathoms; off American Shoals, Cudjoe Key in 50 fathoms; off Sombrero Light in 90–100 fathoms (all L. A. Burry).

Epitonium (*Asperiscala*) *turritellulum* Mörch

Plate 137

Scala turritellula Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 264; Mörch 1875, Malakozologische Blätter **22**, p. 151; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 202 (St. Martin's [Lesser Antilles]).

Scala turritellula var. *riisei* Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 264; Mörch, 1875, Malakozologische Blätter **22**, p. 151; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 202 (St. Thomas [Virgin Islands]; Porto Plata [Hispaniola]).

Scala rushii stylina Dall 1889, Bulletin Museum Comparative Zoölogy **18**, pt. 2, p. 313 (Samana Bay, Santo Domingo [Hispaniola]).

Description. Shell reaching 6.4 mm. (about $\frac{1}{4}$ inch) in length, attenuate, imperforate and fairly strong. Whorls 10, moderately convex and attached. Color a flat china-white. Spire extended and formed at an angle of 17° to 18° . Suture deep but not profound. Aperture circular with a moderately thickened lip. Columella short and arched. Axial sculpture consisting of numerous, low, blade-like costae which become somewhat higher at the suture. A few of these costae become thickened, forming varices. There are 20 costae on the body whorl. Spiral sculpture consisting of numerous and very regular

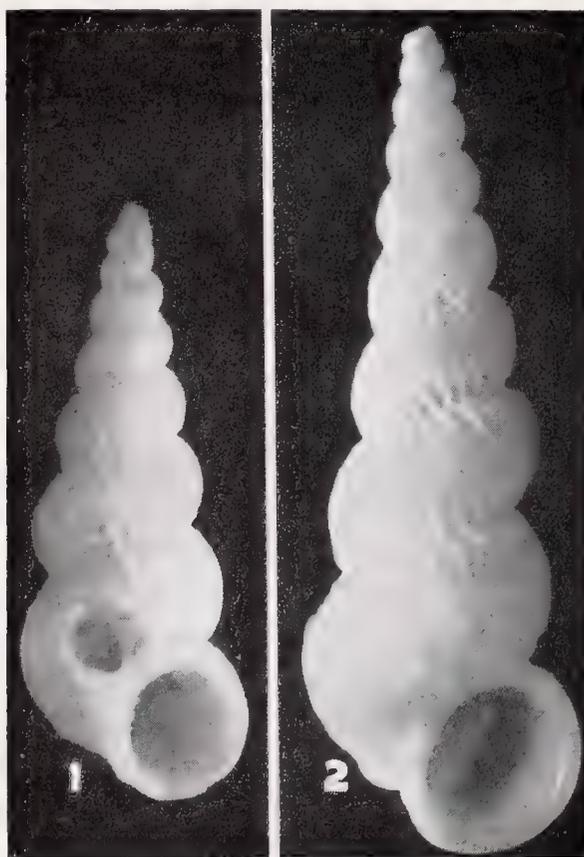


Plate 137. *Epitonium turritellulum* Mörch

Fig. 1. *Epitonium rushii* var. *stylinum* Dall (= *E. turritellulum* Mörch) Bahía de Samaná, Santo Domingo, Hispaniola. Holotype (14x). Fig. 2. *Epitonium turritellulum* var. *riisei* Mörch (= *E. turritellulum* Mörch) St. Thomas, Virgin Islands. Cotype (13.5x).

threads which do not cut over the costae. Nuclear whorls 2 to 3, glass-like and smooth. Operculum unknown.

length	width	whorls	
6.4	2 mm.	11	Cotype of <i>riisei</i>
4.7	1.7	9 (broken)	Holotype of <i>stylinum</i>

Types. The whereabouts of the type of *E. turritellulum* Mörch is unknown. A cotype of *E. turritellulum riisei* Mörch from St. Thomas, Virgin Islands is in the Universitetets Zoologiske Museum, København, Denmark. The holotype of *E. rushii stylinum* Dall is in the United States National Museum, no. 54828, from Bahía de Samaná, Hispaniola.

Remarks. See remarks under *E. rushii* Dall. *Epitonium turritellulum* Mörch is a very rare species and to date is known from only three rather widely separated localities. Dall's *E. rushii stylinum*, even though a broken specimen, is an unquestionable synonym.

We have no knowledge as to where this present species lives. It probably occurs in fairly deep water as so few specimens have been obtained.

Range. Known only from Jamaica and east to the Virgin Islands.

Records. HISPANIOLA: Bahía de Samaná, Santo Domingo (USNM). VIRGIN ISLANDS: St. Thomas (Univ. Zool. Mus. København, Denmark). JAMAICA: Robins Bay, St. Mary's (USNM).

***Epitonium (Asperiscala) tenuistriatum* d'Orbigny**

Plate 138

Scalaria tenuistriata d'Orbigny 1840, Voyage dans l'Amérique Méridionale 5, pt. 3, p. 390, pl. 54, fig. 4-6 (Bahía Blanca [Buenos Aires, Argentina]).

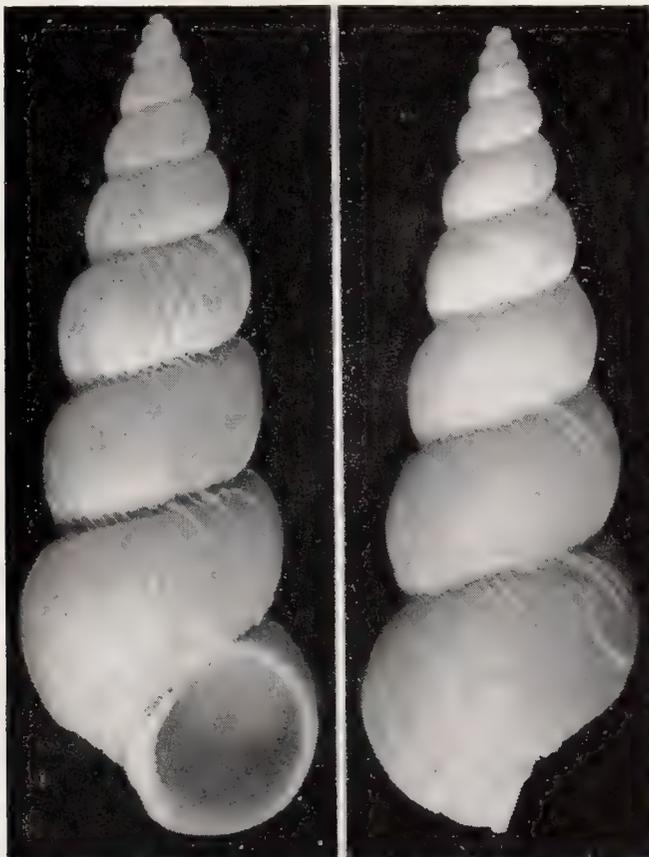


Plate 138. *Epitonium tenuistriatum* d'Orbigny
Puerto San Antonio, Rio Negro, Argentina (2.3x).

Description. Shell reaching 28.5 mm. (about $1\frac{1}{8}$ inches) in length, attenuate, imperforate and fairly solid. Whorls 10 (nuclear whorls missing), strongly convex and attached. Color a flat china-white. Spire produced and formed at an angle of 27° . Suture deep but not profound. Aperture subcircular. A small parietal shield is pressed tightly over the low costae. Columella short and arched. Axial sculpture consisting of numerous low almost cord-like costae which are not angled at the whorl shoulder. There are 34 costae on the body whorl. These costae vary considerably in width. Spiral sculpture consisting of numerous and rather strong threads which do not pass over the costae. Generally the earlier whorls have far more costae than appear on the body whorl. There is no basal ridge. Nuclear whorls and the operculum unknown.

length	width	whorls	
28.5	9.8 mm.	9*	Puerto San Antonio Oeste, Golfo San Matías, Rio Negro, Argentina
17.5	7.0	8*	La Coronilla, Uruguay

* loss of 2 or 3 early whorls

Types. According to Gray 1854, the types of *E. tenuistriatum* d'Orbigny are in the British Museum. The type locality is Bahía Blanca (39° South Latitude), Buenos Aires, Argentina.

Remarks. This is a large and characteristic species of the Argentinian coast line. In relationship it appears to be nearest to *E. multistriatum* Say from which it differs by being much larger and by having more numerous and much finer axial costae. The two species appear to be related, based upon the similarity in their sculpture and the fact that they have more numerous costae on their earlier whorls.

Range. Cabo Palonio, Uruguay south to the Golfo San Matías, Rio Negro, Argentina.

Records. URUGUAY: Cabo Palonio (USNM); La Coronilla (A. Carcelles); Maldonado (Univ. of Michigan; ANSP). ARGENTINA: Puerto San Antonio Oeste, Golfo San Matías, Rio Negro (A. Carcelles).

Epitonium (Asperiscala) frielei Dall

Plate 139

Scala frielei Dall 1889, Bulletin Museum Comparative Zoölogy **18**, pt. 2, p. 313 (*Albatross*, station 2595, off Cape Hatteras, North Carolina).

Description. Shell reaching 15.5 mm. (about $\frac{5}{8}$ of an inch) in length, conic, umbilicate and very light in structure. Whorls 12, strongly convex and attached. Color a flat white. Spire somewhat extended and produced at an angle of about 40° . Aperture nearly circular. Columella short and arched. Axial sculpture consisting of numerous very low, thin, blade-like costae. There are 52 costae on the body whorl. In addition these costae appear somewhat irregular, particularly as to their spacing. Spiral sculpture consisting of numerous threads which, crossing the costae, form a reticulated surface on the shell. The axial costae are without hooks at the whorl shoulder and are a little stronger than the spiral threads. Umbilicus fairly wide and deep and partially covered by the parietal reflection. There is no basal ridge. Nuclear whorls $3\frac{1}{2}$, very small, smooth, glass-like and faintly brown in color. Operculum unknown.

length	width	whorls	
15.5	9.5 mm.	12	Lake Worth, Florida
4.8	2.6	8	Holotype

Types. The holotype of *E. frielei* is in the United States National Museum, no. 83727, from the *Albatross*, station 2595 (N. Lat. 35°08'; W. Long. 75°05') about 20 miles off Cape Hatteras, North Carolina in 63 fathoms.

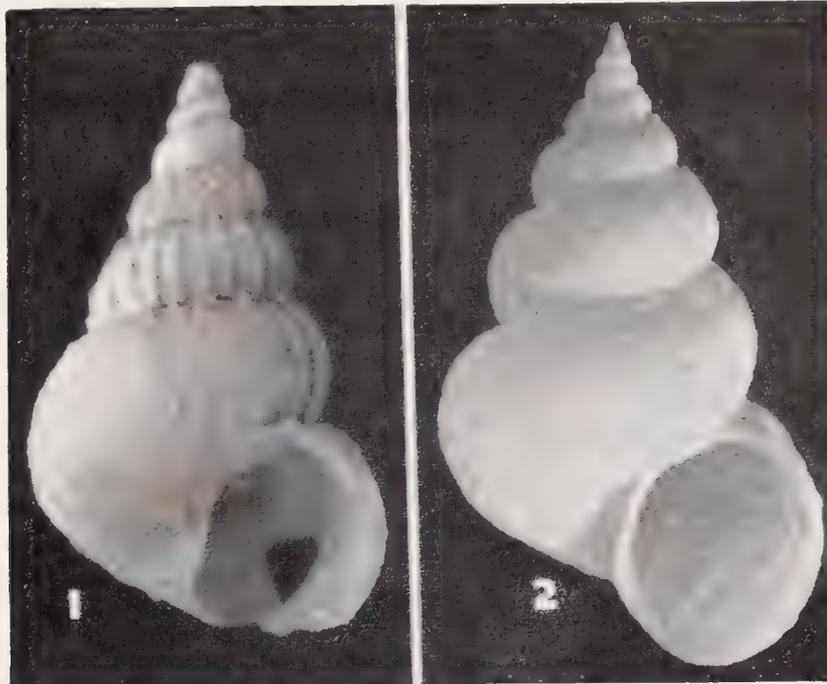


Plate 139. *Epitonium frielei* Dall

Fig. 1. From *Albatross*, station 2595, 22 miles off Cape Fear, North Carolina in 63 fathoms. Holotype (13.3x). Fig. 2. From off Lake Worth, Florida in 75 fathoms (4x).

Remarks. We have seen but six specimens of this very beautiful species. Dall's type is a young and broken specimen, and a single paratype, somewhat smaller, is also broken. However, we are able to figure a large specimen collected by Tom McGinty from off Lake Worth, Florida.

Range. North Carolina south to the Florida Keys.

Records. NORTH CAROLINA: *Albatross*, station 2595, 20 miles off Cape Hatteras (N. Lat. 35°08'; W. Long. 75°05') in 63 fathoms (USNM). FLORIDA: off Lake Worth in 75 fathoms (T. McGinty); *Eolis*, station 329, off Sambo Reef in 135 fathoms (USNM).

Epitonium (Asperiscala) candeanum d'Orbigny

Plates 140, 141

Scalaria candeana d'Orbigny 1842 [in] Sagra, Histoire de l'Isle de Cuba, Mollusques 2, p. 20, pl. 11, fig. 28-30 (Jamaica and St. Thomas).

Scalaria turricula Sowerby [in part] 1844, Thesaurus Conchyliorum 1, Scalaria, p. 92, pl. 34, fig. 88 (West Indies); not plate 33, fig. 61¹; non *Scalaria turricula* Sowerby 1873,² Conchologica Iconica 19, pl. 8, fig. 59a-b (West Indies); non *S. turricula* Cantraine 1842.

¹ Sowerby has figured two different species under this name, one from the West Indies and one from the Philippines. The Philippine species has been named *S. confusa* by E. A. Smith, based upon Sowerby's description and figure. (E. A. Smith 1890, Proc. Zoological Society, London, p. 273.)

² This reference applies to the Philippine form described by the elder Sowerby.

Scalaria turrita Nyst 1871, Annales Société Malacologique de Belgique **6**, p. 142 [new name for *turricula* Sowerby 1844, non *Contraîne* 1842]; non *turrita* de Blainville 1827.

Scalaria antillarum de Boury 1909, Journal de Conchyliologie **57**, p. 258 [new name for *turrita* Nyst 1871; non de Blainville 1827].

Description. Shell reaching 10 mm. (about $\frac{1}{2}$ inch) in length, attenuate and imperforate. Whorls 11 to 13, moderately convex and attached. Color a more or less uniform dull-white to a light-brown. Suture deeply impressed. Aperture subcircular with a thickened and somewhat expanded lip. A small parietal shield extends over the umbilical area. Columella short and arched. Axial sculpture consisting of numerous, strong, blade-like and occasionally reflected costae which sometimes develop small angles at the whorl

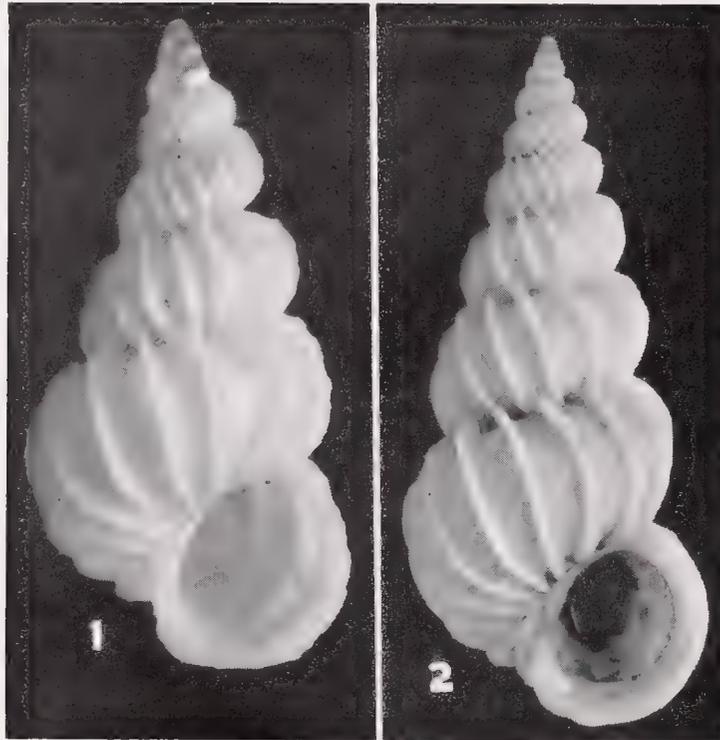


Plate 140. *Epitonium candeanum* d'Orbigny

Fig. 1. Off Fowey Light, Florida (about 19.5x).

Fig. 2. Lake Worth, Boynton, Florida (10.5x).

shoulder. On the body whorl these costae pass below the parietal shield and into the umbilicus and above they extend well into the suture, a factor causing the whorls to become nearly separated. There are 18 to 25 costae on the body whorl. Spiral sculpture consisting of numerous, fine, distinct ridges which are crossed by exceedingly fine axial threads. There is no basal ridge. Nuclear whorls 3 and smooth. Operculum paucispiral, thin and yellowish-brown in color.

length	width	whorls	
7.0	2.3 mm.	13	Boynton, Lake Worth, Florida
9.5	3.0	13	" " " "

Types. The types of this species are probably in the British Museum. The type locality is here restricted to Kingston, Jamaica, a locality from which we have seen specimens.

Remarks. *Epitonium candeanum* differs from *E. novangliae*, *E. denticulatum*, and *E. pourtalesi* by lacking the angles or hooks on the costae at the whorl shoulder or else having these angles very small and relatively inconspicuous. Also the microscopic sculpture between the costae is generally coarser. From *E. multistriatum* it differs by having fewer and stronger costae and in being smaller.

This species occurs in depths from low water to about 300 fathoms.

Range. Florida, Bermuda, the Bahamas, and south through the Lesser Antilles to the Barbados.

Records. FLORIDA: off Palm Beach in 50 to 70 fathoms; Lake Worth; off Lake Worth in 90 fathoms; Boynton Beach (all T. McGinty): *Eolis*, station 51, off Miami in 24 fathoms; *Eolis*, station 78, off Fowey Light in 30 fathoms; *Eolis*, station 182, off Fowey Light in 75 fathoms; *Eolis*, station 339, off Ragged Key in 100 fathoms; *Eolis*,

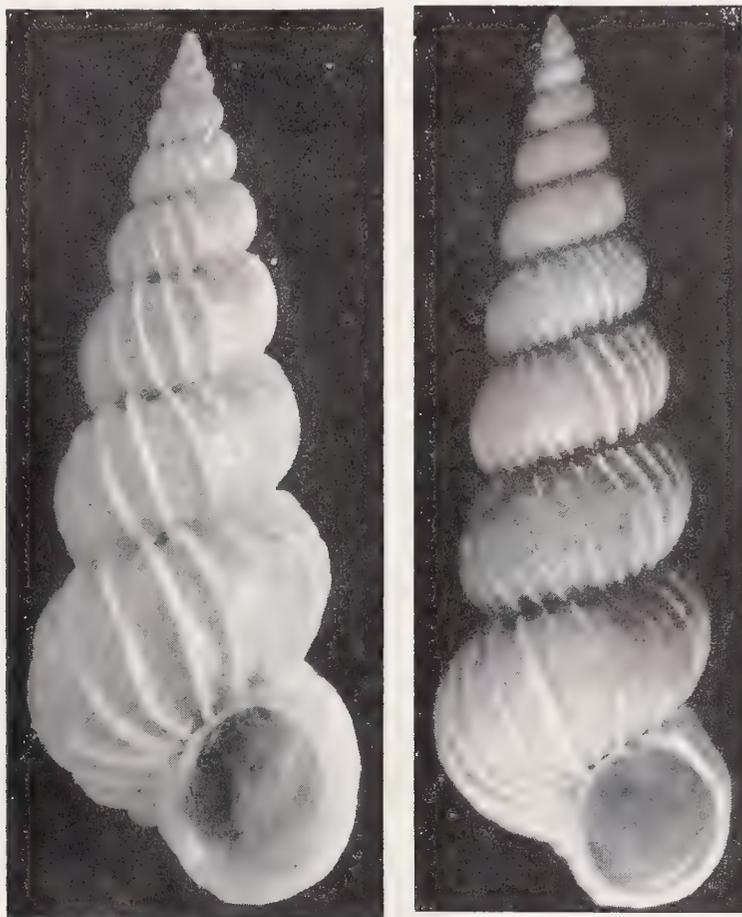


Fig. 1.

Fig. 2

Plate 141. *Epitonium candeanum* d'Orbigny, Lake Worth, Florida (Fig. 1, about 10x; Fig. 2, 16x).

station 100, off Sand Key in 65 fathoms; off Key West in 7 fathoms; off Tortugas in 90 fathoms (all USNM); Dry Tortugas (ANSP); Cape Sable (N. E. Schmidt). BERMUDA: Harrington Sound (MCZ). BAHAMA ISLANDS: off Mintie Bar, southeast end of South Bight, Andros Island (USNM). CUBA: *Barrera*, station 208, Bahía Honda in 1 to 12 fathoms (USNM). HISPANIOLA: Bahía de Samaná, Santo Domingo; Les trois Pavillons, Dept. du Nord-Ouest, Haiti; Saltrou, Dept. de l'Ouest, Haiti (all USNM). LESSER ANTILLES: Anguilla in 300 to 400 fathoms (B. Hubendick); Falmouth, Antigua; English Harbour, Antigua; off Barbados in 94 fathoms; off Pelican Island, Barbados in 33 to 80 fathoms; off Telegraph Station, Barbados in 18 fathoms (all USNM).

***Epitonium candeanum* subspecies *marcoense* Dall**

Plate 142

Epitonium marcoense Dall 1927, Proceedings United States National Museum 70, Art. 18, p. 60 (off Fernandina; off Marco, Florida and off Georgia¹).

¹ All of the stations are off Florida. Actually Dall's record for Georgia is south of the station given for Fernandina.

Description. Shell reaching about 8 mm. (about $\frac{1}{3}$ inch) in length, attenuate and imperforate. Whorls 10, convex, barely attached, and with a profound suture. Axial sculpture consisting of numerous, thin, blade-like costae numbering 22 on the body whorl. Spiral sculpture consisting of exceedingly fine spiral threads. Nuclear whorls 3, glass-like, smooth and white. Operculum unknown.

length	width	whorls	
8.0	3 mm.	10	Holotype, off Fernandina, Florida
6.2	2.8	9	off Fowey Light, Florida
8.0	3.0	10	off Palm Beach, Florida

Types. Holotype, United States National Museum, no. 108017, from the *Albatross*, station 2668 (N. Lat. $30^{\circ}58'$; W. Long. $79^{\circ}38'$) in 294 fathoms. Paratypes from the same locality and from the *Albatross*, station 2415 (N. Lat. $30^{\circ}44'$; W. Long. $79^{\circ}26'$) in 440 fathoms, both off Fernandina, Florida.

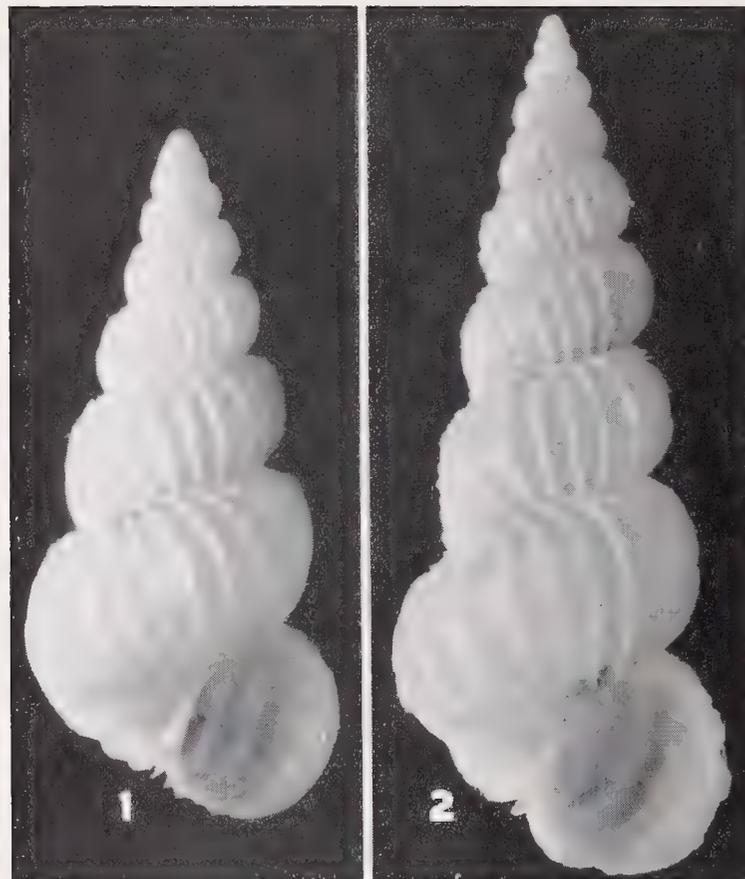


Plate 142. *Epitonium candeanum marcoense* Dall

Fig. 1. From *Albatross*, station 2668, off Fernandina, Florida in 294 fathoms. Holotype (16x). Fig. 2. From off Palm Beach, Florida in 110 fathoms (11.3x).

Remarks. This subspecies is only slightly different from *Epitonium candeanum*. It differs in being smaller, much lighter in structure and in having finer, more numerous costae and having the spiral threads exceedingly fine.

Dall's choice of name was most unfortunate as the specimens that he had from Marco Island on the west coast of Florida were not at all the same as his type specimens from deep water of the northeast coast of Florida. His original specimens from Marco are *Epitonium multistriatum matthewsae* Clench and Turner, a very different form.

Range. Off the northeast coast of Florida south to the northern Florida Keys.

Records. FLORIDA: *Albatross*, station 2668 (N. Lat. 30°58'; W. Long. 79°38') in 294 fathoms; *Albatross*, station 2415 (N. Lat. 30°44'; W. Long. 79°26') in 440 fathoms, both off Fernandina (both USNM); off Palm Beach in 110 fathoms (T. McGinty); *Eolis*, station 179, off Fowey Light in 70 fathoms; *Eolis*, station 351, off Fowey Light in 90 fathoms; *Eolis*, station 350, off Triumph Reef, Elliott Key in 70-90 fathoms (all USNM).

***Epitonium (Asperiscala) tiburonense*, new species**

Plate 143

Description. Shell reaching about 6.8 mm. ($\frac{1}{4}$ inch) in length, attenuate and imperforate. Whorls 9, convex and attached. Color a light reddish-brown throughout, occasionally with a darker area just below the suture. Costae white. Suture deeply impressed. Aperture subcircular with a thickened outer lip. Parietal area rather narrow and tightly appressed against the body whorl. Columella short and arched. Axial sculpture consisting of numerous strong and somewhat thickened blade-like costae which do not produce



Plate 143

Epitonium tiburonense Clench and Turner, Aquin,
Dept. du Sud, Haiti. Holotype (12.5x).

angles or hooks at the whorl shoulder. The costae merge at the parietal area where they become somewhat flattened to form a thickened pad. There are 12 to 14 costae on the body whorl. Spiral sculpture consisting of very fine axial threads which are uniformly disposed over the whorl. There is no basal ridge. Nuclear whorls 3, smooth, glass-like and whitish in color. Operculum unknown.

length	width	whorls	
6.8	3 mm.	9	Aquin, Haiti (Holotype)
6.2	2.8	8.5	“ “ (Paratype)

Types. Holotype, United States National Museum, no. 440128, from Aquin, Dept. du Sud, Haiti. Paratypes from the same locality in the United States National Museum and the Museum of Comparative Zoölogy. Additional paratypes in the United States National Museum from Baie Anglaise, Dept. du Sud, Haiti.

Remarks. Fresh specimens of this species can be distinguished readily from all other *Epitonium* in the Western Atlantic by their uniform red-brown color, small, white costae and lack of a basal ridge. In relationship this species appears to be nearest to *E. candeanum* d'Orbigny. It differs from this species by being smaller, proportionately wider, by having much finer spiral threads and fewer costae. The costae on one whorl of *E. tiburonense* usually line up with those on the whorl above, while in *E. candeanum* the costae are more numerous on the early whorls and do not have a tendency to line up from one whorl to the next. From *E. albidum*, another species with which it might be confused, it differs in having well developed spiral sculpture, in being red-brown in color and in being proportionately smaller. It is similar to *E. albidum* in its shape and in having the costae more or less line up with the costae on the whorl above.

It is quite remarkable that this new form seems to have such a limited distribution, the two localities from which specimens are known are actually only one area, the Baie d'Aquin being only a small part of the larger Baie Anglaise.

This species is named for the southwest peninsula of Haiti which is often referred to as the Shark or Tiburón Peninsula.

Range and Records. Known only from Baie Anglaise and Aquin, Dept. du Sud, Haiti.

***Epitonium (Asperiscala) novangliae* Couthouy**

Plates 144, 145, 146

Scalaria novangliae Couthouy 1838, Boston Journal of Natural History **2**, p. 96, pl. 3, fig. 5 (from stomach of a cod taken off Cape Ann, Massachusetts).

Scalaria uncinati-costa d'Orbigny 1842 [in] Sagra, Histoire de l'Isle de Cuba, Mollusques **2**, p. 19, pl. 11, fig. 25-27 (Guadeloupe).

Scala aeospila Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 15 (St. Croix); Mörch 1875, Malakozoologische Blätter **22**, p. 151; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 202.

Scalaria muscapedia Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, pt. 2, p. 314 (25 miles off Cape Fear, North Carolina).

Epitonium bahamensis 'Dall' Peile 1926, Proceedings Malacological Society London **17**, p. 80 (nude name).¹

Description. Shell reaching about 14 mm. (about $\frac{1}{2}$ inch) in length, attenuate, umbilicate, rather light in structure and having axial costae and spiral threads. Whorls 8 to 10, strongly convex, with the early whorls attached, while generally the later whorls are attached by the costae only. Color white to banded light-brown, with the interrupted bands of brown being just above and below the periphery of the whorl. Generally the coloration is strongest on the last two whorls. Occasional specimens occur in which the brownish coloration is diffused throughout the shell. Suture rather deeply impressed to profound. Aperture subcircular to ovate with a narrowly expanded lip. Parietal lip moderately developed, thickened and appressed to the body whorl above the umbilical opening.

¹ As this name has appeared in Peile's list we include it here as a synonym. We figure the specimen of Dall, but so far as we can trace, this species was never described by Dall.

Columella not defined. Umbilicus narrow and partially hidden by the parietal lip. Axial sculpture consisting of numerous blade-like to cord-like costae. The cord-like costae are produced by a backward and downward reflection of the outer edge of the costae. There are from 9 to 16 costae on the body whorl. On the whorl shoulder there is generally developed a fine hook or angle on each costa, these angles usually being reflected backwardly. Spiral sculpture consisting of exceedingly numerous and fine thread-like lines which are crossed by somewhat finer axial threads giving a fine reticulated pattern to the

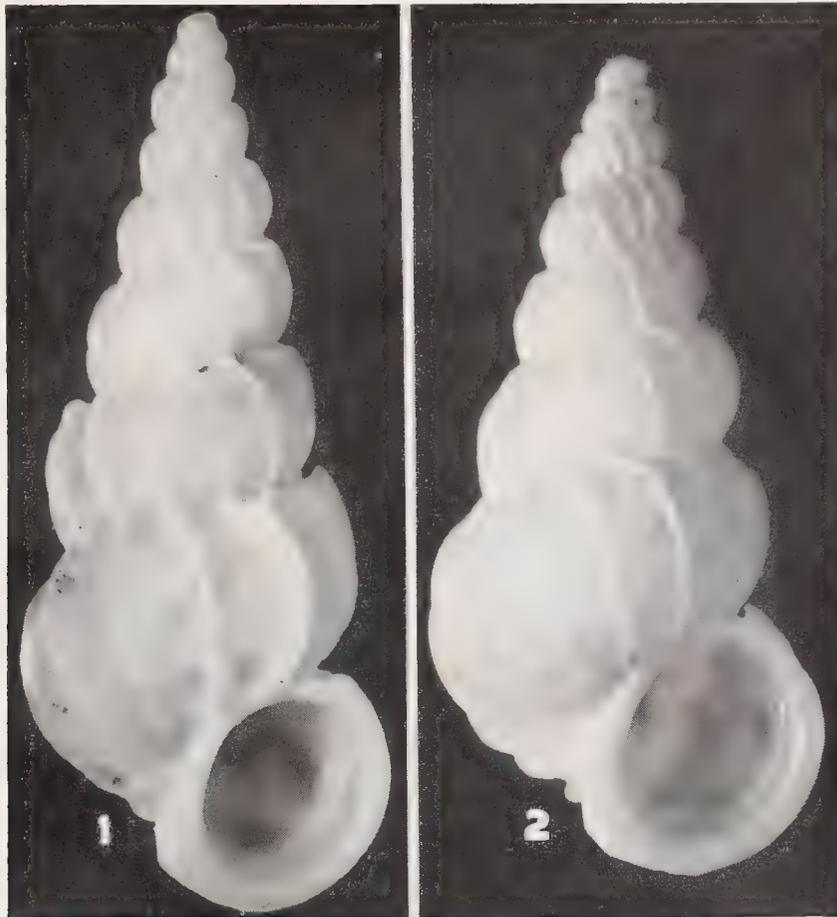


Plate 144. *Epitonium novangliae* Couthouy

Fig. 1. From stomach of a cod, taken off Cape Ann, Massachusetts. Holotype (7x). Fig. 2. *Epitonium muscapedium* Dall (= *E. novangliae* Couthouy), from *Albatross*, station 2619, off Cape Fear, North Carolina. Holotype (7x).

shell between the costae. However, there appears to be a fair amount of variation in the strength of the axial threads; in some specimens they are detected only under rather strong magnification. On young specimens the spiral threads are generally much stronger than the axial threads, while on the body whorl of large specimens the spiral and axial threads are of nearly equal strength. Nuclear whorls white to brownish, opaque, glass-like and smooth. There is no basal ridge. Operculum corneous, paucispiral and dark-brown in color.

length	width	whorls	
13.2	5.4 mm.	9*	Holotype of <i>novangliae</i> Couthouy
14.3	6.0	10*	off Cape Lookout, North Carolina
11.8	5.5	9*	Holotype of <i>muscapedium</i> Dall

* loss of one and possibly two early whorls.

Types. The holotype of *E. novangliae* Couthouy is in the Museum of Comparative Zoölogy, no. 182888, taken from the stomach of a cod off Cape Ann, Massachusetts. The holotype of *E. muscapedium* Dall is in the United States National Museum, no. 83721 from the *Albatross*, station 2619, from off Cape Fear, North Carolina (N. Lat. 33°38'; W. Long. 77°36') in 15 fathoms. The type of *E. uncinati-costum* d'Orbigny is probably in the British Museum.

As the type of *E. novangliae* was adventitiously present off Cape Ann, it seems best to select the locality of *E. muscapedium* Dall for the type locality of this species. This latter came from the *Albatross*, station 2619, about 25 miles off Cape Fear, North Carolina. To our knowledge *E. novangliae* has never been collected north of Virginia since the original specimen was obtained.



Plate 145. *Epitonium novangliae* Couthouy
Epitonium denticulatum bahamense 'Dall' Peile
 (= *E. novangliae* Couthouy) Bahamas (8.2x).

Remarks. This species is one of the larger members of this complex. The whorls are unattached other than by the costae and are very globose. One of the distinctive characters is the spotted coloration which appears on many of the specimens. However, this color is not strong and may be entirely absent. In relationship it appears nearest to *candeanum*, but differs by its much larger size, by having heavier and more widely spaced costae and unattached whorls. The intercostal sculpture is much finer in this species than in *candeanum* and this latter species does not possess a reticulated sculpture.

This species has an extensive distribution ranging from Virginia south through the West Indies to Brasil. It appears, however, to be rare at the extremities of its range. *Epitonium novangliae* occurs in depths from low water to about 250 fathoms.

Range. From Massachusetts (adventitious) and Virginia south to Brasil.

Records. MASSACHUSETTS: off Cape Ann, in stomach of a cod (MCZ). VIRGINIA: *Fish Hawk*, station 8338, off Butler's Bluff in 4 fathoms (USNM); *Fish Hawk*, station

8369, off Horseshoe Light, Chesapeake Bay (USNM). NORTH CAROLINA: *Albatross*, station 2278, off Cape Hatteras (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}20'$) in 16 fathoms (Yale University); *Albatross*, station 2596, 17 miles off Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}10'$) in 49 fathoms; *Albatross*, station 2112, off Cape Hatteras (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}18'$) in $15\frac{1}{2}$ fathoms (both USNM); *Albatross*, station 2277, off Cape Hatteras (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}19'$) in 16 fathoms (Yale University); Beaufort (MCZ; USNM; Univ. of Michigan); *Albatross*, station 2619, 25 miles off Cape Fear (N. Lat. $33^{\circ}38'$; W. Long. $77^{\circ}36'$) in 15 fathoms; off Cape Lookout in 6 to 9 fathoms; off Fryingpan Shoals in 12 fathoms (all USNM). FLORIDA: St. Augustine (USNM); Cape Canaveral (Charleston Museum); off Palm Beach in 20 to 110 fathoms; Lake Worth in 2-3 fathoms (both T. McGinty); off Fort Lauderdale in 75 fathoms; off Hollywood in 45 fathoms (both L. A. Burry); *Eolis*, station 49, off Miami in 30 fathoms; *Eolis*, station 165, off Fowey Light in 78 fathoms (both USNM); off Looe Key, Marathon in 70-90 fathoms (L. A. Burry); *Eolis*, station 338, off Sand Key in 61-85 fathoms; *Eolis*, station 42, off Key West in 60 fathoms; *Eolis*, station 33, off Tortugas in 16 fathoms (all USNM); off Destin in 14 fathoms (T. McGinty); off Fort Walton in 16 fathoms (L. A. Burry); Little Clearwater Pass (ANSP); off St. Petersburg; Boca Grande; Marco (all USNM); Sanibel (MCZ); Fort Myers Beach (N. E. Schmidt); TEXAS: Gulf Beach, Padre Island (L. A. Weisenhaus). BERMUDA: (Bermuda Government Museum; USNM). BAHAMA ISLANDS: Clifton Point, New Providence (T. McGinty). CUBA: Veradero, near Cardenas (ANSP); off Habana (M. Jaume); *Barrera*, station 208, off Bahía Honda in 1-12 fathoms (USNM); *Atlantis*, station 3331

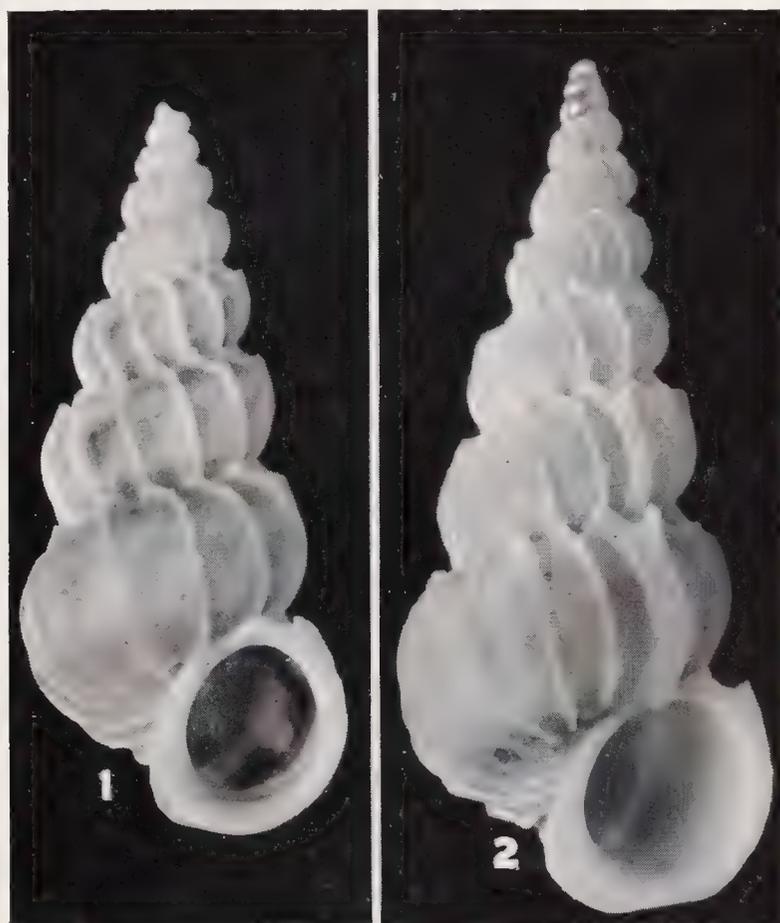


Plate 146. *Epitonium novangliae* Couthouy

Fig. 1. From off Fort Walton, Florida in 16 fathoms (6.7x).

Fig. 2. From off Sand Key, Florida in 85 fathoms (about 14x).

and 3332, Bahía Cochinos in 230 to 260 and 175 to 225 fathoms (MCZ). PUERTO RICO: Culebra Island (USNM). JAMAICA: Kingston Harbour; Montego Bay (both USNM). HISPANIOLA: Anse O'Hamvolt, Haiti (USNM); Baie Anglaise, near Aquin, Dept. du Sud, Haiti (USNM). VIRGIN ISLANDS: St. Thomas (MCZ). LESSER ANTILLES: Anguilla in 100–250 fathoms; St. Martins in 200–300 fathoms (both H. Hubendick); St. Martins (ANSP); *Blake*, off Barbados in 100 fathoms (MCZ); Spey Side, Tobago Island (H. G. Kugler). BRASIL: off Rio de Janeiro in 59 fathoms (USNM).

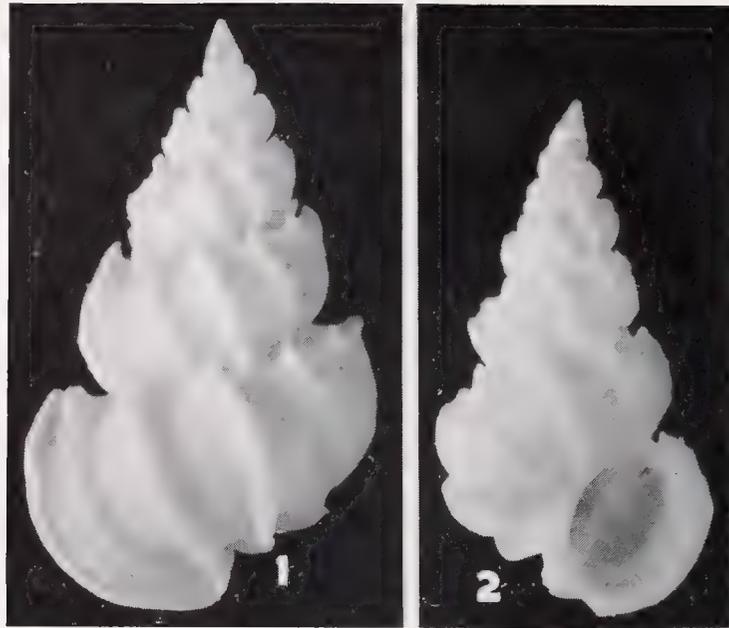


Plate 147. *Epitonium denticulatum* Sowerby

Fig. 1. Boynton, Lake Worth, Florida (10x). Fig. 2. Off Bears Cut, Miami, Florida in 18–20 fathoms, *Eolis*, station 113 (9.2x).

Epitonium (Asperiscula) denticulatum Sowerby

Plates 147, 148

Scalaria denticulata Sowerby 1844, Thesaurus Conchyliorum 1, Scalaria, p. 87, species 19, pl. 32, fig. 25–26 (West Indies).

Scala (Aciona) centiquadra Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 255 [new name for *Scalaria denticulata* Sowerby,¹ non *Turbo denticulata* Montagu]; Mörch 1875, Malakozoologische Blätter 22, p. 145; Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) 8, p. 194, pl. 29, fig. 4 (Anguilla; St. Thomas; St. Croix).

Scala octocostata Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 260 (St. Thomas [Virgin Islands]); Mörch 1875, Malakozoologische Blätter 22, p. 148; Mörch 1875, Journal Academy Natural Sciences, Philadelphia (2) 8, p. 198.

Description. Shell reaching 15 mm. (about $\frac{5}{8}$ of an inch) in length, attenuate and umbilicate. Whorls 12 to 13, strongly convex and separated, being attached by the costae only. Color a flat china-white. Spire produced and formed at an angle of about 30°. Suture profound. Aperture subcircular and holostomatous. A small parietal shield is

¹ Mörch proposed the name *centiquadra* for *Scalaria denticulata* Sowerby 1844, non *Turbo denticulata* Montagu 1803. However, Montagu's species was described as a *Turbo* and is now considered to be in the Rissoidae, not in the Epitoniidae. Montagu's species was never figured, and according to Forbes and Hanley 1853, p. 149, the type is lost and the species remains unknown.

generally formed and is appressed against the costae and may extend somewhat over the umbilical area. Columella short and oblique. Axial sculpture consisting of numerous and well developed blade-like costae which are strongly angled at the whorl shoulder. These costae may be bent slightly backward. There are 11 to 12 costae on the body whorl, and these pass below the parietal shield and into the umbilical area. Spiral sculpture consisting of numerous and very fine threads which are crossed by exceedingly fine axial threads giving the shell a reticulated surface. There is no basal ridge. Nuclear whorls 5, glass-like and smooth. Operculum thin, paucispiral, corneous and yellowish-brown in color.

length	width	whorls	
15.0	7 mm.	9 *	St. Thomas, Virgin Islands
9.5	4.6	11	Boynton, Lake Worth, Florida

* early whorls lost.



Plate 148. *Epitonium denticulatum* Sowerby
Epitonium centiquadrum Mörch (= *E. denticulatum* Sowerby),
 St. Thomas, Virgin Islands. Lectotype ($5\frac{1}{2}x$).

Types. The type specimen of *E. denticulatum* Sowerby is probably in the British Museum. Original specimens of *E. centiquadrum* Mörch are in the Universitetets Zoologiske Museum, København, Denmark and the Academy of Natural Sciences, Philadelphia. As Sowerby gave only the West Indies as a locality we here limit the type locality to St. Thomas, Virgin Islands where many collectors such as Krebs, Swift, and Riise obtained the material upon which Mörch's name is based.

Remarks. This species is exceedingly close to *E. pourtalesii* Verrill and Smith from which it differs by being a little smaller, more attenuate and having the microscopic sculpture faintly reticulate. In *E. pourtalesii* the spiral threads predominate, the axial threads being either exceedingly weak or entirely absent.

Epitonium denticulatum appears to be limited to the West Indian Zone while *E. pourtalesii* extends nearly to the northern limit of the Carolinian Zone.

Epitonium denticulatum occurs from just below low water line to depths up to 75 fathoms. The *Blake*, at station 2, in the Straits of Yucatan, obtained a dead specimen in 805 fathoms but this would appear to be adventitious at this locality.

Range. From Fort Pierce, Florida, the Bahama Islands and south to the Virgin Islands.

Records. FLORIDA: Fort Pierce (USNM); off Palm Beach in 20 fathoms; Lake Worth; Boynton Beach (all T. McGinty); off Hillsboro Light in 30 to 50 fathoms; off Fort Lauderdale in 40 to 75 fathoms (both L. A. Burry); *Eolis*, station 139, off Miami in 30 fathoms (USNM); off The Elbow, Key Largo in 66 fathoms; off Molasses Reef, Key Largo in 75 fathoms; 1½ mi. southeast of Looe Key, off Marathon in 25-39 fathoms (all L. A. Burry). BAHAMA ISLANDS: Great Abaco (USNM); Northeast Point, Cat Island (MCZ). CUBA: *Blake*, station 2, Yucatan Straits in 805 fathoms; *Barrera*, station 203, Bahía de Cabañas in 3-12 fathoms (both USNM). VIRGIN ISLANDS: St. Thomas (Univ. Zool. Mus. Denmark; ANSP).

Epitonium (Asperiscala) pourtalesii Verrill and Smith

Plate 149

Scalaria pourtalesii Verrill and Smith 1880, American Journal of Science **20**, p. 395; Verrill 1882, Transactions Connecticut Academy **5**, pt. 2, p. 527, pl. 57, fig. 32 (*Fish Hawk*, station 874, from off Barnegat Bay, New Jersey in 85 fathoms).

Description. Shell reaching 22 mm. (about $\frac{7}{8}$ inch) in length, rather attenuate and umbilicate. Whorls 9 to 10, very strongly convex and separated, attached by the costae only. Color a flat white. Spire produced at an angle of about 35° to 40°. Suture profound. Aperture subcircular and holostomatous. A small parietal shield is usually formed and is appressed against the costae. Columella short and oblique. Axial sculpture consisting of numerous and well developed blade-like costae which are strongly angled or hooked at the whorl shoulder, and may be bent slightly backward. There are 11 to 14 costae on the body whorl and these pass below the parietal shield and into the umbilical area. Spiral sculpture consisting of numerous fine threads. Axial threads barely visible or lacking. There is no basal ridge. Nuclear whorls 4, glass-like and smooth. Operculum thin, paucispiral, corneous and dark-brown in color.

length	width	whorls	
18	9.5 mm.	7*	Bermuda
15.5	9.1	7*	Holotype
22	12	7*	off Barnegat Bay, New Jersey

* early whorls lost.

Types. The holotype of *E. pourtalesii* Verrill and Smith is in the United States National Museum, no. 44801 from the *Fish Hawk*, station 874 (N. Lat. 40°00'; W. Long. 70°57') in 85 fathoms. There is a single paratype in the Peabody Museum, Yale University from the *Fish Hawk*, station 873 (N. Lat. 40°02'; W. Long. 70°57') in 100 fathoms. Both these stations are about 145 miles east of Barnegat Bay, New Jersey.

Remarks. See also remarks under *E. denticulatum*.

This species has been dredged in depths of 43 to 600 fathoms. It seems to be quite rare as only one or two specimens appear in any one dredge haul. This species occurs in much deeper water than *E. denticulatum*.

Range. In deep water from New Jersey south to the Virgin Islands.

Records. NEW JERSEY: about 120 miles east of Barnegat Bay in 80 fathoms (MCZ): *Fish Hawk*, station 873 about 145 miles east of Barnegat Bay (N. Lat. $40^{\circ}02'$; W. Long. $70^{\circ}57'$) in 100 fathoms; *Fish Hawk*, station 871, about 160 miles east of Barnegat Bay (N. Lat. $40^{\circ}02'$; W. Long. $70^{\circ}23'$) in 115 fathoms (both Yale University): *Fish*

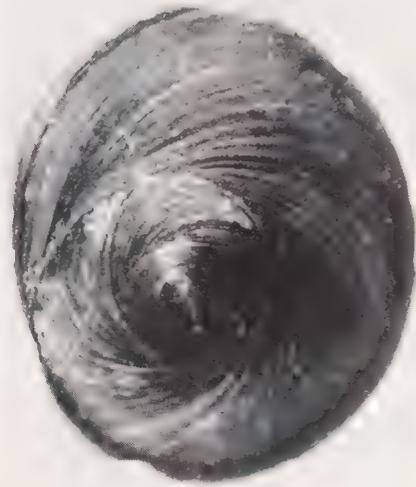


Fig. 2

Fig. 1 Plate 149. *Epitonium pourtalesii* Dall

Fig. 1. *Fish Hawk*, station 874, from about 145 miles east of Barnegat Bay, New Jersey. Holotype (6x). Fig. 2. Operculum of the same specimen (12x).

Hawk, station 874, about 145 miles east of Barnegat Bay (N. Lat. $40^{\circ}00'$; W. Long. $70^{\circ}57'$) in 85 fathoms; *Fish Hawk*, station 876, about 150 miles east of Barnegat Bay (N. Lat. $39^{\circ}57'$; W. Long. $70^{\circ}56'$) in 120 fathoms; *Albatross*, station 2244, about 160 miles east of Barnegat Bay (N. Lat. $40^{\circ}05'$; W. Long. $70^{\circ}23'$) in 67 fathoms; *Fish Hawk*, station 949, about 170 miles east of Barnegat Bay (N. Lat. $40^{\circ}03'$; W. Long. $70^{\circ}31'$) in 100 fathoms; *Fish Hawk*, station 1038, about 180 miles east of Barnegat Bay, (N. Lat. $39^{\circ}58'$; W. Long. $70^{\circ}06'$) in 146 fathoms (all USNM). NORTH CAROLINA: *Albatross*, station 2596, about 18 miles off Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}10'$) in 49 fathoms; *Albatross*, station 2600, about 45 miles east of Cape Lookout (N. Lat. $34^{\circ}39'$; W. Long. $75^{\circ}35'$) in 87 fathoms; *Albatross*, station 2601, about 50 miles east of Cape Lookout (N. Lat. $34^{\circ}39'$; W. Long. $75^{\circ}33'$) in 107 fathoms (all USNM).

FLORIDA: *Atlantis*, station 3779, off St. Augustine (N. Lat. $30^{\circ}21'$; W. Long. $79^{\circ}55'$) in 230–250 fathoms (MCZ); off Lake Worth in 90 fathoms (T. McGinty); 18 miles off Delray in 300–325 fathoms (L. A. Burry); *Eolis*, station 309, off Fowey Light in 60 fathoms (USNM); off Cudjoe Key in 50 fathoms; off Sombrero Light in 90 to 100 fathoms (both L. A. Burry); *Eolis*, station 337, off Sand Key in 90 fathoms; *Eolis*, station 43, off Key West in 43 fathoms (both USNM); off Fort Walton (L. A. Burry). BERMUDA: (H. Moore). BAHAMA ISLANDS: 14 miles west of Gun Cay, Bimini Islands in 351 fathoms (USNM). CUBA: *Atlantis*, station 2989, off Sagua la Grande (N. Lat. $23^{\circ}10'$; W. Long. $80^{\circ}04'$) in 360 fathoms (MCZ); *Atlantis*, station 3459, off Sagua la Grande, Las Villas (N. Lat. $23^{\circ}21'$; W. Long. $80^{\circ}36'$) in 500 fathoms (Museo Poey); *Atlantis*, station 3369, off Puerto Tanamo (N. Lat. $20^{\circ}49'$; W. Long. $75^{\circ}08'$) in 600 fathoms (Museo Poey). VIRGIN ISLANDS: *Caroline*, station 93, 20 miles northwest of St. Thomas (N. Lat. $18^{\circ}38'$; W. Long. $65^{\circ}09'$) in 350 fathoms (USNM). LESSER ANTILLES: Barbados, off Lazaretto (USNM).

Epitonium (Asperiscala) babylonium Dall

Plate 150

Scala babylonia Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, pt. 2, p. 311 (*Albatross*, station 2678, 160 miles due east of Charleston, South Carolina).

Description. Shell reaching 29.5 mm. ($1\frac{1}{4}$ inches) in length, very attenuate, imperforate and rather thin. Whorls 16 to 17, strongly convex and attached. Color a flat china-white. Spire greatly extended and formed at an angle of about 15° . Suture deep but not profound. Aperture subcircular with a flattened parietal shield appressed against the costae and extending completely over the umbilical area. Columella short and straight. Axial sculpture consisting of numerous and well developed blade-like costae which are strongly angled or hooked near the whorl shoulder. There are 24 costae on the body whorl of the holotype. These costae pass below the parietal shield and into the umbilical area. Spiral sculpture consisting of rather numerous fine threads which are crossed by exceedingly fine axial threads. There is no basal ridge. Nuclear whorls $2\frac{1}{2}$, glass-like and smooth. Operculum unknown.

length	width	whorls	
28.5	6.5 mm.	$14\frac{1}{2}$ *	Holotype
12.8	4.5	$12\frac{1}{2}$ (young)	off Bahía de Cardenas, Cuba

* loss of about two early whorls.

Types. The holotype of *E. babylonium* is in the United States National Museum, no. 83723, *Albatross*, station 2678 (N. Lat. $32^{\circ}40'$; W. Long. $76^{\circ}40'$) in 731 fathoms, about 160 miles due east of Charleston, South Carolina.

Remarks. This species is very close in its general appearance to *E. fractum* and *E. dallianum*. It differs from both by possessing fine spiral threads. From the group or species associated with *novangliae* and *multistriatum*, it differs by being larger and far more attenuate.

The two specimens figured on our plate look rather different, but figure 2 is double the magnification of figure 1 and, in addition, the specimen is in perfect condition, showing the well developed angles on the whorl shoulder. In this species the angles are de-

veloped much lower on the costae than they are on other species that we have examined.

This species is found in rather deep water, the few records obtained having a depth range of 66 to 731 fathoms.

Range. In deep water from off Cape Lookout, North Carolina south to the north coast of Cuba.

Records. NORTH CAROLINA: *Albatross*, station 2600, about 45 miles due east of Cape Lookout (N. Lat. $34^{\circ}39'$; W. Long. $75^{\circ}35'$) in 87 fathoms (USNM). SOUTH CAROLINA: *Albatross*, station 2678, about 160 miles due east of Charleston (N. Lat. $32^{\circ}40'$; W. Long. $76^{\circ}40'$) in 731 fathoms (USNM). FLORIDA: off Hillsboro Light in 66 to 83 fathoms (L. A. Burry); *Eolis*, station 371, off Fowey Light in 110 fathoms (USNM). CUBA: *Atlantis*, station 3475, off Bahía de Cardenas (N. Lat. $23^{\circ}18'$; W. Long. $80^{\circ}48'$) in 400 fathoms (MCZ).

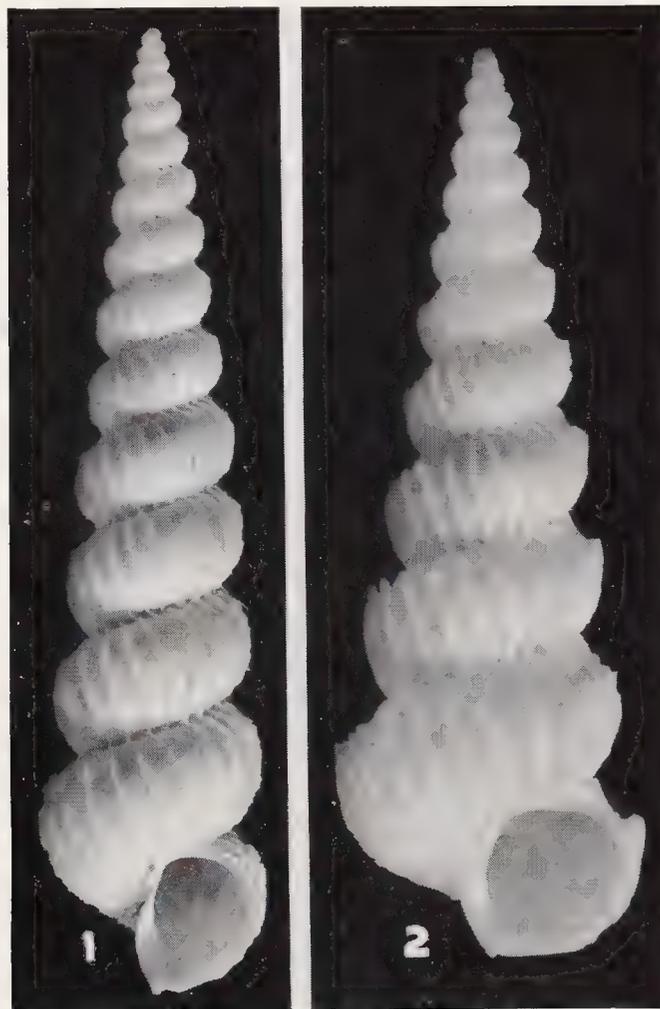


Plate 150. *Epitonium babylonium* Dall

Fig. 1. From 160 miles east of Charleston, South Carolina, *Albatross*, station 2678. Holotype (3.3x). Fig. 2. From off Bahía de Cardenas, Cuba (7x).

Epitonium (Asperiscula) polacium *Dall*

Plate 151

Scala polacia Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, pt. 2, p. 319, pl. 18, fig. 10 (off Cuba [30 miles southwest of Key West, Florida]).

Description. Shell reaching 8 mm. (about $\frac{3}{8}$ of an inch) in length, attenuate, imperforate and rather light in structure. Whorls 12 to 13, moderately convex and attached. Color a flat white. Spire extended and produced at an angle of 15° . Suture well indented. Aperture subcircular. Columella rather short and nearly straight. Axial sculpture consisting of numerous low, thin, blade-like costae. There are 26 to 28 costae on the body whorl, with no indication of hooks or angles at the whorl shoulder. Spiral sculpture consisting of numerous and very fine threads with no indication of axial threads. There is no basal ridge. Nuclear whorls 3 to 4, the first three very small, glass-like, smooth and brownish in color. Operculum unknown.

length	width	whorls	
7	2.5 mm.	12	Holotype
8	2.7	13	off Sambo Reef, Florida



Plate 151. *Epitonium polacium* Dall

Blake, station 5, from off Florida (N. Lat. $24^\circ 15'$; W. Long. $82^\circ 13'$). Holotype ($10\frac{1}{2}x$).

Types. The holotype of *E. polacium* is in the United States National Museum, no. 106910, from the *Blake*, station 5 (N. Lat. $24^\circ 15'$; W. Long. $82^\circ 13'$) in 229 fathoms, about 30 miles southwest of Key West, Florida.

Remarks. This species is characterized mainly by the peculiar shape of the spire. The first three whorls are very small, the fourth whorl enlarges rapidly and as a consequence the apex appears somewhat dome-shaped.

This species, so far as is known, has a very limited distribution being known only from the reefs off Key West, Florida in 115 to 229 fathoms.

Range. Known only from off Key West, Florida.

Records. FLORIDA: *Eolis*, station 322, off Sand Key in 115 fathoms; *Eolis*, station 316, off Sand Key in 120 fathoms; *Eolis*, station 331, off Sambo Reef in 118 fathoms; *Eolis*, station 330, off Sambo Reef in 120 fathoms; *Eolis*, station 329, off Sambo Reef in 135 fathoms; *Blake*, station 5, 30 miles southwest of Key West (N. Lat. 24°15': W. Long. 82°13') in 229 fathoms (all USNM).



Plate 152. *Epitonium sericifilum* Dall
From Honduras. Holotype (13x).

***Epitonium (Asperiscala) sericifilum* Dall**
Plate 152

Scala sericifila Dall 1889, Bulletin Museum Comparative Zoölogy 18, pt. 2, p. 313 (coast of Honduras).

Description. Shell reaching 5.1 mm. (about $\frac{1}{4}$ inch) in length, attenuate, imperforate and rather strong. Whorls 10, attached and angled at the periphery. Color a flat white. Spire extended and formed at an angle of 15°. Suture deep but not profound. Aperture subcircular with no parietal shield indicated. Columella short and arched. Axial sculpture consisting of very numerous and well developed low, oblique, costae which are quite uniform. There are 25 costae on the body whorl of the holotype. Spiral sculpture consisting of very numerous fine threads which do not pass over the costae. There is no basal ridge. Nuclear whorls $2\frac{1}{2}$, smooth and glass-like. Operculum unknown.

length	width	whorls	
5.1	1.8 mm.	10	Holotype

Types. Holotype, United States National Museum, no. 61190, from the coast of Honduras, Simpson collection.

Remarks. This species is known from only a single specimen. The oblique costae and well angled whorl periphery separates it from all other species in this group known to us.

Dall (1889, p. 124) has listed this species as possibly occurring in Texas but the specimen upon which the record from Galveston, Texas was based is badly worn and broken. It may be this species but was probably fortuitous at this locality as it has not been taken since that time.

Range and Records. Honduras (USNM).

Epitonium (Asperiscula) championi, new species

Plate 153

Description. Shell reaching about 14 mm. ($\frac{1}{2}$ inch) in length, attenuate, imperforate, rather solid and strongly sculptured. Whorls 10 to 11, convex and attached. Color a flat white to a light cream. Aperture subcircular, with both the palatal and parietal margins thickened, the palatal or outer lip being greatly thickened in older specimens. Columella short and arched. Spire extended and produced at an angle of 20° . Suture moderately impressed. Axial sculpture consisting of 8 or 9 flattened cord-like, slightly impressed costae which are rather variable as to width. Spiral sculpture consisting of 19 to 20 flattened ridges, those nearest the umbilical area being a little narrower. Basal ridge absent. Operculum thin, paucispiral and brown in color. Nuclear whorls $2\frac{1}{2}$ to 3, smooth and opaque.



Plate 153. *Epitonium championi* Clench and Turner
Lewis Bay, Hyannis, Massachusetts. Holotype (8.3x).

length	width	whorls	
13.7	5.5 mm.	9*	Shackleford Island, North Carolina
11.5	4.6	8*	Holotype

* early whorls broken.

Types. Holotype, Museum of Comparative Zoölogy, no. 182900 from Lewis Bay, Hyannis, Cape Cod, Massachusetts, M. E. Champion, collector. Paratypes from the same locality and from Dennisport; Mattapoissett and off Gay Head, Marthas Vineyard, all Massachusetts. Paratypes from Hyannis deposited in the United States National Museum.

Remarks. This species has been confused with *E. greenlandicum* Perry. It is, however, readily distinguished by its much smaller size, flattened axial costae and, most important, the lack of a basal ridge. The sculpture in *E. championi* appears much like a basket weave in which the upright and outer struts (the axial costae) are woven tightly, causing the horizontal weave (the spiral ridges) to bulge outwardly between the struts.

The species does not appear to be closely related to any other in the subgenus *Asperiscala*. It is perhaps a divergent element of *E. candeanum*, in which both axial and spiral sculpture have had an excess of development. On the other hand, it is somewhat similar to *E. greenlandicum* but the lack of a basal ridge easily separates these two species. We have considered the presence or absence of a basal ridge of subgeneric value but we may have over emphasized its importance.

This species is rare and local in its distribution. It has been found in the intertidal area and in depths up to 22 fathoms.

Range. South coast of Cape Cod, Massachusetts south to North Carolina.

Records. MASSACHUSETTS: Dennisport; Lewis Bay, Hyannis (both MCZ); Woods Hole (USNM); Mattapoissett; off Gay Head, Marthas Vineyard in 10 fathoms (both J. Miller); West Jetty, Nantucket (D. Taylor). RHODE ISLAND: Block Island (MCZ). NEW YORK: Noyack Bay, South Hampton, Long Island (R. Latham). NEW JERSEY: Atlantic City; Anglesea (both ANSP); McCrie Shoals, off Cape May (USNM). VIRGINIA: *Albatross*, station 2015, off Chincoteague Bay (N. Lat. 37°31'; W. Long. 74°53') in 19 fathoms; Smiths Island, Cape Charles (both USNM). NORTH CAROLINA: *Albatross*, station 2608, about 17 miles southeast of Cape Lookout (N. Lat. 34°32'; W. Long. 76°12') in 22 fathoms (USNM); Shackleford Island (MCZ); Frying Pan Shoals, Cape Fear (Univ. of Michigan).

Subgenus *Boreoscala* Kobelt

Boreoscala Kobelt 1902, Icon. der Schalentragenden europäischen Meeresconchylien 3, p. 23.

Arctoscala Dall 1909, United States Geological Survey, Professional Papers no. 59, p. 53 (subgenotype, *Scalaria greenlandica* Perry, original designation).

Liriscala de Boury 1909, Journal de Conchyliologie 57, p. 255 (subgenotype, *Scala groenlandica* Chemnitz, original designation).

Pyramiscala de Boury 1909, Journal de Conchyliologie 57, p. 255 (subgenotype, *Scalaria billaudeli* Mayer, original designation).

Subgenotype, *Scala groenlandica* Chemnitz (= *Scalaria greenlandica* Perry), original designation.

Shells imperforate and strongly sculptured, having axial costae which are generally thickened and not blade-like. Spiral sculpture rather coarse and consisting of flattened ridges. The whorls are attached and there is a well developed basal ridge.

Epitonium (*Boreoscala*) *greenlandicum* Perry

Plate 154

Turbo clathrus groenlandicus Chemnitz 1795, Conchylien-Cabinet (1) **11**, p. 155, pl. 195a, fig. 1878-1879 (Greenland) [non binomial].

Scalaria greenlandica Perry 1811, Conchology, London, pl. 28, fig. 8 (Greenland).

Scalaria similis J. Sowerby 1813, The Mineral Conchology of Great Britain **1**, p. 49, pl. 16, fig. 1-2 (fossil, Bramerton near Norwich, England); non *S. similis* G. B. Sowerby 1844.

Scalaria subulata Couthouy 1838, Boston Journal of Natural History **2**, p. 93, pl. 3, fig. 4 (Massachusetts Bay in the vicinity of Cape Ann).

Scalaria planicosta Kiener 1839, Iconographie Coquilles Vivantes **10**, Scalaria, p. 18, pl. 7, fig. 21 (locality unknown).

Scalaria grønlandica var. *crebricostata* G. O. Sars 1878, Mollusca, Regionis Arcticae Norvegiae, Christiania, p. 194, pl. 23, fig. 1 (Vadsö, Norway); non *S. crebricostata* Cooper 1870.

Scalaria groenlandica Posselt 1898, Grönlands Brachiopoder og Blöddyr. Meddelelser om Grönland **23**, p. 233.

Description. Shell reaching about 60 mm. ($2\frac{1}{2}$ inches) in length, attenuated, chalky and imperforate. Whorls 11 to 12, moderately convex and joined. Color a uniform grayish tan to chalky white. Suture moderately impressed. Aperture subcircular. Lip usually thickened. Columella short and arched. Axial sculpture consisting of numerous strong blade-like to ridge-like costae varying from 9 to 12 on the body whorl. These costae may be so strongly developed and recurved that they almost cover the intercostal spaces (form *lovenii*). Spiral sculpture consisting of a weak to a well developed basal ridge, though occasionally it may be entirely absent. In addition there are about 9 flattened and regularly spaced spiral cords above the basal ridge, and 3 to 5 flattened and relatively inconspicuous cords below it. Nuclear whorls 2 and smooth. Operculum paucispiral, corneous and generally colored a dark brown.

length	width	whorls	
36	12.8 mm.	11 *	Georges Bank, off Massachusetts
61	21	8 *	Alaska
35	12.5	11 *	Middle Bank, off Massachusetts

* probable loss of 2 or more whorls.

Types. The whereabouts of Perry's types is unknown to us. We here restrict the type locality to Godthaab, southwest Greenland, one of the several localities listed by Posselt. The type specimen of *Scalaria subulata* Couthouy has been lost. The type of *Scalaria planicosta* Kiener is in the Paris Museum. A cotype of *S. grønlandica* var. *crebricostata* G. O. Sars is in the Oslo Museum, Oslo, Norway.

Remarks. This species has long been known under the name of *groenlandicus* Chemnitz, but as the Conchylien-Cabinet (1) **11** is non-binomial it must date from Perry. Perry evidently attempted to copy the figure in Chemnitz and embellished his drawing with a few characters certainly not found in any specimen of this species that we have seen. All of Perry's figures on plate 28 are overdrawn and he also gave free rein to his imagination when coloring them.

This species occurs along the coast of southwest Greenland to Newfoundland and south to Long Island, New York. It is exceedingly rare in Labrador as Packard mentions but a single fragment obtained in his dredgings along this coast (1867, p. 284) and it is reported by Whiteaves as very rare in the Gaspé area of Quebec.

J. G. Jeffreys (1884, Proc. Zool. Soc. London, p. 137) reports a living specimen of *E. greenlandicum* that was dredged by the *Porcupine* between the Hebrides and Faroe Islands in 345 fathoms.

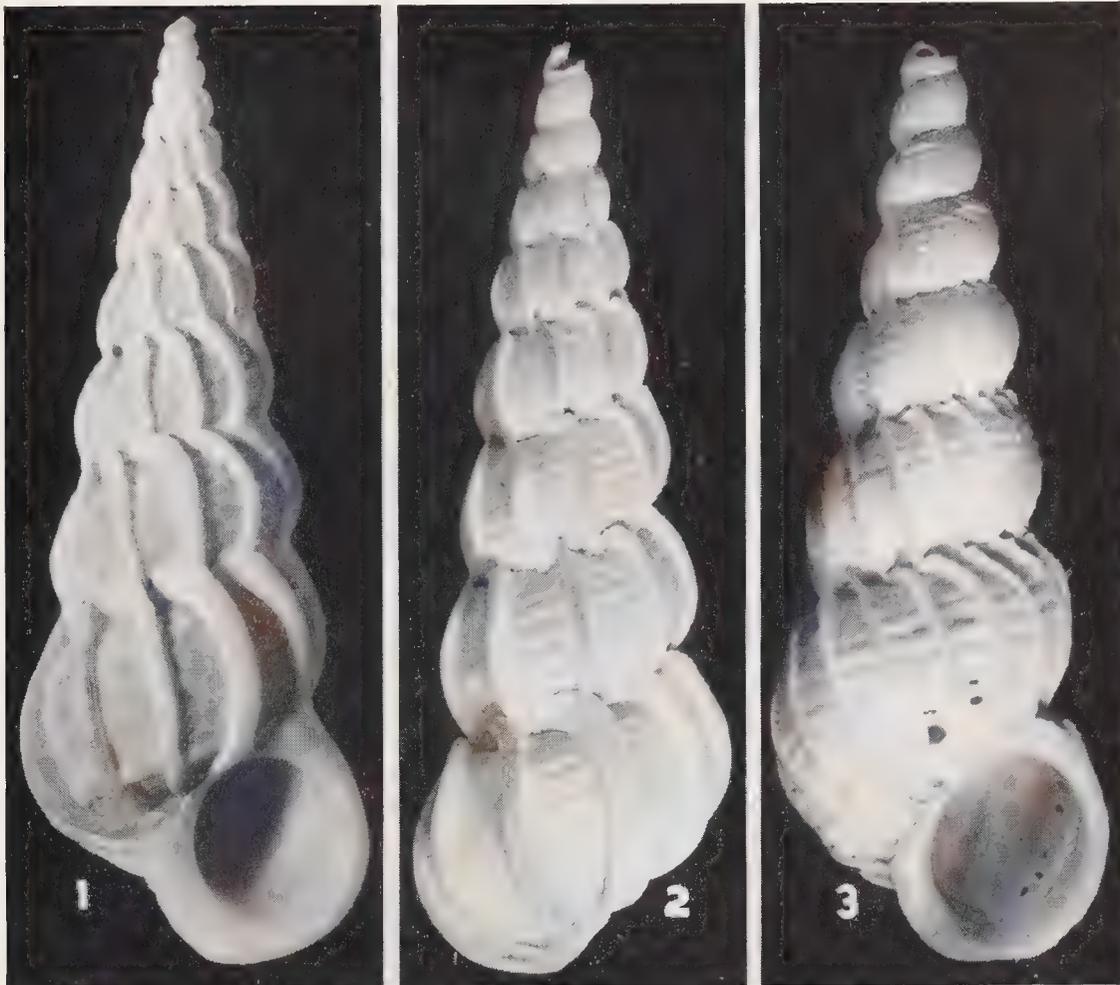


Plate 154. *Epitonium greenlandicum* Perry

Fig. 1. From Middle Bank, off Massachusetts in 35 fathoms (3x). Fig. 2. From Swampscott, Massachusetts (2.8x). Fig. 3. *Epitonium greenlandicum crebricostatum* Sars (= *greenlandicum* Perry), from Vadsö, Norway. Cotype (3.5x).

Range. Probably circumpolar. **EASTERN ATLANTIC:** From Spitzbergen south to southern Norway, the Faroe Islands and Iceland. **WESTERN ATLANTIC:** Godhavn, Greenland south to Montauk Point, Long Island, New York. **NORTHERN PACIFIC:** coasts of Alaska and Siberia.

Records. **WESTERN ATLANTIC. GREENLAND:** (Zool. Mus. Oslo). **NEWFOUNDLAND:** *Albatross*, station 2446, Eastern Shoals (N. Lat. $46^{\circ}20'$; W. Long. $49^{\circ}52'$) in 40 fathoms. **NOVA SCOTIA:** *Speedwell*, station 70, Emerald Bank (N. Lat. $42^{\circ}45'30''$; W. Long. $62^{\circ}43'$) in 190 fathoms (USNM); 14 miles south of Cape Sable; Bradelles Bank; Banquereau; Sable Island Bank; Brown's Bank in 40 fathoms (all MCZ); *Speedwell*, station 39, Brown's Bank (N. Lat. $42^{\circ}44'$; W. Long. $66^{\circ}27'$) in 75 fathoms; Digby; Halifax; *Albatross*, station 2520, off Cape Sable (N. Lat. $42^{\circ}41'$; W. Long. $64^{\circ}55'$) in 62 fathoms

(all USNM). NEW BRUNSWICK: Grand Manan Island in 40–45 fathoms (MCZ). MAINE: Eastport (MCZ); Little River Light in 20–40 fathoms; Bar Harbor (both USNM); Mt. Desert; Ironbound Island, Frenchman's Bay (both MCZ); Blue Hill Bay; Penobscott Bay (both USNM); Casco Bay (MCZ; USNM); Old Orchard (MCZ); Cape Porpoise (Charleston Museum). NEW HAMPSHIRE: *Bache*, station 46B, off Portsmouth (N. Lat. $43^{\circ}03'$; W. Long. $70^{\circ}04'$) in 51 fathoms (USNM); 150 miles off Portsmouth in 110 fathoms (MCZ). MASSACHUSETTS: Ipswich (MCZ); *Speedwell*, station 199, off Cape Ann (N. Lat. $42^{\circ}30'$; W. Long. $70^{\circ}20'$) in 98 fathoms; Salem (both USNM); Lynn; Duxbury; off Provincetown in 105 fathoms (all MCZ); *Speedwell*, station 344, off Provincetown (N. Lat. $42^{\circ}19'$; W. Long. $69^{\circ}47'$) in 130 fathoms (USNM); 17 miles off Chatham in 22 fathoms; 8 miles east of Nauset Light, Cape Cod (both MCZ); *Speedwell*, station 322, Stellwagen Bank (N. Lat. $42^{\circ}12'30''$; W. Long. $70^{\circ}01'$) in 67 fathoms; *Albatross*, station 2580, Cultivator Shoals (N. Lat. $41^{\circ}25'$; W. Long. $69^{\circ}01'$) in 83 fathoms; *Bache*, station 81B, Georges Bank (N. Lat. $41^{\circ}25'$; W. Long. $66^{\circ}45'$) in 28 fathoms (all USNM); Georges Bank (N. Lat. $41^{\circ}23'$; W. Long. $68^{\circ}45'$) in 50 fathoms (MCZ). RHODE ISLAND: *Fish Hawk*, station 815, 17 miles off Block Island Light in 29 fathoms (USNM). NEW YORK: *Fish Hawk*, station 986, off Montauk Point, Long Island (N. Lat. $40^{\circ}55'$; W. Long. $70^{\circ}48'$) in 28 fathoms (USNM); Fort Pond Bay, Montauk, Long Island (R. Latham).

EASTERN ATLANTIC. NORWAY: Vadsö; Vardö (both Tromsö Museum and Zool. Mus. Oslo); Porsanger Fjord (Tromsö Museum); Hammerfest (Zool. Mus. Oslo); Tromsö in 40 to 70 fathoms (Tromsö Mus.; Oslo Museum; Bergens Mus.; MCZ); Mestervik, Malangen (Tromsö Museum); Röstad in 27 to 43 fathoms (Tromsö Museum); Trondheim (Trondheim Museum); Bergen; Oslo Fjord; Foldafjord, Namdalen; Bodö, Store Hjerö in 24 to 30 fathoms; Skraaven in 10 to 20 fathoms (all Zool. Mus. Oslo).

Epitonium greenlandicum form *lovenii* A. Adams

Plate 155, fig. 2

Scalaria lovenii A. Adams 1856, Proc. Zoological Society London, p. 1 (Scandinaviae); G. O. Sars 1878, Mollusca Regionis Arcticae Norvegiae, Christiania, p. 194, pl. 10, fig. 16 (Norway).

Description. Similar to the typical form but having the axial costae recurved backward leaving a recessed area under each costa. Occasional specimens have this character so well developed that the inter-costal areas are completely covered over.

length	width	whorls	
28	10.5 mm.	9 *	Browns Bank, off Cape Sable, Nova Scotia
18.5	7	9 *	Vardö, Norway

* 2 or more early whorls lost.

Types. The type of *E. greenlandicum lovenii* A. Adams is probably in the British Museum. The type locality is here restricted to Vardö, Norway.

Remarks. This is only an extreme variation occurring in this species. It probably has no geographic or environmental significance as specimens of *lovenii* occur with the typical form and intergrade completely with it.

Range. Probably co-extensive with the typical form.

Records. WESTERN ATLANTIC. NOVA SCOTIA: about 43 miles off Cape Sable in 110 fathoms; Browns Bank in 40 fathoms (both MCZ); Lahave Bank in 45 fathoms (USNM). MASSACHUSETTS: Georges Bank (N. Lat. $41^{\circ}51'$; W. Long. $66^{\circ}18'$) in 45 fathoms (MCZ); *Albatross*, station 2524, Georges Bank (N. Lat. $41^{\circ}48'$; W. Long. $65^{\circ}47'$) in 85 fathoms (USNM).

EASTERN ATLANTIC. NORWAY: Tromsö (Tromsö Museum; MCZ); Vardö (Tromsö Museum); Balsfi (Oslo Museum).

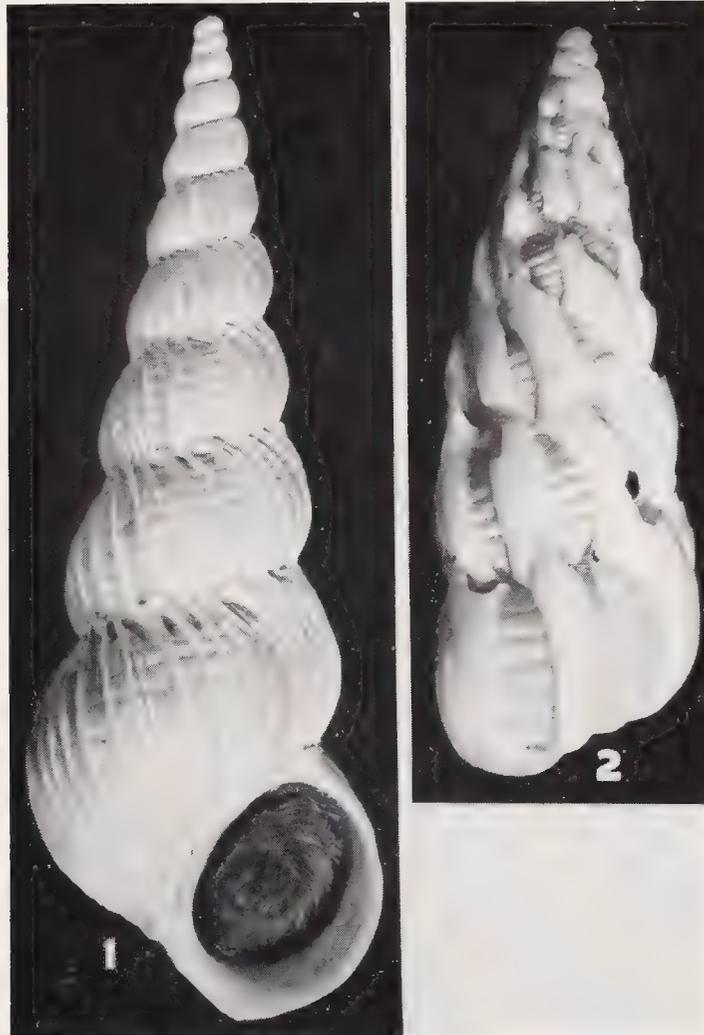


Plate 155

Fig. 1. *Epitonium greenlandicum ornatum* Friele and Grieg (= *E. norvegicum* Clench and Turner) from off Vest Fjorden, Norway. Holotype (2.8x). Fig. 2. *Epitonium greenlandicum lovenii* A. Adams from Browns Bank off Cape Sable, Nova Scotia in 40 fathoms (2.8x).

***Epitonium greenlandicum* subspecies *norvegicum*, new name**
Plates 155, fig. 1

Scalaria groenlandica var. *ornata* Friele and Grieg 1901, Norwegian North Atlantic Expedition 1876-1878, Christiania, Mollusca 3, p. 79; (S.S. *Vöringen*, station 124, off Vest Fjorden, Norway); non *S. ornata* Baily 1865.

Description. Somewhat similar to *greenlandicum*, differing in being lighter in structure, and more attenuated. In addition, the axial costae are much finer, more numerous and

exceedingly weak on the early whorls. There are 15 to 34 costae on the body whorl. The operculum is paucispiral, corneous and dark brown in color.

length	width	whorls	
44	13 mm.	10	Nordkapp, Norway
38	12.8	11	off Vest Fjorden, Norway

Types. The holotype of *Scalaria groenlandica ornata* Friele and Grieg is in the Zoologisk Museum, Universitetet, Bergen, Norway, no. 21669. We figure the holotype from station 124 (N. Lat. 66°41'; E. Long. 6°59') off Vest Fjorden, Norway.

Remarks. This is a deep water subspecies which appears to be limited in its distribution to the arctic region off Norway. It is quite possible that when more material is available it will be seen to intergrade with the typical form. We have seen only two specimens of this subspecies.

So far as we can check the record, the description of *ornata* dates from the publication given above by Friele and Grieg, though no indication was given that this was being described as new.

Range. Known only from Norway, in deep water.

Records. EASTERN ATLANTIC. NORWAY: off Nordkapp (N. Lat. 72°53'; E. Long. 21°51') in 223 fathoms; off Vest Fjorden (N. Lat. 66°41'; E. Long. 6°59') in 350 fathoms (both Bergen Museum).

Epitonium (Boreoscala) magellanicum Philippi

Plate 156

Scalaria magellanica Philippi 1845, Archiv für Naturgeschichte for 1845, **1**, p. 65 (Straits of Magellan).

Scalaria (Opalia) magellanica Philippi, Strebel 1905, Zoologischen Jahrbüchern **22**, p. 656, pl. 23, fig. 44a-f.

Scalaria (Opalia) magellanica var. *latecostata* Strebel 1905, Zoologischen Jahrbüchern **22**, p. 658, pl. 23, fig. 43a-d (Straits of Magellan and Lenox Island [south coast of Tierra del Fuego]).

Cirsotrema douvillei Fenaux 1937, Journal de Conchyliologie **81**, p. 219, pl. 2, fig. 1 (Santa Cruz River, Patagonia [Argentina]).

Description. Shell reaching about 30 mm. (about 1¼ inches) in length, attenuate, chalky and imperforate. Whorls 10 and moderately convex. Color a uniform chalky-white. Suture moderately impressed. Aperture circular. Lip thickened. Parietal or inner lip with a small thickened area caused by the union of the terminal ends of the axial costae. Columella short and arched. Axial sculpture consisting of numerous strong blade-like to ridge-like costae varying from 16 to 18 on the body whorl. These costae are generally slightly recurved backwardly. Spiral sculpture consisting of a well defined basal ridge with numerous but rather indistinct spiral cords between the basal ridge and the suture above. There is only a slight indication of spiral cords below the basal ridge. Nuclear whorls 2 and smooth. Operculum chitinous, paucispiral and dark-brown in color.

length	width	whorls	
29.5	11.5 mm.	10	off Puerto Gallegos, Argentina
25.5	10.5	8 *	off Mar del Plata, Buenos Aires, Argentina

* early whorls lost.

Types. The whereabouts of the type of *E. magellanicum* is unknown to us. The type locality is the Straits of Magellan. It may possibly be in the British Museum as Sherburn mentions that Philippi's collection went to the British Museum and the Museum at Santiago de Chile. Fenaux does not state where his types were deposited.



Plate 156. *Epitonium magellanicum* Philippi
From Mar del Plata, Buenos Aires, Argentina (2.7x).

Remarks. *E. douvillei* Fenaux appears to be only a very large example of *magellanicum*. According to Fenaux, the broken holotype, if "reconstructed" would have been 95 mm. in length, which would make it one of the largest of the recent species. Excessively large specimens in other species are known, however.

This species is strikingly similar to *E. greenlandicum* Perry. It differs, however, in having more numerous costae, having a more strongly developed basal ridge and in having the spiral cords somewhat smaller and more numerous.

This species is quite rare in collections, probably because it is a fairly deep water species and as it occurs along a rather infrequently visited coast.

Range. Southern Argentina south through the Straits of Magellan and probably north along the southern coast of Chile, also the Falkland Islands.

Records. ARGENTINA: off Mar del Plata, Buenos Aires (S. Lat. $39^{\circ}28'$; W. Long. $57^{\circ}02'$) in 55 fathoms (A. Carcelles); *Hassler* Voyage, off Puerto Gallegos (S. Lat. $51^{\circ}26'$; W. Long. $68^{\circ}05'$) in 55 fathoms (MCZ); Isla de los Estados, off Tierra del Fuego (S. Lat. $54^{\circ}41'$; W. Long. $64^{\circ}01'$) in 30 fathoms (A. Carcelles). FALKLAND ISLANDS: Lively Island, Falkland Islands (A. Carcelles). CHILE: *Hassler* Voyage, Straits of Magellan (MCZ).

Epitonium (Boreoscala) pandion, new name

Plate 157

Acirsa gracilis Verrill 1880, Proceedings United States National Museum 3, p. 377; Verrill 1882, Transactions Connecticut Academy 5, p. 528, pl. 57, fig. 31 (*Fish Hawk*, station 894 (N. Lat. 39°53'; W. Long. 70°58') in 365 fathoms; non *Scalaria gracilis* Sowerby 1844; non *Acirsa (Acirsella) gracilis* Fenaux 1937.¹

Description. Shell reaching about 8 mm. (about $\frac{1}{3}$ of an inch) in length, attenuate and imperforate. Whorls probably 8 or 9, moderately convex and attached. Color a light ivory. Spire extended and produced at an angle of 12°. Suture deep but not profound. Aperture ovate, simple and slightly flaring below. Parietal lip consisting of a thin fold over the umbilical area. Columella short and somewhat arched. Axial sculpture consisting of rather numerous low and broad costae which are stronger above the periphery. Generally these costae are stronger on the early whorls, becoming very weak to almost absent on the body whorl of adult specimens. Spiral sculpture consisting of numerous and fine threads which end just below the whorl periphery, the lowest thread occasionally larger and forming a basal ridge. Basal area nearly smooth, sculptured only by exceedingly fine growth lines. Nuclear whorls unknown. Operculum paucispiral, thin and light-brown in color.

length	width	whorls	
7.1	2.5 mm.	7*	off Cape Hatteras, North Carolina
5.0	2.2	6*	Holotype

* early whorls lost.

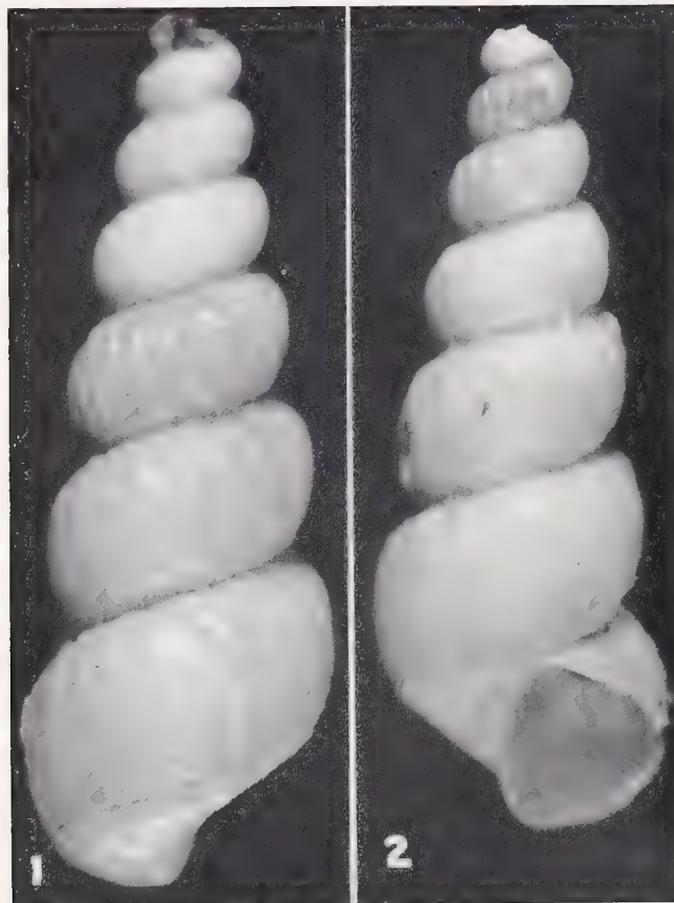


Plate 157. *Epitonium pandion* Clench and Turner

Fig. 1. *Albatross*, station 2115, 60 miles northeast of Cape Hatteras, North Carolina (13x). Fig. 2. *Acirsa gracilis* Verrill (= *E. pandion* Clench and Turner) *Fish Hawk*, station 894, 150 miles east of Barnegat Bay, New Jersey. Holotype (15x).

¹ If this species of Fenaux proves to be valid it will have to have a new name owing to the prior use of *Acirsa gracilis* by Verrill.

Types. The holotype of *E. gracilis* Verrill is in the United States National Museum, no. 44813, *Fish Hawk*, station 894, about 150 miles east of Barnegat Bay, New Jersey (N. Lat. $39^{\circ}53'$; W. Long. $70^{\circ}58'$) in 365 fathoms. Paratypes from the same locality in the Peabody Museum, Yale University.

Remarks. It is with some hesitation that we include this species in the subgenus *Boreoscala*. In our opinion it is certainly not in the genus *Acirsa* as originally assigned by Verrill.

This is a deep water species. It occurs off the continental shelf in depths ranging from 349 to 1004 fathoms. Specimens that we have seen have all lost their nuclear whorls and most if not all were dead when collected.

The name *pandion* is taken from the generic name of the fish hawk or osprey, the bird after which the United States Fish Commission vessel, *Fish Hawk*, was named.

Range. In deep water in the latitude of northern New Jersey south to Cape Hatteras, North Carolina.

Records. *Albatross*, station 2048, about 250 miles east of Asbury Park (N. Lat. $40^{\circ}02'$; W. Long. $68^{\circ}50'$) in 547 fathoms (USNM); *Albatross*, station 2213, about 175 miles east of Barnegat Bay (N. Lat. $39^{\circ}58'$; W. Long. $70^{\circ}30'$) in 384 fathoms (USNM; Yale); *Fish Hawk*, station 1093, about 210 miles east of Barnegat Bay (N. Lat. $39^{\circ}56'$; W. Long. $69^{\circ}45'$) in 349 fathoms (USNM); *Albatross*, station 2547, about 185 miles east of Barnegat Bay (N. Lat. $39^{\circ}54'$; W. Long. $70^{\circ}20'$) in 390 fathoms (USNM; Yale); *Fish Hawk*, station 894, about 150 miles east of Barnegat Bay (N. Lat. $39^{\circ}53'$; W. Long. $70^{\circ}58'$) in 365 fathoms (USNM; Yale); *Fish Hawk*, station 892, about 145 miles east of Barnegat Bay (N. Lat. $39^{\circ}46'$; W. Long. $71^{\circ}05'$) in 487 fathoms (USNM); *Albatross*, station 2689, about 135 miles east of Barnegat Bay (N. Lat. $39^{\circ}42'$; W. Long. $71^{\circ}15'$) in 525 fathoms (Yale Univ.); *Albatross*, station 2682, about 200 miles east of Atlantic City (N. Lat. $39^{\circ}38'$; W. Long. $70^{\circ}22'$) in 1004 fathoms (USNM); *Fish Hawk*, station 1143, about 115 miles east of Atlantic City (N. Lat. $39^{\circ}29'$; W. Long. $72^{\circ}01'$) in 452 fathoms (USNM; Yale); *Albatross*, station 2237, about 130 miles east of Cape May (N. Lat. $39^{\circ}12'$; W. Long. $72^{\circ}09'$) in 520 fathoms (Yale); *Albatross*, station 2721, about 125 miles east of Cape May (N. Lat. $38^{\circ}56'$; W. Long. $72^{\circ}11'$) in 813 fathoms (USNM). DELAWARE: *Albatross*, station 2233, about 95 miles east of Cape Henlopen (N. Lat. $38^{\circ}36'$; W. Long. $73^{\circ}06'$) in 630 fathoms (USNM; Yale). NORTH CAROLINA: *Albatross*, station 2115, about 60 miles northeast of Cape Hatteras (N. Lat. $35^{\circ}49'$; W. Long. $74^{\circ}34'$) in 843 fathoms (USNM).

Genus *Depressiscula* de Boury

Depressiscula de Boury 1909, Journal de Conchyliologie 57, p. 258.

Genotype, *Scala aurita* Sowerby, original designation.

Shells attenuate, shining, umbilicate or imperforate, usually colored a diffused brown or purple and having low, white costae. There is no basal ridge. Nuclear whorls smooth, glass-like and lighter in color than the post nuclear whorls.

The two Western Atlantic species in this genus are quite different and are readily separated from each other and from *Epitonium*. They differ mainly from *Epitonium* by their

coloration and by the very low and somewhat recurved costae (*D. nautlae*). The surface between the costae is highly polished, with microscopic sculpture exceedingly fine or absent.

There is no single character that separates *Depressiscula* from *Epitonium* or its several subgenera. In their aggregate, however, the several characters of *Depressiscula*, indicate a series of species quite different from the assemblage of species grouped together in *Epitonium*.

Depressiscula nitidella Dall

Plate 158

Scala nitidella Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, p. 314 (15 to 30 miles off the North Carolina coast;¹ Dall 1902, Proceedings United States National Museum **24**, p. 505, pl. 30, fig. 8.

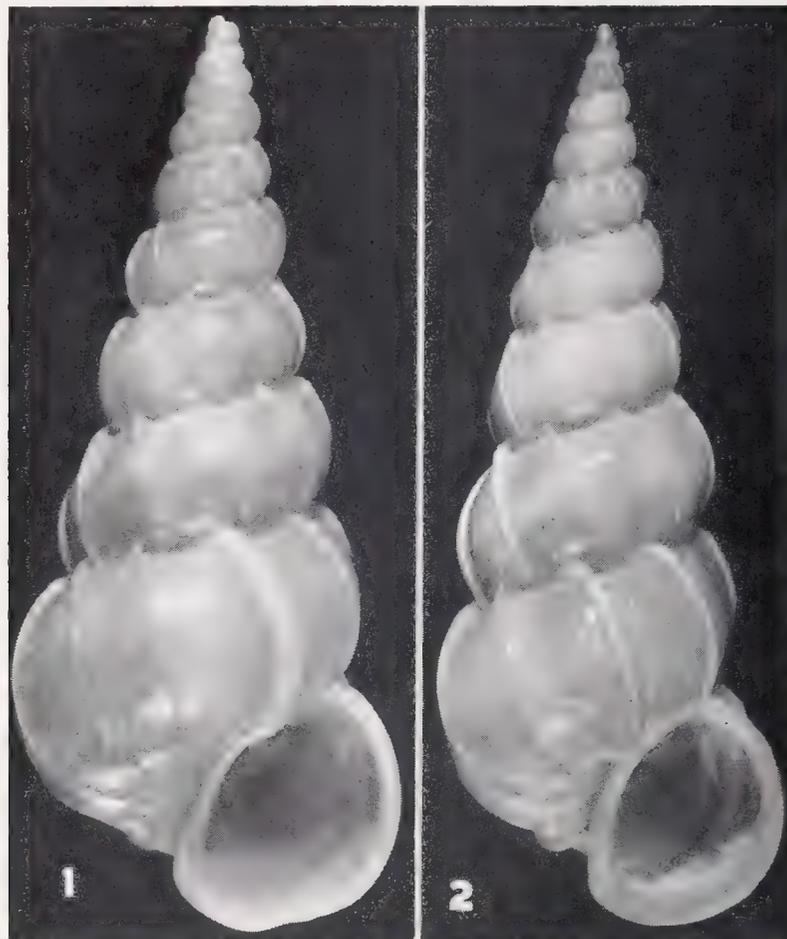


Plate 158. *Depressiscula nitidella* Dall

Fig. 1. *Albatross*, station 2596, from off Cape Hatteras, North Carolina. Holotype (7x). Fig. 2. Boynton, Lake Worth, Florida ($5\frac{1}{2}x$).

Description. Shell reaching 20 mm. (about $\frac{3}{4}$ of an inch) in length, attenuate, umbilicate and shining. Whorls 10 to 13, strongly globose and attached. Color a glossy-white with irregular patches of light-brown which may become rather widely diffused. Spire extended and produced at an angle of about 28° . Suture deep but not profound. Aperture subovate with the parietal area thickened and nearly straight. Columella not defined. Axial sculpture consisting of a few very low blade-like costae which number 9 to 10 on the body whorl. On certain specimens many of the costae may be cord-like. Spiral sculpture consisting of a few, exceedingly fine, slightly incised threads. There is no basal

¹ *Albatross*, station 2596, about 20 miles southeast of Cape Hatteras, North Carolina.

ridge. Umbilical opening partially covered by the parietal wall with the costae entering the umbilicus in a spiral formation. Nuclear whorls 3, glass-like and smooth. Operculum thin, paucispiral and light brown in color.

length	width	whorls	
20	7.6 mm.	10 *	Great Abaco, Bahama Islands
16.5	6.5	13	Lake Worth, Boynton, Florida
13	5.0	11 *	Holotype, off Cape Hatteras, North Carolina

* 1 or 2 early whorls lost.

Types. The holotype of *D. nitidella* Dall is in the United States National Museum, no. 83716, from the *Albatross*, station 2596, about 20 miles east of Cape Hatteras, North Carolina (N. Lat. 35°08'; W. Long. 75°10') in 49 fathoms.

Remarks. This species, similar to *D. nautlae*, has a discontinuous distribution. Undoubtedly more collecting will fill in many of the gaps in our present records. It has been dredged in depths ranging from 32 to 117 fathoms. A few beach specimens are known which would indicate that it probably lives also in rather shallow water, at least in certain areas.

See also remarks under *D. nautlae*.

Range. From off Cape Hatteras, North Carolina and from off Palm Beach, Florida south to Key West. Then again off northwest Florida, the Bahamas and south through the West Indies to Barbados, Lesser Antilles.

Records. NORTH CAROLINA: *Albatross*, station 2596, about 20 miles east of Cape Hatteras (N. Lat. 35°08'; W. Long. 75°10') in 49 fathoms; *Albatross*, station 2595, about 22 miles east of Cape Hatteras (N. Lat. 35°08'; W. Long. 75°05') in 63 fathoms; *Albatross*, station 2612, about 30 miles southeast of Cape Lookout (N. Lat. 34°11'; W. Long. 76°10') in 52 fathoms (all USNM). FLORIDA: off Palm Beach in 50 to 70 fathoms; off Lake Worth in 70 to 85 fathoms; Lake Worth, Boynton (all T. McGinty); *Eolis*, stations 157 and 48, off Miami in 22 and 60 fathoms; *Eolis*, stations 152 and 309, off Fowey Light in 40 and 60 fathoms (all USNM); Carysfort Reef, Key Largo in 66 fathoms; northeast of The Elbow, Key Largo in 50 to 83 fathoms; southeast of The Elbow, Key Largo in 58 to 117 fathoms; off Looe Key, Lower Florida Keys in 70 to 90 fathoms; off Cudjoe Key, Lower Keys in 50 fathoms (all L. A. Burry); *Eolis*, station 160, off Sand Key (USNM); off Sombrero Light in 90 to 100 fathoms (L. A. Burry); *Eolis*, station 43, off Key West in 63 fathoms (USNM). ALABAMA: *Albatross*, station 2387, 55 miles south of Mobile Bay (N. Lat. 29°24'; W. Long. 88°04') in 32 fathoms (USNM). BAHAMAS: Great Abaco (USNM). CUBA: *Tomas Barrera*, station 224, off Cape San Antonio (USNM); Arenas de la Chorrera, Habana (M. Jaume). LESSER ANTILLES: Bathsheba, Barbados (MCZ).

Depressiscala nautlae Mörch

Plate 159

Scala nautlae Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 265 (between Veracruz and Nautla, Mexico); Mörch 1875, Malakozoologische Blätter 22, p. 151; Mörch 1875, Journal Academy Natural Sciences, Philadelphia (2) 8, p. 202, pl. 29, fig. 12.

Scala scipio Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, p. 310 (Veracruz [Mexico]).

Scalaria teres Bush 1885, Transactions Connecticut Academy **6**, p. 465, pl. 45, fig. 8 (*Albatross*, station 2276, about 12 miles east of Cape Hatteras, North Carolina).

Description. Shell reaching 15 mm. (about $\frac{5}{8}$ of an inch) in length, very attenuate, imperforate, shining and rather solid. Whorls 10 to 12, moderately convex and attached. Color red-brown to purplish-brown with an occasional specimen nearly white. Spire greatly extended and formed at an angle of about 25° . Suture impressed but not very deep. Aperture ovate. Parietal area smooth and tightly appressed against the body whorl. Columella short and arched. Axial sculpture consisting of numerous, rather low and reflected costae which usually have a small angle or hook on the whorl shoulder. There are 12 to 14 costae on the body whorl. There is no trace of spiral sculpture and no basal ridge. Nuclear whorls 4, glass-like, smooth and a very light amber-brown in color. Operculum thin, corneous, paucispiral and yellow-brown in color.

length	width	whorls	
15	4 mm.	10*	Veracruz, Mexico
15	4	11*	Holotype of <i>scipio</i> Dall
13.2	3.5	11*	off Fort Lauderdale, Florida
12	3.1	14	off Destin, Florida
4	1.3	8	Holotype of <i>teres</i> Bush

* 1 or 2 early whorls lost.

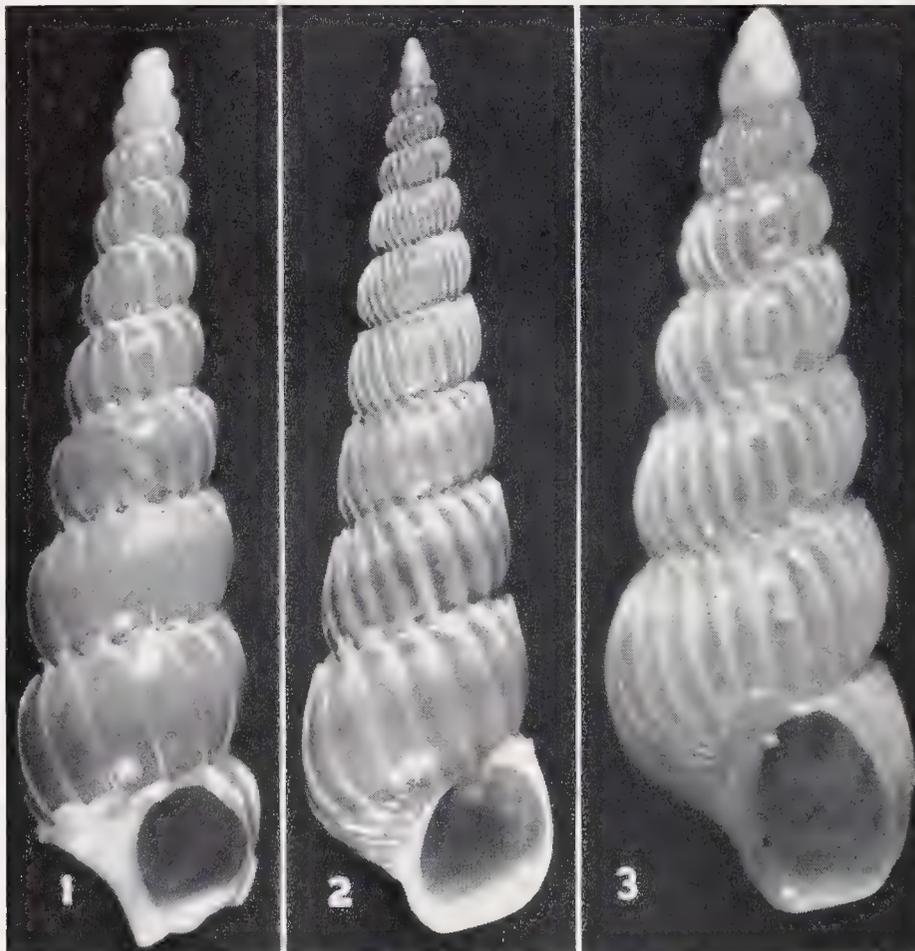


Plate 159. *Depressiscula nautlae* Mörch

Fig. 1. *Scalaria scipio* Dall (= *nautlae* Mörch) from Veracruz, Mexico. Holotype (6.3x). Fig. 2. From off Destin, Florida (8x). Fig. 3. *Scalaria teres* Bush (= *nautlae* Mörch) from *Albatross*, station 2276, off Cape Hatteras, North Carolina. Holotype (24x).

Types. The whereabouts of the holotype of *D. nautilae* Mörch is unknown to us. It was collected by a Mr. Rathsack between Veracruz and Nautla, Mexico in 1842. The holotype of *Depressiscala scipio* Dall is in the United States National Museum, no. 10694, from Veracruz, Mexico. The holotype of *D. teres* Bush is in the United States National Museum, no. 44842, from *Albatross*, station 2276, about 20 miles east of Cape Hatteras, North Carolina (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}19'$) in 16 fathoms.

We here restrict the type locality to Veracruz, Mexico.

Remarks. *Depressiscala teres* Bush is but a very young specimen of *D. nautilae*. The range of this species, so far as we now know, is very discontinuous. The specimens of *D. nautilae* obtained off North Carolina are all very young and it may well be that these were carried north by the Gulf Stream and became established for only a short time. They are the form that was described as *teres* Bush. This species has been dredged in depths between 15 and 66 fathoms. Occasionally beach specimens have been found which would indicate that it probably does occur near low water line.

Depressiscala nautilae differs from *D. nitidella* by being much narrower proportionately, having the whorls far less globose, by being imperforate and having small hooks on the costae at the whorl shoulder.

Range. From off Cape Hatteras, North Carolina and off Florida from Palm Beach south through the Florida Keys. Then again off northwest Florida, the western Bahamas, the northern coast of Cuba and southern Mexico.

Records. NORTH CAROLINA: *Albatross*, station 2276, about 20 miles east of Cape Hatteras (N. Lat. $35^{\circ}20'$; W. Long. $75^{\circ}19'$) in 16 fathoms; *Albatross*, station 2597, about 15 miles southeast of Cape Hatteras (N. Lat. $34^{\circ}57'$; W. Long. $75^{\circ}43'$) in 15 fathoms; *Albatross*, station 2598, about 25 miles south of Cape Hatteras (N. Lat. $34^{\circ}51'$; W. Long. $75^{\circ}40'$) in 22 fathoms; *Albatross*, station 2611, about 65 miles south southeast of Cape Hatteras (N. Lat. $34^{\circ}15'$; W. Long. $76^{\circ}11'$) in 31 fathoms; 12 miles east of Frying Pan Shoals (all USNM). FLORIDA: off Palm Beach in 20 and 50 fathoms; North Inlet, Lake Worth (all T. McGinty); Boynton (G. Voss); off Fort Lauderdale in 20 fathoms (L. A. Burry); *Eolis*, station 113, off Bear's Cut, Miami in 18 to 20 fathoms (USNM); off Sombrero Light, Lower Keys in 50 to 66 fathoms; off Fort Walton in 16 fathoms (both L. A. Burry); off Destin in 18 to 20 fathoms (T. McGinty). BAHAMA ISLANDS: off Bimini Islands (Univ. of Michigan). CUBA: Boca del Almandares, Habana (M. Jaume); Arenas de la Chorrera, Habana (MCZ; C. G. Aguayo). MEXICO: Veracruz (ANSP; USNM).

Genus *Cylindriscala* de Boury

Cylindriscala de Boury 1909, Journal de Conchyliologie 57, p. 256 (nomen nudum); de Boury 1912, Journal de Conchyliologie 60, p. 169 (subgenotype, *Scala* (*Cylindriscala*) *acus* Watson, monotypic).

Genotype, *Scalaria acus* Watson, monotypic.

Shells with whorls attached, strongly sculptured with axial costae and generally with spiral threads. Basal ridge strongly developed. Nuclear whorls 3 and smooth.

This genus appears to be closely allied to *Opalia* H. and A. Adams. Superficially the sculpture is very similar in certain forms. In *Opalia*, however, most of the species we

have examined possess pitted spiral threads and the axial costae usually extend above the suture creating a series of bosses. In *Cylindriscala* the new whorl follows along the basal ridge so that the sutures possess a thin narrow cord (Plate 161, fig. 1).

Cylindriscala watsoni de Boury

Plate 160; 161, figs. 3-4

Scalaria funiculata Watson 1883, Journal Linnean Society **16**, p. 608; Watson 1886, Voyage of H.M.S. *Challenger*, Zoology **15**, p. 141, pl. 9, fig. 4 (off Pernambuco [Recife] Brasil); 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).

Opalia (Opalia) watsoni 'de Boury' Clench and Turner 1950, *Johnsonia* **2**, p. 231 (in part).



Plate 160. *Cylindriscala watsoni* de Boury
Eolis, station 316, off Sand Key, Florida in 120 fathoms (15.2x).

Description. Shell reaching about 7 mm. (about $\frac{1}{4}$ of an inch) in length, attenuate, imperforate and strongly sculptured. Whorls 11, moderately convex and attached. Color a grayish-white. Spire produced and formed at an angle of about 18° . Suture rather deeply impressed. Aperture subcircular. Columella short and arched. Axial sculpture consisting of exceedingly heavy and thickened costae which end at the basal ridge. Below the ridge the shell is definitely flattened. Occasionally one of the costae becomes greatly thickened to form a varix. Spiral sculpture consisting of numerous and fine incised threads which are crossed by somewhat finer axial threads. Both these fine thread-like incised lines pass over the costae. Nuclear whorls smooth and glass-like. Operculum unknown.

length	width	whorls	
7.0	2.5 mm.	10 *	off Sand Key, Florida
5.5	1.6	10	Holotype, after Watson

* loss of 1 or 2 early whorls

Types. The types of *funiculata* Watson are probably in the British Museum, from the *Challenger*, station 122, off Pernambuco [Recife] Brasil (S. Lat. 9°05'; W. Long. 34°05') in 350 fathoms.

Remarks. In *Johnsonia* 2, p. 231 we described under the name of *Opalia watsoni* a species which we now realize is new. It is described in this number as *Opalia abbotti*. The synonymy on p. 231 applies to *watsoni* de Boury while the description and figures apply to *abbotti*. At the time of our first description we lacked material and depended entirely upon Watson's figure and description of *funiculata* (= *watsoni*). Believing that Watson had possibly overlooked the pitted sculpture typical of *Opalia* we placed his species in that genus. We now have a specimen dredged off Sand Key, Florida that agrees entirely with the description and figure given by Watson in the *Challenger* report. We figure this specimen and also the original figures of Watson.

In relationship this species is close to *C. tortilis* Watson, differing by being proportionately wider and not having the axial costae notched by the spiral threads.

Range. Lower Florida Keys and probably through the West Indies, Central and South America to Brasil.

Records. FLORIDA: *Eolis*, station 316, off Sand Key, Key West in 120 fathoms. BRASIL: *Challenger*, station 122, off Pernambuco (S. Lat. 9°05'; W. Long. 34°05') in 350 fathoms (from the Challenger Report).

Cylindriscala acus Watson

Plate 161, figs. 5-6

Scalaria acus Watson 1883, Journal Linnean Society 16, p. 608 (off the Azores in 1000 fathoms); Watson 1886, Report of the Voyage of H.M.S. *Challenger*, Zoology 15, p. 140, pl. 9, fig. 2.

Scala fulgens de Boury 1909, Journal de Conchyliologie 57, p. 256 (nomen nudum); de Boury 1912, Journal de Conchyliologie 60, p. 169.

Description. Shell reaching 5 mm. (about 1/5 of an inch) in length, attenuate, imperforate and sculptured. Whorls 12, moderately convex and attached. Color ivory-white. Suture moderately impressed. Aperture probably subcircular [specimen broken]. Spire extended and produced at an angle of about 21°. Columella short and arched. Axial sculpture consisting of numerous, strongly developed costae which number about 17 on the last whorl of the holotype. Spiral sculpture consisting of exceedingly fine threads. Basal ridge well developed. Nuclear whorls 3, brownish-yellow, smooth and glass-like. Operculum unknown.

length	width	whorls	
5	1.4 mm.	12	Holotype (after Watson)

Types. The holotype of this species is probably in the British Museum. The type locality is about 160 miles west of Fayal Island, Azores (N. Lat. 38°30'; W. Long. 31°14') in 1000 fathoms.

Remarks. Watson in the Challenger Report mentions that the nuclear whorls of this species have exceedingly fine axial threads. The artist, however, did not indicate them in the enlarged drawing of the apex. We suspect that these axial threads may be only faint growth lines rather than actual sculpture. We have not seen any specimens of this species.

This is a deep water species and it has been collected on both sides of the Atlantic. According to Jeffreys (Proceedings Zoological Society London, 1884, p. 139) it has been obtained in depths ranging from 49 to 1254 fathoms.

Range. Probably throughout the West Indies in deep water and in deep water in the Eastern Atlantic.

Records. WESTERN ATLANTIC. PUERTO RICO: *Challenger*, station 24, off Culebra Island (N. Lat. $18^{\circ}38'$; W. Long. $65^{\circ}05'$) in 390 fathoms (ex Challenger Report).

EASTERN ATLANTIC. AZORES: *Challenger*, station 73, 160 miles west of Fayal Island (N. Lat. $38^{\circ}30'$; W. Long. $31^{\circ}14'$) in 1000 fathoms (ex Challenger Report). PORTUGAL: *Porcupine*, station 16 (N. Lat. $39^{\circ}55'$; W. Long. $09^{\circ}56'$) in 994 fathoms; *Porcupine*, station 17 (N. Lat. $39^{\circ}42'$; W. Long. $09^{\circ}43'$) in 740 to 1095 fathoms (both from Jeffreys). GIBRALTAR: *Porcupine*, station 31 (N. Lat. $35^{\circ}56'$; W. Long. $07^{\circ}06'$) in 477 fathoms; *Porcupine*, station 34 (N. Lat. $35^{\circ}44'$; W. Long. $06^{\circ}53'$) in 414 fathoms (both from Jeffreys).

Cylindriscala tortilis Watson

Plate 161, figs. 1-2

Scalaria tortilis Watson 1883, Journal Linnean Society 16, p. 607; Watson 1886, Voyage of H.M.S. *Challenger*, Zoology 15, p. 139, pl. 9, fig. 1 (North of Culebra Island [Puerto Rico] West Indies).

Description. Shell reaching 10 mm. (about $\frac{3}{8}$ of an inch) in length, attenuate, rather solid, strongly sculptured and imperforate. Whorls 10 or more, moderately convex and attached. Color white. Spire extended and produced at an angle of about 20° . Suture moderately impressed. Aperture subcircular. Columella short and slightly arched. Axial

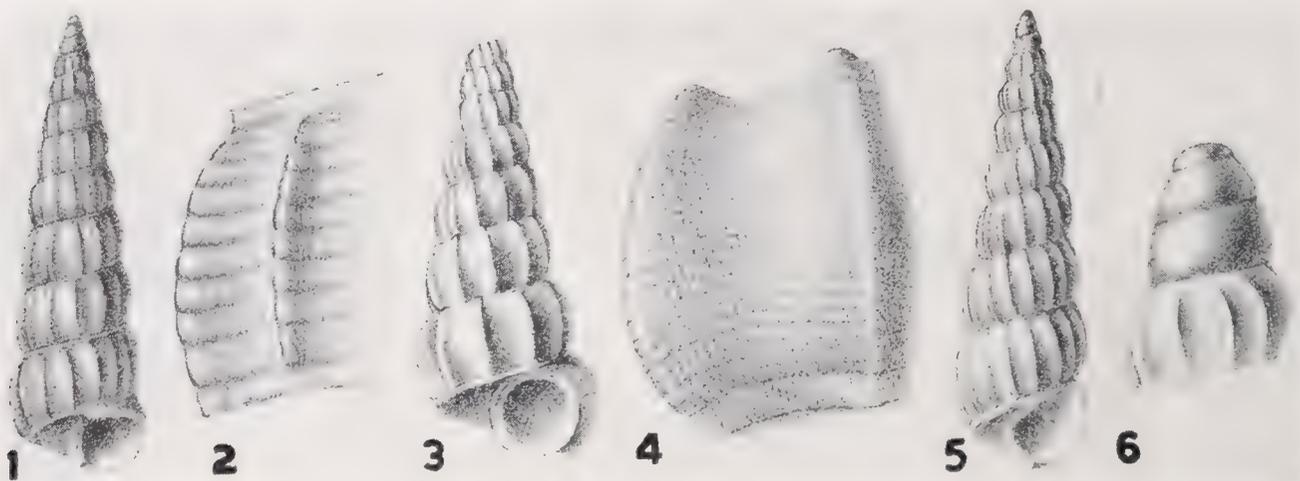


Plate 161

Figs. 1-2. *Cylindriscala tortilis* Watson (5x) and enlarged sculpture (25x). Figs. 3-4. *Cylindriscala funiculata* Watson (= *watsoni* de Boury) (9x) and enlarged sculpture (40x). Figs. 5-6. *Cylindriscala acus* Watson (10x) and enlarged apex (50x). All after Watson, Challenger Report, plate 9.

sculpture consisting of numerous well developed axial costae which do not extend below the basal ridge. There are 14 costae on the body whorl of the holotype. These costae are crossed by several rather fine spiral threads which cut in very slightly where they pass over the costae. Basal ridge present. Nuclear whorls and operculum unknown.

length	width	whorls	
10	3 mm.	10 *	Holotype (ex Watson)

* early whorls lost.

Types. The holotype of this species is probably in the British Museum. The type locality is north of Culebra Island, Puerto Rico (N. Lat. $18^{\circ}38'$; W. Long. $65^{\circ}05'$) in 390 fathoms.

Remarks. We have not seen a specimen of this species. Our description and measurements have been taken from Watson and though the figure of *tortilis* on pl. 9, fig. 1 of the Challenger Report shows the embryonic whorls, Watson in his description said that they are broken.

This species is fairly close to *watsoni* de Boury, differing in possessing less robust costae and in having the spiral threads cut very slight notches where they pass over the costae.

Range and Records. Known only from the type locality, off Culebra Island, Puerto Rico.

Cylindriscala andrewsii Verrill

Plate 162

Scalaria (Opalia) andrewsii Verrill 1882, Transactions Connecticut Academy 5, pt. 2, p. 526, pl. 57, fig. 35 (*Fish Hawk*, station 873, from off Newport, Rhode Island [150 miles east of Barnegat Bay, New Jersey]).

Description. Shell reaching 8 mm. (about $\frac{1}{3}$ of an inch) in length, attenuate, rather solid, strongly sculptured and imperforate. Whorls 13, convex and attached. Color a rather dull flat-white. Spire extended and produced at an angle of 15° . Suture deeply impressed. Aperture subcircular. Columella short and arched. Axial sculpture consisting of numerous well developed, rounded and somewhat nodulose costae which number 13 on the body whorl. Spiral sculpture consisting of several ridges which are much smaller than the axial costae. The lowest peripheral ridge is enlarged to form a basal ridge. There appears to be no microscopic sculpture. Nuclear whorls $3\frac{1}{2}$, smooth, glass-like and colored a very light brown. Operculum unknown.

length	width	whorls	
7.5	2 mm.	13	off Western Dry Rocks, Florida
6.5	2	12	off Ragged Key, Florida
5.5	2	7 *	Holotype

* early whorls lost.

Types. The holotype of *C. andrewsii* Verrill is in the United States National Museum no. 44807 from the *Fish Hawk*, station 873, about 150 miles east of Barnegat Bay, New Jersey (N. Lat. $40^{\circ}02'$; W. Long. $70^{\circ}57'$) in 100 fathoms.

Remarks. *Cylindriscala andrewsii* Verrill differs from other species in this complex by having much stronger spiral ridges, besides having the axial costae slightly nodulose. It is an exceedingly rare species as only 7 specimens have come to our attention. So far as

our records indicate, this species lives on the continental slope in depths ranging between 85 and 500 fathoms.

See also remarks under *Nystiella cania* Dall, a species which it superficially resembles.

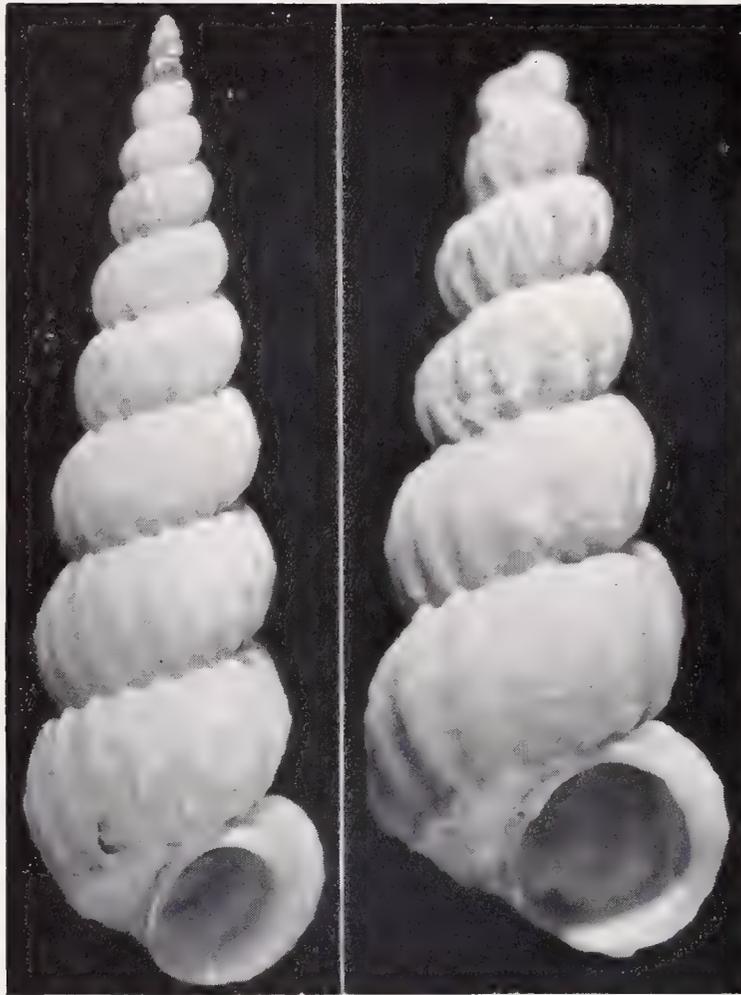


Plate 162. *Cylindriscala andrewesii* Verrill

Fig. 1. *Eolis*, station 317, off Western Dry Rocks, Key West, Florida in 110 fathoms (14x). Fig. 2. *Fish Hawk*, station 873, about 150 miles east of Barnegat Bay, New Jersey in 100 fathoms. Holotype (20x).

Range. In deep water from the latitude of central New Jersey south to Cuba.

Records. NEW JERSEY: *Fish Hawk*, station 873, about 150 miles east of Barnegat Bay (N. Lat. $40^{\circ}02'$; W. Long. $70^{\circ}57'$) in 100 fathoms (USNM); about 125 miles east of Barnegat Bay (N. Lat. $39^{\circ}55'$; W. Long. $71^{\circ}30'$) in 170 fathoms (J. Miller). FLORIDA: *Eolis*, station 317, off Western Dry Rocks in 110 fathoms; *Eolis*, station 339, off Ragged Key in 100 fathoms; *Eolis*, station 338, off Sand Key in 85 fathoms. CUBA: *Atlantis*, station 3459, off Sagua la Grande (N. Lat. $23^{\circ}21'$; W. Long. $80^{\circ}36'$) in 500 fathoms.

Nystiellinae, new subfamily¹

Shells with the whorls attached or solute, sculptured both axially and spirally. First nuclear whorl smooth, remaining nuclear whorls with strong and regular axial costae. There is usually a rather abrupt change in the sculpture and the shape of the whorls at the beginning of the first postnuclear whorl.

¹ All other species and genera so far considered in these studies of the family belong to the subfamily Epitoniinae.

This subfamily differs from the Epitoniinae by reason of the strong, axial sculpture on the nuclear whorls. In the Epitoniinae, the nuclear whorls are smooth, shining and glass-like. In addition, there is no abrupt change in the whorl shape at the start of the post-nuclear whorls. Radula of the Nystiellinae are very different from those in the Epitoniinae. See Plate 176.

It is quite possible that the smooth and costate whorls represent two different larval periods, the first smooth whorl representing the larval stage developed in the egg, the next three costate whorls developed during the veliger or free swimming period. The same is probably true of the early development of all members of this family only that sculptural differences are not indicated in the larval development in the Epitoniinae. Young stages in both subfamilies, however, are quite different in their characters compared with the sculpture developed on the postnuclear whorls.

Nystiella, new genus

Shells with the whorls attached, usually strongly and axially costate and having the nuclear whorls beyond the first whorl strongly and evenly axially ribbed or costate. Spiral sculpture of the postnuclear whorls usually much finer than the axial sculpture.

The genus is named for P. H. Nyst, a very able and distinguished Belgian malacologist of the middle of the 19th century. His catalogue of the Scalidae¹ has been of great value in our present study.

Genotype, *Epitonium opalinum* Dall.

Nystiella opalina Dall

Plates 163: 164

Epitonium opalinum Dall 1927, Proc. United States National Museum **70**, art. 18, p. 61 (off Georgia, *Albatross*, station 2415 in 440 fathoms).

Epitonium lavaratum Dall 1927, Proc. United States National Museum **70**, art. 18, p. 62 (off Georgia, *Albatross*, station 2415 in 440 fathoms).

Opalia (?) *dromio* Dall 1927, Proc. United States National Museum **70**, art. 18, p. 63 (off Fernandina, Florida, *Albatross*, station 2668 in 294 fathoms).

Description. Shell reaching 11–12 mm. (about $\frac{1}{2}$ inch) in length, attenuate, imperforate and strongly sculptured. Whorls 8 to 10, slightly convex and attached. Color a yellowish-brown with the nuclear whorls somewhat darker. Spire produced and formed at an angle of 15° . Suture well defined but not deep. Aperture subcircular to subquadrate. Columella rather short and arched. Axial sculpture consisting of numerous, low costae with 15 costae on the body whorl. In addition, there are numerous and exceedingly fine axial threads between the costae. Spiral sculpture consisting of from 7 to 10, low ridges that do not pass over the crests of the axial costae. What appears to be a thin, dark periostracum remains in the base of the axial threads, but worn away on the crests of the spiral ridges. This gives a rather striking appearance to the spiral sculpture. Base of body whorl sharply angled, somewhat flattened and occasionally sculptured with a few spiral incised lines. The ridge is not seen on the earlier whorls as the aperture is built forward along its superior margin. Nuclear whorls: first $1\frac{1}{2}$ whorls smooth, remaining 2 to $2\frac{1}{2}$ whorls finely but axially costate. These nuclear whorls are less convex than

¹ Annales Société Malacologique de Belgique **6**, pp. 77–147, 1871.

the postnuclear whorls and, in addition, the first postnuclear whorl is proportionally much larger.

length	width	whorls	
10.3	3.0 mm.	14	Holotype of <i>opalina</i> Dall
10.9	3.5	8	Lectotype of <i>lavarata</i> Dall
5.8	2.2	9	Holotype of <i>dromio</i> Dall

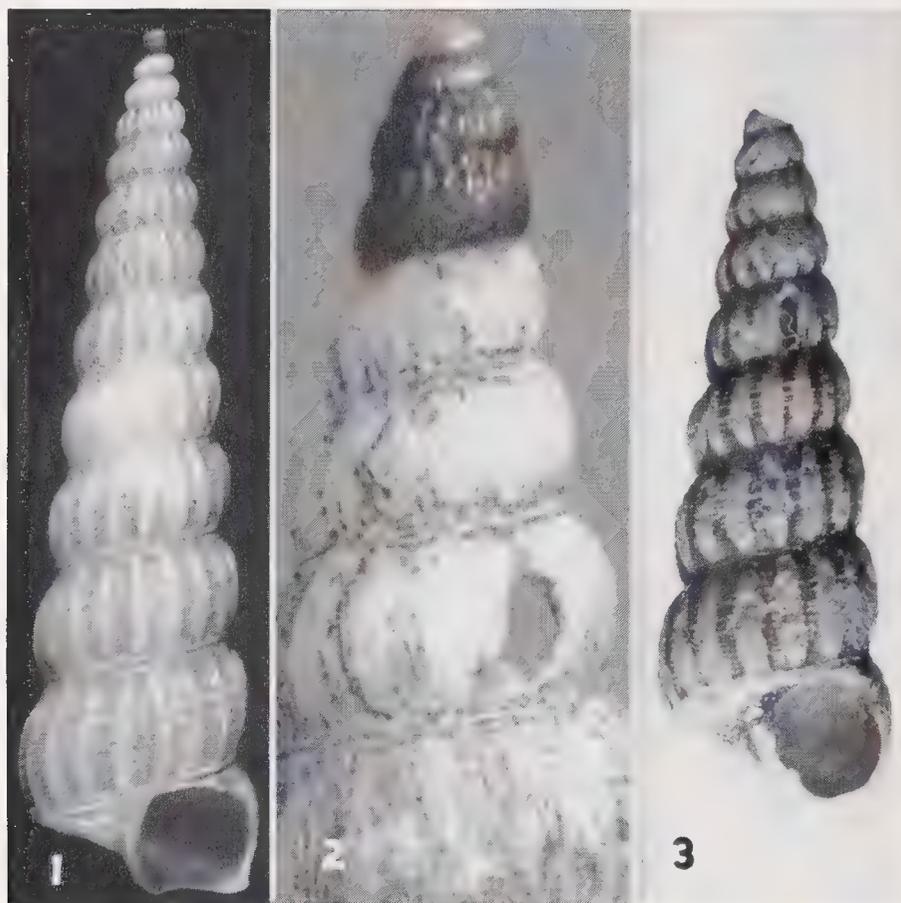


Plate 163. *Nystiella opalina* Dall

Fig. 1. *Albatross*, station 2415, off Fernandina, Florida in 440 fathoms. Holotype (9x). Fig. 2. A paratype from the same locality to show nuclear whorls (37x). Fig. 3. *Epitonium lavaratum* Dall (= *N. opalina* Dall) from the same locality. Holotype (6.3x).

Types. The following holotypes are all in the National Museum. *Epitonium opalinum* Dall, no. 108368; *E. lavaratum* Dall, no. 347845; both from *Albatross*, station 2415 off Georgia [105 miles off Fernandina, Florida]; *Opalia dromio* Dall, no. 108018, from *Albatross*, station 2668, from off Fernandina, Florida.

Remarks. There appears to be little question that the three names indicated in our synonymy above all belong to the same species. Dall was dealing with a variable species. All specimens were collected dead and all were in a somewhat worn condition. Two of the above were collected at the same station, the third at a station only about 18 miles away. See remarks under *N. concava*.

Range. From off northern Florida and south to the Lesser Antilles in deep water.

Records. FLORIDA: *Albatross*, station 2415, 105 miles off Fernandina (N. Lat. 30°44'; W. Long. 79°26') in 440 fathoms; *Albatross*, station 2668, about 95 miles east of Fernandina (N. Lat. 30°58'; W. Long. 79°38') in 294 fathoms (both USNM); LESSER ANTILLES: off St. Kitts in 687 fathoms (USNM).

Nystiella concava Dall

Plate 165

Scala (Opalia) concava Dall 1889, Bulletin Museum Comparative Zoölogy **18**, p. 323 (off Sand Key, Key West, Florida in 15 fathoms).

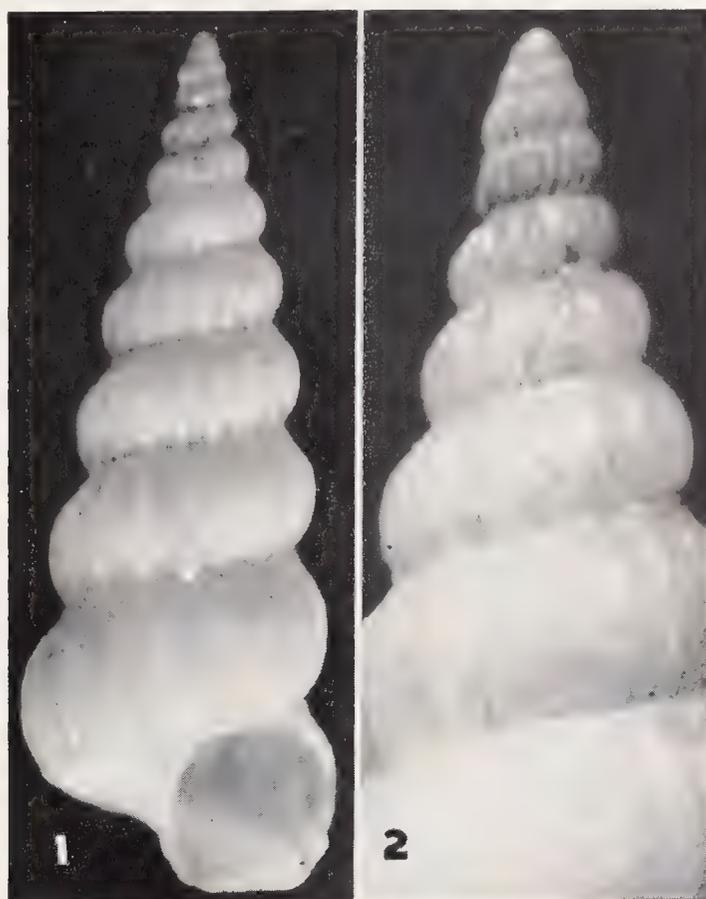


Plate 164. *Nystiella opalina* Dall

Epitonium dromio Dall (= *N. opalina* Dall) off Fernandina, Florida in 294 fathoms. Holotype. Fig. 1 (15.5x). Fig. 2. Showing nuclear whorls (30x).

Description. Shell probably reaching 15 mm. (a little over $\frac{1}{2}$ inch) in length, attenuate, probably imperforate and rather strong in structure. Whorls about 14, attached and very slightly convex. There is a strong peripheral ridge produced with the portion of the whorl below the ridge being flattened. As the new whorl grows forward, it extends itself along the lower margin of this ridge, the peripheral ridge then becoming a sutural cord. Color unknown. Spire extended and produced at an angle of 15° . Aperture subcircular. Columella short and arched. Axial sculpture consisting of rather numerous and very strong axial costae which number 11 on the last whorl of the broken holotype. Spiral sculpture consisting of numerous and very fine threads which cut over the tops of the costae. Nuclear whorls and operculum unknown.

length	width	whorls	
13.8	4 mm.	10*	Holotype

* both early whorls and aperture broken.

Types. The holotype and only specimen is in the United States National Museum, no. 106916, from the *Blake*, an unnumbered station off Sand Key, Key West, Florida in 15 fathoms.

Remarks. Unfortunately, this species is known from only the single holotype, a badly worn and broken specimen. It appears to be a member of this genus but a final decision cannot be made until fresh specimens possessing nuclear whorls are obtained.

Nystiella concava appears to be related to *N. opalina* by its general shape and by its type of sculpture, both having very well developed axial costae and relatively weak spiral threads. It differs from *opalina* by being much larger and by having much stronger axial costae.

Dall stated that his specimen was originally inhabited by a hermit crab. It is quite probable that the depth of 15 fathoms may not be the true depth at which this species lives.

Range and Records. Known only from the type locality off Key West, Florida.



Plate 165. *Nystiella concava* Dall

From off Sand Key, Key West, Florida in 15 fathoms. Holotype ($6\frac{1}{2}x$).

Nystiella cania Dall

Plate 166

Epitonium canium Dall 1927, Proceedings United States National Museum **70**, art. 18, p. 62 (off Georgia, Albatross, station 2415 in 440 fathoms).

Description. Shell reaching 9.8 mm. (about $\frac{3}{8}$ of an inch) in length, solid, attenuate, very strongly sculptured and imperforate. Whorls 13, moderately convex and attached. Color a dull yellowish-gray with the nuclear whorls brown. Spire extended and produced at an angle of about 32° . Suture well defined and rather deeply impressed. Aperture subcircular. Columella short and arched. Axial sculpture consisting of many strongly developed axial costae numbering 14 on the body whorl. Several of the costae may be enlarged to form varices. Covering the surface of the shell there are fine thread-like axial

ridges which are particularly pronounced in the intercostal areas. Spiral sculpture consisting of several rather strong ridges which are somewhat nodulose where they cross the costae. Basal ridge well developed and below this the axial costae disappear while 3 or 4 of the spiral ridges are strongly developed. Nuclear whorls 3, amber-brown in color and axially costate. Operculum unknown.

length	width	whorls	
6.5	1.4 mm.	9	Holotype
9.8	3.6	13	off Lantana, Florida

Types. The holotype of *N. cania* Dall is in the United States National Museum, no. 333464 from the *Albatross*, station 2415, about 105 miles off Fernandina, Florida (N. Lat. 30°44'; W. Long. 79°26') in 440 fathoms.



Plate 166. *Nystiella cania* Dall
Albatross, station 2415, off Fernandina,
 Florida in 440 fathoms. Holotype (15x).

Remarks. *Nystiella cania* differs from *N. opalina* and *N. concava* by having much stronger spiral ridges and more globose whorls. From *N. azelotes* it differs by having more numerous spiral ridges and from *N. atlantis* by having the area below the strong basal ridge devoid of axial costae while the spiral sculpture is greatly reduced. See also remarks under *N. atlantis*.

This species is close superficially to *Cylindriscala andrewsii* Verrill but differs by having the nuclear whorls costate and by possessing very fine intercostal axial threads.

This is a rare species and our entire knowledge is based upon 6 specimens, three of which are young.

Range. In deep water off the east coast of Florida from Fernandina south to the Keys.

Records. FLORIDA: *Albatross*, station 2415, about 105 miles off Fernandina (N. Lat.

30°44'; W. Long. 79°26') in 440 fathoms; *Eolis*, station 349, off Fowey Light in 100 to 150 fathoms (both USNM).

Nystiella azelotes Dall

Plate 167

Epitonium azelotes Dall 1927, Proceedings United States National Museum 70, art. 18, p. 61 (off Georgia [off Fernandina, Florida]).

Description. Shell reaching 4 mm. (about $\frac{1}{6}$ of an inch) in length, attenuate and imperforate. Whorls 10 and moderately convex. Color a flat-white. Spire extended and produced at an angle of 20°. Aperture subcircular. Columella short and arched. Suture deeply indented. Axial sculpture consisting of numerous, nodulose costae which number 17 on the body whorl. Spiral sculpture consisting of 4 very strong ridges, the lowest one



Plate 167. *Nystiella azelotes* Dall
Albatross, station 2415, off Fernandina, Florida
in 440 fathoms. Holotype (about 24x).

forming the basal ridge. The areas in-between the costae and the ridges are square and rather deep. Below the basal ridge the shell is somewhat flattened and nearly devoid of sculpture. Nuclear whorls 3 to 4, axially costate and amber-brown in color. Operculum unknown.

length	width	whorls	
4.1	1.7 mm.	10 *	Holotype

* loss of 1 or 2 early whorls.

Types. The holotype of *N. azelotes* Dall is in the United States National Museum, no. 108370, from *Albatross*, station 2415, 105 miles east of Fernandina, Florida (N. Lat. 30°44'; W. Long. 79°26') in 440 fathoms.

Remarks. This species is readily differentiated from all others in the genus *Nystiella* by its strongly developed and reticulate sculpture. It is perhaps nearest in relationship to *N. cania* Dall which was obtained at the same station. The present species differs from *cania* by having fewer spiral ridges and having the excavations between the costae and the ridges much deeper. In addition, *cania* possesses a few fine spiral threads below the basal ridge.

This species is based upon a single specimen.

Range and Records. Known only from the type locality off Fernandina, Florida.

***Nystiella atlantis*, new species**

Plate 168

Description. Shell reaching 9.7 mm. ($\frac{3}{8}$ of an inch) in length, attenuate, strongly sculptured and imperforate. Whorls 14, moderately convex and attached. Color a dull brownish-white with the costae and the spiral ridges light-brown. Spire extended and produced at an angle of 23° . Columella short and arched. Aperture subcircular and slightly flaring below. Axial sculpture consisting of numerous and well developed costae, numbering 15 on the body whorl of the holotype. Nearly all whorls possess 1 or 2 costae which have become enlarged to form varices. Spiral sculpture consisting of 8 to



Plate 168. *Nystiella atlantis* Clench and Turner
Atlantis, station 3330, Bahía de Cochinos, Cuba. Holotype (9.7x).

12 strongly developed spiral ridges which, on passing over the costae, form small nodules. In addition, there are numerous fine axial threads which are most prominent in the intercostal areas. There is a moderately developed basal ridge with both the axial and spiral sculpture continued below it, but not as strong as in the peripheral area. Nuclear whorls 3, dark amber-brown and axially costate. Operculum nearly circular, paucispiral, corneous and yellowish-brown in color.

length	width	whorls	
9.7	3 mm.	14	Holotype

Types. Holotype, Museum of Comparative Zoölogy, no. 187988 from *Atlantis*, station 3330, Bahía de Cochinos, Cuba (N. Lat. 22°09'; W. Long. 81°10') in 230–265 fathoms. A paratype from off Lantana, Florida is in the collection of T. McGinty and a paratype from *Eolis*, station 43, from off Key West, Florida, is in the United States National Museum.

Remarks. This species is rather distantly related to *N. cania* Dall, differing by being larger, more attenuate, having stronger axial costae and having the base of the whorl sculptured by both the axial costae and spiral ridges.

This species is named after the ketch *Atlantis*, the research vessel of the Woods Hole Oceanographic Institute.

Range. From off southern Florida to the south coast of Cuba in deep water.

Records. FLORIDA: off Lantana in 83 fathoms (T. McGinty); *Eolis*, station 43, off Key West Florida in 63 fathoms; *Eolis*, station 321, off Western Dry Rocks, Key West in 65 fathoms (both USNM). CUBA: *Atlantis*, station 3330, from Bahía de Cochinos (N. Lat. 22°09'; W. Long. 81°10') in 230–265 fathoms (MCZ).

Genus *Solutiscala* de Boury

Solutiscala de Boury 1909, Bull. Muséum d'Histoire Naturelle, Paris 15, p. 482.

Shell freely coiled or solute, small and finely sculptured both axially and spirally. First nuclear whorl smooth, remaining nuclear whorls axially costate. All nuclear whorls attached, remaining postnuclear whorls separated.

Genotype, *Scalaria dissoluta* Locard, original designation.

Remarks. E. de Boury also included *S. vermetiformis* Watson and *S. revoluta* Hedley in his genus *Solutiscala*. Unfortunately, Locard makes no mention regarding the nuclear whorls of *S. dissoluta*, the species de Boury chose for his genotype. However, the axial costae on the nuclear whorls of *S. vermetiformis* are well figured by Watson, a species included by de Boury in *Solutiscala*.

Subgenus *Foratiscala* de Boury

Foratiscala de Boury 1909, Bull. Muséum d'Histoire Naturelle, Paris 15, p. 484.

Shell rather small, scarcely 10 mm. in length, thin, sculptured both spirally and axially and having the nuclear whorls axially costate. Generally the whorls are angled and attached. Basal ridge, if present, is formed by the greater development of lowest spiral cord.

Subgenotype, *Scalaria formosissima* Jeffreys, monotypic.

Solutiscala (*Foratiscala*) *formosissima* Jeffreys

Plate 169

Scalaria formosissima Jeffreys 1884, Proc. Zoological Society London, p. 140, pl. 10, fig. 10 (*Porcupine*, station 16 and 17a, off Portugal).

Scala formosissima Jeffreys, Dall 1889, Bull. Museum Comparative Zoölogy 18, p. 319, pl. 18, fig. 11; Dall 1889, Bull. United States National Museum 37, p. 124, pl. 18, fig. 11.

Description. Shell reaching $6\frac{1}{2}$ mm. (about $\frac{1}{4}$ of an inch) in length, thin, sculptured, attenuate and narrowly umbilicate. Whorls 9 to 12, strongly convex and somewhat angled at the whorl shoulder. Color white and somewhat shining. Spire extended and formed at an angle of about 30° . Suture rather deep. Aperture subcircular, the outer lip thin, the inner lip thin and slightly reflexed, partially closing over the narrow umbilicus. Axial sculpture consisting of rather numerous, low, blade-like costae which are a little higher over the whorl shoulder. There are 18 to 20 costae on the body whorl. Spiral sculpture consisting of numerous, raised threads more or less equally disposed over the surface of the whorl. Nuclear whorls 3, the first smooth, the second and third axially costate. First postnuclear whorl much larger than the last nuclear whorl. Operculum very thin, paucispiral and light yellow-brown in color.

length	width	whorls	
6.5	2.9	9	off Fowey Light, Florida
6.5*	2.8	7	off Mobile Bay, Alabama
6.5*	2.7	7	off Mobile Bay, Alabama

* loss of nuclear whorls.



Plate 169. *Solutiscala formosissima* Jeffreys

Off Fowey Light, Florida. Fig. 1 (12.5x). Fig. 2. Showing nuclear whorls (25x).

Types. Lectotype, here selected, is the specimen upon which Jeffreys based his figure. There are two paratypes in the United States National Museum, no. 182744. The type locality is *Porcupine*, 1870, stations 16 and 17a (N. Lat. $39^\circ 55'$; W. Long. $09^\circ 56'$) and (N. Lat. $39^\circ 39'$; W. Long. $09^\circ 39'$) off Portugal, about 50 miles northwest of Lisbon.

Remarks. So far as we are able to determine, the specimens of this species from Europe and from the Western Atlantic are identical. This is a very delicate species and as a consequence nearly all of the specimens obtained have been injured in some manner. It ranges in depth from 120 to 944 fathoms. The figure of Dall which appeared in the Bul-

letin of the Museum of Comparative Zoölogy and that of the United States National Museum is apparently overdrawn, at least so far as the aperture is concerned. In specimens which we have seen the aperture is subcircular and is similar to others in this group.

In relationship, *S. formosissima* is nearest to *S. pyrrhias* Watson. In this latter species, the spiral threads are reduced to only 3 or 4 and these are grouped in the peripheral area. In addition, there seem to be fewer axial costae in *pyrrhias*.

Range. Florida Keys and deep water in the Gulf of Mexico south of Alabama. Also in the Eastern Atlantic off Portugal.

Records. WESTERN ATLANTIC. FLORIDA: *Eolis*, station 304, off Fowey Light in 120 fathoms (USNM). ALABAMA: *Albatross*, station 2384, about 100 miles due south of Mobile Bay (N. Lat. 28°45'; W. Long. 88°15') in 940 fathoms; *Albatross*, station 2385, about 90 miles due south of Mobile Bay (N. Lat. 28°51'; W. Long. 88°18') in 730 fathoms (both USNM).

EASTERN ATLANTIC. PORTUGAL: *Porcupine*, station 16 (N. Lat. 39°55'; W. Long. 09°56') in 994 fathoms (USNM).

Solutiscala (Foratiscala) pyrrhias Watson

Plate 170, figs. 3-4

Scalaria (Acirsa) pyrrhias Watson 1886, Voyage of H.M.S. *Challenger*, Zoology 15, p. 145, pl. 9, fig. 7 (off Culebra Island, West Indies).

Description. Shell small, reaching about 5 mm. (about $\frac{1}{4}$ of an inch) in length, turreted, imperforate and very thin. Whorls 8, rather strongly convex and attached. Color white. Spire extended and produced at an angle of about 35°. Suture deep but not profound. Aperture subcircular. Columella short and arched. Axial sculpture consisting of rather widely spaced and thin costae. There are 11 costae on the body whorl of the holotype. Spiral sculpture consisting of 3 to 4 threads which are grouped near the peripheral area of the whorl. Nuclear whorls 4, the first smooth, the next 3 very slightly convex and rather strongly costate. Operculum unknown.

length	width	whorls	
5	2.03 mm.	8	Holotype

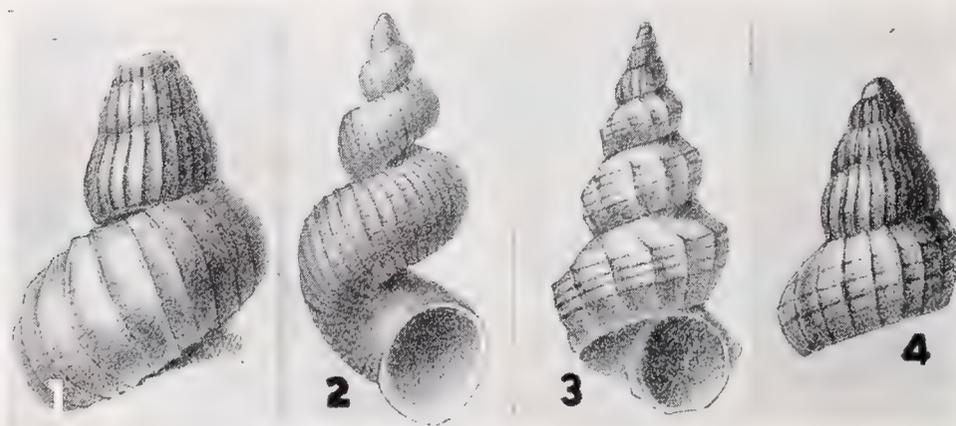


Plate 170

Figs. 1-2. *Solutiscala vermetiformis* Watson, from off Pernambuco [Recife], Brasil. Fig. 1. Showing nuclear and first postnuclear whorls (40x). Fig. 2 (about 8x). Figs. 3-4. *Solutiscala pyrrhias* Watson, from off Culebra Island, Puerto Rico. Fig. 3 (about 8x). Fig. 4. Showing nuclear and first postnuclear whorls (30x). All after Watson.

Types. The holotype of this species is probably in the British Museum. The type locality is *Challenger*, station 24, off Culebra Island, Puerto Rico, West Indies (N. Lat. $18^{\circ}38'$; W. Long. $65^{\circ}05'$) in 390 fathoms.

Remarks. This species appears to be close in its relationship to *formosissima* Jeffreys. However, it is quite distinct and readily differentiated. *Solutiscala pyrrias* Watson is a broader species possessing fewer axial costae and much stronger spiral threads. In *pyrrias* the spiral threads are grouped near the periphery of the whorl while in *formosissima* they are equally distributed over the entire whorl.

Range and Records. Known only from the type locality, from off Culebra Island, Puerto Rico, West Indies.

Subgenus *Solutiscala* de Boury

Solutiscala de Boury 1909, Bulletin Muséum d'Histoire Naturelle, Paris **15**, p. 482.

Subgenotype, *Scalaria dissoluta* Locard, original designation.

Shells small, thin, with the postnuclear whorls unattached or solute. Nuclear whorls attached, the first whorl usually smooth, the remaining nuclear whorls being axially costate.

Solutiscala (*Solutiscala*) *vermetiformis* Watson

Plate 170, figs. 1-2

Scalaria vermetiformis Watson 1886, Voyage of H.M.S. *Challenger*, Zoology **15**, p. 142, pl. 9, fig. 6 (off Pernambuco [Brasil]).

Description. Shell reaching 5.5 mm. (about $\frac{1}{4}$ of an inch) in length, thin, whorls unattached and finely sculptured. Whorls $7\frac{1}{2}$, nearly cylindrical and solute, only the nuclear whorls being attached. Color a transparent white and not glossy. Aperture subcircular and holostomatous. Axial sculpture consisting of numerous fine and rather regularly spaced costae. Spiral sculpture consisting of numerous fine, rounded threads which do not pass over the costae, the interspaces about double the width of the threads. Nuclear whorls: first whorl smooth, next three whorls finely and axially costate. First post-nuclear whorl proportionally much larger. All nuclear whorls are slightly convex with a moderately indented suture.

length	width	whorls	
5.5	2.5 mm.	$7\frac{1}{2}$	Holotype (from Watson)

Types. The holotype of *S. vermetiformis* Watson is probably in the British Museum. The type locality of this species is *Challenger*, station 122, from off Pernambuco [Recife] Brasil (S. Lat. $09^{\circ}05'$; W. Long. $34^{\circ}50'$) in 350 fathoms.

Remarks. This species is unknown to us. Our description and measurements are based entirely upon Watson's description in the Challenger Report. We have reproduced his figures. This species is probably closely related to *Solutiscala dissoluta* Locard. Watson compared his species to *Scalaria semidisjuncta* Jeffreys, but according to Jeffreys the nuclear whorls of this species are smooth and in our opinion *semidisjuncta* is a true *Epitonium* which is closely allied to *E. babylonium* Dall (see p. 315).

Range and Records. Known only from the type locality.

Additions, Corrections and Notes

We append to this study of the Epitoniidae species not considered in the earlier numbers, new records for other species and data on the radulae. Under the caption of Corrections and Notes we include names of species wrongly assigned to the Western Atlantic or other information regarding names that may aid in the clarification of the nomenclature of this family.

* * * *

Additions

Opalia (Opalia) abbotti, new species

Plate 171

Opalia watsoni 'de Boury' Clench and Turner 1950, *Johnsonia* 2, p. 232 (in part), pl. 100, figs. 1-2.

This species is figured and described in this volume of *Johnsonia*, pp. 231 and 232, under the name of *Opalia watsoni* de Boury. We redescribe it as certain minor changes are necessary.

Descriptions. Shell reaching 4.5 mm. (about 1/5 of an inch) in length, attenuate, imperforate and sculptured. Whorls 10, moderately convex. Color a flat-white. Suture well impressed and not crenulated or only slightly so. Aperture subcircular. Outer lip thickened. Columella short and arched. Axial sculpture consisting of strong costae which terminate below on the basal ridge, the costae numbering 12 on the body whorl. Microscopic sculpture consisting of numerous and exceedingly fine spiral threads which are minutely pitted. Nuclear whorls $3\frac{1}{2}$ to 4, smooth and glass-like. Operculum unknown.



Plate 171. *Opalia abbotti* Clench and Turner
Atlantis, station 3374, off Puerto Tanamo, Oriente,
Cuba in 300 fathoms. Holotype (24.8x).

length	width	whorls	
4.3	1.5 mm.	10	off Puerto Tanama, Cuba
4.5	1.6	10	Fowey Light, Florida
2.7	1.0	8	Bahía de Matanzas, Cuba

Types. Holotype, Museum of Comparative Zoölogy, no. 184511, from *Atlantis*, station 3374, off Puerto Tanamo, Cuba (N. Lat. 20°45'; W. Long. 75°19') in 300 fathoms.

Remarks. We were in error regarding our determination of *O. watsoni* de Boury. The specimen we figured is different and we are now able to figure both a specimen and the original figures of *S. funiculata* Watson (= *O. watsoni* de Boury). This new species is named for R. T. Abbott, Associate Curator in the United States National Museum.

Range. Southern Florida and the north coast of Cuba in deep water.

Records. FLORIDA: *Eolis*, stations 351, 355 and 340 off Fowey Light in 90, 70 and 209 fathoms; *Eolis*, station 6 off Sand Key, Key West, in 35 fathoms (all USNM). CUBA: *Atlantis*, station 3485, Bahía de Matanzas (N. Lat. 23°13'; W. Long. 81°22') in 385 fathoms; *Atlantis*, station 3435, off Sagua la Grande (N. Lat. 23°05'; W. Long. 79°25') in 255 fathoms; *Atlantis*, station 3374, off Puerto Tanamo (N. Lat. 20°45'; W. Long. 75°19') in 300 fathoms (all MCZ and Museo Poey).

Opalia (Opalia) leeana Verrill

Plate 172

Scalaria (Cirsotrema) leeana Verrill 1882, Transactions of the Connecticut Academy 5, pt. 2, p. 256 (off Martha's Vineyard, *Fish Hawk*, station 1038 in 146 fathoms [185 miles E. of Barnegat Bay, New Jersey]).

Description. Shell reaching 5 mm. (1/5 of an inch) in length, attenuate, moderately sculptured and imperforate. Whorls 5¹ remaining, moderately convex and attached. Color a dull grayish-white. Spire extended and produced at an angle of 14°. Suture well depressed and indented. Aperture subcircular. Columella short and arched. Sculpture consisting of numerous axial costae which are fairly low and do not extend below a well developed basal ridge. Spiral sculpture consisting of numerous fine and evenly pitted threads. Nuclear whorls 3, smooth and glass-like. Operculum unknown.

length	width	whorls	
5	2 mm.	5*	Holotype

* probable loss of 5 or 6 whorls.

Types. Holotype of *O. leeana* Verrill is in the United States National Museum, no. 44806, from *Fish Hawk*, station 1038, from about 185 miles east of Barnegat Bay, New Jersey (N. Lat. 39°58'; W. Long. 70°06') in 146 fathoms.

Remarks. We know but little about this species. Only two lots have been obtained, the holotype from off northern New Jersey and three fragmented specimens from off Cape Hatteras, North Carolina. It does not appear to be closely related to any other Western Atlantic species.

Range. From the latitude of northern New Jersey south to Cape Hatteras, North Carolina in fairly deep water.

¹ This specimen, the holotype, is broken and many of the early whorls as well as the last whorl are lost.

Records. NEW JERSEY: *Fish Hawk*, station 1038, about 185 miles east of Barnegat Bay (N. Lat. $39^{\circ}58'$; W. Long. $70^{\circ}06'$) in 146 fathoms. NORTH CAROLINA: *Albatross*, station 2595, about 22 miles southeast of Cape Hatteras (N. Lat. $35^{\circ}08'$; W. Long. $75^{\circ}05'$) in 63 fathoms.



Plate 172. *Opalia leana* Verrill
Fish Hawk, station 1038, 185 miles east of Barnegat Bay, New Jersey in 146 fathoms. Holotype (20.4x).

Epitonium (Epitonium) eulita Dall and Simpson

Plate 173

Scala eulita Dall and Simpson 1901, Bulletin United States Fish Commission for 1900, **1**, p. 412, pl. 57, fig. 2 (Mayagüez Harbor, Puerto Rico, *Fish Hawk*, station 6062, in 25 to 30 fathoms).

Description. Shell reaching 4 mm. ($\frac{1}{6}$ of an inch) in length, attenuate and imperforate, whorls 9, strongly convex and attached well down in the suture. Color a glossy-white. Spire extended and produced at an angle of 23° . Suture very deep. Aperture subcircular. Columella short and arched above. Sculpture consisting of numerous low, blade-like costae which number 16 on the body whorl (specimen broken). These costae are very slightly hooked at the whorl shoulder. There is no indication of spiral sculpture nor is there a basal ridge. Nuclear whorls 3, glass-like and smooth. Operculum unknown.

length	width	whorls	
4	1.2 mm.	9	Holotype

Types. The holotype of *E. eulita* Dall and Simpson is in the United States National Museum, no. 160493, from *Fish Hawk*, station 6062, Mayagüez Harbor, Puerto Rico, dredged in 25 to 30 fathoms.

Remarks. The figure of *E. eulita* Dall and Simpson is poor. Under the remarks in their original description the authors state: "The specimen is somewhat defective and the figure hardly shows the little angular projections near the suture, which is normal to the varices." So far as we can detect, this species is exceedingly close to or identical with *E. fractum* Dall. It is perhaps best to retain this name until additional material, particularly young specimens, is available for comparative study.

It is unfortunate that Dall published descriptions of this and other species that he based on unique and broken specimens. This has left the burden of proof as to the validity of the species to future students.

Range and Records. Known only from the type locality.



Plate 173. *Epitonium eulita* Dall and Simpson
Fish Hawk, station 6062, off Mayagüez, Puerto
Rico in 25-30 fathoms. Holotype (25.7x).

***Epitonium (Epitonium) albidum* d'Orbigny**

Plate 174

Scala undecimcostata Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 260 (St. Thomas [Virgin Islands]; Jamaica); Mörch 1875, Malakozologische Blätter 22, p. 148; Mörch 1876, Journal Academy Natural Sciences, Philadelphia (2) 8, p. 198.

The above reference is to another synonym of *Epitonium albidum* d'Orb. (see *Johnsonia* 2, 1951, no. 30, p. 260). We figure a lectotype kindly loaned to us by Dr. A. F. Bruun of the Universitetets Zoologiske Museum, Köbenhavn, Denmark. There is an additional paratype specimen in the Academy of Natural Sciences, Philadelphia.

Epitonium (Epitonium) dallianum *Verrill and Smith*

A specimen of this species was obtained by the *Eolis*, from off Miami in 120 fathoms. This extends the range from North Carolina south to off southern Florida. See this volume, p. 279.



Plate 174. *Epitonium albidum* d'Orbigny
Scalaria undecimcostata Mörch (= *albidum* d'Orbigny)
 from St. Thomas, Virgin Islands. Holotype (8.8x).

* * * *

Anatomical Notes

All of the morphological structures shown in Plate 175 remained after the soft parts were completely macerated in boiling potassium hydroxide.

The entire radula (A) is composed of many rows of teeth and, so far as we can detect, all of these are marginal teeth, both the rachidian or central tooth and the lateral teeth have been lost.¹ The teeth, though usually similar in shape for the entire width of the ribbon, generally become somewhat smaller toward the lateral margins. There is usually a narrow, central band, devoid of teeth extending the entire length of the ribbon; this is probably the area of the missing lateral and central teeth. In a few cases, two somewhat different marginal teeth have been obtained from the same radula, a condition not at all unusual in the radulae of prosobranchs.

Between the radula and the esophagus there are two lateral plates (B) which are composed of chitin impregnated with calcium carbonate. The function of these plates is unknown but it is possible that they are attachment points for muscles which aid in keeping the forward portion of the esophagus open for the reception of food.

¹ In error we said marginal teeth were lost (p. 246).

The tube of the esophagus (C) that extends behind these plates is of a chitinized material and from its pleated appearance can be extended or retracted as the animal feeds. It would also appear that the esophagus may function as a crop. The very small size of the radula teeth and the inclusion of sand grains in the esophagus (Figs. 2 and 3) would indicate that these animals are detritus feeders and depend upon a long crop-like esophagus and sand grains to grind up the food. A single foraminifera shell is seen in fig. 2. Far more material is needed before any real understanding can be had of the soft parts.

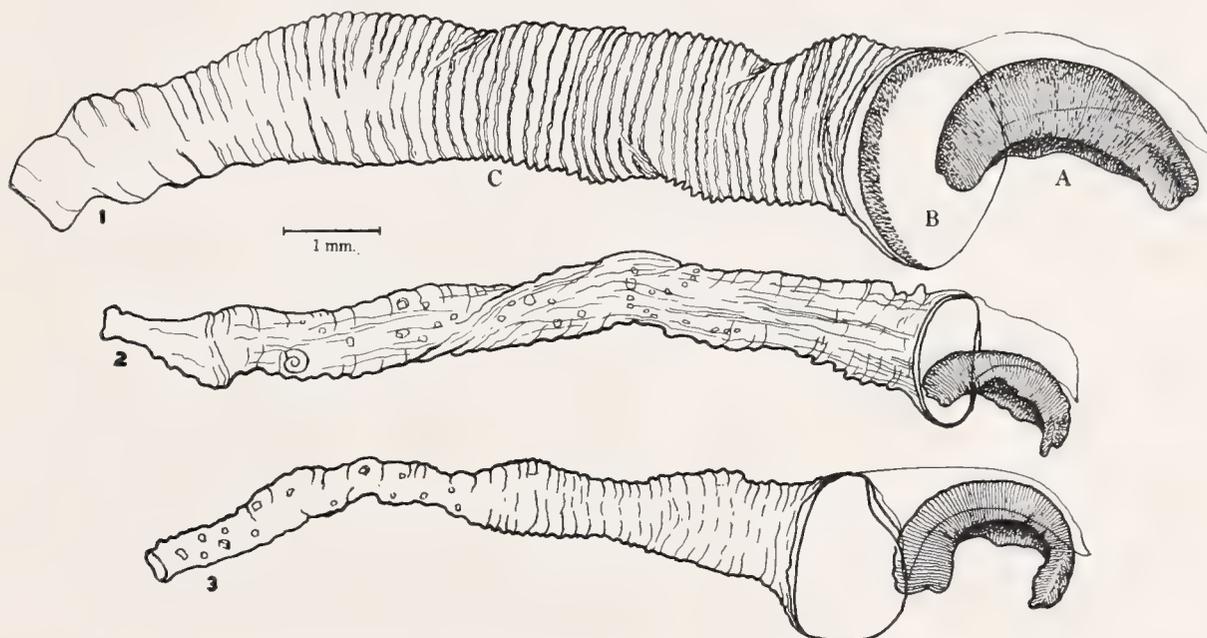


Plate 175. Esophagus, esophageal plates and radula of the Epitoniidae

Fig. 1. *Epitonium lamellosum* Lamarck. Fig. 2. *Epitonium greenlandicum* Perry. Fig. 3. *Epitonium angulatum* Say.

The taxonomic significance of these morphological structures is largely in the esophageal plates, that is, their general shape and sculpture, as both the entire radula and the esophagus are subject to variation as a result of the techniques involved in their preparation.

Troschel in his *Das Gebiss der Schnecken* 1875, 2, pp. 153-154, pl. 15, figs. 1-3, mentions the esophageal tube and plates. The latter, on the basis of poor and inadequate material, he considered jaws. He also mentions that a Fritz Muller, writing him from Brasil, described two pointed rods, one found on either side of the radula. Trochel was unable to find these rods in the material sent by Muller and we have seen nothing resembling them. They were perhaps some bits of debris in Muller's preparation.

Thiele in 1928 when writing on the ptenoglossate snails illustrated the radula of several species of Epitoniidae and with these our own observations agree in general.

In the very few species examined in this complex family the radular teeth appear to have several characters of generic value. Far more species must be examined anatomically, however, to prove or disprove the validity of the enormous number of subgenera proposed in this family.

The series of teeth illustrated on Plate 176 show types of 4 genera in the Epitoniidae and indicate the general similarity in the shape of all the teeth except those of *Solutiscala* and *Cirsotrema*.

It was noticed when preparing the slides of the radulae that the radular ribbon of *E. lamellosum* was much broader for its length and the rows of teeth were placed much farther apart than in those of other species examined. In *Epitonium echinaticostum*, *E. foliaceicostum* and *E. tollini* the teeth were very loosely attached to the membrane. The

radular ribbon of *E. foliaceicostum* had only 30 to 40 rows of teeth at the widest point of the ribbon while *lamellosum* and *greenlandicum* had over twice that number. The ribbon in all species, except *Solutiscala formosissima*, was generally cap-shaped, narrowing anteriorly and posteriorly, but wide and folded in the central portion. The teeth of all species, except *Solutiscala*, are flat and more or less sickle-shaped, varying little in thickness from the free end to the point of attachment. In *Solutiscala formosissima* the teeth are short and thick and arise from a very heavy bulbous base. The radular ribbon of *S. formosissima* is small, nearly equal in width for its entire length and it has relatively few large, heavy, loosely attached teeth. Unfortunately we were able to get the radula of only one species in the Nystiellinae. The teeth from this single species, however, indicate a substantial difference between the Nystiellinae and the Epitoniinae.



Plate 176. Radular teeth of the Epitoniidae

Fig. 1. *Epitonium angulatum* Say. Fig. 2. *E. humphreysii* Kiener. Fig. 3. *E. lamellosum* Lamarck. Figs. 4-5. *E. championi* Clench and Turner. Fig. 7. *E. tollini* Bartsch. Figs. 8-9. *E. echinaticostum* d'Orbigny. Fig. 11. *E. foliaceicostum* d'Orbigny. Figs. 12-13. *E. greenlandicum* Perry.

Fig. 6. *Cirsotrema dalli* Rehder. Fig. 10. *Opalia crenimarginata* Dall (a species from California). Figs. 14-15. *Solutiscala formosissima* Jeffreys.

All drawings made with the aid of a camera lucida and greatly enlarged.

* * * *

Notes

Epitonium acutum Pfeiffer

Scalaria acuta Pfeiffer 1840, Archiv für Naturgeschichte 6, (1) p. 256 (Cuba); non Sowerby 1813; non Sowerby 1827.

This name has been applied often to Western Atlantic species, but Pfeiffer's description could apply to any of several species in the tropical Western Atlantic.

Epitonium brevis d'Orbigny

Scalaria brevis d'Orbigny 1840, Voyage dans l'Amérique Méridionale **5**, pt. 3, p. 390, pl. 75, figs. 22-24 (Iles Malouines [Falkland Islands]).

This species falls outside the region which we consider the Western Atlantic and we include the name only to complete the record. This species was based by d'Orbigny upon a very young specimen. It is widely umbilicated, axially costate and has rather well developed spiral threads. There appears to be no basal ridge.

Epitonium coronatum Lamarck

Scala coronata Lamarck 1816, Encyclopédie Méthodique, Vers **3**, pl. 451, fig. 5a-b, List p. 11 (no locality given).

This species has been listed occasionally as coming from the West Indies. Most modern authors, however, believe this to be a species from South Africa. The Western Atlantic references probably apply to *E. lamellosum* Lamarck.

Cerithidea costata da Costa

Plate 177

Scala (Opalia) discobalaria Dall 1889, Bulletin Museum Comparative Zoölogy **18**, p. 234, pl. 18, fig. 2 (off Bahía Honda, Cuba, Blake, station 20 (N. Lat. 23°02'; W. Long. 83°11') in 220 fathoms).

It seems incredible that Dall should have attempted to describe this badly worn fragment. In our opinion, this is nothing more than a fragmented specimen of *Cerithidea costata* da Costa (*Johnsonia* **1**, no. 5, p. 2, pl. 2, figs. 1-7), an intertidal species which was advectitious at the locality where it was dredged.



Plate 177. *Scala discobalaria* Dall (= *Cerithidea costata* da Costa), off Bahía Honda, Cuba in 220 fathoms. Holotype ($14\frac{2}{3}x$).

Epitonium filare Mörch

Scalaria filaris Mörch 1874, Vidensk. Medd. Naturhist. Forening i Kjöbenhavn no. 17, p. 265 (St. Martins [Lesser Antilles]); Mörch 1875, Malakozoologische Blätter **22**, p. 152; Mörch 1876, Journal Academy Natural Sciences, Philadelphia (2) **8**, p. 203.

We are unable to recognize this species among the collections that we have studied from the Western Atlantic. The whereabouts of the type is unknown to us. In his description Mörch mentions a basal ridge and bands of color on both sides of the suture of an otherwise white shell. This description fits certain specimens we have seen of *Epitonium lamellosum* Lamarck.

Epitonium inconspicuum Sowerby

Scalaria inconspicua Sowerby 1844, Thesaurus Conchyliorum **1**, Scalaria, p. 90, pl. 33, fig. 53 (West Indies).

We are unable to recognize this species. Sowerby's description is practically useless as the few characters he mentions would fit many species in the Western Atlantic. His figure exhibits no detail at all.

Janthoscala Mörch

Janthoscala Mörch 1875, Malakozoologische Blätter **22**, p. 152.

Dall later designated *Scala modesta* 'C. B. Adams' Mörch (= *S. permodesta* Dall) as the sectional type, but this species is unrecognizable and as a consequence, the name *Janthoscala* has no standing. [See Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, p. 311.]

Epitonium permodesta Dall

Scala permodesta Dall 1889, Bulletin Museum of Comparative Zoölogy **18**, p. 311. Based upon *Scalaria modesta* 'C. B. Adams' Mörch 1876, Journal Academy Natural Sciences Philadelphia (2) **8**, p. 203 (Puerta Plata [Hispaniola]); non *Scalaria modesta* C. B. Adams 1845.

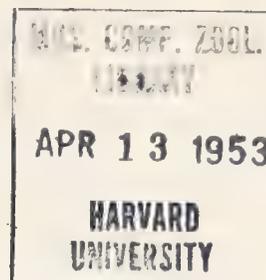
This species is unrecognizable. It was not figured by Mörch and the very brief description would cover any of several species in the West Indian region. It is probably a very young specimen. See also remarks in *Johnsonia* **2**, p. 264.

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The notes and descriptions of new species in this review number cover but little of the new information actually on hand for publication. However, space is limited and we give pertinent data on only a few genera that have been covered to date in *Johnsonia*. It is our plan to devote more space in Volume III to reviewing many genera that have been covered in the earlier numbers of this publication.

THE GENUS *BANKIA* IN THE WESTERN ATLANTIC

BY

RUTH D. TURNER AND DOROTHY J. BROWN¹

A number of new records, several of which extend the ranges of the various species of *Bankia*, have been received from the Clapp Laboratories since the publication of *Johnsonia* No. 19 which covered this genus. This was a result of new test board locations and continued collecting from the many old stations. The specimens collected from test boards placed on various lightships, most of them well out to sea, indicate the distance the free swimming larval forms can regularly be carried either directly by the currents or by driftwood containing adults from which young are being liberated. The pallets of many of the specimens taken from the test boards on the lightships were in excellent condition, often with the very early cones, possibly because they were free from browsing fish which are generally far more abundant in inshore waters.

Bankia (*Bankiella*) *gouldi* Bartsch

Bankia (*Bankiella*) *gouldi* Bartsch, Clench and Turner 1946, *Johnsonia* 2, p. 13.

Records. MARYLAND: Annapolis. VIRGINIA: Portsmouth; Yorktown. NORTH CAROLINA: Harbor Island; Wilmington; Southport; Morehead City; Ocracoke; Fort Mason; Frying Pan Shoals. GEORGIA: Savannah Lightship, off Savannah. FLORIDA: St. John's Lightship, off Mayport; Ormond Beach; Fort Pierce; Panama City. TEXAS: Freeport. CUBA: Preston; Guantánamo. COSTA RICA: Golfito. PANAMA: Armuelles; Fort Amador, Canal Zone. VENEZUELA: Bahía de Amuay (all MCZ).

Bankia (*Bankiopsis*) *caribbea* Clench and Turner

Bankia (*Bankiopsis*) *caribbea* Clench and Turner 1946, *Johnsonia* 2, p. 16.

Records. MASSACHUSETTS: Nantucket. NORTH CAROLINA: Diamond Shoal Lightship; Frying Pan Shoals; about 18 miles off Assateague Island (all MCZ): FLORIDA:

¹ Biologist, William F. Clapp Laboratories, Inc., Duxbury, Mass.

Miami (A. Merrill). JAMAICA: Montego Bay. HISPANIOLA: Puerto Libertador. PUERTO RICO: Mona Island; Muertos Island. HONDURAS: Puerto Cortes. GUATEMALA: San José (all MCZ).

The record of *B. caribbea* Clench and Turner from Nantucket, Massachusetts would appear on the surface to be a great extension of the range of this species northward. However, since the specimens are always taken from a test board submerged in June and removed in October of the same year, it probably indicates nothing more than a fortuitous occurrence of this species at Nantucket during the summer months only. Probably driftwood containing adults with eggs is carried up to Nantucket by the Gulf Stream from the West Indies. Young colonies then become established only to be killed out with the onset of winter.

Bankia (Liliobankia) katherinae Clench and Turner

Bankia (Liliobankia) katherinae Clench and Turner 1946, *Johnsonia* 2, p. 18.

Records. CUBA: Guantánamo. HONDURAS: Puerto Cortes. VENEZUELA: Bahía de Amuay (all MCZ).

Bankia (Neobankia) destructa Clench and Turner

Bankia (Neobankia) destructa Clench and Turner 1946, *Johnsonia* 2, p. 20.

Records. CUBA: Guantánamo Bay. VENEZUELA: Bahía de Amuay (all MCZ).

Bankia (Plumulella) fimbriatula Moll and Roch

Bankia (Plumulella) fimbriatula Moll and Roch, Clench and Turner 1946, *Johnsonia* 2, p. 22.

Records. FLORIDA: Biscayne Bay; Panama City. CUBA: Preston; Banos. PANAMA: Fort Sherman, Canal Zone. VENEZUELA: Bahía de Amuay (all MCZ).

An interesting record for *Bankia fimbriatula* Moll and Roch was reported upon by W. S. S. van Benthem Jutting (1952, *Basteria* 16, no. 3, p. 37). The specimens were from a piece of driftwood that had been thrown up on the beach between Ijmuiden and Zandvoort, Netherlands. Many records of *Bankia* of driftwood origin from the West Indies are known for the British Isles but this is the first record we have encountered from the Netherlands.

Bankia (Plumulella) fosteri Clench and Turner

Bankia (Plumulella) fosteri Clench and Turner 1946, *Johnsonia* 2, p. 24.

At the time that *Bankia fosteri* was described only fragmentary specimens from two localities on the mainland of South America were known. The new specimens, taken from test boards at the Diamond Shoal Lightship off Cape Hatteras, have greatly extended the known range of the species and, in addition, are much larger than any we had seen. This species has now occurred in the test boards at Diamond Shoal Lightship on two successive years which would indicate either that it is reintroduced each year or that it actually is able to withstand the winter months and can breed at this locality. This species probably occurs throughout the West Indies though the only record known to date is Muertos Island, Puerto Rico.

The pallets of the largest specimen received from North Carolina had lost the early

cones; however, there were 26 cones remaining and the complete pallet would probably have measured well over 85 millimeters. The stalk of this specimen measured 43 mm. in length, the longest proportionately that we have seen. A specimen in the collection at the W. F. Clapp Laboratories had pallets 90 mm. in length. So far as we now know *Bankia fosteri* has the longest pallets of any species of *Bankia* on record.

Shell		Pallet	
height	length	length	no. of cones
11.9	10.5	77 mm.	26 (incomplete)

Records. NORTH CAROLINA: Diamond Shoal Lightship, about 15 miles off Cape Hatteras. PUERTO RICO: Muertos Island (all MCZ).

Bankia (Plumulella) cieba Clench and Turner

Bankia (Plumulella) cieba Clench and Turner 1946, *Johnsonia* 2, p. 25.

Records. CUBA. Preston (MCZ).

Notes

Xylotrya fimbriata var. *subaequalis* Dall 1883, Proc. United States National Museum 6, no. 22, p. 337 (Cedar Keys, Florida). [Nomen nudum.]

This name probably refers to some species of *Bankia*. No description was given and the few remarks are completely meaningless as it is impossible to tell whether Dall is referring to the shells or the pallets. We quote Dall in full: "Cedar Keys. This differs from the type in having the anterior and posterior areas subequal in size."

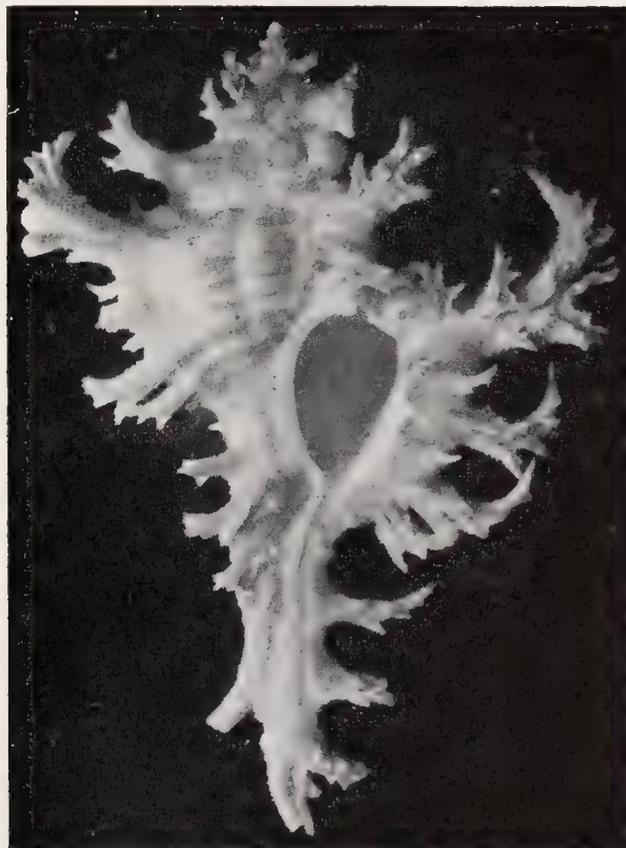


Plate 178. *Murex argo* Clench and Farfante
Holotype of *Murex imbricatus* Higgins and Marrat
(= *M. argo* Clench and Farfante) (natural size).

THE GENUS MUREX IN THE WESTERN ATLANTIC

BY

WILLIAM J. CLENCH

Murex argo *Clench and Farfante*

Plate 178

Murex argo Clench and Farfante 1945, *Johnsonia* 1, no. 17, p. 31.

We are indebted to Mr. W. K. Ford, Department of Zoology, Liverpool Museums, for the figure of *Murex argo*. As the original figure by Higgins and Marrat was a drawing, Mr. Ford sent us a photograph of the holotype from which our present plate was made. A biographical sketch of Rev. Higgins by Mr. Ford has been published in the Liverpool Bulletin.¹ In addition to a portrait of the Rev. Higgins, there is an excellent plate of *Murex argo*, twice natural size.

Murex (Murex) branchi, new species

Plate 179

Description. Shell large, reaching 121 mm. (about $4\frac{3}{4}$ inches) in length, rather solid and having a very few short spines. Whorls 9 and rather strongly convex. Color white or a very light gray with spiral bands of chestnut-brown. There are three wide bands on the body whorl and three bands on the siphonal canal. Spiral threads of brown exist in between the wide bands. Spire extended. Suture deeply impressed. Aperture subcircular, slightly oblique and open below into a long siphonal canal. Parietal lip adherent to the body whorl, the upper portion completely attached, the lower portion erect and standing free. Palatal or outer lip rather strong and not crenulated. Siphonal canal rather broad and curved slightly and very slightly recurved upwards. Two previous stages of the siphonal canal remain and these terminate above the end of the present canal. The sculpture consists of three strong and relatively narrow varices. Each varix supports a series of very low and blunt spines, the largest being at the whorl shoulder. The varices of one whorl are nearly aligned with the varices on the whorls above. Spiral sculpture consisting of numerous and fine cords and these are minutely nodulose where they cross a similar series of axial cords. Nuclear whorls probably smooth, the next three to four whorls are finely costate, the costae nearly equal in size to the varices. On the remaining whorls the varices become much larger and the costae become finer and continue as the axial cords. Operculum unknown.

length	width	whorls	
121	44.5 mm.	9	Holotype
93.5	40	8	Paratype

Types. The holotype is in the collection of C. L. Branch of Rockport, Texas and was dredged in the Gulf of Campeche, Mexico by Mr. Branch in 1952. A single dead specimen was obtained by Mr. J. L. Baughman from off Corpus Christi, Texas (N. Lat. $27^{\circ}36'$; W. Long. $96^{\circ}55'$). This specimen, no. 2115, is in the Museum of the Game and Fish Commission, Rockport, Texas.

¹ Liverpool Bulletin, Libraries, Museums and Arts Committee 2, pp. 67-76, 1952.

Remarks. This species appears to be close in its relationship to *M. antillarum* Hinds. It differs mainly in being much larger, having more color and lacking nearly all spines. *M. branchi* has numerous axial cords, seven to eight between each varix, while in *M. antillarum*, the axial cords are reduced to three and are usually somewhat larger, even on a smaller shell.

We are indebted to Mr. Branch for the privilege of reporting upon this fine species and to Mr. Baughman for the loan of the specimen obtained off the Texas coast which he had collected in August 1952.

Range. From off Corpus Christi, Texas south to the Gulf of Campeche, Mexico.

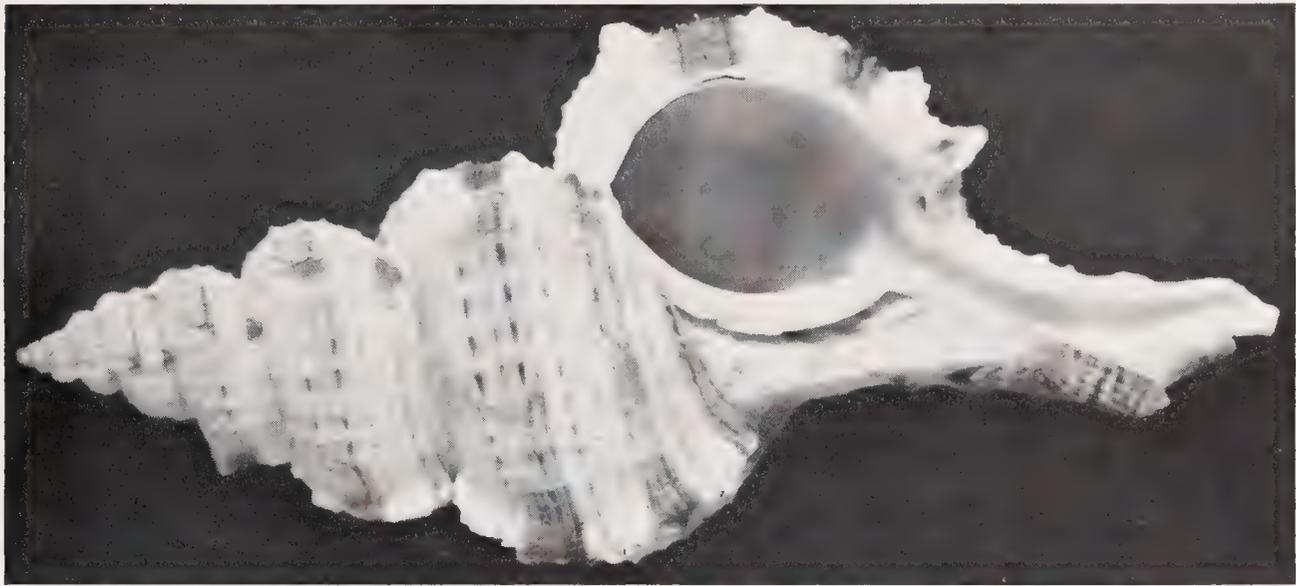


Plate 179. *Murex (Murex) branchi* Clench
Gulf of Campeche, Mexico. Holotype (1.3x).

THE GENERA EPITONIUM, OPALIA AND CYLINDRISCALA IN THE WESTERN ATLANTIC

BY

WILLIAM J. CLENCH AND RUTH D. TURNER

Epitonium (Boreoscala) blainei, new species

Plate 180

Description. Shell reaching about 30 mm. ($1\frac{1}{8}$ inches) in length, attenuate, imperforate and strongly sculptured. Color a uniform white. Whorls 9 (nuclear whorls lost), rather strongly convex and attached. Suture deeply impressed. Aperture circular. Lip thickened. Columella short and arched. Axial sculpture consisting of numerous and well rounded costae which number 13 on the body whorl. These costae are convex on the forward side, slightly concave on the inner side. Spiral sculpture consisting of several well developed ridges which number 7 on the last whorl above the basal ridge. They are absent on the shoulder of the whorl. Below the basal ridge several more ridges appear but they are exceedingly fine. The axial costae are crenulated due to a series of small rounded knobs, each reflecting a point above a corresponding spiral ridge. Basal ridge strongly developed in between the axial costae: it does not, however, pass over the costae. Nuclear whorls and operculum unknown.

length	width	whorls	
25.3	9.5 mm.	9*	Holotype
28	10	8*	Paratype

* early whorls lost.

Types. Holotype, Museum of Comparative Zoölogy, no. 189246 from southwest of the lighthouse, Boca Grande, Florida [about 45 miles] in 22 fathoms. Collected by Soson Vatikiotis in 1937. Paratype, from Bear Cut, Crandon Park, Miami, Florida. Collected by Arthur Merrill in 1951.

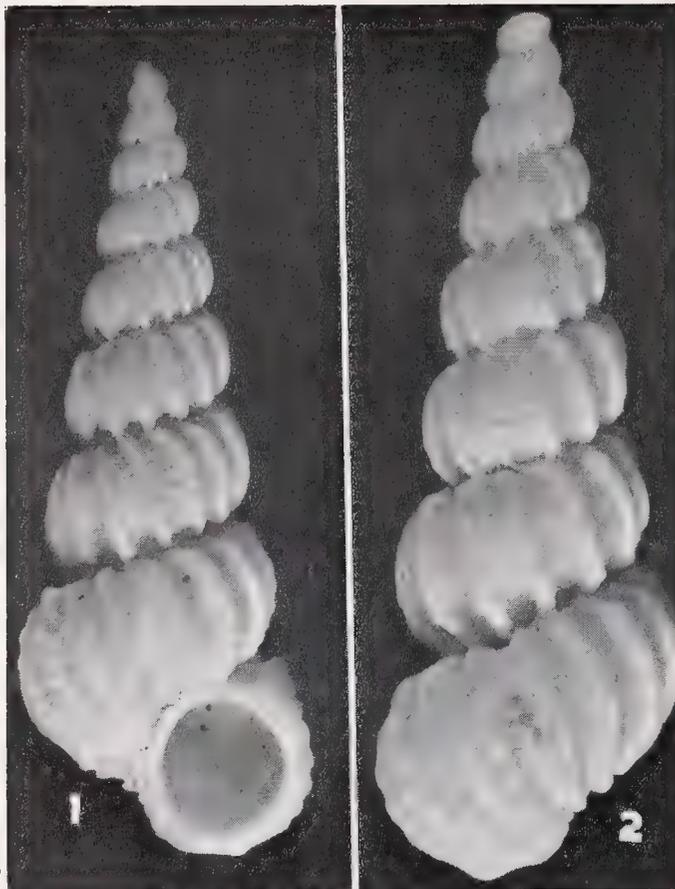


Plate 180. *Epitonium (Boreoscala) blainei* Clench and Turner

Fig. 1. About 45 miles off Boca Grande, Florida. Holotype (3.2x).

Fig. 2. Bear Cut, Crandon Park, Miami, Florida. Paratype (3.2x).

Remarks. We are indebted to Mr. A. P. Blaine for the opportunity of reporting upon this fine species. It bears no close relationship to any other *Epitonium* occurring in the Gulf of Mexico or on the Lower Florida Keys and it is the only species in the subgenus *Boreoscala* recorded from the tropical portion of the Western Atlantic. It approximates *E. magellanicum* Philippi from Patagonia in many of its characters, differing, however, in possessing much stronger spiral ridges, in having the crenulated axial costae and in being narrower proportionately. From *E. greenlandicum* Perry it differs in having the crenulated or nodulose axial costae and somewhat stronger basal ridge. In proportions, these two species appear to be about the same. In our arrangement of this group this species would follow the *Epitonium greenlandicum* complex.

Range. Western Florida and south to off Miami.

Records. FLORIDA: off Boca Grande in 22 fathoms (A. P. Blaine); Bear Cut, Crandon Park, Miami (A. Merrill).

Opalia (Nodiscala) eolis *Clench and Turner*

Opalia (Nodiscala) eolis Clench and Turner 1950, *Johnsonia* **2**, p. 242.

Records. LESSER ANTILLES: off Anguilla in 100–250 fathoms (B. Hubendick).

Opalia (Nodiscala) aurifilia *Dall*

Opalia (Nodiscala) aurifilia Dall, Clench and Turner 1950, *Johnsonia* **2**, p. 240.

Records. NORTH CAROLINA: *Albatross*, station 2595, off Cape Hatteras (N. Lat. 35°08'; W. Long. 75°05') in 63 fathoms (USNM).

Opalia pumilio var. **morchiana** *Dall*

Opalia pumilio morchiana Dall, Clench and Turner 1950, *Johnsonia* **2**, p. 239.

Scala (Nodiscala) barbadensis de Boury 1913, *Journal de Conchyliologie* **61**, p. 76. [New name for *morchiana* Dall, non *morchii* Angas 1881, non *morchii* Sowerby 1874.] The name *morchiana* is not a homonym of *morchii* and should not have been renamed by de Boury.

Cylindriscala andrewsii *Verrill*

Cylindriscala andrewsii Verrill, Clench and Turner 1952, *Johnsonia* **2**, p. 335.

Records. FLORIDA: 16 miles off Tortugas in 90 fathoms (USNM). CUBA: *Atlantis*, station 3485, Bahía de Matanzas in 385 fathoms (MCZ).

THE GENUS CONUS IN THE WESTERN ATLANTIC

BY

WILLIAM J. CLENCH

Since the publication of our monograph of this genus in *Johnsonia* (1942, **1**, no. 6, pp. 1–40) there have appeared several descriptions of new species of *Conus* from the Western Atlantic region. We attempt to review these various species in this number and in addition, add several new locality records for the species considered in our earlier work.

Conus regius *Gmelin*

Conus regius Gmelin, Clench 1942, *Johnsonia* **1**, no. 6, p. 3, pl. 3, figs. 1–4.

Records. LESSER ANTILLES: Barbados (MCZ). BRASIL: Fernando de Noronha (W. A. Williamson).

Conus regius abbotti *Clench*

Conus regius abbotti Clench 1942, *Johnsonia* **1**, no. 6, p. 7, pl. 4, figs. 5–6.

Records. BAHAMA ISLANDS: Stocking Island, Great Exuma Island (MCZ).

Conus dominicanus *Hwass*

Conus dominicanus Hwass, Clench 1942, *Johnsonia* **1**, no. 6, p. 6, pl. 4, fig. 4.

Records. CUBA: Mariel (R. Humes). LESSER ANTILLES: 10 fathoms off St. Lucia (R. G. Fennah); Chaguraramas Bay, Trinidad (H. G. Kugler).

Conus citrinus *Gmelin*

Conus citrinus Gmelin, Clench 1942, *Johnsonia* 1, no. 6, p. 7, pl. 4, figs. 5-6.

Records. PUERTO RICO: San Juan; Mona Island (both MCZ).

Conus stearnsii *Conrad*

Conus stearnsii Conrad, Clench 1942, *Johnsonia* 1, no. 6, p. 9, pl. 5, figs. 1-4.

Records. FLORIDA: 5 miles N.E. of Carysfort Light, Key Largo in 117 fathoms (L. A. Burry).

Conus jaspideus *Gmelin*

Conus jaspideus Gmelin, Clench 1942, *Johnsonia* 1, no. 6, p. 10, pl. 6, figs. 1-4.

Records. PUERTO RICO: San Juan (MCZ).

Conus jaspideus branhamae, new subspecies

Plate 181, fig. 2

Description. Shell reaching about 27 mm. (about 1 inch) in length. Whorls 11, nearly flat-sided but slightly convex near the whorl shoulder and slightly concave near the base. Color pattern consisting of a few rather large and very irregular axial patches of dark mahogany-brown which extend from the peripheral area above to the whorl shoulder

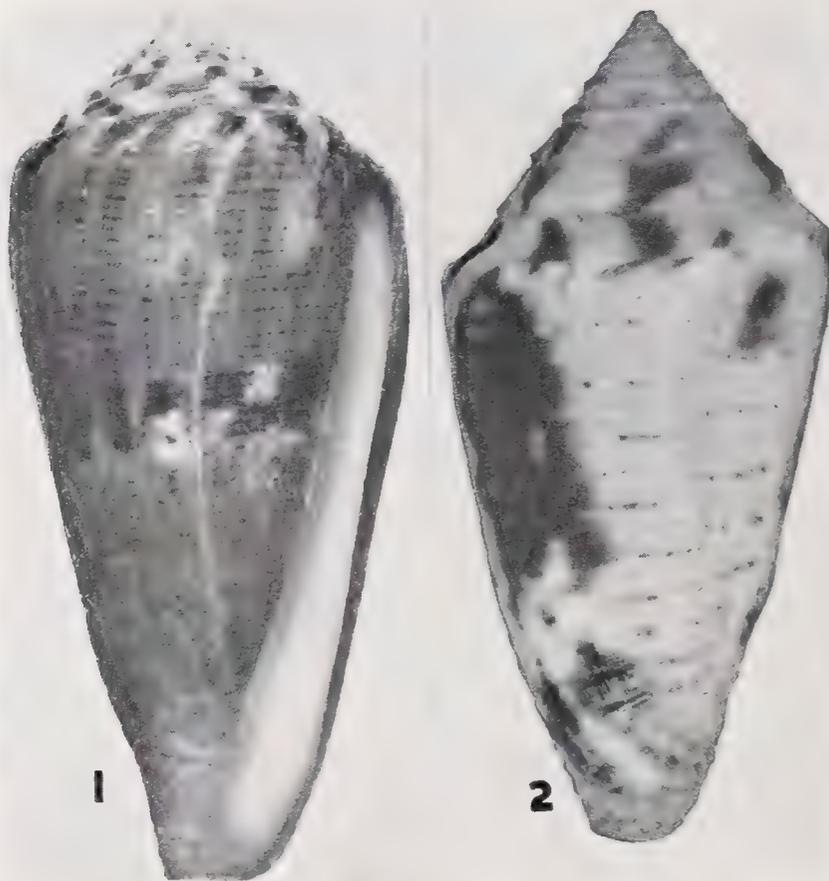


Plate 181

- Fig. 1. *Conus granulatus* Linné. Dry Rocks, off Key Largo, Florida (about 1.5x).
 Fig. 2. *Conus jaspideus branhamae* Clench. Green Turtle Cay, Great Abaco, Bahama Islands. Holotype (about 3x).

with additional patches on the spire. There is another but much smaller series of patches of the same color near the base. There is also a series of spiral threads that have small minute brown spots of the same dark mahogany-brown which are spaced by small white areas. Spire concave, acute and finely carinate, the carinae being the acutely shouldered margin of each whorl. The spire is produced at an angle of about 70° . Aperture oblique, a little wider near the base and deeply inset above at the anal notch. Aperture colored a dull brownish deeply within. Outer lip thin and flatly arched in profile. Sculpture consisting of numerous fine, spiral threads which are a little more strongly developed near the base. Whorl shoulder sharply angled. Periostracum thin and a light-brown in color. Operculum unknown.

length	width	whorls	
27.5	13 mm.	11	Holotype

Types. Holotype and only known specimen in the collection of Mrs. Hugh Branham of Fort Myers Beach, Florida. This specimen was collected on a coral mud flat at Green Turtle Cay, Great Abaco, Bahama Islands.

Remarks. This subspecies differs from the typical form by being somewhat larger, having a straighter and more elevated spire and having the sculpture much weaker. In general, the incised lines on most specimens of *C. jaspideus* Gmelin are deeply cut and the ridges between them are nodulose. From *C. jaspideus pygmaeus* Reeve this present subspecies differs by being proportionately narrower, having far less prominent sculpture and possessing a more attenuate spire.

Range and Records. Known only from the type locality.

***Conus verrucosus* Hwass**

Conus verrucosus Hwass, Clench 1942, *Johnsonia* 2, no. 6, p. 13, pl. 8, figs. 1-4.

Records. BRASIL: off Bahía (S. Lat. $11^\circ 45'$: W. Long. $37^\circ 20'$) in 40 fathoms (MCZ, Hassler Voyage).

***Conus verrucosus piraticus* Clench**

Conus verrucosus piraticus Clench 1942, *Johnsonia* 1, no. 6, p. 14, pl. 11, fig. 1.

Records. FLORIDA: Molasses Reef, Key Largo (L. A. Burry). LESSER ANTILLES: Dry Rocks, east side of Buccoo Reef, Tobago (MCZ).

***Conus havanensis* Aguayo and Farfante**

Plate 182, fig. 5

Conus havanensis Aguayo and Farfante 1947, *Revista Sociedad Malacologica Carlos de la Torre* 5, p. 11, text figure (Arenas de la Chorrera, Habana, Cuba).

Description. Shell reaching 20 mm. (about $\frac{3}{4}$ of an inch) in length, rather solid in structure and sculptured. Whorls 8, and slightly convex. Nuclear whorls ($1\frac{1}{2}$) papillose. Color a light and somewhat suffused lemon-yellow with fairly strong flames of reddish-brown on the spire and whorl shoulder. Occasionally there is a peripheral band of reddish-brown which consists of irregular patches of color. Spire depressed, finely nodulose, obtuse and formed at an angle of about 130° . Aperture oblique, of a nearly uniform width

throughout and not deeply notched above. Sculpture consisting of numerous spiral threads which are minutely papillose. Whorl shoulder finely nodulose. Operculum and periostracum unknown.

length	width	whorls	
20.2	11.3 mm.	7	Holotype
18.0	10.8	8	Paratype
17.5	10.5	8	Paratype

Types. Holotype, Museo Poey, Universidad de la Habana, no. 12133 from Arenas de la Chorrera, Habana, Cuba.¹ Paratypes from the same locality in the Museum of Comparative Zoölogy, no. 175241.

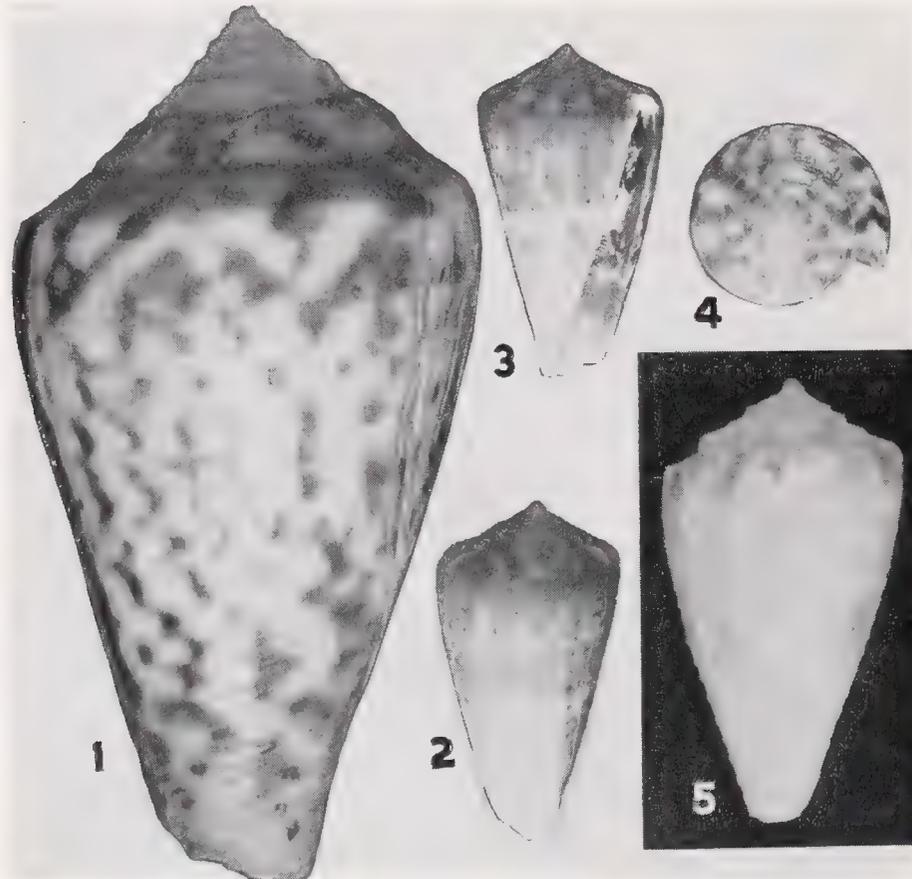


Plate 182

Fig. 1. *Conus carcellesi* E. A. Martins. Mar del Plata, Buenos Aires, Argentina. Paratype (about 3.3x). Figs. 2-4. *Conus clenchi* E. A. Martins. Barra do Furado, Municipio de Campos, State of Rio de Janeiro, Brasil (natural size). Fig. 5. *Conus havanensis* Aguayo and Farfante. Arenas de la Chorrera, Habana, Cuba. Paratype (3.2x).

Remarks. This species is closely related to *C. verrucosus* Hwass, differing, however, by having a more depressed spire and having very much finer sculpture. In *C. havanensis* the threads are minutely papillose while in *C. verrucosus* the little knobs are situated between the fine incised lines. The color in *C. havanensis* may not be quite the same in living examples, probably somewhat darker. From *C. verrucosus piraticus* Clench it differs by having a more depressed spire, finer papillose sculpture and having larger nodules on the whorl shoulder.

Range and Records. Known only from the type locality.

¹ See footnote, *Johnsonia* 2, p. 229.

Conus stimpsoni Dall

Conus stimpsoni Dall, Clench 1942, *Johnsonia* 1, no. 6, p. 15, pl. 5, fig. 5.

Records. FLORIDA: off The Elbow, Key Largo in 75 fathoms; 5 miles east of Carysfort Light, Key Largo in 96 to 107 fathoms (both L. A. Burry).

Conus austini Rehder and Abbott

Plate 183, fig. 7

Conus austini Rehder and Abbott 1951, *Journal Washington Academy of Sciences* 41, p. 22, text fig. 7 (off Loggerhead Key, Dry Tortugas, Florida).

Description. Shell medium in size, reaching 55 mm. (about $2\frac{1}{4}$ inches) in length, solid and strongly sculptured. Color a dull-white. Whorls 13 to 14, nearly straight-sided above and very slightly concave near the base. Whorl shoulder somewhat rounded to carinate, the carinae indicated on the spire as a small sutural ridge. Spire extended, moderately concave, acute and formed at an angle of about 80° . Nuclear whorls $1\frac{1}{2}$, smooth and glass-like. Aperture narrow, of equal width throughout, deeply notched above and flatly arched in profile. Outer lip thin and finely crenulate. Sculpture consisting of about 40 well developed spiral cords which are somewhat stronger near the base. Periostracum a dull yellowish-brown. Operculum unknown.

length	width	whorls	
55.5	25.3 mm.	14	Holotype
43.1	22.0	13	Paratype
51.0	25.5	13	Paratype
50.5	27.5	13	East of St. Joseph Island, Texas

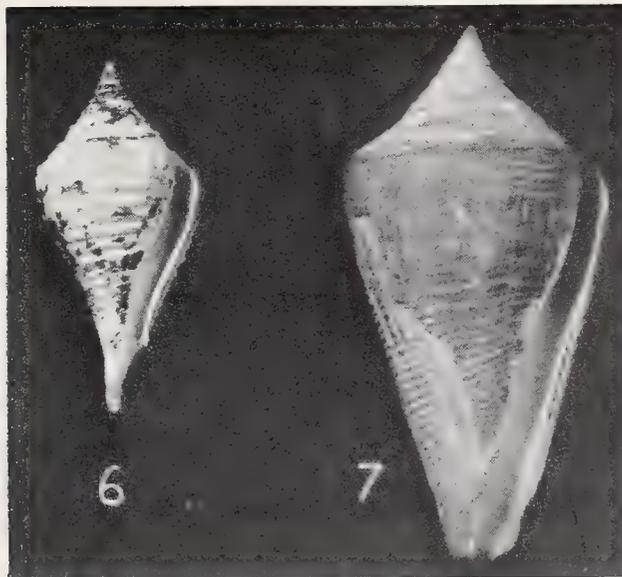


Plate 183

Fig. 6. *Conus clarki* Rehder and Abbott. Fifty miles south-southeast of Marsh Island, Iberia Parish, Louisiana. Holotype (natural size).
 Fig. 7. *Conus austini* Rehder and Abbott. Off Loggerhead Key, Dry Tortugas, Florida. Holotype (natural size).

(Plate 183 is the original halftone received through the kindness of Rehder and Abbott.)

Types. Holotype, United States National Museum, no. 603017 from southeast of Loggerhead Key, Tortugas, Florida in 40 to 46 fathoms. Collected by W. L. Schmitt from the *Anton Dohrn*, June 1932. An additional paratype from the same locality and another paratype obtained by J. B. Henderson from the *Eolis*, dredged at the entrance of English Harbour, Antigua, Lesser Antilles.

Remarks. See under *Conus clarki* Rehder and Abbott.

Range. From off Alabama and Texas south to Campeche, Mexico and east to the Lesser Antilles.

Records. ALABAMA: Bayou la Batre (H. I. Johnstone). TEXAS: east of St. Joseph Island and 100 miles south of Port Isabel (both H. Hildebrand). MEXICO: Tampico; 25 miles off Obregon; Tecolutla (all T. E. Pulley); off Campeche in 13-16 fathoms (H. Hildebrand). FLORIDA: off Loggerhead Key, Tortugas in 40-46 fathoms (USNM). LESSER ANTILLES: off English Harbour, Antigua (USNM).

Conus clarki Rehder and Abbott

Plate 183, fig. 6

Conus clarki Rehder and Abbott 1951, Journal Washington Academy of Sciences 41, p. 22, text figures 1-6 (50 miles south-southeast of Marsh Island, Iberia Parish, Louisiana).

Description. Shell reaching 36 mm. (about 1½ inches) in length, moderately strong, broadly fusiform in shape and strongly sculptured. Color a chalky-white and occasionally faintly spotted with small red squares. Whorls 11, convex above and concave below. Spire acute, extended, and formed at an angle of 70°. Aperture narrow and flatly sigmoid in shape. Outer lip thin and flatly arched when seen in profile. Suture indented and crenulated. The uppermost cord on the whorl shoulder is beaded and as the new growth of the shell proceeds along this cord, the sutural crenulations are produced. Spiral sculpture consisting of 27 to 30 strongly developed cords, the uppermost cord strongly beaded, the cords below much less so. Axial sculpture consisting of exceedingly fine threads, which are strongest in between the spiral cords. Periostracum thin, axially striate, deciduous and light-brown in color.

length	width	whorls	
36	16 mm.	11	Holotype
34.4	15.5	10.8	Paratype

Types. Holotype, United States National Museum, no. 485740 from 50 miles south-southeast of Iberia Parish, Louisiana (N. Lat. 28°27'; W. Long. 92°14') in 29 fathoms. A paratype from the same locality is in the Museum of Comparative Zoölogy no. 181956.

Remarks. Three species, *C. austini*, *clarki* and *frisbeyae*, are all members of a closely related complex. There appear to be distinct characters that separate them. However, the number of specimens available is still relatively small. Certainly more specimens may indicate that both *austini* and *frisbeyae* are only subspecifically distinct from *C. clarki*.

Conus austini differs from both *clarki* and *frisbeyae* by being a larger and more solid shell with somewhat finer spiral cords. *C. clarki* differs from *frisbeyae* by having a less attenuated spire, being proportionately wider at the whorl shoulder and by having much smaller beads and far less color on the beads which are developed on the spiral cords.

These characters, however, are all relative or qualitative, and as stated above, more material may show that they are not as distinctive as they now appear.

***Conus frisbeyae* Clench and Pulley**

Plate 184, fig. 1

Conus frisbeyae Clench and Pulley 1952, Texas Journal of Science no. 1, p. 59, pl. A, fig. 1 (Campeche Banks, Yucatan, Mexico).

Description. Shell medium to small in size, reaching 33 mm. (about 1¼ inches) in length, rather solid and strongly sculptured. Whorls 12, last whorl slightly convex above, rather deeply concave below. Color consisting of a series of brown spots regularly disposed on the spiral cords and somewhat irregularly aligned axially. The basic color of the shell is a light-cream with fine axial threads of white in the interspaces between the cords. Spire extended, acute and moderately concave. Aperture narrow and nearly equal in width throughout its length, deeply and concavely inset at the anal notch. Outer lip thin. Inner lip not indicated by any glaze. Columella not indicated. Suture slightly indented and a little wavy owing to its development along the beaded cords. Sculpture consisting of a series of beaded or knobbed spiral cords which number about 20 on the body whorl. The small knobs are best developed on the shoulder cord and become progressively less so toward the base of the shell. On the spire, the knobs are well developed and the early post-nuclear whorls are, in addition, slightly carinated. Operculum unknown.

length	width	whorls	
32.5	14.4 mm.	12	Holotype

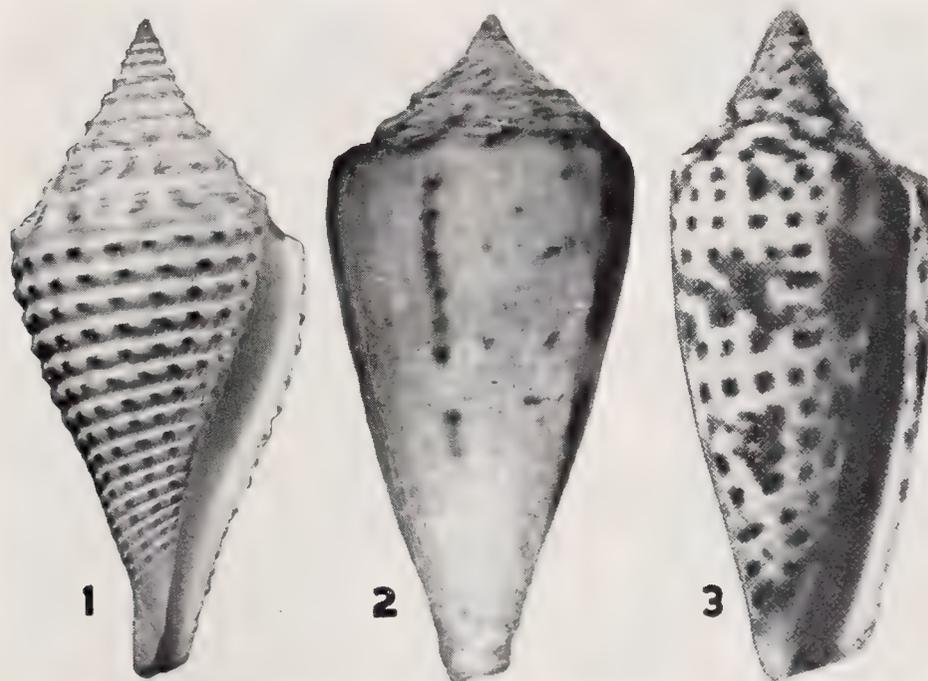


Plate 184

Fig. 1. *Conus frisbeyae* Clench and Pulley. Campeche Banks, Yucatan, Mexico. Holotype (about 2x). Fig. 2. *Conus amphiurgus* Dall (= *C. villepini* Fischer and Bernardi). Off Cabo Catoche, Yucatan, Mexico. Holotype (about 2x). Fig. 3. *Conus cavailloni* Fenaux. Bermuda (after Fenaux, enlarged a little less than 2x from the original plate).

Types. Holotype, Museum of Comparative Zoölogy, no. 187708 from the Campeche Banks, Yucatan, Mexico in about 23 fathoms. Received from Mrs. W. C. Frisbey, originally from a shrimp trawler.

Range and Records. Known only from the type locality.

Remarks. This species is fairly close in its relationship to *C. clarki* Rehder and Abbott. It differs from *clarki* by being proportionately narrower, having the spire more acutely conic and in possessing fewer and more pronounced spiral cords. The colored spots on the spiral cords are far more developed in *frisbeyae*, giving the shell a strongly papillose appearance.

Conus sennottorum Rehder and Abbott

Plate 185, figs. 1-2

Conus sennottorum Rehder and Abbott 1951, Revista de la Sociedad Malacologica Carlos de la Torre 8, p. 63, pl. 9, figs. 1-2 (50 miles off Campeche, Yucatan, Mexico).

Description. Shell reaching 35 mm. (about $1\frac{3}{8}$ inches) in length, rather solid in structure and broadly fusiform. Color white with numerous spiral rows of small dots and dashes. Whorls 12, convex above and concave below and having a sharp angle at the whorl shoulder. Spire moderately extended and strongly concave forming an angle of 90° when measured from nuclear whorls to whorl shoulder. Aperture narrow, oblique, of equal width throughout and faintly sigmoid in shape. Anal notch deeply inset. Outer lip exceedingly thin. Suture slightly indented. Sculpture consisting of 4 or 5 rather flat spiral cords which are produced near the base of the shell. Axial sculpture consisting only of very fine growth lines.

length	width	whorls	
35	20 mm.	11	Holotype
31	16	12	Paratype
31	17.5	12	Paratype

Types. Holotype, United States National Museum, no. 597519 from 50 miles off Campeche, Yucatan, Mexico (N. Lat. $19^\circ 40'$; W. Long. $91^\circ 20'$) in 15-16 fathoms. Additional paratypes are in the United States National Museum and in the collection of Mrs. J. M. Sennott from the same locality.

Remarks. This species appears to be rather closely allied to *C. austini* Rehder and Abbott and *C. clarki* Rehder and Abbott. It differs, however, in being smooth, lacking the strong spiral cords and in having spiral rows of orange-brown dots. It seems to be more distantly related to *C. stimpsoni* Dall but this latter species differs in having broad bands of color and much straighter sides to the body whorl and the spire.

Range and Records. Known only from the Gulf of Campeche and the Campeche Banks.

Conus mazei Deshayes

Conus mazei Deshayes, Clench 1942, *Johnsonia* 1, no. 6, p. 17, pl. 9, figs. 1-2.

Record. TEXAS: about 50 miles east of Padre Island (N. Lat. $26^\circ 48'$; W. Long. $96^\circ 23'$) in 200 fathoms (J. L. Baughman).

Conus granulatus Linné

Plate 181, fig. 1

Conus granulatus Linné, Clench 1942, *Johnsonia* 1, no. 6, p. 18, pl. 9, fig. 3.

Remarks. We are indebted to Mrs. E. N. Townsend for the loan of two fine specimens of this species collected in two feet of water at mean low water at Dry Rocks, off Garden Cove, Key Largo, Florida by James Higman.

The periostracum is rather thin, straw-yellow in color and finely ridged axially. The operculum is very small, only 7 mm. in length, from the specimen which measured 43 mm. in length. We give the measurements of these two specimens as both exceeded in size the measurements given in our earlier report.

length	width	whorls	
60.2	27.4 mm.	13	Dry Rocks, Key Largo, Florida
43.0	18.5	11	Dry Rocks, Key Largo, Florida

Records. FLORIDA: Dry Rocks, $4\frac{1}{4}$ miles off Garden Cove, Key Largo (Mrs. E. N. Townsend); Molasses Reef, Key Largo (A. S. Merrill). BAHAMA ISLANDS: Nassau, New Providence (USNM). CUBA: Cuesco Beach, Guantánamo Naval Base (MCZ). VIRGIN ISLANDS: St. Thomas (USNM). LESSER ANTILLES: Barbados (MCZ). CARIBBEAN ISLANDS: Curaçao (USNM). PANAMA: Colón (MCZ).

Conus spurius aureofasciatus Rehder and Abbott

Plate 185, figs. 3-4

Conus spurius aureofasciatus Rehder and Abbott 1951, *Revista de la Sociedad Malacologica Carlos de la Torre* 8, p. 64, pl. 9, figs. 3-4 (off Tortugas, Florida).

Description. Shell reaching 67 mm. (about $2\frac{1}{2}$ inches) in length, solid and nearly smooth. Color consisting of numerous, pale orange, spiral bands which vary in width.

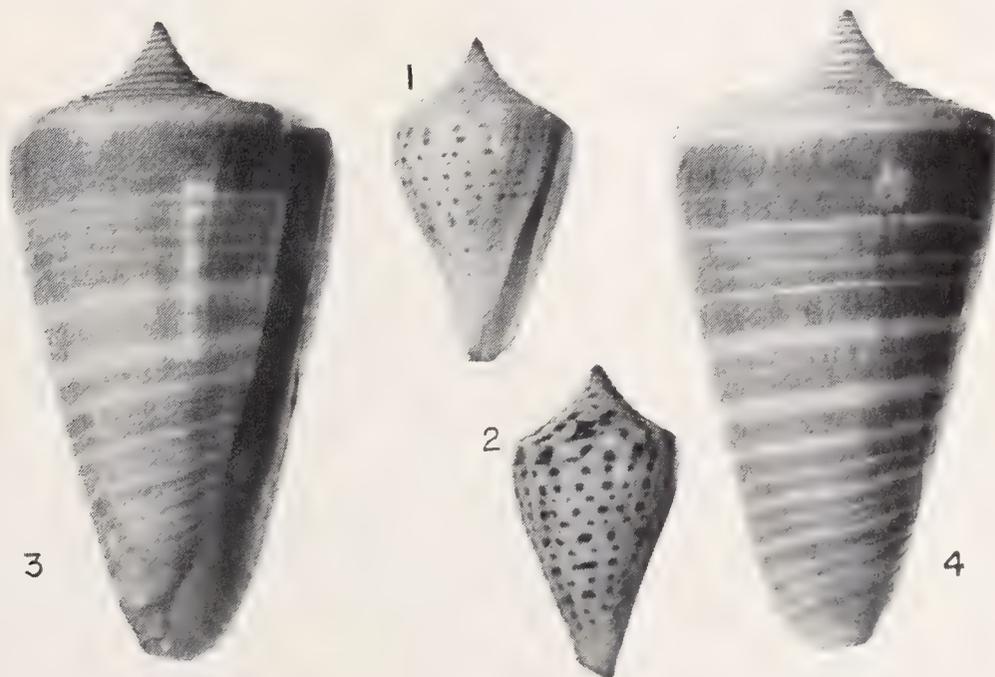


Plate 185

Figs. 1-2. *Conus sennottorum* Rehder and Abbott. Fifty miles off Campeche, Yucatan, Mexico. Holotype, fig. 1; paratype, fig. 2. Figs. 3-4. *Conus spurius aureofasciatus* Rehder and Abbott. Off Tortugas, Florida. Holotype (all natural size).

Ground color a china-white. Whorls 13 and nearly flat-sided. Spire acute, extended and deeply concave. The entire spire, however, is really obtuse, being 100° , if the angle measured is from the summit to the whorl shoulder. Whorl shoulder angled. In the holotype, the early whorls are slightly offset or scalariform as the forward growth of each whorl was just a little below the whorl shoulder. Aperture oblique and of nearly equal width throughout. Anal notch deeply inset. Outer lip straight and very thin. Sculpture consisting of numerous and very fine axial growth lines. Spiral cords appear near the base and above for about one-third of the length of the body whorl. Operculum long and narrow, its length being about one-third the length of the aperture.

length	width	whorls	
67.5 *	36.5 mm.	13	Holotype
59.5	29.0	12	Paratype
34.5	18.5	10	Paratype

* Corrected measurements.

Types. Holotype, United States National Museum, no. 597521, from off Tortugas, Florida in 20 fathoms. A paratype from the same locality is in the collection of Mrs. J. N. Sennott. Another paratype from Sanibel Island, Florida is in the collection of Mr. H. M. Woolsey.

Remarks. This subspecies is exceedingly close to *Conus spurius* Gmelin. It differs mainly in the color mottlings on the spire and by having solid spiral bands of color rather than dots of color in spiral arrangement. It is perhaps only an individual variant of either *spurius* or *spurius atlanticus* in which the color pattern has been modified.

Range. Sanibel Island, Florida south to Tortugas and west to the Gulf of Campeche, Mexico.

Records. FLORIDA: off Tortugas in 20 fathoms (USNM; J. N. Sennott); Sanibel Island (H. M. Woolsey). MEXICO: Gulf of Campeche (USNM).

Conus carcellesi Martins

Plate 182, fig. 1

Conus sp. Carcelles 1944, Revista del Museo de la Plata (n.s.) *Zoology* 3, p. 261, pl. 5, figs. 49-50.

Conus carcellesi Martins 1945, Notas del Museo de la Plata 10, no. 88, p. 260, text figures (Mar del Plata, Buenos Aires, Argentina).

Description. Shell reaching 30 mm. (about $1\frac{1}{8}$ inches) in length, rather solid and nearly smooth. Whorls 8 to 9, and nearly flat-sided. Color consisting of numerous, irregular axial flames of brown which extend above on the spire, the ground color being a very pale ivory. Spire moderately depressed, nearly straight-sided and produced at an angle of 90° . Aperture oblique, of a nearly uniform width and having a moderate anal notch. Outer lip thin and flatly arched when seen in profile. Sculpture limited to a few fine, incised, spiral lines near the base of the shell; remainder of the shell nearly smooth. Shoulder of the whorl rather sharply angled but not nodulose. Periostracum yellow and thin. Operculum unknown.

length	width	whorls	
29	14 mm.	7 *	Holotype
29	15	7	Paratype
26	14	7	Paratype
30	14	7	Paratype

* Probably a loss of 1 to 2 nuclear whorls.

Types. Holotype, Museo Nacional de Rio de Janeiro, no. 36300, from Mar del Plata, Buenos Aires, Argentina. Additional paratypes from the same locality in the Museo Argentino de Ciencias Naturales and the Museum of Comparative Zoölogy, no. 146473.

Remarks. *Conus carcellesi* Martin does not appear to be closely related to any other known species in the Western Atlantic. It is probably nearest to *C. flavescens* Sowerby as both possess a very similar shape and have the same kind of limited sculpture. These two species differ widely in color pattern and in size, *C. carcellesi* being a somewhat larger species. Superficially it approaches *C. cleryii* Reeve, but here the resemblance is only in a somewhat similar color pattern. Shape of spire, sculpture and shoulder angle are quite different in the two species.

Range and Records. This species extends from Uruguay south to central Argentina, possibly as far as Puerto Deseado. We have seen only the paratypes from the type locality.

***Conus daucus* Hwass**

Conus daucus Hwass, Clench 1942, *Johnsonia* 1, no. 6, p. 21.

Conus praeclarus Fenaux 1942, Bull. L'Institut Oceanographique (Monaco) no. 814, p. 2, fig. 3 (Bermuda).

Remarks. In our opinion both the figure and description of *C. praeclarus* Fenaux refer to *C. daucus* Hwass.

Records. FLORIDA: off The Elbow, Key Largo in 55 fathoms (L. A. Burry). LESSER ANTILLES: Grand Anse, Grenada (H. G. Kugler).

***Conus flavescens* Sowerby**

Conus flavescens Sowerby, Clench 1942, *Johnsonia* 1, no. 6, p. 22, pl. 11, fig. 3.

Records. FLORIDA: off the town of Gulf Stream, Palm Beach Co., in 10 fathoms (F. B. Lyman).

***Conus caribbaeus* Clench**

Conus caribbaeus Clench 1942, *Johnsonia* 1, no. 6, p. 23, pl. 11, figs. 4-5.

Records. FLORIDA: Dry Rock Reef, off Garden Cove, Key Largo (R. Humes).

***Conus centurio* Born**

Conus centurio Born, Clench 1942, *Johnsonia* 1, no. 6, p. 24, pl. 12, fig. 1.

Conus woolseyi M. Smith 1946, *Nautilus* 60, p. 1, pl. 1, fig. 5 (off Ocho Rios, Jamaica).

Remarks. *Conus woolseyi* Smith appears to be an absolute synonym of *C. centurio* Born. Smith makes his comparisons with *Conus regius* Gmelin, a species not at all closely related to this present form. *C. centurio* is perhaps more nearly related to *C. caribbaeus* Clench and perhaps a little more distantly to *C. floridanus* Gabb.

This is a very rare species and probably occurs only in relatively deep water. So far as the present records indicate, it has been recorded from Puerto Plata, Hispaniola and off Ocho Rios, Jamaica.

Conus juliae Clench

Conus juliae Clench 1942, *Johnsonia* **1**, no. 6, p. 26, pl. 12, fig. 4.

Remarks. We are indebted to Dr. Jeanne Schwengel for the gift of a specimen of this exceedingly rare species and to Mrs. E. N. Townsend for the loan of another. Both specimens were collected originally by T. McGinty from off Palm Beach in 30 fathoms. Mr. Arthur S. Merrill loaned us a third specimen which had been obtained originally in 15 fathoms off Obregon, Tabasco, Mexico. These two records extend the range very materially, the only other record being from off Fort Walton, Florida in the northern Gulf of Mexico.

Conus villepinii Fischer and Bernardi

Plate 184, fig. 2

Conus villepinii Fischer and Bernardi, Clench 1942, *Johnsonia* **1**, no. 6, p. 25, pl. 12, fig. 3; pl. 13, fig. 5.

Conus amphiurgus Dall 1889, Bull. Museum Comparative Zoölogy **18**, p. 70; Clench 1942, *Johnsonia* **1**, no. 6, p. 30.

Remarks. We figure the holotype of *Conus amphiurgus* Dall as a synonym of *C. villepinii* F. and B. The holotype of *amphiurgus* has fewer brown color markings and is somewhat larger than the holotype of *villepinii*, otherwise they appear to be the same in all other characters. Measurements of *C. amphiurgus* are as follows:

length	width	whorls	
40.5	20 mm.	12	Holotype

Range. Lesser Antilles and west to Yucatan.

Records. FLORIDA: off Cape San Blas in 115 fathoms (A. S. Merrill). MEXICO: *Albatross*, station 2366, off Cape Catoche, Yucatan (N. Lat. 22°28'; W. Long. 87°02') in 27 fathoms (Holotype of *C. amphiurgus* Dall, USNM no. 87303).

Conus clenchi Martins

Plate 182, figs. 2-4

Conus clenchi Martins 1943, Boletim Museu Nacional Brasil, Zoologia no. 12, p. 2 (Barra do Furado, Município de Campos, Rio de Janeiro, Brasil).

The following is the original description of this species. We are grateful to Dr. Martins for the photographs of the holotype.

“*Description.* Shell turbinated, extended, solid but not heavy. Spire low, slightly convex, formed by eight closely coiled whorls, smooth and marked with fine curved threads; papiliform apex; shoulder margin smooth. Last whorl smooth, traversed by thin spiral lines crossed axially by equally thin growth lines; near the base the spiral lines are more developed, producing beaded threads. Aperture oblique, long and narrow; outer lip thin, finished and even. Color yellow shading to white near the base. On the spire, there are white and brownish-yellow alternating bands radiating in a zig-zag pattern from the apex to the shoulder. White and brownish-yellow alternating and articulated bars of color form fine spiral bands that cross the body whorl. In the mid portion there is a white and oblique band. Internal surface¹ of the shell is smooth, white and porcelaneous. Periostracum and operculum unknown.”

¹This refers to the inner surface of the aperture.

length	width	aperture	
38	20	30 x 4 mm.	Holotype

Types. Holotype, Museu Nacional Brasil, no. 11.720, from Barra do Furado, Município de Campos, State of Rio de Janeiro, Brasil. E. A. Martins collector, March 1943.

Remarks. This species is based upon a single dead, though fresh specimen. It does not appear to be closely related to any other species known to us that occurs in the Western Atlantic. It may be distantly related to *C. juliae* Clench, differing mainly in being much smaller and having a moderately different color pattern. We have not seen the type specimen.

Range and Records. Known only from the type locality.

***Conus floridanus* Gabb**

Conus floridanus Gabb, Clench 1942, *Johnsonia* 1, no. 6, p. 27, pl. 13, figs. 1-2.

Records. MEXICO: Isla del Carmen, Campeche (M. E. Bourgeois).

***Conus floridanus burryae* Clench**

Conus floridanus burryae Clench 1942, *Johnsonia* 1, no. 6, p. 29, pl. 14, figs. 3-4.

Records. MEXICO: Isla del Carmen (M. E. Bourgeois).

***Conus sozoni* Bartsch**

Conus sozoni Bartsch, Clench 1942, *Johnsonia* 1, no. 6, p. 30, pl. 15, figs. 1-4.

Records. TEXAS: off Port Isabel (Mrs. L. A. Weisenhaus). FLORIDA: 5 miles northeast of Carysfort Light, Key Largo in 117 fathoms (L. A. Burry); 40 miles off Cedar Keys in 21 fathoms (Mrs. Fiske Warren).

***Conus ranunculus* Hwass**

Conus ranunculus Hwass, Clench 1942, *Johnsonia* 1, no. 6, p. 32, pl. 15, figs. 6-7.

Records. BAHAMA ISLANDS: Bimini Islands (USNM). CUBA: Cuesco Beach, Guantánamo Naval Base (MCZ). JAMAICA: Montego Bay (MCZ). VIRGIN ISLANDS: St. Croix; St. Thomas (both USNM). LESSER ANTILLES: Barbados (MCZ). CARIBBEAN ISLANDS: Curaçao (USNM).

***Conus cavailloani* Fenaux**

Plate 184, fig. 3

Conus cavailloani Fenaux 1942, Bull. L'Institut Oceanographique (Monaco) no. 814, p. 4, fig. 12 (Bermuda).

The following is a translation of the original French description:

"Shell elongate, subcylindrical, base attenuate, color pattern consisting of numerous rather regularly square, orange dots and three bands of irregular orange flammules: spire acuminate, elevated in tiers of slightly concave, straight whorls, ornamented with orange flammules; aperture normal above, broadening at the base: lip arched and sinuous: base with broad, deep, plicate cords.

"Bermuda. Dedicated to M. Cavaillo, Judge.

"This beautiful species recalls by its contour *C. scalaris* (Valenc.) and *C. fuscomaculatus* Smith but differs distinctly by its spire as well as the color pattern."

The figure we have given is a photograph of Fenaux's plate. We seriously question Bermuda as being the original locality for this species. The marine mollusks of Bermuda are very well known and it seems quite remarkable that a large cone such as this newly described form should have escaped notice until as late as 1942.

THE GENERA SCAPHELLA AND AURINIOPSIS IN THE WESTERN ATLANTIC

BY

WILLIAM J. CLENCH

The following records and descriptions of new forms are based upon material obtained by shrimp trawlers in various areas in the Gulf of Mexico.

Scaphella junonia Shaw

Plate 186, fig. 1

Scaphella junonia Shaw, Clench 1946, *Johnsonia* 2, p. 49, pl. 28, figs. 1-3.

Records. FLORIDA: off Wreck Buoy, Key West in 15-17 fathoms; off Rebecca Shoals Light, Tortugas (both J. H. Butler).

Scaphella junonia johnstoneae, new subspecies

Plate 186, fig. 2

Description. Shell fusiform, reaching 115 mm. (about $4\frac{1}{2}$ inches) in length¹ solid and strong. Whorls 6 to $6\frac{1}{2}$, slightly shouldered and moderately convex. Color a slightly shining brownish-orange with a series of dark mahogany-brown spots in spiral rows. These spots are subcircular to almost square, the subsutural row being lengthened axially. Aperture lengthened and subelliptical in shape, upturned slightly at its base forming the siphonal canal. Outer lip thin and sharp, thickened below. Parietal area thinly glazed. Columella somewhat oblique and margined below by a convex ridge which is formed by the successive growth stages of the siphonal canal. Parietal area supporting four strongly developed plicae. Nuclear whorls $1\frac{1}{2}$ and smooth, followed by two whorls that are finely and spirally ridged and axially costate. Beyond these whorls the shell is nearly smooth, the sculpture consisting of exceedingly fine growth lines with a few, low and rather irregular spiral cords near the base of the whorl. Nuclear whorls tipped with reddish-brown. Periostracum light-brownish and exceedingly thin. Operculum probably absent.

length	width	whorls	
98	37.5 mm.	6	Holotype
101	41.0	$6\frac{1}{2}$	Paratype
103	42.0	$6\frac{1}{2}$	Paratype
115	46.5	$6\frac{1}{2}$	Paratype (dead)

¹This is the largest specimen we have seen. Specimens may be found eventually that equal in size the typical *Scaphella junonia* Shaw. A specimen of this latter species from Wreck Buoy, Key West in 15 fathoms measured 128 mm. (5 inches) in length. This is in the collection of J. H. Butler of Marathon, Florida.

Types. Holotype, Museum of Comparative Zoölogy, no. 194190, from off Petit Bois Island, Alabama in about 10 fathoms, received from Mr. and Mrs. H. I. Johnstone. Paratypes in the United States National Museum and the collection of Mr. and Mrs. Johnstone. Paratypes from the same locality and from 20 to 45 miles off Bayou Labatre; off Mobile Bay; 40 miles off Southport (all Alabama) and off the Alabama-Mississippi line in 10 fathoms. All of the above were collected by shrimp trawlers.

Remarks. This present new subspecies is readily distinguished from the typical form by the presence of the dull golden-brown ground color. In all other respects the characters are very much the same. Our black and white photograph (Plate 186, fig. 2) does not show this coloration but does show the similarity of shape.

Range. From 10 to 45 miles off the Alabama coast. We have seen two specimens of this subspecies labeled as "off the Texas Coast." This record should be verified.

Records. See under *Types*.

***Scaphella junonia butleri*, new subspecies**

Plate 186, fig. 3

Description. Shell very similar to typical *junonia*, differing mainly in its type of color spots. In the present subspecies, the blackish-brown spots are much smaller on a ground color of china-white. In *S. junonia* the ground color is usually a pale ivory. In addition, the nuclear whorls or calcarella, are much less pigmented with brown in *butleri* than in *junonia*. The periostracum is a dull and pale straw-yellow.

length	width	whorls	
126	52 mm.	6½	Holotype
125	51.5	6½	Paratype
120	47	6¼	Paratype

Types. Holotype, Museum of Comparative Zoölogy, no. 193591, from the Bay of Campeche, Yucatan, Mexico. Received from Mr. H. Hildebrand. Additional paratypes from the same general area in the United States National Museum, the collection of Mr. J. H. Butler, of Marathon, Florida, Mr. A. S. Merrill and Mr. C. L. Branch.

Remarks. This subspecies differs from typical *junonia* by having the blackish-brown spots much smaller. In addition, the ground color is white and there is less pigmentation in the nuclear whorls. In fully adult specimens the whorl shoulder near the aperture turns upwards in *butleri*, almost reaching the suture above the body whorl.

Typical *Scaphella junonia* is limited to the coast of North Carolina south to Florida, while *Scaphella junonia butleri* appears to be confined to the coast of Mexico. All specimens that we have seen come from the Campeche Bank and the Gulf of Campeche.

Range. Campeche Bank south to the Bay of Campeche, Yucatan, Mexico.

Records. MEXICO: Bay of Campeche (H. Hildebrand); Campeche Bank (L. A. Weisenhaus: USNM); northwest coast of Yucatan in 15–20 fathoms (USNM); off Champoton in 12–14 fathoms (J. H. Butler); west of Obregon, Tabasco (C. L. Branch).

Scaphella (Aurinia) florida *Clench and Aguayo*

Scaphella (Aurinia) florida Clench and Aguayo, Clench 1946, *Johnsonia* 2, p. 52, pl. 29, fig. 4.

Range. Palm Beach and south along the Florida Keys to Key West.

Records. *Triton*, station 630, off Palm Beach in 120 fathoms: *Triton*, station 903, off Delray Beach in 105 fathoms (both T. McGinty).

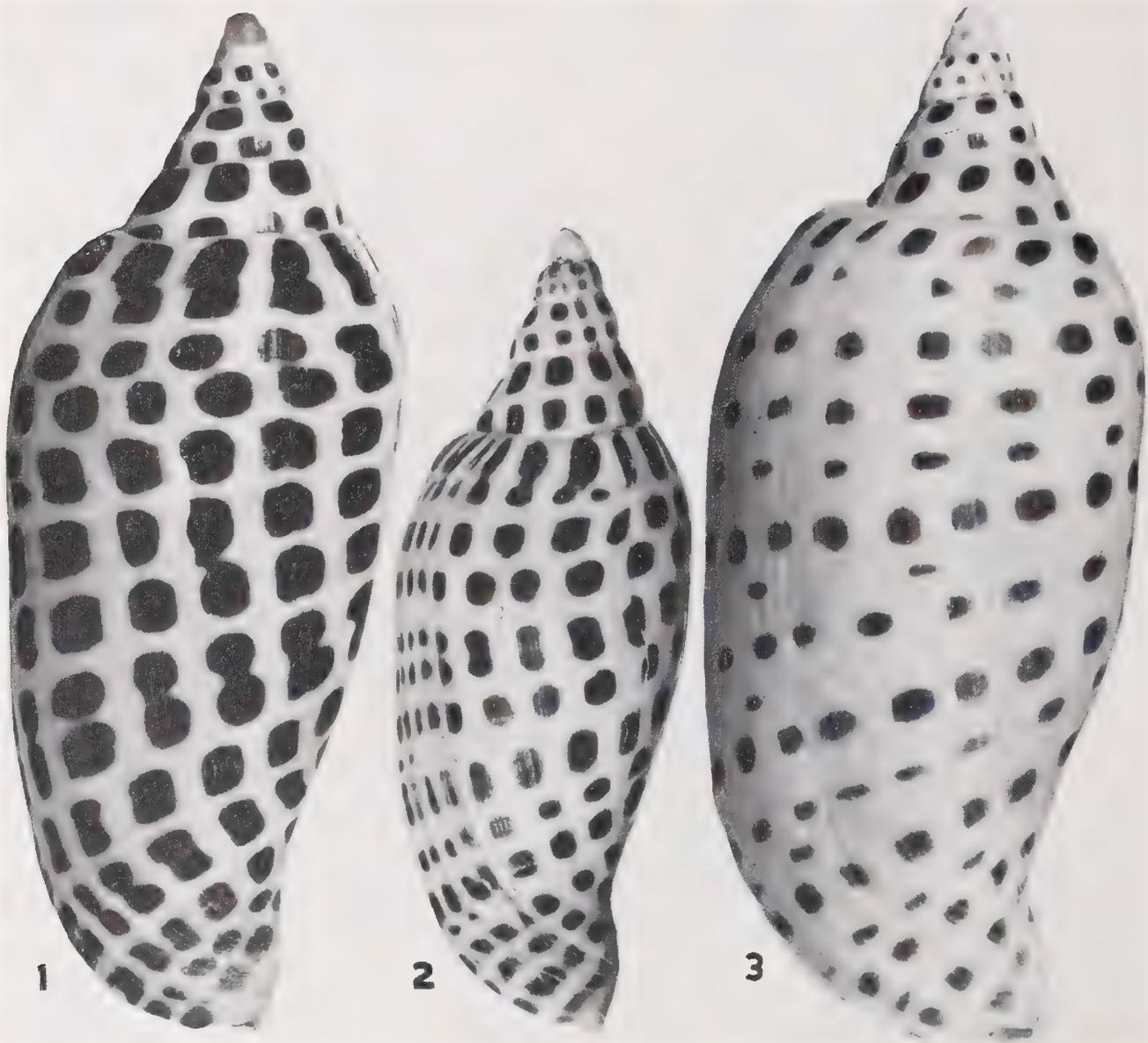


Plate 186

- Fig. 1. *Scaphella junonia* Shaw. Off Rebecca Shoals Light, Tortugas, Florida (natural size).
 Fig. 2. *Scaphella junonia johnstoneae* Clench. Off Petit Bois Island, Alabama (natural size).
 Fig. 3. *Scaphella junonia butleri* Clench. Bay of Campeche, Yucatan, Mexico (natural size).

Auriniopsis,¹ new genus

Shell large, reaching 197 mm. (about $7\frac{1}{2}$ inches) in length, thin, light in structure, spotted and without columellar plicae. Early post-embryonic whorls finely to moderately axially costate. Calcarella large, usually larger than the first post-embryonic whorl.

Genotype, *Fusus tessellatus* Kiener (= *Scaphella kieneri* Clench).

¹ Appearance or aspect of *Aurinia*.

In appearance, *Auriniopsis* is certainly fairly close in its relationship to *Bathyaaurinia* and *Rehderia*. *Auriniopsis* differs from *Rehderia* in its lack of columellar plicae, heavy periostracum and fine spiral striae. It differs from *Bathyaaurinia* by not having the mantle more or less completely enveloping the shell and by having the strongly marked subquadrate spots. It is more distantly related to *Aurinia*, differing in having a much thinner shell and in lacking the columellar plicae. The radula still remains to be investigated.

***Auriniopsis kieneri* Clench**

Plate 187

Scaphella kieneri Clench 1946, *Johnsonia* 2, p. 58, pl. 31, fig. 1.

There appears to be no question but that the specimens now being obtained in the Gulf of Mexico represent this "lost" species of Kiener. This species, along with *Busycon coarctatum* Sowerby and possibly many others, was probably obtained from Mexican fishermen in the early 19th century and eventually reached Europe.

My thanks are due to Mr. J. L. Baughman for the loan of the first specimen that came to us for study. Since then, others have been loaned to us. We figure a specimen that exhibits a little more black on the siphonal canal than exists on the other material.

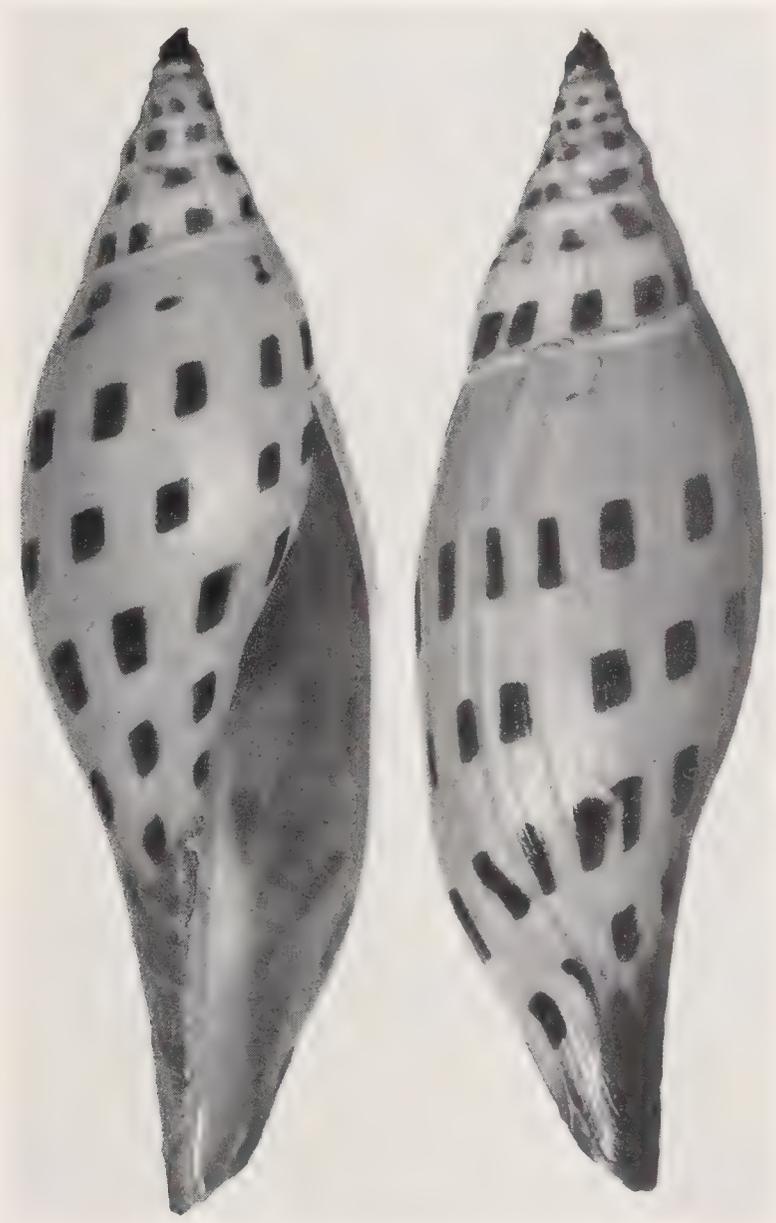


Plate 187. *Auriniopsis kieneri* Clench
Off mouth of the Mississippi River, Louisiana (natural size).

length	width	whorls	
197	61.5 mm.	7	off Obregon, Mexico
145	46.5	6	off Tampa, Florida
138	45.0	6	off Louisiana

Range. Gulf of Mexico from Florida west to Texas and south to Yucatan, Mexico.

Records. FLORIDA: about 150 miles west of Tampa in 80 fathoms (A. S. Merrill). LOUISIANA: off the mouth of the Mississippi River in 40 fathoms (A. S. Merrill). TEXAS: about 80 miles east of Padre Island (N. Lat. 27°12'; W. Long. 96°21') in 100 fathoms (J. L. Baughman). MEXICO: off Obregon, Tabasco, in 30 fathoms (C. L. Branch).

* * * *

Recent Works on the Marine Mollusks of Argentina

In recent years three very important papers have been published on the marine mollusks of Argentina. They are all the result of the work of Dr. Alberto R. Carcelles, head of the Division of Protozoology and Invertebrates in the Argentina Museum of Natural Sciences, Buenos Aires. The first of these is on the fauna of Puerto Quequén, Buenos Aires. In this paper Carcelles outlines briefly the faunal provinces of Argentina and gives a short account of the various vessels that have been responsible for zoological work in the area. In the systematic portion he gives the distribution and habitat of each species, its relative abundance and geologic horizon.

The second paper, a catalogue of the marine mollusks of Patagonia, covers that area extending from Rio Colorado on the north to Cabo Virgenes on the south. Dr. Carcelles introduces the catalogue with a descriptive account of the area and an historic sketch of the work that has been done there. A total of 296 species are listed for this region of which 23 are chitons, 179 gastropods, 69 bivalves, 3 scaphopods and 22 cephalopods. Under each species he has given the original citation and range, with occasional additional references and notes.

The third report, on the marine mollusks of the Magellanic Province, covers in area the Golfo Nuevo in Argentina south including Tierra del Fuego, the Malvinas or Falkland Islands, the Burwood Bank and north on the Chilian coast to Concepción. An account of the limits and characteristics of the province is given. As in the two previous reports, he includes an excellent summary of the expeditions and voyages in this area and an outline of the important works published. In the systematic portion of the catalogue there are included the original citation, range and important references for each species.

The first two papers include several good plates and all three have excellent bibliographies, the one on the Magellanic Province being complete for the papers published on this province to that date. Numerous papers by Carcelles, Doello-Jurado, Parodiz and others have also appeared in recent years, but the three catalogues discussed give the overall of the area and references to additional literature.

Carcelles, Alberto 1944, Catálogo de los Moluscos Marinos de Puerto Quequén. Revista del Museo de la Plata (N.S.) Zoology 3, pp. 233-309, pls. 1-15.

Carcelles, Alberto 1950, Catálogo de los Moluscos Marinos de Patagonia. Anales del Museo Nahuel Huapi 2, pp. 41-100, pls. 1-6.

Carcelles, A. and Susana I. Williamson 1951, Catálogo de los Moluscos Marinos de la Provincia Magalánica. Revista del Instituto Nacional de Investigacion de los Ciencias Naturales. Zoological Sciences, 2, no. 5, pp. 225-383.

—RUTH D. TURNER

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BY

MERRILL E. CHAMPION

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