

# Hawaiian Shell News

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## THE CASE HISTORY OF THE PLEUROTOMARIIDS THEIR GEOLOGICAL HISTORY

by E. R. CROSS

No group of shells has attracted more scientific interest in recent years than the molluscan family Pleurotomariidae. This is due to several factors: their recent discovery in a living state (they had been known only in fossil form before 1856); their primitive state of evolutionary development; their unusual appearance; their general rarity; and, perhaps most of all, their long geological history. Another point of interest, particularly to collectors: only a few species of this family exist.

As pointed out in the previous review of this group of shells (Ref. 26) the family Pleurotomariidae is considered one of the living fossils. For many years it was thought to be the oldest living mollusk and is still considered the oldest living gastropod. Pleurotomariids are considered primitive partly because of having two gill plumes whereas, the right gill plume is absent in the more advanced gastropods.

### EONS OF TIME

The life history of any mollusk must of necessity start eons ago. Mollusks certainly were not the first form of life on earth. Nor the most abundant. But mollusks, including direct line ancestors of present day pleurotomariids, were there, in large numbers, in the early Phanerozoic (visible life) eon some 500 million or more years ago.

At this time in the earth's development only a few forms of life existed on the rocky land except for a profusion of green algal films that had crept ashore from out of the sea. From this early Cambrian period through the Silurian, a time span of nearly 175 million years, the quickening pulse of life on earth was in the warm primeval seas.

### PLEUROTOMARIANS DEVELOPED IN A CROWDED SEA

By comparison with the billion or so year span of Precambrian time, the Cambrian period was relatively brief. But it was in this brief, 100 million year span, that life forms waxed with almost unbelievable diversity. However, it was not this great diversity that was the most important development in this evolutionary period. The most important thing that occurred in these warm waters was that many animals developed hard parts: exoskeletons in the case of the thousands of arthropods and in the case of mollusks. Before this era ended members of every major animal group except the worms had developed a hard, shell-like covering of some sort. And it was in these same crowded seas that the early ances-

(Cont'd on Page 14)

## THE DISCOVERY OF THE LIVING PLEUROTOMARIIDAE

by ROBERT W. MORRISON

The discovery of the first slit shell to be accurately described was made by Commandant M. Beau, a French naval officer whose duty took him to the Lesser Antilles in the mid-19th century. Beau was also an energetic naturalist whose collection of Caribbean shells included many new species and rarities.

One of Beau's most productive collecting techniques involved the regular examination of fish traps which the Antillian fishermen set in 40 to 100 fathoms of water. It was such a fish trap, set in November, 1855, between the islands of Marie Galante and Dominica, that yielded a small slit shell, occupied by a hermit crab.

The record seems clear that the Japanese knew of the existence of slit shells prior to this discovery. However, there appears to be no evidence that they were aware of the true significance — the "living fossil" aspect — of the genus. One such shell, probably *Mikadotrochus beyerchii* Hilgendorf, was pictured in 1843 in *Mokuhachi-fu* ("Illustration of Shells") by Sekiju Musashi.

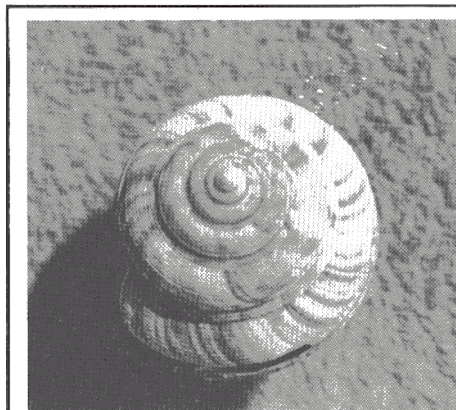
In 1856 Beau's collection, including a small slit shell, was passed on to Paul Fischer and A. C. Bernardi for study, cataloging, and publication. They recognized the slit shell as a recent specimen of the genus *Pleurotomaria*, thought to have been extinct since the upper Cretaceous 65 million years ago.

Fischer and Bernardi described the shell in 1856 in the *Journal de Conchyliologie* and named it *Perotrochus quoyana* in honor of Rene Jean Couston Quoy, a French naturalist who made significant voyages of observation in 1817 and 1826. (See name changes, page 7.)

Beau died in 1858, one year too early to realize the full significance of his discovery. For, in 1859, Charles Darwin published his theory of evolution by natural selection. Interest in fossils skyrocketed and the discovery of a "living fossil" became a very significant event. The acceptance of Darwin's theory made fossils the key to present and future life and early links in the evolutionary chain.

Beau's collection remained intact through two owners after his death. But in 1867 it was purchased by Robert Damon, a respected dealer in natural science objects in Weymouth, England. He disposed of the collection piece-meal. The holotype of *P. quoyana* was sold to the de

(Cont'd on Page 14)



*Perotrochus quoyana* Fischer and Bernardi, 1856. Photo Bert Porreca.

This is a specimen of the first living representative of the family Pleurotomariidae. It was dredged from 120 fathoms north-east of Venezuela.



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Items of interest to shell collectors are solicited for publication in the Shell News. Deadline is 10th of the monthly preceding date of publication. Address all contributions, comments, suggestions, and other correspondence, including information and payments for ads to The Hawaii Malacological Society, 2777 Kalakaua Avenue, Honolulu, Hawaii 96815. Advertisements are accepted at the rate of \$10.00 per column inch per issue. For special six or twelve time rate write The Editor.



by LYMAN HIGA

Gerry Bluehdorn has been at it again. Recently found, along the Waianae Coast, two *Cypraea vitellus*, each 76mm, and a *Conus circumactus*.

How rare is *Cypraea cernica* in Hawaii? After 10 years, one case of the bends, and 2,184 logged dives, Bobby Gutierrez found his second *C. cernica*. This beauty was found in 50' depth at Moku-leia.

Ron and Phyllis Macomber really hit the "rarepot" off Fort DeRussy. In 50' they found 3 *Cypraea tessellata*, 1 *C. rashleighana* and a *Conus spiceri*, all live taken.

Ed DeVaul, working sand pockets off Nanakuli, fanned many sand dwellers in 90' depth and collected hard-to-find *Terebra*, *Turris*, *Cerithium* and *Mitra*.

Tom Richert's record *Conus textile* (124.2mm) is in danger as Tom Fair's *C. textile* has added a fraction of a millimeter. After 4 months, Tom's *C. textile* is still alive and doing well. The Fairs have done quite well during June in their dredging at Pokai Bay, including *Mitra peasei*, *M. foveolata*, *Turris gemmula monilifera* and numerous species of *Terebra*.

## SHELL SHOW OF 1971

Applications were mailed to the H.M.S. membership in June for the 1971 Shell Show. Interest is intense and we look forward to our greatest show. It will be held at the Ala Moana Center from September 6 to 12th. Publicity will be released to the newspapers and via television late in August according to Publicity Chairman Ruth Fair.

Among the very rare shells that will be shown will be a *Conus bengalensis*, at least four *Conus gloriamaris*, a minimum of four species of *Pleurotomaria* including the probable world record *P. teramachii* of 5¾ inches. We expect at least ten Golden Cowries to be on view. One of our members from Tahiti will be coming to Hawaii to display his shells which include *Cyp. armeniaca*, *Cypraea rosselli*, *C. teramachii*, *C. exusta* and many others. Local member Colonel Charles Wolfe will have many of his outstanding shells on display.

The committee is gratified to announce the addition of eight excellent local monkey pod bowls with engraved silver plates to the awards previously mentioned. Categories and names of the donors are as follows: Best Exhibit in the Show, Ala Moana Hotel, Mrs. Dee Prather; Best Shell in the Show, Aluminum Products Hawaii, Ltd., Mr. Robert A. Jones; Best Hawaiian Shell (self collected) in the Show, Skin Diving Hawaii, Mr. and Mrs. Ward Noxon; Most Popular Exhibit in the Show, First Hawaiian Bank, Mr. Walter Dods, Jr.; Best Junior Exhibit, Mr. and Mrs. Ellis R. Cross; Best Live Shell Aquarium Exhibit, Capt. and Mrs. Arch Harrison; Largest *Cypraea tigris schilderiana* Cate, Mr. and Mrs. Elmer G. Leehman; Best Shell Novelty, Mr. and Mrs. Elmer G. Leehman. The usual attractive ribbons will be awarded additionally of course, all of which should be highly inviting to all concerned.

The Show Committee is still interested in the display of additional rare shells for display. We wish to thank Mr. Chien Chih Chen of the Chien Shen Company of Taiwan and Mr. Kenneth W. K. Kiong of Sea Spray Marine Specimens of Singapore for their thoughtful offer to send some of their extra rare shells for our show.

Secretary Zetta Williams is quite occupied with the applications. Vice Chairman Stu Lillico has been working almost daily rehabilitating the cases for the show. Bob O'Brien is assisting with case repairs. These hard workers need help, so get in touch with them if you have some spare time. There is still a great deal to be accomplished.

Your committee has spared neither time nor effort to make this an outstanding show. It is obvious that a number of participants will carry home some very fine awards. Everyone who displays will enjoy the warm satisfaction of having shared the beauty of his shells with many others. If your application is not already mailed, send it in today!!!

## CORRECTION PLEASE

Page 1 of June, 1971, HSN illustrated four microshells. On page 2 it was implied all these shells were from Hawaii. All were not. Shell 1, *Hydrobia ventrosa* (Montagu) was from the Black Sea, Odessa, USSR. Shell 3 should have been identified as possibly *Triphora dolicha* (not *dolicta*).

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# THE PLEUROTOMARIIDAE - A SURVEY OF THE KNOWN LIVING SPECIES

by E. R. CROSS

The molluscan family Pleurotomariidae Swainson, 1840, contains only three recent genera according to Knight et al (1960:219). They are *Entemnotrochus* P. Fischer, 1885; *Perotrochus* P. Fischer, 1885; and *Mikadotrochus* Lindholm, 1927. The type genus, *Pleurotomaria* DeFrance, 1826, is extinct and is found only in fossil form from the Lower Jurassic to Lower Cretaceous. Seventeen species in the three genera are here considered with at least two species being of doubtful rank.

A great deal of work has been done describing the color, form, and sculpturing of the shells of these animals. Little has been published describing or illustrating the anatomy of the mollusks. In the Golden Field Guide, *Seashells of North America*, (Ref. 1) Abbott shows a stylized drawing of the various parts of a typical pleurotomarian mollusk (page 53). In their description of the new species *Mikadotrochus notialis* in *Papes Avulsos Zool. S. Paulo*, Vol. 22, ART. 21: 225-230, estes 1-2, 1969, (Ref. 14) Leme and Penna describe the animal of *M. notialis* quite completely and show drawings of gross morphological features and details of the radula system. In *Physiology of Mollusca*, by Morton and Yonge, (Ref. 18) theoretical evolutionary stages of mollusks are shown and discussed with relationship to the pleurotomariids (Vol. 1, pages 13, 16-18) and the spawning habits of this group of shells is mentioned briefly on page 143. Some additional information will be found in *Encyclopaedia Britannica* under the listing SNAIL, *Archeogastropoda*. Probably there is a great deal of other information available on this group of shells but it seems not to be readily available.

Only one species of the pleurotomariids can even remotely be called abundant. Most species are known from less than a dozen specimens and three are known only by the holotype (see table, pages 6-7). This is one of the major difficulties in the final establishment of species. Also the fact that so little is known about the animals of this group makes division of species rest on conspicuous shell characteristics. Among these, according to F. M. Bayer (Ref. 3) are size of shell, shape, depth and location of slit, sculpturing, and color. Abbott (Ref. 1) adds presence or absence of an umbilicus and angle of the spire as species determining characteristics.

Basically these shells are rather large, measuring from about 1" for the smallest to nearly 8" for the larger species. The shells are conical and mostly solid. They are nacreous within and may or may not have an umbilicus. There is a slit band, usually at the periphery of the body



Photo: Mr. Choo, Taiwan

Living specimen of *Entemnotrochus rumphii* (Schepman, 1879), made in an aquarium at the Taiwan Provincial Museum in Taipei, Taiwan.

whorl, that terminates in a deep marginal slit.

According to Bayer (Ref. 3) the depth of the marginal slit is constant within each genera, being deepest in *Entemnotrochus*, intermediate in *Perotrochus*, and shallowest in *Mikadotrochus*. Bayer also feels the position of the slit on the whorl is a generic level characteristic, being above mid-whorl in species of *Entemnotrochus*, and mid-whorl or below in all others.

Some species of the pleurotomariids are quite heavily constructed; others quite light and one quite fragile. In the large thin-shelled species the slit is placed somewhat closer to mid-whorl than in the smaller or more solid forms.

The color of the shells seems nearly constant in any particular species but there is some variation in hues. That is, the markings of a species will all be very similar but the shade of the color and amount of streaking with lighter color will vary.

The operculum of these shells is thin, horny, nearly circular, and is multispiral. Most opercula do not close the aperture of the shell tightly but apparently serve as a pad on which the shell rests when the animal has its foot fully extended.

Dr. Frederick M. Bayer, Institute of Marine Science, University of Miami, has worked as much with the pleurotomariid species as has any one researcher. His papers published in *Bulletin of Marine Science* (Vol. 13, No. 3, pp. 488-492; Vol. 15, No. 4, pp. 737-796; and Vol. 17, No. 2, pp. 389-397) provide a thorough study and evaluation of shell characteristics. With minor variations his arrangement of species will be followed.

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**Genus *Entemnotrochus***

**P. Fisher, 1885**

Shells in this genus are large and openly umbilicate with a very deep slit located above mid-whorl. Sculpturing becomes obscure on the later whorls. The animals, according to Lindholm, have tuberculated surfaces; a triangular platform behind the operculum and will be divided lengthwise by a deep groove in the middle. The shell will be large with a diameter of 70 to 190mm. Or the shell will be smaller (45-50mm) in animals with the triangular platform but without the longitudinal groove. Bayer (Ref. 3) feels "*Entemnotrochus* is sharply distinguished by the widely open umbilicus, very deep slit, large shell size, and dwindling sculpture on the later whorls." Shells are as broad as or broader than they are high.



Photo: Tzimoulis, *Skin Diver Magazine*  
*E. adansonianus* taken by divers at 280 feet. Rocky ledge, Andros Barrier Reef, Bahamas.

***E. adansonianus* (Crosse and Fisher, 1861)**

This is the second largest of the slit shells and will reach a width of at least 5" to 8". It is collected from deep water in the West Indies and Caribbean to the northern coast of South America. Divers, using a closed-circuit scuba, collected two specimens at a depth of 280 feet on the outside wall of the Andros Barrier Reef, Bahamas. It has also been dredged from depths as great as 1,500 feet.

The umbilicus of *E. adansonianus* is round, open, and very deep. The slit extends for about one-half the circumference of the shell. The base color is cream with reddish splotches. *Skin Diver Magazine* (Ref. 27) shows an excellent color view of the base and umbilicus of this shell. A specimen was also illustrated in HSN for July, 1966 (Ref. 22) and other photos were shown in HSN for October, 1970 (Ref. 26).

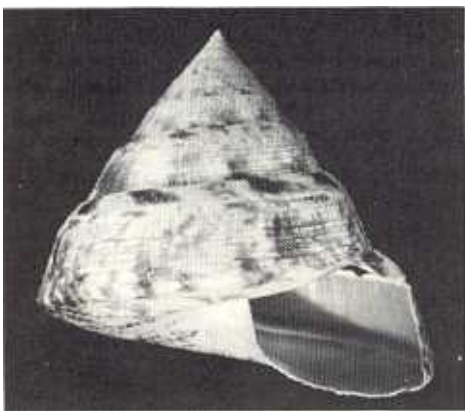


Photo: F. M. Bayer

*E. adansonianus*, collected off Andros Is., Bahamas. Note extremely deep slit in right photo.

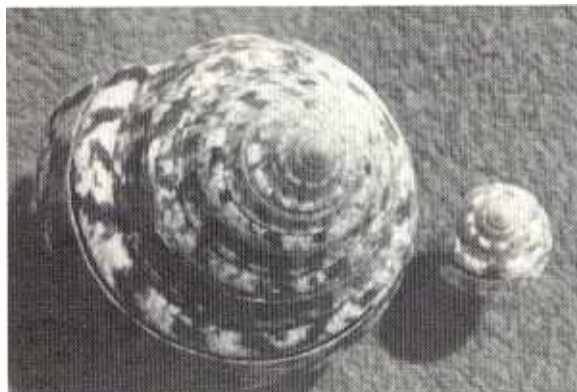


Photo: Bert Porreca  
*E. adansonianus* dredged from 110 fathoms (660 feet) north of Georgetown, Guyana, South America, in May, 1969. Note the very short slit in the juvenile shell at right. However, it will also be seen that color and sculpturing are the same as in the fully adult shell.

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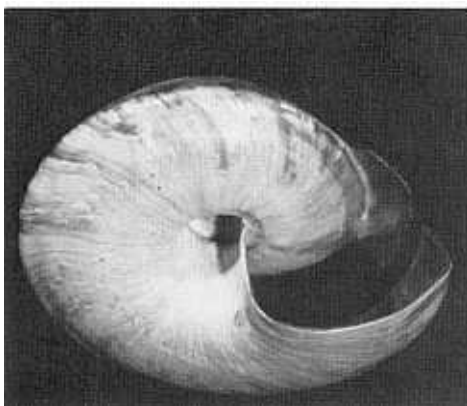
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***E. rumphii*  
(Schepman, 1879)**

Owing to its size and beauty this shell has been illustrated quite frequently since its discovery. The holotype of the species was reportedly collected in the Moluccas and is in the Naturhistorisch Museum, Rotterdam. All other specimens have been collected in the Taiwan-Japan area. Five or six specimens have now been reported. One specimen is in the collection of HMS vice president Elmer Leehman. The shell has been illustrated several times in HSN (Refs. 24, 25, and 26.)

The shell is typically *Entemnotrochus*; large size, deep slit, open, deep umbilicus and brightly colored with dwindling sculpturing on the later whorls (note change in sculpturing in illustration, below). The slit in this specimen is much wider than in normal *E. rumphii*. It appears the collector (in Taiwan) tried to repair nicks in the slit by filing it wider. The remnant of the original, very narrow, slit can be seen at the right edge of the widened slit.



The shell illustrated above is in the collection of HMS vice-president Elmer Leehman. It was collected from deep water off the coast of Taiwan in 1970.

**Genus *Perotrochus*  
*P. Fischer, 1885***



Species of *Perotrochus* so far described have been much smaller than typical *Entemnotrochus*. However, some species do reach moderate size. They will be turritiform or trochiform with base shallowly excavate. The depth of the slit in *Perotrochus* is the shortest of all the pleurotomariids, usually one-fourth the circumference or slightly less and the slit will be mid-whorl or below. Generally sculpturing and beading are quite pronounced in the genus. Photo left, by Donna and Riley Black, is of *P. amabilis* and shows typical characteristics of the genus.

Shells in this genus will be without an umbilicus or it will be nearly closed. The external part of the columella will be thin and will not be curved.

***P. africanus* (Tomlin, 1948)**

This shell is illustrated in several publications, including the HSN (Ref. 21 and 26). Apparently deep water east and north of Durban, South Africa is the center of the population of this species at a depth of about 200 fathoms.

The shell is basically thin and quite light. Coloring is a dull yellowish-red with light cream or whitish streaks and blotches. Dr. Frederick M. Bayer (Ref. 3) describes the shell, "Although the margins of the fasciole are somewhat raised and sharp, the resulting keels are equally inconspicuous and the upper one is not stronger than the lower as described in the type. The raised red marginal line bordering the slit as mentioned by Tomlin is not conspicuous, but within the aperture there is a reddish line along the edge of the nacreous layer where it approaches the margin of the slit."

The left shell (below) is 4" x 3" high and was collected 40 miles east of Durban from 350 fathoms in 1962. Photo by F. Mehta. The shell below, right, is in the collection of Donna and Riley Black and was collected off the south coast of Zululand (about 50 miles north of Durban) from 160 to 180 fathoms of water. Photo by Bert Porreca.



***P. amabilis* (F. M. Bayer, 1963)**

Donna and Riley Black, Dredged Specimen Shells, P.O. Box 6845, Ft. Myers, Florida 33901, wrote saying, "To date we have dredged four of the seven known specimens of *P. amabilis*. The enclosed photographs (see page 8) are of a specimen dredged west of Tampa, Fla., from 115 fathoms, rubble bottom. It is almost 3½" wide."

The shell is moderately large, trochoid, rather thin and light in structure, according to Bayer (Ref. 2) in his description of the holotype. The base of the shell is convex and excavate in the umbilical region but is not perforate. The slit is about one fifth the circumference of the shell and lies slightly below the middle of the whorl. Sculpturing is mainly strong spiral cords and rather pronounced beading.

The ground color of *P. amabilis* is a creamy-white with streaks and flames of a rusty-red. The interior of the aperture and the umbilical area is covered with nacre and is iridescent. The operculum is fairly typical of this group of shells but is somewhat more circular. See photos top center page 5 and on page 8. The shell is collected from water off the Southeast Florida coast in the Gulf of Mexico.

(Cont'd on Page 8)

## LIST OF REFERENCES CITED

1. Abbott, R. Tucker — 1968, Seashells of North America, pp. 52-53. Excellent artists illustrations of anatomy of slit shells and also of *P. amabilis* and *E. adansonianus*.
2. Bayer, Frederick M. — A New Pleurotomariid Gastropod Trawled in the Straits of Florida by R/V Gerda; Bulletin of Marine Science of the Gulf and Caribbean, Vol. 13, No. 3, pp. 488-492, Sept., 1963. Describes and illustrates *Mikadotrochus amabilis* = *Perotrochus amabilis*. 4 black and white views of holotype.
3. Bayer, Frederick M. — New Pleurotomariid Gastropod from the Western Atlantic, with a Summary of the Recent Species; Bulletin of Marine Science, Vol. 15, No. 4, pp. 737-796; December, 1965. Describes and illustrates the following: *P. midas*, 4 color photos plus 2 black and white and sketches and microphotos of sculpturing; *P. lucaya*, five views of holotype plus sketches of sculpturing; *P. gemma*, four views of holotype and four of paratype plus sketches and microphotos of sculpturing; *P. quoyanus*, three views of holotype, plus five other specimens and microphotos and sketches of sculpturing; *Entemnotrochus adansonianus*, five views of two shells; *E. rumphii*, six views of two shells; *P. africanus*, four views of one specimen; *P. teramachii* Kuroda, two views of holotype; *Perotrochus* sp. from Kira; *P. hirasei*, 3 views of one shell; *Mikadotrochus beyrichi*, four views of one shell and two of hypotype; *M. salmianus*, four views of one specimen and three of *M. salmianus* the hypotype of *M. schmalzi*.
4. Bayer, Frederick M. — Another New Western Atlantic Pleurotomariid Gastropod, Bulletin of Marine Science, Vol. 17, No. 2, June, 1967, pp. 389-397. Describes and illustrates *Perotrochus pyramus* with four photos and sketches and microphotos showing sculpturing.
5. Dance, S. Peter — Shell Collecting, An Illustrated History, 1966, Plate XIV (b) illustrates the holotype of *Perotrochus quoyanus*.
6. Fretter, Vera — Observations on the Anatomy of *Mikadotrochus amabilis* Bayer; Bulletin of Marine Science, Vol. 14, No. 1, pp. 172-184, March, 1964.
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8. Dance, S. Peter — Rare Shells, 1969, Plate II (a), illustrates, in color, the holotype of *P. quoyanus*.
9. Habe, T. — Shells of the Western Pacific in Color, Vol. II, Plate I, (1) illustrates in color, *Perotrochus teramachii* non Kuroda = *Perotrochus* sp. indet. and *Mikadotrochus schmalzi* (2).
10. Habe, T. and Sadao Kosuge — A List of the Indo-Pacific Molluscs, concerning to the Japanese Molluscan Fauna Superfamily Pleurotomarioidea. Occ. No. 55629, C/O Nat. Sci. Museum, Ueno Park, Tokyo Japan, June, 1964. Lists thirteen pleurotomariids of the Indo-Pacific including four fossil species. Also Scissurellidae and Hallioidae. No illustrations.
11. Hirase, S. and S. Taki — An Illustrated Handbook of Shells in Natural Colors from the Japanese Islands and Adjacent Territory, Plate 59, (1) *Pleurotomaria hirasei* and (2) *P. salmiana*, in color.
12. Kira, Tetsuaki — Shells of the Western Pacific in Color, Vol. I, 1965, Plate 2, (1) *M. beyrichi* and (2) *M. hirasei*. Excellent color.
13. Kira, Tetsuaki — Colored Illustrations of the Shells of Japan, 1960, Plate 1, (1) *P. beyrichi* and (2) *P. hirasei*. This book is in the Japanese language version of 9 above, with same fine color illustrations. Also has black and white illustrations of *P. salmianus*, *P. teramachii* and *Entemnotrochus rumphii* not found in the English language version.
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15. Platt, Rutherford — Shell Take You Over World Horizons; Nat. Geographic Magazine, July, 1949, p. 71 color plate, Fig. 7, *Pleurotomaria salmiana* (*Mikadotrochus salmianus*), excellent color illustration.
16. Rios, E. de C. and H. R. Matthews — Nova especie de Pleurotomariidae do Brasil (Mollusca Gastropoda); Arg. Est. Biol. Mar. Univ. Fed. Ceara, 8 (1): 65-68, Junho, 1968. A description and four views of holotype of *Perotrochus atlanticus*. Also contains good bibliographical references.
17. Shikama, T. — Selected Shells of the World Illustrated in Colours. Plate 1, Fig. 1, magnificent color photo of holotype of *P. teramachii*; Fig. 2, an equally excellent photo of *P. africanus*; Plate 2, excellent color photos of *M. beyrichi*, *M. salmianus*, *M. schmalzi* and *P. hirasei*. In Part II of the book is a discussion in Japanese and illustrations (black and white) of *P. quoyanus*, *P. adansonianus*, *E. rumphii* and *P. africanus*.
18. Wilbur, K. M. and C. M. Yonge — Physiology of Mollusca, Vol. 1, 1964, pp. 15 and 16, discusses Pleurotomariidae in Classification and Structure of Mollusca with stylized illustrations of mantle and slit development.
19. Yamashita, H. and T. Habe — East China Sea, a New Locality of *Perotrochus teramachii* Kuroda; Venus, Vol. 27, No. 4, November, 1969. Illustrates and discusses the East China Sea *P. teramachii* and compares it with holotype of *P. teramachii* Kuroda.
20. Zahl, Dr. Paul A. — The Magic Lure of Sea Shells; National Geographic, March, 1969, pp. 386-429. Illustrates *P. midas* in color on page 415.
21. — Hawaiian Shell News, Vol. XI, No. 12, October, 1963, p. 7; excellent black and white photo of *P. africanus* (life size) with operculum.
22. — HSN, Vol. XIV, No. 9, July, 1966, p. 6; poor black and white illustration and brief discussion of *P. adansonianus*.
23. — HSN, Vol. XVII, No. 1, January, 1969, p. 3; nearly life size illustration and discussion of 4th known *P. teramachii* (from East China Sea).
24. — HSN, Vol. XVII, No. 3, March, 1969, p. 5; two excellent views of *E. rumphii* with discussion of shell by Dr. Sadao Kosuge.
25. — HSN, Vol. XVII, No. 10, October, 1969, p. 1; three views of shell and animal of *E. rumphii*.
26. — HSN, Vol. XVIII, No. 10, October, 1970, pp. 1, 4-7 and Supplement 6-70; *Pleurotomaria* "The Millionaire Shells"; illustrates *P. africanus*, *M. beyrichi*, *P. teramachii*, *P. hirasei*, *E. rumphii* and *E. adansonianus*.
27. — Skin Diver Magazine, August, 1970, p. 33; color photo of *E. adansonianus*, basal view.

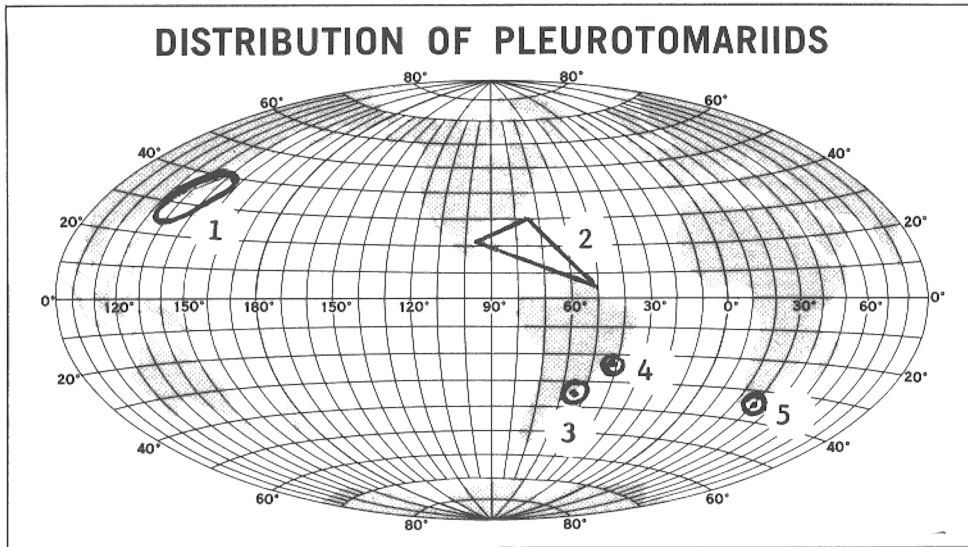
NO. SPECIES KNOWN	RECENT GENERA AND SPECIES	DISTRIBUTION		SLIT CHARACTERISTICS				
		GEOGRAPHICAL (See map above)	DEPTH	SIZE	DEPTH	LOCATION		
14(?)	<b>ENTEMNOTROCHUS</b> <i>E. adansonianus</i>	Area 2	250' to 1,500' rough steep slopes	Narrow	1/2 circum.	Above midpoint	139 x 146.4mm, large	
5	<i>E. rumphii</i>	Area 1	700'		1/2 circum.	Above midpoint	71 x 190mm (to 8")	
12	<b>PEROTROCHUS</b> <i>P. africanus</i>	Area 5	1,200'			Below midpoint	100 to 130mm (1-4.9")	
	<i>P. amabilis</i>	Area 2	300'-700'	Narrow	1/5 circum. 42mm	Below midpoint	Small—moderately (3")	
2	<i>P. atlanticus</i>	Area 4	450' sand & mud		15mm 1/6 circum.	Midpoint		
2	<i>P. gemma</i>	Area 2	600'	2mm	29mm 1/4 circum.	Above midpoint	42 x 46.5mm (1.75"),	
	<i>P. hirasei</i>	Area 1	400'-1,000'		Shallow 1/7 circum.	Midpoint	85 x 91mm (3" to 5")	
1	<i>P. lucaya</i>	Area 2	1,000'	1.4mm	20mm 1/4 circum.	Midpoint	28 x 32mm (1")	
	<i>P. midas</i>	Area 2	2,000'	5.0mm	60mm 1/4 circum.	Midpoint	88.8mm high, 118.3 4 1/2"	
1	<i>P. pyramus</i>	Area 2	To 2,000'	2mm	25mm 1/5 circum.	Below midpoint	Moderate size 48 x 3	
Several	<i>P. quoyanus</i>	Area 2	450'-750' to 1,800'		30mm (2) 35mm		35.2 x 45.1mm (1"-3")	
6(?)	<i>P. teramachii</i>	Area 1	1,200'				78-100mm (3"-4")	
Few (?)	<i>P. "teramachii"</i> Habe	Area 1	1,300'		Small	Above periphery	To 95mm (3 3/4")	
	<b>MIKADOTROCHUS</b> <i>M. beyrichi</i>	Area 1	120'-600'			Very short	Midpoint	62 x 64mm, 65 x 71mm
1	<i>M. notialis</i>	Area 3	488' muddy			1/7 circum.	Immediate below midpoint	71mm (2 3/4")
	<i>M. schmalzi</i>	Area 1	460'-700' (from rocks)				Above suture	Large—solid (2 1/2"-3")
Several	<i>M. salmianus</i>	Area 1	180'-1,000'		35mm Very short			99 x 100mm (3"-4")

## Name Changes In The Pleurotomariids

Several name changes have occurred in the pleurotomariids. Some changes are in the spelling of the species; others reflect a change in the genus.

One reason for changing the name of a shell is to comply with spelling or latinization of names. In general a name of female gender will be latinized by adding "iana"; a masculine name will be latinized by adding "us" or "ianus". Several of the pleurotomariid species were named in honor of men but the names were latinized by adding "iana", *E. adansoniana* being a case in point. Since the shell was named honoring a man the name should have been latinized by adding "ianus", and the spelling should have been *E. adansonianus*. Others noted are *P. quoyanus* instead of *P. quoyana* (not *quayana* as spelled in some books); *P. africanus* instead of *P. africana*; and *M. salmianus* instead of *M. salmiana*.

(Cont'd on Page 9)

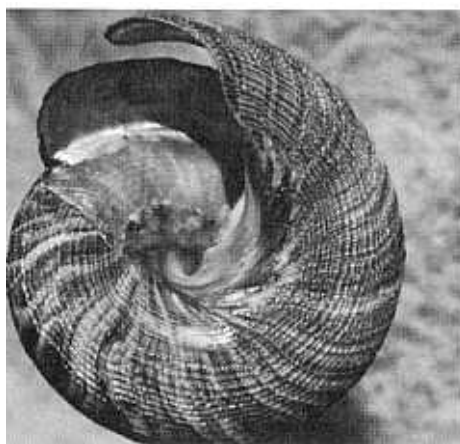


It will be seen from Table 1 (below) that only one species each has been collected from areas 3, 4, and 5. Seven species have been collected from each of areas 1 and 2 if two questionable species are counted from area 1. A study of ocean conditions in these areas would indicate considerable warming, even of the deeper water, by equatorial waters flowing into the areas. The only remaining area with comparable geological age and geophysical features in which a pleurotomariid might some day be found is the east coast of Australia north of Brisbane.

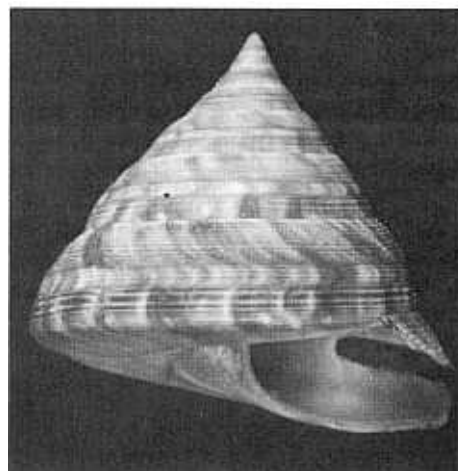
E 1

### SHELL CHARACTERISTICS

	CONSTRUCTION	SCULPTURE	COLOR	UMBILICUS
	Trochiform		Cream with reddish splotches	Very deep
	Trochoidal			Widely open
	Thin—light weight	Raised red marginal line borders slit	Dull, yellowish-red with whitish streaks and blotches	Widely open
78mm		Finely beaded with strong spiral chords	Cream white with brownish-red streaks and blotches	Open
	Trochoidal			
x 44.8mm	Trochoidal—conical	Spiral and axial cords with low rounded tubercles, finely beaded	Whitish with broad orange or reddish-brown streaks	Almost Closed
	Thick, heavy, large pointed spire	Very light fasciole finely sculptured	Whitish with reddish-orange axial streaks	
	Flat sided cone	Fine spiral cords beaded at intersections	Pale tan with yellowish axial streaks	Faintly indicated
	Inflated whorls—thin broadly turbiniform	Deeply impressed sutures	Yellow with pinkish-orange streaks "metallic sheen"	Not open
	Very thin & fragile low turbiniform	Predominately spiraled, faintly beaded		
(1.5" avg.)	Low turbiniform trochoid	Corded and beaded	Pale brown with yellowish-tan streaks	Open
	Very thin	Fine cancellated	Light yellowish with light orange bands	
	Thin—broadly conical	Fine reticulations	Iridescent orange red streaked	
(2½"-3")	Thick, inflated whorls	Heavy beaded cords sparsely sculptured	Yellowish with reddish radial patterns	Not open
	Trochoid	Beaded Cords	Whitish with reddish-brown longitudinal stripes	Nearly closed
	High conical	Slit band above each whorl	Yellowish-orange	
		Thin orange marginal line on slit (both sides) with 2 cords	Reddish-orange markings	Open

*P. amabilis* (F. M. BAYER, 1963) (Cont'd from Page 5)

*P. amabilis* collected by Donna and Riley Black dredging from their M. V X Donna L. The shell measures 3½" wide. Photos by Black.



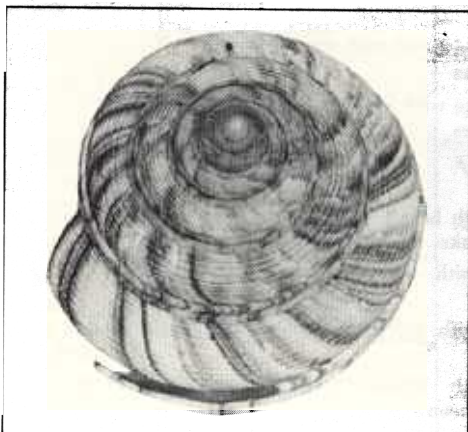
*P. gemma*; photo of holotype by F. M. Bayer.

*Perotrochus atlanticus* Rios and Matthews, 1968

This species is one of the more recently discovered; and it was discovered in an area new to this genus. To date only two specimens of this species have been collected, both off the coast of Brazil. The type specimen was collected in area 4 (see map, page 7) off Isla Sao Sebastiao in Long. 44° 34' W., Lat. 24° 22' S., from a depth of 133 meters on March 2, 1968 by the Oceanographic vessel "Walter Herwig". This specimen (the type) has been deposited in the Museum of Oceanography of Rio Grande, Rio Grande do Sul, Brazil. A second specimen was later collected off Sao Paulo, Brazil by the R/V "W. Besnard". Habitat of both shells was sand with mud bottom.

The type specimen measured 60 x 54 x 53 mm. *P. atlanticus* somewhat resembles *P. amabilis* and *P. quoyanus* but differs in several important aspects as described in Dr. Rios' and Mathews' original description (Ref. 16). Operculum is typical of the pleurotomariids.

The base color is cream with yellow overtones with irregular axial streaks of dark red which carry over onto the base of the shell. The interior of the aperture, the umbilical area, and the lip of the columella are nacreous. See photos below for, left, *P. atlanticus*, dorsal view and, right, aperture view.

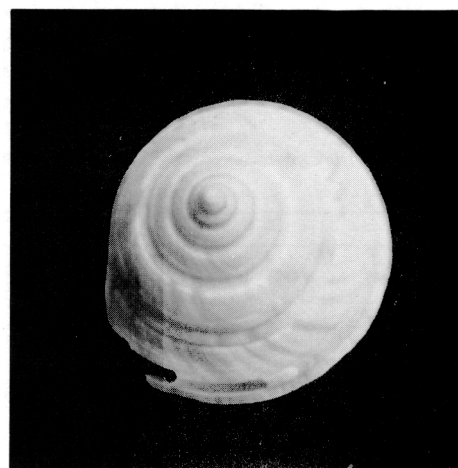
*P. gemma* F. M. Bayer, 1965

Only two specimens of this species have so far been collected, both from the Barbados area and both from 100 fathoms. The holotype is in the Academy of Natural Sciences, Philadelphia. The paratype in the collection of Mr. John Finlay.

According to Dr. Bayer (Ref. 3) the shell is of moderate size, trochoid and resembles *P. quoyanus* but is more regularly conical, has less inflated whorls, weakly impressed sutures, is brighter colored, and has a flatter base. The slit and fasciole originate near the suture as in *P. lucaya* and *P. midas*. It differs from these by being more coarsely sculptured and brighter colored. The slit is short, being about one quarter the circumference of the shell.

The primary color is whitish to yellow-cream with heavy markings of broad axial streaks of orange brown. The base is lighter than the sides, being almost white and only slightly colored with the darker colors.

See photos, top right column.



*P. gemma*; photo of paratype by Bert Porreca.

*P. hirasei* Pilsbry, 1903

In recent correspondence with Dr. Shikama, Yokohama, Japan, he stated, in part, "*Perotrochus hirasei* is extremely variable in shell outline, but rather constant in its sculpture of shell surface. The five photographs I sent you are all *P. hirasei* and all shells were collected in the vicinity of Tosa, Japan." (See page 9 for illustrations).

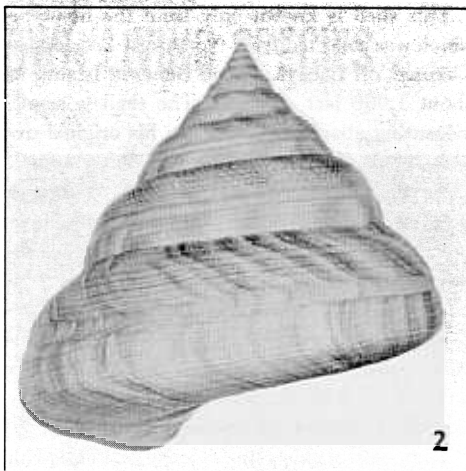
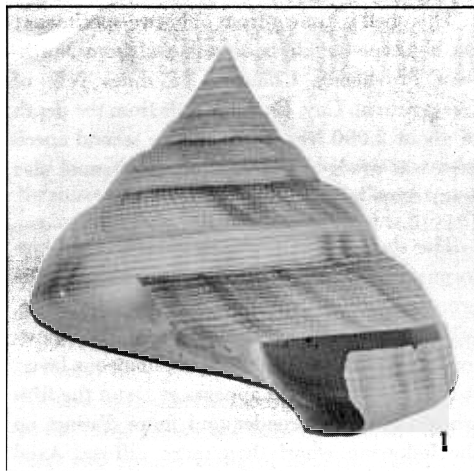
This is undoubtedly the most common of the pleurotomariids and one of the most sought after since it is the "Emperors top shell" around which almost as many stories have developed as around any other shell in history. Hundreds of specimens are to be found in private collections and in museums.

According to Bayer (Ref. 3), "Although *P. hirasei* is a large, heavy-shelled form, it has a deeper slit than do *beyrichi* and *salmiana*, thus it is excluded from *Mikadotrochus*. It is here retained in *Perotrochus*, but differs from the other large-shelled species of that genus (*africanus*, *amabilis*, *midas*, *teramachii*) by its thick, heavy shell."

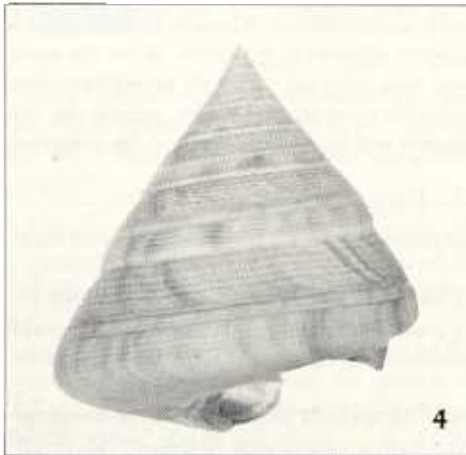
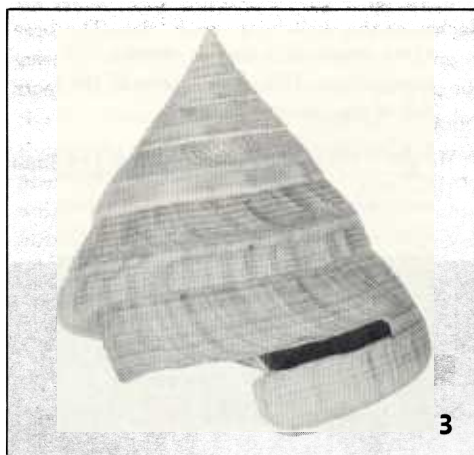
Specimens illustrated at right, on page 9, are all from Tosa Bay Japan



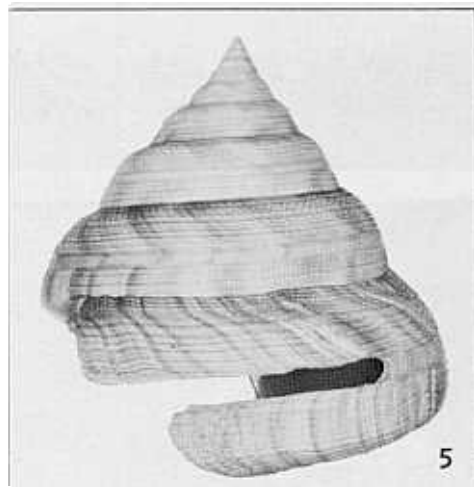
***P. hirasei* Pilsbry, 1903**



Shell illustrated above measures 85mm x 83mm high. Photos 1 through 5 courtesy of Dr. Shikama.



Above shell measures 88mm x 95mm (approx.), and shows the variability of shell outline but consistency of sculpturing and color pattern.



*P. hirasei* is the only species of the pleurotomariids of which enough specimens exist to permit evaluation of shape, color, pattern, and sculpturing in determining species characteristics. The shell illustrated in 5, above, measures 105mm across the base. That in 6, above, right, measures 3" in dia. x 2¾" in height. Photo courtesy Mr. F. Mehta. Shell shown in 7, right, was collected in deep water off Japan, exact locality not known. Photo courtesy Bert Porreca.

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**NAME CHANGE (Cont'd from Page 7)**

Dr. F. M. Bayer, after further study, has now placed the species *amabilis* in the genus *Perotrochus* instead of *Mikadotrochus*. Therefore the correct name for this shell is *Perotrochus amabilis* (F. M. Bayer, 1963), the author's name being in parenthesis even though the genus change was made by the same author.

### *P. lucaya* F. M. Bayer, 1965



*P. lucaya* F. M. Bayer. Photo of the holotype deposited in U.S. National Museum. Photo by F. M. Bayer.

This shell is known only from the holotype which was collected from Northwest Providence Channel, off Lucaya, Grand Bahama Island, in about 1,000 feet of water. The shell is small, measuring about 1" x 1¼". In his original description of the shell (Ref. 3) Dr. Bayer stated, "The small size and pale coloration of *P. lucaya* suggests relationship with *P. quoyanus*. However, it differs in the flat-sided spire with the sutures scarcely impressed, and in the finer sculpture. The sculptural differences separating *lucaya* from *quoyanus* are on the order of magnitude similar to those separating *Mikadotrochus beyrichi* and *M. salmianus* which are clearly recognized as distinct species."

The color of this shell is very pale tan with faint axial streaks of yellowish brown. The interior of the whorls is nacreous except on the parietal wall where only a narrow band of nacre is exposed adjacent to the suture. When the specimen was collected traces of exceedingly thin, yellowish periostracum were present in the fasciole and in the depression of the sculpture.

### *P. pyramus* F. M. Bayer, 1967

This shell is known only from the holotype which was collected from La Desirade Straits, off Guadeloupe, Lesser Antilles by the R/V "Gerda".

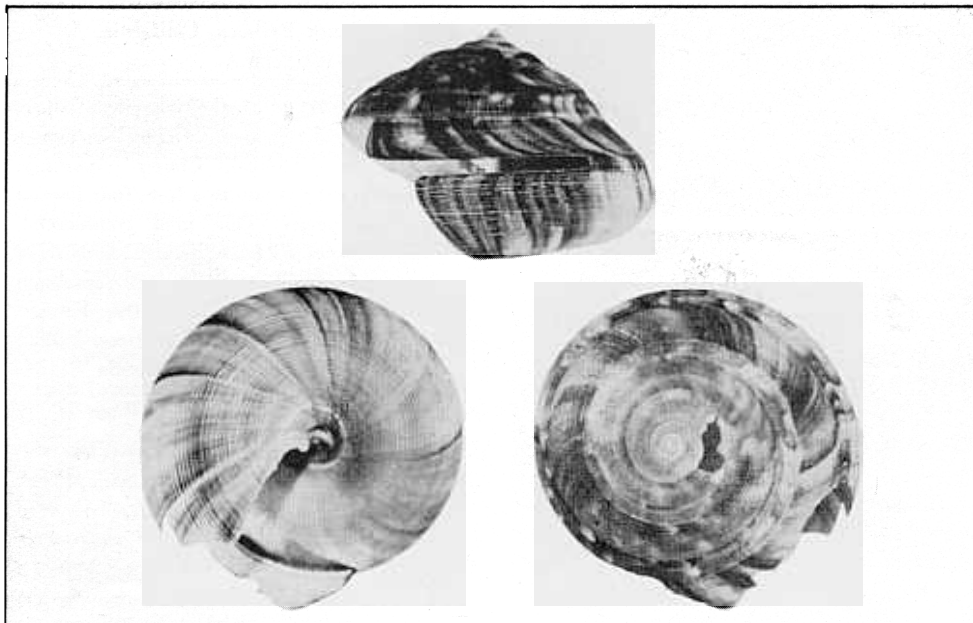
The holotype is moderate in size and is very thin and fragile. It is turritiform with moderately inflated whorls. The base is distinctly convex and slopes gently into the umbilical depression around the columella. The slit occupies 25mm of a total circumference of 125mm, or one-fifth of the body whorl.

The color of the shell is reddish orange being the darkest on the body whorl. It has axial streaks of venetian red and nebulous streaks of light orange. The base is pale orange or cream with radial streaks of reddish orange.

Ornamentation is rather weak but is predominately spiral and very faintly beaded.

According to Dr. Bayer (Ref. 4), "The new species (*P. pyramus*) is quite distinct from *P. quoyanus*, *P. amabilis*, *P. lucaya*, and *P. gemma*, all of which are inhabitants of much shallower water. *P. pyramus* more closely resembles the deep-water species of *Perotrochus* group B: *teramachii* Kuroda, "*teramachii*" Habe (non Kuroda), *africanus* (Tomlin) and *midas* Bayer.

Illustration, below, was adapted from Bulletin of Marine Science, Vol. 17, No. 2 (Ref. 4).

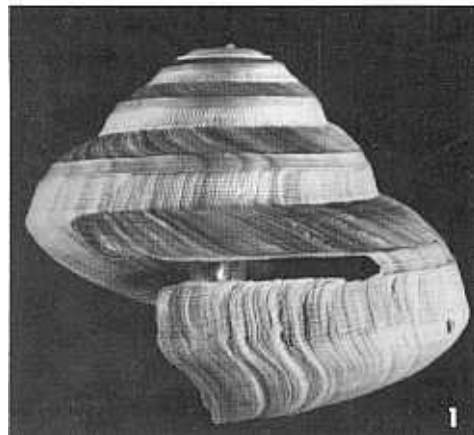


### *P. midas* F. M. Bayer, 1965

This shell is known from only two specimens; the holotype having been collected from Northwest Providence Channel, 15 miles NW of Great Stirrup Cay, Berry Islands from the depth of about 2,000 feet (Ref. 3). The second specimen was dredged from Santaren Channel also from deep water.

The shell is thin, large, and broadly turritiform with a rather bluntly rounded apex. The ground color of the shell is golden yellow above, with the iridescence of the nacreous layer showing through the translucent porcellaneous layer. A darker yellow band appears at about the fifth whorl becoming broader and more distinct on the following whorl then more diffuse. Axial streaks of pinkish orange appear at the seventh and eighth whorls and become progressively darker as the shell increases in size. The base is pinkish cream with darker streaks following the growth lines. This must be one of the more colorful of the pleurotomariids.

Height of the holotype is 88.8mm x 118.3mm x 102.2mm.



Shell shown in photo 1 above is of the holotype of *P. midas*. The specimen is now in the U.S. National Museum. The shell shown in photo 2 is the second known specimen of *P. midas* collected. Photos courtesy Dr. F. M. Bayer.

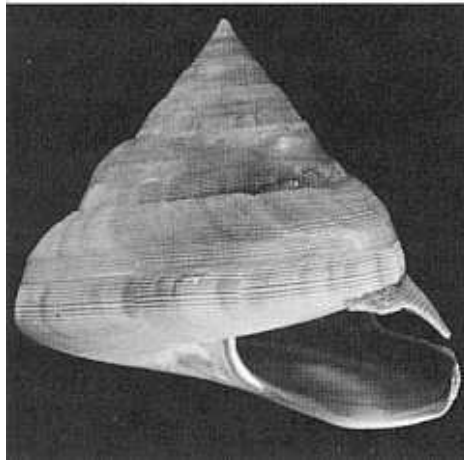
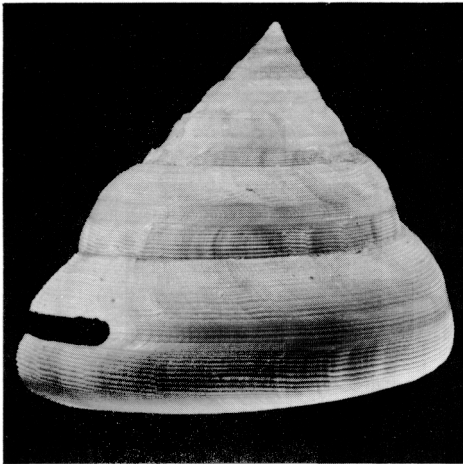
***P. quoyanus* (Fischer and Bernardi 1856)**

Perhaps a dozen specimens of this shell are known to exist. The holotype is in the British Museum (Natural History); four specimens are in the U.S. National Museum; and four may be found in the Museum of Comparative Zoology, Harvard University, including preserved soft parts of one specimen.

*P. quoyanus* was the first recent species of the pleurotomariids known to science. This shell is one of the small *Perotrochus* complex, the others being *amabilis* and *gemma*. The few known specimens of *P. quoyanus* have in common the rather low, trochoid shape seen in the type specimen.

The color of this species is pale rose with faint yellowish-tan streaks. Sculpturing is similar to *P. amabilis* but can be differentiated from the latter. For comparative studies of sculpturing of the small *Perotrochus* researchers should see Ref. 3. (Bayer, F. M., *New Pleurotomariid Gastropods from the Western Atlantic, with a Summary of the Recent Species*, Vol. 15, No. 4, Bulletin of Marine Science, Institute of Marine Science, University of Miami.)

Both photos below by F. M. Bayer, Approx. 1.5 x.



***P. teramachii* Kuroda, 1955**

For several years there has been the problem of having two different shells illustrated as *P. teramachii* in the several shell books from Japan, all of which are in color. Apparently only a very few of each of the two shells are in existence but it does seem they are distinct species.

The first of the two shells to be called *P. teramachii* was described and illustrated by Dr. T. Kuroda in 1955. The holotype of this shell is illustrated by Bayer in Ref. 3. The holotype is also illustrated by a superb color photo in Dr. Shikama's *Selected Shells of the Western World in Color*. (Ref. 17). The illustration immediately below is adapted from the color photo in Dr. Shikama's excellent book. Size of the shell is approximately 90mm.

On the problem of the two *teramachii* shells, Dr. Shikama stated, "The upper figure of Plate 1 of my book is of the holotype of *P. teramachii* which belonged to Mr. Teramachi. Figure 1 or Plate 1 of Dr. Habe's book, also called *teramachii*, is of a shell in Mr. Sakurai's collection. Mr. Sakurai regarded his specimen as belonging not to *teramachii* but to another unknown species. However, I regarded it as *africanus*. The original color of this second *teramachii* is not as red as shown in Dr.

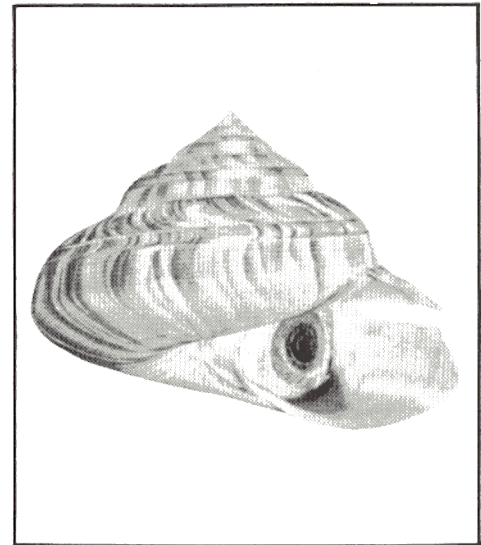
Habe's book (*Shells of the Western Pacific in Color*, Ref. 9) but was rather yellowish and lighter colored. In my opinion the shell of *P. teramachii* Kuroda is very thin, light yellowish with light orange color bands and bears much fine cancellated sculpturing. The shell of the other *teramachii* and of *africanus* is rather thicker, a darker red, and cancellations of the surface sculpture are not so distinct as in *P. teramachii* Kuroda. Be that as it may, both species are very close to each other and perhaps both should be put in subspecies of *africanus*." From a study of the illustrations available it appears more than color and sculpturing are involved as *P. teramachii* Kuroda has a higher spire and less inflated whorls than the other "*teramachii*".



***Perotrochus* Sp. Indet.**

This shell is *P. teramachii*, Kira, 1961 page 4, text fig. (Ref. 13) and *P. teramachii* Habe, Plate 1, Fig. 1. (Ref. 9). Of this shell Dr. Bayer (Ref. 3) states, "This shell is different in shape and, apparently in color, from the type of *teramachii*. Shikama and Horikoshi (1963:5) suggest a relationship with *P. africanus*. Although I have not been able to compare the actual specimens, the published photographs of the Japanese specimen show a more depressed shell with little sigmoid flexure of the columella and the slit rather high on the whorl, quite different from specimens of *P. africanus* in the U.S. National Museum."

This shell is illustrated below, the illustration being adapted from the color plate in Habe's *Shells of the Western Pacific in Color*.



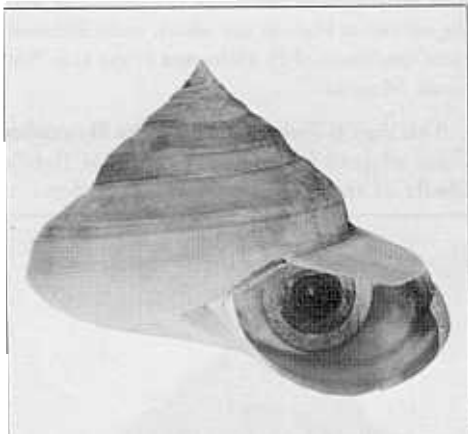
Recently several specimens of a pleurotomariid have been collected from deep water in the East China Sea hundreds of miles south of the type locality of *P. teramachii* Kuroda. Of these specimens Dr. Shikama stated, "A number of specimens of *teramachii* have been collected from the East China Sea and I also have obtained a specimen of this shell. The coloring and sculpture of the shell quite agree with the figure in my book of the type specimen of *P. teramachii* Kuroda."

Of other specimens of these shells from the East China Sea, Hideo Yamashita and Tadahige Habe wrote (in Ref. 19), "A single specimen of *Perotrochus teramachii* Kuroda, 1955 was taken alive from the East China Sea. — The specimen has the lower spire and more inflated whorls than the type specimen described by Kuroda and is very similar to the second specimen illustrated in Plate 1, Fig. 1 of Habe (1961). Bayer (1966) claimed that this type may be a different species from typical *P. teramachii*. But it may be more natural to treat this

**PEROTROCHUS (Cont'd from Page 11)**

type as a varietal form within a single species than to take it as a different species, if one recalls a large variation within *Mikadotrochus hirasei*." The shell illustrated immediately below is the specimen being discussed in Yamashita and Habe's paper.

The shells illustrated at right are apparently of the East China Sea pleuromariids. Photo top right courtesy Bert Porreca; at bottom right courtesy Chien Shen, Taiwan.



**Genus *Mikadotrochus* (Lindholm, 1927)**

Shells of this genus are trochiform, moderately large, and moderately heavy. The shallow slit will be broad, slightly below midpoint in the body whorl and with upper margin advanced beyond the lower. The columellar lip is distinctly thickened by pearly callus and will have a strong sigmoid curvature.

The base of the shell will be moderately convex and will be excavate but not perforate.

The shell will be ornamented with obscurely nodose or beaded spiral cords, axial riblets that are sometimes minute and nearly obsolete.

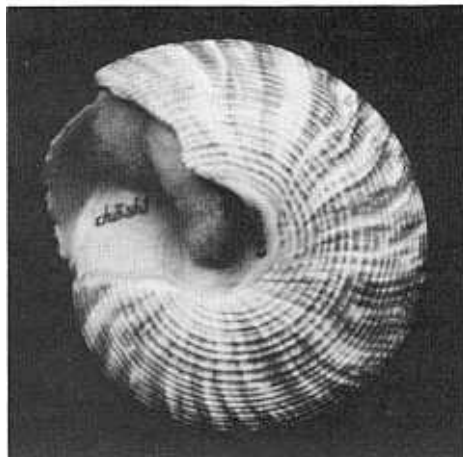
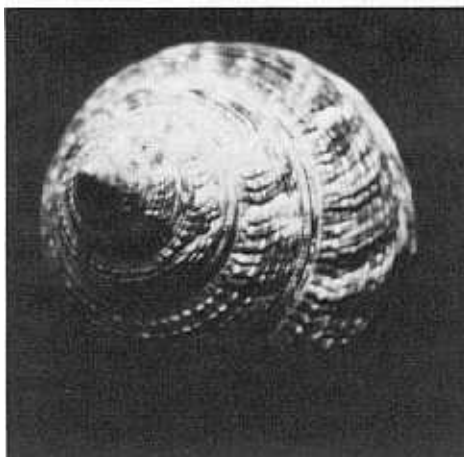
The type species for *Mikadotrochus* was *P. beyrichi* Hilgendorf.

***M. beyrichi* (Hilgendorf, 1877)**

This is the "shallow water species" of the pleuromariids. It is collected in 20 to 30 fathoms usually but is sometimes found as deep as 100 fathoms. It will measure from 3 to 4 inches in width.

The color of the shell is cream-white with dark red blotches and flame patterns. A distinctive color pattern is the radial pattern of the base of the shell.

A specimen in the U.S. National Museum had six spiral cords above the fasciole and four below with 19 on the base of the shell. The shell illustrated (below) was photographed by the author in the Yokohama National University collection.



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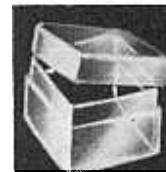
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**Philippine Shell Post Card Followup**

Regarding the Philippine shell postcards, there were four members of the Philippine shell club involved. It was the original idea of Mr. Larry Gotuaco and was later joined by Mr. F. Dayrit, Mr. V. Dan and Mrs. Fely Leobrera. All the shells used in the postcards were Mr. Victor Dan's and a professional photographer took the pictures.

***M. notialis* Leme and Penna, 1969**

The unique holotype of this species was collected off Rio Grande do Sul, Brazil, in 84 fathoms with a muddy bottom. See area 3 on map, page 7. The shell was trawled in a fish trawl.

The shell is moderately large (71mm.), trochoid in shape, with more than 8 whorls, convex. The last three whorls are moderately angulated. Suture impressed and irregular (Ref. 14).

Color of the shell is whitish-cream with numerous and irregular longitudinal light, reddish-brown stripes. Aperture subquadrate, iridescent. The slit is about one-seventh the circumference of the body whorl at the longest (top) part; much less on the bottom. The slit is immediately below the midpoint of the suture and periphery.

The base of the shell is slightly convex; the umbilical region excavate but not perforate. Sculptured by beaded cords that increase in number, the body whorl having 14 to 18 above and 5 to 6 below the fasciole.

The shell most closely resembles *Perotrochus amabilis* but differs from it in having a different shaped shell, more convex spire, smaller slit, different radular formation with bicuspid rachidian teeth and left epipodial tentacle as long as the right.

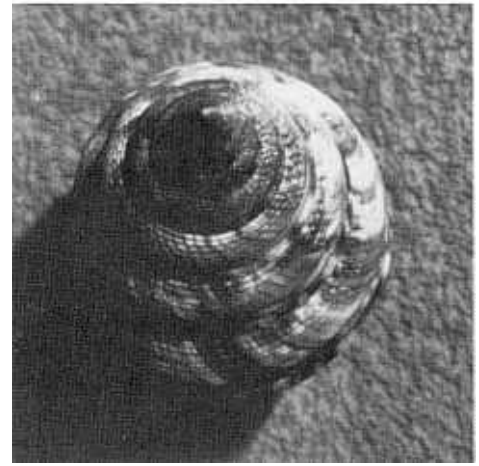
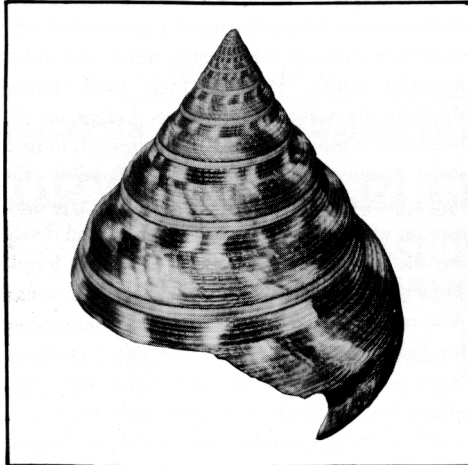
Photos below courtesy Dr. Leme.



***M. schmalzi* Shikama, 1961**

As stated in HSN for October, 1970, there is some uncertainty about the validity of this species, some workers feeling this is a synonym for *M. salmianus* (Rolle). Until the uncertainty is eliminated, one way or the other, *M. schmalzi* is being illustrated (below) from two separate specimens.

Dr. Bayer points out (Ref. 3) that Shikama's description of *M. beyrichi* and Rolle's description of *M. salmiana* agree quite closely. However, according to Dr. Shikama, "*M. beyrichi* is not found in the Tosa Bay region and it can be distinguished (from *M. salmianus*) by its rugose (columella) and less spiral ridges. Also *M. schmalzi* has a much more convex basal surface."

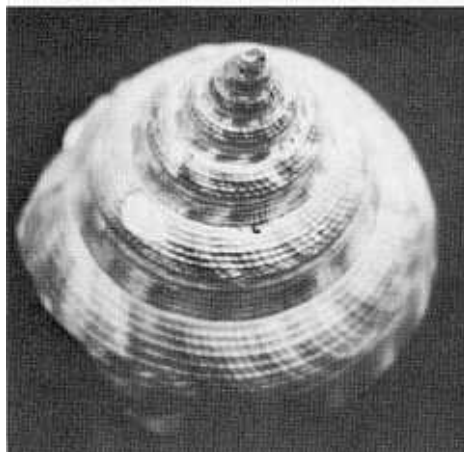


***M. salmianus* (Rolle, 1899)**

According to Dr. Shikama, Yokohama National University, Yokohama, Japan, "*M. salmianus* is not yet established among the Japanese conchologists. I regard a shell collected in the Choshi area as *M. salmianus* and cited this shell in my book. However, Dr. Habe prefers to list this shell as *M. beyrichi*. Also some additional specimens were collected from the area of Ogasawara Islands and there is some uncertainty about their identification. Accordingly I am most anxious to see photographs of the type specimen of *M. salmianus*".

The maximum diameter of *M. salmianus* seems to be about 100mm. The slit is quite short, being about 35mm. long on the upper margin and even shorter (about 16mm) on the lower margin. A specimen in the U.S. National Museum is described by Bayer (Ref. 3) as follows, "On the body whorl there are 17 spiral cords (of which 5 are weak intercalary cords not yet strongly developed) above the fasciole, 5 between fasciole and periphery, and 29 on the base. The reddish orange markings are distinct all the way to the apex of the shell, the base has faint radial rays of brownish orange, inside the aperture the slit has a thin orange marginal line, the fasciole is edged with an orange line on both sides and is sculptured with two cords."

Can HSN readers provide the editors with a photograph of the holotype of this shell? Or advise the location of the holotype? Photos of other specimens that have positively been identified as this shell would also be appreciated.



*M. salmianus* (Rolle). Better photos of this shell are urgently needed to complete HSN file on this group of shells. We would particularly like to receive photographs, preferably in color, of the holotype. Location unknown.

## THE GEOLOGICAL HISTORY

(Cont'd from Page 1)

of the present pleurotomarians developed and, in most cases, became extinct. A few forms survived for more millions of years and were found as fossils laid down as late as 65 million years ago. And then they apparently disappeared. But one family is now known to have survived through the tremendous changes of the earth's development. The first living representative of the modern Pleurotomariidae was collected only 115 years ago in the Caribbean.

### EXTINCTION OF

### PLEUROTOMARIIDS STARTS

Probably no life form has become extinct in a short period of time. Imperceptible changes occur that cause one or more species to disappear. Later others. This was probably the case with the pleurotomarians.

Some 300 million years ago, in the Carboniferous period, there was a great period of mountain building and a period of heavy glaciation, the amount of land ice present being greater than in any other period of earth's history. A great extinction of the vast coral growths indicates a lowering of the sea's temperature. These and other related combining factors could have caused some species, unable to adapt to the slowly changing conditions, to become extinct.

Temperature changes in the seas may have been a factor although the present depth range of living pleurotomarians indicates they can tolerate some temperature range. Abundance of fresh water, or a too saline sea, might have been a factor. A highly specialized diet was undoubtedly the cause of many life forms becoming extinct. When conditions caused their diet to become extinct, they also ceased to exist.

### DISTRIBUTION OF

### PRESENT PLEUROTOMARIIDS

The several species of the living Pleurotomariidae are widely distributed geographically (see map, page 7). However, most are found in only two general areas. Seven species are known from the Caribbean (area 2 on map); seven

from Japan and the North China Sea (area 1); two from Brazil (areas 3 and 4); and one species from South Africa (area 5). They are found at depths ranging from about 200 feet to as great as 2,000 feet.

Their habitat seems to be on or very near the sometimes nearly cliff-like abyssal slopes. The fact that some species have been taken in fish traps would indicate they might prefer the relatively narrow ledges frequently associated with undersea cliffs on which silt, sand, and other material settles. Possibly their food, falling through the water from above, lodges on the ledges, or it may grow on these ledges if, in fact, some species are herbivorous. Possibly the shells themselves provide a clue to the type bottom on which they thrive. Generally mud dwelling mollusks make relatively thin and fragile shells compared to those living in rocky areas. Also mud dwellers usually develop a larger foot for helping stay on top of the softer material. Some pleurotomariids are thin, light, and wide; others heavy, thick, and more narrow.

All Pleurotomariidae are found in tropical faunal areas although the two Brazilian and the one African pleurotomariids were collected in transitional areas. Since one of the main geographical features that separates faunal areas is sea temperature, it is possible temperature is one of the factors limiting wider distribution. However, depth range of some species (*Entemnotrochus adansoniana*) is such that temperature differences should normally occur. Ocean salinity, possibly another factor in distribution, ranges from about 35 ppt for the Caribbean species to as high as 36.5 ppt for *Perotrochus atlanticus* and perhaps as low as 34.5 ppt for the Japanese and Taiwanese species. However, for each area the salinity remains fairly constant, probably within the errors of salinity determinations.

Undoubtedly there are other factors that both limit the distribution of present species and permitted the development of known living species to survive for 65 million years.

## THE DISCOVERY (Cont'd from Page 1)

Brugh collection in 1872, then to V. M. MacAndrew in 1914. The British Museum acquired the shell in 1941.

The next chapter in the slit shell story was the discovery, in 1861, of a second species of Pleurotomariidae. This one was found by Joseph Crosse, the eminent French attorney-conchologist, in the collection of a Dr. Commarand. Crosse and Fischer described this shell the same year in the *Journal de Conchyliologie*. The new species was named *Entemnotrochus adansoniana*, honoring the name of a prominent 18th century French naturalist, Michel Adanson. (See name changes, page 7.)

Prompted in part by the discovery of two species of slit shells so close to the shores of the United States, in part by the revived interest in deep-sea exploration, and in part by the success of the British Challenger's around-the-world deep-sea exploration voyage of 1872-1876, the U.S. undertook a series of deep-sea sounding and dredging operations in the Gulf of Mexico and Caribbean.

These were accomplished by the now famous Blake explorations of 1877-78 and 1879-80. The Blake dredged a second specimen of *P. quoyana* in deep water off the Yucatan Peninsula and a second *E. adansoniana* from 100 fathoms in the Caribbean.

Both shells were described by William Healy Dall, one of the American "giants" of both malacology and paleontology, in the monumental "Blake Reports" published by Harvard's Museum of Comparative Zoology from 1886 to 1889.

*Ed. Note: A preliminary discussion of the pleurotomariids was published in the October, 1970, issue of HSN. Primarily the article was designed to point out how little general information was available on these shells and to bring additional information in so a more complete survey of this interesting family of mollusks could be published. Hopefully we wanted to obtain photos and descriptions of all the living Pleurotomaria species. The response has been excellent and we have now completed our file of photos and information. I would like to particularly thank Dr. Shikama, Geological Institute, Yokohama National University, Yokohama, Japan; Dr. Frederick M. Bayer, Professor of Marine Science, University of Miami; Dr. Licia Penna, Museu de Zoologia da Universidade de Sao Paulo, Sao Paulo, Brazil; Dr. Eliszer de Carvalho Rios, Museu Oceanografico, Rio Grande, Rio Grande do Sul, Brazil; Robert W. Morrison, Cleveland Heights, Ohio; Donna and Riley Black, Ft. Myers, Florida; Mr. F. Mehta; and Mr. Bert Porreca, West Henrietta, N.Y.*

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Good news for members who receive HSN by foreign airmail. These airmail rates will not be increased. Therefore, dues rates for foreign airmail delivery will not be increased but will remain at the present \$15.00 per year.

### Conus textile Article Next Month

Due to the length of pleurotomariid material the second part of Olive Schoenberg's *Conus textile* article will appear in the September issue of HSN.