# OCCASIONAL PAPERS ON MOLLUSKS

*Published by*
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoology
Harvard University

VOLUME 2
Numbers 19 to 34

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PRINTED AT
BOTANICAL MUSEUM OF HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS
1955–1965

# DR. JOSEPH C. BEQUAERT

THIS second volume of *Occasional Papers On Mollusks* is dedicated to Dr. Joseph C. Bequaert, colleague and friend of many years. During the twenty-four years of his association with the Mollusk Department he was available at all times for advice or to answer the innumerable questions of both students and colleagues on many varied topics.

Dr. Bequaert was born in 1886 in Thourout, a small town in the province of West Flanders, Belgium, not far from the city of Bruges where he spent his youth and developed a lively interest in Botany and Malacology.

His early training was in Botany, and he obtained his Ph.D. in this subject at the University of Ghent, Belgium, in 1908. Between 1910 and 1912 he was Entomologist for the Belgian Sleeping Sickness Commission in the Belgian Congo, and from 1913 to 1915 was in charge of botanical explorations in the Belgian Congo for the Belgian Colonial Government.

In 1916 he migrated to the United States and became a naturalized citizen in 1921. His first position in the United States was Research Associate in Congo Zoology at the American Museum of Natural History in New York from 1917 to 1922. He moved to the Boston area in 1923 and at that time was appointed instructor in the Department of Tropical Medicine at Harvard Medical School, where two years later he became an Assistant Professor. At the same time (1929–1945) he was also an Associate Curator of Insects in the Museum of Comparative Zoology. From 1945 to 1951 he was Curator of Insects, and from 1951 to 1956, Agassiz Professor of Zoology in the Museum of Comparative Zoology. Upon his retirement from Harvard University in 1956 he joined the staff of the Department of Biology at the University of Houston, Texas, and in

1960 moved to Tucson, Arizona as visiting Entomologist, and later as Curatorial Assistant in the Department of Zoology, University of Arizona.

His first association with the Department of Mollusks was in the summer of 1927 upon his return from a fourteen months trip to Liberia, the Belgian Congo and East Africa. From then on until his retirement he was a frequent visitor, weekends at first, then almost daily during his curatorship at the Museum of Comparative Zoology.

He took over the task of curating our land and freshwater mollusks of Africa which is now considered one of the largest collections in the world from this continent. His many trips to Africa added a vast array of new material, and the many friends he made during these trips continued to send him specimens throughout the years. Trips to other areas also yielded much material, and since his retirement he has sent to the Department many hundreds of lots from Texas, New Mexico, Arizona and northern Mexico.

He is a member of many scientific societies in North and South America and in Europe.

The following summary of Dr. Bequaert's expeditions and field studies shows the breadth of his interests and extent of his travels. All mollusca collected since 1926 have been deposited in the Museum of Comparative Zoology. A set of each lot collected in Arizona, New Mexico and northern Mexico have also been deposited in the University of Arizona, Tucson. Our accession files credit Dr. Bequaert with 10,948 lots to date; the total number of specimens would probably run well over 100,000.

January to June 1910, to Algeria as holder of a Belgian University traveling fellowship, and again as a visitor in April and May 1913. Acquaintance was made with leading Malacologist of the country, Mr. P. Pallary, who guided him to the type localities of land snails described from the Oran area.

Jos. Bequaert

JOSEPH CHARLES BEQUAERT
Agassiz Professor, Emeritus
Museum of Comparative Zoology
(photograph about 1920)

1910 to 1912, to the Belgian Congo as Entomologist for the Belgian Sleeping Sickness Commission. Incidental mollusks were collected along the Congo River, from the estuary to near the headwaters, particularly in Katanga Province, which at that time was virgin malacological territory. P. Dautzenberg and L. Germain studied this material, published on it in 1914, and deposited the types of the new species in the Musée Royal de l'Afrique Centrale (formerly the Congo Museum) at Tervuren, Belgium.

1913 to 1915, botanical explorations for the Belgian government in the Belgian Congo, chiefly in the northeastern section and the mountains along the Uganda border (Ruwenzori, Kivu Volcanoes). The collection of mollusks made during this trip was part of the material used by H. A. Pilsbry for his two volumes on the Mollusks of the Belgian Congo, published in 1919 and 1927, the second volume being co-authored with J. C. Bequaert.

May to August 1917, with an expedition of naturalists organized by Prof. J. C. Bradley across the United States from New York southward to Alabama and then westward to California.

March and April 1924, to the Republic of Honduras for a study of the sandfly problem for the Medical Department of the United Fruit Company.

July to September 1924, as part of the Hamilton Rice 7th Amazon Expedition to Rio Negro and Rio Branco, Brasil, with a medical team from Harvard Medical School. Mollusks collected were reported upon by Pilsbry (1926) and by Bequaert (1925, 1926).

March and April 1926, to Cuba for a study of malaria mosquitos for the Medical Department of the United Fruit Company.

May 1926 to July 1927, to Liberia, the Belgian Congo and East Africa, on a tropical African expedition organized by Dr. Richard P. Strong, as a member of a medical team from Harvard Medical School. Extensive mollusk collections were made.

MRS. BEQUAERT, FRANK BEQUAERT AND DR. BEQUAERT
Cambridge, Massachusetts
(photograph 1941)

July 1928, a summer trip to Colorado, including a stay at Granite Peaks Camp near Bayfield.

April 1929, to Dewees Island, near Charleston, South Carolina, for a study of ticks.

May and June 1929, to Yucatan, Mexico, as part of a medical survey for the Carnegie Institute. The mollusks collected were reported upon in a joint paper by W. J. Clench and J. C. Bequaert (1933).

July 1929, second summer trip to Colorado.

January to May 1931, to Guatemala for a study of onchocerciasis, with a team from Harvard Medical School led by Dr. Richard Strong.

October and November 1933, to European museums for the study of the Achatinidae and other African non-marine mollusks under a grant from the Milton Research Fund of Harvard University.

April to September 1934, to the Belgian Congo, particularly the Katanga, for a study of onchocerciasis. A large collection of mollusks was also made with native help.

June to September 1936, to Colombia for a study of yellow fever under the auspices of the International Health Division of the Rockefeller Foundation.

November 1943 to August 1944, to Liberia and Ghana (which was then the Gold Coast) to study African sleeping sickness and schistosomiasis. A large collection of mollusks was also made.

June 1947, a summer trip to Texas.

April 1949, to Hawaii for consultation on the *Achatina fulica* problem.

August and September 1951, to Europe and the Entomological Congress in Amsterdam.

September 1956 to date, local collecting in the southwestern states and Mexico with students and faculty members of the University of Houston and the University of Arizona which has resulted in large collections of land and freshwater mollusks from this little known area.

JOSEPH CHARLES BEQUAERT
Honolulu, Hawaii
(photograph 1949)

## CONTRIBUTORS



## ACKNOWLEDGMENTS


We are most grateful to many friends who have given time and material to make these studies possible. Specific mention is given in the Acknowledgments of the various numbers.

Our thanks are given to our subscribers for their continued interest and support.


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# PREFACE

THE pollution of our freshwater lakes, ponds, rivers and streams increases at an alarming rate. Within a few years most of our localized endemic genera and species will be only history of what was once the greatest freshwater molluscan fauna of any area in the world. From the Ohio River in the North, and south to the rivers which drain into the Gulf of Mexico east of the Mississippi River there is a remarkable number of endemic species as well as several endemic genera, which are rapidly becoming extinct.

Pollution began as soon as early man first reached this continent, and from this infinitesimal start it has continued at an ever increasing rate. There is little documentation as to the number of species destroyed, as it would be most difficult and costly to make a broad survey with this point in view, but we do know that certain areas, once rich in mollusks, are now completely destitute of these animals.

Pollution of sufficient concentration to initiate the decline of our mollusks had its start about the middle of the past century. Overfarming in the South brought about heavy silting in many of our southern rivers, and at the same time industrial wastes were becoming a serious problem in New England and elsewhere in the Northeast. Now the problem is a pressing one throughout the country.

Pollution is not the only factor contributing to the disappearance of our molluscan fauna. Navigational and flood control dams have contributed their share. As a result of these dams, particularly in the Coosa River in Alabama and in the Tennessee River in Alabama and Tennessee, the once numerous shoals are now covered with many feet of silt-laden water which has had a catastrophic effect upon the endemic shoal-inhabiting populations in these rivers.

In 1834, T. A. Conrad wrote regarding the remarkable *Paludina magnifica* Conrad [now *Tulotoma magnifica* in the Viviparidae, see plate 46]: "A beautiful species, when perfect, occurring in vast abundance on the masses of calcareous rock,

which have fallen from the strata above, into the Alabama River, at Claiborne." Not a specimen lives today nor has one been seen for many years. In 1933, we failed to find this species on the same rocks mentioned by Conrad. The species, however, does still exist in a few of the smaller tributaries and possibly in some stretches of the Coosa River itself, but it would appear to be only a question of time when these colonies will also disappear.

At the time this introduction was written we received a letler from Mr. Herbert Athearn of Cleveland, Tennessee, and quote the following paragraph:

"This past Tuesday [October 12, 1965] I returned to the Coosa to examine the 'progress' on the new Lock 3 Dam. Water has now been raised about 20 feet at its base and this has been sufficient to inundate all the remaining shoals that we have known as 'Ten Island Shoals'. My main work, however, on this day was to do some final collecting on Big Canoe Creek. This stream will be completely inundated by Lock 3 Dam for about one-half mile above Williams. The stream contains such species as *Tulotoma magnifica* and *Apella pyramidatum* in large numbers. Hundreds of live specimens of the latter species were taken as well as several dozen more live *Tulotoma,* probably for the last time here."

Lock 3 Dam is at Ten Island Shoals, St. Clair Co., Alabama, about 10 miles ESE of Ashville.

Regardless of what is done, even in the immediate future, to clear up the pollution, it cannot bring back the many endemic species which once existed and have been destroyed. Flood control and water storage dams are certainly necessary to meet the demands of an increased population, but they will have a profound effect upon the fauna in our freshwater systems. Unfortunately there are not enough interested people in any given area who can collect the fauna in the specific places which are to be changed. Most museums, maintaining collections of systematic and geographical value, would be delighted to receive such material for their collections, as the specimens lodged in their cabinets would be the only indication that these species once existed in the area which had been changed.

Pollution is not limited by any means to our freshwater

rivers and lakes. Certainly most of our harbors and estuarine areas are badly polluted, not only from sewage and industrial waste, but from oil spillage and run-off from city streets and highway systems. All intertidal species are affected by the last mentioned source, and at this time there appears to be no relief in sight from this type of pollution. With the continued increase in the number of automobiles and trucks, more and more lost oil will reach our streams and seashores. Pollution of this kind is of direct economic importance as it affects the shell fisheries as well as feeding areas for ducks and shore birds and eventually even inshore fisheries.

Just how much pollution may be affecting our land mollusks is difficult to assess, as there are so many other factors deleterious to their existence. Wide use of pesticides, weed killers and other chemicals must do considerable damage to the molluscan populations in the immediate vicinity where they are used, and where surface run-off exists; this could affect other areas seriously. Many times it is the indirect factor which is the most serious. In the drainage of certain portions of the Everglades in southern Florida it was not the loss of water which directly affected the tree snails of the genus *Liguus* but the fires during the winter months which were encouraged by the dryness of the 'glades.

The pollution and destruction of our natural areas is a local as well as a state and national problem. The development of an area for housing or industry should not mean the almost automatic loss of natural beauty and the destruction of the fauna. In order to improve the situation or even to prevent further destruction, a constant battle must be fought for the preservation of our natural heritage.

*Pages i–xvi published November 8, 1965.*

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Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts



VOLUME 2 AUGUST 13, 1955 NUMBER 19[1]

# The North American Genus Lioplax in the Family Viviparidae[2]

*By* WILLIAM J. CLENCH AND RUTH D. TURNER

The genus *Lioplax* Troschel presents one of the most interesting distributional problems among our freshwater mollusks. The genus is limited to four species and each of these occupies a different area, the two northern species being completely isolated from each other and from the two southern species. The two southern species, though in nearly adjacent areas, do not occur in the same drainage systems and, in addition, are separated by the Escambia and Perdido Rivers in Florida and southern Alabama.

The occurrence of each species within its own distributional area is not continuous. Wide gaps occur between localities even in a single stream and in regions of apparently similar ecological conditions. Certainly, many more localities will be found where these various species occur than are indicated on our map. However, the present study is based upon most of the material in this genus contained in our largest museums, collections that represent better than a century of field work.

From the records we have available and the distributional pattern as shown on the map for *L. sulculosa* Menke, it would appear that this species is beginning to invade the Great Lakes area. It has been found at the southern end of Green Bay,

[1] Volume 2 starts with Number 19.

[2] Research supported in part by the United States National Park Service in cooperation with the University of Florida and the Museum of Comparative Zoölogy, Harvard University.

Wisconsin (Lake Michigan) and this, to our knowledge, is the only Great Lakes record.

R. E. Call (1894, p. 137) states that *L. cyclostomaformis* Lea is locally very abundant and we found *Lioplax pilsbryi* Walker exceedingly common at nearly all stations in the Chipola River, Florida during our collecting this past summer (1954). We also found the same species fairly common in the Suwannee River near Oldtown, Dixie County, Florida. It was found along the margins of the rivers, usually in mud and muddy sand.

Call also states that *L. cyclostomaformis* Lea was found in considerable numbers in mud under large flat rocks. This is a most unusual ecological station for a member of this family. Other genera such as *Viviparus* and *Campeloma* are usually in exposed situations, though both *Campeloma* and *Viviparus* will often exist on very soft bottoms occasionally buried an inch or two below the surface. We found *Campeloma geniculum* Conrad buried in two inches of sand and mud in the Flint River, Georgia, and most abundant about the roots of aquatic vegetation.

In its shell morphology *Lioplax* is close to the genus *Campeloma* Rafinesque, differing usually by having a carina at the whorl periphery, rather finely developed sculpture and a well defined sigmoid outer margin to the aperture when seen in profile. The operculum is different from that of *Campeloma,* having the nucleus subcentral and being paucispiral in its early stage, then having concentric growth lines developed during the later stages in its life. In *Campeloma* the nucleus is submarginal (parietal margin) and continuously concentric throughout the life of the animal. The embryonic shell of *Lioplax* differs markedly from *Campeloma* by being strongly shouldered, usually having fine spiral sculpture and by having the first nuclear whorl extending above the second. *Campeloma* is without the whorl shoulder and sculpture and has the first one and one half whorls in a single plane.

According to the list of Fossil Non-marine Mollusca of North America by J. Henderson (1935, p. 15), *Lioplax* first appeared in the Cretaceous, and other species have been recorded from the Oligocene and the Miocene. No new fossil forms have been recorded later than the Miocene. Very careful consideration should be given all fossils that have been placed in the

genus *Lioplax*. The characters which differentiate this genus from *Campeloma* Rafinesque are the position of the nucleus in the operculum, and to a lesser degree, the radula, and the fine sculpture on the surface of the shell. This leaves little in the way of positive characters for the certain generic determination of any fossil member of the group.

Dall (1890) described a *Lioplax floridana* from the Lower Miocene Silex Beds, Ballast Point, Tampa, Florida, which in our opinion is not a *Lioplax*. It may be the young stage of some bulimoid, but the specimen is so fragmentary it is impossible to place it with any degree of certainty.

ACKNOWLEDGMENTS

We are deeply indebted to several friends for the loan of material used in this study, and we wish to thank the following for their interest and cooperation: H. D. Athearn, Cleveland, Tennessee; L. A. Fraser and Robert Nero, University of Wisconsin; R. A. Heilman, Lebanon, Pennsylvania; M. K. Jacobson, Rockaway Beach, New York; Winnie McGlamery, University of Alabama; J. J. Parodiz, Carnegie Museum, Pittsburgh; H. A. Pilsbry, Academy of Natural Sciences, Philadelphia; H. A. Rehder, United States National Museum; Henry vander Schalie, University of Michigan; and F. V. Weir, American Museum of Natural History, New York.

## Genus **Lioplax** *Troschel*

*Lioplax* Troschel 1857, Das Gebiss der Schnecken, Berlin **1**, p. 100, pl. 7, fig. 5 (type species, *Paludina* (*Lioplax*) *subcarinata* Say, monotypic).

*Haldemania* Tryon 1862, Proceedings Academy Natural Sciences Philadelphia, p. 451 (type species, *Vivipara subcarinata* Say, monotypic).

Shell subglobose to moderately attenuate with strongly convex whorls which are generally shouldered and usually have a carina at the whorl periphery. This carina is well marked on the early whorls. Color a light to dark olivaceous-green. There is generally present a fine microscopic sculpture which gives the surface a very fine granular appearance, The shells are usually imperforate and the outer lip when seen in profile is sigmoid in outline. Periostracum usually present. Operculum chitinous, usually dark horn in color, subelliptical in outline, paucispiral in its early stage and then concentric. Nucleus

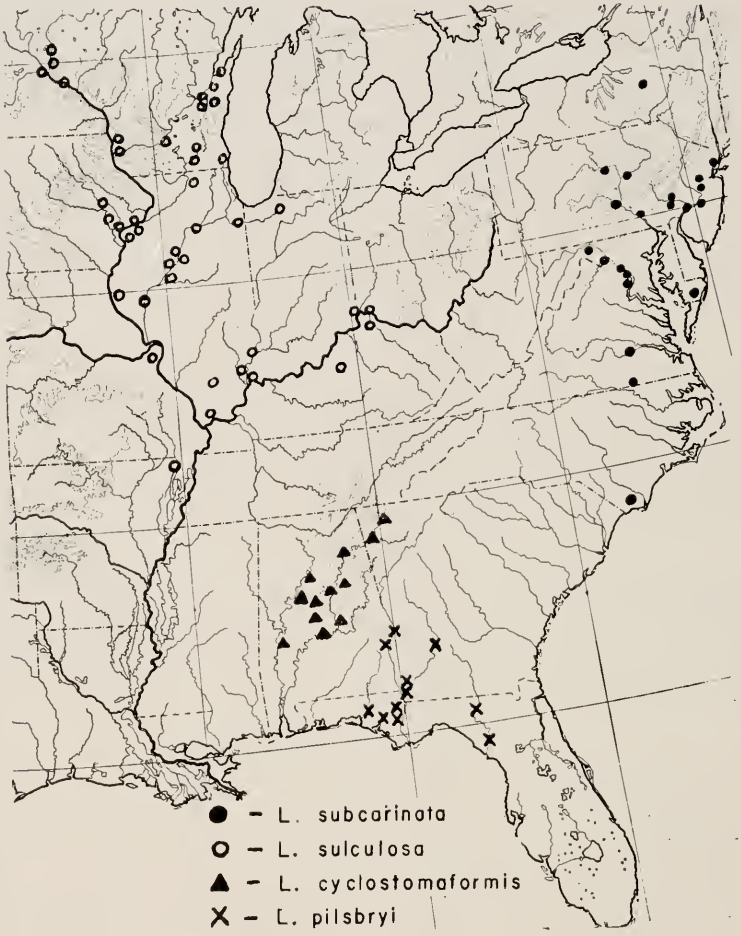



Plate 1
Distribution of the genus *Lioplax*.

The collections made of *Lioplax pilsbryi* Walker during 1954 are not indicated on the plate above as this was engraved before this trip was contemplated. However, the only major addition would be the two stations on the Ocklockonee River which would appear a little to the left of center between the Apalachicola System and the Suwanee River on the above plate.

subcentral. The embryonic shell at the time of birth consists of two and one half to three whorls. It is strongly shouldered and is sculptured with a series of very fine spiral threads. The radula is quite similar to that of *Campeloma* differing only in minor points. According to Baker (1928, p. 48) the genitalia are somewhat different from those of both *Campeloma* and *Viviparus*.

Type species, *Paludina* (*Lioplax*) *subcarinata* Say, monotypic.

## **Lioplax sulculosa** *Menke*

Plate 3, figs. 4–5

*Paludina sulculosa* Menke 1828, Synopsis Methodica Molluscorum, Pyrmont, p. 80 (Ohio River, Cincinnati, Ohio).

*Lioplax subcarinata wisconsinensis* Baker 1928, Wisconsin Geological and Natural History Survey, Bull. **70,** pt. 1, p. 50, pl. 3, figs. 1–9 (Fox River, Brown Co., Wisconsin).

*Lioplax subcarinata occidentalis* Pilsbry 1935, Nautilus **48,** p. 143 (Cincinnati, Ohio).

*Description.* Shell reaching about 23 mm. in length, rather thin in structure, spire somewhat extended, finely umbilicate, with the early whorls and occasionally the later whorls carinate. Color generally a pale olivaceous-green. Whorls 6, convex with generally a well-defined shoulder. Spire somewhat extended and produced at an angle of about 55°. Aperture subcircular to ovate with the outer lip thin; inner lip composed of a rather thickened callus on the parietal wall. Columella short and arched. Umbilicus small, occasionally covered by the reflection of the inner lip. Suture well impressed. Sculpture consisting of a well developed carina which occasionally occurs on the body whorl. Microscopic sculpture consisting of very fine thread-like spiral lines which frequently have a beaded appearance. These are crossed by fine growth lines. Operculum with the nucleus subcentral. Periostracum olivaceous-green in color, generally thin and usually persistent.

| length | width | whorls | |
|---|---|---|---|
| 22.5 mm. | 17.0 mm. | 6 | Ohio River, Cincinnati, Ohio |
| 22.5 | 13.0 | 6 | Kishwaukee River, Winnebago, Co., Illinois |
| 21.5 | 14.0 | 6 | Bank Lick Creek, Kentucky |
| 20.0 | 12.8 | 6 | Ohio River, Cincinnati, Ohio |
| 19.5 | 13.0 | 6 | " " " " |

*Types.* The location of the type of *Paludina sulculosa* Menke is unknown. The type locality is Cincinnati, Ohio. The holotype of *L. s. occidentalis* Pilsbry is in the Academy of Natural Sciences, Philadelphia, no. 123539, from Cincinnati, Ohio. The holotype of *L. subcarinata wisconsinensis* Baker is in the Zoological Museum, University of Wisconsin, Madison, Wisconsin, no. 437. The type locality is Fox River, Brown Co., Wisconsin. Several paratypes are in the University of Wisconsin from the Fox River and other nearby localities. A single paratype is in the Museum of Comparative Zoölogy, no. 189660, from Lake Butte des Morts, Winnebago County, Wisconsin.

*Remarks.* We have now but three localities for this species from south of the Ohio River. In eastern Wisconsin, in the vicinity of Green Bay, this species presents the only record for the Great Lakes-St. Lawrence drainage system. It would appear that this species is probably slowly extending its range and that eventually it may occupy a larger area in the Great Lakes system. We cannot in any way discover differences between Baker's subspecies *wisconsinensis* and the typical *sulculosa.* It appears to us that there was no reason whatsoever for the name *occidentalis* Pilsbry replacing *sulculosa* Menke. This name was introduced by Pilsbry only on the supposition that there may have been a mistake in locality assignment by Beschke who had sent shells to Menke from both Philadelphia and Cincinnati. Menke's very brief description would fit either *sulculosa* or *subcarinata.* However, if such a name change in the future is thought necessary Baker's *wisconsinensis* would have priority.

See remarks under *Lioplax subcarinata* Say.

*Range.* This species ranges from northwestern Wisconsin and eastern Minnesota south to northeastern Arkansas and east to southwestern Ohio.

*Specimens examined.* MINNESOTA: St. Croix River, 9 miles east of Rock Creek, Pine Co. (USNM); Lake Pepin, Goodhue Co. (C. Dawley). WISCONSIN: Lake Michigan, Green Bay, Brown Co. (Univ. of Michigan); Lake Butte des Morts, Winnebago Co.; Winnebago Lake, near Oshkosh, Winnebago Co. (both

Univ. of Wisconsin); Wisconsin River, Prairie du Sac, Sauk Co. (Univ. of Michigan); St. Croix River, Hudson, St. Croix Co. (M.K.Jacobson); Prairie du Chien, Crawford Co. (USNM); Mississippi River, Lynxville, Crawford Co. (Univ.of Michigan). IOWA: Iowa River, Iowa City, Johnson Co. (USNM); Red Cedar River, Cedar Rapids, Linn Co.; Mississippi River, Davenport, Scott Co.; Mississippi River, Muscatine, Muscatine Co. (all MCZ; USNM). MISSOURI: Meramec River, Kirkwood, St. Louis Co. (MCZ); St. Louis, St. Louis Co. (USNM). ARKANSAS: St. Francis River, Greenway, Clay Co. (USNM). ILLINOIS: Mississippi River, Mercer Co. (USNM); Pope Creek, Mercer Co. (MCZ); Kishwaukee River, Winnebago Co. (MCZ; Univ. of Alabama); Illinois and Mississippi Canal, LaSalle Co. (M. K. Jacobson); Wabash River, Mount Carmel, Wabash Co. (MCZ); Little Wabash River, Carmi, White Co.; Lake Meredosia, Meredosia, Morgan Co. (both Univ. of Alabama). INDIANA: Lake Maxinkuckee, Marshall Co. (very old specimens, possibly extinct now) (USNM); Wabash River, Grand Chains, and Big Creek, Solitude, both Posey Co. (both Univ. of Alabama); LaPorte, LaPorte Co. (USNM); Ohio River, 2½ miles below Lawrenceburg, Dearborn Co. (MCZ). OHIO: Ohio River, Sedansville, Hamilton Co. (USNM); Ohio River, Cincinnati, Hamilton Co. (MCZ; USNM; Carnegie Museum). KENTUCKY: Licking River; Bank Lick Creek, 6 miles S. of Covington, Kenton Co.; Beech Fork, Salt River, 1 mile S. of Bardstown, Nelson Co. (all MCZ).

## **Lioplax subcarinata** *Say*

Plate 4, figs. 1–3

*Limnaea subcarinata* Say 1816, British Encyclopedia, American edition by William Nicholson, 1st edition **2** [**4**] [p. 17], pl. 1, fig. 7 (Delaware River, Pennsylvania).

*Paludina bicarinata* 'Say' Potiez and Michaud 1836, Galerie des Mollusques, Paris **1**, p. 249, pl. 25, figs. 17–18 (La Delaware, rivière de l'Amérique Septentrionale).

*Description.* Shell reaching about 21 mm. in length, rather thin in structure, spire somewhat extended, finely umbilicate and having the early whorls carinate. Color generally a pale brownish- to olivaceous-green. Whorls 6, convex and with a narrow shoulder. Spire somewhat extended and produced at

Plate 2

Young of *Lioplax* and *Campeloma*

Figs. 1–2. *Lioplax sulculosa* Menke, Davenport, Iowa. Fig. 1. Young at time of birth. Fig. 2. A less developed young with angled whorls, taken from the same parent.

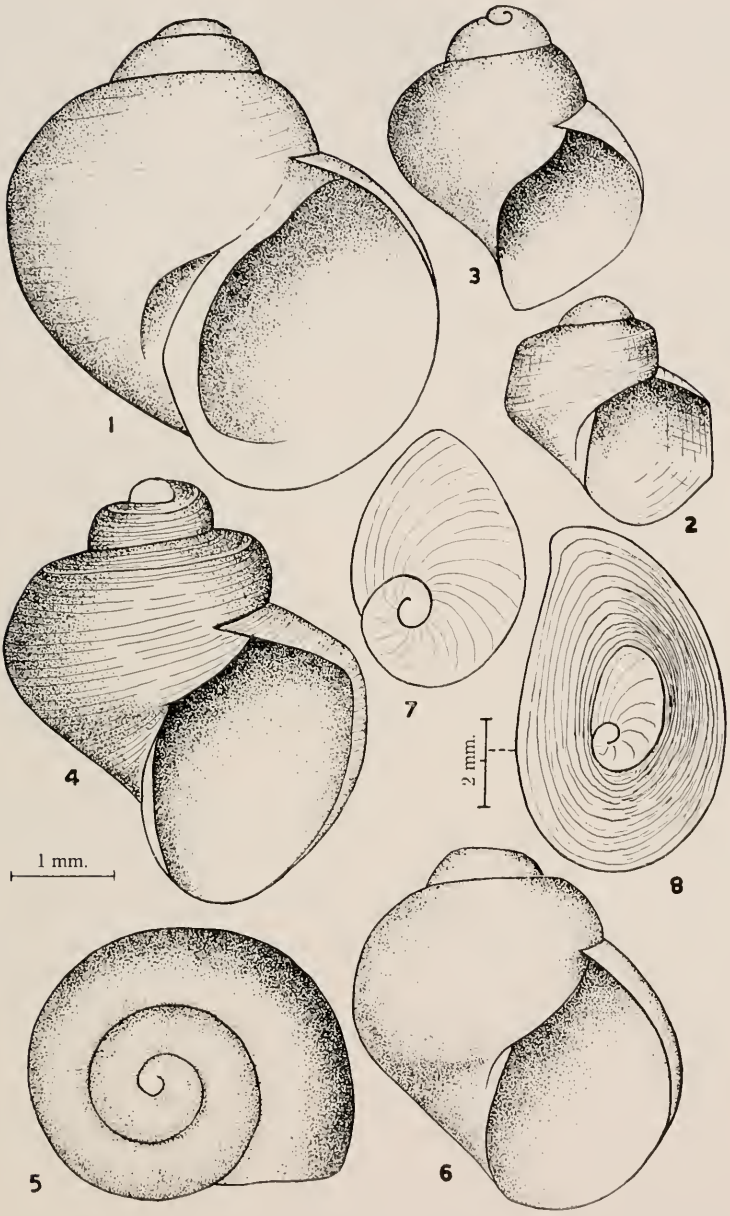
Fig. 3. *Lioplax subcarinata* Say, Delaware River, Pennsylvania.

Fig. 4. *Lioplax pilsbryi* Walker, Chipola River, Jackson County, Florida.

Figs. 5–6. *Campeloma decisum* Say, Middle Saranac Lake, New York. Fig. 5. Apex view to show the first whorl which cannot be seen in the apertural view. Fig. 6. Apertural view.

Figs. 7–8. Operculum of *Lioplax sulculosa* Menke from Davenport, Iowa. Fig. 7. A paucispiral operculum from an unborn specimen. Fig. 8. Operculum from an adult specimen to show the later concentric growth.

All of the specimens figured except fig. 8, were obtained as unborn young. All figures except fig. 8 are based on the 1 millimeter scale at fig. 4.


1
3
2
7
4
2 mm.
8
1 mm.
5
6

an angle of about 47°. Aperture subcircular with the outer lip thin and the inner lip consisting of a thickened callus on the parietal wall. Columella short and arched. Umbilicus very small and partially to nearly completely covered by the reflection of the inner lip. Sutures well impressed. Sculpture consisting of a single carina on all of the whorls which becomes much less defined on the body whorl. Microscopic sculpture consisting of very fine thread-like spiral lines which frequently have a beaded appearance. These are crossed by fine growth lines. Operculum with the nucleus subcentral and the lines of growth in paucispiral arrangement. Periostracum thin and usually adhering throughout life, except on the first one or two whorls.

| length | width | whorls | |
|---|---|---|---|
| 21.5 mm. | 13.0 mm. | 6 | Pennsylvania Canal, Columbia, Penna. |
| 17.0 | 10.8 | 6 | Outlet of Cedar Lake, Litchfield, N.Y. |
| 15.8 | 10.0 | 4* | Lectotype of *L. subcarinata* Say |

* Early whorls missing

*Types.* A lectotype, here selected, and three paratypes of *L. subcarinata* Say are in the Museum of Comparative Zoölogy, no. 189709 and 187164. The type locality is the Delaware River, Pennsylvania. The original specimens were probably collected in the vicinity of Philadelphia, Pennsylvania. These type specimens were received from Mrs. Say.

*Remarks.* This eastern species of *Lioplax* is exceedingly close in its relationship to *L. sulculosa* Menke, the western form. Their characters differ mainly in degree. The shells of *L. subcarinata* Say are usually somewhat thinner and are proportionately a little more attenuate. It appears also that *Lioplax subcarinata* Say on the average is somewhat smaller, though selected examples of the largest specimens of both species are about equal in size. In addition, the umbilical opening of *L. sulculosa* is much larger.

The distribution is far from being uniform and there are many river systems between the extreme northern and southern localities from which no material is available. The greatest gap occurs between the southernmost Virginia locality and Lake Waccamaw in North Carolina. It is possible that in the

latter locality this northern species has persisted owing to the springs that feed the lake, keeping the water somewhat cooler during the warm summer months than the streams to the immediate north. This, however, needs actual proof from field observations.

*Range.* This species ranges from Cedar Lake near Litchfield, New York (upper Susquehanna drainage) south to Lake Waccamaw, Columbus County, North Carolina.

*Specimens examined.* NEW YORK: Outlet of Cedar Lake, Litchfield, Herkimer Co. (MCZ). PENNSYLVANIA: Perkiomen Creek, Montgomery Co.; West Branch, Susquehanna River, Williamsport, Lycoming Co. (both Carnegie Mus.); Pennsylvania Canal, Columbia Co. (MCZ); Juniata River, Perry Co. (R. Heilman); Columbia, Lancaster Co. (USNM); Delaware River, Holmesberg, near Philadelphia; Delaware River, Philadelphia; Canal Manayunk, Philadelphia; Schuylkill River, Philadelphia; Schuylkill River, Phoenixville, Chester Co. (all MCZ). NEW JERSEY: Old Reservoir, Arlington, Hudson Co. (MCZ); Delaware-Raritan Canal, near Princeton, Mercer Co. (Carnegie Mus.); Raritan River (USNM); Delaware River, Florence, Burlington Co. (Carnegie Mus.); Delaware River, Burlington, Burlington Co. (USNM); Outlet of Crystal Lake, Roebling, Burlington Co. (H. D. Athearn); Delaware River, Pavonia, Camden Co. (MCZ). MARYLAND: Canal, Great Falls, Montgomery Co. (MCZ; USNM); Above Cabin John (C. & O. Canal), Montgomery Co.; Anssawango Creek, Snow Hill, Worcester Co.; Poplar Point, Anacostia, Washington, D.C.; (all USNM); WEST VIRGINIA: Potomac River, Harpers Ferry, Jefferson Co. (MCZ), VIRGINIA: Swift Creek, Chesterfield Co. (Carnegie Mus.); Potomac River, Great Falls, Fairfax Co. USNM); Potomac River, 4 miles north of Great Falls, Fairfax Co. (MCZ; USNM); Potomac River, Mount Vernon, Fairfax Co. (MCZ). NORTH CAROLINA: Turkey Creek, near Wilmington, Brunswick Co.; Lake Waccamaw, Columbus Co. (both USNM).

Plate 3

Fig. 1. *Lioplax pilsbryi* Walker, Chipola River, Florida. Lectotype (1.8x).

Fig. 2. *Lioplax elliottii* Lea (=*L. cyclostomaformis* Lea), Oothkalooga Creek, Georgia. Lectotype (1.8x).

Fig. 3. *Lioplax cyclostomaformis* Lea, Coosa River, Alabama. Lectotype (2x).

Fig. 4. *Lioplax sulculosa* Menke, Ohio River, Cincinnati, Ohio (2x).

Fig. 5. *Lioplax subcarinata wisconsinensis* Baker (=*L. sulculosa* Menke), Winnebago Lake, near Oshkosh, Wisconsin. Lectotype (2x).

Fig. 6. *Lioplax pilsbryi choctawhatchensis* Vanatta (=*L. pilsbryi* Walker), Horseshoe Lake, Choctawhatchee River, Florida. Lectotype (2x).

Fig. 7. *Campeloma decampi* Binney, Decatur, Alabama. Lectotype (1.8x).

Fig. 8. *Campeloma spillmannii* Lea (=*C. decampi* Binney) Jackson Co., Alabama. Lectotype (1.8x).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## Lioplax cyclostomaformis *Lea*

Plate 3, figs. 2–3

*Paludina cyclostomaformis* Lea 1841, Proceedings American Philosophical Society **2**, p. 83 (Coosa River, Alabama).

*Paludina cyclostomatiformis* Lea 1844, Transactions American Philosophical Society **9**, p. 23 (Coosa River, Alabama); ibid. 1848, Observations on the Genus Unio, Philadelphia **4**, p. 23.

*Paludina contorta* 'Shuttleworth' Küster 1852, Conchylien Cabinet (2) **1**, pt. 21a, p. 20, pl. 4, figs. 7–9 (Alabama).

*Paludina elliottii* Lea 1858, Proceedings Academy Natural Sciences Philadelphia, p. 166 (Othcalooga Creek [Oothkalooga], Georgia).

*Description.* Shell reaching about 28 mm. in length, rather solid in structure, spire extended, imperforate and often slightly carinated on the early whorls. Color light to dark olivaceous-green with the interior of the aperture somewhat bluish. Whorls seven, usually strongly convex and generally with a well-defined shoulder. Spire extended and produced at an angle of about 32°. Aperture subovate to subquadrate with the outer lip thin and the inner lip consisting of a rather moderate callus. The outer lip in profile is moderately sigmoid. Shell generally imperforate though occasional specimens show a little chink under the parietal callus. Sculpture consisting of a moderate carina on the early whorls though not present on the body whorl. Microscopic sculpture consisting of very fine spiral beaded threads. These are crossed by fine growth lines. Operculum with a subcentral nucleus. Periostracum rather heavy and generally colored a rather dark olivaceous-green.

| length | width | whorls | |
|---|---|---|---|
| 28 mm. | 16.0 mm. | 7 | Oothkalooga Creek, Georgia (lectotype of *L. elliottii* Lea) |
| 21 | 11.6 | 5* | Coosa River, Alabama (lectotype of *L. cyclostomaformis* Lea) |
| 23 | 13.8 | 5* | Cahaba River, near Gurnee, Shelby County, Alabama |

* Apex corroded

*Types.* The lectotype, here selected, of *Paludina cyclostomaformis* Lea, is in the United States National Museum, no. 106307 from the Coosa River, Alabama. The lectotype, here selected, of *Paludina elliottii* Lea is also in the United States National Museum, no. 106260 from Oothkalooga Creek, Bar-

tow County, Georgia. Paratypes of the latter are in the Museum of Comparative Zoölogy. The whereabouts of the type specimens of *Paludina contorta* Küster is unknown to us.

*Remarks.* This species is confined entirely to the vast Alabama River system in Alabama and Georgia. In this species the whorls are less shouldered than in the other three members of the genus; they are only occasionally carinated and then only on the early whorls. The shell is proportionately narrower and the spire more straight-sided.

The lectotype of *Paludina elliottii* Lea is an exceptionally fine and large specimen of this species.

*Range.* Coosa-Alabama-Tombigbee River system from northwest Georgia, south to Selma, Dallas County on the Alabama River and Big Prairie Creek, Marengo County on the Tombigbee River in Alabama.

*Specimens examined.* GEORGIA: Oothkalooga Creek, Bartow County (MCZ; USNM); Coahulla Creek, 6 miles east of Dalton, Whitefield Co.; Armuchee Creek, 5 miles north of Rome, Floyd Co. (both Univ. of Alabama). ALABAMA: Valley Creek, Toadvine, Jefferson Co. (Univ. of Alabama); Black Warrior River, Jefferson Co. (MCZ; Univ. of Alabama); Little Cahaba[1] Creek, Jefferson Co. (Univ. of Alabama); Cahaba River at Gurnee, Shelby Co. (MCZ; Carnegie Mus.; USNM); Cahaba River, Lilly Shoals, Bibb Co. (MCZ; Univ. of Alabama); Cahaba River, Piper, Bibb Co. (Univ. of Alabama); Little Wills Creek, Attalla, Etowah Co. (Carnegie Mus.; Univ. of Ala.); Choccolocco Creek, 3 miles south of Lincoln, Talladega Co. (MCZ); Yellowleaf Creek, near Wilsonville, Shelby Co. (MCZ; Carnegie Mus.); Yellowleaf Creek, Shelby Co. (Univ. of Alabama); Coosa River, Weduska Shoals, Shelby Co. (USNM; Carnegie Mus.; Univ. of Alabama); Coosa River, Wetumka, Elmore Co. (MCZ; Univ. of Alabama); Alabama River, Selma, Dallas Co. (MCZ; USNM). Big Prairie Creek, Marengo Co. (USNM).

[1] Also called Cahawba.

## **Lioplax pilsbryi** *Walker*
Plate 3, figs. 1 and 6

*Lioplax pilsbryi* Walker 1905, Nautilus **18,** p. 133, pl. 9, figs. 1–3 (Chipola River, Florida).

*Lioplax pilsbryi choctawhatchensis* Vanatta 1935, Nautilus **49,** p. 66 (Horseshoe Lake, Choctawhatchee River, Washington Co., Florida).

*Description.* Shell reaching about 28 mm. in length, rather solid in structure, the spire somewhat extended, imperforate and usually carinated, particularly on the early whorls. Color light olivaceous-green to blackish-green with the interior of the aperture bluish-green. Whorls seven, usually moderately to strongly convex and with a well pronounced shoulder. Spire somewhat extended and produced at an angle of about 50°. Aperture subcircular to ovate with the outer lip thin; the inner lip composed of a thickened callus. The outer lip in profile is strongly sigmoid. Generally imperforate. Suture deeply impressed. Sculpture consisting of a well developed carina, usually high up on the whorl forming the shoulder. On the body whorl the carina has become well rounded. Microscopic sculpture consisting of fine spiral and somewhat beaded threads which are crossed by somewhat irregular, sigmoid growth lines. Operculum with a subcentral nucleus. Periostracum rather heavy and colored olivaceous-green to almost black.

| length | width | whorls | |
|---|---|---|---|
| 27.2 mm. | 18 mm. | 5 (apex corroded) | Lectotype |
| 28.0 | 20 | 5 " " | Paratype |
| 27.5 | 19 | 5 " " | Paratype |

*Types.* The lectotype, here selected, of *Lioplax pilsbryi* Walker is in the Museum of Zoology, University of Michigan; paratypes are in the Museum of Comparative Zoölogy. The type locality as given by Walker is the Chipola River, Florida. We here restrict the type locality to the Chipola River, 2 miles east of Clarksville, Calhoun Co., Florida. The holotype of *L. p. choctawhatchensis* Vanatta is in the Academy of Natural Sciences, Philadelphia, no. 162240, from Horseshoe Lake, Choctawhatchee River, Washington County, Florida.

*Remarks.* This is the most distinctive member of the genus *Lioplax.* It is darker in color and has developed a rather broad and flattened whorl shoulder. It is completely imperforate and the sculpture generally is far more pronounced on the body whorl than in any other species.

*Lioplax pilsbryi* Walker reaches its greatest development in the Chipola River. It is exceedingly abundant at most stations that we investigated in this river. It appears to thrive best where there is a good admixture of sand, mud and decaying vegetation. Individuals of this species were rare and rather small at the stations where we found them in the Choctawhatchee and Ochlockonee Rivers. Here they were living in rather coarse sand with very little plant detritus.

It is quite possible that this species may occur in the Aucilla, Econfina (Taylor Co.), Fenholloway and Steinhatchee Rivers, all in Florida. Our time in the field (1954) was limited and these rivers have not yet been investigated.

*Range.* This species ranges from the Choctawhatchee River east to the Suwannee River, Florida. In the Apalachicola system it extends north as far as Columbus, Georgia on the Chattahoochee and to the mouth of Gum Creek, Crisp County, Georgia, on the Flint River.

*Specimens examined.* ALABAMA: Uchee Creek, Russell Co. [Chattahoochee drainage] (USNM); Pea River, one half mile southwest of Geneva, Geneva Co. (MCZ; U of F). GEORGIA: Chattahoochee River, Columbus, Muscogee Co. (USNM); Flint River, mouth of Gum Creek, Crisp Co. (MCZ; U of M); Spring Creek, Reynoldsville, Seminole Co.; Spring Creek, 2½ miles south of Reynoldsville, Seminole Co.; Spring Creek near Brinson, Decatur Co. (all MCZ and U of F). FLORIDA: Choctawhatchee River, 8 miles west of Miller Cross Roads, Holmes Co. (MCZ; U of F); Choctawhatchee River, 1 mile west of Caryville, Holmes Co. (MCZ; U of F); Horseshoe Lake, Choctawhatchee River, Washington Co. (ANSP); Econfina River[1], Bay Co. (U of M); Big Creek, 8 miles west of Malone, Jackson Co. [Chipola drainage]; Chipola River, 1 mile north of Mariana,

[1] This is not the Econfina River, Taylor Co., Florida.

Jackson Co.; Chipola River, 3 miles south of Mariana, Jackson Co.; Chipola River, 1 mile west of Sink Creek, Jackson Co.; Chipola River, 2½ miles southeast of Chason, Calhoun Co.; Chipola River, about 2 miles east of Clarksville, Calhoun Co.; Chipola River, Scotts Ferry, Calhoun Co.; Dead Lake, Chipola River, 16 miles south of Clarksville, Calhoun Co.; Ochlockonee River, 8 miles west of Tallahassee, Leon Co.; Ochlockonee River, 7½ miles east of Hosford, Liberty Co.; Suwannee River at mouth of the Withlacoochee River, Madison Co.; Suwannee River, Ellaville, Madison Co.; Suwannee River, Oldtown, Dixie Co.; Suwannee River, Fannin Spring, Gilchrist Co. (all MCZ; U of F).

### **Campeloma decampi** *Binney*
Plate 3, figs. 7–8

*Melantho decampi* 'Currier' Binney 1865, Land and Freshwater Shells of North America, Part 3, p. 115, figs. 227–229 (Huntsville or Stevenson, Alabama).

*Paludina spillmanii* Lea 1867, Proceedings Academy of Natural Sciences Philadelphia, p. 81 (Jackson County, Alabama); Lea 1868, Journal Academy Natural Sciences Philadelphia **6**, p. 343, pl. 54, fig. 29; Lea 1868, Observations on the Genus Unio, Philadelphia **12**, p. 103, pl. 54, fig. 29.

This species has frequently been listed and named as a *Lioplax* only because many specimens have a faint microscopic sculpture that somewhat simulates that found on *Lioplax,* and also because young specimens occasionally show a slight carina which is seldom present in the adult. Many specimens have rather strongly developed axial growth ridges. These become worn and show up as axial stripes. However, both the shell characters and that of the operculum are definitely those of *Campeloma.* We include it here only to aid in a clarification of the problem.

The type locality given by Binney as recorded in the synonymy above is apparently an error as we have a specimen from the original series from W. H. DeCamp which was sent to J. G. Anthony and carries these data:

"*Melantho decampii* Currier
Loc. Decatur, Alabama
The only one I have except my cabinet specimens
or I would send you more (only about 15 found)."

We add below the localities from which we have seen material. So far these localities are all in Alabama and all north of the Tennessee River. The species is not a common one and because of its fine sculpture and rather remarkable tapered and pointed spire it is relatively easy to identify.

*Paludina spillmannii* Lea from Jackson County, Alabama is this same species.

*Types.* The lectotype of *Melantho decampi* Binney (here selected) is in the Museum of Comparative Zoölogy, no. 189656.[1] Paratypes are in the Museum of Comparative Zoölogy and the United States National Museum. The type locality is Decatur, Alabama. The lectotype of *Paludina spillmannii* Lea (here selected) is in the United States National Museum, no. 121433, from Jackson County, Alabama. Additional paratypes are in the United States National Museum and the Museum of Comparative Zoölogy.

*Specimens examined.* ALABAMA: Bass and Swan Lakes, Decatur, Limestone County (USNM); Decatur, Limestone County (USNM; MCZ); Piney Creek, near Mooresville, Limestone County; Outlet of Byrd Spring Lake, 5 miles south of Huntsville, Madison County; Byrd Spring Lake, 5 miles south of Huntsville, Madison County; Brim Spring, Huntsville, Madison County (all MCZ); Jackson County (MCZ; USNM).

## BIBLIOGRAPHY

Baker, F. C. 1928: The Freshwater Mollusca of Wisconsin, Part I. Gastropoda. Wisconsin Academy of Sciences, Arts and Letters, Bulletin 70, Wisconsin Geological and Natural History Survey, pp. 45–52.

Binney, W. G. 1865: Land and Freshwater Shells of North America, Part III. Smithsonian Miscellaneous Collections, no. 144, pp. 55–60.

Call, R. E. 1894: On the Geographic and Hypsometric Distribution of North American Viviparidae. American Journal of Science **48**, pp. 132–141.

Dall, W. H. 1890: Transactions Wagner Free Institute of Science, Philadelphia **3**. pt. 1, p. 3, pl. 1, fig. 3.

Henderson, J. 1935: Fossil Non-Marine Mollusca of North America. Geologic Society of America. Special Series no. 3, pp. 7+313.

Prashad, B. 1928: Recent and Fossil Viviparidae. Memoirs of the Indian Museum, Calcutta **8**, no. 4, pp. 153–251.

[1] Figure 229 in Binney's report given above.


Plate 4
*Lioplax subcarinata* Say
Fig. 1. Lectotype from the Delaware River, Pennsylvania.
Figs. 2-3. From the outlet of Cedar Lake, New York (all 2.9x).

ABBREVIATIONS

ANSP — Academy of Natural Sciences, Philadelphia

MCZ — Museum of Comparative Zoölogy, Harvard University

U of F — University of Florida, Gainesville

U of M — Museum of Zoology, University of Michigan, Ann Arbor

USNM — United States National Museum

# Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 SEPTEMBER 22, 1956 NUMBER 20


## The Eastern Pacific Marine Mollusks Described by C. B. Adams

*By* RUTH D. TURNER

In 1950, William J. Clench and I published a paper on the Western Atlantic Marine Mollusks Described by C. B. Adams.[1] This was the first in a series of papers planned to cover all of the species described by Adams. In this first report we gave a complete account of Adams' life, a bibliography of all of the papers published by him and references to many papers concerning him and his work. Of the eighty-four papers listed in Adams' bibliography, his "Catalogue of Shells Collected at Panama" is by far the largest. One interested in Adams' work in the Eastern Pacific has only to refer to this paper and to one short paper describing a new *Haliotis* which he published in the American Journal of Science for 1848. The "Catalogue of Shells Collected at Panama with Notes on Their Synonymy, Station and Geographical Distribution" was originally published in the Annals of the Lyceum of Natural History New York. A repaged edition which, except for the addition of a "Preface" and "Catalogue of Works Referred To," is an exact reprint of this paper, is far more common than copies of the original. Consequently, reference is made to the paging of both the original and the reprint, the first number quoted being to the reprint and the second number referring to the paging of the original. Of the 159 Eastern Pacific species described by Adams we have been able to locate types of all but eleven. Five

[1] Occasional Papers On Mollusks **1**, no. 15, pp. 233–404, pls. 29–49.

of the missing types were studied and figured by Dall and Bartsch, the types being lost subsequent to their work. This leaves only six species of which there are no published figures of the original specimens. This is really quite remarkable considering the age of the collection and the fact that it was left virtually unattended from the time of Adams' death in 1853 until it came to the Museum of Comparative Zoölogy in 1942. The three species of *Eulima* were studied and figured by Bartsch in 1917, but the types were not in the collection when it was received by the Museum of Comparative Zoölogy. This is also the case with *Cingula turrita* Adams which was figured by Dall and Bartsch in 1909. Through the kindness of Harald A. Rehder we have been able to borrow the original figure of Dall and Bartsch for use in this report.

As stated in our first report, Adams sold duplicate sets of his material to help finance his field work and publications. He printed extra copies of the index to his Catalogue of Shells Collected at Panama and these he sent to collectors all over the world who checked their wants and returned them to Adams. Consequently, Adams' Panama material may be found in many museums today and since Adams made only the one trip to Panama, any specimens of his new species which he distributed would be paratypes. According to P. P. Carpenter (1863, p. 339), "the second specimens of new species were sent to Mr. Cuming." This material presumably is now in the British Museum.

Many of the species described by Adams are no longer in the genera in which he placed them and some are now considered to be synonyms of species described earlier by Sowerby, d'Orbigny, Hinds and others. In some cases these changes have been noted under the species concerned. However, it is far beyond the scope of this paper to bring all of C. B. Adams' species up to date. In many cases entire families would have to be monographed in order to do this satisfactorily. The purpose here is to present the original descriptions as Adams gave them and to figure for the first time his type specimens.

As Adams did not select holotypes, this term can be applied only to the types of species which he based upon single specimens. For the majority of his species, lectotypes are selected from his cotype series for this paper. When the types of

Adams' species have been previously illustrated by Pilsbry, Dall, Bartsch or others, the specimens selected by these authors have been retained as the lectotypes. It must also be remembered that in this report only Adams' types are being figured and in many cases the specimens he described are badly worn and in poor condition. The only thing that can be done is to give the best possible figure of the type specimens as retained in his own collection.

The last section of his report Adams entitles "Specierum Novarum Conchyliorum in Sinu Panamensi Repertorum, Synopsis." This is composed of brief Latin diagnoses of the new species which he had described in English in the main body of the report. These Latin diagnoses contribute nothing to the descriptions of the species and therefore are not included here as they would only add needless bulk and expense.

In the introduction to his paper, C. B. Adams discusses the marine zoological province of Panama and points out the analagous species existing on the west coast of Panama and in the West Indies, particularly Jamaica. He also gives a brief account of the expeditions and of the individuals who had worked in the area, as well as a summary of the works published on the Panamic Province up to that time. He concludes his introduction with a brief narrative of his own expedition to Panama.

Many people have referred to the Adams' Panamic collection, chief among them being P. P. Carpenter who has published a detailed account of this collection in the Proceedings of the Zoological Society of London. The Vitrinellidae were reviewed by H. A. Pilsbry and A. A. Olsson, and they figured the Adams' types in this group. Dall and Bartsch referred to the collection for many groups when doing their studies on the west coast marine mollusks.

## Acknowledgments

Without the financial aid of friends, the publication of this report would have been impossible. We are greatly indebted to them for their continued interest and support. Harald A. Rehder of the United States National Museum has been most helpful, and H. A. Pilsbry very kindly loaned us the original plates of the species of *Vitrinella* which had been so carefully drawn for Pilsbry and Olsson. These minute shells would be

most difficult to photograph. We are also grateful to R. T. Abbott of the Academy of Natural Sciences, Philadelphia, for checking several types. Particular thanks are extended to Frank White, Staff Photographer at the Biological Laboratories, Harvard University, for his work in photographing the shells.

### *Bibliography of C. B. Adams' Publications on the Eastern Pacific*

July 1848, Description of a Species of Haliotis supposed to be New. American Journal of Science and Arts (2) **6**, pp. 137–138.

June and July 1852, Catalogue of Shells Collected at Panama with Notes on Synonymy, Station and Habitat. Annals Lyceum Natural History, New York **5**, pp. 222–296 (June); pp. 297–549 (July).

—— 1852, Catalogue of Shells Collected at Panama with Notes on Their Synonymy, Station and Geographic Distribution. New York, R. Craighead, Printers, pp. viii+334.
This is an exact but repaged reprint of the previous paper with a slight change in the title and the addition of a Title Page, Preface and Catalogue of Works Referred To.

### Selected Bibliography

The following references are some of those in which C. B. Adams' species are considered. It is in no way complete, as such a reference list would include nearly all of the papers that have been written on the area since the time of Adams. It does include papers which are monographs of genera and those in which C. B. Adams' type specimens have been figured or discussed as well as some of the latest papers on the area in which genera are brought up to date.

Bartsch, P. 1907, The West American Mollusks of the Genus Triphoris. Proceedings United States National Museum **33**, pp. 249–262, pl. 16.

Bartsch, P. 1911, West American Mollusks of the Genus Eumeta. Proceedings United States National Museum **39**, pp. 565–568, text figures 1–3.

Bartsch, P. 1912, A Zoogeographic Study Based on the Pyramidellid Mollusks of the West Coast of America. Proceedings United States National Museum **42**, pp. 297–349.

Bartsch, P. 1913, The Recent and Fossil Mollusks of the Genus Cerithiopsis from the West Coast of America. Proceedings United States National Museum **40**, pp. 327–367, pls. 36–41.

Bartsch, P. 1915, Recent and Fossil Mollusks of the Genus Rissoina from the West Coast of America. Proceedings United States National Museum **49,** pp. 33–62, pls. 28–33.

Bartsch, P. 1917, A Monograph of West American Melanellid Mollusks, Proceedings United States National Museum **53,** pp. 295–356, pls. 34–49.

Bartsch, P. 1940, The West American Haliotis. Proceedings United States National Museum **89,** pp. 49–58, pls. 6–8.

Bequaert, J. 1942, Random Notes on American Potamididae. Nautilus **56,** pp. 20–30.

Carpenter, P. P. 1855–1857, Catalogue of the Reigen Collection of Mazatlan Mollusca in the British Museum, Oberlin Press, Warrington, pp. 16+552.

Carpenter, P. P. 1858, First Steps toward a Monograph of the Caecidae, a Family of Rostriferous Gastropoda. Proceedings Zoological Society London, pp. 413–444.

Carpenter, P. P. 1863 [April 1864], Review of Prof. C. B. Adams's 'Catalogue of the Shells of Panama,' from the Type Specimens. Proceedings Zoological Society London, pp. 339–370.

Carpenter, P. P. 1864, Supplementary Report on the Present State of our Knowledge with regard to the Mollusca of the West Coast of North America. Report of the British Association for the Advancement of Science for 1863, pp. 517–686 [notes on C. B. Adams, pp. 549–553].

Dall, W. H. and P. Bartsch 1909, A Monograph of West American Pyramidellid Mollusks. Bulletin United States National Museum **68,** pp. 1–258, pls. 1–30.

Dall, W. H. 1909, Report on a Collection of Shells from Peru, with a Summary of the Littoral Marine Mollusca of the Peruvian Zoological Province. Proceedings United States National Museum **37,** pp. 147–294, pls. 20–28.

Desmond, J. 1952, The Nassariidae of the West Coast of North America between Cape San Lucas, Lower California and Cape Flattery, Washington. Pacific Science **6,** no. 4, pp. 300–317.

Hertlein, L. G. and A. M. Strong 1940–1951, Mollusks from the West Coast of Mexico and Central America, Parts 1–10. Zoologica, New York Zoological Society, Volumes 25–36.

Hertlein, L. G. and A. M. Strong 1955, Marine Mollusks Collected During the "Askoy" Expedition to Panama, Columbia and Ecuador in 1941. Bulletin American Museum of Natural History **107,** Art. 2, pp. 163–317.

Pilsbry, H. A. 1932, Note on a Panamic Corbulid Clam — Panamicorbula, new subgenus of Corbula. Nautilus **45,** p. 105.

Pilsbry, H. and H. N. Lowe 1932, West Mexican and Central American Mollusks Collected by H. N. Lowe 1929–31. Proceedings Academy Natural Sciences Philadelphia **84,** pp. 33–144, pls. 1–17.

Pilsbry, H. A. and A. A. Olsson 1941, A Pliocene Fauna from Western Ecuador. Proceedings Academy Natural Sciences Philadelphia **93,** pp. 1–79, pls. 1–19.

Pilsbry, H. A. and A. A. Olsson 1945, Vitrinellidae and Similar Gastropods of the Panamic Province. Part I. Proceedings Academy Natural Sciences Philadelphia **97,** pp. 249–278, pls. 22–30.

Pilsbry, H. A. and A. A. Olsson 1952, Vitrinellidae of the Panamic Province. Part II. Proceedings Academy of Natural Sciences Philadelphia **104,** pp. 35–88, pls. 2–13.

Tryon, G. W. and H. A. Pilsbry, 1879–1888, Manual of Conchology, Philadelphia, Volumes 1–17.

Zilch, A. 1954, Moluscos de los Manglares de El Salvador. Comunicaciones del Instituto Tropical de Investigaciones Científicas de la Universidad de El Salvador **3,** pp. 77–87, pls. 1–4.

## *Original descriptions of the Eastern Pacific Marine Mollusks described by C. B. Adams*

As all but one of the species described by C. B. Adams from the Eastern Pacific were published in his "Catalogue of Shells Collected at Panama" no reference is given after the species name except to the paging in the original and the reprint of his catalogue. The first number quoted is to the paging of the reprint and the second refers to the original.

All species are arranged alphabetically in the body of this report regardless of the genera in which they were described. However, as far as possible, species are grouped on the plates according to the various genera in which Adams had placed them. Following the original descriptions there is a list of the species grouped under the genera in which C. B. Adams originally placed them.

**aberrans** *Adams* **Calyptraea** [219:443] Plate 13, fig. 3

Shell irregularly, somewhat concave externally: papyraceous, pearly, with fine irregular striae of growth: apex very minute, subterminal: the cup in our unique specimen is probably imperfect: what remains consists of a very thin, deeply concave, narrow lamina, transversely attached under the apex of the shell. In texture this shell much resembles a valve of an *Anomia.*

Length .7 inch; breadth .59 inch. Station.—Unknown. Habitat.—Panama; C.B.A.![1] Only 1 specimen was found.

[Is a valve of *Anomia.*]

[1] The "!" was used by Adams after his initials to indicate that he was the collector. This was a common practice at that time and the exclamation point is still used in many museums on their labels to indicate the collector.

**abjecta** *Adams* **Adeorbis** (?) [183:407] Plate 9, fig. 7

Shell subglobular: sometimes wholly of a yellowish white or wholly of a dingy black, or partly of each color: with several stout spiral raised lines and more or less distinct intermediate striae on the upper part of the whorls: apex subacute: spire small, much eroded in mature shells: whorls three or more, convex, with a distinct suture; last whorl ventricose: aperture effuse, nearly semicircular, the inner lip being straight: umbilicus small.

Mean divergence about 110°; length .1 inch; breadth .09 inch; length of spire .045 inch.

*A. scaber* Phil., from Panama, is described as having sublamellar striae of growth and an acute periphery of the last whorl. Our shell resembles *Littorina porcata* Phil. of the Gallapago Is.

[184] Station.—Unknown. Habitat.—Panama; C.B.A.! 40 specimens were found in the sand.

**aculeus** *Adams* **Chemnitzia** [164:388] Plate 8, fig. 11

Shell conic, very slender: white: with, on each whorl, about seventeen obtuse ribs, which terminate abruptly at the periphery of the last whorl: spire with the outlines rectilinear except near the apex: whorls twelve, moderately convex, with a well impressed suture; last whorl with the periphery subangular: aperture subovate: labrum thin: columella scarcely curved: umbilicus wanting.

Mean divergence about 13°; length .18 inch; breadth .04 inch; length of spire .145 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 4 specimens were found in the sand.

[Is *Turbonilla* (*Chemnitzia*) *aculeus* Adams, Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 38, pl. 2, figs. 2–2a.]

**acuminata** *Adams* **Chemnitzia** [164:388] Plate 8, fig. 10

Shell fusiform conic: dingy white: with about sixteen or eighteen transverse somewhat oblique ribs, which terminate ab- [165] ruptly on the periphery of the last whorl: spire with the outlines nearly rectilinear: whorls eight, very acutely shouldered above, slightly convex, with a deep suture; last

whorl long: aperture subovate, acute at both extremities: labrum thin: umbilicus wanting.

Mean divergence about 23°; length .11 inch; breadth .043 inch; length of spire .07 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen was obtained.

[Is *Turbonilla* (*Turbonilla*) *centaota* Dall and Bartsch, new name for *Chemnitzia acuminata* C. B. Adams, non *C. acuminata* Keyserling 1846, non *Turbonilla acuminata* Goldfuss 1852; Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 30, pl. 2, figs. 6–6a.]

**aequalis** *Adams* **Potamomya** [295 : 519] Plate 19, figs. 5–6

Shell subovate, nearly equilateral, slightly inequivalve; with the margin subangulated posteriorly, otherwise well rounded: white beneath a pale brown epidermis: with unequal striae of growth; posteriorly with an umbonial angle not very prominent: beaks small: right umbo very prominent, both somewhat compressed: tooth rather small; teeth of the left valve with a medial ridge.

Length .78 inch; height .66 inch; breadth .42 inch.

Station.—In soft impalpable mud, under a mangrove thicket, near high water mark, and near the outlet of a small stream, with *Arca tuberculosa.* [296] Habitat.—Panama; C.B.A.! 1 specimen was obtained about $2\frac{1}{2}$ miles east of Panama.

**affinis** *Adams* **Cancellaria** [132 : 356] Plate 8, fig. 3

Shell ovate fusiform: brown, sometimes with one or two [133] spiral bands of white: with, on each whorl, about thirty narrow prominent transverse ridges more or less inequidistant; with numerous raised spiral lines, of which five are seen on the spire, and which on the last whorl are less prominent and wide than the transverse ridges: apex subacute: spire with the outlines nearly rectilinear: whorls six, convex, with the suture subcanaliculate; last whorl rather large: aperture semiobovate, with long sharp ridges within on the right side: labrum sharp, thickened a little behind the edge, scalloped by both the internal and the external sculpture: columella stout, with three plaits, of which the upper one is lamelliform and very prominent, and the lower one is small and very oblique: canal short: with a small umbilical chink bounded by the raised labrum and a spiral bridge.

Mean divergence about 68°; length 1.05 inch; breadth .65 inch; length of spire .45 inch.

This species is not so densely and finely sculptured as *C. elegans* Sowb., and is less ventricose than *C. asperella* Lam.

Station.—Unknown. Habitat.—Panama; C.B.A.! 3 specimens were obtained.

**affinis** *Adams* **Chemnitzia** [165 : 389] Plate 8, fig. 12

Shell long, conic: pale yellowish brown: with, on each whorl, about twenty-four rather slender ribs, which terminate abruptly at the periphery of the last whorl; very smooth anteriorly: spire with the outlines nearly rectilinear: whorls ten, moderately convex, with a well impressed suture; last whorl angular at the periphery: aperture subovate: labrum thin: columella rather stout: umbilicus wanting.

Mean divergence about 18°; length .21 inch; breadth .055 inch; length of spire .165 inch.

Most easily distinguished from *C. striosa* (p. 169), by the sculpture of the last whorl.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found in the sand.

[Is *Turbonilla* (*Strioturbonilla*) *affinis* C. B. Adams, Dall and Bartsch 1909, Bulletin United States National Museum **68**, p. 56, pl. 4, fig. 11.]

**affinis** *Adams* **Solecurtus** [300 : 524] Plate 19, figs. 17–18

Shell much elongated, compressed cylindric, well rounded at both extremities; ventral edge straight or slightly arcuated: white beneath a deep yellowish brown epidermis: with unequal striae of growth: beaks not prominent, a little behind the middle of the shell: umbones compressed along the middle: ligament broad, with stout nymphaeal callosities: teeth small, one in the left, and two in the right valve. This is the analogue of *S. Caribaeus.*

Length 2.25 inches; height .8 inch; breadth .55 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 10 specimens were collected.

[Is *Tagelus* (*Tagelus*) *affinis* C. B. Adams, Hertlein and Strong 1950, Zoologica **35**, p. 222.]

**alta** *Adams* **Fissurella** [236 : 460] Plate 11, figs. 7–8

Shell subconic, high: dingy white, often more or less covered with broad ashy black rays, which may be seen through the shell: with prominent radiating ribs, of which the alternate ones are excessively developed, and intermediate small raised lines; with many concentric ridges, which are less prominent than the larger radiating ribs, and more so than the others: summit nearer to and somewhat inclined towards the anterior extremity: fissure small, ovate-elliptic: margin pectinated by the radiating ribs.

The following are the dimensions of a very large and high shell and of another of average size:

Height .42 inch; length .55 inch; breadth .41 inch.
" .22 " " .42 " " .29 "

Station.—Unknown. Habitat.—Panama; C.B.A.! 26 specimens were obtained.

**alternatus** *Adams* **Triphoris** [158 : 382] Plate 9, fig. 13

Shell long, conic, sinistrorsal: blackish red except that in the lower whorls a dingy white spiral stripe occupies the lower two-thirds of each whorl: with two stout marginal spiral ridges, and a rather smaller intermediate one, which is wanting on the upper whorls; with about twenty-five transverse moderately developed ridges, which terminate at the periphery of the last whorl, with the intersections strongly nodulous; anteriorly with two additional spiral ridges: apex very acute: spire with the outlines slightly curvilinear: whorls twelve, nearly flat, with an indistinct suture; last whorl short, concave anteriorly: aperture rhombic: canal rather deep, short.

Mean divergence about 30°; length .2 inch; breadth .06 inch; length of spire .155 inch.

Station.—Unknown. [159] Habitat.—Panama; C.B.A.! 3 mature and 2 young shells were found.

[Is *Triphoris alternatus* C. B. Adams, Bartsch 1907, Proceedings United States National Museum **33**, p. 258, pl. 16, fig. 11.]

**alta** *Adams* **Anatina** [294 : 518] Plate 19, figs. 19–20

Shell ovate, short; anteriorly subangular and flexuous; otherwise with the margins well rounded: pearl-white, with a thin

brownish epidermis: with unequal striae of growth; surface microscopically sagrinate: beaks small, prominent, approximate: umbones moderately convex: spoon-shaped tooth followed by a well rounded deep sinus under the beak.

[295] Length 1.98 inch; height 1.35 inch; breadth .7 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 valve only was found.

**angiostoma** *Adams* **Littorina** (?) [170 : 394] Plate 13, fig. 1

Shell obliquely ellipsoidal; dingy white: surface covered with deep regular spiral striae: apex obtuse: spire rather small with curvilinear outlines: whorls three and one half, very convex, with a distinct suture: aperture subeffuse, nearly semi-elliptical, the inner lip being straight, and well developed: umbilicus conspicuous.

Mean divergence about 85°; length .13 inch; breadth .1 inch; length of spire .055 inch.

The generic character of this species is doubtful. The shell resembles some small species of *Narica*.

Station.—Unknown. Habitat.—Panama; C.B.A.! 3 specimens were found in the sand.

[Is in the genus *Fossarus*.]

**angulata** *Adams* **Pedipes** [207 : 431] Plate 10, fig. 6

Shell ovate globose: dark brownish red, white in the aperture: solid; with crowded wrinkled unequal raised spiral lines, which are much finer on the upper part of the whorls, and which on the middle of the whorls are larger, and are disposed with one or two smaller lines between the larger lines: apex subacute: spire with the outlines somewhat curvilinear; whorls a little more than four, very angular, concave above the angle, imbricately appressed at the suture; last whorl large and ventricose, subangular below the middle: aperture subelliptical: labrum very sharp, sinuated by the angle on the whorls, a little within much thickened by a white callus, which is interrupted at the angle, and next below it, is developed into a long tooth: columella expanded with a broad flat surface, with two acute transverse plaits, of which the lower one is smaller: labium with a very large lamelliform spiral plait above the columella: umbilicus wanting.

Mean divergence about 90°; length .25 inch; breadth .19 inch; length of spire .1 inch.

Station.—Under stones at high water mark. Habitat.—Panama; C.B.A.!

We collected 90 specimens at the foot of the sea wall at Panama. This and the two species of *Truncatella* were found only in one place less than two yards in diameter.

Mr. Cuming obtained at Iquiqui a very small species of *Pedipes,* which has not been described. We believe that these two are the only known species in this zoological province.

**aspersa** *Adams* **Calyptraea (Syphopatella)** [219:443] Plate 12, figs. 9–10

Shell conic: thin: dingy or brownish white, irregularly sprinkled with many reddish brown spots: with very short and irregular minute wrinkles: apex acute, central: lamina with the fold appressed only at the inner margin, broadly expanded, making about two thirds of a revolution: margin very thin and acute.

Diameter .55 inch; height .21 inch.

Station.—Under stones at low water mark. Habitat.—Panama; C.B.A.! 3 specimens were found.

**assimilatum** *Adams* **Cerithium** [150:374] Plate 9, fig. 1

Shell very long, conic: very dark brownish red, with some [151] irregular linear spots of white on the spiral keels: with three excessively prominent compressed acute nearly equal and equidistant spiral keels, with narrow deep interspaces, which are crossed by microscopic raised lines, with a fourth keel on the periphery of the last whorl, and another anteriorly which is more minute: apex acute: spire with the outlines nearly rectilinear: whorls sixteen to eighteen, planulate, with the suture very indistinct: last whorl very short: aperture ovate: labrum deeply scalloped by the spiral ridges: canal large, very short.

Mean divergence about 18°; length .23 inch; breadth .06 inch; length of spire .19 inch.

This species is allied to *C. trilineatum* Phil. and to *C. terebellum* Ad.

Station.—Under stones, sponges, and marine plants, &c., near low water mark. Habitat.—Panama; C.B.A.! Eight specimens were collected.

[Is in the genus *Scila* A. Adams, Bartsch 1913, Proceedings United States National Museum **40**, p. 327.

**atrata** *Adams* **Littorina** [171 : 395] Plate 9, fig. 5

Shell conic when young, subglobular when mature: black sometimes with a few whitish spots on the last whorl: with spiral keels varying in size and number; usually a strong sharp keel is seen on the periphery of the last whorl and in the suture, and another appears on the upper part of the whorls, with one slightly developed between them; with two or three well developed keels beneath the periphery of the last whorl: apex acute: spire small, eroded in full grown shells, with the outlines moderately curvilinear: whorls four, a little convex, with a well impressed suture; last whorl with an acute periphery in the young, rounded in the mature shell: aperture broadly ovate: labrum well excurved: umbilicus very small. This species is variable in form and in sculpture.

Mean divergence from 65° to 90° in different stages of growth; length .08 inch; breadth .06 inch.

Station.—In or near cavities of rocks between half tide and high water levels. [172] Habitat.—Panama; C.B.A.! 3,300 specimens were collected.

[Is in the genus *Fossarus*.]

**atrior** *Adams* **Pleurotoma** [138 : 362] Plate 7, fig. 10

Shell subfusiform: jet black, with a paler translucent spiral stripe below the middle of the whorls: with a spiral series of [139] granules next above the suture, and a not very prominent keel above the middle of the whorls; on the last whorl three other keels appear, which are more or less granulated: apex very acute: spire with convex outlines: whorls eleven, angular under the spiral keel, beneath it concave, with an indistinct suture: aperture long, with a rather deep sinus: canal very short, wide. This species has some resemblance to *P. discors*. It must also resemble *P. Melchersi* Menke, Zeitschr. 1851, p. 20.

Mean divergence about 38°; length .8 inch; breadth .28 inch; length of spire .5 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen was obtained.

**bairdiana** *Adams* **Truncatella** [213:437] Plate 12, fig. 7

Shell cylindric: of a rich amber color: with rather small crowded ribs, which are obsolete behind the labrum, less prominent on the convexity of the whorls, well developed anteriorly, in number about twenty-four on the penult whorl: apex acute, truncate with the loss of four whorls: spire with the outlines slightly curvilinear; whorls nearly four after truncation, convex, with a well impressed suture: aperture ovate, slightly effuse above: labrum advanced along the middle, reflected, double: labium with a thick deposit, continuous with the labrum.

Mean divergence about 22°, being considerably less in the lower whorls and more above; length after truncation, .21 inch; breadth .075 inch; length of spire .15 inch.

This species must resemble *T. scalariformis* Reeve from the island of Annaa; but that shell is figured with five whorls after truncation, in color it is described as "luteola," and the labrum is said to be sharp and simple.

Station.—Under a heap of stones at the high water mark of spring tides. Habitat.—Panama; C.B.A.! 400 specimens were collected at the bottom of the sea wall of Panama.

One specimen has come to maturity without the loss of the apex, which, however, is white and cretaceous from partial decay.

We dedicate this species to Professor S. F. Baird, whose name is so well known to Herpetologists.

[Is *Truncatella bairdiana* C. B. Adams, Clench and Turner 1948, Occasional Papers On Mollusks **1**, p. 195.]

**bellus** *Adams* **Fusus** [129:353] Plate 8, fig. 2

Shell rather elongate and regularly fusiform; white, with some reddish brown spots in spiral series, mostly in three series, one above and two next below the middle of the whorls: with, on each whorl, about ten rather narrow prominent ribs, some of which are varicoid, with spiral raised lines, with the

intersections nodulous, and spiral striae: apex acute: spire conic: whorls seven, very convex, with a moderately impressed suture: aperture long ovate; canal wide, moderately lengthened.

Mean divergence about 50°; length .44 inch; breadth .21 inch; length of spire .22 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! One specimen only was obtained.

**bicolor** *Adams* **Amphidesma** [288 : 512] Plate 18, figs. 7–8

Shell elliptical, scarcely flexuous, inequilateral, the posterior side being larger; with the posterior dorsal margin a little con- [289] cave; otherwise with all the margins well rounded: purple near the beaks, otherwise dingy white: interior similarly colored, but with the purple region larger: smooth near the beaks, otherwise with fine raised concentric lines, and crowded radiating striae, which are mostly microscopic, and which posteriorly are divergent and wholly microscopic; beaks small, prominent: umbones convex.

Length .85 inch; height .74 inch; breadth .42 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 valve was found.

**bimarginatum** *Adams* **Cerithium** [151 : 375] Plate 9, fig. 2

Shell long, conic: wax color, dark brown on the upper whorls: with a spiral ridge at each margin of the whorls of the spire and an intermediate raised line; on each whorl with about eighteen transverse small ridges with intersections strongly nodulous; with a simple spiral ridge at the periphery of the last whorl; anteriorly without sculpture: apex very acute: spire with the outlines rectilinear: whorls thirteen, concave, with a well impressed suture; last whorl very short, concave anteriorly, with the periphery angular: aperture subquadrate: columella with a very prominent spiral fold: canal rather short, recurved.

Mean divergence about 20°; length .175 inch; breadth .055 inch; length of spire .14 inch.

Station.—Unknown. [152] Habitat.—Panama; C.B.A.! 2 specimens were found.

[Is *Eumeta bimarginata* C. B. Adams, Bartsch 1911, Proceedings United States National Museum **39**, p. 566, text fig. 2.]

**buddiana** *Adams* **Chama** [253 : 477] Plate 20, figs. 7–8

Shell orbicular or subtriangular: exterior surface and inner margins purplish red, with the spines pure white: surface uneven, with interrupted radiating striae; upper valve ornamented with a few radiating series of short thick triangular vaulted spines: lower valve attached by about two-thirds to three-quarters of its surface, the rest being like the upper valve, but with the dentiform spines smaller: within both valves are deeply and finely crenulated at the junction of the white surface and red margin: beak submarginal. Easily distinguished from *C. Pacifica* and *C. Broderipii* by the small thick dentiform triangular white spines.

Diameter about 3 inches.

Station.—On ledges of rocks, a little above low water mark. The lower valve is so firmly attached as to render it difficult to obtain specimens entire without the use of mineralogical tools. Habitat.—Guaymas; Lt. Green! Mus. Essex Inst. Panama; C.B.A.! 6 specimens were obtained.

Named in honor of Dr. B. W. Budd of New York City.

**canescens** *Adams* **Nassa** [59 : 283] Plate 5, fig. 8

Shell rather long, ovate conic: pale brown on all the raised portions of the surface, with the interspaces pale gray: with ten or eleven very prominent narrow ribs, and many raised spiral lines, which are not interrupted by the ribs, and of which two on the middle of the whorls and some anteriorly are larger: spire with the outlines nearly rectilinear: apex acute: whorls eight or nine, subangular in the middle, with a well impressed suture; last whorl moderately ventricose, anteriorly spirally subcanaliculate: aperture subelliptical: labrum subacute, much thickened by a varix a little behind the edge, finely grooved within: labium finely wrinkled, a little dilated but not appressed: notch large and deep.

Mean divergence about 50°; length 1.05 inch; breadth .6 inch; length of spire .6 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

[Is *Nassarius pagodus* Reeve, Hertlein and Strong 1955, Bulletin American Museum Natural History **107**, p. 245.]

**cerithicola** *Adams* **Crepidula** [225:449] Plate 11, figs. 14–15

Shell ovate, convex: posteriorly whitish, sometimes with a broad ray of dark brownish red on each side of the umbo; anteriorly subtransparent, pale brownish red, with narrow dark rays of the same color; sometimes all the rays are confluent, and more rarely the entire shell is of a dark brownish red; with the septum white: smooth: apex acute, terminal and marginal, a little dextrorsal: septum slightly angulated along [226] the middle, with a small sinus at the left, a broad one at the middle of the edge, and none at the right side.

Length .23 inch: breadth .14 inch: convexity .07 inch.

Station.—On *Cerithium irroratum* [Gould], q.v. Habitat.—Taboga; C.B.A.!

This species was not observed until after the shells arrived here. When cleaning a quantity of *C. irroratum,* 45 specimens were obtained.

[Is *Crepidula onyx* Sowerby, Dall 1909, Proceedings United States National Museum **37,** p. 283.]

**clandestina** *Adams* **Rissoa** [177:401] Plate 12, fig. 6

Shell long, ovate conic: dingy white: with, on each whorl, about eighteen or nineteen stout prominent compressed ribs, which are continued to the anterior extremity: apex acute: spire with the outlines moderately curvilinear: whorls seven, moderately convex: with a well impressed suture: last whorl rather large: aperture large, oblique, moderately effuse at both extremities: labrum much advanced along the middle, much thickened with a broad varix; umbilicus wanting.

Mean divergence about 30°; length .115 inch; breadth .05 inch; length of spire .07 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found.

[Is *Rissoina clandestina* C. B. Adams, Bartsch 1915, Proceedings United States National Museum **49,** p. 55, pl. 32, fig. 5.]

**clathratula** *Adams* **Chemnitzia** [165:389] Plate 11, fig. 5

Shell ovate conic, much elongate: white: with, on each whorl, about thirty minute ribs, which gradually become obsolete on the periphery of the last whorl, and which are decussated by

spiral raised lines, of which five or six appear on the spire [166] and of which the remainder cover the anterior part of the last whorl: apex very minute: spire with the outlines nearly rectilinear: whorls eight, more or less angular in the upper part, with a well impressed suture; last whorl rather long, with a well rounded periphery: aperture subovate: labrum thin: columella rather stout: umbilicus wanting.

Mean divergence about 16°; length .13 inch; breadth .04 inch; length of spire .1 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 10 specimens, in various stages of growth, were collected from the sand.

[Is *Odostomia* (*Chrysallida*) *clathratula* C. B. Adams, Dall and Bartsch 1909, Bulletin United States National Museum **68**, p. 145, pl. 14, figs. 7–7a.]

**cognata** *Adams* **Petricola** [286 : 510] Plate 19, figs. 3–4

Shell pholas-shaped, inequilateral: dingy white: in the upper posterior area with very fine crowded radiating equal [287] striae; in the lower posterior area with unequal fine raised radiating lines; in the anterior half with radiating ribs, which are ornamented with small thick vaulted scales; beaks small, prominent: umbones prominent, somewhat flattened: lunule defined by the anterior ribs, a little depressed: ventral margin scalloped anteriorly. It is allied to *P. pholadiformis* Lam.

Length .92 inch; height .42 inch; breadth .44 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

[Is *Petricola cognata* C. B. Adams, Pilsbry and Lowe 1932, Proceedings Academy Natural Sciences Philadelphia **84**, p. 99, pl. 13, figs. 10–11.]

**cognata** *Adams* **Tellina** [279 : 503] Plate 18, figs. 9–10

Shell subelliptical, solid, convex, subequilateral; ventral margin slightly excurved; anterior margin broadly rounded; anterior dorsal margin nearly straight, sloping; posterior dorsal margin slightly concave, sloping equally with the posterior dorsal; posterior extremity somewhat obliquely and very broadly truncated; flexure slight; white, with a pale reddish or brownish tinge; with excessively minute unequal radiating [280] striae; with concentric crowded somewhat oblique minute striae, which terminate much before reaching the umbonial angle, covering less than half of the posterior side, and

which are also wanting near the anterior dorsal margin: beaks not very prominent: ligament short, conspicuous: lateral teeth obsolete. It is closely allied to *T. similis,* which is said to be a Caribbean species.

Length 1.75 inch; height 1.23 inch; breadth .5 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! A single valve was found.

[Is *Tellina* (*Scissula*) *cognata* C. B. Adams, Hertlein and Strong 1949, Zoologica **34**, p. 84.]

**collaria** *Adams* **Nassa** [59:283] Plate 5, fig. 4

*Nassa collaria* Gould MSS.

Shell ovate conic: dingy white, with a dark reddish brown band on each side of the whorl: with, on each whorl, about ten or twelve ribs, which are smaller and more approxi- [60] mate but not obsolete on the last part of the last whorl; with many spiral raised lines. with the intersections subnodulous: spire with the outlines nearly rectilinear: apex acute: whorls seven, slightly convex, with a distinct suture; last whorl with a minute spiral canal anteriorly: aperture subelliptical: labrum subacute, thickened with a stout varix, within crenulated coarsely and unequally: labium a little thickened, not appressed: with a deep notch.

Mean divergence about 50°; length .38 inch: breadth .21 inch; length of spire .23 inch.

Var. *a;* smaller (.23 inch long); with the lower fascia much broader, and darker anteriorly.

Station.—Unknown. Habitat.—Panama; (var. *a*); E. Jewett! Gould Mss. Panama; C.B.A.! We obtained 4 specimens of the type, and one of the variety.

[Is in the genus *Nassarius.*]

**communis** *Adams* **Chemnitzia** [166:390] Plate 10, fig. 5

Shell long, fusiform conic: dingy white: with, on the penult whorl, about twenty-two transverse ridges, and on the last whorl a greater number, which are less prominent, and which become obsolete anteriorly: with spiral ridges, of which four or five are seen on the spire, and which on the last two whorls are as prominent as the transverse ridges, but above are less

developed: apex with the axis oblique: spire with the outlines curvilinear: whorls eight, moderately convex, with a well impressed suture: last whorl rather long: aperture ovate, acute above, very broadly effuse below: labrum rather thin, but not sharp: columellar lip well thickened, below reflected over a minute umbilical indentation: columella with one small plait. A large specimen has the following dimensions:

Mean divergence about 23°; length .165 inch; breadth .05 inch; length of spire .11 inch.

Station.—Under stones near low water mark. Habitat.—Panama and Taboga; C.B.A.! 90 specimens were collected.

[Is *Odostomia* (*Chrysallida*) *communis* C. B. Adams, Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 141, pl. 14, figs. 10–10a.]

[When studying the type series of *Chemnitzia communis* Adams, Dall and Bartsch found that it was a mixed lot and from it they separated two additional species which they described as *Odostomia* (*Chrysallida*) *tyleri* (ibid., p. 157, pl. 16, fig. 5; Holotype, Museum of Comparative Zoölogy no. 186556) and *Turbonilla* (*Dunkeria*) *andrewsi* (ibid., p. 124, pl. 12, figs. 7, 7a; Paratypes, Museum of Comparative Zoölogy no. 155936 and 155937).]

**concinna** *Adams* **Auricula** [208 : 432] Plate 13, fig. 4

Shell ellipsoidal: blackish brown, paler on the convexity of the last whorl, with a yellowish white spiral band on the last whorl issuing from beneath the suture; with the plaits and callus in the aperture white: smooth and shining: apex acute: spire with the outlines very curvilinear: whorls five, convex, imbricately appressed, with the suture moderately impressed; last whorl long: aperture narrow and very acute above, much contracted by the plaits: labrum sharp, in the lower part much thickened within by a broad thick deposit: plaits three, of which the lower one is very oblique, and the upper one is very large, [209] concave on the lower side, and on the upper side extended to the summit of the aperture with a transversely ridged surface.

Mean divergence about 80°; length .32 inch; breadth .2 inch; length of spire .09 inch.

Station.—Our specimens were found mostly on the short suckers, which were growing up thickly beneath the mangroves, near high water mark. Habitat.—Panama; C.B.A.! We collected 74 specimens two and one-half miles east of Panama.

**concinna** *Adams* **Pleurotoma** [140 : 364] Plate 8, fig. 8

Shell fusiform: white, tinged more or less with reddish brown: with numerous crowded small ribs, which become obsolete near the labrum, and crowded spiral striae, which are finer on the spire: apex acute: spire with moderately convex outlines: whorls eight, angular along the middle, with a moderately impressed suture: aperture very long and narrow: labrum very much thickened a little behind the edge, with the sinus deep and very near the suture: canal scarcely distinct from the aperture. It resembles *P. triticea* Kiener, and may be a *Mangelia.*

Mean divergence about 43°; length .42 inch; breadth .17 inch; length of spire .18 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

**concinna** *Adams* **Tellina** [280 : 504] Plate 18, figs. 16–17

Shell subelliptical, rather thin, convex, with the anterior side a little larger; ventral margin moderately excurved; anterior margin broadly rounded; anterior dorsal margin a little excurved, moderately sloping; posterior dorsal margin nearly straight, sloping equally with the anterior dorsal margin; posterior extremity somewhat obliquely and very broadly truncated; flexures slight: shining, snow-white, with a slight tinge of pink in the middle; with very unequal, and, for the most [281] part, very fine concentric striae, which are much coarser posteriorly; with excessively minute unequal radiating striae: beaks not very prominent: ligament short, conspicuous: lateral teeth obsolete.

Length 1.6 inch; height 1.02 inch; breadth .47 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 3 fine specimens were obtained.

**concinna** *Adams* **Vitrinella** [184 : 408] Plate 15, fig. 4, a–b

Shell discoidal: white: with five prominent acute spiral keels, of which one is next below the suture: the second is about equidistant between the suture and the periphery of the last whorl; the third is a little below the periphery; the fourth is on the middle of the lower side of the last whorl; and the fifth

is within the umbilicus; with a more or less distinct ridge between the first two keels; with curved transverse elevated lines, which become obsolete on the last half of the last whorl: apex minute, papillary: spire nearly flat: whorls three and one-half: planulate above, with the suture subcanaliculate; last whorl declining near the aperture below the plane of the spire: aperture orbicular, very oblique: lip moderately thickened, slightly angulated by the keels: umbilicus broad and deep.

Divergence about 175°; greatest breadth .062 inch; least breadth .05 inch; height .03 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen was found.

[Is *Solariorbis concinnus* C. B. Adams; Pilsbry and Olsson 1952, Proceedings Academy Natural Sciences Philadelphia **104**, p. 57.]

**conica** *Adams* **Pyramidella** [200:424] Plate 10, fig. 12

Shell long, regularly conic: white on the upper whorls, dark brown on the others, with a pale spiral line just above the suture: surface smooth and shining: apex very acute: spire with the outlines rectilinear: whorls fourteen, flat, with the suture in a narrow deep groove: last whorl sharply angulated at the periphery: aperture oblique: labrum thin: columella with three plaits, of which the one is lamelliform, and the other two are very small.

Mean divergence about 23°; length .52 inch; breadth .175 inch; length of spire .38 inch.

This species is remarkable for the exact conical form of the spire.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

[Is *Pyramidella* (*Longchaeus*) *conica* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68**, p. 23, pl. 1, fig. 9.]

**consanguinea** *Adams* **Cytherea** [272:496] Types lost

Shell obovate, subcordate, with the ventral margin well excurved: very pale straw color, with numerous yellowish brown linear rays, which are more or less interrupted, and which usually terminate before reaching the margin: smooth and shining, with the lines of growth very minute: beaks pro- [273]

minent, approximate: posterior area long and narrow, well defined: lunule cordiform, defined by a well impressed line; both areas striate: margin of the interior not crenulate: anterior tooth much larger than the others. This shell belongs to a group of very closely allied species, among which are *C. inflata, C. albida, C. convexa,* &c.

Length 1.25 inches; height 1 inch; breadth .68 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! We found 8 specimens on the reef.

[Is *Pitar* (*Pitar*) *consanguineus* C. B. Adams; Hertlein and Strong 1955, Bulletin American Museum Natural History **107,** p. 189.

**conspicua** *Adams* **Columbella** [83 : 307] Plate 7, fig. 3

Shell ovate-conic: with a broad white spiral band on the convexity of the whorls, on each side of which is a broad band of brownish orange; anteriorly white with irregular brown spots; with deep brown spots near the summits of the alternate ridges; with, on each whorl, nine very prominent obtuse transverse ridges, which are obsolete at the upper part of the whorls; with coarse spiral striae, which traverse the ridges except at the summit of the middle and most prominent part: apex subacute; spire with the outlines nearly rectilinear; whorls eight, convex, with a moderately impressed suture; last whorl subangular; aperture a little wider above; labrum moderately thickened, with a few wrinkles on the inside: notch wide and deep.

Mean divergence about 35°; length .21 inch; breadth .1 inch; length of spire .12 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only one specimen of this elegant shell was found.

**cornuta** *Adams* **Pandora** [295 : 519] Plate 17, figs. 15–16

Shell elongate, ovate, very inequilateral, the posterior part being much longer and higher; dorsal margin nearly straight, posteriorly sharply rostriform; posterior margin much excavated next beneath the rostriform projection; ventral margin well rounded: pearl-white: with some unequal striae of growth; right valve with a prominent angle extending from the beak to the middle of the sinus of the posterior margin; left valve

with a corresponding depressed angle; beaks indistinct: umbones slightly and almost equally convex.

Length .7 inch; height .42 inch; breadth .11 inch.

We adopt the appropriate name suggested by Dr. Gould.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen was found.

**coronulatus** *Adams* **Trochus** [191 : 415] Plate 13, fig. 8

Shell conic, moderately elevated, thick: dingy white, with broad reddish brown oblique flammules, with the nodules pale red: with minutely undulated spiral raised lines: anteriorly with four or five larger raised lines: with, on the periphery of the last whorl, two spiral nodulous keels, of which one appears on the spire: with a series of larger nodules on the shouldered margin of the whorls: spire with the outlines moderately curvilinear: apex subacute: whorls six, planulate above the keels, with the suture broadly and deeply canaliculate: aperture nearly orbicular: labrum much advanced in the upper part: columella bidentate: umbilicus one third as wide as the aperture, reaching to the apex.

Mean divergence about 90°; length .55 inch; greatest breadth .72 inch; least breadth .6 inch.

Station.—Unknown. Habitat.—Taboga; C.B.A.! We found 2 specimens.

[Is *Tegula rubroflammulata* Koch 1843, Pilsbry and Lowe 1932, Proceedings Academy Natural Sciences Philadelphia **84**, p. 86.]

**corpulenta** *Adams* **Nassa** [60 : 284] Plate 5, fig. 3

Shell ovate conic, very robust: spirally banded with white and brown, sometimes mostly white, sometimes mostly brown, with a broad white stripe below the middle of the last whorl, white in and about the aperture: with, on each whorl, about eleven narrow ribs, which are traversed by spiral raised lines: spire with the outlines rectilinear or slightly concave; apex acute: whorls nine, moderately convex, with a well impressed suture; last whorl very large and ventricose, spirally canaliculate anteriorly: aperture subelliptical, contracted: labrum subacute thickened with a very stout varix, within coarsely sulcate: labium wrinkled, a little thickened but not appressed:

notch large and deep. *N. festiva* Powis must resemble this shell, and possibly may be identical with it.

Mean divergence about 46°; length .88 inch; breadth .63 inch; length of spire .46 inch.

[61] Station.—Unknown. Habitat.—Panama; E. Jewett! Gould Mss. Taboga and Panama; C.B.A.! 17 specimens were obtained.

[Is *Nassarius corpulentus* C. B. Adams; Desmond 1952, Pacific Science **6**, p. 314.]

**diminuta** *Adams* **Columbella** [85 : 309] Plate 7, fig. 2

Shell subfusiform: pale yellowish brown, black or brownish black anteriorly: ribbed, with the interstices covered with spiral striae, which are coarser anteriorly where the ribs are obsolete; apex acute: spire conic: whorls seven, scarcely convex: with the suture lightly impressed: aperture rather narrow: labrum variciform, broadly thickened, sinuate posteriorly, crenulated within: columellar lip with the granules obsolete.

Mean divergence about 45°; length .155 inch; breadth .07 inch; length of spire .08 inch.

This species resembles a dwarfed *C. nigrescens.*

Station.—Under stones near low water mark we found this shell. Habitat.—Panama; C.B.A.! 19 specimens were obtained.

**diminutum** *Adams* **Coecum** [161 : 385] Plate 17, fig. 7

Shell well arcuated, slender, with the diameter uniform, except near the summit: white: with about 17 stout rings, which are rather distant and are but slightly flattened at the summits, followed by about 10 rings which are small and less prominent: apex lateral, not prominent.

Length .06 inch: breadth .018 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

**dubiosa** *Adams* **Littorina** [174 : 398] Plate 13, fig. 13

If our shell is distinct from Philippi's species, it may take the name of *L. dubiosa,* with the following description.

Shell conoid: blue, whitish next below the suture and anteriorly, with oblique brown bars on the whitish parts: very dark brown inside, spotted with brown and white in the labrum:

with several impressed spiral lines, which are more or less indistinct on the spire and on the middle of the last whorl, and of which one next above the angle of the last whorl is deeper: apex subacute: spire with the outlines moderately curvilinear: [175] whorls nearly six, a little convex, with a distinct suture; last whorl angular: aperture ovate, acute above, slightly effuse: columellar lip slightly flattened and dilated.

Mean divergence about 55°; length .25 inch; breadth .17 inch.

Some of the more strongly striated and colored individuals resemble the young of *L. aspera,* but the spire is always less acute.

Station.—In the cavities of a rough ledge of rocks, at and above high water mark. Habitat.—Panama; E. B. Philippi! Philippi. Taboga; C.B.A.! 600 specimens were taken at Taboga.

[This species was listed under *Littorina parvula* Phil.? It is a subspecies of *Littorina aspera* Philippi.]

**dubiosa** *Adams* **Truncatella** (??) [213 : 437] Plate 12, fig. 8

Shell ovate conic: translucent, deep yellowish brown: thin, smooth, and shining: apex subacute: spire with the outlines moderately curvilinear: whorls six, convex, with a well [214] impressed suture; last whorl rather short and subangular, but ventricose: aperture broadly ovate: labrum thin: labium a little reflected below, above interrupted by the penult whorl.

Mean divergence about 45°; length .083 inch; breadth .055 inch; length of spire .045 inch.

Operculum corneous.

Station.—With *Truncatella Bairdiana.* Habitat.—Panama; C.B.A.! 550 specimens were collected.

This species cannot properly be referred to *Truncatella.* The apex is not truncated; the operculum is horny; and the general form and texture indicate a different genus. In form it approximates to *T. fusca, T. littorea, &c.,* which are not Truncatellae, but which probably belong to *Bembicium.* From the habits of our species, it may be inferred to be an air-breathing mollusc, while the characters of the shell are very different from those of *Bembicium.* The shell appears too deficient in characters suitable for generic distinction, and we refrain from proposing a new genus until the soft parts shall be known.

[Is in the genus *Aroapyrgus* H. B. Baker; Clench and Turner 1948, Occasional Papers On Mollusks **1**, no. 13, p. 198.]

**eburneum** *Adams* **Coecum** [161 : 385] Plate 17, fig. 3

Shell rather slender, well arcuated, scarcely widening towards the aperture, slightly contracted at the summit: ivory white: with about 33 broad stout approximate rings with flat summits; with the first 4 to 10 rings and sometimes the last 2 or 3, very prominent and less approximate, and the rest slightly prominent and closely approximate: apex prominent.

Length .09 inch; breadth .025 inch.

A var. (?) has only 24 rings, of which the last 3 or 4 are prominent, indicating maturity.

Station.—Unknown. Habitat.—Panama; C.B.A.! 22 specimens were found in the sand.

**excavata** *Adams* **Littorina** (?) [172 : 396] Plate 13, fig. 2

Shell obliquely ellipsoidal: very dark brown at the apex, in the umbilical region and in the fauces, otherwise pale horn color: with several spiral raised lines, and intermediate very minute spiral striae; apex subacute: spire small, with the outlines very curvilinear: whorls nearly four, compressed, with a distinct suture; last whorl ventricose: aperture subovate: labrum very sharp, but thickened much a little behind the edge: columella dilated and thickened: region around the umbilicus much excavated: umbilicus small.

Mean divergence about 90°; length .17 inch; breadth .13 inch; length of spire .04 inch.

The generic character of this species is doubtful. It resembles a small *Narica.*

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the sand.

[Is in the genus *Fossarus.*]

**exigua** *Adams* **Pleurotoma** [142 : 366] Plate 8, fig. 6

Shell slender: pale cream color, with very fine brown spiral lines, of which the two or three upper ones are single, and the rest are in pairs: with distant obtuse transverse ridges, about six or seven on each whorl, obsolete on the anterior half of the

last whorl: apex acute: spire with the outlines moderately convex: whorls six, convex, with a distinct suture: aperture narrow: labrum thickened by the last ridge a little behind the edge, with a deep sinus near the suture: canal very short.

Mean divergence about 34°; length .175 inch; breadth .06 inch; length of spire .1 inch.

[143] Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen of this elegant little shell was obtained in the calcareous sand on the shore.

**exigua** *Adams* **Vitrinella** [184 : 408] Plate 15, fig. 2, a–b

Shell subdiscoidal: white: on the periphery of the last whorl [185] is a keel, which is visible on a small part of the penult whorl, and then runs into the suture; with another somewhat less prominent keel below the periphery, and a third, which is nearly obsolete, around the umbilicus; with not very distinct transverse raised lines, which are most developed between the two lower keels: apex obtuse: spire convex, slightly elevated: whorls nearly three, with a well impressed suture, very convex above so as to simulate a moderately developed carina; last whorl concave on each side of the periphery: aperture orbicular: labrum slightly thickened, modified by the ends of the spiral keels; umbilicus very narrow, deep.

Mean divergence about 170°; greatest breadth .045 inch; least breadth .036 inch; height .021 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 7 specimens were found in the calcareous sand.

[Is *Cyclostremiscus trigonatus* Carpenter; Pilsbry and Olsson 1945, Proceedings Academy Natural Sciences Philadelphia **97**, p. 268, pl. 27, fig. 2, a–b; non *C. exigua* Philippi 1849.]

**famelicum** *Adams* **Cerithium** [152 : 376] Plate 9, fig. 3

Shell long, ovate conic: dingy white, more or less profusely mottled with irregular brown spots, which are divided by fine white spiral lines; or nearly covered with fine alternating white and brown lines: with a narrow spiral ridge on the middle of the whorls, crossing transverse obtuse ridges, with very prominent acute intersections; with the upper margin of the whorls more or less granulous; anteriorly with two more granulous spiral ridges; surface covered with fine spiral striae: apex

acute: spire with the outlines slightly curvilinear: whorls twelve, moderately convex, with the suture lightly impressed; last whorl short, gibbous on the left, with an anterior concave area: aperture large, obliquely elliptical: labrum advanced in the lower half: labium with a moderately thick deposit and a stout transverse plait above: canal short, oblique.

Mean divergence about 33°; length 1.13 inch; breadth .5 inch; length of spire .75 inch.

In color and sculpture only, this shell has some resemblance to *C. maculosum* Kr. (*C. adustum* of Kr.'s plate).

Station.—Unknown. Habitat.—Taboga; C.B.A.! 17 specimens were collected.

**firmata** *Adams* **Rissoa** [177 : 401] Plate 10, fig. 10

Shell long, ovate conic: dingy white: with, on each whorl, about twelve very stout, prominent, rather acute ribs, which are continued to the anterior extremity: apex acute: spire with the outlines curvilinear: whorls seven, convex, with a well impressed suture: last whorl rather large: aperture oblique, subovate, effuse at both extremities: labrum well advanced along the middle,thickened with a broad stout rib: umbilicus wanting.

Mean divergence about 30°; length .185 inch; breadth .075 inch; length of spire .13 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the sand.

[Is *Rissoina firmata* C. B. Adams; Bartsch 1915, Proceedings United States National Museum **49**, p. 38, pl. 32, figs. 4, 6.]

**firmatum** *Adams* **Coecum** [161 : 385] Plate 17, fig. 6

Shell rather stout, well arcuated, widening towards the aperture, moderately contracted at the summit: ivory white: with about 25 very stout broad prominent not closely approximate rings, with flat summits: apex not very prominent.

Length .09 inch; breadth .03 inch.

[162] A variety (?) is more slender, and has the ribs less prominent.

Station.—Unknown. Habitat.—Panama; C.B.A.! 85 specimens were collected from the sand.

**fortis** *Adams* **Rissoa** [178 : 402] Plate 10, fig. 11

Shell long, ovate conic: white: with, on each whorl, about twenty-two to twenty-four stout prominent approximate ribs, which converge at the anterior extremity, where they become very small: apex acute: spire with the outlines curvilinear: whorls ten, slightly shouldered, moderately convex, with a well impressed suture; last whorl ventricose: aperture oblique, ovate, retreating above, deeply effuse: labrum much advanced in the lower half, very thick: labium thick: umbilicus wanting.

Mean divergence about 33°; length .29 inch; breadth .12 inch; length of spire .185 inch.

This species resembles *R. ambigua* Gould, and is very different from *Rissoina Inca* Orb.

Station.—Under stones near low water mark. Habitat.—Taboga; C.B.A.! 31 specimens were collected.

[Is *Rissoina fortis* C. B. Adams; Bartsch 1915, Proceedings United States National Museum **49,** p. 40, pl. 29, figs. 5, 6.]

**foveolata** *Adams* **Purpura** [76 : 300] Plate 6, fig. 9

Shell obliquely rhombic: white: with very prominent compressed transverse ridges, about nine on each whorl, and four spiral keels which are very prominent and much compressed, of [77] which the upper one is seen on the middle of the whorls of the spire, and of which the anterior one is much less developed; with the intersections prominent; with rather fine spiral striae: apex acute: whorls six, concave on both sides of the keel, with the suture indistinct: aperture long ovate, produced into a short canal: labrum rather thin, scalloped by the keels and finely serrated by the striae.

Mean divergence about 70°; length .43 inch; breadth .28.

Station.—Under stones, near low water mark. Habitat.—Panama; C.B.A.! 3 specimens were obtained.

**foveata** *Adams* **Littorina** (?) [173 : 397] Plate 9, fig. 6

Shell globose conic: dingy white, with a very broad dark brown spiral stripe occupying the middle of the last and more or less of the upper whorls: with several inequidistant spiral raised lines: apex subacute: spire with the outlines moderately curvilinear: whorls nearly four, subangular, with a distinct

suture; last whorl angular below the middle: aperture subovate: labrum very sharp, but much thickened a little behind the edge: columella dilated and thickened: region around the umbilicus much excavated, and forming with the umbilicus a funnel-shaped pit.

Mean divergence about 80°; length .19 inch: breadth .15 inch; length of spire .08 inch.

The generic character of this species is doubtful. It may possibly be a *Narica*.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found in the sand.

[Is in the genus *Fossarus*.]

**fusoides** *Adams* **Triton** [116 : 340] Plate 8, fig. 1

Shell ovate-fusiform, slender: whitish, stained with brown, with a white spiral stripe near the middle of the whorls: with prominent narrow not approximate ribs, about nine on each whorl, crossed by numerous raised fine spiral lines, of which the alternate ones are mostly larger: apex acute: spire conic: whorls eight, convex, with a well impressed suture: aperture long subovate: canal short.

Mean divergence about 35°; length .76 inch; breadth .28 inch.

Station.—Unknown. Habitat.—Taboga; C.B.A.! We obtained only 1 specimen.

**gemmulosa** *Adams* **Nassa** [61 : 285] Plate 5, fig. 5

Shell ovate conic, ventricose: whitish, more or less tinged with yellowish brown; with a narrow spiral stripe of brown at the upper margin of the whorls, and another anteriorly; with two or three minute spiral brown lines on the middle of the last whorl, which are interrupted by the nodules: with about fifteen or sixteen minute ribs on each whorl, and spiral raised lines, of which three or four are visible on the spire; with the intersections developed into well rounded nodules: spire with the outlines rectilinear: apex very acute: whorls seven, a little convex, with a distinct suture; last whorl spirally subcanaliculate anteriorly: labrum subacute, well thickened by a varix, coarsely ridged within: labium much arcuated, a little thickened but not appressed: notch deep.

Mean divergence about 56°; length .25 inch; breadth .17 inch; length of spire .15 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

**gemmulosa** *Adams* **Pleurotoma** [143 : 367] Plate 7, fig. 7

Shell long, subfusiform: brown, with some pale spots: surface densely covered with small transverse and spiral ridges, with the intersections developed into elegantly rounded prominent nodules, except near the end of the last whorl, where the transverse ridges are obsolete: apex acute: spire with the outlines very curvilinear: whorls eight, a little convex, with a moderately impressed suture: aperture very narrow, with a small sinus near the suture: labrum thickened without and within: canal very short.

Mean divergence about 33°; length .22 inch; breadth .08 inch; length of spire .14 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

**glauca** *Adams* **Nassa** [61 : 285] Plate 5, fig. 6

Shell ovate conic, ventricose: glaucous or olivaceous, with a broad spiral stripe of dingy white a little above the suture, whitish about the aperture, deeply colored in the anterior spiral canal: with, on each whorl, about ten ribs, of which the last two or three next to the aperture are nearly obsolete; with many spiral striae, which traverse the ribs: spire with the outlines nearly rectilinear: apex acute: whorls eight, [62] moderately convex, with a distinct suture; last whorl ventricose, with a narrow deep spiral canal anteriorly: aperture subelliptical: labrum subacute, thickened with a stout varix, within with about five acute spiral ridges: labium well thickened, not appressed: notch deep.

Mean divergence about 55°; length .5 inch; breadth .31 inch; length of spire .28 inch.

Var. *a;* with the color nearly black.

Station.—Unknown. Habitat.—Taboga; C.B.A.! 32 specimens were collected.

**gracilior** *Adams* **Chemnitzia** [167 : 391] Plate 10, fig. 2

Shell very long, conic: very pale yellowish brown: with, on each whorl, about twenty-eight slender ribs, which terminate abruptly just below the periphery of the last whorl: with a well impressed spiral line next behind the anterior termination of the ribs, and a few obsolete spiral striae: spire with the outlines nearly rectilinear except near the apex: whorls twelve, slightly convex, with a well impressed suture: aperture ovate, acute above: labrum very thin: columella a little curved: umbilicus wanting.

Mean divergence about 13°; length .31 inch; breadth .06 inch; length of spire .255 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found in the sand.

[Is *Turbonilla* (*Strioturbonilla*) *gracilior* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68**, p. 58, pl. 4, fig. 6.]

**gracilis** *Adams* **Columbella** [89 : 313] Plate 7, fig. 5

Shell long ovate conic; upper whorls pale brown; with irregular spots of darker reddish brown, mostly near the suture and nearly covering the last whorl, on the periphery of which is a whitish band articulated with arrow-headed brown spots: with very numerous small ribs, of which the posterior ends only remain on the back of the last whorl; anteriorly with revolving striae: apex acute: spire conic: whorls eight, scarcely convex, with the suture distinctly impressed: aperture narrow: labrum variciform, rather sharp-edged, thickened behind, a little sinuate posteriorly, with a few granules inside: columellar lip nearly smooth.

Mean divergence about 37°; length .3 inch; breadth .125 inch; length of spire .2 inch.

Var. with the color nearly uniform dingy brown.

Station.—Unknown. Habitat.—Panama; C.B.A.! We are indebted to the hermit crabs for 7 specimens.

**grandimaculata** *Adams* **Pleurotoma** [143 : 367] Plate 7, fig. 9

Shell long, ovate pyramidal: black, with a single spiral series of very large dingy white spots: with excessively minute in-

cremental and spiral striae, the latter of which are obsolete anteriorly; with a sharp simple spiral keel a little below the suture; a little below the middle of the whorls is a sharp tuberculated keel, which is less developed between the tubercles; these tubercles coincide with the white spots, and on the last whorl are transversely elongated; on the last whorl four or five more spiral linear keels are seen: apex acute: spire conic: whorls ten, concave between the keels, with the suture indistinct; aperture rather narrow; labrum moderately thickened, with the sinus rather deep: labium well developed: canal very short.

[144] Mean divergence about 38°; length .95 inch; breadth .35 inch; length of spire .62 inch.

Having received from Mr. Cuming specimens of this species labelled *P. zonulata,* we infer that it has been confounded with that species in collections. Mr. Cuming's specimens are said in the MS. catalogue to have come from the Philippine Is., but as their specific identity with our species is unquestionable, it is probable that the catalogue is erroneous.

Station.—Unknown. Habitat.—Panama; C.B.A.! We obtained 1 fresh and 1 faded specimen.

**inconspicua** *Adams* **Cingula** (?) [181 : 405] Plate 9, fig. 12

Shell ovate fusoid: white: with several spiral ridges, of which four are seen on the penult whorl, and of which the upper two are less prominent; anteriorly the ridges are also less prominent; with transverse ridges decussating the upper spiral ridges and terminating at the third: apex subacute: spire with the outlines a little curvilinear: whorls five, a little convex, with a well impressed suture; last whorl small: aperture small, ovate, acute above: labrum rather thin: labium well developed: umbilical region a little indented.

Mean divergence about 30°; length .065 inch; breadth .035 inch; length of spire .045 inch.

Some authors would refer this species to *Rissoa:* but the aperture is Turbinoid rather than Melanoid.

Station.—Unknown. Habitat.—Panama; C.B.A.! 3 specimens were found in the calcareous sand.

[Is *Odostomia* (*Chrysallida*) *inconspicua* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 139, pl. 14, fig. 3.]

**inconspicua** *Adams* **Oliva** [50 : 274] Plate 6, fig. 4

Shell rather slender: white: smooth: spire about as long as the aperture: apex rather obtuse: whorls six, with a well impressed suture, slightly convex: aperture acuminate in the upper half, subrectangular in the lower half: labrum thin: anterior notch very slight, wide.

Mean divergence about 30°; in another specimen nearly 40°; length .15 inch; breadth .055 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! We obtained only 3 mature specimens and one immature, in picking over several quarts of fine drift materials gathered on the shore near the city wall.

[51] A kindred undescribed species occurs in Jamaica. Like the above and like most of the minute rare tropical species, it appears to have escaped the notice of collectors.

**inconspicua** *Adams* **Rissoa** (?) [178 : 402] Plate 9, fig. 8

Shell ovate conic: white: with several spiral ridges, of which two or three are seen on the spire: with about twelve or fourteen transverse narrow ridges, which are obsolete anteriorly: apex subacute: spire with curvilinear outlines: whorls four, very convex, with a deep suture: last whorl rather ventricose, short: aperture orbicular, scarcely effuse: lip well thickened: with a very minute umbilicus. Perhaps this species should have been referred to *Cingula*.

Mean divergence about 55°; length .045 inch; breadth .03 inch; length of spire .032 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

**inconspicuus** *Adams* **Triphoris** [159 : 383] Plate 9, fig. 10

Shell long, ovate fusiform, sinistrorsal: blackish red, fading into a cinereous color: with three spiral equidistant strongly nodulous ridges on each whorl, of which the intermediate one is wanting on the upper whorls, and three or four additional scarcely nodulous ridges anteriorly; with about twenty or twenty-two transverse less prominent ridges on each whorl: apex very acute: spire with curvilinear outlines: whorls twelve, moderately convex, with the suture indistinct; last whorl with

the periphery subangular: aperture subrhombic, with a sinus above: labrum much advanced: canal deep, short.

Mean divergence about 22°; length .165 inch; breadth .055 inch; length of spire .13 inch.

Station.—Under stones near low water mark. Habitat.—Taboga and Panama; C.B.A.! 16 specimens were collected.

[Is *Triphoris inconspicuus* C. B. Adams; Bartsch 1907, Proceedings United States National Museum **33**, p. 258, pl. 16, fig. 15.]

**inflata** *Adams* **Potamomya** [296 : 520] Plate 17, figs. 12-13

Shell ovate, ventricose, inequilateral, moderately inequivalve; posterior margin subtruncated between the extremities of two umbonial angles, of which the upper one is indistinct; ventral margin moderately excurved; anterior margin abruptly and regularly rounded: white beneath a pale brown epidermis: with unequal striae of growth: beaks small: umbones very prominent, somewhat compressed: teeth small; tooth of the left valve with a medial ridge.

Length .7 inch; height .57 inch; breadth .5 inch.

A less ventricose variety has the following dimensions: Length .6 inch; height .46 inch; breadth .33 inch.

Station.—With *P. aequalis,* q.v. Habitat.—Panama; C.B.A.! 3 specimens were obtained with *P. aequalis.*

[Pilsbry (1932, Nautilus **45**, p. 105) created a new subgenus in the genus *Corbula* for this species. It is *Panamicorbula* Pilsbry, the type species, *Potamomya inflata* C. B. Adams.]

**inflata** *Adams* **Stomatella** [216 : 440] Plate 12, fig. 13

Shell very obliquely elliptical: white, thick and opaque anteriorly, above thinner and translucent: with very fine irre-[217] gular striae of growth; without spiral striae: apex minute, obtuse, prominent: whorls two, very convex, with a well impressed suture; last whorl very oblique, much inflated and very convex: aperture contracted, yet exhibiting the spiral columella to the apex; columellar side of the aperture abruptly arcuated.

Length obliquely .45 inch; breadth obliquely .31 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

**infrequens** *Adams* **Auricula** [209:433] Plate 12, fig. 5

Shell ellipsoidal: brown, with a pale ill-defined spiral band a little below the suture: with fine striae of growth: apex acute: spire with the outlines moderately curvilinear: whorls six, obtusely shouldered, with a deep suture; last whorl compressed: aperture subelliptical, rather wide: labrum very thin: with two plates, of which one is at the anterior part of the aperture and is oblique, and the other is transverse and is at the middle.

Mean divergence about 80°; length .23 inch; breadth .15 inch; length of spire .1 inch.

Station.—Under stones, near high water mark. Habitat.—Panama; C.B.A.! We collected 6 specimens, in company with *Pedipes angulata,* at the base of the sea wall of Panama.

**infrequens** *Adams* **Bulla (Tornatina)** [214:438] Plate 12, fig. 4

Shell cylindric, not compressed about the middle: white: smooth: apex papillary, very minute and prominent: spire moderately elevated, convex: whorls four and one-half, acutely shouldered, with a deeply channeled suture: aperture long and narrow, anteriorly rounded: labrum very thin, much advanced along the middle: columella terminating in a very robust spiral plait.

Mean divergence about 130°; length .28 inch; breadth .11 inch; length of spire .03 inch.

Station.—Unknown. [215] Habitat.—Panama; C. B. A.! 2 specimens were found.

**infrequens** *Adams* **Rissoa** [179:403] Plate 12, fig. 2

Shell very long, ovate conic: white: with, on each whorl, sixteen very obtuse slightly elevated indistinct ribs, which are separated only by striae, and a few microscopic revolving striae: apex subacute: spire with the outlines nearly rectilinear: whorls seven, contracted above, otherwise convex or subangular with a moderately impressed suture; last whorl long, subangular: aperture oblique, subovate, scarcely effuse: labrum much excurved, well thickened: umbilicus wanting.

Mean divergence about 23°; length .24 inch; breadth .075 inch; length of spire .18 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

**infrequens** *Adams* **Triphoris** [159:383] Plate 9, fig. 11

Shell long, conic: blackish red: with three excessively prominent much compressed spiral ridges on the spire, and another on the periphery of the last whorl; with about sixteen or eighteen less prominent transverse ridges on each whorl; anteriorly without sculpture: apex acute: spire with the outlines nearly rectilinear: whorls thirteen, nearly flat, with the suture indistinct; last whorl very short: aperture subquadrate: labrum scalloped by the spiral ridges: canal rather wide, very short.

Mean divergence about 20°; length .13 inch; breadth .045 inch; length of spire .105 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found.

[Is *Cerithiopsis infrequens* C. B. Adams; Bartsch 1913, Proceedings United States National Museum **40,** p. 355, pl. 37, fig. 1.]

**iota** *Adams* **Eulima** [198:422] Type lost

Shell subulate: smooth and shining: with a microscopic line a little below the middle of the whorls, above which line the shell is chalcedonic white and translucent, and below which it is transparent: apex subacute: spire much arcuated: whorls ten, moderately convex, with a distinct suture: aperture small, ovate, subeffuse: labrum much advanced along the middle. It may be a *Stylifer.*

Mean divergence about 20°; length .08 inch; breadth .03 inch; length of spire .06 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! We found 1 mature and 1 young specimen.

[Is *Melanella* (*Balcis*) *iota* C. B. Adams; Bartsch 1917, Proceedings United States National Museum **53,** p. 332, pl. 40, fig. 5].

**janus** *Adams* **Rissoa** [179:403] Plate 12, fig. 1

Shell long, ovate conic: white: anteriorly with fine crowded spiral striae; elsewhere covered with small crowded transverse ribs, which on the last whorl appear merely as transverse striae becoming obsolete near the periphery: apex acute: spire with

the outlines moderately curvilinear: whorls nine, moderately convex, with a lightly impressed suture: aperture large, oblique, moderately effuse below, more deeply effuse above: labrum much advanced along the middle, thickened by a broad stout varix: umbilicus wanting.

Mean divergence about 30°; length .19 inch; breadth .07 inch; length of spire .115 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found in the sand. Var. a is larger, being .24 inch long.

[Is *Rissoina janus* C. B. Adams; Bartsch 1915, Proceedings United States National Museum **49**, p. 60, pl. 32, fig. 8. *Rissoa janus* var *a* was subsequently described as a new species *Rissoina adamsi* Bartsch 1915, ibid. p. 47, pl. 30, fig. 5. The holotype is in the Museum of Comparative Zoology no. 186424.]

**janus** *Adams* **Vitrinella** [185 : 409] Plate 15, fig. 5 a–b

Shell subdiscoidal: white: with four very narrow acute spiral keels, of which one on the periphery is very prominent, another a little below the periphery is less prominent, and the other two, on the middle of the upper and lower sides, are moderately developed; with minute spiral striae within the lower keel; otherwise with transverse striae, which are interrupted by the keels: apex prominent; spire moderately elevated: whorls three and one-third, with a distinct suture: aperture orbicular, very oblique: lip slightly thickened, angulated by the keels: umbilicus deep.

Mean divergence 160°; greatest breadth .068 inch; least breadth .06 inch; height .03 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

[Is *Cyclostremiscus janus* C. B. Adams; Pilsbry and Olsson 1945, Proceedings Academy Natural Sciences Philadelphia **97**, p. 270, pl. 27, figs. 5, 5a, 5b.]

**jugosa** *Adams* **Ricinula** [101 : 325] Plate 7, fig. 8

Shell with a rhomboidal outline: mostly dark brown; tubercles mostly white; with a white fascia next below the periphery of the last whorl; with some of the tubercles partly rufous: with eight or nine very prominent transverse ridges, which are crossed by ten or eleven spiral ridges, of which three or four appear on the spire; with the intersections sharply tuber-

culous; with fine spiral striae: apex acute: spire conic: whorls eight or nine, convex, with a moderately impressed suture: aperture rather long: labrum rather sharp, strengthened by the last ridge, which is very long, scalloped by the spiral ridges, with corresponding plaits within: inner lip excavated above, with a few wrinkles above and granules below; canal moderately long. This species is much like a *Murex*.

[102] Mean divergence 55°; length .94 inch; breadth .47 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only one specimen was obtained.

[Is *Engina jugosa* C.B.Adams; Pilsbry and Lowe 1932, Proceedings Academy Natural Sciences Philadelphia **84**, p. 64.]

**laeve** *Adams* **Coecum** [162 : 386] Plate 17, fig. 5

Shell well arcuated, rather stout, of nearly uniform diameter: white: smooth and shining: apex very prominent.

Length .08 inch; breadth .027 inch.

Var. (?) *minus* is more slender, with the apex less prominent.

Length .062 inch; breadth .02 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found, viz. 1 of each variety.

**laqueatum** *Adams* **Coecum** [162 : 386] Plate 17, fig. 4

Shell slender, moderately arcuated, with the diameter regularly increasing: white: longitudinally furrowed with about 20 shallow somewhat unequal grooves: apex moderately prominent, lateral.

Length .11 inch; breadth .028 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were obtained.

**leanus** *Adams* **Trochus** [191 : 415] Plate 13, fig. 9

Shell conic, well elevated: pale yellowish or reddish brown, with broad dark brown oblique flammules; anteriorly somewhat articulated with red and yellowish white in fine con- [192] centric lines: with many elevated granulous spiral lines, of which three larger are next above the suture: spire with the outlines nearly rectilinear: apex acute: whorls nine, planulate or concave next below the suture, very convex or subangular next above the suture, which is moderately impressed,

last whorl subplanulate anteriorly: aperture subquadrate: labrum thin: columella obliquely produced, nearly straight: umbilicus wanting.

Mean divergence about 60°; length .48 inch; greatest breadth .44 inch; least breadth .4 inch.

Station.—Under stones at low water mark. Habitat.—Panama; C.B.A.! 7 specimens were collected on the reef. We have named this pretty species in honor of Isaac Lea, Esq., of Philadelphia.

**lugubre** *Adams* **Buccinum** [69:293] Plate 5, fig. 7

Shell long ovate-fusiform: very dark brown with a cinereous tinge: with small ribs, from nine to thirteen on each whorl, traversed by rather coarse unequal spiral striae, with the intersections of the larger striae rather acutely nodulous: apex acute: spire conic: whorls eight, very convex, with a [70] moderately impressed suture: aperture ovate: labrum rather sharp, thickened behind: with a short recurved canal.

Mean divergence about 44°; length .67 inch; breadth .31 inch; length of spire .4 inch.

After much doubt respecting the generic characters of this species, we have provisionally referred it to that group of Buccina, which have a short recurved canal.

Station.—Under stones at low water mark. Habitat.—Panama and Taboga; C.B.A.! We collected 175 specimens.

[Is in the genus *Latirus,* Pilsbry and Lowe 1932, Proceedings Academy Natural Sciences Philadelphia **84**, p. 114].

**luticola** *Adams* **Bulla (Cylichna)** [215:439] Plate 11, fig. 11

Shell subcylindric, wider anteriorly: pale horn color, subtransparent: with the striae of growth very minute: apex in a deep narrow umbilicus, which is partly covered by the upper part of the labrum: last whorl compressed around the middle: aperture rising higher than the umbilicus, linear above, suborbicular below: labrum very thin, much advanced along the middle: columella thickened with a callus: anterior umbilical region indented, partly covered with a deposit.

Length .2 inch; breadth .095 inch.

Station.—This species was found crawling on liquid mud, near low water mark, at the bottom of a steep sand beach.

Habitat.—Panama; C.B.A.! 28 specimens were collected half a mile east of Panama.

**major** *Adams* **Chemnitzia** [167 : 391] Plate 10, fig. 1

Shell conic, long: dingy white: with, on each whorl, about twenty-four stout obtuse approximate ribs, which are obsolete anteriorly; with lightly impressed fine spiral striae over all the surface except the summits of the ribs: spire with the outlines rectilinear: whorls fifteen, moderately convex, with a well impressed suture: aperture subovate: labrum thin: columella nearly straight: umbilicus wanting.

Mean divergence about 17°; length .38 inch; breadth .09 inch; length of spire .31 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen only was found.

[Is *Turbonilla* (*Mormula*) *major* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 116, pl. 11, fig. 11.]

**marginata** *Adams* **Chemnitzia** [167 : 391] Plate 10, fig. 3

Shell fusiform cylindric; dingy white: with, on each whorl, [168] eleven or twelve very prominent strong compressed ribs: in the interspaces with fine spiral striae, of which five or six are seen on the penult whorl: apex with the axis oblique: spire with the outlines curvilinear: whorls seven, margined above with a spiral compressed ridge, moderately convex, with a well impressed suture: last whorl with the periphery rounded: aperture small, oblique, ovate: labrum thin: labium with a distinct deposit: umbilicus wanting.

Mean divergence about 28°; length .115 inch; breadth .042 inch; length of spire .08 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found.

[Is *Odostomia* (*Pyrgulina*) *marginata* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 169, pl. 18, figs. 5–5a.]

**maritima** *Adams* **Cyrena** [275 : 499] Plate 20, figs. 5–6

Shell subtriangular, but with the ventral margin well excurved, ventricose, thin: dingy white, more or less violaceous in the posterior half: with an olivaceous coarsely striate epi-

dermis: with well impressed striae of growth: beaks very prominent, approximate: umbones very prominent: with a prominent posterior angle, and another less developed posterior [276] angle, which defines the area of the corselet: with an indistinct intermediate angle: lunule broad and deep, but not well defined: ligament large: margins thin: with all the cardinal and lateral teeth well developed, but not thick.

The dimensions of two specimens are as follows:—

Length 2 inches; height 1.75 inches; breadth 1.5 inches.
" 2.7 " " 2.25 " " 1.95 "

Station.—In impalpable mud, under bushes, at high water mark, where a small stream emptied.

Some of the dead shells, which had not been moved from their station, had Balani growing in them.

Habitat.—Panama; C.B.A.! 2½ miles east of Panama 9 specimens were collected.

[Is in the genus *Polymesoda.*]

**megasoma** *Adams* **Littorina** (?) [174 : 398] Plate 11, fig. 6

Shell obliquely ovoid: dingy white: with eight or nine small spiral ridges, of which three are seen on the spire; with very coarse deep regular transverse striae: apex acute: spire very small, with the outlines nearly rectilinear: whorls three, angular, with an excavated suture: last whorl very large and obliquely dilated: aperture subelliptical, with the margin continuous and thin: umbilical region well defined by the anterior spiral ridge, well excavated, and forming with the umbilicus a funnel-shaped pit.

Mean divergence about 135°; length .09 inch; breadth .09 inch; length of spire .035 inch.

This species also is referred to *Littorina* with much hesitation: it approaches *Narica* more nearly than any of the species which we have mentioned as resembling that genus.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the sand.

[Is in the genus *Fossarus.*]

**minor** *Adams* **Marginella** [40 : 264] Plate 6, fig. 3

Shell ovate: white, or pale horn color, subtransparent; rather thin, smooth: spire slightly elevated: whorls about three (?)

with a very indistinct suture: aperture linear: lip rather thin at the margin, thickened behind, posteriorly ascending the spire: columella with two well developed plaits at the end, with a third one less developed, and sometimes with a fourth which is more or less indistinct. Length, .09 inch: breadth, .063 inch: some of our specimens, which appear to be full grown, are much smaller.

This little shell closely resembles the Caribbean species, *M. lavelleana* Orb. (*M. minima* Guild.): the most obvious difference is in the outline, which in the Caribbean species is broader across the upper part of the last whorl, the lip consequently being, at this part, more excurved.

Station.—Unknown. Habitat.—Panama; C.B.A.! We obtained 10 more or less perfect specimens from the calcareous sand, which had been washed up near the sea wall of Panama.

[Is *Marginella* (*Gibberula*) *minor* C. B. Adams; Pilsbry and Olsson 1941, Proceedings Academy Natural Sciences Philadelphia **93**, p. 27.]

**minus** *Adams* **Coecum laeve** (?) var. [162 : 386]
Type MCZ 186582

[Is *Coecum laeve* C. B. Adams, which see.]

**minuta** *Adams* **Vitrinella** [186 : 410] Plate 14, figs. 1–2

Shell discoidal: dingy white, shining: with excessively minute transverse striae: apex obtuse: spire scarcely elevated: whorls nearly three, depressed above, with a well impressed suture; last whorl much depressed, subangular at the periphery: aperture rather large, orbicular: labrum slightly thickened: umbilicus rather deep, nearly covered.

Mean divergence about 170°; greatest breadth .042 inch; least breadth .036 inch; height .017 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 4 specimens were found in the calcareous sand.

[Is *Solariorbis minutus* C. B. Adams; Pilsbry and Olsson 1952, Proceedings Academy Natural Sciences Philadelphia **104**, p. 48; figured by Pilsbry and Olsson 1945, ibid. **97**, pl. 26, figs. 1–2.]

**modesta** *Adams* **Vitrinella** [186 : 410] Plate 16, fig. 1, a–b

Shell discoidal: dingy white, translucent: with a spiral elevated line next below the suture, and a spiral keel around the

umbilicus; with few microscopic spiral striae about the periphery of the last whorl: apex not prominent: spire a little elevated and regularly convex: whorls three and one-half, with the suture distinct: aperture orbicular: umbilicus deep.

Mean divergence 170°; greatest breadth .06 inch; least breadth .05 inch; height .028 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

[Is *Vitrinella modesta* C. B. Adams; Pilsbry and Olsson 1952, Proceedings Academy Natural Sciences Philadelphia **104**, p. 72; figured by Pilsbry and Olsson 1945, ibid. **97**, p. 278, pl. 28, fig. 1, a–b.]

**moesta** *Adams* **Columbella** [94 : 318] Plate 7, fig. 6

Shell slender, subfusiform: black, or brownish black, with the color less intense on the back of the last whorl: upper [95] whorls smooth or with one or two revolving striae; middle whorls with twelve to fifteen ribs, with the interstices spirally striate; with the ribs and striae obsolete on the back of the last whorl; more strongly striated anteriorly: apex acute: spire very slender: whorls eight, scarcely convex, with the suture lightly impressed: aperture long and narrow: labrum varicose, very thick, sinuate posteriorly, crenulated within: columellar lip nearly smooth.

Mean divergence about 35°; length .3 inch; breadth .11 inch; length of spire .17 inch.

Station.—We found this species about sticks and stones in a grove of trees, a little above half tide level. Habitat.—Panama; C.B.A.! 58 specimens were obtained about two miles west of the city.

**monstrosum** *Adams* **Coecum** [162 : 386] Plate 17, fig. 2

Shell well arcuated, stout in the lower half and very slender in the upper half, with the transition abrupt, as if the effect of an accident: ivory white: on the upper part with about 18 rather stout approximate moderately prominent rings with flat [163] summits; in the lower part with about 12 very stout prominent not closely approximate rings with flat summits; with 2 or 3 ribs on the middle with intermediate characters: apex prominent.

Length .09 inch; breadth of the upper part .018 inch; breadth of the lower part .03 inch.

This extraordinary shell appears like a monstrosity. It cannot however be a deformed *C. firmatum,* since it is the *last half* of the shell which resembles that species. If it were the last half which is contracted, it would look more like the effect of an accident. But accidents to mollusks do not, so far as we have seen, cause a greater development of the shell.

7 specimens, agreeing in all the above described characters, establish the species.

Station.—Unknown. Habitat.—Panama; C.B.A.!

**neglecta** *Adams* **Mangelia** [149 : 373] Plate 8, fig. 4

Shell subfusiform: pale brownish red: with, on each whorl, eight or nine prominent curved ribs, and an elevated spiral line on the middle of the whorls, which becomes obsolete on the last whorl; anteriorly with several spiral striae: apex acute: spire with the outlines moderately convex: whorls seven, rather convex, with a distinct suture: aperture rather narrow, mostly parallel with the axis of the spire: labrum much thickened within and without, with a narrow sinus: canal very short.

Mean divergence about 40°; length .2 inch; breadth .07 inch; length of spire .11 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! We obtained 2 specimens from the calcareous sand at Panama; also other 2, of a more slender variety.

This is one of the many species whose claim to a place in the genus *Mangelia* will not be universally conceded.

**neglecta** *Adams* **Ovula** [31 : 255] Plate 6, fig. 1

Shell rather slender: dark violaceous red, sometimes with a light tinge of brown; paler on the lip: smooth, sometimes with microscopic revolving striae: aperture very narrow in the posterior three-fifths, wider anteriorly; slightly produced at both extremities, and slightly emarginate anteriorly: lip well thickened, nearly straight along the middle: columella acuminate at both extremities, with a longitudinal impressed line, and a callus behind it. Length, .31 inch; breadth, .1 inch.

This species resembles the fig. of *O. rufa,* Sowb., which is represented as much larger, with a broader aperture.

Station.—With *O. avena,* which see. Habitat.—Panama.—C.B.A.! We collected 13 specimens on the reef.

**neglectum** *Adams* **Cerithium** [154:378] Plate 9, fig. 9

Shell long, ovate conic: blackish red, with the apex white: with three prominent spiral ridges on each whorl, of which the upper two are less distant; with prominent transverse ridges, sixteen or eighteen on the last whorl, where they are less robust than on the spire, and which become obsolete on the periphery of the last whorl; with the intersections developed into very prominent elegantly rounded nodules; anteriorly with two additional subgranulous spiral ridges; apex acute: spire with curvilinear outlines: whorls ten, moderately convex, with the suture indistinct; last whorl rather short: aperture obliquely subovate: labrum a little modified by the spiral ridges: canal deep, very short.

Mean divergence about 20°; length .125 inch; breadth .04 inch; length of spire .09 inch.

Station.—Under stones, in old shells, in dead sponges, &c., near low water mark. [155] Habitat.—Panama; C.B.A.! 33 specimens were collected.

[Is *Cerithiopsis* (*Cerithiopsis*) *neglecta* C. B. Adams; Bartsch 1913, Proceedings United States National Museum **40,** p. 343, pl. 40, fig. 5.]

**nivea** *Adams* **Crepidula** [234:458] Plate 11, figs. 12–13

Shell ovate-elliptic: rather thick: within snow white: without dingy white, sometimes with a faint tinge of brown: very irregularly concentrically more or less wrinkled, with very distinct striae of growth: apex turned more or less to the right, moderately prominent, marginal: septum longitudinally subangular, with a deep sinus at the left and a shallow one at the right: margin thick, exhibiting striae of growth. It closely resembles *C. unguiformis,* but constantly differs in characters and station.

Length 1.4 inch; breadth 1 inch; height .4 inch.

Station.—Under stones, near low water mark. Habitat.—Panama; C.B.A.! 45 specimens were collected on the reef.

[Is *Crepidula* (*Ianacus*) *nivea* C. B. Adams; Hertlein and Strong 1955, Bulletin American Museum Natural History **107,** p. 279.]

**notabilis** *Adams* **Rissoa** [180:404] Type lost

Shell long ovate-conic: white: with, on each whorl, about fourteen transverse very prominent ribs, which have concave

summits; with four spiral keels, of which the upper two are more distant and are seen on the spire on each side of the suture; the transverse ribs are smaller in the parts between the second and third keels, and are obsolete below the third: apex subobtuse, smooth and shining: spire with the outlines rectilinear except near the apex: whorls six, abruptly shouldered, planulate, with the suture subcanaliculate: aperture ovate: umbilicus wanting.

Mean divergence about 24°; length .06 inch; breadth .027 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

[The holotype of this species was lost by P. P. Carpenter. Concerning this species he wrote (1863, Proceedings Zoological Society London, p. 353) "After drawing this unique shell carefully under the microscope, and making copious notes on the diagnosis from the specimen, an untoward cough lodged it among the meshes of the Curator's carpet, whence I endeavoured in vain to extricate it. This unfortunate accident is, however, the less to be regretted, as I can state with perfect confidence that it was exactly identical with another shell in the collection, P [anama] 255 [*Cingula turrita* C. B. Adams], q.v.; and with M [azatlan Catalogue] 498, *Parthenia quinquecincta.* The 'concave summits' of the ribs imply that the ribs are sharp, with concave interstices; and the 'upper keel' is simply due to the angulation of the whorls. Though the lip was broken, the columellar plait, as well as the sinistral apex, escaped the Professor's notice."

As noted above, Carpenter definitely states that *Rissoa notabilis* C. B. Adams was the same as *Cingula turrita* Adams and his own *Parthenia quinquecincta.* Therefore, *notabilis* being the first name introduced, becomes the name for the species. Consequently, the new name *Odostomia* (*Ividella*) *orariana* introduced by Dall and Bartsch (1909, Bulletin United States National Museum **68,** p. 175) for *Cingula turrita* C. B. Adams is unnecessary. This species should be referred to as *Odostomia* (*Ividella*) *notabilis* C. B. Adams with all of the above mentioned names included in the synonymy. Though Dall and Bartsch considered *quinquecincta* Carpenter as a distinct species, we agree with Carpenter that it is identical with C. B. Adams' species.]

**osculans** *Adams* **Crepidula** [234 : 458] Plate 16, fig. 4, a–b

Shell elliptical: pale horn color, subtransparent: surface minutely decussated with numerous very small radiating and concentric ridges: apex subterminal, very prominent, not marginal, with the nuclear portion smooth, shining, transparent and slightly directed to the right: septum but little above the margin, extremely narrow or linear, extending around the posterior

part of the shell: margin very thin. In some respects, this species is allied to *Pileopsis*.

Length .14 inch; breadth .1 inch; height .045 inch.

[235] Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen of this extraordinary species was obtained.

**osculans** *Adams* **Purpura** [79:303] Types lost

Shell obliquely rhombic: dingy white, pure white within: with, on each whorl, 9 transverse, rather small, prominent, well-rounded ridges, which are produced to the anterior extremity: with crowded spiral closely imbricately scaled narrow ridges, which traverse the transverse ridges, and of which the alternate ones are more prominent: apex acute: spire with the outlines rectilinear: whorls six and one-half, convex, with a well-impressed suture: aperture obovate: labrum finely scalloped, transversely grooved within: with a short, deeply-notched canal. Allied to *Purpura galea* and other kindred species.

Mean divergence about 70°; length .27 inch; breadth .17 inch; length of spire .12 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were obtained.

[This species appears to be the young of *Rhizochcilus nux* Reeve; Carpenter 1863, Proceedings Zoological Society London, p. 344.]

**pacifica** *Adams* **Gouldia** [275:499] Plate 20, figs. 3–4

Shell subtriangular, but with the ventral margin well excurved: the color varying in different specimens from dingy white to pale brown, often tinged with red about the beaks, with some narrow rays of brown, and rarely with short irregular lines of brown: with eight to twelve stout subequal concentric ridges: sometimes radiately striated; beaks very acute and closely approximate: posterior area moderately depressed: lunule defined by a well impressed line, rising at the margin of the valves: margin of the interior not crenulate. It is closely allied to *G. parva* Ad.

Length .22 inch; height .19 inch; breadth .09 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! We collected 4 entire shells and 60 odd valves.

[Is *Crassinella pacifica* C. B. Adams; Pilsbry and Olsson 1941, Proceedings

Academy Natural Sciences Philadelphia **93,** p. 56; Hertlein and Strong 1946, Zoologica **31,** p. 103.]

**panamensis** *Adams* **Auricula** [209:433] Plate 13, fig. 5

Shell long ovate: blackish red throughout except that the plaits are white: smooth and shining, with a few microscopic spiral striae near the apex: apex acute: spire with the outlines very curvilinear over the middle whorls, and nearly rectilinear on the lower whorls: whorls eight, convex, imbricately appressed; [210] upper part of the lower whorls compressed; last whorl subangular next below the compressed part: aperture rather long, very acute above: labrum moderately thickened but not reflected: with three plaits on the left side, of which the middle one is larger and the lower one is the least; sometimes with a small toothlike plait on the right side.

The general form varies, as will be seen in the following dimensions of two specimens, the first number expressing the mean divergence, the second the length, the third the breadth, and the fourth the length of the spire:—

50°; .44 inch; .17 inch; .23 inch.
65°; .37 " .2 " .13 "

Station.—Under stones, at high water mark; or crawling over wet stones. Habitat.—Panama and Taboga; C.B.A.! 650 specimens collected near the sea wall of Panama, where the species was most abundant.

**panamensis** *Adams* **Chemnitzia** [168:392] Plate 10, fig. 4

Shell long, conic: white: with, on each whorl, about twenty-seven oblique ribs, which become obsolete on the middle of the last whorl, the anterior part of which is very smooth: spire with the outlines nearly rectilinear: whorls twelve, moderately convex, with a well impressed suture: last whorl sub-angular at the periphery: aperture obliquely ovate: labrum thin: columella nearly straight: umbilicus wanting.

Mean divergence about 17°; length .22 inch; breadth .055 inch; length of spire .17 inch.

Station.—In the sand between high water and half tide levels. Habitat.—Panama; C.B.A.! 11 specimens were found on the reef.

[Is *Turbonilla* (*Strioturbonilla*) *panamensis* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68,** p. 42, pl. 3, figs. 12–12a.]

**panamensis** *Adams* **Nassa** [64:288] Plate 5, fig. 9

Shell long ovate conic: bluish olivaceous, with a whitish spiral line below the middle of the whorls; colors more distinct on the ribs; whitish near the upper part of the labrum; anteriorly with a pale spiral band, which is sometimes obsolete: with, on each whorl, about eleven narrow acute ribs, which are obsolete anteriorly; with very minute spiral striae, which are less distinct below the middle of the whorls: spire with the outlines moderately curvilinear: apex acute: whorls eight, slightly convex, with a distinct suture; last whorl not ventricose: aperture elliptical; labrum thickened by a stout varix: labium thickened but not appressed: notch deep.

Mean divergence about 37°; length .58 inch: breadth .25 inch; length of spire .35 inch.

Station.—Under stones, a little above low water mark, in company with several species of *Columbella.* Habitat.—Panama; C.B.A.! We collected about 1500 specimens on the reef.

**panamensis** *Adams* **Vitrinella** [186:410] Plate 14, fig. 5, a–b

Shell subdiscoidal: white: with a stout spiral keel on each side of the periphery of the last whorl, and two others on the lower side of the shell, of which one next to the umbilicus is slightly prominent; with transverse rather distant curved ribs: apex obtuse: spire convex, but little elevated: whorls a little [187] more than three, convex above and concave below the middle, with a distinct suture: aperture orbicular: labrum angulated externally by the spiral ridges, a little thickened: umbilicus deep, narrow. A variety has the ridge around the umbilicus well developed.

Mean divergence about 160°; greatest breadth .07 inch; least breadth .06 inch; height .04 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 24 specimens were found in the calcareous sand.

[Is *Cyclostremiscus panamensis* C. B. Adams; Pilsbry and Olsson 1945, Proceedings Academy Natural Sciences Philadelphia **97**, p. 267, pl. 26, fig. 5, a–b.]

**parva** *Adams* **Vitrinella** [187:411] Plate 14, fig. 3, a–b

Shell subdiscoidal: white: with numerous stout prominent transverse ribs; with, on each side of the periphery of the last whorl, a not very prominent keel, of which the upper one is

visible on the spire: apex very obtuse: spire convex, slightly elevated: whorls three and a half, angular above, concave between the angle and the keel, with the suture not very distinct; last whorl very large: aperture orbicular, very oblique in consequence of the advance of the labrum above: lip slightly thickened: umbilicus deep, narrow. This species resembles *V. panamensis.*

Mean divergence about 160°; greatest breadth .047 inch; least breadth .04 inch; height .026 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 13 specimens were found in the calcareous sand.

[Is *Cyclostremiscus parvus* C. B. Adams; Pilsbry and Olsson 1945, Proceedings Academy Natural Sciences Philadelphia **97,** p. 269, pl. 26, fig. 3, a–b.]

**parvum** *Adams* **Coecum** [163 : 387] Holotype, MCZ 186586

Shell well arcuated, slender, of nearly uniform diameter: white: with about 15 acute-edged moderately prominent distant rings: apex lateral, prominent.

Length .065 inch; breadth .019 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

[Only a small apical fragment of the holotype remains and this is not worthy of photographing. The unique specimen was dead and beach rolled at the time of collecting. P. P. Carpenter believed this to be the same as his *Caecum undatum* (1863, Proceedings Zoological Society London, p. 360.]

**paupercula** *Adams* **Cingula** [181 : 405] Plate 9, fig. 4

Shell conoid: dingy white, sometimes with a pale brown spiral stripe on the middle of the whorls: surface smooth: apex subacute: spire with the outlines nearly rectilinear: whorls five, planulate, with a well impressed suture: aperture broadly ovate: labrum slightly thickened: labium well developed: umbilicus very minute.

[182] Mean divergence about 33°; length .085 inch; breadth .05 inch; length of spire .058 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 4 specimens were found in the calcareous sand.

[This is a good species in the genus *Cingula.* It is not *Odostomia* (*Chrysallida*) *paupercula* C. B. Adams as given by Dall and Bartsch (1909, Bulletin United States National Museum **68,** p. 144, pl. 14, fig. 4). They figured and described

the type of *Cerithium pauperculum* C. B. Adams, but referred to it as *Cingula paupercula*. This was an understandable error as Adams used only an initial for the genus. Later, following the same error, Bartsch in his paper on the genus *Cingula* (1912, Proceedings United States National Museum **41**, p. 485) again stated that it is in the Pyramidellidae. He apparently never saw the type of *Cingula paupercula* Adams.]

**pauperculum** *Adams* **Cerithium** [155 : 379] Plate 8, fig. 9

Shell slender: pale horn color: with several spiral keels, of which five are visible on the spire, with many transverse ridges on the upper whorls, which are reduced to raised lines on the lower whorls, with the intersections slightly granulous; anteriorly the spiral ridges are obsolete: apex acute: spire with the outlines nearly rectilinear: whorls eight, slightly convex, with a moderately impressed suture; last whorl rather long: aperture long, acute above, with a small umbilical chink: canal very short.

Mean divergence about 18°; length .13 inch; breadth .04 inch; length of spire .09 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found.

[Is *Odostomia* (*Chrysallida*) *paupercula* C. B. Adams; Dall and Bartsch (1909, Bulletin United States National Museum **68**, p. 144, pl. 14, fig. 4) described and figured the type of this species but referred to it *Cingula ? paupercula* Ad. This was in complete error. *Cingula paupercula* Adams is a smooth, conical shell, while *Cerithium pauperculum* is highly sculptured. Adams did not write generic names on his labels and so there were two species in his collection labeled *C. pauperculum* or *paupercula*. Unfortunately Dall and Bartsch failed to check Adams' original description.]

**perparva** *Adams* **Vitrinella** [187 : 411] Plate 14, fig. 4, a–b

Shell subdiscoidal: white: with a very prominent acute spiral keel on each side of the periphery of the last whorl, and a less prominent one around the umbilicus; with transverse [188] wrinkles, which are obsolete on the upper part of the whorls; apex obtuse: spire flat: whorls nearly three, moderately convex, with a distinct suture; last whorl very large: aperture orbicular, very oblique: lip slightly thickened: umbilicus deep.

Mean divergence 180°; greatest breadth .037 inch; least breadth .031 inch; height .015 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 3 specimens were found in the calcareous sand.

[Is *Cyclostremiscus perparvus* Adams; Pilsbry and Olsson 1945, Proceedings Academy Natural Sciences Philadelphia **97**, p. 270, pl. 26, fig. 4, a–b.]

**phasianella** *Adams* **Turbo** (?) [195 : 419] Plate 16, figs. 5–8

Shell ovate conoid: color various, mostly red or brown, sometimes uniform, frequently in dark flammules on a light ground, sometimes with spiral darker stripes or series of spots: surface covered with strong spiral striae: apex subacute: spire conoid, with the outlines moderately curvilinear: whorls five, convex, with a distinct suture: aperture broad ovate, subeffuse: labrum thin: umbilicus very small.

Mean divergence about 64°; length .16 inch; breadth .11 inch; length of spire .08 inch.

Operculum calcareous, very thick and solid. But for the want of a polished surface, this species would have been referred to *Phasianella.* It may be a *Trochus.* It may be *Littorina phasianella* Phil. in Zeitschr. Malak. 1848, p. 149.

[196] Station.—Unknown. Habitat.—Panama; C.B.A.! In the calcareous sand we collected 112 specimens in various stages of growth.

**pholadiformis** *Adams* **(Byssoarca) Arca** [260 : 484] Plate 19, figs. 11–12

Shell extremely elongated, subcylindrical, contracted anteriorly, very inequilateral: inferior margin a little irregular, somewhat excurved, scarcely gaping for the passage of the byssus: posterior margin very oblique, moderately excurved: anterior margin well rounded: dingy white: surface very finely and closely fimbriated, with the concentric ridges larger except above the posterior angle of the umbo, on which the concentric ridges are lamellar: with the intersections nodular and deeply marked beneath with the arcuate striae of growth: umbones flattened, with a very prominent and very oblique posterior angle, from which the radiating ribs divaricate: beaks small: area of ligament linear, nearly concealed: margins of the interior finely crenulate; teeth obsolete at the middle of the series, at the ends divaricate. The sculpture is like that of *A. divaricata* Reeve.

Length 1.25 inch; height .53 inch; breadth .48 inch.

Station.—In soft stones, near low water mark. Habitat.—

Taboga; C.B.A.! 2 specimens of this extraordinary shell were obtained.

**planulata** *Adams* **Calyptraea** [223:447] Plate 13, figs. 11–12

Shell flat, suborbicular: thin: pure white: with very minute radiating striae, which are obsolete around the apex: apex subcentral, acute, slightly elevated above the plane of the shell: cup with the sides free and the corners acute, thin, curved through about 220°: margin very thin. It belongs to *Calyptraea* as restricted by Broderip.

Length .32 inch: breadth .35 inch.

Station.—Adhering to an oyster, a little below half tide level. Habitat.—Panama; C.B.A.! Only 1 specimen was found.

**ponderosa** *Adams* **Haliotis** Type lost

1848, American Journal of Science and Arts (2) **6**, p. 138.

H. t: magna, ovata, crassissima, convexa; striis incrementi magnis, irregularibus; rugis concentricis, irregularibus, subnodosis; spira elevata, subterminali; foraminibus quatuor, magnis; externe rubra, intus maculis plurimis rubris viridibusque iridescente.

Shell ovate, convex, ponderous, with coarse unequal incremental striae and concentric ridges (not folds), and a few broad low tubercles on the ridges; spire elevated, subterminal; four perforations open, the inner one very large; exterior surface brick red; inner surface elegantly iridiscent with innumerable shades of delicate red, purplish red, and green.

Length $8\frac{1}{2}$ in.; breadth $6\frac{2}{3}$ in.; depth within $3\frac{1}{8}$ in.

Comparison with the well known *H. rufescens,* Swains., will render a figure unnecessary. A large specimen of Swainson's shell before me, has exactly the same superficial dimensions, but is only $2\frac{1}{2}$ inches deep. *H. ponderosa* is nearly or quite destitute of the spiral waves of *H. rufescens,* is of a darker red without, wants the red inner margin [p. 139] of the outer lip, and within has the clouds of iridescent colors remarkably small and numerous, while in *H. rufescens* they are remarkably large. It is more ponderous than any *Haliotis* which we have seen, weighing 2 lbs. 2 oz. avoirdupois.

Zoological Museum, Amherst College. Hab.—?

Not finding this species in Reeve's very complete and excellent monograph, I have ventured to describe it as new.

[Bartsch (1940, Proceedings United States National Museum **89,** p. 52, pl. 7) redescribed and figured this species from Adams' holotype specimen. The type, however, was lost subsequent to Bartsch's work; it was not in the Adams' collection at the time it was transferred to the Museum of Comparative Zoology. Bartsch stated that it appeared to be related to *Haliotis rufescens* Swainson, but that it could be distinguished by its well elevated spire, pale interior and more ponderous shell.]

**proxima** *Adams* **Nassa** [64 : 288] Plate 6, fig. 5

Shell like that of *N. versicolor* (v. infrà), but much more slender, with the ribs less prominent, and very densely covered with very minute uninterrupted striae, which give a silky lustre to the surface.

Mean divergence about 38°; length .44 inch; breadth .21 inch; length of spire .28 inch.

[65] Station.—Unknown. Habitat.—Taboga; C.B.A.! One specimen was obtained.

**proximum** *Adams* **Amphidesma** [289 : 513]
Plate 18, figs. 14–15

Shell suborbicular, slightly flexuous, a little inequilateral, with the anterior dorsal margin concave, with the posterior dorsal margin a little excurved, subtruncated posteriorly, otherwise with the margins well rounded: snow white, with a thin slate or umber-colored epidermis: centrally and anteriorly with very fine rather distant raised lines; with extremely minute [290] radiating striae over the whole surface: beak small, approximate: left umbo more convex than the right one: corselet and lunule long and narrow, concave. It is closely allied by varieties to *A. ellipticum* Sowb.: it corresponds mostly to the descriptions of *A. lenticulare* Sowb., but the figures of that species in Sowb. Conch. Ill. and Hanley App. Wood Ind. appear to represent a distinct species.

Sometimes the shell is tinged with brownish orange near the beaks and middle portion, especially in the interior. In some specimens the inner surface within the pallial line is finely and deeply punctated, and the deep pallial sinus is marked with striae radiating from the opening of the sinus.

Length 1.8 inch; height 1.58 inch; breadth .82 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 18 specimens were taken on the reef at low water mark.

**puella** *Adams* **Tellina** [283 : 507] Plate 19, figs. 13–14

Shell elongate, rather solid, convex, moderately inequilateral; ventral margin slightly excurved, posteriorly straight; anterior margin broadly rounded; anterior dorsal margin slightly excurved; posterior dorsal margin straight, rapidly sloping to an acute posterior extremity; flexure moderate: white, more or less deeply tinged with red, mostly near the margin: shining; with excessively minute concentric striae, and some faint microscopic radiating striae: beaks not very prominent: ligament small: lateral teeth well developed.

Length .9 inch; height .53 inch; breadth .28 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 12 odd valves were collected.

**pulchrior** *Adams* **Columbella** [96 : 320] Plate 6, fig. 10

Shell rather long ovate: with a whitish revolving band next below the suture articulated with large spots of a dark slate color; with a translucent ground of pale yellowish brown, on which are placed in quincunx order rather numerous, excessively minute sharply defined dots of reddish brown; with one or two large irregular spots of dark brown near the end of the last whorl: surface smooth and shining: apex acute: spire conic: whorls six or seven, scarcely convex, with the suture lightly impressed: aperture narrow: labrum rather sharp, thickened behind, with a few granules inside: columellar lip nearly smooth.

Mean divergence about 45°; length .15 inch; breadth .07 inches; length of spire .075 inches.

Station.—Under stones near low water mark. Habitat.—Panama; C.B.A.! We found of this rare and elegant little shell only 5 specimens.

**pulchrum** *Adams* **Cerithium** [156 : 380] Plate 11, fig. 1

Shell rather long, subconic; very dark brownish red, with a yellowish white spiral line on the middle of the whorls: with about forty slender acute ribs on each whorl, which terminate

abruptly on the periphery of the last whorl; with very stout varices 240° distant; with a narrow acute spiral keel, above the middle of the whorls, traversing the ribs and varices: with a few raised spiral lines and many minute spiral striae, which do not traverse the ribs; anteriorly with crowded coarse spiral striae: apex acute: spire with the outlines moderately curvilinear: whorls eleven, convex, with a deep suture; last whorl short: aperture large, quadrate-orbicular, broadly effuse above, with a very narrow sinus in place of the canal; labrum and labium continuous, very thick and highly polished.

Mean divergence about 33°; length 1.25 inch; breadth .65 inch; length of spire .82 inch.

This species must closely resemble *C. Montagnei* Orb. But in Kiener's figure and description, Orbigny's species appears to be destitute of varices. Menke, however, in his specimen of *C. Montagnei* from Mazatlan, finds 48 ribs on the last whorl, but mentions no varices.

Station.—Half buried in muddy sand under bushes at high water mark. Habitat.—Panama; C.B.A.! 125 specimens were collected, near the mangrove thicket, $2\frac{1}{2}$ miles east of Panama.

[Is *Cerithidea pulchra* C. B. Adams. There has been considerable confusion and misunderstanding concerning this species of Adams. It has been considered a subspecies of *Cerithidea montagnei* d'Orbigny by Hertlein and Strong (1955, p. 269) and Bequaert (1942, p. 25) considered it a variety of *C. hegewischii* Philippi. Carpenter (1863, p. 350) and Zilch (1954, p. 83) both regarded it as a good species, and, after examining the types, I agree with them. There appear to be no intergrades between *pulchra* and *hegewischii*. *Cerithidea pulchra* has much finer, more blade-like costae than *hegewischii* and the lip is always a dark chocolate brown in color. In *hegewischii* the lip is white, with occasional specimens having the lip edged with brown, the costae are rounded, much heavier and generally not as numerous as they are in *pulchra*. In addition, the spiral sculpture of the two species is quite different; in *pulchra* there is a fine spiral cord at the whorl shoulder with a much weaker one between it and the suture; the remaining spiral sculpture is composed of very fine threads which do not cross the costae so that the shell is not nodulous in appearance. In *hegewischii* there are several spiral cords of about equal strength which are more or less evenly spaced and which cross the axial costae giving the shell a nodulose appearance.

*Cerithidea pulchra* differs from *C. montagnei* d'Orbigny in producing varices, and in having a definite spiral sculpture. In addition, the color pattern is quite different; *montagnei* has a white band at the suture and another at the whorl periphery, while *pulchra* has a single yellow-brown band at the whorl periphery. See also the notes under *Cerithium validum* C. B. Adams.]

**pygmaea** *Adams* **Cancellaria** [136 : 360] Plate 8, fig. 5

Shell subovate, short; pale wax color, with minute dark brown dots on the ribs, and dark brown irregular rays on the upper part of the last whorl; with slender prominent ribs, which are only nine in number on the last whorl, but are crowded and numerous on the spire, and which are much developed at the angle of the whorls; with several fine raised spiral lines, which are stouter on the summits of the ribs, and crowded intermediate microscopic striae: apex subacute: spire with the outlines rectilinear: whorls five, acutely shouldered, with a broad concave area above, moderately convex below the angle, with a well impressed suture: aperture triangular, effuse below: labrum thickened by the last rib; labrum thin, elevated: columella with two lamelliform slightly oblique plaits; umbilicus narrow, deep, bounded by an acute angle in the last whorl.

Mean divergence about 100°; length .33 inch; breadth .25 inch; length of spire .15 inch.

This species is allied to *C. contabulata* Sowb., and *C. bicolor* Hinds.

Station.—Unknown. Habitat.—Taboga; C.B.A.! One specimen was found.

**pygmaeum** *Adams* **Coecum** [163 : 387] Plate 17, fig. 1

Shell well arcuated, slender, of nearly uniform diameter: white: with about 23 narrow but very prominent rings with flattened summits: apex lateral, prominent.

Length .06 inch; breadth .018 inch.

Station.—Unknown. [164] Habitat.—Panama; C.B.A.! 2 specimens were found.

**recta** *Adams* **Eulima** [199 : 423] Type lost

Shell long, ovate conic: chalcedonic white, with a more opaque and another less opaque spiral band at the upper part of the whorls; with two minute delicate brown spots on the labrum, and above with several similar pairs of spots at the stages of growth: smooth and shining, with a few very faint transverse striae marking stages of growth: apex very acute: spire with the axis straight, with the outlines nearly rectilin-

ear: whorls eleven, subplanulate, with the suture very indistinct; last whorl long, with the periphery very regularly rounded: aperture narrow and very acute above: labrum sharp, retreating anteriorly: columella stout, nearly straight.

Mean divergence about 21°; length .41 inch; breadth .1 inch; length of spire .285 inch.

Station.—Unknown. Habitat.—Taboga; C.B.A.! 5 specimens were collected.

[Is *Melanella* (*Melanella*) *recta* C. B. Adams; Bartsch 1917, Proceedings United States National Museum **53,** p. 311, pl. 39, fig. 3. Bartsch had C. B. Adams' material for study and figured the lectotype. The specimens were subsequently lost and none were in the Adams' collection in 1942 at the time it was transferred to the Museum of Comparative Zoology.]

**reevianum** *Adams* **Cerithium** [156 : 380] Plate 11, fig. 2

Shell rather long, subconic: dark reddish brown, with a yellowish white spiral line on the middle of the whorls, which is darker between the ribs; with a similar spiral line anteriorly, and another tipping the upper ends of the ribs on the lower whorls: without varices: on each whorl with about twenty-four prominent subacute, not approximate, ribs, which are less [157] regular and prominent on the last whorl, on the periphery of which they become obsolete; anteriorly with spiral raised lines, of which one near the periphery is larger: apex acute: spire with the outlines moderately curvilinear: whorls fifteen, convex, with a well impressed suture: aperture large, quadrate-orbicular, broadly effuse above, with a narrow sinus in place of the canal: labrum and labium thick, not continuous; labium reflected below.

It resembles Orbigny's figure (not Kiener's) of *C. montagnei;* Orbigny's description is too meagre to enable us to identify our species with it, and the figure represents it with flattened approximate ribs, and with several spiral white bands, most of which are wanting on our shell.

Mean divergence about 28°; length 1.55 inch; breadth .66 inch; length of spire 1.04 inch.

Station.—With *C. pulchrum,* q.v. Habitat.—Panama; C.B.A.! 190 specimens were collected with *C. pulchrum.*

[Is *Cerithidea montagnei* (d'Orbigny), Bequaert 1942, Nautilus **56,** p. 24.]

**reeviana** *Adams* **Ricinula** [102:326] [new name]

*Buccinum pulchrum* Reeve, Conch. Icon. [**3**] pl. 11, f. 80. . . Dec. 1846.

Mr. Reeve's specific name of this shell is preoccupied in *Ricinula.*

Station.—Under stones, near low water mark. Habitat.—Gallapago [Galapagos] Is.; Cuming! Reeve. Panama and Taboga; C.B.A.! 110 specimens were collected.

[Pilsbry and Lowe (1932, Proceedings Academy Natural Sciences Philadelphia **84**, p. 64) place *reeviana* C. B. Adams in the genus *Engina.* They further state that though *pulchrum* Reeve is said to be a homonym of a species of Lesson they could find no reference to it. Therefore, this name of C. B. Adams is unnecessary.]

**regularis** *Adams* **Calyptraea (Syphopatella)** [224:448] Plate 12, figs. 11-12

Shell with a circular margin, regularly conic: moderately thickened: snow white, tinged with brown about the apex: with very fine lightly impressed striae of growth, somewhat shining: apex subacute, subcentral: lamina folded so as to form a tube about one-third of its own width, produced to the margin so as to make one complete revolution: margin acute.

Diameter 1.27 inch: height .55 inch.

Station.—Unknown. Habitat.—Mazatlan; Lt. Green! Mus. Essex Inst.: also Gould MSS. Panama; C.B.A.! 3 specimens were obtained.

**regularis** *Adams* **Vitrinella** [188:412] Plate 16, fig. 2, a-b

Shell subdiscoidal: pearl white: smooth and shining, with an impressed spiral line just below the suture: apex subacute: spire convex, moderately elevated: whorls four and one-half, convex, with a distinct suture; last whorl somewhat ventricose: aperture nearly orbicular: lip thin: umbilical region deeply indented.

Mean divergence about 120°; greatest breadth .07 inch; least breadth .06 inch; height .05 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the calcareous sand.

[Pilsbry and Olsson (1952, Proceedings Academy Natural Sciences Philadelphia **104**, p. 58) placed this species provisionally in the genus *Solariorbis.* They figured the holotype of the species in the Proceedings 1945, **97**, pl. 28, fig. 2, a-b.]

**rostrata** *Adams* **Crepidula** [235 : 459] Plate 11, figs. 9–10

Shell very convex, irregularly elliptic: livid brown, sometimes with pale ill-defined spots: irregularly somewhat corrugated both radiately and concentrically: apex very acute and prominent, rostriform, very distant from but extending beyond the posterior margin, slightly directed to the right: septum far within the margin, planulate, usually very oblique to the plane of the aperture: margin thin, irregular.

Length .48 inch; breadth .3 inch; height .29 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 5 specimens were obtained in different stages of growth.

**rostratus** *Adams* **Donax** [278 : 502] Type lost

Shell elongated, inequilateral, rostrated anteriorly; ventral edge excurved along the middle, anteriorly rectilinear; anterior margin very oblique, nearly rectilinear, forming with the ventral edge a rostriform extremity: purple and dingy yellowish brown, more or less in ill defined zones; interior with the same colors not in zones: posteriorly and near the beaks smooth and shining; with rather distant very fine radiating striae over the middle of the disc; striae coarser anteriorly, more distant next behind and more crowded before the umbonial angle; the latter are slightly rugose: beaks small, prominent: umbones prominent; with a very sharp angle separating a concave anterior surface; within slightly radiately striated; with the anterior and ventral margins crenulated, more coarsely and deeply at the anterior extremity: with a prominent lateral tooth on each side of the cardinal teeth. It somewhat resembles *D. cardinatus* Hanley.

Length 1.6 inch; height 1.15 inch; breadth .8 inch.

[279] Station.—Unknown. Habitat.—Mazatlan; Lt. Green! Gould MSS. Santa Barbara; Col. Jewett! Gould MSS. Panama; C.B.A.! 1 valve only was obtained.

**rubra** *Adams* **Corbula** [299 : 523] Plate 17, figs. 8–9

Shell subovate, moderately inequivalve and inequilateral, posteriorly acuminate, with the ventral margin arcuate, anteriorly rounded: rufous, with a short white ray on the anterior side of the umbo, and a dark red spot before it: with fine concentric striae, decussated by radiating microscopic striae:

beaks not very prominent: umbones prominent, somewhat angulated on both sides near the beaks: teeth small. Our unique specimen has a broad flexure a little behind the middle; but this may be an accidental growth.

Length .31 inch; height .19 inch; breadth .14 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen was obtained.

**rudis** *Adams* **Solen** [300 : 524] Plate 19, figs. 1–2

Shell solid, straight or slightly recurved; with the posterior extremity abruptly truncated nearly perpendicularly; anteriorly with very thick rounded margins: white beneath a brown deciduous epidermis, which is produced much beyond the margins: with only indistinct striae of growth on the shell; with some radiating lines on the epidermis: beaks inconspicu- [301] ous, at one seventh of the length from the anterior extremity: ligament large, with stout nymphaeal callosities: teeth large in old shells.

Length 5.8 inches; height 1.3 inch; breadth 1 inch.

Station.—In coarse sand, among stones, near low water mark. Habitat.—Panama; C.B.A.! 55 specimens were collected on the reef. It is an edible species, and many of our specimens were obtained from the natives, who were digging them for food.

**rutilus** *Adams* **Turbo** [196 : 420] Plate 13, fig. 10

Shell trochiform, well elevated: bright red, with pale, ill defined transverse streaks: with very numerous small very oblique subnodulous ridges on the spire, which are traversed by two or three small spiral grooves on the lower half of the whorls; anteriorly with six to eight narrow deep inequidistant spiral grooves: spire with the outlines nearly rectilinear: apex obtuse (?); whorls (seven?) * planulate, with a distinct suture; last whorl with the periphery angular, subplanulate anteriorly: labrum much advanced above: columellar lip very much dilated and thickened, appressed: umbilicus wanting.

Mean divergence about 70°; length 2.5 inches; greatest breadth 3 inches; least breadth 2.7 inches.

* Our unique specimen is imperfect.

Station.—Unknown. Habitat.—Panama; C.B.A.! We obtained 1 specimen on the reef. Fragments of a few others were seen.

[Is *Astraea gibberosa* Dillwyn, having the spiral cords on the flat base so characteristic of that species.]

**saxicola** *Adams* **Litiopa** (?) [183 : 407] Plate 10, fig. 7

Shell long ovate conic: pale horn color, subtransparent: surface covered with deep regular crowded spiral striae; apex acute: spire with the outlines slightly curvilinear: whorls five, convex, with a well impressed suture; last whorl rather ventricose: aperture broadly ovate, acute above: labrum thin: labium with a distinct deposit: umbilicus wanting.

Mean divergence about 45°; length .14 inch; breadth .075 inch; length of spire .07 inch.

The generic character of this species is doubtful. The shell has the appearance of a *Litiopa,* but the station is that of *Cingula,* to which Dr. Gould is inclined to refer it. We leave it doubtful, until the soft parts shall have been examined.

Station.—Under stones at low water mark. Habitat.—Panama; C.B.A.! 7 specimens were found on the reef.

**scalariformis** *Adams* **Rissoa** [180 : 404] Plate 12, fig. 3

Shell elongate, ovate conic: dingy white: with, on each whorl, eleven stout prominent acute compressed ribs, which are continuous on the successive whorls; covered with microscopic spiral striae, which ascend the sides of the ribs but are obsolete on their summits: apex acute: spire with the outlines moderately curved: whorls eight, convex, with a well impressed suture: aperture obliquely ovate, effuse above and below: labrum moderately thickened, well excurved and produced along the middle.

Mean divergence about 33°; length .13 inch; breadth .05 inch; length of spire .08 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the sand.

[Is the young of *Rissoina firmata* C. B. Adams; Bartsch 1915, Proceedings United States National Museum **49**, p. 38, pl. 32, fig. 4.]

**seminuda** *Adams* **Vitrinella** [188 : 412] Plate 15, fig. 3, a–b

Shell discoidal: white: above with excessively minute striae of growth; beneath covered with spiral striae: apex obtuse: spire scarcely elevated, convex: whorls three, moderately convex, with a distinct suture; last whorl with the periphery subangular: aperture orbicular, very oblique: lip thin: umbilicus narrow, deep.

[189] Mean divergence about 170°; greatest breadth .062 inch; least breadth .053 inch; height .32 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the calcareous sand.

[Is *Solariorbus seminuda* C. B. Adams; Pilsbry and Olsson 1952, Proceedings Academy Natural Sciences Philadelphia **104**, p. 51. The type of this species was figured by Pilsbry and Olsson in the Proceedings 1947, **97**, pl. 27, fig. 3, a–b.]

**senior** *Adams* **Triton vestitus** ? var. [118 : 342] Type lost

We found also near Panama a shell which differs but little from the preceding [*Triton vestitus* Hinds]. It is not so deeply colored, and is lengthened by the addition of another whorl, and consequently it has an additional varix. The sculpture of the lower whorls is less prominent; and the shell is distorted.

**siliqua** *Adams* **Tellina** [284 : 508] Plate 19, figs. 15–16

Shell elongate, subelliptic, very thin, very convex, very inequilateral; ventral margin nearly straight; anterior margin well rounded; anterior dorsal margin slightly excurved, moderately sloping; posterior dorsal margin straight or concave, sloping to a small subtruncate posterior extremity; flexure great: pure white: with excessively minute concentric striae: beaks acute: ligament small: cardinal teeth small; lateral teeth wanting. Dr. Gould suggested the very appropriate name which we have adopted.

Length .7 inch; height .4 inch; breadth .3 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

**similis** *Adams* **Arca** [261 : 485] Plate 20, figs. 1–2

Shell ellipsoidal, very inequilateral, slightly auriculate: inferior margin subrectilinaer; anterior and posterior margins well [262] rounded: dorsal margin somewhat oblique: white:

with an epidermis, which is greenish brown on the young shell, and brownish black on an old shell: with forty to forty-four ribs, which are larger and more sharply angled posteriorly: umbones prominent, flattened, not angulated: area of the ligament narrow, depressed: margins of the interior pectinated by the ribs: teeth small. It resembles *A. tuberculosa* Sowb.

Length 2.2 inches; height 1.3 inch; breadth 1.1 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 10 specimens were obtained.

**similis** *Adams* **Chemnitzia** [168 : 392] Plate 10, fig. 9

Shell long, conic: white: with, on each whorl, about twenty-six rather obtuse ribs, which terminate abruptly on the periphery of the last whorl: spire with the outlines nearly rectili- [169] near: whorls eleven, convex, with a rather deep suture: last whorl rather long, with the periphery well rounded: aperture subovate: labrum thin: columella straight: umbilicus wanting.

Mean divergence about 17°; length .17 inch; breadth .045 inch; length of spire .13 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 2 specimens were found in the sand.

[Is *Turbonilla* (*Chemnitzia*) *paramoea* Dall and Bartsch (1909, Bulletin United States National Museum no. 68, p. 37, pl. 2, figs. 4–4a) new name for *Chemnitzia similis* C. B. Adams, non Forbes 1848; non d'Orbigny 1850.]

**simulans** *Adams* **Tellina** [284 : 508] Plate 18, figs. 5–6

*Tellina punicea* (pars) Hanley in Sowb. Thes. Conch. **1**, p. 239, 1846.

Shell subovate, solid, moderately convex, nearly inequilateral; ventral margin slightly excurved; anterior margin well rounded; anterior dorsal margin slightly excurved; posterior dorsal margin nearly straight, sloping; posterior extremity obliquely truncated; flexure slight: white, more or less deeply tinged with rose color except near the margin and around the [285] pure white beaks; within of a very deep red: shining; with deep crowded regular concentric sulci, which are of equal depth at both extremities: beaks prominent: ligament short, conspicuous: with a long posterior dorsal area well defined by an angle: lateral teeth nearly obsolete. The difference between this shell and *T. punicea* is slight: its furrows are deeper and

are continued over the flexure without change of depth; the interspaces are less flattened, and the lateral teeth are nearly obsolete.

Length 1.13 inch; height .7 inch; breadth .3 inch.

Station.—In sandy mud at 10 fathoms: Cuming! Hanley. Habitat.—Xipixapi; Cuming! Hanley. Panama; C.B.A.! 1 valve was found.

**solitaria** *Adams* **Eulima** [199:423] Type lost

Shell long, ovate conic: chalcedonic white, with a brownish tinge above the middle of the spire: smooth and shining: apex acute: spire with the axis nearly straight, with the outlines nearly rectilinear: whorls eleven, planulate, with the suture very indistinct: last whorl with the periphery very regularly rounded: aperture ovate, acute above: labrum sharp, much advanced along the middle into an elegantly curved edge: columella stout, slightly curved. This may be a *Stylifer*.

Mean divergence about 23°; length .19 inch; breadth .055 inch; length of spire .14 inch.

Station.—On Holothuriae. The small species of Holothuria, which is very common at Panama and at Taboga, did not furnish any specimens. A larger species, which is more rare, afforded one shell. Habitat.—Taboga; C.B.A.!

[Is *Melanella* (*Melanella*) *solitaria* C. B. Adams; Bartsch 1917, Proceedings United States National Museum **53**, p. 308, pl. 35, fig. 4. Bartsch had C. B. Adams' specimens for study and figured the holotype. The specimen was subsequently lost and was not in the Adams collection in 1942 at the time it was transferred to the Museum of Comparative Zoology.]

**solitaria** *Adams* **Mitra** [44:268] Plate 5, fig. 1

Shell rather slender, fusiform: of a very deep blackish brown, less deep in the aperture, and quite pale on the plaits: with very numerous small transverse ribs, which are obsolete anteriorly, and which are granulated by revolving striae, that are obsolete in the interspaces posteriorly, and are strongly developed anteriorly, with microscopic incremental striae; apex acute: whorls ten, moderately convex, slightly shouldered above, with a moderately impressed suture: aperture long, with a rather short canal: labrum thick, with numerous sharp plaits inside, with a sinus near the posterior end: columella with four plaits.

Length .68 inch; breadth, .23 inch; length of aperture, .34 inch.

Station.—Under stones near low water mark we found this elegant and rare shell. Habitat.—Panama; C.B.A.! We found a single specimen on the reef.

**stimpsonianum** *Adams* **Buccinum** [72 : 296] Plate 7, fig. 1

Shell long ovate-conic: rather pale slate color, more or less white above, with the revolving ridges brownish red or white where they cross the ribs, white in the upper half of the labrum, often with a broad white spiral band on the middle of the whorls: on each whorl with seven or eight stout transverse ridges, which are less prominent on the back of the last whorl; with several spiral linear ridges, of which four are visible on the penult whorl, which are obsolete between the transverse ridges, and are more numerous and smaller anteriorly; covered [73] with five crowded spiral striae: apex acute: spire conic: whorls eight, scarcely convex: aperture ovate: labrum much thickened, with a few plaits inside: columellar lip irregularly plaited: with a short well notched canal.

Mean divergence about 38°; length .72 inch; breadth .32 inch.

I take pleasure in dedicating this species to William Stimpson, Esq., whose researches on the Mollusca of this country will furnish a most valuable contribution to Malacology.

Station.—Under stones, near low water mark. Habitat.—Panama; C.B.A.! We obtained 19 specimens, of which a few only were alive.

**striata** *Adams* **Nassa** [65 : 289] Plate 6, fig. 6

Shell long ovate conic: white about the aperture, otherwise dingy white more or less tinged with yellowish brown: with, on each whorl, twelve or thirteen small ribs, and many coarse spiral striae: spire with the outlines a little curvilinear: apex acute: whorls eight, convex, with a well impressed su- [66] ture; last whorl spirally canaliculate on the left side: aperture subelliptical: labrum rather sharp, thickened by a broad varix, coarsely grooved within: labium well thickened, not appressed, with two small wrinkles anteriorly: notch deep.

It resembles *N. versicolor* (v. infrà) var. *striatula:* but besides

being more coarsely striated and minutely ribbed, the whorls are much more convex.

Mean divergence about 48°; length .58 inch; breadth .31 inch; length of spire .33 inch.

Station.—Unknown. Habitat.—Taboga; C.B.A.! 2 specimens were obtained.

[Is in the genus *Nassarius*.]

**striatula** *Adams* **Nassa versicolor** var. [66 : 290] Plate 6, fig. 7

See under *Nassa versicolor* Adams.

[Is *Nassarius versicolor* C.B.Adams; Desmond 1952, Pacific Science **6**, p. 310.]

**striosa** *Adams* **Chemnitzia** [169 : 393] Plate 11, fig. 4

Shell long, conic: yellowish brown: with, on each whorl, about forty very minute slender ribs, which gradually become obsolete on the periphery of the last whorl; covered with distinct spiral striae, of which one a little below the suture and also those which are anterior are larger: spire with the outlines nearly rectilinear: whorls ten, slightly convex, with a well impressed suture: aperture ovate, acute above: labrum thin: columella a little twisted: umbilicus wanting.

Mean divergence about 20°; length .21 inch; breadth .06 inch; length of spire .16 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the sand.

[Is *Turbonilla* (*Pyrgiscus*) *striosa* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum no. 68, p. 83, pl. 7, figs. 8–8a.]

**striosa** *Adams* **Pleurotoma** [147 : 371] Plate 8, fig. 7

Shell slender: dingy white, with a more or less distinct brown spiral stripe on the last whorl issuing from the upper part of the aperture: with indistinct crowded spiral striae, with ten or twelve very slender ribs on each whorl: apex acute: [148] spire with the outlines nearly rectilinear: whorls eight, convex with a moderately impressed suture: aperture rather narrow: labrum rather sharp, thickened behind the edge by a very stout rib: canal rather wide, very short.

Mean divergence about 33°; length .3 inch; breadth .1 inch; length of spire .2 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 13 specimens were found in the calcareous sand on the shore.

**striosum** *Adams* **Amphidesma** [291:515] Plate 18, figs. 1–2

Shell elliptical, slightly flexuous, inequilateral; with the posterior dorsal margin slightly excurved, with the anterior dorsal margin concave, otherwise with the margins well rounded: pale yellowish brown: with numerous fine raised concentric lines, and closely crowded radiating striae, which are mostly microscopic: beaks small, approximate: umbones convex: corselet and lunule not well defined.

Length .78 inch; height .71 inch; breadth .33 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found.

**tabogensis** *Adams* **Arca (Byssoarca)** [262:486] Plate 19, figs. 7–8

Shell not much elongated, not very inequilateral; inferior margin nearly straight, a little gaping for the passage of the byssus; posterior margin oblique, rectilinear or mode- [263] rately excurved; anterior margin well rounded: dingy white, with blackish brown epidermis: with numerous very prominent but very narrow linear ribs, which are often alternately large and small, and of which a few at each extremity are a little stouter and are subnodulous; with a few indistinct concentric lines: umbones prominent, flattened: area of the ligament very narrow, anteriorly widened abruptly: margins of the interior finely and irregularly crenulated: middle teeth very small. The epidermis is between pilose and lamellar, with the points long posteriorly.

Length 1.3 inch; height .85 inch; breadth .65 inch.

Station.—Under stones near low water mark. Habitat.—Taboga and Panama; C.B.A.! 60 specimens were collected, mostly at Taboga.

**tabogensis** *Adams* **Auricula** [211:435] Plate 13, fig. 6

Shell obovate: very dark brownish red, more or less rufous on the columella, usually white on the plaits and callus within; smooth and shining, with some fine spiral striae on the upper whorls: apex acute: spire with the outlines very curvilinear:

whorls ten, imbricately appressed, with a distinct suture: last whorl large: aperture long and narrow, in the right side mostly covered by a transversely ridged callus: with three plaits on the left side, of which the upper one is a little larger, and the two lower are separated by a sinus.

Mean divergence about 100°; length .59 inch; breadth .36 inch; length of spire .15 inch.

Two specimens of *A. fusca* Phil., which we have received from M. Petit, are more angular in the upper part of the whorls, and have the callus within the labrum more finely and closely ridged. *A. fusca,* as figured by Küster, more robust and less pyriform than our shell. According to M. Petit's label, *A. fusca* occurs at the Marquesas, and Küster mentions the Sandwich Islands as its habitat. In outline our shell resembles *A. pyriformis* Petit (West Columbia, Cuming!), but within the aperture there is no resemblance.

Station.—On and under stones and rocks at high water mark. Habitat.—Taboga and Panama; C.B.A.! 800 specimens were collected.

[Is *Melampus tabogensis* C. B. Adams; Hertlein and Strong 1955, Bulletin American Museum Natural History **107,** p. 209.]

**tenuis** *Adams* **Anomia** [245 : 469] Plate 18, fig. 13

Shell orbicular: flat, extremely thin: white, subtransparent, pearly: externally somewhat uneven: upper scar large, rounded, with the lower side arcuated: two lower scars small, circular, equal: anterior one nearly entering the arcuation of the upper scar; posterior one near the other, with the upper margin as high as the centre of the other.

Diameter about .85 inch.

Station.—Near low water mark. Habitat.—Panama; C.B.A.! 3 specimens were obtained.

**terebellum** *Adams* **Cingula** (?) [182 : 406] Plate 10, fig. 8

Shell subcylindric: white: with four very prominent compressed acute spiral keels, of which two are seen on the spire: apex subacute: spire with the outlines moderately curvilinear: whorls six, slightly convex, with an indistinct suture; last whorl small: aperture small, ovate, acute above: labrum thin: labium indistinct: umbilicus wanting.

Mean divergence about 28°; length .08 inch; breadth .04 inch; length of spire .055 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the calcareous sand.

[Is *Odostomia* (*Miralda*) *terebellum* C.B.Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68**, p. 177, pl. 19, fig. 4.]

**tessellata** *Adams* **Columbella** [99 : 323] Plate 7, fig. 4

Shell rather long ovate: dark sea-green, tinged with black or brown, fading to a brownish red; more or less tesselated with nearly quadrangular white spots: with about fifteen stout approximate ribs, which lean forward, and which are obsolete on the back of the last whorl; with all the surface ridged by strongly impressed revolving striae: apex acute: spire conic: whorls eight, scarcely convex, with a distinct suture: aperture rather long: labrum variciform, thick behind, a little sinuate posteriorly, with three or four granules inside: columellar lip slightly granulous.

Mean divergence about 48°; length .225 inch; breadth .105 inch; length of spire .13 inch.

This species resembles the small variety of *C. nigricans*. It also resembles *C. lentiginosa* Hinds (Zool. Sulph. Moll. pl. 10, f. 21, 22), in coloring and sculpture; but the latter is represented as being much wider and as having a short spire.

Station.—This species was found under stones, near low water mark. Habitat.—Panama; C.B.A.! We collected 27 specimens.

[Is *Columbella guatemalensis* Reeve; Tryon 1883, Manual of Conchology **5**, p. 242; Dall 1909, Proceedings United States National Museum **37**, p. 282.]

**tortuosum** *Adams* **Amphidesma** [291 : 515]
Plate 17, figs. 10–11

Shell compressed, subequilateral, triangular above, orbicular below, the slightly excurved posterior dorsal margin and the slightly concave anterior dorsal margin meeting at an angle of about 125°, and the rest of the margins being well rounded; posterior side very flexuous, with a broad deep groove on the left valve and a corresponding ridge on the right valve: dingy white: with numerous concentric ridges, which are crossed by radiating striae that are partly microscopic: beaks very

minute, approximate: left umbo flat, right one convex: corselet and lunule long and narrow, deeply concave.

Length 1.25 inch; height 1.1 inch; breadth .35 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was obtained.

[Is in the genus *Semele.*]

**tricarinata** *Adams* **Vitrinella** [189 : 413] Plate 16, fig. 3, a–b

Shell subdiscoidal: white: with three prominent spiral keels, one on the periphery of the last whorl, and one on each side of it, of which the upper one is visible on the spire: with some irregular transverse striae: spirally striate within the umbilicus: apex subacute: spire convex, a little elevated: whorls three, depresssd above and compressed below the keel, with a distinct suture: aperture oblique, orbicular, angulated by the keels: umbilicus wide and deep.

Mean divergence about 150°; greatest breadth .072 inch; least breadth .065 inch; height .035 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 1 specimen was found in the calcareous sand.

[Is *Cyclostremiscus tricarinatus* C. B. Adams; Pilsbry and Olsson, 1945, Proceedings Academy Natural Sciences Philadelphia **97**, p. 271, pl. 28, fig. 3, a–b.]

**trigonalis** *Adams* **Potamomya** [296:520] Plate 18, figs. 3–4

Shell solid, triangular, moderately inequivalve, subequilateral; upper posterior margin moderately excurved, forming an angle with the slightly excurved ventral margin; anteriorly with the dorsal margin abruptly and regularly rounded into the ventral margin: white beneath a pale brown epidermis: with fine striae of growth; with a sharp umbonial angle defining a posterior area: beaks large and prominent: umbones prominent, somewhat compressed: teeth large and robust; tooth of the left valve with a medial ridge.

Length .95 inch; height .8 inch; breadth .56 inch.

Station.—With *P. aequalis,* q.v. Habitat.—Panama; C.B.A.! 2 specimens were obtained.

**trilineata** *Adams* **Auricula** [212 : 436] Plate 13, fig. 7

Shell obovate: dark brownish red, with three revolving distant white lines on the last whorl, of which the anterior line is not so well defined: rufous on the columella: with irregular

striae of growth: apex obtuse? spire very small, with the outlines curvilinear: whorls —,* very narrow, imbricately appressed, with the suture distinct: last whorl very large, convolate: aperture very long, narrow: labrum not sharp, with a deposit over the whole visible interior, which is transversely plaited: at the end of the columella with a twisted plait, separated by a sinus from a large transverse plait, above which are four small approximate transverse plaits.

Mean divergence about 135°; length .71 inch; breadth .43 inch; length of spire .05 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! Only 1 specimen was found.

*In our unique specimen the suture of the upper whorls is obliterated by erosion. Probably the number of whorls is six or seven.

**turrita** *Adams* **Chemnitzia** [169 : 393] Plate 8, fig. 13

Shell subcylindric in the lower whorls, conic in the upper whorls: white: with, on each whorl, about eighteen sharp compressed slender ribs, which are less prominent on the last whorl, and terminate abruptly at its periphery; with an impressed spiral line next below the upper margin of the whorls, another at the periphery of the last whorl, and an anterior spiral groove: spire with the outlines curvilinear above the middle, otherwise nearly rectilinear: whorls ten, acutely shouldered, slightly con- [170] vex, with a well impressed suture; last whorl angular at the periphery: aperture subovate: labrum thin: columella straight: umbilicus wanting.

Mean divergence about 23°; length .185 inch; breadth .055 inch; length of spire .14 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 3 specimens were found in the sand.

[Is *Turbonilla* (*Asmunda*) *turrita* C. B. Adams; Dall and Bartsch 1909, Bulletin United States National Museum **68**, p. 130, pl. 12, figs. 14–14a.]

**turrita** *Adams* **Cingula** (?) [182 : 406] Plate 20, fig. 12

Shell conic, elongate: white: with numerous prominent compressed transverse ribs, which terminate a little above the suture, where they are crossed by a spiral raised line; anteriorly with two or three spiral ridges: apex acute: spire with the outlines nearly rectilinear: whorls six, above abruptly should-

ered, planulate, with the suture in a broad groove, which is continued along the periphery of the last whorl: aperture small, ovate, acute above, very slightly effuse: labrum thin: umbilical region with a very minute indentation.

Mean divergence about 30°; length .08 inch; breadth .033 inch; length of spire .024 inch.

Station.—Unknown. [183] Habitat.—Panama; C.B.A.! 1 specimen was found in the sand.

[Is *Odostomia notabilis* C. B. Adams. See notes under *Rissoa notabilis* C. B. Adams. Dall and Bartsch had Adams' material for study at the time they wrote their "Monograph of the West American Pyramidellid Mollusks" (1909, Bulletin United States National Museum no. 68) and they figured the holotype of *Cingula turrita* C. B. Adams. The specimen was subsequently lost and was not in the Adams collection at the time it was transferred to the Museum of Comparative Zoology. Dr. Rehder has kindly loaned the original drawing made for Dall and Bartsch's paper for illustration here.]

**validum** *Adams* **Cerithium** [157 : 381] Plate 11, fig. 3

Shell long, conic: dark reddish brown, with a pale spiral line along the middle of the whorls: rufous on the varices, and white in the aperture: sometimes whitish on the varices, the spiral ridges, and the last whorl: with, on each whorl, about twenty arcuate ridges, which are prominent and rather narrow but not compressed, and which terminate abruptly at the periphery of the last whorl: with stout varices about 270° distant: with six spiral ridges, of which two next below the suture are small and approximate, and are sometimes replaced by a single ridge: and of which one is partly concealed in the suture: with intermediate minute spiral striae: anteriorly covered with slightly wrinkled spiral ridges: apex acute: spire with the outlines moderately curvilinear: whorls twelve, convex, with a deep suture: last whorl subangular at the periphery, very short: aperture [158] sub-quadrate, effuse below, sub-effuse above: labrum produced very far in the lower half, in old shells excessively thickened.

Mean divergence about 32°; length 1.6 inch; breadth .75 inch; length of spire 1.15 inch.

This species must closely resemble *C. varicosum* Sowb., and *C. varicosum* Kiener, which are probably distinct from each other. *C. Hegeswichii* Phil.[1] is also similar to our shell. (It is to

[1] [A misspelling for *hegewischii* Phil.]

be regretted that Dr. Philippi has not stated which side of Mexico his species inhabits.) Sowerby's shell may be ours. It appears like a dwarfed variety. Orbigny considers it as the young of the shell which he had from Guayaquil, but speaks of a circular umbilicus.

Station.—With *C. pulchrum.* Habitat.—Panama; E. Jewett! Gould MSS. Panama; C.B.A.! 250 specimens were collected with *C. pulchrum.*

[Is *Cerithidea hegewischii valida* C. B. Adams. This is a large form of *hegewischii* which intergrades with the typical form. Zilch (1954, p. 82) considered it to be synonymous with *hegewischii* Philippi. It is certainly much larger than specimens of the typical form which we have in the collection. Bequaert (1942, p. 25) not having seen the types of Adams, considered *valida* C. B. Adams and *pulchra* C. B. Adams to be synonymous and his remarks should be applied to the name *valida* rather than *pulchra.* Hertlein and Strong (1955, p. 270) considered *valida* as a good species. See also notes under *Cerithium pulchrum* C. B. Adams.]

**valvatoides** *Adams* **Vitrinella** [189 : 413] Plate 15, fig. 1, a–b

Shell discoidal: whitish, sub-transparent: last whorl with a prominent keel above, which is visible on the spire, with another prominent keel beneath, and a third, less developed, around the umbilicus: spire concave: whorls three, concave above the keel, with a distinct suture: last whorl subangular at the periphery: umbilicus wide and deep.

Greatest breadth .1 inch; least breadth .075 inch; height .04 inch.

Station.—Unknown. [190] Habitat.—Panama; C.B.A.! 3 specimens were found in the calcareous sand.

[Is *Cyclostremiscus valvatoides* C. B. Adams; Pilsbry and Olsson 1945, Proceedings Academy Natural Sciences Philadelphia **97,** p. 272, pl. 27, fig. 1, a–b.]

**variabilis** *Adams* **Ovula** [31 : 255] Plate 6, fig. 2

Shell very slender: usually white, with a slight tinge of rufous, with the lip opaque white; sometimes of a rich red purple: smooth: aperture not very narrow, a little widened anteriorly, moderately produced, effuse, and slightly inflected posteriorly; obliquely emarginate anteriorly: lip well thickened: columella with a longitudinal keel, acute and obliquely produced anteriorly, posteriorly somewhat biplicate.

Length .54 inch; breadth .15 inch.

This shell resembles *O. inflexa,* Sowb., but is more slender. Perhaps on comparison of specimens, they may be proved identical. *O. uniplicata,* Sowb., is larger, with a wider aperture.

[32] Station.—At the low water mark of the spring tides. The light colored specimens were found on a cream-colored species of Gorgonia, and the purple specimens on a Gorgonia of the same color. Of 56 specimens, four are purple, and 14 are mature, and 42 immature.

Habitat.—San Juan, Lower Calif.—Lt. Green! Gould Mss. Purple shells. Santa Barbara.—E. Jewett! Gould Mss. Pale, or moderately tinged with purple. Panama.—C.B.A.!

The 56 specimens were all taken on the reef at Panama. Mr. Cuming found one specimen of *O. inflexum* in the Gulf of Dulce.

**ventricosum** *Adams* **Amphidesma** [292 : 516]

Plate 19, figs. 9–10

Shell suborbicular, subequilateral, ventricose, flexuous; with the anterior and posterior dorsal margins nearly straight; with the margins otherwise well rounded: dingy white, brownish in ill-defined zones: with unequal striae of growth; densely covered with radiating microscopic striae: beaks small, approximate: umbones very convex: corselet and lunule not very well defined.

Length .7 inch; height .62 inch; breadth .36 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! A single valve only was found.

[Is in the genus *Semele.*]

**versicolor** *Adams* **Nassa** [66 : 290] Plate 6, fig. 8

Shell long ovate conic: pale yellowish brown, or nearly white, with a darker sutural line, or blackish brown: sometimes the ends or the summits of the ribs are whiter than the interspaces; sometimes the sutural fascia covers the anterior part of the last whorl: with, on each whorl, nine or ten narrow very prominent ribs; with very minute spiral striae, which are nearly obsolete on the middle of the whorls; spire with the outlines nearly or quite rectilinear: apex acute: whorls eight, slightly convex, with a well impressed suture; last whorl spirally canaliculate anteriorly: aperture subelliptical: labrum

subacute, thickened with a stout varix: labium thickened, not appressed, finely wrinkled: notch deep. Var. *striatula* is covered with very distinct striae.

Mean divergence about 45°; length .6 inch; breadth .33 inch; length of spire .35 inch.

*N. ambigua,* the Caribbean analogue, is also an extremely variable species.

Station.—Unknown. [67] Habitat.—Taboga; C.B.A.! More than 500 specimens were collected, all occupied by hermit crabs.

[Is *Nassarius versicolor* C. B. Adams; Desmond 1952, Pacific Science **6,** p. 310.]

**vicina** *Adams* **Tellina** [285 : 509] Plate 18, figs. 11–12

Shell very short, subovate, solid, convex, subequilateral; ventral margin well excurved, sometimes slightly incurved near the flexure; anterior margin broadly rounded; anterior and posterior dorsal margins nearly straight, sloping; posterior extremity subtruncated; flexure moderate: dingy white, sometimes tinged with yellowish brown; sometimes deep red, with [286] a tinge of blue or grey; some whitish specimens are ornamented with bluish purple zigzag lines on the umbones, or with a short ray of the same color before the beaks: with deep unequal crowded concentric striae: beaks prominent: ligament short, conspicuous: lateral teeth rather small. This species is closely allied to *T. bimaculata,* and has similar varieties of coloring, but is larger, higher, and has coarser striae.

Length .95 inch; height .78 inch; breadth .4 inch.

Station.—Unknown. Habitat.—Panama; C.B.A.! 10 specimens were collected.

**wilsoni** *Adams* **Nassa** [67 : 291] Plate 5, fig. 2

Shell ovate conic, ventricose: blackish brown, with a dingy white spiral band, at or a little above the suture: with sixteen to twenty small ribs, some of the last of which are obsolete on the convexity of the whorl, and of which one next behind the varix is larger; with many spiral raised lines, which are smaller on the summits of the ribs, and which are nearly obsolete in the region where the ribs are obsolete: spire with the outlines curvilinear: apex acute: whorls seven, slightly con-

vex, with a distinct suture: last whorl ventricose, anteriorly with a small spiral canal: aperture suborbicular: labrum subacute, much thickened within and without, with a few sharp ridges within: labium thickened, not appressed: notch deep.

Mean divergence about 58°; length .32 inch; breadth .19 inch; length of spire .18 inch.

This pretty little species is named in honor of Dr. Thomas B. Wilson, of Philadelphia, the munificent patron and successful cultivator of Natural History.

Station.—Unknown. Habitat.—Panama; C.B.A.! 5 specimens were obtained.

* * * *

The following is a list of the various species described by C. B. Adams. They are grouped under the genera to which they were originally assigned. Subsequent generic changes for a few of the species are indicated in the main body of this report.

---

*Adeorbis:* abjecta.

*Amphidesma:* bicolor; proximum; striosum; tortuosum; ventricosum.

*Anatina:* alta.

*Anomia:* tenuis.

*Arca:* pholadiformis; similis; tabogensis.

*Auricula:* concinna; infrequens; panamensis; tabogensis; trilineata.

*Buccinum:* lugubre; stimpsonianum.

*Bulla:* infrequens; luticola.

*Cancellaria:* affinis; pygmaea.

*Calyptraea:* aberrans; aspersa; planulata; regularis.

*Cerithium:* assimilatum; bimarginatum; famelicum; neglectum; pauperculum; pulchrum; reevianum; validum.

*Chama:* buddiana.

*Chemnitzia:* aculeus; acuminata; affinis; clathratula; communis; gracilior; major; marginata; panamensis; similis; striosa; turrita.

*Cingula:* inconspicua; paupercula; terebellum; turrita.

*Coecum:* diminutum; eburneum; firmatum; laeve; laqueatum; minus; monstrosum; parvum; pygmaeum.

*Columbella:* conspicua; diminuta; gracilis; moesta; pulchrior; tesselata.

*Corbula:* rubra.

*Crepidula:* cerithicola; nivea; osculans; rostrata.

*Cyrena:* maritima.

*Cytherea:* consanguinea.

*Donax:* rostratus.

*Eulima:* iota; recta; solitaria.

*Fissurella:* alta.

*Fusus:* bellus.

*Gouldia:* pacifica.

*Haliotis:* ponderosa.

*Litiopa:* saxicola.

*Littorina:* angiostoma; atrata; dubiosa; excavata; foveata; megasoma.

*Mangelia:* neglecta.

*Marginella:* minor.

*Mitra:* solitaria.

*Nassa:* canescens; collaria; corpulenta; gemmulosa; glauca; panamensis; proxima; striata; striatula; versicolor; wilsoni.

*Oliva*: inconspicua.

*Ovula:* neglecta; variabilis.

*Pandora:* cornuta.

*Pedipes.* angulata.

*Petricola:* cognata.

*Pleurotoma:* atrior; concinna; exigua; gemmulosa; grandimaculata; striosa.

*Potamomya:* aequalis; inflata; trigonalis.

*Purpura:* foveolata; osculans.

*Pyramidella:* conica.

*Ricinula:* jugosa.

*Rissoa:* clandestina; firmata; fortis; inconspicua; infrequens; janus; notabilis; scalariformis.

*Solecurtus:* affinis.

*Solen:* rudis.

*Stomatella:* inflata.

*Tellina:* cognata; concinna; puella; siliqua; simulans; vicina.

*Triphoris:* alternatus; inconspicuus; infrequens.

*Triton:* fusoides; senior.

*Trochus:* coronulatus; leanus.

*Truncatella:* bairdiana; dubiosa.

*Turbo;* phasianella; rutilus.

*Vitrinella;* concinna; exigua; janus; minuta; modesta; panamensis; parva; perparva; regularis; seminuda; tricarinata; valvatoides.

Plate 5

Fig. 1. *Mitra solitaria* Adams. Holotype MCZ 186351 (4x).
Fig. 2. *Nassa wilsoni* Adams. Lectotype MCZ 186372 (7.2x).
Fig. 3. *Nassa corpulenta* Adams. Lectotype MCZ 186352 (2.3x).
Fig. 4. *Nassa collaria* Adams. Lectotype MCZ 186354 (5.5x).
Fig. 5. *Nassa gemmulosa* Adams. Holotype MCZ 186392 (8x).
Fig. 6. *Nassa glauca* Adams. Lectotype MCZ 186386 (4x).
Fig. 7. *Buccinium lugubre* Adams. Lectotype MCZ 186388 (3.9x).
Fig. 8. *Nassa canescens* Adams. Holotype MCZ 186350 (2.3x).
Fig. 9. *Nassa panamensis* Adams. Lectotype MCZ 186283 (3.9x).


Plate 5

Plate 6

Fig. 1. *Ovula neglecta* Adams. Lectotype MCZ 186358 (7.8x).
Fig. 2. *Ovula variabilis* Adams. Lectotype MCZ 186360 (4.9x).
Fig. 3. *Marginella minor* Adams. Lectotype MCZ 186356 (22.6x).
Fig. 4. *Oliva inconspicua* Adams. Lectotype MCZ 186362 (13.3x).
Fig. 5. *Nassa proxima* Adams. Holotype MCZ 186417 (5.5x).
Fig. 6. *Nassa striata* Adams. Lectotype MCZ 186380 (3.7x).
Fig. 7. *Nassa versicolor* var. *striatula* Adams. Lectotype MCZ 186374 (3.8x).
Fig. 8. *Nassa versicolor* Adams. Lectotype MCZ 177145 (3.8x).
Fig. 9. *Purpura foveolata* Adams. Lectotype MCZ 186391 (6.2x).
Fig. 10. *Columbella pulchrior* Adams. Lectotype MCZ 186384 (11.2x).


Plate 6

Plate 7

Fig. 1. *Buccinum stimpsonianum* Adams. Lectotype MCZ 186378 (3.8x).
Fig. 2. *Columbella diminuta* Adams. Lectotype MCZ 186401 (16x).
Fig. 3. *Columbella conspicua* Adams. Holotype MCZ 186390 (12.4x).
Fig. 4. *Columbella tesselata* Adams. Lectotype MCZ 186376 (9.5x).
Fig. 5. *Columbella gracilis* Adams. Lectotype MCZ 186393 (6.5x).
Fig. 6. *Columbella moesta* Adams. Lectotype MCZ 186382 (6.9x).
Fig. 7. *Pleurotoma gemmulosa* Adams. Holotype MCZ 186399 (7.8x).
Fig. 8. *Ricinula jugosa* Adams. Holotype MCZ 186394 (2x).
Fig. 9. *Pleurotoma grandimaculata* Adams. Holotype MCZ 186400 (3.1x).
Fig. 10. *Pleurotoma atrior* Adams. Holotype MCZ 186396 (3.5x).


Plate 7

Plate 8

Fig. 1. *Triton fusoides* Adams. Holotype MCZ 186395 (3.3x).
Fig. 2. *Fusus bellus* Adams. Holotype MCZ 177176 (5.1x).
Fig. 3. *Cancellaria affinis* Adams. Lectotype MCZ 186403 (1.8x).
Fig. 4. *Mangelia neglecta* Adams. Lectotype MCZ 186406 (8.3x).
Fig. 5. *Cancellaria pygmaea* Adams. Holotype MCZ 186415 (5.8x).
Fig. 6. *Pleurotoma exigua* Adams. Holotype MCZ 186398 (8.4x).
Fig. 7. *Pleurotoma striosa* Adams. Lectotype MCZ 186426 (8.4x).
Fig. 8. *Pleurotoma concinna* Adams. Holotype MCZ 186397 (6.9x).
Fig. 9. *Cerithium pauperculum* Adams. Lectotype MCZ 186460 (16.9x).
Fig. 10. *Chemnitzia acuminata* Adams. Holotype MCZ 186420 (19.8x).
Fig. 11. *Chemnitzia aculeus* Adams. Lectotype 186435 (13.5x).
Fig. 12. *Chemnitzia affinis* Adams. Lectotype MCZ 186446 (11.7x).
Fig. 13. *Chemnitzia turrita* Adams. Lectotype MCZ 186433 (12.2x).


Plate 8

Plate 9

Fig. 1. *Cerithium assimilatum* Adams. Lectotype MCZ 186405 (11.6x).
Fig. 2. *Cerithium bimarginatum* Adams. Lectotype MCZ 186428 (12.4x).
Fig. 3. *Cerithium famelicum* Adams. Lectotype MCZ 186409 (1.9x).
Fig. 4. *Cingula paupercula* Adams. Lectotype MCZ 186341 (19.5x).
Fig. 5. *Littorina atrata* Adams. Lectotype 186444 (10.7x).
Fig. 6. *Littorina foveata* Adams. Lectotype MCZ 186454 (7.3x).
Fig. 7. *Adeorbis* (?) *abjecta* Adams. Lectotype MCZ 186338 (11.2x).
Fig. 8. *Rissoa inconspicua* Adams. Holotype MCZ 186416 (24.5x).
Fig. 9. *Cerithium neglectum* Adams. Lectotype MCZ 186413 (21.4x).
Fig. 10. *Triphoris inconspicuus* Adams. Lectotype MCZ 186552 (17.1x).
Fig. 11. *Triphoris infrequens* Adams. Lectotype MCZ 186459 (19.4x).
Fig. 12. *Cingula inconspicua* Adams. Lectotype MCZ 186456 (22x).
Fig. 13. *Triphoris alternatus* Adams. Lectotype MCZ 186449 (13.5x).

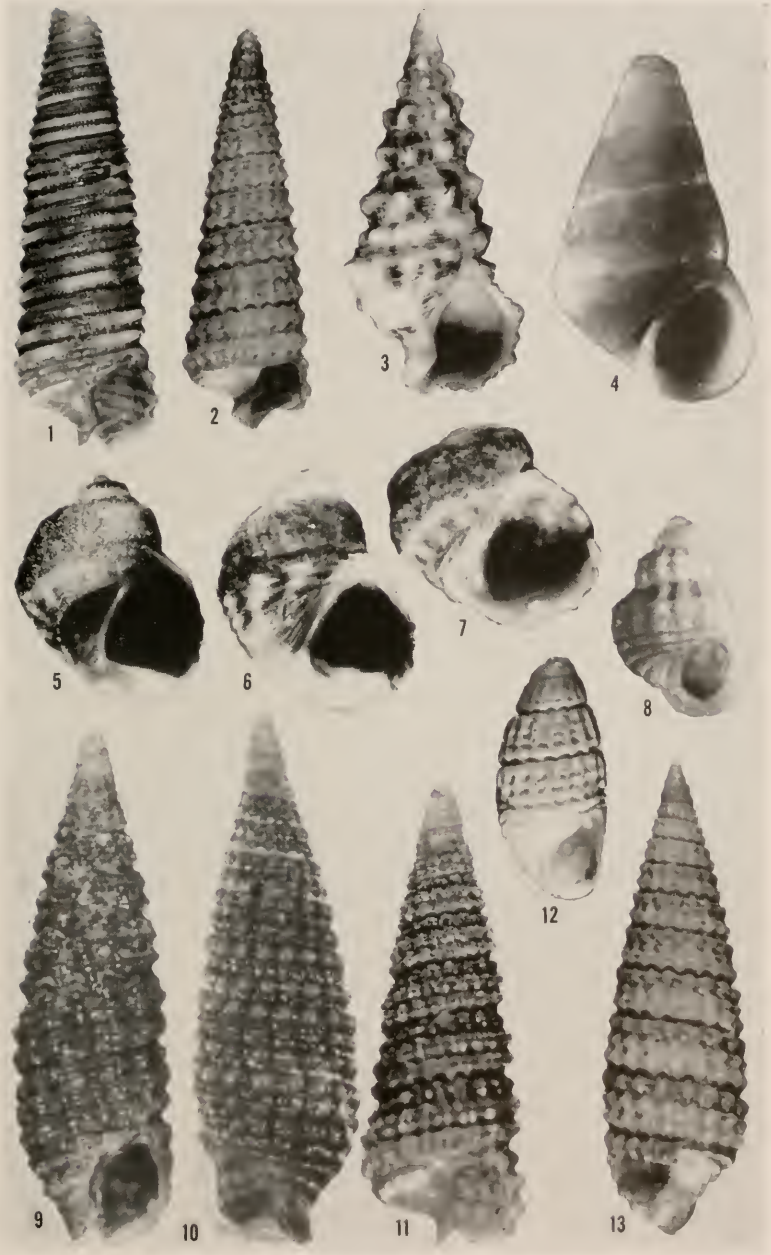


Plate 9

Plate 10

Fig. 1. *Chemnitzia major* Adams. Holotype MCZ 186448 (7.1x).
Fig. 2. *Chemnitzia gracilior* Adams. Lectotype MCZ 186447 (10x).
Fig. 3. *Chemnitzia marginata* Adams. Lectotype MCZ 186450 (20.3x).
Fig. 4. *Chemnitzia panamensis* Adams. Lectotype MCZ 186431 (10.4x).
Fig. 5. *Chemnitzia communis* Adams. Lectotype MCZ 155966 (20.2x).
Fig. 6. *Pedipes angulata* Adams. Lectotype MCZ 177345 (5.4x).
Fig. 7. *Litiopa* (?) *saxicola* Adams. Lectotype MCZ 186348 (16.1x).
Fig. 8. *Cingula terebellum* Adams. Holotype MCZ 186312 (23.1x).
Fig. 9. *Chemnitzia similis* Adams. Holotype MCZ 186555 (11.2x).
Fig. 10. *Rissoa firmata* Adams. Holotype MCZ 186430 (12.2x).
Fig. 11. *Rissoa fortis* Adams. Lectotype MCZ 186425 (8.1x).
Fig. 12. *Pyramidella conica* Adams. Lectotype MCZ 186346 (4.8x).


Plate 10

Plate 11

Fig. 1. *Cerithium pulchrum* Adams. Lectotype MCZ 186274 (1.6x).
Fig. 2. *Cerithium reevianum* Adams. Lectotype MCZ 186276 (1.5x).
Fig. 3. *Cerithium validum* Adams. Lectotype MCZ 186279 (1.4x).
Fig. 4. *Chemnitzia striosa* Adams. Holotype MCZ 186421 (12.6x).
Fig. 5. *Chemnitzia clathratula* Adams. Lectotype MCZ 186437 (22.1x).
Fig. 6. *Littorina megasoma* Adams. Holotype MCZ 186419 (20x).
Fig. 7. *Fissurella alta* Adams. Lectotype MCZ 186344;
Fig. 8. " " " Paratype MCZ 186345 (both 2.4x).
Fig. 9. *Crepidula rostrata* Adams. Lectotype MCZ 186295;
Fig. 10. " " " Paratype MCZ 186296 (both 3.2x).
Fig. 11. *Bulla* (*Cylichna*) *luticola* Adams. Lectotype MCZ 186411 (10x).
Fig. 12. *Crepidula nivea* Adams. Lectotype MCZ 186291;
Fig. 13. " " " Paratype MCZ 186292 (both natural size).
Fig. 14. *Crepidula cerithicola* Adams. Lectotype MCZ 186293;
Fig. 15. " " " Paratype MCZ 186294 (both 5.3x).


Plate 11

Plate 12

Fig. 1. *Rissoa janus* Adams. Lectotype MCZ 186458 (12.5x).
Fig. 2. *Rissoa infrequens* Adams. Holotype MCZ 186418 (10.6x).
Fig. 3. *Rissoa scalariformis* Adams. Holotype MCZ 186423 (19.1x).
Fig. 4. *Bulla* (*Tornatina*) *infrequens* Adams. Lectotype MCZ 186451 (8.7x).
Fig. 5. *Auricula infrequens* Adams. Lectotype MCZ 186347 (6.2x).
Fig. 6. *Rissoa clandestina* Adams. Lectotype MCZ 186440 (14.6x).
Fig. 7. *Truncatella bairdiana* Adams. Lectotype MCZ 177110 (8.4x).
Fig. 8. *Truncatella* (?) *dubiosa* Adams. Lectotype MCZ 186571 (16.6x).
Fig. 9. *Calyptraea aspersa* Adams. Paratype MCZ 186331;
Fig. 10. " " " Lectotype MCZ 186330 (both 2.2x).
Fig. 11. *Calyptraea* (*Syphopatella*) *regularis* Adams. Paratype MCZ 186324);
Fig. 12. " " " " Lectotype MCZ 186323 (both about 4/5 natural size).
Fig. 13. *Stomatella inflata* Adams. Holotype MCZ 186340 (4.1x).


Plate 12

Plate 13

Fig. 1. *Littorina angiostoma* Adams. Lectotype MCZ 186442 (15x).
Fig. 2. *Littorina excavata* Adams. Holotype MCZ 186422 (9.5x).
Fig. 3. *Calyptraca aberrans* Adams. Holotype MCZ 186322 (2.5x).
Fig. 4. *Auricula concinna* Adams. Lectotype MCZ 186332 (5.2x).
Fig. 5. *Auricula panamensis* Adams. Lectotype MCZ 186334 (4.9x).
Fig. 6. *Auricula tabogensis* Adams. Lectotype MCZ 186273 (3.4x).
Fig. 7. *Auricula trilineata* Adams. Holotype MCZ 186562 (2.3x).
Fig. 8. *Trochus coronulatus* Adams. Lectotype MCZ 186328 (2.1x).
Fig. 9. *Trochus leanus* Adams. Lectotype MCZ 186336 (3.1x).
Fig. 10. *Turbo rutilus* Adams. Holotype MCZ 177273 (about 1/2 natural size).
Figs. 11–12. *Calyptraca planulata* Adams. Holotype MCZ 186321 (4x).
Fig. 13. *Littorina dubiosa* Adams. Lectotype MCZ 186573 (9.8x).


Plate 13

Plate 14

Fig. 1, a–b. *Vitrinella minuta* Adams. Lectotype MCZ 156260 (31.6x).
Fig. 2. *Vitrinella minuta* Adams, base of a small specimen (35.5x).
Fig. 3, a–b. *Vitrinella parva* Adams. Lectotype MCZ 156268 (26.6x).
Fig. 4, a–b. *Vitrinella perparva* Adams. Lectotype MCZ 156261 (29.5x).
Fig. 5, a–b. *Vitrinella panamensis* Adams. Lectotype MCZ 156266 (24.6x).
Figs. 6, 6a. *Vitrinella panamensis,* variety.

We are indebted to Dr. H. A. Pilsbry for the loan of this plate as well as plates 15 and 16. They appeared originally in the Proceedings Academy Natural Sciences, Philadelphia **92**, plates 26, 27 and 28, December 27, 1945.

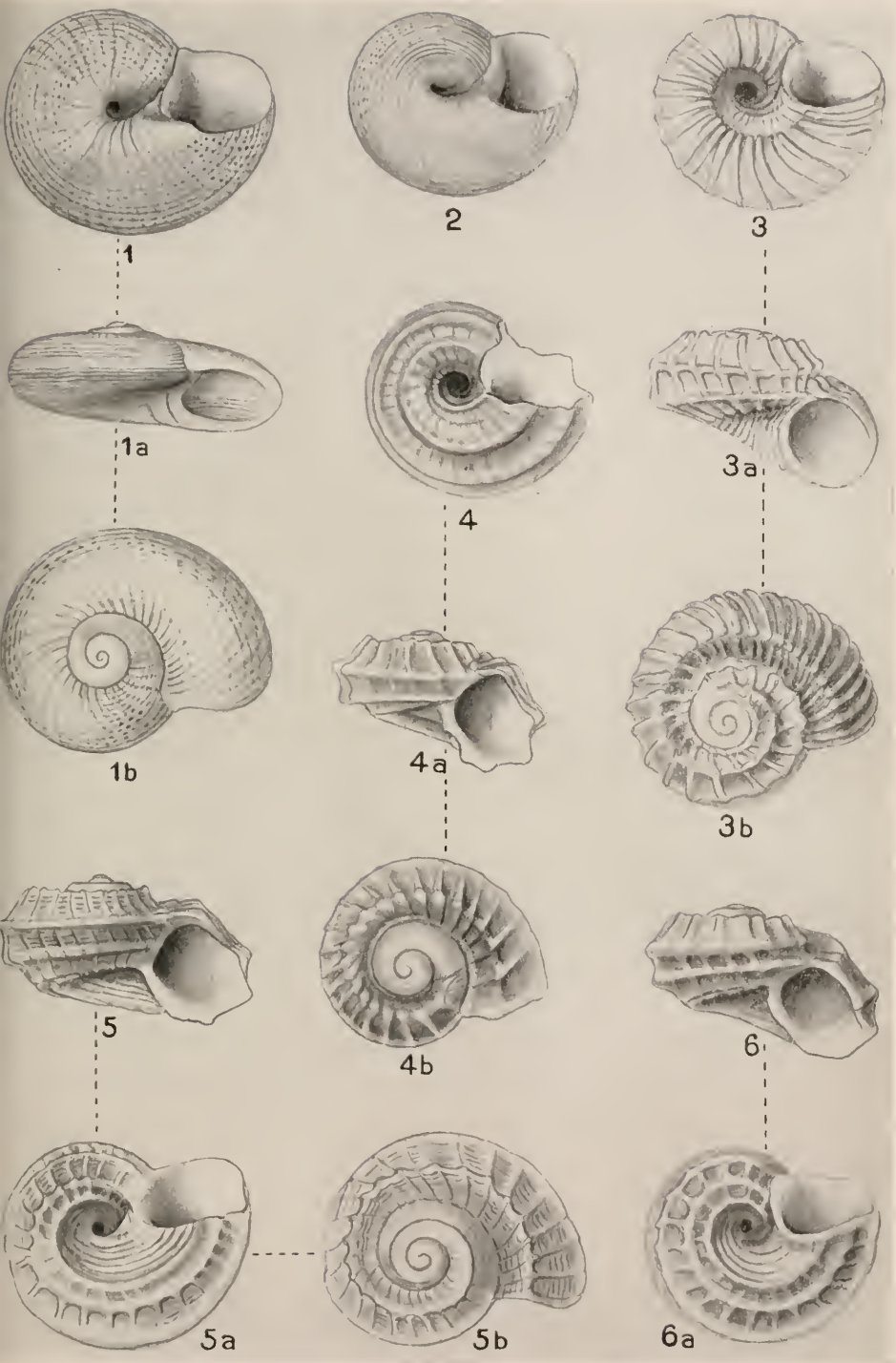


Plate 14

Plate 15

Fig. 1, a–b. *Vitrinella valvatoides* Adams. Lectotype MCZ 156273 (14.6x).
Fig. 2, a–b. *Vitrinella exigua* Adams. Lectotype MCZ 156265 (24.3x).
Fig. 3, a–b. *Vitrinella seminuda* Adams. Lectotype MCZ 156258 (22.6x).
Fig. 4, a–b. *Vitrinella concinna* Adams. Holotype MCZ 156264 (26x).
Fig. 5, a–b. *Vitrinella janus* Adams. Holotype MCZ 156267 (22.5x).

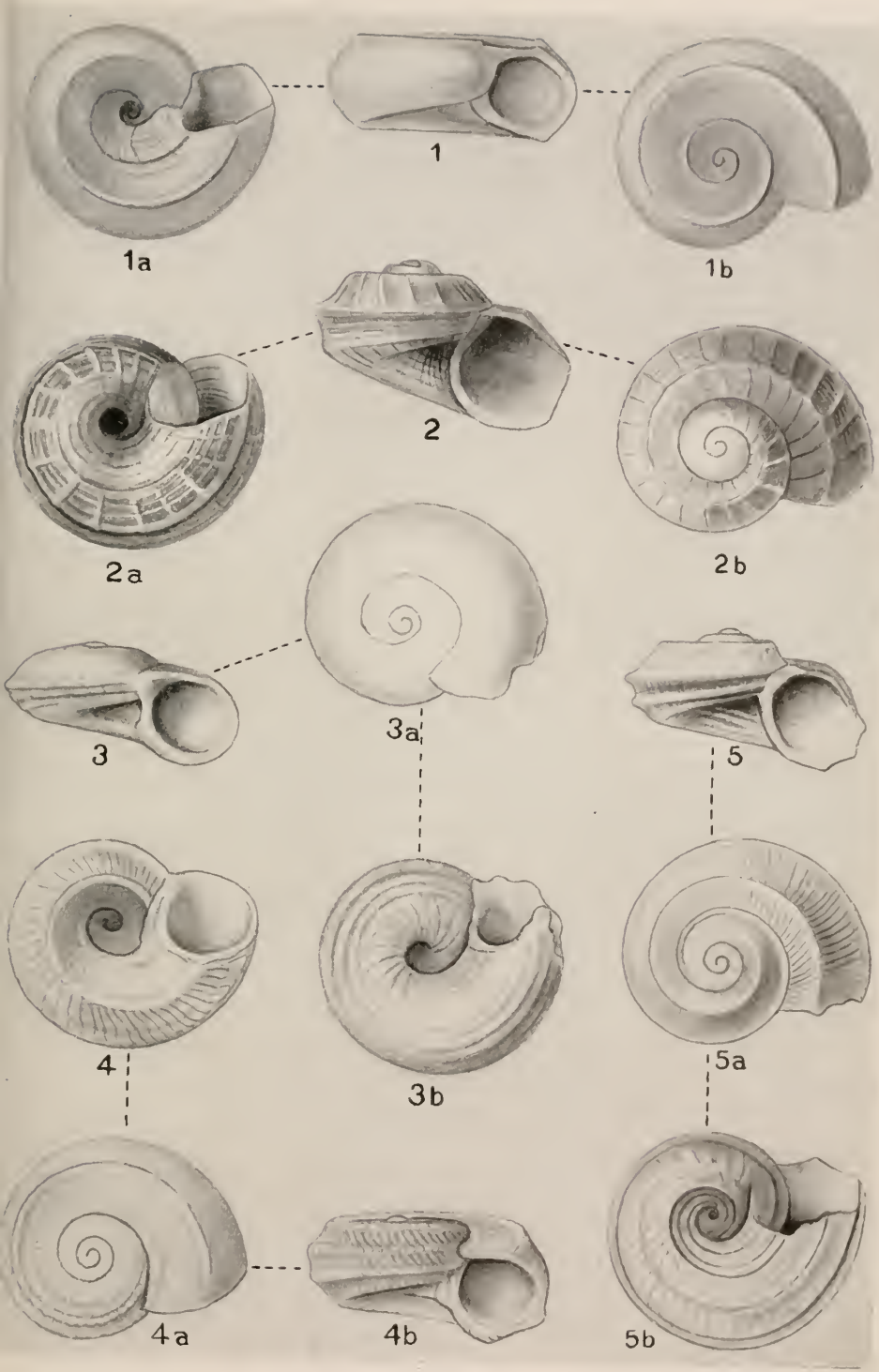


Plate 15

Plate 16

Fig. 1, a–b. *Vitrinella modesta* Adams. Holotype MCZ 156259 (20.8x).
Fig. 2, a–b. *Vitrinella regularis* Adams. Lectotype MCZ 156274 (21.2x).
Fig. 3, a–b. *Vitrinella tricarinata* Adams. Lectotype MCZ 156263 (20.5x).
Fig. 4, a–b. *Crepidula osculans* Adams. Lectotype MCZ 156277 (scale line equals 1 mm.).
Figs. 5–8. *Turbo phasianella* Adams. Fig. 5, Lectotype MCZ 186236; Figs. 6–8, Paratypes (11.4x).

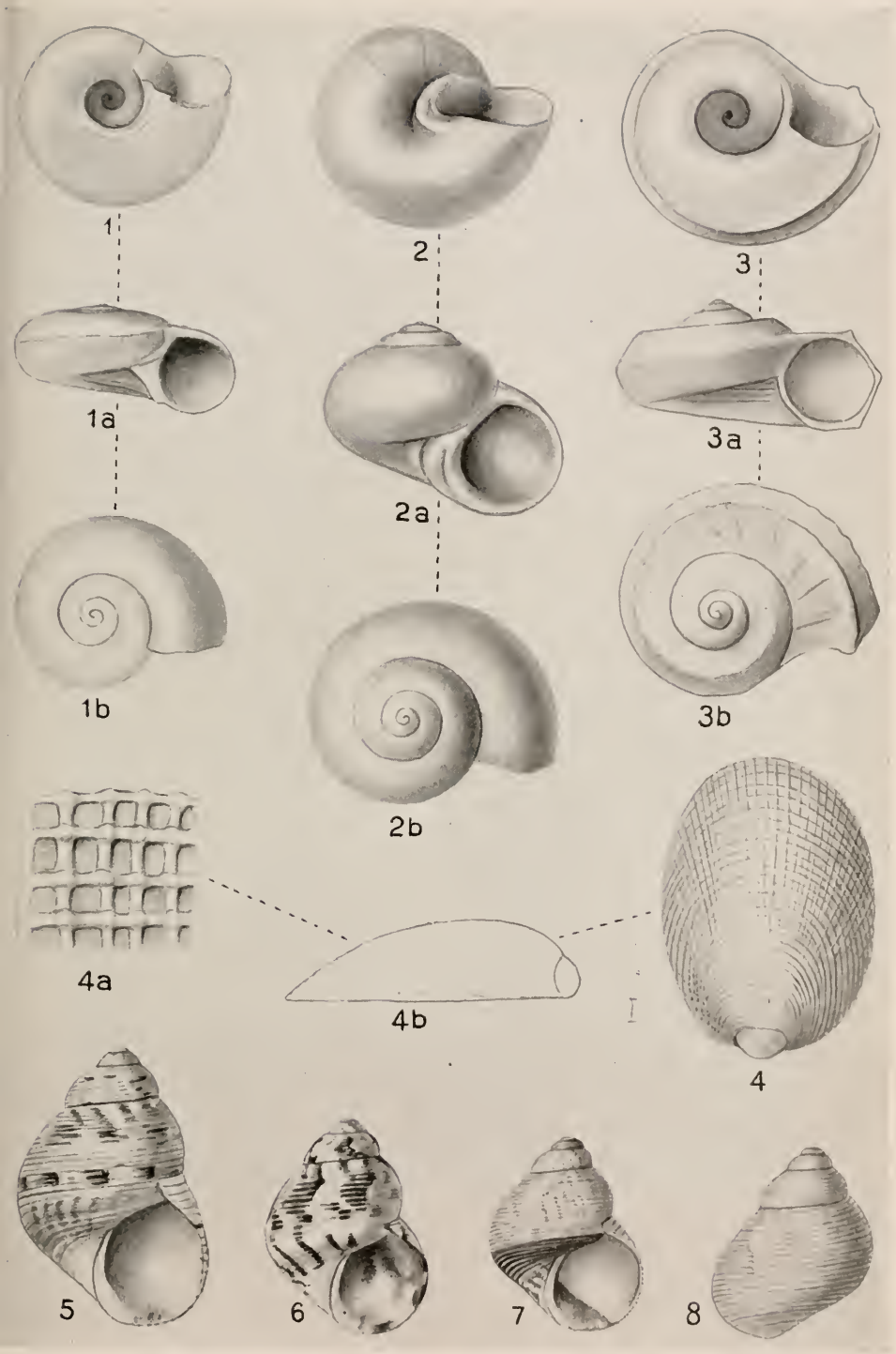


Plate 16

Plate 17

Fig. 1. *Coecum pygmaeum* Adams. Holotype MCZ 186587 (33.3x).
Fig. 2. *Coecum monstrosum* Adams. Lectotype MCZ 186584 (24.3x).
Fig. 3. *Coecum eburneum* Adams. Lectotype MCZ 186575 (24.3x).
Fig. 4. *Coecum laqueatum* Adams. Holotype MCZ 186583 (24x).
Fig. 5. *Coecum laeve* Adams. Holotype MCZ 186581 (30.5x).
Fig. 6. *Coecum firmatum* Adams. Lectotype MCZ 186578 (21x).
Fig. 7. *Coecum diminutum* Adams. Holotype MCZ 186574 (30.5x).
Figs. 8–9. *Corbula rubra* Adams. Holotype MCZ 186313 (3.6x).
Figs. 10–11. *Amphidesma tortuosum* Adams. Holotype MCZ 186366 (about 9/10 natural size).
Figs. 12–13. *Potamomya inflata* Adams. Lectotype MCZ 186315 (1.7x).
Figs. 14–15. *Pandora cornuta* Adams. Holotype MCZ 186309 (1.9x).

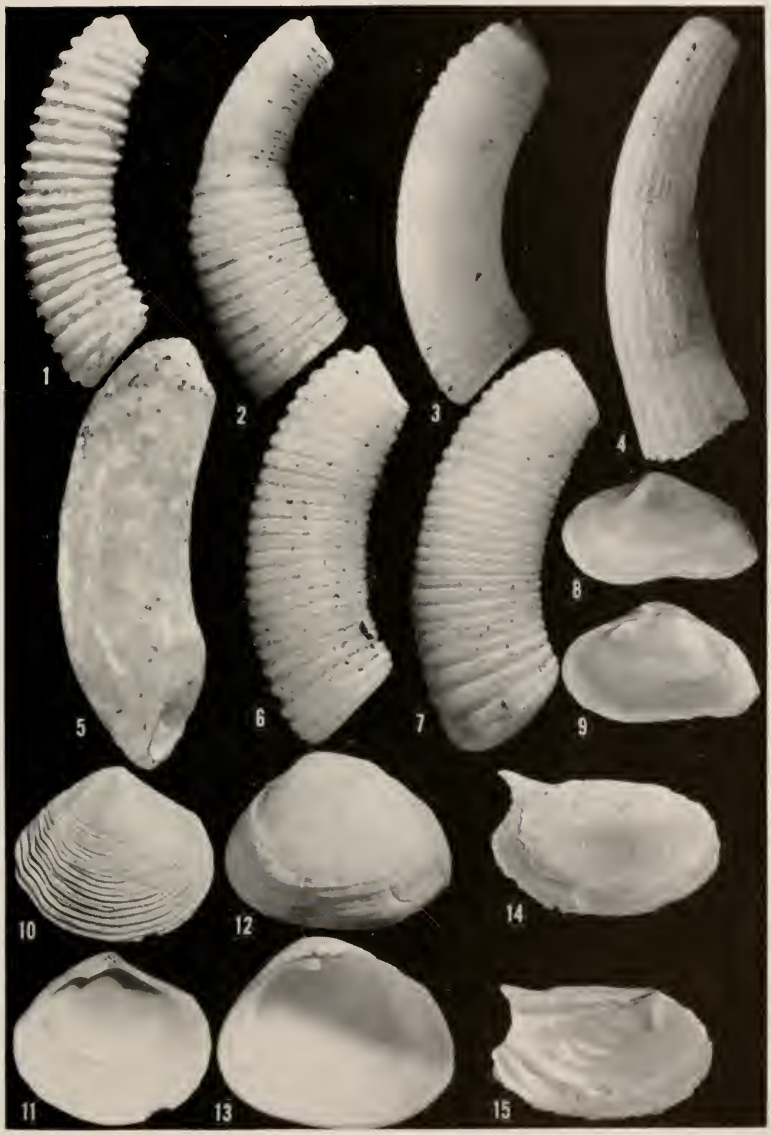


Plate 17

Plate 18

Figs. 1–2. *Amphidesma striosum* Adams. Holotype MCZ 186542 (1.6x).
Figs. 3–4. *Potamomya triagonalis* Adams. Lectotype MCZ 186314 (1.1x).
Figs. 5–6. *Tellina simulans* Adams. Holotype MCZ 186307. Fig. 5 (1.5x), Fig. 6 (1.3x).
Figs. 7–8. *Amphidesma bicolor* Adams. Holotype MCZ 186504 (1.6x).
Figs. 9–10. *Tellina cognata* Adams. Holotype 186304. Fig. 9 (about 2/3 natural size), Fig. 10 (about 3/4 natural size).
Figs. 11–12. *Tellina vicina* Adams. Lectotype MCZ 186365 (1.3x).
Fig. 13. *Anomia tenuis* Adams. Lectotype MCZ 186137 (1.5x).
Figs. 14–15. *Amphidesma proximum* Adams. Lectotype MCZ 186563 (about 1/2 natural size).
Figs. 16–17. *Tellina concinna* Adams. Lectotype MCZ 186302 (about 3/4 natural size).


Plate 18

Plate 19

Figs. 1–2. *Solen rudis* Adams. Lectotype MCZ 186271 (about 1/2 natural size).
Figs. 3–4. *Petricola cognata* Adams. Holotype MCZ 186308. Fig. 3 (1.6x), Fig. 4 (1.8x).
Figs. 5–6. *Potamomya aequalis* Adams. Holotype MCZ 186325 (1.5x).
Figs. 7–8. *Arca* (*Byssoarca*) *tabogensis* Adams. Lectotype MCZ 186299 (1.1x).
Figs. 9–10. *Amphidesma ventricosum* Adams. Holotype MCZ 186364. Fig. 9 (1.5x), Fig. 10 (1.8x).
Figs. 11–12. *Arca pholadiformis* Adams. Lectotype MCZ 186368 (1.3x).
Fig. 13. *Tellina puella* Adams. Lectotype MCZ 186305 (1.6x).
Fig. 14. *Tellina puella* Adams. Paratype MCZ 186306 (1.6x).
Figs. 15–16. *Tellina siliqua* Adams. Holotype MCZ 186301 (1.6x).
Figs. 17–18. *Solecurtus affinis* Adams. Lectotype MCZ 186558 (about 2/3 natural size).
Figs. 19–20. *Anatina alta* Adams. Holotype MCZ 186363. Fig. 19 (about 7/8 natural size), Fig. 20 (about 3/5 natural size).


Plate 19

Plate 20

Figs. 1–2. *Arca similis* Adams. Lectotype MCZ 186564 (about 3/4 natural size).
Figs. 3–4. *Gouldia pacifica* Adams. Lectotype MCZ 186297 (7.9x).
Figs. 5–6. *Cyrena maritima* Adams. Lectotype MCZ 186284 (about 2/3 natural size).
Figs. 7–8. *Chama buddiana* Adams. Lectotype MCZ 190150 (about 9/10 natural size).
Fig. 9. *Cingula turrita* Adams. Type lost. Figure of type from Dall and Bartsch 1909, pl. 18, fig. 12 (14x).


Plate 20

Plate 21

Fig. 1. *Mitra exigua* Adams. Lectotype MCZ 186593 (16.5x).
Fig. 2. *Scalaria ligata* Adams. Lectotype MCZ 186590 (12.8x).
Fig. 3. *Litiopa effusa* Adams. Lectotype MCZ 186589 (16.6x).
Fig. 4. *Phasianella brevis* Adams. Neotype MCZ 186592 (17.9x).
Fig. 5. *Buccinum candidissimum* Adams. Holotype MCZ 186591 (6.8x).

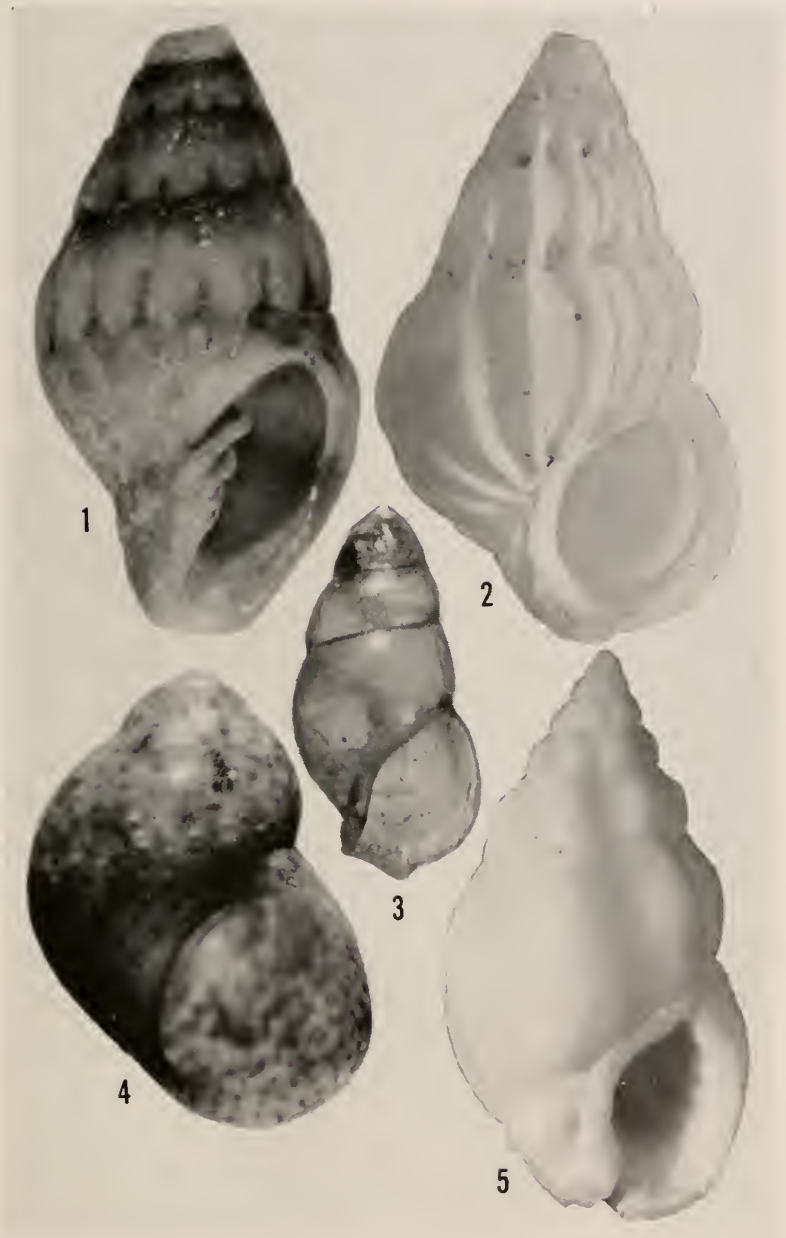


Plate 21

## Additions to the Western Atlantic Marine Mollusks Described by C. B. Adams

*By* RUTH D. TURNER

Since the publication of our paper on the Western Atlantic Marine Mollusks described by C. B. Adams, type specimens of six species which were then reported as lost have been located. Of these, five are figured for the first time, the sixth specimen is so badly broken it is not worthy of photographing.

**brevis** *Adams* **Phasianella** Plate 21, fig. 4

1850, Adams, Contributions to Conchology no. 4, p. 67.

1950, Clench and Turner, Occ. Pap. On Mollusks **1**, no. 15, p. 262.

[A neotype is here selected for this species. The specimen was in the Adams Collection but was collected by T. Bland in St. Thomas.]

**candidissimum** *Adams* **Buccinum** Plate 21, fig. 5

1845, Adams, Proc. Boston Soc. Nat. Hist. **2**, p. 2.

1950, Clench and Turner, Occ. Pap. On Mollusks **1**, no. 15, p. 264.

**effusa** *Adams* **Litiopa** Plate 21, fig. 3

1850, Adams, Contributions to Conchology no. 5, p. 71.

1950, Clench and Turner, Occ. Pap. On Mollusks **1**, no. 15, p. 276.

[Is the embryonic shell of a *Cymatium,* probably *Cymatium martinianum* d'Orbigny.]

**exigua** *Adams* **Mitra** Plate 21, fig. 1

1845, Adams, Proc. Boston Soc. Nat. Hist. **2**, p. 2.

1950, Clench and Turner, Occ. Pap. On Mollusks **1**, no. 15, p. 278.

**ligata** *Adams* **Scalaria** Plate 21, fig. 2

1850, Adams, Contributions to Conchology no. 4, p. 67.

1950, Clench and Turner, Occ. Pap. On Mollusks **1**, no. 15, p. 204.

[Is *Epitonium albidum* d'Orbigny; Clench and Turner 1951, Johnsonia **2**, no. 30, p. 260.

**obesa** *Adams* **Litiopa** Holotype MCZ 186594

1850, Adams, Contributions to Conchology no. 5, p. 71.

1950, Clench and Turner, Occ. Pap. On Mollusks **1**, no. 15, p. 319.

[Is the embryonic shell of a *Cymatium,* probably *Cymatium muricinum* Röding.]

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 JANUARY 23, 1957 NUMBER 21

## Charles Johnson Maynard and his work in Malacology

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In many ways Charles Johnson Maynard was a unique and brilliant man. He was a born naturalist, teacher, and field worker, who not only interested others in his work but kept detailed notes on all he observed. He was very much an individualist and an original thinker, but he lacked the basic biological training so essential to one working in the field of systematics. This individuality and lack of training was evident in his work, as well as in his inability to get along with those professionally engaged in the same field. Consequently, as time went on he isolated himself more and more from his fellow workers and showed little interest in the literature of the day. In his scientific work, Maynard became a very lonely man and the tremendous energy which he put into his nature walks and into the Maynard Chapter of the Newton Natural History Society was probably a result of a frustrated desire for leadership. There is no question that Maynard influenced many young people in natural history both directly and indirectly through the teachers who attended his classes. It was most unfortunate that he did not have a good early training, for his contributions could have been far more important had he understood the field of systematic zoology and the principles upon which his fellow scientists based their work.

One of the young boys who attended Maynard's classes and who spent many happy hours in his workshop later spoke with real feeling of his love for the man, recalling the fact that at one time when Maynard was very ill he had gone home to pray for his recovery. He said that Maynard was a hard worker,

often even eating his meals in the barn while he worked. Apparently Maynard paid little attention to his personal appearance, a factor which perhaps was disturbing to some of his associates, but meant little to a teen-age boy.

Charles W. Townsend (1930) who knew Maynard in his later years wrote: "He was of a sunny and cheerful disposition, as an observer he was keen and accurate and his writings abound in interesting and original observations. He was what has sometimes been called a 'natural naturalist' and it was to be regretted that he had not had a more thorough foundation in science."

Charles Foster Batchelder (1951) wrote in a similar vein. "The limitations of his early education probably contributed to making him the solitary observer and student he was. This somewhat solitary habit no doubt deprived him of much wholesome criticism of his work, which, had he had it, might have given him much higher standards. Yet, in various fields, research that he did might never have been attempted had he been fully aware of the standards and the existing background of knowledge that formed the basis from which others worked. His independence of mind and disregard, perhaps to some degree unconscious, of other scientific writers' accepted standards and habitual ways in matters of writing and publishing are more than conspicuous in his own writings."

## Acknowledgments

I am most grateful to the late Pearl J. Maynard, only child of Charles Johnson Maynard, for much help in preparing this account. She not only loaned me Maynard's autobiography, a manuscript of about a thousand typewritten pages, but also a photograph of her father. She talked very freely about her father and showed me his workshop in the barn. Since the death of Miss Maynard in 1953, we have been unable to trace the manuscript but fortunately all data pertaining to his work on the genus *Cerion* had been copied and is now in the files of the Department of Mollusks at the Museum of Comparative Zoology.

Mrs. William F. Clapp, who collaborated with Maynard on some of his *Cerion* papers, was most kind in telling me of her work with Maynard.

* * * *

Charles J. Maynard.

May 6, 1845–October 15, 1929

Plate 22. From an original photograph.

Charles Johnson Maynard was a direct descendant of John Maynard who had emigrated from England in 1640 and settled in Sudbury, Massachusetts. Charles' father, whose name was also John, married Emeline Sanger and for a time they lived in Waltham, Massachusetts. Here, their first son, George Sanger Maynard, was born in 1832. In 1840, they bought a farm of about 40 acres in Newton where both Gilbert and Charles were born. Charles was born on May 6, 1845 and at a very early age he began to show an interest in natural history, particularly in birds. His mother was sympathetic towards this interest and encouraged him throughout his childhood. His father died in the summer of 1857 when Charles was only twelve years old and in 1860 his older brother George died of tuberculosis. This left Gilbert and Charles to run the farm, though apparently Gilbert took most of the responsibility. According to his daughter, Charles was the pet of the family and was allowed to do pretty much as he pleased. He attended the local school until he was sixteen but after that was expected to work on the farm. However, he was not interested in farming and expressed his feeling on this in his biography. "My innate desire to investigate the mysteries of nature was too strong to allow me to settle down to farming. Besides this, I was ambitious to achieve more than the usual aspirations of the mere farmer of that time. My mother, however, thought that the studies I preferred would not lead to financial success in life and strongly urged me to select some trade or other occupation."

Following his mother's advice he looked into several trades, among them wood engraving, about which he wrote as follows: "When I was a child I took a great liking to the art of wood engraving. Not because I had ever seen any of that work done, for I had not, but with the idea in mind that I should like the work, I consulted a neighbor who was a wood engraver. After questioning me as to my ability to make drawings and after finding me not at all proficient in that art, he said emphatically that I would not succeed as an engraver so I abandoned that project." It is interesting to see that in later years he made all of his own illustrations and wood engravings, as well as hand coloring many of his plates. These illustrations are remarkably well done considering his complete lack of training.

Maynard tried working in the Waltham Watch Factory for

a time but again he was not happy and wrote: "I soon saw that my heart was not in the business and I embraced every opportunity to return to my favorite study . . . . and after a year left the factory." In 1864 he went to work for a watch and clock repairer in Waltham. He stayed there a year and then went to one or two other places where the advantages for learning appeared greater and he had more time to devote to nature study. Though he was always looking for an increased opportunity to study, there does not seem to have been any idea in Maynard's mind of going on to college; at least there is no mention of it in his notes.

In 1866 he met Mr. Floyd, the taxidermist, who had been engaged to unpack the Lafresnaye collection of birds which had been purchased by Dr. Henry Bryant for the Boston Society of Natural History. Floyd asked Maynard to help him with this work and it was while doing this that Maynard had an opportunity to meet the great scientists then associated with that institution. Here he received the necessary start in the collecting and taxidermy business and was soon making collections for private schools in Boston and vicinity, for John Cumings, E. A. Samuels, Henry Henshaw, J. A. Allen and others. His acquaintance with William Brewster, who collaborated with him on some of his early papers, probably also dates from this period.

According to his daughter, it was about this time that he opened a small business in natural history supplies, with an office at 36 Winter Street, Boston, Massachusetts. There seems to be considerable confusion as to the exact time and place of his various offices in Boston, but it is clear that his first office was on Winter Street, that in 1885 he was at 339 Washington Street, and that at one time he had a shop in Pemberton Square and also one on West Street. His letter head is typical of his business—"C. J. Maynard and Co./Publishers, Dealers in Birds Eggs, Skins, Minerals, and Naturalists Supplies./Artistic Taxidermists/339 Washington Street, Boston."

Maynard's early publications were largely on birds and his first paper was published in the American Naturalist in 1868. This was followed by a number of papers appearing in the Proceedings of the Boston Society of Natural History, the Bulletin of the Essex Institute, and the Salem Naturalist. Maynard's Naturalist Guides were published by Fields, Osgood and

Co., of Boston, one of the outstanding publishing houses in Boston at that time. About 1881, however, he established the house of C. J. Maynard and Company, Newtonville, Massachusetts. From that date, though he continued to send a few papers to other journals, his main works were published by himself. He not only set his own type but he made his own woodcuts and he printed, colored and bound the entire publication. He was proud of this ability and, in fact, wrote that he even made many of his tools.

Maynard was a very active field man and beginning in 1866 he made a number of collecting trips to Ipswich, Massachusetts, where he later lived for three years. He also visited Grand Manan and the Magdalen Islands, largely for bird study. Most of his trips, however, were to the south—to Florida and the Bahama Islands. Love of natural history, desire for travel, and the necessity of procuring specimens for his business motivated his field work. There seem to be some discrepancies in the dates given, especially for his early trips, in the various published accounts and in his own notes. He apparently did not begin writing his autobiography until some time after 1924 and completed it only shortly before his death. Consequently, it is not surprising that errors slipped in.

Maynard made his first trip to Florida during 1868–1869 with Charles Thurston for the purpose of collecting birds. A detailed and most interesting account of this trip was given by Maynard in his series of articles entitled, "A Naturalist in Florida," published in the Florida Naturalist between October 1928 and January 1930. Many of the birds collected on this as well as on other trips are now in the Museum of Comparative Zoology. Unfortunately, the special preserving method which he "invented," and of which he was so proud, has changed the color of the specimens, including the types, making them virtually useless.

In his notes covering his first expedition to the Florida Keys, a trip devoted mainly to the collecting of birds, Maynard wrote: "I saw my first living *Cerion* in November 1870, when I collected specimens of what I then knew as *Pupa incana* on Key West, Florida." In October 1873 Maynard and his friends sailed in the yacht "Nina" from Woods Hole, Massachusetts to Jacksonville, Florida, stopping along the way to collect, and arriving at the St. John's River on January 10, 1874. According to

his daughter, Maynard financed many of his early trips by taking with him well-to-do boys who were interested in camping and collecting. In 1882 Maynard was again in Florida, and with him was his bride Elizabeth Buxton Cotter of Boston. They spent their wedding trip collecting in the Indian River country of Florida. All of these Florida trips were devoted largely to collecting birds.

In 1884 he made his first trip to the Bahamas and, like his Florida trips, this one was mainly devoted to birds. In his notes he wrote: "I collected some land shells on this trip, but strangely, although I must have passed several species of *Cerion,* I collected a single species only. This I afterward described as *Strophia neglecta* and found it common a mile or so west of Fort Charlotte" [Nassau, New Providence]. Apparently his first trip to the Bahamas was restricted to the island of New Providence.

The Cerionidae is a family of land snails which are peculiar to the West Indies and the Lower Florida Keys. They live in a narrow band along the upper strand line usually within the reach of salt spray. They may be extremely abundant where they are found and in general live on sea grapes or other low vegetation, feeding mainly upon lichens and fungi. They are colonial in habit and the colonies though often separated by only short distances may be quite different in appearance. Most of these differences are now known to be of little or no taxonomic value at the species level. When Maynard reached the Bahamas he became fascinated with the group and eventually the Cerionidae became the main focus of his collecting. There is but a single genus in this family. *Cerion* is the valid generic name for this group with *Strophia* as a synonym: Maynard used both names in his writings.

On his second Bahama trip in 1887–1888 he landed at Nassau, New Providence, and from there went to Andros Island where he collected in the region from Fresh Creek to Middle Bight. From there he visited Rum Cay, Long Island, and Inagua. In his notes he does not mention collecting any *Cerion* on Andros, his notes being concerned largely with birds. He was on Rum Cay in January 1888 and wrote: "I did not collect any birds on the key but began my first important collections of *Cerion* here. I found a white species quite common on the west side near the salt ponds. This I named *Strophia alba,* and a species,

also white but well flecked with brown, further in the interior. This I named *Strophia lentiginosa.*"

On January 20, 1888, he went ashore at Clarence Town, Long Island, where he found "three specimens of a rather remarkable *Cerion* which was perfectly smooth, polished and flesh-colored (*Strophia nuda* Maynard)." His stay on Inagua, like that on Long Island, was apparently very short, as he visited only Matthew Town and collected very little.

On March 18, 1888 he was in Kingston, Jamaica, and from there took a small schooner for Grand Cayman but prevailed upon the captain to let him off on Cayman Brac where he spent some time collecting before going to Little Cayman. He apparently spent considerable time on these islands and made large collections of *Cerion,* for he wrote, "I obtained four species, one of them exceedingly abundant. All of the shells were inactive on account of the prevailing dry weather. The common *Strophia,* as I called it *Strophia copia,* had gathered in such large numbers about the base of coconut trees that grew along the shore south of the hamlet that I could take them up in double handfuls. Many had climbed the trunks of the trees and a large number were on the debris cast up by the sea along the beach. Others had found their way into dug-outs that had been drawn up on the shore, and thus were undoubtedly carried about when the canoes were taken from this portion of the island to the other parts, or as I afterwards found out, to Little Cayman, where at least two colonies had been established, but where in one case a distinct species had been evolved. Some had crawled on some barrels which I had placed on the beach, and in which I had packed some corals, while quite a number had ventured in among the specimens. When I opened these at my house in Newton, the strophias came out and fastened themselves to grass and other herbage where they remained alive until winter."

From the above quotation it is obvious that Maynard had observed the ease with which *Cerion* are distributed and the tenacity for life which these animals have; yet, though he had the answer at his finger tips, he did not apply it to his science. Perhaps it was solely from a desire to describe new forms or perhaps from the fact that he sold collections, charging on the basis of the number of named forms, that he continued to name even the slightest variations. Certainly he did not apply what

he had observed, and when two obviously similar colonies occurred on separate islands or were separated by a creek, inlet or other barrier, they were given different names.

About Little Cayman he records that he found "at least ten species of Cerionidae. All of the species except one were found in a coconut grove on the north side near the west end. They were chiefly in a section grown up with guinea-grass." It was the study of these species which awakened his interest more than ever in this family. He states: "I became thoroughly convinced that I had to deal with an exceedingly plastic group of mollusks with many species having a very limited distribution." However, though he realized that he was dealing with a plastic group, he did not grasp the idea of minor differences between unit populations. He interpreted everything as a static, fixed picture and apparently felt that all minor differences, once established, would remain unchanged, leaving no room for interbreeding of the various elements.

On his return from his second Bahama trip he decided to issue a publication of his own rather than scatter his observations and descriptions of his new species through various journals. With this in mind he issued the first number of his "Contributions to Science," in April 1889. A monograph of the genus *Strophia* was included here. He wrote in his notes that "the early articles were illustrated by plates drawn in stone by myself, but not printed by me. Subsequently illustrations in this volume were from drawings made on wood and engraved by me, and I also manufactured the tools with which they were made." At this same time he also gave up his rooms in Boston and moved everything to his home in West Newton where he had made a laboratory and printing office for himself in the large barn.

He wrote very little about his third Bahama trip made in 1893 with George F. Curtis and J. W. Thorndike. They landed at Nassau and from there went to Treasure Cay, U Cay, Pimlico Cay, Highborne[1] Cay and cays near Allen Cay in the northern end of the Exuma group. They also visited Andros Island working from Fresh Creek to Middle Bight, and then touched at Green and High Cays. They collected several thousand *Cerion,* from which he described 28 species as new.

[1] The spelling of all place names are from United States H. O. chart no. 26b.

The fourth Bahama trip was made in 1897. On this five months trip which extended from February to July, Maynard sailed entirely around New Providence, collecting at many localities on this island and the small cays near shore. He then collected along the line of cays extending from the northeast of New Providence to Eleuthera and on Eleuthera near Current Settlement. On this trip he collected some 32,000 specimens and later described 37 new species from this material.

Maynard did not make another trip to the Bahamas until 1913, but in the sixteen years which intervened he was busy with a wide variety of activities and in writing numerous papers, most of which he published himself. These papers covered a variety of subjects, mostly on birds but including papers on trees, mosses, taxidermy, the use of formalin, the hibernation of animals and a series of papers on systematic zoology for teachers. At the same time he was also selling zoological supplies, running a course of nature study at Camp Metacomet in Centerville, Massachusetts, and giving nature study courses in the schools, in addition to conducting his nature walks. In 1908 he began the publication of his "Records of Walks and Talks with Nature" which included lists of plants and animals observed on the weekly walks which he conducted for teachers and others who wished to attend. It was from the sale of specimens, natural history supplies, his publications and the small fees charged for his classes and nature walks that Maynard procured a very frugal living. His "Contributions to the History of the Cerionidae" appeared as appendices in his series "Walks and Talks with Nature."

Maynard returned to the Bahamas for a fifth trip in 1913, arriving in New Providence on February 21. He collected in the vicinity of Nassau and noticed many changes that had occurred since his trip in 1897. The first automobile road had been built and there was a lighthouse at East Point; but what disturbed Maynard most was the fact that two old cemeteries, where *Cerion* had formerly been very abundant, had been converted into a botanical garden and a park, and the mollusks had been exterminated. On this trip he went across to Hog Island, opposite Nassau and collected a fossil *Cerion* which he named *C. thompsoni* in honor of his friend and host, Mr. Charles Thompson of Nassau. He also visited Spruce Cay, Athol Island and Long Cay, all just off the northeast end of

New Providence. This trip was cut short when Maynard accidentally shot himself in the left leg while climbing over a stone wall. He stated, however, that although the trip had been shortened he collected 1030 specimens of *Cerion,* which included two new species.

The sixth Bahama trip, in 1915, was, from the point of view of *Cerion,* the largest and most important trip he made. It extended from February 14 to June 3. On this trip he chartered a 10-ton sloop, the "Merry May," and engaged his old friend Charles Thompson and a helper, Joe Kemp, to sail her. They put in provisions for two months and set out from Nassau for the Silver Cays, then, going north and around Hog Island, ran down between Athol Island and Rose Island, landing on Low Bay Cay and Rose Island where both fossil and living *Cerion* were collected. Continuing south they landed on Bush Cay, one of the Ship Channel Group, where they collected 1040 specimens of a new species in two hours. Many of the specimens were living on exposed rock, an unusual place for *Cerion.* Their next stop was on Ship Channel Cay where again fossil and living specimens were collected. Both the fossil and living forms were described as new species, though he states that the "dead" individuals clearly illustrated the evolution of one species into the other! From here they continued south along the Exuma chain to the Allen Cays, U Cay, Highborne Cay, Long Cay, Little Norman Cay and East Cay collecting new species of *Cerion* on each island. They did not stop on Great Norman Cay, as hogs were seen roaming about and consequently the land shells would have been eaten. They stopped at Wax Cay, a small cay with a salina crossing it from east to west. The *Cerion* were exceedingly abundant on the under sides of the palm fronds and on the mangrove near the salina. Maynard wrote: "The Cerions which occurred on the mangroves of the salina were much dwarfed. We named the larger form *Strophia palmata* and the smaller one *S. p. minuta.*" From here they went south stopping at Hawksbill Cays, Cistern Cay, Bell Cay, Fowl Cay, the Pipe Cays, Sampson Cay, Harvey Cay, Bitter Guana Cay, Farmers Cay and then, going through the Pimlico Cays without stopping, they headed for Norman Pond Cay. They collected here and on the small cays around the northern tip of Great Exuma Island. They made one station on Great Exuma and then went north to

Stocking Island. As it had rained all the preceding night the *Cerion* on Stocking Island were very active and Maynard found several pairs mating. He noticed here as elsewhere that many specimens were feeding on decaying vegetation, and that some specimens would burrow in the moist sand. Though they may have been laying eggs, he was never able to find any. They then ran south along Great Exuma and visited Maria Cay and the northern tip of Little Exuma Island.

At this point Maynard noticed that the men were becoming dissatisfied. The remainder of the trip as Maynard had planned it was to Long Island then north to Conception, Cat and Eleuthera Islands. This was unknown territory to the men and they were uneasy about venturing into a new area. Consequently, Maynard compromised, and it was agreed that they should round Great Exuma and then turn north along the western shore of the island and, sailing north, collect at numerous islands on the trip back to Nassau. This they did, making many new stations and arriving back in Nassau about April 1. The results of the Exuma Trip were some 50,000 specimens collected on 48 cays and islands, including a total of 55 species, of which 49 were described as new.

Maynard remained in Nassau until April 18 when he engaged the sloop "Joyful" with three men to sail her, and they left Thompson's Wharf and headed for Andros Island. They anchored first at Fresh Creek, Andros, and here Maynard spent most of his time collecting birds, though he did get one species of *Cerion.* On Goat Cay, at the mouth of Fresh Creek, *Cerion* were very abundant. Leaving here they sailed north along the lagoon between the reef and Andros, stopping at Stanyard Creek Settlement collecting birds and *Cerion,* then moving north to Calabash Cay where he records seeing huge Indian shell mounds composed largely of conch shells. He next landed at Pigeon Cay and then proceeded north to Saddleback Cay, Mastic Point, Nicholls Town and Morgan's Bluff where they collected in the low shrubs along the shore. They continued north to the Joulter Cays and across to Chub Point Cay in the Berry Islands where he again saw a large Indian shell mound, this one over a mile in length. They then went across to Crab Cay and thence to Thompsons Cay where Maynard collected *Cerion thayeri,* which he named in honor of Col. John E. Thayer of Lancaster, Massachusetts, who had helped finance some of

his Bahama trips. On Frazers Hog Cay he collected a coarse and very different *Cerion,* many specimens of which appeared to have been gnawed by rodents. They then stopped at Cat Cay, Whale Cay, and Little Whale Cay, where Maynard spent his time collecting birds as no *Cerion* were to be found. Going on to Bond's Cay, Little Harbour Cay, Cabbage Cay, Guano Cay and Bridgewater Cay he collected on each and on the latter cay he found a large *Cerion* which he named *Strophia travellii* in honor of Charles I. Travelli, whose kindness had made the Berry Island trip possible. Other stopping places in the Berry Islands included Holmes Cay, East Marketfish Cay, and East Soldiers Cay in the middle group. They then worked north along Hains Cay to Hawks Nest and out to Petit Cay. This is a very small cay with nothing but a heavy grass cover, but cerions were very abundant and they collected 1690 specimens of what he called *S. scutata.* As they were experiencing heavy seas at this time they ran north into Great Harbour where they anchored and visited Goat Cay. It was on this little cay that Maynard obtained what he considered three species of fossil *Cerion* from one small, low cliff. From here they went to Great Stirrup Cay then dropped south to Lignumvitae Cay, Bullocks Harbour and Bamboo Cay. As the month for which he had hired the "Joyful" was almost up and as they could not find a channel which would allow them to go farther south on the inside of the outer cays, Maynard decided to head back for Nassau so they turned north, crossed through Great Harbour and then proceeded straight to Nassau.

The result of the trip to Andros and the Berry Islands was a collection of some 50,000 specimens of *Cerion* comprising 46 species of which 42 were described as new. Maynard remained in Nassau from May 20 to June 1, collecting in the vicinity of the city and packing his collection for shipment to Newton. This was Maynard's last important collecting trip.

With the tremendous collections of *Cerion* which he had amassed, Maynard now began a series of papers which he entitled "Contributions to the History of the Cerionidae." There were twelve papers in this group, published between 1915 and 1926. Two papers describing new species of *Cerion* appeared in 1913 and 1914 and a "Catalogue of Specimens of the Family Cerionidae for Sale," which also contained descriptions of a number of new species, appeared in 1924. All these were pub-

lished as appendices to the various volumes of his "Records of Walks and Talks with Nature." Maynard wrote Part Two of his "Contributions" in collaboration with Mrs. William F. Clapp. At that time her husband, the late Dr. Clapp, was curator of Mollusks at the Museum of Comparative Zoology and they lived in Cambridge, Massachusetts. About once a week Mrs. Clapp went to Newton where she worked with Maynard in his laboratory-workshop in his barn. Here she did most of the radular and anatomical preparations, as well as aiding in the descriptions of the new species. However, she was not enthusiastic about the type and quality of the work Maynard was doing and so did not remain associated with him for long.

In connection with his work on *Cerion,* Maynard formulated a number of "laws," the most curious of which were the "Law of Cyclic Recession" and the "Law of Individual and Specific Reincarnation." It is difficult to distinguish the difference between these two laws and the essence of each is that "individual shells frequently occur in one species that so closely resemble others in another species, which may inhabit an island a hundred miles or more away (thus precluding any close phylogenetic relationship), that they would appear to be members of that distant species. Furthermore, a similar resemblance may extend over an entire species." By this means he could explain his many species, completely overlooking the fact that a continuous chain of islands connected the two points and that the shells could easily be distributed by hurricanes, by native boats plying between the islands, by floating debris or other mechanical means. Many of these factors he had noted in his early days of collecting and so it is difficult to understand why he ignored so completely the facts of his earlier observations.

Maynard made one more trip to the Bahamas in the summer of 1924. He was 80 years old at the time and was accompanied by his daughter, Pearl J. Maynard. Though Pearl had often worked with her father, she did not have his interest in natural history and this was the only trip she took with him. It was a trip of only five weeks and was confined to the island of New Providence and a few of the nearby cays. However, even though Maynard had collected on New Providence on all of his previous trips, he still found eleven "species" which he described as new.

After 1924 Maynard did not take any further collecting trips but spent his time writing and conducting his nature classes. At the time of his death he was writing a series of articles on his experiences in Florida, which were appearing in the Florida Naturalist. These articles were well written and give a vivid picture of conditions in that state just after the Civil War.

Charles Johnson Maynard died at his home on 457 Crafts Street, West Newton, Mass. on October 15, 1929 at the age of 84. He had been seriously ill for some time and had not worked with his collection or conducted nature walks, but he was actively writing almost to the time of his death.

Shortly after his death, Miss Pearl J. Maynard, his daughter, wrote to Dr. Thomas Barbour at the Museum of Comparative Zoology and offered his large collection of Cerionidae for sale. As the collection was so large and the specimens so numerous, it was decided to buy it jointly with the United States National Museum for $500. The collection was divided equally between the two institutions with the holotypes being retained at the Museum of Comparative Zoology. A few duplicate sets of the larger series of Maynard's types were sold to various institutions so that much of Maynard's type material is now well distributed.

The collection had been stored on the second floor of Maynard's barn which he had converted into his study and workshop. His small printing press was in the harness room on the first floor. A leaky roof and broken windows which Maynard failed to repair in the last years of his life let in not only the elements but also the pigeons. These pigeons, entering through the broken windows, took over the second floor, and Maynard, who was essentially a "zoophile," allowed them free reign. Consequently, the collection, at the time it was sold, was in rather sad shape, for the cabinet drawers had warped and once pulled open could not be closed. The top drawers of the cabinets became a parade ground for the pigeons, and their droppings cemented the shells together in a solid mass! After transferring the collection in its original drawers to the Museum of Comparative Zoology, each lot was sorted, cleaned and properly labelled—a truly gigantic task.

There are 553 named forms in the family Cerionidae as listed by Clench (1957) in his catalogue of this group. Of these 328 are from the Bahama Islands and Maynard was responsi-

ble for 220. Probably less than ten per cent of these will remain as valid species or subspecies when the revision of the Bahama Cerionidae is completed.

As indicated throughout this account of Maynard's work, his early observations and plans for studying this group were good. However, the deeper he went into the problem the more involved his ideas became and eventually, instead of trying to arrange the various species and subspecies in natural groups, he saw only the slight differences between populations. He described these "species" very briefly and inadequately and the last ones were reduced to a few lines published in a sales catalogue. As pointed out by Clench (1957), his work was marred by a multitude of inaccuracies. Much of this was due to the lack of formal training and also isolation from scientific workers, even though he was living in the middle of one of the most active and important centers of taxonomic study in the world. If Maynard had only realized his own shortcomings and taken advantage of the help that could have been his, he would have had the benefit of association with many outstanding scientists. Under such circumstances his own lack of training might not have been such a drawback. Maynard's most important contribution to the study of the Cerionidae was his large collection. He visited and made collections at many isolated localities in the Bahama and Cayman Islands many of which have not been visited since. He was a tireless collector and accomplished much for which he should be given a great deal of credit.

## References

Batchelder, C. F. 1951. A Bibliography of the Published Writings of Charles Johnson Maynard [1845–1929]. The Journal of the Society for the Bibliography of Natural History **2:** pp. 227–260.

Clench, W. J. 1957. A Catalogue of the Cerionidae. Bull. Museum Comparative Zoology **116:** pp. 121–169.

French, Mena V. 1930. Charles J. Maynard. The Florida Naturalist **3:** p. 58.

Johnson, C. W. 1930. Charles Johnson Maynard. Nautilus **43:** pp. 101–103, 1 pl.

Maynard, C. J. Oct. 1928–Jan. 1930. Adventures of a Naturalist in Florida, Parts I to VI. Florida Naturalist **2,** nos. 1–4; **3,** nos. 1–2.

Townsend, Charles W. 1930. Charles Johnson Maynard. Bulletin Boston Soc. Nat. Hist. no. 54, pp. 1–7, 2 pls.

# Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 | MAY 29, 1958 | NUMBER 22

## The Genus Hemitrochus in Puerto Rico

*By* RUTH D. TURNER [1]

Though the land shells of Puerto Rico are better known than those of other West Indian islands there is still much to be done before the ecology, origin and distribution of its mollusk fauna are understood. This paper began as a routine description of a new species from that island. However, the problem quickly enlarged and produced some rather interesting taxonomic results.

ACKNOWLEDGMENTS

For the loan of material used in this paper I wish to express my thanks to Dr. R. T. Abbott of the Academy of Natural Sciences Philadelphia (ANSP), Dr. H. van der Schalie of the Museum of Zoology, University of Michigan, Ann Arbor, Michigan (U of M); and Dr. H. A. Rehder of the United States National Museum (USNM). The loan of Shuttleworth's type specimens from the Natural History Museum, Berne, Switzerland was most important and I am grateful to Dr. W. Kuenzi, Director of the Museum for this material. To Dr. Juan Rivero and Mrs. G. Warmke of the University of Puerto Rico, Mayagüez, I am indebted for the opportunity to visit the island and for aid in collecting. I am grateful to Dr. Clench and my associates in the Mollusk Department who have been helpful in discussing systematic problems and in reading the manuscript.

* * * *

[1]This work was supported in part by the Institute of Marine Biology, University of Puerto Rico, Mayagüez, Puerto Rico, where the author has the honor of being a Research Associate.

The species of *Hemitrochus* in Puerto Rico seem to be most closely related to those of Hispaniola. *Hemitrochus dermatina* Shuttleworth of Puerto Rico has a fine dull velvet-like periostracum similar to that of *H. cerosa* Clench and Aguayo from La Viste, La Selle Range, Haiti. This is a very rare condition in this group, in fact these two species are the only ones now known to possess this character, and so it might indicate that these two species had a common origin. The remaining four species in Puerto Rico seem to be most closely related to an undescribed species from Hispaniola.[1] This is particularly true of *Hemitrochus clenchi* Turner which has a similar shape and color pattern. *Hemitrochus anguliferus* von Martens and *H. riveroi* Turner are most closely related to *H. clenchi* of Puerto Rico and probably had their origin on the island. Though we now know the anatomy of four of the Puerto Rican species none of the Hispaniola species has been studied and so comparisons can be made only on the basis of shell and radular characters. These indicate a much closer relationship within this group of species than any of the species have to those from Cuba, Jamaica, the Bahamas or elsewhere in the range of the genus. This relationship of Puerto Rican and Hispaniolan species agrees with findings in other groups and is supported by the known geology of the area.

There has been considerable confusion in the literature concerning the status of *Hemitrochus* and particularly the name of the family to which it belongs. *Hemitrochus* was introduced by Swainson in 1840 as a subgenus of *Geotrochus* which was included in the family Helicidae. In the Manual of Conchology (2) **5,** 1889, Pilsbry considered *Hemitrochus* a subgenus of *Helix* in the family Helicidae. Later it was considered a subgenus of *Cepolis* Montfort 1810 and for a time was variously placed as a subgenus of *Cepolis,* or of *Helix,* or as a section of the subgenus *Cepolis* in the genus *Helix.* Then, as anatomical studies led to the division of the large family Helicidae, the genus *Cepolis* was firmly established and in Manual of Conchology (2) **9,** 1894 Pilsbry considered *Hemitrochus* a subgenus of *Cepolis.* Recent authors have considered *Hemitrochus* a subgenus

[1] W. J. Clench, New Land Shells from Hispaniola in the Families Camaenidae and Fruticicolidae, to be published probably in 1958.

of *Cepolis* or as a full genus. Consequently, in tracing the name of the family to which this group belongs, the genus *Cepolis* becomes important, as in the early definitions of the families concerned the name *Hemitrochus* seldom appeared.

In 1923 Wenz instituted the family name Eulotidae based on the genus *Eulota* Hartmann 1843 and including the genera *Cepolis, Oreohelix* Pilsbry and *Epiphragmophora* Doring. Lindholm (1927), following Article 5 of the International Rules of Zoological Nomenclature, used the family name Fruticicolidae, as the genus *Eulota* Hartmann 1843 is a synonym of *Fruticicola* Held 1837. The type species of each is *Helix fruticum* Müller.[1] Hoffman in 1928 used the family name Eulotidae and divided the family into six subfamilies, introducing the subfamily Cepolinae for the genera *Cepolis* Montfort, *Polymita* Beck and *Averellia* Ancey. Thiele (1931) followed Lindholm, using the family name Fruticicolidae, and this name has been used generally by European authors since that time. In 1934, Pilsbry, in the Proceedings of the Malacological Society of London **21,** p. 47, showed that *Bradybaena* Beck was a prior name for *Fruticicola* Held, and consequently, in another paper published the same year (1934, p. 7), he instituted the family Cepolidae based on the senior genus *Cepolis* Montfort 1810, and placed the Asiatic genera in the subfamily Bradybaeninae. Following this the family name Cepolidae was generally used by American authors. In 1939, Pilsbry, realizing that the name Cepolidae was preoccupied in fishes based on the genus *Cepola* Linné (A. Gunther 1861, Catalogue of the Fishes in the British Museum **3,** p. 486), proposed the name Bradybaenidae for "Eulotidae of authors and Fruticicolidae Lindholm." However, for the American and West Indian species he created the family Helminthoglyptidae comprising the subfamilies Cepoliinae, Helminthoglyptinae, Sonorellinae and Humboltianinae. In his description of the Helminthoglyptidae, Pilsbry mentioned *Xanthonyx* Crosse and Fischer, and *Metostracon* Pilsbry 1900, as genera in this family in which the shell is more or less de-

[1] *Fruticicola* Held 1837 [in] Isis von Oken, p. 914 (type species, *Helix fruticum* Müller, by tautonomy and subsequent designation Herrmannsen 1847, p. 450). Not *Fruticicola* as used by von Martens and others.

*Eulota* J. D. W. Hartmann 1843, Erd-und Susswasser Gasteropoden der Schweiz, St. Gallen, p. 179 (type species, *Helix fruticum* Müller, by monotypy).

generate. Now, to climax this confused family taxonomy, H.B. Baker (1956) has pointed out that if the law of priority is to be applied to family names, this group should probably be called Xanthonycidae Strebel and Pfeffer 1879. This name was based on the above-mentioned aberrant genus *Xanthonyx* which, on the basis of anatomy, is now considered close to the cepolids, but at the time Strebel and Pfeffer were publishing, it was thought so different that it was placed in a separate family.

One fact should be strongly apparent from the above discussion, and that is, the limits and status of the families of this area of the pulmonate land mollusca are far from being settled. None of the families mentioned above, all of which include the genus *Cepolis,* are exactly equivalent, for each contains at least one genus not included in the others. In attempting to decide upon the proper family name for *Hemitrochus* two problems are evident. First, how much should this area of the Pulmonata be split up and second, what name will be best understood and cause the least confusion. If the divisions are small enough there will be a family name for each zoogeographic region, i.e., Bradybaenidae for Asia, Fruticicolidae for Europe and Helminthoglyptidae for the Americas — perhaps this is the easiest solution. However, when families become too small they have little meaning, and many valuable relationships are lost. It then becomes necessary to work on the superfamily or order level when considering world distribution patterns. Therefore it seems best, at least at the present time, to be more conservative, recognizing one family with several subfamilies. Since *Bradybaena* is now restricted to the Asiatic species and *Fruticicola* is used as the generic name for the European species, there is no longer any problem concerning the family name Fruticicolidae. The problem now is to decide between Fruticicolidae, a name which has been in use since 1927, and Xanthonycidae, a name which has never been used but was instituted in 1879 for an aberrant genus which is now included with the cepolids. It seems most unwise to change the name of an entire group to this family name based on a genus which may again be separated from the main group. Consequently, I am using the name Fruticicolidae more or less as limited by Thiele with the subfamily Helminthoglyptinae for the American and West Indian species.

## Family **Fruticicolidae** *Lindholm*

Shells ranging in size from about 5 mm. to 75 mm. in greatest diameter; globose, trochoid or lenticular in shape, but degenerate in *Xanthonyx* Strebel and Pfeffer and *Metostracon* Pilsbry. Lip narrow, slightly to moderately expanded and usually reflected. Apertural armature usually lacking, but present in some forms as a small tooth on the basal lip (*Plagioptycha*), a thickening on the parietal lip (*Jeanneretia*), or as a gular fold (*Jeanneretia, Cepolis*). Shell umbilicate or imperforate, the umbilicus varying greatly in size. Color pattern extremely variable, ranging from highly colored *Polymita* to uniform brown *Plagioptycha.* The color pattern may consist of from one to many spiral bands of varying widths and color or of axial flames or of a combination of both.

Radula with the central and inner lateral teeth usually without cusps. Jaws ribbed or smooth.

Reproductive system having a dart sac or sacs, with one or two mucous glands which are globular, club-shaped or irregular, not tubular or digitate as in the Helicidae. Spermatheca nearly circular, oval or oblong, and usually with a long duct which is never branched, as in the Helicidae. Penis with an epiphallus and flagellum.

The anatomical drawings made for this paper have been arranged similarly to those of H. B. Baker so that comparisons can be made with his work. Even a casual survey of anatomical literature on land mollusks shows a great lack of uniformity both in the arrangement of the organs and in the illustrations and in their labeling. Consequently, it is often difficult to compare various works with any degree of certainty.

## Genus **Hemitrochus** *Swainson*

*Hemitrochus* Swainson 1840, Treatise on Malacology, pp. 165 and 331.

*Phaedra* Albers 1850, Die Heliceen, p. 100 (type species, *H. varians* Menke, here selected).

*Polytaenia* von Martens 1860, Die Heliceen, p. 129 (type species, *Helix multifasciata* Weinland and von Martens, by monotypy).

Type species, *H. haemastoma* Swainson [=*H. varians* Menke], by monotypy.

Shell small to medium in size, reaching 15 to 20 mm. in greatest diameter, depressed-globose to trochoid, fragile to

rather solid in structure, and usually having spiral bands of color. Umbilicus lacking or very small. Aperture without teeth and descending slightly. Lip simple, narrow and slightly reflected. Jaw smooth or nearly so.

In his outline of the Antillean helicids, H. B. Baker (1943, p. 82) considers *Hemitrochus* a subgenus of *Cepolis* and recognizes four sections in *Hemitrochus* and seven in *Cepolis* s.s. On the basis of shell characters *Hemitrochus* appears to be worthy of generic rank, particularly when the differences in shell characters are combined with those of the radula and soft parts as noted by Baker.

In Puerto Rico there are five species in the genus *Hemitrochus* all of which appear to be rather rare.

### **Hemitrochus dermatinus** *Shuttleworth*

Plate 23, figs. 1–2; Plate 24, figs. 1–2

*Helix dermatina* Shuttleworth 1854[1] Mittheilungen der Naturforschenden Gesellschaft in Berne, nos. 314–316, p. 41 (Luquillo, Puerto Rico), non *H. dermatina* of authors.

*Description.* Shell globose-trochiform, fragile, finely sculptured, imperforate, and with a definite though not pronounced keel at the whorl periphery. Color a golden-brown with a narrow spiral band of red-brown above the keel, and a slightly broader one below. Whorls 5, slightly convex both above and below the keel. Spire extended and produced at an angle of about 85°. Aperture ovate, depressed downward and produced at an angle of about 50° from the base. Palatal lip thin, narrow, reddish brown in color and slightly reflected. Parietal area very lightly glazed. The area at the base of the columella a reddish brown. Columella short, slightly thickened and curving into the base of the outer lip. Suture slightly impressed. Axial sculpture consisting of fine growth lines. Spiral sculpture consisting of 8 to 10 fine threads above the keel and 10 to 12 below the keel. The crossing of the axial growth lines and the

[1] Pfeiffer, Pilsbry and others have referred to the original description of this species as in "Diagnosen Neuer Mollusken, no. 6, p. 133, 1854." The Diagnosen Neuer Mollusken was a collection of Shuttleworth papers which were renumbered and repaged, but the originals appeared in the Mittheilungen der Naturforschenden Gesellschaft in Berne.

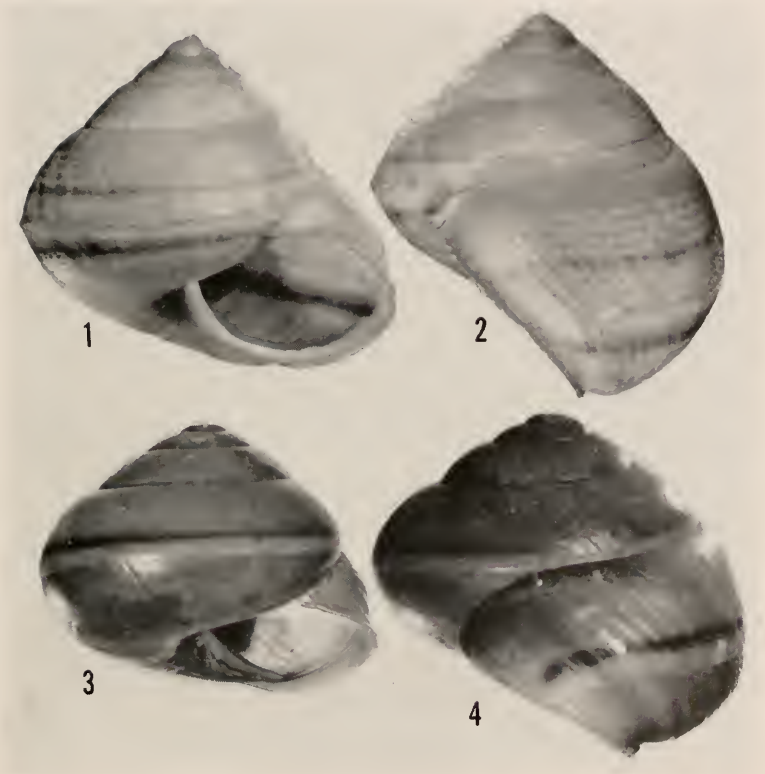



Plate 23

Figs. 1–2. Lectotype of *Helix dermatina* Shuttleworth from near Luquillo, Puerto Rico (3.4x).

Figs. 3–4. Holotype of *Hemitrochus clenchi* Turner from the Maricao Forest, Puerto Rico. Fig. 3 (2.84x). Fig. 4 (3.4x).

spiral threads gives the shell a somewhat reticulated appearance under magnification. Embryonic whorls 1½, smooth and papilliform. Periostracum thin, dull, golden-brown in color, and with a fine velvety texture.

| greater diameter | lesser diameter | height | whorls | |
|---|---|---|---|---|
| 15 mm. | 14 mm. | 14 mm. | 5 | Lectotype |
| 13.5 | 12.5 | 12 | 4¾ | Paratype |

*Types.* The lectotype of *Helix dermatina* Shuttleworth, here selected, is in the Natural History Museum, Berne, Switzerland, Blauner, no. 111. The type locality is "near Luquillo, Puerto Rico," B. F. Blauner, collector. Two paratypes from the same locality are also in the Berne Museum.

*Remarks.* This species has long been misunderstood. It was not figured by Shuttleworth and apparently subsequent workers did not refer to the type specimens. Through the kindness of Dr. W. Kuenzi, Director of the Berne Natural History Museum I have had the loan of the type lot of *Helix dermatina* for study and figuring. This species from the eastern tip of the island is certainly different from the species which has generally been called by this name. *Hemitrochus dermatinus* differs from other species in this genus by its papilliform embryonic whorls, its dull and slightly velvety periostracum, its pronounced spiral sculpture and the reddish brown coloration at the base of the columella. *Hemitrochus riveroi* Turner, which also has a pronounced spiral sculpture, is a much larger and more strongly keeled species, and lacks the velvety periostracum of *dermatinus.* From the keeled specimens of *H. clenchi* which it most closely resembles it differs in its more extended and acute spire, in addition to other characters mentioned above. See also remarks under *H. clenchi.*

This is a very rare species and apparently has not been collected since Blauner found it on a banana plant near Luquillo, Puerto Rico. It seems safe to assume that Blauner collected this species in the lowlands near the town of Luquillo, for Shuttleworth in his paper referred to the Sierra de Luquillo when describing species that were collected in the mountains.

*Specimens examined.* Near Luquillo (Nat. Hist. Mus. Berne).

**Hemitrochus clenchi,** new species
Plate 23, figs. 3–4; Plate 24, figs. 7–8; Plate 25; Plate 30, fig. 2

*Cepolis dermatina* of authors, not of Shuttleworth 1854.

*Description.* Shell globose, fragile, with only a slight indication of a keel in occasional specimens, smooth and imperforate. Color a light straw-yellow to medium red-brown with a narrow band of dark brown just above the periphery, a yellow band at the periphery, and occasional specimens with an additional brown band just below the periphery. Whorls 5, moderately convex, and occasionally slightly keeled, but with the periphery becoming rounded about $1\frac{1}{4}$ whorl before the lip is formed. Spire somewhat depressed and produced at an angle of about 95°. Aperture ovate, depressed downward and produced at an angle of about 45° from the base. Palatal lip thin, narrow, very slightly reflected and white to pink or lavender in color. Parietal area thinly glazed. Columella short, slightly thickened and curving into the base of the outer lip. Suture slightly impressed. Axial sculpture consisting of extremely fine growth lines. Spiral sculpture when seen with a 14x lens consisting of exceedingly fine, interrupted threads. Periostracum thin, smooth and glossy. Embryonic whorls $1\frac{1}{2}$, depressed and smooth.

| greater diameter | lesser diameter | height | whorls | |
|---|---|---|---|---|
| 17 mm. | 15 mm. | 13 mm. | 5 | Maricao Forest |
| 16.5 | 15 | 12.5 | 5 | 20 km. SW. of Arecibo |
| 15 | 13.5 | 11.5 | 5 | 10 km. W. of Utuado |
| 15 | 12.5 | 10 | $4\frac{3}{4}$ | Guajataca Ranger Station |
| 14 | 12 | 10.8 | $4\frac{3}{4}$ | " " " |

*Types.* The holotype from the Maricao Forest, Puerto Rico is in the Museum of Comparative Zoölogy, no. 216146.

*Remarks.* It is surprising that this, the most common species of *Hemitrochus* in Puerto Rico, should be without a name. It has always been confused with *dermatinus* Shuttleworth, because the original description of *dermatinus* was rather brief and the species was never figured. This is understandable, even though Shuttleworth did mention the subpapilliform embryonic whorls and the spiral sculpture. An examination of the type lot of *dermatinus* showed immediately that two spe-

Plate 24

Embryonic whorls in *Hemitrochus*.

Figs. 1–2. *Hemitrochus dermatinus* Shuttleworth. Lectotype.

Figs. 3–4. *Hemitrochus anguliferus* von Martens, 1 mile from Adjuntas on road to Guazas, Puerto Rico.

Figs. 5–6. *Hemitrochus riveroi* Turner, Holotype.

Figs. 7–8. *Hemitrochus clenchi* Turner, Holotype.

All drawings made with the aid of a camera lucida.

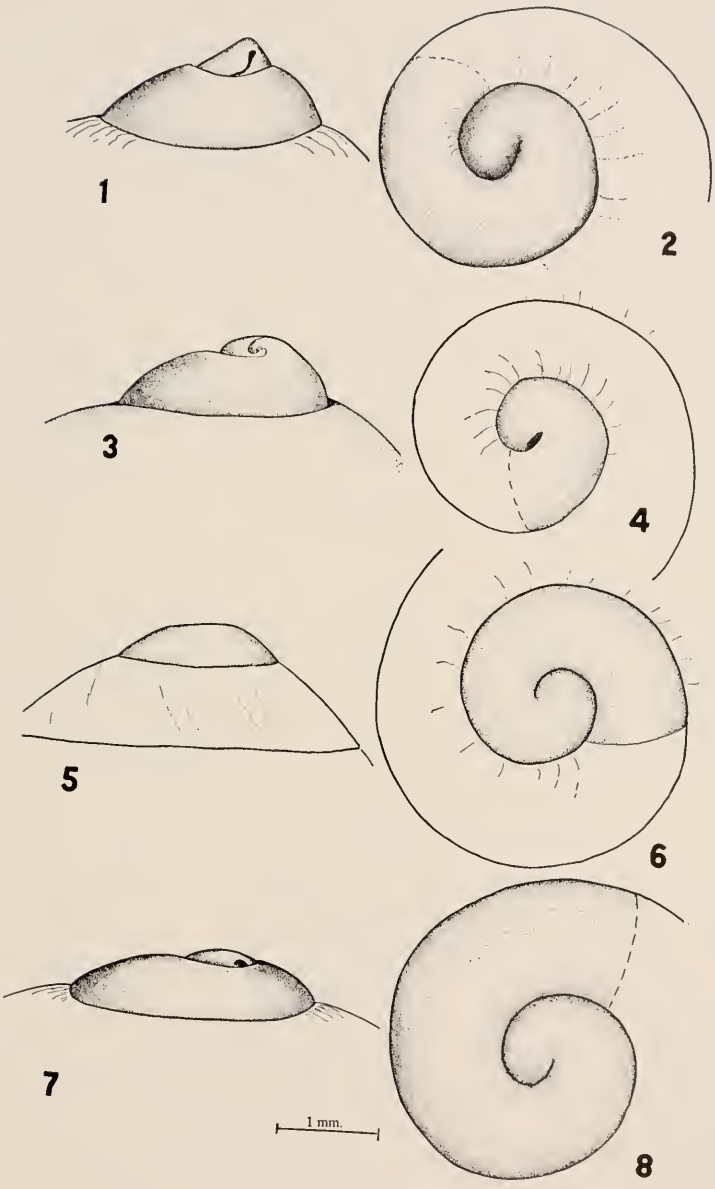



Plate 24

cies were involved. *Hemitrochus clenchi* is readily distinguished from *H. dermatinus* Shuttleworth by its more globose shape, greater spire angle, its shining periostracum, its extremely fine sculpture and large, depressed embryonic whorls. From *H. anguliferus* von Martens, which has also been confused with *clenchi,* it differs by having rounded rather than strongly keeled whorls. Those specimens of *clenchi* which produce a slight keel become rounded about $\frac{1}{4}$–$\frac{1}{2}$ whorl before the lip is produced, while in *anguliferus,* the keel continues to the lip. In addition, *clenchi* has larger, more depressed embryonic whorls, the lip is usually pink or lavender rather than white, and the spiral sculpture is absent or extremely fine.

The anatomy of the reproductive system of *clenchi* is figured on Plate 25. It differs from *anguliferus* in having only four lobes to the ovotestis, in having the spermatheca nearly globular, the sheath glands larger and in other details as shown in the illustration. In anatomical details it seems to be more closely related to *H. boriquenus* Baker.

*Specimens examined.* Maricao Forest at about 2000 feet (MCZ); Trail N of Guajataca Ranger Station; Guajataca Forest Station; 15 km. S of Arecibo; 20 km. SW of Arecibo on road to Lares; 10 km. W of Utuado on road to Lares; 9 km. NE of Jayuya; 15 km. NW of Ponce on road to Adjuntas; Barrio Rucio, near Peñuelas (all U of M).

## **Hemitrochus boriquenus** *H. B. Baker*
Plate 26

*Helix diaphana* Lamarck 1822, Histoire Naturelle des Animaux sans Vertèbres **6,** (2) p. 85 (l'ile de Ténériffe, Maugé); Deshayes 1858 [in] Lamarck ibid., 2nd. ed. **8,** p. 62; non *H. diaphana* Poriet 1801.

*Helix diaphana* Lamarck. Pfeiffer 1847, Monographia Heliceorum Viventium **1,** p. 281 (Rio Janeiro, Mus. Berol.).

*Helix diaphana* Lamarck. Férussac and Deshayes 1850, Histoire Naturelle des Mollusques **1,** p, 222, pl. 104, fig. 1 (l'ile de Ténériffe).

*Helix diaphana* Lamarck. Shuttleworth March 1854, Mittheilungen der Naturforschenden Gesellschaft in Berne, nos. 314–316, p. 39 (San Juan and Humacao, Puerto Rico, Blauner).

*Helix diaphana* Lamarck. Reeve July 1854, Conchologia Iconica **7, Helix,** pl. 188, species 1312 (Island of Puerto Rico, West Indies, Blauner).

*Helix diaphana* (Lamarck) Pfeiffer. Pilsbry 1889, Manual of Conchology (2) **5,** p. 22, pl. 19, figs. 51–52 (Porto Rico; Viéque).

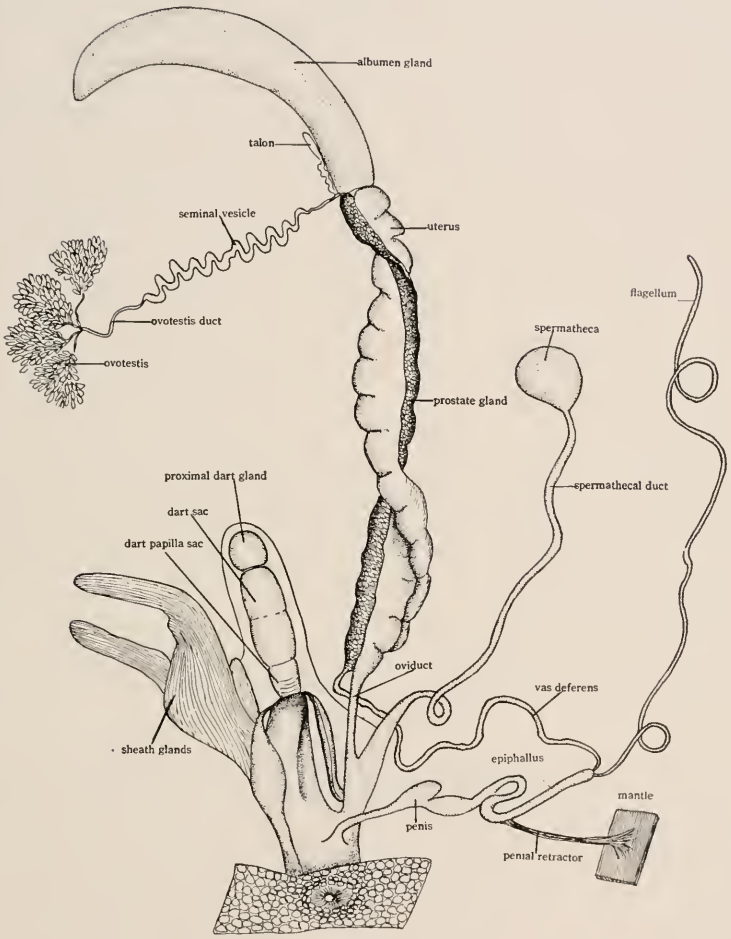



Plate 25

Anatomy of the reproductive system of *Hemitrochus clenchi* Turner (about 4½x).

*Cepolis* (*Plagioptycha*) *boriquenae* H. B. Baker 1940, Nautilus **53,** p. 107 (new name for *Helix diaphana* Lamarck, Pilsbry 1889; non Poriet 1801).

*Cepolis* (*Levicepolis*) *boriquenae* H. B. Baker 1943, Nautilus **56,** pp. 82 and 88, pl. 9, fig. 6.

*Cepolis boriquenae* Baker. van der Schalie 1948, Miscellaneous Publications Museum of Zoology, University of Michigan, no. 70, p. 85, pl. 6, fig. 14.

*Description.* Shell globose, fragile, smooth, shining and imperforate. Color a light straw-yellow to rich golden brown with occasional specimens having a spiral band of brown at the periphery. Columellar area a conspicuous china-white. Whorls 4 to $4\frac{1}{4}$, slightly convex. Spire depressed, obtuse and produced at an angle of about 105°. Aperture ovate, depressed slightly downward and produced at an angle of about 50° from the base. Palatal lip thin, narrow and with a very slight reflection at the basal and outer portion. Parietal area thinly glazed. Umbilical area deeply indented, the columella truncate in young specimens. In adult specimens the columella margin is reflected and slightly thickened and curved into the base of the outer lip. Suture slightly impressed. Axial sculpture consisting of exceedingly fine growth lines which are best seen under 10x magnification. Spiral sculpture lacking. Periostracum thin, smooth and glossy. Embryonic whorls 1 to $1\frac{1}{4}$, depressed and smooth.

| greater diameter | lesser diameter | height | whorls | |
|---|---|---|---|---|
| 14 mm. | 12.5 mm. | 9.5 mm. | $4\frac{1}{2}$ | Loiza, Puerto Rico |
| 13 | 11.5 | 9 | 4 | " " " |

*Types.* The type of *Helix diaphana* Lamarck may possibly be in the Paris Museum. See discussion under *Remarks.* H.B. Baker designated a holotype (ANSP no. 28335) and paratypes (ANSP no. 226299) for his *C. boriquenae,* based upon the specimens Pilsbry had used in describing *H. diaphana* 'Lamarck' Pilsbry (loc. cit.). However, if time proves that Lamarck's *diaphana* is not the Puerto Rican species, the actual type specimens of *boriquenae* should be specimens of Shuttleworth who first described this species from known Puerto Rican specimens. In essence, Baker's introduction of the name *boriquenae* was only a change of names for a homonym, *H. diaphana* Lamarck 1822, non Poriet 1801.

*Remarks.* There has been some question about the identity of *Helix diaphana* Lamarck based on the facts that Lamarck's description was inadequate and the locality given was Ténériffe. This locality was apparently in error. Lamarck states that the species was collected by Maugé, and though Maugé had been on Ténériffe he had also been in Puerto Rico. According to Ledru (1810) Maugé was the zoologist on the voyage to Ténériffe, La Trinite, St. Thomas, St. Croix and Puerto Rico under the direction of Captain Baudin. Gundlach (1883) and Fischer (1892) also state that the naturalists Maugé and Krauss sent material from Puerto Rico to Lamarck. In fact, Lamarck (1822) lists a number of species from that island collected by Maugé. Therefore the chances of an error were great.

Férussac (1822) in the Corrections et Additions of his "Tableaux Systematique des Animaux Mollusques" (often referred to as his Prodrome), p. 69, no. 319 bis, gives "*diaphana,* Lamarck, communicavit. Habit.? Cabinet de M. de Lamarck." Plate 104, fig. 1 of Férussac and Deshayes, "Histoire Naturelle des Mollusques," Atlas **2,** figures a shell which certainly appears to be the Puerto Rican species. This plate according to Bourguignat (1925) was published in 1822. The description by Férussac and Deshayes in the Histoire **1,** p. 222, was not published until 1850. It is very probable that Férussac borrowed Lamarck's specimen to figure it as implied by his "communicavit" mentioned above. The fact that Deshayes worked with both Férussac and Lamarck makes this seem even more likely. It also agrees with the fact that Mermod (1951) states that Lamarck had only one specimen of *diaphana* in his collection, that it is not in the museum at Geneva and that it was probably lost before the Lamarck collection was transferred to Geneva. The Férussac collection is in the Paris Museum according to Sherborn (1940) and it is likely that Lamarck's type of *diaphana* may be there.

Shuttleworth was apparently the first to apply the name *diaphana* to specimens known to come from Puerto Rico. This was from the material collected by Blauner which was also described and figured by Reeve. The name *diaphana* was used for the Puerto Rican species from 1854 until 1940 when H. B. Baker introduced the name *boriquenae* for *Helix diaphana* Lamarck as used by Pilsbry in 1889, non *H. diaphana* Poriet

Plate 26

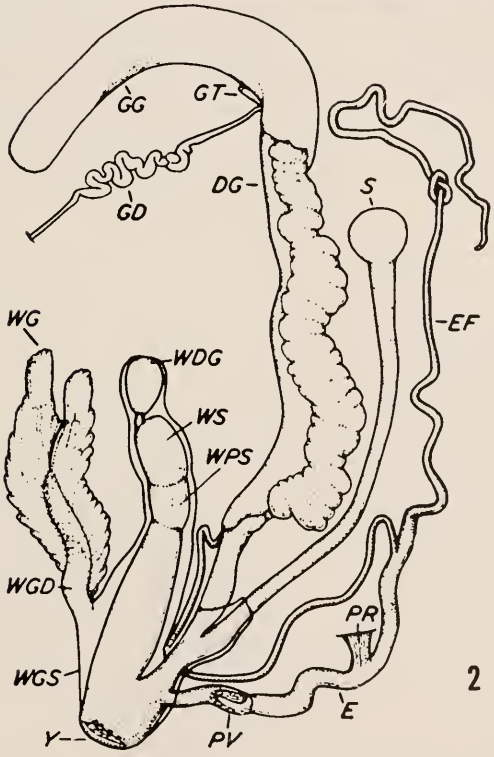
*Hemitrochus boriquenus* H. B. Baker

Fig. 1. Loiza, Puerto Rico. Specimen selected by Baker as the holotype of *boriquenae,* ANSP 28335 (4.6x).

Fig. 2. Anatomy of the reproductive system. This figure was copied from Baker, 1943, Nautilus **56,** pl. 9, fig. 6 (about 4x).

Fig. 3. Radula of a juvenile specimen from Arecibo, Puerto Rico.

The 1/10 mm. refers only to the radula.



1/10 mm.

Plate 26

1801. He gave no synonymy but restricted his name to the description and figures of Pilsbry which were based on material collected by Swift at Loiza, Puerto Rico. From the above discussion it seems reasonably certain that Lamarck was dealing with the Puerto Rican species and that the locality was in error. Therefore, *boriquenae* is simply a change of name rather than a new species as indicated by Baker. See also discussion under *Types.*

This species is most closely related to *H. clenchi* from which it differs in being smaller, more depressed, having fewer whorls, and in lacking completely even microscopic spiral sculpture. In addition, the umbilical area is deeply indented, and the columellar margin is reflected to form a slight callus which is a conspicuous china-white.

The reproductive anatomy of the two species is similar as is shown in the illustrations. Baker (1943) provisionally placed his *dermatina* [=*angulifera*] in *Jeanneretia.* He created the subgenus *Levicepolis* for *boriquenae* stating that this species was more arboreal than typical *Plagioptycha,* the subgenus in which he had formerly placed it. However, in his remarks he mentions the similarity of the anatomy of these two species and states that "*dermatina* [=*angulifera*] seems fairly closely related to *C. boriquenae* and may be nearer *Levicepolis* than the Cuban *Jeanneretia.*" The anatomy of *boriquenae* is even closer to that of *clenchi,* and both are close to *riveroi* and *angulifera.* Therefore, with the possible exception of *dermatina* Shuttleworth, the anatomy of which is unknown, all of these species probably belong in the subgenus *Levicepolis.*

Although it has a wide range, particularly in the eastern and northern parts of the island, this is not a common species. Most records are from low altitudes though the species has been found in the mountains. Van der Schalie (1948) indicated 26 localities for this species on his distribution map.

*Specimens examined.* Loiza (ANSP); Barceloneta (USNM); Cambalache Forests; Areciba; Vieques Island (all MCZ).

### **Hemitrochus anguliferus** *von Martens*

Plate 24, figs. 3–4; Plate 27, figs. 3–4; Plate 28; Plate 30, fig. 1

*Helix* (*Thelidomus*) *angulifera* von Martens 1877, Jahrbücher der Deutschen Malakozoologischen Gesellschaft **4,** p. 347, pl. 12, fig. 2.


Plate 27

Figs. 1–2. *Hemitrochus riveroi* Turner, from Doña Juana, Toro Negro National Forest, Puerto Rico. Fig. 1, Holotype; Fig. 2, Paratype (3.4x).

Figs. 3–4. *Hemitrochus anguliferus* von Martens, 1 mile from Adjuntas on the road to Guazas, Puerto Rico (3.4x).

*Cepolis ( Jeanneretia ?) dermatina* 'Shuttleworth' H. B. Baker 1943, Nautilus **56**, p. 88, pl. 11, figs. 19–21.

*Description.* Shell trochiform, fragile, keeled, smooth to very finely sculptured and imperforate. Color a light straw-yellow with a single red-brown band just below the periphery on the body whorl of most adult specimens. Whorls 5, slightly convex and keeled. Spire extended and produced at an angle of about 85°. Aperture ovate, slightly descending and produced at an angle of about 48° from the base. Palatal lip thin, narrow, white and very slightly reflected. Parietal area thinly glazed. Columella very short, slightly thickened and curving into the base of the outer lip. Suture slightly impressed. Axial sculpture consisting of inconspicuous growth lines. Spiral sculpture consisting of fine, irregular, and interrupted threads which are best seen with transmitted light. Embryonic whorls 1, and smooth. Periostracum very thin, smooth, glossy and pale yellow in color.

| greater diameter | lesser diameter | height | whorls | |
|---|---|---|---|---|
| 17 mm. | 15 mm. | 12.5 mm. | 5 | 1 mile from Adjuntas |
| 17 | 15 | 12 | 5 | " " " |
| 15.5 | 13.5 | 11 | 5 | " " " |
| 15 | 13.5 | 11.5 | 5 | " " " |

*Types.* The type specimens of *H. angulifera* von Martens are in the Berlin Museum according to Gundlach (1883). However, in a recent letter, Professor S. Jaeckel of the Berlin Museum informed me that they have been unable to locate them. The type locality as given by von Martens was "An der Westküste von Puertorico südlich von Mayagüez" that is, the west coast of Puerto Rico, south of Mayagüez. However, Gundlach in his Apuntes para La Fauna Puerto-Riqueña (1883) stated: "Despues visité á Yayuya [Jayuya] á distancia de algunas leguas en direccion ESE de Utuado, pasando por el pié de la Sierra de Morales, donde Hjalmarson ha descubierto el *Chondropoma terebra* Pfr. Allí encontré una especie nueva de *Helix,* la *angulifera* von Mart." [Afterward I visited Yayuya a distance of some leagues ESE of Utuado, passing by the foot of the Sierra de Morales, where Hjalmarson discovered the *Chondropoma terebra* Pfr. There I found a new species of *Helix,* the *angulifera* von Mart.] This statement by Gundlach, who col-

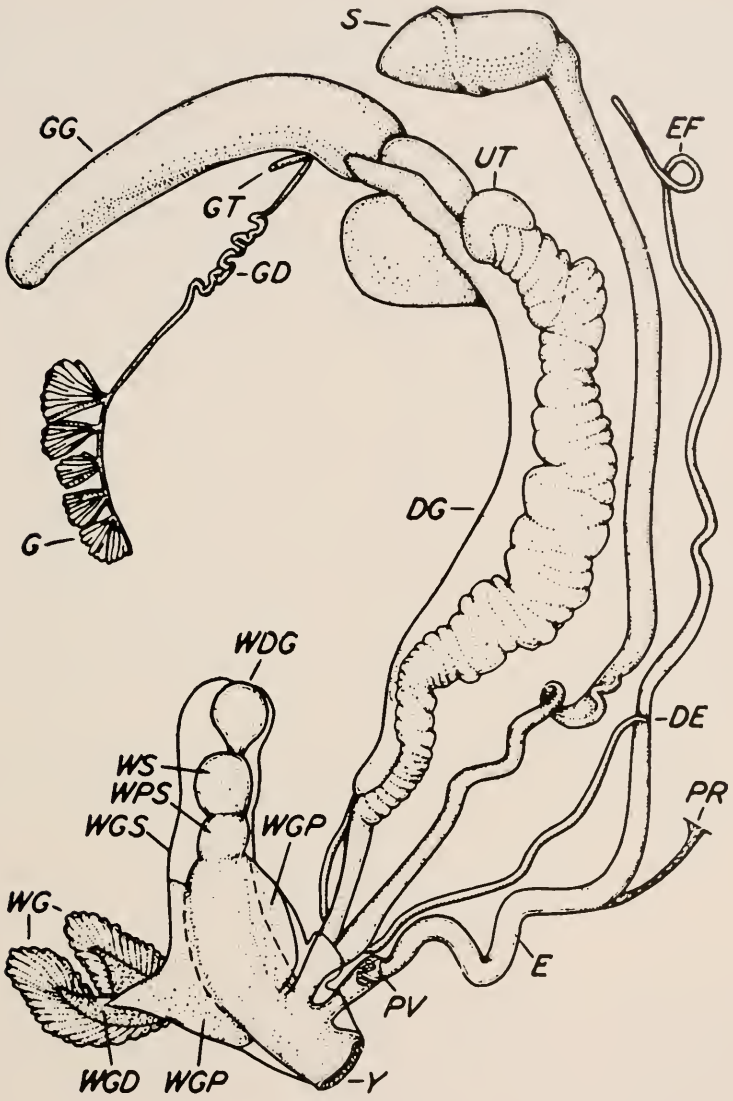



Plate 28

Anatomy of the reproductive system of *Hemitrochus anguliferus* von Martens.

This plate was copied from H. B. Baker, Nautilus **56**, pl. 11, fig. 19, where he published it under the name of *Cepolis* (*Jeanneretia?*) *dermatina* Shuttleworth. The shell from which the soft parts were taken is shown on Plate 27, figs. 3–4 (about 5x).

lected the original material and sent it to von Martens, places the type locality in the central portion of the island and in the same general type of country where H. B. Baker collected his specimens.

*Remarks.* This is apparently quite a rare species. It has been confused with *H. dermatinus* Shuttleworth and *H. clenchi* Turner. It differs from *clenchi* in having a trochiform rather than globose shell, in having the columella and lip white and the periphery keeled. From *H. riveroi* Turner it differs in being much smaller, in having the whorls slightly convex rather than concave above the periphery and in having much finer spiral sculpture. See also remarks under *dermatinus* and *clenchi.*

The specimens figured (Plate 27, figs. 3–4) are the ones from which H. B. Baker (1943, Nautilus **56,** p. 88, pl. 11, figs. 19–21) figured the anatomy of the reproductive system under the name of *Cepolis dermatina* Shuttleworth. The anatomy as figured by Baker is very close to that of *H. riveroi* but differs in having the spermatheca larger and the spermatheca duct proportionately much longer. The dart sac of *riveroi* is nearly twice as long as the proximal dart gland while in *anguliferus* they are about of equal length.

*Specimens examined.* 1 mile from Adjuntas on road to Garzas (ANSP); Finca Pagán, 19 km. NW of Ponce; km. 21 on road from Ponce to Adjuntas (both U of M).

**Hemitrochus riveroi,**[1] new species
Plate 24, figs. 5–6; Plate 27, figs. 1–2; Plate 29; Plate 30, figs. 3–6

*Description.* Shell trochiform, fragile, sharply keeled, finely sculptured, and imperforate. Color a uniform, medium golden to olivaceous brown with a single dark brown band just below the periphery. In some specimens there is an indication of an additional brown band just above the keel. Whorls $5\frac{1}{4}$, nearly

[1] It is a pleasure to name this species in honor of Dr. Juan Rivero, Director of the Institute of Marine Biology, University of Puerto Rico, Mayagüez, Puerto Rico.

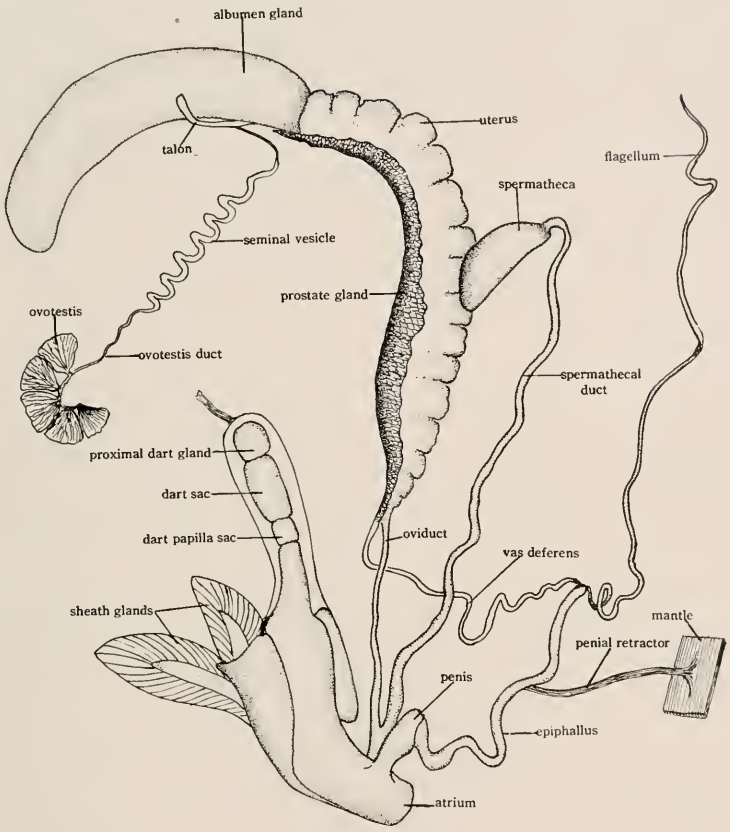



Plate 29

Anatomy of the reproductive system of *Hemitrochus riveroi* Turner (about $4\frac{1}{2}$x).

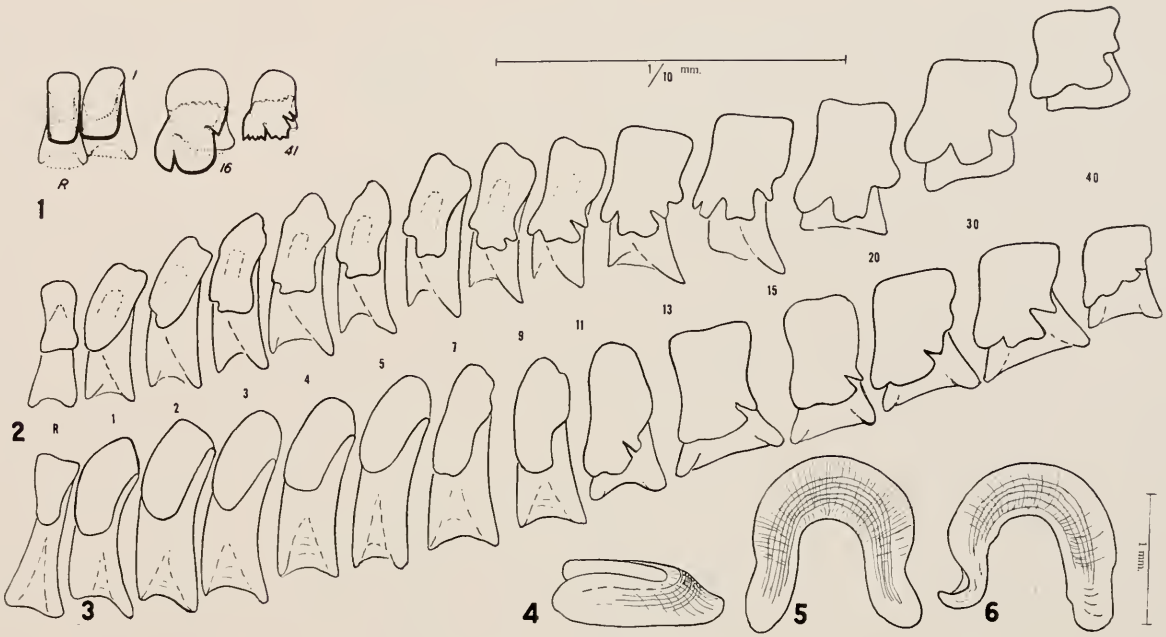



Plate 30

Radula and jaws of *Hemitrochus.*

Fig. 1. Radula of *Hemitrochus arguliferus* von Martens from Baker, 1943, Nautilus **56,** pl. 11, fig. 21, where it was published as *Cepolis* ( *Jeanneretia?*) *dermatina* Shuttleworth (see Plate 27). Fig. 2. *Hemitrochus clenchi* Turner, Holotype. Fig. 3. *Hemitrochus riveroi* Turner, Holotype. Figs. 4–6. Jaws of *Hemitrochus riveroi.* Fig. 4, side view. Fig. 5, dorsal view. Fig. 6, ventral view. All drawings made with the aid of a camera lucida.

straight sided and sharply keeled; slightly concave above the keel and slightly convex below. Spire extended and produced at an angle of about 80°. Aperture ovate, depressed slightly downward, and produced at an angle of about 42° from the base. Palatal lip thin, narrow, white and slightly reflected. Parietal wall thinly glazed. Columella short, not noticeably thickened and curving into the base of the outer lip. Suture well marked but not impressed. Axial sculpture consisting of fine growth lines which become coarser on the later whorls. Spiral sculpture consisting of numerous fine and somewhat irregular threads. Nuclear whorls 1¼ and smooth. Mantle a rather uniform light chocolate-brown with a dark brown subperipheral stripe. Foot light brown, darkening posteriorly.

| greater diameter | lesser diameter | height | whorls | |
|---|---|---|---|---|
| 20 mm. | 18.5 mm. | 16 mm. | 5¼ | Holotype |
| 21 | 19.5 | 19 | 5¼ | Paratype |
| 20 | 18.2 | 18 | 5¼ | " |
| 18.5 | 17.5 | 16 | 5¼ | " |

*Types.* The holotype is in the Museum of Comparative Zoölogy, no. 216144 from Cerro Doña Juana, Toro Negro National Forest, Puerto Rico. Paratypes from the same locality are in the Museum of Comparative Zoölogy, no. 216145.

*Remarks.* This is an extremely thin and fragile species. It is closely related to *Hemitrochus anguliferus* von Martens from which it differs by being much larger, having a higher spire, and having the whorls slightly concave above the keel. From *Hemitrochus dermatinus* Shuttleworth, and *H. clenchi* it is readily separated by its sharp keel and larger size.

*Hemitrochus riveroi* Turner is known only from the type locality. It was collected in the rain forest at night; the five specimens were on two adjacent palm trees crawling on the underside of the fronds at a height of about 10 feet.

The anatomy of the reproductive organs of *riveroi* is close to that of *H. anguliferus* von Martens, though the spermatheca duct is shorter and more slender. There were no gelatinous swellings at the apical end of the uterus and the five lobes of the ovotestis were far more closely packed. The ovotestis was deeply embedded in the digestive gland and difficult to dissect. See remarks under *H. anguliferus* von Martens.

## References

Baker, H. B. 1940, New Names for Puerto Rican Snails. Nautilus **53,** p. 107.

Baker, H. B. 1943, Some Antillean Helicids. Nautilus **56,** pp. 81–91.

Baker, H. B. 1956, Family Names in Pulmonata. Nautilus **69,** pp. 128–139.

Bourguignat, J-R. 1925, Dates des Livraisons de l'Histoire des Mollusques de Férussac et Deshayes. Journal de Conchyliologie **69,** pp. 15–18.

Crosse, H. 1892, Faune malacologique terrestre et fluviatile de l'ile de Porto-rico. Journal de Conchyliologie **40,** pp. 5–71.

Crosse, H. and P. Fisher 1867, Note sur le nouveau genre Xanthonyx et catalogue des espèces qu'il comprend. Journal de Conchyliologie **15,** pp. 221–228.

Gundlach, J. 1883, Apuntes para La Fauna Puerto-Riqueña. Anales de la Soc. Española de Hist. Nat. Madrid **12,** pp. 5–58.

Hoffmann, H. 1928 [in] Bronn, Klassen und Ordnungen des Tier-Reichs **3,** abt 2, Buch 2, Lief. 151, p. 1239.

Lindholm, W. A. 1927, Zur Systematik und Nomenklatur einiger Heliciden und ihrer Vanwandten. Archiv für Molluskenkunde **59,** pp. 116–138.

Mermod, G. 1951, Les Types de la Collection Lamarck au Muséum de Genève, Mollusques vivants II. Revue Suisse de Zoologie **58,** pp. 693–752.

Pfeiffer, L. 1847–1848, Monographia Heliceorum Viventium **1,** pp. 33, 484.

Pilsbry, H. A. 1889, Manual of Conchology (2) **5,** pp. 1–200, pls. 1–64.

Pilsbry, H. A. 1894, Manual of Conchology (2) **9,** pp. 48–366, pls. 1–71.

Pilsbry, H. A. 1900, Metostracon, a slug-like genus of dart-bearing Helicidae. Proceedings Malacological Society London **4,** pp. 24–30.

Pilsbry, H. A. 1934, Zoological Results of the Dolan West China Expedition of 1931—Part II, Mollusca. Proceedings Academy of Natural Sciences Philadelphia **86,** pp. 5–27, pls. 1–6.

Pilsbry, H. A. 1939, Land Mollusca of North America. Academy of Natural Sciences Philadelphia, Monograph No. 3, **1,** pt. 1, pp. 1–537, figs. 1–377.

Sherborn, C. D. 1940, Where is the – – – – Collection? Cambridge University Press, pp. 1–148.

Strebel, H. G. and G. Pfeffer 1880 [Nov. 1879], Beitrag zur Kenntniss der Fauna mexikanischer Land-und Süsswasser-Conchylien, Hamburg, pt. 4, pp. 25–28.

Thiele, J. 1931, Handbuch der Systematischen Weichtierkunde **2,** pp. 688–702.

van der Schalie, H. 1948, The Land and Freshwater Mollusks of Puerto Rico. Miscellaneous Publications, Museum of Zoology, University of Michigan, no. 70, pp. 1–134, pls. 1–14.

Wenz, W. 1923, Fossilium Catalogus **1,** Animalia, pt. 18, Gastropoda extramarina tertiaria **2,** p. 360.

## Book Review

Voyage aux Iles de Ténériffe, La Trinité, Saint-Thomas, Saint-Croix et Porto Rico by Andre-Pierre LeDru. Published by Arthus Bertrand, Paris 1810, Vol. 1, 47+315 pages; Vol. 2, 324 pages, 1 map.

This is an interesting and apparently little known account of one of the early expeditions which were sent out expressly to study natural history. According to the introduction, the voyage was planned by the Professors of the Muséum d'Histoire Naturelle, Paris and presented to the Government. Captain Nicholas Baudin was chosen as director of the expedition because he had collected much valuable material on earlier voyages. The scientists on the voyage included René Maugé, Zoologist; André-Pierre LeDru, Botanist; Anselme Rieddle, Horticulturist; Alexander Phillip Advenier, Mineralogist; Antoine Gonzales, Artist; and Benjamin Le Villain, J. Louis Hogard and Louis Le Gros, amateur naturalists. Aboard the flûte *Belle-Angelique* (a troop transport of 800 tons) there was a total of 108 officers, enlisted men and naturalists. They sailed from Le Havre, France, September 30, 1796 and returned June 7, 1798. Since France was then at war with England and the expedition was to visit West Indian Islands belonging to Great Britain, Captain Baudin carried a letter of safe conduct received from the British Admiralty through the solicitation of Sir Joseph Banks. The purpose of the voyage was to make observations on the climate, people, economy, agriculture, geology and natural history of the islands and to collect specimens for the botanical and zoological gardens and the Muséum d'Histoire Naturelle, Paris. The general account of the voyage was written by the botanist Le Dru, but there are many additions on the Natural History by M. Sonnini.

The first volume is concerned with Ténériffe, Canary Islands and La Trinité [Trinidad] and volume II is concerned with Saint Thomas, Saint Croix and Puerto Rico. While many of the plants and vertebrates are mentioned in some detail so little was known of the invertebrates of the islands at that time that little could be said about them in this general account. The chapter on the natural history of Puerto Rico covers some 80 pages and in the section on mollusks it is said

that Baudin and Maugé collected a large number of land and marine shells which were for the most part unknown.

Concluding the account of the voyage is a brief report on the zoological collections written to Baudin by Lamarck in which he said that the collection of invertebrates, though less interesting, were perhaps richest in rare and new specimens. At the end is a large, folded map of the "l'Ile de Saint Jean de Puertorico" made by Thomas Lopez with additions by Le Dru. This map is interesting, for on it there are many names and spellings which are no longer in use.

The entire account of the voyage is most interesting and readable, recounting a great deal of the early history of the islands, giving descriptions of them as they appeared to a naturalist at that time, as well as vivid accounts of the difficulties they had in getting living plants and animals back to France. In addition, the book is a good source of references to still earlier works on the islands.—R. D. TURNER

* * * *

I have used the spelling of Porto Rico in all original citations. The spelling of this island name was made official as Puerto Rico a few years ago.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 APRIL 29, 1959 NUMBER 23

## Notes on the Genus Taheitia (Truncatellidae) in New Guinea with the description of a new species

*By* RUTH D. TURNER

The genus *Taheitia* is widely distributed on the Pacific Islands. Species have been recorded from the Tuamotu Islands in the Central Pacific to the Philippine Islands and New Guinea in the Western Pacific. No species have been recorded from Indonesia though it is certainly possible that members of this genus may occur on these islands but may have been overlooked owing to their small size and secretive habits. Only two species have been recorded previously from New Guinea and the closely associated islands, Waigeo and Misool — *T. wallacei* H. Adams and *T. gracilenta* E. A. Smith.

*Taheitia* is a genus of terrestrial species in the family Truncatellidae. Similar to other rather primitive prosobranchs, such as the Neritidae and Helicinidae (a few species in the Neritidae and all known species in the Helicinidae), *Taheitia* has become adapted to living on land. A monograph of the genus *Taheitia* is impossible at this time for the collections available for study are far too small and in most cases contain only dried specimens. The radulae of only a very few species have been figured but the differences shown suggest that further study of this organ might be of considerable aid in indicating relationships among the various species. The opercula, too, are strikingly different to judge from the relatively few species for which they are known. All consist of a paucispiral, chitinous base with a heavy, but distinctly sculp-

tured calcareous plate on the outer surface. No detailed anatomical work has ever been done on any species in this genus or even in the entire family. A discussion of the genus *Taheitia* and a summary of the known species were given by Clench and Turner (1948).

The following new species was collected at Biak, Dutch New Guinea by A. W. B. Powell while on an expedition under the auspices of the Natural Science Foundation, Academy of Natural Sciences, Philadelphia. The party consisted of Alfred Ostheimer, Virginia Orr and A. W. B. Powell. During a recent visit to the British Museum (Natural History) it was possible for me to study the type series of *T. gracilenta* Smith and topotypes of *T. wallacei* Adams. Descriptions of these species are included to allow a ready comparison of the three species now known from New Guinea. I am most grateful to Ian Galbraith and Peter Dance for their kindness to me while I was working in the Mollusca Division at the British Museum (Natural History). I am also grateful to R. T. Abbott for the loan of material from the Academy of Natural Sciences, Philadelphia.

## **Taheitia gracilenta** *Smith*

Plate 31, fig. 4

*Truncatella gracilenta* Smith 1897, Proceedings Malacological Society, London **2,** p. 289, pl. 17, figs. 16–17 (Andai, New Guinea).

*Truncatella* (*Taheitia*) *gracilenta* Smith. Rensch 1937, Achiv für Naturgeschichte (NF) **6,** pt. 4, pp. 629, fig. 54.

*Taheitia gracilenta* Smith. Clench and Turner 1948, Occasional Papers On Mollusks, Harvard Univ. **1,** no. 13, p. 191.

*Description.* Shell reaching 14.3 mm. (truncate specimen) in length, cylindrical, strong, imperforate and sculptured. Whorls remaining, 7 to 7½, slightly convex with the body whorl slightly angled. Color a light golden brown. Aperture holostomatous, oval and with a broadly reflected lip. There is a distinct parietal gap. Spire extended and abruptly truncated. Sculpture consisting of numerous fine axial blades which are more or less evenly spaced and equally strong over the surface of the shell with the exception of the axial blades extending over the base of the body whorl which are stronger and higher. Young, non-truncated specimens have 10 whorls, with sculpture similar to that of the adult except that the embryonic whorls are

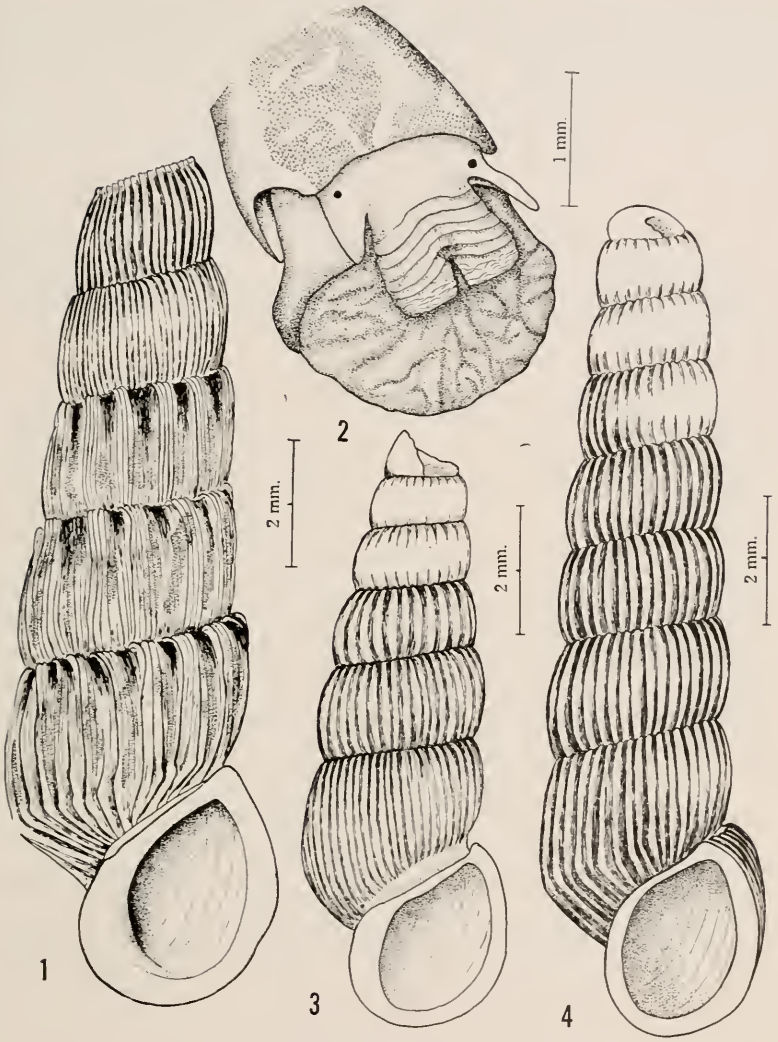



Plate 31

Fig. 1. *Taheitia orrae* Turner, Holotype, Academy Natural Sciences, Philadelphia, no. 223656. The stippled areas indicate the translucent patches.

Fig. 2. *Taheitia orrae* Turner. From a specimen which had been preserved in alcohol and relaxed with trisodium phosphate.

Fig. 3. *Tahcitia wallacei* H. Adams. Topotype drawn from specimen in the British Museum (Natural History), no. 1904.12.15.56.59.

Fig. 4. *Truncatella gracilenta* Smith (=*Taheitia gracilenta* Smith). Lectotype, British Museum (Natural History), no. 98.10.25.16.

smooth and the first four post-embryonic whorls have weak, more widely spaced costae which disappear over the whorl periphery. Operculum unknown.

| length | width | whorls | |
|---|---|---|---|
| 14.3 mm. | 3.5 mm. | 7½ | lectotype |
| 11.5 | 2.5 | 7 | paratype |
| 14.2 | 3.5 | 7½ | " |
| 14.0 | 3.2 | 7½ | " |

*Types.* The lectotype of *T. gracilenta* Smith is in the British Museum (Natural History), no. 98.10.25.16. The type locality is Andai, New Guinea.

*Remarks.* This species is close in its relationship to both *T. wallacei* and *T. orrae.* From *wallacei* it differs in having a more elongate, nearly straight sided, cylindrical shell, in having the body whorl slightly angled and the costae less crowded on the body whorl. From *T. orrae* it differs in having a less flaring lip, in having the costae arranged as approximately parallel ridges rather than grouped to form bosses and in lacking the irregular color markings of *orrae.* The radula of *gracilenta* as figured by Rensch (1937) is very close to that of *orrae,* though unfortunately the marginal teeth were not figured. It is these teeth on the radula of *orrae* that differ strikingly from others known for this genus.

*Range.* Probably restricted to New Guinea.

Rensch has recorded this species from New Britain and New Ireland in the Bismarck Archipelago, but considering the restricted ranges of the better known species of *Taheitia* and *Geomelania* (its West Indian counterpart in the Truncatellidae), this is open to question.

*Specimens examined.* DUTCH NEW GUINEA: Andai (BMNH).

### **Taheitia wallacei** *H. Adams*
Plate 31, fig. 3

*Truncatella* (*Taheitia*) *wallacei* H. Adams 1865, Proceedings Zoological Society, London, p. 416, pl. 21, figs. 13–14 (Waigiou, New Guinea).

*Taheitia wallacei* H. Adams. Clench and Turner 1948, Occasional Papers On Mollusks, Harvard Univ. **1**, no. 13, p. 192.

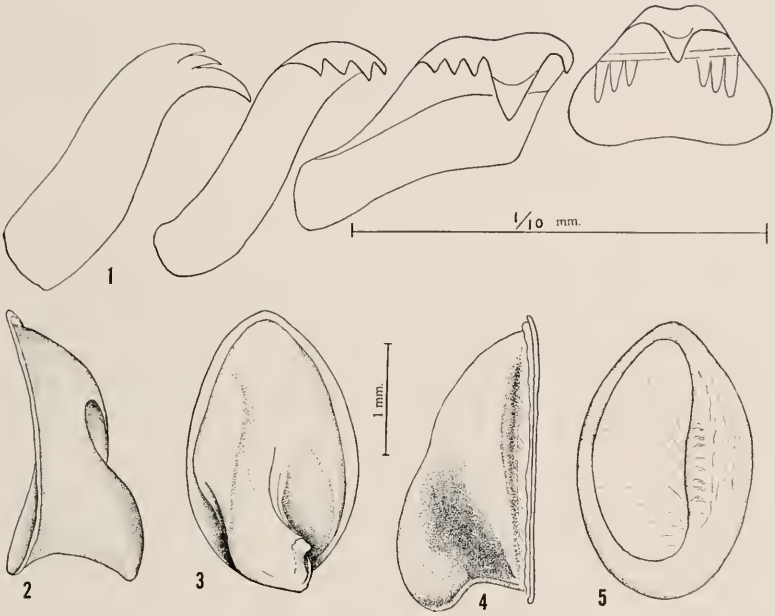



Plate 32

Fig. 1. Radula of *Taheitia orrae* Turner.

Figs. 2–5. Operculum of *Taheitia orrae* Turner. Fig. 2. View from the parietal margin. Fig. 3. Outer surface. Fig. 4. View from palatal margin. Fig. 5. Inner surface. The thin basal plate is chitinous while the thick, irregular outer plate is calcareous.

*Description.* Shell reaching 10.5 mm. in length (truncate specimen). Tapering, elongate, imperforate and sculptured. Whorls remaining, 5½ and slightly convex. Color a uniform light golden brown. Aperture holostomatous with a broadly reflected lip. Gap between the parietal lip and the body whorl variable and occasionally absent. Spire extended, somewhat tapering and abruptly truncated. Sculpture consisting of numerous fine axial rounded blades which are more or less evenly spaced but become more crowded on the body whorl. Blades on the body whorl similar to those on the previous whorls. Young, non-truncated specimens not seen. Operculum unknown.

| length | width | whorls | |
|---|---|---|---|
| 10.5 mm. | 3.5 mm. | 6 | Waigeo, Dutch New Guinea |
| 9.5 | 3.5 | 5½ | " " " " |

*Types.* The location of the holotype of *T. wallacei* H. Adams is unknown. It is not in the British Museum (Natural History). Adams states in the original description that the specimens were in the collection of William Wilson Saunders Esq. The present location of this collection is unknown. The type locality is Waigiou, New Guinea [Waigeo Island, Dutch New Guinea].

*Remarks.* This species is closely related to *T. gracilenta* Smith (see remarks under that species). Nothing is known of the radula or operculum of this species.

*Range.* Known only from Waigeo and Misool Islands.

*Specimens examined.* DUTCH NEW GUINEA: Waigeo (BMNH).

**Taheitia orrae,** new species
Plate 31, figs. 1–2; Plate 32, figs. 1–5

*Description.* Shell reaching 12.8 mm. in length (truncated specimen), cylindrical, rather strongly formed, imperforate and sculptured. Whorls remaining, 5 and slightly convex. Color a light tan to medium reddish brown with irregular patches of a darker red-brown. The irregular patches are translucent, especially in transmitted light, while the light areas are opaque. Aperture holostomatous, subovate and with a broadly reflected lip. There is no parietal gap. Spire extended and abruptly

truncated. Sculpture consisting of numerous fine axial blades which are grouped to form bosses along the suture on the upper portion of the whorls. The axial blades become weak over the periphery of the whorl but much stronger at the base of the shell. Young non-truncated specimens have 10 to 11 whorls and have much stronger axial blades, particularly near the suture. The blades on the juvenile specimens are not grouped into bosses. Nuclear whorls two, and smooth. Operculum with a paucispiral, chitinous base and a heavy calcareous plate on the outer surface (Plate 32, figs. 2-5).

| length | width | whorls | |
|---|---|---|---|
| 12.8 mm. | 4 mm. | 5 | Holotype |
| 12.4 | 4 | 5 | Paratype |

*Types.* The holotype in the Academy of Natural Sciences Philadelphia, no. 223656 was found under fern roots in a large sink-hole cave behind the air strip, Biak, Dutch New Guinea, Station 503, A. W. B. Powell collector, February 7, 1956. Paratypes from the same locality are in the Academy of Natural Sciences, Philadelphia and the Museum of Comparative Zoology, no. 221170.

*Remarks.* This species is close in its relationship to *T. gracilenta* Smith and *T. ultima* Rensch from New Britain in the Bismarck Islands. It differs from *ultima* in being somewhat smaller (*T. ultima* ranges from 16.4 to 18.5 mm. in length while *orrae* does not exceed 13 mm. in length), in having the costae grouped to form bosses, and in having irregular color markings. See also remarks under *T. gracilenta* Smith.

Several preserved specimens of *T. orrae* were available for study but unfortunately no special care was taken in their preservation and so detailed anatomical studies were impossible. However, after soaking in trisodium phosphate it was possible to remove the anterior portion of the animal. The mantle was a grayish ivory with markings of dark chestnut brown to nearly black. The tentacles were short and broad with the black eyes at the base. The radula is similar to that of *gracilenta* as figured by Rensch though unfortunately the marginal teeth of *gracilenta* were not shown. The marginals of *orrae* are quite different from those of *T. abbotti* as figured

by Clench and Turner (1948), those of *orrae* having few large denticles while those of *abbotti* have many small ones.

*Range.* Known only from the type locality.

*Specimens examined.* DUTCH NEW GUINEA: From sink-hole cave behind the air strip, Biak.

## REFERENCES

Clench, W.J. and R.D. Turner 1948, A Catalogue of the Family Truncatellidae with Notes and Descriptions of New Species. Occasional Papers On Mollusks, Harvard Univ. **1,** no. 13, pp. 157–212, pls. 22–25.

Jutting, W. S. S. van B. 1958, Non-marine Mollusca of the Island of Misool. Nova Guinea (N.S.) **9,** pp. 293–338.

Rensch, Ilse 1937, Systematische und tiergeographische Untersuchungen über die Landschneckenfauna des Bismarck-Archipel II. Archiv für Naturgeschichte (N.F.) **6,** pt. 4, pp. 526–564, figs, 1–54.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 OCTOBER 20, 1959 NUMBER 24

# Calvin Goodrich; a Bibliography and Catalogue of His Species

*By* JOSEPH ROSEWATER

> Thank you for naming the sub-genus for me. In the days to come when the new generation rolls up its sleeves to undo the work of this one, as this one is undoing that of workers who thought they had done a good, decent job, some one will note the name and speculate a bit about the guy it honors, and that will be in the nature of fame.—(Calvin Goodrich, in a letter to W. J. Clench, 1927.)

Calvin Goodrich was born in Chicago, Illinois on February 22, 1874. His father, Dewitt C. Goodrich, a civil engineer, died in 1920. His mother, Harriet E. Landon, died in 1883. A sister, Beatrice, now Mrs. Farmer Murphy, lives in New Canaan, Connecticut. Mrs. Calvin Goodrich, his wife, the former Georgie Houston, now resides in Toledo, Ohio. There are no children.

It was the habit of the family, no doubt as a result of Dewitt's occupation, to move frequently. They moved to Kansas in 1879 and resided in Leavenworth for a time. Calvin attended high school in Paola, Kansas. He attended the University of Michigan for two years, 1892–1894. A year spent at the University of Kansas was devoted to a special course in English, preparatory to a possible career in journalism.

Information concerning certain events in Goodrich's life during the time of his college days and just afterward is somewhat nebulous. Data kindly supplied by his wife and sister indicate that his early experiences were many, varied, interesting, and

generous appetizers which preceded a long life of service to literature and science. He was said to have had 31 jobs before entering newspaper work. Either during college or just afterward he worked his way out west and spent some time on a sheep ranch. Mrs. Goodrich writes that he:

> . . . ran out of money in San Francisco, went to a jailer and asked to be taken in for the night. The jailer, recognizing that he was not an ordinary hobo, brought him paper and ink and made him write home for money to get back on. His pride was severely hurt.

He also worked in a circus, and for a wholesale drug company. He sailed around the Horn as a crew member on a sailing vessel to South Pacific islands; then on a cattle boat to Australia. Goodrich and a man called McCrea walked across New Zealand together, then parted company, never to see each other again, but corresponded until the death of the latter. He returned to the United States by way of London.

"I think above all his gifts ranked that of writing," wrote Mrs. Goodrich about her husband. His journalistic career began in earnest with a position on *The Kansas City Star.* He was also employed at some time, according to his wife, by a now extinct magazine, *Musical Courier.* With the occurrence of the Spanish-American War in 1898 he left the *Star* and enlisted in the U.S. Army. He was a victim of the typhoid fever epidemic at Chickamauga Park, Tennessee. His sister Beatrice, a Red Cross nurse with the Army, obtained leave to nurse him through his sickness. Concerning his advancement in the Army during the war, Goodrich wrote the following to Dr. W. J. Clench (July 28, 1942):

> In the great and virulent war with Spain, I joined up at the end of April. In a week or ten days I was a corporal. A duty sergeant recited his opinions of the company captain to the captain's face, an error of judgment, and almost at once I was a duty sergeant. The Spanish fleet was blown to bits early in July, and for a matter of days only damn fools like myself showed up for drill. Almost simultaneously with coming down with typhoid I rose to top sergeant. The second lieutenant when he got back home took entertainment from his boss's wife, got caught and was extensively publicized. I took his place to the mustering out depot. You can see by simple calculation that had the war lasted, say two years, I would have been corps commander.

After his war service Goodrich returned to newspaper work on *The Kansas City Star.* He was later employed by another

CALVIN GOODRICH, 1874–1954

Plate 33. From a photograph in the Department of Mollusks, Museum of Comparative Zoology; taken in 1925.

newspaper, *The New York Commercial.* Having left employment with the latter he went abroad once more to live for several months in France and then England. Upon his return to the United States he was employed by *The Cleveland Leader.* In 1908 Goodrich went to Toledo, Ohio as associate editor on *The Toledo Blade.* It was there that he and Mrs. Goodrich met. They were married March 18, 1912, in Sancti Spiritus, Cuba, where Mrs. Goodrich's parents were living at the time. In 1917, the publishers of *The Toledo Blade* (the Locke family, sons of the founder, D. R. Locke, who wrote under the pseudonym, Petroleum V. Nasby) bought *The Detroit Journal* and sent Goodrich there. The latter paper was soon sold and Goodrich then became editor of the *Newark Star-Eagle.* He was transferred briefly to *The Toledo Blade* before retiring from journalism in 1926.

It was sometime in the period from 1900–1910 according to Mrs. Goodrich, that Calvin developed his interest in mollusks. He came across a book in a public library which told of the great number of species of snails. This was astonishing to him, so he began to collect them. Early in this period of his growth as a malacologist, Goodrich became acquainted and initiated correspondence with others having similar interests. Two of these were Bryant Walker of Detroit, Michigan, and A. E. Ortmann of the Carnegie Museum, Pittsburgh, Pennsylvania. These men profoundly influenced his development and his earlier publications mirror their effect upon his work. A discussion of the effects of these early associations is given by van der Schalie (1955 a, b; 1956) in the memorial by him to Calvin Goodrich at the time of the latter's death.

In 1924, Goodrich became Honorary Associate Curator of Mollusks at the Museum of Zoology, University of Michigan, an institution with which he had been connected for many years. He retired from editorship of *The Toledo Blade* in 1926 and was appointed Assistant Curator of Mollusks at the Museum of Zoology. When Miss Mina Winslow retired from the curatorship in 1930, Goodrich assumed that position which he held until his retirement at the age of 70 in 1944. He was retired with the title of Curator Emeritus and moved to western North Carolina.

During the period of time from 1911 through 1950, Goodrich

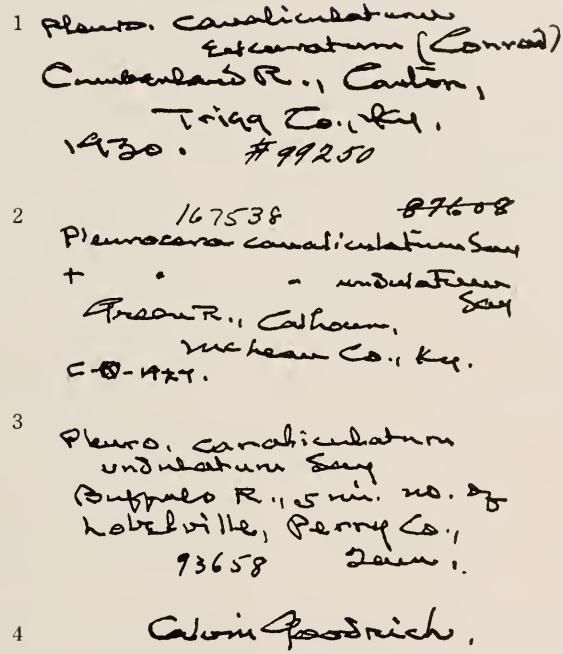



Plate 34. Examples of Calvin Goodrich's writing.

Fig. 1. Original label from a lot in the Museum of Comparative Zoology. Specimens were collected by Goodrich in the Cumberland River in 1930.

Fig. 2. From a lot, identified by Goodrich, collected by W. J. Clench and Peter Okkelberg in the Green River, Kentucky, September 1, 1927.

Fig. 3. From a lot collected by Goodrich in 1931 from a tributary of the Duck River, Tennessee.

Fig. 4. Goodrich's signature.

produced some 87 publications concerning malacology. Most of these had to do with some aspect of his studies of the family Pleuroceridae. His early dealings with the group appear to reflect a typological viewpoint, perhaps influenced by the notes from and respect he held for H. H. Smith. Smith, who was curator of the Alabama Museum of Natural History (1908–1919), and his wife made systematic collections of pleurocerids in the Coosa River system and nearby waters in the early part of this century. After Smith's death (1919) Goodrich was called upon to work up the material. This was done and resulted in several publications with descriptions of new species and studies of distribution in this group (Anculosae, 1922; Gyrotomae, 1924). Goodrich appended Smith's name to many of the newly described species in these publications. It is the belief of this writer, gained from the discussion of this problem with others and from certain statements in letters written by Goodrich, that it was Goodrich himself who described these new species. Smith was a fine collector and naturalist of considerable talent, as pointed out by Holland (1919). He may have indicated that certain specimens appeared distinct in his field notes, to which Goodrich had access, but he did not describe the species. It is for this reason that the notation, " 'Smith' Goodrich," will be found in the catalogue of species. Specimens of pleurocerids collected by W. J. Clench also contributed in great degree to Goodrich's studies of these gastropods. Large collections were made systematically by Clench throughout the Green River system and other waters of Kentucky, in the Tennessee River and its upper tributaries, and in portions of the Coosa River system in the 1920's and early 30's. Later work by Goodrich shows the development of an understanding of clinal variation, as evidenced by the Pleuroceridae, which would be a delight to any evolutionist.

Goodrich's malacological writings are available to all for perusal. But the man himself may be an enigma to many who knew or corresponded with him as he rarely spoke about himself or his experiences, preferring rather to draw out the person with whom he was conversing. It is therefore intended that the remaining portion of this sketch be devoted to a consideration of the man himself, his character and personality, as revealed by letters written to his friend, William J. Clench, over the years from 1923 through 1954.

Goodrich was a prolific writer of high excellence. This was obvious in his professional journalistic accomplishments, his scientific work, and also in the many letters full of wit and wisdom which he wrote to friends. Mrs. Goodrich wrote concerning Calvin's wit, "The publisher of the (Toledo) Blade said, 'You know Calvin will say something with a perfectly straight face, and I won't realize until I turn to leave, that he has said something excruciatingly funny!' "

He wrote, concerning how to succeed:

(1925) All my newspaper career I have had to study the character of my bosses and associates. Some people call this politics or policy and despise it. But it is simply a problem in human relations. If you will let me advise you *do this,* and submerge your own self. The thing becomes a fascinating game, rich in philosophy. You will get ahead thereby and experience the fewest bumps.

In relation to giving and taking credit for help received:

(1926) I observe that here the instinct for seizing credit is active and lusty, corresponding to the economic determinism which affects the doings and decisions of men in private life. The aloofness of the professorial class from the ordinary pressures of existence is, I find, a good deal of a joke—(there) being in fact no such thing. One young surgeon . . . is very bitter against a fellow worker who grabbed off the whole credit for some research in which several men took part. I got the impression that . . . (he) will do the same thing when he gets the chance. I would be far from blaming him, since he would be only conforming to the custom of the country.

Concerning the conservation of space in museums (and elsewhere):

(1927) There goes with an extreme extravagance of space what you might call an attic mind—the kind of mind, common once to New England, that cannot bear to throw anything away. It compels the owner to keep materials that cannot possibly be of use to anyone ever.

At the time of A. E. Ortmann's death:

(1927) You have heard, of course, of Ortmann's sudden death. . . . I was mighty fond of Ortmann. We had a great trip together in 1913, and I suspect I lost several pounds in trying to keep up with him. In going into the upper Tennessee region over the Virginian road, he got wound up on the subject of Unios and presently everyone in the observation car left off gazing at the scenery and opened up their ears in the Doctor's direction. He was altogether unconscious of the attention. . . . I have never seen another such manifestation of the tremendous power of the mere sound of words. Twice afterwards I saw him, and he was still the untiring enthusiast. My notion is that he wore himself out at 61, strong as he was. The race is not always to the man with the steam engine innards.

On wetting old shells:

(1927) I ran water through . . . mixed lots of Call's shells to get the sand and soot out of them, and, lo, I woke up smells that had been sleeping for forty years! We are having a damp spell just now, and it has the effect of resurrecting very ancient and unsubtle odors until it would be a very stupid thing for anyone to argue against immortality.

Regarding remarks on catalogue entries: (also see Nautilus, **55:** 119–120.)

(1930) Some of the . . . helpers apparently relieved the tedium of their work by joking in the catalogue, seemingly certain that no one would look over their labors after they were done. For example, P.O., which was Rush's indication for Pacific Ocean was twice written into the catalogue as Post Office. St. Kitts was invariably St. Kilts. Wabash River was located in Texas. Dr. Case brought us things from Cook Islands, South Pacific, and they were blithely credited to Dr. Cook. Shells from Guernsey Island came here with scientific names lacking author's names. So the references were all made like this: 'Helix lactea Guernsey. Locality unknown.' And so on to . . . persuade you that most people were drooling idiots.

The following facetious news story was prepared by Goodrich at the time a friend was to go forth on a collecting expedition:

(1931) Miami, Fla., Mch. 2,—Professor W. B. Kentz, distinguished savant of Harvard University, New Haven, Conn., has been rescued from the Everglades into which he ventured in search of the Lost Tribes of Israel, long rumored to be hidden among inaccessible swamps and described in an ancient Spanish document found by Prof. Kremps while carrying on researches among the archives of the Spanish Government in Malta, Spain. When rescued, Klantz was reduced to eating his leather puttees for food and was damaged considerably by savage water moccasins. He said he could have held out for a few more days because he still had some buckles left. He did not find the lost tribes, but he is sure he saw a tribesman while peering into a pawnshop window in Jacksonville. When he entered, however, the tribesman was wearing a false nose, and refused to uncover.

Concerning Clench's students, after having met them:

(1931) Your students are of a high order. I was delighted with them, and would steal them away if I knew just how to go about it. After all, you've more than you should have, considering the rarity of boys interested in mollusks. I wish you would tell them that I consider it far more than a pleasure to have met them and have delighted in their friendliness and intelligence, *whatever the police may think of them.*

## A New Year's wish:

(December 30, 1931) I hope that all your family will have a happy year and that—for yourself—you will kick your toe against a cache of bootleggers' capital as a boy in Windsor did the other day.

## During a lighter moment in his studies:

(1932) Under the title of Morphological Characters of Coosa River Pleuroceridae, I purpose to write the following article: There are no characters.

## Some views on trends in taxonomy:

(1933) . . . I have become aware that malacologists are a blamed sight too taxonomic and too little biological. Some day the taxonomic system is going to tumble over into a heap of dust and mortar simply because, as it stands, it won't stand the patching and the overloading and the additions and supplements. To be brief, it doesn't provide a portrait or anything like a portrait, of nature as she is. There are infinitely more resemblances in life than there are differences, meaning that there is uniformity where we have been pointing out the lack of it. We do it by making new species, by erecting subgenera, by talking and writing as if genera had thick partitions between them.

## Remarks on a discussion of Rafinesque's names:

(1942) It all goes to prove that blessed few matters ever really get settled. Slavery was supposed to have gone out even in Ethiopia some time ago. But here are Germany and France reviving it. We fought a war to end war, and it looks now as if we may have it continuously for scores of years. I suppose that if we traced the history of a present-day argument we'd find that the Medes and Persians, or maybe Neanderthals, jawed about it until their teeth fell out.

## And a joke he thought well enough of to transcribe:

A farmer named Moore was seen traipsing about town with a jug. Some one finally asked him what the jug contained. 'Al-ke-hal,' he said.

'Surely not all alcohol.'

'Al-ke-hal clean up to the cork.'

'But Jim, what 'll you do with all that alcohol?'

'I'm goin' to take it home and weaken down a kag of cider with it.'

## On the occasion of the receipt of a $0.60 bill in arrears (at age 70):

(1943) Just now, I've a mind to tell you to go to the devil, you and your back dues. For you remind me that time is fleeting, that what I'd a mind to think of as yesterday, is in fact last year. One of the incredible phenomena of my experience is that once upon a time the days lagged, the weeks dragged. The last time I saw you I was stepping out to Africa, and here, b'gosh, by calendar reckoning, that was four years ago. Damn it, I can remember pausing as I

went up your stairs to marvel over some simian or other—and that seems scarcely longer ago than was the last snowstorm.

Remarks on the statistical method:

(1945) I am leery of (the statistical method) as regards making it a basis of general conclusions. Especially do I despise it when it is used to work toward a mathematical summary. Still, I think it is a fair and proper system when you want to find and fix the limits of variation. I am inclined to suspect that the method is resorted to on two counts: Once when a writer wants language and so copies a conventionalized formula and, again, where he gets the mistaken notion that mathematics sum up natural history—as if the divinity arranged the cosmos according to an algebraic equation.

In 1944, Goodrich retired from the curatorship at Ann Arbor and with Mrs. Goodrich moved to North Carolina because of the milder climate. His interest in mollusks remained active, but there were few available in the region for him to collect. Late in 1946 he wrote concerning his work:

I flounder along with a measure of typewriting, and incidently monkey at oil painting. This latter suits my temperament insofar as getting me splotched with violent colors. An accepted manuscript has been awaiting a publisher's finikiness about paper. Getting together what you might call a scenario for a novel, I ran the thing to 65,000 words before I could quit. It will be shaped up if I live long enough.

On the occasion of the death of the father of a friend:

(1946) . . . it is just such relative trivialities and inconsequences that take hold of the mind, and stay there. In the case of my own father who died twenty-six years ago the memory of him lingers not for a singularly high sense of justice he had and his repeated struggles with misfortune, but for his one oath which was 'confound it!,' a habit of walking with hands clasped behind him, and certain other oddities none of which was striking. It may well be that it will be nothing greatly outstanding which has stamped your father on your memory, and by this he will be fondly recalled.

In 1953, Goodrich suffered an attack of prostatitis and required an operation. The condition persisted. A letter dated September 19, 1954, begins with another joke obviously an attempt at making light of his illness:

A drummer recovering from a bat dictated a letter to his wife. He said, 'I will be delayed here for a day or two longer, and before starting home must call on a customer at Tuscarawas . . .

'How do you spell Tuscarawas?,' the stenographer asked.

'Can't you spell it?'

'No.'

'Well make it Columbus.' "

It ends:

> We went into hospital at a sanitarium run by the Seventh Day Adventists who have a queer mixture of up-to-date medicine and old-fashioned piety. I am at present devoting time to recovering according to the army regime. Oddly, I am undergoing shrinkage, coming down from 172 pounds to just under 125. I am trying to believe that the physical change does not involve mental deterioration, though, for all I might tell of the matter, it might be doing so.

This was the last letter Goodrich wrote to Clench. It contained, in addition to the two preceding items, a discussion of things malacological which evidenced his strong continuing interest in the field.

Calvin Goodrich died a little over a month later in Asheville, North Carolina, November 7, 1954.

## Acknowledgments

The writer wishes to express his thanks to Mrs. Calvin Goodrich and Mrs. Farmer Murphy for supplying information concerning the early life of Calvin Goodrich; to Dr. William J. Clench for making his file of letters from Mr. Goodrich available to me; and to Dr. R. D. Turner and my associates in the Department of Mollusks, Museum of Comparative Zoology for offering helpful suggestions. Dr. Henry van der Schalie and members of his department were most helpful during a visit paid to the Museum of Zoology, University of Michigan where the Goodrich types were examined. They also sent paratype material of some of Goodrich's species for inclusion in the collection of the Museum of Comparative Zoology. Miss Winnie McGlamery of the Alabama Museum of Natural History, University, Alabama, also supplied information on types.

## Literature Cited

Holland, W. J. 1919. Herbert Huntington Smith. Science **46:** 481–483.

van der Schalie, Henry. 1955a. Calvin Goodrich 1874–1954. Nautilus **68:** 135–142.

—— 1955b. Calvin Goodrich, 1874–1954. Report of the Director of the Museum of Zoology, Univ. of Michigan **56:** 9–13.

—— 1956. Calvin Goodrich, 1874–1954. American Malacological Union, Annual Reports for 1955, Bull. No. 22, pp. 1–4.

*Bibliography of Calvin Goodrich's Works on Mollusks:*

1911, May, Lymnaea auricularia in Ohio. Nautilus **25:** 11–12.

1913, November, Spring collecting in southwest Virginia. Nautilus **27:** 81–82.

1913, December, Spring collecting in southwest Virginia. Nautilus **27:** 91–95.

1914, March, Union of the Wabash and Maumee drainage systems. Nautilus **27:** 131–132.

1916, July, A trip to islands in Lake Erie. Annals Carnegie Museum **10:** 527–531.

1917, March, Pleurocera subulare Lea. Nautilus **30:** 122–124.

1920, January, Goniobases of Ohio. Nautilus **33:** 73–74.

1921, January, Three new species of Pleuroceridae. Occ. Pap. Mus. Zool., Univ. Mich. No. 91: 1–5, pl. 1.

1921, July, River barriers to aquatic animals. Nautilus **35:** 1–4.

1921, July, Anculosae north of the Alabama drainage. Nautilus **35:** 9–12.

1921, December, Something about Angitrema. Nautilus **35:** 58–59.

1922, July, The Anculosae of the Alabama River drainage. Misc. Pub. Mus. Zool., Univ. Mich. No. 7: 1–57, pls. 1–3. (Published in cooperation with Geological Survey of Alabama as Museum Paper No. 6, Alabama Museum of Natural History).

1923, April, Variations in Goniobasis edgariana Lea. Nautilus **36:** 115–119.

1924, February, The genus Gyrotoma. Misc. Pub. Mus. Zool., Univ. Mich. No. 12: 1–29, pls. 1–2. (Published in cooperation with Geological Survey of Alabama as Museum Paper No. 7, Alabama Museum of Natural History.)

1924, October, Some old Pleurocerids and a new one. Nautilus **38:** 43–48.

1927, October, Some misplaced Pleurocerids. Nautilus **41:** 57–62.

1928. March, Strephobasis: a section of Pleurocera. Occ. Pap. Mus. Zool., Univ. Mich. No. 192: 1–15, pls. 1–2.

1928, July, The group of Goniobasis catenaria. Nautilus **42:** 28–32.

1928, October, Goniobasis undulata. Nautilus **42:** 67.

1929, April, The nomenclature of ecological varieties. Nautilus **42:** 114–118.

1929, July, The Pleurocerid fauna of the Falls of the Ohio. Nautilus **43:** 1–17.

1930, February, Goniobases of the vicinity of Muscle Shoals. Occ. Pap. Mus. Zool., Univ. Mich. No. 209: 1–25. (Published in cooperation with Geological Survey of Alabama as Museum Paper No. 10, Alabama Museum of Natural History.)

1930, April, Unio spinosa Lea. Nautilus **43:** 140.

1930, April, Pleurocera (Strephobasis) curtum (Haldeman). Nautilus **43:** 141.

1931, March, The Pleurocerid genus Eurycaelon. Occ. Pap. Mus. Zool., Univ. Mich. No. 223: 1–9, pl. 1.

1931, August, Pleurobema aldrichianum, a new naiad. Occ. Pap. Mus. Zool., Univ. Mich. No. 229: 1–4, pl. 1.

1931, October, Some conchological beginnings. Nautilus **45:** 41–47.

1931, November, Mollusks of Keweenaw County, Michigan. Occ. Pap. Mus. Zool., Univ. Mich. No. 233: 1–9, pl. 1.

1932, The Mollusca of Michigan. Michigan Handbook Series, Mus. Zool., Univ. Mich. No. 5: 1–120, pls. i–vii, text figs.

1932, April (with Henry van der Schalie) I. On an increase in the naiad fauna of Saginaw Bay, Michigan. II. The naiad species of the Great Lakes. Occ. Pap. Mus. Zool., Univ. Mich. No. 238: 1–14.

1932, April, Collecting in Tennessee. Nautilus **45:** 136–137.

1932, July, Cress a possible introducer of species. Nautilus **46:** 35–36.

1932, October, The true position of Bruguière's Bulimus carinatus. Nautilus **46:** 38–40.

1933, July [June], Mollusks of Moose Factory. Nautilus **47:** 7–9.

1933, July, The usefulness of Mollusca in local biological studies. [In] Opportunity for investigation in natural history for high school teachers. Journ. Michigan Schoolmasters' Club, Univ. of Mich. Official Pub. **35:** 89–91.

1934, June, Studies of the gastropod family Pleuroceridae—I. Occ. Pap. Mus. Zool., Univ. Mich. No. 286: 1–17, pl. 1.

1934, June, Studies of the gastropod family Pleuroceridae—II. Occ. Pap. Mus. Zool., Univ. Mich. No. 295: 1–6, fig. 1.

1934, November, Studies of the gastropod family Pleuroceridae—III. Occ. Pap. Mus. Zool., Univ. Mich. No. 300: 1–11.

1935, April, Studies of the gastropod family Pleuroceridae—IV. Occ. Pap. Mus. Zool., Univ. Mich. No. 311: 1–11.

1935, July, Studies of the gastropod family Pleuroceridae—V. Occ. Pap. Mus. Zool., Univ. Mich. No. 318: 1–12.

1935, October [November], A species of Goniobasis new to the Great Basin. Nautilus **49:** 66.

1936, January, Notes on Philippine freshwater mollusks. Nautilus **49:** 73–79.

1936, June, Goniobasis of the Coosa River, Alabama. Misc. Pub. Mus. Zool., Univ. Mich. No. 31: 1–60, pl. 1.

1936, October, Bryant Walker 1865–1936. Nautilus **50:** 59–64 (portrait).

1937, January, Goniobasis columbiensis Whiteaves. Nautilus **50:** 82–84.

1937, March, Studies of the gastropod family Pleuroceridae—VI. Occ. Pap. Mus. Zool.. Univ. Mich. No. 347: 1–12.

1937, March (with Henry van der Schalie) Mollusca of Petén and North Alta Vera Paz, Guatemala. Misc. Pub. Mus. Zool., Univ. Mich. No. 34: 1–50, pl. 1, fig. 1, 1 map.

1938, May, Studies of the gastropod family Pleuroceridae—VII. Occ. Pap. Mus. Zool., Univ. Mich. No. 376: 1–12.

1939, March, The scientific writings of Bryant Walker; an annotated bibliography. Occ. Pap. Mus. Zool., Univ. Mich. No. 402: 1–28.

1939, April, Aspects of depauperization. Nautilus **52:** 124–128.

1939, April, Certain mollusks of the Ogeechee River, Georgia. Nautilus **52:** 129–131.

1939, April, New opercula for old. Nautilus **52:** 140.

1939, June, Pleuroceridae of the St. Lawrence River basin. Occ. Pap. Mus. Zool., Univ. Mich. No. 404: 1–4.

1939, June, Pleuroceridae of the Mississippi River basin exclusive of the Ohio River system. Occ. Pap. Mus. Zool., Univ. Mich. No. 406: 1–4.

1939, October, Who or what? Nautilus **53:** 66–67.

1939, December (with Henry van der Schalie) Aquatic mollusks of the Upper Peninsula of Michigan. Misc. Pub. Mus. Zool., Univ. Mich. No. 43: 1–45, 2 maps.

1940, January, Sequence in the distribution of aquatic species. Nautilus **53:** 73–77.

1940, January, Mollusks of a Kansas Pleistocene deposit. Nautilus **53:** 77–79.

1940, January, Another immigrant. Nautilus **53:** 105–106.

1940, January, Regarding O. G. B. Nautilus **53:** 106.

1940, June, The Pleuroceridae of the Ohio River drainage system. Occ. Pap. Mus. Zool., Univ. Mich. No. 417: 1–21.

1940, July, Civilization and aquatic mollusks. Nautilus **54:** 6–10.

1940, October [November], From Capt. Frederick Marryat, "A Diary in America, With Remarks On Its Institutions." Nautilus **54:** 70.

1941, January [February], On certain land shell localities. Nautilus **54:** 78–80.

1941, March, Two new species of Goniobasis. Occ. Pap. Mus. Zool., Univ. Mich. No. 426: 1–4, figs. 1–2.

1941, March, Pleuroceridae of the small streams of the Alabama River system. Occ. Pap. Mus. Zool., Univ. Mich. No. 427: 1–10.

1941, March, Distribution of the gastropods of the Cahaba River, Alabama. Occ. Pap. Mus. Zool., Univ. Mich. No. 428: 1–30.

1941, April [May], Lymnaea contracta Currier. Nautilus **54:** 121–122.

1941, April [May], A sinistral albino. Nautilus **54:** 141.

1941, September, Studies of the gastropod family Pleuroceridae—VIII. Occ. Pap. Mus. Zool., Univ. Mich. No. 447: 1–13.

1941, October, A senatorial conchologist. Nautilus **55:** 66.

1942, January, The American species of Viviparus. Nautilus **55:** 82–92.

1942, January, The Pleuroceridae of the Atlantic Coastal Plain. Occ. Pap. Mus. Zool., Univ. Mich. No. 456: 1–6.

1942, April [May], Observations upon a Florida form of Viviparus. Nautilus **55:** 115–118.

1942, April [May], Certain remarks about labels. Nautilus **55:** 119–120.

1942, December, The Pleuroceridae of the Pacific Coastal drainage, including the Western Interior basin. Occ. Pap. Mus. Zool., Univ. Mich. No. 469: 1–4.

1943, July, The Walker-Beecher Paper of 1876 on the Mollusca of the Ann Arbor area. Occ. Pap. Mus. Zool., Univ. Mich. No. 475: 1–26, 1 map.

1944, April [May], Precedence. Nautilus **57:** 141.

1944, May, Pleuroceridae of the Great Basin. Occ. Pap. Mus. Zool., Univ. Mich. No. 485: 1–11, figs. 1–2.

1944, July [August], Certain operculates of the Coosa River. Nautilus **58:** 1–10.

1944, July [August], Pulmonates of the Coosa River. Nautilus **58:** 11–15.

1944, September [November], (with Henry van der Schalie) A revision of the Mollusca of Indiana. Amer. Midl. Nat. **32:** 257–326.

1944, October [November], Pleuroceridae of the Coosa River basin. Nautilus **58:** 40–48.

1944, October [November], Sphaeriidae of the Coosa River basin. Nautilus **58:** 48–52.

1944, December, Variations in Strombus pugilis alatus. Occ. Pap. Mus. Zool., Univ. Mich. No. 490: 1–10, tables 1–2.

1945, December, Goniobasis livescens of Michigan. Misc. Pub. Mus. Zool., Univ. Mich. No. 64: 1–36, pl. 1, fig. 1, 1 map.

1950, January [February], Goniobasis proxima (Say). Nautilus **63:** 78–80.

* * * *

*List of the recent mollusks described by Calvin Goodrich with their original references and type localities.*

The initials MZUM refer to the Museum of Zoology, University of Michigan; OPMZUM to Occasional Papers Museum of Zoology, University of Michigan; MPMZUM to Miscellaneous Publications Museum of Zoology, University of Michigan; Al.MNH to Alabama Museum of Natural History and MCZ to Museum of Comparative Zoology.

In a few cases catalogue numbers of types in the MZUM do not agree with those puplished with the original descriptions. In these cases the types were apparently recatalogued at a later date.

**aguadae** Goodrich and van der Schalie, **Ferissia (Laevapex):** 1937, MPMZUM No. 34: 34–35, pl. 1, figs. 7, 7a (Aguada de Copó, one mile south of La Libertad, Petén, Guatemala). Holotype MZUM 65583; paratypes MCZ 99399.

**aldrichi** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 31–33, pl. 1, figs. 1, 2, pl. 3, fig. 16 (Coosa River, near mouth of Yellowleaf Creek, Chilton County, Alabama. T. H. Aldrich, collector). Holotype MZUM 10139; paratype MCZ 169987.

**aldrichianum** Goodrich, **Pleurobema:** 1931, OPMZUM No. 229: 2–4, pl. 1 (Conasauga River, near Conasauga, Polk County, Tennessee. Herbert H. Smith collector, October 20, 1916). Holotype Al.MNH 83; paratypes MCZ 221156.

**alvaradoi** Goodrich and van der Schalie, **Spiraxis:** 1937, MPMZUM No. 34: 23, pl. 1, fig. 1 (Limestone knoll five miles north of El Paso de los Caballos, Petén, Guatemala. Taken March 14, 1935). Holotype MZUM 65165; paratypes MCZ 99398.

**annettae** Goodrich, **Goniobasis:** 1941, OPMZUM No. 426: 1–3, fig. 1 (Cahaba River, Lily Shoals, Bibb County, Alabama). Holotype MZUM 128908; paratypes MCZ 99734.

**brevispira** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 35–37, pl. 1, fig. 6, pl. 3, fig. 12 (Fort William Shoals, Coosa River, Talladega County, Alabama. Collected by Herbert H. Smith, June 1914). Holytype MZUM 10144; paratype MCZ 169991.

**chiltonensis** Goodrich, **Goniobasis:** 1941, OPMZUM No. 426: 3–4, fig. 2 (Warsan Creek, near junction with Waxahatchee Creek, Chilton County, Alabama. Collector, Herbert H. Smith). Holotype MZUM 137905; paratypes MCZ 149448.

**choccoloccoensis** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 34–35, pl. 1, fig. 7, pl. 3, fig. 14 (Choccolocco Creek at Jackson Shoals, Talladega County, Alabama. Collected by Herbert H. Smith, September 1905). Holotype MZUM 10145; paratype MCZ 169989.

**clenchi** Goodrich, **Goniobasis:** 1924, Nautilus **38:** 46, figs. 1–4 (Choctawhatchee River, Newton, Dale County, Ala. Collected by W. J. Clench, July 23, 1923). Holotype MZUM 31618; paratypes MCZ 51282.

**clenchi** Goodrich and van der Schalie, **Somatogyrus:** 1937, MPMZUM No. 34: 37, pl. 1, fig. 6 (Río de la Pasión, Sayaxché, Petén, Guatemala). Holotype MZUM 65371; paratypes MCZ 99396.

**clipeata** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 19–21, pl. 1, figs. 8, 9, 10; pl. 3, fig. 8 (Coosa River, Fort Wlliam Shoals, Talladega County, Alabama. Collected by Herbert H. Smith, June 1914). Holotype MZUM 10146; paratypes MCZ 221162.

**excellens** 'Smith' Goodrich, **Goniobasis:** 1935, OPMZUM No. 311: 2, 3 [not figured] (Little River, 5 miles north of Cedar Bluff, Cherokee County, Alabama). Holotype Al.MNH 86; paratypes MCZ 97961.

**flexuosa** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 33, 34, pl. 1, fig. 17; pl. 3, figs. 17, 18 (Coosa River, Wetumpka, Elmore County, Alabama. Collected by Herbert H. Smith, October 1903). Holotype MZUM 10154; paratype MCZ 169990.

**francesae** Goodrich and van der Schalie, **Cochliopa:** 1937, MPMZUM No. 34: 38, pl. 1, fig. 3 (Río de la Pasión, at mouth of Arroyo Chajchiníc, northwest of Porvenir, Alta Vera Paz, Guatemala). Holotype MZUM 65338; paratypes MCZ 99376.

**funibus** Goodrich and van der Schalie, **Spiraxis:** 1937, MPMZUM No. 34: 23, 24, pl. 1, fig. 2 (Limestone knoll five miles north of El Paso de los Caballos, Petén, Guatemala. Taken March 14, 1935). Holotype MZUM 65166; paratypes MCZ 99358.

**gibbera** 'Smith' Goodrich, **Goniobasis:** 1936, MPMZUM No. 31: 41, 42, pl. 1, fig. 9 (Coosa River, Lonigan Shoals, two miles below Lock 2, St. Clair County, Alabama). Holotype Al.MNH [unnumbered]; paratypes MCZ 221163.

**hendersoni** 'Smith' Goodrich, **Gyrotoma:** 1924, MPMZUM No. 12: 18, 19, pl. 2, figs. 19, 20, 21 (Coosa River, Fort William Shoals, Talladega County, Ala.). Holotype MZUM 27433; paratypes MCZ 175257.

**hinkleyi** Goodrich, **Pleurocera:** 1921, OPMZUM No. 91: 1, 2, pl. 1, figs. 1, 1a (Little Muddy Creek, Dubois, Washington Co., Ill. Mr. A. A. Hinkley, collector). Holotype MZUM 10587; paratypes MCZ 51303.

**interioris** Goodrich, **Goniobasis:** 1944, OPMZUM No. 485: 3, 4, fig. 2 (Badger Creek, Bitner Ranch, Washoe County, Nevada. Collected by C. L. Hubbs, 1942). Holotype MZUM 160005; paratypes MCZ 221163.

**jonesi** Goodrich, **Goniobasis:** 1936, MPMZUM No. 31: 31, 32 [new name for *Goniobasis wheatleyi* Lea 1868, non *Lithasia wheatleyi* Lea 1866 (both are *Goniobasis*) ].

**laurae** Goodrich, **Goniobasis:** 1944, OPMZUM No. 485: 2, 3, fig. 1 (Spring west of Home Camp, Long Valley, Washoe County, Nevada. Taken in 1934. C. L. Hubbs, collector). Holotype MZUM 160002; paratypes MCZ 221159.

**lirata** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 45, 46, pl. 1, fig. 25, pl. 3, fig. 22 (Coosa River, Fort William Shoals, Talladega County, Alabama. Collected by Herbert H. Smith, June 1913). Holotype MZUM 10168; paratype MCZ 169996.

**lucida** Goodrich, **Anculosa taeniata**: 1944, Nautilus **58:** 42 (Coosa tributaries) [apparently no types were designated by Goodrich, however, according to Dr. H. van der Schalie, specimens bearing this name are present in the MZUM].

**macglameriana** Goodrich, **Goniobasis:** 1936, MPMZUM No. 31: 48, 49, pl. 1, fig. 20 (Coosa River, near Center Landing, Cherokee County, Alabama). Holotype Al.MNH [unnumbered]; paratypes MCZ 221158.

**microlineata** Goodrich, **Goniobasis:** 1921, OPMZUM No. 91: 4, 5, pl. 1, figs. 4, 4a (Rough Creek, Falls of the Rough, Grayson County, Kentucky. Collected July 24, 1917). Holotype MZUM 10584.

**mimica** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 39, 40, pl. 2, figs. 27, 28, pl. 3, fig. 24 (Little Cahaba Creek, three miles east of Piper, Bibb County, Alabama. Herbert H. Smith, collector, June 1916). Holotype MZUM 10170; paratype MCZ 169994.

**modesta** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 23, 24, pl. 2, figs. 29, 30, pl. 3, fig. 9 (Coosa River, Riddle's Bend, Cherokee County, Alabama. Collected by Herbert H. Smith, October 1904). Holotype MZUM 10172; paratype MCZ 169995.

**occultata** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 48, 49, pl. 2, figs. 31, 32, 33, pl. 3, fig. 21 (Coosa River, Duncan's Riffle, Chilton County,

Alabama. Herbert H. Smith, collector). Holotype MZUM 10173; paratype MCZ 169993.

**pasionensis** Goodrich and van der Schalie, **Amnicola:** 1937, MPMZUM No. 34: 36, pl. 1, fig. 4 (Arroyo Subín, tributary to the Río de la Pasión, about two miles above Santa Teresa, Petén, Guatemala). Holotype MZUM 65357; paratypes MCZ 99352.

**pilsbryi** Goodrich, **Goniobasis:** 1927, Nautilus **41:** 58 [new name for *Melania showalterii* Lea 1861, non *Lithasia showalterii* Lea 1850 (both are *Goniobasis*) ].

**posti** 'Pilsbry and Johnson' Goodrich, **Goniobasis:** 1942, OPMZUM No. 456: 3 [nomen nudum].

**pygmaea** 'Smith' Goodrich, **Goniobasis:** 1936, MPMZUM No. 31: 49, 50, pl. 1, fig. 17 (Coosa River, Three Island Shoals, Talladega County, Alabama). Holotype Al.MNH [unnumbered]; paratypes MCZ 221164.

**smithi** Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 42, 43, pl. 2, figs. 43, 44, pl. 3, fig. 26 (Valley Creek, Toadvine, Jefferson County, Alabama. Drainage of the Black Warrior. Collected by Herbert H. Smith, June 27, 1913). Holotype MZUM 10183; paratypes MCZ 221161.

**sulcata** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 46–48, pl. 2, fig. 45, pl. 3, fig. 20 (Coosa River, Ten Island Shoals, St. Clair County, Alabama. Collected by Herbert H. Smith, October 1914). Holotype MZUM 10184; paratypes MCZ 221160.

**taintori** Goodrich and van der Schalie, **Xenodiscula:** 1937, MPMZUM No. 34: 26, 27, pl. 1, figs. 5–5b (Woodland just east of El Paso de los Caballos, Petén, Guatemala). Holotype MZUM 65177; paratypes MCZ 99371.

**timidus** Goodrich, **Goniobasis mutabilis:** 1942, OPMZUM No. 456: 5 [not figured] (Spring two miles northwest of Hawkinsville, Pulaski County, Georgia, in the basin of the Altamaha River. Collected by W. J. Clench and Peter Okkelberg 1929). Holotype MZUM 49210; paratypes MCZ 91775.

**torrefacta** 'Smith' Goodrich, **Anculosa:** 1922, MPMZUM No. 7: 27–29, pl. 2, figs. 50, 51; pl. 3, fig. 11 (Coosa River, Wedusca Shoals, Shelby County, Alabama. Herbert H. Smith, collector, August 1913). Holotype MZUM 10189; paratype MCZ 169988.

**vanhyningiana** Goodrich, **Goniobasis:** 1921, OPMZUM No. 91: 2–4, figs. 2, 2a, 3 (Creek below Seminole Springs, Lake County, Florida. T. Van Hyning, collector, May 11, 1918). Holotype MZUM 133336; paratype MCZ 93755.

**walkeri** 'Smith' Goodrich, **Gyrotoma:** 1924, MPMZUM No. 12: 25, pl. 2, figs. 30, 31, 32 (Coosa River, Cedar Island, Chilton County, Alabama). Holotype MZUM 27438; paratype MCZ 169992.

**walkeri** Goodrich, **Pleurocera:** 1928, OPMZUM No. 192: 14, 15, pl. 2, figs. 13, 15–17 (Sequatchie River, Jasper, Marion County, Tenn. Collected in August 1923). Holotype MZUM 37452; paratypes MCZ 51825.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 NOVEMBER 25, 1959 NUMBER 25

# A Comparison of *Cyclopecten nanus* Verrill and Bush and *Placopecten magellanicus* (Gmelin)

*By* ARTHUR S. MERRILL *

Recently during a study of shell characteristics of the young of the sea scallop *Placopecten magellanicus* (Gmelin) the author had occasion to check closely the existing literature in search of similar work on this species done by others. The only detailed description found of the young of this species was that of Jackson (1890) in his memoir *Phylogeny of the Pelecypoda.*

The description and figures offered by Jackson for young *P. magellanicus* of 2 to 6 mm. differed radically from similar sized specimens in our collection. The material examined for this study included a large series of specimens ranging in size from 0.3 mm. to 180 mm. in which it was easy to follow the progressive changes in shell development from the early post-larval to the adult form. Since we were sure of our identification it was desirable to procure the original specimens used by Jackson in order to determine their identity. According to Jackson his original specimens were entered in the Smithsonian Institution Catalogue as number 62307.

We were unable to locate lot number 62307 at the United States National Museum but later found part of the original lot in the Mollusk Department at the Museum of Comparative Zoology. Several labels informed us that the specimens had passed from the Robert T. Jackson collection to the collection of the Boston Society of Natural History and from there to the

*Bureau of Commercial Fisheries, Biological Laboratory, U.S. Fish and Wildlife Service, Woods Hole, Massachusetts.

M.C.Z. collection. Jackson's collection label reads "dredged by the *Albatross,* Station 2612, off Cape Hatteras in 52 fathoms. U.S. Nat. Mus. No. 62307. Gift of W. H. Dall."

As we suspected, they proved to be another species; indeed, at the time of Jackson's memoir the species had not yet been named.

Verrill (1897) described and figured the species in his study of the Pectinidae, giving it the name *Cyclopecten nanus.* A year later in another publication Verrill and Bush (1898) remarked that *C. nanus* resembled the young of *P. clintonius* [=*P. magellanicus*] more than any other native species but thought a detailed comparison unnecessary because of the marked differences in the two species. However, Verrill, an authority on this group, failed to recognize Jackson's error even though he had occasion to refer often to the memoir in his monograph of the Pectinidae.

There is evidence that past workers have had difficulty in identifying the young of *P. magellanicus.* This will be brought out subsequently in a discussion of the synonymy.

The purpose of this paper is twofold. First, to compare the young and adult shell of the sea scallop as this is essential for species identification. Second, to give more adequate descriptions and figures of the two species in question in order to make clear their major differences. Since specimens of *C. nanus* average about 5 mm. in height, young sea scallops of this size range will be used for comparison.

The value of Jackson's memoir is not lessened by the misidentification, the specific name being of little importance in this case. His careful descriptions and illustrations added materially to our understanding of the complexities found within the Aviculidae and their allies.

## Acknowledgments

We wish to express appreciation to Dr. Harald A. Rehder, Curator of Mollusks at the Smithsonian Institution, for the loan of *C. nanus,* including the type; to Mr. Richard Foster, associate at the Mollusk Department in the Museum of Comparative Zoology at Harvard University, for his aid in helping identify *C. nanus;* and to Dr. William J. Clench, Curator of Mollusks and Dr. Ruth D. Turner, Research Associate, for the

use of the facilities at the Mollusk Department of the M.C.Z. and for their critical reading and constructive criticism of this paper. The photographs were made by Mr. Frank White in the photographic department at the Biological Laboratories, Harvard University and the camera lucida drawings were made at the Fish and Wildlife laboratory in Woods Hole, Massachusetts with the help of Mr. Frank Bailey. To both of these gentlemen a debt of gratitude is acknowledged.

## Genus **Placopecten** *Verrill*

*Placopecten* Verrill 1897, Trans. Connecticut Acad., **10,** p. 69.

Type species, *Pecten clintonius* (Say) [=*Placopecten magellanicus* (Gmelin)], by original designation.

Shell large, rounded, compressed, and with sharp, rather thin edges. The valves meet ventrally and gape dorsally near the hinge-line. Valves subequal, the right flatter, smoother and paler. Radial and concentric sculpture present on both valves but more pronounced in the left (upper). Wings small in adult, nearly symmetrical and sculptured. Byssal notch small in adult; pectinidial teeth lacking in adult, present in young. Inner surface smooth except for a crystalline structure within the pallial line. Hinge-line with a single ligamental groove along the wings separated by a prominent internal resilium.

### **Placopecten magellanicus** (*Gmelin*)

Pl. 35, figs. 1, 2; Pl. 36, figs 1, 2; Pl. 38, fig. 2; Pl. 39, fig. 2

*Ostrea grandis* Solander 1776, Portland Cat., p. 50, p. 99 [nomen nudum].

*Ostrea magellanica* Gmelin 1791, Syst. Nat., Ed. 13, **6,** p. 3317.

*Pecten magellanicus* (Gmelin). Lamarck 1819, Anim. s. Vertèbres, **6,** p. 165. ed. Deshayes, **7,** p. 134, 1834.

*Pecten tenuicostatus* Mighels and Adams 1841, Proc. Boston Soc. Nat. Hist., **1,** p. 49.

*Pecten fuscus* Linsley 1845, American Journ. Sci., (1) **48,** p. 278 [nomen nudum]; "Linsley" Gould 1848, American Journ. Sci., (2) **6,** p. 235, fig. 6 [non Linsley].

*Pecten brunneus* Stimpson 1851, Shells of New England, p. 58, in errata. [New name for *P. fuscus* Gould, non Linsley.]

*Pecten tenuicostatus solidus* Verkrüzen 1881, Jahr. Deut. Malak. Gesell., **8,** p. 97.

*Pecten clintonius* "Say" Verrill 1884, Trans. Connecticut Acad. Sci., **6,** (1), p. 261. [non Say.]

*Pecten tenuicostatus aratus* Verrill 1884, *op. cit.,* p. 262.

*Pecten clintonius tenuicostatus* Verrill 1884, *op, cit.,* p. 262.

*Pecten pleuronectes* Jacobs 1885, Proc. Newport Nat. Hist. Soc., 1884–5, Doc. 3, p. 71. [nomen nudum.]

*Pecten* (*Pseudamusium*) *striatus* "Müller" Dall 1889, Bull. U.S. Nat. Mus., No. 37, p. 34. [non Müller.]

*Pecten* (*Pseudamusium*) *mülleri* "Dall" Verrill 1897, Trans. Connecticut Acad. Sci., **10**, p. 78. [non Dall.] [Corrected in addenda and errata, p. 96, *op. cit.* as follows: "Page 78, line 22. For *mulleri* read *striatus*."]

*Description.* Shell resting on right valve, large, 125 to 200 mm. in size (about 5 to 8 in.), subcircular, compressed (Pl. 35, figs. 1, 2). Valves subequal, slightly convex, the right somewhat flatter in form, smoother in sculpture and paler in color. Shell valves moderately thin, lips simple. The valves gaping near the dorsal hinge-line but meeting along the ventral margin with the left (upper) valve slightly overlapping. Radial sculpture apparent in both valves in the form of raised ribs which are more pronounced in the left valve and sometimes imbricated. Concentric sculpture consisting of inconspicuous lamellae or growth lines which at intervals are more prominent due to occasional marginal growth stoppage with subsequent thickening of the shell in that area. Color of left valve usually various shades of reddish brown, rarely shades of yellow or lavender; of right valve pale cream to white. Hinge-line simple, straight, edentulous, provided internally with a thin hinge ligament overlying a narrow groove which is separated by a triangular resilium centrally located between the beaks of the valves. Wings of the left valve small and nearly equal, of the right valve asymmetrical due to a small shallow sinuation at the base of the anterior wing which forms the byssal notch. The dorso-lateral slope above the notch ridged, pectinidial teeth obsolete in the adult. Inner surface lustrous and smooth unless roughened by secretions laid down in repairing damage caused by boring organisms. Adductor muscle and pallial scars quite distinct; in some specimens the suspensory gill muscle scars also clearly seen. Area within adductor muscle scar has a pearly luster; area outside the muscle scar, but within the boundary of the pallial line, is of a crystalline structure. Adductor muscle scar almost centrally located, just slightly nearer the dorsal and posterior border; the scar in the left valve much larger.

The young scallop at a size of about 5 mm. has some features

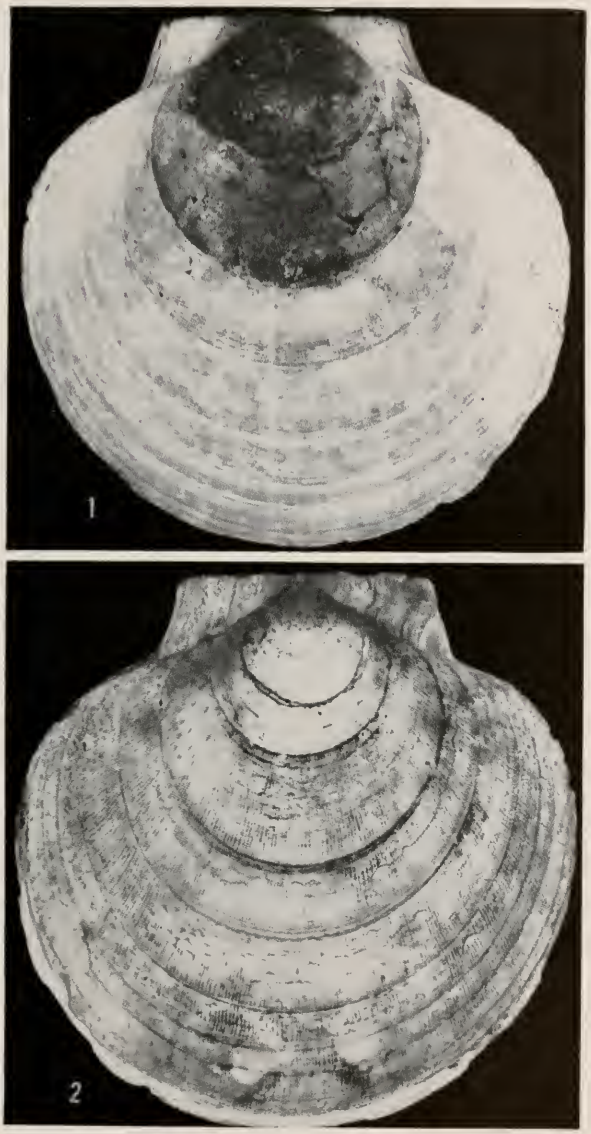



Plate 35

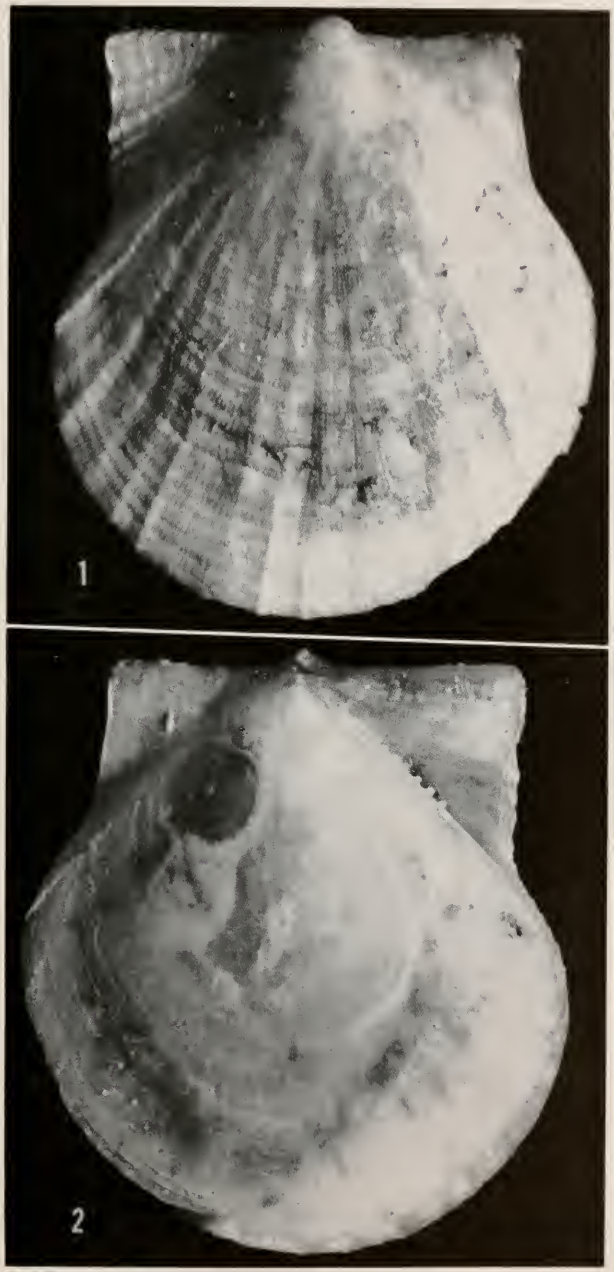
Fig. 1. *Placopecten magellanicus* (Gmelin). Exterior of left (upper) valve of a mature specimen. (0.5×)

Fig. 2. The same. Exterior of right valve of a mature specimen. (0.5×)

Plate 36

Fig. 1. *Placopecten magellanicus* (Gmelin). Exterior of left valve of a young specimen. (14×)

Fig. 2. The same. Exterior of right valve of a young specimen. (14×)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which are quite dissimilar from those of the adult (Pl. 36, figs. 1, 2). The valves are subcircular, higher than long, the right somewhat flatter. Both valves thin, the right especially so. Lips fragile, meeting at the ventral margin, the upper or left valve slightly overlapping. The gaping of the valves below the wing less noticeable than in the adult. Umbo of left valve prominent, overlapping the hinge-line. Sculpture of left valve more pronounced. Radial sculpture present in left valve as fine vermiculated lines within strong ribs; radial sculpture lacking in right valve at this size. Concentric sculpture strong in left valve, but very fine and delicate in right. Shape of hinge and resilium similar to the adult except that the hinge-line is proportionately wider. Wings large, fairly well developed, the anterior ones well sculptured. Wings nearly equal except that the anterior wing of the right valve is sharply keeled in forming the byssal notch and is separated from the body of the shell by a narrow groove. Pectinidial teeth present along a raised ridge, there being 15 in the 5.7 mm. scallop in figs. 1, 2, Pl. 36; teeth sometimes lacking or few in number. Inner surface smooth, the muscle scar distinct, the pallial line somewhat less so but with crystalline structure present within its confines. Muscle scar well off center, more so in the right valve (Pl. 38, fig. 2). Right valve much thinner and more translucent than left so that the muscle and pallial scars show through. A layer of prismatic structure can be defined in the thin right valve. The prisms are irregular in shape and are laid down in an uneven concentric pattern (Pl. 39, fig. 2). The prismatic layer cannot be seen in sizes much larger than 5 mm. and is more apparent in smaller specimens.

| height | length | location |
|---|---|---|
| 5.7 mm. | 5.0 mm. | Nantucket Shoals (N. Lat. 40°33′; W. Long. 69°28′) |
| 60.2 | 59.3 | East Georges Bank (N. Lat. 41°23′; W. Long. 66°25′) |
| 102.1 | 102.1 | East Georges Bank (N. Lat. 41°23′; W. Long. 66°25′) |
| 130.2 | 132.7 | East Georges Bank (N. Lat. 41°23′; W. Long. 66°25′) |
| 178.0 | 188.0 | Cape Cod Bay, near Brewster, Massachusetts |

*Types.* The location of the type specimen of *Ostrea magellanica* Gmelin is unknown. Gmelin referred to Chemnitz, Conch. Cab. **7,** Pl. 62, fig. 597 and this is here selected as the type figure. The locality, Straits of Magellan, given by Gmelin, was in error. The type locality is here designated as Georges Bank,

off Massachusetts where over 80% of the total commercial catch is obtained.

*Remarks. Placopecten magellanicus* (Gmelin) is a very common scallop as well as the largest found in the waters of the Northwest Atlantic. The largest specimen ever recorded, as indicated by the literature, measured 230 mm. in length, 208 mm. in height (Norton 1931).

This species is dredged commercially in depths ranging from 10 to 60 fathoms. Verrill and Smith (1874) recorded them from Passamaquoddy Bay and Bay of Fundy in depths as shallow as 1 fathom. Bush (1893) recorded fragments from depths of 7 to 813 fathoms but not living in depths less than 9 nor more than 146 fathoms. Our records extend the bathymetric range to 210 fathoms.

The adult is easily recognized for there are no closely related species in its range. However, the young differs sufficiently from the adult to be easily confused with several small species of *Pecten*. Comparison of the adult sea scallop and the young at a size of about 5 mm. shows the following major differences. The adult scallop shell is moderately thick and heavy, the young scallop thin and fragile. The shape changes with age: the height is greater than the length in small scallops, the shell is almost circular at about 100 mm., but in larger sizes has a correspondingly greater length than width. The adult shows more pronounced sculpture than the juvenile. The fine radial lines present in the upper valve of the young are lost in the adult, leaving only distinct ribs; conversely the fine radial lines in the lower valve of the adult have not yet formed in the very young. The wings in the young are much larger proportionally but less strongly sculptured. The anterior of the right valve is strongly keeled, and so more sharply defines the byssal notch. Pectinidial teeth are usually found in the young but are not formed after the shell reaches about 25 mm. The muscle scar of the adult is more centrally located than that of the young, especially on the right valve.

Much of the synonymy of *Placopecten magellanicus* can be attributed to the fact that the young of the sea scallop was not recognized as such. For example: Mighels, in Mighels and Adams (1841), described *Pecten tenuicostatus,* four specimens of which had been taken from the stomach of haddock in Casco

Bay, Maine. Later, in Mighels and Adams (1842) he stated, "this is unquestionably a very rare species. It does not appear to be very nearly allied to any of the other species found on our coast. Further research will be necessary to determine whether or not the specimens already found are mature." In 1843, Mighels cleared up the question of maturity when he wrote as follows: "*P. tenuicostatus*, Nob., I am now fully convinced is nothing more than the very young of *P. magellanicus*. Capt. W. found them at all ages at Nashe's Island, with which I have been enabled to form a series, from the size of a dime to that of 6 or 7 inches in width and from which it is plainly to be seen that they gradually and almost imperceptibly merge into each other." Thus Mighels neatly synonymizes his *P. tenuicostatus*. Unfortunately, too many later workers either failed to notice this work or refused to recognize earlier names and so the name *P. tenuicostatus* appears in many important papers.

Other synonyms appearing in the literature directly or indirectly as a result of the misidentification of young sea scallops include *Pecten fuscus* Linsley (1845), a nude name subsequently described and figured by Gould (1848), *Pecten brunneus* Stimpson (1851), *Pecten* (*Pseudamusium*) *striatus* Müller by Dall (1889), and *Pecten* (*Pseudamusium*) *mülleri* Verrill (1897).

There have been occasions over the years when controversies have arisen regarding the question of the name for the sea scallop (see Verrill 1897, Dall 1898). There is no need to review once again the pros and cons of name preference. However, during a review of practically all major references pertaining to the sea scallop, a record was kept of the specific name preferred by the various authors in their publications. The results are listed below.

| Specific name | Number of publications |
|---|---|
| *magellanicus* | 106 |
| *tenuicostatus* | 53 |
| *grandis* | 28 |
| *clintonius* | 17 |
| *fuscus* | 10 |
| *brunneus* | 2 |
| *striatus* | 1 |
| *mülleri* | 1 |
| Total publications examined | 218 |

It is clear that *P. magellanicus* is by far the most commonly accepted name.

The synonymy of *P. magellanicus* can be extended to include certain fossil synonyms by those who believe the modern and fossil form to be one and the same. Dall (1898) was able to separate the species on the basis of a careful study of a large series of recent and fossil forms. Since the separation of the fossil and recent species is so well documented, the fossil synonymy has not been included in this paper.

*Range.* From the northern shore of the Gulf of St. Lawrence to Cape Hatteras. Sea scallop beds of sufficient extent and density to support a fishery occur from Port au Port Bay, Newfoundland (N. Lat. 48°30′) to the Virginia Capes (N. Lat. 36°50′) (Posgay 1957).

*Specimens examined.* The specimens from the stations listed below are among those received at the Fish and Wildlife Laboratory at Woods Hole, Massachusetts for study and analysis. The lots from Canada were collected by biologists of the Fisheries Research Board of Canada and kindly placed at our disposal. All other lots were taken during 1958 and early 1959 by Bureau of Commercial Fisheries personnel as part of a bottom sampling program. A set of the material examined from each station has been deposited at the Museum of Comparative Zoology. The vessels *Sandy Point, Charlotte, Whaling City, Dartmouth,* and *Jacquelyn* referred to below are equipped to fish scallops and with the exception of the *Charlotte* have been under government charter at various times to aid in special research studies.

*Western Atlantic:* NEWFOUNDLAND: *Sandy Point*, W. of Current Island (N. Lat. 51°10′; W. Long. 56°50′) in 20 fathoms. NOVA SCOTIA: Buoy Ground, Bay of Fundy, Digby (N. Lat. 44°45′; W. Long. 65°47′). MAINE: W. of Dix Island (N. Lat. 44°01′; W. Long. 69°05′) in 40 fathoms. MASSACHUSETTS: *Charlotte,* Cape Cod Bay (N. Lat. 41°50′; W. Long. 70°24′) in 12 fathoms; *Whaling City,* northern edge of Georges Bank (N. Lat. 42°05′; W. Long. 66°50′) in 35 fathoms; *Albatross III,* 10 miles W. of Corsair Canyon, eastern Georges Bank (N. Lat. 41°23′; W. Long. 66°25′) in 51 fathoms; *Dartmouth,* east side

of Great South Channel, 30 miles E. of #10 buoy (N. Lat. 41°06′; W. Long. 68°45′) in 30 fathoms. RHODE ISLAND: *Jacquelyn,* 10 miles S.E. of Block Island (N. Lat. 41°05′; W. Long. 71°22′) in 30 fathoms; *Albatross III,* 5 miles N.W. of Atlantis Canyon (N. Lat. 40°00′; W. Long. 70°18′) in 210 fathoms. NEW JERSEY: *Albatross III,* 42 miles N.E. of Barnegat Light (N. Lat. 39°53′; W. Long. 73°15′) in 30 fathoms; *Albatross III,* 50 miles E. of Cape May (N. Lat. 38°31′; W. Long. 73°52′) in 32 fathoms. VIRGINIA: *Albatross III,* 60 miles E.S.E. of Cape Henry (N. Lat. 36°45′; W. Long. 74°44′) in 42 fathoms. NORTH CAROLINA: *Albatross III,* 45 miles N.E. of Cape Hatteras (N. Lat. 35°46′; W. Long. 74°51′) in 80 fathoms; *Albatross III,* 40 miles N.E. of Cape Hatteras (N. Lat. 35°48′; W. Long. 74°53′) in 45 fathoms (all USFWS).

## Genus **Cyclopecten** *Verrill*

*Cyclopecten* Verrill 1897, Trans. Connecticut Acad., **10,** p. 70.

Type species, *Pecten pustulosus* Verrill, by subsequent designation, Suter, Manual of New Zealand Mollusca, 1913, p. 880.

Shell thin, rounded, with simple margins and prominent wings. In the typical species the right valve has regularly spaced concentric lamellae which allow the shell to be highly flexible at the margins. The upper valve usually radially sculptured, with rows of arched lines which may be pustulated, cancellated or scaled. Umbos fairly prominent and projecting beyond the wide hinge-line. Wings well developed, angular, subequal. Byssal notch strong, pectinidial teeth absent or few.

### **Cyclopecten nanus** *Verrill and Bush*

Pl. 37, figs. 1, 2; Pl. 38, fig. 1; Pl. 39, fig. 1

*Pecten magellanicus* "Gmelin" Jackson 1890, Mem. Boston Soc. Nat. Hist., **4,** p. 347. [non Gmelin.] [Description and figures of young only.]

*Cyclopecten nanus* Verrill and Bush [in] Verrill 1897, Trans. Connecticut Acad. **10,** p. 85 [*C. parus* on p. 93, in error].

*Description.* Shell small, 5 to 7 mm. in size (about $\frac{1}{4}$ inch.), subcircular, the length somewhat greater than the height (Pl. 37, figs. 1, 2). Valve subequal, the left (upper) valve the more inflated. Valves thin, meeting at margins, lips simple, the right valve particularly fragile where it approaches the ventral mar-

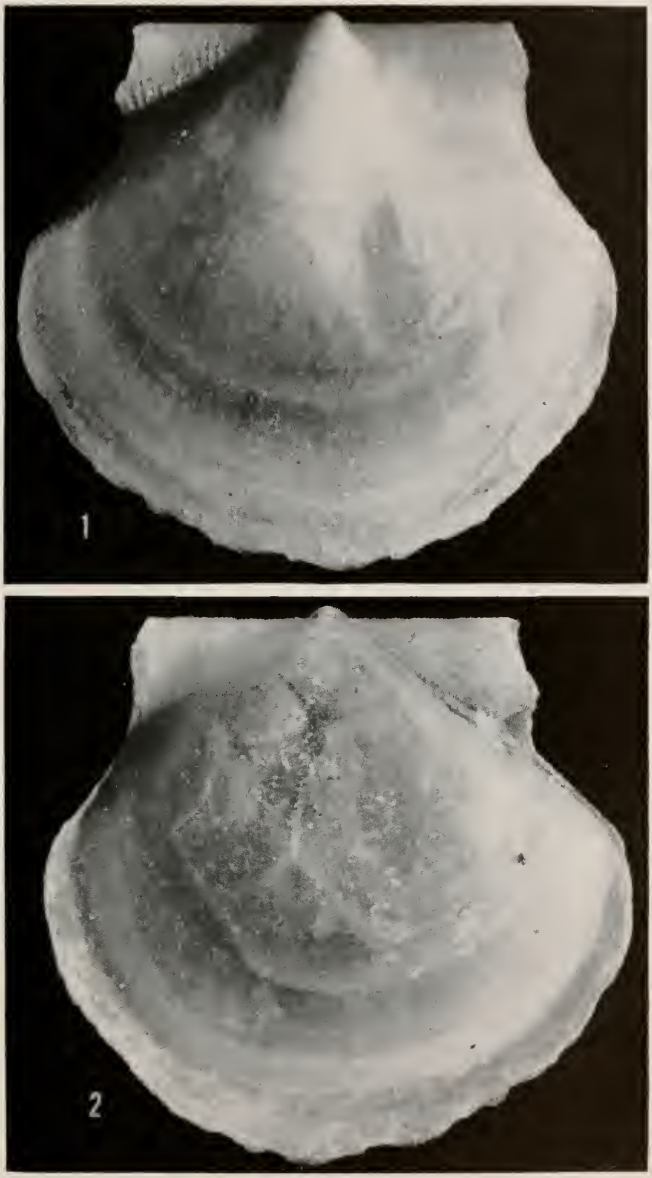


Plate 37

Fig. 1. *Cyclopecten nanus* Verrill and Bush. Exterior of left valve. Lectotype. (15×)

Fig. 2. The same. Exterior of right valve. Lectotype. (15×)

gin. Color grayish white, sometimes mottled. Sculpture fine and delicate, the upper valve covered with fine radiating lines which are lacking in the bottom valve. Umbonal area cancellated as a result of the sharp concentric ridges which are crossed by the radiating lines. Right valve surface nearly smooth except for very fine regularly spaced concentric lamellae. Hinge margin wide, straight. Internal ligament small, semi-rounded, centrally located well up in the umbo. Internal hinge-plate broad and crossed by numerous transverse lines. Wings strong, large, nearly equal in the left valve, unequal in right because of the formation of a byssal notch at the base of the anterior wing. Byssal notch acute and angular, its margin lacking pectinidial teeth. Anterior wings of both valves with strong, ribbed structure. Inner surface smooth, glossy, and translucent. Muscle scar distinct and visible through the shell. Pallial scar very indistinct or not visible. Edge semi-flattened on bottom valve. Thin layer of prismatic structure easily visible in right valve in specimens of all sizes. Prisms rectangular in shape and laid down in a regular concentric pattern (Pl. 39, fig. 1).

| height | length | location |
|---|---|---|
| 3.7 mm. | 4.1 mm. | Off Cape Hatteras, North Carolina |
| 4.7 | 4.9 | Off Cape Hatteras, North Carolina |
| 5.0 | 5.5 | Off Chesapeake Bay, Virginia |
| 6.2 | 6.8 | Off Chesapeake Bay, Virginia |

*Types.* The type specimens of *Cyclopecten nanus* Verrill and Bush are located in the United States National Museum. USNM No. 44624 is here designated as the lectotype. The type locality is here restricted to Station 2307 of the United States Fish Commission steamer *Albatross* from off Cape Hatteras, North Carolina from which the lectotype was collected.

*Remarks. Cyclopecten nanus* Verrill and Bush appears to be a rather common species judging by the material to be found in our leading museums. We were able to examine hundreds of specimens from various sources, of which most were single valves. The largest specimen measured 6.8 mm. in length, 6.2 mm. in height. Verrill (1897) and Verrill and Bush (1898) reported the size of one of the largest specimens as length 7.0 mm., height 6.0 mm. and also mentioned that although very small, the species seemed to be adult.

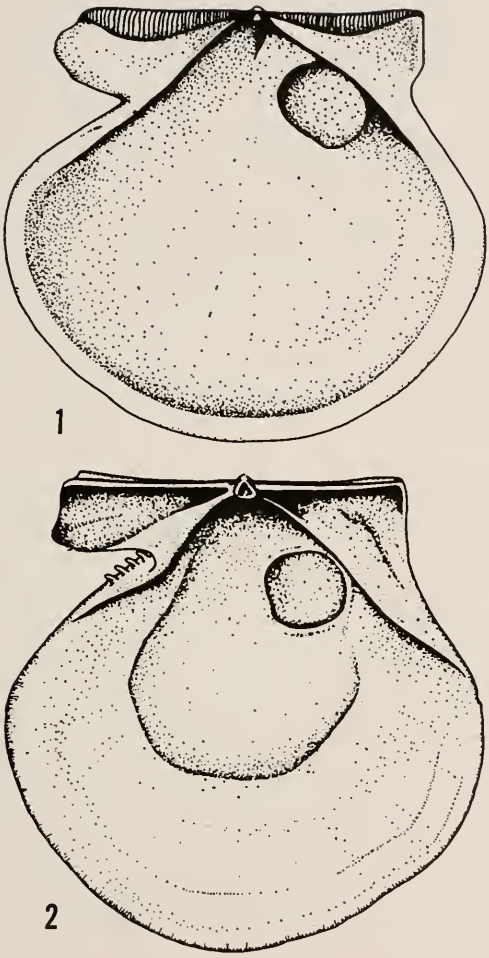


Plate 38

Fig. 1. *Cyclopecten nanus* Verrill and Bush. Right valve. Interior view of same specimen as shown in Pl. 37, figs. 1 and 2. (12×)

Fig. 2. *Placopecten magellanicus* (Gmelin). Right valve. Interior view of same young specimen as shown in Pl. 36, figs. 1 and 2. (12×)

*C. nanus* does not even superficially resemble *Placopecten magellanicus* (Gmelin) when comparing specimens of similar size. Although the shell of the young sea scallop is thin and somewhat delicate as compared to the adult it in turn appears thick and substantial when compared to the finer structure of *C. nanus*. In young *P. magellanicus* the height usually exceeds the length, this being the opposite in *C. nanus*. In both species the wings are prominent, the umbo in the upper valve pronounced and overlying a wide, straight hinge-line. The radial and concentric sculpture is better developed in the sea scallop; also the anterior wing of the lower valve is more sharply defined with the byssal notch more acute. In the sea scallop the margin below the notch is pectinated; this feature is lacking in *C. nanus*. In *P. magellanicus* the hinge-plate has a narrow, submarginal ligamental groove extending its length with the exterior margin of the valve recurved inward partly over the groove (Pl. 38, fig. 2). In *C. nanus* the hinge-plate is thin in the middle, relatively broad on each wing with numerous fine, transverse striations (Pl. 38, fig. 1). The internal cartilage in *C. nanus* is small and rounded, in *P. magellanicus* larger and more triangulate. The muscle scars are similarly positioned in both species and can be seen through the translucent valves. In *C. nanus* the pallial line scar is not apparent, but in the sea scallop it is not only clearly visible but a nacreous secretion of crystalline structure is deposited within its confines which further outlines this area. In *C. nanus* the margin of the under valve is very thin and fragile, somewhat flattened, and highly flexible. This allows the bottom valve to fit snugly against the upper (Pl. 37, fig. 2). The lip of the under valve of the sea scallop is flexible in the very young but has almost lost this characteristic at the size of 5 mm. A well-developed prismatic layer can be seen in both species. However, in *C. nanus* the prisms are rectangular in shape and laid down regularly in a concentric pattern whereas in *P. magellanicus* the prisms are irregularly shaped—usually 5- or 6-sided and arranged in a haphazard concentric fashion.

When the two species are placed side by side, the above differences are easily seen. However, if only one species is available the following major differences clearly define the species.

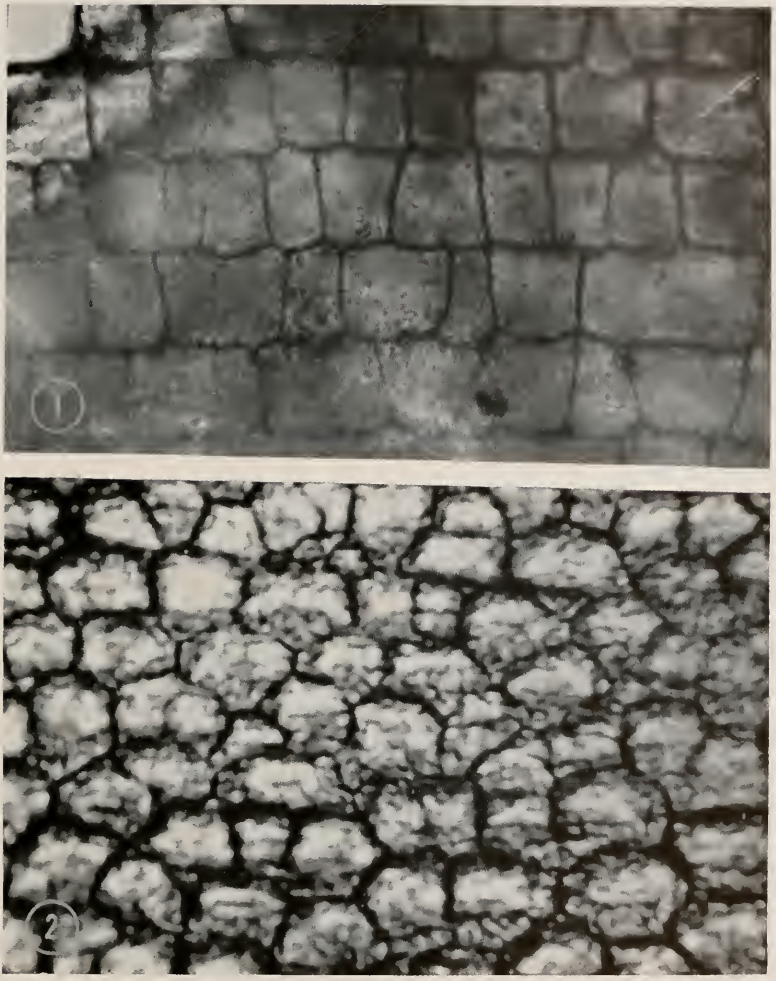


Plate 39

Fig. 1. *Cyclopecten nanus* Verrill and Bush. Surface of right valve near edge of shell to show prismatic structure. (about 700×)

Fig. 2. *Placopecten magellanicus* (Gmelin). Surface of right valve of young specimen near edge of shell to show prismatic structure. (about 600×)

1. In *C. nanus* the length is usually greater than the height. The opposite holds in *P. magellanicus.*

2. Pectinidial teeth are usually well-developed in small *P. magellanicus.* None is formed in *C. nanus.*

3. In *C. nanus* many transverse lines are apparent within the hinge-plate on the wings. In *P. magellanicus* there is but a single, thin, longitudinal groove running the length of the hinge-plate except where interrupted by the internal ligament.

4. In *P. magellanicus* the pallial scar is distinctly outlined by deposition of a partly crystallized substance within its confines. The pallial scar is either not visible or very poorly defined in *C. nanus.*

5. In the under valve of *C. nanus* the prismatic structure is easily visible. The prisms are rectangular and deposited in orderly concentric fashion. In *P. magellanicus* the shell is thicker and the prismatic layer is less easily seen. The prisms are irregular in shape and irregularly though concentrically deposited.

*Range.* From off Chesapeake Bay, Virginia to off Mayagüez, Puerto Rico. According to Verrill (1897, 1898), *Cyclopecten nanus* Verrill and Bush was taken in considerable numbers by the U.S. Fish Commission in 1884 off the Atlantic Coast at three stations opposite Chesapeake Bay, Virginia and Cape Hatteras, North Carolina in 43 to 132 fathoms. Dall (1927) recorded the species from off Fernandina, Florida in 294 fathoms. It has also been dredged from off Palm Beach, Florida and at points along the Florida Keys by private collectors. Dall (1901) and McLean (1951) recorded the species from deep water near Mayagüez, Puerto Rico. It is a fairly common species in the deeper waters.

*Specimens examined.* VIRGINIA: *Albatross,* station 2265, off Chesapeake Bay, 70 fathoms, temperature 57.9° C (USNM); *Albatross III,* station 5–4, cruise number 126, S.E. of Lightship *Winterquarter,* 130 fathoms (MCZ). NORTH CAROLINA: *Albatross,* station 2307, off Cape Hatteras, 42 fathoms; *Albatross,*

station 2310, off Cape Hatteras, 132 fathoms (all USNM); *Albatross,* station 2612, off Cape Hatteras, 52 fathoms (MCZ); off Cape Lookout in 52 fathoms (USNM). FLORIDA: off Palm Beach in 60 fathoms (T. L. McGinty); off Miami in 65 fathoms (USNM); S.E. of Carysfort Reef, Key Largo in 66–117 fathoms; S.E. of Sombrero Key, Key Vaca in 22–66 fathoms; S.E. of Looe Key, Big Pine Key in 25–50 fathoms (all MCZ); off Key West in 87 fathoms (USNM). CUBA: Bahía de Cochinos (N. Lat. 22°09′; W. Long. 81°11′) in 117–225 fathoms (MCZ).

ABBREVIATIONS

MCZ — Museum of Comparative Zoology, Harvard University
USNM — United States National Museum
USFWS — United States Fish and Wildlife Service

## REFERENCES

Bush, K. J. 1893, Report on the Mollusca Dredged by the "Blake" in 1880, including Descriptions of Several New Species. Bulletin Museum Comparative Zoology **23,** (6), p. 236.

Dall, W. H. 1898, Contributions to the Tertiary Fauna of Florida. Transactions of the Wagner Free Institute of Science of Philadelphia **3,** (4), pp. 725–727.

Dall, W. H. 1927, Small Shells from Dredgings off the Southeast Coast of the United States by the United States Fisheries Steamer "Albatross" in 1885 and 1886. Proceedings United States National Museum **70,** (18), p. 13.

Dall, W. H. and C. T. Simpson. 1901, The Mollusca of Porto Rico. United States Fish Commission Bulletin for 1900 **1,** p. 466.

Jackson, R. T. 1890, Phylogeny of the Pelecypoda, the Aviculidae and their allies. Memoirs Boston Society Natural History **4,** (8), pp. 347–348.

McLean, R. A. 1951, The Pelecypoda or Bivalve Mollusks of Porto Rico and the Virgin Islands. The New York Academy of Sciences **17,** (1), p. 31.

Mighels, J. W. 1843, Catalogue of the Marine Fluviatile and Terrestrial Shells of the South of Maine and Adjacent Ocean. Boston Journal Natural History **4,** pp. 308–345.

Mighels, J. W. and C. B. Adams. 1841, Descriptions of Twenty-five New Species of New England Shells. Proceedings Boston Society Natural History **1,** pp. 48–50.

Mighels, J. W. and C. B. Adams. 1842, Descriptions of Twenty-four Species of the Shells of New England. Boston Journal Natural History **4,** pp. 37–54.

Norton, A. H. 1931, Size of the Giant Scallop (*Pecten Grandis* Sol., *P. Magellanicus* Gmel.). The Nautilus **44,** (3), pp. 99–100.

Posgay, J. A. 1957, The Range of the Sea Scallop. The Nautilus **71,** (2), pp. 55–57.

Verrill, A. E. 1897, A Study of the Family Pectinidae, with a Revision of the Genera and Subgenera. Transactions Connecticut Academy **10,** pp. 41–95.

Verrill, A. E. and K. J. Bush. 1898, Revision of the Deep-water Mollusca of the Atlantic Coast of North America, with Descriptions of New Genera and Species. Part 1.—Bivalvia. Proceedings United States National Museum **20,** pp. 825–841.

Verrill, A. E. and S. I. Smith. 1873, Report upon the Invertebrate Animals of Vineyard Sound and Adjacent Waters, with an Account of the Physical Features of the Region. Report of the United States Fish Commission for 1871–72.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 MAY 3, 1961 NUMBER 26

# Land and Freshwater Mollusks of Caicos, Turks, Ragged Islands and Islands on the Cay Sal Bank, Bahamas

*By* WILLIAM J. CLENCH

The Caicos, Turks, Ragged Islands and the islands on the Cay Sal Bank are all miniature archipelagos. All of these island groups, other than the Ragged Islands, are on small banks with deep water between them and other island groups. The Ragged Islands are remnants of a once much larger island, an island as large as the present Great Bahama Bank. The Ragged Islands are located on the southeast portion of this large bank and only shallow water separates them from the Exuma chain of islands and Long Island to the north and northeast.

## HISTORICAL

### TURKS AND CAICOS ISLANDS

The first species to be described from these islands was *Hemitrochus gallopavonis* Pfeiffer in 1842. Pfeiffer received this species from the Paris Museum and gave, as its type locality, St. Croix. This was in error as this species does not occur outside of the Bahamas other than Mona Island where it probably has been introduced by commerce.

In 1858, Justus Hjalmarson, a Swedish naturalist, made a three months trip to Hispaniola. Upon his return to Europe he made a trip to Grand Turk Island. All of the new species he collected were described by Pfeiffer. About 1866, Daniel Sargent, then American Vice-consul at Matthew Town, Great

Plate 40

TURKS ISLANDS

1 Grand Turk
2 Long Cay
3 Salt Cay
4 Cotton Cay
5 East Cay
6 Sand Cay

CAICOS ISLANDS

1 West Caicos
2 Providenciales
3 Pine Cay
4 Water Cay
5 Stubbs Cay
6 Parrot Cay
7 North Caicos
8 Grand Caicos
9 East Caicos
10 South Caicos
11 Ambergris Cays

The solid line indicates the margin of the bank.


Plate 40

Inagua, paid a visit to the Turks Islands. The material he collected was sent to Thomas Bland of New York and later Bland sent a few specimens to the Academy of Natural Sciences in Philadelphia. All of Bland's material went to Amherst College when they purchased his collection about 1870. In 1929, the Amherst collection was obtained for the Museum of Comparative Zoology in exchange for fossil vertebrate material. A *Hemitrochus* and a few *Cerion* were described by Pilsbry from the specimens collected by Sargent. The few names introduced by Weinland from the Turks Islands were based probably on specimens collected by Sargent and sent to Weinland by T. Bland.

Little, if any, collecting was attempted in these islands from the time of Daniel Sargent until 1930. During the summer of 1930 Paul Bartsch of the United States National Museum made an extended trip to most of the southern Bahamas with a chartered vessel, the "Island Home," a small vessel of 33 tons. Bartsch and his staff of four assistants left Miami, Florida on June 9 for Key West and then proceeded to the islands on the Cay Sal Bank. From here they crossed the lower portion of the Great Bahama Bank to the Ragged Islands. Following south they investigated most of the cays in this group from the Jamaica Cays to Great Ragged Island. From these islands they sailed east to the Crooked Island group, West Plana Cay and to Mariguana Island. Still easterly, they sailed to the Caicos and Turks Islands and then southwest to Little and Great Inagua Islands. On August 10, 1930 they left for Guantánamo, Cuba.

In 1936, James C. Greenway of the Museum of Comparative Zoology and his brother Gilbert made a trip by seaplane to both Turks and Caicos Islands. Bird collecting was their main object but many land mollusks were also collected. C. B. Lewis and G. R. Proctor of the Institute of Jamaica made a short visit to the Turks and Caicos Islands in 1953. Many lots of land shells were collected and these were sent to me for determination.

## The Ragged Islands

The Ragged Islands form a curvilinear series of cays on the southeast corner of the Great Bahama Bank. Their eastern

RAGGED ISLANDS


1 Little Water Cay
2 Water Cay
3 Lanzadera Cay
4 Torzon Cay
5 Flamingo Cay
6 Man of War Cay
7 Jamaica Cay
8 Seal Cay
9 North Cay
10 South Cay
11 Frog Cay
12 Knife Cay
13 Nurse Cay
14 Bonavista Cay
15 Raccoon Cay
16 Pimlico Cay
17 Johnson Cay
18 Double Breasted Cay
19 Maycock Cay
20 Hog Cay
21 Great Ragged Island
22 Little Ragged Island
23 Margaret Cay

Plate 41

The solid line indicates the eastern margin of the Great Bahama Bank.

side faces the deep water of the Crooked Island Passage; the western side, the shoal waters of the Great Bahama Bank.

These cays probably composed a single island during the lower eustatic change of the oceanic level in the Pleistocene. They formed a continuous land mass with the present Long Island and Exuma chain. Higher oceanic level and much subsequent erosion has fragmented this area into a long series of cays with shallow water passes between them. Little Ragged Island, the southernmost of this chain of cays, is 70 miles from and nearly due north of Punta Lucrecia, Oriente, Cuba. A single isolated cay, Cay Santo Domingo, the southeasternmost part of the Great Bahama Bank, is only 30 miles north of Punta Lucrecia. To our knowledge, no one has ever collected on this small cay.

All of the cays and islets forming this chain have but scant vegetation. Some are bare rocks, while others support only a fringe of scrub growth. Nearly all of these cays are uninhabited at this time. Only Great Ragged Island is populated with any number of people and their number is given as 366 (1926) in "Maps of the Bahama Islands." This last is a small atlas of maps covering the Bahama Islands. Both Turks and Caicos Islands are omitted as they are politically under the administration of Jamaica. These maps were "Published by Authority," i.e., the British Government in London. An index and table of areas and population are included.

There is virtually little history concerning the collecting of mollusks on these islands. Alexander Agassiz collected specimens of *Cerion juliae,* which I described in 1936. These specimens were collected during Agassiz' reconnaissance of the Bahamas in 1893 while on the voyage of the "Wild Duck."

Dall (1905) in his list of the land mollusks from the Bahama Islands notes a *Cepolis* (*Plagioptycha*) *bryanti* Pfr. from Water Cay and *Cerion cinereum* Maynard from Ragged Island. The first was collected by Henry Bryant in 1866, during a collecting trip for birds in the Bahamas and was sent to Pfeiffer and subsequently described. The second, *Cerion cinereum,* was probably collected by A. Agassiz and was part of the material I described as *Cerion juliae.*

As stated before in this report, Paul Bartsch of the United States National Museum collected on most of these cays dur-

ing a collecting trip in 1930. Much later, in the summer of 1952, Mr. and Mrs. George Kline of Madison, New Jersey paid a visit to certain of these cays during an extended fishing and shell collecting trip. The land shells collected were sent to the Museum of Comparative Zoology.

## Cay Sal Bank

The first naturalist to visit these islands was Count Pourtalès, student, friend, and later an associate of Louis Agassiz. He visited Cay Sal Bank during 1866 to 1868 while he was in the United States Coast Survey and in charge of dredging operations of the U.S. Survey Steamer "Bibb." He collected a few specimens of *Plagioptycha maynardi* Pilsbry.

The first and only species to be described as new from these islands is *Cerion niteloides* Dall. Specimens of this species were collected by C. C. Nutting in 1893 on Water Cay. These specimens were collected during a voyage of the "Emily E. Johnson" under the auspices of the State University of Iowa with C. C. Nutting in charge of the expedition. This expedition did considerable marine collecting in the Bahamas, off the Florida Keys and off Cuba. Some land shell collecting was attempted at many stations. All of these collections made by Nutting and his party were deposited in the United States National Museum in 1935.

The only complete survey of the Cay Sal Islands was made by Paul Bartsch in 1930. More about this expedition is mentioned earlier in this report.

Since 1930 several people have visited these islands, mainly Cay Sal. It was here that Leo Burry collected a large series of *Livona pica* Linné which he introduced at Marathon, Florida. Harvey Bullis, Chief Naturalist on the "Oregon" of the United States Fish and Wildlife Service, collected a few *Cerion* for us, as did Leo Burry on Cay Sal.

## Acknowledgments

I am most grateful to H. A. Rehder of the United States National Museum for the loan of a large collection from all of these islands made by Paul Bartsch in 1930. I am also indebted for the gift or loan of material to J. C. Greenway of this mu-

seum, to George and Mary Kline of Madison, New Jersey, and to B. C. Lewis and G. R. Proctor of the Jamaica Institute.

I am indebted to my colleagues, Merrill E. Champion and Ruth D. Turner for reading the manuscript and aid in many other ways.

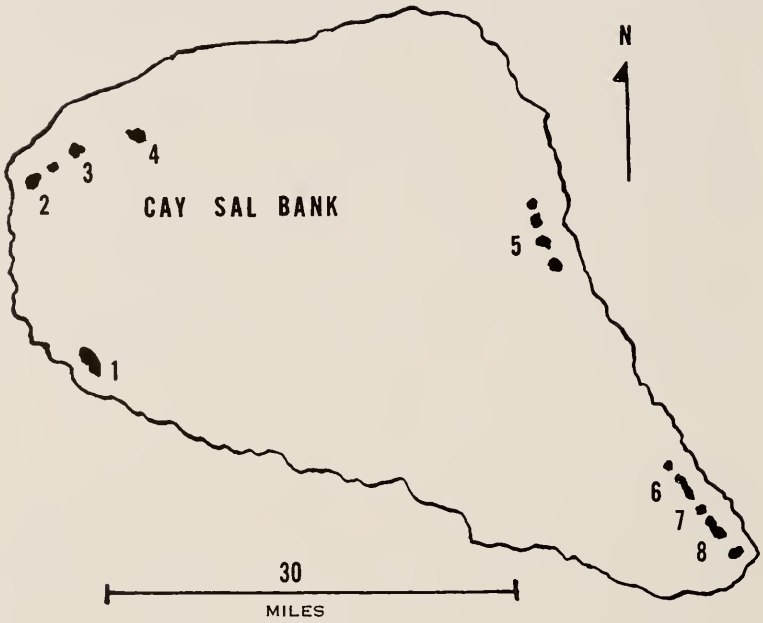


Plate 42

CAY SAL BANK

1 Cay Sal
2 Elbow Cay
3 Bay Cay
4 Water Cay
5 Damas Cay
6 Anguila Cay
7 Little Cotton Cay
8 Cotton Cay

Solid line indicates the margin of the bank.

### *Notes on the land and freshwater mollusks*

The 42 species and subspecies of land and freshwater mollusks occurring on these islands may be grouped as follows:[1]

| | Bahamas and beyond | Widely distributed in Bahamas | Limited in distribution in Bahamas | Endemic | Total |
|---|---|---|---|---|---|
| Caicos Ids. | 9 | 2 | 5 | 4+4[2] | 24 |
| Turks Ids. | 7 | 0 | 7 | 4+2 | 20 |
| Ragged Ids. | 4 | 2 | 3 | 5 | 14 |
| Cay Sal Bank | 1 | 0 | 1 | 1 | 3 |

The figures given above are more or less proportionate for other islands in the Bahamas. The endemic elements are a little higher in ratio to land area but there are far more islands in these groups and thus more chance for endemic elements to evolve. In general, as has been stated before, in these studies on the land and freshwater mollusks of the Bahama Islands, the relationships of the mollusks are on the basis of island proximity and not necessarily on any former land connection in the geologic history of these islands.

### *List of the species known from Turks, Caicos, Ragged and Islands on the Cay Sal Bank*

#### HELICINIDAE

#### **Alcadia (Analcadia) moussoniana** *Pfeiffer*

*Helicina moussoniana* Pfeiffer 1866, Malakozoologische Blätt. **13:** 89 (Turks Island, Bahamas).

*Remarks.* This species occurs also on Mariguana, Great and Little Inagua Islands.

*Specimens examined.* CAICOS ISLANDS: south coast, Kingston and Sugarloaf Cay, Providenciales; Pine Cay; Water Cay; Parrot Cay; Kew, North Caicos; south side of Salt Lagoon and Little Halfway Creek, Grand Caicos; West End, Jones Hill and

[1] Excluding the Ellobiidae.

[2] Four species are endemic to both Caicos and Turks Islands.

Cape Comete, East Caicos; South Caicos. TURKS ISLANDS: central Grand Turk; Cotton Cay.

### Lucidella (Poniella) tantilla *Pilsbry*

*Helicina tantilla* Pilsbry 1902, Nautilus **16:** 53 (Palm Beach, Florida).
*Lucidella (Poniella) tantilla* Pilsbry. Clench 1937, Proc. New England Zool. Club **16:** 77.

*Remarks.* This species is now known to have a wide distribution in the Bahama Islands as well as in Cuba and southern Florida. The records below are the first for the Caicos Islands.

*Specimens examined.* CAICOS ISLANDS: Southeast Point and Kingston, Providenciales; Water Cay; Stubbs Cay; Parrot Cay; Jones Hill, Cape Comete, East Caicos.

### Helicina rawsoni *Pfeiffer*

*Helicina rawsoni* Pfeiffer 1867, Malakozoologische Blätt. **14:** 165 (Inagua Island, Bahamas).

*Remarks.* A species of wide distribution in the Bahamas. It does not appear, however, to be at all abundant at any one station.

*Specimens examined.* CAICOS ISLANDS: Malcolm Bay, Providenciales; Pine Cay; Water Cay; Parrot Cay; near Bottle Creek and Kew, North Caicos; Grand Caicos. RAGGED ISLANDS: Bonavista Cay; Raccoon Cay; Hog Island; Great Ragged Island.

### Eutrochatella calida *Weinland*

*Helicina calida* Weinland 1862, Malakozoologische Blätt. **9:** 91 (Crooked Island, Bahamas).

*Remarks.* This species is very close to *E. candida* Pfeiffer, differing by being a little larger and by having numerous but rather faint, spiral, incised lines.
This species occurs also on Great Inagua and the Crooked Island Group.

*Specimens examined.* CAICOS ISLANDS: south coast, Blue Hill and Kingston, Providenciales; Salt Pond, Grand Caicos; Big Iguana Cay, Bells Cay, Jones Hill and West End, East Cai-

cos; Salt Pond and Cockburn Harbour, South Caicos. TURKS ISLANDS: Salt Cay.

### Eutrochatella candida *Pfeiffer*

*Helicina candida* Pfeiffer 1858, Malakozoologische Blätt, **5:** 145, pl. 2, figs. 13–16 (northern part of Turks Island).

*Specimens examined.* CAICOS ISLANDS: Sugarloaf Cay, Malcolm Bay and south coast, Providenciales; Little Halfway Creek, Grand Caicos; Cape Comete, East Caicos. TURKS ISLANDS: North Wells, Grand Turk; salt pan, Salt Cay; Cotton Cay.

### Eutrochatella greenwayi *Clench*

*Eutrochatella greenwayi* Clench 1933, Proc. New England Zool. Club **13:** 81, pl. 1, fig. 16 (Eleuthera Island, Bahamas).

*Remarks.* This species is also known from Long, Andros and Eleuthera Islands.

*Specimens examined.* RAGGED ISLANDS: Little Ragged Island.

## POMATIASIDAE

### Chondropoma (Chondropoma) hjalmarsoni *Pfeiffer*

*Chondropoma hjalmarsoni* Pfeiffer 1858, Malakozoologische Blätt. **5:** 143, pl. 2, figs. 9–12 (northern part of Grand Cay [Grand Turk], Turks Islands).

*Chondropoma* (*Chondropoma*) *hjalmarsoni salinum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 212, pl. 35, fig. 2 (Salt Cay, Turks Islands).

*Chondropoma* (*Chondropoma*) *hjalmarsoni gossypinum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 212, pl. 35, fig. 1 (Cotton Cay, Turks Islands),

*Chondropoma* (*Chondropoma*) *necopium* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 208, pl. 34, fig. 6 (Lightborn Creek, Grand Caicos, Caicos Islands).

*Chondropoma* (*Chondropoma*) *necopium auspicatum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 208, pl. 34, fig. 3 (Big Iguana Cay, Cape Comete. East Caicos, Caicos Islands).

*Chondropoma* (*Chondropoma*) *graniferum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 204, pl. 32, fig. 8 (southeast point of Providenciales, Caicos Islands).

*Chondropoma* (*Chondropoma*) *graniferum burnetense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 204, pl. 32, fig. 10 (west coast of West Caicos, Caicos Islands).

*Chondropoma* (*Chondropoma*) *graniferum saxicolum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 204, pl. 32, fig. 5 (Kingston, Providenciales, Caicos Islands).

*Chondropoma* (*Chondropoma*) *graniferum malcolmense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 205, pl. 32, fig. 7 (Malcolm Bay, northwest coast of Providenciales, Caicos Islands).

*Specimens examined.* CAICOS ISLANDS: west coast of West Caicos; Southeast Point, Kingston and Malcolm Bay, Providenciales; Lightborn Creek, Grand Caicos; Big Iguana Cay, Cape Comete, East Caicos; Six Hill Cay, South Caicos. TURKS ISLANDS: Grand Turk; Salt Cay; Cotton Cay.

### Chondropoma (Chondropoma) pannosum *Bartsch*

*Chondropoma* (*Chondropoma*) *pannosum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 206, pl. 34, fig. 2 (Great Ragged Island, Bahamas).

*Chondropoma* (*Chondropoma*) *pannosum panniculum* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 207, pl. 34, fig. 1 (Little Ragged Island, Bahamas).

*Specimens examined.* RAGGED ISLANDS: Great Ragged Island. Little Ragged Island.

### Chondropoma (Chondrops) biforme *Pfeiffer*

*Chondropoma biforme* Pfeiffer 1858, Malakozoologische Blätt. **5**: 143 (Turks Island).

*Chondropoma* (*Chondrops*) *biforme cottonense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 194, pl. 33, fig. 14 (Cotton Cay, between Grand Turk and Cay Sal, Turks Islands).

*Chondropoma* (*Chondrops*) *biforme arenarium* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 194, pl. 33, fig. 13 (Sand Cay, Turk Island Group).

*Chondropoma* (*Chondrops*) *biforme salarium* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 195, pl. 33, fig. 7 (Salt Cay, south of Grand Turk Island).

*Remarks.* This species occurs also on Great and Little Inagua Islands.

*Specimens examined.* TURKS ISLANDS: Central Grand Turk; Salt Cay; Sand Cay; Cotton Cay.

### Chondropoma (Chondrops) biforme cometense *Bartsch*

*Chondropoma* (*Chondrops*) *cometense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 189, pl. 33, fig. 1 (Stubb Guano Cave, Cape Comete, East Caicos).

*Chondropoma* (*Chondrops*) *biforme bellense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 194, pl. 33, fig. 15 (Bell Cay, off Cape Comete, East Caicos).

*Chondropoma* (*Chondrops*) *biforme gambelense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 194, pl. 33, fig. 12 (Gambel's Cay, Grand Caicos).

*Chondropoma* (*Chondrops*) *baconi* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 191, pl. 33, fig. 4 (west end of East Caicos).

*Chondropoma* (*Chondrops*) *baconi rathbuni* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 191, pl. 33, fig. 9 (salt pond, west side of South Caicos).

*Chondropoma* (*Chondrops*) *baconi caicosense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 192, pl. 33, fig. 3 (Salt Lagoon, Lightborn Creek, Grand Caicos).

*Specimens examined.* CAICOS ISLANDS: Salt Lagoon, Lightborn Creek and Gambel's Cay, Grand Caicos; Bell Cay, Cape Comete, and west end, East Caicos; Salt Pond and Cockburn Harbour, South Caicos.

## Chondropoma (Chondropomisca) saccharinetense *Bartsch*

*Chondropoma* (*Chondropromisca*) *saccharinetense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 202, pl. 32, fig. 3 (Sugarloaf Cay, Providenciales, Caicos Islands).

*Chondropoma* (*Chondropomisca*) *providencialense* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 201, pl. 32, fig. 2 (southeast point of Providenciales, Caicos Islands).

*Specimens examined.* CAICOS ISLANDS: Sugarloaf Cay and southeast point of Providenciales.

## Opisthosiphon (Opisthosiphon) reticulatus *Bartsch*

*Opisthosiphon* (*Opisthosiphon*) *reticulatus* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 227, pl. 36, fig. 7 (Buena Vista Cay [Bonavista], Ragged Island Group).

*Opisthosiphon* (*Opisthosiphon*) *reticulatus pannosus* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 227, pl. 36, fig. 5 (Great Ragged Island, Bahama Islands).

*Opisthosiphon* (*Opisthosiphon*) *phoenicopterus* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 237, pl. 37, fig. 10 (Flamingo Cay [Ragged Islands] Bahama Islands).

*Opisthosiphon* (*Opisthosiphon*) *phoenicopterus nutricius* Bartsch 1946, Bull. United States Nat. Mus. no. 192, p. 237, pl. 37, fig. 13 (Nurse Cay, Ragged Islands, Bahamas).

*Specimens examined.* RAGGED ISLANDS: Flamingo Cay; Knife Cay; Nurse Cay, Bonavista Cay; Great Ragged Island.

## ELLOBIIDAE

### **Melampus flavus** *Gmelin*

*Voluta flava* Gmelin 1791, Systema Naturae, ed. 13, **1:** 3436 (locality unknown).

*Specimens examined.* TURKS ISLANDS.

### **Tralia ovula** *Bruguière*

*Bulimus ovulus* Bruguière 1789, Encyclopédie Méthodique **1:** 139 (Guadeloupe [Lesser Antilles] ).

*Specimens examined.* TURKS ISLANDS.

### **Detracia bullaoides** *Montagu*

*Voluta bullaoides* Montagu 1808, Testacea Britannica, Supplement, p. 102, pl. 30, fig. 6 (locality unknown).

*Specimens examined.* EAST CAICOS. CAY SAL.

## PLANORBIDAE

### **Drepanotrema cimex** *Moricand*

*Planorbis cimex* Moricand 1839, Mem. Soc. Phys. Geneve **8:** 143, figs. 8–9 (Bahia, Brasil).

*Specimens examined.* TURKS ISLANDS: Cotton Cay.

### **Tropicorbis albicans** *Pfeiffer*

*Planorbis albicans* Pfeiffer 1839, Archiv für Naturgeschichte **5:** 354 (Cuba).

*Specimens examined.* TURKS ISLANDS: Cotton Cay.

## SUCCINEIDAE

### **Succinea barbadensis** *Guilding*

*Succinea barbadensis* Guilding 1828, Zoological Journal **3:** 532 (Barbados).

*Remarks.* A species of wide distribution in the West Indies.

*Specimens examined.* CAICOS ISLANDS: Salt Pond and Cockburn Town. TURKS ISLANDS: Central Grand Turk.

## PUPILLIDAE

### Pupoides nitidulus *Pfeiffer*

*Bulimus nitidulus* Pfeiffer 1839, Archiv für Naturgeschichte **5**: 352 (Cuba).

*Specimens examined.* CAICOS ISLANDS: Southeast Point, Kingston and Sugarloaf Cay, Providenciales; Stubbs Cay; Salt Lake, Grand Caicos; Jones Hill, Big Iguana Cay and Cape Comete, East Caicos; Salt Pond and Cockburn Town, South Caicos. TURKS ISLANDS: North Wells and Waterloo, Grand Turk; Salt Cay; Cotton Cay. RAGGED ISLANDS: Pimlico Cay; Raccoon Cay.

### Gastrocopta pellucida *Pfeiffer*

*Pupa pellucida* Pfeiffer 1841, Symbolae ad Historiam Heliceorum **1**: 46 (Cuba).
*Gastrocopta pellucida* Pfeiffer. Pilsbry 1916, Man. of Conch. (2) 75, pl. 15, figs. 1–3, 5.

*Remarks.* This species is widely distributed throughout most of the Bahamas as well as elsewhere in the West Indies.

*Specimens examined.* CAICOS ISLANDS: Malcolm Bay, Southeast Point and Sugarloaf Cay, Providenciales; Water Cay; Parrot Cay; Little Halfway Creek, Grand Caicos; Big Iguana Cay and Cape Comete, East Caicos; Salt Pond, South Caicos; Ambergris Cay. TURKS ISLANDS: Grand Turk; Salt Cay; Cotton Cay. RAGGED ISLANDS: Great Ragged Island.

### Gastrocopta rupicola marginalba *Pfeiffer*

*Pupa marginalba* Pfeiffer 1840, Archiv für Naturgeschichte **1**: 253 (Cuba).
*Gastrocopta rupicola marginalba* Pfeiffer. Pilsbry 1916, Man. of Conch. (2) **24**: 60, pl. 11, figs. 10–13; pl. 10, figs, 6, 8, 9.

*Remarks.* I believe this to be the first time this species has been recorded from the Bahama Islands. It has been recorded for Cuba, Jamaica and Bermuda.

*Specimens examined,* CAICOS ISLANDS: Water Cay; Big Iguana Cay and Cape Comete, East Caicos; Salt Pond, South Caicos. RAGGED ISLANDS: Great Ragged Island.

## STROBILOPSIDAE

### Strobilops hubbardi vendryesiana *Gloyne*

*Helix vendryesiana* Gloyne 1871, Jour. de Conchyliologie **19:** 333 (Bellevue, St. Andrew, Jamaica).

*Strobilops hubbardi vendryesiana* Gloyne. Pilsbry 1927, Man. of Conch. (2) **28:** 48, pl. 7, figs. 4–12; pl. 8, figs. 1–9.

*Remarks.* A rare species in the Bahamas where it is known also from Great Inagua. It occurs also in Cuba, Bermuda, Jamaica, Florida and Mexico.

*Specimens examined.* CAICOS ISLANDS: Rocky Hill, Grand Caicos; Cape Comete, East Caicos. TURKS ISLANDS: Cotton Cay.

## OLEACINIDAE

### Varicella gracillima floridana *Pilsbry*

*Varicella gracillima floridana* Pilsbry 1907, Man. of Conch. (2) **19:** 57 (Key West, Florida).

*Varicella gracillima bahamensis* Bartsch 1913, Proc. United States Nat. Mus. **46:** 109, pl. 3, fig. 13 (Mangrove Cay, Andros Island, Bahamas).

*Remarks.* A species of wide distribution in the Bahamas and southern Florida. It is closely related to *V. gracillima* Pfeiffer of central and western Cuba.

It is interesting to note the absence of *Oleacina solidula* Pfeiffer from all of the islands considered in this report. It is widely distributed elsewhere in the Bahamas.

*Specimens examined.* CAICOS ISLANDS: Kingston, Providenciales; Water Cay, Salt Lake and Salt Lagoon, Grand Caicos; Cape Comete, East Caicos; Salt Pond, South Caicos. TURKS ISLANDS: Salt Cay; Cotton Cay.

## POLYGYRIDAE

Two species in this family occur in the Bahamas and *Polygyra lingulata* Deshayes is to be found only in the Caicos Islands. Complete synonymies of both species are given as their histories have been somewhat complicated.

## Polygyra plana *Dunker*

*Helix microdonta* Deshayes 1839 [in] Férussac, Histoire Naturelle des Mollusques **1:** 6, pl. 72, fig. 13 (? Central America; ? Cuba); non *H. microdonta* Deshayes 1832.

*Helix plana* Dunker 1843, Abbildungen Neuer Conchylien **1:** 51, Helix, pl. 3, fig. 11 (? West Indies).

*Helix delitescens* 'Shuttleworth' Bland 1860, Ann. Lyceum Nat. Hist. New York **7:** 134; 140 (Bermuda).

*Helix cheilodon* Say 1860 [in] Bland, Ann. Lyceum Nat. Hist. New York **7:** 141 (Bermuda).

*Helix ringens* W. G. Lane 1891, The Spiral Snails of Bermuda, Hamilton, Bermuda, p, 2 [nomen nudum].[1]

*Polygyra plana bahamensis* Vanatta 1919, Nautilus **33:** 72 (Current Settlement, Bahamas).

*Types.* The types of *plana* Dunker are in the Königl. Zoologisches Museum, Berlin. The holotype of *Polygyra plana bahamensis* Vanatta is in the Acad. Nat. Sci. Philadelphia and paratypes are in the Museum of Comparative Zoology. The type locality is Bermuda.

*Remarks.* This species is closely related to *Polygyra lingulata* Desh. of Cuba and the Caicos Islands. It differs by having finer axial costae, a much heavier parietal tooth, and in having the spire more depressed.

It prefers damp situations and is usually to be found under plant debris and wood. In favorable places it can be exceedingly abundant. It occurs in Bermuda as well as the central and northern islands of the Bahama archipelago.

*Specimens examined.* Grand Bahama; Great Abaco; Mores Island; Bimini Islands; Andros; New Providence; Eleuthera; Cat Island and Crooked Island (all MCZ).

## Polygyra lingulata *Deshayes*

*Helix* (*Polygyra*) *insularum* Beck 1837, Index Molluscorum, p. 23 (Havana) [nomen nudum].

*Helix paludosa* Pfeiffer 1839, Archiv für Naturgeschichte **5:** 350 (Cuba); non DaCosta 1778.

[1] Vanatta (Proc. Acad. Nat. Sci. Philadelphia 1911, p. 664) lists the name of *H. ringens* as a synonym of *P. plana.* There is no description and the reference to two plates and a map are evidently to a single copy in the library at Hamilton, Bermuda, and are hand drawn.

*Helix lingulata* Deshayes [in] Férussac 1839, Histoire Naturelle des Mollusques **1**: 6, pl. 69 D, fig. 1 (Havana, Cuba).

*Helix bardenflehtii* 'Beck' Villa 1841, Dispositio Systematica Conchyliarum, Mediolani, p. 15 (Cuba) [nomen nudum].

*Helix ramonis* d'Orbigny 1841 [in] de la Sagra, Histoire de L'Ile de Cuba **1**: 142 (Cuba).

*Helix ramondi* d'Orbigny 1842 [in] de la Sagra, Histoire de L'Ile de Cuba, atlas, pl. 8, figs. 1–4.

*Helix bardenflecthi* 'Villa' Arango 1879, Contribucion a la Fauna Malacologica Cubana, Habana, p. 79 [error for *bardenflehtii* Villa].

*Types.* The present location of the types of both *paludosa* and *lingulata* is unknown to me. The type locality is Habana, Cuba.

*Remarks.* As stated under *P. plana* Dunker, these two species are closely related. A careful study of the Caicos Island specimens indicates that they are *lingulata* and not *plana.* It would appear that *plana* is an old species in the Bahamas, perhaps dating back to the early Pleistocene, while *lingulata* is a more recent arrlval from Cuba, possibly by commerce.

In addition to our Bahama records we list all of the Cuban localities from which we have seen specimens.

*Specimens examined.* CAICOS ISLANDS: Kew; between Bottle Creek and Whitby, North Caicos (both MCZ). CUBA: Catalina de Guane; Cabañas; Guanajay; Artemisa; Rangel; Sierra Anafe; Dos Hermanos, Viñales, all Pinar del Río Prov. (all MCZ); San Antonio de los Baños; Habana; Somorrostro; Jamaica; Cangrejera; Managua; all Habana Prov. (all MCZ); Matanzas; Cardenas; both Matanzas Prov. (both MCZ); Soledad, Cienfuegos; Caibarién; Ceiba de Ojo de Agua; all Las Villas Prov. (all MCZ); Laguna de Leche, San Juan Canal; Isla Turiguano; both Camagüey (both MCZ); Nueva Gerona; Bibijagua; both Isla de Pinos (both MCZ).

## SAGDIDAE

### **Hojeda inaguensis** *Weinland*

*Helix inaguensis* Weinland 1880, Jahr. Deut. Malak. Gesell. **7**: 369, pl. 12, fig. 22 (Little Inagua).

*Specimens examined.* CAICOS ISLANDS: Sugarloaf Cay and Kingston, Providenciales; Parrot Cay; Little Halfway Creek

and Salt Lake, Grand Caicos; Cape Comete, East Caicos; Salt Pond, South Caicos. TURKS ISLANDS: Cotton Cay. RAGGED ISLANDS: Bonavista Cay; Pimlico Cay, Raccoon Cay; Great Ragged Island; Little Ragged Island.

### Lacteoluna selenina *Gould*

*Helix selenina* Gould 1848, Proc. Boston Soc. Nat. Hist. **3:** 38 (Georgia and Florida).

*Remarks.* A species of wide distribution in the West Indies, Georgia and Florida.

*Specimens examined.* CAICOS ISLANDS. Kingston, Providenciales; Water Cay; Parrot Cay; Salt Lake, Grand Caicos; Cape Comete, East Caicos. RAGGED ISLANDS: Pimlico Cay, Raccoon Cay.

## UROCOPTIDAE

### Microceramus swifti *Bland*

*Microceramus swifti* Bland 1875, Ann. Lyceum Nat. Hist. New York **6:** 83 (Turks Island, also Inagua, Bahamas).

*Specimens examined.* CAICOS ISLANDS: Kingston, Sugarloaf Cay and Malcolm Bay, all Providenciales; between Bottle Creek and Whitby, North Caicos; Rocky Hill, Salt Pond, both Grand Caicos; Big Iguana Cay, Cape Comete, Jones Hill, all East Caicos; Salt Pond, South Caicos. TURKS ISLANDS: North Wells, Grand Turk; Salt Cay; Cotton Cay.

### Microceramus russelli *Clench*

*Microceramus russelli* Clench 1937, Proc. New England Zool. Club **16:** 63, pl. 3, figs. 4–5 (Blue Hole Hill, Orange Creek, Cat Island, Bahamas).

*Specimens examined.* RAGGED ISLANDS: Bonavista Cay; Great Ragged Island; Little Ragged Island.

### Gongylostoma bahamensis *Pfeiffer*

*Cylindrella bahamensis* Pfeiffer 1861, Malakozoologische Blätt. **7:** 214, pl. 2, figs. 8–11 (Nassau, Bahamas).

*Specimens examined.* CAICOS ISLANDS: Malcolm Bay and

Kingston, Providenciales; Kew, North Caicos; Grand Caicos; Jones Hill, Cape Comete, East Caicos.

## CERIONIDAE

### Cerion (Maynardia) periculosum *Clench*
Plate 43, fig. 2

*Cerion* (*Strophiops*) *periculosum* Clench 1934, Proc. Boston Soc. Nat. Hist. **40:** 215, pl. 2, fig. B (South Cay, Mira Por Vos Group, Bahamas).

*Remarks.* This may well be a recent introduction into the Ragged Islands. It is only known from four small cays in the Jamaica Cay group, which is about midway in the Ragged Islands chain of islands. This species is known elsewhere from South Cay, Mira Por Vos Cays, Crooked Island Group. It varies from smooth to costate.

*Specimens examined.* RAGGED ISLANDS: Cays "D," "E," "H" and "I," Jamaica Cays.[1]

### Cerion (Maynardia) juliae *Clench*
Plate 43, fig. 3

*Cerion* (*Strophiops*) *juliae* Clench 1936, Nautilus **48:** 112, pl. 8, fig. 6 (Great Ragged Cay, Ragged Island Group, Bahamas).

*Remarks. Cerion juliae* is distributed throughout the Ragged Islands.

*Specimens examined.* RAGGED ISLANDS: Little Water Cay; small cay just north of Flamingo Cay; Jamaica Cay; cays "C," "D," "E" and "G," Jamaica Cays; Seal Cay; South Seal Cay; Frog Cay; third cay northwest of Frog Cay; cay due west of Frog Cay; Knife Cay; Loggerhead Cay; Doublebreasted Cay; Margaret Cay; Salt Pond and Duncan Town, Great Ragged Island; Western Beach, Little Ragged Island.

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[1] Bartsch had given letter symbols to several small cays in the Jamaica Group. Unfortunately his map associated with his account of this area has been lost or at least mislaid.

### Cerion (Maynardia) blandi *Pilsbry and Vanatta*

*Cerion blandi* Pils. and Van. 1896, Proc. Acad. Nat. Sci. Philadelphia **48**: 334, pl. 11, fig. 7 (Turks Island, Bahamas).

*Specimens examined.* TURKS ISLANDS: southeast side of salt pans; west side of town; South Point; all Grand Turk; Salt Cay, near lighthouse.

### Cerion (Maynardia) klineae, new species
Plate 43, fig. 1

*Description.* Shell reaching 40 mm. in length, rather solid in structure, sculptured and umbilicated. Color a grayish white with occasional colonies showing a brownish mottling. Whorls 11 to 12½, nearly flat sided to slightly convex, the first 8 or 9 whorls forming the tapering apex. Suture well defined. Aperture subquadrate and colored a dark brown within. Lip simple and built forward to form a well defined parietal ridge. Parietal tooth large and white. Columellar tooth small and extending back for about a whorl. Umbilicus small and occasionally closed. Shell rarely smooth, generally sculptured with coarse and usually widely spaced ribs.

| length | width | |
|---|---|---|
| 40 mm. | 15 mm. | Holotype |
| 38 | 15.5 | Paratype |
| 35 | 14.5 | Paratype |
| 31.5 | 16.5 | Paratype |

*Types.* Holotype is in the Museum of Comparative Zoology, no. 189209, from Bonavista Cay, Ragged Islands, Bahamas, collected by George and Mary Kline on July 7, 1952. Paratypes from the same locality in the Museum of Comparative Zoology no. 189210, the Academy of Natural Sciences, Philadelphia, and the United States National Museum.

*Remarks.* The species is close in its relationship to *C. marmorosum* Maynard and Clapp from Well Cay, about 6 miles N.W. of Great Exuma Island. It differs by being more coarsely sculptured, having the parietal tooth white in color and not brownish as it is in *marmorosum,* and by being on the average a much larger shell.

In distribution, *C. klineae* is limited to the southern Ragged Islands from Nurse Cay south to Great Ragged Island.

This species is named for Mrs. George F. Kline of Madison, New Jersey.

*Specimens examined.* RAGGED ISLANDS: south and north ends of Nurse Cay; Bonavista Cay; 1st, 2nd and 3rd cays south of Bonavista Cay; Raccoon Cay; Hog Cay; Salt Cay, Great Ragged Island.

### Cerion (Strophiops) regina *Pilsbry and Vanatta*

*Cerion* (*Maynardia*) *regina* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 208; ibid. 1896, **48:** 330, pl. 11, figs. 23–24 (Turks Island, Bahamas).

*Cerion regina swiftii* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 208 (Turks Island [Bahamas] ).

*Cerion regina eucosmium* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 208 (no locality given [Turks Island, Bahamas] ).

*Cerion regina comes* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 208 (Turks Island [Bahamas] ).

*Cerion regina percostatum* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 208 (Turks Island [Bahamas] ).

*Cerion brevispira* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 209 (Turks Island [Bahamas] ).

*Cerion incanoides* Pils. and Van. 1895, Proc. Acad. Nat. Sci. Philadelphia **47:** 209 (Turks Island [Bahamas] ).

*Remarks.* Most, if not all, of the synonyms given above were based upon selected specimens from this small island. Unit populations may show a dominance of one or more characters, but these characters grade as well into other populations with different degrees of intensity.

*Specimens examined.* TURKS ISLANDS: Burial Ground; Waterloo; North Wells; North Creek; Bailey's Pond; south of lighthouse; all Grand Turk. Cotton Cay.

### Cerion (Strophiops) caicosense *Clench*

*Cerion* (*Strophiops*) *caicosense* Clench 1937, Proc. New England Zool. Club **16:** 23, pl. 1, fig. 4 (Cockburn Town, South Caicos Island, Caicos Islands, Bahamas).

*Specimens examined.* CAICOS ISLANDS: Kingston and Malcolm Bay, Providenciales; Stubbs Cay, North Caicos; Little

Halfway Creek, Salt Lake and Gambels Bay, Grand Caicos; Salt Pond, Cape Comete and Bell Cay, East Caicos; Eastport and Cockburn Town, South Caicos.

**Cerion (Strophiops) utowana abbotti,** new subspecies
Plate 43, fig. 4

*Description.* Shell reaching 32 mm. in length, solid in structure, umbilicated, smooth to moderately sculptured. Color a grayish white and mottled with patches of light brown. Whorls 10 to 10½, flat sided to slightly convex, the first seven whorls forming the tapering apex. Suture well defined. Aperture subcircular. Lip greatly thickened, broadly reflected and recurved. There is no parietal ridge, though the parietal area is thinly glazed. Parietal tooth centered and extending backwards for ½ whorl. Columellar tooth formed well within the aperture, low and extending backward for ½ whorl. Umbilicus rather small but deep. Sculpture consisting of fine growth lines with many specimens showing well formed axial ribs, particularly on the last whorl.

| length | width | |
|---|---|---|
| 32 mm. | 14 mm. | Holotype |
| 31.5 | 14.5 | Paratype |
| 29.5 | 15 | Paratype |
| 27.5 | 13.5 | Paratype |

*Types.* The holotype is in the United States National Museum, no. 610285, from Long Island, South Caicos, Caicos Islands, Bahamas. P. Bartsch collector, July 29, 1930. Paratypes from the same locality are in the United States National Museum, no. 392752 and in the Museum of Comparative Zoology, nos. 189854, 219190 and 219191.

*Remarks.* This subspecies is close in its relationship to the typical form, *C. utowana* Clench from East Plana Cay. *C. u. abbotti* is much smaller and has the last three whorls straight, while in *C. utowana* all whorls taper toward the apex. The presence of axial ribs in *abbotti* is a character possibly obtained through crossing with *C. caicosense* Clench, typical *utowana* being smooth, other than the fine axial growth lines. The series of specimens obtained from Dove Cay were dead and appeared to be very old specimens

Plate 43

Fig. 1. *Cerion klineae* Clench. Bonavista Cay, Ragged Islands, Bahamas. Holotype MCZ 189209 (about 1.9×).

Fig. 2. *Cerion periculosum* Clench. South Cay, Mira Por Vos Group, Crooked Islands, Bahamas. Holotype MCZ 103019 (about 1.9×).

Fig. 3. *Cerion juliae* Clench. Great Ragged Island, Ragged Islands, Bahamas. Holotype MCZ 10369 (about 1.9×).

Fig. 4. *Cerion utowana abbotti* Clench. Long Cay, South Caicos. Caicos Islands, Bahamas. Holotype USNM 610285 (2.5×).

Fig. 5. *Cerion lewisi* Clench. Pine Cay, Caicos Islands, Bahamas. Holotype USNM 610286 (2.5×).

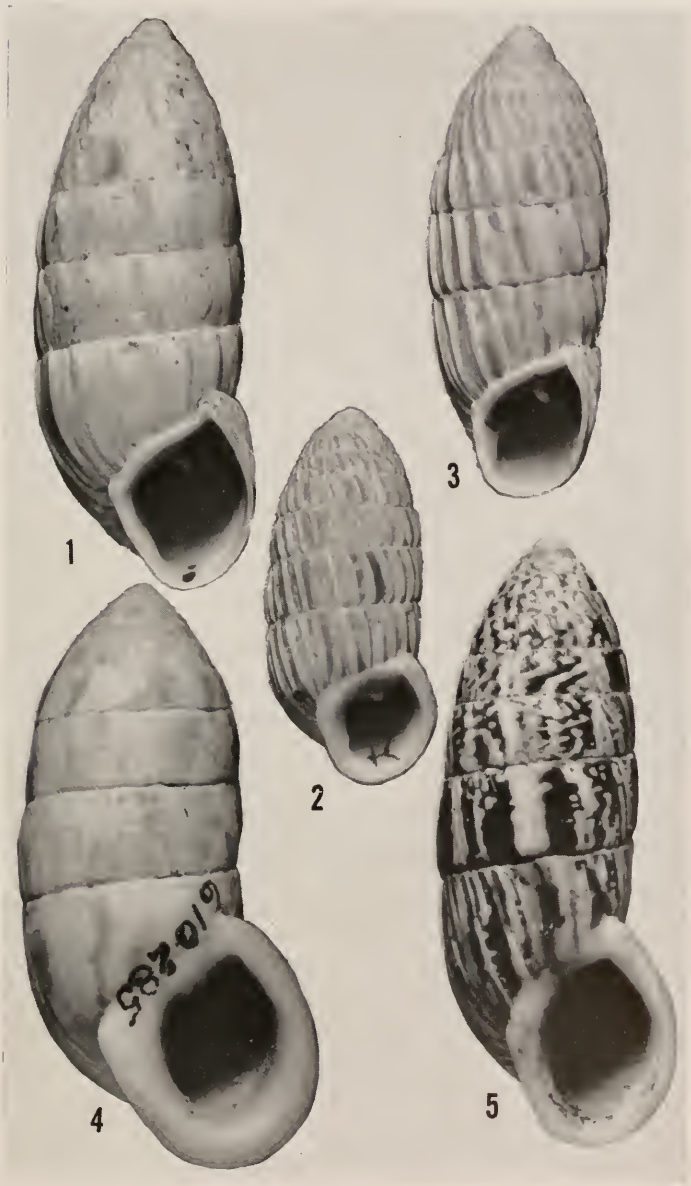


Plate 43

This species is named for R. T. Abbott of the Academy of Natural Sciences, Philadelphia.

*Specimens examined.* CAICOS ISLANDS: Dove Cay, East Caicos (dead); Long Cay, South Caicos. TURKS ISLANDS: Long Cay north of beacon; south end of Sand Cay.

### Cerion (Maynardia) niteloides *Dall*

*Cerion* (*Maynardia*) *niteloides* Dall 1896, Bull. Lab. Nat. Hist., State Univ. of Iowa **4:** 15, pl. 1, fig. 2 (Water Cay, Cay Sal Bank, Bahamas).

*Remarks.* This is a variable species. Many of the populations on the several islands composing the Cay Sal Group look quite different from one another. Other populations are variable within themselves and show all of the characters held by these others.

Typical *niteloides* from Water Cay, the type locality, are nearly smooth and mottled with brown. A colony from Elbow Cay only a few miles away is very strongly costate. All colonies of this species from Cay Sal are strongly costate. Colonies from Anguila Cay are all large and vary from nearly smooth to costate and from white to brown in coloration.

*Specimens examined.* CAY SAL BANK: Elbow Cay; Bay Cay; Water Cay; Middle Damas Cay; Anguila Cay; Little Cotton Cay; Cotton Cay.

### Cerion (Multostrophia) microdon *Pils. and Van.*

*Cerion microdon* Pilsbry and Vanatta 1896, Proc. Acad. Nat. Sci. Philadelphia **48:** 328, pl. 11, fig. 5 (Cuba).

*Remarks.* It appears that this Cuban species had become established on Cotton Cay, Cay Sal Bank and is now probably extinct. Bartsch mentions in his journal, "Here on cleared ground we found millions of a very small brown *Cerion.* These were all dead and that in spite of the fact that the ground had not been burned over."

I believe that this also holds true for the same species at Gibara, Cuba, the type locality of *C. microdon.* In localized areas this species occurs in considerable numbers but all are dead.

*Specimens examined.* CAY SAL BANK: Cotton Cay, middle east side.

**Cerion (Multostrophia) lewisi,** new species
Plate 43, fig. 5

*Description.* Shell cylindrical, rather elongate, rather light in structure, smooth to finely ribbed and rimately perforate. Color a shining reddish brown and irregularly marbled with white. Whorls 10½ to 11, slightly convex, the first 7 whorls forming the tapering apex. Suture well defined. Aperture ovate to subcircular. Lip slightly thickened, narrowly reflected and recurved. Parietal ridge moderately to well developed. Parietal tooth centered and extending backwards for ½ whorl. Columella tooth formed well within the aperture and extending backward for ½ whorl. Umbilicus small. Sculpture consisting of fine, irregular, axial ribs.

| length | width | |
|---|---|---|
| 32 mm. | 12.4 mm. | Holotype |
| 32 | 12.5 | Paratype |
| 30.5 | 11 | Paratype |
| 29.5 | 11 | Paratype |

*Types.* The holotype is in the United States National Museum, no. 610286, from Pine Cay, Caicos Islands, Bahama Islands. Paratypes from the same locality are in the Museum of Comparative Zoology, no. 221564, Paul Bartsch collector, July 24, 1930.

*Remarks. C. lewisi* is not closely related to any other species of *Cerion* in the Turks and Caicos Islands. It appears to be nearest to *C. lepidum* Clench and Aguayo of Punta de Mulas, Banes, Cuba, the same species which may be ancestral to the *C. rubicundum* Menke complex on Great Inagua. It is to be noted that this species is limited to the northwestern cays of the Caicos Islands.

It is quite possible that all species in the subgenus *Multostrophia* are derivatives of *C. lepidum* from Cuba. In general, the species in this subgenus are rather light in structure, most are finely ribbed or smooth, and in the Bahamas occur on the western sides of the large islands or the western cays of the small island groups.

*Specimens examined.* CAICOS ISLANDS: Pine Cay; Parrot Cay; Water Cay; Fort George Cay; Burnets Bay, West Caicos; Southeast Point, Providenciales; Sugarloaf Hill, Providenciales (all USNM).

## FRUTICICOLIDAE

### Hemitrochus gallopavonis *Pfeiffer*

*Helix gallopavonis* 'Valenciennes' Pfeiffer 1842, Symbolae ad Historiam **2:** 28 (St. Croix [Turks Island, Bahamas] ).

*Helix constantior* Weinland 1880, Jahrbucher der Deut. Malac. Gesell. **7:** 371, pl. 12, fig. 19 (Inagua, Rum Cay, Turks Island).

*Helix gallopavonis major* Weinland 1880, Jahrbucher der Deut. Malac. Gesell. **7:** 373 (Turks Island).

*Helix gallopavonis elatior* Weinland 1880, Jahrbucher der Deut. Malac. Gesell. **7:** 374 (Turks Island).

*Helix* (*Hemitrochus*) *calacaloides* Pilsbry 1889, Man. of Conch. (2) **5:** 28, pl. 31, figs. 24–26 (Ambergris Cay, Turks Island Group).

*Remarks.* I am convinced that all of the above names refer to but a single species. All of the numerous polychromatic species of land snails have had their share of synonyms, such as species in the genera *Liguus, Achatinella, Papuina* and many others. These color differences are far more apparent than real. Many colors are concerned with unit populations while others are individual variations within a single population.

All species in Bahama *Hemitrochus* are polychromatic and vary as well in shape and size. These factors are, of course, responsible for the many names occurring in this genus.

*Specimens examined.* CAICOS ISLANDS: west coast, West Caicos; Kingston, Southeast Point, Sapodilla Bay, all Providenciales; Pine Cay; Water Cay; Parrot Cay; between Bottle Creek and Whitby, Kew, both North Caicos; Salt Lake, Gambels Bay, Little Halfway Creek, all Grand Caicos; Cape Comete, Bill Cay, both East Caicos; Salt Pond, Cockburn Harbour, both South Caicos; Ambergris Cay. TURKS ISLANDS: North Wells, Waterloo, both Grand Turk; Salt Cay. RAGGED ISLANDS: Jamaica Cay; Nurse Cay; Bonavista Cay; Raccoon Cay; Margaret Cay; Johnstone Cay; Hog Cay; Great Ragged Island; Little Ragged Island.

### Plagioptycha bahamensis *Pfeiffer*

*Helix bahamensis* Pfeiffer 1845, Proc. Zoological Soc. London **13:** 66 (Bahamas).
*Helix* (*Plagioptycha*) *holostoma* Pilsbry 1889, Man. of Conch. (2) **5:** 18, pl. 19, figs. 34–35 (Turks Island, Bahamas).

*Remarks.* This species occurs only in the Caicos and Turks Island Groups. Published records of *Cepolis* (*Plagioptycha*) *disculus* Deshayes by Pfeiffer, Bland and Dall were probably based upon young specimens of *P. bahamensis* Pfr.

*Specimens examined.* CAICOS ISLANDS: Burnets Bay, West Caicos; Kingston and Malcolm Bay, Providenciales; Pine Cay; Water Cay; Kew and near Whitby, North Caicos; Gambels Bay, Salt Lagoon and Lightborn Creek, Grand Caicos; Cape Comete, East Caicos; Cockburn Town, South Caicos. TURKS ISLANDS: North Wells, Grand Turk.

### Plagioptycha sargenti *Bland*

*Helix sargenti* Bland 1875, Ann. Lyceum of Nat. Hist. New York **11:** 79 (Little Inagua, Bahama Islands).

*Remarks.* Mr. George R. Proctor collected a small series of dead shells of this species at Sapodilla Bay, Providenciales Island, Caicos Group. This is the only record other than those from the type locality, Little Inagua, for this species in the Bahama Islands. The present series of shells is very old and bleached and it is possible that this species is now extinct on Providenciales.

### Plagioptycha maynardi *Pilsbry*

*Helix* (*Plagioptycha*) *maynardi* Pilsbry 1891, Nautilus **5:** 83 (Bahamas).
*Helix* (*Hemitrochus*) *maynardi* Pilsbry 1893, Man. of Conch. (2) **8:** 241.

*Specimens examined.* CAY SAL BANK: Cotton Cay; Little Cotton Cay (USNM); Cay Sal Islands (MCZ, collected by Count Pourtalès).

### Plagioptycha salvatoris *Pfeiffer*

*Helix salvatoris* Pfeiffer 1867, Malakozoologische Blätt. **14:** 127 (Bight of San Salvador [Cat Island] Bahamas).

*Remarks.* A rare species in the Ragged Island Group. It occurs elsewhere in the Bahamas on Long, Eleuthera, Cat and Great Exuma Islands.

*Specimens examined.* RAGGED ISLANDS: south end of Raccoon Cay; Raccoon Cay opposite Pimlico Cay; Pimlico Cay.

### **Plagioptycha bryanti** *Pfeiffer*

*Helix bryani* Pfeiffer 1862, Malakozoologische Blätt. **9:** 204 (Water Key, Ragged Island [s] Bahama Islands); Pfeiffer 1863, Novitates Conchologicae **2:** 215, pl. 57, figs. 4–6 [error for *bryanti*].

*Helix bryanti* Pfeiffer 1868, Mono. Heliceorum Viventium **5:** 371.

*Remarks.* This species is closely related to *P. maynardi* Pilsbry from Andros Island and from the Cay Sal Islands. It was collected originally by Henry Bryant in 1866.

*Specimens examined.* RAGGED ISLANDS: Cay "L" Jamaica Cays.

## REFERENCES

Agassiz, A. 1880. Louis François de Pourtalès. American Jour. Science (3) **20:** 253–255.

Bartsch, P. 1931. Further Explorations for Mollusks in the West Indies. Explorations and Field Work of the Smithsonian Institution in 1930, pp. 91–102, Washington, D.C.

Bartsch, P. 1946. The Operculate Land Mollusks of the Family Annulariidae of the Island of Hispaniola and the Bahama Archipelago. Bull. United States National Museum **192:** 1–264, pls. 1–38.

Brown, J. J. 1886. Notes on the Mollusca of the Bahamas. The Conchologists Exchange [Nautilus] **1:** 12–13.

Clench, W. J. 1937. Shells of Mariguana Island, with a Review of the Bahama Helicinidae and Descriptions of New Bahama Species. Proc. New England Zool. Club **16:** 57–79, pl. 3.

Clench, W. J. 1938. Origin of the Land and Freshwater Mollusk Fauna of the Bahamas, with a List of the Species Occurring on Cat and Little San Salvador Islands. Bull. Museum of Comparative Zoology **80:** 481–541, pls. 1–3.

Clench, W. J. 1952. Land and Freshwater Mollusks of Eleuthera Island, Bahama Islands. Revista de la Sociedad Malacologica "Carlos de la Torre" **8:** 97–116, 1 map, 2 plates.

Clench, W. J. 1959. Land and Freshwater Mollusks of Great and Little Inagua, Bahama Islands. Bull. Mus. Comp. Zool. **121:** 29–54, 1 map, 1 plate.

Dall, W. H. Cruise of the Steam Yacht "Wild Duck" in the Bahamas, January to April, 1893, in Charge of Alexander Agassiz. Bull. Museum of Comparative Zoology **25:** 113–124, pl. 1.

Dall, W. H. 1905. Fossils of the Bahama Islands, with a list of the Non-Marine Mollusca. [in] The Bahama Islands. The Geographic Soc. of Baltimore, pp. 23–47.

Hjalmarson, J. and L. Pfeiffer. 1858. Beitrage zur Fauna von Westindien. Malakozoologische Blätt. **5:** 135–155, 2 plates.

Nutting, C. C. 1895. Narrative and Preliminary Report of the Bahama Expedition. Natural History Bull., State Univ. of Iowa **3:** 1–251.

Bahama Government. 1926. Maps of the Bahama Islands with Statistics and Index. 20 pages of maps, index of place names with areas and population data.

## Book Review

Traité de Zoologie, published under the direction of Pierre-P. Grassé, 1960, Vol. 5, fascicule 2, Embranchement des Mollusques, pp. 1625–2164, text figs. 1469–1830, and 2 colored plates. Masson et Cie Editeurs, Libraires de l'Académie de Médecine, 120 Boulevard Saint-Germain, Paris, France.

The second half of Volume 5, fascicule 2 of the Traité is devoted to the phylum Mollusca and contains the sections on "Généralités sur les Mollusques" by A. Portmann (pp. 1625–1654); "Classe des Aplacophores" by E. Fischer-Piette and A. Franc (pp. 1655–1700); "Classe des Polyplacophores" by E. Fischer-Piette and A. Franc (pp. 1701–1785); "Classe des Monoplacophores" by H. Lemche and K. G. Wingstrand (pp. 1787–1821); "Coquille des Mollusques: Structure et Formation" by P. Manigault (pp. 1823–1844); "Classe des Bivalves" by A. Franc (pp. 1845–2133) and "Bivalves Fossiles" by Colette Dechaseaux (pp. 2134–2164).

There has long been a need for a general account of the biology of the mollusca which would bring together the information contained in the multitude of papers which has appeared since the time of Pelseneer's great work in 1906. The excellent series of reports contained in the volume certainly goes a long way toward filling this need and when Volume 5, fascicule 3, which will deal with the gastropods, cephalopods and the embryology of the mollusks has been published, we will have a most useful account of this phylum. The present volume deals largely with the morphology of the classes covered, usually with a discussion of the functioning of the systems or organs involved. The sections on ecology, geographic distribution and evolution, though generally brief, are well documented giving the greatest possible amount of information in a few pages. The systematic sections give short but precise definitions of the taxa down to families with a listing of the important genera and their geographic range. All the accounts are beautifully illustrated with detailed and clearly labeled line-cuts or half-tones. Extensive bibliographies allow the reader to go further into the subjects covered if desired.

—Ruth D. Turner

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 FEBRUARY 26, 1962 NUMBER 27

# A Catalogue of the Viviparidae of North America with Notes on the Distribution of *Viviparus georgianus Lea*

*By* WILLIAM J. CLENCH

The following catalogue is a list of genera and species in the Family Viviparidae for North America. The single Cuban species included is the only Recent species in the Americas which exists outside of North America.

Prashad (1928) has given an excellent review of this family, both recent and fossil, from a world standpoint.

No Recent species in this family are known from South or Central America. Two fossil species have been described, *Paludina araucaria* Philippi from the Tertiary of Chili and *Viviparus wichmanni* Duello-Juardo from the Upper Cretaceous of the Rio Negro area of Argentina.

In North America, various species in this family occur in rivers which drain into the Atlantic from northeast Mexico to the St. Lawrence River. Two oriental species, *V. malleatus* Reeve and *V. japonicus* v. Mts., were introduced into California prior to 1900 and have now become widespread, particularly in the north central and northeastern states.

The fossil history of this family in North America is rather extensive and it extends back at least to the Lower Cretaceous and possibly the Upper Jurassic (see Henderson, J., 1935). With few exceptions the fossil record centers in the region of the Rocky Mountains and the western plains from New Mexico north into northern Alberta.

It is questionable whether *Lioplax andersoniana* Hannibal (1912, p. 196) from the Eocene of Tesla, California is a *Lioplax*. It appears to be a smooth form of *Goniobasis*.

This present study brings together in one report all of the names employed in this important family of North American freshwater mollusks. Other than the genus *Lioplax*, no attempt has been made to monograph any genus in this family in North America since that of Tryon in 1870.

ACKNOWLEDGMENTS

I am most grateful to several curators for their kindness in loaning material in this family for this study. They are: R.T. Abbott, Juan Parodiz, Alan Solem, Ernest Roscoe, Arthur Clarke, Byron Leonard, Henry van der Schalie and H.A. Rehder. I am indebted to my colleagues, Merrill Champion, Richard Johnson and Ruth Turner for reading the manuscript and also for aid in many other ways.

ABBREVIATIONS

| | |
|---|---|
| ANSP | Academy of Natural Sciences of Philadelphia |
| CM | Carnegie Museum |
| CNHM | Chicago Natural History Museum |
| MCZ | Museum of Comparative Zoology |
| NMC | National Museum of Canada |
| U of K | University of Kansas |
| U of M | University ot Michigan |
| USNM | United States National Museum |

## Viviparus georgianus *Lea*

Plate 44; Plate 45, figs. 1–2; Plate 46, fig. 3

*Lymnaea vivipara* 'Linne' Say 1817, Nicholson's Encyclopedia **2:** [seventeenth page], pl. 2, fig. 5 (no locality given); non Linné 1758.

*Paludina georgiana* Lea 1834, Trans. American Philosophical Soc. (n.s.) **5:** 116, pl. 19, fig. 85 (Hopeton, near Darien, Georgia).*

*Paludina linearis* 'Valenciennes' Küster 1852, Conchylien-Cabinet (2) **1,** pt. 21, p. 19, pl. 4, fig. 4 (Simpson Creek Lake, East Florida).

*Vivipara haldemanniana* 'Shuttleworth' Frauenfeld 1862, Verh. K. K. Zool. Bot. Gesell. Wien, p. 1162 (Black Creek [Clay Co.] East Florida).

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* Hopeton or Hopeton's Landing was about 10 to 15 miles up the Altamaha River from Darien, Georgia. This was a plantation landing and, like many others, was used when the larger rivers were the main source of transportation. Most place names of this type have long since disappeared.

*Vivipara contectoides* W.G. Binney 1865, Smithsonian Misc. Collections, **10**: 144, pt. 3, p. 23, text figures 41–44 (Florida).

*Vivipara georgiana fasciata* Tryon 1870, Monograph of the Freshwater Univalve Mollusca of the United States, Philadelphia, p. 17 (no locality given [Florida] ).

*Vivipara georgiana altior* Pilsbry 1862, Nautilus **5**:142 (aboriginal shell heap, left bank Hitchen's Creek, near entrance of St. Johns River into Lake George, Florida).

*Vivipara georgiana limnothuma* Pilsbry 1895, Nautilus **8**:116 (aboriginal shell-field, Hitchen's Creek [near entrance to St. Johns River into Lake George] and 2 fathoms, Lake George [Florida] ).

*Viviparus walkeri* Pilsbry and Johnson 1912, Nautilus **26**:48, pl. 3, figs. 6–7 (Juniper Creek, Lake Co., Florida).

*Viviparus contectoides impolitus* Pilsbry 1916, Nautilus **30**:41 (in marsh, Paint Rock River, Jackson Co., Alabama).

*Viviparus contectoides compactus* Pilsbry 1916, Nautilus **30**:42 (Dougherty, Georgia); non *compactus* Kobelt 1906.

*Viviparus contectoides limi* Pilsbry 1918, Nautilus **32**:71 [new name for *V. compactus* Pilsbry 1916; non Kobelt 1906].

*Viviparus contectoides goodrichi* Archer 1933, Nautilus **47**:19, pl. 3, figs. 1–3 (spring-fed stream, tributary of the Chipola River, 5 miles NE of Marianna, Jackson Co., Florida).

*Description.* Shell subglobose in outline and varying in size, large specimens reaching about 44 mm. (about $1\frac{3}{4}$ inches) in length, imperforate or with a narrow slitlike umbilicus. Usually rather thin in structure, but strong and smooth. Color yellowish or olivaceous green to dark brownish green, banded or uniform in color. Banded specimens usually have four dark reddish-brown bands about evenly spaced. Whorls 4 to 5, strongly convex and generally with a slight shoulder. Spire somewhat extended and produced at an angle of from 50° to 65°. Aperture ovate to subcircular. Outer lip thin, parietal lip consisting of a thickened glaze. Columella narrow and arched. Suture deeply indented. Sculpture consisting only of fine growth lines. Young specimens with a few spiral threads which eventually disappear as they grow older. Operculum corneous, thin, with concentric growth lines and a submarginal nucleus.

| length | width | |
|---|---|---|
| 44 mm. | 35 mm. | Holotype, *V. goodrichi* Archer |
| 26 | 19.5 | Holotype, *V. georgianus* Lea |
| 26 | 21 | Lectotype, *V. limi* Pilsbry |
| 33 | 21.5 | Lectotype, *V. contectoides* Binney |

*Types.* The holotype of *V. georgianus* Lea is in the United States National Museum, No. 106252. Type specimens of Tryon and Pilsbry are in the Academy of Natural Sciences, Philadelphia. The holotype of *V. contectoides goodrichi* Archer is in the Museum of Comparative Zoology. I do not know where the type specimens of *Paludina linearis* Küster and *Vivipara haldemanniana* Frauenfeld are located.

The lectotype of *V. contectoides* Binney here selected is in the Museum of Comparative Zoology, No. 74393, from Florida. This is the specimen which was figured (page 23, no. 41) in Binney's Monograph. His substitute figure on p. 113 (fig. 224) was to show the four colored bands. His fig. 41 only shows three bands though the specimen does have four bands.

The statement that the European *V. viviparus* Linné has three bands and the North American *V. georgianus* Lea always has four bands is not true. Three-banded specimens of *V. georgianus* are rare but do exist in certain populations such as in the large series we obtained in the Richelieu River, 2 miles south of Iberville, Quebec. It is the lowermost band which may be absent. In other populations this band is frequently weak and even interrupted. Rarely all four bands are lacking.

*Remarks.* As far as can now be determined, the original distributional pattern of *V. georgianus* was from north central Florida, Georgia, Alabama and north, mainly in the Mississippi River system, to Illinois and northwest Indiana. It has invaded Ohio, Michigan, Wisconsin, Virginia, Pennsylvania, New York, New Jersey, New England and Quebec since 1867, the earliest dated record which we have been able to locate. In 1860 James Lewis* of Mohawk, New York published a

* James Lewis was a dentist who had resided in Mohawk, Herkimer Co., New York. He was an avid amateur conchologist and did much collecting in the area of central New York. His first collection was destroyed by fire but with the help of his friends and his own energy he shortly brought together an even larger collection. This collection was eventually bought by Bryant Walker of Detroit, Michigan and later went to the Museum of Zoology, University of Michigan. His very large duplicate series was purchased by A.E. Gray of Watertown, Mass. and later was given to the Museum of Comparative Zoology. Most, if not all, of the material Lewis obtained from eastern Tennessee was collected by Annie Law of Maryville, Tennessee. Somewhere in his letters or writings he stated that for every tooth he pulled at $1.00 each he could pay Annie a dollar a day to collect shells for him.

Miss Annie Law was the daughter of a school teacher in Maryville, Tennes-

catalogue of the mollusks of that area. This *Viviparus* was not mentioned. In a copy of this catalogue which we have is a hand-written note by Lewis, stating "Deposited over 200 *Vivipara contectoides* (W.G.B.) in the Canal and River, Nov. 1867." Unfortunately, he made no mention from where he obtained the original 200 specimens of this species.

DeKay in 1843 in his Natural History of New York, lists *Paludina georgiana* Lea as "extra limital" which would indicate that no specimens of *V. georgianus* had been seen by him from anywhere within the state limits of New York at that time.

The first record for New England was published by C.W. Johnson (1916, p. 72). Specimens were collected in the pond in the Boston Public Gardens. A little later several colonies were obtained in areas near Boston and later from localities elsewhere in New England.

No specimens of any species of *Viviparus* were recorded by Winslow (1926, p. 18) for Michigan. It is possible that the few records which we now have from Michigan were introduced since 1926. It is important to realize that the mollusks from Michigan have been and still are better known than for any other state in the middle west. The state has had a long history of active collectors since 1839 when Dr. Abram Sagar published the first list of 76 species of Michigan mollusca.

Sterki, in his list of Ohio mollusca (1907) makes no mention of this species in Ohio. In the addition to this list (1914) he states: "A specimen is said to have been found in Sandusky Bay." We have not seen this specimen.

We have seen one large lot of *V. georgianus* from Cincinnati and two small lots from Covington, Kentucky which is opposite and across the Ohio River from Cincinnati. There are no specimens of this species in J.G. Anthony's collection, which is now in our possession. Anthony lived for many years in Cincinnati and should have found this species had it been there in 1850.

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see. During the War between the States she was a dispatch rider for the South and thus became familiar with much of the mountainous country of southeastern Tennessee. After the war she collected quantities of land and freshwater mollusks which were sold or exchanged. Much of this material went to James Lewis and to John G. Anthony of Cincinnati who later became the first custodian of Mollusks at the Museum of Comparative Zoology.

A single specimen was recorded as *V. contectoides* by C.H. Chadwick (1906) from the Kinnikinnick River in Milwaukee Co., Wisconsin and Mr. Ernest Roscoe of the Chicago Natural History Museum has sent us specimens from Sunset Lake, Waupaca Co.

The most recent published record is that of E.L. Bousfield (1955) from several localities in the St. Lawrence River, all in Quebec Province. These he recorded as *Viviparus viviparus* Linné, believing the specimens to have been introduced from Europe. We have seen these specimens and they are *V. georgianus* Lea. We have also collected a large series of *V. georgianus* from the Richelieu River near Iberville, Quebec.

Probably most of the present records from Michigan, Ohio and east of these states have been chance introductions from the contents of discarded aquaria. *Viviparus* make excellent aquarium snails as they feed on the algae and thus aid in keeping the aquarium clean. This may also explain the spotted distribution of the oriental snails, *Viviparus malleatus* Reeve and *V. japonicus* v. Martens throughout many of the northeastern states.

*Specimens examined.*

GREAT LAKES–ST. LAWRENCE RIVER SYSTEM

LAKE MICHIGAN DRAINAGE. *Wisconsin:* Sunset Lake, Waupaca, Waupaca Co. (CNHM). *Illinois:* Chicago River, Chicago; Wolf Lake; Calumet River, Chicago; Washington Park, Chicago, all Cooke Co. (all MCZ). Owosso, Shiawassee Co. (U of M). LAKE ERIE DRAINAGE. *New York:* Lake Erie, Dunkirk, Chautauqua Co. (MCZ); Oatka Creek, LeRoy, Genesee Co. (U of M); Lime Lake, Cattaraugus Co. (MCZ). LAKE ONTARIO DRAINAGE. *Ontario:* Green Bay, Hinchinbrook Twp. Frontenac Co. (NMC). *New York:* Silver Lake, 2 miles S of Perry, Wyoming Co.; Cazenovia Lake, Cazenovia, Madison Co. (all MCZ); Lower South Bay, Lake Oneida, Madison Co. (CM). LAKE CHAMPLAIN DRAINAGE. *Vermont:* Lake Bomoseen, Bomoseen, Rutland Co.; *Quebec:* Richelieu River, 2 miles S of Iberville (MCZ). ST. LAWRENCE RIVER DRAINAGE. *New York:* Claton, Jefferson Co. (MCZ). *Quebec:* Isle d'Orleans, St. Michel; St. Vallier (both MCZ); Montmagny West (NMC).

MYSTIC, CHARLES AND NEPONSET RIVER SYSTEMS

*Massachusetts:* Fresh Pond and Little Fresh Pond, Middlesex Co. (MCZ); Muddy River, Fenway, Boston; Pond, Public Gardens, Boston; Sargent's Pond, Brookline, all Suffolk Co.; Houghton's Pond, Milton, Norfolk Co. (all MCZ).

CONNECTICUT RIVER SYSTEM

*Massachusetts:* Forest Park, Springfield, Hampden Co. (S.L.H. Fuller).

HOUSATONIC RIVER SYSTEM

*Connecticut:* Lake Waramaug, Washington, Litchfield Co. (MCZ).

HUDSON RIVER SYSTEM

*New York:* Erie Canal, Frankfort and Mohawk, both Herkimer Co.; Amsterdam, Montgomery Co.; Glen Lake, Glen's Falls, Warren Co.; Lake Central Park; Prospect Park, Brooklyn, both New York Co. (all MCZ).

DELAWARE RIVER SYSTEM

*New Jersey:* Riverton, Burlington Co. (MCZ). *Pennsylvania:* Fairmont Park, Philadelphia (ANSP).

POTOMAC RIVER SYSTEM

*Maryland:* Potomac River, Great Falls and Chesapeake and Ohio Canal below lock at Seneca, both Montgomery Co. (both MCZ); Potomac River, Washington, D.C. (MCZ). *Virginia:* Hunter's Point near Alexandria; Little Hunting Creek, Potomac River, Mt. Vernon, all Fairfax Co. (all USNM).

ALTAMAHA RIVER SYSTEM

Altamaha River Drainage. *Georgia:* Altamaha River, near Darien, McIntosh Co. (MCZ). Ocmulgee River Drainage. Oscewickee Springs, 10 miles S of Abbeville, Wilcox Co. (MCZ).

ST. JOHNS RIVER SYSTEM

*Florida:* Lake Jessup; Wekiva River, 15 miles NW of Winter Park; Lake Monroe; all Seminole Co.; Benson Springs; Lake Woodruff; Spring Garden Creek, near DeLeon Springs; all Vo-

lusia Co.; Silver Springs; Oklawaha River, 2 miles E of Orange Springs; both Marion Co.; Silver Springs, Lake George; Lake George; both Putnam Co.; Juniper Creek; Alexander Spring Run; both Lake Co. (all MCZ).

WITHLACOOCHEE RIVER SYSTEM*

*Florida:* Withlacoochee River, 9 miles N of Dare City, Pasco Co.; Withlacoochee River, near Dunnellon, Marion Co. (both MCZ).

SUWANNEE RIVER SYSTEM

SANTA FE RIVER DRAINAGE. *Florida:* Poe Springs, Santa Fe River, 3 miles S of High Springs, Santa Fe River, High Springs; both Alachua Co.; Ichtucknee River below the main spring, Columbia Co. (all MCZ). WITHLACOOCHEE RIVER DRAINAGE. *Georgia:* Withlacoochee River, Olympia, Lowndes Co., Florida; Withlacoochee River, Blue Springs, Madison Co. (both MCZ). SUWANNEE RIVER DRAINAGE. *Florida:* Suwannee River, Ellaville; Suwannee River at mouth of Withlacoochee River, both Madison Co.; Suwannee River below the mouth of Santa Fe River, Gilchrist Co.; Suwannee River, Oldtown, Dixie Co. (all MCZ).

STEINHATCHEE RIVER SYSTEM

*Florida:* Steinhatchee River, 9 miles E of Salem, Taylor Co. (MCZ).

OCHLOCKONEE RIVER SYSTEM

*Florida:* Lake Talquin, 1 mile NE of power plant, Leon Co. (MCZ).

APALACHICOLA RIVER SYSTEM

FLINT RIVER DRAINAGE. *Georgia:* Kiokee Creek, 15 miles SE of Dawson, Terrell Co.; Creek 6 miles W of Albany, Dougherty Co.; Keels Creek, 2.3 miles S of Leary, Calhoun Co.; Spring

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*There are two rivers in Florida by this name. The northernmost has its origin in Fort Worth Co., Georgia and flows south to join the Suwannee River at Ellaville in Madison Co., Florida. The second Withlacoochee has its origin in northern Polk Co., Florida and flows northwest, entering the Gulf of Mexico about 15 miles southeast of Cedar Keys, Florida.


Plate 44

*Viviparus georgianus* Lea.

Present distribution of *V. georgianus* Lea based upon specimens examined.

Creek, Colquitt, Miller Co.; Spring Creek, Reynoldsville, Seminole Co.; Spring Creek, near Brinson; Four Mile Creek, 3 miles SW of Bainbridge; Paul Clark Spring, 2½ miles W of Recovery; Sealeys Spring, 5 miles NW of Recovery; Shackleford Spring, 3 miles NW of Recovery; Blue Spring, 7½ miles W of Recovery; all Decatur Co. (all MCZ). CHIPOLA RIVER DRAINAGE. *Florida:* Reedy Creek, 6 miles W of Malone; Big Creek, 8 miles W of Malone; 5 miles NE of Marianna; Chipola River, 5½ miles West of Greenwood; all Jackson Co.; Chipola River, 2 miles E of Clarksville; Chipola River, Scotts Ferry; Dead Lake, Chipola Park; all Calhoun Co. (all MCZ).

CHOCTAWHATCHEE RIVER SYSTEM

*Florida:* Holmes Creek, 3 miles E of Bonifay, Holmes Co. (MCZ).

COOSA RIVER SYSTEM

COOSA RIVER DRAINAGE. *Alabama:* Big Canoe Creek, 7 miles ENE of Ashville; Rock Creek, Henry's Mill, 9½ miles NE of Ashville, both St. Clair Co. (both H. Athearn). BLACK WARRIOR DRAINAGE. *Alabama:* West Fork, Sipsey River, 4 miles W of Grayson, Winston Co. (H. Athearn). TOMBIGBEE RIVER DRAINAGE. *Mississippi:* Tibbee, Clay Co. (USNM).

MISSISSIPPI RIVER SYSTEM

MISSISSIPPI RIVER DRAINAGE. *Illinois*: Quincy, Adams Co. (MCZ). ILLINOIS RIVER DRAINAGE. *Indiana:* Bass Lake, Starke Co. (MCZ). *Illinois:* Des Plaines River, Cook Co.; Kankakee River, Kankakee Co.; Morris, Grundy Co.; canal at Utica and Illinois Rivers, Peru, both LaSalle Co.; Lake Senachwine, Putnam Co.; Peoria Lake, Peoria Co. (all MCZ). WHITE RIVER DRAINAGE. *Missouri:* Current River; Jack Forks; Spring Valley Branch, all Shannon Co. (all MCZ and U of K). *Arkansas:* New Port, Jackson Co. (MCZ); Spring River, Black Rock, Lawrence Co. (USNM). ARKANSAS RIVER DRAINAGE. Fourche, Perry Co. (USNM and U of K). RED RIVER DRAINAGE. *Louisiana:* Frierson's Mill, DeSoto Parish; Alexandria, Rapides Parish (both USNM). WABASH RIVER DRAINAGE. *Indiana:* Lake Maxinkuckee, Culver, Marshall Co.; Tippecanoe River, 5 miles SW of Pulaski, Pulaski Co. (both U of M); Foot's gravepond, Gibson Co. (CM); Wabash River at old dam, S of New Har-

mony, Posey Co. (U of M). *Illinois:* Mt. Carmel, Wabash Co.; Little Fox River, White Co. (both MCZ). KANAWHA RIVER DRAINAGE. *Virginia:* Fish Hatchery, Wytheville, Wythe Co. (USNM). GREEN RIVER DRAINAGE. *Kentucky:* Bowling Green, Warren Co. (U of M). CUMBERLAND RIVER DRAINAGE. *Tennessee:* Lebanon, Wilson Co. (USNM); Cumberland River, Nashville, Davidson Co. (U of M); Stone's River; Murphreesboro, Rutherford Co. (MCZ and ANSP). TENNESSEE RIVER DRAINAGE: *Alabama:* pond, Paint Rock River, Jackson Co.; outlet, Brym Spring, Huntsville; Byrd Spring Lake, 5 miles S of Huntsville; Flint River, 7 miles W of New Hope, all Madison Co.; Swan Lake; Flint Creek, 3 miles NW of Hartsville and Tennessee Rivers, Decatur, all Morgan Co.; Swan Creek, 5 miles N of Decatur and 1 mile S of Athens, both Limestone Co.; ditch near Mussel Shoals Canal, Lauderdale Co.; creek near Great Spring, Tuscumbia, Colbert Co. (all MCZ). *Tennessee:* Shelbyville, Bedford Co. (MCZ). OHIO RIVER DRAINAGE. *Pennsylvania:* Pittsburgh, Allegheny Co. (CM). *Ohio:* Cincinnati, Hamilton Co. (CM); Newton, Hamilton Co. (U of M). *Kentucky:* Covington, Kenton Co. (CM). *Illinois:* Ohio River, Elizabethtown, Hardin Co. (MCZ).

## **Tulotoma** *Haldeman*

*Tulotoma* Haldeman 1840, Supplement to a Monograph of the Freshwater Univalve Mollusca of the United States, Philadelphia, p. 2.

*Tylotoma* 'Haldeman' Fischer 1885, Manuel de Conchyliologie, p. 734 [emendation for *Tulotoma* Haldeman].

Type species, *Paludina magnifica* Conrad, subsequent designation, Walker 1918, Univ. of Michigan, Mus. of Zool., Misc. Publication no 6, p. 26.

### **Tulotoma magnifica** *Conrad*
Plate 45, fig. 4; Plate 46, fig. 4

*Paludina magnifica* Conrad 1834 (May), New Fresh Water Shells of the United States, Philadelphia, p. 48, pl. 8, fig. 4 (Alabama River, Claiborne, Alabama).

*Paludina bimonilifera* Lea 1834 (Sept.), Trans. American Phil. Soc. (N.S.) **5**:58, pl. 19, fig. 71; 1834, Observations on the Genus Unio **1**:170, pl. 19, fig. 71 (Alabama River, Alabama).

*Paludina angulata* Lea 1841, Proc. American Phil. Soc. **2**:83; 1841, Trans.

American Phil. Soc. **9**:22; 1848, Observations on the Genus Unio **4**:22 (Coosa River, Alabama).

*Paludina coosaensis* Lea 1841, Proc. American Phil. Soc. **2**:83; 1841, Trans. American Phil. Soc. **9**:23; 1848, Observations on the Genus Unio **4**:23 (Coosa River, Alabama).

*Remarks. Tulotoma magnifica* is limited to the Coosa-Alabama River system in Alabama. This species prefers rocks and rock ledges and at one time probably lived throughout much of this river system wherever suitable conditions occurred. Heavy silting in this river during the past century has killed most of the populations of this species. Dr. van der Schalie and I failed to find it at Claiborne in 1933, at the type locality where Conrad found it "occurring in vast abundance on the masses of calcareous rock, which have fallen from the strata above into the Alabama River at Claiborne."

It is impossible to say that its former distribution included the large tributaries of the Coosa-Alabama system, that is, the Tombigbee and Black Warrior Rivers. Specimens of *Tulotoma magnifica* have been found in Indian burial sites at Moundville on the Black Warrior, but these burial sites also contained *Io fluvialis* Say, a genus occurring only in the Tennessee River system from Bridgeport, Alabama and north into its various tributaries. These Moundville specimens of *Tulotoma* may well have been items of trade as was the case with *Io.*

*Specimens examined. Alabama:* Big Canoe Creek, 9½ miles NE of Ashville, St. Clair Co. (H.D. Athearn); Coosa River, Fort William Shoals; Choccolocco Creek, 1 mile NW of Eureka, both Taladega Co. (both MCZ); Coosa River, mouth of Yellow River, Chilton Co. (MCZ); Coosa River, Wetumka, Elmore Co. (MCZ); Alabama River, Claiborne, Monroe Co. (MCZ).

## *Catalogue of the North American Viviparidae*

### Family VIVIPARIDAE

Shell medium to large (10 to 15 mm.), globose to globose-turbinate, imperforate to subimperforate, green to greenish-black in color and banded or unicolored. Operculum corneous. Respiration by means of gills.

Some recent members of this family are found on all continents other than Central and South America.

The specific and subgeneric names in this catalogue are arranged alphabetically under the genera to which they are now known to belong.

Key to the Genera of the Viviparidae *

1. Operculum wholly concentric . . . . . 3
2. Operculum with a subspiral nucleus . . . . . *Lioplax*
3. Reflected apices of the lateral teeth of radula simple . . . . . *Campeloma*
4. Reflected apices of the lateral teeth of radula denticulate . . . . . 5
5. Inner margin of the operculum simple . . . . *Viviparus*
6. Inner margin of the operculum reflected, forming an elevated marginal fold . . . . . *Tulotoma*

## **Campeloma** *Rafinesque*

Plate 45, fig. 6; Plate 46, fig. 2

*?Ambloxis* Rafinesque 1818, American Monthly Magazine **3**:355 (*A. eburnea* Raf. and *A. ventricosa* Raf. [both are nomina nuda] ).

*Campeloma* Rafinesque 1819, Jour. de Physique de Chimie d'Histoire Naturelle, Paris, **88**:423 (type species, *C. crassula* Raf., monotypic).

*Melantho* Bowditch 1822, Elements of Conchology, Paris, p. 27, pl. 6, fig. 15 (no locality given and no species cited).

*Amblostoma* Rafinesque 1865 [in] Binney, Land and Freshwater Shells of North America, pt. 3. Smithsonian Misc. Collections, No. 144, p. 46 [is a synonym of *Ambloxis* Raf. with the same type species. *A. eburnea* Raf. 1865, subsequent designation Pilsbry 1917].

*Lymnulus* Rafinesque 1865 [in] Binney, ibid. p. 46. [Is a synonym of *Ambloxis* Raf. with the same type species *A. eburnea* Raf. 1865, subsequent designation, Pilsbry 1917.]

*Remarks.* I fail to understand why Pilsbry (1917, p. 113) attempted to substitute *Ambloxis* Raf. 1818 for *Campeloma* Raf. 1819. Both genera are poorly defined. Rafinesque gave two names, *eburnea* Raf. and *ventricosa* Raf. under *Ambloxis,* both of which are nomina nuda. Under *Campeloma,* Rafinesque at least defined the species *crassula,* though in very limited terms, but I think sufficient to be recognized as a *Campeloma.*

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* Modified after Walker, 1918, p. 24, for North America.

Plate 45

Radulae

Fig. 1. *Viviparus georgianus* Lea, Glen Lake, Glens Falls, New York.

Fig. 2. *Viviparus georgianus* Lea, Chipola River, Scotts Ferry, Calhoun Co., Florida.

Fig. 3. *Viviparus intertextus* Say, Little Ohoopee River, 2 miles N of Kite, Johnson Co., Georgia.

Fig. 4. *Tulotoma magnifica* Conrad, Coosa River, Wetumpka, Elmore Co., Alabama.

Fig. 5. *Lioplax pilsbryi* Walker, Chipola River, 2 miles E of Clarksville, Florida.

Fig. 6. *Campeloma lima* Anthony. Ochwalkee Creek, 2 miles E of Glenwood, Montgomery Co., Georgia.

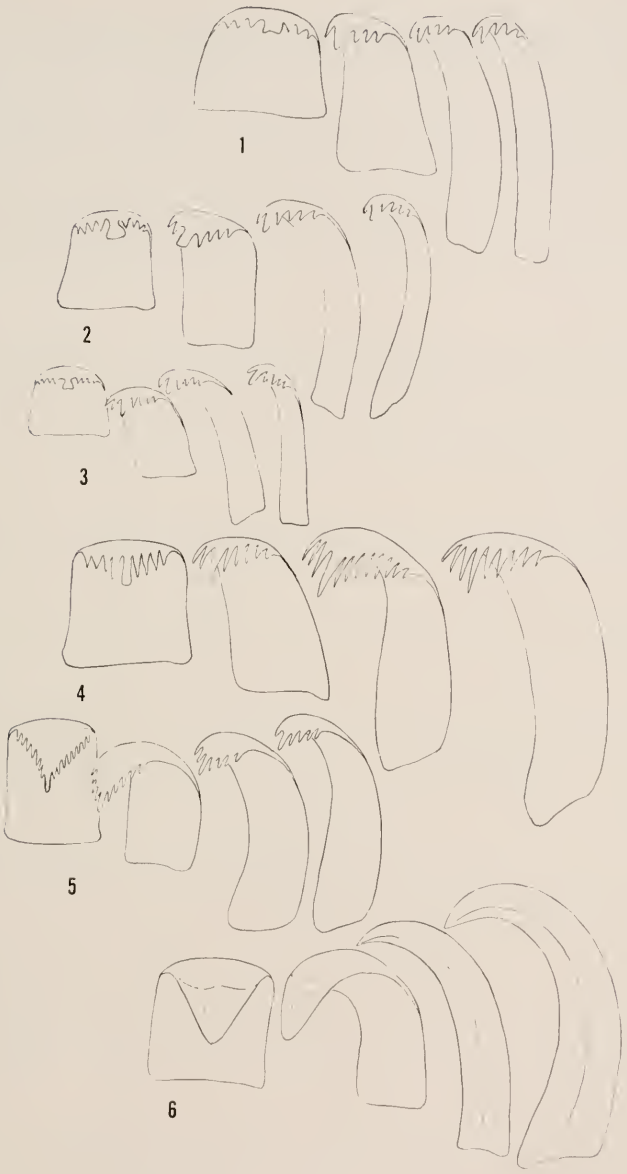


Plate 45

In the next paragraph Pilsbry completely reversed his logic by stating "*Omphiscola* Raf., No species mentioned. Under opinion 46 of the International Commission, no type can be selected for this genus, since no species 'can be recognized from the original generic publication.' " This is exactly true for *Ambloxis* as the two names mentioned are nomina nuda.

The generic name *Campeloma* has been in general use for nearly one hundred years, while *Ambloxis* has never been used, other than casually mentioned as being possibly the same as *Campeloma.*

In 1865, W.G. Binney published portions of Rafinesque's manuscript "Conchologia Ohioensis." Two crude figures are reproduced (figs. 91 and 92). Binney states: "I find rough figures of *Melantho decisa* under the name of *Ambloxis, Amblostoma,* or *Lymnulus major* Rafinesque or *Lymnea eburna* Rafinesque. All these names are given and I find it impossible to decide which was the one finally fixed upon or to decipher more of the description than the following: 'Whorls 5, last very large, form obtuse oval, aperture obtuse oval, lip thickened within, columella covered with callus (Rafinesque).' "

Through the kindness of Dr. A.H. Clarke we have what may prove to be the most northern record for *Campeloma.* Specimens of *C. decisum* Say were collected by Dr. Clarke in August 1960 in the Bousquet River (Ottawa–St. Lawrence River System) approximately 20 miles east of Rouyn, Quebec (approximately 48° N; 70° W). No specimens of *Campeloma* were found in streams draining into Hudson Bay.

The genus *Campeloma* is widespread in North America from the Mississippi River system east to the Atlantic States and north into Ontario and Quebec.

It occurs in lakes, rivers and small streams, usually buried an inch or more in sand or mud, sometimes in great numbers. The various species feed on detritus, mainly on dead plant material and occasionally on dead animal matter. All species are ovoviviparous.

On a specific level, probably few genera among our North American freshwater mollusks are in a more confused state. The answer to this condition is fairly simple, as there are but few morphological characters upon which specific differentiation can be made and these few characters differ only in de-

gree. As a consequence it has been easier to add a "new species" rather than attempt to fit a given series of specimens under an older name.

When a large series is studied and an attempt made to group the individual lots by river systems a specific pattern does emerge. This may be a realistic rather than a completely biological approach to this problem but some semblance of order can be made by this approach. In this way, at least, a host of names, many in present use, can be relegated to the synonymy of older names.

**brevispirum** F.C. Baker, **Campeloma:** 1928, Bull. 70, pt. 1, Wisconsin Geological and Natural History Survey, p. 74, pl. 5, figs. 13–18 (Mirror Lake, Sauk Co., Wisconsin). [Holotype, Univ. of Wisconsin 4573.]

**coarctata** 'Lea' Binney, **Melantho:** 1865, Land and Freshwater Shells of North America, pt. 3, Smithsonian Misc. Collections, no. 144, p. 52, fig. 106. [Is *C. exilis* Anthony.]

**coarctata** Lea, **Paludina:** 1843, Proc. American Phil. Soc. **2:**243; 1844, Trans. American Phil. Soc. **9:**30; 1848, Observations on the Genus Unio **4:**30 (Alabama). [Is *C. regulare* Lea. Types USNM 106311.]

**compressa** 'Lewis' Binney, **Paludina:** 1865, Land and Fresh-Water Shells of North America, pt. 3, Smithsonian Misc. Collections, no. 144, p. 53 (Jackson, Mississippi). [Nomen nudum.]

**cornea** Valenciennes, **Paludina:** 1827 [in] Humboldt and Bonpland, Recueil D'Observation de Zoologie **2:**255 (Delaware River). [Is *C. decisum* Say.]

**crassa** Deshayes, **Ampullaria:** 1830, Encyclopédie Méthodique **2:**32 (Ohio and most of the North American rivers). [Is *C. crassula* Raf.]

**crassula** Rafinesque, **Campeloma:** 1819, Journal de Physique de Chimie d'Histoire Naturelle, Paris **88:**423 (The Ohio).

**decampi** 'Currier' Binney, **Melantho:** 1865, American Jour. Conchology **1:** 49, pl. 7, fig. 1 (Huntsville or Stevenson, Alabama [Decatur, Alabama] ). [See Clench and Turner 1955. Lectotype MCZ 189656, paratypes MCZ and USNM.]

**decapitata** Anthony, **Paludina:** 1860, Proc. Acad. Nat. Sci. Philadelphia, p. 71 (Tennessee). [The original label of Anthony has only a question mark for the locality. The specimen appears to be identical to a young *Campeloma regulare* Lea from the Coosa River system in Alabama. [Holotype MCZ 161888.]

**decisa** Say, **Limnaea:** 1816, Nicholson's Encyclopedia, ed. 1 [no pagination], pl. 2, fig. 6 [Delaware River?].

**disscisa** DeKay, **Paludina:** 1843, Zoology of New York **5:**84, pl. 6, figs. 131a–b, pl. 7, fig. 134 (New York State). [Emendation for *decisa* Say.]

**dissimilis** Wood, **Helix:** 1828, Index Testaceologicus, Supplement, p. 21, pl. 7, fig. 18a (no locality given). [Is *C. decisum* Say.]

**eburnea** Rafinesque, **Ambloxis:** 1818. American Monthly Magazine **3:**355 (Ohio River). [Nomen nudum.]

**eburnea** Rafinesque, **Lymnaea:** 1865 [in] W.G. Binney, Land and Fresh-Water Shells of North America, pt. 3. Smithsonian Misc. Collections, no. 144, p. 45, fig. 92 (Ohio River). [Is *C. crassula* Raf.]

**exilis** Anthony, **Paludina:** 1860, Proc. Acad. Nat. Sci. Philadelphia, 71 (Mississippi). [Holotype MCZ 161885.]

**fecunda** Lewis, **Melantho:** 1868, American Jour. Conchology **4:**135 (Ohio). [Nomen nudum.]

**flava** 'Currier' Walker, **Campeloma decisa:** 1893, Nautilus **6:**138 (Long Lake, Grand Traverse Co., Michigan). [Nomen nudum.]

**floridense** Call, **Campeloma:** 1886, Bull. Washburn College Laboratory **1:** 159, pl. 6, fig. 7 (Florida [Wekiva River, Orange Co.]). [See Clench and Turner 1956, p. 116. Lectotype MCZ 189592.]

**genicula** Conrad, **Paludina:** 1834, New Fresh Water Shells of the United States, Philadelphia, p. 48, pl. 8, fig. 3 (Flint River, Georgia). [Holotype ANSP 29199.]

**geniculiforme** Pilsbry, **Campeloma rufum:** 1916, Nautilus **30:**42 (Dooly Co., Georgia). [Is *C. geniculum* Conrad. Holotype ANSP 122782.]

**gibba** Currier, **Melantho:** 1867, American Jour. Conchology **3:**112, pl. 6, fig. 3 (Grattan, Michigan). [Types ANSP.]

**heros** DeKay, **Paludina:** 1843, Zoology of New York **5:**85, pl. 7, figs. 132a–b (Walcott Creek, Wayne Co., New York). [Is *C. decisum* Say.]

**heterostropha** Kirtland, **Paludina:** 1838, Second Annual Report on the Geological Survey of the State of Ohio, Columbus, p. 200 (Mahonging River, Trumbull Co., Ohio) [nomen nudum]; Kirkland [in] Tappan 1839, The American Jour. Science and Arts **35:**269, pl. 3, fig. 2 (Mill and Yellow Creeks, Mahonging River, Ohio). [Is *C. crassula* Raf.]

**humerosa** Anthony, **Paludina:** 1860, Proc. Acad. Nat. Sci. Philadelphia, p. 71 (Alabama [Tennessee River]). [Is *Lithasia verrucosa* Raf. Holotype MCZ 72332.]

**incrassata** Lea, **Paludina:** 1842 [1843], Proc. American Phil. Soc. **2:**243; 1844, Trans. American Phil. Soc. **9:**30; 1848, Observations on the Genus Unio **4:**30 (Alabama). [Is *C. regulare* Lea. Types USNM 106308.]

**integra** Say, **Paludina:** 1821, Jour. Acad. Nat. Sci. Philadelphia **2:**174 (Inhabits waters of the Missouri).

**leptum** Mattox, **Campeloma:** 1940, Nautilus **54:**12, pl. 1, figs. 1–3 (Mill pond near St. Thomas, Ontario). [Paratypes MCZ 144538; ANSP 176688.]

**lewisii** Walker, **Campeloma:** 1915, Nautilus **28:**126, pl. 5, fig. 3 (Yallabusha River, Grenada, Mississippi). [Is *C. exile* Anthony.]

**lima** Anthony, **Paludina:** 1860, Proc. Acad. Nat. Sci. Philadelphia, p. 70 (South Carolina). [Holotype MCZ 161887.]

**limosa** 'Say' Valenciennes, **Paludina:** 1827 [in] Humboldt and Bonpland, Recueil D'Observation de Zoologie **2:**253 (no locality given). [Is *C. decisum* Say.]

**major** Rafinesque, **Lymnulus:** 1865 [in] W.G. Binney, Land and Fresh-Water Shells of North America. pt. 3. Smithsonian Misc. Collections No. 144, p. 42; 46. [Nomen nudum.]

**melanostoma** 'Currier' Walker, **Campeloma decisa:** 1893, Nautilus **6:**138 (Grattan, Michigan). [Nomen nudum.]

**melanostoma** 'Currier' Walker, **Melantho decisa:** 1879, Jour. of Conch. **2:** 332. [Nomon nudum.]

**meridionale** Pilsbry, **Campeloma rufum:** 1916, Nautilus **30:**42 (Little Sugar Creek; Crozier's Branch, Cabarras Co., North Carolina). [Is *C. lima* Anthony. Holotype ANSP 122781.]

**microstoma** Kirtland, **Paludina:** 1838, Second Annual Report on the Geological Survey of the State of Ohio, Columbus, p. 200 (Ohio). [Nomen nudum.]

**milesii** Lea, **Paludina:** 1863, Proc. Acad. Nat. Sci. Philadelphia, p. 156; 1866, Jour. Acad. Nat. Sci. Philadelphia **6:**184, pl. 24, fig. 144; 1866, Observations on the Genus Unio **11:**140, pl. 24, fig. 144 (Branch Lake, Antrim Co., Michigan). [Types USNM 106149.]

**nolani** Tryon, **Vivipara:** 1870, Monograph of the Fresh-Water Univalve Mollusca of the United States, Philadelphia, p. 25, pl. 12, figs. 10–11 (Coosa River, Alabama). [Is *C. regulare* Lea.]

**obesa** Lewis, **Melantho:** 1868, American Jour. Conchology **4:**134 (Ohio Canal, Columbus, Ohio). [Nomen nudum.]

**obesa** 'Lewis' Tryon, **Vivipara:** 1870, Monograph of the Freshwater Univalve Mollusca of the United States, Philadelphia, p. 25, pl. 13, fig. 6 (Ohio, Michigan, western New York). [Is *C. crassula* Raf.]

**obesum** 'Lewis' Binney, **Paludina:** 1865, Land and Fresh-Water Shells of North America, pt. 3. Smithsonian Misc. Collections No. 144, p. 47, text fig. 95 (Mohawk, New York, Ohio and Michigan). [Is *C. crassula* Raf.]

**ovularis** Menke, **Melania:** 1830, Synopsis Methodica Molluscorum, 2nd. ed., p. 134 (Cincinnati, Ohio). [Is *C. crassula* Raf.]

**ponderosa** Say, **Paludina:** 1821, Jour. Acad. Nat. Sci. Philadelphia **2:**173 (Ohio River). [Is *C. crassula* Raf.]

**regularis** Lea, **Paludina:** 1841, Proc. American Phil. Soc. **2:**34; 1844, Trans. American Phil. Soc. **9:**13; 1848, Observations on the Genus Unio **4:**13 (Ohio? [Coosa River, Alabama] ). [Types USNM 118409.]

**rufa** Haldeman, **Paludina:** 1841, Monograph of the Freshwater Univalve Mollusca of the United States, Philadelphia, p. 3 of cover of no. 3, pl. 3, fig. 1 (Ohio). [Is *C. crassula* Raf. Holotype ANSP 8492.]

**spillmanii** Lea, **Paludina:** 1867, Proc. Acad. Nat. Sci. Philadelphia, p. 61; 1868, Jour. Acad. Nat. Sci. Philadelphia **6:**343, pl. 54, fig. 29, 1868, Observations on the Genus Unio **12:**103, pl. 54, fig. 29 (Jackson Co., Alabama). [Is *C. decampi* Binney. See Clench and Turner 1955, p. 18. Lectotype USNM 121433, paratypes USNM and MCZ.]

**subsolida** Anthony, **Paludina:** 1844, Proc. Acad. Nat. Sci. Philadelphia **2:** 161 (Ohio). [Nomen nudum;]; 1860, Proc. Acad. Nat. Sci. Philadelphia, p. 71 (Illinois). [Is *C. crassula* Raf. Holotype MCZ 161882.]

**tannum** Mattox, **Campeloma:** 1940, Nautilus **54:**15, pl. 1, figs. 4–6 (Speed River, near Hespeler, Ontario). [Paratypes MCZ 144537; ANSP 176687.]

**ventricosa** Rafinesque, **Ambloxis:** 1818, American Monthly Magazine **3:** 355 (Ohio River). [Nomen nudum.]

**ventricosa** Rafinesque, **Lymnula:** 1865 [in] W.G. Binney, Land and Fresh-Water Shells of North America, pt. 3. Smithsonian Misc. Collections, no.144, p. 45, fig. 91 (Ohio River). [Is *C. crassula* Raf.]

## **Lioplax** *Troschel**

Plate 45, fig. 5; Plate 46, fig. 1

See Clench and Turner 1955, in this series, **2:**1–20 for a monographic study of this genus. We here list, however, the species and their synonyms.

**bicarinata** 'Say' Potiez and Michaud, **Paludina:** 1836, Galerie des Mollusques, Paris, **1:**249, pl. 25, figs. 17–18 (La Delaware, rivière de l'Amerique septentrionale). [Is *L. subcarinata* Say.]

**choctawhatchensis** Vanatta, **Lioplax pilsbryi:** 1935, Nautilus **49:**66, Horseshoe Lake, Choctawhatchee River, Washington Co., Florida). [Is *L. pilsbryi* Walker. Holotype ANSP 162240.]

**contorta** 'Shuttleworth' Küster, **Paludina:** 1852, Conchylien-Cabinet (2) **1:** pt. 21a, p. 20, pl. 4, figs. 7–9 (Alabama). [Is *L. cyclostomaformis* Lea.]

**cyclostomaformis** Lea, **Paludina:** 1841, Proc. American Phil. Soc. **2:**83 (Coosa River, Alabama). [Lectotype USNM 106307.]

**cyclostomatiformis** Lea, **Paludina:** 1844, Trans. American Phil. Soc. **9:**23 (Coosa River, Alabama). [Is an emendation for *cyclostomaformis* Lea.]

**elliottii** Lea, **Paludina:** 1858, Proc. Acad. Nat. Sci., Philadelphia, p. 106 (Othcalooga [Oothkalooga] Creek, Bartow Co., Georgia). [Is *L. cyclostomaformis* Lea. Lectotype USNM 106260, paratypes USNM and MCZ.]

**occidentalis** Pilsbry, **Lioplax subcarinata:** 1935, Nautilus **48:**143 (Cincinnati, Ohio). [Is *L. sulculosa* Menke. Holotype ANSP 123539, paratype MCZ.]

**pilsbryi** Walker, **Lioplax:** 1905, Nautilus **18:**133, pl. 9, figs. 1–3 (Chipola River, Florida). [Lectotype Univ. of Michigan, paratypes MCZ.]

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* See page 288 also.

**subcarinata** Say, **Limnaea:** 1817, British Encyclopedia, American Edition by William Nicholson, 1st ed. **2** [**4**:17], pl. 1, fig. 7 (Delaware River, Pennsylvania). [Lectotype MCZ 189709.]

**sulculosa** Menke, **Paludina:** 1828, Synopsis Methodica Molluscorum, p. 80 (Ohio River, Cincinnati, Ohio).

**wisconsinensis** F.C. Baker, **Lioplax subcarinata:** 1928, Bull. 70, pt. 1, Wisconsin Geological and Natural History Survey, p. 50, pl. 3, figs. 1–9 (Fox River, Brown Co., Wisconsin). [Is *L. sulculosa* Menke. Holotype Univ. of Wisconsin 437.]

## **Tulotoma** *Conrad*

Plate 45, fig. 4; Plate 46, fig. 4

See page 271 of present study for remarks on this genus.

**angulata** Lea, **Paludina:** 1841, Proc. American Phil. Soc. **2**:83, 1841, Trans. American Phil. Soc. **9**:22; 1848, Observations on the Genus Unio **4**:22 (Coosa River, Alabama). [Is *T. magnifica* Conrad. Types USNM 121075.]

**bimonilifera** Lea, **Paludina:** 1834 [Sept.] Trans. American Phil. Soc. (N.S.) **5**:58, pl. 19, fig. 71; 1834, Observations on the Genus Unio **1**:170, pl. 19, fig. 71. (Alabama River, Alabama). [Is *T. magnifica* Conrad. Types USNM 106263.]

**coosaensis** Lea, **Paludina.** 1841, Proc. American Phil. Soc. **2**:83, 1841, Trans. American Phil. Soc. **9**:23; 1848, Observations on the Genus Unio **4**:23 (Coosa River, Alabama). [Is a young specimen of *T. magnifica* Conrad. Types USNM 117818.]

**magnifica** Conrad, **Paludina:** 1834 [May], New Fresh Water Shells of the United States, Philadelphia, p. 48, pl. 8, fig. 4 (Alabama River, Claiborne, Alabama).

## **Viviparus** *Denys de Montfort*

Plate 45, figs. 1–3; Plate 46, fig. 3

*Viviparus* Denys de Montfort 1810, Conchyliologie Systématique **2**:247 [type species, *V. fluviorum* Mont. (=*Helix vivipara* Linné) original designation].

*Paludina* Lamarck 1812 [in] Férussac, Ann. du Muséum d'Hist. Nat. Paris **19**:253 [type species, *Helix vivipara* Linné].*

*Vivipara* J. Sowerby 1813, Mineral Conchy. **1**:75.

*Viviparella* Rafinesque 1815, Analyse de la Nature, Palerme, p. 144 [a substitute name for *Viviparus.* Type species, *Helix vivipara* Linné, subsequent designation, Pilsbry 1917].

The genus *Viviparus* is found on portions of all continents other than Central and South America, though fossil species

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* *Paludina* Lamarck has been used as a generic name for species in the four genera of North America Viviparidae. The type species, *Helix vivipara* Linné, limits it as a synonym of *Viviparus Montfort,* both having the same type species.

are recorded for South America. In North America, various species occur in drainage systems of the Gulf States and north to the St. Lawrence River System. No recent species occurs on the Pacific slope other than *V. malleatus* Reeve and *V. japonicus* v. Martens, both having been introduced from the Orient.

Most species in this genus prefer quiet waters of lakes, ponds, sluggish streams and rivers where there is a muddy substrate and plant cover. Their more restricted ecological requirements make the various species far less abundant than *Campeloma* which has a much wider ecologic range. *Viviparus,* however, can be exceedingly abundant where the proper conditions exist.

**altior** Pilsbry, **Vivipara georgiana:** 1892, Nautilus **5:**142 (aboriginal shell heap, left bank Hitchen's Creek, near entrance of St. Johns River into Lake George, Florida). [Is *V. georgianus* Lea. See Clench and Turner 1956, p. 109. Holotype ANSP and paratypes MCZ 78391.]

**bermondiana** d'Orbigny, **Paludina:** 1842 [in] Ramon de la Sagra, Hist. de L'Ile de Cuba, Mollusques **2:**7, pl. 10, fig. 5 (Cuba. [Rio Hanábana, Cienega de Zapata, Las Villas] ).

**Callina** Hannibal [subgenus]: 1912, Proc. Malac. Soc. London **10:**193, non Lowe 1855 (type species, *Paludina intertexta* Say).

**Callinina** Thiele: 1931, Handbuch der Systematischen weichtierkunde **1:**747 (index) [new name for *Callina* Hannibal 1912, non Lowe 1855].

**carinata** Valenciennes, **Paludina:** 1827 [in] Humboldt and Bonpland, Recueil D'Observations de Zoologie **2:**252, pl. 56, figs. 2a–b (Mexico); non Swainson 1822; Menke 1829. [This is a synonym of *V. costatus* Quoy and Gaimard from northern Celebes, Indonesia. See v. Martens 1890, p. 426.]

**contectum** Millet, **Cyclostoma:** 1813, Moll. Maine et Loire, p. 5. [Is a synonym of *V. viviparus* (Linné). North American references to this species are misidentifications for *V. georgianus* Lea.]

**Cipangopaludina** Hannibal [subgenus]: 1912, Proc. Malac. Soc. London **10:** 194 (type species, *Paludina malleata* Reeve).

**compactus** Pilsbry, **Viviparus contectoides:** 1916, Nautilus **30:**42 (Dougherty [Co?] Georgia, also Chetachee Creek, Alabama). [Is *V. georgianus* Lea, Clench and Turner 1956, p. 109; non *V. compactus* Kobelt 1906. Holotype ANSP 27731.]

**contectoides** Binney, **Vivipara:** 1865, Smithsonian Misc. Collections No. 144, pt. 3, p. 23. figs. 41–44; 224 (Florida, Georgia, South Carolina, Alabama, Arkansas, Missouri, Illinois, Indiana and Michigan). [Lectotype MCZ 74393. Paratypes USNM 27756.]


Plate 46

Fig. 1. *Lioplax pilsbryi* Walker, Chipola River, Florida, Lectotype, Univ. of Michigan (1.8×).

Fig. 2. *Campeloma geniculum* Conrad, Flint River, Bainbridge, Decatur Co., Georgia. MCZ no. 190336 (1.4×).

Fig. 3. *Viviparus georgianus* Lea, Hopeton, near Darien, McIntosh Co., Georgia. Lectotype USNM no. 106252 (1.4×).

Fig. 4. *Tulotoma magnifica* Conrad, Alabama River, Claiborne, Monroe Co., Alabama. MCZ no. 86974 (about 2×).

**georgiana** Lea, **Paludina:** 1834, Trans. American Phil. Soc. (NS) **5**:116, pl. 19, fig. 85 (Hopeton, near Darien, Georgia). [Holotype USNM 106252, paratype MCZ 186792.]

**goodrichi** Archer, **Viviparus contectoides:** 1933, Nautilus **47**:19, pl. 3, figs. 1–3 (spring-fed stream, tributary of the Chipola River, 5 miles NE of Marianna, Jackson Co., Florida). [Is *V. georgianus* Lea, Clench and Turner 1956, p. 109. Holotype MCZ 92432.]

**fasciata** Tryon, **Vivipara georgiana:** 1870, Monograph of the Fresh-Water Univalve Mollusca of the United States, Philadelphia, p. 17 (no locality given [Florida]). [Is *V. georgianus* Lea.]

**haldemanniana** 'Shuttleworth' Frauenfeld, **Vivipara:** 1862, Verh. K.K.Zool. Bot. Gesell. Wien, p. 1162 (Black Creek [Clay Co.], east Florida). [Is *V. georgianus* Lea.]

**haleanus** 'Lea' Walker, **Viviparus:** 1918, Mus. of Zool., Univ. of Michigan, Misc, Publications No. 6, p. 125. [Error for *V. haleianus* Lea.]

**haleiana** Lea, **Paludina:** 1845, Proc. American Phil. Soc. **4**:167; 1848, Trans. American Phil. Soc. **10**:96, pl. 9, fig. 58; 1848, Observations on the Genus Unio **4**:70, pl. 9, fig. 58 (Alexandria, Louisiana). [Is *V. intertextus* Say. Types USNM 106256.]

**illinoisensis** Baker, **Viviparus intertextus:** 1928, Wisconsin Geological and Natural History Survey, Bull. 70, pt. 1, p. 38, pl. 2, figs. 18–21 (Illinois River, Havana, Illinois). [Holotype Univ. of Illinois Z18025.]

**impolitus** Pilsbry, **Viviparus contectoides:** 1916, Nautilus **30**:41 (in marsh, Paint Rock River, Jackson Co., Alabama). [Is *V. georgianus* Lea. Holotype ANSP 66701.]

**inornata** Binney, **Vivipara:** 1865, American Jour. Conchology **1**:49, pl. 7, fig. 1 (near Chopatilo, Mexico [probably NE Mexico]). [Lectotype MCZ 234704; Paratypes USNM 9168.]

**intertextus** Say, **Paludina:** 1829, New Harmony Disseminator of Useful Knowledge **2**:244 (marshes near New Orleans and on bank of Carondelet Canal, Louisiana).

**japonica** v. Martens, **Paludina:** 1860, Malakozoologische Blätter **7**:44 (Japan). [Introduced into North America.]

**limi** Pilsbry, **Viviparus contectoides:** 1918, Nautilus **32**:71. [New name for *V. contectoides compactus* Pilsbry 1916; non Kobelt 1906. Is *V. georgianus* Lea, Clench and Turner 1956, p. 109.]

**limnothuma** Pilsbry, **Vivipara georgiana:** 1895, Nautilus **8**:116 (aboriginal shell-field, Hitchen's Creek [near entrance of St. Johns River into Lake George] and 2 fathoms, Lake George [Florida]). [Is *V. georgianus* Lea.]

**linearis** 'Valenciennes' Küster, **Paludina:** 1852, Conchylien-Cabinet (2) **1:** pt. 21, p. 19, pl. 4, fig. 4 (Simpson Creek Lake, east Florida). [Error for *lincata* Val.]

**lineata** Valenciennes, **Paludina:** 1827 [in] Humboldt and Bonpland, Recueil D'Observation de Zoologie **2:**256 (Lake Erie). [According to Potiez and Michaud (1838, p. 245) this species is a synonym of *Paludina bengalensis* Lamarck from Bengal, India.]

**malleata** Reeve, **Paludina:** 1863, Conchologia Iconica **14:** *Paludina,* pl. 5, fig. 25 (Japan). [Introduced into North America.]

**multicarinata** Haldeman, **Paludina:** 1842, Mono. Freshwater Univalve Shells of North America, Philadelphia, pt. 4, p. 4 of cover. [New name for *P. carinata* Val. 1827; non Swainson 1822; Menke 1829.

**multilineata** Say, **Paludina:** 1829, New Harmony Disseminator of Useful Knowledge **2:**245 (St. Johns River, Florida). [Nomen nudum, as a synonym of *P. elongata* (= *V. bengalensis* Lamarck); non *P. multilineata* Meek and Hayden 1866. [Is *V. bengalensis* Lam. from Bengal, India. See Morrison and Pilsbry 1953, Nautilus **67:**56–61; Clench 1955, Nautilus **68:**107.]

**subpurpurea** Say, **Paludina:** 1829, New Harmony Disseminator of Useful Knowledge **2:**245 (Fox River, an arm of the Wabash [White Co., Illinois] ).

**texana** Tryon, **Vivipara:** 1862, Proc. Acad. Nat. Sci., Philadelphia, p. 451 (Texas). [Is *V. subpurpureus* Say. Holotype ANSP 27714.]

**transversa** Say, **Paludina:** 1829, New Harmony Disseminator of Useful Knowledge **2:**244 (near New Orleans). [Is *V. intertextus* Say.]

**troostiana** Lea, **Paludina:** 1841, Proc. American Phil. Soc. **2:**34 (Tennessee); 1844, Trans. American Phil. Soc. **9:**14; 1848, Observations on the Genus Unio **4:**14. [Is a young *V. intertextus* Say. Types USNM 121119.]

**vivipara** Linné, **Paludina** or **Helix:** [This is a European species. North American references to this species are to *V. georgianus* Lea.]

**walkeri** Pilsbry and Johnson, **Viviparus:** 1912, Nautilus **26:**48, pl. 3, figs. 6–7 (Juniper Creek, Lake Co., Florida). [Is *V. georgianus* Lea. Holotype ANSP 70053.]

**waltoni** Tryon, **Viviparus:** 1866, American Jour. Conchology **2:**108, pl. 10, fig. 2 (St. Johns River, Florida). [Is *V. georgianus wareanus* Küster. Holotype ANSP].

**wareana** 'Shuttleworth' Küster, **Paludina:** 1852, Conchylien-Cabinet (2) **1:** pt. 21, p. 21, pl. 4, figs. 10–11 (Ostflorida im Ware-See [Lake Weir, Marion Co., Florida] ).

## References

Baily, Joshua T. 1909. Viviparus in Philadelphia. Nautilus **23:** 60.

Baker, F. C. 1928. The Fresh Water Mollusca of Wisconsin. Wisconsin Geological and Natural History Survey, Bull. **70:** pt. 1, pp. 31–76.

Binney, W. G. 1865. Land and Fresh-Water Shells of North America. Smithsonian Misc. Collections No. 144, pt. 3, pp, 16–65; 113–115.

Bousfield, E. L. 1955. Viviparus viviparus L. in Eastern Canada. Canadian Field Naturalist **69:**27–28.

Call, R. E. 1894. The Geographic and Hypsometric Distribution of North American Viviparidae. American Jour. Science **48:**131–141.

Chadwick, C. H. 1906, List of Wisconsin Shells. Nautilus **20:** 24.

Clench, W. J. and R. D. Turner. 1955. The North American Genus Lioplax in the Family Viviparidae. Occ. Papers On Mollusks **2:**18, pl. 3, figs. 7–8.

Clench, W. J. and R. D. Turner. 1956. Freshwater Mollusks of Alabama, Georgia and Florida from the Escambia to the Suwannee River. Bull. Florida State Mus. **1:**109–239.

Goodrich, C. 1942. The American Species of Viviparus. Nautilus **55:**82–92.

Hannibal, H. 1912. A Synopsis of the Recent and Tertiary Freshwater Mollusca of the Californian Province, based upon an Ontogenetic Classification. Proc. Malacological Soc. London **10:**192–196.

Henderson, J. 1935. Fossil Non-Marine Mollusca of North America. Geological Society of North America, Special Papers No. 3, pp. 165–188.

Johnson, C. W. 1915. Fauna of New England. Occ. Papers of the Boston Soc. Nat. Hist. **7:**112.

Johnson, C. W. 1916. Viviparus contectoides Binn. in Boston, Mass. Nautilus **30:**72.

Johnson, C. W. 1923. Viviparus japonicus v. Mts. from another Locality in Boston. Nautilus **36:**105.

Lewis, James. 1860. Catalogue of the Mollusks in the Vicinity of Mohawk, New York. Proc. Acad. Nat. Sciences Philadelphia, pp. 17–19.

Pilsbry, H.A. 1917. Rafinesque's Genera of Fresh-Water Snails. Nautilus **30:**109–114.

Potiez, V. L. and A. L. Michaud 1838. Galerie des Mollusques, Paris, pp. 244–258.

Prashad, B. 1928. Recent and Fossil Viviparidae, A Study in Distribution, Evolution and Palaeogeography. Records of the Indian Museum **8:**153–251.

Sterki, V. 1907. A Preliminary Catalogue of the Land and Fresh-Water Mollusks of Ohio. Proc. Ohio State Acad. of Sci. **4:**384.

Tryon, C. W. 1870–71. A Monograph of the Fresh-Water Univalve Mollusca of the United States, Philadelphia, pp. 8–36; 69–76, 4 plates.

Walker, B. 1918. A Synopsis of the Classification of the Freshwater Mollusca of North America North of Mexico. Misc. Pub. No. 6, Mus. of Zoology, Univ. of Michigan, pp. 1–88.

Winslow, Mina L. 1926. A Revised Check List of Michigan Mollusca. Occ. Papers of the Museum of Zoology, Univ. of Michigan, No. 181, pp. 1–28.

## New Records for the Genus Lioplax*

*By* WILLIAM J. CLENCH

### Lioplax sulculosa (*Menke*)

*Specimens examined.* ILLINOIS: Mississippi River, Nauvoo, Hancock Co. KENTUCKY: Beech Fork, Salt River, 3 miles S of Bardstown, Nelson Co.; Salt River, 5 miles W of Taylorsville, Spencer Co. ALABAMA: Paint Rock River, 2 miles NE of Paint Rock, Jackson Co. (all MCZ).

*Remarks.* The series of specimens from the Paint Rock River is remarkable for being the only known record for the Tennessee River System as well as being so distant from all other recorded localities. At the time our original study was made, a series of specimens from this river came to our notice. It was not included as a record as we then believed that there was a possible error in locality. Mr. Herbert Athearn on September 2, 1957, collected a large series at the above station.

### Lioplax cyclostomaformis (*Lea*)

*Specimens examined.* ALABAMA: Coosa River, Old Lock 2, about 3 miles S of Greenport, St. Clair Co.; Big Canoe Creek, 9½ miles NE of Ashville, St. Clair Co. (both H. D. Athearn). LOUISIANA: Tensas River, 6 miles E of Delhi, Madison Co. (J. R. Hood).

*Remarks.* The above record from the Tensas River is of considerable interest as being the only known locality outside of the Coosa-Alabama River System. In a measure this parallels the distribution of *Margartifera hembeli* Conrad which is known from the small tributaries of the Escambia River in Alabama and from a spring-fed creek, tributary to Bayou Cocodrie in Louisiana with no known records anywhere in between.

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* See *Occasional Papers On Mollusks* **2**:1–20, 1955.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 FEBRUARY 26, 1962 NUMBER 28



# *Nettastomella japonica* Yokoyama in North America and notes on the Pholadidae

*By* RUTH D. TURNER

The genus *Nettastomella* is an aberrant and little known genus of the family Pholadidae closely related to the genus *Jouannetia.* At the time this family was monographed (Turner 1955) only *Nettastomella rostrata* Valenciennes was known to occur on the west coast of North America. Recently we have received specimens of *Nettastomella japonica* Yokoyama from Masset Inlet, Masset Island, in the Queen Charlotte Islands, British Columbia. This species was formerly known only from Japan. Mr. Peter Hensen collected the first living Canadian specimens at the mouth of the Watum River in Masset Inlet in the summer of 1957 where they were boring into soft sandstone at the low tide level. At the suggestion of Dr. D. B. Quayle of the Biological Station at Nanaimo, British Columbia, the specimens were sent to me for study. These specimens were sufficient to prove the identity of the species and to point out the fact that *N. japonica* differed from other members of the genus in being inequivalve. It was necessary, however, to have preserved material in order to describe fully the species and to modify the definition of the genus *Nettastomella.* Mr. Hensen kindly made a special effort to satisfy this need and I wish to express my appreciation for his aid.

The genus *Nettastomella* has always been characterized as being bilaterally symmetrical throughout life. In the young stage there is a large pedal gape but in the adult stage a partial calcareous callum is produced on the anterior margin of

the valves, the remainder of the pedal gape being closed by a membranous periostracal callum. The siphonoplax is equal on both valves, being short and divergent or long and acuminate. There is only a partial calcareous covering for the anterior adductor muscle which is equal on both valves and there are no accessory dorsal plates.

These characters readily and definitely separate this genus from *Jouannetia* which is characterized by being bilaterally symmetrical in the young stage but inequilateral in the adult stage. In this genus the pedal gape is closed by a large calcareous callum which is much larger on the left valve than on the right, the siphonoplax is produced on the right valve only and there is a small mesoplax which is displaced by the greater production of the dorsal extension of the callum over the anterior adductor muscle on the left valve. (See Plate 53.)

These two genera have always been considered to be closely related because, in the young stage, the shells are indistinguishable and because both lack apophyses. When preserved specimens of *N. japonica* were studied it was evident that these genera were even more closely related, as this species has characters which are shared by both. The incomplete calcareous callum of *N. japonica* as well as its lack of a mesoplax relates it to *Nettastomella*. However, the calcareous portion of the callum is much wider on the left valve than on the right and the siphonoplax is produced only on the right valve, characters which would place it in the genus *Jouannetia*. As shown in plates 50 to 52 there is a close resemblance between *Nettastomella* and *Jouannetia* in the arrangement of such organs as the gills, the adductor muscles and the siphons. In addition, the anatomy of the digestive tract of both *N. rostrata* and *N. japonica* is very similar to that illustrated for *Jouannetia cumingii* Sowerby by Egger (1887; pl. 2, fig. 65).

At the present time it seems best to retain both *Nettastomella* and *Jouannetia* at the generic level based on the differences in the callum and the siphonoplax and the presence of a rudimentary mesoplax in *Jouannetia*. However, if further intergrades are found it may be necessary to reduce *Nettastomella* Carpenter 1864 to a subgenus of *Jouannetia* des Moulins 1828. It is difficult to attempt any evolutionary arrangement of the Pholadidae at present as the fossil record is very incom-

plete and even many living species are known only from their shells. Only three genera of the Pholadidae, *Jouannetia*, *Nettastomella* and *Xylophaga* lack apophyses and of these *Jouannetia* has a complete calcareous callum, *Nettastomella* has a partial calcareous callum and *Xylophaga* lacks a callum. The first two are rock borers while all species in *Xylophaga* are wood borers. It is possible that these three groups arose from a common pholad-like ancestor before the apophyses developed or that they came from a common ancestor which had lost the apophyses. Though less likely, it is also possible that the apophyses were lost independently. Conversely, of these three genera, *Jouannetia* and *Xylophaga* have a mesoplax while it is lacking in *Nettastomella*. Further anatomical and developmental studies as well as additional fossil data are needed to resolve many problems in this family.

Though the genus *Nettastomella* was fully treated in the monograph of the Pholadidae (Turner 1955, pp. 141–145) a redescription of the genus is given here because of the changes made necessary by the discovery of living *N. japonica*. Full descriptions of the two species found on the west coast of North America are also included for ease in their comparison.

## Genus **Nettastomella** *Carpenter*

*Netastoma* Carpenter 1864, Report British Association Advancement of Science for 1863, p. 637 (type species, *Netastoma darwinii* 'Sowerby' Carpenter); non *Nettastoma* Rafinesque 1810.

*Nettastomella* Carpenter 1865, Proc. Zoological Society London, p. 202 [new name for *Netastoma* Carpenter non *Nettastoma* Rafinesque]; Hertlein and Strong 1950, Zoologica **35**:247; Turner 1955, Johnsonia **2**:141.

*Netastoma* Carpenter. Vokes 1956, Journal of Paleontology **30**:768.*

Type species, *Netastoma darwinii* 'Sowerby' Carpenter 1864 [= *Nettastomella rostrata* Valenciennes non *darwinii* Sowerby], monotypic.

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* When discussing the effects of the Copenhagen Decisions of the International Commission on Zoological Nomenclature in defining the limits of generic homonymy, Vokes pointed out that *Netastoma* Carpenter is not preoccupied by *Nettastoma* Rafinesque. Also according to the International Code of Zoological Nomenclature (1961) Article 56a, two names are not considered homonyms if differing in one letter. However, *Nettastomella* has been used for this genus ever since it was introduced by Carpenter in 1865 and for the sake of stability it seems best to continue to use Carpenter's second name rather than to go back to a name which was in use for only a single year.

Shells small to moderate in size, bilaterally symmetrical and widely gaping anteriorly in the young stage. Valves divided by an umbonal-ventral constriction, the anterior portion triangular in outline and sculpture by imbricate concentric ridges and radial ribs; the posterior portion rounded and sculptured with concentric ridges and growth lines. In the adult stage the shells may be equivalve or inequivalve. The anterior gape is only partially closed by the calcareous portion of the callum, the main portion of the callum being composed of a periostracal substance. The calcareous portion of the callum is laid down as a narrow band anterior to the imbricated area and may be sculptured with thin high flutes or simply marked by growth lines. The calcareous portion of the callum may be produced equally on both valves or may be much wider on the left valve than on the right. The siphonoplax may be produced equally on both valves or only on the right valve; it may be short to long and straight or diverging. Apophyses and dorsal plates are lacking. The foot atrophies in the adult.

There are only three species known in this genus, *N. darwinii* Sowerby from Uruguay, Argentina and Chile, *N. rostrata* Valenciennes in the Eastern Pacific and *N. japonica* from the Northern Pacific.

### **Nettastomella japonica** *Yokoyama*
Plate 47; Plate 48, fig. 2; Plate 50

*Jouannetia japonica* Yokoyama 1920, Journal College of Science, Imperial University of Tokyo **39,** no. 6, p. 105, pl. 7, fig. 1 (Fossil, Yokosuka Zone, Otsu [in Yokosuka, Kanagawa Perf.], Honshu, Japan).

*Nettastomella japonica* Yokoyama. Habe 1955, Publications from the Akkeshi Marine Biological Station, Sapporo, Japan, no. 4, p. 24, pl. 4, fig. 9; pl. 7, fig. 3; Taki and Habe 1955, Illustrated Catalogue of Japanese Shells **2,** no. 2, p. 14, pl. 2, figs. 3–4.

*Description.* Shell reaching about 24 mm. in length and inequivalve in the adult stage. In the young stage the valves are fragile, equivalve, beaked and widely gaping anteriorly and closed posteriorly. The valves are divided into two distinct parts by an umbonal-ventral constriction though no true sulcus is formed. Anterior portion triangular in outline and sculptured with numerous high, thin, concentric ridges and weak radial ribs. Rounded imbrications are formed where the radial ribs cross the ridges. Posterior portion sculptured by thin con-

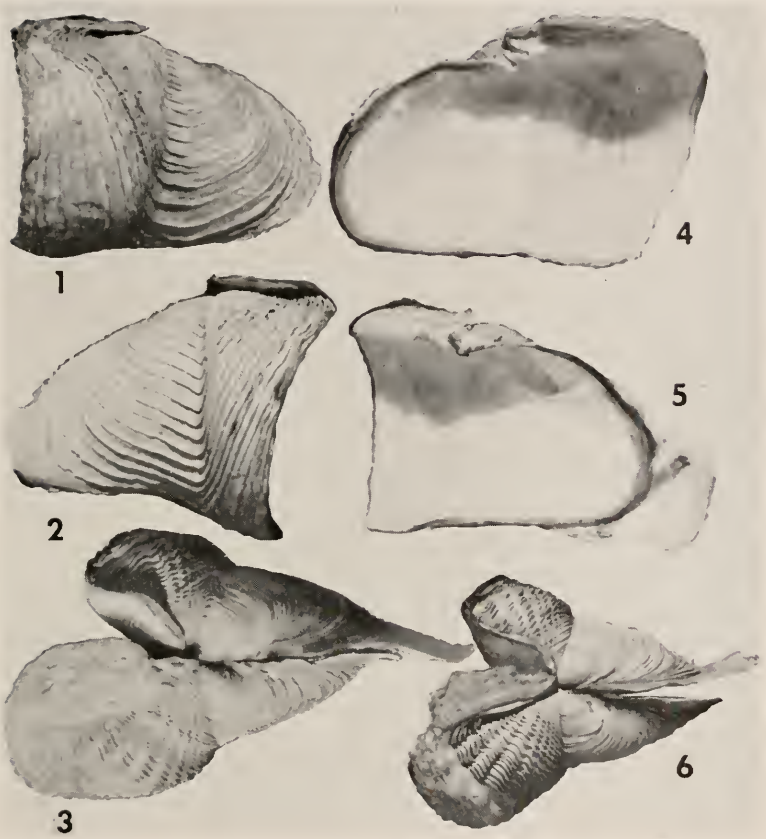


Plate 47

*Nettastomella japonica* Yokoyama, Masset Inlet, Masset Island, Queen Charlotte Islands, British Columbia.

Fig. 1. External view of left valve showing the wide calcareous callum.

Fig, 2. External view of left valve showing the narrow calcareous callum which is produced mainly near the ventral margin, and the siphonoplax.

Figs. 3 and 6. Dorsal views of apposed valves showing the inequivalve condition.

Fig. 4. Internal view of left valve showing the covering of the anterior adductor muscle produced by the extension of the callum dorsally.

Fig. 5. Internal view of the right valve showing the siphonoplax.

(All about 2.3×.)

centric flutes which are continuations of those of the anterior portion. They are highest near the umbonal-ventral constriction. Umbos prominent, located near the anterior one-third of the valve. The umbonal reflection narrow and free or appressed. In the adult the shell becomes very inequivalved. The calcareous portion of the callum is greatly produced on the left valve, usually becoming much wider than the anterior portion of the valve. This is continued dorsally over the umbonal reflection and covers the left half of the anterior adductor muscle. On the right valve the calcareous portion of the callum is narrow and produced only near the ventral margin. The calcareous portion of the callum is sculptured with thin flutes. The remainder of the pedal gape is closed with a periostracal covering over the muscular mantle which extends between the valves. In the young specimens there is a small opening in the mantle for the protrusion of the foot but this is almost completely closed in the fully adult animal. Siphonoplax a simple rounded prolongation which may reach half the length of the valve on the right valve but only slightly produced or lacking on the left valve. There are no other accessory plates. Periostracum thin and light straw in color.

Interior of the valve white and shining. Posterior adductor muscle scars deeply impressed and set high on the posterior slope. Anterior adductor muscle scars extending over the umbonal reflection. Ventral adductor muscle scar lightly impressed and located at the base of the umbonal-ventral ridge. Pallial line irregularly marked along the anterior margin of the valves extending posteriorly to the posterior adductor muscle dorsally and to the ventral adductor at the ventral end of the umbonal-ventral ridge. Pallial sinus not marked. Apophyses lacking. Siphons combined in a single sheath, the basal portion covered with a rather heavy, medium to dark brown periostracal sheath, the distal portion with a thin light tan sheath. Just behind the openings the combined siphons are surrounded by a collar bearing small papillae. The excurrent siphon in the preserved specimens studied appears to be slightly longer than the incurrent siphon. The siphons may be extended well beyond the end of the siphonoplax or contracted within the shell. Foot large, rounded and truncate in young specimens, atrophied in the adult.

| | | | |
|---|---|---|---|
| 21 mm. | 15 mm. | (left valve) | Masset, Queen Charlotte Islands, B.C. |
| 18 | 15 | (right valve) | " " " |
| 19.3 | 16.6 | (young specimen) | Straits of Juan de Fuca, Washington |

*Types.* The holotype of *Jouannetia japonica* Yokoyama is probably in the collection of the Imperial University, Tokyo, Japan. The type locality is Yokosuka Zone, Lower Musashimo, Otsu, Yokosuka, Kanagawa Prefecture, Japan.

*Remarks.* At the time *N. japonica* was described it was known only as a fossil occurring in the Yokosuka Zone of the Lower Musashimo (Pliocene) at Otsu, Miura Peninsula, Honshu, Japan. It was later recorded living at Akkeshi Bay, Hokkaido (Habe 1955) as well as from the north coast of Honshu off the Noto Peninsula in 305 meters and off Sado Island in 117 meters (Taki and Habe 1955). The occurrence of this species to the north and in the colder waters of the Japan Sea agrees with the statement made by Yokoyama when he discussed the fossil fauna at Otsu. "It is noteworthy" he said "that, while there are many species which now only live north of the fossil localities, there is not a single one which lives exclusively south of them." This was a cold water assemblage containing many species not found in the Tokyo area today. The occurrence of *N. japonica* at Masset in the Queen Charlotte Islands is only a slight extension of the range to the north but is a new record for the North American continent and it is another species added to the growing list of those known to be common to northern Japan, the Aleutian arc and the west coast of Canada.

The specimens received from Masset are almost identical in size and appearance to those figured by Habe and though readily distinguished from typical *rostrata* of California there was a possibility that they could be large, abnormal specimens of that species. However, through the kindness of Dr. I. MacT. Cowan of the University of British Columbia, specimens of both *N. japonica* and *N. rostrata* collected in the vicinity of Vancouver were made available for study. Though the specimens of both species were about equal in size they were readily identified. Consequently there is no doubt that there are two clearly defined species of *Nettastomella* on the west coast

Plate 48

Fig. 1. *Nettastomella rostrata* Carpenter from Whites Point, San Pedro, California. Specimen *in situ* showing the extension of the siphonoplax to the opening of the burrow at the surface (3×).

Fig. 2. *Nettastomella japonica* Yokoyama from Masset Inlet, Masset Island, British Columbia. Specimen *in situ* showing the posterior end of the valves only, the burrow being much deeper than the length of the shell. The edge of the right hand side of the burrow was outlined in ink on the photograph so that it would show clearly in the plate (2×).



Plate 48

of North America and both of them occur in the Puget Sound area.

*Nettastomella japonica* is found boring into blue clay and friable sandstone from near or just below low tide line probably out to depths of about 150 fathoms. Unfortunately it is not known if the specimens recorded from deep water were living at the time they were collected. The anterior end of the burrow is smoothly rounded but it is not lined with a calcareous deposit nor is there a chimney at the posterior end. The animals bore to a depth of two to three times the length of the shell but it is doubtful that they move up and down in their burrows for the tunnels reduce sharply in size toward the opening and the diameter is not sufficient to allow much movement other than that of boring. Nothing is known of the life history and means of dispersal of this species.

See also *Remarks* under *N. rostrata.*

*Range.* Though this species is actually recorded from only a very few localities it probably can be found in suitable habitats from the Noto Peninsula, Honshu, Japan, north through the Aleutian Islands and then south on the west coast of Canada to Puget Sound.

*Specimens examined.* BRITISH COLUMBIA: Masset Inlet, Masset Island, Queen Charlotte Islands (P. Hensen); Stanley Park, Vancouver (I. MacT. Cowan). WASHINGTON: *Albatross,* station 3450, about 5 miles NE of Cape Flattery, Straits of Juan de Fuca (48°26′50″ N; 124°39′35″ W) in 151 fathoms (USNM).

### **Nettastomella rostrata** *Valenciennes*
Plate 48, fig. 1; Plate 49; Plate 51

*Pholas rostrata* Valenciennes 1845 [in] Abel du Petit-Thouars, Voyage Autour du Monde sur la Frégate La Venus. Atlas de Zoologie, Mollusques, pl. 24, fig. 4 [name listed on plate; no locality given]; Lamy 1921, Bulletin Museum National d'Histoire Naturelle, Paris **27**:182 (Monterey, California).

*Nettastomella darwinii* 'Sowerby' Carpenter 1865, Proc. Zoological Society London, p. 202 (Monterey and San Diego [California]; Vancouver [British Columbia] ).

*Nettastomella rostrata* Valenciennes. Turner 1955, Johnsonia **3**:145, pl. 87.

*Description.* Shell reaching about 20 mm. (about $\frac{3}{4}$ inch) in length, equivalve in the young and adult stage, fragile, beaked

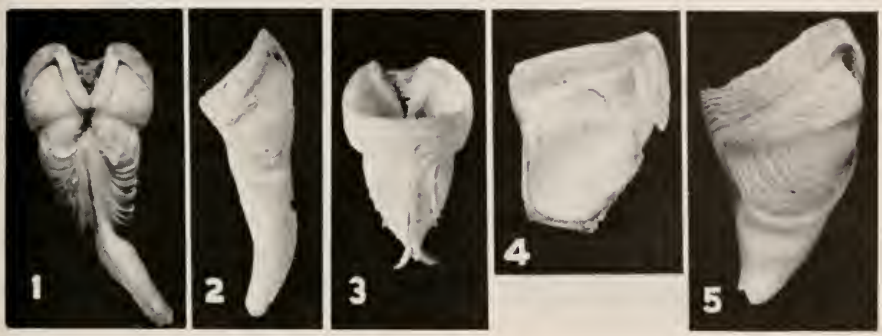


Plate 49

*Nettastomella rostrata* Valenciennes

Fig. 1. San Diego, California. Dorsal view of the adult specimen showing the siphonoplax and the calcareous portion of the callum which is equal on both valves.

Fig. 2. San Pedro, California. External view of the left valve showing the siphonoplax and callum.

Figs. 3–4. Laguna, California. Fig. 3. Ventral view of a young specimen just beginning to produce the siphonoplax. Fig. 4. Internal view of the right valve showing the cavity formed by the extension of the callum dorsally to cover the anterior adductor muscle. The siphonoplax has been broken off in this specimen.

Fig. 5. San Pedro, California. External view of left valve showing sculpturing on the callum and the free umbonal reflection. (All $2\frac{1}{2}\times$.)

(From Turner 1955, Johnsonia **3**, Plate 87.)

Explanation of figures used on anatomical illustrations, Plates 50–52.

1. Anterior adductor muscle.
2. Central pore of the periostracal portion of the callum.
3. Periostracal portion of the callum.
4. Thickened muscular anterior margin of the mantle.
5. Mantle.
6. Shell.
7. Posterior adductor muscle.
8. Excurrent siphon.
9. Siphonoplax.
10. Siphonal retractor muscle.
11. Incurrent siphon.
12. Labial palps.
13. Foot.
14. Visceral mass.
15. Inner demibranch of gill.
16. Outer demibranch of gill.
17. Intestine.
18. Closed mantle of adult.
19. Edge of calcareous callum.

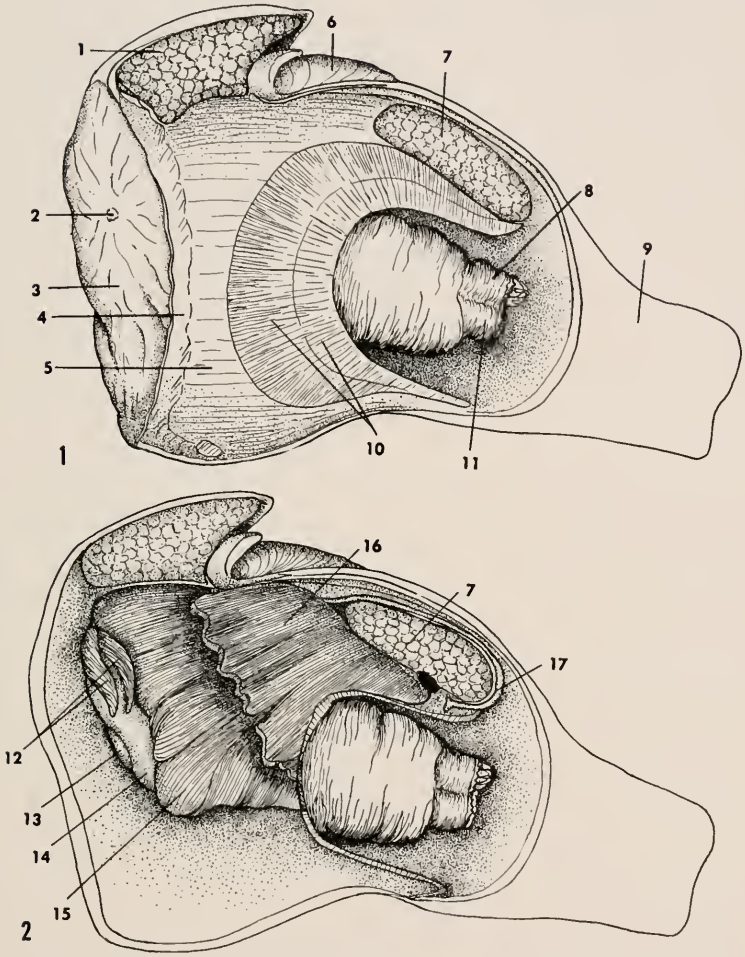


Plate 50

*Nettastomella japonica* Yokoyama from Masset Inlet, Masset Island, Queen Charlotte Islands, British Columbia.

Fig. 1. Specimen with left valve removed.

Fig. 2. Specimen with left valve and the left lobe of the mantle removed.

Note the greater width of the siphonal retractor muscle of this species which bores to depth several times the length of the shell.

and widely gaping anteriorly in the young stage, closed posteriorly. Shell divided into two areas by a marked umbonal-ventral constriction though no true sulcus is formed. Anterior portion triangular in outline and sculptured with numerous thin, high concentric ridges and weak radial ribs. Rounded imbrications are formed where the radial ribs cross the ridges. Posterior portion sculptured with thin, high concentric flutes which are continuations of the ridges on the anterior portion. Umbos prominent, located near the anterior third of the shell. Umbonal reflection narrow and free. In the adult stage the narrow calcareous portion of the callum is produced equally on both valves as a narrow band which extends along the anterior margins and dorsally over the umbos to enclose partially the anterior adductor muscle. The callum is fragile and sculptured with high thin flutes. The remainder of the pedal gape is closed by a periostracal callum covering the muscular mantle which extends between the valves, only a minute pore remaining open in the fully adult animal. In the young stage there is a small opening in the mantle for the protrusion of the foot but this is almost completely closed in the adult. The siphonoplax varies in length and width depending upon the age of the animal and the depth to which it is boring. In young specimens it may be very short and broad and may be reflected outwardly, but as the specimen grows the siphonoplax elongates, becoming acuminate and often irregular in shape to fit the contours of the burrow. There are no other accessory plates. Interior of valves white and glazed. Posterior adductor muscle scar oval in outline and set high on the posterior slope. Anterior adductor muscle scar extending over the umbonal reflection. Ventral adductor muscle scar lightly impressed and located at the base of the umbonal-ventral ridge. Pallial sinus extending anteriorly to the umbonal-ventral ridge. Apophyses lacking. Siphons white, slightly papillose at the posterior end, and with a thin pale yellowish periostracal sheath only at the base. They may be extended a short distance beyond the siphonoplax or contracted completely within the shell. Foot large rounded and truncate in young specimens; atrophied in the adult.

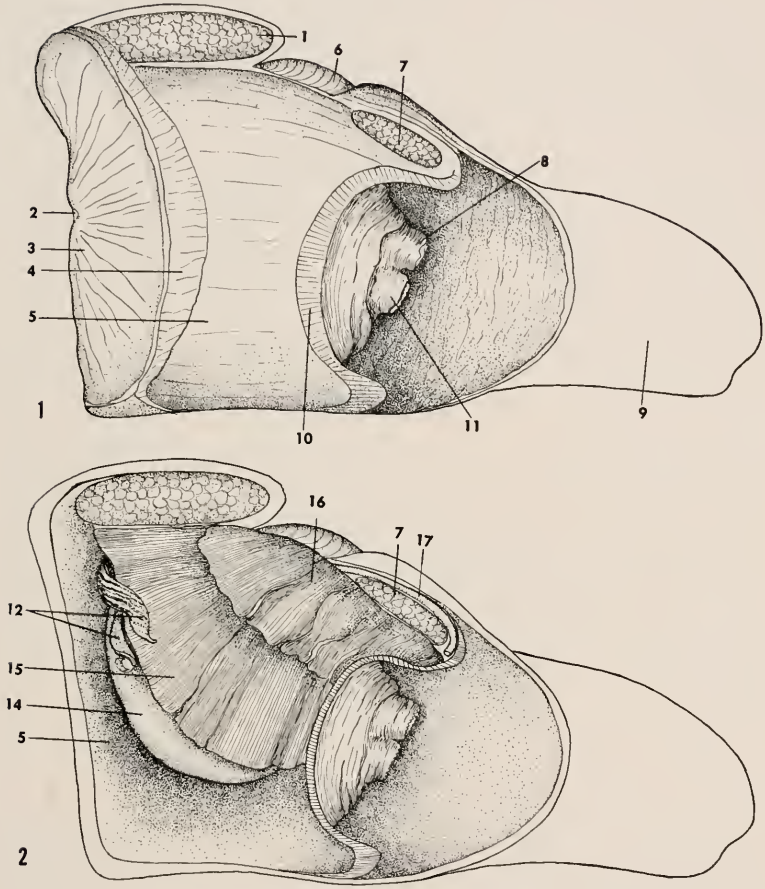


Plate 51

*Nettastomella rostrata* Valenciennes from White Point, San Pedro, California.

Fig. 1. Specimen with left valve removed.

Fig. 2. Specimen with left valve and left lobe of the mantle removed.

Note the proportionately smaller posterior adductor muscle and the narrow siphonal retractor muscle of this species, the siphonoplax of which extends to the surface.

| length | height | |
|---|---|---|
| 12.5 mm. | 12.0 mm. | White Point, San Pedro, California |
| 8.2 | 5.5 | San Pedro, California |
| 13.5 | 6.5 | Pender Island, Vancouver, British Columbia |

*Types.* The holotype of *P. rostrata* Valenciennes is in the Muséum National d'Histoire Naturelle, Paris. The type locality is Monterey, California.

*Remarks.* Adult specimens of *Nettastomella rostrata* may be readily differentiated from *N. japonica* by their bilateral symmetry and smaller size. The young stages of the two species, however, are almost impossible to distinguish. *Nettastomella rostrata* is a warmer water species and its occurrence in the Puget Sound area is still difficult to explain for there is no record of this species between Bolinas, California and British Columbia. This does not appear to be due to the lack of collecting for there are numerous records of other pholads such as *Penitella penita* Conrad and *Penitella gabbi* Tryon which live in similar habitats. The specimen sent by Dr. Cowan, though small, is quite typical and there are two lots in the United States National Museum which were not included under 'Specimens Examined' in my previous paper because it was thought the generalized locality Puget Sound was in error. This species bores into blue clay or soft rock and the siphonoplax extends to the surface as shown in Plate 46, fig. 1.

*Range.* Puget Sound and from Bolinas, California south to off Cedros Island, Baja California, Mexico.

*Specimens examined.* BRITISH COLUMBIA: Puget Sound (USNM); South Pender Island (I. MacT. Cowan). CALIFORNIA and MEXICO (see Turner 1955, p. 145).

### **Diplothyra curta** *Sowerby*

*Pholas curta* Sowerby 1834, Proceedings Zoological Society London, p. 71 (Isle of Lions, Province of Veragua, Colombia [Isla Leones, Golfo de Nontijo, Province of Veraguas, Panama] ).

*Diplothyra curta* Sowerby. Turner 1955, Johnsonia **3**:121, pl. 72.

This little known species has generally been thought to bore only into soft stone. However, Mrs. Faye Howard of Santa

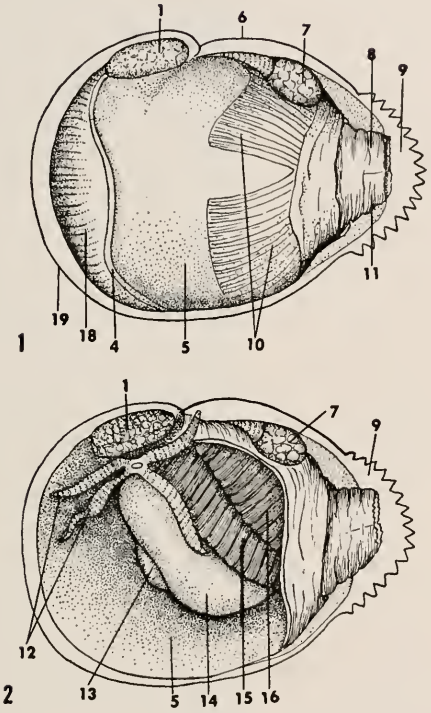


Plate 52

*Jouannetia globulosa* Quoy and Gaimard (after Fischer 1860, Journal de Conchyliologie **8**, pl. 15, figs. 6–7 under the name of *Jouannetia globosa* Sowerby) included here for easy comparison of the gross anatomy of *Jouannetia* and *Nettastomella*.

Barbara, California has found *Diplothyra curta* boring into the shells of the black murex, *Muricanthus negritus* Philippi, and a species of clam belonging to the genus *Chione,* as well as into coquina rock and shale. At San Felipe, Baja California, they were found in a calcareous shale along with specimens of *Lithophaga, Hiatella* and *Diplodonta* at the extreme low tide level. Specimens received from Mr. E. P. Chace of San Diego, California were boring into the spire of a murex which was covered by an encrusting calcareous bryozoan and worm tubes. These specimens had extended their burrows above the surface of the shell as oval crystalline structured pipes to keep from being smothered by the encrusting growth. In this small piece of shell (about 30 mm. in diameter) there were eight specimens of *D. curta,* two of them paralleling each other so closely that the anterior ends of their burrows had come together. I am most grateful to Mrs. Howard and Mr. Chace for sending us this interesting material.

*Specimens examined.* MEXICO: 18 miles N of San Felipe, Baja California (F. Howard); Punta Peñasco, Sonora (F. Howard; E. P. Chace); Puertecito, Sonora (F. Howard; E. P. Chace). [For additional records see Turner 1955.]

### Penitella gabbi *Tryon*

*Zirfaea gabbi* Tryon 1863, Proceedings Academy Natural Sciences Philadelphia, p. 10, pl. 1, fig. 1 (Coast of Japan? [Monterey, California]).

*Penitella gabbi* Tryon. Turner 1955, Johnsonia **3**:85, pls. 52–54.

Specimens of this species received from Mr. Peter Hensen from Masset, Queen Charlotte Islands, British Columbia are most interesting because they are nearly twice as large as any previously recorded. The average sized specimen is about 45 mm. in length and the largest known to me was 55.5 mm. The measurements of the Masset specimens are as follows.

| length | height | |
|---|---|---|
| 93 mm. | 50 mm. | adult specimen |
| 90 | 53.5 | " " |
| 89.5 | 45.5 | " " |
| 85 | 47.5 | young specimen |

Though *Penitella gabbi* is known to reach Alaska, this record from Masset is an addition to the scanty records from the west coast of Canada.

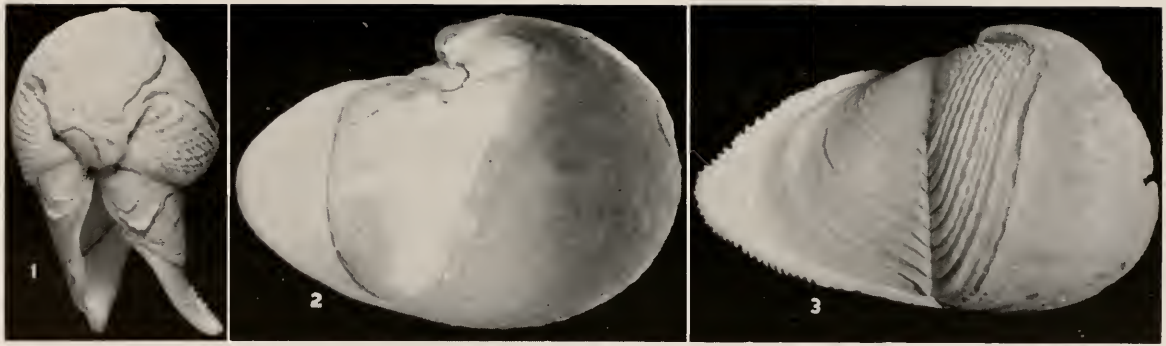


Plate 53

*Jouannetia pectinata* Conrad

Fig. 1. Dorsal view of the paratype showing the greatly enlarged, overlapping callum, the small mesoplax which has been displaced by the growth of the callum, and the pectinate siphonoplax of the right valve.

Fig. 2. Internal view of the left valve of the holotype showing the tremendous callum, the small posterior adductor muscle scar, the small chondrophore and the lack of the apophysis.

Fig. 3. External view of the right valve of the holotype showing the much smaller callum of this valve and the pectinate siphonoplax. (All $1\frac{1}{3}\times$.)

This species occurs from Baja California to Peru.

(From Turner 1955, Johnsonia **3,** Plate 83 — included here for ease in comparing *Jouannetia* and *Nettastomella.*)

## References

Dall, W. H. 1921. Summary of the Marine Shellbearing Mollusks of the Northwest Coast of America. United States National Museum, Bulletin **112:**1–217, pls. 1–22.

Egger, Ernst. 1887. Jouannetia cumingii Sow. Privately published, Wiesbaden, pp. 1–69, pls. 1–3.

Fischer, P. 1860. Études sur les Pholades. Journal de Conchyliologie **8:**337–351, pl. 15, figs. 1–8.

Habe, T. 1955. Fauna of Akkeshi Bay XXI, Pelecypoda and Scaphopoda. Publications from the Akkeshi Marine Biological Station no. 4, pp. 1–31, pls. 1–7.

Oldroyd, I. S. 1924. Marine Shells of Puget Sound and Vicinity. Publications of the Puget Sound Biological Station **4:** 1–271, pls. 1–49.

Taki, I. and T. Habe. 1955. Illustrated Catalogue of Japanese Shells **2:** no. 2, pp. 7–16, pl. 2.

Turner, R. D. 1954. The Family Pholadidae in the Western Atlantic and the Eastern Pacific, Part I—Pholadinae. Johnsonia **3:**1–64, pls. 1–34.

Turner, R. D. 1955. The Family Pholadidae in the Western Atlantic and the Eastern Pacific, Part II—Martesiinae, Jouannetiinae and Xylophaginae, Johnsonia **3:**65–160, pls. 35–93.

Yokoyama, M. 1920. Fossils from Miura Peninsula and its Immediate North. Journal of the College of Science, Imperial University of Tokyo **39:** Art. 6, pp. 1–198, pls. 1–20.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 AUGUST 7, 1964 NUMBER 29

# New species of *Tellina* from the Western Atlantic

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Washington, D.C.

During the course of a revisionary study of the Tellininae of the Western Atlantic, six new species were encountered. As the publication of the complete monograph of this group will be long in preparation and as these new species may be of interest to workers, it was deemed advisable to publish descriptions of these species without delay.

The rather specialized vocabulary utilized in the description of each species is explained in Plate 54, figs. 1 and 2. Abbreviations used consistently in the text include: MCZ, Museum of Comparative Zoology, Harvard University; BMNH, British Museum (Natural History), London; USNM, United States National Museum, Washington, D.C.; ANSP, Academy of Natural Sciences of Philadelphia; IMBPR, Institute of Marine Biology of Puerto Rico; and CNM, Canadian National Museum, Ottawa.

## **Tellina (Merisca) alerta,** new species

Plate 55, figs. 1–2

*Description.* Shell extending to 8.3 mm. (about 1/3 inch) in length and to 6.5 mm. (about 1/4 inch) in height, elongate-subtrigonal, subsolid to thin, a little tumid with the left valve more convex and with a sharp flexure to the right posteriorly. Umbos central and pointed. Anterior margin smoothly rounded; ventral margin gently convex and rising in a concave basal arcuation posteriorly; anterior dorsal margin

straight and gently inclined; posterior margin short, parallel with the dorso-ventral axis and forming a blunt truncation. Sculpture consisting of regularly spaced, raised lamellae (about 10–12 per millimeter) separated by sulci. Ligament light brown and slightly protuberant. Calcareous portion of the ligament poorly developed. In the left valve, the cardinal complex consists of an anterior subdeltoid bifid tooth with subequal lobes and of a posterior extremely elongate laminate tooth; distal anterior and posterior lateral teeth present, protruding and weak. In the right valve, the cardinal complex consists of a posterior thickened bifid tooth with subequal lobes and of an anterior subdeltoid laminate tooth; distal anterior and posterior lateral teeth present, elongate, strong, upcurled and socketed. Adductor muscle scars well impressed. Anterior adductor scar elongate, pointed above and rounded below; posterior adductor scar subquadrate. Pallial sinus equal in opposite valves, rising gently behind, widely separated from the anterior adductor scar and forming a short confluence posteriorly. Periostracum dull reddish-brown; the external surface of the valves eroded in the umbonal region and the remainder a dull white.

| length | height | width | |
|---|---|---|---|
| 8.3 mm. | 6.5 mm. | 3.0 mm. | Paratype of *alerta* |
| 8.3 | 6.0 | 2.8 | Holotype of *alerta* |

*Types.* The holotype of *Tellina* (*Merisca*) *alerta* is in the British Museum (Natural History), no. 79.10.15.171.2; type locality, 32°45′ S; 50°39′ W, about 15 miles SE of Rio Grande do Sul, Brasil, in 48 fathoms; specimen collected by R. W. Coppinger on the HMS *Alert.*

*Remarks. Tellina alerta* is most closely allied to *Tellina aequistriata* Say. The shape of the shell, the concentric sculpture and the configuration of the lateral teeth of the right valve serve to indicate the close relationship between these species. The pallial sinus is the most important character used to distinguish these species. In *aequistriata,* the sinus falls to and is confluent with the pallial line at or very near the base of the anterior adductor muscle scar while in *alerta* it is widely separated from the anterior adductor scar and the confluence of the sinus, and the pallial line is short. *Tellina alerta* possesses a distinct reddish-brown periostracum which differs from the

white periostracum of *aequistriata,* and the lateral compression of the valves appears to be greater in *alerta.*

*Range and specimens examined.* The species is known only from the type locality.

**Tellina (Angulus) paramera,** new species
Plate 55, figs. 3 and 8

*Description.* Shell extending to 14.5 mm. (about 5/8 inch) in length and to 12.5 mm. (about 1/2 inch) in height, ovate, subsolid to solid, moderately inflated with both valves of more or less equal convexity and with or without a slight posterior flexure to the right. Umbos posterior to the middle, somewhat elevated, inflated and blunt. Anterior margin broadly rounded; ventral margin convex and rising slightly posteriorly; anterior dorsal margin straight and gently sloping; posterior dorsal margin rather steeply inclined, short and slightly convex; posterior margin short and forming an irregular blunt truncation. Concentric sculpture consisting of closely set, raised ridges (about 8–10 per millimeter) separated by shallow sulci; radial sculpture consisting of poorly developed, evenly spaced lirations which more or less cover the disc. Ligament reddish brown, poorly developed, not protuberant and sunken in an elongate and narrow escutcheon; lunule poorly defined, shallow and broad. Calcareous element of the ligament moderately developed and resting on a flattened hinge plate; no true nymphal callosities. In the left valve, the cardinal complex consists of an anterior deltoid bifid tooth with subequal lobes and of a posterior elongate thickened laminate tooth; no true lateral teeth present. In the right valve, the cardinal complex consists of a posterior, elongate slightly skewed bifid tooth with subequal lobes and of an anterior thickened, subdeltoid laminate tooth; anterior lateral tooth large, strong, thickened and proximal to the cardinal complex; posterior lateral absent or obsolete, consisting of a weak enlargement in the distal terminus of the hinge plate with an indented socket above. Adductor muscle scars not strongly impressed. Anterior adductor elongate and lunate; posterior scar transversely quadrate. Pallial sinus usually equal in opposite valves, rising abruptly behind, forming a rounded apex above and descending gently to the

Plate 54

Diagrammatic representation of the shell morphology of a generalized *Tellina*.

Fig. 1. Internal view of a right valve.

1. Cardinal complex with the single anterior laminate cardinal tooth and the bifid cardinal tooth.
2. Ligament.
3. Nymphal callosity.
4. Posterior lateral tooth.
5. Posterior adductor muscle scar.
6. Cruciform muscle scars.
7. Pallial sinus.
8. Pallial line.
9. Interlinear scar.
10. Anterior adductor scar.
11. Pedal retractor scars.
12. Anterior lateral tooth.

Fig. 2. External view of a left valve.

1. Umbo.
2. Anterior dorsal margin.
3. Oblique sulcus or scissulation.
4. Anterior margin.
5. Disc.
6. Ventral margin.
7. Concentric sculpture.
8. Posterior margin.
9. Posterior slope.
10. Posterior dorsal margin.

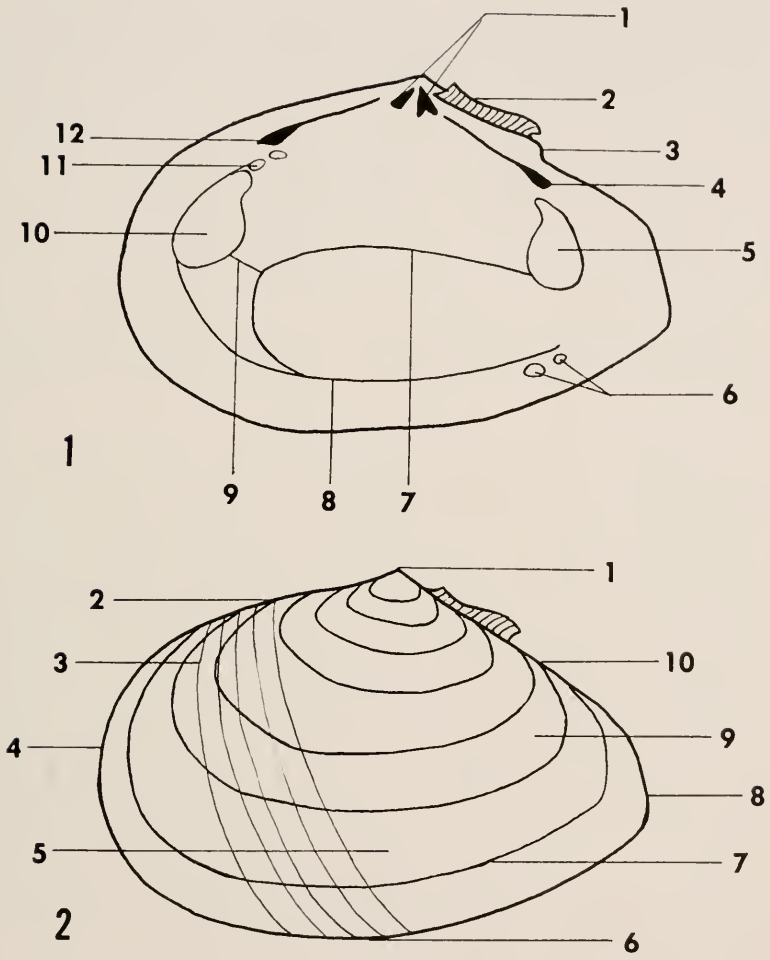


Plate 54

pallial line below; confluence entire. The pallial sinus generally does not coalesce with the anterior adductor scar but unites with the pallial line just beneath the anterior adductor scar. Externally, the shell is dull white; internally, shining, not highly polished and tending to become chalky; the internal surface often possesses radial vermiculations which reflect the external radial sculpture.

| length | height | width | |
|---|---|---|---|
| 12.5 mm. | 10.0 mm. | 5.2 mm. | Holotype of *paramera* |
| 14.5 | 12.5 | 6.5 | 'Florida Keys' |
| 10.3 | 8.4 | 4.3 | Off Miami, Florida |
| 9.2 | 7.2 | — | Off Miami, Florida |
| 6.2 | 4.5 | — | Off Miami, Florida |

*Types.* The holotype of *Tellina* (*Angulus*) *paramera* is in the Museum of Comparative Zoology, no. 242904; type locality, off Miami Beach, Florida, in 8 1/2 fathoms.

*Remarks.* This species is easily confused with *Tellina mera* Say, its nearest ally in the fauna of the Western Atlantic. The similarity in shape and color combined with the morphological similarities of the hinge line serve to indicate the close relationship of *mera* and *paramera.* In the latter, however, the shell is noticeably thicker and heavier and, in addition, the posterior margin forms a diagnostic blunt truncation. The configuration of the pallial sinus distinguishes *paramera* from its relatives. In *mera,* the sinus though extending toward the anterior adductor muscle scar, is separated from it; the sinus then parallels the pallial line and unites with it posteriorly, forming a short confluence. In *paramera,* the pallial sinus is closely aligned to the anterior adductor muscle scar, if not contiguous with it, and the confluence of the pallial sinus with the pallial line is virtually complete, extending the entire ventral length of the pallial line.

*Tellina paramera* occurs from the shore line to depths of fifty fathoms. As specimens are relatively rare and the species has remained unrecognized to date, it is postulated that an offshore habitat in moderate depths is preferred. An analog of *Tellina paramera* is not recognized from the Eastern Pacific.

*Range.* The species occurs from Bermuda, through the Ba-

hama Islands and off the coast of southeastern Florida to the Barbados, British West Indies.

*Specimens examined.* FLORIDA: off Miami Beach, in 6–30 fathoms; off Bear's Cut, Miami, in 18–20 fathoms; off Government Cut, in 3–38 fathoms; off Bell Buoy, Miami, in 15–22 fathoms; off Fowey Light, in 22–40 fathoms; Bird Key, Biscayne Bay, in 2–10 feet (all USNM); off American Shoals, in 45 fathoms (MCZ); Key West; Tortugas, in 15 fathoms (both USNM). BERMUDA: Ferry Point, St. George's Island (USNM). BAHAMA ISLANDS: Grand Bahama (USNM); Thompson's Bay, Long Island (MCZ). CUBA: Cape Cajon; Cayo Levisa; Bahia Honda, in 1–12 fathoms (all USNM). HISPANIOLA. SANTO DOMINGO: Puerto Sousa (MCZ). LESSER ANTILLES: off Payne's Bay Church, in 50 fathoms, and Carlisle Bay, in 6 fathoms, Barbados (both USNM).

### **Tellina (Angulus) exerythra,** new species
Plate 55, fig. 7

*Tellina* (*Eurytellina*) *vespuciana* 'd'Orbigny' Dall and Simpson 1901, Bull. U.S. Fish. Comm., **20**(1): 480, non d'Orbigny 1842.

*Description.* Shell extending to 18.5 mm. (about 3/4 inch) in length and to 11 mm. (about 3.8 inches) in height, subtrigonal, subsolid to solid, inflated with the left valve more convex and with a variously developed posterior flexure to the right. Umbos just posterior to the middle, slightly elevated and pointed. Anterior margin broadly rounded; ventral margin slightly convex and rising in a gentle arcuation posteriorly; anterior dorsal margin elongate and convex; posterior dorsal margin rather steeply inclined and straight; posterior margin short, parallel to the dorso-ventral axis and forming a small truncation. Concentric sculpture consisting of more or less widely and evenly spaced sulci separated by broad, flattened bands; no radial sculpture. Ligament light brown, weak and protuberant. Calcareous portion of the ligament subtended by short and weak nymphal callosities. In the left valve, the cardinal complex consists of an anterior elongate bifid tooth with subequal lobes and of a posterior elongate laminate tooth; no true lateral teeth present. In the right valve, the cardinal complex consists of a posterior, skewed and thickened bifid tooth with subequal

Plate 55

Fig. 1. *Tellina alerta* n. sp., paratype, BMNH; 32°45′ S; 50°39′ W, off Rio Grande do Sul (right valve internal; 4.5×).

Fig. 2. *Tellina alerta* n. sp., holotype, BMNH; 32°45′ S; 50°39′ W, off Rio Grande do Sul (left valve external; 4.6×).

Fig. 3. *Tellina paramera* n. sp., holotype, MCZ 242904, off Miami Beach, Florida (right valve external; 2.6×).

Fig. 4. *Tellina probrina* n. sp., holotype, USNM 461905, off Fowey Light, Florida (right valve internal; 2.7×).

Fig. 5. *Tellina euvitrea* n. sp., holotype, USNM 461952, Santa Lucia, Pinar del Rio, Cuba (right valve internal; 2.8×).

Fig. 6. *Tellina diantha* n. sp., holotype, MCZ 239110, Barbados, British West Indies (right valve internal; 2×).

Fig. 7. *Tellina exerythra* n. sp., holotype, MCZ 239220, Boca del Infierno, Bahía de Samaná, Santo Domingo (right valve internal; 2.9×).

Fig. 8. *Tellina paramera* n. sp., holotype, MCZ 242904, off Miami Beach, Florida (right valve internal; 3.4×).

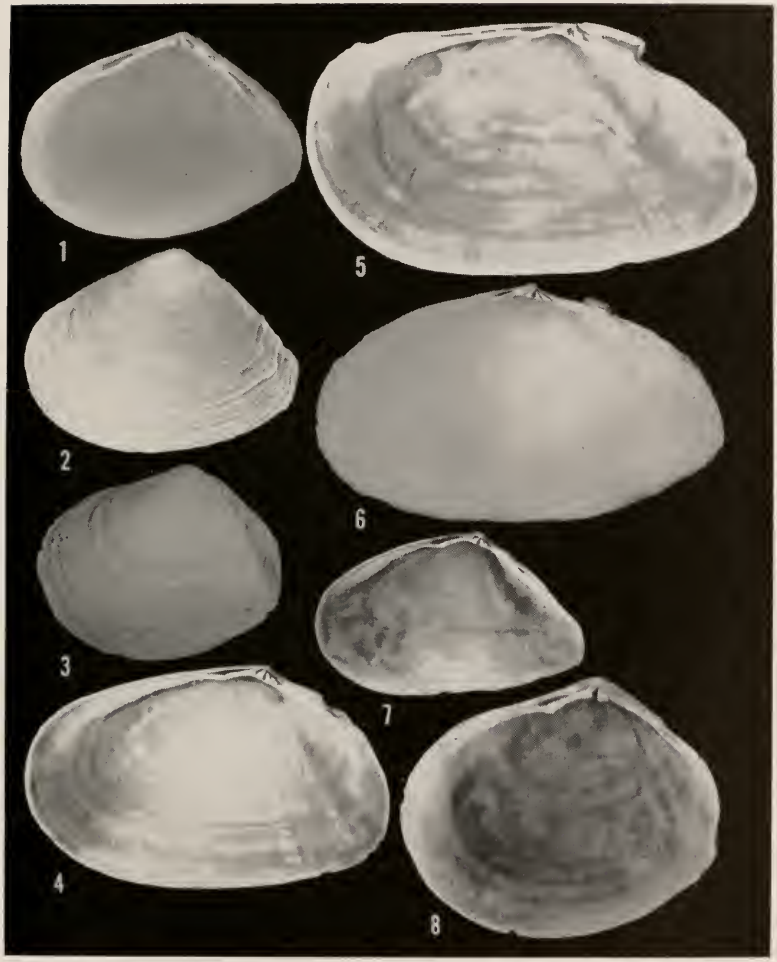


Plate 55

lobes and of an anterior subdeltoid laminate tooth; anterior lateral tooth thickened, upcurled and proximal to the cardinal complex; small distal vestige of the posterior lateral tooth evident. Adductor muscle scars moderately impressed. Anterior adductor scar elongate and rounded below; posterior adductor scar rounded. Pallial sinus more or less equal in both valves, rising gently posteriorly, descending in a concave line, extending nearly to but separated from the anterior adductor muscle scar and falling in a short rounded arcuation to the pallial line. Shell basically ivory white in color with a predominance of red suffusion; the periphery is generally white and variously formed rays of red, white or pink underlie the posterior ridge; external surface shining and sometimes iridescent; internal surface generally highly polished.

| length | height | width | |
|---|---|---|---|
| 12.0 mm. | 7.0 mm. | 3.5 mm. | Holotype of *exerythra* |
| 18.5 | 11.0 | — | West Indies |
| 10.3 | 6.5 | 3.0 | Mayaguez, Puerto Rico |
| 7.0 | 4.3 | 1.9 | Bahía de Samaná, Santo Domingo |

*Types.* The holotype of *Tellina* (*Angulus*) *exerythra* is in the Museum of Comparative Zoology, no. 239220; type locality, Boca del Infierno, Bahía de Samaná, Santo Domingo, Hispaniola.

*Remarks. Tellina exerythra* appears to occur in considerable numbers off the two easternmost islands of the Greater Antilles. It is most easily confused with and closely related to *T. versicolor* De Kay. In general, *exerythra* is subtrigonal in shape, bright red in color and relatively high in proportion. In this respect it can be contrasted with the elongate elliptical shape and whitish coloration of *versicolor.* The shell of *exerythra* is thicker, heavier and of a greater convexity than that of *versicolor.* The posterior ridges of *exerythra* are rather strongly developed, and there are generally one or two supernumerary ridges separated by weak sulci upon the posterior slope. In contrast, *versicolor* possesses less definitely developed posterior ridges, and extra ridges do not seem to be evident.

In the south Atlantic, *Tellina gibber* v. Ihering, because of its strong shell and the configuration of its pallial sinus, may be related to *exerythra,* but *gibber* lacks the red coloration and possesses a distinctly divided posterior margin with a peculiar and strongly developed posterior sulcus.

*Tellina subtrigona* Sowerby of the Eastern Pacific is quite similar to *T. exerythra* but the Pacific species attains a greater size.

*Range.* The species appears to be concentrated in the area of the Greater Antilles exclusive of Cuba. Some specimens have been found at Colon, Panama and others in Brazil.

*Specimens examined.* GUATEMALA: Livingston (ANSP). BRITISH HONDURAS: Belize (ANSP). JAMAICA: Little Goat Island, Portland Bight (MCZ). HISPANIOLA. HAITI: Aquin; Bizoton (both USNM). SANTO DOMINGO: Monte Cristi (ANSP); Puerto Plata; Bahía de Samaná (both MCZ). PUERTO RICO: Mayaguez; Puerto Real; Ponce (all IMBPR). PANAMA: Colon (MCZ). BRAZIL: (MCZ).

**Tellina (Angulus) probrina,** new species
Plate 55, fig. 4

*Description.* Shell extending to 25 mm. (about one inch) in length and to 14 mm. (about 9/16 inch) in height, elongate to subrectangular in shape, fragile, compressed, with the left valve of slightly greater convexity and with a slight posterior flexure to the right. Umbos posterior to the middle, small and pointed. Anterior margin broadly rounded; ventral margin straight to slightly convex; anterior dorsal margin long and gently sloping; posterior dorsal margin short, slightly concave and slightly inclined; posterior margin long and forming an oblique and blunt truncation. Sculpture consisting of weakly incised and irregularly spaced, concentric sulci; no radial sculpture present. Ligament light brown and protuberant. The calcareous portion of the ligament is subtended by strongly developed and protuberant nymphal callosities in both valves. In the left valve, the cardinal complex consists of a narrow anterior bifid tooth with elongate lobes and of a thin and curved laminate tooth; no true lateral teeth. In the right valve, the cardinal complex consists of a strongly skewed posterior bifid tooth whose posterior lobe is the larger and of an anterior slightly thickened and subdeltoid laminate tooth; anterior lateral proximal, laminate and curved upward; posterior lateral absent or obsolete. Adductor muscle scars moderately

impressed. Anterior adductor muscle scar irregularly shaped, but elongate and rounded below; posterior adductor more or less rounded. Pallial sinus rising very abruptly from the posterior adductor muscle scar to a high point beneath the umbo, then gently descending, rounded anteriorly and arcuately falling to the pallial line. The pallial sinus is well separated from the anterior adductor muscle scar. Shell white to pink or flesh-colored with a variously shaped posterior ray which may be absent in bleached individuals. The periostracum imparts an iridescence to the external surface of the valves, and the internal surface may be shining.

| length | height | width | |
|---|---|---|---|
| 18.5 mm. | 11.0 mm. | — | Holotype of *probrina* |
| 25.3 | 14.0 | — | Off Freeport, Texas |
| 16.0 | 9.4 | — | Bird Key, Florida |
| 14.2 | 8.4 | 2.5 mm. | Off Fowey Light, Florida |
| 11.1 | 6.5 | 2.1 | Sombrero Key, Florida |
| 8.3 | 4.8 | — | Bird Key, Florida |

*Types.* The holotype of *Tellina* (*Angulus*) *probrina* is in the U.S. National Museum, no. 461905; type locality, *Eolis* Station 151, off Fowey Light, Florida, in 55 fathoms.

*Remarks. Tellina probrina* is most easily recognized by its subrectangular shape and its broad, flattened and oblique posterior truncation. Young individuals closely assume the proportions of average adults but very large individuals have the truncation more oblique and the anterior dorsal margin less gently inclined. The vitreous external appearance also identifies this species, but its nearest relative in the Western Atlantic, *Tellina euvitrea,* may be confused with it. However, *euvitrea* has a straight and peculiar anterior dorsal margin, nearly parallel with the ventral margin. In contrast to *probrina, euvitrea* is more tumid, much more pointed behind, and with a pallial sinus which does not arise so abruptly from the posterior adductor muscle scar.

Another species with which *Tellina probrina* may be confused is *T. consobrina* d'Orbigny, however, the latter is distinctly allied to the subgenus *Scissula* and its sculpture may be used to distinguish it from *probrina.* In addition, *probrina* is more compressed, higher in proportions, and more strongly and broadly truncate.

*Range.* This species occurs in depths up to 100 fathoms. It is found in the Straits of Florida off Miami, in the Gulf of Mexico, and in the Caribbean to Tobago.

*Specimens examined.* FLORIDA: off Government Cut, Miami; off Fowey Light; off Ragged Key; off Bird Key; off Triumph Reef (all USNM); off Sombrero Key (MCZ); off Sand Key; Key West; Dry Tortugas (all USNM). TEXAS: 68 miles SE of Freeport, in 48 fathoms; 80–100 miles S of Port Isabel, in 40 fathoms (both MCZ). BAHAMA ISLANDS: (USNM). LESSER ANTILLES: Grenada (USNM); 2 miles S of Fort George, Scarborough, Tobago, in 36 fathoms (MCZ).

### **Tellina (Angulus) euvitrea,** new species
Plate 55, fig. 5

*Tellina* (*Angulus*) *vitrea* 'd'Orbigny' Dall and Simpson 1901, Bull. U.S. Fish. Comm. **20**(1): 481, non d'Orbigny 1842.

*Description.* Shell extending to 21 mm. (about 3/4 inch) in length and to 12 mm. (about 7/16 inch) in height, elongate-elliptical, thin, only slightly inflated with the right valve of a greater convexity and with only a slight flexure to the right posteriorly. Umbos just posterior to the middle, opisthogyrous, pointed and not elevated. Anterior margin very broadly rounded; ventral margin straight and with a slight postbasal arcuation: anterior dorsal margin not descending, long, straight and parallel to the ventral margin; posterior dorsal margin variously sloping and short; posterior margin short and poorly defined. Sculpture consisting of weak concentric sulci which are separated by broad bands. Radial sculpture consisting of extremely weak and obscure lirations which are more or less restricted to the peripheral areas. Ligament light brown, strong and protuberant. Calcareous portion of the ligament well developed and subtended by a short nymphal callosity. In the left valve, the cardinal complex consists of an anterior fragile bifid tooth and of a posterior thin and weak laminate tooth; no true lateral teeth present. In the right valve, the cardinal complex consists of a strong posterior bifid tooth with a poorly developed sulcus and a strong anterior and heavy laminate tooth; no true posterior lateral tooth present; anterior lateral proximal to the cardinal complex, rather small and laminate.

Adductor muscle scars generally well impressed. Anterior adductor scar irregularly elongate, smaller than the posterior scar. Pallial sinus equal in opposite valves, pointed above, descending rather steeply, and smoothly arcuate anteriorly. The sinus is deep but is well separated from the anterior adductor muscle scar. Externally the shell is iridescent and banded with white or pink; internally, the shell is usually white.

| length | height | width | |
|---|---|---|---|
| 21.0 mm. | 11.0 mm. | 4.5 mm. | Holotype of *euvitrea* |
| 20.0 | 11.0 | 4.0 | Bahía de Samaná, Santo Domingo |
| 11.0 | 6.0 | — | Puerto Plata, Santo Domingo |

*Types.* The holotype of *Tellina* (*Angulus*) *euvitrea* is in the U.S. National Museum, no. 461952; type locality, *Barrera* Station 200, Santa Lucia, 15 miles SW of La Esperanza, Pinar del Rio, Cuba, in 2–4 fathoms.

*Remarks.* This species had actually been recognized by Dall and Simpson in their report on the mollusks of Puerto Rico, and it was at that time called '*Tellina vitrea* d'Orbigny', but the holotype of *vitrea* d'Orbigny is a young individual of *Tellina magna* Spengler. *Tellina euvitrea* is characterized by its periostracum which imparts a vitreous lustre to the external surface of the valves. Its closest relative in the Western Atlantic is *Tellina probrina,* from which *euvitrea* may be separated by a more gently rising pallial sinus, a more pointed posterior end, and by a peculiar anterior dorsal margin which is parallel to the ventral margin. In addition, *Tellina probrina* is compressed whereas *euvitrea* is somewhat inflated. Some individuals of *T. versicolor* may be confused with *euvitrea,* but generally the red coloration and the pallial sinus which is closely aligned to the anterior adductor muscle scar in *versicolor* serve to identify it.

*Range.* This species appears to be restricted to the Greater Antilles except for Jamaica where it has not been recorded.

*Specimens examined.* CUBA: Santa Lucia, in 2–4 fathoms; La Esperanza, in 4–6 feet; Bahia Honda, in 1–12 fathoms; Cabanas Harbor, in 3–12 fathoms (all USNM). HISPANIOLA. SANTO DOMINGO: Puerto Plata (MCZ); Bahía de Samaná (USNM).

PUERTO RICO: Aguadilla; mouth of Anasco River, in 40–60 feet (both MCZ); Mayaguez, in 42–60 feet (IMBPR; USNM); off Ponce, in 50 feet (IMBPR).

**Tellina (Angulus) diantha,** new species
Plate 55, fig. 6

*Description.* Shell extending to 26 mm. (about 1 inch) in length and to 15 mm. (about 5/8 inch) in height, elongate-subelliptical, thin, fragile, with the right valve of a greater convexity and with a slight flexure to the right posteriorly. Umbos posterior to the middle, inflated and blunt. Anterior margin generally narrowly rounded; ventral margin straight to slightly convex and rising posteriorly; anterior dorsal margin long and gently sloping; posterior dorsal margin straight and short; posterior margin short and forming a poorly defined, oblique truncation. Sculpture consisting of closely set, weakly developed concentric lines; no true radial sculpture present. Ligament light to dark brown and slightly protuberant. Calcareous portion of the ligament subtended by slightly protuberant nymphal callosities. In the left valve, the cardinal complex consists of an anterior small, subdeltoid bifid tooth with subequal lobes and of a posterior, very thin, extremely elongate laminate tooth; a subproximal anterior lateral thickening represents a vestige of the anterior lateral tooth; no posterior lateral dentition. In the right valve, the cardinal complex consists of a posterior skewed bifid whose posterior lobe is much the larger and of an anterior short slightly thickened laminate tooth; the anterior lateral tooth is proximal to subproximal, thin, laminate and often weakly upcurled; no true posterior lateral tooth present. Adductor muscle scars moderately impressed. Anterior adductor muscle scar narrow and rounded below; posterior adductor scar subquadrate. Pallial sinus more or less the same in opposite valves, rising gently behind, rounded above, descending gently in a more or less straight line and falling in an arcuation to the pallial line; the sinus is distinctly removed from the anterior adductor scar. Externally, shell smooth, shining and suffused with pink or yellowish green; internally, chalky.

| length | height | width | |
|---|---|---|---|
| 26.5 mm. | 15.0 mm. | 7.0 mm. | Holotype of *diantha* |
| 23.0 | 14.0 | 7.5 | Totness, Coronie, Surinam |
| 22.3 | 13.0 | 6.4 | Rio de Janeiro, Brasil |
| 22.0 | 13.0 | 6.0 | Belem, Brasil |
| 18.0 | 10.5 | 5.4 | Totness, Coronie, Surinam |

*Types.* The holotype of *Tellina* (*Angulus*) *diantha* is in the Museum of Comparative Zoology, no. 239110; type locality, Barbados, British West Indies.

*Remarks.* The relationship of this species with others obviously allied to it is obscured by its apparent rarity and the fact that no ontogenetic series of specimens has yet been collected. The large adult size of this species quickly distinguishes it from other members of *Angulus,* but such a character is undesirable as a diagnostic trait. The peculiarly elongate posterior cardinal tooth in the left valve possesses important diagnostic value. In addition, the width and general tumidity of the valves constitute a further aid in identification.

The closest relatives of this species are *Tellina euvitrea* and *T. probrina.* With respect to both of these species, *diantha* is more tumid and of a different outline, possessing a poorly differentiated posterior truncation and a comparatively shorter anterior dorsal margin with the umbo more nearly equilateral. The pallial sinus does not rise abruptly from the posterior adductor muscle scar and it extends more anteriorly than in either *euvitrea* or *probrina.*

A fine series of *diantha* has been found by Altena in Surinam. The series from Totness, Coronie, consists of two complete specimens plus five right valves and two left valves and are designated as paratypes for this species; the specimens are preserved in the Rijksmuseum van Natuurlijke Historie, Leiden.

*Range.* Although there are only a few records for the species they indicate a rather extensive range, from the Barbados in the Lesser Antilles south to Rio de Janeiro, Brasil.

*Specimens examined.* LESSER ANTILLES: Barbados (MCZ). SURINAM: Totness, Coronie (Rijksmuseum, Leiden). BRASIL: Belem, Para (MCZ); Rio de Janeiro (USNM).

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 AUGUST 7, 1964 NUMBER 30

# Anatomy and Relationships of *Temnoconcha brasiliana* Dall

*By* KENNETH J. BOSS[1] AND VIDA C. KENK[2]

The genus *Temnoconcha* has been previously known only from the holotype of the type species, *T. brasiliana* Dall, which is figured herein for the first time. During the course of a revisionary study of the family Tellinidae, additional specimens of this species were found, including a single specimen suitable for dissection. The following notes were prepared to clarify the taxonomic position of the genus within the family and to present the known distribution of fossil and recent species in the genus.

## ACKNOWLEDGMENTS

We wish to thank the following persons for their cooperation in sending study material: C. Altena, R. Steger, A. Olsson, G. Warmke, and J. Rosewater. C. P. Nuttall and W. Dean aided in the photographs of d'Orbigny material and M. Carrington inked the line cuts. Acknowledgment is also given to N. Tebble and the Trustees of the British Museum (Natural History) for permission to photograph their material. W. J. Clench and R. D. Turner read the manuscript and the authors are indebted to them for their helpful criticism.

## ABBREVIATIONS

MCZ—Museum of Comparative Zoology, Harvard University
IMBPR—Institute of Marine Biology, Puerto Rico

[1] United States Fish and Wildlife Service, Washington, D.C.
[2] Museum of Comparative Zoology, Harvard University, Cambridge, Mass.

USNM—United States National Museum
BMNH—British Museum (Natural History)

## Systematic Notes

In 1921, Dall described *Psammacoma brasiliana,* creating for it a new section, *Temnoconcha,* on the basis of its unusual sculpture. The type locality of *brasiliana* is São Sebastian Island, São Paulo, Brasil. The holotype (USNM, no. 333023) measures 35 mm. in length, 23 mm. in height, and 8 mm. in width. The shell is characterized by finely incised and closely set transverse sculpture which crosses the external surface of the valves from a high point along the anterior dorsal margin to a low point along the ventral and posterior margins. This sculpture is out of phase with the concentric incremental sculpture. This mode of sculpture is also characteristic of the subgenus *Scissula* (type species, *Tellina decora* Say 1826 [= *Tellina similis* Sowerby 1806]). As *Temnoconcha brasiliana* does not possess lateral teeth in either valve, it is definitely not tellinoid, but macomoid.

Since *Temnoconcha brasiliana* is outwardly similar to *Tellina similis,* some confusion has resulted in the identification of the former species. For example, *brasiliana* was probably first seen by d'Orbigny, as in his collection, which is preserved in the British Museum (Natural History), specimens of Dall's species are labeled '*Tellina similis* Sowerby.' Plainly, d'Orbigny (1822; 1845; 1853) did not know Sowerby's species, for in 1842 he proposed the name *Tellina caribaea* for the common West Indian species which Sowerby had previously described as *similis.*

In his original description of *Temnoconcha brasiliana,* Dall noted the finer points of the hinge dentition, indicating that it consists of only two cardinal teeth in each valve. They depart from the usual macomoid pattern in that both cardinals in the right valve are bifid (see pl. 5, fig. c) while in the left valve, the anterior cardinal is bifid and the single posterior cardinal is laminate. Recently, Olsson (1961) noticed the same configuration in the Eastern Pacific species, *Tellina cognata* Adams 1852 (= *Tellina concinna* Adams 1852) and erected a new genus, *Psammothalia* with *cognata* as its type species. The name *Psammothalia* is therefore a junior synonym of *Temnoconcha* Dall. Olsson gave in the synonymy of *cognata* the various

genera and subgenera to which this species had been assigned previously, thus illustrating that many authors were aware of the peculiar affinities of *cognata.* The species was referred to *Psammobia* by Reeve, *Quadrans* by Dall, *Scissula* by Hertlein and Strong, and *Macoma* by Smith. Certainly, there is no question that *cognata* and *brasiliana* belong to the same group and that they are extremely closely related. Differences between the two species are rather difficult to discern, but they are apparently distinguishable by the thickness of the valves and the width of the shell (see table of measurements). In *brasiliana,* the umbo appears to be farther behind the middle, the shell is more compressed, and the individual valves are thinner than in *cognata.*

According to Olsson (1961), *cognata* is rather common and is widely distributed in the eastern Pacific, being found from Mexico to northern Peru. It is also represented in the Pliocene of Ecuador, and a fossil species in the Miocene of Ecuador appears in the ancestry of *cognata.* Specimens which Olsson referred to as occurring in the Gulf of Mexico have been studied by the authors and are *brasiliana.*

In addition to the original type locality given by Dall for *brasiliana,* the following records of specimens examined are listed and the range of this species is extended:

PUERTO RICO: Punta Algorrobo; Mayagüez (both IMBPR).

LESSER ANTILLES: Matura Bay, Trinidad; 2 miles S of Fort George, Scarborough, Tobago, in 36 fathoms (both MCZ).

HONDURAS: 17 miles NE of Lake Taratasca (Steger).

PANAMA: mouth of Rio Coclé del Norte.

VENEZUELA: 4.3 km. W of Barcelona (both USNM).

SURINAM: Paramaribo; Braams Punt, E of mouth of Surinam River (both Altena).

BRASIL: Praia Comprida, Vitoria, Estado do Espirito Santo (MCZ).

*Temnoconcha* has recently been collected in the Pleistocene of Surinam by Altena and the fossil species, *Tellina* (*Scissula*) *cercadica* Maury (1917) from the Miocene of Santo Domingo appears to be an ancestor of *brasiliana. Temnoconcha brasiliana* is apparently widely dispersed but rare.

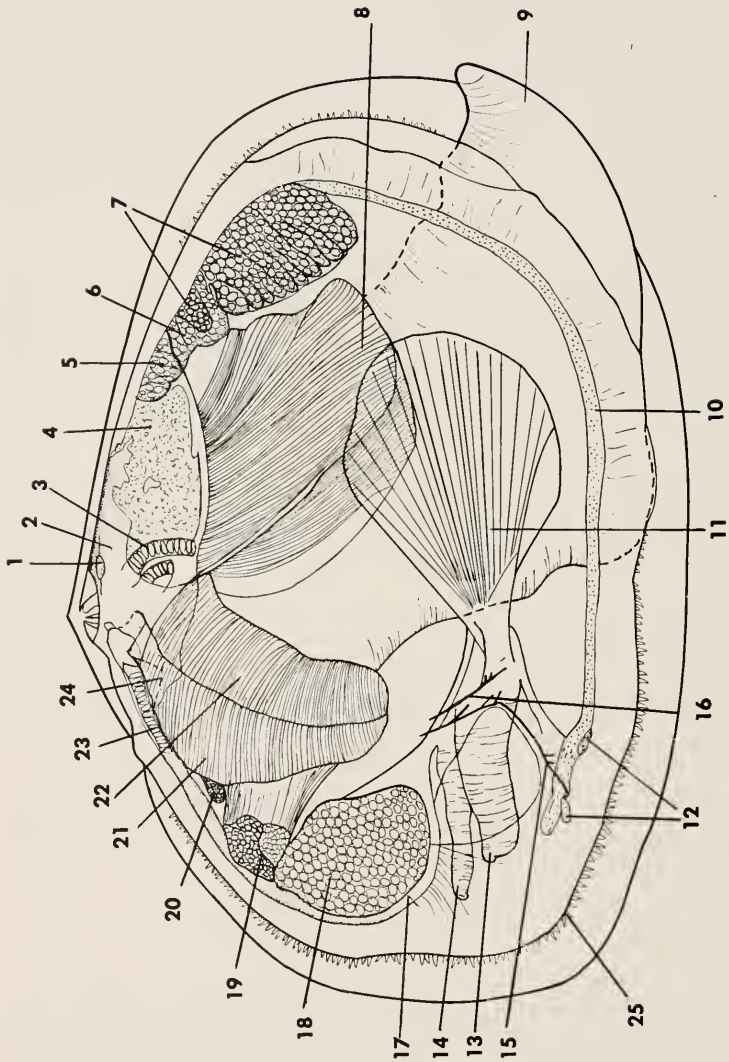


Plate 56

Plate 56

Semidiagrammatic illustration of the anatomy of *Temnoconcha brasiliana*. Specimen with the right valve removed to show general external structural features.

1. medial muscle.
2. gonad.
3. intestine.
4. digestive gland.
5. anterior pedal retractor muscle.
6. pedal protractor muscle.
7. anterior adductor muscle.
8. labial palps.
9. foot.
10. pallial line.
11. siphonal retractor muscle.
12. cruciform muscle.
13. incurrent siphon.
14. excurrent siphon.
15. nerve to the cruciform muscle.
16. nerve to the siphonal retractor muscles.
17. anus.
18. posterior adductor muscle.
19. posterior retractor muscle.
20. kidney.
21. outer demibranch.
22. inner demibranch.
23. rectum.
24. pericardium.
25. tentacles of mantle.

| length | height | width | |
|---|---|---|---|
| *cognata* | | | |
| 44.0 mm. | 29.5 mm. | 7.0 * mm. | Holotype of *cognata*, MCZ 186304 |
| 38.0 | 25.0 | 11.0 | Lectotype of *concinna* Adams, MCZ 186302 |
| 37.5 | 24.5 | 10.5 | Paratype of *concinna* Adams, MCZ 186303 |
| 53.7 | 35.8 | 15.1 | Tumbez, Peru |
| 65.5 | 41.0 | 9.0 * | Zorritos, Peru |
| *brasiliana* | | | |
| 35.0 | 23.0 | 8.0 | Holotype of *brasiliana*, USNM 333023 |
| 28.0 | 19.5 | 7.5 | Punta Algorrobo, Puerto Rico |
| 29.0 | 10.0 | — | d'Orbigny Collection (BMNH), no locality |
| 23.5 | 16.0 | — | " " " " |
| 44.0 | 30.0 | 5.0 ** | " " " " |

* semiwidth, right valve only; ** semiwidth, left valve only.

## Anatomy

The mantle is thin and transparent over most of its surface but is thickened and muscular at its periphery where it attaches to the valves. It is united dorsally beneath the hinge line of the shell but open ventrally, except at the formation of the cruciform muscle and no specialized pedal gape is formed. As in other macomoids (Yonge, 1957), the mantle margin is differentiated into outer, middle, and inner lobes. Along the postero-ventral border of the mantle, the middle lobe is provided with small, elongate, transparent, and pointed tentacles (pl. 56). Shorter tentacles are present along the anterior dorsal margin of the edge of the mantle. A mantle fold or ridge, similar to that described by Yonge (1949) for *Abra* and *Scrobicularia,* extends from the vicinity of the cruciform muscle anteriorly to form a ventral channel (pl. 57 and pl. 58). The origin of the bilateral fan-shaped siphonal muscle is impressed as a muscle scar, called the pallial sinus, on the internal surface of each valve. The siphonal muscles are slightly asymmetric with those of the left side being somewhat larger. In consequence of this asymmetry, the anterior margin of the pallial sinus in the left valve is closer to the anterior adductor muscle scar. The siphonal musculature becomes confluent with the mantle musculature postero-ventrally; the posterior confluence of the pallial sinus and the pallial line in each valve reflects this anatomical feature.

The siphons are free along most of their length and are united basally. They are not tentaculate distally. At the proximal opening of the incurrent siphon where the inflow of water into the mantle cavity occurs, a right unilateral siphonal organ and bilaterally paired parasiphonal organs are found (pls. 57 and 58). The siphonal organ is thickened, plicate, and 'cushiony' and probably serves a function similar to that of the osphradium of gastropods. The paired parasiphonal organs, previously called 'valvule palleale' by Pelseneer (1911) or 'mantle folds' by Yonge (1949), are thin and phylloid. They function to prevent pseudofeces from being swept onto the gills by the strong incoming flow of water. Both these organs are attached to the inner surface of the walls of the siphonal musculature, and both are innervated by nerves from the visceral ganglion.

The cruciform muscle subtending the siphonal apparatus is well developed and possesses the small cruciform organs discussed and figured by Yonge (1949). The posterior portion of the cruciform muscle is divided near its origin, forming two small scars on each valve; the anterior portion has a single origin. Concordant with the asymmetry of the siphonal musculature, the anterior and posterior cruciform muscle scars are closer together on the left valve than on the right.

The anterior and posterior adductor muscles are large and subequal in size. The anterior adductor is subdivided into two portions of which the ventral is the larger; the muscle is irregularly elongate and semilunate in shape. The posterior adductor muscle tends to be subquadrate. Mediodorsally there is a small muscle which splays out in the mantle lateral to the convoluted intestine and attaches the visceral mass to the valves. This muscle is structurally different from but may be functionally similar to the medial adductor muscle which Yonge (1949) illustrated connecting the two valves and passing under the postero-dorsal caecum of the stomach in other tellinoids. This medial muscle leaves a distinct, variously formed scar just anterior and ventral to the cardinal hinge plate in both valves.

The pedal musculature consists of anterior and posterior pedal retractors and of a pedal protractor; all the complex of pedal musculature inserts into the foot. The anterior pedal retractor originates along the anterior dorsal margin of the

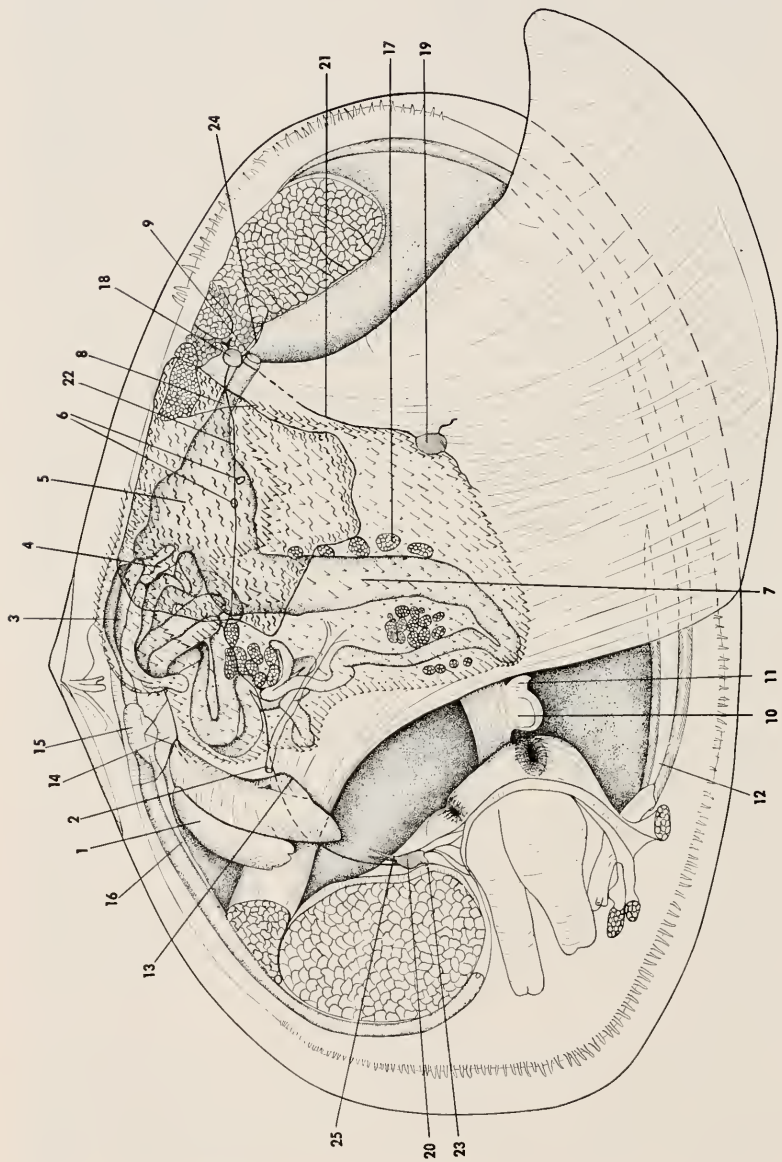


Plate 57

Plate 57.

Semidiagrammatic illustration of the anatomy of *Temnoconcha brasiliana*. Specimen with the mantle, ctenidia and palps removed to show internal features. Ovary indicated by check marks, digestive gland by wavy lines.

1. kidney.
2. oviduct.
3. convoluted portion of the intestine.
4. appendix.
5. stomach.
6. ducts to digestive gland on right side of stomach.
7. mid-gut and style sac.
8. esophagus.
9. mouth.
10. siphonal organ.
11. parasiphonal organ.
12. ventral channel.
13. nephroproct.
14. auricle.
15. ventricle.
16. posterior aorta.
17. transverse muscle (one of many).
18. cerebropleural ganglion.
19. pedal ganglion.
20. visceral ganglion.
21. cerebropleural-pedal connective.
22. cerebropleural-visceral connective.
23. nerve to posterior adductor.
24. nerve to anterior adductor.
25. branchial nerves.

valve and inserts deeply in the foot. The posterior pedal retractor originates dorsal to the posterior adductor muscle and courses anteriorly to insert in the foot beneath the fibers of the pedal protractor and intermeshing with the fibers of the anterior pedal retractor. The pedal protractor has a diffuse origin along the anterior dorsal margin between the anterior adductor muscle and the anterior pedal retractor. The pedal protractor splays out in a superficial insertion immediately beneath the heavy epidermal tissue of the foot. The foot itself is rather large and laterally compressed; its well developed retractor, protractor, and many transverse muscles reflect its strength and extensibility.

The gills of *Temnoconcha* are typically macomoid in form and placement. They consist of a dorsally upturned outer demibranch and a ventral inner demibranch. The individual demibranchs are united medially, and the combined demibranchs of the right and left ctenidia are united distally along the ventral surface of the posterior retractor muscle. Contiguous with the proximal boundary of the inner demibranch are the large labial palps which are similar to those of other macomoids (Thiele, 1886). The filter feeding mechanisms of *brasiliana* are probably similar in function to those of *Macoma secta* as described by Kellogg (1915).

Plates 57 and 59 illustrate the structure of the alimentary canal. At the median union of the right and left pairs of labial palps is the mouth. A short esophagus leads to the stomach which is enveloped by the digestive gland. The stomach in the Tellinidae has been described in detail by Graham (1949) and Purchon (1960). In *brasiliana,* the style sac and mid-gut are united and leave the stomach postero-ventrally. The stomach has right and left ventral caeca, a dorsal pouch, and a postero-dorsal appendix. Two large ducts from the digestive gland enter the right ventral caecum and a single duct enters the left ventral caecum. The gastric shield differs markedly from that of *Tellina tenuis* as illustrated by Yonge (1949) in that it extends into the esophagus, the dorsal pouch, and the posterior portion of the stomach dorsal to the appendix. The intestine is tortuously convoluted before it passes through the ventricle of the heart in the pericardial cavity. The rectum extends from the pericardial cavity along the dorsal margin above the

ctenidium and the posterior adductor muscles, forming the terminal anus near the opening of the excurrent siphon. In the specimen dissected, the intestine and rectum contained coin-shaped fecal pellets (length/breadth ratio = 0.5) which upon examination were found to consist of unidentifiable plant remains, including diatoms, and some sand grains with detritus, indicating the normal filtering habit of a benthic deposit feeder.

The heart is located postero-dorsally in the pericardial cavity. It is simple in form, consisting of laterally paired thin-walled auricles and a single thick-walled median ventricle through which the rectum passes. An aorta extends posteriorly from the ventricle along the ventral side of the rectum. The relatively large kidney which is postero-ventral to the heart connects with the pericardium via the laterally paired ciliated reno-pericardial funnels. Waste products from the kidney are expelled via the nephroproct.

*Temnoconcha* appears to be dioecious though only a female specimen was available for dissection. The large ovary is imbedded in the foot, surrounds the style sac, mid-gut, and the ventral portion of the digestive gland and extends dorsally and superficially over the convoluted portion of the intestine into the mantle tissue. The extension of the gonad into the mantle tissue has been reported in certain species of *Arca* and *Chama* (White, 1942). A long and branched oviduct leads to the genital pore which opens near the nephroproct in a urogenital sinus which is coextensive with the mantle cavity. Eggs in the ovary were 130–140 $\mu$ in diameter and quite yolky, indicating lecithotrophic larval development and a short pelagic stage. Odhner (1912) has discussed in detail the nephridial system and its relationship with the circulatory and reproductive systems in *Macoma balthica,* which in many respects is similar to *brasiliana.*

The structure of the nervous system of *Temnoconcha* is similar to that of *Psammobia* as described by Durvernoy (1854). The cerebropleural ganglia, located on the inner surface of the anterior adductor muscle, are united via a cerebro-pleural commissure. Anteriorly the ganglia give rise to a branching complex of nerves which innervates the anterior adductor muscle as well as the anterior pallial musculature. The cerebropleural-pedal connectives extend ventrally from the cerebropleural

Plate 58

Ventral posterior view of *Temnoconcha brasiliana* to show the structural features of the cruciform muscle and the siphonal apparatus.

1. tentacles.
2. rectum.
3. anus.
4. posterior adductor muscle.
5. excurrent siphon.
6. incurrent siphon.
7. cruciform muscle.
8. cruciform organs.
9. mantle fold forming ventral channel.
10. siphonal organ.
11. parasiphonal organ.
12. base of incurrent siphon.
13. foot.

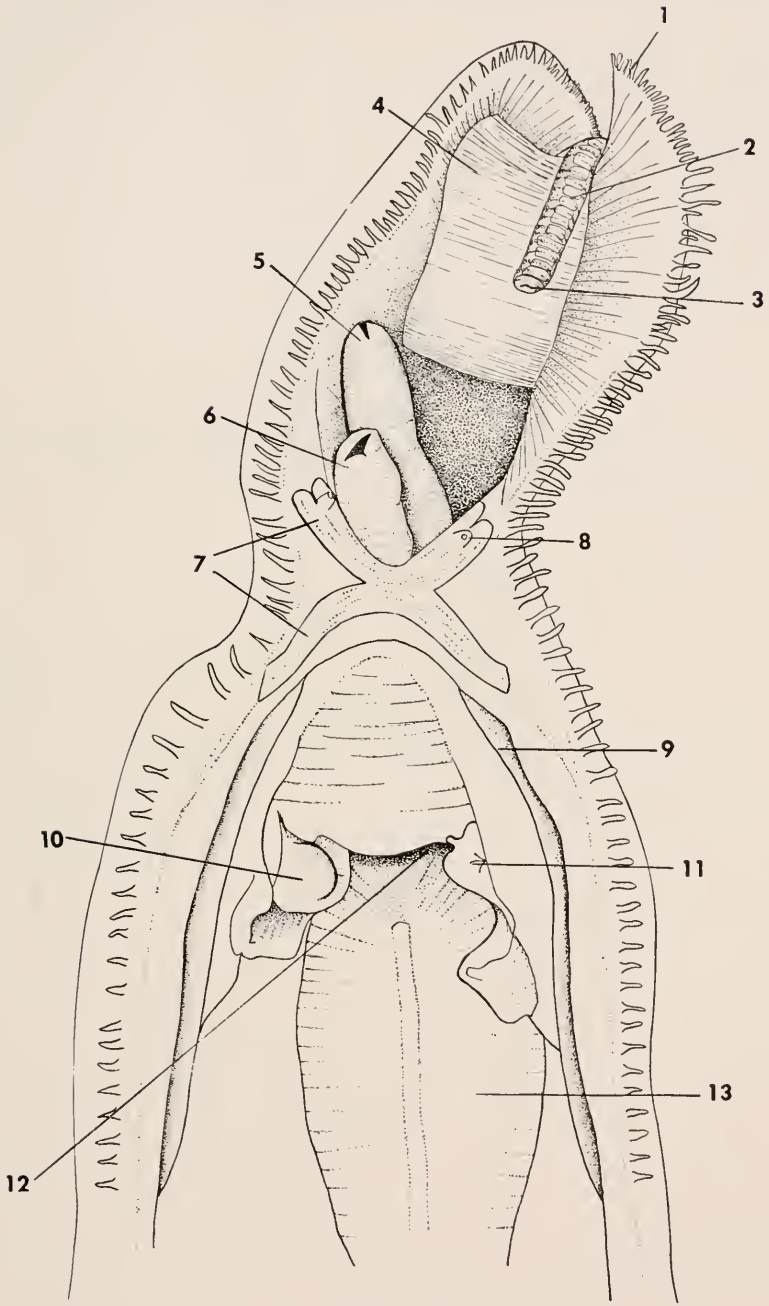


Plate 58

Plate 59

Upper figure. The style sac and stomach of *Temnoconcha brasiliana* viewed from the right side. Lower figure. The gastric shield of *Temnoconcha brasiliana* viewed from the right side.

1. style sac and mid-gut.
2. crystalline style.
3. appendix.
4. esophagus.
5. right ventral caecum.
6. gastric teeth.
7. extension to dorsal pouch.
8. extension to esophagus.
9. extension to style sac.
10. extension toward postero-dorsal appendix.

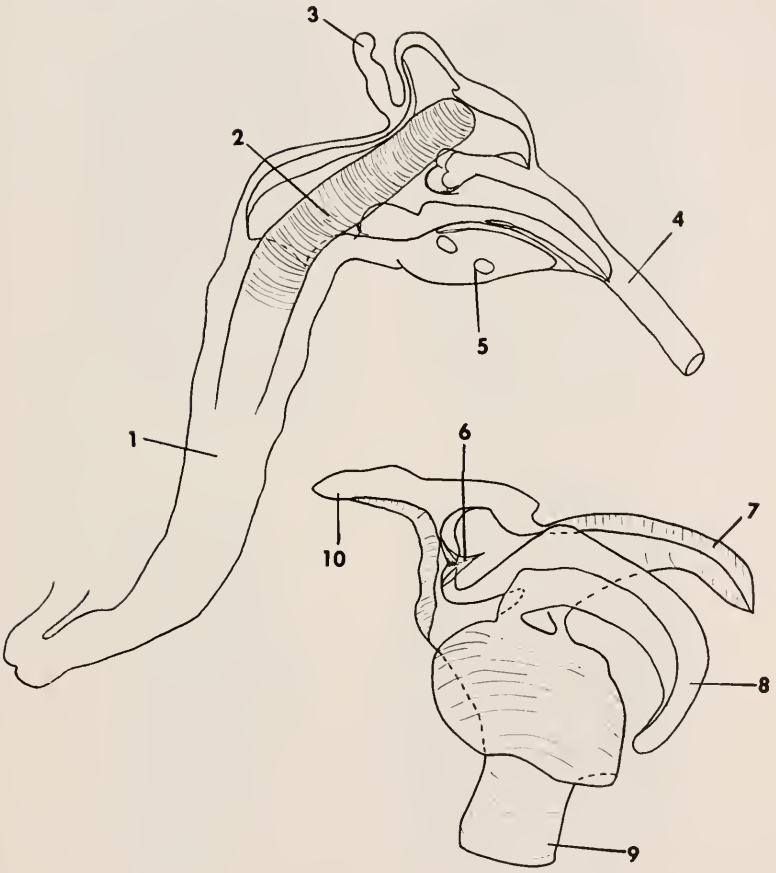


Plate 59

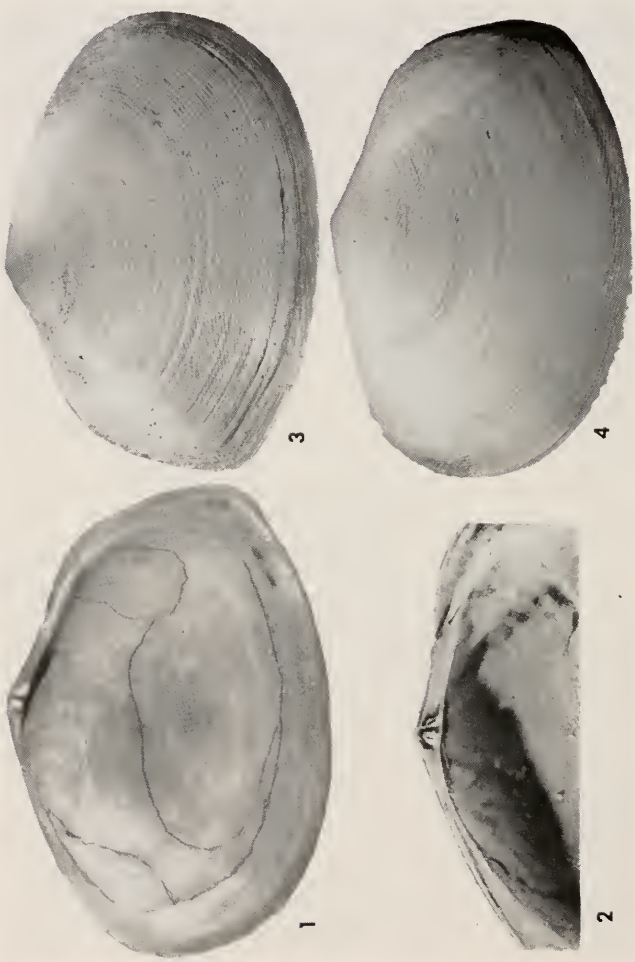


Plate 60

Plate 60

Fig. 1. Internal view of the right valve of the holotype of *Temnoconcha brasiliana* Dall, showing configuration of the pallial sinus (1.8×).

Fig. 2. Internal view of a portion of the right valve of *Temnoconcha brasiliana* Dall, showing the bifid cardinal teeth and absence of lateral teeth (specimen from the d'Orbigny collection, BMNH; 2.8×).

Fig. 3. External view of the right valve of the holotype of *Temnoconcha brasiliana* Dall (1.8×).

Fig. 4. External view of the left valve of the holotype of *Temnoconcha brasiliana* Dall (1.8×).

ganglia to the paired but closely juxtaposed pedal ganglia. From the pedal ganglia numerous branches innervate portions of the pedal retractor and protractor musculature as well as portions of the viscera extending into the foot. Arising from the cerebropleural ganglia and coursing posteriorly are the laterally paired cerebropleural-visceral connectives which communicate with the nearly fused, compacted visceral ganglia near the inner surface of the posterior adductor muscle. Paired nerves are given off to the ctenidia from the visceral ganglia and the posterior adductor muscle. The largest pair of nerves extends ventrally and gives off branches to the mantle, the siphonal musculature, the siphonal and parasiphonal organs, and the cruciform muscle.

## Relationships

The affinities of *Temnoconcha* with the family Tellinidae are clearly shown by anatomical characters such as the formation of the gills and the muscles, the union of the style sac and the mid-gut, the simple structure of the heart, the dioecious condition of the reproductive system and the specialization of the nervous system. Within the family, the subfamilies Tellininae and Macominae may be distinguished by the presence or absence of lateral teeth, the relative size of the ctenidia and the labial palps, the degree of convolution of the distal portion of the intestine and the structure of the cruciform organs. The genus *Temnoconcha* has macomoid shell characters but is distinctive in the possession of two bifid cardinal teeth in the right valve. As in *Macoma,* the palps of *Temnoconcha* are larger than the ctenidia, the distal portion of the intestine is extensively convoluted and the cruciform organs open externally via tubular papillae. Therefore, *Temnoconcha* appears to belong to the subfamily Macominae.

*Temnoconcha* differs from other members of the Tellinidae for which the anatomy is known in the following characters: 1) the gastric shield is very complex; 2) the medial muscle splays out over the viscera dorsally rather than passing beneath the postero-dorsal appendix of the stomach; 3) the posterior portion of the cruciform muscle has a double rather than a single origin; and 4) the reproductive tissue extends into the mantle.

## Bibliography

Dall, W. H. 1921. Two new South American Shells. Nautilus, **34:** 132.

d'Orbigny, A. 1842 [in] Sagra, Hist. l'Ile Cuba, Atlas, pl. 25, figs. 47–49; 1845, Spanish Text, Molluscos. **2**(5): 303; 1853, French Text, Mollusques, **2:** 251.

Duvernoy, M. 1854. Memoires sur le Systeme Nerveux des Mollusques Acephales. Memoires de l'Academie des Sciences (Paris), **24:** 3–212.

Graham, A. 1949. The Molluscan Stomach. Trans. Roy. Soc. Edinburgh, **61:** 737–778.

Kellogg, J. L. 1915. Ciliary Mechanisms of Lamellibranchs with Descriptions of Anatomy. Jour. Morph., **26:** 625–701.

Mauay, C. J. 1917. Santo Domingo Type Sections and Fossils. Bull. Amer. Paleo., **5**(29): 223–388.

Odhner, N. 1912. Morphologische und phylogenetische Untersuchungen über die Nephridien der Lamellibranchien. Zeitschrift für wissenschaftliche Zoologie, **100:** 287–391.

Olsson, A. A. 1961. Mollusks of the Tropical Eastern Pacific. Panamic-Pacific Pelecypoda. Paleontological Research Inst., Ithaca, N.Y., 574 pp.

Pelseneer, P. 1911. Les Lamellibranches de l'Expedition du Siboga. Partie anatomique. Siboga-Expeditie, Monographie 103a, 125 pp., 26 pls.

Purchon, R. D. 1960. The Stomach in the Eulamellibranchia: Stomach Types IV and V. Proc. Zool. Soc. London, **135:** 431–489.

Thiele, J. 1886. Die Mundlappen der Lamellibranchiaten. Zeitschrift für wissenschaftliche Zoologie, **45:** 239–272.

White, K. M. 1942. The Pericardial Cavity and the Pericardial Gland of the Lamellibranchia. Proc. Mala. Soc. London, **25:** 37–88.

Yonge, C. M. 1949. On the Structure and Adaptations of the Tellinacea. Phil. Trans. Roy. Soc. London, Ser. B, **234:** 29–76.

Yonge, C. M. 1957. Mantle Fusion in the Lamellibranchia. Pubblicazioni della Stazione Zoologicadi Napoli, **29:** 151–171.

## Supplement to the Poison Cone Shell[1]

*By* WILLIAM J. CLENCH

The following appeared anonymously in a newspaper under the title of "Natural History." I am indebted to Dr. D. F. McMichael of the Australian Museum, for bringing it to my attention.

The Sidney Mail, January 10, 1874, p. 50.

"A strange instance of poisoning occurred on the Island of Maré [Loyalty Islands, New Caledonia]. On a Monday morning the *John Williams* anchored off the station of the Rev. J. Jones. For a long time no notice was taken of our visit, not a canoe came off. When at last the missionary pulled off to us in his boat, we anxiously inquired the cause of delay.

"Mr. Jones had been burying a poor man who had been poisoned by handling a fish. After attending the services of the Sabbath, the thoughtless fellow went fishing on the reef at sunset. In the doubtful light he unhappily took up a good sized shell-fish and put it in his basket. He immediately felt a painful sensation running up his right arm to the shoulder. He went home. The pain increased until he writhed in agony. The body swelled to an enormous size and by daylight he was a corpse. So remarkable did this seem to me that I requested a sight of the shell-fish which poisons by the mere touch, although the skin be uninjured. The request was kindly complied with by the friends of the deceased; and the shell proved to be the *Conus textile.*

"This variety of shell-fish is well known to the natives of Western Polynesia for its dangerous qualities. A virulent poison is injected by means of numerous minute barbs connected with the mantle. These barbs somewhat resemble the sting of a bee."

[1] See *Occasional Papers On Mollusks,* 1946, **1:** 49–80.

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 SEPTEMBER 25, 1964 NUMBER 31

# Land and Freshwater Mollusca of the Cayman Islands, West Indies

*By* WILLIAM J. CLENCH

The Cayman Islands consist of three separate islands: Grand Cayman, Little Cayman and Cayman Brac. Grand Cayman is about 100 miles northwest of Jamaica and 210 miles west-southwest of Cabo Cruz, Cuba. Little Cayman and Cayman Brac are 5 miles apart, and are 60 miles northeast of Grand Cayman.

The total area of these islands is about 100 square miles, Grand Cayman being 76, Cayman Brac about 14 and Little Cayman about 10 square miles.

C. A. Matley (1926, p. 355) described these islands as follows: "All the islands are low-lying, and do not attain anywhere a height of more than 60 feet above sea-level, except Cayman Brac, the eastern end of which rises to 140 feet. Viewed from the sea they have a general resemblance to the flat-topped islands of the Bahama group. They are formed entirely of calcareous rocks, which the present survey has shown to be separable into two formations. An older limestone, which I call the Bluff Limestone, forms the central and larger part of each island; and a younger formation of consolidated coral-sand and marl, with some limestone, which I call the Ironshore Formation, occupies most of the periphery as a low coastal terrace, which never rises to a greater height than 12 or 15 feet above the sea, and generally terminates abruptly inland against raised marine cliffs of the Bluff Limestone. In addition to the above are the recent deposits which, at sea, are living

coral-reefs that almost surround the islands of Grand Cayman and Little Cayman, but occur only to a limited extent at the south-west of Cayman Brac, and ashore, consist of blown coral-sand and storm-beaches of coral-shingle piled up by winds, storms, and hurricanes on the seaward side of the coastal platform. All the islands are entirely devoid of streams, owing to the porosity of the limestones, and even dry valleys are absent."

The central and elevated portions of these islands are of Miocene age while the coastal platform reaching a height of 12 to 15 feet above the sea is probably Pleistocene as it contains reef-building corals and mollusks which occur in the sea around these islands at the present time.

Matley's statement that "they have a general resemblance to the flat-topped islands of the Bahama group" is misleading as the Bahama Islands, certainly those I have seen, are composed of lithified sand dunes and not of reef formation other than the low coastal limestone. An excellent example is provided by the "Queen's Staircase" in Nassau, New Providence. This is a deep, excavated cut through a lithified dune. Fossil land snails of the genus *Cerion* are to be seen in layers several feet below the surface of the dune.

## Historical

The collections of land and freshwater mollusks of the Cayman Islands are well documented. This is quite different from other islands or island groups in the West Indies where most of the early history has been lost. The collector of only a single species, *Cerion martinianum* Küster, is unknown. Pilsbry (1930, p. 221) has stated "it was probably picked up by a sailor or buccaneer about a hundred years ago and brought to Europe in his chest of shells and curios." Until 1930 only six species of land snails were known from the Cayman Islands.[1]

A Mr. Clark P. Streator visited the Cayman Islands sometime prior to 1889 and collected a few mollusks. These were described by Pilsbry. In April 1896 an ornithologist, Mr. Charles B. Taylor from Kingston, Jamaica, also collected a few land mollusks, which were described in 1911 by H. B. Preston.

[1] Not including the numerous "species" of *Cerion* by Maynard.

These shells Preston had obtained from Rosenberg, a London dealer in bird skins.

During March 1888, Charles Johnson Maynard spent considerable time on Cayman Brac and Little Cayman. He left Kingston, Jamaica, and "took a small schooner for Grand Cayman but prevailed upon the Captain to let him off on Cayman Brac where he spent some time collecting before going to Little Cayman" (Turner 1957, p. 144). He apparently did not go to Grand Cayman, as there are no *Cerion* in his collection from that island.

Maynard's interest in mollusks was limited to the genus *Cerion,* but he would occasionally pick up a few other land mollusks if they were abundant. His collection of *Cerion* was purchased by the Museum of Comparative Zoology and the United States National Museum and divided equally between these two institutions.

Maynard was a "splitter" far beyond what is generally meant by this term. His species concept was that of a single population. In his descriptions he emphasized the slight differences existing between two "species," without mentioning the many specimens that were identical in their characters.

In 1929, H. A. Pilsbry was invited by former Governor Pinchot of Pennsylvania to join him on a trip to the South Seas on the schooner "Mary Pinchot." Several stops were made in the West Indies including the island of Grand Cayman. Several new species of land mollusks from this island were described by Pilsbry as a result of this trip.

The most important expedition to these islands for land mollusks was that of Dr. Paul Bartsch of the United States National Museum and his party during September 1930. Much of both Cayman Brac and Little Cayman was covered, but only the western portion of Grand Cayman was explored. The early part of this extended West Indian trip had been in the southern Bahama Islands.

Ornithologist, James Bond of the Academy of Natural Sciences, Philadelphia, collected birds and land shells in the Cayman Islands in 1930.

In 1938, C. B. Lewis of the Institute of Jamaica, was associated with an Oxford University Biological Expedition. Land shells were collected from all three islands of the Cayman

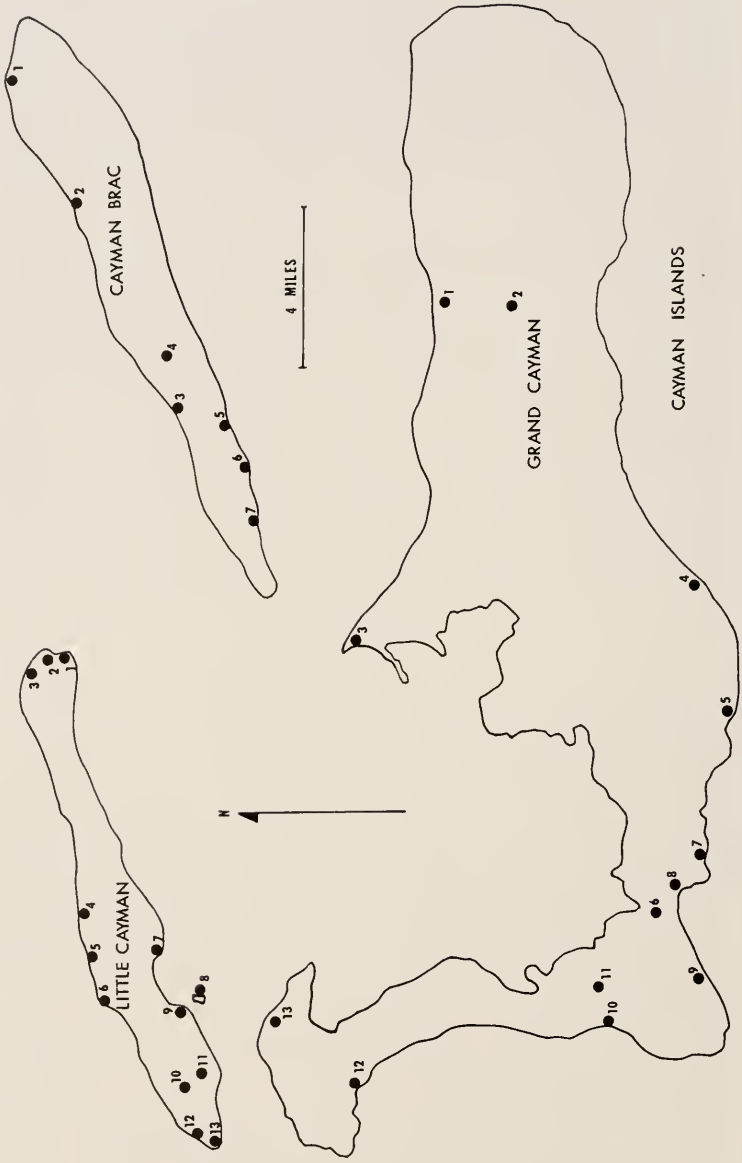


Plate 61. Cayman Islands. Scale accurate, grouping arbitrary.

Plate 61

GRAND CAYMAN

1 ¼ mile S of north shore
2 Center of island on north-south road which intersects the road paralleling the north shore road at Old Man Bay
3 Rum Point
4 Bodden Town
5 3 miles W of Bodden Town
6 Between North Sound and Red Bay
7 Between George Town and Bodden Town
8 Red Bay
9 Between Southwest Point and Red Bay
10 George Town
11 Between George Town and North Sound
12 1½ miles E of Northwest Point
13 Between Conch Point and Palmetto Point

Branching of Forest Glen Road from Further Land Road [not located]

LITTLE CAYMAN

1 Near eastern end
2 Reef Harbour [also called Snipe Harbour]
3 N side near East Point
4 N coast opposite Sparrowhawk Hill
5 1 mile E of Jackson Point
6 E side of Bloody Bay
7 Rocky Point
8 Owen Island
9 Blossom Village
10 halfway across island
11 N side of first ridge, western end
12 N coast near Southwest Point
13 Western end

CAYMAN BRAC

1 Booby Point
2 The Bight
3 Stake Bay
4 Road crossing island from Custom House
5 S end of Bluff Road from Stake Bay
6 At lagoon, southwest coast
7 2 miles E of Southwest Point

group and were reported upon by Pilsbry in 1942. Again in 1940, Lewis spent one week on Cayman Brac while en route to the Pedro and Morant Cays on behalf of the Jamaican Government. Material from this trip was also reported upon by Pilsbry in 1949.

Charles B. Wurtz spent one day on Grand Cayman while on a collecting trip, the Catherwood-Chaplin West Indies Expedition, 1948. He described four new species from this island.

## Acknowledgments

My sincere thanks are due to Dr. R. T. Abbott of the Academy of Natural Sciences, Philadelphia for the loan of many species from these islands. I am particularly indebted to Dr. H. A. Rehder of the United States National Museum for the loan of the material collected by Paul Bartsch and his party in 1930. To Dr. Grace Hunter of the Stranahan High School, Fort Lauderdale, Florida, I am indebted for eight lots of *Cerion* from Cayman Brac which she collected during a brief trip to this island in July 1963.

I am indebted to my colleagues, Dr. Ruth D. Turner and Mr. Richard I. Johnson for reading the manuscript.

## Abbreviations

| | |
|---|---|
| Academy of Natural Sciences of Philadelphia | ANSP |
| Museum of Comparative Zoology | MCZ |
| United States National Museum | USNM |

## Notes on the Land and Freshwater Mollusks

The fauna of land mollusks of the Cayman Islands is disharmonic, judging by the relationships of the endemic species and the origin of the non-endemic elements. Thirty out of the forty-eight recorded species are endemic and seventeen of these show a relationship with species of Jamaica, ten with Cuba, two with Central America, and one with the Isle of Pines.

Pilsbry has stated (1930, p. 226) that Grand Cayman was at one time connected with Jamaica, but the relationships given above hardly warrant this assumption. See also notes at end of this report for the relationships of the reptiles, amphibians and butterflies of these islands. Pilsbry's statement relative to this land connection was based entirely upon the evidence of

relationships of the several species of land shells concerned and not upon any geological evidence other than a few speculative remarks.

We give below the comparisons of the land snail fauna of two island groups, the Caymans and the Crooked Island Group in the Bahamas. This comparison is given to indicate the factors of time, of distance from other islands, and of square mile area. So far as I am able to tell from the data available to me, the differences in the ecological niches are far more favorable in the Crooked Island Group than in the Cayman Islands.

There are two species of freshwater mollusks, *Biomphalaria havanensis* and *Drepanotrema lucidum* found in a well and in a solution hole, the remainder are all land.

Comparison of the Molluscan Faunas

| | widely distributed | limited in distribution | endemic species | total species | area in square miles |
|---|---|---|---|---|---|
| Crooked Island group | 25 | 3 | 20 | 48 | 219 |
| Cayman Islands | 11 | 6 | 30 * | 48 | 100 |

* One "endemic" species, *Choanopoma caymanense* Pilsbry, is not included as it has never been recorded since it was described in 1891 and it may not be from the Caymans.

In the tabulation given above, both island groups have the same number of species; the Caymans have one-third more endemic species, but with only half the land area. In addition, the Crooked Island group is much nearer other islands and island groups than are the Caymans, and they also have more types of ecological areas for the successful introduction of species which have arrived by fortuitous means. This would seem to indicate that the factor of time has played its part, and the smaller area and the greater distance from other land areas were somewhat offset by the longer existence of the Caymans as a habitable area. The large number of endemic species is possibly due to the greater age of these islands as compared with the Crooked Island group in the Bahamas (Clench 1963). The fauna on the Crooked Island group possibly dates only from the Pliocene or early Pleistocene, as prior to that time these islands had been covered with water during a positive eustatic oceanic level.

DISTRIBUTION WITHIN THE CAYMAN ISLANDS

| | Grand Cayman | Little Cayman | Cayman Brac |
|---|---|---|---|
| *Eutrochatella fisheri* | X | | |
| *Helicina fasciata substriata* | X | X | X |
| *Alcadia lewisi* | | X | X |
| *Lucidella caymanensis* | | X | X |
| *Stoastoma atomus* | X | | |
| *Cyclopilsbrya fonticula* | X | | |
| *Chondropoma caymanense* | X | | |
| *Chondropoma caymanbracense* | | | X |
| *Chondropoma caymanbracense parvicaymanense* | | X | X |
| *Tudora rosenbergiana* | X | | |
| *Geomelania alemon* | X | | |
| *Biomphalaria havanensis* | X | | |
| *Drepanotrema lucidum* | X | | |
| *Veronicella laevis* | X | | |
| *Succinea latior* | X | | |
| *Gastrocopta rupicola marginalba* | X | X | |
| *Gastrocopta pellucida* | X | X | X |
| *Pupoides albilabris* | | X | |
| *Strobilops wenziana* | X | | |
| *Strobilops hubbardi* | | X | |
| *Cecilioides iota* | X | X | |
| *Lamellaxis gracilis* | X | | |
| *Lamellaxis micrus* | X | | |
| *Synopeas pumilum* | X | | |
| *Subulina octona* | X | | |
| *Spiraxis subrectaxis* | X | | |
| *Spiraxis caymanensis* | X | | |
| *Varicella caymanensis* | X | X | X |
| *Varicella pinchoti* | X | | |
| *Varicella infantia* | X | | |
| *Varicella adolescentia* | X | | |
| *Melaniella gracillima* | | X | X |
| *Lacteoluna summa* | X | | |
| *Lacteoluna caymanensis* | X | | |
| *Lacteoluna steveni* | X | | |
| *Lacteoluna trochella* | X | | |
| *Lacteoluna caymanbracensis* | | X | X |
| *Proserpinula lewisi* | | X | X |
| *Orthalicus jamaicensis* | X | | |
| *Cerion pannosum* | | X | X |
| *Cerion martinianum* | X | | |
| *Cerion nanus* | | X | |
| *Microceramus caymanensis* | X | X | X |
| *Pineria perpusillus* | X | | |
| *Brachypodella caymanensis* | X | X | X |
| *Hemitrochus streatori* | X | X | X |
| *Hemitrochus lewisiana* | X | | |
| Total number of species | 36 | 18 | 14 |

## List of the Species known from the Cayman Islands

### HELICINIDAE

#### Eutrochatella fisheri *Pilsbry*

*Pyrgodomus fisheri* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 243, pl. 15, fig. 3 (Swan Island near radio station). [Holotype, ANSP no. 150868]; Wurtz 1950, Proc. Acad. Nat. Sci. Philadelphia **102:** 102.

*Remarks.* This minute species was found on Grand Cayman by Wurtz (1950, p. 102). He could not differentiate it from Swan Island specimens.

*Eutrochatella fisheri* is rather close in its relationships with *E. rupestris* Pfeiffer from Cuba, differing by being smaller and having a weaker sculpture of spiral threads.

*Specimens examined.* Grand Cayman: $\frac{1}{4}$ mile S of north shore (ANSP).

#### Helicina fasciata substriata *Gray*

*Helicina substriata* Gray 1825, Zool. Jour. **1:** 66, pl. 6, fig. 4 (West Indies).
*Helicina fasciata caymanensis* Pilsbry 1949, Nautilus **63:** 40, pl. 3, fig. 7 (Cayman Brac). [Holotype, ANSP no. 187666.]

*Remarks.* The Cayman Brac form was separated from *substriata* of the Lesser Antilles on the basis of having more "broadly rounded" whorls. In a large series of *substriata,* however, broadly rounded specimens occur which are identical to the Cayman specimens.

*Specimens examined.* Grand Cayman: George Town (MCZ; USNM); between North Sound and Red Bay (ANSP).

Little Cayman: north coast near Southwestern Point; Blossom Village; north side near East Point; east of Reef Harbour entrance (all USNM).

Cayman Brac: (MCZ; ANSP); road crossing island at Custom House; Booby Point (both USNM).

#### Alcadia lewisi *Pilsbry*

*Alcadia lewisi* Pilsbry 1942, Nautilus **56:** 4, pl. 1, fig. 4 (bush road behind Stakes Bay, Cayman Brac). [Holotype, British Museum.]

*Remarks.* In relationship, this species is nearest to *Alcadia minima* (d'Orb.), a species widely distributed throughout Cuba. *A. lewisi* differs by being less than half the size and in having a weak basal lip notch.

*Specimens examined.* LITTLE CAYMAN: N side of first ridge, western end; E of Reef Harbour entrance; Blossom Village; N side near East Point (all USNM).

CAYMAN BRAC: Booby Point; road across island at Custom House (both USNM); behind Stakes Bay (ANSP).

### Lucidella caymanensis *Pilsbry*

*Lucidella caymanensis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 230, pl. 15, figs. 1–1b (road between North Sound and George Town, Grand Cayman). [Holotype, ANSP no. 150867.]

*Remarks.* This species is closely related to *Lucidella pilsbryi* Clapp from Swan Island, differing by being far more depressed. Both of these species are related to *L. lineata* C. B. Adams of Jamaica which differs by having a small apertural tooth within the outer lip, as well as a much larger basal tooth.

*Specimens examined.* GRAND CAYMAN: road between North Sound and George Town (ANSP; MCZ).

LITTLE CAYMAN: E of Reef Harbour entrance; half way across island at western end (both USNM).

CAYMAN BRAC: Booby Point (USNM).

### Stoastoma (Blandia) atomus *Pilsbry*

*Stoastoma* (*Blandia*) *atomus* Pilsbry 1930, Proc. Acad. Nat. Science Philadelphia **82:** 230, pl. 15, figs. 4–4b (road between North Sound and George Town, Grand Cayman). [Holotype, ANSP no. 150863.]

*Remarks.* Pilsbry states that this species is close in its relationship to *Stoastoma blandiana* C. B. Adams from Manchester, Jamaica, having the same shape but being very much smaller.

## CYCLOPHORIDAE

### Cyclopilsbrya fonticula *Preston*

*Neocyclotus fonticulus* Preston 1911, Proc. Malac. Soc. London **9:** 359, text fig. (Grand Cayman).

*Poteria caymanensis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 227, pl. 18, figs. 4–5 (1 mile S of George Town, Grand Cayman). [Holotype, ANSP no. 150857.]

*Poteria laevitesta* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 227, pl. 16, figs. 18–18a; 19–19a (Grand Cayman). [Holotype, ANSP no. 150657.]

*Poteria caymanensis oligoptyx* Pilsbry 1942, Nautilus **56:** 2, pl. 1, figs. 12–13a (East End, Grand Cayman). [Holotype, British Museum.]

*Cyclopilsbrya* (*Cyclocaymania*) *caymanensis* (Pilsbry). Bartsch 1942, United States National Mus. Bull. **181:** 80, pl. 13, figs. 7–12.

*Cyclopilsbrya* (*Cyclocaymania*) *fonticula* (Preston). Bartsch 1942, United States National Mus. Bull. **181:** 81, pl. 13, figs. 13–18; pl. 42, figs. 6–7.

*Cyclopilsbrya* (*Cyclocaymania*) *laevitesta* (Pilsbry). Bartsch 1942, United States National Mus. Bull. **181:** 82, pl. 13, figs. 22–24.

*Poteria fonticula* (Preston). Wurtz 1950, Proc. Acad. Nat. Sci. Philadelphia **102:** 102.

*Remarks.* I am in full agreement with Wurtz (1950, p. 102) that no real distinctions exist among the various specimens which have been named as "species" given in the synonymy above.

Bartsch (1942) created a number of new genera and subgenera for various species in this complex which have been grouped previously in the genus *Poteria.* His generic characters were based upon sculpture and minor morphological differences in the opercula. The validity of these names will have to remain in abeyance until we have far more knowledge of the soft anatomy.

In the Caymans the genus *Cyclopilsbrya* occurs only on Grand Cayman. In relationship, *C. fonticula* is close to species found in western Jamaica.

*Specimens examined.* GRAND CAYMAN: (MCZ; ANSP; USNM; James Poling); between George Town and Bodden Town (USNM).

## CHONDROPOMIDAE

### Chondropoma caymanense *Preston*

*Chondropoma caymanense* Preston 1911, Proc. Malac. Soc. London **9:** 360, text fig. (Grand Cayman).

*Remarks.* This species is closely related to *C. caribbeum* Clapp from Little Swan Island. In *C. caymanense* the sculpture is coarser and the spiral threads are particularly strong. These

species are related to the *Chondropoma poeyanum* d'Orb. complex of Cuba.

*Specimens examined.* GRAND CAYMAN: (MCZ); Bodden Town (ANSP; USNM).

### Chondropoma caymanbracense *Pilsbry*

*Chondropoma caymanbracense* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 352, pl. 30, fig. 1 (Cayman Brac). [Holotype, ANSP no. 151796.]

*Remarks.* This is a larger species than *C. caymanense* and with a more globose body whorl. This species is related to the *C. poeyanum* complex of Cuba.

*Specimens examined.* CAYMAN BRAC: road crossing island at Custom House; Booby Point; at lagoon, southwest coast (all USNM); behind Stake Bay (ANSP).

### Chondropoma caymanbracense parvicaymanense *Pilsbry*

*Chondropoma parvicaymanense* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 352, pl. 30, fig. 5 (Little Cayman). [Holotype, ANSP no. 13590.]

*Specimens examined.* LITTLE CAYMAN: (MCZ); western end; E of Reef Harbour entrance; Owen Island; near eastern end; Blossom Village (all USNM).

### Choanopoma caymanense *Pilsbry*

*Choanopoma caymanensis* Pilsbry 1891, Nautilus **5:** 83, (Cayman Islands); Pilsbry 1930. Proc. Acad. Nat. Sci. Philadelphia **82:** 352, pl. 30, figs. 2–3. [Holotype, ANSP no. 105773.]

*Remarks.* It is quite possible that this species did not come from the Cayman Islands. It has not been collected by any of the several collecting parties since Pilsbry published this species in 1891.

### Tudora (Colobostylus) rosenbergiana *Preston*

*Choanopoma rosenbergianum* Preston 1911, Proc. Malac. Soc. London **9:** 359, text fig. (Grand Cayman).

*Choanopoma caymanicola* Pilsbry 1928, Nautilus **42:** 68 (Grand Cayman). [Holotype, ANSP no. 145014.]

*Colobostylus rosenbergianus caymanicola* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 229, pl. 16, fig. 14.

*Colobostylus rosenbergianus boddensis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 228, pl. 16, figs. 3–6 (west end of Bodden Town, Grand Cayman). [Holotype, ANSP no. 150933.]

*Remarks.* This species appears nearest to *C. retrorsus* C. B. Adams from Jamaica.

*Specimens examined.* GRAND CAYMAN: Bodden Town (ANSP; USNM); ¼ mile S of North Shore (ANSP).

## TRUNCATELLIDAE

### Geomelania (Merrilliana) alemon *Pilsbry*

*Geomelania alemon* Pilsbry 1942, Nautilus **56:** 3, pl. 1, fig. 9 (Boilers, near George Town, Grand Cayman). [Holotype, British Museum.]

*Geomelania (Merrilliana) alemon* Pilsbry. Clench and Turner 1948, Occasional Papers On Mollusks **1:** 182.

*Remarks.* Marine species in this family are not included. *Geomelania alemon* appears nearest in relationship to *G. pygmaea* (C. B. Ad.) from Jamaica. It is similar in size and sculpture, but differs in having the aperture extending out beyond the body whorl.

*Specimens examined.* GRAND CAYMAN: near George Town (ANSP).

## PLANORBIDAE

The two following species are the only freshwater mollusks recorded for these islands. This is completely understandable for an area with no permanent freshwater owing to the porosity of the limestone.

### Biomphalaria havanensis *Pfeiffer*

*Planorbis havanensis* Pfeiffer 1839, Archiv für Naturgeschichte **5:** 354 (Cuba).

*Planorbis terverianus* d'Orbigny 1841 [in] de la Sagra, Histoire de l'Ile de Cuba, Paris. Mollusques **1:** 194, pl. 13, figs. 20, 23 (Habana, Cuba).

*Planorbis maya* Morelet 1849, Testacea Noviss. Insulae Cubanae Amer. Centr. **1:** 16 (city of Campeche [Mexico]).

*Planorbis liebmanni* Dunker 1850 [in] Martini-Chemnitz, Systematisches Conchylien-Cabinet (2) **1:** pt. 17, p. 59, pl. 10, figs. 32–34 (Veracruz [Mexico]).

*Tropicorbis havanensis insularum* Pilsbry 1942, Nautilus **56:** 8 (cow well,

Further Land Road, north side area, Grand Cayman). [Holotype, British Museum.]

*Taphius havanensis* Pfeiffer. Paraense and Deslandes 1958, Rev. Brasil. Biol. **18:** 87–91.

*Remarks.* Pilsbry (1942, p. 8) admitted that "these small planorbs may represent a dwarf ecologic form rather than a true subspecies, but as it has been found only in a single place, it seems simpler to give it a varietal name."

*Biomphalaria havanensis* is a widely distributed species in the West Indies and Central America. Like most of our freshwater pulmonates, no two populations are exactly the same. It serves little purpose, however, to give names to these slightly divergent populations.

Barbosa (1961) and others have indicated recently their preference for the generic name *Biomphalaria* for this and several other species, even though it is not the earliest name. Both *Planorbina* Haldeman 1842 and *Taphius* H. and A. Adams 1855 predate *Biomphalaria* Preston 1910. *Biomphalaria* is now widely used by medical parasitologists for the intermediate hosts of *Schistosoma mansoni.* The question regarding the use of *Biomphalaria* has been placed before the International Commission on Zoological Nomenclature.

### Drepanotrema lucidum *Pfeiffer*

*Planorbis lucidus* Pfeiffer 1839, Archiv für Naturgeschichte **5:** 354 (Cuba).

*Planorbis lanierianus* d'Orbigny 1841 [in] de la Sagra, Histoire de l'Ile de Cuba, Paris. Mollusques **1:** 195, pl. 14, figs. 1–4 (Havana, Cuba). Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 239 (about ½ mile from North Sound, Grand Cayman).

## VERONICELLIDAE

### Veronicella laevis *Blainville*

*Veronicella laevis* Blainville 1817, Jour. Phys. **85:** 440, fig. II-4 (Jamaica).

*Veronicella laevis* Blainv., var. Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 239 (midway between North Sound and Red Bay, Grand Cayman).

*Remarks.* According to H. B. Baker's anatomical notes which Pilsbry quotes, the specimen differed somewhat from typical *laevis* from Jamaica.

## SUCCINEIDAE

### Succinea latior *C. B. Adams*
Plate 62, fig. 2

*Succinea latior* C. B. Adams 1849, Contributions to Conchology, pt. 3, p. 38 ([Montego Bay] Jamaica). [Holotype, MCZ no. 247408]; Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 238 (road between George Town and North Sound, Grand Cayman).

*Remarks.* We have not seen specimens of this species from the Cayman Islands. The lectotype, here selected, from Jamaica is figured.

## PUPILLIDAE

### Gastrocopta rupicola marginalba *Pfeiffer*

*Pupa marginalba* Pfeiffer 1840, Archiv für Naturgeschichte **1:** 253 (Cuba).
*Gastrocopta rupicola marginalba* Pfr. Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 238 (½ mile from North Sound, Grand Cayman).

*Remarks.* This subspecies is widely distributed in the West Indies.

*Specimens examined.* LITTLE CAYMAN: south side of island (USNM).

### Gastrocopta pellucida *Pfeiffer*

*Pupa pellucida* Pfeiffer 1841, Symbolae ad Historiam Heliceorum **1:** 46 (Cuba).
*Gastrocopta pellucida* Pfr. Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 238 (½ mile from North Sound, Grand Cayman).

*Remarks.* A species of wide distribution in the West Indies and Mexico

*Specimens examined.* LITTLE CAYMAN: E of Reef Harbour entrance (USNM).
CAYMAN BRAC: road across island from Custom House; Booby Point (both USNM).

### Pupoides albilabris *C. B. Adams*

*Cyclostoma marginata* Say 1821, Jour. Acad. Nat. Sci. Philadelphia **2:** 171 (Upper Missouri).
*Bulimus nitidulus* Pfeiffer 1839, Archiv für Naturgeschichte **5:** 352 (Cuba); non *B. nitidulus* Beck 1837.
*Pupa albilabris* C. B. Adams 1841, American Jour. Sci. Arts **40:** 271, new name for *Cyclostoma marginata* Say 1821, non Fischer 1807.

*Pupoides albilabris* (C. B. Adams). Pilsbry 1948, Acad. Nat. Sci. Philadelphia, Monograph no. 3, **2**: 921, fig. 499: 1–7.

*Remarks.* This species is widely distributed in North America and the West Indies.

*Specimens examined.* LITTLE CAYMAN: ½ way across island at western end (USNM).

## STROBILOPSIDAE

### Strobilops (Strobilops) wenziana *Pilsbry*

*Strobilops wenziana* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82**: 238, pl. 19, figs. 1–7 (between Red Bay and North Sound, Grand Cayman). [Holotype, ANSP no. 150861.]

*Remarks.* Pilsbry compares this species with *S. salvini* (Tristram) from the mountain forests of Vera Paz, Guatemala and states also that "I have seen all other American species of this genus, and none is at all like *S. wenziana.*"

*Specimens examined.* GRAND CAYMAN: between North Sound and Red Bay (ANSP).

### Strobilops (Discostrobilops) hubbardi *Brown*

*Helix hubbardi* A. D. Brown 1861, Proc. Acad. Nat. Sci. Philadelphia, p. 333, text fig. (Indianola, Calhoun Co., Texas). [Holotype, ANSP no. 124.]
*Helix vendryesiana* Gloyne 1871, Jour. de Conch. **19**: 333 (Jamaica).
*Strobilops hubbardi stevensoni* Pilsbry 1899, Acad. Nat. Sci. Philadelphia **51**: 404 (Miami, Florida).

*Remarks.* A species of wide distribution from northeastern Mexico, Texas to Georgia and Florida, Bermuda, the Bahamas, Cuba and Jamaica.

*Specimens examined.* LITTLE CAYMAN: halfway across island at western end (USNM).

## CIONELLIDAE

### Cecilioides (Karolus) iota *C. B. Adams*
Plate 62, fig. 1

*Achatina iota* C. B. Adams 1845, Proc. Boston Soc. Nat. Hist. **2**: 13 (Jamaica).

*Cecilioides* (*Karolus*) *iota* (C. B. Adams). Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 239.

*Remarks.* It has been known previously only from Jamaica.

*Specimens examined.* GRAND CAYMAN: ½ mile from North Sound (ANSP).

LITTLE CAYMAN: E of Reef Harbor entrance (USNM).

## SUBULINIDAE

The four species given below are among the most widely distributed land pulmonates known.

### Lamellaxis gracilis *Hutton*

*Opeas gracile* Hutton 1834, Jour. Asiatic Soc. Bengal **3:** 84, 93 (Mirzapur, India); Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 236 (road between George Town and North Sound).

### Lamellaxis micrus *d'Orbigny*

*Helix micra* d'Orbigny 1835, Mag. de Zool., p. 9 (easternmost foothills of the Andes, not far from Santa Cruz de la Sierra, Bolivia); Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 236 (road between George Town and North Sound; Bodden Town).

### Synopeas pumilum *Pfeiffer*

*Helix goodallii* Miller 1822, Annals of Philosophy **19:** 381 (Bristol, England), non *H. goodalli* Férussac 1821.

*Bulimus pumilus* Pfeiffer 1840, Archiv für Naturgeschichte **1:** 252 (Cuba); Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 236 (road between George Town and North Sound; Bodden Town).

### Subulina octona *Bruguière*

*Bulimus octonus* Bruguière 1789, Encyclopédie Méthodique **1:** 325 (Guadeloupe, Lesser Antilles); Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 236 (road between George Town and North Sound; Bodden Town).

## OLEACINIDAE

### Spiraxis (Volutaxis) subrectaxis *Pilsbry*

*Spiraxis subrectaxis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 237, pl. 17, fig. 3 (½ mile from North Sound, Grand Cayman). [Holotype, ANSP no. 150903.]

*Remarks.* Both this and the following species are close in their relationship to *S. terebella* of Jamaica.

Plate 62

Fig. 1. *Cecilioides iota* C. B. Adams, Grand Cayman (about 70×).

Fig. 2. *Succinea latior* C.B.Adams, Jamaica, holotype, MCZ no. 247408 (5.2×).

Fig. 3. *Cerion martinianum caymanense* Pilsbry (= *martineanum*), Grand Cayman, paratype, MCZ no. 88904 (4.2×).

Fig. 4. *Cerion martinianum* Küster, N of George Town, Grand Cayman (4.2×).


Plate 62

### Spiraxis (Volutaxis) caymanensis *Pilsbry*

*Spiraxis* (*Volutaxis*) *caymanensis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 237, pl. 17, figs. 1–2 (between Red Bay and North Sound, Grand Cayman). [Holotype, ANSP no. 150902; paratypes, MCZ no. 85870.]

### Varicella (Varicella) caymanensis *Pilsbry*

*Varicella caymanensis* Pilsbry 1942, Nautilus **56:** 7, pl. 1, fig. 6 (branching of Forest Glen Road from Further Land Road, north side area, Grand Cayman). [Holotype, British Museum; paratypes, ANSP no. 265779.]

*Varicella caymanensis ampla* Pilsbry 1942, Nautilus **56:** 8, pl. 1, fig. 5 (branching of Forest Glen Road from Further Land Road, north side area, Grand Cayman). [Holotype, British Museum; paratypes, ANSP no. 265778.]

*Varicella lewisi* Pilsbry 1949, Nautilus **63:** 47, pl. 3, fig. 6 (Stake Bay below the bluff, Cayman Brac, Cayman Islands). [Holotype, ANSP no. 272751.]

*Remarks.* From the excellent figures of these two forms it would appear that *ampla* is only a more mature specimen. From a somewhat larger series at hand I cannot separate *V. lewisi* from *V. caymanensis.* Pilsbry relates this species to *V. pinchoti* of Grand Cayman and in turn *pinchoti* to *V. dissimilis* C. B. Adams of Jamaica.

*Specimens examined.* GRAND CAYMAN: branching of Forest Glen Road from Further Land Road (ANSP).

LITTLE CAYMAN: halfway across island at western end; western end of island (both USNM).

CAYMAN BRAC: behind Stake Bay (ANSP).

### Varicella (Varicella) pinchoti *Pilsbry*

*Varicella pinchoti* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 236, pl. 17, fig. 11 (½ way between Red Bay and North Sound, Grand Cayman). [Holotype, ANSP no. 150886.]

*Varicella pinchoti signata* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 237 (½ way between Red Bay and North Sound, Grand Cayman). [Holotype, ANSP no. 150897, paratype, MCZ no. 85868.]

*Remarks.* This species is related to *V. dissimilis* Pils. from Jamaica, differing by being smaller, by having more numerous and coarse, axial, incised grooves.

*Specimens examined.* GRAND CAYMAN: halfway between Red Bay and North Sound (ANSP; MCZ).

### Varicella (Euvaricella) infantia *Wurtz*

*Varicella* (*Euvaricella*) *infantia* Wurtz 1950, Proc. Acad. Nat. Sci. Philadelphia **102:** 104, pl. 2, fig. 7 (where the north-south road intersects the road paralleling the north shore, Grand Cayman). [Holotype, ANSP no. 186183.]

*Remarks.* Both this and the following species are related to the *Euvaricella* complex of Jamaica.

### Varicella (Euvaricella) adolescentia *Wurtz*

*Varicella* (*Euvaricella*) *adolescentia* Wurtz 1950, Proc. Acad. Nat. Sci. Philadelphia **102:** 104, pl. 2, fig. 8 (where the north-south road intersects the road paralleling the north shore, Grand Cayman). [Holotype, ANSP no. 186184.]

### Melaniella gracillima *Pfeiffer*

*Achatina gracillima* Pfeiffer 1839, Archiv für Naturgeschichte **5:** 352 (Cuba).
*Varicella gracillima* Pfeiffer. Pilsbry 1907, Manual of Conch. (2) **19:** 55, pl. 14, figs. 26, 29–30.
*Varicella* (*Melaniella*) *caymanbracensis* Pilsbry 1949, Nautilus **63:** 48, pl. 3, fig. 5 (Cayman Brac). [Holotype, ANSP no. 187682.]

*Remarks.* Pilsbry related his *caymanbracensis* to *M. gracillima* but held them distinct. With the present series, however, from both Cayman Brac and Little Cayman I cannot separate the Cayman specimens from the Cuban *M. gracillima* Pfr.

*Specimens examined.* LITTLE CAYMAN: halfway across island at western end (USNM).
CAYMAN BRAC: S end of bluff road from Stake Bay (ANSP); on road across island from Custom House (USNM).

## SAGDIDAE

### Lacteoluna (Stauroglypta) summa *Pilsbry*

*Lacteoluna summa* Pilsbry 4930, Proc. Acad. Nat. Sci. Philadelphia **82:** 231, pl. 16, figs. 16–16a (half way between North Sound and Red Bay, Grand Cayman). [Holotype, ANSP no. 150880.]

*Remarks.* Pilsbry relates this species to *Lacteoluna spreta* C. B. Adams of Jamaica. *L. summa* Pilsbry is, however, a much larger species.

*Specimens examined.* GRAND CAYMAN: halfway between North Sound and Red Bay (ANSP).

### Lacteoluna (Stauroglypta) caymanensis *Pilsbry*

*Lacteoluna caymanensis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 232, text fig. 1 (halfway between North Sound and Red Bay, Grand Cayman). [Holotype, ANSP no. 150890.]

*Lacteoluna cistula* Pilsbry 1942, Nautilus **56:** 5, pl. 1, fig. 7 (branching of Forest Glen Road from Further Land Road, north side area, Grand Cayman). [Holotype, British Museum.]

*Remarks.* Related to *L. summa* Pils., but being very much smaller. It is also related to *L. spreta* C. B. Adams of Jamaica.

*Specimens examined.* GRAND CAYMAN: halfway between North Sound and Red Bay (ANSP; MCZ).

### Proserpinula lewisi *Pilsbry*

*Proserpinula lewisi* Pilsbry 1949, Nautilus **63:** 42, pl. 3, fig. 2 (Cayman Brac). [Holotype, British Museum; paratypes, ANSP no. 187673.]

*Remarks.* This species is related to *P. infortunata* Bland of Jamaica, but differs by being a little smaller and subglobose in outline and not flattened as is the Jamaican species.

*Specimens examined.* LITTLE CAYMAN: near western end (USNM).

CAYMAN BRAC: (ANSP).

### Lacteoluna (Aerotrochus) trochella *Wurtz*

*Lacteoluna (Aerotrochus) trochella* Wurtz 1950, Proc. Acad. Nat. Sci. Philadelphia **102:** 104, pl. 2, fig. 9 (where the north-south road intersects the road paralleling the north shore, Grand Cayman). [Holotype, ANSP no. 186189.]

*Remarks.* According to Wurtz this species is related to the Jamaican *L. subpyramidalis* C. B. Adams.

*Specimens examined.* GRAND CAYMAN: $\frac{1}{4}$ mile S of North Shore (ANSP).

### Lacteoluna (Aerotrochus) caymanbracensis *Pilsbry*

*Lacteoluna caymanbracensis* Pilsbry 1949, Nautilus **63:** 42, pl. 3, fig. 1 (Cayman Brac). [Holotype, ANSP no. 272860.]

*Remarks.* Pilsbry relates this species to the much larger Jamaican *L. ptychodes* Pfr. It is also closely related to *L. trochella* Wurtz from Grand Cayman.

*Specimens examined.* LITTLE CAYMAN: N coast near western end; near Blossom Village (both USNM).
CAYMAN BRAC: behind Stake Bay (ANSP).

### Lacteoluna (Stauroglypta) steveni *Pilsbry*

*Lacteoluna steveni* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 232, text fig. 2 (½ mile from North Sound, Grand Cayman). [Holotype, ANSP no. 150891.]

*Remarks.* As with the other species in the subgenus *Stauroglypta,* this species is related to the *L. spreta* complex of Jamaica.

*Specimens examined.* GRAND CAYMAN: between George Town and North Sound (ANSP; MCZ).

## ORTHALICIDAE

### Orthalicus undatus jamaicensis *Pilsbry*

*Oxystyla undata jamaicensis* Pilsbry 1899, Man. of Conch. (2) **12:** 107, pl. 27, figs. 19–23 (Rock Fort near Kingston; Hope River; Yallahs) [Holotype, ANSP no. 61885a]; 1942, Nautilus **56:** 5 (George Town, Grand Cayman).

*Remarks.* This species is a rather recent introduction on Grand Cayman. It was reported by Pilsbry (1942, p. 5). Three specimens were collected by Mr. C. B. Lewis at George Town in 1938. The introduction was most certainly from Jamaica where it is very abundant in the vicinity of Kingston. Even the Jamaica race is believed to have been introduced in early post-Columbian times from Trinidad. The nominate species has been introduced in the Bahamas on New Providence and Andros Islands (Clench 1942, p. 61). It is quite surprising that no members of the Bulimulacea managed to reach the Caymans other than this introduced species. Though various genera in this superfamily are widely distributed throughout the West Indies they have failed to reach, on a specific level, the richness such as exhibited by the Camaenidae, Urocoptidae, Cerionidae, Chondropomidae and Helicinidae. Elsewhere, as in Central and South America, the Bulimulacea are exceedingly rich in both species and genera.

*Specimens examined.* GRAND CAYMAN: George Town (MCZ).

This record is based upon two specimens collected in June 1941 by William Osment.

## CERIONIDAE[1]

### Cerion pannosum *Maynard*
Plate 63, figs. 1–13

*Strophia pannosa* Maynard 1889, Contributions to Science **1:** 10, pl. 1, figs. 1–2, 13; pl. 2, figs. 1a–d (west end of Little Cayman). [Lectotype, MCZ no. 246343.]

*Strophia levigata* Maynard 1889, Contributions to Science **1:** 12, pl. 2, figs.2–2b (west end of Little Cayman). [Lectotype, MCZ no. 247021.]

*Strophia intermedia* Maynard 1889, Contributions to Science **1:** 13, pl. 2, figs. 3–3b (south side of Little Cayman and south side of Cayman Brac). [Holotype, MCZ no. 76067.]

*Strophia acuta* Maynard 1886, Contributions to Science **1:** 15, pl. 2, figs. 4–4b (south side of Little Cayman). [Lectotype, MCZ no. 247022.]

*Strophia festiva* Maynard 1889, Contributions to Science **1:** 17, pl. 2, figs. 5a–c (western path, ½ mile from the sea, Little Cayman). [Lectotype, MCZ no. 247023.]

*Strophia picta* Maynard 1889, Contributions to Science **1:** 18, pl. 2, figs. 6–6b (west end of Little Cayman). [Lectotype, MCZ no. 247019.]

*Strophia lineota* Maynard 1889, Contributions to Science **1:** 20, pl. 2, figs. 7–7b (south side of Little Cayman and south side of Cayman Brac). [Lectotype, MCZ no. 246346.]

*Strophia copia* Maynard 1889, Contributions to Science **1:** 22, pl. 1, figs. 1, 3, 7–12; pl. 2, figs. 8–8b (west end of Cayman Brac and north side of Little Cayman). [Holotype, MCZ no. 76065.]

*Strophia parva* Maynard 1889, Contributions to Science **1:** 24, pl. 2, figs. 9–9b (west end of Cayman Brac). [Lectotype, MCZ no. 246423.]

*Strophia glaber* Maynard 1889, Contributions to Science **1:** 25, pl. 2, figs. 10–10b (west end of Cayman Brac). [Lectotype, MCZ no. 246344.]

*Strophia perplexa* Maynard 1889, Contributions to Science **1:** 71, pl. 7, figs. 15–15a (Cayman Brac, 2 miles from west end). [Lectotype, MCZ no. 246345.]

*Strophia nitela* Maynard 1889, Contributions to Science **1:** 73, pl. 7, figs. 16–16a (west end of Little Cayman). [Lectotype, MCZ no. 247020.]

*Strophia fusca* Maynard 1889, Contributions to Science **1:** 77, pl. 7, figs. 19a; text figs. 12a–b (west end of Little Cayman). [Holotype, MCZ no. 76069.]

*Description.* Shell reaching 31 mm. in length, solid in structure, sculptured and minutely umbilicated. Color grayish white

[1]Rather recently, H. B. Baker suggested a change of spelling of this family to Ceriidae (1957, p. 141). This was adopted later by Taylor and Sohl (1962, p. 11). Cerionidae was introduced by Pilsbry in 1901 and has been in continuous use since that time. Even if Ceriidae is the correct way to form the family name, such a change at this late date will only add confusion.

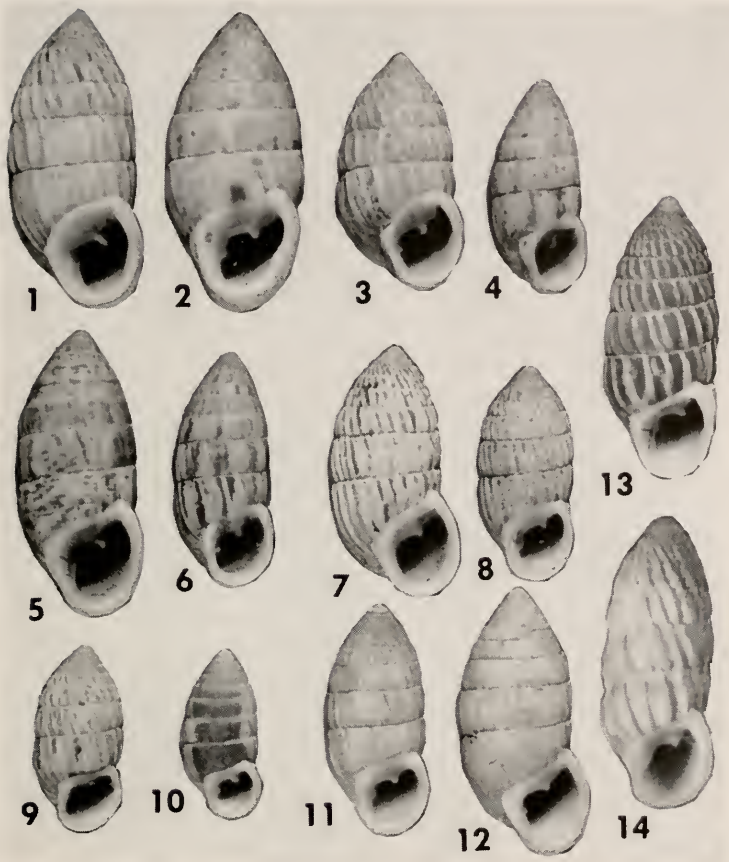


Plate 63

Fig. 1. *Strophia pannosa* Maynard, lectotype, MCZ no. 246343. Fig. 2 *S. levigata* Maynard, lectotype, MCZ no. 247021. Fig. 3. *S. intermedia* Maynard, holotype, MCZ no. 76067. Fig. 4. *S. acuta* Maynard, lectotype, MCZ no. 247022. Fig. 5. *S. festiva* Maynard, lectotype, MCZ no. 247023. Fig. 6. *S. picta* Maynard, lectotype, MCZ no. 247019. Fig. 7. *S. lineota* Maynard, lectotype, MCZ no. 246346. Fig. 8. *S. copia* Maynard, holotype, MCZ no. 76065. Fig. 9. *S. parva* Maynard, lectotype, MCZ no. 246423. Fig. 10. *S. glaber* Maynard, lectotype, MCZ no. 246344. Fig. 11. *S. perplexa* Maynard, lectotype, MCZ no. 246345. Fig. 12. *S. nitela* Maynard, lectotype, MCZ no. 247020. Fig. 13. *S. fusca* Maynard, holotype, MCZ no. 76069 (all 1.24×). Fig. 14. *S. nanus* Maynard, lectotype, MCZ no. 246737 (2.7×).

to marbled with a purplish brown. Whorls 10 to 11, slightly convex the first 7 whorls forming the tapering apex. Suture well defined. Aperture subcircular and with a well developed parietal ridge. Lip thickened and reflected. Parietal tooth well developed and continuing within for one-half whorl. Columellar tooth small and short. Protoconch of one and one-half whorls, white, the last whorl being very finely costate. Remaining whorls with axial ribs which vary in number and spacing on the body whorl in specimens in a single population and even more so in different populations. A few populations, particularly those on Little Cayman near Blossom Village are nearly smooth but this type of sculpture variation is fairly common in this genus.

| length | width | |
|---|---|---|
| 31.0 mm. | 13.5 mm. | Lectotype of *S. pannosa* Maynard |
| 30.5 | 15.0 | Lectotype of *S. levigata* Maynard |
| 29.5 | 12.5 | Lectotype of *S. festiva* Maynard |
| 28.0 | 11.5 | Holotype of *S. fusca* Maynard |
| 27.5 | 12.0 | Lectotype of *S. nitela* Maynard |
| 26.0 | 12.5 | Lectotype of *S. lineota* Maynard |
| 25.0 | 13.0 | Holotype of *S. intermedia* Maynard |
| 24.0 | 9.5 | Lectotype of *S. picta* Maynard |
| 23.5 | 10.0 | Lectotype of *S. perplexa* Maynard |
| 22.0 | 9.0 | Lectotype of *S. acuta* Maynard |
| 21.5 | 10.0 | Holotype of *S. copia* Maynard |
| 19.0 | 9.0 | Lectotype of *S. parva* Maynard |
| 17.5 | 8.0 | Lectotype of *S. glaber* Maynard |

In several cases Maynard failed to select a holotype, so lectotypes have been selected here which agree as closely as can be determined with his descriptions and measurements.

Measurements of 20 paratypes of *S. pannosa* Maynard

| length | width | length | width |
|---|---|---|---|
| 30.5 mm. | 13.0 mm. | 28.0 mm. | 13.0 mm. |
| 29.5 | 15.0 | 28.0 | 12.5 |
| 29.5 | 14.0 | 27.0 | 14.0 |
| 29.5 | 13.0 | 27.0 | 13.0 |
| 29.0 | 13.5 | 27.0 | 12.5 |
| 29.0 | 13.5 | 26.5 | 13.5 |
| 29.0 | 12.5 | 26.0 | 14.5 |
| 28.5 | 14.5 | 25.0 | 12.0 |
| 28.5 | 13.0 | 24.5 | 11.5 |
| 28.5 | 12.5 | 23.5 | 11.5 |

*Remarks.* All names in the synonymy above refer to but a single species. These are but different populations which show a considerable amount of variation between them. There is also, however, much variation within each population.

Pilsbry (1901) had admitted *C. levigatum* (Maynard) as a valid species, basing his judgement on Maynard's remarks and the few selected specimens which he had received from Maynard. These are the "smooth" forms which occur in greater numbers on Little Cayman Island, mainly in the vicinity of Blossom Village. Most of the lots collected by Maynard also contain costate specimens in limited numbers.

*Cerion pannosum* may have been derived from *C. iostomum* Pfr. of the south coast of Cuba.

*Specimens examined.* LITTLE CAYMAN: north side; western end; south side (all MCZ); 1 mile E of Jackson Point: Blossom Village; north coast opposite Sparrowhawk Hill; between Blossom Village and Salt Rock; east side of Bloody Bay; western edge of mangrove swamp near Blossom Village; western end; E of entrance to Reef Harbour; Owen Island; in bog E of Blossom Village; Rocky Point (all USNM).

CAYMAN BRAC: Buccaneer's Inn; West End Point; 2 miles from west end; south side (all MCZ); eight populations from various areas on this small island (Grace O. Hunter; MCZ); Booby Point; south shore, $2\frac{1}{2}$ miles E of West End Point; the Bight; Stake Bay; road across island from Custom House (all USNM).

### **Cerion martinianum** *Küster*

Plate 62, figs. 3–4

*Pupa martiniana* Küster 1844, Conchylien-Cabinet (2) **1:** pt. 15, p. 75, pl. 11, figs. 3–4 (West Indies [Grand Cayman] ).

*Cerion caymanense* 1902, Manual of Conch. (2) **14:** 196, pl. 44, figs. 85–86 (Grand Cayman); Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 235. [Holotype, ANSP; paratypes, MCZ no. 88904.]

*Description.* Shell reaching 28 mm. in length, solid in structure, sculptured and minutely umbilicate. Color a grayish white to light brown. Whorls 9 or 10, slightly convex, the first 7 or 8 forming the tapering apex. Suture well defined. Aperture subcircular and with a well developed parietal ridge. Lip thickened and reflected. Parietal tooth well developed and

continuing within for one-half whorl. Columellar tooth small and short. Protoconch of one and one-half whorls, white and smooth. Remaining whorls with numerous and rather fine axial ribs. On most specimens examined there is a slight depression on each rib just below the suture.

| length | width | |
|---|---|---|
| 28.0 mm. | 11.5 mm. | Grand Cayman |
| 21.5 | 11.0 | " " |
| 20.0 | 9.0 | " " |
| 18.0 | 8.7 | " " |
| 18.0 | 9.5 | " " |
| 18.0 mm. | 9.0 mm. | Paratypes of *C. caymanense*, Grand Cayman |
| 16.5 | 8.0 | " " " |
| 16.0 | 9.0 | " " " |
| 19.0 mm. | 8.0 mm. | 10 miles E of George Town, Grand Cayman |
| 17.5 | 8.5 | " " " |
| 16.5 | 8.0 | " " " |
| 16.0 | 8.4 | " " " |
| 15.0 | 7.5 | " " " |
| 13.5 | 7.5 | " " " |

*Remarks.* The measurements above give some idea of the range of size as well as the variation in the proportions of length and width. All are adults.

Lewis (in Pilsbry 1942, p. 6) has stated that this *Cerion* is very abundant along the entire western coast of Grand Cayman. He could find no living examples along the eastern coast. "It is very curious, however, that the sand which extends behind the storm beach some 200 yards to the foot of the abruptly rising Miocene 'Bluff' is strewn with dead shells. The people of these parts all claim that the shells were washed up during the terrible hurricane of 1932. They were strange to the people of the district, and as a result many bottles were filled and kept as curiosities."

One wonders and speculates as to what may have happened to the biota in the Caymans and the south coast of Cuba during the four day stay of "Flora," in Oct. 1963, the most damaging hurricane known in the weather history of the West Indies.

Pilsbry (1930, p. 234) considered his *C. caymanense* as "only a small race or form of *C. martinianum.*"

There appears to be a close relationship between *C. martinianum* and *C. sanctacruzence* Aguayo and Jaume. This lat-

ter species occurs at Santa Cruz del Sur and the cays which make up the archipelago of the Jardines de la Reina on the south coast of Camagüey Province, Cuba.

*Specimens examined.* GRAND CAYMAN: 1 mile N of George Town; Bodden Town; 10 miles E of George Town (all MCZ); Red Bay; near Rum Point; midway between Conch Point and Palmetto Point; 1 mile W of Red Bay; about $1\frac{1}{2}$ miles E of Northwest Point (all USNM).

### **Cerion nanus** *Maynard*
Plate 63, fig. 14

*Strophia nana* Maynard 1889, Contributions to Science **1:** 27, pl. 2, figs. 11–11d (west end of Little Cayman). [Lectotype, MCZ no. 246737.]

*Cerion nanus* Maynard. Pilsbry 1901, Manual of Conch. (2) **14:** 183, pl. 27, figs. 1–3.

*Description.* Shell small, reaching 17.5 mm. in length, the greater number being between 15 and 17 mm. Color a dull gray. Whorls $8\frac{1}{2}$ to 10, slightly convex, the first 5 whorls forming the tapering cone. Spire extended. Aperture subcircular. Outer lip reflected but not turned backward. Parietal lip with a well formed and straight ridge. Parietal tooth large but extending within no more than $\frac{1}{4}$ of a whorl. Columellar tooth small and extending within about $\frac{1}{3}$ of a whorl. Umbilicus rimate and exceedingly small. Suture well defined. Sculpture consisting of numerous axial ridges which are depressed slightly just below the suture. Protoconch consisting of 2 whorls which are opaque and glass-like.

| length | width | |
|---|---|---|
| 14.5 mm. | 5.5 mm. | Lectotype, *C. nanus* Maynard |
| 17.0 | 6.5 | Paratype |
| 16.0 | 6.0 | " |
| 15.0 | 6.5 | " |
| 15.0 | 6.0 | " |
| 14.0 | 6.0 | " |
| 14.0 | 6.0 | " |
| 14.0 | 5.5 | " |

*Remarks.* Maynard collected this species during the winter of 1888 and the area was again collected by Bartsch in 1930. It would be of considerable interest to know if this colony still exists after a period of more than 33 years. This may well be,

as little or no development has been attempted on this small island where there is but little soil. Admiralty chart no. 462 gives the height on the western end as 25 to 30 feet, possibly high enough to give some protection against hurricane seas. Maynard stated:

"The dwarf Strophias occur in a space which is only five or six yards wide by twenty long, on this little key, and as they were rigidly confined to this narrow area . . . I consider that this species has the most restricted range of any animal with which I am acquainted. This spot is on the west end of Little Cayman, on the eastern most of the two paths that cross the key, near their junction.

"In habit, this species is social, and I found many of them clinging to a kind of heath-like plant which was about eighteen inches high, and which had small gray leaves of nearly the same color as the shells, and which on being crushed, gave out a strong odor. Here these Strophias were exposed to the burning rays of a nearly vertical sun, and the heat in which they lived during the day, was intense . . .

"It is evident that in this species, we have a *Strophia* dwarfed to an extreme degree, from feeding on the pungent leaves of the plant described, and isolated as it is by surrounding areas of rough, jagged rocks . . . the ground was strewed with thousands of dead shells, showing that mortality among them was great . . ."

The mortality rate was probably no greater than in most *Cerion* populations. The shells of dead specimens can last for many years in an area composed of limestone and little soil cover. *Cerion microdon* Pils. and Van. was described in 1896 (Gibara, Cuba) from dead specimens. C. G. Aguayo and I collected dead specimens in the same area in 1945. No live specimens of this species have ever been collected at Gibara or anywhere else for that matter.

*Cerion microdon* was recorded by Bartsch in his unpublished journal from Cotton Cay, Cay Sal Bank, Bahamas. "Here on cleared ground we found millions of a very small *Cerion.* These were all dead and that in spite of the fact that the ground was not burned over."

This small colony of *C. nanus* had become dwarfs probably because of natural selection and not because of feeding on the

heath-like plant mentioned by Maynard above. Survival in an environment of this sort would certainly favor the smaller individuals because of an inadequate food supply. Most species of *Cerion* feed upon lichens and not upon herbaceous plants. I have seen this same situation at the Balcón de las Dames, Guarda la Vaca, Banes, Cuba. The habitat here was exposed coastal limestone some 20 to 50 feet above the sea. In the depressions where there was a little soil there were a few dwarf sea grapes (*Cocoloba* sp.) 2 to 3 feet high. Some twenty-odd depressions were examined before any *Cerion hessei* were found and at this spot only a few specimens were obtained, and several of these are the smallest on record. The area of this small colony was about a yard square. Variation in size was considerable, ranging from 9 mm. to 22 mm.

*Cerion hessei* Clench and Aguayo

| millimeters * | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|
| no. of specimens | 1 | 1 | 11 | 18 | 11 | 11 | 7 |
| millimeters | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| no. of specimens | 6 | 8 | 5 | 1 | 0 | 0 | 1 |

* Measurements made to the nearest millimeter.

Some 42 years later in 1930, Paul Bartsch of the United States National Museum collected at this same locality of Maynard. I quote from his unpublished journal "Station 4 was at about halfway between Blossom Village and Salt Rock in a stretch of woodland where in a space some 50 yards in length and 20 in width we found Maynards *Cerion nanus* quite abundant, and we gathered two 8 oz. bottles full of them." The following measurements are from this series of specimens. All measurements are based upon adults and are selected at random.

| length | width | |
|---|---|---|
| 17.5 mm. | 6.0 mm. | Little Cayman, halfway between Blossom |
| 17.5 | 6.0 | Village and Salt Rock |
| 17.0 | 6.5 | |
| 17.0 | 6.0 | |
| 16.5 | 6.5 | |
| 16.5 | 6.5 | |
| 16.0 | 6.0 | |
| 15.5 | 6.5 | |
| 15.5 | 5.5 | |
| 15.5 | 5.5 | |
| 14.0 | 6.0 | |

In the aggregate, these measurements are slightly higher than those of Maynard, but Bartsch had three or four collectors while Maynard was alone. The sample made by Bartsch probably gave better coverage of the colony than the more limited coverage by Maynard.

*Cerion nanus* does not appear to be closely related to the other species of *Cerion* on the Cayman Islands or to any *Cerion* from the south coast of Cuba.

*Specimens examined.* LITTLE CAYMAN: west end of Little Cayman (MCZ; USNM); eastern of two paths, west end of Little Cayman (USNM); between Blossom Village and Salt Rock (USNM).

## UROCOPTIDAE

### Microceramus caymanensis *Pilsbry*

*Microceramus caymanensis* Pilsbry 1942, Nautilus **56:** 2, pl. 1, fig. 8 (Battle Hill, interior of eastern end, Grand Cayman) [Holotype, British Museum; paratypes, ANSP no. 279021.]

*Remarks.* This species is quite variable in size and in the number of whorls, varying from 7 to 9 whorls. All other characters appear to be the same.

Pilsbry (1942, p.6) relates this species to similar species which occur in Central America, Florida, Jamaica, Hispaniola and Cuba. "The Grand Cayman form appears somewhat nearer to the West Indian species."

*Specimens examined:* GRAND CAYMAN: Battle Hill; $\frac{1}{4}$ mile S of north shore (both ANSP).

LITTLE CAYMAN: near Blossom Village; E of Reef Harbour entrance; halfway across W end of island; N side near East Point (all USNM).

CAYMAN BRAC: on road across the island from the Custom House (USNM).

### Pineria perpusillus *Wurtz*

*Microceramus perpusillus* Wurtz 1950, Proc. Acad. Nat. Sci. Philadelphia **102:** 105, pl. 2, fig. 10 (where the north road intersects the road paralleling the north shore, Grand Cayman) [Holotype, ANSP no. 186185.]

*Remarks.* Based upon shell characters, this species belongs to the genus *Pineria* and it is related to *P. beathiana* Poey from the Sierra de Caballos, Isle of Pines, Cuba.

*Specimens examined.* GRAND CAYMAN: north shore road at intersection (ANSP).

### Brachypodella (Cyclauchen) caymanensis *Pilsbry*

*Brachypodella caymanensis* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 233, pl. 17, figs. 8–10 (between Red Bay and North Sound, Grand Cayman). [Holotype, ANSP no. 150046.]

*Brachypodella erratica* Pilsbry 1930, Proc. Acad. Nat. Sci. Philadelphia **82:** 234, pl. 17, figs. 6–7a (½ mile from North Sound, Grand Cayman). [Holotype, ANSP no. 150050.]

*Remarks.* This species is closely related to *B. insulaecygni* Clapp from Swan Island, differing however, by having more numerous and smaller axial ribs than found in *insulaecygni.* Clapp (1914, p. 99) relates *B. insulaecygni* Clapp of the Swan Islands to *B. minuta* Pfeiffer of eastern Cuba; and Pilsbry (1930, p. 245) relates *B. caymanensis* to the Swan Island species and placed both in the subgenus *Cyclauchen* which he created for these two species. In essence, both these species may be quite old and have become well differentiated. The genus *Brachypodella* Beck has a peculiar distribution: West Indies (other than central and western Cuba and the Bahamas) and from Venezuela and Colombia north to the isthmus of Tehuantepec, Mexico. All are mainly ground forms living under stones.

*B. erratica* Pils. is but a slight variant of *caymanensis.* The minor differences in the spire are generally determined by where the plug is made and where the spire breaks. In most species in this remarkable family the early whorls are lost. At or approaching maturity an internal plug is formed, closing off several of the early whorls. In time these early whorls usually break off at the point where the plug is attached to the inner surface of the shell.

*Specimens examined.* GRAND CAYMAN: south of North Sound (ANSP; MCZ).

LITTLE CAYMAN: north side near East Point; east of Reef Harbour entrance; western end (all USNM); halfway across western end (USNM; MCZ).

CAYMAN BRAC: road leading across the island from Custom House (USNM).

## FRUTICICOLIDAE

### Hemitrochus streatori *Pilsbry*

*Helix* (*Hemitrochus*) *streatori* Pilsbry 1889, Proc. Acad. Nat. Sci. Philadelphia **41:** 413, pl. 12, fig. 1 (Cayman Islands). [Holotype, ANSP no. 60276; paratypes, USNM no. 101417.]

*Hemitrochus caymanensis* 'Maynard' Pilsbry 1893, Man. of Conchology (2) **8:** 241, pl. 56, figs. 10–12 (Little Cayman Island). [Holotype, ANSP no. 62591a; paratypes, USNM no. 187473; MCZ no. 31784.]

*Cepolis* (*Hemitrochus*) *caymanensis* Pilsbry 1942, Nautilus **56:** 5, pl. 1, figs. 10–11a (Cayman Brac).

*Remarks.* I cannot separate specimens of these two species. It occurs on all three islands and it could easily be transported from one island to another by inter-island commerce. It lives on trees and bushes and other vegetation.

*Specimens examined.* GRAND CAYMAN: (MCZ); between Southwest Point and Red Bay (USNM).

LITTLE CAYMAN: halfway between Blossom Village and Salt Rock; western end in elevated portion; 1 mile E of Jackson Point; near Blossom Village (all USNM).

CAYMAN BRAC: south side, about 2 miles E of Southwest Point; Stake Bay Point; Booby Point (all USNM).

### Hemitrochus lewisiana *Pilsbry*

*Cepolis* (*Hemitrochus*) *lewisiana* Pilsbry 1942, Nautilus **56:** 4, pl. 1, figs. 14–14a (Battle Hill, interior of eastern end of Grand Cayman, Cayman Islands). [Holotype, British Museum.]

*Remarks.* According to Pilsbry (1942, p. 5) this species is closely related to *H. streatori* but differs by having a thinner, unicolored shell, with the umbilicus more widely open. It is known only from Grand Cayman.

## REFERENCES

Abbott, R. T. 1958. The Marine Mollusks of Grand Cayman Island, British West Indies. Monographs, Acad. Nat. Sci. Philadelphia **11:** 138.

Anonymous 1961. Cayman Islands. Report for the Years 1959 and 1960. Her Majesty's Stationery Office, London, pp. 1–46, map.

Barbosa, F. S., B. Hubendick, E. T. A. Malek and C. A. Wright 1961. The Generic Names *Australorbis, Biomphalaria, Platytaphius, Taphius* and *Tropicorbis* (Mollusca, Planorbidae). Ann. and Mag. of Nat. Hist. (13) **4:** 371–375.

Bartsch, P. 1931. Further Explorations for Mollusks in the West Indies. Publication no. 3111, Explorations and Field Work of the Smithsonian Institution in 1930, pp. 91–102, Washington, D.C.

Bartsch, P. 1942. The Cyclophorid Operculate Land Mollusks of America. United States National Mus. Bull. **181:** 71–82.

Clapp, W. F. 1914. List of Land Shells from Swan Island, with Descriptions of Five New Species. Nautilus **27:** 97–101.

Clench, W. J. 1938. Origin of the Land and Freshwater Mollusk Fauna of the Bahamas, with a List of the Species Occurring on Cat and Little San Salvador Islands. Bull. Mus. Comp. Zool. **80:** 481–541.

Clench, W. J. 1942. Land Shells of the Bimini Islands, Bahama Islands. Proc. New England Zoological Club **19:** 53–67.

Clench, W. J. and R. D. Turner 1948. A Catalogue of the Family Truncatellidae with Notes and Descriptions of New Species. Occasional Papers On Mollusks **1:** 157–212.

Clench, W. J. and R. D. Turner 1950. Edward Chitty, with a Bibliography and a Catalogue of his Species of Jamaica Land Shells. Occ. Papers of the Museum of the Institute of Jamaica, no. 1, pp. 1–12.

Clench, W. J. 1961. Land and Freshwater Mollusks of Caicos; Turks, Ragged Islands and Islands on the Cay Sal Bank. Occasional Papers On Mollusks **2:** 229–259.

Clench, W. J. 1963. Land and Freshwater Mollusks of the Crooked Island Group, Bahamas. Bull. Mus. Comp. Zool. **128:** 393–414.

Grant, C. 1940. The Herpetology of the Cayman Islands. Bull. Inst. of Jamaica, Science Series no. 2, pp. 1–65.

Matley, C. A. 1926. The Geology of the Cayman Islands (British West Indies) and their relation to the Bartlett Trough. Quarterly Jour. Geol. Soc. London **82:** 352–387, map.

Pilsbry, H. A. 1901. Manual of Conchology (2) **14:** 174–191.

Pilsbry, H. A. 1930. Land Mollusks of the Caribbean Islands, Grand Cayman, Swan, Old Providence and St. Andrew. Proc. Acad. Nat. Sci. Philadelphia **82:** 221–261.

Pilsbry, H. A. 1930. Land Mollusks of the Canal Zone, The Republic of Panama, and the Cayman Islands. Proc. Acad. Nat. Sci. Philadelphia **82:** 339–365.

Pilsbry, H. A. 1942. Land Mollusca of the Cayman Islands collected by the Oxford University Biological Expedition, 1938. Nautilus **56:** 1–9.

Pilsbry, H. A. 1949. Land Mollusks of Cayman Brac. Nautilus **63:** 37–48.

Pinchot, Gifford 1930. To the South Seas. John C. Winston Co., Philadelphia, pp. 27–28.

Proctor, G. R. 1959. Observations of Navassa Island. Quart. Jour. of the Jamaica Group of the Geologists' Association, London **2:** 49–54.

Taylor, D. W. and N. F. Sohl 1962. An Outline of Gastropod Classification. Malacologia **1:** 7–32.

Turner, R. D. 1957. Charles Johnson Maynard and his work in Malacology. Occasional Papers On Mollusks **2:** 137–152.

Turner, R. D. 1960. Land Shells of Navassa Island, West Indies. Bull. Mus. Comp. Zool. Harvard College **122:** 233–244.

Wurtz, C. B. 1950. Results of the Catherwood-Chaplin West Indies Expedition, 1948. Part IV. Land Snails of North Cat Cay (Bahamas), Cayo Largo (Cuba), Grand Cayman, Saint Andrews and Old Providence. Proc. Acad. Nat. Sci. Philadelphia **102:** 95–110.

# Remarks on the relationships of the Butterflies (excluding Skippers) of the Cayman Islands

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Carpenter & Lewis (1943) have given a report on the extensive collection of butterflies made by the Oxford University Biological Expedition to the Cayman Islands in 1938, and their list serves as the basis for these comments, supplemented by collateral information from various sources. The Hesperiidae are necessarily omitted from the discussion here: there are too many points of uncertainty on distribution and subspeciation.

The Cayman Islands butterflies are overwhelmingly Cuban in their affinities. With one exception only every species found in the Caymans occurs also in Cuba and among these are several that are absent from Jamaica, Hispaniola and the islands to the east. In those species that occur both on Cuba and on other islands, but as distinctive subspecies, it is the Cuban subspecies that is found in the Caymans.

The single non-Cuban species is the endemic lycaenid, *Hemiargus* (*Cyclargus*) *erembis* Nabokov (1948). It is closely related to *H.* (*C.*) *thomasi* Clench, which occurs in Hispaniola, the Bahamas and southern Florida, but is not known from Cuba. Possibly (as Nabokov suggests) *erembis* may eventually be found in Cuba; or it may once have occurred there and is now extinct.

There is no evidence of a particular relationship between the Cayman fauna and that of Jamaica. Many of the Cayman butterflies are shared with Jamaica, but these are all widely distributed Antillean species and all occur on Cuba as well.

Lewis (*in* Carpenter & Lewis 1943: 396) thought he could discern some evidence of mainland (Mexican and Central American) affinities, but this seems to be better explained otherwise. The species (or, in some cases, subspecies) which

the Cayman Islands share with the mainland are all found in identical form on Cuba; and in those species in which the mainland subspecies is distinct from the one or ones found in the Antilles it is again the Cuban form which is found in the Caymans. This supposed mainland relationship thus seems to be simply a further reflection of Cuban affinity.

Endemism in the Caymans is surprisingly slight for islands so isolated. Of the 32 known species of Cayman Islands butterflies only two show endemism: *Papilio andraemon* Hübner and *Hemiargus erembis* Nabokov. The first has an endemic subspecies (*tailori* Rothschild & Jordan) on Grand Cayman, but the nominate (Cuban) subspecies occurs on Little Cayman and Cayman Brac. *H. erembis* is an endemic species and is discussed above. There are several species in the Caymans that are known to exhibit extensive subspeciation elsewhere in the West Indies, though the characters differentiating these subspecies are often slight and not evident to casual examination. It is possible that careful study of Cayman material of these species will reveal additional subspecies endemic to the islands.

## REFERENCES

Carpenter, G. D. Hale, and C. B. Lewis 1943. A collection of Lepidoptera (Rhopalocera) from the Cayman Islands. Ann. Carnegie Mus. **29:** 371–396, 9 figs.

Nabokov, V. 1948. A new species of *Cyclargus* Nabokov (Lycaenidae, Lepidoptera). Entomologist [London] **81:** 273–280, 11 figs.

## Remarks on the relationships of the Reptiles and Amphibians of the Cayman Islands

*By* ERNEST WILLIAMS
Museum of Comparative Zoology

All the herpetofauna of the Caymans appears to have come across water by rafting, unless a few of the undifferentiated forms have been accidentally imported by man.

In most cases the affinities and therefore the source area are unequivocally indicated. However, in the case of the small geckos *Sphaerodactylus,* all three Cayman taxa are related to *S. argus,* the commonest sphaerodactyl of Jamaica, a species which occurs also on eastern Cuba. *S. argus* is often believed to have been brought to Cuba by human agency and its limited distribution there is regarded as evidence of this. I have hesitantly adopted this view. *Anolis sagrei* on Little Cayman is the reverse case: it is the commonest species on Cuba and has a limited (western) distribution on Jamaica and has not differentiated there. It may not be zoogeographically significant in either case: it is the only instance in the whole Cayman fauna of a second species of one genus on any one island. Since it is quite undifferentiated, it may have come very recently with human aid.

*Crocodylus* has been omitted from the table. The relevant species — *acutus* — has an uncertain distribution in the Caymans and in any case is a marine and brackish water species, wide-ranging and of little zoogeographic significance. It occurs on both Cuba and Jamaica and on the fringes of mainland.

For all three of the Cayman Islands, despite interesting faunal differences, about 70% of the total herpetofauna — all of the amphibia and two-thirds or more of the reptiles — are Cuban in origin. It is a curious point that all the geckos seem to be of Jamaican affinities, though Cuba is quite rich in members of this family. It is less surprising that the single anguid is Jamaican, since the related Jamaican form is quite common, while the single Cuban species is not.

Starred (*) genera are those in which the Cayman taxon is to a greater or lesser degree differentiated — at all events clearly not identical with the parent population.

| Grand Cayman | | Little Cayman | | Cayman Brac | |
|---|---|---|---|---|---|
| Salientia | | | | | |
| Hylidae | | Hylidae | | — | |
| *Hyla* | C | *Hyla* | C | — | |
| Leptodactylidae | | — | | Leptodactylidae | |
| *Eleutherodactylus* | C | — | | *Eleutherodactylus* | C |
| Sauria | | | | | |
| Gekkonidae | | Gekkonidae | | Gekkonidae | |
| *Gonatodes* | J | — | | — | |
| *Sphaerodactylus* | J* | *Sphaerodactylus* | J* | *Sphaerodactylus* | J* |
| *Aristelliger* | J | *Aristelliger* | J | *Aristelliger* | J |
| Iguanidae | | Iguanidae | | Iguanidae | |
| *Cyclura* | C* | *Cyclura* | C | *Cyclura* | C |
| *Leiocephalus* | C* | *Leiocephalus* | C | *Leiocephalus* | C |
| *Anolis* | J* | *Anolis* (2) | C* | *Anolis* | C |
| — | | Anguidae | | Anguidae | |
| — | | *Diploglossus* | J* | *Diploglossus* | J* |
| Serpentes | | | | | |
| Typhlopidae | | — | | — | |
| *Typhlops* | C | — | | — | |
| Boidae | | Boidae | | Boidae | |
| *Tropidophis* | C | *Tropidophis* | C | *Tropidophis* | C |
| Colubridae | | Colubridae | | Colubridae | |
| *Alsophis* | C | *Alsophis* | C | *Alsophis* | C |
| *Tretanorhinus* | C | — | | — | |
| Testudines | | | | | |
| Testudinidae | | — | | Testudinidae | |
| *Pseudemys* | C | — | | *Pseudemys* | C |
| 9 Cuba; 4 Jamaica | | 7 Cuba; 3 Jamaica | | 7 Cuba; 3 Jamaica | |

Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 JULY 9, 1965 NUMBER 32

# The Genus *Viviparus* (Viviparidae) in North America[1]

*By* WILLIAM J. CLENCH AND SAMUEL L. H. FULLER[2]

The North American species of *Viviparus* can easily be distinguished on the basis of shell morphology. The confusion centered about the taxonomic status of *V. georgianus* (Lea) and a host of synonymous names and forms has been previously discussed (Clench 1962a). This report distinguishes between this species and five additional species endemic in North America. One species is restricted to Cuba and two others are distinctive oriental introductions.

The genera *Tulotoma, Lioplax* and *Campeloma* comprise the viviparid genera which are endemic to North America. The genus *Lioplax* Troschel has been monographed (Clench and Turner, 1955). *Viviparus* (s.l.) is widely distributed throughout much of the world, except Central and South America, though it occurred in the mid-Tertiary in Argentina.

According to Prashad (1928), a number of fossil and possibly ancestral viviparids are to be found in North America. These are chiefly from the Laramie beds of the West which extend from New Mexico through the Rocky Mountain region into northern Alberta in a vast series of deposits variously considered to be of Cretaceous or Jurassic age. Prashad cites *Viviparus gillianus* [*gilli*] Meek and Hayden (probably Jurassic) as the ancestor from which rose modern *Lioplax,* possibly

[1] Publication costs supported in part by the Milton Fund, Harvard University.
[2] Harvard undergraduate student.

*Campeloma,* and the Recent North American forms of *Viviparus.* He considers modern *Viviparus* to be of fourfold polyphyletic origin, with the Laramie forms representing the ancestral locus on this continent. He points out that we have no extinct forms from any of the areas where in the past there might conceivably have once been a land connection between North America and other continents; that the fossil record is barren of viviparids from Mexico and Central America, Alaska, and Eastern Canada. Given our scanty knowledge of the fossils of these areas, these facts are hardly evidence that North American viviparids evolved independently from those of Europe, Asia, Africa and South America. Moreover, the degree of convergence necessary for Prashad's four viviparid groups to have arisen independently is virtually impossible.

The existing evidence that North American fossil viviparids are among the earliest known for the family indicates an origin of the Viviparidae, possibly in some area other than this continent. The oldest of our fossil forms examined by Prashad were in an advanced state of differentiation, which could argue equally that North America *might* be the original viviparid locus, or that the Viviparidae might have reached the Laramie region from elsewhere in this highly evolved state. Lack of information renders the whole question equivocal at best, but we do feel that it is erroneous to postulate a polyphyletic origin for the Viviparidae.

The distribution of the Recent Viviparidae is another matter. Certainly the present North American fauna has arisen independent of any influence from other regions, with the exception of the two introductions mentioned previously. The genera *Viviparus* and *Lioplax* have begun to reinvade glaciated areas to any extent only during the past century (Clench and Turner, 1955; Clench, 1962a).

The development since the days of the Laramie beds of fluviatile connections between the Missouri and eastern river drainages would account for the recent expansion and modest proliferation of *Viviparus* east of the Mississippi River. Today the genus is found from the Sabine River in eastern Texas, throughout the rivers of the Gulf States, and in virtually every river system north along the Atlantic coast to the St. Lawrence River. *Campeloma* has an even wider distribution in

eastern North America, reaching as far north as Red Lake, Ontario, in the Hudson Bay Drainage. *Tulotoma* is restricted to the Alabama-Coosa River System, and *Lioplax* has evolved four related but distinguishable species in closely delimited ranges east of the Mississippi River (see Clench and Turner, 1955; Clench, 1962b).

The basis for this vast modern distribution is ecological; viviparids have an extraordinary tolerance of and adaptability to new and demanding environments. Certainly *Campeloma* is most tolerant, but *Viviparus* itself is almost equally so. Members of this latter genus, especially *V. georgianus* and, in some cases, *V. intertextus,* may occur under the most adverse conditions in water fouled by silting and pollution. *Viviparus* prefers a mud and detritus substrate in nearly stagnant to moderately flowing water, usually in areas with some protective vegetation. The majority of North American species are essentially southern, reflecting a predilection for warmer waters. They exhibit great morphological plasticity (see Pl. 64, figs. 1–12).

ACKNOWLEDGMENTS

The authors are much obliged to several curators and others for advice, information, and the loan of material for the study of this genus. They are R. T. Abbott, Leslie Hubricht, H. A. Rehder and Juan Parodiz. We are indebted additionally to our colleague, Ruth D. Turner, for reading the manuscript and for aid in several other ways. Finally, we are grateful to C. O. van Regteren Altena for photographs of material in the Leiden Museum.



ABBREVIATIONS

| | |
|---|---|
| ANSP | Academy of Natural Sciences of Philadelphia |
| MCZ | Museum of Comparative Zoology |
| RVNH | Rijksmuseum van Natuurlijke Historie, Leiden |

## **Viviparus subpurpureus** (*Say*)

Plate 65, figs. 5–8; Plate 67

*Paludina subpurpurea* Say 1829, New Harmony Disseminator of Useful Knowledge **2**:245 (Fox River, an arm of the Wabash [White Co., Illinois]). [Holotype lost.]

*Vivipara texana* Tryon 1862, Proc. Acad. Nat. Sci. Philadelphia, p. 451 (Texas). [Holotype, ANSP 27714a; paratypes MCZ 250644.]

Plate 64

All are *Viviparus georgianus* (Lea)

Fig. 1. Wekiva River, 15 miles NW of Winter Park, Seminole Co., Florida (1.8×).

Fig. 2. *Paludina georgiana* Lea (= *Viviparus georgianus* (Lea)). Altamaha River, Hopeton, near Darien [McIntosh Co.], Georgia. Syntype, MCZ 186792 (1.9×).

Fig. 3. Canal, Utica, La Salle Co., Illinois (1.2×).

Fig. 4. Lake Monroe, Seminole Co., Florida (1.8×).

Fig. 5. Decatur, Morgan Co., Alabama (1.2×).

Fig. 6. *Vivipara inornata* Binney (= *Viviparus georgianus* (Lea)). Near Chopatilo, Mexico [northern Florida?]. Lectotype, MCZ 234704 (1.8×).

Fig. 7. Chesapeake and Ohio Railroad canal, above Violets Lock, Seneca, Montgomery Co., Maryland (1.9×).

Fig. 8. Lake Talquin, Leon Co., Florida (1.8×).

Fig. 9. Steinhatchee River, 9 miles E of Salem, Taylor Co., Florida (1.9×).

Fig. 10. Kiokee Creek, 15 miles SE of Dawson, Terrell Co., Georgia (1.9×).

Fig. 11. St. Lawrence River, S of Ile d'Orlean, St. Michel, Bellechasse Co., Quebec, Canada (1.8×).

Fig. 12. Silver Springs, near Silver Springs, Marion Co., Florida (1.9×).

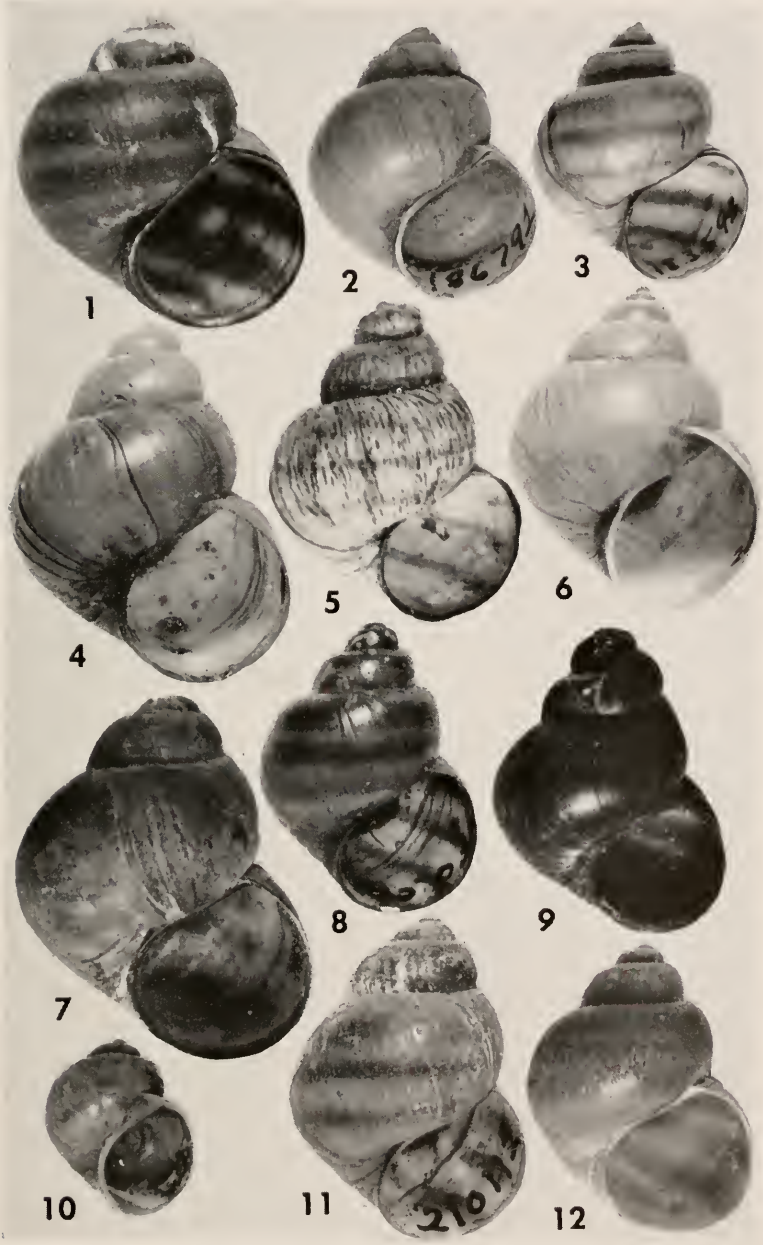


Plate 64

*Description.* Shell subglobose to attenuate in outline and varying in size, large specimens reaching about 33 mm. (about $1\frac{1}{2}$ inches) in length, imperforate or with a narrow, slit-like umbilicus. Usually rather heavy in structure, strong and smooth. Color yellowish or olivaceous brown. Color bands, when present, are typically of brownish color, three in number and generally evenly spaced. Whorls 5 to $6\frac{1}{2}$, moderately convex and occasionally with a slight shoulder. Spire extended and produced at an angle of about 45° to 55°. Aperture subcircular. Outer lip thin. Parietal lip consisting of a thickened glaze. Columella narrow and arched. Suture deeply indented. Sculpture consisting of fine growth lines, with some specimens showing exceedingly fine spiral threads, and occasionally with faint malleations. Operculum corneous, thin, with concentric growth lines and a submarginal nucleus.

| length | width | |
|---|---|---|
| 33.0 mm. | 21.5 mm. | Mississippi River, Vicksburg, Warren Co., Mississippi |
| 24.0 | 18.0 | Kaskaskia River, 2 mi. W of Baldwin, Randolph Co., Illinois |
| 23.0 | 16.5 | Neches River, Town Bluff, Tyler Co., Texas |
| 27.5 | 20.0 | Wabash River, New Harmony, Posey Co., Indiana |

*Remarks.* So far as we can determine, all of the characters given by Tryon for *Vivipara texana* are found among populations throughout the range of *Viviparus subpurpureus* and thus possess no geographic significance.

The range of *V. subpurpureus* is confined mainly to the Mississippi River System and a few small systems in eastern Texas and western Mississippi. This distribution overlaps in part with that of *V. intertextus* Say, but there is absolutely no resemblance between the two forms. We have sexed material of *V. subpurpureus* received through the kindness of Leslie Hubricht and these show that there can be pronounced sexual dimorphism in this species; female specimens being much larger than males. It is ordinarily the smaller male individuals in a given population which exhibit the squat and somewhat twisted features to be seen in Plate 65, figs. 6 and 8. Larger and less twisted specimens may closely resemble certain specimens from the presumably depauperate populations of *V.*

*georgianus* Lea in the middle and southern portions of Florida (compare Plate 65, fig. 5 with Plate 64, figs. 4 and 11). However, individuals of the latter species will always be much lighter in structure, are more likely to have spiral bands of color as well as fewer whorls. Individuals of *V. subpurpureus* may commonly have only three bands while *V. georgianus* generally has four bands.

*Viviparus subpurpureus,* like *intertextus* are often found on rocky substrates in swift water, a rather atypical habitat for species in this genus.

*Specimens examined.* NECHES RIVER SYSTEM. TEXAS: Neches River, $\frac{1}{2}$ mi. below dam, Town Bluff, Tyler Co. and Evadale, Jasper Co. (both MCZ). SABINE RIVER SYSTEM. TEXAS: Sabine River, Smith's Fish Camp, 1 mi. N of Deweyville; confluence of Sabine River and Cypress Creek, 5 mi. N of Deweyville, both Newton Co. (both MCZ). LOUISIANA: Sabine River, 18 mi. SW of Many, Sabine Parish (MCZ). ATCHAFALAYA RIVER SYSTEM. LOUISIANA: Arm of the Atchafalaya River, 10 mi. SE of LeBeau, St. Landry Parish (MCZ). MISSISSIPPI RIVER SYSTEM. MISSISSIPPI RIVER DRAINAGE. LOUISIANA: University Lake, Louisiana State University, Baton Rouge, East Baton Rouge Parish (MCZ); Lake Concordia, Concordia Parish (L. Hubricht; MCZ). MISSISSIPPI: Big Black River, 3 mi. NW of Edwards, Hinds Co. (L. Hubricht; MCZ); Mississippi River; Yazoo River, both Vicksburg, Warren Co.; Natchez, Adams Co. (all MCZ). ARKANSAS: Grand Lake, Chicot Co. (MCZ). ILLINOIS: Mississippi River, Nauvoo, Hancock Co. and Mercer Co. (both MCZ). IOWA: Mississippi River, Davenport, Scott Co.; above McGregor, Clayton Co. (both MCZ). RED RIVER DRAINAGE. LOUISIANA: Saline Bayou at U.S. 84, east of Clarence, Natchitoches Parish; canal, 6.5 mi. W of Krotz Springs, St. Landry Parish; Tensas River; Tendal, Madison Parish (all L.Hubricht; MCZ); Black River, Jonesville; Lake St. John, 9 mi. NE of Ferriday, both Concordia Parish; Old River, 8 mi. SE of Jena, LaSalle Parish (all H. D. Athearn; MCZ); outlet, Lake Catahoula; Little River, both 1 mi. SW of Archie, Catahoula Parish; Ouachita River, near Columbia, Caldwell Parish; Lake Bisteneau, Bienville Parish; Bayou Pierre, Frierson's Mills, DeSoto Parish (all MCZ). TEXAS: Caddo Lake, Harrison Co.

(MCZ). ARKANSAS: Bartholomew Bayou, near Jerome, Drew Co. (MCZ). OKLAHOMA: Little River, 6 mi. NE of Idabel, McCurtain Co. (L. Hubricht; MCZ). WHITE RIVER DRAINAGE. ARKANSAS: Indian Bay, near Baytown, Monroe Co.; Caches River (both MCZ). ST. FRANCIS RIVER DRAINAGE. ARKANSAS: St. Francis River, Wittsburg, Cross Co. (MCZ). OHIO RIVER DRAINAGE. INDIANA: Wabash River, Grand Chains Rapids below New Harmony, Posey Co. (MCZ). ILLINOIS: Ohio River, Elizabethtown, Hardin Co.; Wabash River, Mt. Carmel, Wabash Co.; Little Wabash River, Carmi, White Co.; Saline River, Saline Mines, Gallatin Co. (all MCZ). KENTUCKY: Kentucky River, Gratz, Owen Co.; Tradewater River, Belleville, Webster Co. (both MCZ). ILLINOIS RIVER DRAINAGE. ILLINOIS: Illinois River (MCZ). KASKASKIA RIVER DRAINAGE. ILLINOIS: Kaskaskia River, New Athens, St. Clair Co., 2 mi. W of Baldwin, Randolph Co. (both L. Hubricht; MCZ). PASCAGOULA RIVER SYSTEM. MISSISSIPPI: Pascagoula River, Merrill, George Co. and 6 mi. W of Wade, Jackson Co. (both L. Hubricht; MCZ).

## **Viviparus intertextus** (*Say*)

Plate 65, figs. 2–3; Plate 68

*Paludina intertextus* Say 1829, New Harmony Disseminator of Useful Knowledge **2**:244 (marshes near New Orleans and on bank of Carondolet Canal, Louisiana). [Lectotype, ANSP 124545.]

*Paludina transversa* Say 1829, New Harmony Disseminator of Useful Knowledge **2**:244 (near New Orleans). [Types lost.]

*Paludina troostiana* Lea 1841, Proc. American Phil. Soc. **2**:34 (Tennessee); 1844, Trans. American Phil. Soc. **9**:14; 1848, Observations on the Genus Unio **4**:14. [Lectotype, USNM 121119.]

*Paludina haleiana* Lea 1845, Proc. American Phil. Soc. **4**:167; 1848, Trans. American Phil. Soc. **10**:96, pl. 9, fig. 58; 1848, Observations on the Genus Unio **4**:70, pl. 9, fig. 58 (Alexandria, Louisiana). [Lectotype, USNM 106256.]

*Viviparus haleanus* 'Lea' Walker 1918, Mus. of Zool., Univ. of Michigan, Misc. Publications no. 6, p. 125. [Error for *V. haleianus* Lea.]

*Viviparus intertextus illinoisensis* Baker 1928, Wisconsin Geological and Natural History Survey, Bull. 70, pt. 1, p. 38, pl. 2, figs. 18–21 (Illinois River, Havana [Mason Co..], Illinois). [Holotype, Univ. of Illinois Z18025.]

*Description.* Shell ranging from globose to depressed globose and varying somewhat in size, large specimens reaching about 32 mm. in length. Imperforate or with a narrow, slit-like to circular umbilicus. Rather thin in structure and smooth.

Color dark yellowish green to dark olivaceous green. All examined mature specimens totally lacking bands; occasional immature individuals with three reddish bands, possibly a fourth indistinct band. Whorls usually $4\frac{1}{2}$, strongly convex and with a slight shoulder. Spire moderately extended and produced at an angle of about 55° to 80°. Aperture subovate. Outer lip thin and generally with a blackened margin extending shortly within. Inner lip also margined with black, and with the parietal area somewhat thickened. Columella narrow and arched. Suture deeply indented. Sculpture consisting of fine axial growth lines and minutely beaded spiral threads. Operculum corneous, thin, with concentric growth lines and a depressed submarginal nucleus.

| length | width | |
|---|---|---|
| 23.0 mm. | 22.5 mm. | New Orleans, Orleans Parish, Louisiana |
| 32.0 | 28.0 | pond, 13 mi. W of Houston, Harris Co., Texas |
| 26.0 | 24.0 | Winnebago Co., Illinois |
| 27.0 | 24.0 | White Bear Lake, Ramsey Co., Minnesota |
| 26.5 | 22.0 | " " " " " " |

*Remarks. Viviparus intertextus* has a rather unusual distribution as shown on Plate 68. This is possibly a reflection of the ecology of the animals and the recent trend of various species of North American *Viviparus* to extend their ranges to the north. At present there is no satisfactory explanation for its occurrence in eastern Georgia and South Carolina.

This species is usually found around and among the roots and stems of underwater vegetation in cool and comparatively swift water. The substrate is generally of a coarser nature than that tolerated by other North American species in this genus, being gravelly and stony with an admixture of sand. Sometimes the streams in which they are found are no more than a yard or two in width, and we have found specimens in areas where they must be exposed to rather thorough scouring when the streams are in flood.

Baker (1928) distinguished his *Viviparus intertextus illinoisensis* from the typical form on the basis of the fact that "typical *intertextus* has a very wide, somewhat globular shell with a broadly depressed spire, the nuclear whorls of which are coiled in the same plane, while in *illinoisensis* the shell is subglobose, the spire rather elevated, the spire whorls being

Plate 65

Fig. 1. *Viviparus georgianus* (Lea). Stone's River, 7 miles NNE of Murfreesboro, Rutherford Co., Tennessee (1.9×).

Fig. 2. *V. intertextus* (Say). Cedar River, Cedar Rapids, Lynn Co., Iowa (1.9×).

Fig. 3. *V. intertextus* (Say). Little Ohoopee River, 2 miles N of Kite, Johnson Co., Georgia (1.9×).

Fig. 4. *V. georgianus* (Lea). Chipola Rivar, 5.5 miles W of Greenwood, Jackson Co., Florida (1.2×).

Fig. 5. *V. subpurpureus* (Say). Mississippi River, Vicksburg, Warren Co., Mississippi (1.8×).

Fig. 6. *V. subpurpureus* (Say). [St. Francis River], Wittsburg, Cross Co., Arkansas (1.8×).

Fig. 7. *V. subpurpureus* (Say). Kentucky River, Gratz, Owen Co., Kentucky (1.8×).

Fig. 8. *V. subpurpureus* (Say). Outlet, Lake Catahoula, 1 mile SW of Archie, Catahoula Parish, Louisiana (1.8×).

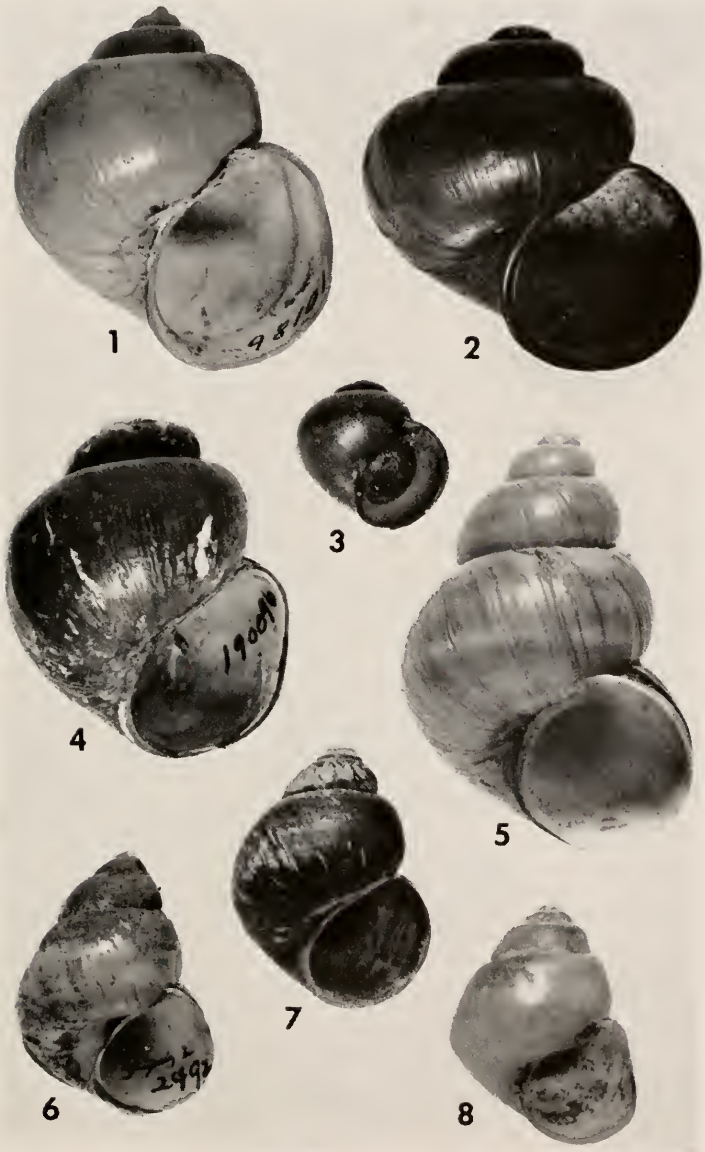


Plate 65

more regularly descending, and the sutures are more deeply impressed." This statement is true only in part, as all of the characters mentioned are variable, and any one population will have specimens transitional between these two 'subspecies'. On the whole, the northern populations tend to be a little more openly umbilicate, but even this character is variable and does not separate the two forms.

Some specimens of *intertextus* closely resemble *V. georgianus* Lea, but adult specimens can, so far as we know, always be distinguished by the complete lack of banding in *intertextus,* its depressed spire and lighter structure.

*Specimens examined.* HOUSTON SHIP CHANNEL SYSTEM. TEXAS: Addicks; 13 mi. W of Houston, both Harris Co. (both MCZ). SAN JACINTO RIVER SYSTEM. TEXAS: Cleveland, Liberty Co. (MCZ). LIBERTY RIVER SYSTEM. TEXAS: Dayton, Liberty Co. (MCZ). NECHES RIVER SYSTEM. TEXAS: Neches River, Town Bluff, Tyler Co. (MCZ). BAYOU TECHE SYSTEM. LOUISIANA: Bayou Teche, near St. Martinville, St. Martin Parish; Grand Coteau, St. Landry Parish (both MCZ). MISSISSIPPI RIVER SYSTEM. MISSISSIPPI RIVER DRAINAGE. LOUISIANA: New Orleans, Orleans Parish (MCZ); Harahan, Jefferson Parish; near Houma, Terrebonne Parish (both USNM). ARKANSAS: L'Anguelle River, St. Francis Co. (ANSP). TENNESSEE: Samburg, Obion Co. (MCZ). ILLINOIS: Warsaw, Hancock Co.; Glancy's Lake, Mercer Co.; Rock Island, Rock Island Co. (all MCZ); Lake Harmon (USNM); Rockford (MCZ), both Winnebago Co. IOWA: Burlington, Des Moines Co.; Muscatine, Muscatine Co. (both MCZ); Davenport, Scott Co. (USNM; ANSP). MINNESOTA: Minneapolis, Hennepin Co. (USNM); White Bear Lake, Ramsey Co. (MCZ). RED RIVER DRAINAGE. LOUISIANA: Bayou Boeuf, Richland Parish; Ouachita River, Alabama Landing, Union Parish (both ANSP); Alexandria, Rapides Parish (USNM); Frierson, DoSoto Parish (MCZ); Shreveport, Caddo Parish (USNM). WABASH RIVER DRAINAGE. ILLINOIS: Wabash River, Mt. Carmel, Wabash Co. (ANSP). ILLINOIS RIVER DRAINAGE. ILLINOIS: Havana, Mason Co. (ANSP); Canton, Fulton Co. (MCZ); Putnam Co. (ANSP); Joliet, Will Co. (USNM). IOWA RIVER DRAINAGE. IOWA: Cedar River, Cedar Rapids, Linn Co. (MCZ); Waterloo,

Blackhawk Co. (USNM). PEARL RIVER SYSTEM. MISSISSIPPI: Conway's Slough, Jackson, Hinds Co. (MCZ). COOSA-ALABAMA RIVER SYSTEM. ALABAMA: Alabama River, Halley's Landing, E of Pine Hill, Wilcox Co. (ANSP; USNM); floodplain, Tombigbee River, Jackson, Clarke Co. (ANSP). ALTAMAHA RIVER SYSTEM. GEORGIA: Ohoopee River, Wrightsville; Little Ohoopee River, Kite, both Johnson Co.; Alligator Creek, 10 mi. S of Rentz, Laurens Co.; Gum Swamp Creek, McRae, Telfair Co. (all MCZ). EDISTO RIVER SYSTEM. SOUTH CAROLINA: Summerville, Dorchester Co. (MCZ). SANTEE RIVER SYSTEM. SOUTH CAROLINA: Pocotaligo River, Manning; Clarendon Co.; Santee Canal, Berkeley Co. (both ANSP). GREAT LAKES–ST. LAWRENCE RIVER SYSTEM. LAKE SUPERIOR DRAINAGE. MINNESOTA: Rainy Lake at Rainy Lake, Koochiching Co. (ANSP).

## **Viviparus georgianus** *Lea*

Plate 64, figs. 1–12; Plate 65, figs. 1, 4

*Lymnaea vivipara* 'Linnaeus' Say 1817, Nicholson's Encyclopedia **2**:17, pl. 2, fig. 5 (no locality given); non Linnaeus 1758.

*Paludina georgiana* Lea 1834, Trans. American Philosophical Soc. (n.s.) **5**: 116, pl. 19, fig, 85 (Hopeton, near Darien, [McIntosh Co.], Georgia).[1] [Holotype, USNM 106252; paratype, MCZ 186792.]

*Paludina linearis* 'Valenciennes' Küster 1852, Conchylien-Cabinet (2)**1**(pt. 21):19, pl. 4, fig. 4 (Simpson Creek Lake, East Florida).

*Paludina wareana* 'Shuttleworth' Küster 1852, Conchylien-Cabinet (2)**1**:(pt. 21), pl. 4, figs. 10–11 (Ostflorida in Ware-See [Lake Weir, Marion Co., Florida]).

*Vivipara haldemanniana* 'Shuttleworth' Frauenfeld 1862, Verh. K. K. Zool. Bot. Gesell. Wien, p. 1162 (Black Creek [Clay Co.], East Florida).

*Vivipara inornata* Binney 1865, American Jour. of Conchology **1**:49, pl. 7, fig. 1 (near Chopatilo, Mexico). [Lectotype, MCZ 234704; paratype, MCZ 20512.]

*Vivipara contectoides* Binney 1865, Smithsonian Misc. Collections, no. 144, pt. 3, p. 23, text figs. 41–44 (Florida). [Lectotype, MCZ 74393; paratypes, USNM 27756.]

*Vivipara georgiana fasciata* Tryon 1870, Monograph of the Freshwater Univalve Mollusca of the United States, Philadelphia, p. 17 (no locality given [Florida]). [Types lost.]

*Paludina inornata* Binney [in] Fischer and Crosse 1890, Mission Scientifique au Mexico et dans l'Amerique Centrale **2**:291. [Lectotype, MCZ 234704; paratypes, USNM 9168.]

[1] Hopeton, or Hopeton's Landing, was about 10 to 15 miles up the Altamaha River from Darien, McIntosh Co., Georgia. This was a plantation landing, and, like many others, was used when the larger rivers were the main source of transportation. Most place names of this type have long since disappeared.

*Vivipara georgiana altior* Pilsbry 1892, Nautilus **5**:142 (aboriginal shell heap, left bank of Hitchen's Creek, near entrance of St. Johns River into Lake George [Putnam Co.], Florida). [Lectotype, ANSP 63420a.]

*Viviparus georgiana limnothauma* Pilsbry 1895, Nautilus **8**:116 (aboriginal shell-field, Hitchen's Creek [near entrance of St. Johns River into Lake George, Putnam Co.], Florida and in 2 fathoms, Lake George [Florida]). [Lectotype, ANSP 70052a.]

*Viviparus walkeri* Pilsbry and Johnson 1912, Nautilus **26**:48, pl. 3, figs. 6–7 (Juniper Creek, Lake Co., Florida). [Lectotype, ANSP 70053a.]

*Viviparus contectoides impolitus* Pilsbry 1916, Nautilus **30**:41 (in marsh, Paint Rock River, Jackson Co., Alabama). [Holotype, ANSP 66701a.]

*Viviparus contectoides compactus* Pilsbry 1916, Nautilus **30**:42 (Dougherty, [Co.?], Georgia). [Holotype, ANSP 27731]; non *compactus* Kobelt 1906.

*Viviparus contectoides limi* Pilsbry 1918, Nautilus **32**:71 (Dougherty, [Co.?], Georgia). [Holotype, ANSP 27731]; [new name for *V. compactus* Pils.; non Kobelt].

*Viviparus contectoides goodrichi* Archer 1933, Nautilus **47**:19, pl. 3, figs. 1–3 (spring-fed stream, tributary of the Chipola River, 5 mi. NE of Marianna, Jackson Co., Florida). [Holotype, MCZ 92432.]

*Description.* Shell subglobose in outline and varying in size, large specimens reaching about 44 mm. (about $1\frac{3}{4}$ inches) in length, imperforate or with a narrow, slit-like umbilicus. Usually rather thin in structure, but strong and smooth. Color yellowish or olivaceous green to dark brownish green, banded or uniform in color. Banded specimens usually have four dark, reddish brown bands, fairly evenly spaced. Whorls 4 to 5, strongly convex and generally with a slight shoulder. Spire somewhat extended and produced at an angle of from 50° to 65°. Aperture ovate to subcircular. Outer lip thin, parietal lip consisting of a thickened glaze. Columella narrow and arched. Suture deeply indented. Sculpture consisting only of fine growth lines. Young specimens with a few spiral threads which eventually disappear as they grow older. Operculum corneous, thin, with concentric growth lines and a submarginal nucleus.

| length | width | |
|---|---|---|
| 44.0 mm. | 35.0 mm. | Holotype, *V. C. goodrichi* Archer |
| 26.0 | 19.5 | Holotype, *V. georgianus* Lea |
| 25.0 | 21.0 | Lectotype, *V. c. limi* Pilsbry |
| 33.0 | 21.5 | Lectotype, *V. contectoides* Binney |

*Remarks. Viviparus inornatus* Binney is here considered a tentative synonym of *georgianus* because it very closely re-

sembles certain atypical green and unbanded specimens of *georgianus* found in otherwise normally banded populations from northern Florida. It is our contention that the locality given for Binney's specimens was in error because we have been unable to find "Chopatilo", Mexico on any map, old or new, and because (with the exception of a few recent records for *V. subpurpureus* Say in small rivers of eastern Texas) no *Viviparus* has been known from west of the Mississippi River System. The genus has been recorded in the fossil from the Lower Cretaceous of Alberta, Canada, and the Upper Cretaceous from Utah, and the Eocene from Utah and Washington. In areas in the central and eastern states, all within the present range of this genus, the fossil history dates from the Lower Cretaceous. (See Henderson, 1935, pp. 14–15.)

Clench and Turner (1956) considered *V. georgianus wareanus* Küster as a questionable subspecies, but additional material from south-central Florida has shown that there is no basis for this separation. Specimens from this area are usually smaller than those in the more northern populations, but small specimens do occur throughout the range of the species.

For a discussion of the habitat, range and distribution records of *V. georgianus,* see Clench, this volume, pp. 262–271.

### **Viviparus bermondianus** *d'Orbigny*
Plate 66, fig. 5

*Paludina bermondiana* d'Orbigny 1842 [in] Ramon de la Sagra, Hist. de l'Ile de Cuba, Mollusques **2**:7, pl. 10, fig. 5 (Cuba [Rio Hanábana, Ciénega Oriental de Zapata, Las Villas Province]). [Types in the British Museum (Nat. Hist.).]

*Description.* Shell subglobose in outline and varying considerably in size, large specimens reaching about 17 mm. (about $\frac{5}{8}$ inch) in length, with a wide circular or oval umbilicus and a pronounced depression. Shell thin in structure, strong and smooth. Color olivaceous, usually stained in browns and banded. Bands three in number, brown, and rather evenly spaced, the uppermost one situated at the suture. Whorls 4 to 5, strongly convex, and rarely with a moderate shoulder. Spire somewhat elevated and produced at an angle of about 85° to 110°. Aperture ovate. Outer lip thin and strong. Parietal lip consisting of a thickened glaze. Columella narrow and

arched. Suture deeply indented. Sculpture consisting only of fine growth lines. Operculum corneous, thin, with concentric growth lines and a somewhat indented submarginal nucleus.

| length | width | |
|---|---|---|
| 17.0 mm. | 15.0 mm. | San Francisco, Ciénega de Zapata, Las Villas Province, Cuba |
| 17.0 | 14.0 | Rio Hanábana, Ciénega Oriental de Zapata, Las Villas, Cuba |
| 9.0 | 8.0 | " " " " |

*Remarks.* This species is limited to the region of the Ciénega de Zapata, a great swamp on the Zapata Peninsula, Las Villas Province, Cuba. It is a very distinct species, characterized by a large and consistent umbilicus with a depression or embayment around it, and by the presence of three spiral bands of brown. The species appears closely related to *V. georgianus* Lea and *V. intertextus* Say. The consistent three banded color pattern of *V. bermondianus* distinguishes it from *intertextus,* which ordinarily has none and from *V. georgianus,* which ordinarily has four.

*Viviparus bermondianus* is apparently a rare species, for though known for over a century, specimens are still extremely rare in collections. It is strange that this species is so limited in distribution; and moreover, its presence in Cuba as the only Caribbean species of *Viviparus* is difficult to explain.

*Specimens examined.* CUBA: Rio Hanábana, Ciénaga Oriental de Zapata, Las Villas Province; San Francisco, Ciénaga de Zapata (we have been unable to locate "San Francisco"; if it is a region or a town, we are still unable to verify the province) (both MCZ).

### Subgenus **Cipangopaludina** *Hannibal*

*Cipangopaludina* Hannibal 1912, Proc. Malac, Soc. London **10**:194 (type species, *Paludina mallcata* Reeve, original designation).

*Lecythoconcha* Annandale 1920, Records of the Indian Mus. **19**:111, text fig 1 (type species, *Paludina lecythis* Benson, monotypic); Annandale 1921, Mem. Asiatic Soc. Bengal **6**:401.

When Annandale first introduced his genus *Lecythoconcha* he stated "An examination of the animal of Benson's *Paludina lecythis* proves that it and its allies must be separated from

*Vivipara.* I propose for them the new generic name *Lecythoconcha.*" In his second reference given above he gives "its allies" as *malleata* Reeve, *sclateri* Frauen. and *japonica* v.Mts.

The shell is generally large, broad and with an elevated spire. The young, and frequently the adults of certain species, have one to four spiral, thread-like lines which support short periostracal hairs. Other sculptural features exhibited by species in this subgenus are in the form of malleations and fine carinae. According to Annandale (1920) the mantle differs from *Viviparus s.s.* in the greatly thickened and very muscular free edge.

We have made no attempt to work out the synonymy of the two following Oriental introductions in North America. The most recent study known to us is that of T.-C. Yen (1939) which covers only China. The range of *V. chinensis malleatus* (Reeve) extends at least as far as Japan.

**Viviparus (Chipangopaludina) japonicus** *von Martens*
Plate 66, figs. 3–4, 6–7

*Paludina japonica* von Martens 1861, Malakozoölogische Blätter **7**:44 (no locality given, but there is mention of typical specimens of the same species, "also from Japan"). [Lectotype, Leiden Mus. 50149, here selected.]

*Description.* Shell somewhat extended, varying in size, large specimens reaching 65 mm. (about $2\frac{1}{2}$ inches) in length. Rimately umbilicate. Rather thin in structure, strong and smooth. Color olivaceous green to dark brownish green, without banding. Whorls 7 to 8, strongly convex, with a smoothly rounded shoulder and a moderate carina below the suture, often with faint carinae both above and below the periphery. Spire extended and produced at an angle of some 50° to 55°. Aperture subovate. Outer lip thin. Parietal lip consisting of a thin glaze. Columella narrow and arched. Suture deeply indented. Sculpture of fine to coarse growth lines and a few fine spiral threads. Many specimens exhibit faint malleations, particularly on the earlier whorls. Operculum corneous, thin, with concentric growth lines and a submarginal nucleus.

| length | width | |
|---|---|---|
| 65.0 mm. | 40.0 mm. | Lake Biwa, Japan |
| 62.0 | 41.0 | Koriyama, Japan |
| 53.0 | 31.0 | Spark's Park, Jackson, Jackson Co., Michigan |
| 42.0 | 30.5 | Concord River, Concord, Middlesex Co., Massachusetts |

Plate 66

Fig. 1. *Viviparus malleatus* Reeve. [Lake Erie], Sandusky, Erie Co., Ohio (1.2×).

Fig. 2. *V. malleatus* Reeve. Shiner Pond, Menlo Park, Middlesex Co., New Jersey (1.2×).

Fig. 3. *Paludina japonica* von Martens (= *V. japonicus* (von Martens)). [Japan]. Lectotype, RVNH 50149 (1.0×).

Fig. 4. *V. japonicus* (von Martens). Spark's Park, Jackson, Jackson Co., Michigan (1.2×).

Fig. 5. *V. bermondianus* (d'Orbigny). San Francisco, Cienega de Zapata, Las Villas Province, Cuba (1.9×).

Fig. 6. *Paludina japonica* von Martens (= *V. japonicus* (von Martens)). [Japan]. Syntype, RVNH 50150 (1.0×).

Fig. 7. *V. japonicus* (von Martens). Concord River, Concord, Middlesex Co., Massachusetts (1.2×).

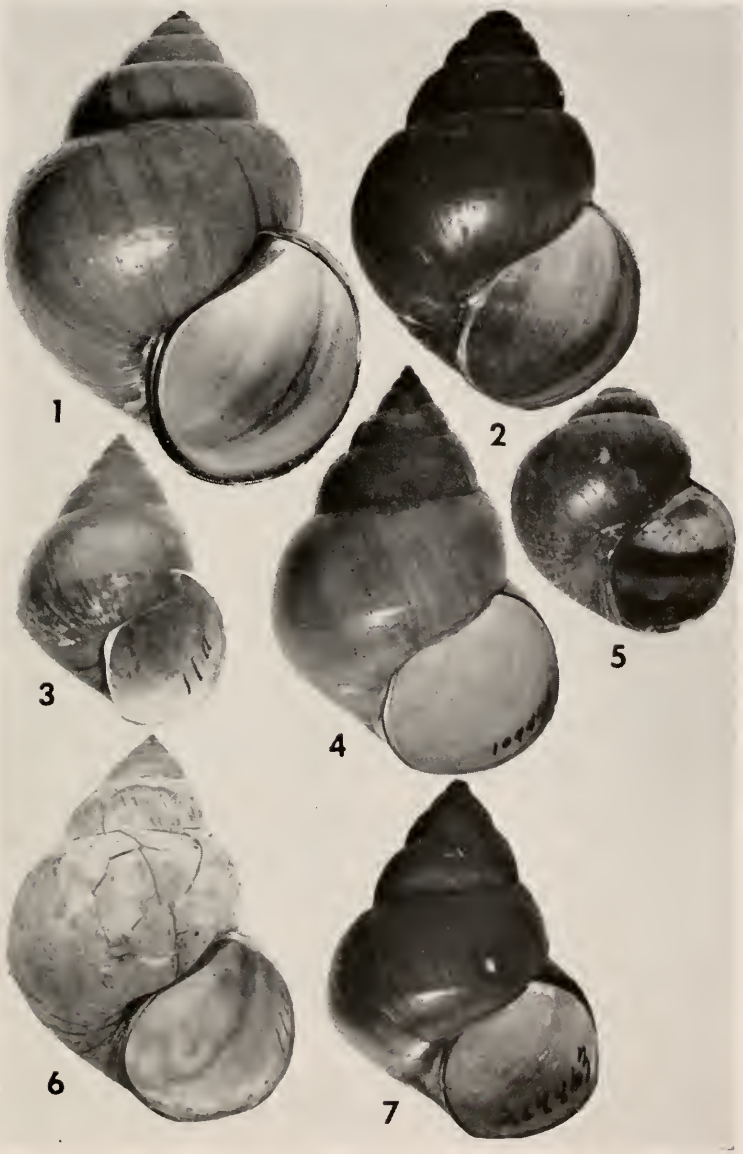


Plate 66

*Remarks.* The original and unillustrated description of *Paludina japonica* by von Martens in 1861 cites a specimen measuring 54 mm. in length by 42 mm. in breadth; mention is made in his remarks of a second specimen with the respective dimensions of 51 and 40 mm., which he considers to be the same species. In both cases this means a height:width ratio of about 4:3, which indicates a degree of globosity roughly equal to that of the more globose specimens of *V. chinensis malleatus* which we have seen. We figure on Plate 66 two specimens from the type lot of *P. japonica* in the Leiden Museum. These are globose and they are also carinate. We here select no. 50149 of the Leiden Museum as the lectotype of *P. japonica,* as this specimen fits most closely von Marten's original description. Number 50150 of that institution includes the paratypes.

*V. japonicus* can be distinguished from *V. malleatus* by having a more acute spire and by having fine carina or carinae. However, we possess individuals of *malleatus* with very faint malleations (see Plate 66, fig. 2), and of *V. japonicus* with a total lack of any carinae (see Plate 66, fig. 4).

Both of these Oriental species which have been introduced into North America may be distinguished from our native species by their larger size and their complete lack of banding at any stage of growth. Small, depressed, dark specimens of either species might be mistaken for *V. intertextus* Say, but the nearly globose shape of the latter species is a consistent and reliable character.

*Specimens examined.* MISSISSIPPI RIVER SYSTEM. OKLAHOMA. Ardmore Mountain Lake, Ardmore, Carter Co.; Stillwater, Payne Co. (both MCZ). GREAT LAKES–ST. LAWRENCE RIVER SYSTEM. MICHIGAN: Spark's Park, Jackson Jackson Co. (MCZ). MERRIMACK RIVER SYSTEM. MASSACHUSETTS: Concord River, Concord, Middlesex Co. (MCZ).

### Viviparus (Cipangopaludina) chinensis malleatus (*Reeve*)

Plate 66, figs. 1–2

*Paludina malleata* Reeve 1863, Conchologia Iconica **14: Paludina,** pl. 5, fig. 25 (Japan).

*Description.* Shell globose in outline, with some variation in size, large specimens reaching some 60 mm. (about 2¼ inches)

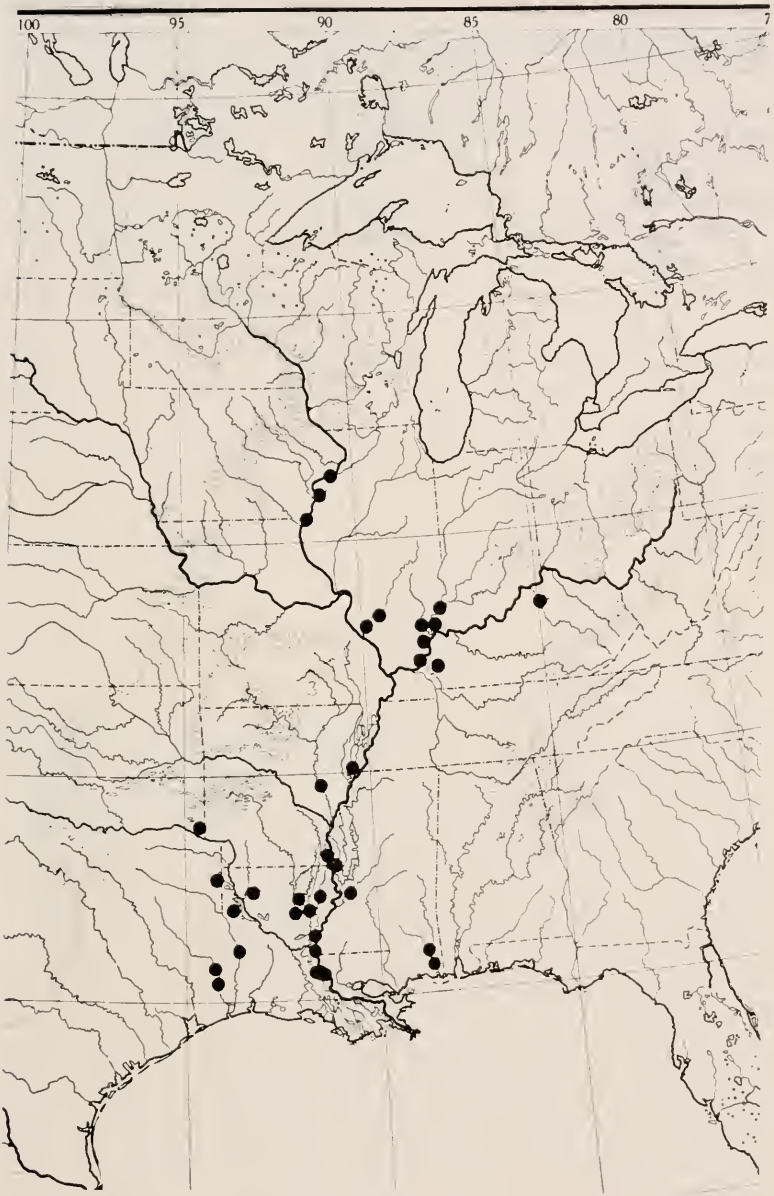


Plate 67
Distribution of *Viviparus subpurpureus* (Say).

in length, with a small, round umbilicus, covered in part by the reflected parietal lip. Thin in structure, rather strong and smooth. Color a uniform light to dark olive-green, without any bands. Whorls 6 to 7, strongly convex, and generally with a very slight shoulder. Spire moderately extended and produced at an angle of 65° to 70°. Aperture subovate and virtually holostomatous. Outer lip very slightly reflected; parietal lip slightly reflected and thickened, especially over the umbilical area. Entire lip and a short distance within the aperture colored black. Columella narrow and arched. Suture deeply indented. Sculpture consisting of fine growth lines, spiral lines, and fine to moderate malleation over the entire surface. Occasional specimens will show older reflected lips as fairly strong axial ridges. Others may have one or more spiral threads developed into slight carinae. Operculum corneous, thin, with concentric growth lines and a submarginal nucleus.

| length | width | |
|---|---|---|
| 60.0 mm. | 41.0 mm. | Nannacatucket River, Hamilton, Washington Co., Rhode Island |
| 55.0 | 43.0 | Peacock Pond, Lexington, Middlesex Co., Massachusetts |
| 41:5 | 32.0 | Agneu, Santa Clara Co., California |
| 54.0 | 40.0 | Lake Erie, Sandusky, Erie Co., Ohio |

The first record for an introduced oriental *Viviparus* in North America is that of Wood (1892); in that year, he purchased a few live specimens in a Chinese market in San Francisco, which were determined as *Paludina japonica* von Martens but were later considered to be *malleatus* by Stearns (1901). Stearns further reports that he was sent some specimens of *Viviparus* from San José, California, where they had been introduced. Hannibal (1911) notes that the species soon became abundant in the so-called "Artesian Belt" between San José and San Francisco Bay. He further records that he personally collected *japonicus* at Hanford, California, in a dry irrigation ditch. He takes care to distinguish his specimens from *malleatus,* since earlier writers had disputed the exact identity of the original *Viviparus* introductions. We have not seen any of this material, but we consider it safe to presume that Hannibal's is the first credible record for the introduction of *japonicus* into North America. Similarly, we may trust Hannibal's determination of Wood's specimens, whereby it is verified that *mallea-*

*tus* first appeared on this continent in 1892. The identity of the *Viviparus* reported by Taylor from Victoria, British Columbia, as noted by Pilsbry (1894), who apparently did not see the specimens, must remain clouded.

Thus, by the turn of the century, species of oriental *Viviparus* were securely established on the North American west coast. In 1914, a collection of *malleatus* was made by the senior author in Muddy River within the city limits of Boston (Johnson, 1915). Again, Johnson (1918), reported this species from Lake Quinsigamond, Worcester, Worcester Co., Massachusetts. Since that time *malleatus* has spread widely in eastern Massachusetts and has appeared in various other eastern localities. At present, the species is to be found in many suitable sites throughout most of central, far western, and eastern United States.

The animal prefers quiet water, either in slow-moving streams or in ponds and lake margins, where there is some vegetation and a substrate of mud.

See also *Remarks* under *V. japonicus*.

*Specimens examined.* (All MCZ.) HAWAII: Halawa Valley, Molokai.[1] WASHINGTON: Green Lake, Seattle, King Co. CALIFORNIA: Suisan City, Solano Co.; Stockton, San Joaquin Co.; Nigger Jack Slough, N of Marysville, Yuba Co.; San José; Agneu; fishpond, Stanford University, all Santa Clara Co.; Quinto Creek, Merced Co.; Santa Barbara, Santa Barbara Co.; Exposition Park, Los Angeles, Los Angeles Co. UTAH: Warm Springs, 4 mi. E of Goshen, Utah Co. ARIZONA: pond, University of Arizona, Tucson, Pimah Co. COLORADO: Radium Hot Springs, Ouray, Ouray Co. TEXAS: pond, Waco, McLennan Co. MICHIGAN: Kalamazoo River, 2 mi. W of Albion and near Marengo, both Calhoun Co.; Red Cedar River, East Lansing, Ingham Co. INDIANA: Mishawaka, St. Joseph Co. OHIO: East End Cove, Lake Erie, Sandusky, Erie Co.; Cleveland, Cuyahoga Co. FLORIDA: Lake Morton, Lakeland, Polk Co.; Mirror Lake, St. Petersburg, Pineilas Co. NORTH CAROLINA: Greenville, Pitt Co. PENNSYLVANIA: Herr's Icepond, Lancaster, Lancaster

[1] In the case of *V. chinensis malleatus* Reeve we eliminate the caption RIVER SYSTEM as so many records are based upon a single locality in any one system.


Plate 68
Distribution of *Viviparus intertextus* (Say).

Co.; Lake Duffy, near Mt. Cretna, Lebanon, Lebanon Co.; pond, Haverford College, Delaware Co. DELAWARE: Silver Lake, Milford, Sussex Co. NEW JERSEY: Raritan Canal, Princeton, Mercer Co.; Shiner Park, Menlo Park, Middlesex Co.; Old Reservoir, Arlington, Hudson Co. NEW YORK: Saw Mill River, Nepera Park, Yonkers, Westchester Co.; Goshen, Orange Co.; Bahnet's Pond, Poughkeepsie, Dutchess Co.; Queens Village, Queens Co; Freeport, Nassau Co. VERMONT: Lake Fairlee, Thetford Center, Orange Co.; Ottauquechee River, Quechee, Windsor Co. RHODE ISLAND: Nannacatucket River, Hamilton, Washington Co. MASSACHUSETTS: Lake Quinsigamond, Worcester, Worcester Co.; Whitman's Pond, East Weymouth, Norfolk Co.; Pine Tree Brook and pond, both Blue Hills Reservation, Turner's Pond, all Milton, Norfolk Co.; Leverett Pond, Jamaica Pond and Muddy River, all Boston, Suffolk Co.; Hawes Pond, Brookline and Trout Brook, 1 mi. S of Dover, both Norfolk Co.; Peacock Pond, Lexington; pond, Mt. Hood, Melrose, both Middlesex Co.; Pillings Pond, Lynnfield, Essex Co. MAINE: Messalonskee River, Waterville, Kennebec Co.

## References

Annandale, N. 1920. Materials for a Generic Revision of the Freshwater Gastropod Molluscs of the Indian Empire, nos. 1–2. Records of the Indian Museum **19:**107–115.

——. 1921. The Viviparous Water-Snail of Lake Biwa, Japan. Mem. Asiatic Soc. of Bengal **6:**399–401.

Baker, F.C. 1928. The Fresh Water Mollusca of Wisconsin, part I. Gastropoda. Wisconsin Geological and Natural History Survey, Bull. **70:**34–44.

Binney, W.G. 1865a. Descriptions of New Species of North American Land and Fresh Water Shells. American Jour. Conchology **1:**49, pl. 7, fig. 1.

——. 1865b. Land and Freshwater Shells of North America. Smithsonian Misc. Collections, no. 144, pt. 3, p. 113, fig. 225.

Call, R.E. 1894. The Geographic and Hypsometric Distribution of North American Viviparidae. Amer. Jour. Science **48:**132–141.

Clench, W.J. 1962a. A Catalogue of the Viviparidae of North America with Notes on the Distribution of Viviparus georgianus Lea. Occasional Papers On Mollusks **2:**261–287.

——. 1962b. New Records for the Genus Lioplax. Occasional Papers On Mollusks **2:**288.

Clench, W.J. and R.D. Turner. 1955. The North American Genus Lioplax in the Family Viviparidae. Occasional Papers On Mollusks **2:**1–5.

——. 1956. Freshwater Mollusks of Alabama, Georgia and Florida from the Escambia to the Suwannee River. Bull. Florida State Museum, Biol. Sciences **1:**97–239.

Crabb, E.D. 1929. Egg Laying and Birth of Young in Three Species of Viviparidae. Nautilus **42:**125–129.

Fischer, P. and H. Crosse. 1890. Mission Scientifique au Mexico et dans l'Amerique Centrale **2:**291.

Henderson, J. 1935. Fossil Non-Marine Mollusca of North America. Geological Society of North America, Special Papers No. 3, pp. 14–15; 165–188.

Hannibal, H. 1911. Further Notes on Asiatic Viviparus in California. Nautilus **25:**31–32.

——. 1912. A Synopsis of the Recent and Tertiary Land and Fresh Water Mollusca of the Californian Province. Proc. Malac. Soc. London **10:**112–211.

Johnson, C.W. 1915. Viviparus malleatus Reeve in Massachusetts. Nautilus **29:**35–36.

——. 1918. Viviparus malleatus and contectoides in Massachusetts. Nautilus **31:**107–108.

Kobelt, W. 1879. Fauna Japonica Extramarina. Abhandlungen d. Senkenbergisch naturf. Gesellsch. **11:**120–127.

Miyazaki, J. 1958. On the Overwinter of the Pond-Snail Cipangopaludina malleata (Reeve). The Collecting and Breeding **20:**270–272.

Pilsbry, H.A. 1894. Paludina japonica in the Chinese Market at Victoria, B.C. Nautilus **7:**144.

Prashad, B. 1928. Recent and Fossil Viviparidae. Memoirs of the Indian Museum **8:**153–251.

Reeve, L. 1862. Conchologia Iconica **14:** text, 11 plates.

Schmeck, E.H. 1942. Viviparus malleatus in Niagara River. Nautilus **55:**102–103.

Stearns, R.E.C. 1901. Japanese Vivipara in California. Nautilus **15:**91.

von Martens, E. 1861. Die Japanesischen Binnenschnecken im Leidner Museum. Malakozoologische Blätter **7:**44–45.

——. 1899. Biologia Centrali-Americana, Mollusca, p. 426.

Wood, W.M. 1892. Paludina japonica v. Martens for Sale in the San Francisco Markets. Nautilus **5:**114–115.

Yen, T.-C. 1939. Die Chinesischen Land- und Süsswasser Gastropoden des Naturmuseums Senckenberg. Senckenbergischen Natur. Gesell. **444:**1–233.

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THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 NOVEMBER 8, 1965 NUMBER 33

# Catalogue of the Family Pandoridae (Mollusca: Bivalvia)

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The following catalogue was initiated during the preparation of a taxonomic revision of the family Pandoridae.[1] At the time of the completion of that manuscript, the catalogue was incomplete but of such magnitude that it was deemed worthwhile to carry it to completion. A work of this kind is primarily bibliographic and proceeds in a disconcertingly haphazard manner. The basic references, Sherborn's Index Animalium, the Zoological Record, and, in this case, the previous monographic work of Lamy, do not supply all the necessary information, nor do they incorporate all the specific taxa attributed to the family. It is by painstaking reference to original and subsequent literature and chance collation that a catalogue of this sort is compiled.

The presentation intends to include: 1) the generic, subgeneric, specific or subspecific name as originally introduced, 2) the original literature and date citation, 3) the type locality, including the geologic age in case of fossils, and 4) the whereabouts of the type specimens. Cases of taxa erroneously referred to *Pandora*, either originally or subsequently, are noted as not belonging to the family Pandoridae. Their correct systematic placement is indicated if known. If the type specimens

[1] Boss and Merrill, 1964.

could not be found, they are listed as lost; footnotes cite the authority for some of these statements. The actual existence of every type specimen has not been corroborated if the original statement of individual authors or the subsequent remarks of Lamy (1934), or Sherborn (1940), present the necessary documentation.

ACKNOWLEDGMENTS

For checking type specimens, catalogue and registration numbers, the author is indebted to: Mr. Norman Tebble, Mr. J. Peake, Mr. C. P. Nuttall, and Mr. S. P. Dance, all of the British Museum (Natural History); Mme. D. Mongin, Laboratoire de Géologie, Institut Catholique, Paris; M. Beauvais, Laboratoire de Géologie, Sorbonne; Prof. E. Fischer, Muséum national d'Histoire naturelle, Paris; Dr. E. Binder, Muséum d'Histoire naturelle, Geneva; Dr. T. Habe, National Science Museum, Tokyo; Dr. D. McMichael, Australian Museum, Sydney; Mrs. W. S. S. van der Feen-van Benthem Jutting, Zoölogisch Museum, Amsterdam; Dr. O. A. Skarlato, Zoological Institute, Academy of Sciences, Leningrad.

For corroboration of literature citations which were unavailable to the author, I am happy to acknowledge the aid of Miss V. C. Kenk and Mr. Richard I. Johnson, Department of Mollusks, Museum of Comparative Zoology, Harvard University. For his critical examination of the manuscript, I would like to thank Dr. J. Rosewater, Division of Mollusks, United States National Museum.

ABBREVIATIONS

| | |
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| ANSP | — Academy of Natural Sciences of Philadelphia |
| BMNH | — British Museum (Natural History) |
| CAS | — California Academy of Science |
| MCZ | — Museum of Comparative Zoology |
| MNHNP | — Muséum national d'Histoire naturelle, Paris |
| USFC | — United States Fish Commission |
| USGS | — United States Geological Survey |
| USNM | — United States National Museum |

## Generic and Subgeneric Taxa

**Andora** 'Bruguière' Morse 1919. Proc. Boston Soc. Nat. Hist., **35**(5): 160, error for *Pandora* Bruguière 1797.

**Calopodium** Röding 1798, Museum Boltenianum, 1st Ed., p. 166 (type species, by monotypy, *Calopodium albidum* Röding, 1798 [ = *Tellina inaequivalvis* (Linnaeus, 1758)]).

**Cleidiophora** 'Carpenter' Conrad 1868. Amer. Jour. Conch., **3**(4): 269, error for *Clidiophora* Carpenter 1864.

**Clidiophora** Carpenter 1864. Proc. Zool. Soc. London, pt. 3, p. 596 (type species, by original designation, *Clidiophora claviculata* Carpenter 1855 [ = *Pandora arcuata* Sowerby 1830]).

**Clidiphora** 'Carpenter' Johnson 1934. Proc. Boston Soc. Nat. Hist., **40**(1): 31, error for *Clidiophora* Carpenter 1864.

**Coelodon** Carpenter 1864. Proc. Zool. Soc. London, pt.3 , p. 599 (type species, by original designation, *Coelodon ceylanicus* (Sowerby 1835)), *non* Audinet-Serville 1832 (Coleoptera), *nec* Lund 1838 (Mammalia).

**Foveadens** Dall 1915. Proc. U.S. Nat. Mus., **49:** 451 (type species, by original designation [*Pandora*] *Foveadens panamensis* Dall 1915).

**Frenamya** Iredale 1930. Rec. Australian Mus., **17:** 387 (type species, by monotypy, *Coelodon patulus* Tate 1889).

**Heteroclidus** Dall 1903. Trans. Wagner Free Inst. Sci., **3**(6): 1518 (type species, by original designation, [*Pandora*] *Clidiophora punctata* Conrad 1837).

**Kenerlia** 'Carpenter' Paetal 1875. Fam. Gatt. Moll., p. 103, error for *Kennerlia* Carpenter 1864.

**Kenerlyia** 'Carpenter' Nomura and Hatai 1940. Saito Ho-on Kai Mus., Res. Bull., **19:** 87, error for *Kennerlia* Carpenter 1864.

**Kennerleya** 'Carpenter' Fischer 1887. Manuel de Conchy., p. 1158, emend. for *Kennerlia* Carpenter 1864.

**Kennerleyia** 'Carpenter' Dall 1903. Trans. Wagner Free Inst. Sci., **3**(6): 1517, emend. for *Kennerlia* Carpenter 1864.

**Kennerlia** Carpenter 1864 (Aug.). Brit. Assn. Adv. Sci., Rept. for 1863, pp. 602 and 638; 1864 (Nov.). Proc. Zool. Soc. London, pt. 3, p. 602 (type species, by subsequent designation, Stoliczka 1871, p. 61, *Pandora* (*Kennerlia*) *bicarinata* Carpenter1864 [ = *Pandora* (*Kennerlia*) *bilirata* Conrad 1855]).

**Kennerlyia** 'Carpenter' Dall 1915. Proc. U.S. Nat. Mus., **49:** 448, error for *Kennerlia* Carpenter 1864.

**Kenverlia** 'Carpenter' Nomura and Hatai 1940. Saito Ho-on Kai Mus., Res. Bull., **19:** 88, error for *Kennerlia* Carpenter 1864.

**Panderella** 'Conrad' Palmer 1958. Memoir 76, Geol. Soc. Amer., p. 76, error for *Pandorella* Conrad 1863.

**Pandora** Bruguière 1797, Encyclopédie Méthodique, Vers Testacés, pl. 250, figs. 1 a–c; Lamarck 1799, Mem. Soc. Hist. Nat. Paris, an. vii, p. 88 (type species by subsequent monotypy, Lamarck 1799, *Tellina inaequivalvis* (Linnaeus 1758)), *non* Mühlfeld 1811 (Mollusca), *nec* Eschscholtz 1829 (Ctenophora), *nec* Haliday 1833 (Diptera), *nec* Chevrolat 1834 (Coleoptera), *nec* Westwood 1848 (Lepidoptera), *nec* Kock 1850 (Arachnida), *nec* Sars 1895 (Crustacea).

**Pandorella** Conrad 1863. Proc. Acad. Nat. Sci. Philadelphia, for 1862, p. 572 (type species, by monotypy, *Pandora arenosa* Conrad 1834), *non* Laseron 1951 (Mollusca).

**Pandorina** Scacchi 1836. Catalogus conchyliorum regni neapolitani, p. 6, *non* Scacchi 1833 (Mollusca), *nec* Bory de St. Vincent 1827 (Protozoa).

**Trutina** Brown 1827. Illustrations of the Conchology of Great Britain and Ireland, 1st. Ed., pl. 13, fig. 5 (type species, by monotypy, *Trutina solenoidea* Brown 1827 [ = *Tellina inaequivalvis* (Linnaeus 1758)]).

## Specific and Subspecific Taxa

**acutedentata** Carpenter 1864, **Clidiophora.** Proc. Zool. Soc. London, pt. 3, p. 598, substitute name for *cornuta* C. B. Adams 1852.

**acutirostrata** Clark 1918, **Pandora (Pandora).** Univ. Cal. Publ., Bull. Dept. Geol., **11**(2): 138, pl. 11, figs. 7, 9, 13 (University of California Locality 1131, ½ mile SW of town of Walnut Creek in creek bed about 100 yards to E of Oakland and Antioch bridge; elevation 150 feet; Contra Costa Co., 122°4′8″ W, 37°53′7″ N; holotype, Invert. Coll'n, Museum of Paleontology, University of California, No. 11111).

**aequivalvis** Philippi 1836, **Pandora.** Enum. Moll. Siciliae, **1:** 18, pl. 1. fig. 11 (fossilis in calcareo Panormitano [Sicily]) [not a *Pandora*].

**aequivatris** 'Philippi' Philippi 1844, **Pandora.** Enum. Moll. Siciliae, **2:** 16, error for *aequivalvis* Philippi 1836.

**albidum** Röding 1798, **Calopodium.** Museum Boltenianum, 1st Ed., pt. 2, p. 166; 1819, 2nd Ed., pt. 2, p. 116 (substitute name for *Tellina inaequivalvis* (Linnaeus 1758)).

**arctica** Dall 1903, **Pandora (Kennerleyia).** Trans. Wagner Free Inst. Sci., **3**(6): 1520, pl. 57, fig. 26 (Saco, Maine [Pleistocene]: holotype, USNM 109290).

**arcuata** Sowerby 1835, **Pandora.** Proc. Zool. Soc. London, p. 93 (Hab. apud Sanctam Elenam; syntypes, BMNH, Reg. No. 1964467).[1]

**arenata** 'Sowerby' H. and A. Adams 1865, **Pandora.** Gen. Rec. Moll., **2:** 371, *nomen nudum.*

**arenosa** Conrad 1834, **Pandora.** Jour. Acad. Nat. Sci. Philadelphia, **7**(1); 130–1 (Yorktown, Virginia [Miocene]; syntypes, ANSP 30584).

**aversus** Hedley 1913, **Coelodon.** Proc. Linn. Soc. New South Wales, **37**(2): 266 (Mast Head Island in 17–20 fathoms [Queensland, Australia]; holotype, Reg. no. C 19389, Australian Museum, Sydney) [see Hedley 1906, ibid, **31** (3): 473–4, pl. 37, fig. 16, *Coelon elongatus* 'Carpenter'].

**bicarinata** Carpenter 1864, **Kennerlia.** Proc. Zool. Soc. London, pt. 3, p. 603 (Catalina Island, California; holotype, USNM 592440).

**bilirata** Conrad 1855, **Pandora.** Proc. Acad. Nat. Sci. Philadelphia, 1st ser., **7:** 267 (California [Miocene]; types, lost [See Palmer, 1958, p. 77]).

**brasiliensis** 'Gould' Paetal 1890, **Pandora.** Catalog der Conchylien-Sammlung **3:** 28, error for *braziliensis* 'Gould MS' Sowerby [in] Reeve 1874.

**braziliensis** 'Gould MS' Sowerby [in] Reeve 1874, **Pandora.** Conch. Icon., **19, Pandora,** pl. 2, fig. 15 (Brazil; holotype, BMNH, Reg. No. 1964464).

**brevifrons** Sowerby 1835, **Pandora.** Proc. Zool. Soc. London, p. 93 (Hab. apud Panamam; types lost).

**brevis** Sowerby 1829, **Pandora.** Catal. Coll. S. Stutchbury, 1, Appx., p. 3 [not a *Pandora;* is the type species of *Myadora* Gray 1840].

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[1] The illustrations of *Pandora arcuata, P. brevifrons, P. ceylanica, P. discors* and *P. radiata* were first published in 1854 in Hanley's 'The Conchological Miscellany.'

**brevis** Verrill and Bush 1898, **Kennerlia.** Proc. U.S. Nat. Mus., **20:** 821, pl. 88, figs. 7a–b (USFC *Albatross* I, station 2248, S of Nantucket, Massachusetts, in 67 fathoms; holotype, USNM 40232).

**brunnichi** 'Beck MS' Lamy 1934, **Pandora.** Jour. de Conchy., **78**(2): 105, *nomen nudum.*

**bushiana** Dall 1886, **Pandora (Kennerlia).** Bull. Mus. Comp. Zool., **12**(6): 312 (Tampa, Florida, in 6 fathoms; holotype, USNM 61029).

**carinatum** Prashad 1932, **Calopodium (Kennerlia).** The Lamellibranchia of the Siboga Expedition. Systematic Part (Monograph 53c). II Pelecypoda, p. 323, pl. 7, figs. 15–18 (*Siboga* station 159, 0°59.1′ S; 129°48.8′ E, in 411 meters [N of Poelau Kofiau, Halmaheira Sea]; holotype, Zoölogisch Museum, Amsterdam).

**carolinensis** Bush 1855, **Pandora.** Trans. Conn. Acad., **6**(2): 474 (USFC *Albatross I* station 2113, off Cape Hatteras, North Carolina, in 15 fathoms; holotype, USNM 35701).

**ceylanica** Sowerby 1835, **Pandora.** Proc. Zool. Soc. London, p. 94 (in Mari Ceylanico, et apud Insulam Muerte, Colombiae Occidentalis [Ceylon]; holotype, BMNH, Reg. No. 196271).

**ceylonica** 'Sowerby' Hanley 1842, **Pandora.** Catalogue Recent Bivalve shells, p. 50, error for *ceylanica* Sowerby 1835.

**cistula** Gould 1850, **Pandora.** Proc. Boston. Soc. Nat. Hist., **3:** 217 (East Patagonia; holotype, USNM 5887).

**clavata** McCoy 1844, **Pandora.** [in] Griffith, Synopsis Carboniferous limestone fossils Ireland, p. 51, pl. 11, fig. 2 (no locality given) [not a *Pandora*].

**claviculata** Carpenter 1855, **Pandora.** Proc. Zool. Soc. London, pt. 23, p. 228 (Mazatlan, Mexico; syntypes, BMNH, Reg. No. 196252).

**clavisulcata** 'Carpenter' Paetal 1883, **Pandora.** Catalog der Conchylien-Sammlung, p. 199, error for *claviculata* Carpenter 1855.

**conradi** Mansfield 1929, **Pandora (Clidiophora).** Proc. U.S. Nat. Mus., **74** (14): 8, pl. 5, figs. 4, 5 (USGS station 1/221, near the bottom of a small ravine entering Blackwater River and about a quarter of a mile from it and one and one-half miles W of Walters, Virginia [Miocene]; holotype, USNM 352441).

**convexa** Dall 1915, **Pandora (Kennerlyia).** Proc. U.S. Nat. Mus., **49:** 449 (Ballenas Lagoon, Lower California, in 48 fathoms; holotype, USNM 171068).

**copiosa** Sorgenfrei 1958, **Pandora.** Danmarks Geologiske Undersögelse, II Raekke, Nr. 79, **1:** 138; **2:** pl. 24, figs. a–e [not a–d, as in text] (Toftlund, 105–110 m. depth [Miocene]; holotype, Geological Survey of Denmark, file no. 150.9.b).

**cornuta** C. B. Adams 1852, **Pandora.** Ann. Lyc. Nat. Hist., New York, **5:** 519 (Panama; holotype, MCZ 186309).

**costata** 'Lamarck' Pallary 1920, **Pandora.** Exploration scientifique du Maroc. Fasc. II. Malacologie (1912), p. 98, error for *rostrata* Lamarck 1818.

**crassa** Conrad 1868, **Pandora (Cleidiophora** [*sic*]). Amer. Jour. Conch., **3**(4): 269, error for *crassidens* Conrad 1838.

**crassidens** Conrad 1838, **Pandora.** Fossils Medial Tertiary United States, p. 2, pl. 1, fig. 2 (James River, near Smithfield, Virginia [Miocene]; types lost [see Moore, 1962, p. 50]).

**cristata** Carpenter 1864, **Clidiophora.** Proc. Zool. Soc. London, pt. 3, p. 597 (Gulf of California; holotype, BMNH, Reg. No. 1963441).

**cumingi** 'Hanley' Lamy 1934, **Pandora (Coelodon).** Jour. de Conchy., **78** (2): 116, error for *cumingii* Hanley 1861.

**cumingii** Hanley 1861, **Pandora.** Proc. Zool. Soc. London, pt. 2, p. 272 (Samar et Negros, Insulas Philippinas; syntypes, BMNH, Reg. No. 1964466).

**dalli** Gardner 1943, **Pandora (Kennerlia).** U.S. Geological Survey, Prof. Paper 199-A, p. 45, pl. 10, figs. 21, 24, 26 (one-quarter of a mile below Jones Point, Essex County, Virginia [Miocene]; holotype, USNM 325503).

**defrancei** 'Deshayes' Deshayes 1860, **Pandora.** Desc. Anim. s. Vert. du Bassin de Paris, **1:** 243, error for *defrancii* Deshayes 1824.

**defrancii** Deshayes 1824, **Pandora.** Desc. Coq. foss. Paris, **1:** 61, pl. 9, figs. 15–17 (Grignon [Eocene]; holotype, l'École des Mines, vitrine 32).

**degrangei** Cossmann and Peyrot 1909, **Pandora.** Conchologie néogénique de l'Aquitaine, Livraison 1, p. 40, pl. 1, figs. 15–18 (Sallespisse, environs d'Orthez, Basses pyrénées (Helvetien supérieur [Miocene]); holotype, Degrange-Touzin collection [*teste* Cossmann and Peyrot], Faculté des Sciences, Bordeaux [*teste* Mongin, *in litt.*]).

**delicatulus** A. Adams [in] Carpenter 1864, **Coelodon.** Proc. Zool. Soc. London, pt. 3, p. 600 [Japan[1]; holotype, BMNH, Reg. No. 196274).

**depressa** Sowerby 1830, **Pandora.** [in] Broderip and Sowerby, Species Conchyliorum, **1**(1): *Pandora*, p. 3, figs. 11, 12 (hab. in littoribus Insularum Maris Pacifici; types lost [see Carpenter 1864, p. 598]).

**diffissa** Mabille et de Rochebrune 1889, **Pandora.** Miss. scient. Cap Horn, Moll., p. 103 (New Year Sound [Cape Horn, 54°45′ S; 64°07′ W]; holotype, MNHNP; [*teste* Lamy 1934]).

**dilatata** Deshayes 1860, **Pandora.** Desc. Anim. s. Vert. du Bassin de Paris, **1:** 243, pl. 17, figs. 6–9 (Parnes, Mouchy [Eocene]; holotype, l'École des Mines, vitrine 32).

**discors** Sowerby 1835, **Pandora.** Proc. Zool. Soc. London, p. 93 (no locality given; holotype, BMNH, 1964465).

**dissimilis** Sowerby 1894, **Pandora.** Jour. of Conch., **7:** 374 (Sea Point, Cape Town, South Africa; holotype, BMNH, Reg. No. 1899.4.14.2845).[2]

**dodona** Dall 1903, **Pandora (Kennerleyia).** Trans. Wagner Free Inst. Sci., **3**(6): 1518, pl. 57, fig. 25 (uppermost Oligocene sands of Oak Grove, Santa Rosa County, Florida [Miocene]; holotype, USNM 135848a).

**edwardsi** Jousseaume 1891, **Pandora.** Le Naturaliste, 13 ann., 2 ser., no. 107, p. 201 (Aden; type lost [see Lamy 1934, p. 118]).

**elongata** Risso 1826, **Pandora.** Hist. Nat. Europe Meridionale, **4:** 373 (La Trinité, Alpes Maritimes [? age]; holotype, Muséum d'Histoire naturelle, Nice [*teste* Risso]).

**elongatus** Carpenter 1864, **Coelodon.** Proc. Zool. Soc. London, pt. 3, p. 600 (China and Borneo; syntypes, BMNH, Reg. No. 196272).

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[1] This locality was given subsequently by Sowerby [in] Reeve, 1874, Conch. Icon., **19, Pandora,** pl. 3, fig. 17.

[2] Barnard (1964, p. 572) lists a cotype in the South African Museum, Reg. No. 5622. The specimen may be a paratype.

**eutaenia** Dall 1915, **Pandora (Kennerlyia) glacialis.** Proc. U.S. Nat. Mus., **49:**449 (Sitka Harbor, Alaska, in 15 fathoms; syntypes, USNM 171062).

**filosa** Carpenter 1864, **Kennerlia.** Proc. Zool. Soc. London, pt. 3, p. 602 (Puget Sound, Washington; syntypes, USNM 4542).

**flexuosa** Sowerby 1822, **Pandora.** Genera of Recent and Fossil Shells, **2**, *Pandora,* figs. 4, 5 (East Indies [Red Sea [1]]; types lost).

**floridana** Dall 1886, **Pandora (Clidiophora).** Bull. Mus. Comp. Zool., **12** (6); 312, *nomen nudum.*

**forresterensis** Willett 1918, **Pandora (Kennerlyia).** Nautilus, **31**(4): 134 (Forrester Island, Alaska, in 50 fathoms; holotype, ANSP 118200).

**gabbi** Dall 1903, **Pandora (Heteroclidus) punctata.** Trans. Wagner Free Inst. Sci., **3**(6): 1521 (Miocene of California near San Buenaventura; holotype, USNM [lost]).

**glacialis** Leach 1819, **Pandora.** Jour. de Physique, **88:** 465 (Baffin's Bay. . . Spitzbergen [restricted to Baffin's Bay, Boss and Merrill (1965, p. 209)]; syntypes, BMNH, Reg. No. 196273).

**gouldiana** Dall 1886, **Pandora(Clidiophora).** Bull. Mus. Comp. Zool., **12** (6): 312 (Woods Hole, Massachusetts; holotype, USNM 95490).

**grandis** Dall 1877, **Pandora (Kennerlia).** Proc. Calif. Acad. Sci., **7:** 11 (Unalashka [*sic*], in 100 fathoms; holotype, USNM 171069).

**granulata** Dall 1915, **Pandora (Kennerlyia).** Proc. U.S. Nat. Mus., **49:** 449 (La Paz, Lower California; holotype, USNM 211348).

**granum** 'Benoist MS' Cossmann 1896, **Pandora.** Sur quelques formes nouvelles ou peu connues des faluns du Bordelais. Association Française pour l'avancement des Sciences, Comte Rendu de la 24me session, Bordeaux 1895, pt. 2, p. 509, pl. 4, figs. 1, 2 (du moulin de l'Eglise, Saucats [St. Médard], Burdigalien [Miocene]; cotypes, Cossmann collection, Laboratoire Géologie Sorbonne, meuble XVI, tirior 1, no. 7678).

**grateloupi** 'Nyst' Bronn 1848, **Pandora.** Index Paleo., **2:** 904, error for *grateloupii* Nyst 1843.

**grateloupii** Nyst 1843, **Pandora.** Desc. Coq. Belgique, p. 74, *nomen nudum.*

**gretschischkini** Slodkewitsch 1938, **Pandora.** Paleontology of USSR, Vol. 10, pt. 3, fasc. 19, Tertiary Pelecypoda from the Far East, Pt. 1, p. 270 [in Russian], Pt. 2, p. 125 [in English], pl. 59, figs. 2a–b (sea coast between sea cliffs and mouth of Etalonnaya River, west coast of Kamchatka, Upper Pliocene; holotype, Geological Museum, F. N. Chernyshev, No. 101/ c 753).

**heberti** de Raincourt 1870, **Pandora.** Bull. Soc. Géol. France, 2nd Ser., **27:** 629, pl. 14, fig. 7 (Le Vivray [Eocene]; holotype, de Raincourt collection, l'École des Mines, vitrine 32).

**higginsoni** 'Phillippi MS' Paetal 1873, **Pandora.** Catalog der Conchylien-Sammlung, p. 129 (Boston; *nomen nudum*).

**hukusimana** Otuka 1943, **Pandora (Heteroclidus).** Jour. Geol. Soc. Japan, **50**(592): 25, pl. 2, fig. 8 (Iisaka and Manseioozi, Hukusima, Pref. [Miocene]; holotype destroyed in World War II [*teste* Habe]).

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This locality was subsequently designated by Sowerby [in] Broderip and Sowerby 1830, Species Conchyliorum, **1**(1): *Pandora,* p. 3.

**inaequalis** 'Linnaeus' Carpenter 1864, **Tellina [Pandora].** Proc. Zool. Soc. London, pt. 3, p. 601, error for *inaequivalvis* Linnaeus 1758.

**inaequivalvis** Linnaeus 1758, **Solen.** Systema naturae, 10th Ed., p. 673, no. 32; 1767, Systema naturae, 12th Ed., p. 1118, *Tellina,* no. 56 (in M. Mediterraneo; holotype, Linnean Collection, Linnean Society, London).

**inconspicua** Gabb 1873, **Pandora.** Trans. Amer. Philos. Soc., **15:** 248 (Tertiary of Santo Domingo; lectotype and paralectotypes, selected by Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, **73:** 414, ANSP 2676).

**indica** Chenu 1862, **Pandora.** Man. Conch., **2:** 51, fig. 214 (no locality given; holotype, Muséum d'Histoire Naturelle, Geneva).

**inflata** Boss and Merrill 1965, **Pandora (Pandorella).** Johnsonia, **4**(44): 205, pl. 124, figs. 1–4, pl. 125, figs. 1–2, new name for *brevis* Verrill and Bush 1898, *non* Sowerby 1829.

**inornata** Verrill and Bush 1898, **Clidiophora.** Proc. U.S. Nat. Mus., **20:** 819, pl. 95, figs. 5, 6 (*Speedwell* station 327, off Cape Cod, south end of Stellwagen Bank, in 17 fathoms; syntypes, USNM 49760).

**intermedia** Jeffreys 1881, **Pandora inaequivalvis.** Proc. Zool. Soc. London, pt. 4, p. 929, *nomen nudum.*

**japanensis** Nomura and Hatai 1940, **Pandora (Kenerlyia).** Saito Ho-on Kai Mus., Res. Bull., **19:** 86, pl. 4, figs. 13 a–d and 14 a–b (Kyuroku-sima, Aomori Pref., Honshu; holotype, Saito Ho-on Kai Museum, Sendai, Japan, Reg. no. 14734).

**lata** Dall 1903, **Pandora (Kennerleyia).** Trans. Wagner Free Inst. Sci., **3** (6): 1520, pl. 57, fig. 18 (Miocene of Maryland; holotype, USNM 11875).

**lemensis** Coen 1937, **Pandora.** R[ept.] Comitato Talassografico Italiano, Mem. 240, p. 166 (Canal di Leme, Istria; holotype, Coen Collection [*teste* Coen]).

**majorina** Gardner 1943, **Pandora (Clidiophora) crassidens.** U.S. Geological Survey, Prof: Pap. 199-A, p. 47, pl. 10, figs. 25, 28 (Halifax on Quankey Creek, Halifax County, North Carolina [Miocene]: holotype, USNM 325501).

**margaritacea** Lamarck 1801, **Pandora.** Syst. Anim. s. vert., p. 137, substitute name for *Tellina inaequivalvis* (Linnaeus 1758).

**maxima** Megerle von Muhlfeld 1811, **Pandora.** Gesellschaft Nat. Freunde, Magazin, Berlin, **5**(1): 59 [not a *Pandora*].

**nasuta** Sowerby 1830, **Pandora.** [in] Broderip and Sowerby, Species Conchyliorum, **1**(1): *Pandora,* p. 3, figs. 18, 19 (locality unknown; types lost).

**naviculoides** Gardner 1943, **Pandora (Kennerlia).** U.S. Geological Survey, Prof. Pap. 199-A, p. 46, pl. 10, figs. 22, 23 (Neills Eddy Landing, Columbus County, North Carolina [Pliocene]; holotype, USNM 325504).

**nipponica** Habe 1952, **Pandora (Kennerlia).** [in] Kuroda, Ill. Cat. Japanese Shells, no. 18, p. 125, pl. 18, fig. 6 (Tosa Bay, Shikoku, about 120 fathoms depth; holotype, National Science Museum, Tokyo, Reg. No. 13313).

**oblonga** Sowerby 1830, **Pandora.** [in] Broderip and Sowerby, Species Conchyliorum, **1**(1): *Pandora,* p. 2, fig. 10 (from Gamberoon; types lost).[1]

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[1] As remarked and discussed by Lamy (1934, p. 107), this species has been the center of some controversy. In the present literature, it appears that the species of *Pandora* which is found on the coast of West Africa has been called *oblonga* Sowerby.

**obtusa** 'Leach MS' Lamarck 1818, **Pandora.** Anim. s. Vert., **5:** 499 (Habite . . . l'Ocean britannique; holotype, Muséum d'Histoire Naturelle, Geneva).

**obovata** 'Conrad' Sherborn 1929, **Pandora.** Index Animalium, p. 4479, *lapsus* for *Cytherea obovata* Conrad.

**otukai** Habe 1952, **Pandora (Kennerlia).** Gen. Jap. Shells, **3:** 259, figs. 689, 690 (name and figures only); [in] Kuroda, Ill. Cat. Jap. Shells, no. 18, p. 124, pl. 18, figs. 11, 12 (Sagami Bay, Honshu, about 50 fathoms in depth; holotype, National Science Museum, Tokyo, Reg. No. 13314).

**panamensis** Dall 1915, **Pandora (Foveadens).** Proc. U.S. Nat. Mus., **49:** 451 (Old Panama [Pacific Ocean]; holotype, USNM 252276).

**patagonica** Dall 1915, **Pandora (Kennerlyia).** Proc. U.S. Nat. Mus., **49:** 450 (west coast of Patagonia [*sic*], in 61 fathoms; holotype, USNM 96937).

**patulus** Tate 1889, **Coelodon.** Trans. and Proc. and Rept. Roy. Soc. South Australia (1887–1888), **11:** 60, pl. 11, fig. 1 (Wool Bay, South Australia, in 10 fathoms; holotype, South Australian Museum, Adelaide, Reg. No. D. 13207).

**perangusta** Preston 1910, **Pandora.** Rec. Ind. Mus., **5**(11): 120, fig. 5 (off the Devi River, Orissa Coast, Bay of Bengal, 17–20 fathoms; holotype, Indian Museum, Calcutta, Reg. No. M. 4686/1).

**pinna** Montagu 1803, **Solen.** Testacea Britannica, pt. 1, p. 566, pl. 15, fig. 3 (Torcorss, England; types not in BMNH, possibly in Exeter Museum).

**pinnoides** 'Montagu' Locard 1899, **Pandora.** Coq. mar. côtes de France, p. 261, emendation for *pinna* Montagu 1803.

**primaeva** Deshayes 1860, **Pandora.** Desc. Anim. s. Vert. du Bassin de Paris, **1:** 244, pl. 11 *bis*, figs. 16–18 (Aizy; [Eocene]; syntypes, l'École des Mines, vitrine 32),

**prodromus** Gardner and Aldrich 1919, **Pandora (Clidiophora).** Proc. Acad. Nat. Sci. Philadelphia, **71:** 44, pl. 4, figs. 9, 11, 12, 14 (Yorktown, York County Virginia, Yorktown Formation [Miocene]; holotype, USNM 325499).

**pseudobilirata** Nomura and Hatai 1940, **Pandora (Kenerlyia.** Saito Ho-on Kai Mus., Res. Bull., **19:** 87, pl. 19 [4], figs. 15a and 15b (Kyuroku-sima, Aomori Pref., Honshu; holotype, Saito Ho-on Kai Museum, Sendai, Japan, Reg. No. 14733).

**pulchella** Yokoyama 1926, **Pandora.** Jour. Fac. Sci. Imperial Univ., Tokyo, Sec. 2, **1**(9): 387, pl, 45, fig. 4 (Anden, Akita Pref., Honshu [Pliocene]: holotype destroyed in World War II [*teste* Habe]).

**punctata** Conrad 1837, **Pandora.** Jour. Acad. Nat. Sci. Philadelphia, **7**(2): 228, pl. 17, fig. 1 (Santa Barbara, California; types lost. Not in Moore (1962).

**radians** Dall 1915, **Pandora (Coelodon).** Proc. U.S. Nat. Mus., **49:** 450 (near Ballenas Lagoon, Lower California, in 5½ fathoms; holotype, USNM 171053).

**radiata** Sowerby 1835, **Pandora.** Proc. Zool. Soc. London, p. 94 (apud Insulam, Muerte, Colombiae Occidentalis [Isla del Muerto, Gulf of Guayaquil, Ecuador]; holotype, BMNH, Reg. No. 1964469).

**rhypis** Pilsbry and Lowe 1932, **Pandora (Kennerlia).** Proc. Acad. Nat. Sci. Philadelphia, **84:** 105, pl. 16, figs. 8–11 (La Union, Gulf of Fonseca, San [*sic*] Salvador; holotype, ANSP 155503).

**rostrata** Lamarck 1818, **Pandora.** Anim. s. Vert., **5:** 498 (habite la Médi-

terranée et dans la Manche, sur nos côtes; holotype, Museum d'Histoire Naturelle, Geneva).

**scapha** Gabb 1866, **Pandora.** Tertiary Invertebrate Fossils, Palaeo. Calif., v. 2, sect. 1, pt. 1, p. 18 (from the Miocene, west of Martinez, California; holotype, ANSP 4539).

**scapho** 'Gabb' Merriam and Clark [in] Lawson 1914, **Pandora.** San Francisco Folio, U.S. Geol. Survey Folio 193, p. 11, error for *scapha* Gabb, 1866.

**sicula** 'Sowerby MS' Lamy 1934, **Pandora (Pandora) inaequivalvis.** Jour. de Conchy., **78**(2): 103 (Palermo, Sicily; syntypes, MNHNP [*teste* Lamy 1934]).

**similis** Sowerby 1897, **Pandora.** Appendix to Marine Shells South Africa, p. 29 (Durban; holotype, BMNH, Reg. No. 1964470).[1]

**solenoidea** Brown 1827, **Trutina.** Ill. Conch. Great Britain and Ireland, pl. 13, fig. 5, substitute name for *Solen pinna* Montagu 1803.

**squamula** 'Payraudea MS' Lamy 1934, **Pandora.** Jour. de Conchy., **78**(2): 105 (Ajaccio, Corsica; *nomen nudum*).

**striata** Quoy and Gaimard 1835, **Pandora** [in] D'Urville, Voyage l'Astrolabe, Zoologie, **3:** 537, pl. 83, fig. 10 (New Zealand; holotype, MNHNP), [is a species of *Myadora* Gray 1840].

**tabacea** 'Meuschen' Carpenter 1864, **Clidiophora** [**Anomia**]. Proc. Zool. Soc. London, pt. 3, p. 597, *nomen nudum.*

**tenuis** Jeffreys 1865, **Pandora inaequivalvis**. Brit. Conch., **3:** 25 (between 85 and 100 f[athoms], off Unst. Shetland; types lost).

**trilineata** Say 1822, **Pandora.** Jour. Acad. Nat. Sci. Philadelphia, 1st Ser., **2:** 261 (Great Egg Harbor, New Jersey; types lost [not in ANSP]).

**truncata** 'Turton' Paetal 1890, **Pandora.** Catalog der Conchylien-Sammlung, **3:** 29, based on *Anatina truncata* Turton 1822, Conch. Ins. Brit., p. 46, pl. 4, fig. 6 [not a *Pandora*].

**tuomeyi** Gardner and Aldrich 1919, **Pandora (Clidiophora).** Proc. Acad. Nat. Sci. Philadelphia, **71:** 45, pl. 4, figs. 8, 10, 13 (Walker's Bluff, Bladen County, North Carolina, Waccamaw Formation [Miocene]; holotype, USNM 325502).

**uncifera** Pilsbry and Lowe 1932, **Pandora.** Proc. Acad. Nat. Sci. Philadelphia, **84:** 104, pl. 17, figs. 17–19 (Acapulco, Mexico, in 20 fathoms; holotype, ANSP 155632).

**unguiculus** Sowerby 1830, **Pandora.** [in] Broderip and Sowerby, Species Conchyliorum, **1**(1): *Pandora*, p. 3, figs. 16, 17 (locality unknown; types lost).

**vanwinkleae** Tegland 1933, **Pandora.** Univ. Calif. Publ., Bull. Dept. Geol. Sci., **23**(3); 113, pl. 7, figs. 1, 2 (in sandstone cliff on north side of Restoration Point, opposite Seattle, Section 12, T. 24, N, R. 2 E, Kitsap County, Washington; holotype, Coll. Invert. Paleo., Univ. Calif. No. 32114).

**vladivostokensis** Skarlato 1955, **Pandora,** [in Strelkov [ed.]. Atlas of the Invertebrates of the far-eastern seas of the USSR [in Russian], p. 198, pl. 53, fig. 10 (Japan Sea; types possibly in the Zoological Institute, Academy of Sciences, Leningrad).

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[1] Barnard (1964, p. 573) lists cotypes in South African Museum, Reg. No. A29743). The specimens may be paratypes.

**wajampolkensis** Slodkewitsch 1938, **Pandora.** Paleontology of USSR, Vol. 10, pt. 3, fasc. 19, Tertiary Pelecypoda from the Far East, Pt. 1, p. 272 [in Russian], Pt. 2, p. 126 [in English], pl. 59, figs. 1 a–b (Belogolovaya River, western coast of Kamchatka, Vayempolka series, Upper Miocene; holotype, Geological Museum, F. N. Chernyshev, No. 101/ c 754).

**washingtonensis** Weaver 1916, **Pandora.** Univ. Washington Publ. in Geol., **1**(1): 37–38, pl. 2, figs. 19, 20 (at locality 256 [University of Washington Paleontological Collection] in railway cuts on the O.-W. R. R. and N. Co. [Oregon-Washington = Union Pacific] one fourth mile northwest of Lincoln Creek Station in Section 27, T. 15 N, R. 3 W., Lowermost Oligocene; holotype, CAS 262).

**wardiana** A. Adams 1859, **Pandora.** Proc. Zool. Soc. London, pt. 3, p. 487 (hab. in littoribus Mantchuriae [Sunday Island, Coast of Mantchuria, in 20 fathoms]; holotype, BMNH, Reg. No. 1964468).

**yakatagensis** Clark 1932, **Pandora (Kennerlia).** Bull. Geol. Soc. Amer., **43**(3): 809, pl. 17, figs. 1, 2 (University of California Locality 3869 [near Fulton Creek, S of Yakataga River, Alaska], upper Oligocene; holotype, Invert. Coll'n, Museum of Paleontology, University of California, No. 30399).

**zealandica** 'Sowerby' Paetal 1883, **Pandora.** Catalog der Conchylien-Sammlung, p. 199, *nomen nudum.*

## References

Boss, K. J. and A. S. Merrill. 1965. The Family Pandoridae in the Western Atlantic. Johnsonia **4**(44): 181–215, pls. 115–126.

Barnard, K. H. 1964. Contributions to the Knowledge of South African Marine Mollusca. Part V. Lamellibranchiata. Ann. South African Mus., **47**(3): 361–593.

Carpenter, P. P. 1864. Contributions toward a monograph of the Pandoridae. Proc. Zool. Soc. London, pt. 3, pp. 596–603.

Lamy, E. 1934. Revision des Pandoridae vivants du Muséum national d'Histoire naturelle de Paris. Jour. de Conchy., **78** (2): 95–125.

Moore, E. J. 1962. Conrad's cenozoic fossil marine mollusk type specimens at the Academy of Natural Sciences of Philadelphia. Proc. Acad. Nat. Sci. Philadelphia, **114:** 23–120.

Palmer, K. v. W. 1958. Type specimens of marine mollusca described by P. P. Carpenter from the West Coast (San Diego to British Columbia). Geo. Soc. Amer. Memoir 76, 376 pp , 35 pls.

Sherborn, C. D. 1940. Where is the —— Collection? Cambridge University Press, 148 pp.

# Occasional Papers On Mollusks

Published by
THE DEPARTMENT OF MOLLUSKS
Museum of Comparative Zoölogy, Harvard University
Cambridge, Massachusetts

VOLUME 2 NOVEMBER 8, 1965 NUMBER 34

## Review Number and Index

The following are additions to the various numbers previously published.

### Supplement to the Catalogue of the Genus Liguus

(*Occasional Papers,* **1:** No. 10)

*By* WILLIAM J. CLENCH

**laureani** Platt, **Liguus fasciatus:** 1949, The National Geographic Magazine **96:**77, fig. 15 (Cuba) [is *L. f. caribaeus* Clench].

**vignalensis** Platt, **Liguus fasciatus:** 1949, The National Geographic Magazine **96:**77, fig. 19 (Cuba) [is *L. f. archeri* Clench].

**vonpaulseni** Young, **Liguus fasciatus:** 1960, Bull. Florida State Mus. **5:** 261, figs. 1–2 (Little Torch Key, Monroe Co., Florida). Holotype no. 18865, Florida State Museum, Gainesville, Florida.

The two species noted above and figured by Platt were based upon manuscript names.

### Supplement to the Catalogue of the Family Truncatellidae

(*Occasional Papers,* **1:** No. 13)

*By* WILLIAM J. CLENCH

**calcarata** Jutting, **Taheitia:** 1963, Nova Guinea **20:**442, text fig. 8 (Biak Id., Schouten Ids., West New Guinea). Holotype, Leiden Museum.

**foliosocostata** Jutting, **Taheitia:** 1963, Nova Guinea **20:**443, text fig. 9a–c (Biak Id., Schouten Ids., West New Guinea).* Holotype, Leiden Museum.

**galactodes** Jutting, **Taheitia:** 1963, Nova Guinea **20:**442, text fig. 7 (Biak Id., West New Guinea). Holotype, Zool. Mus. Amsterdam.

**mansueta** Jutting, **Taheitia:** 1963, Nova Guinea **20:**445, text fig. 10 (Manokwari, near Uriami River, West New Guinea). Holotype, Zool. Mus. Amsterdam.

**oagariensis** Kuroda, **Taheitia:** 1960, A Catalogue of Molluscan Fauna of the Okinawa Islands, Tokyo, p. 72 (Okinawa Islands, Ryukyu Islands, Japan).

**orrae** Turner, **Taheitia:** 1959, Occasional Papers On Mollusks **2:**186, pl. 31, figs. 1–5; pl. 32, figs. 1–5 (Biak Id., West New Guinea). Holotype, ANSP no. 223656; paratypes, MCZ no. 221170.

**riveroi** Clench, **Geomelania (Merrilliana):** 1962, Breviora (Harvard Univ.) no. 173, p. 3, pl. 1, fig. 4 (Colonia Ramfis, 20 km. W of San Cristobal, República Dominicana).

**whitneyi** Clench, **Taheitia:** 1958, The Natural History of Rennell Island, British Solomon Islands, Copenhagen **2:**166, pl. 16, fig. 1 (Bambatana, Choiseul Id., Solomon Islands). Holotype, AMNH no. 73883; paratype MCZ no. 188089.

## Supplement to the North American Genus Lioplax

(*Occasional Papers,* **2:** No. 19)

*By* WILLIAM J. CLENCH

### Lioplax subcarinata (*Say*)

*Specimens examined.* NEW YORK: Normanskill, Albany.

*Remarks.* This record is based upon specimens collected by C. E. Beecher whose collection was originally in the New York State Museum, Albany, and is now in the United States National Museum. This record is of considerable interest as it is the most northeasterly now known for this species.

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* There are two island groups known under the name of Schouten Islands. The larger of the two groups is in West New Guinea, north of Japen Island. The smaller group is some 625 miles east and off the northern coast of Northeast New Guinea.

## INDEX

The index which follows does not include all of the names covered in this volume. All such names are easily found in the various numbers which are alphabetically arranged and are thus self-indexed. These are:

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Goodrich, Calvin, listing all names of mollusks described by him, 189–208.

Pandoridae: A world list of species and genera in this family, 413–424.

Viviparidae of North America, Catalogue of, 261–287.

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