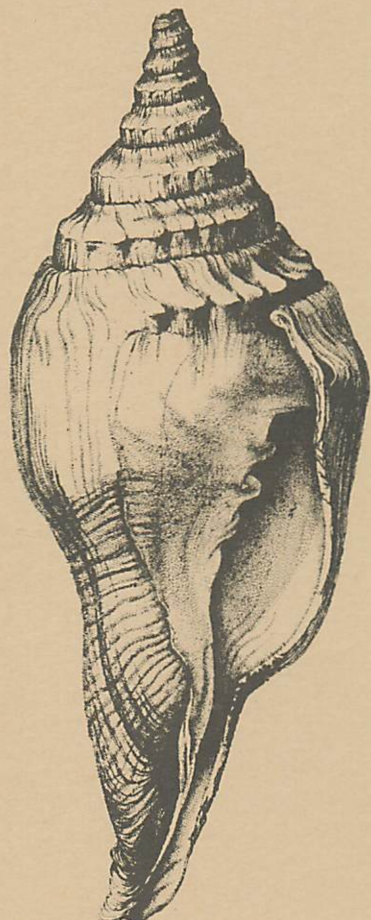
LOWER OLIGOCENE GASTROPODA, SCAPHOPODA, AND CEPHALOPODA OF THE VICKSBURG GROUP IN MISSISSIPPI

F. Stearns MacNeil and David T. Dockery III



BULLETIN 124

MISSISSIPPI DEPARTMENT OF NATURAL RESOURCES
BUREAU OF GEOLOGY

ALVIN R. BICKER, JR.
Bureau Director

Jackson, Mississippi
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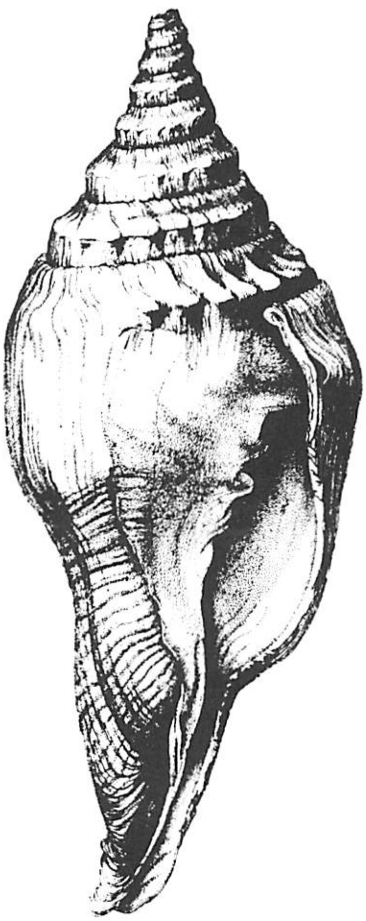

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COVER: Illustration of *Turbinella wilsoni* Conrad, 1848, from the Byram Formation at Vicksburg, Mississippi, drawn by the French naturalist Charles A. Lesueur in 1829 (see Dockery, 1982, Appendix II, pl. 6, fig. 14).

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LETTER OF TRANSMITTAL

Mississippi Department of Natural Resources
Bureau of Geology

Mr. Jim Carraway, Chairman, and
Members of The Commission
Department of Natural Resources

Commissioners:

The Bureau of Geology is pleased to transmit to you Bulletin 124, entitled "Lower Oligocene Gastropoda, Scaphopoda, and Cephalopoda of the Vicksburg Group in Mississippi, " by F. Stearns MacNeil and David T. Dockery III.

This bulletin reports on the gastropods, scaphopods, cephalopods, and the stratigraphy of the lower Oligocene Vicksburg Group in Mississippi. This work was begun by the senior author F. Stearns MacNeil in 1937 as a project for the U.S. Geological Survey, but was not completed before his retirement due in part to his other assignments and in part to the large size of the project. MacNeil with the approval of the United States Geological Survey relinquished the completion of this work to the junior author, and it was accepted as a project for the Mississippi Bureau of Geology.

This bulletin discusses four hundred and eleven species, subspecies, and varieties of mollusks in the classes Gastropoda, Scaphopoda, and Cephalopoda. These species are illustrated in a series of seventy-two plates. One hundred and eighty-nine new species and subspecies are named.

This publication together with the Bureau's Bulletin 123 on bivalves completes a study of the Vicksburg Mollusca that covers five hundred and fifty-five species, subspecies, and varieties. The Vicksburg molluscan fauna is known worldwide, and this publication provides a means for the comparison of this fauna with Oligocene faunas elsewhere. It will be very useful also in stratigraphic correlations and geologic mapping. The publication will add much needed geological data and be especially useful to workers in the mineral industry and academic field. Due to the present international interest in the Eocene - Oligocene boundary and in the excellent upper Eocene and lower Oligocene strata in the northern Gulf Coastal Plain, the author proposes the establishment of the Eocene - Oligocene boundary stratotype at a site in Mississippi.

Respectfully submitted,

Alvin R. Bicker, Jr.
Director and State Geologist

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FIGURES

LOWER OLIGOCENE GASTROPODA, SCAPHOPODA AND CEPHALOPODA OF THE VICKSBURG GROUP IN MISSISSIPPI

F. STEARNS MACNEIL AND DAVID T. DOCKERY III

ABSTRACT

Four hundred and eleven species, subspecies, and varieties of mollusks from the Vicksburg Group are discussed systematically in this work and are illustrated in a series of seventy-two plates. Of these species, three hundred and ninety-seven are gastropods, twelve are scaphopods, and two are cephalopods. One hundred and eighty-nine species and subspecies are described as new. Also, six new gastropod genera and five subgenera are described. The species included in this work along with those of the companion publication on the Vicksburg Bivalvia (Dockery, 1982) bring the total number of molluscan species, subspecies, and varieties published from the Vicksburg Group to five hundred and fifty-five. A stratigraphic discussion of the Vicksburg Group is given and accompanied with sixteen figures. Included in this discussion is a site proposal for the Eocene - Oligocene boundary stratotype.

INTRODUCTION

Contributions of the Co-Authors

This publication is a product of the independent work of the two authors over different periods of time. It was begun by F. Stearns MacNeil in 1937 while working with the U.S. Geological Survey and continued off and on depending on his other assignments until his retirement in 1965. The two authors first came in contact by correspondence in 1969 while the junior author was working at the Mississippi Bureau of Geology (Mississippi Geological Survey) on a collection of mollusks made by F.F. Mellen from the Byram Formation at Vicksburg (MGS localities 115 and 116). Later when the junior author began his dissertation on the lower Oligocene Bivalvia of the Vicksburg Group, E.H. Vokes contacted MacNeil concerning this matter and arranged a meeting on the subject at Tulane University. This meeting took place in February of 1973, at which time MacNeil relinquished the completion of the Vicksburg mollusks to the junior author. The last meeting between the two authors was at the MacNeil home in Ft. Myers, Florida, on June 23, 1982. The junior author and his new wife had dinner with the MacNeils (F. Stearns, his wife Edna and son Ray) while honeymooning at Sanibel Island. After a short hospital stay, MacNeil died on January 24, 1983, from lymphoma. Shortly before that time in November of 1982 MacNeil provided the junior author with a brief history of his work on this project which is included herein.

The completed work of MacNeil included plates 1-39 of this publication, though none were accompanied with plate explanations. Illustrations in these plates are systematically arranged for each of the three most fossiliferous horizons of the Vicksburg Group. This arrangement is as follows: Red Bluff Formation, plates 1-9; Mint Spring Formation, plates 10-25; Byram Formation, plates 26-39. At a later date, MacNeil produced a new set of plates by shuffling the original plates into a more systematic arrangement. Some figures were rearranged in this second set and some new figures were added. This latter series of plates was accompanied with explanations, but was completed only through Plate 15 (Archaeogastropoda and Mesogastropoda) and, therefore, was not used in this publication. The new figures given in these plates are included here in Plate 40. Plate explanations accompanying the second series of plates were utilized for a part of the original series. The remainder of the explanations were made by the junior author. Two week-long trips to the U.S. National Museum in November and December of 1982 were made for this purpose. There MacNeil's figures were compared with his collection of figured specimens. Plates 41-72 were added by the junior author. Figured specimens on these plates, which are not types, are in the figured specimens collection of the Mississippi Bureau of Geology.

MacNeil's systematic manuscript on the Vicksburg gastropods was produced in three parts. These are: Part I - Families Fissurellidae to Naticidae (to Ovulidae of the present arrangement) including the Pyramidellidae, Umbraculidae, Localities, and References; Part II - Families Cassididae to Melongenidae; and Part III - Terebridae, Turridae, and Opisthobranchia (exclusive of the Pyramidellidae and Thecosomata). An outline of the systematics for Part III states that it was completed as of April 1953. A note to Myra Keen in Part II asking her to review the Muricidae is dated July 24, 1963.

The gastropod families Fasciolariidae to Conidae and the Thecosomata were completed by the junior author, and the Scaphopoda and Cephalopoda were added. Also some new species were added to those sections completed by MacNeil. The systematic arrangement followed in this publication is taken in part from Taylor and Sohl (1962), Keen (1971), and Abbott (1974).

Some systematic editorial changes were made for MacNeil's manuscript, but his writing style was not altered. Much of his text is written in first person. There were also some changes made in MacNeil's taxonomic comments. Those discussions that were outdated at the time of this publication were altered or deleted. The three groups in which MacNeil's discussion were most significantly altered are: (1) the Cypraeacea (reviewed by Luc and Cyrille Dolin), (2) the Cymatiidae (reviewed by Alan Beu), and (3) the Muricidae (reviewed by Emily H. Vokes). MacNeil's manuscript will remain at the Mississippi Bureau of Geology for those interested in his unedited discussions.

The following sections, History of the Project, Collections, and Identification and Designation of Types, were written by MacNeil and were included in a letter sent to the junior author in November of 1982.

History of the Project

The present studies of the Vicksburg mollusks were actually initiated by C. Wythe Cooke before 1920 when he undertook a study of the Oligocene stratigraphy (Cooke, 1918, 1921, 1923) and a revision and update of the earlier descriptions of the lower and upper Vicksburg mollusks by T.A. Conrad and T.L. Casey and of the Red Bluff mollusks by T.H. Aldrich. Cooke prepared some detailed hand written notes on the Conrad collection at the Philadelphia Academy of Natural Sciences, and later he described several new species from Mexico (Cooke, 1929), mostly of Byram age. His only subsequent contribution was in 1940 when he assembled in final shape the completed but disorganized manuscript of the late W.C. Mansfield (Mansfield, 1940) on the mollusks of the Chickasawhay Marl.

In 1937 Cooke turned the study of the Vicksburg mollusks over to the senior author as a major project. Much of the time between then and the beginning of the war was spent on additional studies of the Oligocene stratigraphy (MacNeil, 1944) and in adding to the National Museum's already voluminous collections. Systematic description of the gastropods was begun in 1937. Conrad's types were restudied in Philadelphia and photographed. Meanwhile all of the gastropods selected to serve as types and figured specimens were photographed in Washington and the plates were prepared.

Between the beginning of the war and until the senior author's retirement at the end of 1965, the Vicksburg gastropods, although still considered a major ongoing project, became very much of a fill-in job between other special assignments. Among these assignments were that of a stratigrapher for the Geological Survey's wartime bauxite investigations, preparation of new geologic maps for the Tertiary formations of Alabama and Georgia, and as a member of the team preparing a new geologic map of Mississippi. Subsequent assignments included being the stratigrapher on a mapping team on Okinawa, a project to investigate the Uranium content of Florida phosphate deposits, geologist on a U.S. Corps of Engineers expedition to the Marshall Islands, and almost continual work after that on referrals of Alaskan Tertiary and Quaternary fossils. All of these other projects led to the interim preparation of related papers.

When the project was begun in 1937 most authors followed the practice of classifying the gastropods in reverse, that is, from the most complex to the most primitive. Consequently the part completed prior to the war covered the opisthobranchs, the turrids, and the terebrids. It was sometime in 1948 that the project was resumed and work began with the Archaeogastropoda. From 1948 through 1965, when the senior author retired, the manuscript was completed through the Melongenidae by working whenever a few days, or at the most few weeks, became available. During this period two transfers of duty station were made: Washington, D.C., to Denver, Colorado, in 1950, and Denver to Menlo Park, California, in 1958.

After the senior author's retirement, he was approached by Dr. Emily Vokes of Tulane University to see if he would relinquish completion of the Vicksburg mollusks to David T. Dockery III, then a graduate student at Tulane, a request to which the senior author readily acceded. Consequently families Fasciolariidae through Conidae of the gastropods are by Dockery and the bivalves were made the subject of his Doctoral Dissertation.

Collections

The voluminous collections on which the study of the gastropods was based are, with the exception of Conrad's collection at the Philadelphia Academy of Natural Sciences, now in the U.S. National Museum. These are the collections made for W.H. Dall by Frank Burns, who collected by the wagon loads of barrels, shipped them to the U.S. National Museum, and washed and sorted them there. Subsequent extensive corrections were made by T.W. Vaughan, C.W. Cooke and others. The early collections were mostly from type and other classic localities, and probably because they were made before the localities became popular collecting sites, they yielded numerous large and spectacular specimens that have not been found since.

Later collections made largely by MacNeil, Mansfield and MacNeil, and Monroe and MacNeil concentrated on finding better specimens of known species, but because many of these were made at new localities found during the course of stratigraphic studies and mapping, they too yielded many unique and larger species.

Of special interest was a collection, mainly from the Mint Spring Formation at Vicksburg, deposited in the Department of Paleontology, University of California at Berkeley, collected by J. Wyatt Durham, that was heavily weighted with *Turritella.* Some specimens from this collection were figured to show additional variation within the Mint Spring turritellids.

In the late 1930s when the senior author made a study of the Conrad collection at Philadelphia, all of the gastropods were found, but a diligent search made by him and Miss Ann Harbison, then Assistant Curator, failed to turn up any of the bivalves. These were later found and included in the Academy's catalogue of invertebrate fossil types by Richards (1968).

Identification and Designation of Types

Much of the early work was done before the modern concept of types was established. It was necessary, therefore, during the course of obtaining ANSP Catalog Numbers for the Conrad collection to first designate lectotypes for Conrad's species. In most cases it was fairly obvious which specimens had been drawn, and in these cases the specimen so determined was designated the lectotype. In a few cases syntypes were designated because it appeared that more than one specimen had been used in the preparation of a composite drawing. A few lectoparatypes were designated for specimens that showed the details on areas poorly preserved on the lectotypes.

In 1925 the extensive collections of Col. T.L. Casey, U.S. Corps of Engineers, were turned over to the National Museum. Casey, who was primarily interested in the Coleoptera, also collected extensively from both the lower and upper Vicksburg beds at Vicksburg where he was stationed, his interest being mainly in the small species not collected by Conrad.

As with his beetles, Casey's Vicksburg mollusks were mounted on tiny tabs on pins stuck in cigar boxes. Species were clustered together in groups of pins and unlabelled except for one specimen in each group that bore a small handwritten species name. The senior author had the task of dismantling the specimens in the cigar boxes and placing them in glass vials for incorporation into the Museum collections. The labelled specimen was vialed separately and was regarded as the type, a procedure that seemed justified by the fact that the dimensions of the labelled specimens corresponded to those given in Casey's descriptions of the species in the Proceedings of the Philadelphia Academy of Natural Sciences.

There is every reason to believe that Casey shared the entomologists' view-point on the impermanence of types due to the fragility of insect specimens. While he did not designate types for his fossil mollusks, the manner in which he segregated a single specimen and gave its dimensions entirely justifies the identification of these specimens as holotypes, or at least makes them available as lectotypes.

In 1965 when Johns Hopkins University decided to transfer its collection of types to the National Museum for safe keeping, it was found that among the Aldrich types there were specimens of Casey's species that they had assumed to be Casey's types. These had been either deposited with or purchased by Aldrich. None of these specimens corresponded exactly to the dimensions given by Casey in his paper, as did the specimens in Casey's own collection, so it was concluded that they were not Casey's types. Furthermore, it was discovered that Otto Meyer as well as Aldrich had received duplicates of Casey's species and possibly duplicates were sent to the Philadelphia Academy where Casey's paper was published as well.

One unfortunate circumstance attending the Vicksburg mollusks was the discovery that the monograph of the shells of the Claiborne sands by the Marquis de Gregorio contained some Vicksburg species. De Gregorio, who never visited Claiborne himself, bought his collections from Ward's, a supplier of scientific items. He is supposed to have obtained five or six separate collections from Ward's, one of which came from the Byram Marl at Vicksburg rather than from Claiborne Bluff. Some five or six supposed Claiborne species are suspect, among them a *Panopea* and certainly the type species of the turrid genus *Pleurofusia.* Nothing like this turrid is known from Claiborne, whereas it is a common species in the Byram.

ACKNOWLEDGMENTS

The junior author gratefully acknowledges the following individuals who have contributed to the completion of this project. Emily H. Vokes is responsible for the junior author's initial involvement in this publication and also reviewed MacNeil's manuscript on the Muricidae. Harold E. Vokes helped with the identification of various gastropod species. Luc and Cyrille Dolin reviewed the Cypraeacea, and Alan Beu reviewed the Cymatiidae. Pierre Lozouet provided the Oligocene prosobranch gastropods from Gaas, France, figured in this publication, and also gave comments concerning the identity of various figured specimens. Philippe Maestraiti provided the pteropods figured from Gaas.

Ernest E. Russell, Mississippi State University, Gary S. Zumwalt, Louisiana Tech. University, and W. Howard Johnson, University of Southern Mississippi, photographed many specimens of small mollusks using the Scanning Electron Microscopes at their universities.

Warren Blow, Druid Wilson, and Thomas R. Waller provided assistance during and subsequent to the junior author's work at the U.S. National Museum. Joseph Rosewater provided space for this work in the Division of Mollusca's work area at the National Museum, and also sent on loan the specimen of *Xenophora (Stellaria) testigera digitata* Martens, 1878, figured in the plates. Dorothy M. Clark provided the junior author and wife with economical housing while in Washington.

Michael B. E. Bogard edited the text, and Bessie Smith is responsible for much of the typing. Edna R. MacNeil provided information on the senior author's professional career.

Type specimens illustrated in this work were borrowed from both the Philadelphia Academy of Natural Sciences and the U.S. National Museum.

STRATIGRAPHY

David T. Dockery III

Introduction

The Paleogene sequence of the northern Gulf Coastal Plain contains a nearly complete stratigraphic record of the Gulf's depositional history and successive marine faunas for that period of geologic time. This record is less complete in the Atlantic Coastal Plain due in part to erosion and slow deposition and in part to the carbonate composition of many marine units in which aragonitic shells have been removed by solution. To the west, in southern Texas, marine sediments often grade into nonmarine fluvial and deltaic units.

The best preserved Paleocene marine invertebrate faunas (Midway Group and lower Wilcox Group) of the Gulf Coastal Plain occur in Alabama. Alabama, Mississippi, Louisiana, and Texas contain well preserved lower and middle Eocene marine invertebrate faunas (upper Wilcox Group and Claiborne Group). Mississippi, Arkansas, Louisiana, and easternmost Texas contain well preserved upper Eocene marine invertebrate faunas (Jackson Group). Only Mississippi contains a well preserved lower Oligocene marine invertebrate fauna (Vicksburg Group). The lower Oligocene sequence in Alabama, Georgia, and Florida is largely carbonate, and the aragonitic shells in this sequence have been removed by solution. In Louisiana and Texas, the lower Oligocene consists largely of nonmarine, deltaic and fluvial, terrigenous clastic sediments. Mississippi is located on the eastern flank of the Mississippi Embayment where terrigenous clastic sediments, distributed through delta systems located on the Embayment's western flank, mixed with calcareous sediments on a shallow to moderately deep marine shelf. This marine shelf provided a good habitat for a diverse invertebrate fauna and contained terrigenous sediments that insured the preservation of aragonitic shells upon burial.

The lower Oligocene sequence of the Vicksburg Group in Mississippi consists of seven formations, all of which, at least in part, contain a marine fauna. These formations in ascending order are: (1) Red Bluff Formation, (2) Forest Hill Formation, (3) Mint Spring Formation, (4) Marianna Limestone, (5) Glendon Limestone, (6) Byram Formation, and (7) Bucatunna Formation. The most diverse marine invertebrate faunas occur in the Red Bluff Formation, sand lenses in the upper Forest Hill Formation, the Mint Spring Formation, and the Byram Formation. Aragonitic shells have largely been removed from the Marianna and Glendon limestones by solution. The Bucatunna Formation, which consists largely of dark-gray, bedded, mineral rich clay and silt, is only sparsely fossiliferous.

The Eocene - Oligocene Boundary

The Eocene - Oligocene boundary in the northern Gulf Coastal Plain has classically been placed at the disconformable contact of the Jackson and Vicksburg groups. In eastern Mississippi and western Alabama, this boundary is of particular interest as it occurs above the base of calcareous nannoplankton Zone NP21 of Martini (Bybell, 1982, and Siesser, 1983). Martini (1971) defined the NP20-NP21 boundary on the extinction of *Discoaster saipanensis* Bramlette and Riedel, 1954, and placed it as equivalent to the Eocene - Oligocene boundary. The Jackson - Vicksburg contact in eastern Mississippi and western Alabama, however, does coincide with the last occurrence of the planktonic foraminifer *Globorotalia cerroazulensis* (Cole, 1928) s. 1., which is also used to mark the Eocene - Oligocene boundary.

Snyder et al. (1984) noted an offset of nine meters in the last occurrence of *D. saipanensis* and *G. cerroazulensis* in a continuous depositional sequence encountered at DSDP Site 549 in the northern Bay of Biscay (Irish continental margin). At this site they placed the Eocene - Oligocene boundary at the last occurrence of *G. cerroazulensis*, which is equivalent to its placement at the Jackson - Vicksburg contact in the northern Gulf Coastal Plain. Cavelier (1979) pointed out that material from the lower Oligocene stratotype at the Lattorfian type locality is diachronous and lies within Zone NP19/NP20 (late Eocene), a view that agrees with molluscan evidence. Synder et al. (1984, p. 114) suggested that perhaps the best solution to this problem would be to select a new boundary stratotype and to drive a "golden spike" into the section to mark the boundary. They recommended the Jackson - Vicksburg contact in the United States Gulf Coast as a possible stratotype. The writer agrees with this recommendation and further recommends the selection of a boundary stratotype at the Shubuta - Red Bluff contact on the east bank of the Chickasawhay River southwest of Hiwannee, Wayne County, Mississippi, at MGS locality 35 in Section 28, T. 10 N., R. 7 W. (see Figure 5). The reasons for selection of MGS locality 35 for the stratotype are as follows:

1. An Eocene - Oligocene boundary stratotype selection in either eastern Mississippi or western Alabama would be placed at the contact of the Shubuta Clay Member of the Yazoo Formation (Jackson Group, uppermost Eocene) and the Red Bluff Formation (Vicksburg Group, lowermost Oligocene). The type localities of these two units are only a short distance from the proposed stratotype locality.

2. The NP20 - NP21 boundary was placed at the contact of the Pachuta Marl and Shubuta Clay Members of the Yazoo Formation by Bybell (1982, p. 298) and within the Shubuta Clay Member by Siesser (1983, p. 43). The Shubuta Clay Member is eighty-five feet thick in the vicinity of MGS locality 35 (though only the upper few feet are exposed) and is much thicker there than in Alabama, where it is only seven feet thick at St. Stephens Quarry in Washington County and nineteen feet thick at Little Stave Creek in Clarke County. This additional thickness should provide a more complete stratigraphic record of biologic events occurring during the interval between the last occurrences of *Discoaster saipanensis* and *Globorotalia cerroazulensis.*

3. MGS locality 35 provides an unweathered exposure with eight feet of the Shubuta Clay Member overlain by eighteen feet of the Red Bluff Formation. This exposure is continuous for one fourth mile on the outside of a horseshoe bend in the Chickasawhay River and is not strongly affected by slumping. Yearly flooding of the Chickasawhay River maintains an unweathered section at this site. The Shubuta - Red Bluff contact has a discontinuous exposure along a seven mile stretch of the Chickasawhay River beginning at the Red Bluff type locality, where it is about sixty-five feet above the water level, to where it dips below water level about one mile southwest of Hiwannee. The Red Bluff type locality is strongly affected by slumping (Figure 1) as are several other sites and for that reason is not recommended for selection as a stratotype.

4. Probably the most important reason for this site selection is that the Red Bluff Formation at this locality contains a well preserved, diverse, marine, invertebrate fauna as well as an excellent microfauna. The advantage of having such a diverse, lower Oligocene, marine macrofauna at the stratotype is one that can not be offered elsewhere in the Gulf Coastal Plain. The Shubuta Clay Member contains only a few large invertebrate fossils at this site, but its equivalent section in central Mississippi contains a diverse upper Eocene, marine, invertebrate fauna.

5. The upper Eocene sequence of the Jackson Group is well exposed upstream from the proposed stratotype site, and in its basal unit, the Moodys Branch Formation, contains both a well preserved and diverse macrofauna and microfauna. In Alabama, the Jackson Group contains a good microfauna but does not contain a diverse macrofauna due to the poor preservation of aragonitic shells. Upstream from the proposed site, an excellent sequence of the lowermost Oligocene is exposed above the Red Bluff Formation. The following units of that sequence in ascending order are within Zone NP21 according to Siesser (1983): (1) Forest Hill Formation, (2) Mint Spring Formation, and (3) Marianna Limestone. All of these units contain a marine microfauna, but the upper Forest Hill and Mint Spring formations contain a diverse invertebrate fauna as well due to the preservation of aragonitic shells.

Figure 1 — Shubuta Clay Member of the Yazoo Formation and Red Bluff Formation at the Red Bluff type locality (MGS locality 37) on the east side of a horse-shoe bend in the Chickasawhay River in the N/2, SE/4, NE/4, Section 16, T. 10 N., R. 7 W, Wayne County, Mississippi. Slumping at this locality is evidenced by the fresh exposures and the fallen trees. The Shubuta - Red Bluff contact here is about 65 feet above river level. Photograph taken on May 17, 1984.

The Red Bluff and Forest Hill Formations

The Red Bluff and Forest Hill formations are discussed in the companion bulletin to this one (Dockery, 1982) and only a few additional comments are added here. The depositional environments proposed by Dockery (1982, p. 16) for the Red Bluff Formation were: (1) shallow marine shelf, (2) prodelta, and (3) marginal delta bay. These environments are probably correct for the upper part of the Red Bluff Formation, but the very fossiliferous, lower section was probably deposited on a moderately deep marine shelf as indicated by a diverse foraminifer assemblage. Invertebrate shells are concentrated in glauconitic sand lenses within the silty clays of the lower Red Bluff Formation. These sand lenses rest above diastems and show the effects of current action, probably that of storm currents. Large molluscan shells are often clustered together along with otoliths in lag deposits above these diastems. Clay beds separating the glauconitic sand lenses are sparsely fossiliferous in respect to macrofossils.

The disconformity separating the Red Bluff Formation from the Shubuta Clay Member of the Yazoo Formation does not represent a significant period of geologic time. This is indicated by the thickness of sediment above and below the contact that falls into Martini's calcareous nannoplankton Zone NP21. There is a lithologic change above the contact as the light, blue-gray, blocky clay of the Shubuta is overlain by dark-gray clay and glauconitic sand of the Red Bluff Formation (see Figures 1-5). This change is attributed to updip progradation of delta systems in the Forest Hill Formation, which distributed organic rich clays across the Red Bluff marine shelf.

Bybell (1982, p. 295, 298) stated that the Red Bluff Formation and Shubuta Clay Member have a very similar calcareous nannofossil flora and that no change in this flora occurs immediately across the disconformable contact of these units. This disconformable contact, however, does coincide with a sudden and prominent change in the benthic invertebrate fauna and indicates a time of crisis for Eocene mollusks. The latest well preserved Eocene invertebrate fauna in the Gulf Coastal Plain occurs in the Danville Landing Member of the Yazoo Formation at Danville Landing in Louisiana and in the upper part of the Yazoo Formation at the Miss Lite clay pit north of Jackson, Mississippi (MGS locality 15). These units are probably of equivalent age to the Shubuta Clay Member (Zone NP21) and have a fauna very similar to that of the Moodys Branch Formation, the basal

Figure 2 — Contact of the Shubuta Clay and overlying Red Bluff Formation at the Red Bluff type locality. Contact is marked by the arrow. Photograph taken on May 17, 1984.

Figure 3 — Contact of the Shubuta Clay and overlying Red Bluff Formation along the east bank of the Chickasawhay River west of Hiwannee (MGS locality 38) in the NE/4, SE/4, NE/4, Section 28, T. 10 N., R. 7 W., Wayne County, Mississippi. The contact is examined by Delbert Gann in the background and is marked by the arrow in the foreground. Photograph taken on November 2, 1983.

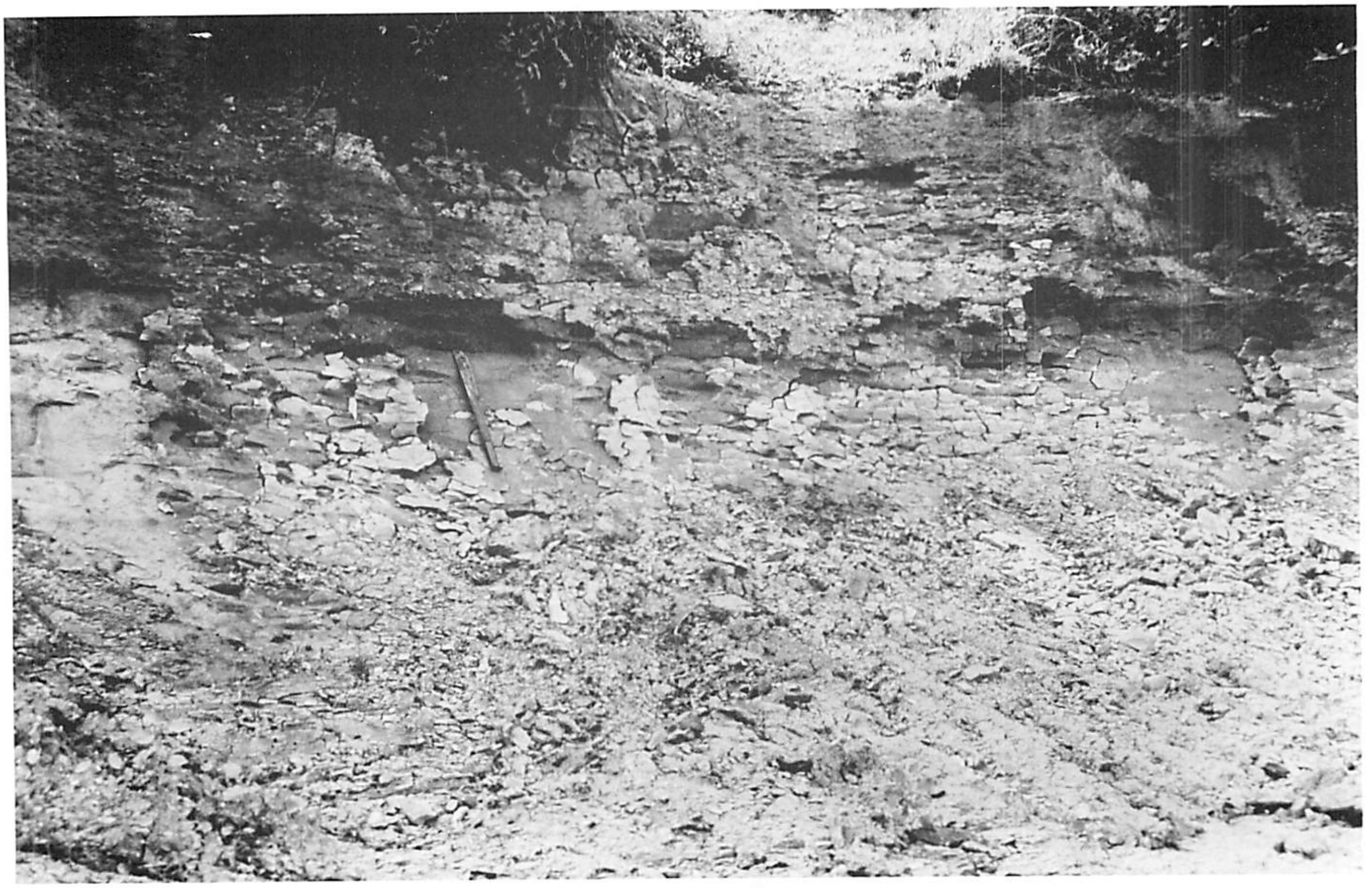


Figure 4 — Contact of the Shubuta Clay and overlying Red Bluff Formation on the west bank of the Chickasawhay River (MGS locality 34) in the E/2, NE/4, NW/4, NW/4, Section 28, T. 10 N., R. 7 W., Wayne County, Mississippi. The top of the machete marks the contact. Photograph taken on September 7, 1978.

unit of the Jackson Group. Very few Eocene molluscan species continue across the Jackson - Vicksburg disconformity into the very fossiliferous sediments of the Red Bluff Formation. Several prominent molluscan genera of Paleocene and Eocene age, such as the bivalve *Venericardia* (*Venericor*) and the gastropods *Calyptraphorus, Pseudoliva,* and *Athleta,* have their last occurrence in the Gulf Coastal Plain in the Jackson Group. *Athleta* does continue into the Oligocene of Europe. On the other hand, several Neogene genera, such as the bivalves *Scapharca, Ervilia,* and *Chione* and the gastropods *Xenophora* (*Stellaria*), *Cassis,* and *Distorsio* (*Distorsio*), have their first occurrence in the Vicksburg Group.

The molluscan fauna of the Red Bluff Formation is representative of the Vicksburg fauna as a whole. Many species of Red Bluff mollusks range throughout the Vicksburg Group or occur in higher units as varieties or subspecies.

The Forest Hill Formation conformably overlies the Red Bluff Formation in eastern Mississippi and disconformably overlies the Yazoo Formation in central and western Mississippi. In eastern Mississippi, the Forest Hill Formation consists of bedded, deltaic clays, silts, and sands with a transitional marine zone just below the upper contact. Figures 6-7 illustrate the Forest Hill - Mint Spring contact in a roadcut at MGS locality 88. The position of a two inch thick, very fossiliferous, marine sand in the upper Forest Hill Formation at this locality is marked by a pick in Figure 7. This sand unit is ten feet below the upper contact and is interpreted as a storm deposit within an estuarine sequence.

The Forest Hill Formation pinches out to the east in Alabama. It thickens westward into central Mississippi, where it contains thick sequences of fluvial channel sands in its lower part, some of which cut deeply into the underlying Yazoo Formation. Petrified logs occur frequently within these channel sands (Blackwell, Brandenburg, and Dukes, 1981, and Blackwell, 1983). The upper Forest Hill Formation at MGS locality 99 in Rankin County and MGS locality 107 in Warren County contains beds of fossiliferous clays and sands in a transitional marine facies similar to that at MGS locality 88. Figures 8-9 show the Forest Hill - Mint Spring contact at MGS

Figure 5 — Contact of the Shubuta Clay and overlying Red Bluff Formation at site of proposed Eocene - Oligocene boundary stratotype at MGS locality 35 on the east bank of the Chickasawhay River in the SW/4, SW/4, SW/4, Section 28, T. 10 N., R. 7 W., Wayne County, Mississippi. Contact is marked by the arrow. Photograph taken on September 7, 1978.

locality 99. Directly below the contact at this locality is a foot-thick bed of dark gray, silty clay, which overlies a sparsely fossiliferous, clayey sand with lenses of very fossiliferous sand. This transition zone of the Forest Hill Formation contains a molluscan fauna similar to that of the overlying Mint Spring Formation. However, some species in this zone, such as *Sassia (Sassia) conradiana menthafons* MacNeil n. sp., are rare in the Mint Spring Formation. The bivalve *Tiza alta* (Conrad, 1848), which occurs as worn specimens in the Mint Spring Formation (these worn specimens are abundant at MGS locality 110), occur as articulated, unworn specimens that are clustered in groups in the upper clay unit of the Forest Hill transitional marine zone. This dark clay unit illustrated in Figure 9 probably was deposited in a salt water marsh that developed during the latter stages of infilling of sediment of upper Forest Hill estuaries. This depositional sequence is remarkably similar to that described by Dockery (1980, p. 49-52, fig. 26-27) for the upper Cockfield and Moodys Branch formations in Clarke County, Mississippi. Estuarine fossils such as *Tiza alta* were incorporated into overlying shelf deposits as estuarine sediments were eroded by the transgressive Mint Spring sea.

The Mint Spring Formation and Marianna Limestone

The Mint Spring Formation is diachronous along its outcrop belt in Mississippi as is indicated by calcareous nannoplankton studies. Both Bybell (1982, p. 299) and Siesser (1983, p. 46) placed the Mint Spring Formation in western Alabama and eastern Mississippi in NP21, while they placed the Mint Spring Formation in central and western Mississippi in NP22. The Mint Spring Formation is one and one half to two feet thick in eastern Mississippi and is highly calcareous. Figures 6-7 show the Forest Hill and Mint Spring formations and the Marianna Limestone at MGS locality 88. The Mint Spring Formation shown in these figures is thin in comparison to that illustrated in Figure 8 on the facing page for locality 99 in central Mississippi. The molluscan fauna of the thin and highly calcareous Mint Spring Formation of

Figure 6 (top) — Forest Hill Formation, Mint Spring Formation, and Marianna Limestone in a roadcut on the south side of Highway 84 (MGS locality 88) in Section 18, T. 9 N., R. 5 W., Wayne County, Mississippi. The Mint Spring Formation is marked by the head of the pick. The pick is nearly vertical and has a length of 26 inches. The light-gray, soft, sandy limestone of the Mint Spring Formation overlies a dark-gray clay bed in the Forest Hill Formation and underlies a hard, foot-thick ledge forming the base of the Marianna Limestone. Photograph taken on February 11, 1984.

Figure 7 (left) — A two-inch thick, fossiliferous, marine sand in the upper Forest Hill Formation at MGS locality 88 marked by pick and arrow. This sand is ten feet below the upper contact. Photograph taken on February 11, 1984.

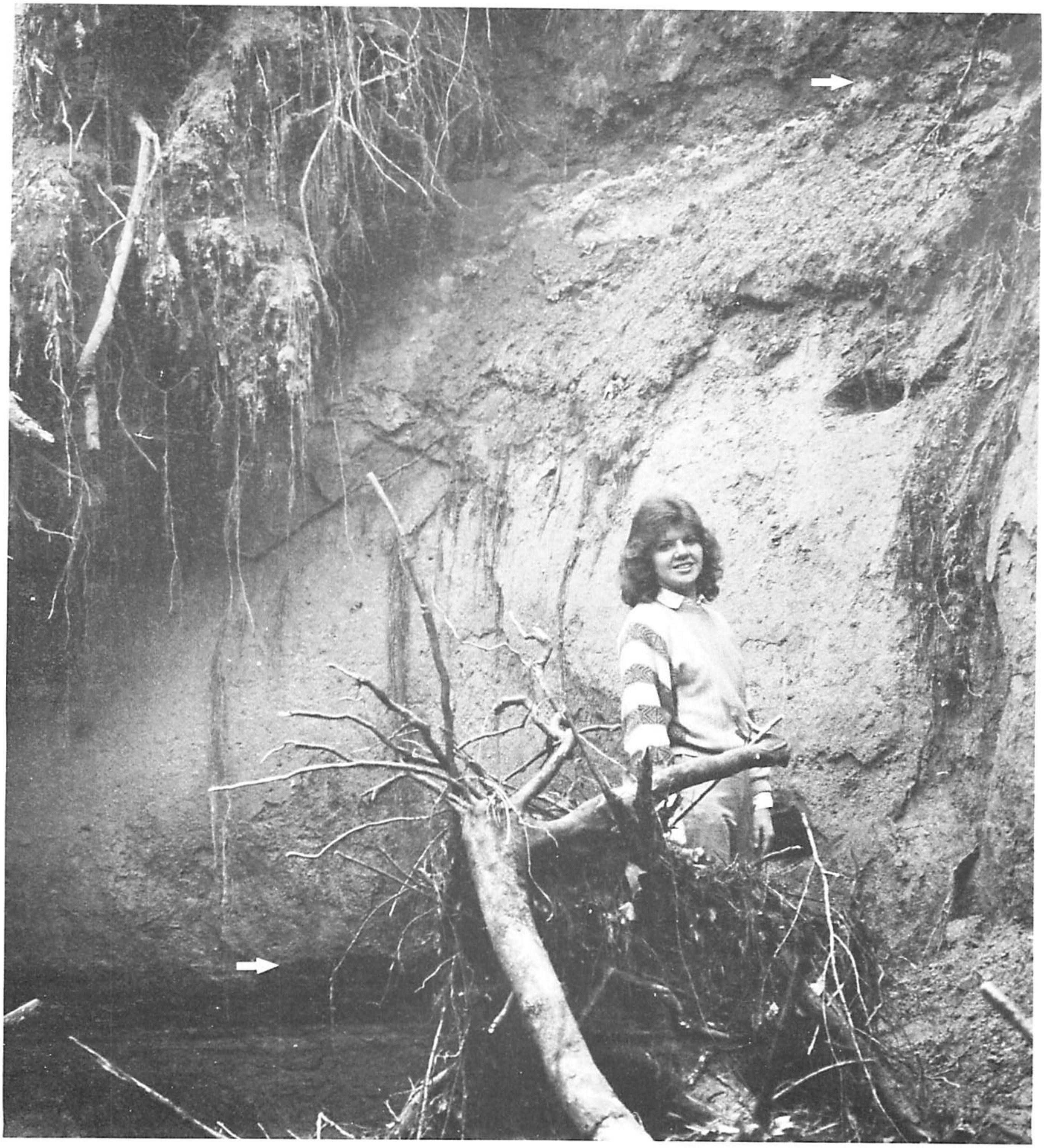


Figure 8 — The Forest Hill Formation, Mint Spring Formation, and badly weathered Marianna Limestone at MGS locality 99 at a pool below a waterfall on the Andrew W. Rees property north of Cleary in the SE/4, SE/4, SW/4, NW/4, Section 22, T. 4 N., R. 1 E., Rankin County, Mississippi. Here the Mint Spring Formation is a nine-foot thick, fossiliferous, calcareous, glauconitic, moderately clean, massive sand. This facies is very different from the two-foot thick, soft, sandy limestone facies occurring in Wayne County as shown in Figure 6 on the facing page. Mary Dockery, 5'8'', for scale. Arrows mark the upper and lower contacts of the Mint Spring Formation. Photograph taken in January of 1984.

Figure 9 — The transitional marine zone of the upper Forest Hill Formation and the overlying Mint Spring Formation at MGS locality 99. The Forest Hill - Mint Spring contact is marked by the pick. Below this is a foot-thick, dark-gray clay bed that is underlain by a sparsely fossiliferous, clayey sand with fossiliferous sand lenses. The pick is 26 inches in length. Photograph taken in February of 1984.

eastern Mississippi is different from that of the rest of the outcrop belt. This difference may be either age or facies related.

The Mint Spring Formation in central and western Mississippi generally averages a little less than ten feet in thickness, though locally the thickness may be much greater. Fossils in the Mint Spring Formation are more fragile than those of the Red Bluff and Byram formations. However, with much care, large and well preserved specimens can be obtained from certain localities. Perhaps the most important of these is MGS locality 99 (= USGS localities 14071 and 14071a) near Cleary, Mississippi. Figure 8 shows a complete section of the Mint Spring Formation at this locality. Here the Mint Spring Formation is a moderately clean, glauconitic, homogeneous, fossiliferous sand, as is characteristic for the formation in central and western Mississippi. In this respect it differs from the Byram Formation, a similar nearshore to offshore shelf facies, which consists of interbedded clayey sands and sandy clays (see Figure 12). Clays were winnowed from the sands of the Mint Spring Formation during the marine transgression in which they were deposited as a destructional shelf facies above Forest Hill deltaic and estuarine sediments. These sands were reworked by burrowing organisms on the nearshore and offshore shelf to form their present massive appearance. The Byram Formation, on the other hand, was deposited during the early part of a marine regression and consists of bedded-clay-rich sands that accumulated on an aggrading marine shelf.

The Marianna Limestone conformably overlies the Mint Spring Formation. In eastern Mississippi the basal Marianna is marked by a foot-thick hard limestone bed (see figures 6-7). The characteristic facies of the Marianna Limestone is that of a soft lime mudstone or wackestone with some calcirudite beds containing the large foraminifer *Lepidocyclina mantelli* (Morton, 1833). This lithology can be traced from the type locality at Marianna, Florida, westward through Alabama and into central Mississippi to the Smith County Lime Plant quarry (MGS locality 92) shown in Figure 10. Here the soft Marianna Lime-

Figure 10 — Marianna and Glendon limestones at the Smith County Lime Plant quarry (MGS locality 92) in the NW/4, NE/4, Section 27, T. 2 N., R. 9 E., Smith County, Mississippi. The soft Marianna Limestone, which forms the vertical portion of the quarry wall in the background, is disked up (foreground) here and allowed to dry before its conversion into agricultural lime. The ledge-forming Glendon Limestone forms the upper slope of the quarry wall. The arrow marks the Marianna - Glendon contact. Gary S. Zumwalt is at right. Photograph taken on October 24, 1983.

stone is disked up and allowed to dry before its conversion into agricultural lime. The hard ledges of the Glendon Limestone can be seen in Figure 10 above a vertical wall in the Marianna Limestone.

A sharp facies change occurs in the Marianna between the Smith County Lime Plant quarry and the old Marquette Cement Manufacturing Company quarry at Brandon (MGS locality 98). At the Marquette quarry, the Marianna Limestone consists of about a thirty foot section of calcareous sand and sandy limestone containing the echinoids *Clypeaster rogersi* (Morton, 1834) and *Cassidulus gouldii* (Bouve, 1846). These echinoids also occur in the underlying Mint Spring Formation at this locality and in the Mint Spring Formation and Marianna Limestone at MGS localities 99-101. *Clypaester rogersi* continues into the Glendon Limestone and Byram Formation, and occurs in abundance in a poorly indurated bed of the Glendon at the Marquette quarry. The Marianna thins westward into Warren County and is only two feet thick at Vicksburg (see Dockery, 1982, fig. 13).

Aragonitic shells have been removed from the Marianna Limestone by solution so that its molluscan fauna is incompletely known, but it is probably similar to that of the Mint Spring Formation as judged from extenal and internal molds and calcitic shells. The most useful molluscan guide fossil to the Marianna Limestone is the calcitic bivalve *Pecten (Pecten) poulsoni* Morton, 1834. *Pecten perplanus* Morton, 1833, a characteristic bivalve of the Red Bluff Formation, occurs in the upper Forest Hill Formation and lower Marianna Limestone of western Alabama and eastern Mississippi. It is possible that the last occurrence of *P. (P.) perlanus* and the first occurrence of *P. (P.) poulsoni* approximate the NP21-NP22 boundary.

Figure 11 — Waterfall over ledge in the Glendon Limestone north of Vicksburg in irregular Section 15, T. 17 N., R. 4 E., Warren County, Mississippi. A travertine dam above the waterfall in the background is breached by a narrow channel. This waterfall is the last of a series of three. Michael B. E. Bograd, 6' 1", for scale. Photograph taken on June 12, 1976.

The Glendon Limestone and Byram and Bucatunna Formations

The Glendon Limestone is a hard, ledge-forming limestone that disconformably overlies the Marianna Limestone in Florida, Alabama, and Mississippi. In western Alabama and eastern and central Mississippi, the Glendon has a similar thickness to the Marianna Limestone, a thickness of about thirty feet. As the Marianna thins from central to western Mississippi, the Glendon Limestone maintains its full thickness, and at Vicksburg comprises most of the carbonate sequence of the Vicksburg Group. Hard ledges of Glendon Limestone north of Vicksburg are illustrated at a waterfall in Figure 11 and at the old Mississippi Valley Portland Cement Company quarry at Haynes Bluff (MGS locality 112) in Figure 12.

Coleman (1983), for the purpose of showing diachronous lithofacies in the Vicksburg Group, gave a general lithologic key for the formations of this group. He followed this key faithfully in measured sections at Haynes Bluff (Figure 12) and at the Marquette quarry at Brandon regardless of the stratigraphic position. As a result, various beds of the Glendon Limestone in these sections (Coleman, 1983, fig. 5-6) were assigned to the Byram Formation or Marianna Limestone. While these sections illustrate the recurrence of lithologies, they confuse the chronostratigraphic picture. The formations of the Vicksburg Group can be distinguished readily in outcrop sections for the purpose of geologic mapping by a comprehensive examination of lithology, stratigraphic sequence, and paleontology. Soft lime mudstones in the Glendon can be distinguished from those of the Marianna by the occurrence of the bivalve *Pecten* (*Pecten*) *byramensis* Gardner, 1945, as well as by being included within other Glendon strata. The Byram Formation, on the other hand, has similar lithologies to those of various terrigenous beds between ledges of the Glendon Limestone at Vicksburg and Brandon and cannot be paleontologically distinguished from the Glendon. It is therefore assigned to the interval above the last ledge of the Glendon Limestone and below the clay sequence of the Bucatunna Formation (Dockery, 1980, p. 60). Clay intervals between fossiliferous sands of the By-

Figure 12 — Glendon Limestone and Byram Formation at the Mississippi Valley Portland Cement Company quarry at Haynes Bluff north of Redwood on Highway 3 (MGS locality 112) in the NW/4, Section 26, T. 18 N., R. 4 E., Warren County, Mississippi. The Glendon Limestone forms the quarry wall above the lower floor, and the Byram Formation forms a wall above the upper floor. The Byram Formation is overlain by loess. A resistant bed of sand in the Byram Formation, which contains abundant *Scapharca (Scapharca) lesueuri* Dall, 1898, forms a thick ledge above a clay sequence in the lower Byram. Michael B. E. Bograd on lower quarry floor for scale. Photograph taken on June 12, 1976.

ram are placed in the Byram Formation rather than assigned as facies of the Bucatunna Formation (see Coleman, 1983, fig. 5).

The Glendon Limestone was designated as the lower unit of the "Glendon - Byram - Bucatunna Regressive Sequence" by Dockery (1982, p. 20). However, a study of foraminiferal communities in the Vicksburg section at Haynes Bluff (Figure 12) by Fisher and Ward (1984) indicated the maximum marine transgression and deepest inner shelf seas to have occurred during the deposition of the middle Glendon Limestone. The regressive sequence began with the upper Glendon and continued through the Bucatunna (Fisher and Ward, 1984, p. 5).

The Byram Formation conformably overlies the Glendon Limestone and contains a diverse molluscan fauna. The majority of the species named by Conrad (1848a and 1848b) are from the Byram Formation at Vicksburg. As shown by Coleman (1983, figure 2), the Byram is a regressive, terrigenous, shelf depositional system somewhat analogous to the transgressive shelf system of the Mint Spring Formation. It differs, as previously mentioned, in that the aggrading Byram shelf received alternating deposits of sand and clay while the destructional Mint Spring shelf winnowed out clays leaving a thin, moderately clean, bioturbated, homogeneous sand. The Byram Formation illustrated in Figure 12 at Haynes Bluff consists of sixteen feet of soft clay and sand overlain by eight feet of more resistant fossiliferous sands. These sands contain an abundance of the bivalve *Scapharca (Scapharca) lesueuri* Dall, 1898, a fossil characteristic of the Byram Formation.

The Bucatunna Formation consists of mineral rich, dark-gray, sparsely fossiliferous clay, which conformably overlies the Byram Formation in western and central Mississippi. This clay was probably deposited in a marginal marine environment.

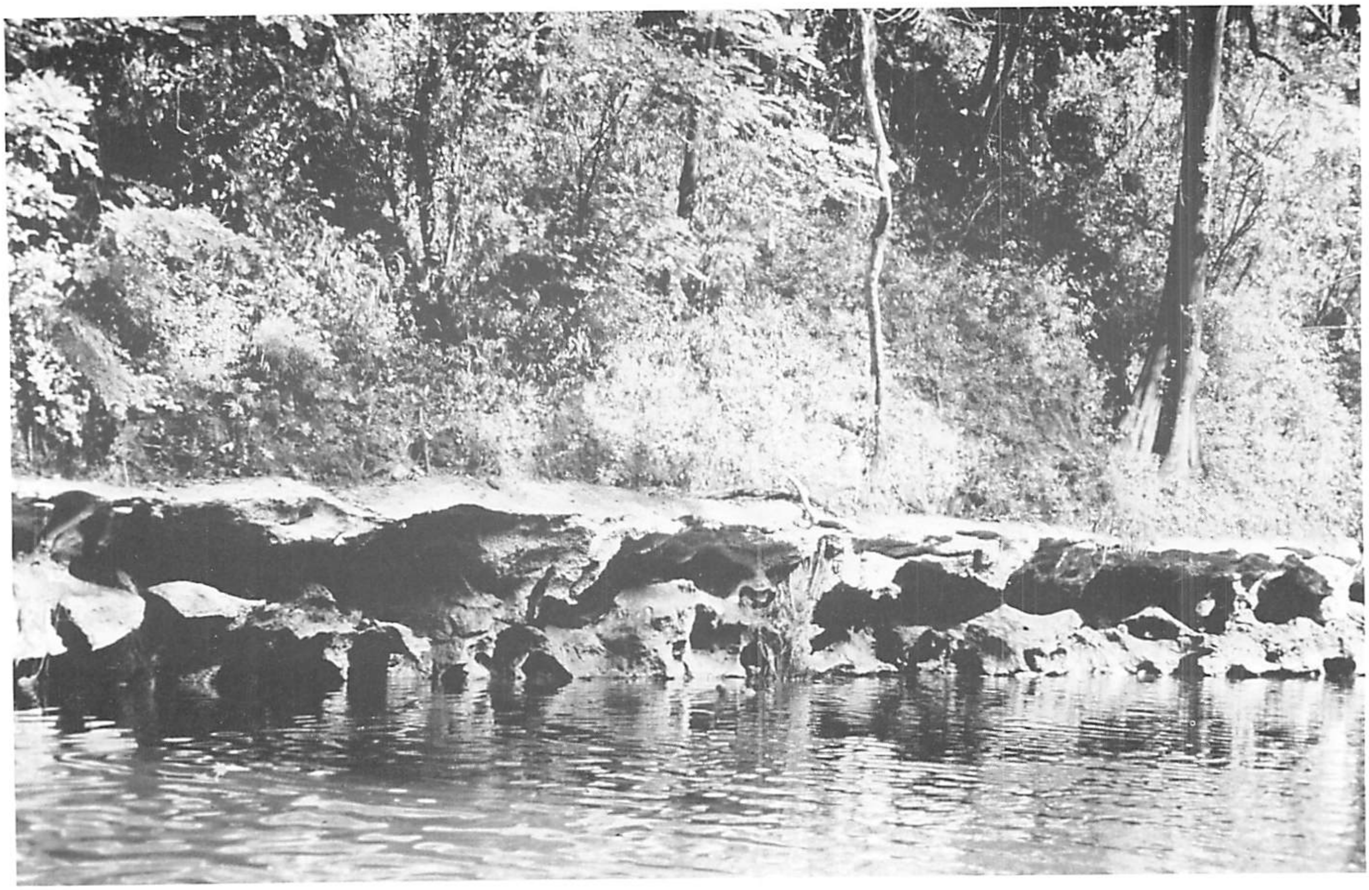


Figure 13 — Cavernous Glendon Limestone on west bank of the Chickasawhay River northwest of Waynesboro and just north of a bridge leading to Woodwards (MGS locality 79) in the SW/4, SW/4, Section 35, T. 9 N., R. 7 W., Wayne County, Mississippi. Photograph taken on September 7, 1978.

However, in eastern Mississippi, this clay is replaced in places by a fluvial unit, the Waynesboro Sand Lentil of the Bucatunna Formation, which disconformably overlies the Glendon and sometimes even the Marianna Limestone. The Waynesboro Sand Lentil was mapped in the subsurface of Wayne County by Johnson (1982, fig. 4) and shown to be an elongate, north-south trending sand body that forked to the southwest and southeast. Fresh water flowing through the Waynesboro fluvial system flushed through the underlying Glendon bedrock to produce vuggy limestones, collapsed rubble zones, and other karst features (Dockery, 1984, p. 21). Figure 13 illustrates the cavernous nature of the Glendon Limestone along the Chickasawhay River in Wayne County. At the Mississippi Agricultural Lime Plant quarries north of Waynesboro, these vugs are often filled with large masses of sparry calcite, a rarity in the coastal plain of Mississippi. Figure 14 shows the contact of the Waynesboro Sand Lentil with collapsed limestone rubble of the Glendon Limestone at one of the quarries north of Waynesboro.

The Chickasawhay Limestone and Paynes Hammock and Catahoula Formations

The upper Oligocene Chickasawhay Limestone disconformably overlies the Bucatunna Formation in western Alabama and eastern Mississippi. Conformably overlying the Chickasawhay Limestone in this same area are the sands and limestones of the Paynes Hammock Formation. Both of these units were placed in calcareous nannoplankton Zone NP24 by Siesser (1983), indicating that Zone NP23 is missing in Mississippi and Alabama. The contact of the Bucatunna Formation and the Chickasawhay Limestone along the Chickasawhay River west of Waynesboro is illustrated in Figure 15. Figure 16 shows the Paynes Hammock Formation along the Chickasawhay River south of Waynesboro.

The Bucatunna Formation in central and western Mississippi is disconformably overlain by deltaic sediments of the Catahoula Formation. Locally, channel sands in the lower Catahoula may cut

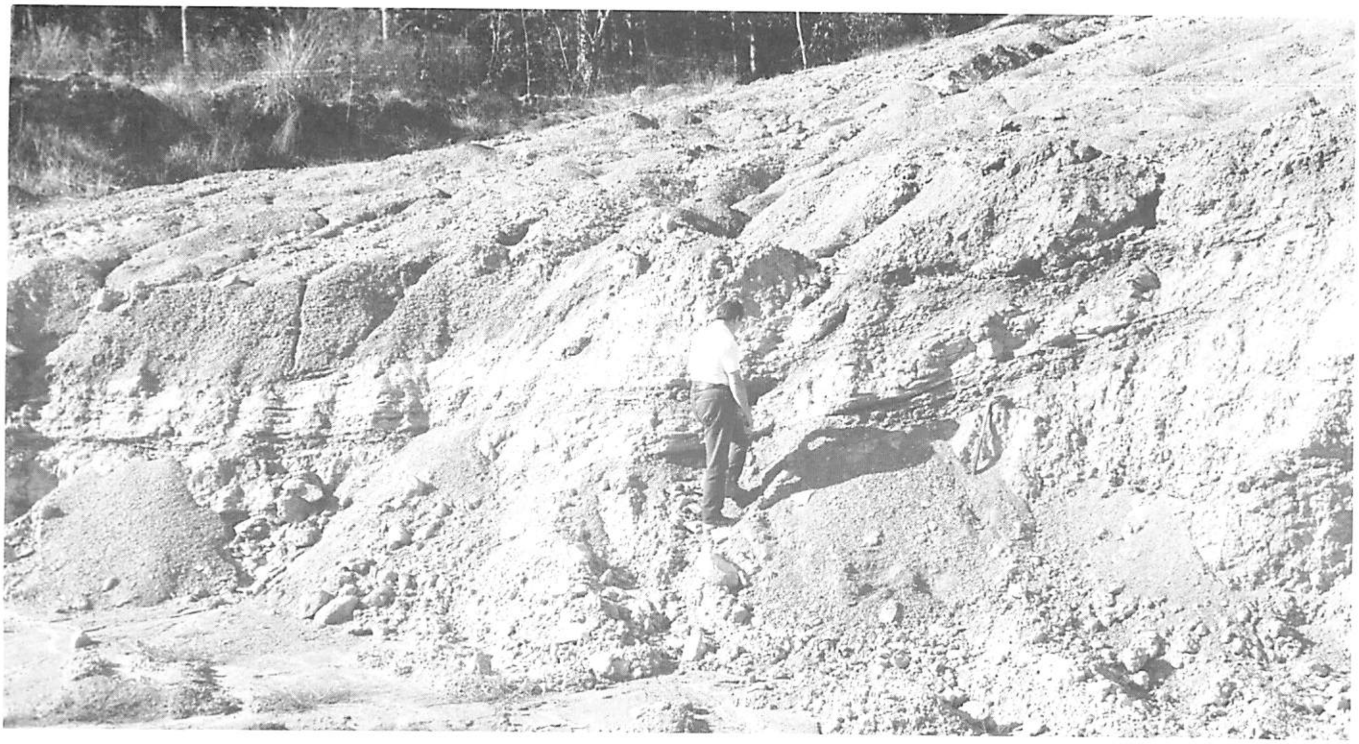


Figure 14 — Channel at the base of the Waynesboro Sand Lentil of the Bucatunna Formation in contact with rubble zone of the weathered Glendon Limestone. Delbert Gann examines the Waynesboro Sand - Glendon Limestone contact. Photograph taken November 2, 1983.

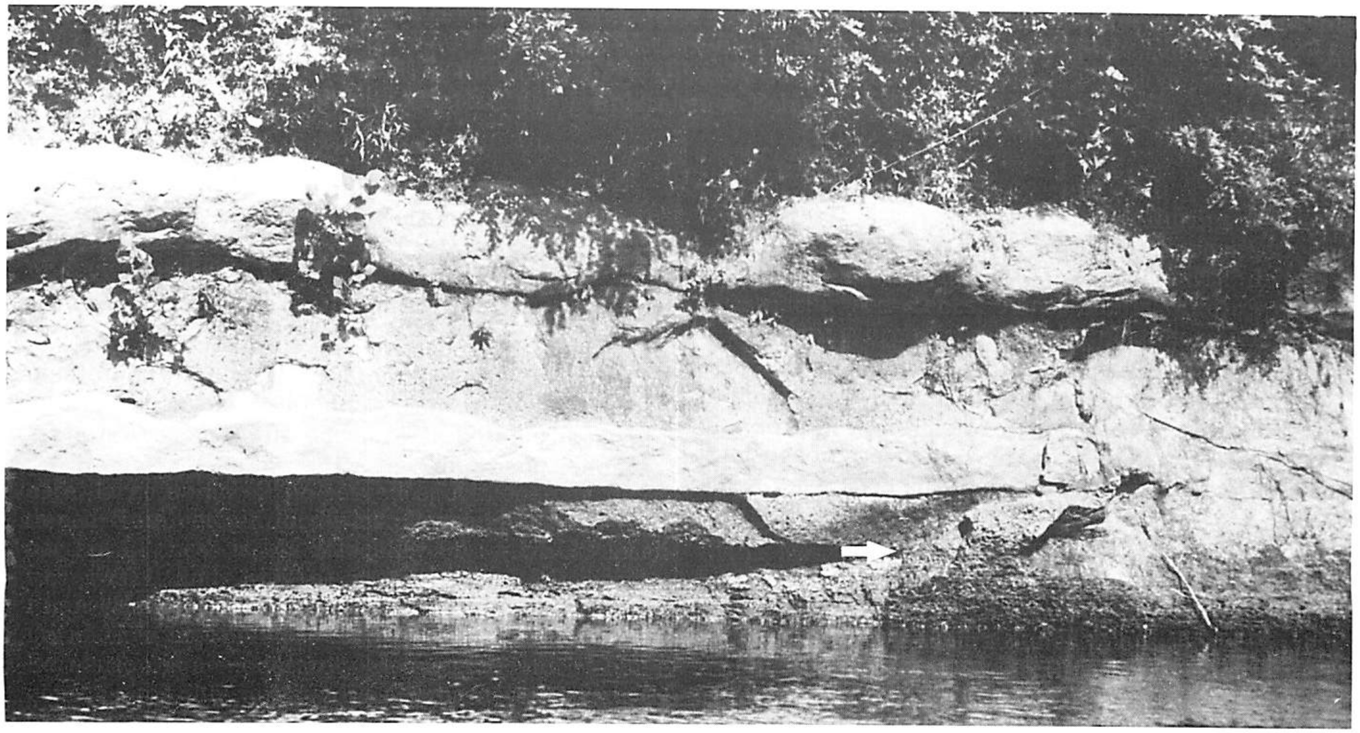


Figure 15 — Contact of the Bucatunna Formation and Chickasawhay Limestone on the west bank of the Chickasawhay River west of Waynesboro (MGS locality 80) in the SE/4, NW/4, SE/4, NE/4, Section 3, T. 8 N., R. 7 W., Wayne County, Mississippi. Bucatunna - Chickasawhay contact marked by the arrow. Photograph taken on September 7, 1978.

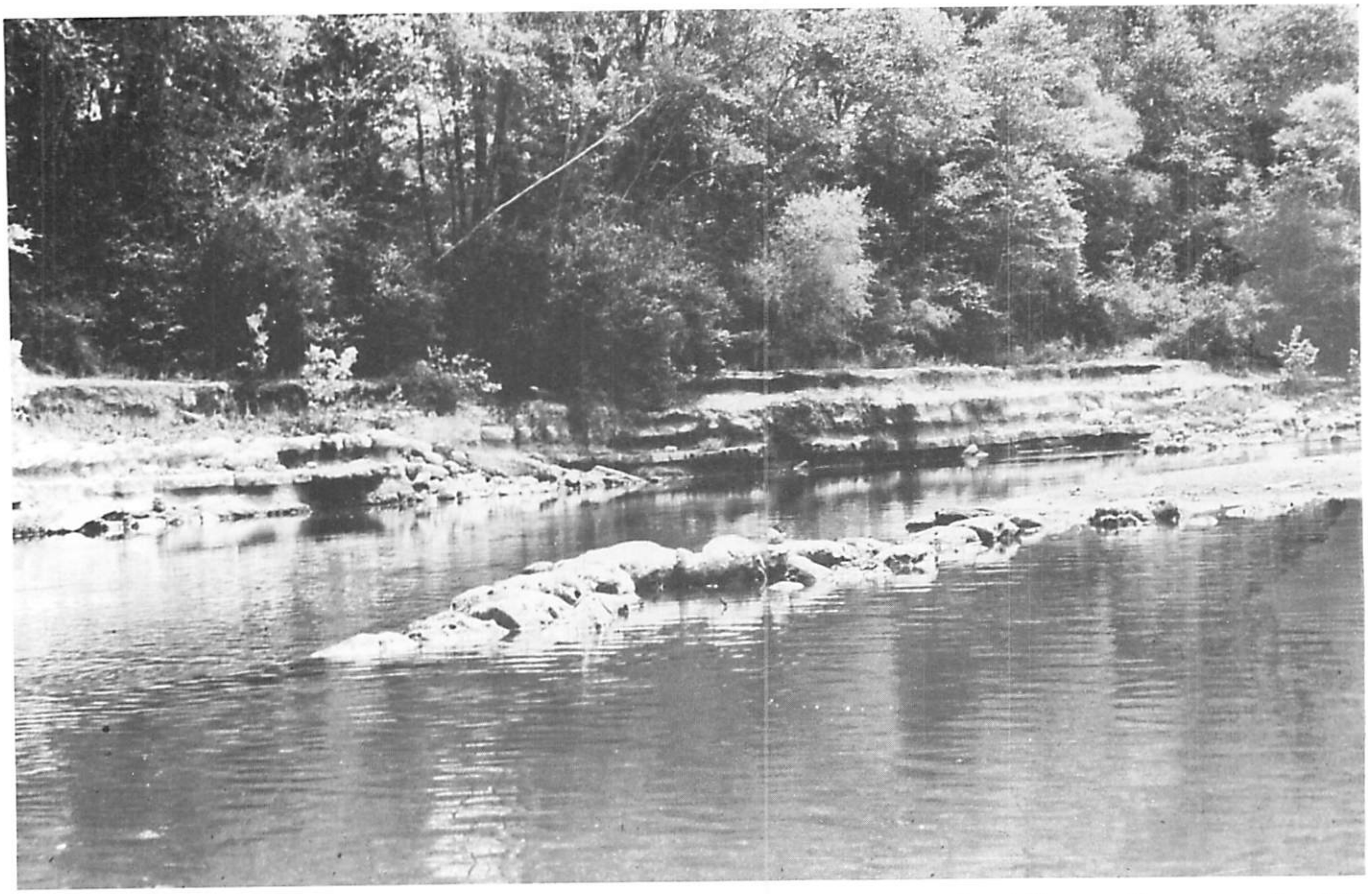


Figure 16 — Paynes Hammock Formation on the east bank of the Chickasawhay River at the corner of a right angle bend south of Waynesboro (MGS locality 83) in the SE/4, NW/4, SE/4, Section 14, T. 8 N., R. 7 W., Wayne County, Mississippi. Photograph taken on September 7, 1978.

through the Bucatunna and into other formations of the Vicksburg Group. In eastern Mississippi the lower Catahoula Formation consists of silty clays that overlie the Paynes Hammock Formation. The nature of the Paynes Hammock - Catahoula contact is not fully understood at present, but in at least one locality on the Chickasawhay River south of Waynesboro it appears to be conformable. The lower part of the Catahoula Formation in Mississippi is probably upper Oligocene in age. In the subsurface of southern Mississippi, deltaic sediments of the lower Catahoula grade into marine sediments of the *Heterostegina* Zone, also called the Tatum Limestone. The *Heterostegina* or "*Het.*" Zone is named for a characteristic foraminifer within this interval and is placed by Skinner et al. (1972, fig. 2) as upper Oligocene in age.

The upper part of the Catahoula Formation is difficult to date as it consists largely of nonfossiliferous deltaic sequences. This interval of the Catahoula is usually dated as Miocene due largely to its stratigraphic position.

OUTLINE OF SYSTEMATICS

Class GASTROPODA
Subclass PROSOBRANCHIA
Order ARCHAEOGASTROPODA
Superfamily FISSURELLACEA
Family FISSURELLIDAE

Diodora mississippiensis (Conrad, 1848)
Diodora postantica MacNeil n. sp.

Superfamily COCCULINACEA
Family LEPETELLIDAE

Sablea minuta Allen, 1970

Superfamily TROCHACEA
Family TROCHIDAE

Solariella menthafontis MacNeil n. sp.
Solariella laevifunda MacNeil n. sp.
Solariella fragum MacNeil n. sp.
Solariella clearyensis MacNeil n. sp.
Solariella tallahalaensis Dockery n. sp.
Calliostoma sp.?

Family LIOTIIDAE

Arene (Arene) nodosa Dockery n. sp.

Order MESOGASTROPODA
Superfamily RISSOACEA
Family RISSOIDAE

Onoba sp. ?

Family VITRINELLIDAE

Vitrinella (Vitrinella) laevis (Meyer, 1886)
Vitrinella (Vitrinella) vicksburgensis (Meyer, 1886)
Vitrinella (Vitrinella) meyeri MacNeil n. sp.
Vitrinella (Vitrinellops) sp.
Solariorbis sp.
Cyclostremiscus menthafons MacNeil n. sp.
Cyclostremiscus quadracordata Dockery n. sp.
"Cyclostremiscus" sp.
Discopsis pilsbryi MacNeil n. sp.
Tornus infraplicatus (Johnson, 1899)
Teinostoma (Teinostoma) caseyi MacNeil n. sp.
Teinostoma (Idioraphe) minuta MacNeil n. sp.
Teinostoma (Idioraphe) verrilli Meyer, 1885

Anticlimax byramensis MacNeil n. sp.

Family CAECIDAE

Caecum solitarium Meyer, 1886

Superfamily ARCHITECTONICACEA
Family ARCHITECTONICIDAE

Architectonica (Architectonica) trilirata (Conrad, 1848)
Architectonica (Architectonica) trilirata palmeri MacNeil n. subsp.
Architectonica (Architectonica) vicksburgensis (Dall, 1892)
Architectonica (Architectonica) fuscicava MacNeil n. sp.
Architectonica (Architectonica) fuscicava MacNeil var. ?
Architectonica (Architectonica) sp.
Architectonica (Architectonica) textilina caseyi MacNeil n. subsp.
Architectonica (Architectonica) menthafontis MacNeil n. sp.
Architectonica (Architectonica) meliconae Robinson and Dockery, 1981
Architectonica (Granosolarium) hargeri (Meyer, 1886)
Architectonica (Pseudotorinia) julia MacNeil n. sp.

Superfamily TURRITELLACEA
Family TURRITELLIDAE

Turritella mississippiensis Conrad, 1848
Turritella boycensis MacNeil n. sp.
Turritella caelatura Conrad, 1848
Turritella caelatura Conrad, 1848 var.
Turritella rubricollis MacNeil n. sp.
Turritella mundula MacNeil n. sp.
Turritella carota MacNeil n. sp.
Turritella aff. **T. planigyrata** Guppy, 1867
Turritella premimetes MacNeil n. sp.
Turritella aff. **T. premimetes** MacNeil n. sp.
Turritella caseyi MacNeil n. sp.

Family MATHILDIDAE

Mathilda regularis (Meyer, 1886)
Mathilda inaequistriata (Meyer, 1886)
Mathilda aff. **M. plexita** Dall, 1896

Family VERMETIDAE

Serpulorbis sp.

Superfamily CERITHIACEA
Family CERITHIIDAE

Semivertagus menthafontis MacNeil n. sp.
Semivertagus silvacollinis Dockery n. sp.
"Bittium" acuta (Meyer, 1886)
Bittium (Argyropeza?) ottoi MacNeil n. sp.
Bittium (Argyropeza?) caseyi MacNeil n. sp.
Eumetula vicksburgella MacNeil n. sp.
Cerithiella langdoni (Aldrich, 1885)
Cerithiella langdoni (Aldrich, 1885) var.
Cerithiella nassuloides MacNeil n. sp.
Cerithiella leafensis MacNeil n. sp.
Cerithiella sp.
Seila aff. **S. constricta** (Lea, 1841)
Seila sp.
Alaba blakneyensis MacNeil n. sp.
Alaba cf. **A. blakneyensis** MacNeil n. sp.
Alaba macneili Dockery n. sp.
Alabina menthafontis MacNeil n. sp.
Alabina aff. **A. menthafontis** MacNeil n. sp.
Litiopa meyeri MacNeil n. sp.
Triphora (Triphora) bilineata (Meyer, 1886)
Triphora (Triphora) meridionalis (Meyer, 1886)
Triphora (Triphora) menthafons MacNeil n. sp.
Triphora (Euthymella) fuscicava MacNeil n. sp.

Family TRICHOTROPIDAE

Cerithioderma sp.?

Family THIARIDAE

Melanatria serratoides (Aldrich, 1894)

Family POTAMIDIDAE

Telescopium leafensis MacNeil n. sp.

Superfamily STROMBACEA
Family APORRHAIDAE

Aporrhais (Goniocheila) lirata (Conrad, 1848)
Aporrhais (Goniocheila) menthafontis MacNeil n. sp.

Superfamily EPITONIACEA
Family EPITONIIDAE

Epitonium (Sthenorytis) whitfieldi (Aldrich, 1885)
Epitonium (Gryoscala) sp.
Epitonium sp.?
Acrilla (Acrilloscala) palmerae MacNeil n. sp.
Scalina trigintanaria (Conrad, 1848)
Scalina trigintanaria (Conrad, 1848) var.
Scalina trigintanaria hopkinsi MacNeil n. subsp.
Scalina menthafontis MacNeil n. sp.
Scalina rubricollis MacNeil n. sp.
Confusiscala (Funiscala) durhami MacNeil n. sp.
Pliciscala (Punctiscala) cookei MacNeil n. sp.
Pliciscala (Nodiscala?) byramensis MacNeil n. sp.
Pliciscala (Nodiscala?) n. sp.
Pliciscala (Nodiscala?) caseyi MacNeil n. sp.

Superfamily MELANELLACEA
Family MELANELLIDAE

Melanella postnotata MacNeil n. sp.
Melanella amnicreta MacNeil n. sp.
Melanella sp.
Strombiformis caseyi MacNeil n. sp.
Niso fuscicava MacNeil n. sp.

Family ACLIDIDAE

Aclis matsoni MacNeil n. sp.
Aclis matsoni MacNeil var.
Aclis sp. A
Aclis sp. ? B

Superfamily HIPPONICACEA
Family HIPPONICIDAE

Hipponix pygmaeus Lea, 1833

Superfamily CALYPTRAEACEA
Family CALYPTRAEIDAE

Calyptraea (Trochita) cf. **C. (T.) aperta** (Solander, 1766)
Calyptraea (Trochita) conradi MacNeil n. sp.
Calyptraea (Trochita) sp.
Crucibulum (Dispotaea) hyalonama MacNeil n. sp.

Family CAPULIDAE

Capulus (Capulus) americanus Conrad, 1854
Capulus (Brocchia) langdoni MacNeil n. sp.
Capulus planus Dockery n. sp.

Family XENOPHORIDAE

Xenophora (Xenophora) humilis (Conrad, 1848)
Xenophora (Xenophora) cf. **X. (X.) reclusa** (Conrad, 1854)
Xenophora (Stellaria) conica Dall, 1892

Superfamily NATICACEA
Family NATICIDAE

Natica (Natica) caseyi MacNeil n. sp.
Natica (Naticarius) acuticallosa MacNeil n. sp.
Natica (Naticarius) aff. **N. (N.) alazana** Cooke, 1928
Euspira vicksburgensis (Conrad, 1848)
Euspira vicksburgensis cookei MacNeil n. subsp.
Euspira sp. ?
Sigatica conradii (Dall, 1892)
Sinum (Sinum) aff. **S. (S.) beatricae** Palmer, 1937
Sinum (Sigaretotrema) mississippiensis (Conrad, 1848)
Sinum (Sigaretotrema) cf. **S. (S.) danvillense** Harris and Palmer, 1947
Ampullinopsis mississippiensis (Conrad, 1848)

Superfamily CYPRAEACEA
Family CYPRAEIDAE

Cypraeorbis sphaeroides (Conrad, 1848)
Cypraeorbis cf. **C. sphaeroides** (Conrad, 1848)
Cypraeorbis aff. **C. ventripotens** (Cossmann, 1903)
Cypraeorbis sp. ?

Family OVULIDAE

Simnia (Calpurna) cookei MacNeil n. sp.
Sulcocypraea lintea (Conrad, 1848)
Sulcocypraea lintea menthafons MacNeil n. subsp.
Sulcocypraea healeyi (Aldrich, 1923)
Sulcocypraea cf. **S. healeyi** (Aldrich, 1923)

Superfamily TONNACEA
Family CASSIDIDAE

Cassis flintensis Mansfield, 1940
Semicassis caelature (Conrad, 1848)
Mambrinia brevidentata (Aldrich, 1885)
Galeodaria shubutensis (Aldrich, 1885)
Galeodaria shubutensis gardnerae MacNeil n. subsp.
Galeodaria tricarinata (Conrad, 1848)
Sconsia lintea (Conrad, 1848)
Sconsia prelintea MacNeil n. sp.

Phalium (Menthafontia) mississippiensis (Conrad, 1848)
Phalium (Menthafontia) menthafons MacNeil n. sp.
Phalium (Menthafontia) sp.
Oniscidia harpula (Conrad, 1848)

Family FICIDAE

Ficus mississippiensis Conrad, 1848

Family CYMATIIDAE

Cymatium (Septa) amnicretum MacNeil n. sp.
Cymatium (Ranularia) vicksburgense Dockery n. sp.
Sassia (Sassia) conradiana (Aldrich, 1885)
Sassia (Sassia) conradiana menthafons MacNeil n. subsp.
Sassia (Cymatiella) fuscicava MacNeil n. sp.
Sassia (Byramia) abbreviata (Conrad, 1848)
Sassia (Byramia) abbreviata (Conrad, 1848) var.
Sassia (Byramia) mississippiensis (Conrad, 1848)
Sassia (Byramia) caseyi MacNeil n. sp.
Distorsio (Distorsio) crassidens (Conrad, 1848)

Order NEOGASTROPODA
Superfamily MURICACEA
Family MURICIDAE

Chicoreus (Phyllonotus) mississippiensis (Conrad, 1848)
Chicoreus (Phyllonotus) stetopus (de Gregorio, 1890)
Chicoreus (Phyllonotus) dormani (E. H. Vokes, 1963)
Murexiella (Murexiella) vaughani MacNeil n. sp.
Pterynotus (Pterynotus) burnsii (Aldrich, 1894)
Pterynotus (Pterochelus) angelus (Aldrich, 1886)
Poirieria (Panamurex) macneili E. H. Vokes, 1970
Dermomurex (Takia) cookei E. H. Vokes, 1975
Urosalpinx ? aspinosus (Meyer, 1886)
Typhis (Typhina) mississippiensis Gertman, 1969
Siphonochelus (Laevityphis) curvirostratus (Conrad, 1848)

Family THAIDIDAE

Cymia (Tritonopsis) subalveatum (Conrad, 1848)
Cymia (Tritonopsis) subalveatum (Conrad, 1848) subsp.?

Superfamily BUCCINACEA
Family BUCCINIDAE

Metula (Metula) fastidiosa Casey, 1903
Metula (Metula) inflata Dockery n. sp.
Metula (Metula) fragilis Casey, 1903
Metula (Caseyella) neptuneiformis MacNeil n. sp.
Metula (Caseyella) hiwanneensis Dockery n. sp.
Metula (Caseyella) blakneyensis MacNeil n. sp.
Tritiaria falsus (Casey, 1903)
Tritiaria mississippiensis (Conrad, 1848)
Tritiaria mississippiensis cookei MacNeil n. subsp.
Tritiaria macilenta (Casey, 1903)
Tritiaria refugensis MacNeil n. sp.
Tritiaria menthafons MacNeil n. sp.
Tritiaria vaughani MacNeil n. sp.
Tritiaria cf. **T. vaughani** MacNeil n. sp.
Tritiaria scapulistriata MacNeil n. sp.
Tritiaria meyeri MacNeil n. sp.
Tritiaria meyeri MacNeil n. subsp.?
Phos (Antillophos) hopkinsi MacNeil n. sp.
Phos (Strongylocera) vicksburgensis (Aldrich, 1885)
Phos (Strongylocera) caseyi MacNeil n. sp.
Pseudofulgur lirata Dockery n. sp.
Pseudofulgur vicksburgensis (Conrad, 1848)

Family COLUMBELLIDAE

Mitrella (Columbellopsis) fuscicava MacNeil n. sp.
Mitrella (Columbellopsis) cf. **M. (C.) fuscicava** MacNeil n. sp.
Mitrella (Columbellopsis) aff. **M. (C.) oryzoides** Gardner, 1947

Family MELONGENIDAE

Melongena (Myristica) crassicornuta Conrad, 1848
Volema hopkinsi MacNeil n. sp.

Family FASCIOLARIIDAE

Latirus mississippiensis (Conrad, 1848)
Latirus protracta (Conrad, 1848)
Latirus aldrichi Dockery n. sp.
Latirus indistinctus Aldrich, 1884
Dolicholatirus perexilis (Conrad, 1848)
Dolicholatirus cervicrassus Dockery n. sp.
Dolicholatirus exilis confertus Dockery n. subsp.
Clavilithes vicksburgensis (Conrad, 1849)
Clavilithes sp. A
Clavilithes longiformis Dockery n. sp.
Clavilithes lesueuri Dockery n. sp.
Clavilithes sp. B
Levifusus spiniger (Conrad, 1848)
Levifusus nodulatum (Conrad, 1849)

Superfamily VOLUTACEA
Family VOLUTIDAE

Lyria (Lyria) nestor Casey, 1903
Lyria (Lyria) mississippiensis (Conrad, 1848)
Lyria (Enaeta) isabellae modesta Dockery n. subsp.
Caricella (Atraktus) demissa Conrad, 1848
Caricella (Atraktus) demissa Conrad, 1848 var. A
Caricella (Atraktus) demissa Conrad, 1848 var. B
Caricella (Atraktus) reticulata (Aldrich, 1885)
Caricella (Atraktus) sp.
Conomitra staminea (Conrad, 1848)
Conomitra vicksburgensis (Conrad, 1848)
Conomitra vicksburgensis laevigata Dockery n. subsp.
Conomitra crenulata Dockery n. sp.
Conomitra crenulata modesta Dockery n. subsp.
Harpa vicksburgiana Dockery n. sp.

Family TURBINELLIDAE

Turbinella wilsoni Conrad, 1848

Family OLIVIDAE

Oliva (Strephonella) mississippiensis Conrad, 1848
Oliva (Strephonella) affluens (Casey, 1903)
Olivella (Callianax) vicksburgensis Dockery n. sp.
Olivella (Callianax) vicksburgensis Dockery var.

Family MARGINELLIDAE

Marginella sp.?
Persicula vicksburgensis Dockery n. sp.

Superfamily MITRACEA
Family MITRIDAE

Mitra (Fusimitra) conquisita Conrad, 1848
Mitra (Fusimitra) mississippiensis Conrad, 1848
Vexillum (Costellaria) lintoidea (Aldrich, 1894)
Vexillum (Costellaria) cellulifera (Conrad, 1848)
Vexillum (Costellaria) laevicostata Dockery n. sp.
Vexillum (Costellaria) multicostata Dockery n. sp.
Vexillum (Costellaria) multicostata Dockery var. ?
Vexillum (Costellaria) cervilirata Dockery n. sp.
Vexillum (Costellaria) tallahalaensis Dockery n. sp.

Family CANCELLARIIDAE

Olssonella elongata Dockery n. sp.
Olssonella elongata Dockery var. ?
Agatrix mississippiensis (Conrad, 1848)
Admetula regularia Dockery n. sp.
Admetula inflata Dockery n. sp.

Superfamily CONACEA
Family CONIDAE

Conus alveatus Conrad, 1865
Conus alveatus spiralis Dockery n. subsp.
Conus protractus Meyer, 1885

Family TEREBRIDAE

Terebra (Terebrellina) divisura Conrad, 1848
Terebra (Terebrellina) divisura clearyensis MacNeil n. subsp.
Terebra (Terebrellina) hiwanneensis MacNeil n. sp.
Terebra (Strioterebrum) tantula Conrad, 1848
Terebra (Strioterebrum) alaba MacNeil n. sp.
Terebra (Strioterebrum) vincta MacNeil n. sp.
Terebra (Strioterebrum) sp.
Terebra (Laeviterebrum) spinula MacNeil n. sp.

Family TURRIDAE

Gemmula rotaedens (Conrad, 1848)
Gemmula mediosa MacNeil n. sp.
Gemmula amica (Casey, 1903)
Gemmula amica (Casey, 1903) var. A
Coronia (Coroniopsis) tenella (Conrad, 1848)
Coronia (Coroniopsis) tenella antetenella MacNeil n. subsp.
Coronia (Coroniopsis) ancilla (Casey, 1903)
Pleuroliria cochlearis (Conrad, 1848)
Pleuroliria cochlearis vetula MacNeil n. subsp.
Pleuroliria subsimilis Casey, 1937.
Pleuroliria tenuis MacNeil n. sp.
Turricula (Orthosurcula) longiforma (Aldrich, 1885)
Turricula (Orthosurcula) byramensis MacNeil n. sp.
Pleurofusia longirostropsis de Gregorio, 1890
Pleurofusia longirostropsis bicollaris MacNeil n. subsp.
Pleurofusia hiwanneensis MacNeil n. sp.
Pleurofusia wythei MacNeil n. sp.
Pleurofusia decliva (Conrad, 1848)
Pleurofusia decliva asper MacNeil n. subsp.
Pleurofusia menthafons MacNeil n. sp.
Pleurofusia menthafons MacNeil var. A
Pleurofusia trichorda MacNeil n. sp.
Pleurofusia servata (Conrad, 1848)
Pleurofusia servata (Conrad, 1848) var. A
Pleurofusia servata (Conrad, 1848) var. B
Pleurofusia clarkeana (Aldrich, 1894)
Pleurofusia clarkeana juba MacNeil n. subsp.
Pleurofusia clarkeana fascia MacNeil n. subsp.
Pleurofusia elegantula MacNeil n. sp.
Pleurofusia oblivia (Casey, 1903)
Pleurofusia (Xestosurcula) plutonica (Casey, 1903)
Pleurofusia (Xestosurcula) fessa MacNeil n. sp.
Tropisurcula caseyi (Aldrich, 1903)
Fusiturricula ichusa MacNeil n. sp.
Amyssodropa clearyensis MacNeil n. sp.
Cochlespira cristata (Conrad, 1848)
Cochlespira cookei MacNeil n. sp.
Cochlespira cookei rubracollis MacNeil n. subsp.
Microsurcula intacta (Casey, 1903)
Microsurcula intacta (Casey, 1903) var. A.
Microsurcula intacta jayensis MacNeil n. subsp.
Microsurcula mentha MacNeil n. sp.
Microsurcula mentha MacNeil var. A
Varicobela smithii (Aldrich, 1885)
Varicobela aldrichi Dockery n. sp.
Clavidrupa anita (Aldrich, 1885)
Syntomodrillia tantula (Conrad, 1848)
Syntomodrillia tantula (Conrad, 1848) var. A
Syntomodrillia funis MacNeil n. sp.
Syntomodrillia funis MacNeil var. A
Syntomodrillia collarubra MacNeil n. sp.
Vetidrillia palmerae MacNeil n. sp.
Pleurotoma eboroides Conrad, 1848
Pleurotoma mississippiensis Conrad, 1848
Crassispira (Crassispirella) abundans (Conrad, 1848)
Crassispira (Crassispirella) lyopleura MacNeil n. sp.
Mitodrillia harmonica (Casey, 1903)
Mitodrillia pharus MacNeil n. sp.
Mitodrillia pharus crassispiropsis MacNeil n. subsp.
Microdrillia vicksburgella Casey, 1903
Microdrillia infans (Meyer, 1886)
Microdrillia brevis (Meyer, 1886)
Microdrillia brevis gemma MacNeil n. subsp.
Microdrillia brevis allo MacNeil n. subsp.
Scobinella caelata Conrad, 1848
Scobinella pluriplicata Casey, 1903
Scobinella pluriplicata subpluriplicata MacNeil n. subsp.
Scobinella macer Casey, 1903
Scobinella famelica Casey, 1903
Bathytoma congesta (Conrad, 1848)
Bathytoma congesta fontis MacNeil n. subsp.

Bathytoma rhomboidea MacNeil n. sp.
Bathytoma rhomboidea lyrata MacNeil n. subsp.
Clathurella meyeri MacNeil n. sp.
Clathurella meyeri sylvarenensis MacNeil n. subsp.
Clathurella blakneyensis MacNeil n. sp.
Clathurella sp.
Kurtziella protatrostyla MacNeil n. sp.
Phandella nepionica Casey, 1903
Phandella monroensis MacNeil n. sp.
Plandella transemma MacNeil n. sp.
Phandella sp.
Spiradaphne lowei MacNeil n. sp.
Spiradaphne lowei refugium MacNeil n. subsp.
Spiradaphne lowei refugium MacNeil var.
Conorbis porcellana (Conrad, 1848)

Subclass OPISTHOBRANCHIA
Order ENTOMOTAENIATA
Family PYRAMIDELLIDAE

Pyramidella (Voluspa) chavanoidea MacNeil n. sp.
Pyramidella (Voluspa) leafensis MacNeil n. sp.
Pyramidella (Voluspa?) microcosta MacNeil n. sp.
Pyramidella (Voluspa) n. sp.
Odostomia (Odostomia) boettgeri Meyer, 1887
Odostomia (Odostomia) aff. **O. (O.) angularis** Dall and Bartsch, 1904
Odostomia (Odostomia) byramensis MacNeil n. sp.
Odostomia (Odostomia) byramensis MacNeil var. ?
Odostomia (Odostomia) vicksburgella Dockery n. sp.
Odostomia (Odostomia) sp.
Odostomia (Miralda) menthafons MacNeil n. sp.
Eulimella clearyensis MacNeil n. sp.
Eulimella sp.
Turbonilla mississippiensis Meyer, 1886
Turbonilla leafensis MacNeil n. sp.
Turbonilla caseyi MacNeil n. sp.

Order CEPHALASPIDEA
Superfamily ACTEONACEA
Family ACTEONIDAE

Acteon (Acteon) meyeri MacNeil n. sp.
Acteon (Acteon) pretextilis MacNeil n. sp.
Acteon (Acteon) aldrichi MacNeil n. sp.
Acteon (Acteon) subaldrichi MacNeil n. sp.
Acteon (Acteon) preluculi MacNeil n. sp.
Acteon (Acteon) menthafons MacNeil n. sp.
Acteon (Acteon) sp. A
Acteon (Acteon) sp. B
Acteon (Kleinacteon) puteatus MacNeil n. sp.
Rictaxis andersoni (Conrad, 1848)
Crenilabium paucicrenulatus MacNeil n. sp.
Crenilabium altispira MacNeil n. sp.
Tornatellaea brevispira MacNeil n. sp.
Tornatellaea sp. ?

Family RINGICULIDAE

Ringicula (Ringiculella) mississippiensis Conrad, 1848
Ringicula (Ringiculella) mississippiensis petila MacNeil n. subsp.
Ringicula (Ringiculella) mississippiensis nuda MacNeil n. subsp.
Ringicula (Ringiculella) mississippiensis Conrad, 1848 subsp. ?
Ringicula (Ringiculella) crassata MacNeil n. sp.
Ringicula (Ringiculella) irrasa MacNeil n. sp.

Superfamily BULLACEA
Family HAMINOEIDAE

Atys (Atys) pinguis MacNeil n. sp.
Atys (Roxaniella) caseyi MacNeil n. sp.
Atys (Roxaniella) caseyi MacNeil var.

Family RETUSIDAE

Volvulella subspinosa MacNeil n. sp.
Pyrunculus laevipyrum MacNeil n. sp.

Superfamily CYLICHNACEA
Family CYLICHNIDAE

Cylichna nida MacNeil n. sp.
Cylichna acutiscapulae MacNeil n. sp.
Cylichna acutiscapulae corrugata MacNeil n. subsp.
Cylichna sp.
Acteocina crassiplica (Conrad, 1848)
Acteocina crassiplica involuta MacNeil n. subsp.
Acteocina crassiplica altispira MacNeil n. subsp.
Scaphander (Scaphander) primus Aldrich, 1885
Scaphander (Coeloscapha) hilgardi MacNeil n. sp.

Order THECOSOMATA
Suborder EUTHECOSOMATA
Family CAVOLINIIDAE

Creseis hastata (Meyer, 1886)
Creseis cf. **C. corpulenta** (Meyer, 1887)
Bovicornu eocenense Meyer, 1886

Family LIMACINIDAE

Limacina cf. **L. inflata** (d'Orbigny, 1847)
Limacina sp.

Order NOTHASPIDEA
Superfamily UMBRACULACEA
Family UMBRACULIDAE

Umbraculum sp.

Class SCAPHOPODA
Family DENTALIIDAE

Dentalium mississippiense Conrad, 1848
Dentalium strenuum Casey, 1903
Dentalium opaculum Casey, 1903
Dentalium varicostata Dockery n. sp.
Dentalium zephyrinum Casey, 1903
Dentalium polygonuum Casey, 1903
Fustiaria (Fustiaria) sp.
Fustiaria (Rhabdus) sp.
Fustiaria (Episiphon) menthifonta Dockery n. sp.

Family SIPHONODENTALIIDAE

Cadulus (Polyschides) vicksburgensis Meyer, 1885
Cadulus (Polyschides) quadriturritus Meyer, 1886
Cadulus (Polyschides) corpulentus Meyer, 1886

Class CEPHALOPODA
Subclass NAUTILOIDEA
Order NAUTILIDA
Superfamily NAUTILACEA
Family ATURIIDAE

Aturia berryi Stenzel, 1940
Aturia cf. **A. alabamensis** (Morton, 1834)

SYSTEMATICS

Class GASTROPODA, Cuvier, 1797
Subclass PROSOBRANCHIA Milne Edwards, 1848
Order ARCHAEOGASTROPODA Thiele, 1925
Superfamily FISSURELLACEA Fleming, 1822
Family FISSURELLIDAE Fleming, 1822
Subfamily FISSURELLIDINAE Fleming, 1822

Genus **DIODORA** Gray, 1821

Diodora Gray, London Medical Repository, v. 15, p. 233, 1821.

Type (by monotypy): *Patella apertura* Montagu. Recent, British Isles.

Diodora mississippiensis (Conrad)

Plate 1, figure 1; Plate 10, figures 1-4; Plate 26, figures 1-3

1829. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 1 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Fissurella mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 282.
1848b. *Fissurella mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 113, pl. 2, fig. 2. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Fissurella mississippiensis* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 1, 34.
1892. *Fissurella mississippiensis* Conrad. Pilsbry and Johnson, Nautilus, v. 5, No. 9, p. 106.
1892. *Fissuridea mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci. Trans., v. 3, pt. 2, p. 425.
1946. *Fissurella mississippiensis* Conrad. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 220 (addendum under *Diodora*).

Original Description: Conrad, 1848a.

Suboval, rather elevated, with numerous unequal radiating lines, and fine transverse lines, giving a minutely granulated appearance to the shell; foramen oval, submedial. Length ½, very rare.

Description: Shell medium sized, ovate, base weakly curved; anterior slope plane, posterior slope ranging from slightly convex to slightly concave (the holotype is slightly concave); apical perforation moderately large and suboval to nearly round, slightly anterior of center; interior callus bluntly pointed anteriorly, broadly rounded to nearly straight posteriorly and subtended posteriorly by a shallow pit; sculpture consisting of medium to strong radial ribs, usually divisible into primary, secondary, tertiary, and quaternary series (the latter absent in some segments), the primaries and secondaries stronger and subequal in strength, radial ribs crossed by fairly regular but weak concentric threads which give a beaded appearance to the radial ribs.

Discussion: The holotype of this species is from the Byram Formation. Two other specimens from the Byram are known to the writer, one, a juvenile (pl. 26, figs. 1, 2), having a convex rather than a concave posterior slope, and the other, a large fragment (pl. 26, fig. 3), having rather weak radial ribs. Two specimens were obtained from the Mint Spring Formation, a juvenile (pl. 10, figs. 1, 2) which compares closely with the holotype, and a much larger specimen (pl. 10, figs. 3, 4) which narrows more towards the anterior than do other specimens examined. The only specimen obtained from the Red Bluff Formation (pl. 1, fig. 1) has a nearly round apical perforation.

This species is very closely related to *D. tenebrosa* (Conrad) (see Palmer, 1937, pl. 3, figs. 2, 7, 9, 10, 12, 13) from the Claiborne Group (middle Eocene) and shows almost the same range of variations as in the specimens figured by Palmer. However, the more coarsely ribbed form (figs. 2, 9) was later separated from the weakly ribbed form regarded as typical *D. tenebrosa* by Harris and Palmer (1947, p. 219) under the name *D. tenebrosa* var. *antica*, an action based on the fact that typical *D. tenebrosa* has a much more prominent apical beak. The variety also has a more elongate apical perforation. A form similar to *D. tenebrosa* occurs in the Mint Spring and it is described next as a new species.

Diodora ceryx (Dall) (1915, p. 115, pl. 1, figs. 10, 11) from the Tampa Limestone is definitely more convex on the posterior slope and has a much narrower apical perforation. *Diodora chipolana* (Dall) (see Gardner, 1947, p. 623, pl. 62, fig. 13) has its apical perforation in a more anterior position and the tertiary and quaternary radial ribs make their first appearance at a relatively greater distance from the apex.

Type: Holotype 13533 ANSP probably from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi.

Occurrence: Red Bluff Formation, USGS locality 5264; Forest Hill Formation, MGS locality 88a; Byram Formation, USGS localities 259, 7372.

Diodora postantica MacNeil n. sp.

Plate 10, figures 5, 9, 10

Description: Shell of medium size, compressed ovate, narrower anteriorly than posteriorly, base weakly curved; anterior slope nearly plane, posterior slope moderately convex; apical perforation moderately elongate, about twice as long as wide and with the anterior border depressed and less callussed than the lateral and posterior borders, located well anterior of center; interior apical callus indistinct anteriorly, bluntly concave posteriorly with a well defined undercut pit subtending the concavity; sculpture consisting of well defined primary, secondary, tertiary, and quaternary threads of which each successive series is of decreased strength, the radials crossed by moderately strong concentric threads which make a reticulate pattern with the radial ribs.

Discussion: This species has coarser radial ribs and a more elongate apical perforation than either *D. mississippiensis* or typical *D. tenebrosa*. Its elongate apical perforation resembles that of *D. tenebrosa antica* Harris and Palmer from the Claiborne Group more than it does the shorter perforation of *D. tenebrosa veatchi* Harris and Palmer (1947, p. 219), a variety described from the Jackson Group. *Diodora postantica* differs from both named varieties of *D. tenebrosa* in being laterally compressed and moderately elongate. However, both the sculpture pattern and the texture of the ribs indicates that *D. antica, D. veatchi,* and *D. postantica* are more closely interrelated than any of them is to typical *D. tenebrosa*, while *D. tenebrosa* and *D. mississippiensis* appear to be closely related. It is likely that two distinct stocks of *Diodora* are represented in the Eocene and Oligocene beds under consideration, a condition which is obscured by the fact that two members of one group were described as varieties of a species of the other group.

Diodora alternata henekeni Maury (see Woodring, 1928, pl. 29, figs. 11-17) from the Bowden Beds (middle Miocene) of Jamaica has similar sculpture but the shell does not narrow anteriorly as in *D. postantica.*

Type: Holotype 658841 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 10, figures 5, 10).

Occurrence: Mint Spring Formation, USGS localities 14071, 3727.

Superfamily COCCULINACEA Thiele, 1909
Family LEPETELLIDAE Dall, 1881

Genus **SABLEA** Allen, 1970

Sablea Allen, Tulane Studies Geol. Paleont., v. 8, No. 1, p. 69-70.

Type (by original designation): *Sablea minuta* Allen, 1970. Eocene and Oligocene, Louisiana and Mississippi.

Original Description: Allen, 1970.

Diagnosis: Shell minute, patelliform, cap-shaped, bilaterally symmetrical. Muscle scar horse-shoe shaped, broadest at anterior ends, open anteriorly. Anterior opening connected by pallial line, impressed in adult specimens, obscure or wanting in immature shells. Apex blunt, posterior in position and curved posteriorly. Aperture narrowly elliptical. Margin not in a single plane, elevated at both ends. Sculpture of growth lines only.

Discussion: This curious little shell is somewhat difficult to place since it combines features of several families. It seems to fall most naturally within the Lepetellidae as it has characters of three genera in that group. It combines the saddle-shaped margins of *Tectisumen* Finley, 1927, the blunt, posteriorly placed apex of *Addisonia* Dall, 1882, and the narrow oval aperture of *Cocculinella* Thiele, 1909. It differs from those genera by having the impressed pallial line connecting the anterior ends of the muscle scar.

The genus is named for my patient and understanding wife, Sable S. Allen.

Sablea minuta Allen, 1970
Plate 47, figures 12-14

1970. *Sablea minuta* Allen, Tulane Studies Geol. Paleont., v. 8, No. 1, p. 70, pl. 2, fig. 1-9.

Original Description: Allen, 1970.

Characters as enumerated for the genus and as figured. Anterior slope convex, posterior slope concave. Nucleus not retained. Apex in posterior third of length in mature specimens, not overhanging margin. Shell thin and fragile in juvenile specimens, much thickened in the adult form.

Type: Holotype 27639 PRI and paratype A 27640 PRI both from the Moodys Branch Formation, Red River below Montgomery Landing, Grant Parish, Louisiana.

Occurrence: Louisiana: Saline Bayou Member of Cook Mountain Formation, Mouth of Saline Bayou, St. Maurice, Winn Parish; Moodys Branch Formation, Red River below Montgomery Landing, Grant Parish. Mississippi: Moodys Branch Formation, MGS localities 1, 2; Red Bluff Formation, MGS localities 37, 38; Mint Spring Formation, MGS locality 90.

Superfamily TROCHAECEA Rafinesque, 1815
Family TROCHIDAE Rafinesque, 1815
Subfamily MARGARITINAE Stoliczka, 1868

Genus **SOLARIELLA** S. V. Wood, 1842

Solariella S. Wood, Annals Mag. Nat. History, v. 9, p. 531, 1842

Type (by original designation): *Solariella maculata* S. Wood. Pliocene, Coralline Crag, England.

Solariella menthafontis MacNeil n. sp.
Plate 10, figures 6-8, 11-13; Plate 41, figure 6

Description: Shell of medium size, spire subconical and ranging from low to moderate height, whorls rounded and biangulate to triangulate, greatest diameter at angle between face of whorl and base, base gently rounded; protoconch consisting of one and a quarter smooth whorls followed by another quarter turn having weak spiral lirations, initial stage slightly bulbous, protoconch flatter than spire; aperture moderately inclined (about 45^{0}) and subrounded with a weak narrow angulation on the umbilical side; outer and inner lips thin, inner lip appressed along middle and outer part of base; umbilicus large with a conical cavity; sutures appressed with the subsutural area forming a shallow but moderately broad concavity; upper part of whorls sculptured by three prominent spiral threads separated by moderately broad concave depressions which on some specimens bear a weaker secondary thread in the interspaces; base bearing eight moderately strong spiral threads, the innermost coarsely beaded and forming a sharp angle at the edge of the umbilicus, and separated from the next outermost weakly beaded spiral by a wider interspace than those separating the other basal spirals; umbilicus sculptured by fine spiral threads; axial sculpture restricted to short angular nodes along the subsutural spiral which extend nearly to the suture, and curved axial wrinkles in the umbilicus. Growth lines cross the spiral interspaces at an angle of about 45^{0}.

Discussion: This species is very closely related to *S. cancellata jacksonia* Harris and Palmer (1947, p. 229, pl. 27, figs. 8-10) from the Moodys Branch Formation of the Jackson Group (late Eocene) of Mississippi. It differs from the Jackson form in having shorter and sharper axial nodes, those of *S. cancellata jacksonia* extending to the second spiral below the suture or beyond, whereas the axials of *S. menthafontis* extend only slightly below the first spiral. More of the basal spirals are granular on *S. jacksonia.*

Harris and Palmer described *S. jacksonia* as a variety of *S. cancellata*, a Claiborne (middle Eocene) species. They use the term variety in the sense that subspecies is generally used; a form not very distinct from the typical form but isolated from it either geographically or stratigraphically. (Variety should be used for forms that differ recognizably from the typical form of the species, but which occur with it and intergrade with it.) If *S. cancellata jacksonia* were to be compared with the specimen figured by Palmer (1937, pl. 4, figs. 9, 13, 17) as *S. cancellata*, the writer would say that *S. jacksonia* is a distinct species. However, it is similar to Meyer's drawing of the type of *S. cancellata* reproduced by Palmer (1937, p. 78, fig. 13). There may be some doubt that the other specimen figured by Palmer is *S. cancellata*, but for the time being it is assumed that Conrad's type is a juvenile and that the specimen figured by Palmer is an adult.

Solariella ephnidia Woodring (1959, p. 156, pl. 26, figs. 2, 3) from the upper part of the Bohio Formation (late Oligocene) of Panama appears to belong to this group of *Solariella*. It has two prominent spiral ribs on the whorls rather than one as in *S. methafontis* and the spirals on the base are more widely spaced. The spiral forming the edge of the umbilicus is not strongly beaded. The spire in *S. ephnidia* is higher than in the higher variant of *S. menthafontis* (pl. 10, fig. 6-8). The Panama species may be a descendent of the Mint Spring species.

Type: Holotype 498304 USNM and paratype 648847 USNM both from the Mint Spring Formation, USGS locality 14071a (Plate 10, figures 6-8 and 11-13 respectively).

Occurrence: Mint Spring Formation, USGS locality 14071a; Byram Formation, MGS locality 93.

Solariella laevifunda MacNeil n. sp.

Plate 10, figures 15-17

Description: Shell of medium size for the genus; spire moderately low, greatest diameter at about middle of whorl, base rounded; protoconch smooth for about two whorls after which weak axials appear, the first weak spirals appearing at about two and a half turns, protoconch flatter than the spire; aperture inclined about 20^{0} from vertical, subrounded; inner lip with a weak angulation on the umbilical side, outer lip moderately thin but thickening rapidly back from the edge; umbilicus of moderate size, partly obscured by the inner lip; sutures depressed by a moderately deep subsutural concavity; spiral sculpture consisting of three moderately strong cords, the lower cord concealed on the spire whorls but smooth and forming a prominent basal angulation on the body whorl, the three upper cords bearing blunt, elongate, slightly inclined axial nodes; base gently rounded with a weak sulcus adjacent to the basal spiral cord, without spiral sculpture or with only a faint trace of spiral sculpture, margin of the umbilicus bearing moderately coarse nodes or wrinkles which mark successive positions of the angulation on the inner lip.

Discussion: Palmer (1937, p. 36) stated that the base of the body whorl of young specimens of *S. cancellata* is smooth with sharp crenulations along the margin of the umbilicus. The base of *S. laevifunda* answers this description. The two species next described have rather coarse basal spirals and are more like the specimen figured by Palmer as *S. cancellata* in this respect. However, there is no indication of intergradation between the form with a smooth base and the forms with strong spirally sculptured bases, even among specimens of comparable size. Futhermore, they occur at different localities. In spite of the possibility that this could be a juvenile variant of *S. fragum*, it is not so regarded. *Solariella tricostata* (Conrad) from the Claiborne Group (see Palmer 1937, pl. 4, figs. 5, 8, 12) has four prominent spirals on its base and delicate raised growth lines in the interspaces, both characters which distinguish it from this species.

Type: Holotype 498308 USNM from the Mint Spring Formation, USGS locailty 3737 (Plate 10, figures 15-17).

Occurrence: Mint Spring Formation, USGS locality 3737.

Solariella fragum MacNeil n. sp.
Plate 10, figures 14?, 18-21, 22-24?, 25, 29

Description: Shell of medium size for the genus, spire low with rounded whorls, greatest diameter at about middle of whorl, base rounded; protoconch not sharply delimited but smooth for just over two whorls at which stage weak axial wrinkles appear, the first weak spirals at about two and a half turns, protoconch flatter than spire; aperture inclined about 30° from vertical, subrounded and thinly appressed to the parietal wall; outer lip moderately thin but thickening rapidly back from the edge, inner lip moderately thick and rounded and extended to form a thin narrow parietal callus; umbilicus of medium size with a low sharp keel at about the midpoint of the wall of each whorl; sutures depressed by a subsutural concavity; spiral sculpture consisting of moderately strong granular spiral cords, four on the spire whorls and a fifth which is more distantly spaced than the upper four and marking the basal angle of the body whorl; five additional cords on the base and a row of blunt axially elongate wrinkles bordering the umbilicus, most of them bridging the interspaces to the third cord from the umbilicus; growth wrinkles moderately strong and moderately inclined, not coinciding throughout with the granules on the spiral cords.

Discussion: This species may be related to *S. cancellata* (Conrad) of Palmer (1937, pl. 4, figs. 9, 13, 17) although it does not particularly resemble the type of *S. cancellata* as drawn by Meyer (see Palmer, 1937, pl. 78, fig. 13). Palmer's specimen has more spirals (6 to 7 on the spire whorls). The two specimens figured here are from the same locality and appear to be identical in all respects. However, there are two worn specimens in the collection from Vicksburg which have much weaker basal spirals and more (5 to 6) spirals on the spire whorls. Whether these belong to *S. fragum* or are distinct cannot be told from the specimens at hand.

Solariella fragum is not closely related to any post Oligocene species described thus far.

Type: Holotype 498302 USNM from the Mint Springs Formation, USGS locality 14071 (Plate 10, figures 19-21).

Occurrence: Mint Spring Formation, USGS localities 14071, 3727, 6448.

Solariella clearyensis MacNeil n. sp.
Plate 10, figures 26-28

Description: Shell of medium size for the genus; spire moderately low, greatest diameter at middle of whorl, base rounded; protoconch smooth for about one and a half whorls after which weak axial wrinkles appear, weak spirals appearing at about two and a half turns; aperture inclined about 20° from vertical, subrounded; inner lip thickened and with a weak angulation on the umbilical side, outer lip thin at edge but thickening rapidly; umbilicus of moderate size with a low wrinkled ridge at the midpoint of the wall of each whorl; sutures depressed and subtended by a shallow concavity; spire whorls bearing three to four strongly beaded spiral cords, another cord concealed by the suture but present on the body whorl, base bearing five more crowded granular spiral cords and a sixth bearing short axial wrinkles along the margin of the umbilicus, the wrinkles not bridging the adjacent interspace; growth wrinkles in interspaces strong and nearly vertical to moderately inclined, often connecting the granules from cord to cord.

Discussion: This species differs from *S. fragum* in having much stronger granules or beads on the spiral cords, sharper and more nearly vertical growth lamellae in the interspaces, and in having shorter growth wrinkles adjacent to the umbilicus; the wrinkles do not bridge the interspaces to the next or second adjacent spiral cord as in *S. fragum.*

Type: Holotype 498305 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 10, figures 26-28).

Occurrence: Mint Spring Formation, USGS locality 14071.

Solariella tallahalaensis Dockery n. sp.
Plate 41, figures 4-5

Description: Shell of medium size for the genus; spire subconical with a prominent flat subsutural ramp and of moderate height, whorls rounded and triangulate, greatest diameter at angle between face of whorl and base, base gently rounded; protoconch consisting of one and a half smooth whorls, protoconch flatter than spire; aperture quadrangular in outline; umbilicus of moderate size; sculpture for three and one quarter whorls after protoconch consisting of fine radial and spiral lirae on the subsutural ramp which form a cancellate pattern, a low and slightly beaded cord on ramp shoulder, fine spiral lirae on the slightly convex slope below the ramp; sculpture on the last one half of the body whorl as described before but without radial lirae on the subsutural ramp; base sculptured with fine lirae and a beaded cord at margin of umbilicus, umbilicus with five spiral lirae inside of marginal cord.

Discussion: This species is known from the single specimen figured, which shows a radial zigzag color pattern. It is similar to *Solariella louisiana* Dall, 1892, from the Cook Mountain Formation in Mississippi and the Lisbon Formation in Alabama. Similarities between these species include the cancellate subsutural ramp, the triangulate outline of the body whorl, and a sculpture of fine spiral lirae. They differ in that *Solariella tallahalaensis* is more triangulate in outline and has a higher spire. The species is named for the type locality on Tallahala Creek.

Type: Holotype 376659 USNM from the Byram Formation, MGS locality 93 (Plate 41, figures 4-5).

Occurrence: Byram Formation, MGS locality 93.

Subfamily CALLIOSTOMATINAE Thiele, 1921

Genus **CALLIOSTOMA** Swainson, 1840

Calliostoma Swainson, Treatise on Malacology, p. 351, 1840.

Type (by subsequent designation): *Trochus conulus* Linné. Recent, Mediterranean and Adriatic Seas; Atlantic at Canary Islands, Madeira and Azores.

Calliostoma sp.?
Plate 41, figure 7

Discussion: This species is known from the single specimen figured and is placed with reservations in the genus *Calliostoma*. The trochid shaped shell lacks an umbilicus as is usually the case in *Calliostoma*. However, its high spire, gently rounded body whorl, and somewhat elongate aperture are not characteristic of this genus. The specimen at hand consists of four and three fourths whorls with a smooth protoconch of one whorl and the remaining whorls cancellate. The latter whorls have five spiral cords visible between sutures with a sixth cord hidden within the deeply incised suture beneath the whorl's shoulder. These cords are crossed by finer prosocline lirae forming a cancellate sculpture. The body whorl has ten cancellate spiral cords with some much smaller secondary cords in a few of the interspaces.

Occurrence: Byram Formation, MGS locality 93.

Family LIOTIIDAE

Genus **ARENE** H. and A. Adams, 1854

Arene H. and A. Adams, Genera of Recent Mollusca, v. 1, p. 404, 1854.

Type (by subsequent designation): *Turbo cruentatus* Megerle von Muhlfield. Recent, West Indies.

Subgenus **ARENE** H. and A. Adams, 1854

Arene (Arene) nodosa Dockery n. sp.
Plate 41, figures 1-3

Description: Shell of medium size for genus and consisting of four and one half whorls; apex of shell flat for two and one half whorls; protoconch consisting of one half smooth whorl, first whorl of teleoconch with fine closely set longitudinal lirae, the second whorl with three prominent nodose spiral cords with the outer one forming a carina, a fourth nodose cord forms between the outer two at the beginning of the third whorl of the teleoconch and becomes prominent on the latter whorls; longitudinal closely set lirae cover the spiral cords and interspaces of the teleoconch with only the tops of nodes being smooth; suture channeled; body whorl with nine nodose spiral cords, the last of which forms the margin of the umbilicus; umbilicus small with a single oblique spiral ridge within; shoulder of body whorl gently rounded; aperture circular; outer lip with crenulations corresponding to spiral cords.

Discussion: This species is known only from the single specimen figured. It is possibly the earliest record of the genus *Arene*, and in its general form and sculpture resembles *Arene* (*Arene*) *machapoorieensis* (Mansfield, 1925), a lower Miocene species from the Machapoorie Quarry, Nariva County, Trinidad. It differs from this latter species in its greater height and in having fewer nodose spiral cords on the body whorl. The species is named for its nodose sculpture.

Type: Holotype 376658 USNM from the Byram Formation, MGS locality 93 (Plate 41, figures 1-3).

Occurrence: Byram Formation, MGS locality 93.

Order MESOGASTROPODA Thiele, 1925
Superfamily RISSOACEA Gray, 1847
Family RISSODAE Gray, 1847
Subfamily CINGULINAE

Genus **ONOBA** H. and A. Adams, 1852

Onoba H. and A. Adams, Ann. Mag. Hist., ser. 2, v. 10, p. 358, 1852.

Type (by monotypy): *Turbo striata* Montague. Recent, North Atlantic.

The generic assignment of the species here figured is made entirely on its resemblance to *Onoba fortis* Pilsbry and Olsson. It does not have the internal striations that characterize the type species.

Onoba sp.?
Plate 40, figure 14

Discussion: This minute shell is the only rissoid known from the Oligocene formations of the Gulf coast. It appears to be very closely related to *Onoba fortis* Pilsbry and Olsson (1941, p. 44, pl. 8, fig. 3) from the Canoa Formation (Pliocene) of Ecuador.

Occurrence: Mint Spring Formation, USGS locality 13287.

Family VITRINELLIDAE Bush, 1897

Subfamily VIRTINELLINAE Bush, 1897

Genus **VITRINELLA** C. B. Adams, 1850

Vitrinella C. B. Adams, Monograph of *Vitrinella*, p. 3, 1850.

Type (by subsequent designation): *Vitrinella helicoidea* C. B. Adams. Recent, West Indies.

Subgenus **VITRINELLA** C. B. Adams, 1850

According to Pilsbry and Olsson (1952, p. 71), typical *Vitrinella* has a straight vertical umbilical wall bounded by a projecting rim. A raised spiral ridge is present on all of the species considered here but the angle and shape of the wall varies from nearly straight and vertical to inclined and strongly undercut on the one hand to rounded with the raised spiral set back from the steepest part of the face on the other hand. The different types are variants of the same plan, however, and the shape of the wall seems in some cases to change with the age of the individual, juveniles having the wall concave and undercut, intermediates having the wall vertical, and full grown adults having the wall convex with the rim receding.

Vitrinella (Vitrinella) laevis (Meyer)

Plate 1, figures 4-6; Plate 42, figures 2-5; Plate 47, figures 1-2

1886. *Adeorbis laevis* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, fig. 29, 29a.

Original Description: Meyer, 1886.

Discoid; umbilicus large, margin rounded; aperture circular; whorls five; convex, smooth; suture distinct.

Locality.—Red Bluff, Miss.

In Vicksburg there occurs a variety "var Vicksburgensis," with smaller umbilicus.

Description: Shell small, about four whorls, spire low and broad, the amount of body whorl envelopment slight for the genus; protoconch relatively large and distinct; sutures incised and well defined; early whorls convex below the suture but the body whorl has a subsutural swelling which is subtended by a narrow depression; aperture asymmetrical in basal view but nearly round in full view; lip entire except at parietal end, not reflected at umbilical margin; parietal callus thin and moderately extensive, not distinct; umbilicus open and moderately broad, wall high and vertical, rim bluntly angulate and projecting; shell smooth.

Discussion: The umbilicus of the type has higher and more nearly vertical walls than any other species known to me and the umbilical opening is exceptionally wide for the genus.

A closely related species occurs in the Eocene beds (probably of middle Claiborne Age) at Newcastle near Hanover on the Pamunkey River, Virginia (see Palmer, 1937, p. 55, pl. 2, figs. 10-12).

It belongs to the group of *V. modesta* C. B. Adams (see Pilsbry and Olsson, 1945, pl. 28, figs. 1-1b).

Type: Holotype 644580 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 1, figures 4-6).

Occurence: Red Bluff Formation, MGS localities 37, 38; Byram Formation, MGS locality 106.

Vitrinella (Vitrinella) vicksburgensis (Meyer)

Plate 11, figures 6-8

1886. *Adeorbis laevis* var. *vicksburgensis* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 67.

Description: Shell small, about three and one-half whorls, spire low and narrow; protoconch small; sutures indistinct on postnuclear whorls, thinly appressed with a weak subsutural sulcus; aperture asymmetrical in basal view; parietal callus thin and extended; lip discontinuous and not detached in parietal region, thickened and broadly notched where it borders the umbilicus; umbilicus moderately narrow and undercut with a rounded projecting rim, rim low with respect to level of base; shell smooth.

Discussion: This species differs from *V. laevis* of the Red Bluff in having a narrower spire, an almost invisible suture on the body whorl in contrast to the incised suture of *V. laevis*, and a narrow umbilical opening with strongly undercut umblical walls in contrast to a wide umbilicus with vertical walls.

Meyer regarded this form a variety of *V. laevis.* If it is descended from *laevis* there was a progressively closer coiling of the umbilical opening. The cavity inside has the form of an inverted funnel.

This species has not been figured previously.

Type: Holotype 644581 USNM probably from the Mint Spring Formation, Vicksburg, Mississippi (Meyer). The formation from which the holotype was obtained is not known. It is assumed to be from the Mint Spring Formation in as much as the Casey collection contains a specimen, the only known, from that member.

Occurrence: Mint Spring Formation, USGS locality 13287.

Vitrinella (Vitrinella) meyeri MacNeil n. sp.
Plate 11, figures 2-4

Description: Shell small, about four and one-half whorls, spire moderately high and broad; protoconch very small; sutures appressed, located well down on the preceding whorl and not progressively enveloping the spire, no subsutural sulcus; aperture asymmetrical in basal view; parietal callus extended but appressed only near upper end; lip detached below, attached and extended above, indented and slightly reflected opposite umbilical wall; umbilicus narrower with overhanging rim on earlier whorls but with a receding rim on the body whorl, the wall concave on early whorls, convex on the body whorl, a spiral cord located at rim on early whorls but set back from rim on the body whorl; shell with very faint and irregular spiral markings under high magnification but essentially smooth under low magnification.

Discussion: This species differs so markedly from *V. vicksburgensis* Meyer in the shape of its spire that is can hardly be a variant of it. The spire is high and enlarges proportionately to the enlargement of the whorls rather than being low and increasingly overlapped by each whorl. The umbilicus of the early whorls of *V. meyeri* has an overhanging rim and is similar to that of *V. goniomphala* Pilsbry and Olsson (1952, pl. 13, fig. 6a), but on the last quarter turn the rim recedes strongly, exposing a strongly convex umbilical wall. This probably is a gerontic charcter and on a younger specimen the difference would not be as great.

Type: Holotype 498313 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 11, figures 2-4).

Occurrence: Mint Spring Formation, USGS locality 13287.

Subgenus **VITRINELLOPS**
Pilsbry and Olsson, 1952

Vitrinellops Pilsbry and Olsson, Acad. Nat. Sci. Philadelphia, Proc., v. 104, p. 73, 1952.

Type (by original designation): *Vitrinella (Vitrinellops) zonitoides* Pilsbry and Olsson. Recent, Gulf of Panama.

This subgenus is distinguished from typical *Vitrinella* by its lack of a keel or thread along the umbilical margin, the walls of the umbilicus being smooth and evenly rounded.

Vitrinella (Vitrinellops) sp.
Plate 1, figures 7-9

Discussion: An immature and incomplete shell is tentatively assigned to this subgenus. It has a small umbilicus with evenly rounded walls and no rim. The spire is raised and the sutures are moderately furrowed, the whorls maintaining their roundness right to the suture. The parietal callus is thin but appressed, the lip not being discrete in the parietal region.

Because this shell is obviously a juvenile and the adult characters might be different it is not described.

Occurrence: Red Bluff Formation, USGS locality 13288.

Genus **SOLARIORBIS** Conrad, 1865

Solariorbis Conrad, Amer. Jour. Conch., v. 1, p. 30, 1865.

Type (by subsequent designation): *Delphinula depressa* I. Lea, 1833. Eocene, Gosport Sand, Alabama; McBean Formation, South Carolina.

Solariorbis sp.
Plate 42, figure 1

Discussion: This species is known from the single specimen figured and is very similar to *Solariorbis subangulatus* (Meyer, 1886) from the Moodys Branch Formation in Mississippi. It differs from the latter species in that its protoconch, though having the same number of whorls (two and a fourth), is smaller, less prominent, and more depressed. Both species are sculptured with fine spiral striae; however, *S. subangulatus* generally has a slight subsutural collar that is not present on the specimen at hand.

Occurrence: Mint Spring Formation, MGS locality 89.

Genus **CYCLOSTREMISCUS**
Pilsbry and Olsson, 1945

Cyclostremiscus Pilsbry and Olsson, Acad. Nat. Sci. Philadelphia, Proc., v. 97, p. 266, 1945.

Type (by original designation): *Vitrinella panamensis* C. B. Adams. Recent, Panama.

Cyclostremiscus menthafons MacNeil n. sp.
Plate 11, figures 10-12; Plate 42, figure 7

Description: Shell moderately large for the family, flattened, spire broadly exposed with the whorls distinct; protoconch moderately small but with a raised spire that rises above the general level of the spire, smooth; suture appressed but not overlapping, located at the base of a convex wall and subtended by a broad moderately deep subsutural sulcus, no collar; aperture asymmetrical in basal view, nearly round in full view; parietal callus thin and extended, not detached or raised, inconspicuous on the parietal wall; lips thin, forming a peripheral point, forming a nearly right angle with the parietal callus and appearing to be discontinuous with parietal callus, weakly indented at umbilical region; umbilicus broad and moderately deep, base rounded, wall rounded; shell with six sharp spirals between keel and subsutural sulcus, five fine spirals in sulcus, a moderate concavity below keel which may be smooth or faintly spiralled, lower carina less prominent than peripheral carina, base with about 13 fine spirals spaced evenly from lower carina to umbilical suture.

Discussion: This species has a stronger peripheral keel and a flatter top than *C. anthera* (Gardner) (1947, pl. 61, figs. 3, 26, 28) from the Shoal River Formation (middle Miocene) of Florida. There is a resemblance to *C. ottonius* (Harris and Palmer) (1947, pl. 27, figs. 3-4) from the Moodys Branch Formation (Jackson) of Mississippi but *C. menthafons* has a larger umbilicus than the Eocene species, the growth lines are not as pronounced, and the coarse spirals outside the subsutural concavity are more abruptly divided from the fine spirals in the subsutural concavity rather than gradually merging with them as in the Eocene species.

Harris and Palmer proposed *C. ottonius* as a new name for *Solarium delphinuloides* Meyer (1887-a, p. 4, pl. 1, figs. 3, 3a) (non d'Orbigny 1845). Meyer's figure is of a shell that more nearly resembles the Mint Spring species, suggesting either that Harris and Palmer's specimen is a different species, or that the species is variable.

Type: Holotype 648850 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 11, figures 10-12).

Occurrence: Mint Spring Formation, USGS locality 7671, MGS locality 89.

Cyclostremiscus quadracordata Dockery n. sp.

Plate 42, figure 6; Plate 67, figure 7

Description: Shell moderately large for family and consisting of four and one half flattened whorls; protoconch consisting of two smooth whorls; first whorl of teleoconch with subsutural sulcus and seven spiral lirae, three within the sulcus, a large one bordering the sulcus, and three below the sulcus; latter whorls with subsutural ramp containing five small spiral lirae and a large cord forming the outer border, slope below ramp with four spiral cords and a fifth one forming a prominent keel along the periphery; base of shell with four prominent spiral cords on an elevated platform around umbilicus; a sulcus containing fine lirations occurs between the outer cord and the keel; umbilicus large, opened, and conical, and with fine spiral lirations.

Discussion: This species is known from the single figured specimen. It is very similar in its prominent sculpture with coarse spiral cords to *Cyclostremiscus guppyi* (Mansfield, 1925), a Miocene species from Montserrat Ward, Caroni County, Trinidad. It differs from this latter species in having stronger and fewer spiral cords on its base. The species is named for its four prominent basal cords.

Type: Holotype 376661 USNM from the Byram Formation, MGS locality 93 (Plate 42, figure 6; Plate 67, figure 7).

Occurrence: Byram Formation, MGS locality 93.

"Cyclostremiscus" sp.

Plate 1, figures 11-13; Plate 42, figure 11

Discussion: A minute shell that has unique characters, but which is believed to be a juvenile, is here recorded. It is not named because the adult may be quite dissimilar, and its naming should wait until a mature specimen is found.

The spire is exposed and moderately broad. The whorls are angulate, the flattened top dropping off abruptly as a high angled wall. The suture is appressed horizontally against the steep wall so that there is a step at each suture. The parietal callus is thin and weakly extended. The aperture is asymmetrical in basal view. The umbilicus is open and moderately narrow, and the wall is rounded with a blunt receding rim. The shell is sculptured with three weak spirals and weak axials which form a tiny point at their intersection.

This may be a juvenile *Anticlimax*.

Occurrence: Red Bluff Formation, USGS locality 13288; Byram Formation, MGS locality 106.

Genus **DISCOPSIS** De Folin, 1870

Discopsis De Folin, Les Fonds de la Mer, v. 1, p. 205, 1870.

Type (by original designation): *Discopsis omalos* (De Folin). Recent, Guadeloupe.

Pilsbry and Olsson discussed this genus as well as its type species under their description of *Chonebasis* Pilsbry and Olsson (1945, p. 258), stating that it had not been identified with certainty since its original description.

The present species is believed to be a true *Discopsis*. It has the very asymmetrical aperture and wide flaring peripheral keel. It differs from *Chonebasis* in its proportions and particularly in its protoconch. *Chonebasis* has a conical protoconch that stands conspicuously above the spire. *Discopsis* has a simple plane-coiled protoconch.

Discopsis pilsbryi MacNeil n. sp.

Plate 11, figures 13-15; Plate 42, figure 8

Description: Shell of medium size for the family, much compressed with a thin broad slightly downturned keel, spire of moderate width but submerged; protoconch simple, smooth and plane-coiled, not raised; suture channelled and sunken, the appressed side swollen and overhanging; whorls weakly sulcated just below the subsutural swelling but broadly and evenly curved thereafter to the edge of the keel; aperture very asymmetrical in basal view, elongate pear-shaped in full view; lip thin, very weakly reflected in region of umbilical margin; parietal callus sharp and tongue-like, pointed and not thinly appressed, a shallow groove extending to the points; umbilicus moderately broad and shallow, walls narrowly rounded, submerged whorl faces broad and flattened; base rounded but with a marginal concavity on the underside of the keel; shell sculptured with weak irregular axial riblets which curve back weakly nearest the suture, more strongly as they approach the keel.

Discussion: This species does not have a pair of spiral threads on its base as does the type species. Tryon (1888, pl. 35, fig. 74) gives a figure of the base of *D. omalos* but not of the top. The tongue-like parietal callus and hollowed underside of the peripheral keel are similar to those of the present species.

Two recent species from Panama described under *Discopsis* by Bartsch (1918, p. 574) are referred to *Chonebasis* by Pilsbry and Olsson (1945, p. 262, 265).

Type: Holotype 498310 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 11, figures 13-15).

Occurrence: Mint Spring Formation, USGS locality 14071a, MGS locality 99 (these localities are the same).

Genus TORNUS Turton and Kingston, 1830

Tornus Turton and Kingston, Guide to the Watering Places, v. 2, Nat. of the District, 1830.

Type (by subsequent designation): *Tornus subcarinatus* (Montagu). Recent, British Isles, eastern Atlantic Coast and Mediterranean; Miocene - Pleistocene, Europe.

Tornus infraplicatus (Johnson)

Plate 42, figures 9-10

1899. *Adeorbis infraplicatus* Johnson, Acad. Nat. Sci. Phildelphia, Proc., v. 51, p. 81, pl. 2, fig. 13, 14.

1947. *Tornus infraplicatus* (Johnson). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 231, pl. 27, fig. 17, 18.

1966. *Tornus infraplicatus* (Johnson). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 955.

1977. *Tornus infraplicatus* (Johnson). Dockery, Miss. Geol. Survey, Bull. 120, p. 39, pl. 1, fig. 14, 15.

1980. *Tornus infraplicatus* (Johnson). Dockery, Miss. Bureau Geol., Bull. 122, p. 76, pl. 57, fig. 3A, 3B.

Original Description: Johnson, 1899.

Shell small, spire depressed, nucleus smooth, whorls three, with two prominent revolving ridges, one at the periphery and one midway between the periphery and the suture, both are very minutely crenulated, between the two ridges smooth or with very fine revolving lines, from the smooth nucleus radiate fine raised lines that increase in size on the body whorl, these are crossed by fine revolving lines, base of the shell with numerous fine revolving lines, umbilicus of moderate size, margin smooth, nearly half-way across the base from the margin of the umbilicus extend numerous radiating plications, crossed by very fine revolving lines. Alt. 1½ mm., greatest diam. 3 mm.

Four specimens from the material collected by Thomas A. Morgan, at Jackson, Miss.

Discussion: The two figured specimens differ somewhat from the typical variety in the Moodys Branch Formation in having a stronger radial sculpture on the subsutural ramp and a more prominent cord bordering the ramp.

Type: Holotype 7472 ANSP from the Moodys Branch Formation, Jackson, Mississippi.

Occurrence: Moodys Branch Formation, MGS localities 1, 16; Red Bluff Formation, MGS locality 34b.

Subfamily TEINOSTOMINAE Cossmann, 1917

Genus TEINOSTOMA H. and A. Adams, 1853

Teinostoma H. and A. Adams, Genera of Recent Mollusca, v. 1, p. 122, 1853.

Type (by monotypy): *Teinostoma politum* A. Adams. Recent, Santa Elena (presumably Ecuador).

Subgenus TEINOSTOMA H. and A. Adams, 1853

Teinostoma (Teinostoma) caseyi MacNeil n. sp.

Plate 11, figures 1, 5, 9

Description: Shell moderately large, flattened, body whorl broad, spire small, envelopment by body whorl considerable; protoconch small, slightly raised above plane of spire; sutures weakly incised and broadly overlapping onto the spire, subtended by a broad rounded swelling which in turn is subtended by a broad shallow rounded depression; aperture asymmetrical, broadly retreating at the position of the umbilical rim, elongate and extended with a moderately strong anal sinus; parietal callus thickened and asymmetrical, appressed only at the anal siphonal end; lip thin, strongly curved at lower peripheral end, subflattened to weakly curved along upper and lower margins; umbilicus nearly closed by a thick overlapping fold of callus but not solidly plugged, a broad chink extending along the callus nearly at right angles to the strike of the parietal callus; shell smooth or very faintly spirally striate.

Discussion: This species is related to *T. calvertense* Martin from the Calvert Formation (lower Miocene) of Maryland. It is larger than the Calvert species and the subsutural sulcus is broader and less well defined. The plan of the umbilical fold is lobate or convex rather than concave as in *T. calvertense*. The umbilical fold is more like that of *T. nanum* from the St. Marys Formation (middle Miocene) of Maryland but the spire of *T. nanum* is more concealed and the shell is less discoidal.

Teinostoma nanum is more like *T. caseyi* than it is like a form from the Shoal River Formation (middle Miocene) which Gardner (1947, p. 614, pl. 61, figs. 8-10) made a subspecies of it, *T. nanum eonanum* Gardner. The Shoal River form has a completely plugged umbilicus rather than a large open chink as do both *T. nanum* and *T. caseyi*.

Type: Holotype 498311 USNM from the Mint Spring Formation, USGS locality 6448 (Plate 11, figures 1, 5, 9).

Occurrence: Mint Spring Formation, USGS locality 6448.

Subgenus **IDIORAPHE** Pilsbry, 1922

Idioraphe Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., v. 73, p. 398, 1922.

Type (by original designation): *Teinostoma angulatum* (Gabb) (= *Cyclops angulatus* Gabb). Miocene, Dominican Republic.

Idioraphe is stated to have a concealed spire but some species referred to it do not have a completely concealed spire; at least the protoconch remains exposed. The species here treated are of the less typical species; there is less envelopment of the spire, leaving somewhat more than the protoconch exposed. The amount of umbilical callus compares with that of other species referred to the subgenus.

Teinostoma (Idioraphe) minuta MacNeil n. sp.

Plate 26, figures 7-9; Plate 42, figures 13-14

Description: Shell small, spire small and inconspicuous, narrowly exposed; protoconch small and smooth, the sutures not appressed at this stage; sutures appressed, overlapping and indistinct on body whorl; aperture nearly circular except for a weak angularity at the position of the anal siphon; parietal callus moderately heavy and distinct but not detached; lip moderately heavy for size of shell, not distinct from callus in umbilical region — the edge of the umbilical callus forming the inner lip; umbilicus completely covered by callus which extends into the umbilical region from the parietal region, no chink; shell smooth.

Discussion: This species may be related to *T. nanum* (Lea) of the St. Marys Formation (middle Miocene) of Maryland. It is more like a specimen figured by Gardner (1948, pl. 25, figs. 23-24) than it is like the specimen figured by Martin (1904, pl. 62, fig. 1). Martin's figures show the spire as being enveloped more asymmetrically than in the Byram species.

Teinostoma verilli Meyer from the Moodys Branch Formation (Jackson) of Mississippi is also closely related. According to Harris and Palmer the degree of envelopment of the spire is variable, ranging from completely closed to partly open. Often the fossil species are known from only a single specimen and it may be that all of them are variable in the amount of spire exposed.

Type: Holotype 648918 USNM from the Byram Formation, USGS locality 5615 (Plate 26, figures 7-9).

Occurrence: Byram Formation, USGS localities 5615, 14682 (these localities are presumed to be the same), MGS locality 106.

Teinostoma (Idioraphe) verrilli Meyer

Plate 42, figure 12

1885. *Teinostoma Verrilli* Meyer, Amer. Jour. Sci, v. 29, p. 463, 468.
1886. *Teinostoma Verrilli* Meyer. Meyer, Geol. Survey Alabama, Bull. No. 1, pt. 2, p. 66, pl. 2, fig. 27, 27a.
1892. *Teinostoma verrilli* Meyer. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 412 (section *Pseudorotella*).
1937. *Teinostoma verrilli* Meyer. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 46 (section *Idioraphe*).
1947. *Teinostoma verilli* Meyer. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 222-223, pl. 28, fig. 2, 4 (section *Idioraphe*).
1966. *Teinostoma verrilli* Meyer. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 944.

Original Description: Meyer, 1885.

Discoid; umbilical region covered and thickened by callus; margin angular, though not carinated, polished, suture entirely indistinct, so that the number of whorls can not be counted; base regularly rounded; aperture trigonal-elliptical.

Locality.—Jackson, Miss.

Discussion: The single specimen of this species collected from the Red Bluff Formation differs from the typical variety of the Moodys Branch Formation in that the last whorl is slightly more involute.

Type: Holotype 638797 USNM from the Moodys Branch Formation, Jackson, Mississippi.

Occurrence: Moodys Branch Formation, MGS locality 1; Red Bluff Formation, MGS locality 34b.

Genus ANTICLIMAX Pilsbry and McGinty, 1946

Anticlimax Pilsbry and McGinty, Nautilus, v. 60, p. 12, 1946 (substitute name for *Climacia* Dall, 1903) (non M'Lachlan, 1869).

Type: (monotype of *Climacia* Dall): *Teinostoma* (*Climacia*) *calliglyptum* Dall. Caloosahatchee Marl, Pliocene, Florida.

Strictly speaking this name is a substitute name for *Climacina* Aguayo and Borro 1946 (non Gemmellaro 1878), a substitute name for *Climacia* Dall but also a homonym.

Pilsbry and McGinty proposed a subgenus, *Subclimax*, which is distinguished from typical *Anticlimax* by having a callus plug over its umbilicus, and a tendency for the spire to be sunken in a small crater. The present species has a spire like typical *Anticlimax* but the curved axials are more like the dorsal sculpture of some species of *Subclimax*. However, the species here described differs from both in having a strong median sulcus on the base and a bicarinate peripheral keel. There is no umbilical plug. Possibly a new subgeneric name should be proposed for this species, but it can wait until a better knowledge of the interrelationships of all species concerned is obtained.

Anticlimax byramensis MacNeil n. sp.

Plate 26, figures 4-6

Description: Shell of medium size for the family, spire dome-shaped, descending to a moderately strong, slightly upturned keel, a strong projecting angularity below the true keel makes with it a double keeled periphery; protoconch small, simple, plane-coiled and smooth; suture not conspicuous, appressed; aperture very asymmetrical, produced to form a foot-shaped extension at the periphery; lip of unequal thickness, thin opposite the umbilical wall, the basal sulcus, and just above the peripheral keel, thick opposite the upper whorl, the periphery, and the umbilical margin; parietal callus moderately thin, narrow and appressed, not distinct; umbilicus of moderate width with a prominent blunt rim, wall convex, umbilical suture channelled; keel concave, really two closely spaced keels, the upper flaring upwards weakly, the lower flaring downwards weakly; base with a strong concavity between the keel and the umbilical rim; sculpture consisting of strong narrow backward curving axials (about 25 on the body whorl) which are crossed by much weaker spiral threads, two spirals below the suture being stronger than the rest, strong axials ending abruptly about two-thirds of the distance to the peripheral keel and replaced by more numerous, weaker and thinner axial frills which continue to the periphery, peripheral concavity with inclined axial wrinkles extending from rim to bottom of sulcus, much finer wrinkles between short wrinkles and continuing across sulcus to peripheral keel.

Discussion: This is a very elegantly sculptured species. It differs from most other species of *Anticlimax* known in having a strong basal sulcus and a double peripheral keel. Its top surface is much more ornate. *Anticlimax hispaniolensis* Pilsbry and Olsson (1950, pl. 3, figs. 10, 11) from the Miocene of Costa Rica comes the closest to having similar dorsal axials but they are less distinct, wider, and only half as numerous (12).

There certainly seems to be some relationship between this species and *Umbonium* (*Solariorbis*) *duplinense* Dall (1896, p. 45; 1903, pl. 60, figs. 8-10) from the Duplin Marl (late Miocene) of North Carolina. The Duplin species has a lower spire, a wider umbilicus, a prominent subsutural band, and less projecting peripheral costae. The two species are about the same size.

This is the oldest known *Anticlimax* and, paradoxically, the most ornate. Its next youngest occurrences are in Miocene beds of Santo Domingo and the Canal Zone.

Type: Holotype 648919 USNM from the Byram Formation, USGS locality 5615 (Plate 26, figures 4-6).

Occurrence: Byram Formation, USGS locality 5615.

Family CAECIDAE Gray, 1859

Genus CAECUM Fleming, 1813

Caecum Fleming, Edinburgh Encyclopaedia, v. 7, pt. 1, p. 67, 1813.

Type (by subsequent designation, Gray, 1847): *Dentalium trachaea* Montagu. Recent, European seas.

Caecum solitarium Meyer

Plate 11, figure 17; Plate 42, figures 15-16

1885. *Caecum* sp. Meyer, Amer. Jour. Science, v. 33, p. 71.
1886. *Caecum solitarium* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 68, pl. 3, fig. 9

Original Description: Meyer, 1886.

Small, regularly curved, somewhat contracted at the aperture; section and aperture circular; smooth except concentric rings of growth.

Locality.—Vicksburg, Miss.; "Lower Vicksburgian."

Discussion: Caecidae are rare in the Paleogene of the Gulf Coastal Plain and are represented by only two species, *Caecum alterum* Meyer, 1887, from the

Jackson Group and *Caecum solitarium* Meyer, 1886, from the Vicksburg Group. These species differ in that the former has a sculpture with more pronounced annular rings. The type of *C. solitarium* illustrated in Plate 11, figure 17, is nearly smooth. Juvenile specimens of this species illustrated in Plate 42, figures 15-16, show the annular rings more clearly. FIgure 15 of this plate shows the planispirally coiled protoconch.

Type: Holotype 644585 USNM from the Mint Spring Formation, Vicksburg, Mississippi (Plate 11, figure 17).

Occurrence: Mint Spring Formation, Vicksburg; Glendon Limestone, MGS locality 112b.

Superfamily ARCHITECTONICACEA Gray, 1850
Family ARCHITECTONICIDAE Gray, 1850

Genus **ARCHITECTONICA** Roeding, 1798

Architectonica Roeding, Museum Boltenianum. p. 78, 1798.

Type (by subsequent designation, Gray, 1847): *Trochus perspectiva* Linné. Recent, Indo-Pacific.

The subgenera of *Architectonica* are not clearly distinguished in the lower Tertiary by morphological gaps. Presumably they represent different phylogenetic lines but as yet there is no clear cut division of gross characters. The different subgenera are defined mainly on single characters. Typical *Architectonica* has a narrow umbilicus. There is a tendency for the development of a deep furrow near the umbilical margin although on some species it is very weak. Typical *Architectonica* may have other narrow strongly incised sprial grooves, both on the base and top, which are separated by interspaces of different width. The interspaces are coarsely granular or with washboard-like axial rippling. The umbilical margin may be nearly entire or serrated by the ripples. In some species the incised spirals are few and the rippling greatly subdued. The periphery may range from angulate and undercut, to tricarinate and rounded. Species in which the furrow is shallow have spiral threads in the furrow, and there may be other similar shallow furrows. This type has a tendency for the interspaces as well as the threads in the grooves to be more numerous and more sharply granular or beaded. It merges with types (*Pseudotorinia*) having furrows and interspaces of nearly equal width, and with baffle-like partitions in the furrows; usually this type has a rounded periphery.

The next progression is to a type (*Granosolarium*) with a larger funnel-shaped umbilicus having no distinctively broader or more serrate marginal band. The interspaces in this type are better described as beaded spiral ribs.

There is reason to believe that the more widely umbilicated type is more primitive, typical *Architectonica* more advanced.

Subgenus **ARCHITECTONICA** Roeding, 1798

Architectonica (Architectonica) trilirata (Conrad)

Plate 27, figures 1-7, 9

1829. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 12, f (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Solarium triliratum* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.
1848b. *Solarium triliratum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113, pl. 11, fig. 4. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Architectonica trilirata* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 30.
1887. *Solarium triliratum* Conrad. Meyer, Bericht Senckenberg. Naturf. Gesell., p. 18, pl. 1, fig. 17, 17a, 17b.
1892. *Solarium bellistriatum triliratum* Conrad. Dall, Wagner Free Inst. Science, Trans. v. 3, pt. 2, p. 327 (in part).
1937. *Architectonica trilirata* Conrad. Palmer, Bull. Amer. Paleontology, v. 7, No. 32, p. 159.
1947. *Architectonica (Architectonica) trilirata* Conrad. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 269, pl. 32, fig. 7.

Original Description: Conrad, 1848a.

Discoidal, with three thick approximate ridges on the periphery; suture channelled; volutions with oblique impressed lines, and 2 fine revolving lines on each whorl; base convex with three revolving impressed lines that near the umbilicus profound, and with coarse rugose transverse lines. Diameter 7-10. Not common.

Description: Shell moderately large and broad, spire low, base rounded, periphery rounded and bluntly tricarinate; protoconch small and smooth, about one whorl exposed, the first whorl appearing to emerge from within; first postnuclear sculpture consisting of a subsutural and a suprasutural row of granules connected by inclined axial ridges, lasting for about one-half whorl; juvenile stage with three incised spiral lines, the upper and lower ones isolating the subsutural and suprasutural rows of granules as distinct beaded spiral ridges, and the middle spiral cutting the connecting cross bars; adult sculpture variable, the juvenile sculpture may persist, or one or both of the upper two incised spirals may become obsolete allowing the segments of the inclined axial ridges, including the subsutral granules, to become confluent, or the axial ridges may themselves become nearly obsolete, the suprasutural spiral band may become smooth and more prominent; periphery of body whorl with three prominent rounded spirals ridges, the top one being the suprasutural spiral of the spire, the middle one concealed on the spire, the bottom one the outermost spiral of the base; base with a deep furrow isolating an umbilical collar and three or four weaker incised spiral grooves dividing the remainder of the base into spiral bands of different widths, the two innermost usually the strongest, all basal spiral bands with granules or inclined washboard-like axial riblets, axials not continuous from band to band and increasing in number in each successive outer band; sutures incised to moderately channelled; umbilicus narrow; parietal callus thin and appressed; aperture rounded on peripheral side, straighter on umbilical side, siphonal notch prominent.

Discussion: The smaller of the two specimens in the type lot agrees more with Conrad's figure and is selected as lectotype. It has a higher spire than the larger paratype and is more like a specimen in the Casey collection (pl. 27, fig. 5) in this respect. Variation in height is common in species of *Architectonica.*

Typical *A. trilirata* is taken to be the form in which the top is weakly divided or not divided by incised spirals, and the inclined axial ripples tend to be continuous, or with a couterpart from spiral band to spiral band. The spire ranges from low to moderately high, and the umbilicus is narrow.

It compares with *A. bellistriata* Conrad from the Claiborne (see Palmer, 1937, pl. 17, figs. 10, 11, 14) in the width of its umbilicus but the Claiborne species does not have the two prominent incised spirals along the middle of the base. *Architectonica amoena* (Conrad) from the Claiborne is related but it is distinguished by having its umbilical collar divided by an incised spiral, and the suture is appressed low on the middle peripheral ridge rather than high on it or above it as in *A. trilirata.*

Typical *A. trilirata* is known only from the Byram Formation. A form reported from the Jackson by Harris and Palmer (1947, p. 269, pl. 32, figs. 4-6) as *A. trilirata* is more like the subspecies from the Mint Spring Formation, *A. trilirata palmeri*, named herein.

Type: Letotype 13519 ANSP and paratype 13520 ANSP both from the Byram Formation, Vicksburg, Mississippi (Plate 27, figure 4 - lectotype).

Occurrence: Byram Formation, USGS localities 13286, 3722, 5623, MGS localities 93, 94, 106, 109, 112c, 114, 115.

Architectonica (Architectonica) trilirata palmeri MacNeil n. subsp.

Plate 13, figures 1-3

Discussion: This form is very closely related to the typical form. It is distinguished by two features. The umbilicus is wider with a narrower collar, and the peripheral bands are weaker. Only two specimens have been seen and on both the dorsal banding is strong, one having two bands, the other three. They fall in or beyond the range of the most acutely sculptured extreme of the typical form; the smoother variant, if it exists , is not known. Its height may exceed the maximum height of *A. trilirata.*

This subspecies has a close analog in the Jackson (see Harris and Palmer, 1947, p. 269, pl. 32, figs. 4-6).

Type: Holotype 498297 USNM and paratype 648860 USNM both from the Mint Spring Formation, USGS locality 14071a (Plate 13, fig. 1 - paratype, fig. 2-3-holotype).

Occurrence: Mint Spring Formation, USGS locality 14071, 14071a; ? Moodys Branch Formation, PRI locality 693.

Architectonica (Architectonica) vicksburgensis (Dall)

Plate 27, figures 8, 13-14

1892. *Solarium bellastriatum vicksburgensis* Dall, Wagner Free Inst. Science, Trans., v. 3, pt. 2, p. 327, pl. 22, fig. 4, 4a

Original Description: Dall, 1892.

Another variety, *vicksburgensis* Dall (pl. 22, figs. 4, 4a), has between the peripheral keel and the suture above four nearly equidistant incised lines, obliquely tessellating the surface when they cut the regularly spaced radial grooves. The base has four tessellated bands between the lower peripheral keel and the sutural sulcus; they decrease in width outward and the three outer ones are taken into the aperture by the proceeding whorl, together with the peripheral keel. Alt. 6.5; max. diam. 12.0 mm. in a specimen having six whorls. It is found in the Eocene of Vicksburg, Miss. If the figure given by Gabb of his *S. Hornii* of the Téjon beds of California be reliable, that species should be ranged in this vicinity.

Discussion: This form occurs with *A. trilirata* and it could be a variety of it. However, since there are two known specimens and no known intermediates it probably is a distinct species.

It is characterized by four nearly equal granular spiral bands alternating with a smooth band on the spire whorls. The smooth band is the peripheral spiral ridge which is broader than on *A. trilirata* and not concealed by the suture. It differs from *A. trilirata*, therefore, in having a stronger and more equal division of the dorsal sculpture by the incised spiral grooves, and in having the smooth peripheral ridge partly exposed on the spire whorls rather than submerged.

The umbilicus is wider than on *A. trilirata* and the umbilical collar is narrower. The lowest of the three peripheral bands is more prominent than on *A. trilirata* and the depression subtending it is more pronounced.

Type: Holotype 6200 USNM from the Byram Formation, Vicksburg, Mississippi.

Occurrence: Byram Formation, Vicksburg, USGS locality 3722.

Architectonica (Architectonica) fuscicava
MacNeil n. sp.

Plate 13, figures 5-8; Plate 27, figures 10-12

Description: Shell of medium size, spire of medium height, base rounded, periphery rounded strongly tricarinate; protoconch smooth, the first turn appearing to emerge from within; postnuclear sculpture beginning abruptly, consisting of beaded subsutural and suprasutural bands and faintly inclined axial riblets between them; juvenile and adult stages with three strong incised spiral lines which isolate the subsutural and suprasutural rows of beads into distinct spiral bands, and divide the middle section into two equal beaded spiral bands, the bands of the subsutural band being axially elongate and only half as numerous as the beads on the other bands, the beads on the suprasutural band being spirally elongate; periphery of body whorl with three strong spiral ridges, the middle ridge straight, the others deflected upwards and downwards respectively; base with a deep furrow marking off an umbilical collar, three other spiral grooves divide the base into spiral bands of decreasing width, lower peripheral ridge subtended by a pronounced V-shaped groove, inner spiral bands ornamented by axially elongate washboard-like ripples, outer bands with more rounded to spirally elongate beads; sutures channelled; umbilicus moderately wide, margin strongly denticulate; parietal callus thin and appressed; aperture rounded, straighter on umbilical side.

Discussion: This species can be distinguished immediately from *A. trilirata* by its more prominent and more coarsely beaded subsutural band. In *A. trilirata* the subsutural beads appear to be continuations of the beads on the adjacent band with only an occasional extra bead coming in on the second row. In *A. fuscicava* there is a subsutural bead for every other bead in the second row. The umbilicus is wider in *A. fuscicava*. There is a slight development of baffle-like cross bars in the basal incisions. The peripheral ridges are much higher and narrower than on *A. trilirata*.

I can find no analog of this species in either the Claiborne or Jackson.

Type: Holotype 498298 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 13, figures 5-6, 8).

Occurrence: Mint Spring Formation, USGS locality 7671; Byram Formation, USGS locality 3722.

Architectonica (Architectonica) fuscicava
MacNeil var. ?

Plate 1, figures 23-25

Discussion: A moderately large specimen from the Red Bluff Formation probably is more closely related to *A. fuscicava* than to *A. trilirata*. It differs from the type of *A. fuscicava* in having a relatively greater number of beads on the subsutural band, although they are relatively fewer on the early whorls. The peripheral ridges are less prominent, and the outer-most furrow on the base is less pronounced. These differences could be largely a matter of size and age and larger specimens of typical *A. fuscicava* might be similar.

Occurrence: Red Bluff Formation, USGS locality 5263.

Architectonica (Architectonica) sp.

Plate 1, figures 29-30

Discussion: Another specimen from the Red Bluff is unusual in two ways. It is deformed and may be pathologic. It is also intermediate in several respects between the *A. lirata* - *A. fuscicava* group and *A. textilina* (Dall), a middle Claiborne species which is represented in both the Red Bluff Formation and the Mint Spring Formation. This may be a hybrid.

It has a very shallow spiral sulcus near the umbilicus. The plan of the basal sculpture is more like that of *A. fuscicava* but the detail is more like that of *A. textilina*. The dorsal sculpture is similar. In plan it resembles *A. fuscicava* but the style of beading on both the subsutural and suprasutural bands gives it more the aspect of *A. textilina*.

Occurrence: Red Bluff Formation, USGS locality 5263.

Architectonica (Architectonica) textilina caseyi
MacNeil n. subsp.

Plate 1, figures 28, 31-33; Plate 43, figures 1-4; Plate 47, figures 3-4

Description: Shell of medium size, spire of medium height, base rounded, sutures sunken, periphery rounded with three well spaced ridges; protoconch consisting of about one and one-half smooth whorls, the first visible part appearing to emerge from within; the first half post nuclear whorl flattened on top and giving way at an angular break to an evenly concave slope to the lower suture, sculptured by oblique transverse growth lines; juvenile stage beginning with the appearance of three rows of rounded beads, one below the suture, one at the angular break, and one above the suture, the central area becoming weakly concave and developing finely beaded spiral threads; adult sculpture not differing from juvenile sculpture; central peripheral ridge stronger and more projecting than ridges above and below, two to three spiral threads in interspaces; base with a strongly wrinkled and inturned umbilical collar which is bounded by a shallow spiral groove in which are two to three fine spiral threads, going outwards there are three subequal spiral bands bearing blunt axially elongate wrinkles and separated by shallow grooves in each of which is a single spiral thread, between the outermost band and the lower peripheral ridge is a moderately broad shallow concavity bearing three to four interrupted spiral threads; sutures weakly incised and weakly submerged; umbilicus moderately narrow; parietal callus thin and appressed; aperture subovate, siphonal notch prominent.

Discussion: This form is hardly more than a subspecies of the middle Claiborne species, *A. textilina* (Dall) (1892, p. 328, pl. 22, figs. 1-3). Another middle Claiborne form, *A. caelatura* Conrad (see Palmer, 1937, p. 160, pl. 82, figs. 3, 5) has a narrower and more extended periphery and in this respect compares more with a form from the Mint Spring Formation, next described. Not enough specimens are known from any level to show the range of variation of both height and the shape of the periphery; *A. textilina* and *A. caelatura* may be end members of the same varietal series.

Architectonica textilina caseyi differs from typical *A. textilina* in rather minor details. The central depressed area on the dorsal side is wider and the shallow sulcus delimiting the umbilical collar contains two to three spiral threads instead of one.

Dall compared *A. textilina* with *A. nupera* Conrad from the Yorktown Formation (Upper Miocene) of Virginia, but the resemblance is not close. A new species of *A.* (*Pseudotorinia*) from the Mint Spring Formation is closer to *A. nupera*.

Were it not for the narrow umbilicus and well defined umbilical collar, I would be inclined to refer this species to *Granosolarium*.

Type: Holotype 498106 USNM from the Red Bluff Formation, USGS locality 2633 (Plate 1, figures 31-33).

Occurrence: Red Bluff Formation, USGS locality 2633, MGS locality 38.

Architectonica (Architectonica) menthafontis
MacNeil n. sp.
Plate 13, figures 11-13

Description: Shell of medium size, spire moderately low, sutures nearly in line with curvature of spire, base subrounded, periphery subangulate, peripheral keel prominent and subtended by weaker peripheral ridges above and below; protoconch not well preserved on type; first postnuclear whorl with a flattened top and angular cut off, slope to suture concave, sculptured by moderately strong washboard-like axial ripples; juvenile sculpture with three rows of beads, one subsutural, one suprasutural, and one along the angularity, four well defined raised spirals between the two upper rows, five spirals broken up into beads by oblique incised growth lines, adult sculpture similar but with two additional fine spiral lines in the suprasutural concavity; peripheral ridge prominent and granular; base with a well defined wrinkled collar, not strongly inturned, collar bounded by a shallow groove containing a single beaded spiral, three wrinkled spiral bands in outward succession, the first two separated by a plain incised spiral, the second and third by a wider groove containing a beaded spiral thread, depression outside the bands containing four to five fine spirals interrupted by growth lines, subperipheral depression with three spiral threads; sutures weakly incised but not submerged; umbilicus of moderate width; parietal callus thin and appressed; aperture subovate; siphonal notch prominent.

Discussion: While obviously related to the Red Bluff form *A. textilina caseyi*, this species can be distinguished from it instantly by its more flattened shell, less channelled sutures, and more prominent peripheral keel. The umbilicus is slightly wider, not much but enough to show more of the descending spiral within.

Architectonica caelatura Conrad from the middle Claiborne is similar to *A. menthafontis* in all of its details except height, *A. caelatura* being even higher than *A. textilina*.

A sufficient number of specimens might show a complete intergradation between all of these forms and indicate that only one variable stock is represented. At the present time, however, I am inclined to regard the *A. textilina - A. textilina caseyi* and the *A. caelature - A. menthafontis* groups as two stocks of common ancestry.

I do not believe *A.* (*Granosolarium*) *meekana* Gabb belongs to this group as suggested by Palmer (1944, p. 13). *A. meekana* does not have a well defined umbilical collar and belongs to *Granosolarium* on this account.

Type: Holotype 498299 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 13, figures 11-13).

Occurrence: Mint Spring Formation, USGS locality 7671.

Architectonica (Architectonica) meliconae
Robinson and Dockery
Plate 72, figures 1-7

1981. *Architectonica* (*Architectonica*) *meliconae* Robinson and Dockery, Mississippi Geology, v. 1, No. 3, p. 13-14, pl. 1, fig. 5A, 5B, 5C, 6A, 6B, 6C, 6D.

Original Description: Robinson and Dockery, 1981.

The dorsal surface consists of one and a half nuclear whorls and three and a half postnuclear whorls. A distinct line separates the smooth nuclear whorls from the latter nodose whorls. The early postnuclear whorls consist of three nodose spiral cords with the subsutural cord being most prominent. After two and one half whorls, the subsutural cord divides to form three cords. The subsutural one of this series remains most prominent. After three and three fourths whorls, traces of an additional nodose spiral cord appears between the third and fourth cords from the suture and becomes more pronounced with growth. The three central spiral cords of the body whorl are subordinate to the subsutural cord and the two marginal cords.

The umbilical margin is coarsely nodose. The base is sculptured by nodose revolving cords, which become progressively smaller from the umbilicus to the prominent marginal cord. A faint, secondary, nodose cord occurs between the fourth and fifth cords from the umbilicus.

The perpipheral margin is squared with a prominent upper and lower marginal cord and two intervening secondary cords.

This species is similar to *Architectonica* (*Architectonica*) *textilina* (Dall, 1982) in its square-shouldered margin and in its general ornamentation. It differs in having fewer nodose revolving cords on the upper and lower surfaces. *A.* (*A.*) *textilina* (Dall) occurs in the Cook Mountain Formation (Claiborne Group) at Wautubbee, Mississippi.

Discussion: MacNeil's discussion of *A. textilina caseyi* and *A. menthafontis* has not been amended to include this recently described species. It belongs to the *textilina* - *textilina caseyi* stock previously mentioned under the discussion of *A. menthafontis*, and differs from the other two species of this stock in its square shouldered periphery. This species is known from two specimens, one of which is from the Mint Spring Formation.

Type: Holotype 30044 PRI from the Moodys Branch Formation at an excavation of Town Creek behind the Russell C. Davis Planetarium, Jackson, Mississippi (Plate 72, figures 4-7).

Occurrence: Moodys Branch Formation, Town Creek; Mint Spring Formation, MGS locality 99.

Subgenus GRANOSOLARIUM Sacco, 1892

Granosolarium Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 12, p. 59, 1892.

Type (by original designation): *Solarium millegranum* Lamarck. Miocene and Pliocene, Italy.

Architectonica (Granosolarium) hargeri (Meyer)

Plate 1, figures 15, 17-18

1886. *Solarium hargeri* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 67, pl. 2, fig. 23, a, b.

Original Description: Meyer, 1886.

Discoid; surface flattened; base convex; margin carinated; whorls five. The ornamentation of the older whorls consists of four granulated revolving striae, the two in the middle smaller than those near the suture. Suture canaliculated; base with revolving lines, those near the umbilicus crenulate; aperture rhombical.

Locality.—Red Bluff, Miss.

The canaliculation along the suture is the main characteristic of this species. Named in honor of Mr. Oscar Harger, the able and careful naturalist in New Haven, Conn.

Description: Shell small (the type may be a juvenile), spire low, base well rounded, periphery keeled; protoconch consisting of about one turn appearing to emerge from within; first quarter whorl after the protoconch rounded with transverse growth lines, next half turn with a prominent upturned edge which drops off to a narrow concave slope to the suture, this stage followed by one having a subsutural row of rounded beads and another row along the angularity, middle area with two fine roundly beaded spirals; periphery has a single strong keel with lesser spirals above and below, the dorsal one being stronger and corresponding to the row of beads along the dorsal angularity of the whorl; base with a row of closely spaced denticles at the umbilical margin but not forming a well defined collar, two equally strong coarsely beaded spirals lie outside the marginal row, followed by three rows of decreasing strength towards the peripheral keel, the outermost interspaces cut by thin baffle-like growth partitions; sutures rather deeply channelled; umbilicus moderately wide, rims only moderately undercut making the cavity subparabolic; parietal callus thin and appressed; aperture ovate; siphonal notch weak.

Discussion: This species is known only from the holotype and it may be a juvenile.

This species may be most closely related to *A.* (*G.*) *meekana* Gabb (see Palmer, 1944, p. 12, pl. 1, figs. 4-7) from the lower Claiborne of Texas. Another middle Claiborne form, *A.* (*G.*) *texcarolina* Palmer (idem, p. 15, pl. 1, figs. 8-11) has coarser beading and a higher spire.

Solarium ornatum Lea was regarded by Palmer (1944, p. 9) as a *Granosolarium* closely related to both *A.* (*G*) *meekana* and *A.* (*G.*) *texcarolina*, but I am inclined to regard it as representing a different stock. It does not have a well developed peripheral keel, and its basal sculpture suggests that it might foreshadow the subgenus *Pseudotorinia*, a species of which is next described.

Type: Holotype 644582 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 1, figures 15, 17-18).

Occurrence: Red Bluff Formation, Red Bluff.

Subgenus PSEUDOTORINIA Sacco, 1892

Pseudotorinia Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 12, p. 66, 1892.

Type (by original designation): *Solarium obtusum* Bronn. Miocene and Pliocene, Italy.

Architectonica (Pseudotorinia) julia MacNeil n. sp.

Plate 13, figures 16-18

Description: Shell moderately small, spire low, whorls rounded, periphery evenly rounded; protoconch consisting of about one full turn, appearing to emerge from within; first half postnuclear turn rounded and roughened, followed by a stage having three well defined spirals, the subsutural spiral more coarsely beaded than the others, a fourth spiral appearing after about one and one-half turns and a fifth appearing on the body whorl, 14 raised beaded spirals in all on the body whorl from the suture to the umbilical rim, the subsutural band and the one forming the umbilical collar being about equal and wider than the others, beads on subsutural band only about half as numerous as beads on adjacent band, baffle-like growth partitions in all incised grooves but not continuous and not corresponding to the beads everywhere, four spiral threads on the periphery stronger than those above and below the periphery; sutures well incised, in places exposing, in places concealing the topmost peripheral spiral; umbilicus moderately wide, wall nearly vertical below a weak overhang and sculptured by inclined thin raised growth varices; parietal callus moderately thick and not tightly appressed; aperture subovate; siphonal notch weak.

Discussion: This species appears to be more closely related to *A.* (*P.*) *nupera* (Conrad) (see Gardner, 1948, p. 200, pl. 24, figs. 8, 11, 15) from the upper Miocene of Virginia and North Carolina than to any known Eocene species. It differs in having wider spiral grooves on top, those of *A. nupera* being narrow and lacking the tiny baffles, and in having its umbilical collar wider than the adjacent band, *A. nupera* having two spiral bands of nearly equal width around the umbilicus. Mansfield (1930, p. 11, pl. 16, figs. 5, 6) described a subspecies, *A. nupera watsonensis* from the Choctawhatchee Formation (upper Miocene) of Florida which he described as having coarser granules than typical *nupera*. It has three equisized spiral bands bordering the umbilicus.

A species from the Bowden beds of Jamaica, *A.* (*P.*) *euprepes* Woodring (1928, p. 357, pl. 27, figs. 15-17), has coarser beads and a coarser spiral on the periphery.

Possibly the closest known Eocene species is *A.* (*Granosolarium*) *ornata* (Lea) (see Palmer, 1937, pl. 18, figs. 15, 16, 19 - as *A. elaborata*). It has a row of denticles at the umbilical margin rather than a well defined collar, and the periphery is sharper. The dorsal sculpture is dissimilar.

Dall's comparison of *A. textilina* with *A. nupera* is no longer of interest inasmuch as its relationships are now known to be with a species of another group, *A. methafontis*.

Type: Holotype 498300 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 13, figures 16-18).

Occurrence: Mint Spring Formation, USGS locality 13287.

Superfamily TURRITELLACEA Clarke, 1851
Family TURRITELLIDAE Clarke, 1851
Subfamily TURRITELLINAE Clarke, 1851

Genus TURRITELLA Lamarck, 1799

Turritella Lamarck, Soc. Hist. Nat. Paris Mem., p. 74, 1799.

Type (by monotypy): *Turbo terebra* Linné. Recent, Indo-Pacific.

The genus *Turritella* is here used in the broad sense. The species dealt with probably are all referable to the subgenus *Haustator* Montfort as used by most authors. The senior author feels that when the subgenera of *Turritella* are finally worked out on anatomical as well as shell characters both the adult sculpture and the juvenile sculpture will be found to be highly homeomorphic in different groups.

The significance of the strength and number of carinations in juvenile *Turritella* is not fully understood. For any given species the juvenile sculpture is fairly constant; at least it varies less than the adult sculpture. In spite of its value in keying out species, the phylogenetic significance is debatable. The juvenile sculpture seems to vary greatly among species which from all other shell characters appear to be closely related. Some Oligocene species which resemble Eocene species so closely that it is difficult to imagine they are not linear descendents have quite different nuclear sculpture from their supposed Eocene ancestors. In fact, it appears that the evolution of species proceeds with simultaneous changes in both the juvenile and the adult, and that the juvenile stage of a later species has neither the same juvenile sculpture as an earlier species, nor does it recapitulate the adult sculpture of an earlier species.

In the writer's opinion the assignment of *Turritella* to groups according to whether they have one, two, three, or a multiple number of primary spirals merely segregates them for key purposes and carries no implication of relationship. Members of different nuclear groups may be very closely related, even in phylogenetic succession.

The genus *Turritella* seems to be a prime example of a group that needs to be studied from a population standpoint before we can do much more about it. A study of large numbers of specimens from single localities probably will reveal that many of the forms that have been treated as unrelated species are really variants of single populations. Population maps showing the separate local populations as well as the greater populations for the whole South and Central American, Caribbean, and West Indian region for each instant of time probably would reveal broad patterns of variability that were evolving, rather than narrow lines of descent connecting restricted morphic types.

Turritella mississippiensis Conrad

Plate 26, figures ?18-19, 23-28

1848a. *Turritella mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 283.
1848b. *Turritella mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 12. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Turritella mississippiensis* Conrad. Conrad, Amer. Jour. Conchology, v. 1, pt. 1, p. 32.
1916. *Turritella halensis* Dall, U. S. Nat. Museum, Proc., v. 51, No. 2162, p. 517, pl. 86, fig. 9.

Original Description: Conrad, 1848a.

Subulate, volutions flattened, with seven revolving lines on the larger ones, the penultimate line large and prominent; longitudinal wrinkles fine, approximate, much curved, crenultaing the revolving lines; the whorls near the apex generally with two prominent distant revolving lines, and a less prominent one margins the suture. Length 3 inches. Not abundant.

Description: Shell moderately large, apical angle about 12°, whorls of adults nearly straight sided except for spirals, basal angle sharp, base slightly concave; protoconch unknown; earliest whorls bicarinate, the upper carina about half as strong as the lower and the two carinae dividing the whorl into almost equal thirds; on succeeding whorls the lower carina becomes broad and rounded and moves closer to the suture below, and a rounded secondary carina developed immediately adjacent to the suture, these two basal spirals being the strongest in adults; the upper of the two primary carinae maintains its position and remains weaker and narrower than the two basal spirals; other secondary spirals develop in the median and subsutural areas, there being two median secondaries of subequal strength on the holotype but other specimens have three, on some the outer two are stronger and the middle weaker, whereas on others the middle spiral is stronger and the outer two are weaker; subsutural slope having 2 to 3 spiral threads; on different specimens any of the spirals may be finely beaded; a micro-sculpture of very fine wavy spirals may be present on the spirals and in the interspaces although it is best developed on the two basal spirals in full grown adults; suture appressed and moderately inconspicuous; aperture subquadrate with the outer lip nearly straight; base slightly concave and nearly smooth or with very fine spiral lines.

Discussion: This was the first described of several related large *Turritella* from the Oligocene and early Miocene beds of the Gulf Coast. Owing to its meager description and inadequate illustration few comparisons have been made with it, one of them in the description of *T. chipolana* Dall (1892, p. 312), a species hardly to be confused with it.

Turritella rina Palmer (1937, p. 192, pl. 22, figs. 3, 4, 9) from the Claiborne may be the radical for the group. The Jackson representative is *T. rivurbana* Cooke (see Harris and Palmer, 1947, pl. 38, figs. 6-9), a species whose published figures all seem to be of juveniles; it may be a variety of *T. martinensis* Dall (see Bowles, 1939, pl. 31, fig. 10) from the Ocala Limestone (Jackson) of Florida. *Turritella rina* and *T. rivurbana* have three spirals in the very young stage, the middle spiral weakening and disappearing in the early adult stage. *Turritella mississippiensis* has no tricarinate stage on the youngest specimens seen, the earliest whorls being bicarinate like juveniles of both Eocene species (see pl. 26, figs. 18, 24-27).

Palmer (1944, p. 17, pl. 1, figs. 12-16) figured five specimens of *T. rina* which, with the three figured previously, covered the varietal range of the species. Inclusion of the extreme members of the series in one species would seem ill-advised if all intermediates were not known. However, this extremely variable species seems to foreshadow several species of *Turritella* found in the Gulf Coast Oligocene, among them *T. mississippiensis* Conrad, *T. boycensis* n. sp., *T. rubricollis* n. sp., *T. caelatura* Conrad, and *T. bowenae* Mansfield. *Turritella mississippiensis* is regarded as having been derived from the variety of *T. rina* with two strong basal spirals (Palmer, 1937, pl. 22, figs. 3, 9), possibly with *T. rivurbana* Cooke in the line of descent. *Turritella rubricollis* from the Red Bluff Formation appears to have developed from the smoother variety of *T. rina*, possibly through *T. martinensis* Dall. It gave rise to *T. caelatura* in the Mint Spring Formation, a species which produced varieties unlike anything in the ancestral *T. rina* stock, and which gave rise in turn to *T. tarponensis* Mansfield and *T. tampae* Dall in the Tampa Limestone (lower Miocene) and possibly other species.

Turritella halensis Dall, described from a mold in silicified Oligocene limestone from near Bainbridge, Georgia, is probably *T. mississippiensis*, but the specimen figured as *T.* cf. *T. halensis* by Mansfield (1937, p. 168, pl. 9, fig. 6) from the Suwannee Limestone of Florida is probably *T. bowenae* Mansfield (1937, p. 166, pl. 9, fig. 3). In *T. bowenae* the lower of the paired basal spirals is much stronger and broader, the reversal of the conditions in typical *T. mississippiensis*.

Mansfield (1940, p. 220, pl. 27, figs. 52, 58) reported *T.* aff. *T. bowenae* from the Chickasawhay Limestone of Alabama along with the description of *T. monroensis* (ibid., p. 219, pl. 27, fig. 59) which is probably just a variety of the same species. There might be some doubt that this species can always be distinguished from *T. pagodaeformis* Heilprin (1887, p. 112, pl. 8, fig. 52; Dall, 1892, p. 310, pl. 17, fig. 9; Dall, 1915, p. 98, pl. 14, fig. 8) from the Tampa Limestone of Florida. The Suwannee Limestone of Georgia and Florida is equivalent to the Byram Formation and Chickasawhay Limestone combined. *Turritella halensis* comes from beds equivalent to the Byram and is indistinguishable from *T. mississippiensis* whose type is from the Byram Formation. *Turritella bowenae* Mansfield is the upper Suwannee and Chickasawhay species, and *T. pagodaeformis* Heilprin is the representative of the same stock in the Tampa Limestone and Paynes Hammock Sand.

Two specimens from the Byram Formation (pl. 26, figs. 18-19) have their basal spiral more projecting; they approach *T. bowenae* in this respect. However, the early whorls of these specimens resemble *T. caelatura* more than *T. mississippiensis* or *T. bowenae*. This Byram form may be a new species, but it is not being described on the basis of the present inadequate material (see discussion of *T. rubricollis*).

Turritella mitchelli Hubbard (1920, p. 137, pl. 22, fig. 3) from the San Sebastian Shale (middle Oligocene) of Puerto Rico may be related to *T. mississippiensis*. It was compared with *T. halensis* by Hubbard.

Turritella hubbardi Hodson (1926, p. 14, pl. 8, figs. 1-6) and *T. gilbertharrisi* Hodson (ibid., p. 17, pl. 13, figs. 1-6) from the "Oligocene-Miocene" of Venezuela resemble this species. Both Venezuelan species have more beaded primary spirals with more subdued microspiral lines on the primary spirals, as well as more rugose growth lines. Also, judging from Hodson's figure (ibid, pl. 13, fig. 5) about the first four whorls of *T. gilbertharrisi* are monocarinate, whereas the earliest known whorls of *T. mississippiensis* are bicarinate.

Type: Lectotype 13516 ANSP and paratype 13517 ANSP both from the Byram Formation judging from their matrix and preservation, Vicksburg, Mississippi (Plate 26, figure 27 - lectotype).

Occurrence: Mississippi: Byram Formation, Vicksburg, USGS localities 259, 13286. Georgia: Flint River Formation (residual chert of Byram age), Hale Landing, Flint River, USGS locality 7074 (holotype of *T. halensis* Dall). Alabama: Residual chert in southern Dale County.

Turritella boycensis MacNeil n. sp.

Plate 11, figures 20, 25-27

Description: Shell moderately large, apical angle about 21°, whorls subflattened in adults, basal angle sharp, base slightly concave; protoconch consisting of two smooth whorls, the first slightly tilted; first postnuclear whorl with a single nearly central carina, a second carina appearing above it on the second whorl and increasing in strength until on about the seventh or eighth whorl it nearly equals the lower carina in strength, lower carina moving closer on successive postnuclear whorls to the suture below; on the sixth or seventh whorl a flattened collar-like spiral develops adjacent to the lower suture and this forms with the lower primary carina a pair of basal spirals of subequal strength in adults; median area shallowly sulcate in adults and bearing three subequal spiral threads; subsutural slope developing 2 to 3 spiral threads; entire surface covered by fine wavy microspirals which are more pronounced on the three main spirals, those on the basal spiral slightly coarser; suture appressed but weakly indented; aperture subquadrate with the outer lip nearly straight; base weakly concave with a moderately sharp recess just behind the basal angle.

Discussion: This species is closely related to *T. mississippiensis* but can be distinguished at once from it by its greater apical angle: 21° as opposed to 12°. The type of *T. halensis* has an apical angle of 12° to 13°. The phylogenetic significance of the size of the apical angle in *Turritella* is not understood. Since *T. rina* from the Claiborne, *T. bowenae* from the late Oligocene, and *T. pagodaeformis* from the early Miocene all have apical angles of about 18°, *T. mississippiensis* and *T. boycensis* are diverging from the norm in opposite directions. This might suggest that, despite their nearly identical sculptural detail and their stratigraphic succession, *T. boycensis* is not the direct ancestor of *T. mississippiensis*.

Turritella megalobasis Dall (see Mansfield, 1937, pl. 9, fig. 8) from the Tampa Limestone has an apical angle of 24°. However, its early whorls have only one prominent basal spiral whereas in *T. boycensis* there is a weak upper spiral as well. Mansfield made *T. tripartita* Dall (1915, pl. 5, fig. 1) a subspecies of *T. megalobasis*. I am inclined to regard it as more closely related to *T. caelatura*, particularly to the nearly smooth variety with an expanded base to the whorl (pl. 12, fig. 22).

Type: Holotype 498342 USNM and paratype 648851 USNM both from the Mint Spring Formation, USGS localities 6647a and 2664 respectively (Plate 11, figures 20, 26 and 25 respectively).

Occurrence: Mint Spring Formation, USGS localities 2664, 6647a, 7671, 14203, MGS localities 74b, 75b.

Turritella caelatura Conrad

Plate 12, figures 1-21, 23-24

1848b. *Turritella caelatura* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 14, fig. 16. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Turritella caelatura* Conrad. Conrad, Amer. Jour. Conchology, v. 1, pt. 1, p. 32.

Original Description: Conrad, 1848b.

Slightly turreted; whorls flattened, with crenulated or beaded revolving lines, about five to each volution; lines of growth sinuous and apparently forming the crenulated character of the striæ; suture profound.

Description: Shell of moderate size, apical angle 10° to 13°, whorls weakly to moderately concave; protoconch consisting of about one and one-half smooth well-rounded whorls; first four postnuclear whorls also smooth, rounded, and slightly swollen in the lower half; subsequent whorls with a weak, sometimes beaded spiral thread below the suture, and a broad rounded swelling above the suture which on the tenth to twelfth whorl may develop into a moderately strong acutely to elongately beaded spiral thread; early whorls very small, the spire attaining a diameter of one millimeter at about the seventh or eight whorl; adults having a weak to moderately strong central concavity; spiral sculpture variable, strong to weak, two spirals above and two spirals below the concavity, those bordering the concavity being moderately to strongly beaded and corresponding to the two earliest appearing spirals, basal spiral adjacent to the suture, topmost spiral separated from the suture by a narrow smooth area; concavity bearing two weaker but sharply beaded spirals and sometimes one or two weaker spirals between them; sutures channelled to tightly appressed; aperture subrounded; base weakly to moderately rounded, smooth or bearing six to eight weak rounded spirals; body whorl of gerontic specimens swollen, the spiral sculpture becoming obsolete, and the sutures becoming broadly furrowed.

Discussion: This species is confined, as far as is known, to the Mint Spring Formation and transitional beds between it and the underlying Forest Hill Formation. It is one of the most abundant species in the Mint Spring Formation; in fact it may be the most prolific species in the whole Gulf Coast Oligocene. Washed samples of matrix from Vicksburg contain great numbers of immature shells; a two quart sample yielded over 200 individuals of all sizes.

The variability of the species is great and several features seem to vary independently of each other. The spiral sculpture may range from strong to very weak on different specimens. The spiral lirations may be subequal in size all over the whorl, but more commonly they are of unequal size. The median depression may vary in depth and width. The sutures range from furrowed and open to tightly appressed. This character coupled with the strength of the central concavity causes the suture to be variously at the narrowest or widest parts of the spire. In some specimens the posterior wall of the suture stands higher than the anterior wall, making a step at each suture. There is also considerable range in the roundness of the base and in the strength of the basal spirals.

Conrad's type is here refigured (pl. 12, fig. 12). The writer regards *T. caelatura* as having descended from *T. rina* through the Jackson *T. martinensis* and the Red Bluff *T. rubricollis*. Harris and Palmer (1947, p. 288) compared it with their species *T. bunkerhillensis* from the Jackson, possibly the only comparison ever made with it owing to its poor illustration. The similarity lies mainly in the finely beaded spirals, but it is certainly possible that *T. bunkerhillensis* is a basally carinated variety of *T. martinensis*, the two corresponding to the strongly and weakly carinated varieties of *T. rina*, respectively.

Harris and Palmer seemed to doubt that Conrad's species came from Vicksburg for they say, "Conrad described *T. caelatura* with Vicksburg species but in later publications he does not include it among Vicksburg species but does list it as from the Eocene of South Carolina." The reference to "Eocene of South Carolina" probably is to the Cooper Marl, now known to be of Oligocene Age. It contains a *Turritella* closely related to *T. caelatura* as well as to *T. tampae* Heilprin (see Dall, 1915, pl. 14, fig. 1) and *T. fuerta* Kellum (1926, pl. 10, fig. 8).

On two occasions (MacNeil, 1944, p. 1317; 1946, p. 48) I misidentified early Oligocene variants of *T. caelatura* as *T. martinensis*, an Ocala species, and suggested that the type locality of *T. martinensis* was the correlative of some parts of the Marianna Limestone. While these species are closely related and probably represent the same linear series, I do not regard the species occurring in the basal zone of the Oligocene at Ellaville on the Suwannee River and in the quarry six miles southeast of Crystal River, Citrus County, Florida, as being identical with the species from Martin Station in Marion (not Hernando) County, Florida.

Turritella perduensis Mansfield (1940, p.220, pl. 27, figs. 50, 54, 55) from the Chickasawhay Limestone (late Oligocene) of Monroe County, Alabama, may connect *T. caelatura* with *T. altilira*.

The very narrow apical angle and the well defined medium sulcus bordered by moderately strong beaded spirals above and below, as well as the tendency to a swollen, irregularly sculptured gerontic whorl, suggest that *T. caelatura* may be the forerunner of the group of *T. altilira* Conrad. *Turritella altilira* (see Woodring, 1957, pl. 23, figs. 1, 7, 12, 13) was described from the Gatun Formation (Miocene) of Panama. Other representatives of the group are *T. perattenuata* Heilprin from the Caloosahatchee Marl (Pliocene or early Pleistocene) of Florida, and *T. vistana* Hodson (1926, pl. 23, fig. 3, 4; pl. 27, figs. 8, 9, 12) from the Miocene of Venezuela. No representative of this group is known in the Byram Formation although *T. ceibana* Cooke (1928, p. 7, pl. 1, figs. 11, 12) from the Alazan Clay, Vera Cruz, Mexico, may be related.

Type: Holotype 13518 ANSP probably from the Mint Spring Formation judging from the matrix and preservation, Vicksburg, Mississippi (Plate 12, figure 12).

Occurrence: Mint Spring Formation, USGS localities 6647, 14524, 2664, 14162, 13287, UC locality A1050.

Turritella caelatura Conrad var.

Plate 12, figures 22, 25?, 26-28

Discussion: *Turritella caelatura* var. includes the less strongly sculptured variants of the species. There is an even gradation between the extreme types, and collections containing a sufficient number of specimens indicate that local populations contain both types. The spiral lines of the smoother variety, instead of being continuous and bearing coarse beads, may consist of rows of elongate granules, rounded bumps, or thin axially elongate plate-like or baffle-like projections.

This variety is closer to *T. rubricollis* of the Red Bluff Formation in which the spiral lines are very weak or absent. The typical form of the species approaches, on the other hand, some more strongly sculptured Miocene species such as *T. tarponensis* Mansfield. Juvenile specimens of *T. rubricollis* do not have a prominent subsutural spiral as do juveniles of *T. caelatura*.

Occurrence: Mint Spring Formation, USGS localities 7941, 13287, 14071a, UC Locality A1050.

Turritella rubricollis MacNeil n. sp.

Plate 1, figures 2-3, 10

Description: Shell of medium size, apical angle about 13°, whorls nearly straight-sided and weakly sculptured to almost smooth, base not preserved on specimens at hand; protoconch unknown; early postnuclear whorls slightly and uniformly rounded, thus differing from young adult whorls whose lower portion is weakly rounded to very weakly carinate and whose upper portion is straight to very weakly concave; juvenile whorls with two faint spiral threads which are closer to their respective sutures than to each other, adult whorls with as many as seven faint weakly beaded spirals; sutures weakly impressed; aperture not preserved on known specimens; growth lines meeting lower suture at a more advanced point than their intersection with the upper suture, making the growth line angle a minus angle of about 3°.

Discussion: This species is most closely related to the smoother variety of *T. rina* Palmer from the Claiborne (see Palmer, 1944, pl. 1, fig. 14-16) and to *T. martinensis* Dall from the Ocala Limestone (Jackson) of Florida. It is related in turn and probably ancestral to *T. caelatura* of the Mint Spring Formation. The three specimens figured here are nearly smooth to very weakly sculptured and recall the smoother varieties of all three of the above species. It may be that more coarsely sculptured specimens of this species will be found.

The range from a swollen to a moderately carinated outline in the lower part of the adult whorl corresponds to a range found in *T. caelatura* in the early juvenile stage. *Turritella rubricollis* does not have a postnuclear stage in which there is a prominent subsutural spiral ridge as does *T. caelatura*.

Turritella fischeri Palmer (1953, p. 14, pl. 1, figs. 1-5) from the Inglis Member of the Moodys Branch Formation (lower late Eocene) of Florida Geological Survey usage (the basal part of the Ocala Limestone of older usage), probably falls within this complex. Palmer compared this species with *T. carinata* Lea, a species having tricarinate early whorls, but I doubt that her paratype (fig. 1), which is tricarinate, is conspecific with another paratype (fig. 3) which appears to be cingulate. In my opinion this species is related to *T. rina*, and it appears to foreshadow in turn both *T. rubricollis* and *T. caelatura*. The pair of strong cords above the suture in adults suggests that it may also be related to *T. mississippiensis* (see particularly the variants of *T. mississippiensis* on pl. 26, figs. 18, 19) which is believed to have descended from the more strongly sculptured variant of *T. rina*.

Type: Holotype 648840 USNM from the Red Bluff Formation, USGS locality 15058 (Plate 1, figure 3).

Occurrence: Red Bluff Formation, USGS locality 15058, MGS localities 37, 38, 39.

Turritella mundula MacNeil n. sp.

Plate 26, figure 20

Description: Shell of medium size, apical angle about 16° to 17°, whorls weakly rounded, spiral sculpture strong, base very weakly rounded; protoconch unknown; postnuclear whorls with three prominent spiral ridges separated by well rounded interspaces, the two prominent interspaces having a single fine spiral thread, subsutural area with two moderately strong spirals, the lower spiral stronger than the one nearest the suture; basal angle marked by a pair of moderately strong, closely set spiral threads; sutures impressed and located in a shallow rounded depression; aperture subquadrate; base slightly convex and gently rounded.

Discussion: I can find no other Gulf Coast Oligocene *Turritella* resembling this, but it is closely related to *T. atacta* Dall from the Tampa Limestone (lower Miocene) of Florida. The two shoulder spirals are stronger on *T. mundula*, giving it the appearance of having a narrower sutural concavity.

Other close relatives of *T. mundula* are *T. chira* Olsson (1930, p. 67, pl. 12, figs. 1-4) from the upper Eocene of Peru, and *T. meroensis* Olsson (1931, p. 76, pl. 13, figs. 1-4) from the upper Oligocene of Ecuador. It is difficult to make accurate comparisons with only illustrations of these species, but probably the relationship of *T. mundula* with the South American Eocene and Oligocene species is closer than with *T. atacta* from the Miocene of Florida.

Type: Holotype 498362 USNM from the Byram Formation, USGS locality 13286 (Plate 26, figure 20).

Occurrence: Byram Fm., USGS locality 13286.

Turritella carota MacNeil n. sp.

Plate 11, figures 18-19, 23; Plate 26, figure 16; Plate 40, figures 1-3

Description: Shell of medium size, apical angle about 16° to 17°, whorls gently convex to straight sided, sutures inverse-tabulate so that the sides of each whorl project inside the sides of the next older whorl; protoconch not preserved on specimens seen; first postnuclear whorls rounded and bearing about eight faint spiral threads, the second, fourth, and sixth from the bottom soon becoming stronger than the others; whorls becoming less rounded and assuming the adult shape at about the eighth to tenth whorl; adult sculpture consisting of about eight weak primary spiral threads, some with weaker interstitial threads between them and usually with one at the base slightly more prominent than the rest; sutures variable, ranging from deeply indented to shallow; base broadly rounded to subflattened, sculptured by faint threads which nevertheless are divisible into primary, secondary, and tertiary threads, the primary threads numbering about eight; more or less of base exposed at each suture depending on the depth of the sutural attachment; aperture subrounded to quadrate.

Discussion: This species resembles *T. dumblei* Harris (see Bowles, 1939, pl. 32, fig. 9) from the middle Claiborne of Texas so closely that it is difficult to distinguish some specimens from it. The difference lies mainly in the extremes of the varietal range. Some specimens of *T. carota* have a more recessed suture, exposing more of the base of the whorls at each suture. Futhermore, the spiral lines of *T. carota* seem to be consistently coarser than in *T. dumblei* and the interstitial threads less commonly present.

The most likely Jackson relative is *T. clevelandia* Harris (see Harris and Palmer, 1947, p. 290, pl. 36, figs. 1-6). This species has variants with a well recessed suture, but the spirals are less regular with a definite tendency in some specimens to have three of the spirals coarser than the others.

The Miocene relatives of this species are not at all clear, although it may be close to *T. mimetes* Brown and Pilsbry from the Gatun Formation of Panama. Brown and Pilsbry's (1911, pl. 27, fig. 1), Olsson's (1922, pl. 14, fig. 5), and Woodring's (1957, pl. 22, figs. 7, 8) figures of this species all show a well defined single broad interspace in which there is a single weak spiral thread at about the lower third of the whorl. *Turritella carota* has a more inversely tabulate suture than *T. mimetes*, but Olsson's figure, at least, appears to be improperly trimmed. The specimen figured by Olsson (1922, pl. 14, fig. 12) as *T. gatunensis* Conrad compares with the more deeply sutured variety of *T. carota* and in all probability this form and *T. mimetes* are varietal forms of one species. It may be that typical *T. gatunensis* (see Woodring, 1957, pl. 23, figs. 4, 5, 9, 14) is descended from *T. carota*.

Turritella listrota Woodring (1959, p. 160, pl. 26, figs. 1, 6, 7) from the Bohio Formation (late Oligocene) of Panama is more slender, and it has a more evenly tapering spire. Its sculpture is very similar.

Type: Holotype 498294 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 11, figure 23).

Occurrence: Mint Spring Formation, USGS locality 14162, UC locality 1050; Byram Formation, USGS locality 3729.

Turritella aff. T. planigyrata Guppy

Plate 26, figures 21-22

1867. *Turritella planigyrata* Guppy, Sci. Assoc. Trinidad Proc., v. 1, pt. 3, p. 169-170.
1874. *Turritella planigyrata* Guppy. Guppy, Geol. Mag. London, v. 1, p. 408, pl. 18, fig. 5.
1925. *Turritella planigyrata* Guppy. Maury, Bull. Amer. Paleont., v. 10, No. 42, p. 232, pl. 42, fig. 6-8.

1925. *Turritella planigyrata* Guppy. Mansfield, U. S. Nat. Museum, Proc., v. 66, No. 2559, 65 p., 10 pl.

Discussion: Two juveniles having a weak medial carination, and which do not match any known adults are so identified. Without the adult stage it is difficult to make comparisons with other species. Besides *T. planigyrata* (see Mansfield, 1925, pl. 9, fig. 1), juveniles of both *T. mimetes* Brown and Pilsbry and *T. gatunensis* Conrad have a medial carination, but these species have one or two pronounced basal carinations as well. *Turritella acropora* Dall from the Caloosahatchee Marl (Pliocene and early Pleistocene) of Florida has a similar medial carination.

Type: Four "cotypes" 115626 USNM from the Caroni Series (Miocene), Savanetta, Trinidad.

Occurrence: Trinidad: Caroni Series, Savanetta. aff. Mississippi: Byram Formation, USGS locality 13286.

Turritella premimetes MacNeil n. sp.

Plate 11, figure 28

Description: Shell of medium size, apical angle about 19°, whorls gently and evenly rounded, spire weakly constricted at the sutures, sutures weakly appressed; protoconch unknown; early whorls (estimated to be about the third to sixth postnuclear whorls) more strongly rounded and more constricted at the sutures, and bearing three subequal lirations; whorls assuming their adult contour at about the seventh whorl; primary spirals subequal on earliest whorls but the lower two become stronger on later whorls and the lowest spiral becomes the strongest spiral of the shell; secondary and tertiary spirals appearing early and quickly becoming nearly as strong as the primaries; quaternary threads finer than the others and sometimes in pairs or groups of three; basal angle prominent; base subflattened to gently convex, sculptured by about seven primary spiral threads between which are secondary and tertiary threads of nearly equal size; aperture subquadrate.

Discussion: This species belongs to the group of *T. broderipiana* d'Orbigny (see Merriam, 1941, p. 50-51). Its closest relatives are *T. planigyrata* Guppy and *T. mimetes* Brown and Pilsbry (1911, pl. 27, fig. 1), but it differs from them in having three primary spirals rather than a single strong liration on the early whorls. The juvenile stage of some specimens of *T. mimetes* (see Woodring, 1957, pl. 22, fig. 6) has a stronger lower primary spiral.

Turritella premimetes is the oldest known representative of its group that can be recognized with any confidence. The others range from middle Miocene to Recent. The fact that the obvious relatives of this species are post Oligocene is in contrast to the greater similarity of most of the Gulf Oligocene species to Eocene species.

Type: Holotype 498295 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 11, figure 28).

Occurrence: Mint Spring Formation, USGS locality 7671, UC locality A1050.

Turritella aff. T. premimetes MacNeil n. sp.

Plate 1, figures 19-22

Discussion: Three immature specimens from the Red Bluff Formation are possibly related to *T. premimetes* of the Mint Spring Formation. If these three specimens are really conspecific they indicate considerable variability. One of them (pl. 1, fig. 19) approaches *T. premimetes* in shape, but it has a prominently beaded spiral near the center of the whorl. Another specimen (pl. 1, fig. 22) has a similar spiral on the earliest whorls, but the suture is more furrowed and the whorls are slightly concave. A bumpy irregularity on one of the early whorls suggests that it may be a pathologic specimen. At any rate, a larger suite of specimens is needed to properly evaluate this form.

Occurrence: Red Bluff Formation, USGS localities 315, 2633.

Turritella caseyi MacNeil n. sp.

Plate 1, figure 26; Plate 11, figure 16; Plate 26, figures 10-15

Description: Shell small, apical angle about 12°, whorls weakly inflated, sculpture dominated by strongly beaded spirals which vary in number and position, spire moderately constricted at sutures, sutures weakly furrowed; protoconch unknown; first postnuclear whorls well rounded and polished, a very weak subperipheral spiral appearing on about the second or third whorl and followed in less than a turn by two spirals above it and one below it; the four primary spirals remaining prominent in the adult whorls and becoming moderately to strongly beaded; spacing between corresponding spirals not constant in different individuals; secondary and tertiary threads ranging from faint and subequal to irregular with one or two stronger than any of the primary threads; rarely one or two of the secondary threads are beaded, more rarely a secondary may be more strongly beaded than any of the primaries; rarely also, only one of the primaries is beaded; basal angle sharp to blunt; base subflattened and finely striated; aperture subquadrate.

Discussion: Most of the known specimens of this species are in the Casey collection and came, presumably, from the Byram Formation. One immature specimen was obtained from the Mint Spring Formation by the writer, and an old collection from the Red Bluff Formation contains a fragment that probably belongs to it.

The relationships of this species are not clear. Its most likely relative is *T. perdita* Conrad from the Jackson. Both species are extremely variable and the assumption of relationship is based on a small percentage of individuals (compare pl. 26, fig. 10, with Harris and Palmer, 1947, pl. 37, fig. 3). No previously described species from the American Oligocene is close to it unless a variant of *T. caleta* Olsson from the late Eocene or Oligocene of Panama figured by Woodring (1957, p. 100, pl. 15, fig. 14-16) can be so regarded. The Panama form has strongly concave whorls and the heavy basal spiral is farther from the suture.

The strongly beaded spirals may not be a reliable indicator of relationship. This species has at least a superficial resemblance to some other species of widely different age; *T. macneili* Stephenson and *T. thomsonia* Stephenson from submarine Cretaceous beds on Georges Banks (see Stephenson, 1936, pl. 5, figs. 13, 14) and *T. filiola* Yokoyama from the Pliocene of Formosa (Yokoyama, 1928, pl. 4, fig. 7).

Type: Holotype 498364 USNM from the Byram Formation judging from the matrix and preservation, "upper bed," Vicksburg, Mississippi - USGS locality 13286 (Casey collection) (Plate 26, figure 10). Paratypes 498364a and 498365 both from the Byram Formation, USGS locality 13286 (Plate 26, figures 11 and 14 respectively).

Occurrence: Mint Spring Formation, USGS localities 13286, 7671; Red Bluff Formation, USGS locality 2633.

Family MATHILDIDAE Dall, 1889

Genus **MATHILDA** Semper, 1865

Mathilda Semper, Jour. Conchyliologie, v. 13, p. 330.

Type (by subsequent designation, De Boury, 1883): *Turbo quadricarinatus* Brocchi. Pliocene, Italy.

The designation of this type is often credited to Cossmann but De Boury's overlooked designation is older. Harris and Palmer (1947, p. 234) interpreted a statement of Semper's as an original designation but the context is a reference to a type of thing, not to the type of a thing.

Mathilda has a superficial resemblance to some species of *Turritella* and *Epitonium*. It has a heterostrophic protoconch like the pyramidellids and some other opisthobranchs.

Meyer (1886, p. 68) described two species from the Red Bluff under *Eglisia*. Neither type has a protoconch preserved. Later (1887-a, p. 5, pl. 1, fig. 12) he figured a specimen from the Jackson with a heterostrophic protoconch which he identified as one of his Red Bluff species and reassigned it to *Mathilda*. Meyer's other species is here referred to *Mathilda* and a species found in the Mint Spring Formation is related to a species described from the Miocene of Jamaica.

Mathilda regularis (Meyer)

Plate 1, figure 14; Plate 26, figure 17;
Plate 43, figures 5-6

1886. *Eglisia regularis* Meyer, Alabama Geol. Survey, Bull. 1, pt. 2, p. 68, pl. 2, fig. 3.
1887. ?*Mathilda regularis* (Meyer). Meyer, Bericht Senckenberg. naturf. Gesell., p. 5, pl. 1, fig. 12.
1892. *Mathilda regularis* (Meyer). Dall, Wagner Free Inst. Sci. Trans., v. 3, pt. 3, p. 320.
1897. *Mathilda regularis* (Meyer). Aldrich, Bull. Amer. Paleont., v. 2, No. 8, p. 6, pl. 1, fig. 1a, b, c.
1912. *Mathilda regularis* (Meyer). Cossmann, Essais Paleoconch. Comp., v. 9, p. 10.
1937. *Mathilda regularis* (Meyer)? Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 89, pl. 9, fig. 7.
1947. *Mathilda regularis* (Meyer)? Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 234, pl. 28, fig. 9.
1966. *Mathilda* sp. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 751.
1977. *Mathilda regularis* (Meyer). Dockery, Mississippi Geol. Survey, Bull. 120, p. 46, pl. 3, fig. 11.

Original Description: Meyer, 1886.

Whorls rather rapidly increasing in size, regularly rounded; covered by four sharp elevated revolving lines, the uppermost of which is the smallest; the interstices with numerous transverse riblets, which in connection with the revolving lines give to the surface an almost cancellate appearance.

Locality.—Red Bluff, Miss.

Discussion: The type is here refigured. Neither the apical whorls nor the aperture is preserved. It has five strong nearly equidistant spirals connected by closely set thin cross bar-like axials. There are no interstitial spiral riblets, a feature possessed by most species of the genus.

A nearly perfect specimen from the Byram Formation at Vicksburg was figured by Aldrich, showing without question that it is a *Mathilda*. The coarse basal spirals on Aldrich's specimen are not visible on the type, but they are similar to those on the Byram specimen figured here (pl. 26, fig. 17) as well as to those of the Mint Spring form here identified as *M. plexita* Dall.

A more inflated *Mathilda*, *M. leana* Aldrich (1897, p. 14, pl. 1, fig. 2) was described from the Bashi Marl Member of the Hatchetigbee Formation (late early Eocene) of Alabama. The same species was later identified by Aldrich (1907, p. 10, pl. 1, figs. 4, 5) from the Matthews Landing Marl Member of the Porters Creek Formation (Paleocene) of Alabama.

Type: Holotype 644583 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 1, figure 14).

Occurrence: Red Bluff Formation, MGS locality 38; Mint Spring Formation, MGS locality 89; Byram Formation, USGS locality 14682; Moodys Branch Formation, MGS locality 1; ? Gosport Sand, Claiborne Bluff, Alabama River, Monroe County, Alabama (Harris and Palmer, 1947, p. 235).

Mathilda inaequistriata (Meyer)

Plate 1, figure 16

1886. *Eglisia inaequistriata* Meyer, Alabama Geol. Survey, Bull. 1, pt. 2, p. 68, pl. 2, fig. 4.

Original Description: Meyer, 1886.

The only specimen found, a fragment of two whorls, has less rounded whorls than the preceding species; they are covered by six revolving striæ, alternating in size and far less elevated than in *Eglisia regularis*; the little riblets in the interstices are similar to those in the preceding species; aperture rounded; subeffuse anteriorly; base flattened, spirally striated.

Locality.—Red Bluff, Miss.

Discussion: The holotype is the only known specimen. It consists of a nearly complete body whorl and parts of the penultimate whorl. It has 5 primary spirals of which the lower 3 are closely set and the upper 2 are more widely separated with a weaker interstitial spiral between them. The basal spirals of *M. inaequistriata* are much finer than the basal spirals of *M. regularis*.

Type: Holotype 644584 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 1, figure 16).

Occurrence: Red Bluff Formation, Red Bluff, Mississippi.

Mathilda aff. M. plexita Dall

Plate 11, figures 21-22

1896. ?*Mathilda plexita* Dall, U.S. Nat. Museum, Proc., v. 19, p. 320, pl. 29, fig. 5.

1903. ?*Mathilda plexita* Dall. Dall, Wagner Free Inst. Science Trans., v. 3, pt. 6, p. 1585.

1928. ?*Mathilda plexita* Dall. Woodring, Carnegie Inst. Washington, pub. 385, p. 406, pl. 32, fig. 7, 8.

Discussion: Only two fragments of this form were obtained, neither of them having a complete aperture. The primary spirals on the Oligocene form may be heavier than on the type of *M. plexita* (see Woodring's figure of the holotype; 1928, pl. 32, fig. 7) and the baffle-like axials do not appear to cross the spirals as they do on *M. plexita*.

Not enough specimens are known to be certain of the possible limits of variation. The Oligocene form may be distinct, but the fragments on hand are not considered sufficient for the differentiation of still another species.

Type: Holotype 115436 USNM from the Miocene of Jamaica.

Occurrence: Miocene of Jamaica; aff. Mint Spring Formation, USGS localities 13287, 7671.

Family VERMETIDAE Rafinesque, 1815

Genus SERPULORBIS Sassi, 1827

Serpulorbis Sassi, Gior. ligust. Sci. Lett. Arti. Genova, v. 1, art. 5, p. 482, 1827.

Type (by monotypy): *S. polyphragma* Sassi (=*Serpula arenaria* Linné). Recent Mediterranean.

Serpulorbis sp.

Plate 1, figures 27, 34; Plate 13, figure 4; Plate 43, figure 7

Discussion: No identification of these forms is attempted beyond the generic assignment. This species is common in the basal Mint Spring Formation along the Chickasawhay River where it is found attached to lithified clay clasts (Plate 43, figure 7).

Occurrence: Red Bluff Formation, USGS localities 319, 320; Mint Spring Formation, USGS locality 14203, MGS localities 74b, 75b, 90, 100; Byram Formation, MGS localities 93.

Superfamily CERITHIACEA Fleming, 1822

Family CERITHIIDAE Fleming, 1822

Subfamily CERITHIINAE Fleming, 1822

Genus SEMIVERTAGUS Cossmann, 1889

Semivertagus Cossmann, Ann. Soc. Roy. Malac. de Belgique, v. 24, p. 32, 1889.

Type (by original designation): *Cerithium unisulcatum* Lamarck. Eocene, Paris Basin, France.

This is the first undoubted record of a *Semivertagus* in America. The genus is known in the Cuisian, Lutetian, and Bartonian of France. In England it is found in the Upper Bracklesham beds (see

Gilbert, 1933, p. 51, for an extended synonymy of the type species). Thiele (1929, p. 213) assigned the living Indo-Pacific species, *Cerithium lacteum* Kiener to *Semivertagus*, but I do not see any generic relationship between it and the Eocene and Oligocene species.

The incomplete shell that Dall (1916, p. 515, pl. 87, fig. 7) described as *Cerithium eutextile* may be a *Semivertagus*. It comes from residual cherts near Bainbridge, Georgia. The accumulation of chert masses is derived from a thick section of limestone probably ranging in age from Marianna to Chickasawhay.

Semivertagus menthafontis MacNeil n. sp.

Plate 13, figures 19?, 20-22

Description: Shell below medium size for the family, moderately inflated, spire rounded, whorls weakly rounded, aperture elongate, inclined, and detached; protoconch (on paratype, a juvenile believed to be this species) consisting of over two small smooth rounded whorls; early postnuclear whorls (paratype) expanding rather rapidly and gradually developing weak moderately narrow spiral swellings, weak axial ripples appear on about the third whorl; adult sculpture consisting of four to five low rounded, closely set spiral bands and weak, slightly inclined axials (about eight visible from an angle), the axials becoming weaker or obsolete on the last whorls; sutures shallow but well defined; aperture subovate in juveniles with the siphonal canal lipped and slightly flaring (paratype), the mature aperture crescent shaped with the inner lip flaring and having a sigmoid curvature, inner lip strongly detached, and notch moderately strong, siphonal canal extremely pointed and strongly inclined towards horizontal; base moderately rounded.

Discussion: The paratype used in the description of the juvenile characters is presumed to be the young of this species. Its apertural characters are so unlike those of the mature aperture that its identity was not recognized at first — and the presumption may be erroneous.

There is nothing else known in the American Tertiary with which this species could be confused, unless it might be the "*Cerithium*" *obesum* group of which several subspecies have been recognized by Pilsbry (1922, p. 371-372, pl. 33) in the Miocene of the Dominican Republic. The latter species has well defined nodes below the suture.

It is shorter and more inflated than *S. unisulcatum* (see Cossmann and Pissarro, 1911, pl. 25, fig. 137-3).

Type: Holotype 648862 USNM and paratype 498266 USNM both from the Mint Spring Formation, USGS locality 14071a (Plate 13, figures 22 and 19 respectively).

Occurrence: Mint Spring Formation, USGS locality 14071a, MGS localities 97, 99, 100.

Semivertagus silvacollinis Dockery n. sp.

Plate 43, figures 8-9

Discussion: This species has the same general form as that described by MacNeil for *S. menthafontis*. It differs from that species in its smaller size and more narrow spire. Ten whorls of the teleoconch are preserved on the holotype; the protoconch has not been observed. The suture is distinct and moderately impressed. The first three whorls of the holotype have five spiral lirae, the next two have seven, the sixth and seventh have eight, the eighth and ninth have nine with the upper two lirae merging to form a broad subsutural collar. The body whorl has nine flattened spiral lirae of different sizes above the aperture and five below. There are faint axial ribs on the holotype. These ribs are more prominent on the specimen illustrated in Plate 43, figure 8, as are the spiral lirae. The name of this species is derived from the Latin *silva*, forest, and *collis*, hills, which refers to its horizon.

Type: Holotype 376662 USNM from the Forest Hill Formation, MGS locality 75a (Plate 43, figure 9).

Occurrence: Forest Hill Formation, MGS locality 75a.

Subfamily CERITHIOPSINAE
H. and A. Adams, 1854

Genus **BITTIUM** Leach (by Gray), 1847

Bittium Leach, Gray, Ann. Mag. Natural Hist., v. 20, p. 270, 1847.

Type (by subsequent designation, Gray, 1847): *Murex reticulatus* Montagu (= *Strobiformis reticulatus* Da Costa). Recent, Europe.

Gray definitely published Leach's manuscript as a posthumous publication so names in it should not be regarded as having been validated by Gray. He designated the type a month later.

"Bittium" acuta (Meyer)

Plate 2, figure 28

1886. *Chemnitzia acuta* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 70, pl. 2, fig. 6
1890. *Bittium acuta* Meyer. Dall, Wagner Free Inst. Science Trans., v. 3, pt. 1, p. 262.

Original Description: Meyer, 1886.

Whorls eleven, nearly flat; aperture ovate. The ornamentation consists of sharp, transverse ribs, crossed by less prominent spiral lines. Each of the four smooth, embryonic whorls is much smaller than the first ornamented whorl, thus forming a pointed nucleus; suture distinct.

Locality.—Red Bluff, Miss.

Chemnitzia Claibornensis, Heilpr., sp., has the revolving lines not elevated, but impressed; and the transverse ribs are not sharp lines, but obtuse folds.

Description: Shell small, slender; spire high, whorls rounded with moderately strong axial sculpture, stronger on early whorls; base rounded, aperture ovate; protoconch slender and pointed (first whorl broken on type), consisting of over three smooth rounded whorls; first two postnuclear whorls expanding more rapidly than nuclear whorls but successive whorls expanding less rapidly; axial ribs appear weakly on first postnuclear whorl and increase in strength on the second and third whorls, diminishing thereafter, axials narrow and curved, concave on side of advanced growth (about 5 to 6 visible from an angle); spiral sculpture consisting of moderately weak raised ribs in the axial interspaces but not crossing the axial ribs (5 to 6 on each whorl); sutures appressed and very weakly upturned; base broadly rounded, not set off by a basal angle, both axial and spiral sculpture becoming obsolete on base; aperture subovate, well rounded anteriorly, outer lip broken on type, inner lip rounded and weakly raised in the umbilical region, appressed on parietal wall; no well defined umbilicus.

Discussion: I can find nothing from the American early Tertiary with which I can compare this species. Dall said it is a *Bittium* allied to *Alaba* and, indeed, its protoconch is more like that found in *Alaba* and *Alabina*. It has some resemblance to a specimen from the Miocene of the Dominican Republic figured by Maury (1917, pl. 21, fig. 17) as *Bittium asperoides* Gabb, but it has less resemblance to one from the Miocene of Panama figured by Woodring (1959, pl. 38, fig. 9) as *Alabina asperoides asperoides* (Gabb). The holotype is the only specimen known.

Type: Holotype 644587 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 2, figure 28).

Occurrence: Red Bluff Formation, "Red Bluff, Mississippi."

Subgenus ARGYROPEZA Melville and Standen, 1910

Argyopeza Melville and Standen, Proc. Zool. Soc. London, p. 371, 1901.

Type (by monotypy): *A. divina* Melville and Standen. Recent, Gulf of Oman.

Argyropeza appears not to have been recognized previously in America. Of the possible American species, "*Bittium*" *koeneni* Meyer from the Jackson of Mississippi seems to be more typical than the two Oligocene species described here. *Bittium pericallum* Woodring (1959, p. 179, pl. 38, fig. 11) from the upper part of the Gatun Formation (middle Miocene) of Panama also seems to be an *Argyropeza*. Its sculpture is similar to that of juveniles of *Cerithiella langdoni* (Aldrich) but the protoconch is smooth and has only two and one-half to three whorls whereas that of *C. langdoni* has six whorls and is sculptured with curved fine axial riblets. Although Thiele treated *Argyropeza* as a subgenus of *Bittium*, it is sometimes regarded as a distinct genus. The matter will not be gone into here, but possibly the species here described represents a subgroup of typical *Argyropeza*.

Bittium (Argyropeza?) ottoi MacNeil n. sp.
Plate 14, figure 18; Plate 27, figure 17;
Plate 43, figures 10-17

Description: Shell small, inflated, whorls moderately rounded, columella short, base moderately broad, flattened; protoconch smooth, about two and one-half whorls; first postnuclear whorl with two prominent spiral cords, next whorl with three spirals and moderately heavy axial ridges, last whorl with strong slightly curved axials (about seven visible) and seven spiral cords, two of them being just below the basal angle and not crossed by spirals; base with a broad smooth depressed band, four to five weak spiral cords nearest the columella; aperture subovate with a moderate angle at the parietal attachment, and a slightly recurved siphonal notch.

Discussion: This species is doubtfully referred to *Bittium*. It is closely related to at least one species from the Lutetian, *B. transenna* (Bayan), included in *Bittium* by Cossmann and Pissarro (1911, pl. 26, fig. 142-2). The curved axials and basal pattern are nearly identical with those of that species. I can find nothing like it in the American Tertiary.

It appears to be closely related to a Recent species collected by the Deutschen Tiefsee - Expedition and described by Thiele as *Argyropeza involuta* (Thiele, 1925, p. 86, pl. 21, fig. 20).

Argyropeza was regarded as a subgenus of *Bittium* by Thiele (1929, p. 212), but it usually has two beaded spirals on each whorl; rarely three. The present species has four. This is a small difference, however, in view of the other characters. *Bittium koeneni* Meyer (see Harris and Palmer, 1947, p. 301, pl. 39, figs. 7-9) from the Jackson is probably an *Argyropeza*. It is much more slender than *B.* (*A.?*) *ottoi*, and its base is less flattened.

Type: Holotype 498265 USNM from the Mint Spring Formation, "lower bed" at Vicksburg (Casey), USGS locality 13287 (Plate 8, figure 18).

Occurrence: Red Bluff Formation, MGS locality 38; Forest Hill Formation, MGS locality 75a; Mint

Spring Formation, USGS locality 13287; Byram Formation, USGS locality 5615, MGS locality 106.

Bittium (Argyropeza?) caseyi MacNeil n. sp.

Plate 14, figures 15-16, 17, 19

Description: Shell medium inflated, whorls weakly rounded, columella moderately short, base moderately narrow, inclined about 45°; protoconch smooth and polished, subnaticoidal and slightly inclined, about one and one-half whorls; first postnuclear whorl with two moderately strong spiral cords, second and third whorls with two strong spirals and a weak third cord above them, weak axials (six to seven visible from an angle) intersect the spirals to form weakly pointed nodes, five moderately strong rounded spiral cords are present on the later whorls and they form elongate beads where they cross the axials, two similar spirals occur below the periphery on the base of the body whorl but the axials do not cross them; base moderately inclined and weakly concave, a broad, weakly depressed smooth band occupies the middle part of it and three faint spiral cords border the columella; aperture subquadrate; inner lip not distinct; no apparent parietal callus; sutures located in narrow but moderately deeply recessed furrows.

Discussion: This species has the same base plan as *B. (A.?) ottoi* but it is more slender; there are two to three subperipheral spirals, a smooth depressed area and three faint spirals near the columella. The spiral sculpture in *B. (A.?) caseyi* predominates over the axial sculpture whereas in *B. (A.?) ottoi* the axial sculpture predominates over the spiral sculpture.

In both species the sculpture on the second postnuclear whorls consists of two spirals crossed by narrow axials which form pointed projections at the point of intersection. This is the kind of sculpture found on the adult whorls of the type of *Argyropeza*. Adults of the species described here have more spirals on the adult whorls. *Bittium koeneni* Meyer, probably an *Argyropeza*, has two prominent spirals on its adult whorls but there are also one or two fine secondary spiral threads.

I can find nothing like this species elsewhere in the American Tertiary.

Type: Holotype 648877 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 14, figure 17).

Occurrence: Mint Spring Formation, USGS localities 14071a, 13287.

Genus **EUMETULA** Thiele, 1912

Eumetula Thiele, Deutsche Sudpolar - Expedition, v. 13, p. 305, 1912.

Type (by original designation): *E. dilecta* Thiele. Recent, Antarctic.

Eumetula vicksburgella MacNeil n. sp.

Plate 2, figure 7; Plate 13, figures 23-25

Description: Shell small, spire high and slender, whorls straight sided to slightly concave, columella short; protoconch unknown; earliest known postnuclear whorl (probably about the third) rounded with strongly curved thin, closely set axial riblets and a poorly defined spiral cord; adult whorls with two strong spiral cords ornamented with strong spirally elongate beads, sometimes with a weak unbeaded spiral thread between them, prominent smooth, sharp spiral cords at both the base and top of the whorl, and rather subdued axial ribs (about seven or eight visible from an angle); sutures indistinct and located just above the sharp, unbeaded spiral, the basal smooth spiral of the whorl above being concealed; aperture incomplete on known specimens; columella short and bearing a single sharp fold which is inclined about 30 degrees from horizontal; base flattened and with a single spiral thread set back from the basal angle, the remainder smooth and weakly concave.

Discussion: This species is the first *Eumetula* to be reported from the American Oligocene. One Eocene species was described under the name of *Cerithiopsis regularoides* Aldrich (1907, p. 9, pl. 1, fig. 7). It comes from the Bashi Marl Member of the Hatchetigbee Formation (early Eocene) of Alabama. *E. regularoides* has much weaker spiral threads than the Oligocene species. It is doubtful that *Cerithiopsis fluviatilis* Aldrich (1897, pl. 1, fig. 4), another Bashi species with which Aldrich compared *C. regularoides*, is a *Eumetula*.

Some fairly close relatives are now living in warm water on the west coast of America, among them being *E. eucosmia* (Bartsch, 1911a, p. 568, fig. 3) from the Galapagos Islands, and *E. intercalaris* (Carpenter) (Bartsch, 1911-a, p. 566, fig. 1) from the Gulf of California. The Recent east coast species, *E. subulata* (Montagu) does not appear to be as much like *E. vicksburgella* as does the west coast species. A specimen identified as "*Cerithiopsis*" *subulata* occurs in the Choptank Formation (middle Miocene) of Maryland (see Martin, 1904, p. 230, pl. 55, fig. 8). It has rounded rather than spirally elongate beads and a wider apical angle.

Type: Holotype 481015 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 2, figure 7).

Occurrence: Red Bluff Formation, USGS locality 5264; Mint Spring Formation, USGS locality 7671.

Genus **CERITHIELLA** Verrill, 1882

Cerithiella Verrill, Trans. Connecticut Acad., v. 5, pt. 2, p. 522, 1882. (New name for *Lovenella* Sars, 1878, non Hincks, 1869).

Type (of *Lovenella*, by monotypy): *Cerithium metula* Loven. Recent, Europe.

Cerithiella langdoni (Aldrich)

Plate 2, figures 4-6; Plate 14, figures 22-23; Plate 44, figure 4

1885. *Cerithium langdoni* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 151, pl. 3, fig. 14.
1886. *Cerithium langdoni* Aldrich. Aldrich, Alabama Geol. Survey, Bull. 1, No. 1, p. 34, pl. 1, fig. 14.
1886. *Cerithiopsis aldrichi* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 71, pl. 2, fig. 14.
1892. *Cerithiopsis (Metaxia) aldrichi* Meyer. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 270.
1892. *Cerithiopsis (Lovenella) langdoni* Aldrich. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 270.
1937. *Cerithiella langdoni* Aldrich. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 226.
1937. *Cerithiella aldrichi* Meyer. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 226, pl. 29, fig. 2.
1947. *Cerithiella aldrichi* Meyer. Harris and Palmer, Bull. Amer. Paleont, v. 30, No. 117, pt. 2, p. 304.

Original Description of *C. langdoni*: Aldrich, 1885.

Shell subulate; whorls 13 to 15(?); surface cancellated; suture indented; about five prominent revolving lines on each whorl; whorls compressed suddenly at both sides of the suture; longitudinal ribs numerous, prominent, wavy, continuing over the impressed spaces and terminating at the suture; revolving line next below the suture splitting into two on the lower whorls; body whorl carinated; mouth nearly round; canal recurved, short, rather close. Length of that part of the shell remaining, 7/10 of an inch.

Locality, Red Bluff, Miss.

The aperture in the specimens on hand is not entire, and several whorls are missing from the spire. A very distinct species approaching *C. nassula* Con. The peculiar indentations around the suture give the shell a screw-shaped appearance.

Named in honor of D. W. Langdon, Jr., Assistant on the Alabama State Geological Survey.

Original Description of *C. aldrichi*: Meyer, 1886.

Subulate; whorls convex; oldest whorls covered by four spiral lines, the second one from above is the smallest and last developed one; they are covered by transverse ribs, about twelve on each whorl; the embryonic whorls are numerous and rounded—on the oldest of them the spiral lines commence to appear, while the others are only covered by numerous curved, transverse ribs. Base covered with minute elevated, revolving lines, the outermost of which is larger; canal reflected.

Localities,—Red Bluff, Miss., Jackson, Miss., Claiborne, Ala.

Description: Shell large for the genus, spire high and slender, whorls rounded on juveniles, flattened on adults, base flattened, columella short and moderately twisted; the only known protoconch has over five well rounded whorls (the tip whorl is missing) which are ornamented with closely set delicate curved raised axials, increasing in strength on successive whorls; first postnuclear whorl with two spiral cords and narrow slightly inclined axial ribs (six to seven visible from an angle) which make a moderately sharp low point at their intersection; a third spiral appearing on the second postnuclear whorl and a fourth spiral on the eighth whorl, full grown adults having four strong spirals on the spire whorl and a fifth at the basal angle which is covered on the spire whorls by the suture; base sculptured by five to six narrow but sharp spiral threads, becoming weaker towards the columella; sutures shallowly entrenched in juveniles, but a raised subsutural collar formed by two closely spaced spiral threads develops in adults and sets off the suture as a deeper U-shaped trench; aperture small and subquadrate; siphonal canal inclined about 45 degrees, short but moderately deep.

Discussion: Without any doubt *C. nassula* (Conrad) from the Claiborne, *C. jacksonensis* (Meyer) from the Jackson, and *C. langdoni* are all very closely related, but it is doubtful if any of them should be combined. Palmer (1937, p. 225-226) and Harris and Palmer (1947, p. 305-306) discussed the conclusions of Dall, DeGregorio, and Cossmann on their synonomy, and it need not be repeated here.

The recognized difference between the juvenile and adult sculpture, combined with the fact that these long slender shells are almost invariably found broken, has made the assignment of individual fragments difficult. One specimen figured here (pl. 2, fig. 5) adequately bridges the gap between the juvenile form described as *C. aldrichi* and the adult stage described as *C. langdoni* and shows beyond question that these Red Bluff forms are the same species, even though they were thought by Dall to belong to different subgenera.

Cerithiella jacksonensis (see Harris and Palmer, 1947, p. 305, pl. 39, figs. 5, 6) has more rounded adult whorls than *C. langdoni*. Harris and Palmer attempted to dispose of the possibility that another Jackson species described by them, *C. ouachitensis*, is the young of *C. jacksonensis*, but their argument is not convincing; this appears to be a situation similar to that of *C. langdoni* and *C. aldrichi*.

Probably the lower Claiborne species, *C. heckscheri* Palmer (1937, p. 227, pl. 29, figs. 1-6, 13, 14), is more like *C. langdoni* than the other Eocene species. The whorls of *C. heckscheri* are slightly concave, but the sculpture is similar; both have a prominent collar-like spiral below the suture.

Some closely related species appear to be present in the Eocene and and Oligocene of Europe. I hesitate to make any comparisons without specimens. However, one species described by Wrigley (1940, p.11, figs. 13,

14) as *Orthochetus elongatus*, from the London Clay, may be very closely related to *C. langdoni*. A similar discrepancy between juvenile and adult stages is shown by Wrigley's figures. The species with which Wrigley associates it to show it is an *Orthochetus*, *Cerithium charlesworthi* Prestwick, has a considerably longer columella. Wrigley probably is correct in believing *C. charlesworthi* to be congeneric with *C. leufroyi* Michelottis (see Cossmann, 1906, p. 95, pl. 4, fig. 15, 16), the type of *Orthochetus*, but "*O.*" *elongatus* does not seem to me to belong to that group.

Type: Holotype of *C. langdoni* 644615 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 2, figure 6). Holotype of *C. aldrichi* 644589 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 2, figure 4).

Occurrence: Red Bluff Formation, USGS locality 320; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 7671.

Cerithiella langdoni (Aldrich) var.

Plate 44, figures 2-3

Discussion: The protoconch of this variation differs from the protoconch of *C. langdoni* s. s. in that it has fewer and less crescentic axial ribs, it is less elevated, and it has an abrupt contact with the teleoconch.

Occurrence: Red Bluff Formation, MGS locality 38.

Cerithiella nassuloides MacNeil n. sp.

Plate 14, figures 20?, 24-25, 26?; Plate 44, figures 1,6

Description: Shell small, spire high, columella short, whorls moderately rounded, greatest inflation at about mid-point of the whorl; protoconch small and pointed, consisting of about four smooth whorls having a slight irregularity in their coiling; first postnuclear whorl more strongly expanding than protoconch whorls and becoming sculptured after a crudely pitted first quarter turn by two prominent spiral cords and a weaker third spiral just below the suture, the spirals crossed by fairly strong axials (seven to eight visible from an angle); all spiral cords and the axial ribs becoming subequal in strength on the adult whorls, forming rounded bead-like bumps at their intersection, the interspaces being round-bottomed, square to axially elongate pits; body whorl with a fourth less projecting irregularly beaded spiral cord which is covered on the spire whorls by the suture; sutures moderately open; aperture subquadrate, produced anteriorly to form a short siphonal notch truncating the base of the columella at an angle of about 45 degrees; base smooth except for axial wrinkles, depressed below the level of the basal spiral cord.

Discussion: This species appears to be more closely related to *C. nassula* (Conrad) from the Claiborne (see Palmer, 1937, p. 224, pl. 29, fig. 9) than to the other American Oligocene or Jackson species. Judging from Palmer's figure, *C. nassuloides* differs from *C. nassula* in havng more rounded whorls with the lowermost spiral cord set back farther on the basal slope. The axials on the Claiborne species are not as heavy although this character could be variable.

Palmer (1937, p. 225) regarded *C. conica* (Aldrich) (1897, p. 12, pl. 1, fig. 4), also from the Claiborne, as a synonym of *C. nassula*. If this is true the strength of the axials varies considerably. However, I am inclined to believe these are different species; *C. conica* is closely related to *C. preconica* Palmer, a lower Claiborne species. *Cerithiella jacksonensis* (Meyer) has more strongly curved axials, and its base, judging from Harris and Palmer's figure (1947, pl. 39, fig. 5), has moderately strong spiral sculpture.

Type: Holotype 498263 USNM and paratype 498262 USNM both from the Mint Spring Formation, USGS locality 14162 (Plate 14, figures 24 and 25 respectively).

Occurrence: Red Bluff Formation, MGS locality 38; Mint Spring Formation, USGS locality 14162, MGS locality 89.

Cerithiella leafensis MacNeil n. sp.

Plate 14, figure 21

Description: Shell small, slender, apical angle very narrow, whorls flattened, columella short and inclined about 45 degrees; protoconch unknown; earliest whorl preserved more rounded than subsequent whorls, suggesting early postnuclear whorls may be well rounded; adult whorls flattened and sculptured by three equisized spiral cords and many (about 12 visible from an angle) vertical axial riblets, the spirals and axials making a reticulate pattern with bead-like swellings at the intersections; body whorl having a moderately strong unbeaded spiral along the line of the parietal attachment and a weaker spiral just below it; base smooth except for weak curved growth lines and weakly convex; aperture small with a well formed, strongly twisted short siphonal canal; columella short and bearing a sharp narrow fold which bounds the canal and is inclined about 45 degrees; sutures not prominent, located in shallow furrows only slightly stronger than the spiral interspaces.

Discussion: This species does not resemble closely any American Eocene species described so far, and is even more remote from any Oligocene species. It may be fairly close to a species figured from the lower Oligocene of South Limburg by Albrecht and Valk (1943, p. 37, pl. 3, figs. 71-74) as *Cerithiopsis* (*Cerithiopsis*) *dactylus* var. B (von Koenen). It differs from it mainly in having its spiral cords of equal strength whereas the European species has a weak middle spiral.

Only one specimen was found so that the amount of variation is unknown.

Type: Holotype 648882 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 14, figure 21).

Occurrence: Mint Spring Formation, USGS locality 7671.

Cerithiella sp.

Plate 44, figure 5

Discussion: This species is known from the single specimen figured. It has a slender spire with six smooth whorls forming the protoconch, the last two of which have a median carina, and four and one half whorls forming the teleoconch. Whorls of the teleoconch are cancellate with one subsutural spiral cord and two medial spiral cords crossing longitudinal ribs of equal strength. The aperture is elongate, and the canal is only slightly inclined.

Occurrence: Byram Formation, MGS locality 106.

Genus **SEILA** A. Adams 1861

Seila Adams, Ann. Mag. Natural Hist. (3), v. 7, p. 131, 1861.

Type (by subsequent designation, Dall, 1889): *Triphoris dextroversa* A. Adams and Reeve. Recent, China seas.

Seila aff. S. constricta (H. C. Lea)

Plate 13, figure 9

1841. *Terebra constricta* H. C. Lea, Amer. Jour. Science, v. 40, p. 100, pl. 1, fig. 18.
1892. *Seila constricta* (H. C. Lea). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 267.
1937. *Seila constricta* (H. C. Lea). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 222-223, pl. 30, fig. 5, 12-13.
1966. *Seila constricta* (H. C. Lea). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 900.
1977. *Seila constricta* (H. C. Lea). Dockery, Mississippi Geol. Survey, Bull. 120, p. 48-49, pl. 3, fig. 15.

Discussion: A single incomplete specimen was obtained from the Mint Spring Formation. It has a very narrow apical angle and compares favorably in this respect with the Claiborne species (see Palmer, 1937, p. 222, pl. 30, fig. 13). All of the upper Tertiary and Recent American species appear to be relatively shorter and more rapidly expanding. Martin (1904, p. 228, pl. 55, fig. 6) figured a specimen from the Calvert Formation (lower Miocene) of Maryland as *Seila adamsii* (H. C. Lea), the Recent Atlantic species. Its apical angle is greater and the whorls are weakly convex rather than weakly concave as in the Mint Spring form. Mansfield (1930, p. 97) placed the Calvert species in the synonymy of *S. clavulus* (H. C. Lea), a species from the Yorktown Formation (upper Miocene) of Virginia. A specimen figured by him (1930, pl. 13, fig. 7) from the Choctawhatchee Formation (upper Miocene) of Florida has the same shape as the Calvert form.

Type: Lectotype 13159 ANSP from the Gosport Sand, Claiborne Bluff, Alabama River, Alabama.

Occurrence: Gosport Sand, Claiborne Bluff, Alabama; Moodys Branch Formation, MGS locality 1; aff. Mint Spring Formation, USGS locality 14203.

Seila sp.

Plate 45, figure 15

Discussion: The figured specimen in Plate 45, figure 15, is placed as *Seila* sp. though it is possible that it is the young of the previously mentioned species. The specimen has a protoconch of three poorly preserved whorls and a teleoconch of six whorls. Whorls of the teleoconch have three prominent spiral cords crossed by less prominent longitudinal lirae. The aperture is circular, and the canal is short. The apical angle is much greater than that of the forementioned species, but this angle may change with growth.

Occurrence: Mint Spring Formation, MGS locality 89.

Subfamily DIASTOMATINAE Cossmann, 1895

Genus **ALABA** H. and A. Adams, 1853

Alaba H. and A. Adams, Genera of Recent Mollusca, v. 1, p. 241, 1853.

Type (by subsequent designation, Nevill, 1885): *Rissoa melanura* (C. B. Adams). Recent, Jamaica.

Alaba blakneyensis MacNeil n. sp.

Plate 27, figure 15

Description: Shell small, moderately inflated; spire high, greatest diameter near base of whorls, base moderately extended and weakly convex; protoconch consisting of about four smooth, rounded whorls, starting from a blunt upright tip; aperture subovate, moderately broad; columella straight and terminating short of the anterior extremity, no umbilical chink; sutures recessed by a prominent swelling near the base of the whorls; spire whorls with broad axial swellings (4 to 5 visible from an angle), the swelling greatest near the base, spiral sculpture consisting of shallow, broad, weakly incised lines, strongest near the base; base more uniformly sculptured by weak spirals.

Discussion: This appears to be the first *Alaba* reported from the American Oligocene. It is more inflated and has more axial swellings than *A.turrita* Guppy from the Miocene of Jamaica (see Woodring, 1928, p. 340, pl. 25, figs. 14, 15). A Claiborne species referred to *Alaba* by Palmer, *A. varicifer* (Cossmann) (see Palmer, 1937, p. 152, pl. 17, fig. 7), has both large and small axials. *Alaba supralirata* Carpenter (see Bartsch, 1910, p. 154, fig. 1), a Recent west coast species, is as much like the present species as any I can find.

Type: Holotype 648927 USMN from the Byram Formation, USGS locality 7376 (Plate 27, figure 15).

Occurrence: Byram Formation, USGS locality 7376.

Alaba cf. **A. blakneyensis** MacNeil

Plate 27, figure 16

Discussion: A single small specimen may belong to this species. If so it gives some idea of its variability. It differs from the type in having narrower axial swellings or riblets, and in having them terminate in a sharper manner near the lower suture. The apical angle is a little larger than on the type.

Occurrence: Byram Formation, USGS locality 5615.

Alaba macneili Dockery n. sp

Plate 44, figure 9

Discussion: This species is known from the single specimen figured. It has an incomplete protoconch of three conical whorls. These whorls are carinate with the carina located one third the whorl's height above the suture. Axial nodes begin to form about this carina on the first whorl of the teleoconch. The teleoconch consists of eleven nodose whorls with the nodes being longitudinally elongate and more prominent on the lower half of the whorls. These nodes are not evenly inflated, and about two nodes per whorl are overly inflated in respect to the others. The teleoconch has a fine sculpture of spiral threads and even finer axial threads. A small collar occurs about the suture.

This species differs from *A. blakneyensis* in that it has more numerous axial nodes, it has a more regular enlargement of successive whorls, and the whorls are not greatly constricted about the suture.

Type: Holotype 376663 USNM from the Byram Formation, MGS locality 106 (Plate 44, figure 9).

Occurrence: Byram Formation, MGS locality 106.

Genus **ALABINA** Dall, 1902

Alabina Dall, Nautilus, v. 15, p. 127, 1902 (new name for *Elachista* Dall and Bartsch, 1901, non Treitschke, 1833).

Type (by original designation): *Bittium cerithioide* (Dall). Recent, North Carolina to West Indies.

Alabina menthafontis MacNeil n. sp.

Plate 14, figures 1-10, 12-14; Plate 44, figures 7-8

Description: Shell of medium size for the genus, spire high and evenly tapering, whorls very weakly convex, greatest diameter near base of whorls; protoconch consisting of about two minute smooth rounded whorls; first postnuclear whorl having a pair of weak blunt spiral threads on the lower part of the whorl; spiral threads increasing about one for each successive whorl, more prominent on later whorls and usually with one or two more deeply incised spiral grooves just below the periphery; well defined and slightly inclined axials appearing on second postnuclear whorl which become gradually less distinct on successive whorls (about seven visible from an angle on adults); aperture subquadrate, more sharply curved at lower corner opposite parietal wall, angulate at anal end, bluntly rounded at siphonal end; inner lip thin and attached or forming a faint umbilical chink (on one specimen); base broadly rounded and with moderately strong incised spirals; columella with a weak twist on an exceptionally large specimen.

Discussion: Several specimens showing considerable variation but believed to belong to the same species are figured. One specimen (pl. 14, fig. 6) having a weak umbilical chink may be abnormal. Otherwise variation is mainly in the strength of the axial ribs and spiral threads.

I can find no certain relative of this species in the North American Tertiary. It may be misplaced under *Alabina*, and the characters described for it may be juvenile characters and therefore misleading. The single large specimen (pl. 14, fig. 10) which is thought possibly to belong to it bears some resemblance to a specimen figured by Cossmann and Pissarro (1910, pl. 24, fig. 137-42) as *Cerithium* (*Ptychocerithium*) *edulcoratum* Cossmann, a Lutetian species.

Bittium yaquense (Gabb) (see Pilsbry, 1922, p. 375, pl. 35, fig. 12), a presumed Miocene species from Santo Domingo, has a longer columella and blunter, less regular axials, but may be the closest American relative of this species, nevertheless.

Pasithea striata Lea (see Palmer, 1937, p. 68, pl. 82, fig. 6), a problematical species from the Gosport Sand (Claiborne) has a similar protoconch and may also be related. If so, it differs in lacking axial sculpture. Palmer suspected it might be a juvenile *Turritella*.

Type: Holotype 498273 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 14, figure 1).

Occurrence: Red Bluff Formation, MGS locality 34b; Mint Spring Formation, USGS localities 14071a, 13287.

Alabina aff. A. menthafontis MacNeil n. sp.

Plate 14, figure 11

Discussion: A single specimen, which seems to fall within the range of *A. menthafontis* as far as adult sculpture is concerned, has a protoconch of over four smooth whorls rather than two. It lacks the characteristic third whorl having a pair of spiral threads. Its aperture is more extended and the anal angle is greater. The specimen is incomplete and probably immature.

Both this form and typical *A. menthafontis* may be related to a species figured by Woodring (1959, p. 180, pl. 38, figs. 3-5) as *Alabina asperoides canaliculata* (Gabb). Woodring's specimens, which came from the Gatun Formation (middle Miocene) of Panama, are juveniles, the largest having a height of 2.5 millimeters. The Gatun specimens have a more acute basal spout than *A. menthafontis*. Even so, they may be congeneric and properly referable to *Alabina* to whose unfigured type Woodring had access.

Occurrence: Mint Spring Formation, USGS locality 13287.

Subfamily LITIOPINAE H. and A. Adams, 1854

Genus **LITIOPA** Rang, 1829

Litiopa Rang, Annales des sciences naturelles, v. 16, p. 306, 1829.

Type (by subsequent designation, Gray, 1847): *Litiopa melanostoma* Rang (= *L. bombix* Kiener). Recent, Newfoundland.

Litiopa meyeri MacNeil n. sp.

Plate 13, figure 10

Description: Shell small, spindle-shaped, moderately inflated, spire low, greatest diameter at midpoint of shell; protoconch not well preserved but apparently minute and less than two whorls; aperture ovate with a sharp narrow oval extremity; inner lip widening towards the anterior end and terminating abruptly as a projecting undercut point, siphonal notch rounded and lying mostly behind the tip of the inner lip; no umbilicus; sculpture consisting of well defined raised spiral cords on early postnuclear whorls but becoming nearly obsolete on the upper part of the body whorl, base of body whorl with moderately well defined spiral grooves.

Discussion: Fossil *Litiopa* are rare. Meyer (see Harris and Palmer, 1947, p. 300, pl. 30, fig. 1) described one from the Jackson of Mississippi under the name of *Cerithioderma spirata* that differs from the present species in having strong spiral sculpture on the adult whorls. The Mint Spring species has strong spirals only on the early whorls.

Type: Holotype 498277 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 13, figure 10).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Subfamily TRIPHORINAE Gray, 1847

Genus **TRIPHORA** Blainville, 1828

Triphora Blainville, Dictionnaire universel des science naturelles, v. 55, p. 344, 1828.

Type (by monotypy): *Triphora gemmata* Blainville. Recent, Mauritius.

It seems likely that Blainville and Deshayes had some exchange of views on these small sinistral gastropods and that they had agreed on a name for them. Actually, similar names were published by both authors, *Triphora* by Blainville in 1828, and *Triforis* by Deshayes (1824-37, p. 429; actually written in 1823-1824). Regardless of their intent and understanding, however, their type species seem to justify recognizing both names. *Triforis* has its mature aperture divided into three distinct openings, a body orifice and separate anal and siphonal tubes. *Triphora* has a larger body orifice and may or may not have its siphonal extension enclosed. Probably only full grown adults have tubes, and owing to their fragility they are seldom found. *Triforis* may be restricted to the Eocene. It is assumed that the Oligocene species treated here belong to the larger and longer ranging genus *Triphora*. Meyer (1886, p. 72) says one specimen of his Claiborne species, *T. similis*, has its siphonal canal nearly closed.

Subgenus **TRIPHORA** Blainville, 1828

Triphora (Triphora) bilineata (Meyer)

Plate 2, figures 9-11; Plate 27, figures 22, 27; Plate 44, figure 11; Plate 45, figures 1-11

1886. *Triforis bilineatus* Meyer, Geol. Survey Alabama, Bull. 1, No. 2, p. 73, pl. 2, fig. 16.

Original Description: Meyer, 1886.

Small; whorls flat, with two lines of separate, rounded nodules; base with a revolving line near the suture.

Locality.—Red Bluff, Miss.

Differs from all the preceding species by having only two revolving lines. As the distance of the lines is about equal, the shell looks like being uniformly covered with spirals, and the whorls can scarcely be distinguished from each other.

Description: Shell of average size for the genus, sinistral, whorls flat and not individually distinct, base flattened, columella short and moderately twisted; protoconch (based on a Byram specimen) a projectile-shaped, curvilinear cone, consisting of about six whorls, the first smooth, the next five having a pair of smooth raised spiral ridges separated by a shallow interspace, and a row of closely set, minute, bead-like wrinkles just above the suture; first postnuclear whorl with the spiral cords stronger, the lower more prominent than the upper, and crossed by axial riblets which make bead-like swellings where they cross the spirals, the interspiral portions being thin and baffle-like; early adult whorls having two spiral rows of high rounded beads, the lower row slightly stronger, and a single spiral thread crowded between the rows of beads; later adult whorls having three equally strong rows of rounded beads, the middle one developing from the middle spiral thread; sutures indistinct, located in a depression only slightly wider than the interspaces between the beaded spirals; base of body whorl with a strong spiral cord at the basal angle and a much weaker cord just under it, remainder of base smooth; aperture small and subrounded with a pronounced siphonal notch curving downwards; columella short with a single fold inside which is inclined about 45 degrees.

Discussion: The type from the Red Bluff is an incomplete juvenile shell matching an equivalent growth stage on the larger Byram specimen (pl. 27, fig. 27) closely enough to justify including both in the same species. The aperture of the type is broken back about a third of a turn giving it a different outline. However, the larger Byram specimen has a similar columellar fold inside and concealed from view; in the more complete aperture the fold does not truncate the columella, and the siphonal canal is not as deflected.

Dall (1892, p. 266) suggested that *T. similis* Meyer from the Claiborne is the same species as *T. bilineatus*, but it has a more rounded body whorl and the midrib, instead of being continuous, is a row of spirally elongate beads. Actually, none of several Eocene *Triphora* described previously is very close to this species.

Several closely related *Triphora* have been reported from the Oligocene of Germany, Belgium, and the Netherlands (see Albrecht and Valk, 1943, p. 37), most of them as *T. perversa* Linné, a Recent Mediterranean species. Speyer (1869, p. 298, pl. 31, fig. 7, 7a) figured a specimen from the Mainz Basin that compares favorably with *T. bilineatus* as far as adult sculpture is concerned, but the protoconch figured by him (fig. 7a) is more slender than the protoconch of the specimen from the Byram figured here, and believed to be the protoconch of *T. bilineatus*. The number of whorls is comparable but the two spiral cords may be closer to the lower suture than in the American species.

Meyer (1886, p. 72) mentions *Cerithium boettgeri* von Koenen from the German Oligocene as a probable relative of his species.

Type: Holotype 644591 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 2, figures 9, 11).

Occurrence: Red Bluff Formation, USGS locality 2623, MGS localities 34b, 38; Forest Hill Formation, MGS locality 75a; Byram Formation, USGS localities 5615, 7376, MGS locality 112c.

Triphora (Triphora) meridionalis (Meyer)

Plate 2, figures 12-13; Plate 13, figure 14;
Plate 44, figure 10

1886. *Triforis meridionalis* Meyer, Geol. Survey Alabama, Bull. 1, No. 2, p. 72, pl. 2, fig. 15.

Original Description: Meyer, 1886.

Large; whorls flat, with three longitudinal lines, which are continuous and only faintly nodulus—the lowest is the largest, the middle line is only one-third and the uppermost two-thirds of its breadth; the suture is defined by one more small, elevated line; base with a revolving line along the suture.

Locality.—Red Bluff, Miss.

Description: Shell moderately large for the genus, moderately slender, whorls straight-sided, spire high, base flattened, columella short; last three protoconch whorls (from Mint Spring specimen) with a pair of closely set raised spiral cords on the lower part of the whorls, the subsutural slope a broad rounded concavity sculptured by delicate axial wrinkles; early postnuclear sculpture consisting of two equally strong raised rows of slightly axially elongate beads which are separated by a groove of about the same size as the sutural depression (about eight beads visible from an angle); late adult sculpture having a sharply raised but narrow bluntly beaded spiral between the two primary beaded spirals, the lower of the primary spirals stronger than the upper and weakly undercut, the upper edge of the beads forming an overhanging serration; base with a low rounded spiral cord just inside the peripheral cord, remainder of base smooth; columella short and curved, no folds; mature aperture unknown but in juveniles it is subquadrate with a narrow siphonal canal which curves back from the plane of the aperture.

Discussion: The more complete specimen from the Mint Spring Formation could be at least subspecifically distinct from the type, a fragment, and the only specimen known from the Red Bluff Formation, but the limits of variation are not apparent from two specimens.

Triphora similis (Meyer) from the Gosport Sand (Claiborne) (see Palmer, 1937, pl. 30, figs. 10, 11) has a much more rounded basal angle. Another fragment of *Triphora* from the Claiborne was figured by Meyer as "*Triphora* sp." DeGregorio named it *T. similis* var. *meyeri* but Dall (1892, p. 266) thought it was more likely a worn specimen of *T. meridionalis*. The basal angle of this shell is sharp as in *T. meridionalis*; if it is from the Claiborne it compares more with *T. meridionalis* in this respect than do any other American Eocene species.

Type: Holotype 644590 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 2, figures 12-13).

Occurrence: Red Bluff Formation, MGS locality 34b; Mint Spring Formation, USGS locality 6647a.

Triphora (Triphora) menthafons MacNeil n. sp.
Plate 13, figures 26-27

Description: Shell moderately large for the genus, moderately inflated, whorls straight-sided, spire high, outline very weakly convex, base flattened, columella short and twisted; protoconch (from the paratype) moderately slender and with very weakly curving sides, about six full whorls, the first smooth, the remainder with a pair of closely set raised spiral cords on the lower part of the whorls, the subsutural slope a broad rounded concavity sculptured by delicate axial wrinkles; first postnuclear whorl with two widely spaced spiral cords, the upper and weaker cord bordering the suture, the lower and stronger cord a short distance above the lower suture, and moderately heavy axial riblets extending from suture to suture, making bead-like swellings where they cross the spirals; later whorls with three spiral cords of about equal strength and equally spaced (about eight visible from an angle), the beads being more spirally elongate than on the juvenile whorls; body whorl with a strong smooth rounded spiral cord at the basal angle and a weaker cord just inside it, the peripheral spiral separated from the lowest of the beaded spirals by a prominent but narrow depression; sutures located at lower border of the basal depression; aperture subquadrate, produced anteriorly to form a short curved siphonal canal; columella short and truncated anteriorly by the siphonal canal, no folds.

Discussion: The paratype is a perfectly preserved specimen consisting of the protoconch and two postnuclear whorls. Its apical angle suggests that it is the young of *T. menthafons* rather than of *T. meridionalis* although the three protoconch whorls preserved on the Mint Spring specimen of *T. meridionalis* are similar to those of this specimen.

I can find no fossil species from North America that is very closely related to this form. For a shell with this amount of inflation and spire outline, it has an abnormally truncated base. It may be a juvenile whose adult whorls would normally be progressively smaller and its base much more rounded, as, for instance, *T. lervanini* Jousseaume (see Tryon, 1887, pl. 38, fig. 34).

Type: Holotype 498268 USNM and paratype 648843 USNM both from the Mint Spring Formation, USGS locality 7671 (Plate 13, figures 27 and 26 respectively).

Occurrence: Mint Spring Formation, USGS locality 7671.

Subgenus **EUTHYMELLA** Thiele, 1929

Euthymella Thiele, Handbuch de systematischen Weichtierkunde, v. 1, p. 219, 1929 (new name for *Euthymia* Jousseaume, 1884, non Stol, 1876).

Type (of *Euthymia*, by original designation): *Triphoris* (*Euthymia*) *regalis* Jousseaume. Recent, New Caledonia.

This shell is certainly unique in the American Tertiary and if anything like it has been reported fossil at all I have been unable to find it. It seems to be very closely related to the type species, a Recent species from the western Pacific.

Triphora (Euthymella) fuscicava MacNeil n. sp.
Plate 13, figure 28

Description: Shell moderately large for the genus, spire rapidly expanding in juvenile stages, swollen in adult stage, whorls with a moderate angulation near the lower suture, basal angle rounded, columella moderately short; protoconch unknown; adult sculpture consisting of three prominent raised spiral cords separated by round bottomed interspaces about twice as wide as the cords, the cords progressively raised anteriorly, the lower cord forming the periphery of the whorl, a fourth and weaker cord bordering the lower suture, and moderately strong broad axial ribs (about five visible from an angle), the spiral cords not swelling where they cross the axials; base sculptured by spiral cords, the strongest being at the basal angle (the suprasutural cord of the spire whorls), the remainder (five in all) decreasing in strength towards the columella, the innermost on the columella very weak; sutures appressed and bordered above by a moderately strong smooth spiral cord; columella truncated anteriorly by a siphonal canal; exact shape of aperture unknown.

Discussion: The holotype is the only specimen known, and I have been unable to find anything like it described as a fossil. It seems to be very closely related to the type species of the subgenus from New Caledonia, *T.* (*E.*) *regalis* (Jousseaume) (see Tryon, 1887, p. 177, pl. 37, fig. 76). The Mint Spring species is a little more inflated and tear-shaped than the Recent species and the basal spirals may be stronger.

Type: Holotype 498269 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 13, figure 28).

Occurrence: Mint Spring Formation, USGS locality 7671.

Family TRICHOTROPIDAE

Genus **CERITHIODERMA** Conrad, 1860

Cerithioderma Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 7, p. 295, 1860 (=*Mesostoma* Deshayes, 1861).

Type (by monotypy): *C. prima* Conrad. Eocene, Alabama.

Cerithioderma sp.?

Plate 46, figure 3

Discussion: This species is known from the single, small specimen figured. It is placed as *Cerithioderma* sp. with reservations and is similar to *Cerithioderma angulatum* (Deshayes) from the Lutetian and Bartonian of the Paris Basin in its aperture and enlarged body whorl.

The shell's protoconch is incomplete and consists of one smooth whorl with the suture being deeply impressed. The first whorl of the teleoconch is somewhat separated from the protoconch along the suture and is cancellate with four spiral cords, the second from the top being the strongest, and closely spaced longitudinal threads. This cancellate sculpture continues on the preceding whorls. Also present on the teleoconch are longitudinal swellings which form modest nodes. A fifth and sixth spiral cord forms on the second whorl, one above the previous four making the third cord down the most prominent, and one below the others just above the suture. The third whorl of the teleoconch, which is also the body whorl, is significantly larger than the previous whorls. It has six spiral cords on the upper part of the whorl and two on the base. The aperture is circular, and no callus covers the umbilical area so that a slight opening is present.

Occurrence: Forest Hill Formation, MGS locality 75a.

Family THIARIDAE
Subfamily MELANATRIINAE

Genus **MELANATRIA** Bowdich, 1822

Melanatria Bowdich, Elements of conchology, v. 1, p. 28, 1822.

Type (by subsequent designation, Gray, 1847): *Buccinum flumineum* Gmelin. Recent, Madagascar. (Generic indication in Bowdich, pl. 6, fig. 20, without a specific name; first species and type supplied by Gray).

This genus has been regarded as a subgenus of both *Pirene* and *Faunus* but the relationships of the three are not apparent to the writer and for the time being it probably is best to regard it as a distinct genus.

The most obvious characters of the genus are the angular nodes developed on the axials in adults and the more elongate curved nodeless axials in juveniles. On the juvenile whorls one of the axials is swollen and enlarged, forming a blunt varix. The varix interval ranges on different individuals from just over one-half turn to exactly two-thirds of a turn. This results in individuals having spires with an apparent random distribution of varices to spires with a definite alignment of varices in three vertical rows.

Melanatria has been used for at least one marine American Cretaceous species, *M. cretacea* Wade (1926, p. 158, pl. 55, figs. 1a, 1b, 2). Several species are represented in the Eocene of France, i.e. *Melania cuvieri* Deshayes (Cossmann, 1909, p. 161, pl. 3, fig. 23: see also Glibert, 1933, p. 43, pl. 2, fig. 14) and *Faunus (Melanatria) pireniformis* (Deshayes) (see Cossmann and Pissarro, 1906-1913, pl. 19, fig. 117-12).

The Red Bluff occurrence is the only one thus far for the American Oligocene. *Melania sylvaerupis* Harris from the Bashi Marl Member of the Hatchetigbee Formation (lower Eocene), and two species from the Claiborne of Texas and Mexico referred to the genus *Texmelanatria* may be related. *Texmelanatria* Palmer (see Gardner, 1945, p. 156), illustrated so far by very poorly preserved material, may be the appropriate name for the Red Bluff species figured here. The two species referred to *Texmelanatria* came from the middle Claiborne of Texas and Mexico. Both Gardner and Palmer (1937, p. 181) pointed out that this supposedly fresh water form occurs with marine shells, as does the Red Bluff species. The possibility of fluvial origin cannot be ruled out for the Red Bluff species because the formation is known to interfinger with deltaic deposits of the Forest Hill Formation, and at least one land snail has been collected from the Red Bluff. *Melanatria* is restricted at the present time to fresh water in Africa and Madagascar.

A large species of *Melanatria* occurs in the Eocene Miyara beds of Ishigaki-shima in the southern Ryukus. What may be the same species was described as *Faunus (Melanatria) kahoensis* Nagao from the Eocene of Kyushu, Japan. Both of these forms have their varices arranged in three vertical rows.

Dirocerithium Woodring and Stenzel (Woodring, 1959, p. 172) has a juvenile sculpture similar to that of the species here considered (compare Woodring, idem., pl. 24, fig. 14 and pl. 2, fig. 3 of this report) but the adults of *Dirocerithium* become smooth with a well marked subsutural collar and there are no pointed nodes. The aperture of *M. serratoides* is not known. However, if this group is related to *Dirocerithium* and has a similar aperture (see Woodring, 1959, pl. 24, figs. 12, 13), it is misplaced in the family Thiaridae and should be in the subfamily Cerithiinae of the family Cerithiidae.

Melanatria serratoides (Aldrich)

Plate 2, figures 1-3

1894. *Cerithium serratoides* Aldrich, Nautilus, v. 7, No. 9, p. 99, pl. 4, fig. 5.

Original Description: Aldrich, 1894.

Shell elongate; suture linear; whorls ornamented with transverse ribs, which are moderate near the suture, but suddenly become enlarged and spinous at the intersection of a spiral near the middle of each whorl; a couple of fine spiral lines occur between the spines and preceding whorl; also a single spiral line just below the suture. Whorls slightly shouldered.

Specimen figured has lost its apex and aperture, but is so evidently a serrate Cerithium that I have concluded to describe it.

Length of part figured is 36 mm.

Type in National Museum. Example in my cabinet.

Description: Shell of medium size, early whorls evenly convex, later whorls convex below the shoulder, concave above the shoulder; protoconch unknown; youngest known whorls with gently curved axials of moderate strength which extend from the suture below almost to the suture above, every 8th to 10th axial being larger and swollen to form a blunt varix, varices occurring at intervals of over half to two-thirds of a turn and with any two nearest adjacent varices not quite visible together in one view, axials on later whorls developing a well defined pointed projection at the shoulder; spiral sculpture consisting of raised spiral threads of subequal stength on the very young whorls, but on the more advanced whorls the spirals are very faint below the shoulder and descend above the shoulder as a series of low steps resembling the edges of progressively but narrowly exposed sheets of paper; base and aperture of adults not known, but an incomplete juvenile shows two well developed spirals at and just below the basal angle, remainder of base with weak spiral threads which are divisible into primary and secondary series; columella moderately short and weakly twisted; siphonal canal short and narrow.

Discussion: I have seen only three specimens of this species, none of them complete. Nothing else very close to it has been reported from the North American Oligocene. Harris (1899, p. 70, pl. 9, fig. 10) described a species of *Melania*, *M. sylvaerupis*, from the Bashi Marl Member of the Hatchetigbee Formation (lower Eocene) of Alabama that may be related but the figure is too poor to be certain. *Texmelanatria texana* (Heilprin) (see Gardner, 1945, pl. 17, figs. 19, 20) may also be related. This latter species is closely related to an Oligocene species from Haiti, *Pyrazisinus? haitensis* Dall (Guppy and Dall, 1898, pl. 29, fig. 8); together they are more like the species from Japan and Ishigaki-shima mentioned in the generic discussion.

Without question the species figured by Dollfus (1909, pl. 4, figs. 6a-c) as *Melania escheri* var. *turrita* is very closely related to this species; the main difference is in the lack of varix-like swellings in *M. escheri turrita*. If I interpret Dollfus' scattered remarks correctly, similar forms range from the Stampian Stage to the Helvetian Stage.

Type: Holotype 135156 USNM and a specimen labelled "cotype" 644624 USNM both from the Red Bluff Formation, USGS locality 309 (Plate 2, figures 1 and 2 respectively).

Occurrence: Red Bluff Formation, USGS localities 309, 2860.

Family POTAMIDIDAE H. and A. Adams, 1854

Genus **TELESCOPIUM** Montfort, 1810

Telescopium Montfort, Conchyliologie systematique, v. 2, p. 438, 1810.

Type (by tautonymy): *Trochus telescopium* Linné. Recent, Indo-Pacific.

Telescopium leafensis MacNeil n. sp.

Plate 13, figure 15

Description: Shell small, spire conical, apical angle large, base broad, columella short and twisted; protoconch unknown; sculpture consisting of a subsutural and a suprasutural row of gear-like, crudely bifid axial nodes (about 11 visible from an angle) separated by a coarse spiral thread which is broken to form segments corresponding in number to the gear-like nodes; base smooth except for growth lines and a narrow, weak spiral groove just below the basal angle; aperture subquadrate; columella short and twisted; siphonal canal deflected to a nearly horizontal position.

Discussion: There are two specimens in the type lot of which the holotype is the larger. However, both are juveniles with immature apertures.

Nothing like this seems to have been described from the American Tertiary. It is similar, however, to a species from the Oligocene of Gaas figured by Cossmann (1906, v. 7, p. 123, pl. 11, fig. 21) as *Telescopium lemniscatum* Brongniart. A less similar but related form from the Oligocene of the Mainz basin was figured by Sandberger (1858-63, p. 106, pl. 8, fig. 3) as *Cerithium margaritaceum moniliforme* Grateloup.

Type: Holotype 498264 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 13, figure 15).

Occurrence: Mint Spring Formation, USGS locality 7671.

Superfamily STROMBACEA Rafinesque, 1815
Family APORRHAIDAE Mörch, 1852

Genus **APORRHAIS** Da Costa, 1778

Aporrhais Da Costa, British Conchology, p. 136, 1778.

Type (by monotypy): *A. quadrifidus* Da Costa (= *Strombus pespelecani* Linné). Recent, Europe and Iceland.

This is the generally accepted status of this genus although there might be some question as to whether the gastropods in Da Costa's British Conchology are binomial. Da Costa (1776, p. 230, pl. 1, figs. 6, 7) used *Aporrhais* for a *Lambis* as did several pre-Linnaean authors. In fact, Roeding included *S. pespelecani* in his genus *Lambis*. Unless Da Costa's 1776 usage preempts the name, *Aporrhais* would still be valid for the group of *S. pespelecani* by virtue of Dillwyn's (1823, p. 395) usage. *Chenopus* Philippi 1836 is the next available name. Da Costa's 1776 usage of *Aporrhais* probably is reflected in Conrad's (1847, p. 287) statement, "I have adopted the above generic name (*Chenopus*) because, as Phillipi observers, the *Pterocera lambis* was made the type of the genus *Aporrhais.*"

Subgenus **GONIOCHEILA** Gabb, 1868

Alipes Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 31, 1865 (non Imhoff, 1854).

Goniocheila Gabb, Amer. Jour. Conchology, v. 4, No. 3, p. 144, 1868.

Type (by subsequent designation, Cossmann, 1904): *Alipes liratus* (Conrad) (= *Chenopus liratus* Conrad). Oligocene, Byram Formation, Mississippi.

Gabb proposed *Goniocheila* as a subgenus of *Aporrhais*, it being distinguished from the latter by an appressed posterior canal rather than a detached one, and by the fact that the anterior canal curves towards the aperture rather than away from it. Wenz (1940, p. 912) regarded *Goniocheila* as a subgenus of *Drepanocheilus* Meek, a Cretaceous genus. However, as shown by Voorthuysen (1944, p. 48, fig. 4), the attachment or detachment of the posterior canal is a matter of individual variation in some species. I am inclined to believe that *Goniocheila* is descended from *Drepanocheilus* and that it gave rise in turn to typical *Aporrhais*.

Arrhoges Gabb (type, by monotypy, *Aporrhais occidentalis* Beck, Recent from Labrador and Newfoundland) (see Morris, 1947, pl. 32, fig. 8), also described as a subgenus of *Aporrhais*, is closer to *Goniocheila* than to typical *Aporrhais*. I see no use for *Arrhoges*; it is indistinguishable from *Goniocheila* and the latter has page priority. Wrigley (1938, p. 79-86) uses *Aporrhais* for the British Eocene and Oligocene species. He make no mention of *Goniocheila* but in my opinion all of the species he figures belong to that subgenus. *Aporrhais* is the older name and therefore the generic name; *Aporrhais* (*Aporrhais*) is an aberrant group with fewer species and a shorter geologic range than *Aporrhais* (*Goniocheila*).

Cossmann suppressed *Goniocheila* as a homonym of *Goniochile*, a crustacean, but the names are not identical.

Aporrhais has not yet been found in the Red Bluff Formation or in any American beds of Claiborne or Jackson age. The Mint Spring Formation is its first occurrence above the basal Gregg's Landing Marl Member of the Tuscahoma Formation (about middle Wilcox). Wrigley (1938, p. 82) commented on the common occurrence of the genus in the London Clay and Rupelian, but the virtual absence of the genus in the Lutetian, Auversian, and Bartonian; the single record in this interval is from the Auversian at Selsey.

Aporrhais (Goniocheila) lirata (Conrad)
Plate 28, figures 11, 12

1848a. *Chenopus liratus* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, No. 11, p. 287.
1848b. *Chenopus liratus* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 117, pl. 11, fig. 35. Plates reprinted in Dockery, 1982, Appendix I.

Original Description: Conrad, 1848a.

Ovate, with a thick dilated labrum; whorls nine, convex, ribbed longitudinally, and with revolving lines; ribs curved, undulated on the body whorl and subnodose above; body whorl gibbous; aperture narrow; callus of the labium profound. Length 3/4. Very rare.

I have adopted the above generic name because, as Phillipi observes, the *Pterocera lambis* was made the type of the genus APOORHAIS.

Description: Shell of medium size for the genus; spire moderately short; whorls weakly rounded, sutures moderately impressed; body whorl partly concealing penultimate whorl; mature aperture with a very thick outer lip, anal sinus appressed on spire, peripheral sinus curved, impressed and forming a prominent upward curving point, siphonal canal shallow; columella short, thick and curving towards the aperture; parietal callus moderately thick, more produced and forming a prominent bump at about the margin of the base; protoconch smooth and slightly bulbous (first whorl crushed on specimen at hand), probably about two whorls; postnuclear whorls with thin curved axial riblets (about 12 visible from an angle) which are flattened and smooth on top, and raised rounded spiral riblets (9 to 10) extending as cross-bars between the axial ribs; last half of body whorl with the axial ribs swollen to form axially elongate nodes where they cross three prominent spiral ridges, and the spirals coarser and crossing the axial ribs; on the apertural flare the spirals diverge and secondary spirals develop; columella with fine regular raised spirals, no axials.

Discussion: Conrad's largest and best specimen is selected as lectotype although he must have measured one of the smaller ones; three-fourths inch is about the size of the specimen figured here. The figured specimen (pl. 28, figs. 11, 12) is more complete than any of the types. Conrad's drawing of this species is inaccurate. He describes the axial ribs as curved but in his drawing they are straight. The outline of the aperture on his specimens is more like that shown here.

The Byram species does not compare closely with any of the British Eocene and Oligocene species figured by Wrigley (1938, pl. 6). *Aporrhais gracilis* Aldrich (see Harris, 1899, pg. 69, pl. 9, fig. 1) from the lower part of the Tuscahoma Sand (early Eocene) of Alabama appears to be more like early Eocene forms from England. According to Aldrich the number of apertural points is variable, younger specimens having only one. However, the large aperture is developed only at maturity so that it might be more correct to say that the peripheral point or sinus develops first.

Possibly the most closely related European species is one figured by Speyer (1863, p. 168, pl. 31, figs. 1, 2) as *Aporrhais speciosa* var. *megapolitana* Beyrich from the "upper Oligocene Sand" of Germany. However, if Görges (1952, p. 82) combining of the above with a specimen figured by Albrecht and Valk (1943, pl. 1, figs. 24, 25) is correct, even the variety has a wide range of variability.

The axial sculpture predominates over the spiral sculpture on the juvenile whorls in *A.* (*G.*) *lirata* whereas in *A.* (*G.*) *menthafontis* the juvenile whorls have only fine, very regular, flat topped spiral ribs. Further comparison between these species will be made under the discussion of the latter.

The U. S. Geological Survey collection contains several specimens (all juveniles except one which is a fragment of an adult) of a species from the Trent Marl (early Miocene) at Silverdale, North Carolina, which is very closely related to *A.* (*G.*) *lirata*. It has somewhat heavier axial ribs which, moreover, are restricted to a lower part of the whorl. The peripheral nodes are stronger than on *A.* (*G.*) *lirata* and they occur with decreasing strength on from 4 to 5 younger spire whorls. This species is undescribed but so far no good specimens of it are known.

Type: Lectotype (largest of 3 cotypes) 13513 ANSP and two syntypes 13514 ANSP all from the Byram Formation, Vicksburg, Mississippi.

Occurrence: Byram Formation, USGS locality 3722, MGS localities 106, 115.

Aporrhais (Goniocheila) menthafontis MacNeil n. sp.
Plate 15, figures 28-31, 33

Description: Shell of medium size for the genus; spire medium high to high; whorls moderately rounded, sutures moderately impressed; body whorl partly concealing penultimate whorl; mature aperture with a moderately thick to very thick outer lip, anal sinus appressed on spire, peripheral sinus impressed or not impressed, curving moderately to sharply upwards to form a prominent point, siphonal canal short, weakly incised, columella short, pointed to blunt, curving towards aperture; parietal callus thick to weak, forming, when mature, a large bump at the basal margin; protoconch smooth and regular with rounded whorls, about two turns; first postnuclear whorls (on paratype) with fine regular raised spirals (about 9 or 10) and well incised interspaces about half as wide as the spirals; weak curved axial riblets appearing on about five postnuclear whorls, increasing in strength on successive whorls; spirals becoming less sharp on later whorls and crossing the axial riblets; body whorl developing rounded to spirally elongate nodes on a peripheral carina, two weaker unnoded spiral ridges on lower part of whorl; on apertural flare the five spiral lirations fan out and secondary lirations appear; spiral threads indistinct on columella.

Discussion: The juvenile sculpture is only preserved on the paratype.

This species differs from *A.* (*G.*) *lirata* in having a higher spire and a shorter and less twisted columella. The axial ribs appear later in *A.* (*G.*) *menthafontis* and die out sooner. On *A.* (*G.*) *lirata* the spirals are present only between the axial riblets on the spire whorls; on *menthafontis* the spirals cross the axial riblets. The body whorl of *lirata* has three prominent spiral ridges bearing axially elongate nodes; the body whorl of *methafontis* has spirally elongate nodes on the uppermost or peripheral spiral ridge only.

The restriction of the nodes to the peripheral spiral on the body whorl makes this species more like the British Eocene and Oligocene species (Wrigley, 1938, pl. 6). However, none of the three specimens at hand develops a well defined point at any spiral ridge other than the peripheral ridge.

In spite of the obvious differences between this species and *A.* (*G.*) *lirata*, I would say that both have as their closest relatives the *A.* (*G.*) *speciosa* group of the European Oligocene.

The Recent *A.* (*G.*) *occidentalis* Beck which now lives from the Gulf of St. Lawrence to North Carolina differs from both of these species in having axial riblets on the body whorl which extend from the suture to the basal part of the whorl and do not make prominent nodes where they cross the principal spiral ridges (see Morris, 1947, pl. 32, fig. 8).

Type: Holotype 498245 USNM and paratype 648911 USNM both from the Mint Spring Formation, USGS locality 3723 (Plate 15, figures 28-29 - holotype, figures 31, 33 - paratype).

Occurrence: Mint Spring Formation, USGS localities 3723, 14071a, MGS locality 99.

Superfamily EPITONIACEA S. S. Berry, 1910
Family EPITONIIDAE S. S. Berry, 1910

Genus **EPITONIUM** Roeding, 1798

Epitonium Roeding, Museum Boltenianum, pt. 2, p. 91, 1798.

Type (by subsequent designation, Suter, 1913): *Turbo scalaris* Linné (= *Scalaria pretiosa* Lamarck). Recent, Western Pacific.

Subgenus **STHENORYTIS** Conrad, 1862

Sthenorytis Conrad, Acad. Nat. Sci. Philadelphia, Proc. v. 14, p. 565, 1863.

Type (by subsequent designation, de Boury, 1890): *Sthenorytis* (*Scalaria*) *expansa* Conrad. Miocene, Maryland.

Epitonium (Sthenorytis) whitfieldi (Aldrich)
Plate 2, figures 18-19

1885. *Scalaria whitfieldi* Aldrich, Cincinnati Soc. Natural Hist., Jour., v. 8, No. 2, p. 152, pl. 3, fig. 18

1886. *Scalaria whitfieldi* Aldrich. Aldrich, Geol. Survey Alabama, Bull. 1, No. 1, p. 34, pl. 1, fig. 18.

Original Description: Aldrich, 1885.

Shell, solid, turrited, lustrous white; whorls, probably six, rapidly tapering, round; ribs, numerous, rather far apart; body whorl with one raised transverse line near the base, microscopic revolving lines between the ribs upon the body of the shell; ribs, very solid, thick, rough on the edges, apparently double on the body whorl, bending toward the mouth at the suture; aperture, round; outer lip, reflected and very heavy, projecting slightly at the base. Length, —? breadth 9/20 of an inch.

Locality, Red Bluff, Miss.

The apex and part of the spire are missing from the only specimen; this species is remarkable for the absence of all revolving lines but the one at the base of the body whorl.

Description: Shell moderately low and inflated, whorls rounded and with strong flaring varices, aperture with flattened extended lips on both the anal and siphonal sides; protoconch and early juvenile whorls unknown; adult sculpture consisting of faint irregular spiral striae, and strong axial flares or varices (about seven visible from an angle) which are composed of book-like bundles of thin lamellae along the upturned edge, varices concave away from the aperture, convex towards the aperture; base set off by a moderately strong but blunt spiral cord which is not reflected on the crest of the varices; umbilicus closed but with a small chink; siphonal fasciole prominent, consisting of the edges of tightly packed growth lamellae; aperture round, lip flaring at the anal and siphonal extremities; inner lip moderately thin and not tightly appressed - it rests on the top of the umbilical end of the varices, leaving a shallow chink in each interspace.

Discussion: The Cooper Marl (Oligocene) of South Carolina contains a *Sthenorytis*, *S. subexpansum* Johnson (1931, p. 9, pl. 1, fig. 6), which appears to be very closely related to this species. It has a less pronounced anal flare.

The holotype of *S. whitfieldi* is the only *Sthenorytis* known from the Gulf Coast Oligocene. Several Eocene species resemble *S. whitfieldi* in most details except that they have higher spires. Among them are *Scala exquisita* Aldrich (1897, p. 14, pl. 1, fig. 7, 7a) from the Tuscahoma Formation (lower Eocene), and *Cirsotrema* (*Coroniscala*) *nassula* (Conrad) and *C.* (*C.*) *lintea* (Conrad) (see Palmer, 1937, pl. 10, figs. 12, 15), both from the Claiborne (middle Eocene). *C.* (*C.*) *danvillense* Harris and Palmer (1947, p. 240, pl. 28, fig. 16) from the Jackson (upper Eocene) is related to them. Palmer followed Cossmann in the generic and subgeneric assignment of these species. Cossmann placed *Sthenorytis* close to *Cirsotrema* (*Coroniscala*) in his classification but whether *Coroniscala* should be regarded as generically distinct from *Sthenorytis* is debatable.

It is entirely possible that the short spired forms referred to *Sthenorytis* are directly descended from these high spired Eocene forms.

Cirsotrema should probably be restricted to forms with both large widely-spaced varices and smaller axial riblets, the latter tending to fuse at their upper edge, but leaving rows of pits to the lower surface (see Abbott, 1954, p. 161, fig. 40a).

Sthenorytis expansa (Conrad) from the middle Miocene of Maryland (see Martin, 1904, p. 215, pl. 53, fig. 7) is very closely related to this species and aside from the absence of a basal spiral cord and a greater flare of the aperture at the anal position, which leaves pointed projections on the varices at the shoulder, it would be difficult to tell them apart. Another species from the Maryland Miocene, *S. pachypleura* (Conrad), has a basal spiral cord which is located a little higher than on *S. whitfieldi*. For a discussion of other Miocene and Pliocene species from tropical America see Woodring (1959, p. 184-186). The later species have less distinctive basal discs and heavier, broader varices.

Type: Holotype 644616 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 2, figures 18-19).

Occurrence: Red Bluff Formation, Red Bluff, MGS locality 37.

Subgenus **GYROSCALA** De Boury, 1887

Gryoscala De Boury, Etude sur les sons genres de Scalidae du Bassin de Paris, p. 15, 1887.

Type (by original designation): *Scalaria commutata* Monterostato (= *Epitonium lamellosum* Lamarck). Recent, Corsica (also west Africa, Florida and West Indies, fide Clench and Turner).

Pictoscala Dall (1917, p. 477), whose type is the Recent western Atlantic *Scalaria lineata* Say, was used by Gardner (1948, p. 209) for an upper Miocene species from Virginia and North Carolina, *Epitonium* (*Pictoscala*) *pratti* Gardner (ibid., pl. 28, figs. 44-46), as well as for a Jackson species, *Scalaria unilineata* Heilprin (see Adlrich, 1897, pl. 3, fig. 5). The fossil species, including the undescribed Oligocene species figured here, appear to be more like species referred to *Gryoscala* by several recent authors than like *S. lineata* Say (see Morris, 1947, pl. 27, fig. 1), and I feel that *Gryoscala* is a more appropriate name for them.

Epitonium (Gryoscala) n. sp.

Plate 14, figure 28

Discussion: A fragment of a body whorl without a complete aperture is all that is known of this species. Although it probably could be described well enough to permit future recognition, it is not being done. The shell is moderately small and the whorls are rounded. The surface is without spiral sculpture except for a prominent basal cord which sets off a basal disc and lies at the exact position followed by the suture. Thin but prominent axial varices (about 11 to 12 visible from an angle) extend from the aperture to the suture above; the varices are weakly S-shaped. Inner lip thin and tightly appressed.

I hesitate to name any close relatives on the basis of this fragment, but its sculpture resembles that of *Epitonium* (*Pictoscala*) *pratti* Gardner from the upper Miocene of Virginia. The axial ribs of the Oligocene species are heavier and more curved.

Woodring (1959, p. 184, pl. 37, fig. 7) figured a specimen from the Chagres Sandstone (Pliocene) of Panama as an undescribed species for which no appropriate generic name exists. It appears to be similar to the species figured here.

Occurrence: Mint Spring Formation, USGS locality 13287.

Epitonium sp. ?

Plate 45, figures 12-14

Discussion: The three figured specimens in Plate 45, figures 12-14, are tentatively placed as *Epitonium* sp. for the lack of better identification. All three are juveniles with high spired shells consisting of numerous rounded, ruffly surfaced whorls that lack spiral or longitudinal elements of sculpture.

Occurrence: Mint Spring Formation, MGS locality 89; Byram Formation, MGS locality 106.

Genus **ACRILLA** H. Adams, 1860

Acrilla H. Adams, Zool. Soc. London, Proc., pt. 28, p. 241, 1860.

Type (by original designation): *Aclis acuminata* Sowerby, 1844. Recent, western Pacific.

The lectotyype (figure 6 of Reeve and Sowerby, 1843-78) of *A. acuminata* H. and A. Adams, which until this time has been illustrated only by unsatisfactory drawings, is figured here (Plate 25, figure 32). This photograph was obtained from the British Museum by Dr. J. Wyatt Durham.

Subgenus **ACRILLOSCALA** Sacco, 1891

Acrilloscala Sacco, Molluschi dei terreni Terziarii del Piemonte e della Liguria, pt. 9, p. 86, 1891.

Type (by subsequent designation, de Boury, 1909): *Turbo geniculatus* Brocchi. Pliocene, Italy.

Acrilla (Acrilloscala) palmerae MacNeil n. sp.

Plate 14, figure 27

Description: Shell moderately small, moderately inflated, whorls rounded with a concave subsutural slope, axials moderately strong and inclined, spirals faint; protoconch unknown; first two or three post-nuclear whorls smooth; the first sculptured whorl with low, nearly vertical axial riblets, the riblets having moderately broad bases, concave sides and a blunt narrow crest (about eight visible from an angle), and with fine incised spiral grooves between the axials; adult whorls with more inclined axials (about 10 visible from an angle), the crest weakly overturned in the direction of advanced growth, interspaces with very weak spiral grooves; original color preserved on the holotype, the early whorls with the whole interspaces light brown, the later whorls with a brownish band adjacent to the last formed axial, the younger side of the interspace uncolored; basal disc prominent and sculptured by weak spiral threads and weak continuations of the axial ribs; aperture subovate, weakly angulate at both the anal and siphonal extremities; outer lip thin, inner lip weakly detached below to form a weak umbilical chink; parietal callus thin.

Discussion: This species may be related to *Epitonium multiliniferum* Aldrich (1921, p. 11, pl. 1, fig. 16) from the Bashi Marl Member of the Hatchetigbee Formation (lower Eocene) of Alabama. *A.* (*A.*) *palmerae* has stronger and fewer axials. I cannot find any Claiborne or Jackson relatives.

It resembles some European Eocene species such as *A. affinis* (Deshayes) (see Cossmann and Pissarro, 1906-13, pl. 7, figs. 52-59) and *Acrilla gallica* De Boury (see Glibert, 1933, pl. 1, fig. 11).

Type: Holotype 498280 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 14, figure 27).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Genus **SCALINA** Conrad, 1865

Scalina Conrad, Amer. Jour. Conchology, v. 1, p. 27, 1865.

Type (by subsequent designation, Palmer, 1937): *Scala staminea* Conrad. ? Gosport Sand (Eocene), Alabama.

The type species of *Scalina* might well be questioned. Conrad listed two species under the genus, *S. staminea* and *S. trigintanaria*, the latter a species from the Byram Formation. Palmer, who was concerned with the Claiborne, selected the supposed Claiborne species as the type. However, aside from the holotype of *S. staminea* no specimens from the Gosport Sand are known, whereas *S. trigintanaria* is fairly common. It is possible that Conrad, who was working with material from both Claiborne and Vicksburg, mislabeled one of his Vicksburg specimens. Palmer (1937, p. 102) stated that the whorls of *S. staminea* are more convex than those of *S. trigintanaria*. However, the type of *S. staminea* (Palmer, 1937, pl. 8, fig. 16) appears to be identical with the large specimen of *S. trigintanaria* figured here (pl. 27, fig. 38), a specimen which I had compared earlier with the type. Possibly Palmer was comparing *S. staminea* with the subspecies (pl. 14, fig. 38) from the Mint Spring Formation, here described, and which is definitely less convex than typical *S. trigintanaria*. If and until *S. staminea* is verified as a Claiborne fossil, I believe it should be regarded as a synonym of the Byram species.

As pointed out by Palmer (1927, p. 102), *Ferminoscala* Dall (1908, p. 315) (type, *Scala ferminiana* Dall, Recent, Gulf of California to Panama) is a synonym of *Scalina*.

Abbott (1954, p. 163) treated *Scalina* as a subgenus of *Amaea*, but a species he refers to typical *Amaea*, *A. mitchelli* (Dall), has the well defined basal disc of *Scalina*. *Amaea magnifica* (Sowerby), the type species of *Amaea*, has no basal disc (see Kira, 1955, pl. 13, fig. 20). I believe *A. mitchelli* is a typical *Scalina*.

The spiral sculpture in typical *Scalina* is as strong as, or predominates over, the axial sculpture. Several authors have suggested that most of the European species described under *Acrilla*, and having moderately strong axials, belong to *Scalina* (see Palmer, 1937, p. 102). *Acrilloscala* may be a more appropriate name for the common European type. *Acrilloscala* is represented in America as well, and the species previously described from the Mint Spring Formation is referred to it. Typical *Scalina* seems to be mainly American. One species from London Clay, *Acrilla wetherelli* (Edwards) (see Wrigley, 1940, p. 9, fig. 10), and several species from the middle Tertiary of Italy figured by Sacco (1891, pt. 9, pl. 2, figs. 49-56) appear to be *Scalina*.

Scalina trigintanaria (Conrad)

Plate 27, figures 19, 21, 37-38;
Plate 45, figure 17; Plate 46, figure 2

1848a. *Scalaria trigintanaria* Conrad, Acad, Nat. Sci. Philadelphia, Proc., v. 3, No. 11, p. 283.
1848b. *Scalaria trigintanaria* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 14. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Scala* (*Scalina*) *trigintinaria* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 27.
1937. *Scalina trigintanaria* (Conrad). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 102.
1945. *Scalina trigintanaria* (Conrad)? Gardner, Geol. Soc. America, Mem. 11, p. 148, pl. 24, fig. 9.

Original Description: Conrad, 1848a.

Turreted, whorls convex, cancellated with numerous prominent lines, the longitudinal one lamellæform and elevated towards the suture, about 32 in number on the body whorl, which is obtusely carinated; revolving lines equally prominent with the longitudinal, but thicker; base below the carina with minute revolving lines. Length 9-10. Very rare.

Description: Shell moderately large, high-spired and evenly tapering, whorls well-rounded, basal disc well-defined, aperture round, lip thin, axial and spiral sculpture fine and subequal; protoconch unknown; first observed whorl (probably about the second or third postnuclear whorl) with very faint sculpture, the spirals more prominent; adult sculpture consisting of narrow, subequal thread-like spirals (eight to nine) separated by interspaces which are two to three times as wide as the spirals, those on the upper half of the whorl having a very fine interstitial thread, and narrow inclined axial threads (about 20 visible from an angle) which make a neatly reticulate pattern with the spirals, the axials slightly flaring and curving slightly just below the suture, surface of shell in rectangular interspaces with a spiral microsculpture; base flattened and delimited by a closely set pair of spirals which are coarser than those above, weak spirals on remainder of base with the axials becoming weaker towards the umbilical region; umbilicus closed; aperture subrounded; outer lip thin, inner lip slightly thickened; parietal callus thin, widening slightly in the umbilical region.

Discussion: The holotype is not refigured but it is identical in all respects with the larger of the specimens figured here (pl. 27, fig. 38). Either the type has been broken or Conrad's drawing is a restoration; at present an estimated 6 mm of the tip is missing.

Aside from the statement by Conrad that the type species of *Scalina*, *S. staminea*, came from Claiborne, there is no record of anything like this from the Gulf Coast Eocene. The writer believes *S. staminea* is a mislabeled specimen of the Byram species. *Scalina trapaquara* (Harris) (see Palmer, 1937, pl. 8, figs. 24-31) from the lower Claiborne is more related to one of the species in the Mint Spring Formation, *S. menthafontis*, here described.

However, *S. trigintanaria* is related to some post-Oligocene species. Among them are *S. pseudoleroyi* (Maury) from the Bowden Formation of Jamaica (see Woodring, 1928, pl. 32, figs. 3, 4). The Jamaican species may have slightly stronger spiral cords and some of the spiral interspaces have two or three secondary threads. Woodring (1959, p. 187, pl. 38, figs. 6, 21) also reported this species from the middle Miocene of Panama.

Of the Recent species of *Scalina*, *S. mitchelli* (Dall) from the western Gulf of Mexico has more nearly the same shape but the axial riblets are more widely spaced, whereas *S. ferminiana* (Dall) from the Gulf of California to Panama has a greater apical angle and fewer spiral cords.

Typical *S. trigintanaria* is recognized only in the Byram Formation although a possible variant of it, discussed next, also occurs in the Byram Formation (pl. 27, fig. 20). The variant may also occur in the Mint Spring Formation (pl. 14, figs. 29, 31-33). Another related form is known from the Red Bluff Formation; it is described as a new species. It has a slenderer spire, more rounded whorls, and a more sunken suture.

Gardner (1945, p. 148, pl. 24, fig. 9) reported a form which she questionably identified as *S. trigintanaria* from both the middle and lower Oligocene of Nuevo León, Mexico. It may be more like the possible variety discussed next than the typical form.

Type: Holotype 13515 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi.

Occurrence: Byram Formation, USGS localities 3722, 10400, 13286, MGS localities 106, 112c. ? Lower Oligocene sandstone, USGS locality 13535, Nuevo León, Mexico.

Scalina trigintanaria (Conrad) var. ?

Plate 14, figures 29?, 31-33?; Plate 27, figure 20

Discussion: This form is separated from typical *S. trigintanaria* with some reservation and it may prove to merge with it through intermediates. The supposed variety has coarser and fewer axial riblets (about 14 visible from an angle) on the adult whorls, but the difference is more noticeable in juveniles. On the typical form the axials and spirals both become faint on the earlier whorls and the axials remain crowded. On the variety the axials are stronger than the spirals on the postnulcear whorls and the axials are fewer and more widely spaced (about seven visible from an angle).

A species from the Calvert Formation of Maryland, described as *Scala* (*Opalia*) *reticulata* Martin (1904, p. 214, pl. 53, fig. 5) bears some resemblance to this form. Judging from Martin's drawing the basal plate of the Calvert species is smooth, however. The basal plate of *trigintanaria* has weak spirals and axials.

The form from Nuevo Léon figured by Gardner (1945, pl. 24, fig. 9) may be more like this variety.

Occurrence: Byram Formation, USGS locality 13286; ? Mint Spring Formation, USGS localities 14162, 14071a, 2664 (Johnson) (Judging from its preservation the specimen in USGS 2664 is from the Mint Spring Formation although the lot is known to contain material from both the Mint Spring and Bryam Formations).

Scalina trigintanaria hopkinsi MacNeil n. subsp.

Plate 14, figures 30, 38

Discussion: Two specimens, supposedly from the Mint Spring Formation, seem to represent a subspecies of the Byram species. They differ from typical *S. trigintanaria* in having stronger spiral cords on the central and lower part of the whorl; on the typical form all cords are subequal. The subsutural area is more flattened on *S. trigintanaria hopkinsi* although not weakly concave as in *S. menthafontis*, described next. On the basis of known specimens, this may be the precursor of typical *S. trigintanaria* in the Byram.

I have not seen this subspecies in any Byram collections, although it may occur in that formation. This may be the form that Palmer (1937, p. 102) took to be typical *S. trigintanaria* in her comparison of that species with *S. staminea*, which latter species I believe is a mislabeled specimen of typical *S. trigintanaria* from the Byram Formation.

This subspecies appears to be more like the Jamaican Miocene species, *S. pseudoleroyi* (Maury) (see Woodring, 1928, pl. 32, fig. 4) than any of the other Oligocene species.

Type: Holotype 648883 USNM and paratype 136910 USNM both from the Mint Spring Formation, USGS locality 7467 (Plate 14, figures 30 and 38 respectively).

Occurrence: Mint Spring Formation, USGS localities 7467, 2664.

Scalina menthafontis MacNeil n. sp.

Plate 14, figures 44-45

Description: Shell moderately large, spire high, adult whorls rounded anteriorly with the periphery located at about the anterior third, posterior third flattened or weakly concave forming a broad subsutural slope, juvenile whorls more rounded, basal disc well defined; protoconch unknown; juvenile whorls with fine, nearly vertical axial riblets (about 12 visible from an angle), and much weaker spiral threads all of which are of about equal strength; adult whorls with the axials reduced to little more than growth lines of irregular strength and spacing (some of them etched to form narrow axial grooves), and the spirals below the subsutural slope (about three to four) moderately strong, those on the subsutural slope weak or obsolete; surface in adults with a microsculpture of closely set raised axial and spiral lines; base set off by a moderately strong spiral cord at the position of the suture, disc weakly rounded and sculptured by weak spiral cords; umbilicus closed; aperture subovate, anal notch moderately developed; outer lip thin, inner lip thickened, weakly flaring in the siphonal region; parietal callus thin and narrow.

Discussion: This species is undoubtedly the Mint Spring analog of *Scalina trapaquara adamsi* Palmer (1937, pl. 8, figs. 27, 28), described as a variety of *S. trapaquara* Harris (see Palmer, 1937, pl. 8, figs. 26, 29, 30, 31), both from the lower Claiborne of Texas.

Both *S. menthafontis* and *S. trapaquara* have a well defined concave subsutural slope and the strongest spiral sculpture is on the whorl below the slope. On *S. menthafontis* there are three to four strong spiral cords whereas on *S. trapaquara* there are four to five; the subsutural slope may bear one or two weak primary spirals on both species. The secondary spirals are much stronger and coarser on *S. trapaquara*, and the axial riblets are stronger in adults.

Scalina waynensis Mansfield (1940, p. 214, pl. 27, fig. 34) from the Chickasawhay Limestone (upper Oligocene) of Mississippi appears to be close to this species but the type and only known specimen is crushed and incomplete.

Woodring (1959, p. 188, pl. 38, figs. 7, 14) figured a specimen from the upper part of the Gatun Formation (late Miocene) of Panama as *Scalina* cf. *S. brunneopicta* (Dall), a Recent species from Lower California. *S. brunneopicta* is one of the two species in the original list of *Ferminoscala* and according to Keen (1958, p. 278) it is a slender subspecies of *S. ferminiana*. At any rate, the Gatun species appears to be much more closely related to *S. menthafontis* than to *S. brunneopicta*. It differs from *S. menthafontis* mainly in having more spiral ribs (about eight) and in having its whorls more evenly rounded rather than weakly concave below the suture. The spiral ribs extend nearly to the suture above rather than being mainly below the subsutural slope.

Scalina menthafontis shares with *Architectonica textilina caseyi* the distinction of being a Mint Spring form whose closest known older relative is in the middle Claiborne. This probably has some ecologic significance which at this time is not apparent. There are deposits of similar lithology in the upper Claiborne, Jackson, and at other Oligocene horizons.

Type: Holotype 498283 USNM and paratype 498282 USNM both from the Mint Spring Formation, USGS locality 14162 (Plate 14, figures 45 and 44 respectively).

Occurrence: Mint Spring Formation, USGS localities 14162, 14071a.

Scalina rubricollis MacNeil n. sp.

Plate 2, figure 15; Plate 45, figure 16

Description: Shell of medium size, spire high, whorls strongly rounded, sutures moderately deep, sculpture coarsely reticulate; protoconch and juvenile sculpture unknown; adult sculpture consisting of narrow, sharp but low weakly inclined axial riblets (about 12 visible from an angle) and spiral cords (about eight) which are only slightly stronger than the axials, two central cords being a little wider than the rest, interspaces with two to three weak blunt secondary spiral threads which are strongest just beyond each axial riblet but dying out before reaching the next younger riblets (seen only on the paratype); basal disc well developed, crossed by the extensions of the axial riblets and bearing fine rounded spiral threads like those in the interspaces above the disc; aperture not known; parietal callus thin.

Discussion: This species has a slenderer spire, more sharply rounded whorls and more constricted sutures than *S. trigintanaria*. The axial riblets are fewer in number (about 12 visible as opposed to about 20 in *S. trigintanaria*), and there are two to three fewer spiral cords in *S. rubricollis*.

I can find no obvious relative of this species in the American Eocene, unless it is typical *S. trapequara* (Harris) from the lower Claiborne of Texas.

Type: Holotype 136554 USNM from the Red Bluff Formation, USGS locality 309 (Plate 2, figure 15).

Occurrence: Red Bluff Formation, USGS locality 309, MGS localities 37, 38.

Genus CONFUSISCALA de Boury, 1909

Confusiscala de Boury, Jour. Conchology, v. 57, p. 256, 1909.

Type (by monotypy): *Scalaria dupiniana* d'Orbigny. Cretaceous (Albian), France.

Confusiscala was used as a genus by Cossmann (1912, v. 9, p. 73) and it is so used here. Some recent authors have used it as a subgenus: Stewart (1926, p. 322) as a subgenus of *Epitonium*, and Durham (1937, p. 503) as a subgenus of *Opalia*. Shells which seem to be nearest to the present species were included by Wenz under *Opalia* (*Pliciscala*).

Subgenus FUNISCALA de Boury, 1891

Funiscala de Boury, Bullettino Societa Malacologica Italiana, v. 15, p. 205, 1891.

Type (fide Cossmann): *Scalaria speyeri* Sacco. Oligocene of Germany?

Funiscala is here used as a subgenus of *Confusiscala* on the assumption that it is a slightly modified direct descendent of the Cretaceous group. In the Oligocene species the spiral threads cross the axial ribs and it has weaker axials on the basal disc. In the Cretaceous species the crest of the axials is not rounded but consists of a book-like bundle of upturned lamellae. On at least some of the Cretaceous species the inner lip is detached.

Cossmann referred *Funiscala* and *Confusiscala* to different subfamilies of Epitonidae: *Confusiscala* to the Clathroscalinae, and *Funiscala* to the Opaliinae.

The Red Bluff species here described is certainly like those Cossmann (1912, p. 86) included under *Pliciscala* (*Funiscala*). According to Cossmann the type of *Funiscala* is *Scalaria speyeri* Sacco, about which he remarked, "Lé genotype primitivement désigné était assimilé, par erreur de determination, à *S. pusilla* Phil., qui doit être un *Bifidoscala*." I have not seen the publication in which Sacco named *S. speyeri*, but I am assuming it is the *Scalaria pusilla* var. of Speyer (1864, p. 284, pl. 40, figs. 9a-e) from the Oligocene of Germany.

I fail to see why the species called *Scalaria pusilla* Philippi by both Sandberger (1858-63, p. 120, pl. 11, fig. 1, a-b) and Speyer (1869, p.334, pl. 35, fig. 2, a-b) is not congeneric with the present one.

De Boury (1910, p. 219) acknowledged that the species he had in mind was not *S. pusilla* but *S. speyeri*.

Other European species are *Funiscala? mioturrita* Sacco (1891, pt. 9, p. 71, pl. 2, fig. 72), Oligocene? of Italy, *Acrilla amoena* Philippi, Oligocene of Germany, and *Pliciscala* (*Funiscala*) *falcifera* Boettger (see Cossmann, 1912, v. 9, p. 86, pl. 4, figs. 7-8), Oligocene of France. *Acrilla brünnichi* Ravn (1939, pl. 2, figs. 9a-c) from the Paleocene of Denmark is almost certainly related. Its basal disc is smaller.

This subgenus may have persisted in the Far East until the Pliocene. The late Tertiary Indo-Pacific species are more inflated, the base less corrugated and the axial ribs are broken up into books of lamellae. One such species, *Amaea* (*Discoscala*) aff. *A.* (*D.*) *niasinsis* Wissema, was figured by MacNeil (1961, pl. 2, figs. 4, 9) from the late Miocene of Okinawa.

Confusiscala (Funiscala) durhami MacNeil n. sp.

Plate 2, figures 8, 16-17

Description: Shell of medium size for the family, thin, spire high, whorls well rounded, basal keel prominent, strong axial ribs and fine spiral threads; protoconch unknown; early postnuclear whorls with thin prominent axial ribs (about seven visible from an angle) and faint spiral threads; adult sculpture consisting of weakly inclined axial ribs (about 10 visible from an angle) which are thicker anteriorly and tend to be weakly concave on the back slope, convex on the foreslope, and fine spiral threads of unequal strength, from one to three intercalary threads appearing between primary threads periodically, surface with microscopic axial wrinkles in places; basal cord prominent and noded where crossed by the axial ribs; base with wrinkle-like axial ribs which die out before reaching the columella, spiral threads similar to those above; aperture subrounded with an angulation at the position of the basal cord; outer lip thin and strongly corrugated within, the corrugations corresponding to the external ribs; inner lip thin and appressed; parietal callus thin but conspicuous; no umbilicus.

Discussion: The holotype is the only specimen known and the species may be unique in the American Tertiary. Although some of the European Tertiary species mentioned in the generic commentary probably are related, there are no living representatives of the group. If my interpretation is correct, it is the survivor of a prominent Cretaceous type.

Scala sp. (Harris, 1899, p. 96, pl. 12, fig. 8) from the Bashi Marl Member of the Hatchetigbee Formation (late early Eocene) of Alabama may be related but I cannot be certain from the drawing.

Type: Holotype 648844 USNM from the Red Bluff Formation, USGS locality 15058 (Plate 2, figures 8, 16-17).

Occurrence: Red Bluff Formation, USGS locality 15058, MGS locality 40.

Genus **PLICISCALA** de Boury, 1887

Pliciscala de Boury, Etude sur les sous genres de Scalidae du Bassin de Paris, p. 19, 1887.

Type (by original designation): *Scalaria gouldii* Deshayes. Eocene, France.

I am following Harris and Palmer (1947, p. 243) in the use of *Pliciscala* for this group. They used the name without subgenera. The shell of the species here described has spiral rows of punctations. Of several subgenera included under *Pliciscala* by Cossmann only three are so defined: *Punctiscala* de Boury (type; *Scalaria plicosa* Philippi, Pliocene, Italy); *Nodiscala* de Boury (type; *Scalaria bicarinata* Sowerby, Recent, Philippines); and *Contemniscala* de Boury (type; *Scalaria interrupta* Sowerby, Eocene, England). Probably the present species is more like the species referred to *Punctiscala* by Cossmann than to the other two. Hertlein and Strong (1951, p. 90), and Keen (1958, p. 276) referred a closely related species to *Punctiscala* as a subgenus of *Epitonium*, whereas Clench and Turner (1951, p. 287) included similar species under *Opalia* (*Nodiscala*).

Subgenus **PUNCTISCALA** de Boury, 1889

Punctiscala de Boury, Soc. Malacol. Italie, Bull, v. 14, p. 175, 1889.

Type (by original designation): *Scalaria plicosa* Philippi. Pliocene, Italy.

Pliciscala (Punctiscala) cookei MacNeil n. sp.

Plate 14, figure 46

Description: Shell of medium size for the family, spire moderately high, whorls moderately rounded with a subsutural depression, basal keel prominent, low, rounded axial ribs and spiral rows of pits, larger varices on early whorls; protoconch unknown; juvenile whorls with nearly vertical low rounded axial ribs (about seven visible from an angle); adult sculpture consisting of low broad rounded slightly inclined axial ribs (about seven or eight visible from an angle) which die out before reaching both the suture above and the basal keel on the body whorl, surface of ribs and interspaces a thin layer which decorticates readily and which is sculptured by closely set spiral rows of minute pits; base set off by a strong rounded keel, base concave and without axial sculpture, both keel and base with the same pitted microsculpture as the face of the whorl; aperture round; lips thick, the inner lip attached to the parietal region to form a ridge-like callus, detached in the umbilical region; umbilicus narrow but open, concealed by the flaring inner lip; varices irregularly placed, holotype with one on the fifth and one on the sixth whorl (the two separated by half a turn) and another at the mature aperture (tenth whorl).

Discussion: The varices on the early whorls are present on the holotype but not on the other specimen at hand; apparently they are individual responses to some local condition.

This species is very closely related to *Pliciscala* (*Punctiscala*) *cribrum* (Cooke 1926, p. 137, fig. 11; Harris and Palmer, 1947, p. 244, pl. 28, fig. 13) from the Moodys Branch Formation (Jackson - upper Eocene) of Mississippi. The holotype of the Jackson species has varices on the fourth and seventh whorls and at the aperture. The axial ribs of *P.* (*P.*) *cribrum* are lower and the shell may be slenderer, but they are so similar that the present form may be no more than a subspecies of it. The group has not been recorded from earlier Eocene beds.

Harris and Palmer suggested that *Scalaria pearlensis* Meyer, also Jackson, might be the young of *P.* (*P.*) cribrum. However, there is another species in the Byram Formatin that appears to be similar to *S. pearlensis*; it is a narrower, smaller species.

Pliciscala (*Punctiscala?*) *colemanum* Hertlein and Strong (1951, p. 90, pl. 3, fig. 14), Recent from the west coast of Mexico, may belong to this group. The Recent species is not depressed below the suture like the Oligocene species but it seems to be very similar in other respects.

Some possible relatives of *P.* (*P.*) *cribrum* and *P.* (*P.*) *cookei* occur in the Pliocene of Italy, among them *Scalaria longissima* Sequenza (see Tryon, 1887, p.75, pl. 15, fig. 85). The base of the Pliocene species is set off by a more pronounced angulation with the spiral cord more prominent; in *P.* (*P.*) *cookei* the cord is much more receding and the enclosed basal area is smaller.

I can find nothing like this in post-Oligocene beds of eastern North America.

Type: Holotype 298287 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 14, figure 46).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Subgenus **NODISCALA** de Boury, 1890

Nodiscala de Boury, Bullettino Societa Malacologia Italiana, v. 14, p. 12, 1890.

Type (by original designation): *Scalaria bicarinata* Sowerby. Recent, Philippines.

Nodiscala is used as it has been used by numerous authors although, as remarked by Woodring (1928, p. 404), "It is very improbable that they have any genetic relation to the peculiar little Philippine shell described by Sowerby, but no other name seems to be available for them."

Possible *Bifidoscala* Cossmann, 1888 (type, *Scalaria lemoinei* de Boury, Eocene, France) is the proper name for this group. One of the species which Cossmann referred to *Bifidoscala*, *Scalaria pusilla* Philippi, Oligocene of ?Germany, is involved by misidentification with the type species of *Funiscala*.

Pliciscala (Nodiscala?) byramensis MacNeil n. sp.

Plate 27, figures 18, 23, 36

Description: Shell small, whorls rounded, depressed below the suture, no basal disc, aperture subtending a varix, lips forming a central rimmed orifice, no umbilicus; first protoconch whorl unknown, last two smooth and rounded; weak axials appearing on the lower (anterior) part of the first postnuclear whorl, adult sculpture consisting of slightly inclined axial ribs (about six or seven visible from an angle) which have broadly concave shapes and moderately narrow rounded crests, and low flattened spiral threads of slightly variable width, the interspaces sometimes weakly pitted by faint baffle-like wrinkles which are less developed on some specimens and in some interspaces; suture appressed with a weak subsutural collar; base not well defined, sloping strongly; aperture rounded, lip continuous and forming a moderately thick raised rim, subtended by a spirally sculptured varix of much greater diameter; no umbilicus but the inner lip is weakly detached.

Discussion: This species probably is related to *Pliciscala pearlensis* (Meyer) (see Harris and Palmer, 1947, p. 243, pl. 28, figs. 15, 18) from the Moodys Branch Formation (Jackson) of Mississippi. Meyer states that his species is spirally punctate but it is not apparent on his drawing. The present specimens are not punctate in the sense of tiny perforations; the spiral grooves are better described as confluent shallow pits. Some interspaces are smooth. However, although the surface of this shell looks fresh, the spiral grooves appear to be like the grooves on decorticated specimens of the next two forms discussed and there may have been a thin punctate layer that was removed.

Type: Holotype 498360 USNM from the Byram Formation, USGS locality 7376 (Plate 27, figure 18).

Occurrence: Byram Formation, USGS localities 7376, 5615, MGS locality 106.

Pliciscala (Nodiscala?) n. sp.

Plate 14, figures 34-36

Discussion: Several small worn specimens of another species were collected from the Mint Spring Marl. They are not considered good enough enough to describe. The apertural characters resemble those of *P.* (*N.?*) *byramensis*. There are prominent varices on some of the spire whorls which are inclined more strongly than the axial ribs. One specimen has its spiral sculpture preserved well enough to show that it consists of tiny spiral punctations which cross both the axial ribs and varices; the punctations are more closely spaced between the ribs. The punctations are in an outer shell layer that decorticates and exposes a deeper rounded channel below that rises nearly to the crest of the axials but does not cross them as do the spiral grooves in *P.* (*N.?*) *byramensis*.

Occurrence: Mint Spring Formation, USGS locality 13287.

Pliciscala (Nodiscala?) caseyi MacNeil n. sp.

Plate 14, figures 37, 39-43; Plate 45, figures 18-19; Plate 46, figure 1

Description: Shell small, whorls rounded, sutures deep, basal disc prominent, aperture subtending a moderate varix, lip thin, no umbilicus; protoconch has about three and a half whorls, moderately elongate with a blunt tip, smooth, sutures appressed; adult sculpture consisting of weakly inclined axial ribs (about eight or nine visible from an angle) which are low, broad, and narrow crested, and fine incised spiral lines which cover all but the very crest of the axials (the grooves may be a decortication — a few patches suggest that the grooves may have been covered by a thin punctate layer); basal disc raised and set off by a smooth, moderately broad cord against which the axial ribs terminate; base with flattened spiral cords of irregular width; aperture subrounded; lips thin and weakly raised from the last varix, inner lip weakly detached.

Discussion: I am placing this species in the same subgenus as the two preceding species with some reservation. It can be readily distinguished from them by its prominent basal cord and basal disc, a character that is constant on the six specimens at hand. The axials on *P.* (*N.?*) *caseyi* overhang the suture above, which is weakly channelled, but on *P.* (*N.?*) *byramensis* the axials terminate on a weak, appressed subsutural collar.

The species may be related to *Rudiscala harrisi* Palmer (1937, p. 107, pl. 8, fig. 18) but the figure of the latter does not show its fine details.

Type: Holotype 498279 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 14, figure 40).

Occurrence: Red Bluff Formation, MGS locality 37; Mint Spring Formation, USGS locality 13287; Byram Formation, MGS locality 106, ? USGS locality 5615.

Superfamily MELANELLACEA Bartsch, 1917
Family MELANELLIDAE Bartsch, 1917

GENUS MELANELLA Bowdich, 1822

Melanella Bowdich, Elements of Conchology, v. 1, p. 27, 1822.

Type (by monotypy): *Melanella dufresnii* Bowdich. Recent. (Locality unknown but believed by Dall to be the species later named *Eulima major* Sowerby, Recent from Tahiti).

Melanella has been rejected in favor of *Eulima* Risso 1826 by several recent authors, mainly because the type species is from an unknown locality. Winckworth (1934, p. 12) interpreted a footnote by Bowdich to mean that the type of *Melanella* was a European fossil, but it is not clear that Bowdich's statement regarding several other genera was meant to include *Melanella*. Dall's interpretation that Bowdich's species is the same as Sowerby's (because Dufresne, from whose cabinet the specimen came, was a Frenchman and might have acquired shells from Tahiti, and *Eulima major* Sowerby from Tahiti is similar) seems more likely. Actually *E. arcuata* Sowerby more closely resembles *M. dufresnii* in the curvature of its spire. Tryon regarded *major* and *arcuata* as conspecific. A topotype of *E. major* was figured by Pilsbry (1917a, p. 220, pl. 14, figs. 1, 1a). At any rate, the rules of nomenclature do not require that a locality be cited. *Melanella* is figured by a good drawing and the plate legend bears the name, *Melanella dufresnii*, which for that date is all that is required.

More problems seem to attend *Eulima* than *Melanella*. As remarked by Iredale (1915, p. 463), the name *Eulima* can be retained on little more than personal opinion. Dall (1915, p. 81) attempted to give the name validity by designating *Helix subulata* Brocchi as type, but he overlooked an earlier designation by Suter (1913, p. 346) of *Eulima elegantissima* (Montagu) (a species believed by some authors to be *Turbo politus* Gmelin) which makes it difficult to distinguish *Eulima* from *Melanella*. Iredale's suggestion that *Melanella* might be used for the "humpbacked" species and *Eulima* for the straight species does not appear to be entirely sound, although he suggested that some apical features might exist as well to distinguish them. Several earlier designations of *Turbo politus* Gmelin are not valid because the designators did not mention *E. elegantissima* as a synonym of *T. politus*.

This situation is further complicated by the fact that both Woodward (1851, p. 126, pl. 8, fig. 13) and Clessin (1899-1902, p. 139, pl. 24, fig. 2) give figures showing *E. elegantissima* to be a *Turbonilla*. Both of these authors apparently followed S. V. Wood (1848, p. 81, pl. 10, figs. 5, 5a) in the interpretation of this species.

Dall's designation of *Helix subulata* Brocchi would have made *Eulima*, along with *Leiostraca* H. and A. Adams and the substitute name *Subularia* proposed for it by Monterosato (type, *Turbo subulatus* Donovan, Cossmann, 1888, pt. 3, p. 117), a synonym of *Strombiformis* Da Costa (type, *Strombiformis glaber* Da Costa [= *Turbo subulatus* Donovan] Iredale, 1915). The fact that *H. subulata* Brocchi (1814) and *T. subulatus* Donovan (1804) are congeneric seems to be a coincidence despite the opinion of some authors. Winckworth (1934) says *Turbo subulatus* in Brocchi is quoted as of Donovan, but I can find no indication that this is so. In fact, Brocchi introduced the species as "*Helix subulata*, nob.", a clear indication that he was describing it as new.

An early designation by Hermannsen (1847, v. 1, p. 431) would have produced the same result as Dall's designation. Herrmannsen designated *Turbo subulatus* Donovan as type of *Eulima*. Both S. V. Wood and Sacco regarded *Turbo subulatus* Donovan as identical with *Helix subulata* Brocchi, but Brocchi's usage does not bear this out; it is Brocchi's name that appears in the original list of *Eulima*. Brocchi's name is a homonym; its valid name may be *E. nitida* Lamarck.

In summary, *Eulima*, by virtue of Suter's designation, and provided this does not make it a *Turbonilla*, can replace *Melanella* only if *Melanella* is invalid; it does not appear to be. *Eulima* could be used for the straight forms and *Melanella* for the crooked forms, but they seem to merge with one another in an unending series. *Eulima*, if it were not for Suter's designation, would replace *Strombiformis* for the slender forms if Harris' designation for *Strombiformis*, which would transfer it to another group, were valid; it does not appear to be. *Balcis* Gray 1847 would be a contender for the inflated forms only if *Eulima* replaced *Strombiformis* and *Melanella* is invalid, neither of which seems to be true. If *Eulima* is a turbonillid, *Balcis* is the next name after *Melanella* for the inflated forms and might, as has been argued for *Eulima*, be made to include the straight ones.

Melanella postnotata MacNeil n. sp.

Plate 15, figure 8; Plate 46, figures 9, 11, 13

Description: Shell small, apical angle moderately large, whorls nearly straight-sided, base rounded, no basal angularity, aperture tear shaped; protoconch small, pointed and consisting of about three smooth whorls, the first decorticated on the type, very weakly inclined from the axis of the adult shell; successive whorls smooth and glabrous, evenly expanding; whorls straight or with a faint convexity; sutures tightly closed but very weakly indented; base well and evenly rounded; aperture broadly rounded anteriorly, angulate posteriorly; outer lip thin, inner lip thickened and weakly detached in the umbilical region, forming a moderate but narrow parietal callus which thins towards the anal angle; no umbilicus but there is a moderate crease in the umbilical region.

Discussion: This species has a wider apical angle and a proportionately lower spire than *M. notata* (Lea) (see Palmer, 1937, p. 61, pl. 6, fig. 27) from the Gosport Sand (upper Claiborne) of Alabama, but it is otherwise similar. No representative of this stock has been reported from either the Jackson or Red Bluff. *Eulima eborea* Conrad (see Martin, 1904, pl. 53, figs. 9, 10) from the middle Miocene of Maryland is related but, if the two specimens are conspecific, ranges to more slender variants; it is possible that the stouter form, figure 10, the one nearest the Mint Spring species, is a variant of the species figured as *Eulima laevigata*, a species having a pronounced basal angularity.

Eulima bowdichi Dall from the Tampa Limestone (Dall, 1915, p. 82, pl. 12, fig. 14) is more inflated than *M. postnotata* and its whorls are more rounded.

Melanella bartschi Gardner and Aldrich (1919, p. 37, pl. 2, fig. 1) from the late Miocene of North Carolina is larger, more slender, and has a more evenly rounded body whorl, whereas *M. magnoliana* Gardner and Aldrich (ibid., p. 38, pl. 2, fig. 8) from the same locality is definitely tear-shaped.

Type: Holotype 498258 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 15, figure 8).

Occurrence: Red Bluff Formation, MGS locality 38; Mint Spring Formation, USGS locality 7671.

Melanella amnicreta MacNeil n. sp.

Plate 15, figures 10-12; Plate 40, figures 5-6; Plate 46, figures 6-8, 10, 12

Description: Shell very small, moderately slender, whorls weakly rounded with a weak subsutural concavity, base rounded, no basal angularity, aperture tear-shaped; protoconch minute and pointed, consisting of about two smooth rounded whorls whose sutures are less flush than on later whorls; post-nuclear whorls smooth and glabrous, evenly expanding, whorls weakly rounded to nearly straight sided; sutures tightly appressed, not indented but slightly overlapping the whorl above and with a weak subsutural concavity on individuals with more rounded whorls; base well rounded and smooth, some individuals with a faint basal angularity; aperture broadly rounded anteriorly, angulate posteriorly; outer lip thin, gently sinuous and depressed nearest the anal angle; inner lip thicker in columellar region, thin and appressed on parietal wall; no umbilicus.

Discussion: This species is smaller and slenderer than *M. postnotata* and it approaches some of the more inflated species of *Strombiformis* in its proportions of height to width.

The differences on which species are based, mainly in rotundity of the whorls, width of the apical angle, and the degree to which the shell is drawn out, are so slight that this and other species are difficult to both define and contrast. This species seems to have more the proportions of some Eocene species such as *Melanella exilis* (Gabb) (see Palmer, 1937, pl. 6, fig. 12) than the Miocene or Pliocene species that have been described.

Among the Recent Pacific species figured by Bartsch it seems to be most like *Eulimostraca galapagensis* Bartsch (1917-a, p. 333, pl. 43, fig. 1) dredged by the Albatross off Galapagos Island from 40 fathoms. The Recent species is about the same size, 3.8 mm in height.

Type: Holotype 498257 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 15, figure 11).

Occurrence: Red Bluff Formation, MGS localities 37, 38; Mint Spring Formation, USGS localities 14071a, 7671a.

Melanella sp.

Plate 46, figures 4-5

Description: Shell small and consisting of about nine whorls including the protoconch; spire slender and moderately curved; apex rounded; suture faintly visible.

Discussion: This species resembles the Recent species *Melanella bipartita* (Mörch, 1859) from El Salvador in its slender, curved spire.

Occurrence: Mint Spring Formation, MGS locality 89.

Genus **STROMBIFORMIS** Da Costa, 1778

Strombiformis Da Costa, British Conchology, p. 107, 1778.

Type (by subsequent designation, Iredale, 1915): *Strombiformis glaber* Da Costa (= *Turbo subulatus* Donovan). Recent, England.

Winckworth (1934, p. 12) made the following statement:

"*Strombiformis* Da Costa 1778, was first applied to this group by Iredale in 1915 who designated *S. glaber* Da Costa as the type. Unfortunately Iredale overlooked the earlier designation by Harris in 1894. It is true that Harris was under a misapprehension in supposing that the first species must be selected as type, but that does not alter the fact that he has definitely designated a type in the words 'his first species, and therefore the type of the genus is *Turbo perversus* Linné.' *Strombiformis* is not, therefore, available for generic use in this family."

Harris' statement is not regarded as a designation since it is a statement of an untrue consequence, not an unequivocal designation. Apparently neither Harris himself, nor Palmer, with whom he was long associated, had the opinion that Harris had designated a type for *Strombiformis* (see Harris and Palmer, 1947, p. 223).

Strombiformis is used for the "very attenuated slender melanellids, with very narrow elongated aperture, having the inner lip appressed to the attenuated basal portion of the preceding whorl" (Bartsch, 1917-a, p. 339). *Leiostraca* H. and A. Adams and *Subularia* Monterosato have the same type species.

Strombiformis caseyi MacNeil n. sp.

Plate 2, figure 20?; Plate 15, figures 9, 13

Description: Shell of medium size for the genus, slender and elongate, spire very slightly convex, whorls fused and indistinct, base rounded, no basal angularity, aperture elongate and tear-shaped; protoconch small, pointed, probably about two whorls (the first whorl broken on type), whorls smooth and rounded; successive whorls smooth and glabrous, successively less expanding and causing the spire to be slightly convex; individual whorls slightly more convex than outline of spire; sutures tightly appressed and indistinct; base broadly rounded, elongate; aperture moderately narrow, rounded anteriorly, pointed posteriorly, outer lip more curved than inner lip; outer lip thin, not sinuous or recurved posteriorly; inner lip thickened but tightly appressed, forming a weak narrow callus on parietal wall; no umbilicus.

Discussion: Probably *Melanella extremis* (Aldrich) (see Palmer, 1937, pl. 6, fig. 13) is a *Strombiformis*. It is more elongate than the present species and the sutures are better defined, if the drawing is to be relied upon. Of the known Miocene species *S. ischna* Gardner (1947, p. 573, pl. 55, fig. 16) from the Shoal River Formation (middle Miocene) of Florida probably comes closest to *S. caseyi*; if these species occurred in nearly equivalent beds they would almost certainly be combined.

Most recent species of *Strombiformis* have characteristic color markings, either bands or maculations, but none are preserved on the Oligocene fossils.

Type: Holotype 498259 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 15, figure 9).

Occurrence: ? Red Bluff Formation, USGS locality 5264; Mint Spring Formation, USGS localities 13287, 14071a.

Genus NISO Risso, 1826

Niso Risso, Histoire naturelle des principales productions de l'Europe meridionale, etc., v. 4, p. 218, 1826.

Type (by monotypy): *Niso eburnea* Risso. Pliocene, Italy.

Niso fuscicava MacNeil n. sp.

Plate 2, figure 21?; Plate 15, figures 7, 17

Description: Shell of medium size for the genus, apical angle moderately large, spire evenly expanding, whorls weakly rounded, sutures moderately incised, basal angle moderate, umbilicus large; protoconch minute and bulbous, about one full whorl, forming a microscopically round blunt tip to a grossly sharp pointed spire, smooth and glassy; first three post-nuclear whorls more rounded than later whorls; resting positions indicated by strongly incised growth lines and a weak swelling on the older wall at each incision; adult whorls with faint thin raised axial riblets which incline weakly to the right posteriorly (about 12-15 visible from an angle); base smooth and weakly rounded, set off by a moderately strong basal angularity; aperture subovate, angulate at both the anal extremity and the anterior extremity which corresponds to the umbilical rim; outer lip thin; inner lip thin and detached at umbilicus, tightly appressed to parietal wall; umbilicus wide, slightly undercut just below rim; swollen within, strongly crinkled at inner extremity.

Discussion: Specimens of *Niso*, all identified as *N. umbilicata* (Lea) have been figured from the Bashi Marl Member of the Hatchetigbee Formation (late lower Eocene) of Alabama (Harris, 1899, p. 97, pl. 12, fig. 13), the Gosport Sand (late middle Eocene) of Alabama (Palmer, 1937, p. 66, pl. 6, figs. 22-25), and from the beds at Danville Landing, Louisiana (late Eocene) (Harris and Palmer, 1947, p. 225, pl. 26, fig. 17). Neither the Jackson (late Eocene) nor the Claiborne (middle Eocene) forms so figured have a basal angularity and in this respect, at least, the Mint Spring species is more like the Wilcox (early Eocene) form. Other details are not well shown by the figures. Particularly, it is not known whether the Eocene forms have crenulations in the interior of their umbilical wall, a character which may distinguish the present species.

Niso lineata Conrad (see Martin, 1904, pl. 53, fig. 13) from the Calvert Formation (early Miocene) of Maryland has a similar basal angularity but seems to have a smaller apical angle.

The incomplete specimen form the Red Bluff Formation has incised lines corresponding to the faint rasied axial threads on the Mint Spring specimens. The Red Bluff specimen is decorticated and possibly the raised threads decorticate more readily than other parts of the shell.

Type: Holotype 498261 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 15, figure 7).

Occurrence: ? Red Bluff Formation, USGS locality 2633; Mint Spring Formation, USGS locality 7671.

Family ACLIDIDAE G. O. Sars, 1878

Genus ACLIS Lovén, 1846

Aclis Lovén, Ofver, Kon. Vetens. Akad. Förh., v. 3, p. 148, 1846.

Type (by monotypy): *Aclis supranitida* Lovén (=*Aclis ascaris* Turton). Recent, northern Europe.

Aclis matsoni MacNeil n. sp.

Plate 27, figure 28; Plate 46, figures 15-17

Description: Shell small; spire high; whorls rounded with strong spiral sculpture; base gently rounded, aperture flaring anteriorly; protoconch consisting of about two smooth whorls, the first naticoidal and slightly tilted, the second conforming with the spire whorls; postnuclear whorls with three narrow but sharp spiral ribs exposed, and a weaker fourth rib which may be partly exposed or concealed by the suture, interspaces smooth and round-bottomed, the top spiral separated from the suture by a smooth, narrow but moderately concave slope; three very thin low growth varices observable on type; base broadly rounded and not set off by a basal angle, nearly smooth or with faint spirals; aperture subovate, appressed on parietal region, detached in umbilical region to form a weak umbilical chink, weakly flaring with a well defined angularity at the shoulder position, broadly flaring anteriorly.

Discussion: *Aclis protracta* Thiele (1925, p. 106, pl. 24, figs. 3, 3a), Recent from Zanzibar, and *A. torta* Thiele (1925, p. 274, pl. 24, fig. 6), Recent from off Padang, Sumatra, are the most closely related species I can find. The former has a similar aperture but the subsutural concavity is broader and it has six spiral ribs on the body whorl. The latter has more similar sculpture but lacks the anterior flare on the aperture, unless it is broken. The Zanzibar species was collected from a depth of 463 meters.

Turbonilla (Cingulina) urdeneta Bartsch (1917, p. 660, pl. 45, fig. 1), a Recent species from Magdalena Bay, Lower California, may or may not be related. It has a similar kind of ribbing but the aperture, unless it is immature, has no anterior flare nor any angularity at the shoulder position.

Type: Holotype 648934 USNM from the Byram Formation, USGS locality 5615 (Plate 27, figure 28).

Occurrence: Byram Formation, USGS locality 5615, MGS locality 112c.

Aclis matsoni MacNeil var.

Plate 46, figure 17

Discussion: This variation differs from *A. matsoni* s. s. in its more rapidly expanding whorls and in its weaker spiral ribs.

Occurrence: Mint Spring Formation, MGS locality 89.

Aclis sp. A.

Plate 46, figure 14

Discussion: This species is known from the single specimen figured. It is small and consists of eight convex, smooth whorls with the suture impressed. It resembles the Recent species *Aclis (Hemiaclis) verrilli* Bartsch, 1911, from the Western Atlantic off Georgia to West Florida and the West Indies.

Occurrence: Byram Formation, MGS locality 106.

Aclis sp. ?B

Plate 72, figure 8

Description: Shell small, slender, apex blunt; protoconch with one and one half smooth whorls; teleoconch with four cancellate whorls having strong axial ribs and weak spiral lirae.

Discussion: This species is known from the single specimen figured. It is tentatively placed as *Aclis* sp. due to its resemblance to the Recent species *Aclis (Costaclis) cubana* (Bartsch, 1911) from Cuba.

Occurrence: Red Bluff Formation, MGS locality 38.

Superfamily HIPPONICACEA Troschel, 1861

Family HIPPONICIDAE Troschel, 1861

Genus **HIPPONIX** De France, 1819

Amalthea Schumacher, Essai Nouv. Syst., p. 181, 1817 (non Rafinesque, 1815).

Hipponix De France, Jour. Physique, Chimie, d'Hist. Nat. et des Arts, v. 88, p. 217, 1819.

Type (by subsequent designation, Gray, 1847): *Patella cornucopia* Lamarck. Eocene, Paris Basin.

Hipponix pygmaeus Lea

Plate 15, figure 23

1833. *Hipponix pygmaea* Lea, Cont. Geology, p. 95, pl. 3, fig. 75.

1860. *Helcion leanus* Gabb, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 4, p. 387, pl. 67, fig. 48.

1890. *Hipponix ingrediens* De Gregorio, Mon faune Eocenique de l'Alabama, p. 146, pl. 14, fig. 8-9.

1937. *Hipponix pygmaeus* Lea. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 149, pl. 13, fig. 1-4, 8-9; pl. 82, fig. 13-14.
1947. *Hipponix pygmaeus* Lea. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 265, pl. 32, fig. 1-3.
1966. *Hipponix pygmaeus* Lea. Palmer and Brann, Bull. Amer. Paleont, v. 48, No. 218, p. 709-710.
1977. *Hipponix pygmaeus* Lea. Dockery, Mississippi Geol. Survey, Bull. 120, p. 55, pl. 5, fig. 3-4.

Original Description: Lea, 1833.

Shell subrotund, obliquely conical, closely ribbed; apex straight, pointed; cicatrices impressed; margin entire.

Long. diam. .2, Transv. diam. 3-20ths, Height nearly .1, of an inch. Figured magnified.

Observations.—This interesting little shell has a strong resemblance in form to *H. cornucopia* (Defrance and Blainville), *Pileopsis cornucopia* (Lamarck). I have determined to place it in that genus in consequence of its possessing the horse shoe shaped cicatrix mentioned by Blainville* , [* Manuel de Malacologie, p. 507] although I have not seen it attached to any support.

Discussion: Harris and Palmer give the following description for this species, "Shell small, conical, with the apex, overhanging; apex knoblike, not spiral, smooth; postnuclear whorls entirely covered with fine radiating striations, the size of the interspaces varies from less than the width of the rib to at least twice the size of the rib. Irregular concentric growth stages are conspicuous."

I can see no way to distinguish the Mint Spring form from the Claiborne and Jackson representatives of the species. The attitude and position of the beak in the Mint Spring specimen is identical with that of the lower Claiborne specimen figured by Palmer (1937, pl. 13, fig. 4).

The beak on the Mint Spring specimen is smooth and knoblike but there are signs of decortication. Although Harris and Palmer (1947, p. 265) stressed the absence of a coiled nucleus and gave it as a means for separating the families Capulidae and Hipponicidae, and more particularly for separating juveniles of *Capulus americanus* and *Hipponix pygmaeus*, I am inclined to believe the *H. pygmaeus* also has a coiled protoconch. A closely related species from the Choptank Formation (middle Miocene) of Maryland, which Martin (1904, p. 251, pl. 59, figs. 6a-d) named *Amalthea marylandica*, and of which an exceptionally well preserved specimen is figured, has a minute coiled early stage. A slight amount of decortication of the beak would almost certainly produce a simple knoblike beak.

Hipponix sylvaerupis Harris (1899, p. 83, pl. 2, fig. 10-a) from the Bashi Marl Member of the Hatchetigbee Formation (late early Eocene) of Alabama has similar sculpture but it has a higher shell with its beak farther removed from the margin.

Hipponix vagus Palmer (1944, p. 6, pl. 2, figs. 1-3) from the Gosport Sand (late middle Eocene) of Alabama is a shell 22 mm long. Palmer did not believe this could be a gerontic *H. pygmaeus* because of the uniformly small size of known specimens of the latter. *H. vagus* has a strongly papillate apex suggesting that its juvenile shell would be very high and narrow.

As pointed out by Palmer (1937, p. 150), Dall's (1915, p. 104) recording of this species from the Tampa Limestone (early Miocene) is probably an error. The Tampa species is larger and higher, and the beak is more coiled. *Capulus chipolanus* Gardner (1947, p. 570, pl. 57, figs. 22, 23) from the Chipola Formation (middle Miocene) of Florida may be closely related to the Tampa form.

Type: Lectotype 5451 ANSP from the Gosport Sand, Claiborne Bluff, Alabama River, Alabama.

Occurrence: Mississippi: Cook Mountain Formation, Clarke County; Moodys Branch Formation, MGS localities 1, 2, 3, 9; Mint Spring Formation, USGS locality 6452. Alabama: Gosport Sand, Claiborne Bluff. Louisiana: Moodys Branch Formation, Montgomery Landing, Red River. Texas: Stone City Formation, PRI localities 725, 727.

Superfamily CALYPTRAEACEA
Family CALYPTRAEIDAE

Genus **CALYPTRAEA** Lamarck, 1799

Calyptraea Lamarck, Soc. Hist. Nat. Paris Mem., tab. facing p. 70, p. 78.

Type (by monotypy): *Patella chinensis* Linné. Recent, England to the Mediterranean Sea.

The synonymy of the calyptraeids is lengthy and involved because of the inability of authors to recognize describable specific differences in them. This is due to the apparent long geologic and wide geographic range of some little variable types.

The known species represent fairly evenly spaced morphologic stages ranging from *Calyptraea* with a wide spiral diaphragm and small umbilicus to *Calyptraea* with a short curved diaphragm and large umbilicus. The succession of stages continues into the genus *Crucibulum* where a range is found from *Crucibulum* with an attached cup (an open, wide umbilicus with little or no diaphragm) to *Crucibulum* with the cup nearly circular and separated from the wall.

The description of the internal perforation or cup as a "false umbilicus," as it is usually called, is, in my opinion, incorrect. This appears to be a true umbilicus and could have developed from a shell having the plan of *Tugurium exutum* (Reeve) (see Tryon, 1886, pl. 46, fig. 91). The interior plan of *Calyptraea* could result by having the basal wall of the aperture recede and the whorl enlarge so that it lines the entire underside of the peripheral keel,[1] and by having the parietal side of the whorl extend as a tongue-like callus around the umbilical opening. The diaphragm would then be homologous with the basal part of the whorl in *Tugurium* and the margin of the shell (the margin of the hood) would be homologous with the edge of the peripheral keel. *Calyptraea* with the largest spiral diaphragms would be, according to this, the most primitive — they are the oldest known type. *Crucibulum* would be the most advanced type. *Crepidula* probably represents an early offshoot from *Calyptraea* in which the umbilicus migrated to one side of the hood and the base of the body whorl remained as a straight shelf rather than as a spiral diaphragm; in *Crucibulum* the umbilicus enlarges to become the cup and the diaphragm is aborted; in *Crepidula* the umbilicus is aborted and the diaphragm becomes the shelf.

A Paleozoic shell having the same plan as *Tugurium* and which is a possible ancestor of the Calyptraeidae is to be found in the genus *Clisospira* Billings (see Moore, Treatise Invert. Pal. 1906, p. I296). *Clisospira* is known form Ordovician and Silurian rocks in North America, Europe and Asia. According to the Treatise, its resemblance to the Calyptraeidae indicates convergence rather than relationship but this remains to be proven. The origin of *Calytraea* is no less obscure. At least *Clisospira* has the necessary structural plan from which the calyptraeid shell could have developed.

Three possible species of *Calyptraea* are here recognized in the middle and early Oligocene formations of Mississippi. One of them is compared with *Calyptraea aperta* (Solander). One juvenile specimen is described as new. I am making no attempt to give a complete synonym for the European and American Tertiary forms referred to *C. aperta.*

Subgenus **TROCHITA** Schumacher, 1817

Trochita Schumacher, Essai d'un noveau Systeme des Habitations des Vers Testaces, p. 184, 1817.

Type (by subsequent designation, Dall, 1909): *T. radians* Lamarck (= *T. spiralis* Schumacher). Recent, Panama to Peru.

Calyptraea (Trochita) cf. C. (T.) aperta (Solander)

Plate 2, figure 29; Plate 15, figure 25;
Plate 18, figure 12; Plate 28, figures 3-6

1766. ? *Trochus apertus* Solander *in* Brander, Fossilia Hantoniensia, p. 9, pl. 1, fig. 1-2.

1802. ?*Calyptraea trochiformis* Lamarck, Ann. Mus. Nat. History, v. 1, p. 385.

1848b. *Infundibulum trochiformis* Lamarck? Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113 (lines 7, 8, misplaced under *Fissurella*), pl. 11, fig. 3. Plates reprinted in Dockery, 1982, Appendix I.

1892. *Calyptraea trochiformis* Lamarck. Dall, Wagner Free Inst. Science Trans., v. 3, pt. 2, p. 352 (at least in part).

1904. ?*Calyptraea aperta* (Solander). Martin, Maryland Geol. Survey, Miocene, p. 247, pl. 59, fig. 1.

1937. ?*Calyptraea aperta* (Solander). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 145, pl. 16, fig. 1-3, 5.

1947. ?*Calyptraea* (Section *Trochita*) *aperta* (Solander). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 260, pl. 31, fig. 2, 11, 12 (not fig. 4-10).

1966. ?*Calyptraea aperta* (Solander). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 547.

1977. ?*Calyptraea* (*Trochita*) *aperta* (Solander). Dockery, Mississippi Geol. Survey, Bull. 120, p. 56-57, pl. 5, fig. 10.

Discussion: *Calyptraea* cf. *C.* (*T.*) *aperta* ranges from faintly to strongly spinose. It has a spire of medium height and a slightly eccentric apex. The diaphragm is strongly spiral, extending about two-thirds the circumference of the shell from its point of origin. The columella is moderately long for the genus. The umbilicus is a small perforation and is strongly inclined from the axial of the columella.

Conrad (1848, p. 113, remark misplaced under *Fissurella*, pl. 11, fig. 3, 2 specimens) figured both a strongly spinose specimen (fig. 3 right) and a faintly wrinkled, weakly spinose specimen (fig. 3 left) under the name *Infundibulum trochiformis*? [Lamarck]. Both of these specimens are refigured here (Plate 28, figures 3-4). In his last paper in which Vicksburg fossils are mentioned, Conrad (1866, p. 28) listed *Trochita tetrica* Conrad, a nude name. In the collections of the Academy of Natural Sciences of Philadelphia the spinose specimen, Conrad's figure 3 - right, is labelled *Infundibulum trochiformis*, whereas another tray labelled *Trochita tetrica* contains his figure 3 - left as well as a perfectly smooth specimen of the species here described as *Calyptraea conradi*. In all probability Conrad intended to describe the smooth form as new and considered his faintly wrinkled specimen as belonging to a new species, *T. tetrica*. Actually his wrinkled specimen is a nearly smooth variant of the species he called *I. trochiformis*.

As most recent authors have maintained, there is

[1]For the umbrellate spiral cap formed by an overhanging peripheral keel I am here proposing the term *hood*.

no apparent difference between European and American late Eocene, Oligocene and Miocene forms referred to this species. However, a thorough study is needed for all of them. The nature of the spiny projections — whether forming closed hollow tubes, open well-spaced indentations along a weakly raised growth lamella, or fine crenulations along a strongly upturned lamella — is a character to be checked for consistency.

I do not regard the higher spired form from the Tuscahoma Sand and the Bashi Marl Member of the Hatchetigbee Formation (middle and upper early Eocene) of Alabama, figured by Harris (1899, p. 84, pl. 11, figs. 13-15) as *C. aperta*, as belonging to the same species as the Oligocene specimen figured in this report.

Harris and Palmer (1947, p. 262, pl. 31, figs. 8-10) included a form with finely wrinkled sculpture in this species, believing it to be the juvenile stage. They believed a similar form, *Calyptraea greensboroensis* Martin (1904, p. 248, pl. 59, figs. 3a-b), from the Choptank Formation (middle Miocene) of Maryland was also a juvenile of *C. aperta*. *C. greensboroensis* has a larger and more marginal umbilicus than *C. aperta* and for the time being I am inclined to regard it as a different species. The umbilicus of *C. greensboroensis* is like that of *C. conradi*, here described.

Type: Two syntypes GG 7016 and GG 7017 British Museum (Nat. Hist.) from the upper Eocene, England.

Occurrence: Eocene - Miocene, North America and Europe. cf. Mississippi: Cook Mountain Formation, PRI localities 726, 728, 729, 731, 803; Moodys Branch Formation, MGS localities 1, 2, 3, 9: Red Bluff Formation, USGS locality 2632; Mint Spring Formation, USGS locality 14071a; Byram Formation, USGS locality 6455.

Calyptraea (Trochita) conradi MacNeil n. sp.

Plate 15, figures 18, 24; Plate 18, figures 11, 13; Plate 28, figure 10?

1829. Lesueur, Walnut Hills fossil shells, pl. 5, figures 2-4 (no name). Printed in Dockery, 1982, Appendix II.

Description: Shell of medium size for the genus, moderately eccentric and with a moderately low spire; protoconch large, rapidly expanding and with a deep suture, about one full turn or more, smooth; adult sculpture consisting of growth lines only, no trace of wrinkles or spines; diaphragm extending less than half the circumference of the shell, attached to the margin of the hood, not recessed; columella short; umbilicus large and having the shape of a flattened spiral funnel, only moderately inclined from the axis of the columella.

Discussion: The umbilicus of this species approaches that of the more *Calyptraea*-like members of the genus *Crucibulum* and is similar to that of *C. greensboroensis* Martin from the Choptank Formation (middle Miocene) of Maryland. There is no suggestion of intergradation between this species and the form referred to *C. aperta*, either in sculpture or in the shape of the umbilicus.

Type: Holotype 498316 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 18, figures 11, 13).

Occurrence: Mint Spring Formation, USGS localities 13287, 6452; Byram Formation, USGS locality 3729.

Calyptraea (Trochita) sp.

Plate 2, figures 26-27; Plate 40, figures 17-18

Discussion: The umbilicus of this species is like that of *C. (T.) aperta* but the shell is more flattened. The growth lines are delicately raised.

Occurrence: Red Bluff Formation, USGS locality 5264; Mint Spring Formation, MGS locality 89.

Genus **CRUCIBULUM** Schumacher, 1817

Crucibulum Schumacher, Essai d'un nouveau systeme des habitations des vers testaces, p. 56, 182, 1817.

Type (by subsequent designation, Burch, 1946): *Crucibulum planum* Schumacher (= *Patella auriculata* Gmelin). Recent, Florida and West Indies.

Subgenus **DISPOTAEA** Say, 1824

Dispotaea Say, Acad. Nat. Sci. Philadelphia, Jour. 1st ser., v. 4, p. 131, 1824.

Type (herewith designated): *Calyptraea costata* Say. Middle Miocene, Maryland.

Say gave the locality for the type species, and *Perna torta* with which it was found, as Upper Marlborough, Maryland. There seems to be little doubt that these and the other fossils associated with them are from Calvert Formation. The best preserved fossils around Upper Marlborough are Eocene, although leached Calvert beds are known in the vicinity. Either these came from an unknown locality or the locality is an error, the fossils actually having come from along Chesapeake Bay (see Martin, 1904, pl. 58, figs. 7a-b; Whitfield, 1894 (1895), p. 122, pl. 22, figs. 11-14).

I can find no previous type designation for *Dispotaea*. Several authors, including Tryon, Thiele, and Wenz, have accepted *C. striata* Say as the type, but that species was not described until 1826. Only three species can be construed as being in the original list of *Dispotaea, D. tubifera, Calyptraea costata,* and *C. grandis*. *Calyptraea grandis* was inadvertently placed in *Dispotaea* in Say's last sentence, "I therefore propose that it be placed in a new genus under the following name and characters;" the description of *Dispotaea* follows. Actually, *C. grandis* has the detached umbilical cup of typical *Crucibulum* and not the attached cup of *Dispotaea*; certainly not the spiral diaphragm of *Calyptraea*.

Dispotaea seems to be the earliest name for the type of *Crucibulum* having a tear-shaped, large, deep, weakly spiral umbilical cup which is still attached on one side to the wall of the hood. It thus connects typical *Crucibulum* and *Calyptraea*.

Bicatillus Swainson 1840 (see Tryon, 1886, p. 102) probably represents that same group as *Dispotaea*. Herrmannsen (1846, p. 112) designated *Calyptraea deformis* Lamarck as type of *Bicatillus*, saying that it was the same as *Dispotaea*. If it should prove that the high, twisted shape distinguishes shells like the present species and *C. extinctorium* Lamarck from low patelliform species like *C. costatum*, *Bicatillus* is probably the appropriate name for the group under consideration.

Turborahyptraea Eames 1957 (type, *T. scabrosa* Eames), from the late Eocene of Nigeria, may have a slightly wider diaphragm than the species here described, but it certainly represents the same group for which *Dispotaea* and *Bicatillus* have already been proposed.

Crucibulum (Dispotaea) hyalonama MacNeil n. sp.

Plate 15, figure 32

Description: Shell of medium size and high, early whorls spiral, adult irregularly cap shaped; protoconch smooth with a well defined suture, flaring greatly after about one full turn; sculpture consisting of crude blunt growth wrinkles and some faint radial wrinkles which may be inherited from the attaching surface; margin moderately thin and very irregular, apparently conforming with the shape of the attaching surface; umbilicus curved tear-shaped, deep and wide, attached along one side to the hood, the line of attachment nearly marginal at the broad end, deeply recessed at the narrow end.

Discussion: A spiral crease on one side of this shell has the appearance of being a suture in which case the shell would not be a cap but a high spiral of less than a full turn. However, I believe this is an abnormality, due either to a strain in the enclosing sediments or a torsion caused by nestling in a pocket. The very sinuous outline of the base suggests the latter.

Nothing else like this has been found in Vicksburg beds. The only species resembling it in the American Tertiary that I can find is one from the St. Marys Formation (middle Miocene) of Maryland figured by Martin (1904, pl. 58, fig. 11) as *Crucibulum constrictum* Conrad. Martin's specimen is a much higher specimen than those figured by Gardner (1947, pl. 56, figs. 8, 9, 21, 22) under this name and her figure 8 shows much stronger radial sculpture.

Possibly *Crucibulum (Bicatillus) extinctorium* Lamarck (see Tryon, 1886, p. 119, pl. 33, fig. 47), Recent from Malaya, is related.

Type: Holotype 648909 USNM from the Mint Spring Formation, USGS locality 6448a (Plate 15, figure 32).

Occurrence: Mint Spring Formation, USGS locality 6448a.

Family CAPULIDAE Fleming, 1822

Genus CAPULUS Montfort, 1810

Capulus Montfort, Conchyliologie systématique, v. 2, p. 55, 1810.

Type (by monotypy): *Patella hungaricus* Linné. Recent, North Atlantic; Iceland to the Aegean Sea and Greenland to Florida.

Subgenus CAPULUS Montfort, 1810

Capulus (Capulus) americanus Conrad

Plate 2, figures 30, 31

1854. *Capulus americanus* Conrad *in* Wailes, Rept. Agr. Geol. Mississippi p. 289, pl. 15, fig. 1a-b.
1855. *Capulus americanus* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 7, p. 259.
1892. *Amalthea americana* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 358.
1947. *Capulus americanus* Conrad. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 263, pl. 32, fig. 8, 12-15.
1966. *Capulus americanus* Conrad. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 547.
1977. *Capulus americanus* Conrad. Dockery, Mississippi Geol. Survey, Bull. 120, p. 56, pl. 5, fig. 11A, 11B.

Original Description: Conrad, 1855.

Obliquely ovate, longitudinally contracted on one side; lines of growth profound; summit very oblique; apex profoundly prominent, acute, curving towards the base and projecting far beyond the basal margin; aperture obtusely oval or suborbicular.

Description of Harris and Palmer, 1947.

"Nucleus minute, dextral, spiral, consisting of about two and a half whorls, elevated and distinctly marked from the postnuclear whorls; postnuclear whorls not coiled, horn shaped, convex above, concave below the beak, the convexity often increasing with age, the umbo becomes hooked; shell smooth, wrinkled; muscle scars prominent; apertural margin thickened with age, irregular in outline, depending on the character of the attachment,"

Discussion: Harris and Palmer list 22 known records of this species in the Jackson but the present specimen is the first to be reported from the Red Bluff. Harris and Palmer called attention to a paper by Langdon (1886, p. 205) in which *Capulus americanus* was recorded from the Byram Formation at Byram station, Mississippi. Langdon stated that it was an unusual occurrence and Harris and Palmer added that it had not been verified. It is probable that the Byram species is the same as one figured here from the Byram Formation at Vicksburg. This species, which is referred to the subgenus *Capulus* (*Brocchia*), was collected by Col. Thomas L. Casey. It has not turned up in other collections and apparently it is a rare form.

Aside from the Eocene and Oligocene shells referred to *C. americanus*, I can find only one unsculptured American Tertiary species. This species, *Capulus* (*Malluvium*) *lius* Woodring (1928, p. 372, pl. 29, figs. 8, 9), comes from the Bowden Formation (late Miocene) of Jamaica, and it is recorded also from the Gurabo Formation (middle Miocene) of the Dominican Republic. It has less extended and more strongly coiled early whorls than *C. americanus* and it is only about a third as large. *Malluvium* is now regarded as a hipponicid on radular characters.

Capulus gymmus Cossmann and Pissarro (1901 (1902), p. 103, pl. 23, figs. 13, 14) from the Bois-Gouët beds (middle Eocene) of Cotentin, France, is smaller and has a more closely coiled and more recurving beak than *C. americanus*; its beak is very much larger than the beak of *C. lius*.

Type: Holotype 13193 ANSP from the Moodys Branch Formation, Jackson, Mississippi.

Occurrence: Mississippi: Moodys Branch Formation, MGS localities 1, 2, 3, 9; Red Bluff Formation, USGS locality 320, MGS localities 37, 38. Louisiana: Moodys Branch Formation, PRI localities 10, 11, 15, 883, 912; Yazoo Formation, PRI localities 2, 913; Danville Landing Member, PRI locality 6. Texas: Moodys Branch Formation, PRI locality 1121.

Subgenus **BROCCHIA** Bronn, 1828

Brocchia Bronn, Leonhards Zeitschr. f. Min., v. 2, p. 538, 1828.

Type (by monotypy?): *Capulus* (*Brocchia*) *sinuosus* Brocchi. Pliocene, Italy.

This name seems to have been disregarded by modern authors although it appeared in most mid-nineteenth century handbooks. It is treated as a valid subgenus of *Capulus* by Wenz (1940, p. 898). Harmer (1923, p. 768-770; 1925, p. 868) referred several species to it, among them a species from the Coralline Crag (idem, p. 768, pl. 61, fig. 10) identified as *B. sinuosa* (Brocchi).

I am recognizing this subgenus for *Capulus* having crude radial and diagonal or concentric plications. These plications may reflect relief on the surface to which the shells are attached and have no significance, but this remains to be proved.

Capulus (Brocchia) langdoni MacNeil n. sp.

Plate 28, figures 1-2

Description: Shell of medium size, stoutly horn-shaped; apex weakly recurving and overhanging; protoconch eroded but the blunt tip inclines weakly to the left in basal view; a small piece of foreign shell embedded under the apex suggests that the juvenile shell may have been attached; postnuclear whorl evenly expanding; left side with crude plications which trend diagonally towards the anterior margin, right side with crude plications which trend more nearly along true radii to the lateral margin, central area with nearly concentric ripple-like plications; growth stages irregular, some forming frilled varices; interior smooth with a weak muscle impression on the right wall, no left wall muscle scar visible; an inner shell layer terminates about two millimeters from the anterior margin.

Discussion: There is no well defined horseshoe-shaped cicatrix visible on the interior of the type of this species although the interior surface is well preserved; if present it must not have been impressed.

Several shells with plicate sculpture were figured by Harmer (1923, pl. 61) from the Coralline and Newbournian Crags of England and the Scaldisien of Holland under the names *B. sinuosa* (Brocchi) (fig. 10), *B. plicata* Harmer (fig. 11), *B. partim-sinuosa* (S. V. Wood) (fig. 12), and *B. incerta* (A. Bell) (figs. 13, 14). However, if the plicate sculpture is inherited from some surface, such as the shell of another mollusk, it may have little systematic meaning.

I can find no similarly sculptured American species, Recent or fossil. This may be the species Langdon (1886, p. 205) reported from the Pearl River near old Byram Station, but I have not seen his specimen.

Type: Holotype 479766 USNM from the Byram Formation, USGS locality 13286 (Plate 28, figures 1, 2).

Occurrence: Byram Formation, USGS locality 13286.

Capulus planus Dockery, n. sp.

Plate 47, figures 5-11

1886. *Cassidaria brevidentata* Aldrich var. operculum. Aldrich, Geol. Survey Alabama, Bull. 1, pl. 1, fig. 19a.

Description: Protoconch cap-shaped, teleoconch expanding annularly from protoconch into an ovate or elongate curved, slightly concave disk; muscle scar loop-shaped, expanded and reniform at anterior ends, narrow and entrenched along and near posterior margin; elongate, curved shells concave on left side and slightly expanded anteriorly; exterior sculptured with annular growth lines.

Discussion: This species inhabited the shells of dead gastropods and is occasionally found in the matrix of gastropod shells in the Red Bluff Formation, especially *Mambrinia brevidentata* and *Clavilithes vicksburgensis*. The position this species occupied within the gastropod shell as indicated by the attachment scar is on the adapical part of the outer wall with the anterior directed toward the aperture. For this reason the shell is often curved and concave on the left side as it grew to fit the curvature of the shell.

C. planus appears to have had an analogous habitat as well as shell morphology to the Recent species *Crepidula (Ianacus) plana* Say. This latter species of a related genus often shares its host shell with a hermit crab. The concave shell of this species prevents competition with the crab for space and utilizes the space available in the concavity of the adapical wall of the host shell. The holotype of *C. planus* was found inside a large specimen of *Clavilithes vicksburgensis* (see Plate 54, figures 1-2). This host shell also bears the scar of a boring barnacle similar to that of the extant genus *Trypetesa*, which inhabits shells occupied by hermit crabs (see explanation for figure 2 of Plate 54).

Aldrich (1886, pl. 1, fig. 19a) illustrated this species but mistook it for the operculum of the shell in which it was found, a specimen of *Mambrinia brevidentata*. This mistake is unusual as Aldrich (1886, p. 34) in the same publication describes and illustrates a similar species *Capulus complectus* [= *Capulus expansus* (Whitfield), fide Palmer and Brann, 1966, p. 588], which he states is found "occupying the cavities of other shells" and that "older forms resemble an operculum." He also correctly noted the similarity of this latter species, which he listed as occurring in the Bashi, Hatchetigbee, and Lisbon formations of Alabama, to *Capulus squamaeformis* Lamarck from the Eocene (Lutetian, Cuisian and Bartonian) of the Paris Basin, France. *C. planus* differs from *C. expansus* in having a cap-like rather than coiled protoconch and in having a strongly impressed muscle scar paralleling the anterior margin. It is larger in its adult stage than is *C. squamaeformis* of the Paris Basin. *C. planus* along with *C. expansus* and *C. squamaeformis* form a subgroup of *Capulus* with similar habitat and shell morphology.

Type: Holotype 376664 USNM from the Red Bluff Formation, MGS locality 38 (Plate 47, figures 9-11).

Occurrence: Red Bluff Formation, MGS localities 37, 38.

Family XENOPHORIDAE Philippi, 1853

Genus **XENOPHORA** Fischer de Waldheim, 1807

Xenophora Fischer de Waldheim, Museum Demidoff, v. 3, p. 213, 1807.

Type (by subsequent designation, G. F. Harris, 1897): *Xenophora laevigata* Fischer de Waldheim (= *Trochus conchyliophorus* Born). Recent, West Indies.

Most authors have accepted Gray's (1847, p. 158) designation of *T. conchyliophorus* Born as the type of this genus. Woodring (1957, p. 77), from whom the above is taken, apparently concluded that Gray's designation is not valid, presumably because the species does not appear in the original list under the name *conchyliophora*. I have not seen Fischer de Waldheim's publication but, at any rate, the problem is an academic one since both designations are of the same species.

According to Abbott (1954, p. 173), *X. conchyliophora* Born is not *X. trochiformis* Born as was claimed by Clench and Aguayo (1943, p. 1-2) and Harris and Palmer (1947, p. 258). The latter species is an older name for *X. radians* (Lamarck), a Peruvian species.

Subgenus **XENOPHORA** Fischer de Waldheim, 1807

Xenophora (Xenophora) humilis (Conrad)

Plate 28, figures 7, 8

1848a. *Phorus humilis* Conrad. Acad. Nat. Sci. Phiadelphia, Proc., v. 3, p. 285.

1848b. *Phorus humilis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 116, pl. 11, fig. 46. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Onustus humilis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 33.

1866. *Onustus humilis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 25.

1892. *Xenophora (Tugurium) humilis* (Conrad). Dall Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 361 (in part).

1947. *Xenophora humilis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 259, pl. 30, fig. 2.

1966. *Xenophora humilis* (Conrad). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 1025.

1983. *Xenophora (Xenophora) humilis* (Conrad).

Ponder and Cooper, Australian Museum, Mem. 17, p. 70.

Original Description: Conrad, 1848a.

Depressed; volutions five, with comparatively large shells and fragments adhering; body whorl very wide, much depressed; base flat; near the periphery concave. Width 8-10. Height 1/2.

I found but one specimen of its shell, which seems to be less elevated than the other species.

Discussion: Conrad's type came from the Byram Formation and I am retaining his name for it. Dall (1892, p. 361) made a clear distinction between *X. humilis* and some fossils of the same approximate age that he referred to *X. conchyliophora*, and in this he was followed by several authors including Martin (1904, p. 251), and Harris and Palmer (1947, p. 259). Palmer and Brann (1966, p. 1025-1026) placed the species common to the Moodys Branch Formation in Mississippi and Louisiana as *X. reclusa* (Conrad) rather than *X. conchyliophora* or *X. trochiformis*.

Both the type and the specimens at my disposal from the Byram are poorly preserved. The only characters visible that seem to distinguish them from specimens of *X.* (*X.*) *reclusa* are the height of the spire and the size of the umbilicus. *X.* (*X.*) *reclusa* has a higher spire and a small umbilicus; *humilis* has a low spire and a moderately large umbilicus. The sculpture on the base and the extent to which they agglutinate foreign objects seems to be about the same for the two species. Some specimens from the Mint Spring Formation (pl. 15, fig. 22) have a similar habit of agglutination but the spire is higher and the umbilicus is partly concealed; they more nearly resemble *X.* (*X.*) *reclusa.*

Type: Holotype 13521 ANSP from the Byram Formation judging from its matrix, preservation, and the inclusion of *Scapharca* (*Scapharca*) *lesueuri* Dall, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 13286, 3722.

Xenophora (Xenophora) cf. X. (X.) reclusa (Conrad)

Plate 15, figure 22; Plate 47, figures 15-16;
Plate 48, figures 8-9

1829. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 20 (no name). Printed in Dockery, 1982, Appendix II.
1854. ?*Phorus reclusus* Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. 17, fig. 6a, 6b.
1856. ?*Phorus reclusus* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1855, v. 7, p. 262.
1865. ?*Onustus reclusus* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 33.
1890. ?*Xenophora reclusa* (Conrad). de Gregorio, Ann. Geol. Paleont., v. 7, p. 144.
1890. ?*Xenophora humilis* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, pl. 4, fig. 10, 10a.
1892. ?*Xenophora conchyliophora* (Born). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 360 (in part).
1947. ?*Xenophora trochiformis* (Born). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 259 (in part), pl. 30, fig. 15-18; not *X. trochiformis* (Born, 1778, p. 258). Not *X. conchyliophorus* (Born, 1780, p. 333).
1966. ?*Xenophora reclusa* (Conrad). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 1025.
1977. ?*Xenophora reclusa* (Conrad). Dockery, Mississippi Geol. Survey, Bull. 120, p. 58, pl. 6, fig. 5A, 5B.

Discussion: This species is compared to *X.* (*X.*) *reclusa* from the Moodys Branch Formation in that its umbilicus which is smaller than that of *X.* (*X.*) *humilis* is nearly concealed by an overlapping callus. Two specimens of this species were obtained from the Mint Spring Formation at USGS locality 14071a. One shows only the scars of attached shells (Plate 15, figure 22; Plate 47, figures 15-16). The other specimen has rock fragments consisting of lithified sands from the Mint Spring Formation agglutinated to the shell (Plate 48, figures 8-9).

Occurrence: Mississippi: Moodys Branch Formation, MGS localities 1, 2; Yazoo Formation, MGS locality 5; cf. Mint Spring Formation, USGS locality 14071a. Louisiana: Moodys Branch Formation, PRI localities 1, 7, 8, 10, 1119.

Subgenus **STELLARIA** Möller, 1832

Stellaria Möller, Isis, Jena, p. 130.

Type (by monotypy): *Trochus solaris* Linné, 1764. Recent, Indo-Pacific.

Xenophora (Stellaria) conica Dall

Plate 3, figures 1-4, 9; Plate 15, figures 26-27;
Plate 48, figures 4-7

1892. *Xenophora* (*Tugurium*) *conica* Dall, Wagner Free Inst. Sci., Trans. v. 3, pt. 2, p. 361.
1983. *Xenophora* (*Stellaria*) *conica* Dall, Ponder and Cooper, Australian Museum, Mem. 17, p. 12, 14, 54, 68.

Original Description: Dall, 1892.

From the Eocene of Carson's Creek, Wayne County, Miss., five miles south of Shubuta, we have and interesting species of the other subgenus, *X.* (*Tugurium*) *conica* Dall. This has the periphery extended in scalloped points each of which bears a very small extraneous piece of shell, or none; the spire is flatly conical, with a subacute apex and eight whorls, the suture closely appressed; the surface is marked by lines of growth and a few obsolete spiral striæ near the periphery; the base is similarly sculptured, almost smooth, excavated near the periphery, with a funicular umbilicus in which the lines of growth are much elevated. Alt. 11; max. diam. 18mm. The stellate margin, nearly smooth surface and conical form will distinguish it easily from any other American Tertiary species.

Description: Shell moderately small for the genus, broadly and evenly conical, spire moderately high, base weakly concave; protoconch prominent, lying within the same cone as the adult spire, and consisting of about three smooth rounded whorls with moderately deep sutures; adult whorls flattened with the suture nearly flush with the shape of the spire and moderately tightly appressed; sutures made irregular by downward extending squared processes which are the attachment surfaces for agglutinated objects, the bits of shell so agglutinated are also impressed on the subsutural part of the next whorl; sculpture, aside from impressed objects, consisting of many, irregular spiral wrinkles which usually are concentric above the suture with agglutinated objects along the periphery; periphery with strong concave indentations between the squared agglutination processes; base weakly recessed and weakly rounded, marked by growth lines but no spiral sculpture; aperture tear-shaped, peripheral extension sharp, inner lip thickened and weakly raised; parietal callus moderate and nearly obscuring the umbilicus in full view although there is a moderate umbilicus opening from an angle.

Discussion: Ponder and Cooper (1983, p. 14) suggest that *X. conica* may be ancestral to *X. testigera* (Bronn) from the Oligocene, Miocene, and Pliocene of Europe. They state that this latter species is clearly conspecific with *X. digitata* Martens, a Recent species living off the west coast of Africa. In a schematic table showing the possible relationships of the Recent species of *Xenophora*, Ponder and Cooper (1983, p. 12) place *conica - testigera - digitata/profunda* in a phyletic series. Dr. Joseph Rosewater graciously sent a specimen of *X.* (*S.*)*testigera digitata* on loan from the U.S. National Museum. This specimen is illustrated in Plate 48, figures 1-3 for the purpose of comparison with *X.* (*S.*) *conica.*

Type: Holotype 112830 USNM from the Red Bluff Formation, USGS locality 315.

Occurrence: Red Bluff Formation, USGS localities 315, 2633, MGS locality 38; Mint Spring Formation, USGS locality 13287.

Superfamily NATICACEA Gray, 1840
Family NATICIDAE Gray, 1840
Subfamily NATICINAE Gray, 1840

Genus NATICA Scopoli, 1777

Natica Scopoli, Introductio ad historiam naturalem, p. 392, 1777.

Type (by subsequent designation, Anton, 1839): *Nerita vitellus* Linné (= *Nerita rufa* of Born and Gmelin). Recent, western Pacific.

In keeping with the practice of most modern authors on the early Tertiary of the eastern United States, I am referring the Vicksburg naticids to the genera *Natica* and *Euspira.* The species described previously all belong to *Euspira* and in my opinion all are the same species. This is the only instance in which a species in the much neglected Vicksburg fauna has been described more than once. In the present treatment one additional subspecies of *Euspira* and three species of *Natica* are described. One of the latter is referred to *Natica* (*Natica*) and two to *Natica* (*Naticarius*).

The generic and subfamily assignment of fossil species is difficult in cases where they are not closely related to living types. Modern Naticinae and Polinicinae are distinguished by calcareous and horny opercula, respectively. Horny opercula are not preserved as fossils, but the absence of opercula may mean merely that calcareous opercula, if Naticinae are present, have not been found. The only two calcareous opercula from Vicksburg beds known to me are from localities where species of the subgenus *Naticarius* are found. Wrigley (1949, p. 14) in his treatment of the English Eocene and Oligocene Naticidae states in his discussion of *Euspira,* "With an abundance of shells, calcareous opercula are not found, which suggests that in *Euspira* the operculum normally was horny." The same negative evidence seems to be true for the Vicksburg species. However, Wrigley (1949, p. 18) notes under his discussion of *Euspira oligocenia* that von Koenen figured a calcareous operculum found in a specimen that he, Wrigley, regards as this species, this being the only known association of a calcareous operculum with *Euspira*. This, if true, would be a conclusive reason for referring the genus to the Naticinae. However, owing to the possibility that the German specimen may not be a *Euspira,* and the fact that calcareous opercula have not been found in American Oligocene beds except where *Naticurius* also occurs, I am referring *Euspira* to the Polinicinae.

Subgenus NATICA Scopoli, 1777

Natica (Natica) caseyi MacNeil n. sp.

Plate 3, figure 24; Plate 16, figures 25, 27;
Plate 29, figures 7-8

Description: Shell small, spire low to moderately high, whorls rounded, sutures angulate, umbilicus moderately small and partly filled by a low broad funicle, parietal callus broad and indented medially, funicle continuous with callus but set off by a weak furrow, outer margin of umbilicus sharply raised; protoconch smooth, not set off from juvenile whorls except that the first one to one and a half turns are plane coiled; adult whorls smooth or with faint growth lines, occasional specimens with very weak subsutural indentations; umbilical opening moderately narrow and crescent-shaped, outer margin steep or weakly undercut, funicle central, and of moderate size, face of funicle confluent with anterior lobe of parietal callus but set off from it by a weak indentation and a shallow groove; parietal callus moderately heavy, medially indented.

Discussion: This species appears to belong to the group of *N. semilunata* Lea from the Claiborne (middle Eocene) of Alabama. As yet, no calcareous opercula have been identified as belonging to this species. Palmer (1937, p. 114) discussed *N. semilunata* and its related forms at length and there seems to be little to add. Palmer referred *semilunata* to *"Natica" "Naticarius"*, apparently an indication that it is not typical of the group.

I do not believe either *N. semilunata* or *N.* (*N.*) *caseyi* belong to the subgenus *Naticarius*. If and until a calcareous operculum is identified with this species, its generic assignment will be in doubt. It is clear from Palmer's discussion that it approaches *Euspira* in several respects and it is entirely possible that it is closely related to *Euspira*. Palmer believed the umbilical fold of *N. semilunata* indicated its relationship to *Naticarius*. However, it is a broad, posteriorly placed fold and it is, in my opinion, unlike the sharp central or anteriorly placed fold found in the species here referred to *Naticarius*. It may prove, when more is known of the Eocene and Oligocene naticids, that the *N. semilunata* group is in reality diverging from the *Euspira* group, and that *N. semilunata* and *N. caseyi* are members of the Polinicinae. Possibly a new generic name is needed for this group. For the time being I am referring it to *Natica* (*Natica*).

It is a little difficult to tell from the figures how much variation there is in the size of the funicle in *N. semilunata*. Palmer's figure 13 (1937, pl. 11) appears to be of a shell with a much larger funicle than those in the Meyer drawings of Lea's and Conrad's types (Palmer, 1937, pl. 80, figs. 1, 6, 11) which she also reproduced. *N.* (*N.*) *caseyi* has a large funicle like that in Palmer's figure 13. However, none of the Claiborne specimens appear to have the weak crease between the funicular callus and the parietal callus.

It is likely that the Oligocene species consistently has a larger funicle than the Claiborne species and this, in addition to the crease, is the main difference between them. There is some range in the height of the spire in *N.* (*N.*) *caseyi;* the holotype has a low spire.

If I am mistaken in the relationship of this species to *N. semilunata,* there is no allied species in Claiborne beds.

Harris and Palmer (1947, p. 251) discussed the erroneous identification of *Euspira jacksonensis* Harris and Palmer as *N. semilunata* by several authors. They did not find any Jackson species related to *N. semilunata.*

Type: Holotype 648944 USNM from the Byram Formation, USGS locality 13286 (Plate 29, figure 7).

Occurrence: Red Bluff Formation, USGS locality 2632; Mint Spring Formation, USGS locality 7671; Byram Formation, USGS locality 13286.

Subgenus NATICARIUS Duméril, 1806

Naticarius Duméril, Zoologie analytique, p. 164, 1806; genus without species.

Type (by monotypy, Froriep, 1806): *Nerita canrena* Linné. Recent, West Indies.

The question of whether Duméril's name is a substitute for *Natica* Lamarck, non Scopoli, an emendation, or a special nomenclature was discussed by Woodring (1957, p. 85). The only thing in favor of the name is that it is widely used. The manner in which it was introduced is so nebulous that it could be interpreted in different ways. Woodring was of the opinion that the name almost certainly calls for a ruling of the Commission on Zoological Nomenclature. He suggested that it could be validated as a new name dating from either Duméril's or Froriep's usage and favored the former. This seems to be the most satisfactory solution and it is here followed.

Natica (Naticarius) acuticallosa MacNeil n. sp.

Plate 3, figures 15?, 20?; Plate 16, figures 20, 22;
Plate 29, figures 14-18; Plate 49, figures 4-5?

Description: Shell small, spire moderately high, whorls rounded, sutures angulate, umbilicus large with a strong narrow funicle, parietal callus moderately narrow to pointed, funicle not continuous with callus, outer margin of umbilicus moderately sharp; protoconch smooth, about two full turns; postnuclear whorls marked by axial wrinkles or creases below the suture, smooth elsewhere except for growth lines; umbilical opening deeper and more cavernous posterior to the funicle, funicle located slightly anterior of the center of the umbilical lip; inner lip narrow above and below funicular callus; parietal callus attachment narrow and moderately high on parietal wall, no medial indentation.

Discussion: The paratype is selected to show the extreme narrowness of the parietal callus. An operculum is in the vial with it but it is not known whether it was in place. It is presumed to belong to this species but owing to the uncertainty is not included in the description.

This species is the Vicksburg analog of *N.* (*N.*) *magno-umbilicata* Lea from the Gosport Sand (late middle Eocene) of Alabama. *N.* (*N.*) *acuticallosa* has finer and more numerous subsutural wrinkles than the Claiborne species and, judging from the best available figures of the latter (see Palmer, 1937, pl. 11, figs. 1-3; pl. 80, figs. 2, 3), its funicle is located a little more anteriorly than in *N.* (*N.*) *magno-umbilicata*. The funicle of the Vicksburg species may be a little larger than in the Claiborne species, but it is smaller than in any of the Miocene species figured by Gardner (1947, pl. 59).

The relationships of *N. alazana* Cooke (1928, p. 8, pl. 2, figs. 1, 1a, 1b) from the Alazan Clay (Oligocene) of Mexico are not clear, but it is the only one of the Mexican species that could be related to this one. *N. alazana* has similar subsutural wrinkles but the parietal callus is much wider and the funicle is larger and lower; the form next discussed is closer to *N. alazana*.

No Jackson analog of this species has been described. *Natica permunda* Conrad (see Harris and Palmer, 1947, p. 246, pl. 29, figs. 3-6) has a lower spire and an appressed, nonangulate suture. The only British Eocene species that even approach *N.* (*N.*) *acuticallosa* in the size of the parietal callus are *N. epiglottina* Lamarck and *N. noae* d'Orbigny (see Wrigley, 1949, pl. 27, figs. 1,3). However, both have a spire and suture like that of *N. permunda*.

Type: Holotype 498385 USNM and paratype 498383 USNM both from the Byram Formation, USGS locality 13286 (Plate 29, figure 16-17 and figure 15 respectively).

Occurrence: Red Bluff Formation, USGS localities 2633?, 2632? (operculum), MGS locality 38?; Mint Spring Formation, USGS localities 3727, 3722; Byram Formation, USGS localities 3722, 13286.

Natica (Naticarius) aff. N. (N.) alazana Cooke

Plate 3, figure 23; Plate 16, figures 18, 26

Discussion: The form so identified may be the species described by Cooke (1928, p. 8, pl. 2, figs. 1, 1a, 1b) from the Alazan Clay (Oligocene) of Mexico. It compares with the Mexican species in the size and position of the funicle and approaches it in the size of the parietal callus. The main difference lies in the stronger subsutural wrinkles in the Mexican species; the Mint Spring form has weak or no axial wrinkles. In as much as it is not known how variable this character is I am not naming the form here figured.

If this species intergrades with *N.* (*N.*) *acuticallosa*, there is no indication of it among the few specimens at hand. It differs from *acuticallosa* in having a wider parietal callus and in having a larger more anterior funicle; the umbilicus is smaller, which together with the larger funicle makes the cavity considerably smaller. In addition *N.* (*N.*) aff. *N.* (*N.*) *alazana* appears to be less inflated than *N.* (*N.*) *acuticallosa*.

Type: Holotype 352704 USNM from the Alazan Clay, Rio Buena Vista west of Alazan, Mexico.

Occurrence: Mexico: Alazan Clay, Rio Buena Vista. aff Mississippi: Red Bluff Formation, USGS locality 5264; Mint Spring Formation, USGS localities 3727, 13287.

Subfamily POLINICINAE Gray, 1847

Genus EUSPIRA Agassiz, 1838

Euspira Agassiz, German edition of J. de C. Sowerby's Mineral Conchology of Great Britain, v. 14, p. 320, 1838.

Type (by subsequent designation, Dall, 1915): *Natica glaucinoides* Sowerby. Eocene, England.

Some of the reasons for placing *Euspira* in the Polinicinae were discussed under the genus *Natica*. Cossmann and Peyrot (1919, p. 385) questioned the value of the operculum in the generic (and subfamily?) division of the Naticidae because *Natica dillwynii* Payraudeau has an operculum that is partly calcareous and partly horny. Even so, its operculum falls among those that are calcareous. Wrigley (1949, p. 14) points out the resemblance of *Lunatica* Gray 1847 to *Euspira* and gives as the best reason for not combining them "that the animal of the living species is, or can be known, while that of a fossil is not." This is not a valid reason for recognizing them as separate genera. I believe the proportions of the umbilicus, the parietal callus, and the funicular swelling, which latter causes a broad extension of the parietal callus, makes it inadvisable to combine *Euspira* with any other genus of Polinicinae.

Wrigley reports that a specimen of *Euspira oligocenia* from Germany had a calcareous operculum inside it. If the operculum belongs to the shell, I would say either that the German specimen is not *oligocenica*, or *oligocenica* is not a *Euspira*. No opercula have been found with *Euspira* in either Eocene or Oligocene beds in either America or England except where *Naticarius* also occurs, and it is assumed they belong to *Naticarius*. Nevertheless it cannot be ruled out that the solid calcareous operculum in the Naticinae is a specialization, and that the early Tertiary and Cretaceous representatives of the two groups were closely related and with a less clear cut distinction in the calcification or amount of calcification of the operculum.

Labellinacca Cossmann 1919 is a synonym.

Euspira vicksburgensis (Conrad)

Plate 3, figure 22; Plate 16, figure 24;
Plate 29, figures 3-4, 6, 10-12

1848a. *Natica vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 282.
1848b. *Natica vicksburgensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 11. Plates reprinted in Dockery, 1982, Appendix I.
1886. *Natica decipiens* Meyer, Alabama Geol. Survey, Bull. 1, pt. 2, p. 69, pl. 2, fig. 22.
1892. *Lunatia vicksburgensis* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 370.
1892. *Lunatia decipiens* (Meyer). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 371.
1928. *Polynices (Euspira) byramensis* Cooke, U.S. Nat. Museum, Proc., v. 73, art. 10, p. 8, pl. 2, fig. 3, 3a, 3b.
1937. *Euspira vicksburgensis* (Conrad). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 131.
1937. *Euspira decipiens* (Meyer). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 131.
1940. *Polinices vicksburgensis* (Conrad). Mansfield, Jour. Paleont., v. 14, No. 3, p. 122.
1947. *Euspira vicksburgensis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 252.

Original Description: Conrad, 1848a.

Subglobose, whorls four or five convex; umbilicus large; columella straight; labium callous. Length 6-10. This species is common.

Discussion: This may be the only instance of synonymy within the Vicksburg Group; *E. vicksburgensis* has been named three times and possibly a fourth synonym has been named from Mexico.

This species is closely related to *Euspira jacksonensis* Harris and Palmer (1947, p. 251, pl. 29, figs. 16-19) from the Moodys Branch Formation (late Eocene) of Mississippi. The Claiborne species which Palmer (1937, p. 130, pl. 12, figs. 14, 16-18) identified as *Euspira marylandica* (Conrad) is an earlier member of the same stock.

It might be difficult to distinguish *E. jacksonensis* from this species. Harris and Palmer (1947, p. 252) state that the whorls of *E. jacksonensis* are decidedly more shouldered. *E. vicksburgensis* ranges from specimens with a low spire and low angled sutures to specimens with moderately high spires and high angled sutures. The holotype of *E. byramensis* has one of the lowest spires observed but there seems to be an even gradation between it and the high spired form. The only specimen known to me from the Red Bluff Formation has a very high spire. If it should prove that the low spired form is restricted to younger beds, *byramensis* might be recognized as a subspecies, but such a situation cannot be demonstrated on the basis of the specimens seen to date.

According to Cooke, the umbilical rib (funicular swelling?) is inconspicuous in all specimens examined except the type. One other specimen here figured (pl. 29, fig. 3) has a comparable funicular swelling and funicular callus.

It is not clear whether Meyer did not realize the similarity of his *N. decipiens* to *E. vicksburgensis* or whether he thought it was different. At any rate his name is a homonym of *Natica decipiens* d'Archaic, 1853, as pointed out by Palmer.

The size of the funicular swelling as well as the anterior extension of the parietal callus on it varies considerably (compare pl. 29, figs. 3, 10, 11). On some specimens there is a well defined notch between the parietal callus and the funicular callus. *Polynices (Lunatia) lacrimans* Cooke (1928, p. 8, pl. 2, figs. 2, 2a-b) from the Alazan Clay (Oligocene) of Mexico has a similar notch and it may prove that this is another synonym of *vicksburgensis*. If so, it represents nearly the opposite extreme in the varietal range of the species from his *byramensis*.

The nearest relative of *E. vicksburgensis* in the American Miocene appears to be *Euspira rotunda* Gardner (1947, p. 552, pl. 59, figs. 25-27) from the Shoal River Formation of Florida. It is less like it than are the Eocene species.

Type: Lectotype of *Natica vicksburgensis* 13531 ANSP (Plate 29, figure 11) and syntype 13532 ANSP both from the Byram Formation judging from matrix and preservation, Vicksburg, Mississippi (Conrad). Holotype of *Natica decipiens* Meyer not found in Aldrich collection and presumed lost. Holotype of *Polynices (Euspira) byramensis* Cooke 352706 USNM from the Byram Formation, USGS locality 3722 (Plate 29, figure 4).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 5264; Mint Spring Formation, USGS locality 6448; Byram Formation, USGS localities 13286, 3722, 6454; ?Chickasawhay Limestone, *Polinices* ? sp. (Mansfield, 1940, p. 221, pl. 27, fig. 43), Wayne County. Mexico: Alazan Clay, Rio Buena Vista west of Alazan (T.W. Vaughan); *Polynices (Lunatia) lacrimans* Cooke (1928, p. 8, pl. 2, fig. 2, 2a, 2b) from the Alazan Clay may be this species.

Euspira vicksburgensis cookei MacNeil n. subsp.

Plate 16, figure 23

Discussion: This form may prove to be no more than a variety when more specimens have been studied. At the present time, however, it is distinctly outside the varietal range of the species as otherwise known. It has a very small umbilicus and the funicular swelling is correspondingly small. The shell is more inflated and the spire lower than in the typical form. The spire does not have the weak apical taper the species generally has; rather, it has a bulbous shape like some of the Vicksburg *Natica*.

Type: Holotype 498324 USNM from the Mint Spring Formation, USGS locality 3727 (Plate 16, figure 23).

Occurrence: Mint Spring Formation, USGS locality 3727.

Euspira sp.?

Plate 3, figure 21

Discussion: A single worn and broken specimen of a very large *Euspira* is present in an old collection from the Red Bluff Formation. It has a low spire and an appressed low angled suture like the holotype of *E. byramensis* Cooke. The parietal callus is very large, possibly a gerontic condition. The umbilicus is very large.

If the specimen were more complete it might be described as new. It resembles *E. byramensis* more than the typical form of the species and might, if more specimens like it were known, be proof that *E. byramensis* is in reality a stock distinct from *E. vicksburgensis*. This may be a *Neverita*.

Occurrence: Red Bluff Formation, USGS locality 2633.

Subfamily SININAE Woodring, 1928

Genus **SIGATICA** Meyer and Aldrich, 1886

Sigatica Meyer and Aldrich, Cincinnati Soc. Nat. Hist. Jour., v. 9, No. 2, p. 42, 1886.

Type (by monotypy): *Sigaretus (Sigatica) boettgeri* Meyer and Aldrich. Middle Eocene, Mississippi.

Sigatica was rejected as a synonym of *Eunaticina* (type, *Natica papilla* Gmelin, a Recent western Pacific species) by Dall (1982, p. 380), but other American authors have regarded them as distinct. However, except for Woodring's use of *Eunaticina* for *E. regia* (Guppy), a Jamaican Miocene species, only one other species, *E. erectoides* Aldrich, from the middle Eocene of Mississippi has been referred to *Eunaticina*.

The type of *Sigatica* is from the same area and formation as *E. erectoides* and they appear to be quite different things. Since there appears to be no post-Eocene American species resembling *E. erectoides*, and, if it is a *Eunaticina*, the genus is no longer present in this part of the world, I am referring the Vicksburg species to *Sigatica*.

I do not regard *Sigatica* as a subgenus of *Sigaretus*, although I am assigning it to the subfamily Sininae. Wenz, on the other hand, puts *Sigatica* (and *Eunaticina*) in the subfamily Polinicinae and *Sinum* in the Sininae.

Narica d'Orbigny, 1842, under which Conrad described the species under consideration, is a synonym of *Vanikoro* Quay and Gaimard, 1832, and unrelated group.

Sigatica conradii (Dall)

Plate 16, figure 16; Plate 29, figures 1-2

1829. *Naticoides sigarettoides* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 21. Printed in Dockery, 1982, Appendix II.
1848a. *Natica mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 282.
1848b. *Narica mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113, pl. 11, fig. 8. Plates reprinted in Dockery, 1982, Appendix I.
1892. *Sigaretus (Eunaticina) conradii* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 380.
1940. *Eunaticina conradii* (Conrad). Mansfield, Jour. Paleont., v. 14, No. 3, p. 223.

Original Description: Conrad, 1848a.

Subglobose, revolving lines fine, regular, equal; longitudinal wrinkles very minute; spire very short; suture somewhat channelled; umbilicus rather large. Length 4-10.

Discussion: Dall transferred *mississippiensis* to *Sigaretus*, in which there already existed a species by that name of Conrad, and declared it a homonym. Although no longer considered congeneric, this is a valid rejection under the rules and the name connot be revived.

This species has incised spiral lines all over the shell with the basal interspaces wider. It is not clear whether *S. boettgeri* Meyer from the Claiborne is smooth centrally, as in the figure (see Palmer, 1937, p. 142, pl. 14, fig. 3), or whether the central spirals are weak or worn. Thus far no Jackson species of this genus has been reported.

Sigatica (Glyptanatica) euglypta Gardner (1947, p. 555, pl. 60, fig. 1), from the Chipola Formation (Miocene) of Florida, is the closest relative of this species I can find. *S. conradii* has a narrower and heavier parietal callus and the subparietal indentation of the inner lip is larger. The Oligocene form also has stronger and more closely set incised spiral lines.

Type: Lectotype 13529 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 6448, 7671; Byram Formation, USGS locality 3722, MGS localities 106, 112c; ?Chickasawhay Limestone, an unfigured fragment of this species was reported by Mansfield (1940) from the Chickasawhay Limestone on Taylor Mill Creek, MGS locality 118.

Genus SINUM Roeding, 1798

Sinum Roeding, Mus. Boltenianum, pt. 2, p. 14, 1798.

Type (by subsequent designation, Dall, 1915), *Helix haliotoidea* Linné (cited by Roeding as of Gmelin). Recent, western Pacific (?).

Woodring (1928, p. 389; 1957, p. 93) tentatively regarded the type species as having come from the western Pacific, but some other authors have thought it to be either a Mediterranean or American species, as stated by Linné, or a West African species. At any rate, there does not appear to be any doubt that it represents the genus as generally understood.

Dall (1909, p. 91) appears to have been the first author to accept *Sinum* as the correct name for *Sigaretus* Lamarck.

Sacco recognized three subgenera of *Sigaretus; Sigaretotrema* Sacco for inflated shells, *Sigaretus* Lamarck for medium flattened shells, and *Cryptostoma* Blainville for flattened shells. The type species of *Cryptostoma* and *Sinum* show them to be congeneric, and the type species of *Sigaretus* is more like them than are shells referred to *Sigaretus* by Sacco. *Sigaretotrema* might, therefore, be available for the more inflated forms like *S. mississippiensis,* here figured. However, there seems to be little justification for removing *Sigaretotrema* from the Sininae and placing it in the subfamily Polinicinae as was done by Wenz.

The type species of *Sinum*, while not definitely determinable, is clearly, as its name implies, a "haliotiform" species.

Subgenus SINUM Roeding, 1798

Sinum (Sinum) aff. S. (S.) beatricae Palmer

Plate 3, figures 18, 19; Plate 29, figures 9, 13; Plate 40, figures 21-23

1937. ?*Sinum beatricae* Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 141, pl. 15, fig. 2, 4, 10.
1966. ?*Sinum beatricae* Palmer. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 906.

Discussion: Each of the three formations here dealt with has yielded one specimen of a small flattened *Sinum,* all of which appear to represent a single species.

According to Palmer (1937, p. 139) the four recognized Claiborne species, *S. beatricae* Palmer, *S. arctatus* (Conrad), *S. declivis* (Conrad), and *S. bilix* (Conrad), range from flattened to more rounded in the order named, but apparently she did not believe they formed an intergrading series. In addition, she distinguished these species by the degree of projection of the apical whorls, *S. bilix,* the most rotund or turbinate species having the apex more prominent whereas *S. beatricae,* the most flattened species, has its apical whorls flattened or submerged.

The present species appears to resemble published figures of *S. beatricae* in outline and in the degree of flattening, but its apical whorls are more projecting; the apex may compare more with that of *S. declivis*. However, in both respects it is difficult to make comparisons with published figures because of the inconsistency in orienting them. A slight turning of a flat oblique specimen makes it appear to be rotund and inflated.

It seems to be certain that this species is distinct from *S. mississippiensis,* but I am making no effort to name it because of the probability that it is identical with one of the Claiborne species which in turn are difficult to appraise.

Type: Holotype 2811 PRI from the Gosport Sand, Claiborne Bluff, Alabama River, Alabama. Paratype 2812 PRI from the Cook Mountain Formation, Wautubbee, Mississippi.

Occurrence: Alabama: Gosport Sand, Claiborne Bluff and Little Stave Creek. South Carolina: McBean Formation, about 3 miles and 6 miles west northwest of Orangeburg. Mississippi: Cook Mountain Formation, Wautubbee; aff. Red Bluff Formation, USGS locality 5264; aff. Mint Spring Formation, USGS locality 7671a; aff. Byram Formation, USGS locality 3722.

Subgenus SIGARETOTREMA Sacco, 1890

Sigaretotrema Sacco, Molluschi dei terreni del terziarii del Piemonte e della Liguria, pt. 8, p. 97, 1890.

Type (by subsequent designation, Cossmann, 1924): *Sigaretus michaudi* Michelotti. Miocene, Italy.

Sinum (Sigaretotrema) mississippiensis (Conrad)

Plate 16, figures 14, 17; Plate 29, figure 5

1829. *Sigareta striata* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 4. Printed in Dockery, 1982, Appendix II.
1848a. *Sigaretus mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 283.
1848b. *Sigaretus mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113, pl. 11, fig. 9. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Catinus mississippiensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 27.
1892. *Sigaretus bilix* var. *mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 378-379.
1937. *Sinum mississippiensis* (Conrad). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 140.
1945. *Sinum mississippiensis* (Conrad). Gardner, Geol. Soc. America, Mem. 11, p. 178.

Original Description: Conrad, 1848a.

Obliquely oval, with fine very closely arranged wrinkled revolving lines; whorls convex; no umbilicus. Length 8-10.

This species is usually much smaller than the specimen described, and scarcely differs from a species of Claiborne, Alabama. Not very common.

Discussion: Dall (1892, p. 378) concluded that *S. mississippiensis* was at most a variety of the Claiborne species, *S. bilix* Conrad. Modern usage of the term variety as a variant of a species rather than a subcategory of a species, as subspecies is now used, makes most of his discussion immaterial. Nevertheless, he believed that *S. mississippiensis* fell within the range of variation of the Claiborne species. Palmer (1937, p. 140) tentatively agreed with him, but Gardner (1945, p. 178) thought the Vicksburg form was "consistently fuller."

In a genus in which observable differences are so minute, I feel that if *S. mississippiensis* is to be combined with *S. bilix,* it would follow that both are synonyms in turn of some other species such as *S. clathratum* (Gmelin) (see Wrigley, 1949, p. 22, figs. 44-46), a European Eocene species. For that reason I am retaining *S. mississippiensis* solely for its geographic and stratigraphic connotation. Possibly this form should be recorded as *S. clathratum mississippiensis.*

Type: Lectotype 13527 ANSP (best preserved of three cotypes) and two paratypes 13528 ANSP all from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Mint Spring Formation, USGS localities 6448, 14071a; Byram Formation, USGS locality 13286; cf. Chickasawhay Limestone (*Sinum* sp. cf. *S. mississippiensis* (Conrad), Mansfield, 1940, p. 223, pl. 27, fig. 46).

Sinum (Sigaretotrema) cf. S. (S.) danvillense Harris and Palmer

Plate 3, figures 16, 17; Plate 49, figures 1-3

1947. ?*Sinum danvillense* Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 253, pl. 30, figs. 6-7.

Discussion: A single specimen from the Red Bluff Formation seems to compare more closely with the Jackson species than with *S. mississippiensis.* The main difference lies in its more rounded shape and lower, less pointed spire; *S. mississippiensis* is definitely more turbinate.

The subtleties in the degree of inflation, height of the spire, and obliqueness are of uncertain value in determining species in this genus, and it is by no means certain how much individual variation exists in one interbreeding population.

Sinum fragilis (Conrad) (see Martin, 1904, p. 255, pl. 60, figs. 5a-b) from the Miocene of Maryland has the same proportions as the present form.

As with *S. mississippiensis*, this form could well be regarded as no more than a subspecies of *S. clathratum* (Gmelin).

Type: Holotype 4521 PRI from the Danville Landing Member of the Yazoo Formation, Danville Landing, Ouachita River, Catahoula Parish, Louisiana.

Occurrence: Louisiana: Danville Landing Member, Danville Landing on the Ouachita River. cf. Mississippi: Red Bluff Formation, USGS locality 5264, MGS localities 38, 39.

Subfamily GLOBULARIINAE

Genus **AMPULLINOPSIS** Conrad, 1865

Ampullinopsis Conrad, Amer. Jour. Conchology, v. 1, p. 27, 1865.

Type (by monotypy): *Natica mississipiensis* Conrad. Oligocene, Mississippi, Louisiana, and Mexico.

Ampullinopsis is regarded as generically distinct from *Ampullina* Bowdich, 1822, (type, a figure, presumably of *Ampullaria depressa* Lamarck, Eocene of the Paris Basin) because of its heavy parietal callus, coarse growth lines, and deeply channelled suture. *Ampullina* has only a wash of callus, the shell is glabrous, and the suture is simply indented and appressed.

The genus *Ampullinopsis* also has a very broad basal disc, formed by a broadly flaring siphonal fasciole (see pl. 16, fig. 21). The margin of the disc is outside the margin of the umbilical depression. It thus differs from *Ampullina* which has a smaller disc and its margin is within the umbilical depression.

Typical *Ampullinopsis* is common in the Mint Spring Formation. I have seen only one specimen from the Red Bluff Formation and one from the Byram Formation. Gardner (1945, p. 175, pl. 10, figs. 18, 23) figures *A. mississippiensis* from "middle Oligocene Sandstone" from Nuevo Léon, Mexico. I am not convinced that the early and middle Eocene species, *Ampullina recurva* (Aldrich) (see Palmer, 1937, pl. 14, figs. 7, 8), or *A. dumblei* (Heilprin) (see Palmer, 1937, pl. 14, figs. 10, 11; Gardner 1945, p. 174), are congeneric with the Oligocene species, or that Gardner was justified in regarding *Ampullinopsis* as a "section" of *Ampullina*. Apparently Palmer (1937, p. 134) regarded the two as distinct genera.

Megatylotus Fischer 1885 (type, *Ampullina crassatina* Lamarck) is a synonym.

Ampullinopsis occurs in the Oligocene of Europe and the Caribbean region, but I do not believe any Eocene species from these areas belong to it. In my opinion *Ampullinopsis* existed during the Eocene in the Far East. Yabe and Hatai (1939, p. 209) described a genus and species, *Hahazimania hahazimensis*, from Eocene beds on the island of Haha-jima in the Bonin Islands that I believe is a true *Ampullinopsis*. Some much better preserved specimens of what I believe to be the same species are illustrated (MacNeil, 1964) in a report on megafossils from the Miyara Formation of Ishigaki-shima, Ryukyu Islands. The Miyara Formation is believed to be about middle Eocene in age.

Ampullinopsis mississippiensis (Conrad)

Plate 3, figure 25; Plate 16, figures 19, 21;
Plate 29, figure 19; Plate 40, figures 24-25

1929. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 19 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Natica mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 283.
1848b. *Natica mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 10. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Ampullinopsis mississippiensis* (Conrad). Conrad, Amer. Jour., Conchology, v. 1, p. 27.
1890. *Natica Missipiensis* Conrad. De Gregorio, Annoles géologie, paléontologie, v. 7, p. 148.
1892. *Ampullina crassatina* Lamarck, var. *mississippiensis*. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 375 (in part).
1941. *Ampullina* (*Ampullinopsis*) *mississippiensis* (Conrad). Wenz Handbuch der Palaozoologie, Gastropoda, bd. 6, teil 5, p. 1020.
1945. *Ampullina* (Section *Ampullinopsis*) *mississippiensis* (Conrad). Gardner, Geol. Soc. America, Mem. 11, p. 175, pl. 10, fig. 18, 23.
1946. *Ampullinopsis mississippiensis* (Conrad). Wrigley, Malacological Soc. London, v. 27, pt. 2, p. 97.
1959. *Ampullinopsis mississippiensis* (Conrad). Woodring, U.S. Geol. Survey, Prof. Paper 306-B, p. 158.

Original Description: Conrad, 1848a.

Subglobose, body whorl flattened above; suture channelled; spire little prominent; base profoundly callous; aperture moderate. Length 8-10.

This rare species I found about seven or eight miles North West of Vicksburg.

Discussion: Numerous authors have stated that *A. crassatina* (Lamarck) and *A. mississippiensis* are one species. The former is restricted to middle Oligocene beds in Europe. Although I am retaining *A. mississippiensis* as a separate species for the time being, Dall's treatment of it may be more nearly correct: to regard it as a variety or subspecies of *crassatina*.

The near identity of *mississippiensis* and *crassatina* strongly suggests that the apparent acme in abundance in Europe and America is in reality a single proliferation and that the Mint Spring Formation correlates with the early part of the Rupelian Stage, or the latest part of the Lattorfian Stage.

Type: Holotype 13525 ANSP from the Mint Spring Formation judging from its matrix and preservation, Smith Plantation, 7 to 8 miles north of Vicksburg (This is probably in the vicinity of Haynes Bluff where there are good exposures of the Mint Spring Formation).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 2632, MGS locality 38; Mint Spring Formation, USGS localities 14074, 14071a, MGS locality 99; Byram Formation, USGS locality 13286. Louisiana: Vicksburg Group, USGS localities 14852, 14853. Mexico: middle Oligocene sandstone, Nuevo Leon, USGS localities 13529, 14023.

Superfamily CYPRAEACEA Rafinesque, 1815
Family CYPRAEIDAE Rafinesque, 1815
Subfamily CYPRAEORBINAE

Genus **CYPRAEORBIS** Conrad, 1865

Cypraeorbis Conrad, Amer. Jour. Conchology, v. 1, p. 31, 1865.

Type (by monotypy): *Cypraea sphaeroides* Conrad. Oligocene, Byram Formation, Mississippi.

Cypraeorbis sphaeroides (Conrad)

Plate 28, figures 17, 19, 23-24

1848a. *Cypraea sphaeroides* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, No. 11, p. 282.
1848b. *Cypraea sphaeroides* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113, pl. 11, fig. 6. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Cypraeorbis sphaeroides* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 31.

1866. *Cypraeorbis sphaeroides* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 25.
1890. *Cypraea sphaeroides* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 165.
1942. *Cypraea sphaeroides* Conrad. Ingram, Bull. Amer. Paleont., v. 27, No. 104, p. 16, pl. 3, fig. 1-2.
1947. *Cypraeorbis sphaeroides* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 317.

Original Description: Conrad, 1848a.

Short ovate, subglobose; posterior end narrow; base rounded; aperture narrow, the margins with numerous teeth. Length 1½.

Very rare. Mr. J.D. Anderson, of Vicksburg, found one, and I obtained only one during the two weeks employed in collecting the fossils around Vicksburg.

Discussion: This species by virtue of being the type species of a common early and middle Tertiary cypraeid genus has probably been mentioned more times in the literature than any other Vicksburg species. The synonymy given here is by no means complete.

The shell is rather short and inflated, and the aperture makes a moderately strong curve anteriorly. The siphonal canal comes off the outer side of the anterior extremity of the aperture, in some specimens at a moderately strong angle (pl. 28, fig. 19), although there seems to be some variation in the angle; the figured specimen is more extreme than the holotype.

The protoconch (pl. 28, fig. 17) is beehive-shaped and consists of about five whorls, the first juvenile whorl expanding over the fourth whorl and part of the third protoconch whorl on the side opposite the termination of the protoconch. The first two whorls are worn but the third and fourth are sculptured by delicate raised axial and spiral riblets which make a regular reticulation resembling the sculpture of *Ficus*. In adults the protoconch is concealed by callus, a smooth shallow pit forming in the callus just to the left of the protoconch in the dorsal view. The margin of the anal sinus is not raised above the callus surface.

Possibly if enough specimens were available it would be found that *C. sphaeroides* merges, through the Mint Spring form (pl. 16, fig. 13) compared with it, with the species here identified as *C.* cf. *C. ventripotens* (Cossmann) (pl. 16, figs. 10, 12, 15). The exterior of these forms is fairly similar. The differences—or extremes—lie in the fact that typical *C. sphaeroides* has a more prominent callus bordering the anal sinus, the aperture curves more strongly posteriorly, and it has a tendency for the siphonal canal to lie at an angle to, rather than in line with, the lower aperture. In addition, the anterior part of the aperture in *C. sphaeroides* tends to be slightly more gaping.

"Cypraea" tumulus Heilprin (see Ingram, 1942, p. 16, pl. 3, fig. 5) from the Tampa Limestone (early Miocene) of Florida has a similarly curving aperture although the shell is less inflated. The greatest difference is that the siphonal canal is twisted to the left rather than to the right in apertural view as in *C. sphaeroides*.

Type: Holotype 13512 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 28, figures 23-24).

Occurrence: Byram Formation, USGS localities 6455, 5615, MGS localities 93, 106.

Cypraeorbis cf. C. sphaeroides (Conrad)

Plate 16, figure 13

Discussion: A single specimen from the Mint Spring Formation is so identified. It is smaller than known adult specimens from the Byram Formation but, nevertheless, it has a mature aperture. The posterior curve of the aperture is more abrupt than on the figured specimen in the U.S. National Museum (pl. 28, fig. 19) but no more so than on the holotype (pl. 28, fig. 24).

Two other specimens from the Mint Spring Formation are referred to *C.* aff. *C. ventripotens* (Cossmann). These comprise, with *C.* cf. *C. sphaeroides*, a uniformly grading series. This condition of intergradation in beds intermediate in age between the beds of the typical named species certainly substantiates Conrad's (1855, p. 262) belief that *pinguis* (= *ventripotens*) is closely allied to *sphaeroides*.

Although I am reluctant to do so on the basis of the few specimens I have seen, I believe it possible that these are one species, *ventripotens* being a subspecies of *sphaeroides* at best.

Occurrence: Mint Spring Formation, USGS locality 14162.

Cypraeorbis aff. C. ventripotens (Cossmann)

Plate 3, figure 6; Plate 16, figures 10, 12, 15

Discussion: *Cypraea ventripotens* Cossmann, 1903, is a new name for *C. pinguis* Conrad, 1854, non Bonelli, 1827. An extended synonymy for the species is given by Harris and Palmer (1947, p. 318). Conrad's specimens were obtained from the Moodys Branch Formation (late Eocene) at Jackson, Mississippi. The species was figured and named (Conrad, 1854, p. 359, pl. 17, figs. 3a-b) without description in Wailes' Report on the Agriculture and Geology of Mississippi (1854); it was described (Conrad, 1855, p. 262) without illustration the next year (1855) in the Academy of Natural Science of Philadelphia Proceedings.

The form here figured is less inflated than *C. sphaeroides*, its apertural cleft is straighter, and the siphonal canal is in line with the apertural cleft rather than at an angle to it. At least on the specimens at hand, the posterior extremity of the outer lip is less projecting than in *C. sphaeroides*.

Type: Lectotype of *C. ventripotens* 13198 ANSP from the Moodys Branch Formation, Jackson, Mississippi.

Occurrence: Mississippi: Moodys Branch Formation, MGS localities 1, 2; aff. Red Bluff Formation, USGS locality 315; aff. Mint Spring Formation, USGS localities 14162, 14071a. Louisiana: Moodys Branch Formation, Montgomery Landing of the Red River, Grant Parish.

Cypraeorbis sp. ?
Plate 3, figures 5, 7

Discussion: MacNeil in his manuscript placed this species in the genus *Bernaya* and named a new species for it: *Bernaya rubracollis*. He stated that this species was close to *"Bernaya" nuculoides* (Aldrich, 1903, p. 98, pl. 3, fig. 4-6) from the Claiborne Group of Alabama and Mississippi and that it could be distinguished at once from *Cypraeorbis sphaeroides* and *C. ventripotens* by its sharp lateral margins and by its abnormally strong hemispherical depression. MacNeil's new species has not been used by the junior author upon the recommendation of Luc Dolin (personal communication) who stated that the distinguishing morphologic features recognized by MacNeil are probably those of an immature specimen of *Cypraeorbis*.

Occurrence: Red Bluff Formation, USGS locality 2633.

Family OVULIDAE Fleming, 1822
Subfamily OVULINAE Fleming, 1822

Genus **SIMNIA** Risso, 1826

Simnia Risso, Histoire naturelle des principales productions de l'Europe Meridionale, v. 4, p. 235, 1826.

Type (by subsequent designation, Gray, 1847): *Simnia nicaeensis* Risso (? = *Bulla patula* Pennant). Recent, Mediterranean Sea.

Subgenus **CALPURNA** Fleming, 1828

Calpurna Fleming, History of British Animals, p. 331, 1828.

Type (by monotypy): *Ovula leathesi* Sowerby (? =*Bulla spelta* Linné). Pliocene and Pleistocene, England.

Calpurna is not, according to modern practice, a homonym of *Calpurnus* Montfort, 1810, and it takes priority, therefore, over *Neosimnis* Fischer, 1884, whose type is the Recent *Bulla spelta* Linné.

According to Woodring (1928, p. 315) there is doubt that *S.* (*C.*) *leathesi* and *S.* (*C.*) *spelta* are the same species, but they are close.

These mollusks are feeders on gorgonians and corals. Bases of gorgonians are found on large pelecypod shells in the Byram Formation.

Simnia (Calpurna) cookei MacNeil n. sp.
Plate 28, figures 9, 18

Description: Shell moderately small, medium inflated, spindle-shaped, involute with the aperture extending the length of the shell; spire concealed; surface smooth; anterior end pointed, posterior end blunt; aperture moderately narrow, outer lip thick; inner lip with a weak diagonal fold posteriorly; columella indistinct but with a weak angulation that curves gently.

Discussion: The subsurface morphology responsible for the posterior diagonal fold and the columellar character in this genus is well shown in a larger but less mature specimen from the lower Claiborne of Texas figured by Palmer (1937, pl. 31, fig. 15) as *Neosimnia texana* (Johnson).

The Byram species is certainly closely related to *S.* (*C.*) *immunita* (Guppy) (see Woodring, 1928, pl. 21, figs. 3-8) from the Bowden Formation (Miocene) of Jamaica. It has a weaker posterior fold, a blunter posterior end, and a more uniform taper than the Bowden species.

Type: Holotype 498348 USNM from the Byram Formation, USGS locality 7376 (Plate 28, figures 9, 18).

Occurrence: Byram Formation, USGS locality 7376.

Genus **SULCOCYPRAEA** Conrad, 1865

Sulcocypraea Conrad, Amer. Jour. Conchology, v. 1, p. 31, 1865.

Type (by monotypy): *Cypraea lintea* Conrad. Oligocene, Byram Formation, Mississippi

Sulcocypraea lintea (Conrad)
Plate 28, figures 13-16, 20-22;
Plate 40, figures 26-28

1829. Lesueur, Walnut Hills fossil shells, pl. 9, fig. 8 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Cypraea lintea* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 282.

1848b. *Cypraea lintea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113, pl. 11, fig. 7, pl. 13, fig. 4. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Sulcocypraea lintea* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 31.
1866. *Cypraea (Sulcocypraea) lintea* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 25.
1866. *Cypraea lintea* Conrad. Aldrich, Alabama Geol. Survey, Bull. 1, p. 32, pl. 5, fig. 2.
1890. *Sulcocypraea lintea* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 165.
1903. *Cypraea (Cypraeovula) lintea* (Conrad). Cossmann, Essais Paleoconch. Comp., v. 5, p. 170.
1927. *Sulcocypraea lintea* (Conrad). Schilder, Archiv. Naturg., v. 91, Abt. A., Heft 10, p. 81 (in part).
1932. *Sulcocyprae lintea lintea* (Conrad). Schilder, Fossilium Catalogus, v. 1, par. 55, p. 223.
1937. *Sulcocypraea lintea* (Conrad). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 235, pl. 30, fig. 31-32.
1941. *Sulcocypraea lintea* (Conrad). Wenz, Handbuck der Palaozoologie, Gastropoda, bd, 6, teil 5, p. 1005, fig. 2886.
1942. *Sulcocypraea lintea* (Conrad). Ingram, Bull. Amer. Paleont., v. 27, No. 104, p. 18, pl. 3, fig. 12-13.
1947. *Sulcocypraea lintea* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 319, pl. 39, fig. 1-2.

Original Description: Conrad, 1848a.

Ovate, elevated, ventricose, with four apprriximate equal impressed lines; base ventricose, profoundly striated; labrum margin much thickened, profoundly striated; summit of the labrum prominent: base slightly produced. Length 6-10. Rare.

Discussion: *Sulcocypraea lintea* is a unique cypraeid and there seems to be nothing like it in younger American deposits. There is a subspecies of it in the Mint Spring Formation, but aside from that its nearest relative is a species found in the Red Bluff Formation and the Mint Spring Formation, *Sulcocypraea healeyi* (Aldrich).

The protoconch of *S. lintea* was observed on the inner whorls that became detached from the interior of the specimen figured on plate 40, figures 26-28. It resembles a minute *Trochus* or *Solariella*. The first whorl is smooth. It is followed by at least two whorls bearing two rows of minute rounded beads, one just below the suture and one near the lower suture, the two rows being connected by minute retractive axial riblets. I cannot see any evidence of cancellate sculpture. The first postnuclear whorl is *Ficus*-like with precise fine spiral threads, and a flat, nearly horizontal subsutural slope or shelf that progressively engulfs the protoconch for about three-quarters of a turn, after which the shelf becomes rounded and rises much more steeply to a position well above the apex of the protoconch.

Adults of this species show considerable variation. The posterior extremity of the outer lip may be angulate and protruding, or it may be lower than the adjacent margin (see pl. 28, figs. 20, 22). The ventral spiral ridges (which are homologus with apertural teeth) are set at variable angles, and they divide and converge irregularly. The sculpture on the dorsum ranges from broad ribs with sharply incised interspaces, to broad interspaces with narrow raised lirations (see pl. 28, figs. 15, 22).

The best preserved specimen of *S. lintea* from the Byram Formation (pl. 28, figs. 15, 16) shows the feather edge of the callus very clearly all around the dorsum, and only a band a millimeter or so wide at its edge is thin enough to resemble enamel. The dorsum is spirally sculptured. Other specimens in which pieces of ventral callus are removed show that the spiral sculpture continues beneath the callus.

Sulcocypraea lintea can be distinguished at once from *Sulcocypraea healeyi* by the spiral sculpture. *S. healeyi* has some faint, widely spaced spiral ridges, but there is no suggestion of the kind of sculpture found in *lintea*, even on specimens on which both the enamel and callus are decorticated.

The specimen on plate 28, figures 20-21, was figured by Aldrich (1886, p. 32, pl. 5, fig. 2).

Type: Lectotype 13510 ANSP (the largest of four cotypes) and three paratypes 13511 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 28, figure 14 - lectotype).

Occurrence: Byram Formation, USGS localities 12175, 13286, 5615, MGS locality 106.

Sulcocypraea lintea menthafons MacNeil n. subsp.
Plate 16, figures 3-8

Discussion: The Mint Spring form is closest to the Byram variants having the most flaring outer lip and the weakest spiral sculpture. Although two of the known specimens are small, a third is of comparable size to the known Byram specimens, and it appears to show the same differences. In addition, the spiral ridges on the callus are thinner in the Mint Spring subspecies.

It might be surmised from the figure of the largest specimen (pl. 16, figs. 7, 8) that the dorsum is decorticated. A close examination of the specimen shows that this is not the case. Only the margin of the callus has become separated; the dorsum had no enamel.

I am making one of the smaller specimens the holotype of the subspecies because it is more complete.

Type: Holotype 648912 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 16, figures 3-4).

Occurrence: Mint Spring Formation, USGS localities 14071a, 13287, MGS locality 99.

Sulcocypraea healeyi (Aldrich)

Plate 3, figures 8, 10-14; Plate 16, figures 1-2; Plate 40, figures 19-20

1894. *Cypraea Dalli* Aldrich, Nautilus, v. 7, No. 9, p. 98, pl. 4 fig. 2, 2a (not *C. dalli* Cossmann, 1893).
1896. *Cypraea dalli* Aldrich. Harris, Acad. Nat. Sci. Philadelphia, Proc., v. 48, p. 474, pl. 14, fig. 5a, 6a.
1903. *Cypraea* (*Cypraeovula*) *dalli* Aldrich. Cossmann, Essais Paleoconch, Comp., v. 5, p. 169, pl. 9, fig. 6-7.
1923. *Cypraea healeyi* Aldrich. Aldrich, Biol. Soc. Washington, Proc., v. 36, p. 199.
1927. *Sulcocypraea healeyi* (Aldrich). Schilder, Archiv Naturgesch., v. 91, abt. A, heft 10, p. 81 (1925 Jahrgang).
1927. *Eocypraea conradi* Schilder, Archiv Naturgesch., v. 91, abt. A, heft 10, p. 74. New name for *C. dalli* Harris, 1896, pl. 14, fig. 6, 6a.
1932. *Sulcocypraea lintea healeyi* (Aldrich). Schilder, Fossilium Catalogue, Animalia, v. 1, pt. 55, p. 223.
1942. *Cypraea healeyi* Aldrich. Ingram, Bull. Amer. Paleont., v. 27, No 104, p. 14, pl. 2, fig. 1-4.
1947. *Cypraea healeyi* Aldrich. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 315, pl. 39, fig. 14, 16.
1977. *Notoluponia healeyi* (Aldrich). Dockery, Mississippi Geol. Survey, Bull. 120, p. 60, pl. 6, fig. 1A, 1B.
1980. *Sulcocypraea healeyi* (Aldrich). Dockery, Mississippi Geol. Survey, Bull. 120, p. 60, pl. 6, fig. 1A, 1B.

Description: Shell inflated, ovate; dorsum covered by a thin enamel; shell surface beneath enamel with faint, widely spaced spiral ridges; callus with spiral ridges that die out just beyond a mid-ventral line; ridges on outer lip not extending, or very weakly extending to the back side of apertural flare.

Discussion: This species differs from *S. lintea* in the possession of a dorsal enamel, the lack of fine primary spiral sculpture, either exposed or concealed, in the shorter spiral callus ridges on the ventrum, and by the presence of strong spiral ridges on only the front side of the apertural flare. *S. healeyi* shows variation in its inflation and in the strength and length of the spiral ridges extending from the inner lip.

Type: Holotype 135157 USNM from the Red Bluff Formation, USGS locality 319 (Plate 3, figures 8, 14).

Occurrence: Mississippi: Moodys Branch Formation, MGS localities 1, 2; Red Bluff Formation, USGS localities 319, 6456, 13288, MGS localities 37, 38, 40: Mint Spring Formation, USGS localities 6647, 14071a, MGS locality 99. Louisiana: Moodys Branch Formation, PRI localities 1, 10, 883.

Sulcocypraea cf. **S. healeyi** (Aldrich)

Plate 16, figures 9, 11

Description: Shell moderately small and inflated, dorsum moderately high and smooth, pear shaped, anterior and posterior canals moderately produced, outer lip weakly flared to form a lateral margin which is slightly sharper posteriorly and does not rise on the dorsum medially, no lateral margin on parietal side; surface of dorsum smooth, thinly callussed or enameled; posterior canal in the same plane as the outer lip, moderately extended, bounded by the outer lip and a strong moderately sharp elongate protuberance on the parietal side; anterior canal strong and rounded, bounded by a truncation on the outer lip and a strong fold on the columellar side; aperture large, wider anteriorly, strongly curved posteriorly; teeth moderately strong, restricted to inner margin of outer lip, barely extending outside of aperture except anteriorly on parietal side, but extending within beyond the limit of view; columellar margin of aperture weakly angulate; no hemispherical depression.

Discussion: MacNeil named this figured specimen as a new species of *Eocypraea.* Cyrille and Luc Dolin (personal communication) recognize it to be an immature specimen of *Sulcocypraea* very similiar to that figured by Ingram, 1942, pl. 2, figures 3-4.

Occurrence: Mint Spring Formation, USGS locality 14071a.

Superfamily TONNACEA Peile, 1926

Family CASSIDIDAE Swainson, 1832

The phylogeny of the American Tertiary Cassididae has been discussed by several authors, among them Pilsbry (1922, p. 361), Wrigley (1934), Palmer (1937, p. 248-254), and Durham (1942, p. 183-190). Much of the early differentiation of the cassid genera seems to have taken place in the Eocene and Oligocene of Europe and America. However, the Cretaceous prototype and the area in which the family originated is still a mystery. The earliest American species is *Mambrinia koureos* Gardner from the Tuscahoma Formation (early Eocene) of Alabama. Possibly *Cassidaria dubia* Aldrich from the slightly younger Hatchetigbee Formation is the same species. I am inclined to believe that *Galeodaria*, whose first American record is in middle or late Eocene beds, is actually a more primitive type, but the earliest known genera, including *Mambrinia*, *Sconsia*, and *Galeodaria*, are related closely enough to justify the assumption that they had a common origin.

No Paleocene Cassididae have been described to date, unless *Cassidaria? elongata* von Koenen (1885, p. 22, pl. 1, figs. 21a-e) from the Paleocene of Denmark is really a cassid. So dubious are the Cretaceous forms that have been assigned to this family that most recent authors have disallowed them.

The *Galeodea-Mambrinia* stock, which has a long siphonal canal set at an angle to the axis of the columella, is one of the most ancient morphic types. *Sconsia* is intermediate between *Galeodaria* and *Mambrinia*. The columella of *Oniscidia* is much heavier with a crude siphonal fasciole. *Gomphopages* Gardner is similar to *Mambrinina* and probably should be regarded as a subgenus of it.

The sculpture of the earliest species of Cassididae consists of raised fine spiral lirations and rows of large pointed protuberances. Wrigley (1934) gives a schematic plan for the sculpture of the Cassididae in which he equates strong raised bands, rows of spines, and color bands, and he states that basically there are six of them, one, two, or more persisting as the characteristic sculpture or coloration in different generic groups.

In the more advanced types the primary bands behave variously. In *Cassis* s.s., the prototype of which is late Eocene, there are two or three rows of protuberances which persist as heavy blunt knobs. In *Galeodea* the protuberances become finer and several narrow ridges are developed. *Galeodaria* has primary, secondary, and tertiary spiral lirations and usually it has tubercles on the shoulder liration.

Semicassis and *Phalium* are fairly closely related. *Semicassis* has numerous smooth or granular spiral lirations, whereas in *Phalium* the shoulder protuberances persist. *Menthafontia*, here described, is a branch of *Phalium* in which the protuberances become very large and axially elongate, the remainder of the shell being smooth in adults. Juveniles have spiral sculpture in which the posterior edge is raised and the anterior edge submerged. One of the Vicksburg species, *Cassis caelatura* Conrad, has been placed in both *Phalium* and *Semicassis* by different authors; I am placing it in *Semicassis*.

Sconsia is one of the earliest known genera of Cassididae. It has fine spiral sculpture like *Mambrinia* but there are no large protuberances. One or two of the shoulder spirals may be denticulate, and on the young whorls they may form cross bars between two spirals as in *Cassis brevicostata* Conrad (see Palmer, 1937, pl. 31, figs. 10, 11). In my opinion, *C. brevicostata* is an ancestral *Sconsia*. Palmer placed the latter in *Phalium*, apparently because of the nodes. Pilsbry (1922, p. 362), on the other hand, thought it bore close relationship to *C. nupera* Conrad which he assigned to *Sconsia*. Dall (1909, p. 62) made *C. nupera* the type of a subgenus of *Sconsia*, *Doliocassis*, whereas Woodring (1928, p. 308) pointed out its similarity to *Galeodosconsia* Sacco. *Doliocassis* may be the prototype of the Tonnidae.

At the present time it is suggested that regardless of the age of the earliest known members of different stocks, *Galeodaria* is the most primitive type. From it, on the one hand, came *Sconsia*, and on the other hand, *Mambrinia*. *Mambrinia* gave rise to *Galeodea*, *Phalium*, *Cassis*, and *Semicassis*. All of these, like *Mambrinia*, have strongly twisted canals although it varies in length. If *Galeodaria* and *Sconsia* gave rise to anything else it is not apparent.

The west American Eocene to Miocene species, which in recent years have been assigned to the genus *Echinophoria* Sacco, and since named *Liracassis* by Moore, appear to have stemmed from some *Mambrinia-Phalium* intermediate. The earliest west coast species have *Mambrinia*-like sculpture but the later *Liracassis* have heavy T-shaped ribs resembling those of *Beringius crebricostatus;* the rather small narrow ribs seen on internal molds are quite misleading.

Genus CASSIS Scapoli, 1777

Cassis Scapoli, Introduction ad Historian naturalem, p. 393, 1777.

Type (by subsequent designation, Montfort, 1810): *Cassis cornutus* (Linné) (= *Buccinum cornutum* Linné). Recent, Indo-Pacific.

The species here described is one of the oldest true *Cassis* known. It bears some resemblance to *Cassidea* (*Semicassis*) *cancellata* (Lamarck) (see Cossmann and Pissarro, 1904-1906, pl. 34, fig. 165-3) from the Lutetian and Bartonian, a species which, in my opinion, is closer to the *Cassis* (*Cassis*) line.

The oldest true *Cassis* in America is from the Moodys Branch Formation (early Jackson - late Eocene), *Cassis taitii* Conrad (see Harris and Palmer, 1947, p. 328, pl. 42, figs. 12, 13). *Cassis taitii* is probably the direct ancestor of the Vicksburg species here discussed.

Another Jackson species, *Cassis creolum* (Harris and Palmer, 1947, p. 328, pl. 42, figs. 7, 8) is closely related to *C. taitii*. Harris and Palmer described *C. creolum* as a subspecies of "*Phalium*" *brevicostatum* from the Claiborne. I refer *brevicostata* to the genus *Sconsia*, but I agree that *C. creolum* is very close to it; I believe that *Cassis* s.s. is derived from an early *Sconsia* and that the generic boundary is to be located between these species.

Semicassis probably diverged from typical *Cassis* in the late Eocene, both having come from a primitive *Sconsia*. In some respects *C. creolum* appears to be closer to the *Semicassis* line whereas *C. taitii* is a true *Cassis*.

Cassis flintensis Mansfield

Plate 17, figures 5-8; Plate 49, figure 6?

1916. *Cassis sulcifera* Sowerby. Dall, U.S. Nat. Museum, Proc., v. 51, No. 2162, p. 508, pl. 86, fig. 4 (non Sowerby, 1850).
1928. *Cassis,* not *sulcifera* Sowerby. Woodring, Carnegie Inst. Washington, Pub. 385, p. 305.
1940. *Cassis flintensis* Mansfield, Jour. Paleont., v. 14, No. 3, p. 214, pl. 27, fig. 47, 48?, 49.
1968. *Cassis sulcifera* Sowerby. Abbott, Indo-Pacific Mollusca, v. 2, No. 9, p. 53 (in part).

Original Description: Mansfield, 1940.

Shell of medium size, broadly biconic, the periphery, however, less than one-third the distance from the apex to the anterior extremity. Sculpture on early whorls not well-preserved, but traces retained of three beaded spirals, the posterior directly in front of the appressed suture, the anterior directly behind the suture, and the third spiral closer to the anterior than to the posterior spiral; posterior of the three spirals continuing directly in front of the suture to the aperture, heavily beaded on the later turns; anterior spiral developed on the body into a series of strong peripheral nodes, of which six can be seen in the rear view; the third spiral with similar but more numerous beads than that in front of the suture; a secondary intercalated on the later whorls between each pair of primaries; a second series of nodes developed on the body, a little behind the middle, fewer in number than in the first series and staggered in position; space between the two series of nodes broken up into squarish pits by the intersection of the axial rugae with evenly spaced spiral fillets; a similar series of checkerboard axials and spirals in front of the anterior nodes; axial sculpture relatively stronger and less regular on the anterior half of the body; an overhang and two or three stronger and more distantly spaced spirals behind the basal groove. Channel behind the fasciole narrow, U-shaped, very deep. Fasciole short, high, bent almost at right angles to the axis of the aperture. Aperture of holotype badly damaged. Outer lip on the paratype nearly vertical, heavily varicose, with traces retained of the characteristic transverse ridges. A wide spread of heavy callus on the inner face, its outer margin free and overlapping the preceding varix at 240° from the outer lip; inner margin of pillar transversely ridged; character of surface of body callus not known. Anterior canal short and narrow; margins parallel and very close together at the anterior extremity.

Discussion: Mansfield made the type of this species a very fine silicified shell collected by Foerste and Pumpelly from the residuum of Oligocene limestones along the Flint River near Bainbridge, Georgia, during the days of their experimental Utopian colony in the late 1880's. It is from the same residual deposit as the specimen figured by Dall. Mansfield's paratype is a mold from the Suwannee limestone of western Florida, presumably from the upper part of the formation equivalent to the Chickasawhay Limestone of Mississippi. The paratype undoubtedly belongs to this species, but I do not believe a specimen figured earlier by Mansfield (1938, p. 100, fig. 11) from the same place is this species. Still another specimen figured by Mansfield (1946, pl. 27, fig. 48) from the Chickasawhay may be this species but, if so, it has weaker spiral sculpture than usual.

In the same publication in which Dall figured his specimen from the residual cherts, he recorded *Cassis globosa* Dall. Mansfield included this citation in the synonymy of *C. flintensis*, but according to an annotation in Mansfield's copy of Dall's paper, it is *C. caelatura* Conrad; I have not examined the specimens.

The species, and for that matter the genus, has been found in Mississippi below the Chickasawhay Limestone only at Vicksburg in the Mint Spring Formation. Most specimens are fragmental but the one shown on pl. 17, figs. 5-6, is a nearly perfect specimen.

I can find no characters on the Mint Spring specimens that would distinguish them from either the Florida or Georgia specimens, both of which are supposed to be from beds stratigraphically higher.

The exact stratigraphic position of the Georgia specimens is not known since it seems fairly certain that the residuum containing them is from limestones of both Byram and Chickasawhay age and possibly Marianna age as well. Locally, however, there is a zone of leached sand at the base of the residuum in areas where the underlying late Eocene limestone is not appreciably dissolved that may represent the Mint Spring Formation. Where the underlying Eocene limestone is also dissolved there is no way to zone the residuum and the age of individual masses of vitreous chert can only be determined from the fossils a particular block contains. In some cases the silicification is restricted to shells themselves and they may occur free in argillaceous or ferruginous residues.

The residual deposits of southwestern Georgia and southeastern Alabama have been named the Flint River Formation and a late Oligocene age has been assigned to it. Undoubtedly some of the residual chert in it is derived from late Oligocene limestones but the time of formation of the residuum is probably Quaternary inasmuch as disarranged and disconnected masses of Miocene sand and clay and large pockets of quartz gravel, probably Quaternary, are included in it.

C. flintensis somewhat resembles *C. elegans* Grateloup (see Plate 49, figures 7-8) from the Stampian (Oligocene) of Gaas, France.

Type: Holotype 498499 USNM from the Flint River Formation, Flint River near Bainridge, Georgia (Foerste and Pumpelly), USGS locality 14083. Paratype 498500 from the Suwannee Limestone, upper bed on A.L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Florida, USGS locality 12723.

Occurrence: Georgia: Flint River Formation, USGS locality 14083. Florida: Suwannee Limestone, USGS locality 12723. Mississippi: Mint Spring Formation, USGS locality 12176a, MGS localities 89, 99; Marianna Limestone, MGS locality 99; ?Chickasawhay Limestone, USGS locality 14281. For additional localities see Mansfield, 1940.

Genus **SEMICASSIS** Mörch, 1852

Semi cassis Mörch, Catalogus conchyliorum . . . comes de Yoldi, pt. 1, p. 112, 1852.

Type (by subsequent designation, G.F. Harris, 1897): *Cassis japonica* Reeve. Recent, Japan.

Conrad (1865, p. 25) appears to have been the first to reassign his own Vicksburg species, *Cassis caelatura*, to *Semicassis*. Wrigley (1934, p. 129) says that *Semicassis* appears in the American Oligocene, a statement that could hardly refer to anything but *C. caelatura*. It seems doubtful that Wrigley had specimens of this species; he may have been reflecting Conrad's views, but Conrad's figure is misleading. Possibly his remark is based on Dall's (1890, p. 162) inadvertant reference to it under *Phalium globosum* which he placed in the genus *Cassis*, subgenus *Phalium*, section *Semicassis*. Pilsbry (1921, p. 362) referred *C. caelatura* to *Cassis* (*Phalium*) and he believed it was probably descended from *C.* (*P.*) *taitii* Conrad, a Jackson species. Woodring (1928, p. 305) stated that *C. caelatura* was a "*Phalium*", the quotation his.

I regard *C. caelatura* as a member of the *Semicassis* line of descent, but it clearly represents a stage of evolution before the genus was clearly differentiated into *Semicassis* s.s. and *Semicassis* (*Tylocassis*), although there is certainly a tendency for the teeth on the inner lip to break up into irregular segments and granules as in *Tylocassis*. Possibly a new subgeneric name should be proposed for *S. caelatura*.

I believe *S. caelatura* is most likely descended from *Sconsia brevidentata* in the Claiborne, through *Cassis creolum* in the Jackson, the abrupt transition of genera merely reflecting the close relationship of these genera, and the rapid differentiation of their prototypes in late Eocene time. *Phalium*, in my opinion, may also have come from *Sconsia* but it is a coderivative with *Cassis*.

There are no known Red Bluff or Mint Spring representatives of this group.

Semicassis caelatura (Conrad)

Plate 30, figures 11-12, 15-18; Plate 50, figures 7-8

1829. *Cassidaria granulata* (Born). Lesueur, Walnut Hills fossil shells, pl. 7, fig. 22-23, pl. 8, fig. 1. Printed in Dockery, 1982, Appendix II.

1848a. *Cassis caelatura* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 288.

1848b. *Cassis caelatura* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 119, pl. 11, fig. 44. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Semicassis caelatura* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, pt. 1, p. 25.

1922. *Cassis* (*Phalium*) *caelatura* Conrad. Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., v. 73, p. 362.

1890. *Cassis* (*Phalium* sec. *Semicassis*) *caelatura* Conrad. Dall, Wagner Free Inst. Sci. Trans., v. 3, pt. 1, p. 162.

1940 *Phalium caelatura* (Conrad). Mansfield, Jour. Paleont., v. 14, No. 3, p. 215.

1968. *Cassis caelata* (sic) Conrad. (= *Galeodea*) Abbott, Indo-Pacific Mollusca, v. 2, No. 9, p. 35.

Original Description: Conrad, 1848a.

Short-elliptical, with revolving lines and series of nodes and granules; tubercles profound on the angle of the body whorl; spire prominent, whorls cancellated; the upper half with a profound revolving line; labium granulated and striated throughout, the upper grains indistinct; labrum with transverse prominent lines. Length 1½.

Discussion: Judging from the present condition of Conrad's type material his drawing is either a composite, or the largest and highest spired specimen has since been broken. I have selected as the lectotype the second largest specimen (pl. 30, fig. 16) which is nearly complete but has a comparatively low spire. The fragment shown in fig. 18 has a high spire like Conrad's drawing. Inasmuch as such a high spire is extreme, and most other characters are inaccurately drawn, Conrad's figure gives a poor indication of what this species is really like.

There is considerable range in the size of the shoulder nodes on different specimens, and both the collar and the prominent spiral on the subsutural slope range from continuous but roughened to strongly beaded. Some specimens have moderately strong nodes on the fourth spiral below the shoulder.

At first glance *S. caelatura* appears to be close to the group of "*Cassis*" *calantica* Deshayes, "*C.*" *quenstedti* Beyrich, and "*C.*" *germari* Beyrich (see von Koenen, 1889, pl. 22, figs. 4-8; Wrigley, 1934, p. 118, pl. 16, fig. 20) which range in age from middle Eocene (Auversian) to early Oligocene (Lattorfian) in England, France and Germany. However the European species have a nearly straight columella and appear to belong to a line more closely related to *Sconsia*; it may be the forerunner of *Echinophoria* s.s. in the Italian Miocene. Other than these species I can find nothing in the European Eocene or Oligocene that even remotely resembles *S. caelatura.*

S. caelatura has a strongly twisted canal and a shape like *Semicassis.* The irregular or subgranular pattern of the columellar teeth suggests relationship to *Tylocassis* Woodring (type, *Buccinum inflatum* Shaw, Recent, West Indies; see Tryon, 1885, pl. 4, fig. 65). The nodes on the spiral lirations become obsolete on the later species of *Tylocassis*. In this respect *S.* (*T.*) *aldrichi* (Dall, 1892, pl. 21, fig. 2) from the Chipola Formation (early Miocene) of Florida is intermediate between *S. caelatura* and *S.* (*T.*) *reclusa* (Guppy) (see Woodring, 1928, pl. 20, figs. 1, 2) from the Bowden Formation (late Miocene) of Jamaica. The inner lip of *S.* (*T.*) *aldrichi* is much more granular than that of *S. caelatura.*

The *Cassis caelatura* listed by Cooke (1923, p. 6) from residual chert near Bainbridge, Georgia, is *Cassis flintensis* Mansfield.

Type: Lectotype 13499 ANSP (Plate 30, figure 16) and six paratypes 13500 ANSP all from the Byram Formation judging from their matrix and preservation, Vicksburg, Mississippi (Conrad.)

Occurrence: Byram Formation, USGS localities 259, 13286, MGS localities 93, 106, 109, 112c, 114.

Genus **MAMBRINIA** Gardner, 1939

Mambrinia Gardner, U.S. Geol. Survey, Prof. Paper 193-B, p. 23, 1939 (proposed as a section of *Galeodea*).

Type (by original designation): *Cassidaria planotecta* Meyer and Aldrich. Claiborne Group (Eocene), Mississippi.

I am inclined to regard this as a distinct genus even though its relationships are obviously with *Galeodea. Gomphopages* Gardner (1939, p. 25), which was described as a subgenus of *Galeodea,* is best regarded, if distinct at all, as a subgenus of *Mambrinia.*

The earliest known species is *Mambrinia koureos* Gardner from the Bells Landing Member of the Tuscahoma Formation (middle early Eocene) of Alabama. Clark and Martin (1901, p. 144, pl. 24, fig. 7) figured a similar form from the Aquia Formation of Maryland. I have a fine specimen from the Bashi Marl Member of the Hatchetigbee Formation (late early Eocene) of Alabama, a slightly higher horizon. This may be the species which Aldrich named *Cassidaria dubia.* If so, his type is an abnormally low spired variant; it may take priority over *M. koureos.* The Bashi species has a microreticulation resembling that of *Galeodaria shubutensis* Aldrich and both species have similarly sculptured early whorls. The Vicksburg *Galeodaria* have straight or very weakly curved siphonal canals whereas *M. koureos* has a strongly curved canal. Harris and Palmer (1947, p. 331) described the canal of *G. petersoni,* the type of *Galeodaria,* as "curved backward", and their figure of it indicates its canal is curved more than in the Oligocene species.

The earliest *Mambrinia* and *Galeodaria* appear, therefore, to be very closely related. Both may have come from a form having a weakly twisted canal, *Galeodaria* developing a straight canal and *Mambrinia* a strongly twisted canal. There does not seem to be much doubt that all of the later true cassids inherited their strongly twisted canal from *Mambrinia.*

Mambrinia brevidentata (Aldrich)

Plate 4, figures 3-5

1885. *Cassidaria brevidentata* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 152, pl. 3, fig. 20.
1885. *Cassidaria carinata* Lamarck. Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 155, pl. 3, fig. 19a, b, 20.
1886. *Cassidaria brevidentata* Aldrich. Aldrich, Geol. Survey Alabama, Bull. 1, pt. 1, p. 33, pl.1, fig. 19a, b, 20.
1899. *Cassidaria brevidentata* Aldrich. Harris, Bull. Amer. Paleont., v. 3, No. 11, pt. 2, p. 67 (in part).
1939. *Galeodea* (*Mambrinia*) *brevidentata* (Aldrich). Gardner, U.S. Geol. Survey, Prof. Paper 193-B, p. 21, 24.
1982. *Galeodea* (*Mambrinia*) *brevidentata* (Aldrich). Dockery, Mississippi Bureau Geol., Bull. 122, p. 96, pl. 76, fig. 5, 8.

Original Description of *C. brevidentata:* Aldrich, 1885.

Shell, oblong-oval, whorls seven; suture, channeled; surface, covered with fine revolving striae; coarser, distant lines upon the body whorl, giving the shell the carinated aspect of the genus; lines of growth fine, a few coarser ones showing on the line of the tubercles; apex, smooth; whorls of the spire carinate and slightly tubercled; a row of upright longitudinal nodes on the shoulder of the body whorl, none below; a single, strong varix on the body whorl; aperture, ovate; inner lip, spread over the whorl, with three plications on the upper part, smooth in the central part and plicate below; outer lip, reflected, plicate on the inner edge above and below, smooth in the center; canal, narrow, strongly twisted. Length 1 4/10; breadth 9/10.

Locality, Red Bluff, Miss.

This species differs from *C. carinata* Lam, in having a single, strong varix. It is lighter in substance. I describe it with reluctance, basing its specific difference principally upon the presence of the strong varix.

Discussion of *C. carinata* Lamarck: Aldrich, 1885.

This species may be the same as described by Conrad under the name of *Galeodaria tricarinata,* from Vicksburg. I have a number of specimens in various stages of growth from Red Bluff, Miss.

Deshayes seems to have made several species of the varieties of this shell, founded on the differences in the number of tuberculose revolving lines, but the form of the aperture is precisely the same through all my varieties: the common form has three tuberculose revolving lines upon the body whorl. This is a generic rather than a specific peculiarity, according to Prof. A. Heilprin. The differences in Conrad's description are as follows: "Labrum profoundly striate or costate within; columella with a deposit, and profoundly rugoso-striate throughout." All my forms have the aperture toothed above, smooth in the center, costate below. Figure 19a shows the largest specimen and the common form.

Figure 19b is the operculem which I was fortunate enough to find with the shell. It is corneus, rounded above, angular below, summit marginal, much smaller than the aperture.

Discussion: *Mambrinia brevidentata* is a very variable species insofar as the height of its spire and the size and spacing of its protuberances are concerned.

While Gardner states that the Tuscahoma species, *M. koureos*, "bears slight resemblance to *C. brevidentata* Aldrich from the Red Bluff", Harris on two occasions (1896, p. 479; 1899, p. 67) considered the Tuscahoma form to be only a variety of *brevidentata.*

These are certainly distinct species. *M. koureos* appears to range from medium to low spired whereas *M. brevidentata* ranges from medium to high spired (compare to pl. 4, figs. 3 and 5). The protuberances on *M. koureos* are sharper and more closely set and they do not appear to become as weak on any of the spiral bands as they do in *M. brevidentata.*

I have a perfect specimen of a *Mambrinia* from the Bashi Marl Member of the Hatchetigbee Formation, which presumably is the species Aldrich described as *Cassidaria dubia.* The Bashi marl member is only slightly younger than the Bells Landing Marl Member of the Tuscahoma Formation and it may well be that the *Mambrinia* from the two zones are identical. In that case, *C. dubia* is an older name for *M. koureos.* The type of *C. dubia* is either a broken specimen or one with a very low spire. Its figure is poor and subsequent authors have reported only fragments of it.

The protoconch on the Bashi species is tilted and larger; that of *M. brevidentata* is smaller, straight and more submerged. The early whorls of the Bashi species have a strong sharp spiral thread between the suture and the shoulder, whereas *M. brevidentata* has neat rounded spiral threads of about equal size and spacing. The protuberances are sharper and more numerous on the Bashi species and those on the middle band are strong; on *M. brevidentata* the protuberances are larger, more blunt, and they may be present on the shoulder band only; there are 8 to 9 protuberances visible from an angle in the Bashi species but in *M. brevidentata* there are only 5 to 6.

The microsculpture of the two species is very different. *M. brevidentata* has a polished surface with shallow slightly concave interspaces between the fine raised spiral lirations; the lirations are often steeper on the posterior side and more sloping on the anterior side, approaching the sloping or imbricating spiral sculpture found on some species of *Phalium* and *Cassis.* The Bashi species, on the other hand, has fine, sharp spiral lirations that are defintely divisible into primary, secondary and tertiary threads and the surface is made finely reticulate by their raised axial microthreads; its sculpture resembles that of the Oligocene species of *Galeodaria.* Thus, while the details of the sculpture of these two species resemble that of different later genera, they have a much closer gross similarity to each other. In both the "cymatid tooth" near the posterior end of the outer lip is prominent and in some specimens it is bifid or trifid.

Mambrinia brevidentata is the last known American species of *Mambrinia.* No trace of the genus has been found in the Mint Spring Formation or the Byram Formation. According to Gardner the genus occurs in the Oligocene of Germany. Apparently this refers to the *nodosa* group. *"Cassidaria" nodosa* Solander, an Eocene species, was identified by von Koenen (1889, pl. 21, figs. 14a-b) from the lower Oligocene of Germany, and *"Cassidaria" buchii* Beyrich is found in the middle Oligocene of Germany, Belgium and France (see Speyer, 1862, pl. 30). *C. nodosa* has four rows of protuberances and *C. buchii* has five rows of protuberances.

The *"Cassidaria" nodosa* group may be the forerunner of and possibly should be referred to the genus *Galeodea* whose type is the Recent *Buccinum echinophorum* Linné. Although *Galeodea* and *Mambrinia* are closely related and probably had a common ancestor they should, in my opinion, be recognized as distinct genera.

Several forms in the middle Eocene of western North America appear to be closely related to east American and European *Mambrinia.* Among them are *Mambrinia sutterensis* (Dickerson), *Mambrinia meganosensis* Vokes, and *Mambrinia tuberculiformis* Hanna.

Type: Holotype of *C. brevidentata* 644617 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Aldrich) (Plate 4, figure 4).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 309, MGS localities 37, 38, 40. Alabama: Red Bluff Formation (upper clay member), Pelham Bluff, north quarry, St. Stephens, Washington County.

Genus GALEODEA Link, 1807

Galeodea Link, Beschr. Nat. Samml. Univ. Rostock, abt. 3, p. 113, 1807.

Type (by monotypy): *Galeodea echinophora* (Linné) (= *Buccinum echinophorum* Linné). Recent, Mediterranean.

This genus was used by Wrigley (1934) for most of the Eocene and Oligocene northern European species that probably are referable to *Mambrinia*. Typical *Galeodea* is derived from *Mambrinia* or some intermediate between *Mambrinia* and *Galeodaria*, but it is unlikely that it is descended from *Galeodaria*, or that *Galeodaria* is either a synonym or a subgenus of it. *Galeodaria* has a straight columella and canal and probably is an independent side branch.

I do not regard any Gulf Coast Eocene or Oligocene species as belonging to *Galeodea* (*Galeodea*), although the *"Cassidaria" nodosa* group of Europe may be its prototype.

Genus **GALEODARIA** Conrad, 1865

Galeodaria Conrad, Amer. Jour. Conchology, v. 1, p. 26, 1865.

Type (by monotypy): *Galeodaria petersoni* (Conrad) (= *Mario petersoni* Conrad). Jackson Group (Eocene), Mississippi.

On the same page Conrad proposed the name *Doliopsis* under which he listed only *D. tricarinatum* Conrad. Presumably this was an error for *D. quinquecosta* which he described on a later page (p. 141). *D. tricarinatum* is presumably the species he listed under *Galeodea* as *G. tricarinata*, the Byram representative of *Galeodaria*. *Doliopsis*, as validated on p. 141, is certainly a synonym of *Galeodaria*.

Most authors have regarded *Galeodaria* as a synonym of *Galeodea* but in my opinion it is needed for a rather distinctive branch of Eocene and Oligocene species and it is here accepted as a distinct genus.

On two occasions Gardner (1939, p. 22; 1945, p. 180) treated *Galeodaria shubutensis* (Aldrich), a red Bluff species, as *Galeodea?* While she did not adopt *Galeodaria*, this was an indication, nevertheless, that she did not regard it as a typical *Galeodea*.

Galeodaria shubutensis (Aldrich)

Plate 4, figures 1-2; Plate 49, figures 9-10

1885. *Cassis* (*Semicassis*) *shubutensis* Aldrich, Cincinnati Soc. Nat. Hist. Jour., v. 8, No. 2, p. 147, pl. 2, fig. 5a, b.

1886. *Cassis* (*Semicassis*) *shubutensis* Aldrich. Aldrich, Geol. Survey Alabama, Bull. 1, pt. 1, p. 33, pl. 2, fig. 5a, b.

1939 *Galeodea? shubutensis* (Aldrich). Gardner, U.S. Geol. Survey, Prof. Paper 193-B, p. 22.

1945. *Galeodea? shubutensis* (Aldrich). Gardner, Geol. Soc. America, Mem. 11, p. 180.

1968. *Cassis* (*Semicassis*) *shubutensis* Aldrich. Abbott, Indo-Pacific Mollusca, v. 2, No. 9, p. 41.

Original Description: Aldrich, 1885.

Shell, rather thin, oblong-oval; whorls six, convex, the surface with revolving lines; suture, distinct; apex, pointed, spire, elevated, the first three whorls nearly smooth, the next two slightly carinate; body whorl, with a sharp nodulous line on the upper part, nodes running transversely, with another finer nodulous line above; center of body whorl, with a strongly raised line, a lesser one above, with fine close set ones between; below the center are four raised lines, with finer ones between; beak, nearly straight, the outer lip meeting it at an acute angle; aperture, ovate, the revolving lines passing into it; labium, with rugose plaits below, upon a reflected callus; labrum reflected, with strong plaits in pairs on the edge. Length, 8/10 of an inch; breadth 5/10.

Localities, 200 yards north of railroad bridge below Shubuta, Miss., and also at Red Bluff.

Differs from all other forms by its prominent lines, absence of any varices, only two nodulous lines, and size.

Discussion: Gardner seems to have been the only author to mention this species in any detail since Aldrich. She stated that the generic determination was dubious, but two other forms which she also identified as *Galeodea?* sp. were compared with *Galeodea* (*Galeodaria*) *petersoni* Conrad and *"Galeodea" tricarinata* Conrad, respectively. She did, in effect, therefore, combine the type species of *Galeodaria* with the then known Oligocene species referable to it. A new subspecies from the Mint Spring Formation is here described. According to Harris and Palmer (1947, p. 331), *Doliopsis quinquecosta* Conrad is from the Moodys Branch Formation at Garland Creek and not from the Claiborne at Enterprise, Mississippi, and they presumed it to be an internal mold of *Galeodaria petersoni*. I am inclined to believe that the specimen figured by Palmer (1937, pl. 31, fig. 9) as *Phalium brevicostatum* (Conrad) var. is a *Galeodaria*, and if Conrad was correct in his locality for *D. quinquecosta*, it could be that species.

Insofar as is known, the above mentioned species include all of the American species of *Galeodaria*. *"Cassis" augustana* Wrigley (1922, p. 118, pl. 16, fig. 21) from the London Clay also appears to be a *Galeodaria*, and, if so, is the oldest known species.

Galeodaria shubutensis has a very fine raised axial microsculpture somewhat resembling that of *Ficus* but finer. Similar microsculpture is present on the Mint Spring subspecies, but the Byram species *G. tricarinata* has unraised growth lines. There is a progressive transition from *G. shubutensis* to *G. tricarinata* in the development of secondary and tertiary spiral ribs. In *G. shubutensis* a weak secondary spiral is present between two or three of the primary spirals below the shoulder, and there may be as many as 10 subequal tertiary threads between each primary spiral. In *G. shubutensis gardnerae* from the Mint Spring Formation there are well defined primary, secondary, tertiary, quaternary, and on some specimens fifth order threads.

G. tricarinata has strong secondary spirals and sharp tertiary threads; a weak quaternary thread may be present in the peripheral interspace. The space between the spiral threads is flatter, smoother and wider than in *G. shubutensis.* The clear distinction between primary and secondary spirals extends to more of the anterior spirals in *G. tricarinata;* in *G. shubutensis* the more anterior primary spirals are subequal and the interspaces are crowded with numerous subequal fine lirations.

The teeth on both the outer and inner lip are variable in all three forms; they may be single to trifid and the "cymatid tooth" in particular is set at different angles.

Type: Holotype 644610 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Aldrich) (Plate 4, figure 1).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 13288, MGS localities 37, 38. Mexico: Oligocene, 3,400 feet south and 11,000 feet east of Rancho la Copa, Zacate, Nuevo Leon, Mexico, USGS locality 13510.

Galeodaria shubutensis gardnerae MacNeil n. subsp.

Plate 17, figures 1-4

Description: Shell of medium size, moderately inflated, spire of moderate height, whorls rounded, sutures angulate, columella straight, siphonal canal moderately short and straight, no siphonal fasciole, aperture elongate, outer lip with a moderate adult varix, parietal callus moderately thin, inner lip with irregular elongate teeth, those on the columella often broken up into pustules, outer lip teeth single or bifid, the "cymatid tooth" single to trifid; protoconch not completely known but apparently small, smooth, straight and pointed; adult whorls with raised spiral lines which are divisible into primary, secondary, tertiary, quaternary, and fifth order lirations, made finely reticulate by delicate raised axial growth lines, spacing of primary lirations diminishing from the shoulder anteriorly, one secondary liration located about midway between the primary liration at the shoulder and the suture, shoulder liration beaded, the beads usually spirally elongate; no umbilical chink but the inner lip is often raised.

Discussion: This subspecies has a microsculpture more like that of *G. shubutensis* but it has gross features more like those of *G. tricarinata*. It is certainly intermediate between them. I am making it a subspecies of the Red Bluff species because of the similarity of their microsculpture. The juvenile whorls of *G. shubutensis* and *G. shubutensis gardnerae* have an interstitial thread between the primary spirals; *G. tricarinata* has no interstitial threads on the first 3 or 4 whorls and the surface is latticed by thin raised axial lamellae. The shoulder is tabulate at an earlier stage in *G. shubutensis,* the peripheral nodes develop earlier, and the subsutural slope has weaker spiral lines; in *G. tricarinata* the early whorls are rounded with equisized spiral lines from suture to suture.

G. shubutensis gardnerae is intermediate in size between typical *G. shubutensis* and *G. tricarinata*. There does not seem to be any doubt that these three forms are one lineage.

This subspecies is known only from the type locality and it is the only record for the genus in the Mint Spring Formation. However, Gardner (1939, p. 23) records poorly preserved specimens as *"Galeodea?* sp." which she states are close to *G. tricarinata,* from three localities in the Oligocene of Mexico. These may prove to be the Mint Spring subspecies.

Type: Holotype 376465 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 17, figures 1-2).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Galeodaria tricarinata (Conrad)

Plate 29, figures 20-22; Plate 49, figures 11-13

1829. *Buccinum circumscripta?* Lesueur, Walnut Hills fossil shells, pl. 8, fig. 8, pl. 9, fig. 7. Printed in Dockery, 1982, Appendix II.

1860. *Galeodea tricarinata* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2md ser., v. 4, p. 393.

1865. *Doliopsis tricarinatum* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 26.

Discussion: Apparently this species has never been illustrated, and aside from Gardner (1939, p. 23) and Mansfield (1940, p. 216) who had the specimen here figured in the Casey collection at their disposal, no one seems to have made a comparison with it. Aldrich (1885, p. 155) wondered if it was the species he identified as *Cassidaria carinata* Lamarck, a variant of *Mambrinia brevidentata.*

The problematical fragment from the A.L. Parrish farm, 3-1/2 miles southeast of Wausau, Washington County, Florida (Mansfield, 1940, p. 216, pl. 27, fig. 38), from limestone probably equivalent to the Chickasawhay Limestone, certainly seems to be a *Galeodaria.* This specimen has numerous fine spiral lirations between the primary spirals recalling the sculpture of *C. shubutensis.*

Judging from Wrigley's valuable paper, there are no Eocene or Oligocene species of *Galeodaria* in England, unless it could be *"Cassis" augustana* (Wrigley, 1934, p. 118, pl. 16, fig. 21) from the London Clay. If so, this would be the oldest known species of the genus. *Galeodaria* is represented in the Oligocene of Germany, however, by *Cassidaria* *echinata* von Koenen (1889, p. 255, pl. 22, figs. 9a-b, 10a-b), the type of which had been figured previously by von Koenen (1867, p. 147, pl. 12, figs. 4a-b) as *Cassidaria echinophora* Linné, the type of *Galeodea*.

The north German and Danish late Miocene also contains a species that has been identified as *Cassidaria echinophora* (see Rasmussen, 1956, p. 61, pl. 5, fig. 3). Although this species has shoulder nodes that are decidedly more cut up by secondary spiral lirations than the older *Galeodaria*, it has a nearly straight canal like *Galeodaria*, rather than a strongly twisted canal like *Galeodea*. I am inclined to regard this form as a terminal *Galeodaria* and to regard *Galeodea* as having descended from *Mambrinia* through the *G. nodosa* group.

The relatively straight canal of *G. tricarinata* distinguishes it from all other Byram cassids except *Sconsia lintea*, and it is distinguished from that species by its much stronger apertural teeth and strong spiral sculpture. I can find no recent cassids that appear to be related to this group; presumably it became extinct during the middle Tertiary.

Type: Lectotype 13503 ANSP (the largest of 3 cotypes) (Plate 29, figure 22) and two paratypes 13504 ANSP all from the Byram Formation judging from their matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS locality 13286, MGS localities 109, 115.

Genus SCONSIA Gray, 1847

Sconsia Gray, Zool. Soc. London, Proc., p. 137, 1847.

Type (by original designation): *Cassidaria striata* Lamarck. Recent, West Indies.

Pilsbry (1922, p. 361-2) regarded *Sconsia* and *Phalium* as having diverged from each other in the Eocene. I am inclined to believe *Sconsia* had an earlier origin than *Phalium*. *Galeodaria*, *Sconsia*, and *Mambrinia* appear to have been differentiated first; *Phalium* is derived from *Mambrinia* or from *Mambrinia-Sconsia* intermediates.

"Cassis" brevicostatus Conrad from the middle Claiborne (middle Eocene) is the oldest American species that could be assigned to *Sconsia*. Even though its canal is weakly twisted, I do not believe it is eliminated on that account, as several authors have maintained. All of the Vicksburg *Sconsia* have weakly twisted canals; they point anteriorly at the end rather than outwards at an angle as in *Mambrinia*.

Wrigley (1922, p. 116, pl. 16, fig. 18) assigns one Bartonian species, *Cassis tessellata* R.B. Newton, to *Sconsia*, and another from the London Clay, *Cassis striata* J. Sowerby, he inadvertantly associated with it. Sacco (1890, p. 69) put *C. striata* in his genus *Galeodosconsia* (type *Cassidaria striatula* Bonelli, Miocene, Italy), but Cossmann (1903, p. 133) regarded *Galeodosconsia* as a synonym of *Sconsia*.

Woodring (1959, p. 200) regarded the Byram species *"Cassidaria" lintea* Conrad as the oldest American *Sconsia*, he having stated earlier (1928, p. 308) that *Cassis nuperus* Conrad is a *Galeodosconsia*. I am inclined to agree that *C. nuperus* is not a *Sconsia*, but I believe *C. brevicostatus* is not only the prototype of *Sconsia*, but of *Phalium* and *Cassis* as well.

Sconsia lintea (Conrad)

Plate 17, figures 14, 20; Plate 30, figures 1-3;
Plate 50, figures 3-4

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 20 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Cassidaria lintea* Conrad, Acad. Nat. Sci. Philadelphia. Proc.. v. 3, No. 11, p. 288.
1848b. *Cassidaria lintea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 118, pl. 11, fig. 43. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Galeodia lintea* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 26.
1922. *Sconsia lintea* (Conrad). Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., v. 73, p. 362.
1928. *Sconsia lintea* (Conrad). Woodring, Carnegie Inst. Washington, pub. 385, p. 308.
1934. *Sconsia lintea* (Conrad). Wrigley, Malacological Soc. London, Proc., v. 21, pt. 2, p. 115.
1945. *Sconsia lintea* (Conrad). Gardner, U.S. Geol. Survey, Prof. Paper 193-B, p. 27.
1959. *Sconsia lintea* (Conrad). Woodring, U.S. Geol. Survey, Prof. Paper 306-B, p. 200.

Original Description: Conrad, 1848a.

Elliptical, with fine closely-arranged revolving lines, crossed by finer longitudinal lines, most distinct towards the margin of the labrum; spire prominent, acute, cancellated; penultimate whorl slightly tuberculated at base; angle of large whorl with unequal small tubercles, wanting towards the labium margin; labium striated above, and with rugose plaits below; submargin of labium striated within, margin entire. Length 1½.

Discussion: I can see no way to separate specimens from the Mint Spring Formation from the Byram species. However, the Red Bluff form is distinct.

Sconsia lintea has only the faintest suggestion of tubercles on the shoulder liration, although the liration on the shoulder and one about midway between the shoulder and the suture are stronger than the rest. The fact that its shoulder is tuberculate was stressed by Wrigley (1934, p. 115) as evidence of its relationship to *S. ambigua* (Solander) from the Bartonian.

Apparently Wrigley believed the tubercles were developing in *Sconsia* at this period in their evolution inasmuch as he refers to *"Cassis" nuperus* Conrad, a non tuberculate form from the Claiborne, as being an obviously older *Sconsia*, and *"Cassis" brevicostata* Conrad, a species with two rows of tubercles, and also from the Claiborne, as being completely distinct.

The Red Bluff species next discussed is intermediate between *S. lintea* and *"Cassis" brevicostata* and shows conclusively, in my opinion, that *"C." brevicostata* is an ancestral *Sconsia*, and that the older *Sconsia* had two rows of tubercles which on the early whorls were connected by crossbars.

Thus *"Cassis" nuperus* appears to be the unrelated homeomorph, not *C. brevicostata; C. nuperus* (which, under the name *sowerbyi* Lea, is the type of *Doliocassis* Dall) is, in my opinion, an early member of the Tonnidae. According to Woodring (1928, p. 308), *Doliocassis* would be a synonym of *Galeodosconsia* Sacco.

The holotype of *S. lintea* has two strong varices but I have seen only one weak varix on one other specimen.

Type: Lectotype 13506 ANSP (the largest of 9 cotypes) (Plate 30, figure 3) and eight paratypes 13507 ANSP all from the Byram Formation judging from their matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Mint Spring Formation, USGS localities 14071a, 3140, MGS locality 99; Byram Formation, USGS locality 13286, MGS localities 106, 115.

Sconsia prelintea MacNeil n. sp.

Plate 4, figures 8-9; Plate 50, figures 3-4

Description: Shell of medium size, moderately inflated, spire of moderate height, whorls flattened, sutures moderately incised, columella weakly twisted, siphonal canal moderately inclined and narrowing towards the aperture, aperture elongate, outer lip with a weak adult varix, parietal callus thin, inner lip raised forming a moderate umbilical chink, parietal callus with several irregular horizontal teeth, columellar callus with weak inclined teeth, outer lip teeth moderately weak, slightly irregular and elongate; protoconch conical and very slightly tilted, consisting of three full smooth turns; juvenile whorls with a concave subsutural depression, below which are a pair of well separated low ridges with a concave area between them, all parts covered by raised rounded spiral lirations, the lirations on the two ridges stronger than the rest and weakly granular, weak axials on the upper part of the whorl which form crossbars between the granules on the two prominent lirations; body whorl with the lower of the spiral lirations more prominent and with the axials better developed along it, lower part of whorl with uniform spiral lirations which are slightly higher on their posterior side and made tesselate by growth lines that are higher on the side away from the aperture; umbilical chink prominent; inner lip in umbilical region thick and detached.

Discussion: This species differs from *S. lintea* in being smaller and in having a stronger pair of spiral ridges on the spire whorls as well as better developed axial nodes on the spiral ridges. The pattern of moderately strong crossbars connecting the nodes on the spiral ridges shows it to be intermediate between *S. lintea* and the Claiborne species, *S. brevicostata* (Conrad) (= *Phalium globosum* Dall) (see Palmer, 1937, pl. 31, figs. 10, 11).

Thus far no Jackson representative of this genus has been reported from the southern United States. *Sconsia zacatensis* Gardner (1939, p. 27, pl. 7, fig. 9) was at the time of its description believed to be from late Eocene beds but it was reassigned later (Gardner, 1945, p. 182) to the early Oligocene.

Possibly if more specimens were available *S. prelintea* and *S. zacatensis* would be found to be identical, but because the Mexican species appears to have stronger axial ridges immediately below the suture and wider and flatter spiral lirations on the body whorl I am keeping them separate; possibly the difference is subspecific. Gardner makes no mention of the Red Bluff specimen although it is absolutely perfect and has been in the U.S. Geological Survey collection for 70 years; if she saw it, she must have regarded it as belonging to *S. lintea*.

The tessellate sculpture on part of the whorl of *S. prelintea* and to a greater extent on *S. tessellata* Newton (Wrigley, 1934, p. 116, pl. 16, fig. 18) is similar although finer than the sculpture on juveniles of *Phalium* (*Menthafontia*), and suggests that *Sconsia* and *Phalium* are related.

Type: Holotype 481067 USNM from the Red Bluff Formation, USGS locality 6456 (Plate 4, figures 8-9).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 6456, MGS localities 37, 38, 39, 40. ?Mexico: (as *S. zacatensis* Gardner) Oligocene, Hacienda Zacate, Nuevo Léon, USGS localities 13509, 13511.

Genus **PHALIUM** Link, 1807

Phalium Link, Beschr. Nat. Samm. Univ. Rostock, abt. 3, p. 112, 1807.

Type (by subsequent designation, Dall 1919): *Buccinum glaucum* Linné..Recent, Indo-Pacific.

Subgenus **MENTHAFONTIA** MacNeil n. subgen.

Type, *Menthafontia menthafons* MacNeil. Oligocene, Mississippi.

The relationships of this group appear to be with *Phalium* and it is regarded tentatively as a subgenus of it. However, I can find no generic or subgeneric name thus far proposed that would unquestionably include it.

Juveniles of both the type from the Mint Spring Formation and its Byram analog, *Cassis mississippiensis* Conrad, have a spiral sculpture all over the whorls in which the posterior edge of each spiral band is raised and the anterior edge is depressed. Adults, however, are nearly smooth. The shoulder has prominent thick nodes and there is usually a much weaker staggered set of nodes below the shoulder. At least from the standpoint of the spiral sculpture, juveniles and adults appear quite different (compare figs. 7 and 8, pl. 30).

Possibly *Cassis tessellata* Newton (see Wrigley, 1934, p. 116, pl. 16, fig. 18) from the Bartonian is a member of this group. If so, the English Eocene species has much weaker nodes than the American Oligocene species. If Wrigley is correct in allying this species to *Sconsia,* a derivation of *Phalium* from *Sconsia* is suggested. However, there are sizeable gaps in such a construction.

The Oligocene *Menthafontia* do not have large serrations on the anterior part of the outer lip like the type of *Phalium, P. glauca* (Linné) (see Tryon, 1885, pl. 6, figs. 79, 80). However, there seems to be a continuum between typical *Phalium* through such forms as *P. decussata* (Lamarck) (Tryon, 1885, pl. 7, figs. 87, 88), in which there are no serrations, to the forms included under *Casmaria,* in which there are axial nodes. In my opinion *Menthafontia* and *Casmaria* should both be regarded as subgenera of *Phalium. Casmaria* and *Menthafontia* probably are more archaic than *Phalium* s.s.

Aside from the similarity of the spiral lirations of *Menthafontia* to the smaller lirations of some early American *Sconsia* and with *"Sconsia" tessellata* (Newton) from the Bartonian of England, there is also a resemblance to similar larger spirals in some of the earliest known *Cassis.*

The early progenitors of true *Cassis*, such as *Cassis creolum* (Harris and Palmer, 1947, p. 328, pl. 42, figs. 7, 8) and *Cassis taitii* Conrad, have two rows of rounded nodes on the shoulder as well as a row on the subsutural collar. These persist in *Semicassis* and in later *Cassis* the shoulder nodes become very large. They seem to have their origin in the noded raised lirations of early *Sconsia,* such as *S. brevicostata;* in later *Sconsia* they become obsolete. In *Phalium* the upper row becomes obsolete, leaving only the shoulder nodes. Nevertheless, the slanted spiral lirations, which resemble upside-down house siding, were transmitted from *Sconsia* to the early *Phalium,* particularly *Menthafontia,* on the one hand, and to the early *Cassis* such as *C. taitii* and *C. creolum* on the other hand.

Phalium (Menthafontia) mississippiensis (Conrad)

Plate 30, figures 4, 7-8; Plate 50, figures 5-6

1848a. *Cassis mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 288.
1848b. *Cassis mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 119, pl. 11 fig. 45. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Semicassis mississippiensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 26 (reference entirely incorrect).
1968. *Cassis mississippiensis* Conrad (= *Galeodea*). Abbott, Indo-Pacific Mollusca, v. 2, No. 9, p. 39.

Original Description: Conrad, 1848a.

Subovate; whorls slightly concave above, the angle nodular; body whorl indistinctly ribbed or waved; revolving lines distinct but fine; body whorl with one sharp compressed varix or carina; apex papillated; pillar with transverse rugose plaits throughout; submargin of labrum regularly and profoundly dentate. Length 9-10. Very rare.

Discussion: The type of this species is a juvenile and its figure, even for that stage, is almost hopelessly unrecognizable. Inasmuch as the adult is quite dissimilar there is little wonder that no one has had any idea as to the identity of this species. *P.* (*M.*) *mississippiensis* is the only species known previously that I can refer with any assurance to the subgenus *Menthafontia* as here defined.

The protoconch of this species is evenly spiralled and bulbous, consisting of about 3-1/2 smooth whorls. On both the type and the specimen here figured the first two postnuclear whorls have the suture well below the shoulder, the third and fourth whorls have the suture exactly at the shoulder, and on the succeeding whorls the suture falls far below the shoulder again. This gives the spire in the late juvenile stage the appearance of expanding in almost the same arc of curvature as the concave subsutural slope. The shoulder is moderately sharp and set with moderately strong nodes that have both an axial and a spiral elongation.

The early whorls have well-defined spiral lirations resembling overlapping house siding; the spiral bands are flat with the posterior side raised and the anterior side depressed. Thus, there are no channelled interspaces. The adult whorls lose the spiral sculpture except for a few irregular vestiges, the surface being nearly smooth. The shoulder nodes on the body whorl are strong and bluntly conical and there is a second weaker set of nodes below and staggered with the shoulder nodes. The apertural teeth are not completely preserved on the adult specimen in the Casey collection; on the holotype, a juvenile, the parietal and columellar teeth are elongate and irregular, the outer lip teeth are short and denticulate. The columella is short and strongly curved as in *Cassis.*

There is an analog of this species in both the Red Bluff Formation and the Mint Spring Formation, but I can find nothing related to it elsewhere. Probably it is descended from the *Mambrinia-Sconsia* complex and existed only in the Gulf region; it did not survive the Byram as far as is known.

Type: Lectotype 13501 ANSP (the smaller of two cotypes) and paratype 13502 ANSP (Plate 30, figures 4, 8) both from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS locality 13286, MGS locality 109.

Phalium (Menthafontia) menthafons MacNeil n. sp.

Plate 17, figures 10-13

1929. Lesueur, Walnut Hills fossil shells, pl. 9, fig. 6 (no name). Printed in Dockery, 1982, Appendix II.

Description: Shell moderately large, moderately inflated, spire high for a cassid and stout, whorls rounded, sutures appressed with a high collar but well below the shoulder, subsutural slope strongly concave, shoulder with strong pointed nodes, aperture elongate, outer lip thick and flaring, thin varices at irregular intervals, inner lip detached, umbilical chink large, columella strongly twisted and of moderate length; protoconch large, bulbous and slightly tilted, consisting of about 3-1/2 smooth, round, inflated whorls; juvenile whorls with moderately fine spiral sculpture which on the shoulder consists of primary, secondary, and tertiary raised threads, but which below the shoulder consists of spiral bands which are high on the posterior side and submerged on the anterior side, some bands having a raised thread in the center; adult whorls nearly smooth, only faint and irregular vestiges of the spiral bands remaining; all postnuclear whorls with strong blunt rounded nodes on the shoulder, the body whorl showing a very weak staggered row below the shoulder; parietal wall with weak irregular teeth, teeth becoming larger and stronger on the columellar callus; outer lip with about 11 short teeth; umbilical chink deep; columella twisted and sharply inclined to form a strong raised siphonal fasciole.

This species is distinguished from *P.* (*M.*) *mississippiensis* mainly by its higher spire, the location of the suture always well below the shoulder rather than near or at the shoulder as on the early whorls of *mississippiensis,* and in the much steeper and more concave subsutural slope.

If these differences are not consistent it may prove necessary to combine these species. Thus far neither the Mint Spring Formation or the Byram Formation has yielded a complete adult.

Type: Holotype 376469 USNM and paratype 498240 USNM both from the Mint Spring Formation, USGS locality 14071a (Plate 17, figure 10 - holotype and figures 11-12 - paratype).

Occurrence: Mint Spring Formation, USGS locality 14071a, MGS locality 99, Vicksburg (Lesueur).

Phalium (Menthafontia) sp.

Plate 4, figures 6-7

Discussion: A single specimen from the Red Bluff Formation has its entire surface dissolved away so that the details of its sculpture are not visible. Its axial nodes are narrow, axially elongate and sharply inclined and in this respect alone seems to be a different species from both the Mint Spring and Byram species.

Occurrence: Red Bluff Formation, USGS localities 315, 14720.

Genus **ONISCIDIA** Swainson, 1840

Oniscidia Swainson, Treatise on Malacology, p. 299, 1840.

Type (by subsequent designation, Dall, 1919): *Morum cancellata* Sowerby. Recent, China.

It would be difficult to find a name so widely accepted and yet so often declared to be a typographical error. Many authors have pointed out that Swainson attributed the name to Sowerby who used *Oniscia,* an exact synonym of *Morum* Roeding, Dall (1909, p.68) attempted to justify the name by attributing it to Mörch, 1852, but Mörch had attributed it to Swainson, which leaves it in exactly the same position.

Swainson also included *oniscus* (Chemnitz) Gmelin, the type of *Morum,* under *Oniscidia,* but in my opinion these are different genera.

I believe *Oniscidia* should be placed on the official list of generic names. In spite of its obvious defects it has been almost universally used as either a genus, or a subgenus of *Morum.* Until 1955 when Kira (1955, pl. 21, fig. 1) figured a species as *Morum* (*Onimusiro*) *grande* (A. Adams) there have been no other names in conflict with it, and as yet *Onimusiro* has not been validly proposed. I can see absolutely nothing to be gained at this date in the rejection of *Oniscidia.*

For other discussions of the problem see Herrmannsen (1847, p. 150), Dall (1909, p. 68), Gardner (1947, p. 538), and Woodring (1959, p. 202). Wrigley (1934, p. 110, emendation in footnote) took a definite stand that the name was untenable.

Dall's contention (1909, p. 69; and 1915, p. 85) that *Herculea* Hanley 1858 (type, *Morum ponderosum* Hanley) should include *Oniscia harpula* Conrad from the Byram Formation, *Oniscia domingensis* Sowerby Dall (= *Morum chipolanum tampanurn* Mansfield) from the Tampa Limestone (early Miocene) of Florida, and *Morum dennisoni* (Reeve), a Recent West Indian species is not true, unfortunately; *Morum ponderosum* represents quite another group. The other three species are the kind of thing that has generally gone under the name of *Oniscidia*.

I cannot agree that *Oniscidia* as generally understood is a subgenus of either *Morum* Roeding or *Oniscia* Sowerby as numerous authors have used it; "*Oniscidia*" has been distinct since the middle Eocene at least (Woodring, 1959, p. 202), and I can find no evidence that they either converge with or are related to *Morum*.

Oniscidia has not been reported from northern Europe but two Italian species, *Oniscia antiqua* Bayan (1870, p. 53, pl. 7, fig. 4) from the Eocene, and *Buccinum cythara* Brocchi (1814, p. 330) from the Miocene appear to belong to it.

Oniscidia harpula (Conrad)

Plate 17, figure 9; Plate 30, figures 5-6, 9-10

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 21 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Oniscia harpula* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 288.
1848b. *Oniscia harpula* Conrad. Conrad, Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 119, pl. 12, fig. 6. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Morum harpula* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 26.
1909. *Morum (Oniscidia) harpulum* (Conrad). Dall, U.S. Geol. Survey, Prof. Paper 59, p. 69.
1931. *Morum (Oniscidia) harpulum* (Conrad). Olsson, Bull. Amer. Paleont., v. 17, No. 63, p. 95.
1934. *Morum (Oniscidia) harpulum* (Conrad). Wrigley, Malacological Soc. London, Proc., v. 21, pt. 2, p. 113.

Original Description: Conrad, 1848a.

Ovate, latticed; longitudinal ribs angular, distant, about ten on the large whorl, with a slightly foliated and waved margin; revolving lines large, distant, about twelve on the body whorl; spire scalariform, the ribs divided by an impressed line; submargin of labrum obtusely dentate. Length 1 2-10. Very rare.

Discussion: I can find nothing to distinguish specimens from the Mint Spring Formation from the species occurring in the Byram Formation. There is some variation in the pattern of the granules on the columellar lip but they tend usually to be arranged in two vertical rows; on the single Mint Spring specimen the two rows are sharply aligned (pl. 17, fig. 9).

The Vicksburg species is more inflated with a shorter aperture than the Eocene species from Central and South America such as *Morum (Herculea) corrugatum* Clark (1946, p. 34, pl. 21, figs. 5, 21) from Colombia, and *Morum ("Oniscidia")* sp. of Woodring (1959, p. 202, pl. 25, figs. 11, 17) from Panama. The same probably applies to the late Eocene or early Oligocene form from Panama that Woodring (1959, p. 203, pl. 25, figs. 12, 13) identified as *Morum ("Oniscidia")* cf. *M. antiquum* (Bayan).

The next younger American species known seems to be *Oniscidia tampana* (Mansfield, 1937, p. 141), a species which Dall had figured earlier (1915, p. 85, pl. 12, fig. 28) as *Morum domingense* Sowerby. This species is from the Tampa Limestone (early Miocene) of Florida. It very definitely does not have two rows of rounded granules on the inner lip; rather they are elongate and irregular. The outer lip teeth are longer, the shell is less inflated and the parietal callus is broader. In most respects the Tampa species is more like *O. chipolana* (Maury, 1925, p. 115, 617, pl. 4, fig. 4) from the Chipola Formation (early Miocene) of Florida. Maury attributed this name to Dall. Gardner (1947, p. 538, pl. 54, fig. 18) again, and unknowingly, described it as a manuscript species of Dall's and Mansfield (1937, p. 141) in the meantime had described *tampana* as a subspecies of "*chipolanum* Dall Ms." without realizing the name had been validated by Maury. This confusing situation was discussed by Woodring (1959, p. 203). Woodring states that Maury's drawing is based on a specimen now lost. However, it may have been based on a specimen in Dall's collection. At any rate, the best solution seems to be to regard the specimen figured by Gardner as either the probable holotype or the neotype.

Oniscidia peruvianum (Olsson, 1931, p. 95, pl. 17, figs. 5, 7) may be the most closely related known species to *O. harpula*. It is from the Chira Formation of supposed Lattorfian (early Oligocene) age of Peru. According to Olsson the main difference lies in the greater inflation and more abrupt basal contriction of *O. harpula*. Olsson's figure, while incomplete, has a suggestion of two rows of granules on the columellar callus.

Type: Holotype 13505 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 30, figures 5-6).

Occurrence: Mint Spring Formation, USGS localities 14071a, 6647; Byram Formation, USGS locality 13286, MGS locality 93.

Family FICIDAE Conrad, 1867
Genus FICUS Roeding, 1798

Ficus Roeding, Museum Boltenianum, p. 148, 1798.

Type (by tautonymy, concealed): *Bulla ficus* Linné (as *Ficus variegata* Roeding). Recent, western Pacific.

Roeding cited *Bulla ficus* under two species, *F. variegata* and *F. communis,* thus establishing the name as a hidden tautonym. However, by synonymy the tautonym is fixed on *variegata,* a younger name for *B. ficus* Linné; *communis* is an older name for *F. papyratia* (Say). In my opinion, Winckworth's (1945, p. 140) subsequent designation of *variegata* is superfluous. Gardner (1939, p. 34) had previously interpreted *Bulla ficus* as the monotype on the assumption that *F. communis* and *F. variegata* were synonyms, and *F. picta,* the only other species listed, was a nomen nudem.

The most serious attempts to work out the phylogeny of *Ficus* are undoubtedly those of Wrigley (1929) and Gardner (1939). According to both of these authors, typical *Ficus*, which lacks nodes and prominent ridges, is not known older than middle Eocene, and must have come from one of the noded, carinated types known in the Paleocene and early Eocene. Noded and carinated types, referred to at least three genera, *Ficopsis* Conrad, *Fulguroficus* Sacco, and *Trophosycon* Cooper, were coexistent with *Ficus* s.s. from the middle Eocene to the middle or late Tertiary.

Burnett Smith (1907) attempted to show that there is a morphological change in *Ficus* from early Tertiary species having a higher spire and a protoconch of three smooth whorls, the first volution being relatively small, to Quaternary and Recent species having a low spire and a protoconch of one or less smooth tumid whorls. However, it is now generally recognized that there are different species groups in which these changes took place in varying degree. *F. mississippiensis* probably belongs to the group of *F. ventricosa* (Sowerby) (= *decussata* Wood), a Recent west American species having a protoconch of two full turns and a small initial volution. On the other hand, *F. carbasea* (Guppy), a species reported from the early to late Miocene at numerous localities in the Caribbean region, has a single smooth blunt embryonic whorl and apparently is a precursor of the Recent West Indian species, *F. communis* Roeding (=*papyratia* Say), which has one smooth swollen nuclear whorl. A Recent Australian species, *F. tessellata* (Kobelt) may belong to the same group; its smooth globular stage is only a small fraction of the first whorl and in this respect it is the most extreme species known.

Both Gardner (1939, p. 35) and Harris and Palmer (1947, p. 325) discussed the number of fine spiral threads in the American Eocene and Oligocene species. Between the primary spiral threads there may be secondary, tertiary, quaternary and 5th order threads. In the older species there tend to be more threads of subequal size, whereas in the more Recent species there usually are fewer threads with a greater difference in the size of threads of different orders. Thus, while the Jackson species, *T. filia* (Meyer) (see Harris and Palmer, 1947, p. 323, pl. 43, figs. 7-10), may have quaternary and 5th order threads (7 to 15 total) of subequal size, *T. communis* may have secondary to tertiary to quaternary threads (1 to 3 to 7 total) of unequal size between the primary lirations. However, although a decrease in the number of interstitial threads with time might appear general, it may be restricted to narrow lines of descent which at the present time are not entirely understood. *Ficus merita* Harris and Palmer (1947, p. 326, pl. 43, figs. 4-6), for instance, from the late Eocene of Louisiana has only secondary and tertiary threads, a total of three interstitial spirals. In all probability *F. merita* belongs to the *F. communis* group whereas *F. filia* and *F. mississippiensis* belong to the *F. ventricosa* group.

Ficus mississippiensis Conrad

Plate 4, figures 10, 14; Plate 18, figures 6-7;
Plate 30, figures 13-14

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 10, 19 (no name). Printed in Dockery, 1982, Appendix II.

1848a. *Ficus mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 286.

1848b. *Ficus mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 117.

1865. *Sycotypus mississippiensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 26.

1866. *Ficopsis mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.

1907. *Pyrula mississippiensis* (Conrad). Smith, Acad. Nat. Sci. Philadelphia, Proc., p. 214, pl. 17, fig. 5 (protoconch).

1938. ?*Ficus* sp. aff. *F. mississippiensis* Conrad. Mansfield, Washington Acad. Sci. Jour., v. 28, No. 3, p. 101.

1939. *Ficus mississippiensis* Conrad. Gardner, U.S. Geol. Survey Prof. Paper 193-B, p. 35, pl. 7, fig. 22.

1940. *Ficus mississippiensis* Conrad? Mansfield, Jour. Paleont., v. 14, No. 3, pl. 27, fig. 36, 45.

1945. *Ficus mississippiensis* Conrad. Gardner, Geol. Soc. America, mem. 11, p. 184.

1947. *Ficus mississippiensis* Conrad. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 322, pl. 43, fig. 1-3.
1958. ?*Ficus* cf. *F. mississippiensis* Conrad. Woodring, U.S. Geol. Survey, Prof. Paper 306-B, p. 210.

Original Description: Conrad, 1848a.

Pyriform, thin and fragile, latticed, with acute prominent lines, the revolving ones largest and distant, the interstices with minute revolving lines; longitudinal lines closely arranged, equal; spire very short, whorls convex, the two nearest the apex entire; large volution flattened at top. Length 1¼.

Discussion: The figure of the lectotype (pl. 30, fig. 14) is the first photograph of one of Conrad's syntypes to be published, although a crude drawing by Meyer of another syntype was reproduced by Harris and Palmer (1947, pl. 43, fig. 1). Harris and Palmer figured two other specimens from Vicksburg, presumably from the Byram Formation. The protoconch of *F. mississippiensis* was figured by Burnett Smith (1907, pl. 17, fig. 5). Aside from the above, Gardner (1939) figured a specimen from Tamaulipas, Mexico, and Mansfield (1940) figured a specimen from the Chickasawhay Limestone of eastern Mississippi.

As pointed out by Pilsbry (1922, p. 364), Gabb thought erroneously that *F. carbasea* (Guppy) was a synonym of *F. mississippiensis,* and in this Guppy later erroneously concurred. As mentioned under the generic discussion the nuclear whorls of these species are quite different.

The number of interstitial threads in *F. mississippiensis* ranges from about 7 to 10, depending on how many 5th order threads are developed. None of the English Eocene species of *Ficus* could be confused with *F. mississippiensis; F. nexilis* (Solander) (see Wrigley, 1929, p. 244, pl. 16, figs. 10, 11) comes closest in shape but has no interstitial threads; *F. sinodonta* Wrigley (ibid, p. 245, pl. 16, figs. 12, 13) has an interstitial thread in some interspaces but has a pronounced basal angle.

Of the German and Dutch Oligocene species, *F. condita* (Brongniart) (see Speyer, 1863, p. 185, pl. 33, figs. 12-14; as *Pyrula reticulata* Lamarck) may be the most closely related to *F. mississippiensis,* and it is the only one with one or several interstitial threads. *F. crassistria* (von Koenen, 1889, p. 161, pl. 7, figs. 12-15; Albrecht and Valk, 1943, p. 58, pl. 4, figs. 116, 117) has much the same shape as the large Mint Spring specimen.

I see no reason to question the assignment of the Mexican Oligocene form to *F. mississippiensis* (Gardner, 1939, p. 35), and what may be the same species was reported from the late Eocene or early Oligocene of Panama by Woodring (1959, p. 210). Olsson (1931, p. 97, 98) described two species, *F. chiraensis* and *F. woodringi,* from the Chira Formation (early Oligocene), and the Heath Formation (late Oligocene), respectively, of Peru. These are both closely related to *F. mississippiensis,* both of them having numerous interstitial lirations. Probably *F. woodringi* is the more closely related of the two.

The few specimens I have seen from the Red Bluff, Mint Spring, and Byram do not show any differences by which they could be separated. The single specimen from the Mint Spring Formation is more inflated than the others, but it is also larger, and the inflation may be a function of size.

Type: Lectotype 13508 ANSP (the better of the two largest of six syntypes) (Plate 30, figure 14) and 5 paratypes 13509 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Mississippi: Red Bluff Formation, USGS localities 309, 5264, MGS localities 37, 38, 39, 40; Mint Spring Formation, USGS locality 14162, MGS localities 89, 99; Byram Formation, USGS locality 3722, MGS localities 106, 112c; Chickasawhay Limestone, USGS locality 13239. Alabama: Chickasawhay Limestone, USGS localities 6735, 14355, 6749, 7166. Florida: Suwannee Limestone, USGS locality 12723. Mexico: See Gardner, 1939, p. 35; and 1945, p. 184. ?Panama: See Woodring, 1959, p. 210.

Family CYMATIIDAE Iredale, 1913

Genus **CYMATIUM** Roeding, 1798

Cymatium Roeding, Museum Boltenianeum, p. 129, 1798.

Type (by subsequent designation, Dall, 1904): *Cymatium femorale* Roeding (=*Murex femorale* Linné). Recent, West Indies.

Subgenus **SEPTA** Perry, 1810

Septa Perry, Arcana, pl. 2, fig. 2.

Type (by monotypy): *Septa scarlatina* Perry, 1810 (=*Murex rubeculus* Linné, 1758). Recent, Indo-West Pacific.

A single specimen from the Mint Spring Formation is here described as a new species of *Cymatium* (*Septa*), *C.* (*S.*) *amnicretum* MacNeil. It has a moderately long straight columella, the canal is not sharply constricted by an internal thickening of the outer lip, the columella is smooth except for a single weak, nearly central tooth located well inside the aperture, and the outer lip and varices have a slight upward twist, especially when viewed from the back. All of these characters suggest a relationship with the *C. femorale* group, although in *C. amnicretum* the characters are much less extreme.

It is the view of Alan Beu (personal communication with the junior author), after viewing the figures on Plate 18, that *C. amnicreta* belongs in *Cymatium* (*Septa*) as it is more like *C. parthenopeum* and *C. pileare* than *C.* (s.s.) *femorale.*

Cymatium (Septa) amnicretum MacNeil n. sp.
Plate 18, figures 4-5

Description: Shell of medium size and medium inflation, spire of medium height, sutures broad and deep, spire whorls rounded and accentuated by two or three strong spiral ribs, varices separated by two-thirds of a whorl, making them aligned in three rows and located on every other whorl in each row, five axial swellings between the varices, the middle one stronger and aligned with the varices, two weaker axial swellings between the varical rows, shoulder moderately angulate; protoconch unknown; sub-sutural slope with two or three weak spirals; lower whorl with moderately strong spiral ribs, about six on the fore of the whorl, and about six on the columella; crude axial swellings on upper part of whorl making spirally elongate swellings where they cross the spirals; spiral interspaces with weak interstitial secondary and weaker tertiary threads; aperture ovate, canal of moderate length and not constricted; parietal callus moderately thin; parietal wall with one weak tooth delimiting the anal notch, the spiral ribs weakly outlined elsewhere; columella with a single weak tooth well inside the aperture; columella straight; canal not deflected; outer lip thick and forming a major varix; no umbilicus.

Discussion: This species probably is related to both *Cymatium* (*Septa*) *ogygium* Woodring (1959, p. 204, pl. 27, figs. 4, 6) from the Caimito Formation (late Oligocene) of Panama and *Gutturnium gracile gurabonicum* Maury (1917, p. 107, pl. 17, fig. 10) from supposed middle Miocene beds of the Dominican Republic. According to Woodring (1928, p. 299) the latter is a synonym of *Cymatium domingense* (Gabb) (see Pilsbry, 1922, pl. 29, fig. 2).

Type: Holotype 376471 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 18, figures 4-5).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Subgenus **RANULARIA** Schumacher, 1817

Ranularia Schumacher, Essai d'un Nouveau des Habitations des Vers Testaces, p. 253, 1817.

Type (by subsequent designation, Herrmannsen, 1846): *Tritonium clavator* Chemitz, 1780 (non-binominal; = *Ranularia longirostra* Schumacher, 1817; = *Cymatium gutturnium* Roeding, 1798). Recent, Indo-Pacific.

Cymatium (Ranularia) vicksburgense Dockery n. sp.
Plate 50, figures 9-10

Description: Shell of modest size for genus, spire short, suture impressed, anterior canal long and relatively straight, one varix present just behind aperture; only four whorls of type preserved, protoconch unknown; aperture oval with seven denticles on outer lip and a strong tooth adjacent the anal notch followed by prominent irregular spiral ribs on the inner lip that continue onto the anterior canal; parietal callus restricted to the apertural region; exterior sculpture of first three whorls with three spiral ribs, the first rib being elevated above the suture, and ten spiral lirae, the second and third ribs each bearing three lirae, and regularly spaced longitudinal ribs; body whorl with more pronounced and more broadly spaced longitudinal ribs (fifteen including varix), seven spiral ribs of which the second through the fourth are most pronounced with each bearing three spiral lirae and being strongly nodose at intersection with longitudinal ribs, and thirty spiral lirae positioned as follows: two on the first rib, one in interspace, three on second rib, one in interspace, three on third rib, one in interspace, three on fourth rib, two in interspace, one in interspace between the fifth and sixth ribs, one in interspace between the sixth and seventh ribs, and twelve on neck after the seventh rib.

Discussion: This species is known only from the type. It resembles *Cymatium* (*Ranularia*) *dunkeri iredalei* (Beu, 1968), a Recent species from the Kermadec Islands in the western Pacific, in its short spire, long and relatively straight anterior canal, and restricted parietal callus. It differs from this latter species in its constricted aperture with prominent denticles on the outer lip and strong irregular spiral ribs on the inner lip. In its general form it also resembles *Cymatium* (*Ranularia*) *moritinctum caribbaeum* Clench and Turne, 1957, from the western Altantic (South Carolina to Florida and the West Indies, Bermuda, and Brazil).

Type: Holotype 376667 USNM from the Byram Formation, MGS locality 112c (Plate 50, figures 9-10).

Occurrence: Byram Formation, MGS locality 112c.

Genus **SASSIA** Bellardi, 1872

Sassia Bellardi, Molluschi dei terreni del Piemonte e della Liguria, v. 1, p. 219, 1872.

Type (by original designation): *Triton appeninicum* Sassi. Miocene, Italy.

The English Eocene and German Oligocene species of *Sassia* were ably discussed by Wrigley (1932) and there is no doubt of the inclusion of the large Red Bluff and Mint Spring species in that genus.

Subgenus **SASSIA** Bellardi, 1872,

Sassia (Sassia) conradiana (Aldrich)

Plate 4, figures 11-13

1885. *Triton* (*Simpulum*) *conradianus* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 148, pl. 2, fig. 8.
1886. *Triton* (*Simpulum*) *conradianus* Aldrich. Aldrich, Alabama Geol. Survey, Bull. 1, No. 1, p. 20, pl. 2, fig. 8.
1903. *Bursa mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 279 (Not of Conrad, 1848).
1926. *Triton conradianus* Aldrich. Cooke, Alabama Geol. Survey, Special Rept. 14, p. 279.
1940. *Triton conradianus* Aldrich, Toulmin, Alabama Geol. Survey, Bull. 46, p. 47.
1982. *Sassia conradiana* (Aldrich). Dockery, Mississippi Bureau Geol., Bull. 122, p. 97-98, pl. 76, fig. 9-10.

Original Description: Aldrich, 1885.

Fusiform; whorls nine, rounded, nodosely ribbed; nodes prominent, rounded, and deeply cut by revolving lines; revolving lines impressed with interstices, flattened upon the upper and middle part of the body whorl; on the lower part the spaces and lines are interchanged, the lines being very prominent; first two whorls of the spire smooth, next six tuberculated; varices very numerous; nodes on the body whorl quite prominent, running lengthwise over the middle; labium dentate, one strong tooth at the upper end, small teeth in the middle, prominent ones on the lower part; outer lip dentate internally, thick; canal recurved, nearly closed, longer than the aperture. Length, 1 8/10 inches.

Locality, Red Bluff, Miss., also at Carson's Ck.

This splendid species resembles *T. Schowalteri* Con., but is distinguished by its size, recurved canal, the absence of the acute lines on the body whorl, and the nodes on the periphery being rounded and longitudinal; rather abundant. Named in honor of the late T.A. Conrad.

Discussion: I find only one brief discussion of this species since its description. Casey suggested erroneously that *Bursa mississippiensis* Conrad was the young of it. Aldrich apparently accepted this opinion and indicated on the label of the type that Conrad's name had priority.

Judging from its abundance in collections, this was one of the most prolific Red Bluff species.

Sassia conradiana is most closely related to the European middle Eocene to late Oligocene group generally referred to *S. flandrica* (de Koninck) (see Wrigley, 1932, p. 130, pl. 10, fig. 11). The English species from the Upper Bracklesham beds figured by Wrigley is shorter, more inflated, and has more regular axial ribs than the Oligocene forms. Specimens from the Red Bluff Formation appear very close to *S. semilaevis* (Beyrich) (see von Koenen, 1889, p. 84, pl. 6, fig. 6) from the early Oligocene of Germany, a form which in my opinion is a subspecies of *S. flandrica*. The Mint Spring subspecies next described, *S. conradiana menthafons*, is closer to typical *S. flandrica* from the Rupelian and Chattian of Germany (see von Koenen, 1889, p. 88, pl. 6, fig. 1) and somewhat resembles *S. subspinosum* (Grateloup) (see Plate 50, figures 11-12) from the Oligocene of the Aquitaine Basin, France.

The similarity of the Red Bluff and Mint Spring subspecies of *Sassia* to forms in the Lattorfian and Rupelian, respectively, gives some support to the correlation of these units.

Type: Holotype 644612 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Aldrich) (Plate 4, figure 13).

Occurrence: Red Bluff Formation, USGS localities 309, 5264, MGS localities 34b, 35b, 37, 38, 39, 40.

Sassia (Sassia) conradiana menthafons

MacNeil n. subsp.

Plate 17, figures 18-19; Plate 18, figures 1-2

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 15 (no name). Printed in Dockery, 1982, Appendix II.
1903. *Triton conradianus* Aldrich. Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 279.

Discussion: There might be some doubt as to whether this form can always be distinguished from the typical form in the Red Bluff. While the species is abundant in the Red Bluff the Mint Spring subspecies is rare; I know of only two specimens. Both of them have stronger and broader axial ribs and the spiral sculpture tends to be sharper in adults. Adults of the Red Bluff form have smoothly rounded spiral ribs, and it is not uncommon for the central part of the whorl to be nearly smooth.

This is the form that Casey reported in the "Lower Vicksburg" (= Mint Spring Formation). There is a specimen of this subspecies in an old collection in the U.S. National Museum from Vicksburg, but there were no specimens of it in the Casey collection when I transferred it to Museum trays.

This species has been found by the junior author to occur frequently in sand lenses in the upper part of the Forest Hill Formation at MGS localities 75a and 99a just below the contact with the Mint Spring Formation. Sometimes several specimens are found in the same sand lens.

Type: Holotype 498338 USNM from the Mint Spring Formation, USGS locality 6647a (Plate 18, figures 1-2).

Occurrence: Forest Hill Formation, MGS localities

75a, 99a; Mint Spring Formation, USGS localities 6647a, 7941, MGS localities 74b, 99b.

Subgenus CYMATIELLA Iredale, 1924

Cymatiella Iredale, Proc. Linn. Soc. NSW 49, p. 253.

Type (by original designation): *Triton quoyi* Reeve, 1844 (= *Triton verrucosus* Reeve, 1844). Pleistocene and Recent, Southern Australia.

Sassia (Cymatiella) fuscicava MacNeil n. sp.
Plate 17, figure 17

Description: Shell small, moderately slender, spire high, whorls weakly convex below the shoulder and weakly concave above the shoulder, appressed at suture, suture weakly indented, shoulder inconspicuous, sculpture weak, varices every two-thirds of a whorl and aligned in three vertical rows, a varix on every other whorl in each row, aperture broadly lenticular, anal notch well defined, siphonal canal short and deep, six well defined outer-lip denticles, inner lip thin but raised and detached, four irregularly spaced denticles on columella and one on the parietal wall where it delimits the anal notch; protoconch about two and three-fourths turns, naticoidal and slightly tilted, the first two and one-fourth turns smooth, the next one-half turn with four weak narrow raised spiral ribs which grow stronger gradually; beginning of juvenile stage marked by appearance of axial riblets, followed in one-half turn by first varix; interstitial threads appearing after first varix; one or two tertiary threads appearing subsequently, making either two or three broad flat threads in the interspaces on the body whorl; both axial and spiral sculpture subdued but moderately regular.

Discussion: Beu (personal communication with the junior author) placed this species in *Sassia* (*Cymatiella*), a world-wide subgenus containing similar small, elongate *Sassia* species such as *S. viperina* (Lamarck) from the Paris Basin Eocene. *Cymatiella* differs from *Sassia* s.s. in its small size, small protoconch, and consistently tall, straight-sided spire.

Type: Holotype 498233 USNM from the Mint Spring Formation, USGS locality 7671a (Plate 17, figure 17).

Occurrence: Mint Spring Formation, USGS locality 7671a.

Subgenus BYRAMIA MacNeil n. subgen.

Type: *Triton abbreviatus* Conrad, 1848. Byram Formation, Oligocene, Mississippi (not *Triton abbreviatus* von Koenen, 1889).

This subgenus is characterized by small, medium to low spired, moderately inflated shells. The whorls are rounded and the sutures are moderately incised. Spiral and axial sculpture are subequal; either may predominate slightly but generally there is an even reticulation; interstitial threads are usually present. The columella is short and heavy. The siphonal canal is moderately short but sharply submerged. The anal notch is broad. The aperture is subovate above the siphonal canal with an extension at the anal notch. The outer lip is moderately sharp but it subtends a heavy rounded varix. The posterior part of the outer lip is produced more than in typical *Sassia* and may be sharply rounded to angulate. The parietal callus is thin and appressed, usually with one or more teeth, the strongest one delimiting the anal notch. Columellar callus moderately thick and weakly detached; bearing short but well defined teeth, usually 3 to 5 in number. The varices usually are aligned in three spiral rows, but on some specimens the alignment is irregular.

If I am in error in allying this group of small, low to medium high spiral shells to *Sassia*, it probably should stand as a separate genus close to *Gyrineum* Link, 1807. Possibly the bivaricate frog shells had their origin in these Eocene and Oligocene small spirally trivaricate shells. Shells such as *Gyrineum* and *Biplex* do not commonly have columellar teeth, although occasional species have them (see *"Ranella" bituberculatis* (Lamarck), Tryon, 1881, pl. 23, fig. 44.

Aside from the Vicksburg species, the only other species I would refer to this subgenus with any confidence is *Triton chalmasi* Vasseur from the Bois Gouët beds (middle Eocene) of France. Cossmann (see 1920, pl. 32, p. 2, figs. 34, 35) at different times referred this species to *Lampusia, Eutritonium,* and *Eutritonium* (*Sassia*).

The Bois Gouet beds contain several named taxa which form an almost continuous series between *S.* (*B.*) *chalmasi* and typical *Sassia* [see Cossmann, 1897, pl. 12; figs. 5-6 (*chalmasi*), 19-20 (*excavata*), 14-15 (*reticulosa*), 10-11 (*dumortieri*), 21-22 (*ishnospira*)]. It is difficult to say how many of these are valid species.

None of the English Eocene *Sassia* (see Wrigley, 1932, pl. 10) appears to be very closely related to *Byramia* but the group almost certainly came from one having a higher spire and a longer columella such as *Sassia fasciata* (Edwards) (see Wrigley, 1932, pl.10, fig. 1) from the London Clay. *S. fasciata* probably is closely related to *S. reticulosa* from the Bois Gouët (Cossmann, 1897, p. 329, pl. 12, figs. 14, 15).

There appears to be nothing like *Byramia* in the American middle Eocene. However, *"Distortrix" jackonensis* Meyer (see Harris and Palmer, 1947, p. 336, pl. 44, figs. 7-9) from the late Eocene may belong to it.

In the Vicksburg formation, as in the Bois Gouët beds, there is a series from very low spired to high spired species. The high spired species resemble tropical *Sassia* in all respects except size. The apparent even gradation from high to low spired forms appears to justify including the entire series in *Byramia*.

The varical interval in the species of *Byramia* is less than two-thirds of a turn, and varices are arranged in three spiral rows. It is thus intermediate between *Cymatium,* which has a vertical interval of two-thirds of a turn, a condition resulting in three vertical rows of varices on the spire with a varix on every whorl in each row, and *Gyrineum,* which has a varix every half turn, the varices being aligned in two vertical rows on opposite sides of the spire, every whorl having a varix in each row. *Byramia* thus shows the geometrical intermediacy in varix position that would be necessary if the frog shells were descended from an Eocene *Sassia.*

Beu (personal communication) thinks that many European Eocene species can usefully be placed in *Sassia (Byramia)*.

Sassia (Byramia) abbreviata (Conrad)

Plate 31, figure 3

1848a. *Triton abbreviatus* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 288.
1848b. *Triton abbreviatus* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 118, pl. 11, fig. 41 (not fig. 42). Plates reprinted in Dockery, 1982, Appendix I.
1865. *Bursa abbreviatus* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 21.
1903. *Bursa abbreviatus* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 279.

Original Description: Conrad, 1848a.

Short-subovate; whorls six, longitudinally ribbed, and with strong alternated revolving lines; whorls of the spire slightly convex, the two nearest the apex entire, rounded; body whorl inflated, and having one large varix; the ribs about fifteen in number; submargin of labrum denticulate; canal short, oblique, straight; aperture and canal about half the length of the shell. Length 4-10.

Discussion: There can be no doubt, after an examination of the types, that the figures of *Triton abbreviatus* and *T. mississippiensis* are reversed on Conrad's plate. The spire of the type of *T. abbreviatus* is drawn too high, making it appear to have a spire like *T. mississippiensis.* Actually the spire of *T. abbreviatus* is much lower. The types are distinguished otherwise by the larger central denticle on the outer lip of *T. abbreviatus,* and by the prominent varices on *T. mississippiensis.*

Whether this is a matter of any great importance depends on whether these are different species. The type of *T. abbreviatus,* as well as a similar specimen here figured (pl. 31, fig. 3), is low with three denticles on the columella; the type of *T. mississippiensis* (pl. 31, fig. 1) is moderately high with five denticles on the columella. Another specimen from the Byram Formation in the Casey collection (pl. 31, fig. 2) is intermediate in height and has four denticles on its columella. For the time being I am keeping these species separate but they may prove to be no more than variants of the same species.

The difference in height observed here, whether it be interspecific or intraspecific, compares favorably with the difference between named species in the Bois Gouet beds (middle Eocene) of France-*S.* (*B.*) *chalmasi* (Vasseur), *S.* (*B.*) *reticulosa* (Deshayes), and *S.* (*B.*) *ischnospira* (Cossmann) (see Cossmann, 1897, pl. 12).

S. (*B.*) *chalmasi* is the only species I can find anywhere else that is very closely related to *S.* (*B.*) *abbreviata* and it is from beds of much greater age.

Type: Holotype 13488 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 31, figure 3).

Occurrence: Byram Formation, Vicksburg, USGS locality 3727. According to Casey (1903) this species is moderately abundant in the "upper marl at Vicksburg", but his collection contains only one of the higher spired variants discussed next.

Sassia (Byramia) abbreviata (Conrad) var.

Plate 17, figure 15; Plate 31, figure 2

Discussion: Two additional specimens from the Byram Formation and one from the Mint Spring Formation are referred to this species tentatively. They have a higher spire than the type. The two Byram specimens have four columellar denticles; the Mint Spring specimen has five.

This form seems to connect *S. abbreviata* and *S. mississippiensis;* in all probability if only one of the latter had been described this form would be combined with it.

Occurrence: Mint Spring Formation, USGS locality 6452; Byram Formation, USGS localities 3140, 13286.

Sassia (Byramia) mississippiensis (Conrad)

Plate 31, figure 1

1848a. *Triton mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 288.
1848b. *Triton mississippiensis* Conrad. Conrad,

Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 118, pl. 11, fig. 42 (not fig. 41). Plates reprinted in Dockery, 1982, Appendix I.

1865. *Bursa mississippiensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 21.

Original Description: Conrad, 1848a.

Acutely subovate; volutions six or seven, latticed, the longitudinal and revolving lines subequal; one varix on the large volution opposite to that on the submargin of the labrum, both elevated, narrow or subcompressed; two varices narrow and prominent on three whorls of the spire; submargin of labrum with six teeth; columella with five transverse plaits, and two or three near the upper angle of aperture. Length ½ nearly.

Of this species I obtained one specimen only.

Discussion: Dall (1890, p. 146) thought, I believe erroneously, that this species might be the prototype of *Eupleura*, a muricid. His remarks refer to the species as here interpreted inasmuch as he realized Conrad's figures for *mississippiensis* and *abbreviatus* were reversed. Casey (1903, p. 279) said that *T. mississippiensis* was "in all probability the young of *Triton conradianus* Aldrich, of the Red Bluff horizon." As far as I know *S.* (*B.*) *mississippiensis* is known only in the Byram Formation. His remark that it "is confined to the lower Vicksburgian" refers, possibly, to the form here named *Sassia conradiana menthafons* from the Mint Spring Formation. However, inasmuch as the Casey collection contains no specimens of the latter, it is equally possible that he was referring to one of the Mint Spring representatives of *Byramia*, either *S.* (*B.*) *abbreviata* var., or *S.* (*B.*) *caseyi* (see pl. 17, figs. 15, 16), and that it was one of these that he regarded as a juvenile *S. conradiana.*

The holotype of *S.* (*B.*) *mississippiensis* has a higher spire and more columellar denticles than the holotype of *S.* (*B.*) *abbreviata*, although, as already suggested, these may be end members of one species. The varices on these forms have the same spacing, but those of *mississippiensis* are larger. *S.* (*B.*) *mississippiensis* may have a sharper angulation at the shoulder on all varices including the apertural varix. This angulation is the most obvious character by which to distinguish the Vicksburg *Byramia* from a similar series in the Bois Gouët beds (middle Eocene) of France.

As far as I can see, the protoconchs of *S.* (*B.*) *mississippiensis* and *S.*(*B.*) *abbreviata* are identical.

Type: Holotype 13488 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 31, figure 1).

Occurrence: Byram Formation, Vicksburg, Mississippi.

Sassia (Byramia) caseyi MacNeil n. sp.
Plate 17, figure 16

Description: Shell small, spire moderately high, whorls weakly rounded, sutures moderately incised, varices strong, axial and spiral ribs subequal and fine, aperture ovate, moderately produced posteriorly, outer lip moderately thin but subtending a thick varix, siphonal canal moderately short and deep, six denticles on outer lip, one denticle on parietal wall where it delimits the anal notch, three indistinct denticles on columella; protoconch low naticoidal and slightly tilted, consisting of about three whorls, smooth with weak spiral lirations appearing on last quarter turn; adult whorls with strong rounded varices every two-thirds of a turn, about 15 to 16 thin axial riblets between varices, six to seven narrow, raised rounded spiral lirations in each spire whorl, those below the shoulder with interstitial threads; columella with sharper, narrower spiral threads and delicately latticed interspaces; inner lip thin and detached; no umbilicus.

Discussion: This species may be related to *S.* (*B.*) *mississippiensis* but it is more slender, has smaller varices, a less angulate posterior outer lip margin, and about twice as many axial riblets per varical interval.

Type: Holotype 498232 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 17, figure 16).

Occurrence: Mint Spring Formation, USGS locality 14162.

Genus **DISTORSIO** Roeding, 1798

Distorsio Roeding, Museum Boltenianum, p. 133, 1798.

Type (by subsequent designation, Pilsbry, 1922): *Distorsio anus* Roeding (*Murex anus* Linné). Recent, western Pacific.

Rhysema Clench and Turner, Johnsonia, v. 3, No. 36, p. 236, 1957.

Type (by original designation): *Triton clathratum* Lamarck. Recent, West Indies.

Since Conrad's (1865, p. 21) proposal of *Personella* (type, *Distorsio septemdentata* Gabb, middle Eocene of Texas) as a subgenus of *Distorsio*, several authors including Dall (1904, p. 130), Pilsbry (1922, p. 357), Wrigley (1932, p. 136), Palmer (1937, p. 261), Gardner (1947, p. 535), Emerson and Puffer (1953, p. 94), and Woodring (1959, p. 205) have discussed the possible or probable derivation of *Distorsio* from *Personella*. Tryon (1881, p. 6) on the other hand commented that *Personella* was "scarcely a *Distorsio*, but more like a *Gutturnium*."

Distorsio seems to be distinct from all other cymatiids in the possession of a sharply raised and beaded ridge along the columellar side of the siphonal canal. This is well developed even on juvenile shells (see pl. 3, fig. 4), but it is not present on other cymatiids of comparable size (pl. 31, figs. 1-3). *Personella septemdentata* (see Wrigley, 1932, pl. 2, fig. 18; Palmer, 1937, pl. 34, figs. 10-11) has no suggestion of such a ridge, nor does its supposed Jackson relative, *P. jacksonensis* (Meyer), have such a ridge.

Distorsio does not form large varices at its growth resting stages, nor do its whorls continue in the same spiral after each resting stage. Rather, following the pause at each apertural position its growth is at a more downward angle, and, at the same time, the shoulder becomes markedly wider for a short distance, giving the shell its distorted coil. Both the coiling habit and the beaded ridge along the canal set *Distorsio* apart from other cymatiids.

Subgenus **DISTORSIO** Roeding, 1798

The following species *Distorsio* (*Distorsio*) *crassidens* (Conrad) would be placed in the subgenus *Rhysema* as used by some workers. This latter subgenus is distinguished from typical *Distorsio* by its much small parietal shield and the much weaker inclination in its columella at the inner end of the siphonal canal. These features are regarded by Lewis (1972) and Beu (personal communication) to be of only specific significance.

It is interesting that *Distorsio* s.s. makes its first occurrence in the Gulf Coastal Plain as the species *D.* (*D.*) *crassidens* (Conrad) and in the Aquitaine Basin in southwestern France as the species *D.* (*D.*) *tortuosa* (Borson) at about the same time during the Oligocene. These two species are closely related and are illustrated in Plate 51, figures 1-6, for comparison.

Distorsio (Distorsio) crassidens (Conrad)

Plate 18, figure 3; Plate 31, figures 4-8;
Plate 51, figures 1-2, 5-6

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 14 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Triton crassidens* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 287.
1848b. *Triton crassidens* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 118, pl. 11, fig. 40. Plates printed in Dockery, 1982, Appendix I.
1865. *Distorio crassidens* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 20.
1903. *Distorio crassidens* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc,. v. 55, p. 279.
1922. *Distorsio constricta crassidens* (Conrad). Pilsbry, Acad. Nat. Sci. Philadelphia, Proc., v. 73, p. 360.
1928. *Distorsio crassidens* (Conrad). Woodring, Carnegie Inst. Washington, pub. 385, p. 299.
1932. *Distorsio crassidens* (Conrad). Wrigley, Malac. Soc. London, Proc., v. 20, pt. 2, p. 136.

Original Description: Conrad, 1848a.

Subfusiform, a little distorted; spire acuminated; whorls latticed, the longitudinal ridge rather distant, prominent; body whorl with the longitudinal ribs distant, and on the angle some of them very prominent or subtuberculous; labrum with one large thick prominent tubercle, and with transverse plates and grains; columella profoundly excavated; canal short. Length 1 6-10.

I have given the name of *crassidens* to this species to distinguish it from *T. cancellinus*, the large tooth on the labrum being very thick and prominent. The large plate on the upper part of the labium is much smaller than the corresponding one in *cancellinus*. It differs in other particulars though the two species are nearly allied.

Discussion: Most references to this species since its description have been merely to cite it as the oldest known species of *Distorsio* (s.s.). As such it naturally figured in discussions of the origin of the genus, most of which favored descent from *Personella septemdentata*, a species from the middle Eocene of Texas. However, this idea now seems unlikely as *Distorsio* has been found in the Paleocene of New Zealand (Beu, personal communication) and in the Eocene of the Spanish Pyrenees as *Distorsio alvaradoi* Comella, 1956.

Distorsio (*Distorsio*) *crassidens* has considerable range in inflation (compare figs. 5 and 8, pl. 31). The only known specimen from the Mint Spring Formation is like the slender variant. I can find no way to separate specimens from the Byram and Mint Spring unless it might be by the thickness of the parietal callus which on the Mint Spring specimen is very thin; this might mean simply that the Mint Spring specimen died shortly after a growth spurt; a new varix had formed but the callus had not yet developed.

Type: Lectotype 13486 ANSP and three paratypes 13487 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 31, figures 5-6 - lectotype).

Occurrence: Mint Spring Formation, USGS locality 14071a, MGS locality 89; Byram Formation, localities 3722, 13286, MGS localities 93, 106, 109, 114, 115.

Order NEOGASTROPODA Wenz, 1938
Superfamily MURICACEA da Costa, 1776
Family MURICIDAE da Costa, 1776
Subfamily MURICINAE da Costa, 1776

Genus CHICOREUS Montfort, 1810

Chicoreus Montfort, Conchyliologie systematique, v. 2, p. 611, 1810.

Type (by original designation): *Chicoreus ramosus* Linné. Recent, Indo-Pacific.

Subgenus PHYLLONOTUS Swainson, 1833

Phyllonotus Swainson, Zoological Illustrations, ser. 2, v. 3, pl. 100 (generic name only), 1833.

Type (by subsequent designation, Swainson, 1833): *Murex (Phyllonotus) imperialis* var. A = *M. imperialis* Swainson, 1831 (not Fischer, 1807) = *M. (P.) margaritensis* Abbott (new name), 1958. Recent, Caribbean.

Keen (1960, p. 104-105) discussed the type species of *Phyllonotus* and the above is her conclusion. Clench (1959, p. 333) regards *margaritensis* as a subspecies of *P. pomum*. However, Abbott (1958, p. 61) demonstrated that they are distinct.

Chicoreus (Phyllonotus) mississippiensis (Conrad)

Plate 18, figures 17-19; Plate 31, figures 12-14; Plate 51, figure 7?

1848a. *Murex (Phyllonota) mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, No. 11, p. 286.

1848b. *Murex (Phyllonota) mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 16, pl. 11, fig. 30. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Murex mississippiensis* Conrad. Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 16.

1890. *Murex mississippiensis* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 139 (in part).

Not 1903. *Murex mississippiensis* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1566 (= *C. tritonopsis*).

1903. *Murex (Chicoreus) mississippiensis* Conrad. Cossmann, Essais Paléonconch. Comp., v. 5, p. 23.

1915. *Murex mississippiensis* Conrad. Dall, U.S. Nat. Museum, Bull. 90, p. 73 (in part).

1922. *Murex mississippiensis* Conrad. Cooke, U.S. Geol. Survey, Prof. Paper 129-E, p. 84.

Not 1929. *Murex mississippiensis* Conrad. Anderson, California Acad. Sci. Proc., (ser. 4) v. 18, No. 4, p. 137 (= *Cantharus scrupeus* Olsson).

1937. *Murex mississippiensis* Conrad. Mansfield, Florida Geol. Survey, Bull. 15, p. 128.

1945. *Murex (Murex) mississippiensis* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 38, 187, pl. 19, fig. 6.

1964. [*Chicoreus (Phyllonotus)*] *mississippiensis* (Conrad). E.H. Vokes, Malacologia, v. 2, No. 1, p. 10.

1967. *Chicoreus (Phyllonotus) mississippiensis* (Conrad). E.H. Vokes, Tulane Studies Geol., v. 5, No. 3, p. 136-137, pl. 1, fig. 6-7.

Original Description: Conrad, 1848a.

Subfusiform, with three elevated varices, and an intermediate prominent obtuse longitudinal ridge; between two of the varices on the body whorl is a smaller ridge; revolving lines prominent, alternated in size, profound on the varices; longitudinal wrinkles distinct; labium with six prominent lines within, the margin regularly foliated; canal long. Length, 1 7-10.

It belongs to the subgenus **PHYLLONOTA** of Swainson.

Discussion of E.H. Vokes, 1967.

The oldest known *Phyllonotus* occurs in the lower Oligocene Red Bluff Clay of Mississippi. This same species, *C. mississippiensis*, continues through the middle Oligocene Mint Springs and Byram marls. In the Mint Springs there is another form which occurs with the typical *C. mississippiensis* and is here separated under the name of *C. stetopus* (de Gregorio). In the younger Byram Marl there is yet another form which has been named *C. dormani* (Vokes). It is quite possible that all three names refer to the same biologic species; however, for stratigraphic purposes it seems more useful to distinguish them. The typical *C. mississippiensis* is found in all three formations; *C. stetopus* occurs in the Red Bluff and the Mint Springs, and *C. dormani* is confined to the Byram.

The three forms have been "lumped" together by all previous authors, including Conrad himself. One of the specimens in the type lot of *C. mississippiensis* is *C. dormani* and is here figured (pl. 1, fig. 9). Cooke (1922, p. 84) listed *"Murex mississippiensis"* as occurring at eight of his ten localities in the Byram Marl, but many of these specimens are actually *C. dormani.*

Comparison of the specimens here figured of *C. mississippiensis* and *C. dormani* might, at first glance, suggest that the lectotype of *C. mississippiensis* more nearly resembles the specimens called *C. dormani* than *C. mississippiensis*. This is a function of the relative magnification of the specimens. The lectotype is X 1½ and the others are X 2. As a result the ornamentation of the lectotype appears more subdued than is actually the case. *C. dormani* may be distinguished from *C. mississippiensis* by the smoother aspect of the ornamentation of *C. dormani* and by the presence of a single strong intervarical node in contrast to the two weaker ones of *C. mississippiensis*.

Type: Lectotype 13482 ANSP (apparently the specimen figured) (Plate 31, figures 12-13) and four paratypes 13483 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Mississippi: Red Bluff Formation, MGS locality 37; Mint Spring Formation, USGS localities 13287, 7671, MGS locality 99; Byram Formation, USGS localities 372, 13286, MGS locality 106. Mexico: middle Oligocene sandstone, Carlos Cantu, Nuevo Leon, USGS locality 13539.

Chicoreus (Phyllonotus) stetopus (de Gregorio)
Plate 4, figures 16-17

1890. *Murex migus* de Gregorio, Ann. Géol. Paléontologie, livr. 7, p. 95, pl. 7, figs. 30-33. Non *Murex craticulatus* var. *migus* de Gregorio, 1885.
1890. *Murex stetopus* de Gregorio, Ann. Géol. Paléontologie, livr. 7, p. 96, pl. 7, fig. 34.
1890. *Murex tingarus* de Gregorio, Ann. Géol. Paléontologie, livr. 7, p. 96, pl. 7, fig. 36.
1893. *Murex migus* de Gregorio. Cossmann, Ann. Géol. Paléontologie, livr. 12, p. 32, (including *M. stetopus* and *M. tingarus* in synonymy).
1937. *Murex migus* de Gregorio. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 268, pl. 35, fig. 3, 7, 8, 11 (after de Gregorio, 1890) (including *M. stetopus* and *M. tingarus* in synonymy).
Not 1937. *Murex* cf. *migus* de Gregorio. Palmer, Bull. Amer. Paleont., v. 7, No. 32, pl. 35, fig. 1 (= *"Murex" laevavaricosus* Whitfield?).
1966. *Murex migus* de Gregorio. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 783.
1966. *Murex stetopus* de Gregorio. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 783, 784.
1966. *Murex tingarus* de Gregorio. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 783, 784.
1967. *Chicoreus (Phyllonotus) stetopus* (de Gregorio). E.H. Vokes, Tulane Studies Geol., v. 5, No. 3, p. 138-139, pl. 1, fig. 1-5.

Discussion of E.H. Vokes, 1967.

In 1890 the Marquis Antoine de Gregorio published an elaborate monograph on the Eocene fossils of Alabama, based on material shipped to him, presumably, from the world famous collecting locality at Claiborne Bluff, on the Alabama River, Monroe County, Alabama. Palmer (1937, p. 5) said of this work: "De Gregorio did a great service by bringing together the literature and illustrations of the Eocene of Alabama. He frequently confused the age of the horizons and in the writer's estimation overnamed species. Many of the specimens represented are merely different stages of growth in the same species." Such seems to be the case with the three species of *Murex* named by de Gregorio in his monograph. These three species, *M. migus, M. tingarus,* and *M. stetopus,* were united in synonymy, under the name *M. migus,* by Cossmann (1893, p. 32). On the basis of the original illustrations this seems to be correct; however, the name *Murex migus* had been used previously by de Gregorio himself (1885, p. 244) and thus another name must be employed for the species. The second name proposed by de Gregorio was *M. stetopus* and because, by great perseverance, Dr. Katherine V.W. Palmer was able to locate the type specimen of this species in the de Gregorio Collection at the University of Palermo, Sicily, (Palmer and Brann, 1966, p. 783 and personal communication) it is the logical choice of available names. The types of both *M. migus* and *M. tingarus* are lost.

Palmer (1937, p. 268) agreed with Cossmann's synonymy but added that "specimens of the form have not been found at Claiborne," having previously remarked (1937, p. 5) of de Gregorio: "There is the possibility that his collections may have become mixed and some of the species described from Claiborne may be extraneous." Almost certainly the species under discussion here falls in this category. No specimens like those figured by de Gregorio have been found by the writer at Claiborne Bluff (= TU 78) but several which match the holotype and the figures very well have been collected at Mint Springs Bayou in Vicksburg, Mississippi (TU 76). It is presumed, therefore, that de Gregorio's locality data was in error and *C. stetopus* actually comes from the middle Oligocene Mint Spring Marl and not from the Eocene formations of Claiborne Bluff.

Because de Gregorio's description is somewhat inconclusive a few additional words of description are in order. On the holotype the early whorls are eroded but other specimens and de Gregorio's illustration of *"Murex migus"* (refigured here pl. 1, fig. 4) show a protoconch consisting of five smooth, conical whorls typical of the early *Phyllonotus* group. The early post-nuclear whorls have three varices with two intervarical nodes between each pair; these two intervarical nodes persist up to the adult stage. The spiral ornamentation is coarse and consists of four strong ribs on the early whorls with smaller secondary riblets intercalated on about the fifth whorl. On the body whorl and pillar there are approximately ten primaries alternating with secondaries. The varices have a slight open flange along the edge and there is a small spine at the shoulder.

C. stetopus occurs with the more common *C. mississippiensis* and is very closely related to it. The two forms differ in *C. stetopus* having coarser ornamentation, a more inflated body whorl and a small spine at the shoulder. It is possible that *C. stetopus* is only an extreme variant of *C. mississippiensis* but the differences appear to be constant.

Type: Holotype 26431 PRI, locality unknown, probably from the Mint Spring Formation at Mint Spring Bayou, Vicksburg, Mississippi (E.H. Vokes).

Occurrence: Red Bluff Formation, USGS localities 5264, 13288, MGS localities 37, 38; Mint Spring Formation, Mint Spring Bayou, Vicksburg, Mississippi.

Chicoreus (Phyllonotus) dormani (E.H. Vokes)
Plate 31, figures 9-11

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 17 (no name). Printed in Dockery, 1982, Appendix II.
1963. *Murex (Phyllonotus) dormani* E.H. Vokes, Tulane Studies Geol., v. 1, No. 4, p. 156, pl. 2, fig. 3a, 3b.
1967. *Chicoreus (Phyllonotus) dormani* (E.H. Vokes). E.H. Vokes, Tulane Studies Geol., v. 5, No. 3, p. 139-140, pl. 1, fig. 8-9.

Original Description: Vokes, 1963.

Shell of moderate size. Nucleus smooth, 3½ whorls ending at a small varix or riblet. Post-nuclear whorls convex, about five in the adult; suture deeply impressed. Axial sculpture consists of three high, rounded varices, which bear a single open spine at the shoulder, commonly lost in the adult. Varices excavated behind, irregularly placed with respect to the corresponding varix on the previous whorl. Between each pair of varices is one strong intervarical node (sometimes two in the younger stages). Spiral ornamentation exceedingly variable, with a tendency toward one primary thread on the shoulder, and three to six secondaries and tertiary threadlets between the suture and this first primary.

Usually two or three secondary threadlets between the first and the second primary thread which is at the periphery; few secondaries and no tertiaries on the remainder of the whorl, in general only primaries, about 15 on the body whorl, becoming obscure on the pillar. Aperture oval, labium smooth, distinct, separate from body wall at anterior end. Outer lip with about eight denticles internally. Anterior canal moderately long, recurved; antecedent canals forming an anterior fasciole.

Discussion: *C.* (*P.*) *dormani* may be distinguished from *C.* (*P.*) *mississippiensis* by its smoother appearance and by having one strong intervarical node rather than two weak ones.

Type: Holotype 644373 USNM from the Byram Formation, Vicksburg, Mississippi.

Occurrence: Byram Formation, TU localities 334, 335, MGS locality 106.

Genus **MUREXIELLA** Clench and Pérez Farfante, 1945

Murexiella Clench and Pérez Farfante, Johnsonia, v. 1, No. 17, p. 49, 1945.

Type (by original designation): *Murex hidalgoi* Crosse. Recent, southeast United States and Caribbean.

Subgenus **MUREXIELLA** Clench and Pérez Farfante, 1945

Murexiella (Murexiella) vaughani MacNeil n. sp.

Plate 5, figure 9

1968. *Murexiella* (*Murexiella*) sp. E.H. Vokes, Tulane Studies Geol., v. 6, No. 3, p. 107, pl. 5, figs. 2a, 2b.

Description: Shell small, spire moderately low; spire whorls made bicarinate by two heavy straight sided spiral ribs, body whorl with four spiral ribs, ribs with a median cleft; varices moderately flaring, back side entire, front side with a bundle of about six frilled growth lamellae, each progressively lower but not noticeably down-curved; shoulder with a moderately strong upward projecting hollow spine; inner lip narrowly attached to parietal wall, detached below; canal set at a moderate angle; no umbilicus but with a weak chink.

The protoconch is not well preserved, but it appears to consist of about two whorls and to form a short, narrow, slightly tilted cone.

Discussion of E.H. Vokes, 1968.

This species is the first to show the median groove on the spiral ribs that is characteristic of most of the later species of *Murexiella* such as *M. macgintyi*, *M. glypta*, and *M. levicula*. This single specimen is the only known Oligocene representative of the *Murexiella* line.

Type: Holotype 498089 USNM from the Red Bluff Formation, USGS locality 5263.

Occurrence: Red Bluff Formation, USGS locality 5263, MGS locality 35b.

Genus **PTERYNOTUS** Swainson, 1833

Pterynotus Swainson, Zoological Illustrations, ser. 2, v. 3, pl. 100, 1833 (no species named).

Type (by subsequent designation, Swainson, 1833, pl. 122): *Murex* (*Pteronotus*) *pinnatus* Swainson. Recent, China seas.

The difference in spelling on Swainson's two plates has been discussed by many authors. Iredale (1915, p. 468) treats *Pterynotus* as a nomen nudum and accepts *Pteronotus*. However, as pointed out by Wrigley (1903, p. 99) *Pteronotus* is preoccupied by Rafinesque 1815, and the only way to save the name is to regard *Pteronotus* Swainson as an error for *Pterynotus*. This is the course followed in this paper.

The most distinctive feature of *Pterynotus* is the structure of its varices. The back side of the varix, the part first formed, is a single thin strongly projecting flare. This is followed by a layer appressed against the lower part of the flare but then curving and bending downwards, the first growth line after the flare being on a downward extending surface. For the remainder of the varix growth lines are successively lower.

Subgenus **PTERYNOTUS** Swainson, 1833

Pterynotus (Pterynotus) burnsii (Aldrich)

Plate 5, figures 1-2

Not 1890. *Murex* (*Chicoreus?*) *burnsii* Whitfield. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 141 (nude name).

1894. *Murex* (*Pteronotus*) *burnsii* Aldrich, Nautilus, v. 7, p. 98, pl. 4, fig. 4, 4a (January).

Not 1894. *Murex shilohensis* var. *burnsi* Whitfield, U.S. Geol. Survey, Mon. 24, pt. 3, p. 98, pl. 17, fig. 2 (= *Murexiella macgintyi faceta* E.H. Vokes) (post-March).

1895. *Murex* (*Pteronotus*) *grandispinosa* Aldrich, Bull. Amer. Paleont., v. 1, No. 2, p. 66. Unnecessary new name for *M. burnsii* Aldrich.

Not 1903. *Murex burnsii* Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 6, p. 1566 (=*Panamurex heilprini*).

Not 1905. *Murex* (*Chicoreus?*) *burnsii* Whitfield [Dall]. Schuchert, *et al.*, U.S. Nat. Museum, Bull. 53, p. 419 (= *Panamurex heilprini* Cossmann).

1905. *Murex* (*Pteronotus*) *burnsii* Aldrich. Schuchert, *et al.*, U.S. Nat. Museum, Bull. 53, p. 419.

Not 1905. *Murex shilohensis burnsi* Whitfield. Schuchert, *et al.*, U.S. Nat. Museum, Bull. 53, p. 420 (= *Murexiella macgintyi faceta*).

Not 1915. *Chicoreus burnsii* (Whitfield). Dall, U.S. Nat. Museum, Bull. 90, p. 75 (= *Panamurex heilprini* and *Murexiella macgintyi faceta*).
Not 1919. *Murex* (*Chicoreus*) aff. *burnsii* Whitfield. Gardner and Aldrich, Acad. Nat. Sci. Philadelphia, v. 71, p. 18 (= *Murexiella macgintyi faceta*).
Not 1942. *Muricidea burnsii* (Whitfield). Richards and Harbison, Acad. Nat. Sci. Philadelphia, v. 94, p. 212, pl. 19, fig. 10 (= *Murexiella macgintyi faceta*).
1963. *Murex* (*Pterynotus*) *burnsii* Aldrich. E.H. Vokes, Tulane Studies Geol., v. 1, No. 3, p. 1, p. 158.
1970. *Pterynotus* (*Pterynotus*) *burnsii* (Aldrich). E.H. Vokes, Tulane Studies Geol. Paleont., v. 8, No. 1, p. 10-11, pl. 2, fig. 1a, 1b.

Original Description: Aldrich, 1894.

Shell large, with three foliated varices, whorls nine. Nucleus pointed, smooth; whorls convex, appresed at suture, whorls following the nucleus have two ribs on centre, each rib bearing a node which is equidistant from apex, which revolve in descending, edges of varices dentate. Body whorl with about thirteen distant spiral raised ribs, the two on the periphery bearing a node each between the foliations. Aperture elongate-oval. Outer lip having internally seven plications, inner lip smooth; canal rather long, almost closed posteriorly, widening anteriorly, and bent upwards. Canal of preceding aperture persistent. Alt. 65 mm.; diam. 33mm.

This elegant Pteronotus is described from the unique example belonging to the National Museum. Named in honor of its discoverer, Mr. F. Burns, of the U.S. National Museum.

Discussion of E.H. Vokes, 1970.

Pterynotus burnsii is a direct descendant of the middle and upper Eocene Tethyan species *P. tripteroides* (Lamarck). This latter species has not been reported from the New World but in the Tulane collections there is a single specimen from the Ocala Limestone (TU 449) that is probably referable to *P. tripteroides*, however it is too poorly preserved for one to be certain. *P. burnsii* differs from *P. tripteroides* in having coarser spiral ornamentation and fewer denticles within the outer lip. The type, and only specimen, of *P. burnsii* is also larger than any specimens seen of *P. tripteroides*, which usually measures a maximum of approximately 55 mm.

P. burnsii is involved in a nomenclatorial tangle due to an overlong delay in publication. In 1889 Whitfield submitted a monograph on the fauna of the Miocene of New Jersey in which he described a species as "*Murex shilohensis* var. *burnsi.*" In 1890, Dall (p. 141) noted that "the truncated specimen upon which Prof. Whitfield has founded his variety *Burnsii*, belongs, in my opinion, to a different species and subgenus [than *Murex shilohensis*]." But he had seen only Whitfield's manuscript, for the work was not finally published until after March, 1894 (*fide* advertisement, p. vi). In the meantime Aldrich had named his *Murex burnsii* after the same man, Frank Burns of the U.S. National Museum, in the January, 1894, issue of "Nautilus." The following year Aldrich (1895, p. 66) noted that Dall had made Whitfield's "variety *burnsi*" into a distinct species and hence he proposed *Murex* (*Pteronotus*) *grandispinosa* as a replacement name for his *Murex burnsii*. Dall's usage of *M. burnsii* Whitfield can only be construed as a nude name and so this change was unnecessary on Aldrich's part.

Type: Holotype 135155 USNM from the Red Bluff Formation, Carson's Creek, 1½ to 2 miles west of Red Bluff, Mississippi (Plate 5, figures 1-2).

Occurrence: Red Bluff Formation, Carson's Creek, MGS locality 37.

Subgenus PTEROCHELUS Jousseaume, 1880

Pterochelus Jousseaume, Le Naturaliste, Année 2, No. 42, p. 335, 1880.

Type (by original designation): *Murex acanthopterus* Lamarck. Recent, western Australia.

Pterynotus (Pterochelus) angelus (Aldrich)
Plate 5, figures 3-5

1886. *Murex* (*Pteronotus*) *angelus* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 145, pl. 2, fig. 2.
1886. *Murex* (*Pteronotus*) *angelus* Aldrich. Aldrich, Alabama Geol. Survey, Bull. 1, pt. 1, p. 18, pl. 2, fig. 2.
1889. *Murex angelus* Aldrich. Von Koenen, Geol. Specialkarte Preuss. Thuring. Staat., Abh., v. 10, No. 1, p. 52.
1890. *Murex* (*Pteronotus*) *angelus* Aldrich, Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 142.
1930. *Murex angelus* Aldrich. Wrigley, Malacological Soc. London, v. 19, pt. 3, p. 98.
1970. *Pterynotus* (*Pterynotus*) *angelus* (Aldrich). Tulane Studies Geol. Paleont., v. 8, No. 1, p. 15, pl. 3, fig. 5a, 5b.

Original Description: Aldrich, 1885.

Shell, oblong, with three spinous varices; whorls convex, seven; spire, elevated; surface, rough, showing three or four revolving lines on the body whorl; spines, channeled to the tips, nearly closed, small sub-spines between the larger ones; aperture, oval; outer lip, ridged; inner lip, reflected; canal, long, longer than the aperture, curving outward. Length, 1 1/10 inches; breadth, 6/10 of an inch.

Locality, Red Bluff, Miss.

This interesting species belongs to the true Murices, modern species of the group only occurring in Africa and East Indies.

Discussion: Both Von Koenen and Wrigley recognized the very close relationship of *M. angelus* to *M. bispinosus* J. de C. Sowerby, a species occurring in the late Eocene of England and the early Oligocene of Germany and Belgium; in fact, both Von Koenen and Wrigley doubtfully placed it in the synonymy of *M. bispinosus*.

None of the specimens at hand have the earliest whorls well preserved, but on the holotype the three rows of varices seem to give way on the first whorls to more numerous thin wavy axial riblets like those of *M. bispinosus* (see Wrigley, 1930, pl. 10, fig. 31).

Nothing has been described from the Eocene of the United States that even remotely resembles this species. Dall (1890, p. 142) suggested that it might be related to *M. matthewsoni* Aldrich (see Harris, 1896, pl. 10, fig. 2) from the Paleocene of Alabama, but, if so, there is no suggestion of the basal truncation of the body whorl in the Paleocene species.

There is no analog of this species in either the Mint Spring Formation or the Byram Formation.

Type: Holotype 644608 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Aldrich) (Plate 5, figure 3).

Occurrence: Red Bluff Formation, USGS localities 309, 2633, MGS locality 35b.

Genus **POIRIERIA** Jousseaume, 1880

Poirieria Jousseaume, Le Naturaliste, Année 2, No. 42, p. 335, 1880.

Type (by original designation): *Murex zelandicus* Quoy and Gaimard. Recent, New Zealand.

Subgenus **PANAMUREX** Woodring, 1959

Panamurex Woodring, U.S. Geol. Survey, Prof. Paper 306-B, p. 217, 1959.

Type (by original designation): *Murex gatunensis* Brown and Pilsbry. Miocene, Panama.

Poirieria (Panamurex) macneili E.H. Vokes, 1970

Plate 31, figures 15-16

1886. *Murex simplex* Aldrich, Alabama Geol. Survey, Bull. 1, pt. 1, p. 19, pl. 5, fig. 8. Non *Murex (Typhis) simplex* Philippi, 1841.
1886. *Murex simplex* Aldrich. Meyer, Alabama Geol. Survey, Bull. 1, pt. 2, p. 74.
1890. [*Ocinebra (Favartia)*] *simplex* (Aldrich). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 150.
1964. [*Poirieria (Panamurex)*] *simplex* (Aldrich). E.H. Vokes, Malacologia, v. 2, No. 1, p. 18.
1970. *Poirieria (Panamurex) macneili* E.H. Vokes, Tulane Studies Geol. Paleont., v. 8, No. 1, p. 30, pl. 6, fig. 1a, 1b, 2a, 2b.

Original Description of *Murex simplex*: Aldrich, 1886.

Shell short, stout; whorls probably five; suture deeply impressed; varices numerous, very large and broadly rounded, terminating above near the suture in sharp points; seven on the body whorl, numerous coarse raised revolving lines cover the whorls; aperture small, elliptical, terminating anteriorly in a nearby closed canal; outer lip thickened and crenate within; three folds appear upon the columella.

Locality, Bryan's Ferry, Miss.; Vicksburg Group.

This type specimen has retained its former apertures, which give to the shell a broad termination and a false umbilicus.

Description: The protoconch of *D. simplex* is not known. The varices are broad, rounded, of moderate height, and arranged in retractive spiral rows. There are six varices per whorl, seven to the same spiral row; five are visible from an angle. The major growth line at each varix (the edge of the lip at each resting stage) is well in advance of the varix. The shoulder spines are narrowly hollow, and their sides, along with the spiral sculptures, bend around them. The spiral sculpture consists of sharp raised spiral lirations (some of them weakly paired), separated by broader round-bottomed interspaces; there are no interstitial threads but the surface may be spirally striate. The inner lip bears three elongate denticles. The umbilicus is narrow but deep. A row of spines spirals the columella.

Discussion of E.H. Vokes, 1970.

The holotype of *P. macneili* is a juvenile specimen but from other larger specimens in the collections of the U.S. National Museum it can be seen that this species is much like the younger *P. heilprini* and *P. fusinoides*. It is the oldest known form referable to *Panamurex* and bears the characteristic denticulations upon the inner lip.

The name *Murex simplex* of Aldrich is preoccupied by that of Philippi, therefore the writer takes pleasure in renaming this species after F.S. MacNeil, a longtime student of the Oligocene faunas.

Type: Holotype 481661 USNM from the Byram Formation, Pearl River at "Byran's Ferry", Byram, Mississippi (Aldrich) (Plate 31, figures 15-16).

Occurrence: Byram Formation, Byram, USGS locality 7895.

Genus **DERMOMUREX** Monterosato, 1890

Poweria Monterosato, Nomen. Conch. Medit., p. 113, 1884 (Non *Poweria* Bonaparte, 1840).

Type (by original designation): *Murex scalarinus* Bivona-Bernardi, 1832 (= *Murex scalaroides* Blainville, 1829).

Dermomurex Monterosato, Natural. Sicil., v. 9, p. 181. New name for *Poweria* Monterosato non *Poweria* Bonaparte.

Type (by original designation): *Murex scalaroides* Blainville, 1829. Recent, Mediterranean.

This name replaces *Poweria* Monterosato 1884 (*non* Bonaparte, 1841). It applies to the same group for which Cossmann (1903, v. 5, p. 47) proposed the name *Hexachorda*, subgenus of *Hadriania*. Glibert (1952, p. 295) referred some French Miocene species of this group to *Aspella* Mörch, but E.H. Vokes (1975) separated the two groups.

Dermomurex has a soft outer shell layer that decorticates readily, a character that is reflected, presumably, in its generic name. The thick soft outer layer has fine spiral threads on its surface but the underlying layer, to which most shells are worn, is smooth; the prominent spiral ribs and varices are developed in the underlying layer. This decortication shell layer has been termed the "intritacalx" by D'Attilio and Radwin (1971). *Dermomurex* has 6 to 7 spiral rows of varices. *Hexachorda* presumably takes its name from six varices; there are six to the same varical spiral, but the sixth varix is the first varix of the next whorl. These two genera are considered as synonyms by E.H. Vokes (1975).

Subgenus TAKIA Kuroda, 1953

Takia Kuroda, Venus, v. 17, No. 4, p. 190, 1953.

Type (by original designation): *Murex inermis* Sowerby, 1841 [non *Murex inermis* Philippi, 1836, non *M. inermis* Dujardin, 1837 (? = Philippi)] = *Dermomurex* (*Takia*) *infrons* Vokes, 1974. Recent, Indo-Pacific.

Dermomurex (Takia) cookei E.H. Vokes, 1975

Plate 4, figures 15, 18-20; Plate 18, figures 8, 14, 20

1975. *Dermomurex* (*Takia*) *cookei* MacNeil MS, E.H. Vokes, Tulane Studies Geol. Paleont., v. 11, No. 3, p. 149-150, pl. 5, fig. 2-4.

Original Description: Vokes, 1975.

Diagnosis: Shell large, with six post-nuclear whorls in adult; protoconch of two large bulbous whorls. Early ornamentation beginning gradually with six small varices that overlap onto the protoconch. Six rib-like varices on each whorl, forming a slightly abaperturally curved spiral line up the spire. Spiral ornamentation minimal, barely perceptible only by fourth or fifth post-nuclear whorl, consisting of faint cords, approximately eight in number on the adult body whorl, but five of these may be stronger. Whorls inflated, suture undulating, varices of each succeeding whorl abutted against the previous one. Aperture rounded; smooth, parietal lip, slightly raised; outer lip with about nine elongate denticles having little correlation with the external ornamentation. Siphonal canal medium in length, open, slightly recurved, becoming more so with increasing size; umbilicus small in juveniles, larger in adult. In life the shell covered by a heavy intritacalx, which seems to have been ornamented by fine spiral grooves, perhaps a dozen or more on the body whorl, but too poorly preserved on type material to be certain.

Discussion: This oldest known *Dermomurex* was described in a manuscript on the fauna of the Vicksburg Group originally prepared by Stearns MacNeil of the U.S. Geological Survey. However, Dr. MacNeil's retirement has forced postponement of publication and so, due to the important position of this species in the history of the *Dermomurex* line in the New World, with Dr. MacNeil's permission it is included here. MacNeil proposed the name *cookei* in honor of C. Wythe Cooke, the noted Tertiary paleontologist, and the writer echoes his sentiment.

This new species from the Oligocene of Mississippi is exceedingly similar to "*Murex*" *cotteavi* Meunier, from the late Oligocene of France. No material is available of "*M.*" *cotteavi* for comparative purposes, but to judge from the original illustration (Meunier, 1880, pl. 14, figs. 29, 30), and subsequent ones in Cossmann and Lambert (1884, pl. 6, fig. 2, as "*Murex* (*Trophon*) *tenellus* Mayer") and Cossmann (1903, pl. 2, fig. 13), the French species is more inflated and also smaller than the American one.

Type: Holotype 647449 USNM from the Red Bluff Formation, USGS locality 15058 (Plate 4, figures 18-19). Paratype A 498087 USNM from the Red Bluff Formation, USGS locality 5263 (Plate 4, figure 20). Paratype B 498209 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 18, figure 20).

Occurrence: Red Bluff Formation, USGS localities 315, 5263, 15058, MGS localities 37, 38; Mint Spring Formation, USGS locality 7671.

Subfamily PURPURINAE Menke, 1828
Genus UROSALPINX Stimpson, 1865

Urosalpinx Stimpson, Amer. Jour. Conchology, v. 1, p. 58, 1865.

Type (by original designation): *Fusus cinereus* Say. Recent, Prince Edward Island to St. Augustine, Florida.

Urosalpinx? aspinosus (Meyer)

Plate 5, figures 6-8

1886. *Murex simplex* Aldrich var. *aspinosus* Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 74, pl. 2, fig. 21.
1890. *Urosalpinx? aspinosus* (Meyer). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 147.

Discussion: Only the last whorl of the protoconch is known; it is smooth, more slender than the equivalent whorl of *C.* (*P.*) *mississippiensis*, and there is no strong terminal varical band. The juvenile sculpture begins with two weak nearly straight axial riblets. The third axial has two angulations which on the following axials become weak spiral threads. On the adult spire whorls there are five moderately sharp spiral lirations separated by round-bottomed interspaces; some interspaces on the body whorl have interstitial threads. There is no distinction between axial ribs and varices, all axial ribs (about five visible from an angle) being alike. The growth lines on the ribs and interspaces alike are raised in tiny frills.

The columellar denticles are irregular in both shape and number (2 to 5). Successive canal teriminations, although distinct, are arranged along the same fasciole. The umbilical chink is moderately strong. The inner lip has the characteristic muricid bend marking the inner end of the canal.

E.H. Vokes (in letter) states that the generic assignment of this species is difficult. Except for the columellar denticles *Urosalpinx* is as likely an assignment as any.

Type: Holotype 644592 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Meyer) (Plate 5, figure 6).

Occurrence: Red Bluff Formation, USGS localities 2633, 5263, MGS locality 40.

Subfamily TYPHINAE

Genus TYPHIS Montfort, 1810

Purpura Bruguière, Encycl. Meth. (Vers), v. 1, p. XV (genus without species) 178a; Bruguière. Jour. Hist. Nat. Paris, v. 1, p. 28, 1792.

Type (by monotypy): *Pupura tubifer* Bruguière, 1792.

Typhis Montfort, Conchyl. Syst., v. 2, p. 614-615, 1810.

Type (by original designation): *Typhis tubifer* (Bruguière). Eocene, France.

Subgenus TYPHINA Jousseaume, 1880

Typhina Jousseaume, Le Naturaliste, Année 2, No. 42, p. 335, 1880.

Type (by original designation): *Typhis belcheri* Broderip, 1833. Recent, West Africa.

Typhis (Typhina) mississippiensis Gertman, 1969

Plate 5, figure 10

1969. *Typhis* (*Typhina*) *mississippiensis* Gertman, Tulane Studies Geol. Paleont., v. 7, No. 149, pl. 1, fig. 2a, b.

Original Description: Gertman, 1969.

Description: Shell moderate in size, stout; protoconch one and one-half whorls, smooth, polished, and rounded; four convex varices per whorl, each crossed by four crenulations, and with a spine at the apical end of the varix; outer lip crossed by four weak spiral ribs not much stronger than the axial growth lines; outer lip narrow and of even width, with a small partition crossing the shoulder; interapertural area of only one part; aperture elongate-ovate, pointed anteriorly, surrounded by a raised rim; tubes midway between varices, pointing abaxially, apically and abaperturally; shoulder slightly depressed and crossed by remnants of former partitions; suture distinct; anterior canal closed, broad, flattened, pointing to the right and abaperturally.

Discussion: T. mississippiensis is recognized by the presence of four crenulations on the varices and four spiral ribs. It is a more inflated shell than the older *T. palmerae* but has a higher spire. It closely resembles *T. patellifer* Martin, 1931, from the upper Eocene of Java, differing principally in that the tubes in *T. mississippiensis* are directed abaperturally but in *T. patellifer* they are directed adaperturally.

This species is known only from the vicinity of the type locality. There are three specimens in the Tulane Collections from the type locality and others in the U.S. National Museum from Red Bluff, which is about two miles north of TU 226.

Type: Holotype 646212 USNM from the Red Bluff Formation, TU locality 226.

Occurrence: Red Bluff Formation, TU locality 226, USGS locality 6456.

Genus SIPHONOCHELUS Jousseaume, 1880

Siphonochelus Jousseaume, Le Naturaliste, Année 2, No. 42, p. 335, 1880.

Type (by original designation): *Typhis avenatus* [sic] Hinds, 1843 (= *T. arcuatus* Hinds). Recent, South Africa.

Subgenus LAEVITYPHIS Cossmann, 1903

Laevityphis Cossmann, Essais Paléoconch. Comp., v. 5, p. 59, 1903.

Type (by original designation): *Typhis coronarius* Deshayes, 1865 (=*Typhis muticus* J. Sowerby, 1834). Eocene, England.

Siphonochelus (Laevityphis) curvirostratus (Conrad)

Plate 18, figure 21; Plate 31, figure 17

1829. *Murex tubifera* (Brugière). Lesueur, Walnut Hills fossil shells, pl. 8, fig. 3. Printed in Dockery, 1982, Appendix II.

1848a. *Typhis curvirostratus* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 285.

1848b. *Typhis curvirostratus* Conrad. Conrad, Acad, Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 16, pl. 11, fig. 29. Plates reprinted in Dockery, 1982, Appendix I.

1890. *Typhis curvirostratus* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 151-152.

1944. *Laevityphis* (*Laevityphis*) *curvirostratus* (Conrad). Keen, Jour. Paleont., v. 18, No. 1, p. 59, 64.

1945. *Typhis curvirostratus* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 189, pl. 14, fig. 1-2.

1969. *Siphonochelus* (*Laevityphis*) *curvirostratus* (Conrad). Gertman, Tulane Studies Geol. Paleont., v. 7, No. 4, p. 172, pl. 6, fig. 3a, b.

Original Description: Conrad, 1848a.

Subfusiform; volutions eight, scalariform, varices or ribs profound; tubes long; that near the margin of aperture thick, elongated; beak elongated, spiniform, much curved. Length 1-10. Not common.

Description of Gertman, 1969.

Description: Shell medium-sized, stout; protoconch smooth, rounded, one and one-half whorls; six post-nuclear whorls; four thickened, convex, smooth varices per whorl; outer lip of constant width, with a short spint at the apical end of the varix; interapertural area of one part; aperture ovate, surrounded by a raised rim; a partition above the aperture connecting the varix to the varix of the preceding whorl; tubes closer to the succeeding than the preceding varices, pointing outward from the shoulder; very weak spiral ribbing on the varices; shoulder slightly depressed, crossed by remnants of former partitions; suture distinct; anterior canal closed, narrow, pointing abaperturally and to the right.

Discussion: S. (*Laevityphis*) *curvirostratus* is similar to, and may be descended from *S. muticus* (Sowerby) from the lower Eocene of England, which species may also be the forerunner of *S. gracilis* (Conrad) and *S. thagus* (Olsson). The latter species, from the upper Eocene of Peru, is more slender and elongate, with smooth convex varices. Of the Miocene forms, *S. curvirostratus* is most like *S. sawkinsi* (Mansfield) of Trinidad, which is more elongate, smaller, and more fragile, but retains the thickened varices, weak ribbing, and general outline of the former.

Type: Lectotype 13484 ANSP (the most complete of four cotypes) and three paratypes 13485 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Mississippi: Red Bluff Formation, MGS localities 35b, 37, 39; Mint Spring Formation, USGS locality 14162; Byram Formation, USGS localities 3722, 13286, MGS localities 93, 106, 109, 112c, 113, 114, 115. Mexico: middle Oligocene sandstone, Nuevo Leon, USGS locality 13539.

Family THAIDIDAE
Subfamily THAIDINAE

Genus **CYMIA** Mörch, 1860

Cymia Mörch, Malakozoologische Blatter, Band 7, p. 97-98, 1860. Substitute name for *Cuma* Swainson, 1840 (non *Cuma* Milne Edward, 1828).

Type (monotype of *Cuma* Swainson): *Cuma sulcata* Swainson (= *Buccinum tectum* Wood). Recent, Panama to Peru.

Subgenus **TRITONOPSIS** Conrad, 1865

Tritonopsis Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 20, 1865.

Type (by monotypy): *Triton subalveatum* Conrad. Oligocene, Mississippi.

Several authors including Dall (1890, p. 154), Wenz (1941, p. 1121), Gardner (1945, p. 186), and Woodring (1959, p. 223) have regarded *Tritonopsis* as either a synonym, subgenus, or section of *Cymia* Mörch.

Gardner placed it in the Family Cymatidae and Woodring placed it in the Family Thaididae, whereas Dall put it in the Family Muricidae, Subfamily Purpurinae, and Wenz in the Family Muricidae, Subfamily Drupinae, in which he also included *Thais* and *Purpura*.

The relationship of *T. subalveata* to *Cymia* seems to have been assumed mainly because of its thin but sharp columellar fold. *Cymia tectum* (Wood) (Recent, western Panama to Peru), the type of *Cymia*, and *Cymia monoplex* (Deshayes) (Rupelian of Europe), both with strong folds, have been mentioned as relatives of *T. subalveata* (see Woodring, 1959, p. 223). Both of these species have a strongly angulate whorl.

Cymia (Tritonopsis) subalveata (Conrad)

Plate 18, figures 9-10, 15-16; Plate 51, figures 8-11

1848b. *Triton subalveatum* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 207.
1850. *Triton subalveatum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 2, p. 41, pl. 1, fig. 2, 8.
1865. *Tritonopsis subalveatum* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 20.
1890. *Cymia subalveata* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 154.
1903. *Tritonopsis subalveata* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 279.
1945. *Cymia* (*Tritonopsis*), type, *Triton subalveatum* Conrad, Gardner, Geol. Soc. America, Mem. 11, p. 186.
1959. *Cymia* (*Tritonopsis*) *subalveata* (Conrad). Woodring, U.S. Geol. Survey, Prof. Paper 306-B, p. 223.

Discussion: The approximate extremes of this species are shown by the two specimens figured on pl. 18. There is some range in the degree of inflation, the length of the columella, the size of the umbilical chink, the strength of the internal lirae and the columellar fold, and in the sharpness and spacing of the spiral ribs. A third specimen has the axial wrinkles more strongly developed, resulting in much stronger beads or granules at their intersection with the spiral ribs on the early whorls. The suture on this specimen is more gaping. A fourth specimen has the two primary spirals below the collar stronger than usual and the remaining ones weaker with a corresponding increase in the strength of the interstitial spirals. This results in two very strong spiral ribs on the spire whorls whereas the lower part of the body whorl has more numerous moderately strong spirals of subequal size. The fourth specimen also has two whorls of its protoconch preserved; it is small, conical, and smooth.

Type: Two syntypes 13470 ANSP (poorly preserved) both from the Mint Spring Formation, judging from their matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Mississippi: Mint Spring Formation, USGS localities 259, 14162; Byram Formation, MGS locality 112c. Louisiana: Vicksburg Group, USGS locality 14852.

Cymia (Tritonopsis) subalveata (Conrad) subsp?

Plate 31, figure 18

Discussion: A single specimen of a *Cymia* (*Tritonopsis*) was discovered in the Casey collection. Its matrix and preservation show without question that it came from the Byram Formation. There is no label or other record of Casey's having recognized this genus after his remark (1903, p. 279), "*Tritonopsis subalveata*, of Conrad, is confined to the Lower Vicksburgian."

The specimen has a perfectly preserved spire, including the protoconch, but most of the body whorl and the end of the columella are missing. It is closest to the unfigured fourth specimen discussed under *C.*

(*T.*) *subalveata,* but the spiral ribs are even stronger. The columella has a narrow but very well defined oblique fold. Whether or not the outer lip had internal ribs is not known.

The protoconch consists of about three smooth inflated whorls. The last whorl does not expand as rapidly as the first two whorls. The entire protoconch, although pointed and subconical, is very slightly tilted. The two prominent spiral ridges of the spire whorls begin abruptly, making the boundary between the protoconch and the juvenile stage sharp.

This specimen may fall well within the varietal limits of *C.* (*T.*) *subalveata,* but it has more extreme ribs than any of the four specimens from the Mint Spring Formation that I have seen. However, until better specimens of it are obtained it would be difficult to determine its status.

Occurrence: Byram Formation, USGS locality 13286.

Superfamily BUCCINACEA
Family BUCCINIDAE

Genus **METULA** H. and A. Adams, 1853

Metula H. and A. Adams, The genera of Recent Mollusca, v. 1, p. 84, 1853.

Type (by tautonymy): *Buccinum metula* Hinds; renamed *M. hindsii* H. and A. Adams. Recent, Pacific coast of Panama.

Apparently H. and A. Adams believed that the adoption of *Metula* as a generic name invalidated it as a specific name, a practice followed by modern botanists. More recently Rehder (1943, p. 199) stated that Woodring, who was the first to interpret *B. metula* as the tautonymic type (1928, p. 286), had concluded that tautonymy could not be strictly maintained, and, accordingly, he accepted Kobelt's (1876, p. 38) designation of *M. clathrata* Adams and Reeve as the type of *Metula.* He proposed *Antemetula* with *B. metula* as its type species.

The oldest known *Metula* in the Gulf Coast Tertiary is *M. sylvaerupis* Harris (1899, p. 56, pl. 7, fig. 7) from the Bashi Marl Member of the Hatchetigbee Formation (late early Eocene) of Alabama. This species has a very high spire for the genus and its sculpture is more subdued than in most later species. According to the description there are 1 or 2 varices on each whorl. *M. brazosensis* Johnson (see Palmer, 1937, pl. 37, fig. 6) from the middle Eocene of Texas has comparable sculpture but much lower spire. Woodring (1928, p. 286) suggested that *M. sylvaerupis* might belong to *Daphnobela* Cossmann.

Two distinct groups are here referred tentatively to *Metula.* One group is certainly congeneric with some middle and late Eocene species referred to the genus; whether it is congeneric with the typical Recent and late Tertiary species is more questionable. The other group is here described as a new subgenus but with no real assurance that it is related. The latter group may belong to a branch that did not survive, and in some respects the known specimens suggest that they are immature individuals of a much larger species. Both the Red Bluff Formation and the Byram Formation have yielded species of both groups.

Subgenus **METULA** H. and A. Adams, 1853

Metula (Metula) fastidiosa Casey
Plate 5, figure 23; Plate 51, figure 12;
Plate 52, figure 2

1903. *Metula fastidiosa* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 280.

Original Description: Casey, 1903.

In the Red Bluff bed there is an apparently undescribed *Metula* greatly resembling *gracilis* Johnson, from the Lower Claiborne of Texas (Proc. Acad. Nat. Sci. Philadelphia, 1899, p. 75, pl. 2, fig. 3). This species, which may be named as above, has a smaller and more rapidly pointed spire than *gracilis,* and has a greater number of varices. The nucleus is simple, smooth, rather higher than wide, ogivally pointed and of about three whorls, the subsequent whorls five in number, broadly, evenly rounded at the sides in profile, each with a feebly elevated flattened varix, relatively rather wide, on which the longitudinal ribbing becomes obsolete and the revolving lyrae also obsolete except on the body whorl, where they continue uninterruptedly over the varix, which here becomes relatively still wider though so slightly elevated as to be scarcely definable. The ribs are small, and, from varix to varix on the spire whorls, about 32 in number; on these whorls the revolving grooves are about 10 in number, and, with the exception of the two posterior and one finer anterior, do not cross the ribs but appear as short excavated lines between them; on the body whorl, however, all the grooves cross the ribs but are reduced in width on their summits; the ribs on the body whorl are also somewhat changed in character, being notably less steep in cross-section on the side lying in the direction of the growth of the shell. The columella is thickened anteriorly below the middle and the aperture and canal together are half as long as the shell. Outer lip with a plicate band parallel with the edge at a short distance therefrom. Length 15.5 mm, width about 6 mm.

Discussion: Some specimens of this species have no varical swellings except at the last apertural position; usually there is one other varix; and no specimens seen have more than two varices. The body whorl has 24-26 spiral threads. In this respect, as well as in the texture of the subsutural spiral threads, this species is more like *M. subgracilis* from the late Eocene than *M. gracilis* from the middle Eocene or any of the other Vicksburg species. Red Bluff specimens range from moderately high, like the figured specimen, to moderately short, the shorter specimens being almost identical with Johnson's (1899, pl. 2, fig. 2) figure of *M. subgracilis.* Possibly the axial riblets in *M. fastidiosa* are slightly more protractive than in any of the Eocene species.

The axial riblets in *M. fastidiosa* are only about half as numerous (40 as compared to 90) as in *M. fragilis*, and the spiral riblets are much stronger; in *M. fragilis* the spirals are nearly obsolete centrally.

Late Tertiary *Metula* from Central and South America and the Dominican Republic (see Olsson, 1922, pl. 10, figs 5, 6, 10, 11, 12; 1942, pl. 9, figs. 8, 9; Pilsbry, 1922, pl. 22, figs. 19, 20) all have shorter spires, broader body whorls, and longer apertures than *M. fastidiosa, M. subgracilis*, and related Eocene species. *M. metula* has a moderately high spire but it is a very slender species (see Keen, 1958, p. 405, fig. 558).

Type: Measured syntype 481658 USNM from the Red Bluff Formation, USGS locality 13288.

Occurrence: Red Bluff Formation, USGS localities 5264, 13288, MGS localities 37, 38, 39, 40; Forest Hill Formation, MGS locality 75a.

Metula (Metula) inflata Dockery n. sp.

Plate 52, figure 3

Description: Protoconch small, conical, with three smooth whorls; teleoconch with six and one half, rather inflated, cancellate whorls with longitudinal ribs nodose at intersection with spiral lirae; nodose sculpture coarsest along first four lirae below suture; weak spiral lirae of early whorls increase in strength until equaling the longitudinal ribs on the fifth whorl; spire with six weak varices; body whorl with two varices, one at the aperture; aperture rather broad with large weak denticles on the outer lip.

Discussion: This species can be easily distinguished from *M. (M.) fastidiosa* and *M. (M.) fragilis* by its greater inflation and coarser cancellate sculpture.

Type: Holotype 376669 USNM from the Red Bluff Formation, MGS locality 39 (Plate 52, figure 3).

Occurrence: Red Bluff Formation, MGS localities 38, 39.

Metula (Metula) fragilis Casey

Plate 32, figures 12-13

1903. *Metula fragilis* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 281, 1903.

Original Description: Casey, 1903.

This is apparently the direct descendant of *fastidiosa* in the Upper Vicksburg Marl and is a much larger species, with more numerous and relatively much finer and more close-set ribs; it is very thin and delicate in substance, very rare and always occurs in a fragmentary condition. From a fragment before me I am able to compute the diameter of the body whorl to be about 10 mm. The longitudinal riblets are at least 90 in number, and the revolving lines on the largest whorl of the spire about 20. No varices can be seen on the fragments before me. The revolving grooves are shallow, those near the base of the whorls broader and more thoroughly obliterating the ribs. The ribs are broadly arcuate longitudinally. The length of the specimen at hand must have been at least 25mm. The shell walls are composed of three layers, of which the inner, very thin, and the outer, thicker, are solid and amorphous in texture, the two separated by a very thin layer of prismatic structure having the fibres perpendicular to the surface.

Discussion: If Casey is correct in assuming this species to have descended from *M. (M.) fastidiosa*, it is unlikely that the stock has any connection with any known American Miocene species. Unfortunately only the central part of the shell is known. Although Casey says there are no varices, the specimen from his collection here figured clearly shows one varical swelling. This specimen also shows the middle shell layer to be crossed-lamellar with strong striations on intersecting crystal faces; not with prisms perpendicular to the surface.

The sculpture of *M. (M.) fragilis* closely resembles that of *Nassarius concinnus* (Powys) (see MacNeil, 1961, pl. 13, fig. 23), an Indo-Pacific species. When this species is better known it may prove to be a nassarid or columbellid. There is no apparent connection with any known European species.

Type: Holotype 479758 USNM from the Byram Formation, USGS locality 13286 (Plate 32, figures 12-13).

Occurrence: Byram Formation, USGS locality 13286.

Subgenus CASEYELLA MacNeil n. subgenus

Type: *Metula (Caseyella) neptuneiformis* MacNeil. Oligocene, Red Bluff Formation, Mississippi.

Shell of medium size, inflated, whorls well rounded, sutures deeply inpressed; protoconch smooth, slender and pointed, about 3 to 4 whorls; adult sculpture consisting of closely set curved axial riblets and raised spiral threads of subequal strength; columella moderately long; aperture moderately wide and extended to form a moderately broad siphonal canal; outer lip thin and with a weak internal thickening on which are numerous short spirally elongate denticles, no external varical swelling, inner lip smooth, both the parietal and columellar wall smooth and weakly recessed, resorbing the axial and spiral sculpture with growth; no umbilical chink.

The protoconch of the type species is so similar to that of *M. fastidiosa* that I am treating this group as a subgenus of *Metula*. Its sculpture is *Metula*-like, but the thin outer lip, constricted body whorl, moderately long columella, and recessed, uncallussed inner lip are unlike typical *Metula*. The subgenus is represented in the late Eocene by *M. johnsoni* (Vaughan), but I can find nothing in the late Tertiary like it; presumably the stock is extinct.

Metula (Caseyella) neptuneiformis
MacNeil n. sp.
Plate 5, figures 24-25

Description: Shell of medium size, spire moderately high and canal moderately long, whorls inflated and strongly rounded with deeply incised sutures; protoconch consisting of nearly four smooth whorls, slender and pointed, and with less deeply incised sutures than the adult whorls, the first whorl minute and subnaticoidal, terminating abruptly at a smooth curved axial riblet; adult sculpture consisting of fine, closely set, curved axial riblets and spiral threads, the axial riblets predominating on the early whorls, but on the body whorl they are subequal, intersecting like a fine woven fabric; axials dying out on the columella, 1 or 2 spiral interspaces on the shoulder may be wider than elsewhere; aperture moderately wide, terminating in a broad siphonal canal; outer lip with a weak narrow internal thickening bearing short spirally elongate denticles; parietal and columellar wall recessed by the partial resorbtion of external sculpture.

Discussion: Aside from the next two species described, the only known relative of this species is *Metula johnsoni* (Vaughan) (see Harris and Palmer, 1947, p. 347, pl. 45, fig. 9) from the Moodys Branch Formation (late Eocene) at Montgomery, Grant Parish, Louisiana.

Type: Holotype 498085 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 5, figure 24).

Occurrence: Red Bluff Formation, USGS localities 5264, 6456, MGS localities 37, 38, 39.

Metula (Caseyella) hiwanneensis Dockery n. sp.
Plate 52, figure 1

Description: Teleoconch with seven inflated, cancellate whorls (apex missing); longitudinal ribs stronger than spiral ribs only on first two whorls, spiral ribs stronger on latter whorls with sixteen occurring between sutures and above aperture; spire with four weak varices, body whorl with one strong varix at aperture; aperture broad with wide anterior canal and thickened inner lip with a longitudinal ridge bearing numerous closely spaced denticles.

Discussion: This species differs from *M.* (*C.*) *neptuneiformis* with which it occurs in having a broader aperture and anterior canal and in having a thickened outer lip. Otherwise it is somewhat similar to it in its sculpture and general form. In this respect, it could be taken as the adult form of the latter, due to the fact that the type (the only known specimen) has a height of 44.7 mm and is considerably larger than the largest known specimen of *M.* (*C.*) *neptuneiformis*, which has a height of 28.0 mm. However, an examination of the spires of these species shows the spire of *M.* (*C.*) *hiwanneensis* to be higher with the whorls more inflated and the suture more inclined and less impressed. The whorls of *M.* (*C.*) *neptuneiformis* are strongly curved at their adapical junction with the suture where they intersect the previous whorl at a right angle. This gives the whorls a truncated appearance below the suture.

Type: Holotype 376668 USNM from the Red Bluff Formation, MGS locality 38 (Plate 52, figure 1).

Occurrence: Red Bluff Formation, MGS locality 38.

Metula (Caseyella) blakneyensis MacNeil n. sp.
Plate 32, figure 16

Description: Shell of medium size, spire of medium height, whorls inflated and moderately rounded, sutures moderately incised; protoconch consisting of three whorls, moderately stout and smooth; adult sculpture consisting of fine curved axial riblets, and alternating finer and coarser spiral threads, the two forming blunt points at their intersection; outer lip and aperture broken on type, a narrow ridge bearing a row of small elongate denticles can be seen inside the shell at a former apertural position, no external varices; parietal wall lightly callussed but there appears to be a resorbtion of sculpture.

Discussion: This species is known from a single incomplete specimen. It has a shorter more inflated protoconch than *M.* (*C.*) *neptuneiformis*, and there is about one less whorl. The sculpture is coarser and the intersections of the axial riblets and spiral threads are more prominent. *M.* (*C.*) *neptuneiformis* has only an occasional spiral finer than the rest, whereas *M.* (*C.*) *blakneyensis* has alternating finer and coarser spirals. The suture of *M.* (*C.*) *blakneyensis* forms more of a collar and the subsutural slope has more crowded spiral threads.

Type: Holotype 376552 USNM from the Byram Formation, USGS locality 14682 (Plate 32, figure 16).

Occurrence: Byram Formation, USGS locality 14682.

Genus **TRITIARIA** Conrad, 1865

Tritiaria Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 21, 1865.

Type (by monotypy): *Buccinum mississippiensis* Conrad. Oligocene, Byram Formation, Mississippi.

The genus *Tritiaria* appears to be indigenous to the Gulf region where it is represented by Eocene, Oligocene, and Miocene species. It is not known in the Eocene or Oligocene of Europe, but it appears to have been present there in the Miocene. Gardner (1945, p.

190) stated that the genus is world-wide in tropical and subtropical seas, but she must have interpreted the genus more broadly than most authors. Woodring (1928, p. 259) did not recognize the typical subgenus outside the Gulf Coastal region, although he thought some Italian Miocene and Pliocene species might be referable to his subgenus *Antillophos*. I (MacNeil, 1961, p. 74, pl. 3, fig. 21) described a late Miocene species from Okinawa as *Phos (Tritiaria) dingsi*. The similarity of an associated species, *Phos (Coraeophos)* aff. *P. reticosus* Hinds (ibid, fig. 20), to the West Indian *Antillophos* suggests that *Tritiaria* and *Antillophos* together may have migrated to the western Pacific by a Tethyan route. No typical members of either group have been described from the West Coast Tertiary, although both names appear in the literature (see Etherington, 1931, p. 100).

Nassa exillis Conrad (see Harris, 1899, p. 57, pl. 7, fig. 9) from the early Eocene of Alabama may be related to *Tritiaria*. *Terebrifusus amoenus* Conrad (ibid, fig. 13) is another possibility. However, neither the middle nor early Eocene progenitors of the genus are obvious at the moment. The oldest species to be described under *Tritiaria* seems to be *T. cerralvensis* Gardner (1945, p. 190, pl. 16, fig. 5) from the lower part of the Paleocene of Nuevo Léon, Mexico. Unfortunately the specimen on which it is based is incomplete and poorly preserved, but it could well be a *Tritiaria*.

Two Peruvian Oligocene species were described by Olsson under *Tritiaria*. One of these, *T. sullana* (Olsson, 1931, p. 100, pl. 21, figs. 8, 15) probably belongs to the genus, but it is difficult to ascertain its relationship to any of the Vicksburg species from the figures. The other species, *T. china* (ibid, fig. 16) has a strong subsutural collar and probably belongs to a different genus. Olsson contrasted the latter with a species from the late Eocene of Peru that he had described earlier as *Alectrion terebratula* (Olsson, 1928, p. 83, pl. 18, figs. 14, 15). *"Alectrion" salina* Olsson (ibid, fig. 13) from the same beds is close to *T. sullana*.

Aside from the possibility, which in itself is by no means certain, that *T. falsus* (Casey) and *T. mississippiensis* (Conrad) fall in the same linear succession, there are no apparent relationships between any of the species here recorded, nor do any of the species occur in more than one formation. Only about 5 or 6 specimens are at hand for the best represented species and most of them are known from only 1 or 2 specimens. Whether more specimens would reveal intergradations not now apparent is problematical, but judging from the differences observed it seems doubtful.

Tritiaria falsus (Casey)

Plate 5, figure 12-14; Plate 52, figures 4-8

1903. *Phos falsus* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 280.

Original Description: Casey, 1903.

I have before me a remarkable Red Bluff *Phos*, which may be named *falsus*. It is very much larger than *macilentus*, though nearly as slender. The nucleus is as in that species and *mississippiensis*, consisting of four whorls, the lowest of which is sculptured with very fine obliquely sigmoid riblets. The body whorls are six in number, with rather widely spaced longitudinal ribs, some eight in number, subequal among themselves on the first four whorls, but then becoming very widely spaced and finally completely disappearing, leaving the surface even; the revolving lines are distinct but not very coarse, and are mutually separated on the larger whorls by two or three fine, closely spaced threads. The type before me has a strong rounded varix on the sixth whorl and another forming the outer lip. Length 19mm, width 6mm.

Discussion: Contrary to Casey's statement, the protoconch of *T. falsus* is not identical with that of either *T. mississippiensis* or *T. macilenta*. The sculpture stage in *T. falsus* begins with fine, curved, moderately protractive axial riblets that gradually thicken and become straighter and more erect over a space of two full turns. In *T. mississippiensis* the sequence is similar, but it is condensed into a single turn. *T. macilenta* has axials on only the last nuclear whorl, but those first appearing are very much more protractive than in the other two species, and they are confined to a lower part of the whorl; the forward part of the arcuate axials is almost tangential to the suture.

Because of the apparent intermediacy of *T. mississippiensis cookei*, typical *T. mississipiensis* and *T. falsus* are contrasted under the discussion of the former.

The most likely ancestor of the *T. falsus-mississippiensis* group appears to be *T. magnocostata* (Johnson, 1899, p. 75, pl. 1, fig. 10; Harris and Palmer, 1947, p. 351, pl. 45, figs. 16, 17) from the Moodys Branch Formation (late Eocene) of Louisiana and Mississippi. Harris and Palmer (1947, p. 350-351) probably are correct in treating *T. magnocostata*, *T. jacksonensis* (Johnson), and *T. hilli* (Harris), all from the Jackson, as distinct species. The first two were described originally as varieties of *T. hilli*.

Type: Holotype 481659 USNM from the Red Bluff Formation, USGS locality 13288 (Plate 5, figure 12).

Occurrence: Red Bluff Formation, USGS localities 5264, 13288, MGS localities 37, 38.

Tritiaria mississippiensis (Conrad)

Plate 32, figures 9-10

1848a. *Buccinum mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. v. 3, p. 285.

1848b. *Buccinum mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser.,

v. 1, pt. 2, p. 16, pl. 11, fig. 28. Plates reprinted in Dockery, 1982, Appendix II.

1865. *Tritiaria mississippiensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 21.

1885. *Buccinum mississippiensis* (Conrad). Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 149.

1903. *Phos mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 279.

1928. *Tritiaria mississippiensis* (Conrad). Woodring, Carnegie Inst. Washington, pub. 385, p. 259.

1945. *Tritiaria mississippiensis* (Conrad). Gardner, Geol. Soc. America, Mem. 11, p. 190.

1947. *Tritiaria mississippiensis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 348, pl. 45, fig. 18.

Original Description: Conrad, 1848b.

Turreted; whorls eight, three from the apex smooth and entire; the others with longitudinal regular distant ribs and intermediate wrinkles; revolving lines raised, alternated in size; labrum with eleven raised lines within, not extending to the margin; columella striated. Length 5-10. Common.

Discussion: The protoconch of this species consists of over four and one-half rapidly expanding whorls. The first whorl is minute, and the first three and one-half whorls are smooth and polished. The last whorl has axial riblets, those first appearing being very faint and more curved. They are moderately protractive but not strongly so. The axial riblets gradually become stronger, less curved and more nearly vertical. The transition to the juvenile sculpture is not sharp; the spiral sculpture that definitely marks the postnuclear stage appears gradually across 3 to 4 axial riblets. A progressive thickening takes place in the same 3 to 4 riblets.

The adult whorls have 7 to 8 axial ribs visible from an angle although the early whorls may show only six. Large individuals usually have one and sometimes two varices behind the final apertural swelling. The axial ribs are relatively stronger on the early whorls.

There is some variation in the strength of the axials where they meet the suture; all axials on some individuals and some axials on other individuals extend to the suture above without diminishing in strength. Other axials may become weaker or die out entirely before reaching the suture.

The spiral lirations are slightly more raised where they cross the axials. On the first two whorls the spirals are separated by smooth interspaces but on the later whorls secondary and usually tertiary riblets are developed.

Casey (1903, p. 279) recognized *T. mississippiensis* in both the Byram Formation and the Mint Spring Formation at Vicksburg. He stated under his description of *"Phos" macilentus* that it was the Red Bluff species commonly confounded with *"P." mississippiensis,* but he did not actually say they formed a linear succession. I regard Casey's other species, *"Phos" falsus,* as a more likely progenitor of *T. mississippiensis*. The adult stage of the possible Mint Spring intermediate (pl. 19, figs. 2,3) is similar to *T. falsus,* but its protoconch is like that of *T. mississippiensis.* I am recognizing the Mint Spring form as a subspecies of *T. mississippiensis*.

The protoconch of *T. falsus* has curved axial riblets on the last two full whorls rather than on the last whorl only.

Type: Lectotype 13478 ANSP (best preserved of six cotypes) and five paratypes 13479 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS locality 3722, MGS localities 93, 106, 109, 112c, 114.

Tritiaria mississippiensis cookei
MacNeil n. subsp.

Plate 19, figures 2, 3, 5?

Discussion: This probably is the form to which Casey (1903, p. 279) alluded in his remark, *"Phos mississippiensis*, of Conrad, occurs in both horizons at Vicksburg, but does not occur at Red Bluff." Its protoconch resembles that of *T. mississippiensis* in that the axial riblets are restricted to the last whorl only; in *T. falsus* the last two whorls of the protoconch have axial riblets. The spire has about the same degree of inflation as that of *T. falsus,* both being considerably more slender than typical *T. mississippiensis.*

T. falsus has weaker axial ribs, particularly on the last whorl, which generally are more widely spaced than in *T. mississippiensis.* More commonly in *T. falsus* there is a shallow subsutural depression that makes the lower wall of the suture stand out as a weak collar; the axial ribs often do not cross the subsutural depression. In typical *T. mississippiensis* there is no subsutural depression, no collar, and the axial ribs usually extend to the suture without diminishing in strength. The spiral lirations are stronger in *T. mississippiensis* than in *T. falsus*, and the finer threads in the interspaces are more clearly divided into secondary and tertiary threads; in *T. falsus* the interspaces may be smooth or they may bear 1 to 3 faint threads of nearly equal size.

T. mississippiensis cookei is much more like *T. falsus* in its adult characters, but the protoconch is like that of *T. mississippiensis.* More coarsely ribbed individuals of *T. falsus* approach the more finely ribbed individuals of *T. mississippiensis* so that the latter probably represents a shift in the mean of variation. The Mint Spring form is more intermediate; I am making it a subspecies of *T. mississippiensis* because of its protoconch.

Type: Holotype 498219 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 19, figure 3).

Occurrence: Mint Spring Formation, USGS 7671, 14071a?.

Tritiaria macilenta (Casey)

Plate 5, figures 11, 17-21; Plate 52, figures 9-10

1903. *Phos macilentus* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 279.

Original Description: Casey, 1903.

Phos mississippiensis, of Conrad, occurs in both horizons at Vicksburg, but does not occur at Red Bluff. The species of the Red Bluff Formation, which has hitherto been confounded with it, may take the name indicated. It is much narrower and more elongate than *mississippiensis.* The ribs are more numerous, finer and not so nodulose at the points where they are crossed by the revolving sculpture. The revolving lines are subequal among themselves, finer than in *mississippiensis* and not so strongly alternating in size. Length of a specimen of six body whorls 14 mm, width 4 mm. *P. mississippiensis* seldom has more than five body whorls, and an average specimen measures 13.5 mm by 5 mm.

Discussion: As already stated, the axial riblets on the protoconch of this species are confined to the last whorl, and the first to appear are more protractive and more nearly tangential to the lower suture.

This species is very variable and undoubtedly Casey's description was based on the most weakly sculptured variant. The more coarsely sculptured variant (pl. 5, figs. 17, 18) is considerably more nodose at the intersection of the axial and spiral lines than is *T. mississippiensis*. Two of the spiral lines at the shoulder tend to be coarser than the others in the strongly sculptured form.

The specimen shown in figures 17 and 18 is one of two that Casey received from Aldrich and which he apparently either recognized as extreme or about whose identity he had doubts. A note in his hand says, "Red Bluff - given by Aldrich as *Phos macilentus* Csy!"

The interstitial thread in this species is very fine and occasionally there are tertiary threads. The opposite extreme has no interstitial threads (pl. 5, fig. 21).

There is a superficial resemblance between *T. macilenta* and *T. refugensis* MacNeil (pl. 19, figs. 6, 7) from the Mint Spring Formation. The early whorls have a very different appearance when examined in detail. In *T. macilenta* the sculpture stands out sharply, whereas in *T. refugensis* the surface is more continuous and glabrous with no sharp demarcation of either the axial or spiral threads. The axial ribs of *T. refugensis* meet the suture more strongly, and the suture rises slightly between the axials of the whorl above. The most conspicuous difference lies in the fact that *T. refugensis* has two sharp denticles on the inner lip, whereas *T. macilenta* has a single weak, more inclined fold.

T. macilenta has an overall resemblance to the stock of *T. hilli* (Harris) and *T. albirupina* (Harris) (see Harris and Palmer, 1947, p. 349-350, pl. 45, figs. 3-6) from the late Eocene of Arkansas and Louisiana. However, the Jackson species have denticles on the inner lip, suggesting they may be more closely related to *T. refugensis.*

There seems to be some confusion over the identity of the specimen figured in Plate 5, figure 11. The manuscript of MacNeil included this figure under the species *T. falsus,* where it seems to belong in comparison to the common, coarsely sculptured variety of *T. macilenta.* However, the specimen which was found to match this figure is in the type collection of the U.S. National Museum and is labeled as the measured syntype of *Phos macilentus* Casey 481660 USNM. MacNeil's manuscript omitted the USNM number and dimensions of the "holotype" of *T. macilentus,* leaving a space for their insertion later. It is probable that MacNeil did not recognize this specimen as the type of *T. macilentus.*

Type: "Syntype" 481660 USNM from the Red Bluff Formation, USGS locality 13288 (Plate 5, figure 11).

Occurrence: Red Bluff Formation, USGS localities 2633, 5264, 13288, MGS localities 37, 38, 39.

Tritiaria refugensis MacNeil n. sp.

Plate 19, figures 6-7

Description: Shell of medium size for the genus, moderately inflated, whorls rounded, sutures moderately indented and wavy on the later whorls; protoconch consisting of four whorls, the first three whorls smooth, the last whorl bearing curved axial riblets that are thinner and more curved when first appearing; axials closely spaced on last part of protoconch; first axial ribs in juvenile stage more widely spaced with spiral sculpture appearing fairly abruptly; sculpture of early whorls consisting of moderately strong axial ribs (about 4 to 5) visible from an angle that extends to the suture, and weak spiral threads that have the appearance of being mainly submerged beneath a glossy surface; later whorls with weak secondary and tertiary interstitial threads; aperture moderately narrow, extended anteriorly in a very weakly constricted canal; outer lip sharp with a weak varical swelling behind the edge, interior with 9 to 10 elongate denticles; inner lip moderately callussed and appressed except near the anterior end where there is a weak umbilical chink, parietal wall with one elongate denticle and columellar wall with two shorter denticles.

Discussion: At first glance this species might be mistaken for *T. macilenta.* It can be identified immediately by its columellar denticles. In addition, the axial ribs of *T. refugensis* are stronger and the suture is wavy. The spiral sculpture on the early whorls of *T. macilenta* stands in much sharper relief.

Two other specimens of supposed *Tritiaria* in the Vicksburg collections have a pair of columellar denticles and a parietal denticle like *T. refugensis*. One from the Mint Spring, here described as *T. menthafons* (pl. 19, fig. 11), is more slender with much weaker but more closely spaced spiral threads and a single interstitial thread. The other from the Byram, here described as *T. vaughani* (pl. 32, fig. 8), has coarser and fewer spiral threads; its axial ribs are more retractive than in either of the Mint Spring species. If the denticles have more than specific importance, the three species having them are not typical *Tritiaria.* The known total of four specimens gives no clue as to possible relationship between these forms. However, I can find no illustration of other species with similar denticles.

Engoniophos vadosus Gardner (1944, p. 464, pl. 50, fig. 18) from the Shoal River Formation (middle Miocene) of Florida has at least three columellar denticles.

Type: Holotype 498221 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 19, figure 6).

Occurrence: Mint Spring Formation, USGS localities 3727, 13287.

Tritiaria menthafons MacNeil n. sp.

Plate 19, figure 11

Description: Shell of medium size for the genus, moderately slender, whorls moderately rounded, sutures moderately indented and wavy on the later whorls; protoconch with four whorls, smooth except for the last half turn which has about five thin curved axial riblets; adult whorls with moderatley strong slightly retractive axial ribs, the first postnuclear whorl with four visible from an angle, the penultimate whorl with six visible; spiral sculpture uniformly fine, restricted to the top of the axial ribs on the early whorls, but extending to the interspaces on the later whorls, irregularly divided into primary and secondary, and in some interspaces tertiary threads; aperture of moderate width, canal not constricted; outer lip broken on type, the interior of a varical swelling bears numerous elongate denticles; inner lip moderately callussed and appressed except anteriorly where it is separated to form a weak chink, parietal wall with a single elongate denticle, columellar wall with two short denticles.

Discussion: This species has an aperture like that of *T. refugensis.* The protoconch has fewer axial riblets. It is more slender than *T. refugensis* and the spiral sculpture is much more subdued. The axial ribs are stronger and slightly more retractive than in *T. refugensis.* It bears no resemblance to any other Vicksburg species.

The species has the weakest spiral sculpture of any Gulf Oligocene photinid.

T. menthafons could possibly be related to *Phos guppyi* Gabb (see Maury, 1917, p. 87, pl. 14, fig. 9), a more inflated but comparably smooth species from the Miocene of the Dominican Republic.

Type: Holotype 498225 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 19, figure 11).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Tritiaria vaughani MacNeil n. sp.

Plate 32, figure 8

Description: Shell of medium size for the genus, medium inflated, whorls moderately rounded, sutures moderately indented and wavy; protoconch consisting of about four whorls, the early whorls smooth, the last three-fourths of a turn with slender axial riblets the first of which are thin and curved, the last nearly straight and vertical; transition to juvenile stage not abrupt; adult sculpture consisting of moderately strong axial ribs (4 to 6 visible from an angle) which are fairly well aligned in retractive axial rows, and moderately coarse rounded spiral threads of which two on the shoulder are stronger than the others, three spirals developed on the middle whorls of the spire, weaker secondary threads developed between some primaries, basal spirals coarser, spiral threads bluntly nodose where they cross the axial ribs; aperture moderately short; siphonal canal short and not constricted; outer lip thin with a varical swelling behind the edge, interior of swelling with short elongate denticles; inner lip weakly callussed and weakly recessed for the greater part of its length, anterior most part weakly detached to form a small chink; parietal wall with a single elongate denticle, columellar wall with two elongate denticles.

Discussion: This species is most closely related to *T. refugensis*. It is distinguished from the latter by having coarser and less numerous spiral threads; its axial ribs are more retractive and more nearly aligned in rows.

Both *T. vaughani* and *T. refugensis* have columellar and parietal denticles like the *T. hilli-T. albirupina* group from the late Eocene (see Harris and Palmer, 1947, p. 349-350, pl. 45, figs. 3-6), and they may be related. However, *T. vaughani* has much coarser spiral sculpture.

Type: Holotype 376549 USNM from the Byram Formation, USGS locality 3722 (Plate 32, figure 8).

Occurrence: Byram Formation, USGS locality 3722.

Tritiaria cf. T. vaughani MacNeil

Plate 19, figure 12

Discussion: A juvenile specimen that may belong to the same species as the preceding was obtained from the Mint Spring Formation at Vicksburg. It has one oblique columellar fold bordering the canal, the higher columellar denticle and the parietal denticle being absent. Otherwise the specimen is much like the holotype of *T. vaughani*.

According to Harris and Palmer (1947, p. 350), the columellar denticles may be absent on some specimens of both *T. hilli* and *T. albirupina*, species which normally have them. If this character is variable, or confined to adult specimens, there would be no way to distinguish this form from the Byram species.

Occurrence: Mint Spring Formation, USGS localities 3727, 14162.

Tritiaria scapulistriata MacNeil n. sp.

Plate 5, figures 15-16

Description: Shell of medium size for the genus, moderately inflated, whorls well rounded, sutures strongly indented; protoconch consisting of about three and one-half whorls, smooth except for the last one-fourth to one-half turn which bears axial riblets, the first riblets weak and curved but becoming stronger and straighter; adults sculptured by moderately strong closely spaced axial ribs (6 to 7 visible on first whorl, 9 to 10 on the penultimate whorl) which meet the suture strongly, and moderately strong closely spaced primary spiral threads which are interspaced with moderately strong interstitial threads; subsutural slope convex and bearing 3 to 4 subequal, moderately strong, sharply raised spiral threads; all spiral threads in somewhat greater relief where they cross the axial ribs; aperture moderately short; outer lip sharp, thickening along a varical swelling within and bearing numerous elongate denticles; inner lip lightly callussed and appressed, smooth except for a thin inclined fold along the edge of the siphonal canal; siphonal fasciole set off on most of the specimens at hand by a thin raised ridge.

Discussion: If enough specimens were known, this form might prove to be an extreme variant of *T. macilenta*. However, the four known specimens are remarkably consistent. Its axial ribs are stronger than those of *T. macilenta*, the spirals are more crowded and more uniform in size and the interstitial thread is stronger. It can be distinguished immediately by the strong, narrow spiral threads on the subsutural slope; corresponding threads in *T. macilenta* are relatively faint.

Type: Holotype 498081 USNM from the Red Bluff Formation, USGS locality 5263.

Occurrence: Red Bluff Formation, USGS localities 2633, 5263.

Tritiaria meyeri MacNeil n. sp.

Plate 19, figure 4

1886. *Nassa mississippiensis* Conrad var. Meyer, Alabama Geol. Survey, Bull. 1, No. 2, p. 73, pl. 2, fig. 11.

Description: Shell moderately large for the genus, moderately inflated, whorls rounded to flattened above the shoulder, suture moderately indented; protoconch with three and one-half whorls, the last half turn bearing axial riblets, the first being thin and curved, the last thicker and straight; transition to juvenile stage rather abrupt because of the much greater thickness of the first postnuclear axials; adult whorls very variable in the width of the axial ribs both between individuals and from whorl to whorl in the same specimen, first whorl with broad ribs (four visible from an angle) and they tend to become thinner and more closely set on the next two whorls, on body whorl ribs tend to become very broad and irregularly spaced; spiral sculpture also irregular, spiral threads sharp and raised, some interspaces with interstitial threads which in less than a full turn become equal to and indistinguishable from the primary threads; aperture moderately short; outer lip with a sharp edge behind which is a varical swelling, numerous elongate denticles along internal swelling; inner lip very lightly callous and resorbing the sculpture as it advances, one weak diagonal fold bordering the siphonal canal.

Discussion: Meyer recognized this form as distinct from *T. mississippiensis*. I can find no record of its occurrence in the Byram as indicated by his remark, "Besides the typical form, there occurs both in the Higher and Lower Vicksburgian, but is rare, a variety with more numerous transverse ribs." The specimen he drew is refigured on plate 19, figure 4. The reverse side of the body whorl has two very wide axial ribs like those on the penultimate whorl of the holotype.

This species can be recognized immediately by the very broad axial ribs on the juvenile whorls. Also, although generalizations are limited to a small number of specimens of all species, it seems to have a much greater tendency to develop very broad axial ribs on the last whorl of full grown specimens.

This species bears some resemblance to both *T. macilenta* and *T. scapulistriata*; it has a tendency for the subsutural slope to be flattened as in the former, and it has moderately sharp spiral threads below the suture as in the latter. However, no specimens I have seen of either *macilenta or scapulistriata* have wide axial ribs on the postnuclear whorls.

Aldrich, who purchased Meyer's collection, noted on the label for Meyer's specimen (pl. 19, fig. 4) "May equal *Phos macilentus* Csy."

Type: Holotype 498220 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 19, figure 4).

Occurrence: Mint Spring Formation, USGS locality 13287.

Tritiaria meyeri MacNeil n. subsp.?
Plate 5, figure 22

Discussion: A single specimen from the Red Bluff is assumed, because of its rather heavy axial ribs on the postnuclear whorls, to be closely related to the Mint Spring species, *T. meyeri.*

It is more slender than either of the known Mint Spring specimens, and its spiral threads are weaker and more widely spaced. Only its terminal axial rib is enlarged, but this corresponds to the approximate position on the larger Mint Spring specimens where the gerontic varices first appear.

Occurrence: Red Bluff Formation, USGS locality 2860.

Genus **PHOS** Montfort, 1810

Phos Montfort, Conchyliologie systematique, v. 2, p. 495, 1810.

Type (by original designation): *Murex senticosus* Linné. Recent, Indo-Pacific.

Typical *Phos* has a much stronger and more curved siphonal fasciole than *Tritiaria.* In all probability *Tritiaria* is the more primitive type.

Woodring (1928, p. 260) made his *Antillophos* a subgenus of *Tritiaria* partly because its fasciole is lower and the canal is less strongly curved than in *Phos.* If the species here referred to *Antillophos* (pl. 19, fig. 13) is properly placed, it certainly indicates a wide range in the prominence and strike of the fasciole in that group. In spite of its *Antillophos*-like sculpture, this species more closely resembles *Strongylocera* in the character of its fasciole.

If *Phos* is derived from *Tritiaria,* it would appear that both *Strongylocera* and *Antillophos* occupy intermediate positions. It may be that the species here referred to *Antillophos* represents an undescribed group.

Subgenus? **ANTILLOPHOS** Woodring, 1928

Tritiaria (Antillophos) Woodring, Carnegie Inst. Washington, pub. 385, p. 259, 1928.

Type (by original designation): *Cancellaria candei* d'Orbigny. Recent, West Indies.

The species here referred to this subgenus has sculpture very much like *T. (A.) moorei* (Guppy) (see Woodring, 1928, p. 261, pl. 15, figs. 10, 11). There is no indication, however, of either a "stromboid notch," or columellar denticles. The siphonal fasciole, and the spiral threads on and beside it, are resorbed as the aperture progresses, and their terminal ends at the line of resorbtion might be described as denticulate.

At any rate, *Antillophos* is the most appropriate name for this species I can find.

The Asiatic Miocene genus, *Coraeophos* Makiyama [type, *Phos (Coraeophos) meisensis* Makiyama, Miocene, Korea] is similar and may be very closely related.

Phos (Antillophos) hopkinsi MacNeil n. sp.
Plate 19, figure 13

Description: Shell small for the genus, moderately slender, whorls rounded, sutures moderately indented, base strongly constricted; protoconch moderately small and slender, slightly over three whorls, the last whorl bearing axial riblets which are very faint and curved over about three-fourths of the whorl but stronger, straight and weakly retractive on the last one-fourth turn, transition to postnuclear stage not abrupt; first juvenile whorl with moderately broad axial ribs (5, barely 6, visible from an angle) and three moderately strong spiral threads which are broken by a narrow crease in each interspace; later whorls with about eight moderately retractive axial ribs; body whorl with seven spiral threads, interspaces evenly rounded with a very fine interstitial thread at the bottom of the concavity, axial ribs and spiral thread forming a very regular grid; aperture moderately narrow; outer lip thin at the edge, thicker within, with about six elongate ridges; inner lip very weakly callussed and recessed, resorbing the exterior sculpture with shell growth, columellar truncation with a moderately strong rounded fold; siphonal fasciole moderately strong and bearing two or three crude spiral threads, the upper marginal thread more sharply raised; umbilical chink weak.

Discussion: Only one specimen of this species is known, and it seems quite unlikely that it is closely related to any other Gulf Oligocene species. Nothing like it has been reported from the Jackson.

It is not obviously related to any described Miocene species, but probably *T.* (*A.*) *dictyola* Gardner (1944, p. 462, pl. 50, fig. 17) from the Chipola Formation (middle Miocene) of Florida and *T.* (*A.*) *moorei* (Guppy) from the Bowden Formation (middle Miocene) of Jamaica come closest. Both of these species have more numerous spiral threads, a less constricted base, and they are larger, more inflated shells.

Actually the strong basal constriction and the siphonal fasciole of this species more closely resemble those of the species of *Strongylocera* next described but the sculpture is more reminiscent of *Antillophos*.

Type: Holotype 376473 USNM from the Mint Spring Formation, USGS locality 7467 (Plate 19, figure 13).

Occurrence: Mint Spring Formation, USGS locality 7467.

Subgenus **STRONGYLOCERA** Mörch, 1852

Strongylocera Mörch, Catalogus conchyliorum Yoldi, p. 80, 1852.

Type (by subsequent designation, Cossmann, 1901): *Buccinum cancellatum* Quoy and Gaimard. Recent, Santa Cruz Islands, South Pacific. (According to Tryon this is a synonym of *B. textum* Gmelin).

Woodring (1928, p. 260, 263) discussed the availability of the name *Strongylocera* for shells related to *Nassa unicincta* Say (included in the original list as *S. textilina* Mörch), and concluded that Cossmann's designation of *B. cancellatum* excluded *N. unicincta* from the group. Judging from the figures of *B. cancellatum* (Quoy and Gaimard, 1833, v. 2, pl. 32, figs. 30, 31), its main distinction lies in its well developed shoulder. Tryon (1881, p. 219) said the shoulder of *Nassa unicincta* varied among individuals. I am inclined to believe that pending much better knowledge of the group, *Strongylocera* is the best available name for such species as *N. unicincta* Say, *P. costatus* Gabb, *P. fasciolatus* Dall, *N. solidulus* Guppy, *P.* (*S.*) *chipolanus* Dall, *B. vicksburgensis* Aldrich, and a new species here described from the Mint Spring Formation. The National Museum collection contains and unidentified specimen from the China Sea that is very close specifically to the new Mint Spring species.

Engoniophos Woodring (type, *Phos erectus* Guppy, from the middle Miocene of Jamaica) was regarded by Woodring (1928, p. 263) as closely related to the group of *Nassa unicincta* Say, which species he did not believe could be included in *Strongylocera*. *E. erectus* has a well developed shoulder, however, and at least in this respect it is more like the type species of *Strongylocera* than it is like *N. unicincta*.

Phos (Strongylocera) vicksburgensis (Aldrich)
Plate 19, figures 8, 10

1885. *Buccinum vicksburgensis* Aldrich, Cincinnati Soc. Nat. Hist. Jour., v. 8, No. 2, p. 149, pl. 2, fig. 9.
1886. *Phos vicksburgensis* (Aldrich). Aldrich, Alabama Geol. Survey, Bull. 1, No. 1, p. 27, pl. 2, fig. 9.
1940. *Tritiaria?* cf. *T. vicksburgensis* (Aldrich). Mansfield, Jour. Paleont., v. 14, No. 3, p. 211.

The only other listing of this name I can find is by Cooke (1923, p. 6), an incorrect reassignment of a form from residual chert blocks along the Flint River, Georgia, that Dall (1916, p. 505, pl. 88, fig. 13) had identified as *Fusinus nexilis* Dall.

Original Description: Aldrich, 1885.

Shell ovate-conic; whorls eight, moderately convex, gradually tapering; surface covered with raised revolving lines sharply defined; strong and fine lines alternating, longitudinally ribbed; ribs numerous, having a number of fine lines between; some specimens showing a regularly cancellated surface, others having nodes at the intersecting points; suture deep, and slightly open; apex slightly mamillated, smooth; spire prominent; body whorl with about ten prominent revolving lines, and an equal number of alternating finer ones; canal short, recurved; aperture one-third the length of the shell; columella striated below; outer lip with 9 to 10 raised lines, stopping short of the edge; margin undulating. Length, nine-tenths of an inch.

Locality: Vicksburg, Mississippi.

Resembles *B. Mississippiensis* Con., but is broader at base, more closely ribbed, and its volutions much less convex.

Discussion: Aside from the fragmental specimens from the Chickasawhay Limestone (late Oligocene) of Mississippi and Alabama that Mansfield compared with this species, nothing like it has been found in the Gulf Oligocene formations outside the Mint Spring Formation.

Undoubtedly the most closely related Miocene species is *Phos* (*Strongylocera*) *chipolanus* Dall (see Gardner, 1944, p. 460, pl. 50, fig. 20) from the Chipola Formation (middle Miocene) of Florida. *P.* (*S.*) *chipolanus* has slightly heavier and more vertical axial ribs, and the base of the whorl is less constricted, but otherwise it is very similar to *P.* (*S.*) *vicksburgensis*. Gardner (1944, p. 461) noted that nothing from younger Miocene formations resembled it.

The specimen shown on plate 19, figure 10, is the only specimen of this species known to me besides the holotype. It is similar except that the axial ribs on the later whorls are weaker and more numerous. These two specimens may not be extreme variants of the species, but even so they show the range to be considerable.

Type: Holotype 644613 USNM from the Mint Spring Formation judging from its color and preservation, Vicksburg, Mississippi (Aldrich) (Plate 19, figure 8).

Occurrence: Mint Spring Formation, Vicksburg, USGS locality 14071a, MGS locality 99.

Phos (Strongylocera) caseyi MacNeil n. sp.
Plate 19, figure 9

Description: Shell large for the genus, inflated, spire moderately low, apical angle wide, whorls very weakly rounded, sutures weakly indented, body whorl strongly rounded centrally; protoconch not completely known but probably similar to that of *P. (S.) vicksburgensis;* adult sculpture consisting of moderately strong rounded, retractive axial ribs (6 to 7 visible from an angle), crossed by moderately strong spiral threads, interspaces more or less rounded, those below the suture more crowded and without interstitial threads, the central interspaces with weak to moderate interstitial threads, and the lower part of the whorl with subequal primary and secondary spiral threads; aperture moderately wide; outer lip thin, thickening rapidly, interior with thin elongate ridges that are thickest on the inner varical swelling; inner lip callussed most heavily high on the parietal wall and on the columella, the central area very thinly callussed, high parietal callus with a weak oblique fold, columellar callus with two continuous nearly horizontal folds and a broken irregular fold between them, edge of columellar callus detached and moderately raised; siphonal canal strongly twisted towards the non apertural side, notch prominent on reverse side; siphonal fasciole strong and bearing about four moderately strong spiral threads; umbilical chink prominent.

Discussion: This species is undoubtedly related to *P. (S.) vicksburgensis,* and it is possible that if large suites were available it would be found to be only a low variant of it.

In general shape *P. (S.) caseyi* is very much like *P. (S.) costatus* Gabb (see Maury, 1917, p. 88, pl. 14, figs. 13, 14) from the Cercado Formation (middle Miocene) of the Dominican Republic. *P. (S.) costatus* has fewer and more widely spaced axial ribs and the basal constriction is deeper.

Type: Holotype 498227 USNM from the Mint Spring Formation, USGS locality 6452 (Plate 19, figure 9).

Occurrence: Mint Spring Formation, USGS locality 6452.

Genus **PSEUDOFULGUR** MacNeil n. gen.

Type: *Pseudofulgur lirata* Dockery. Oligocene, Byram Formation, Mississippi.

MacNeil did not consider *P. lirata* a separate species from *P. vicksburgensis.* His description of the genus is based on the former of these species, which is named in this paper.

Shell of medium size, thin, moderately inflated, subtabulate, sutures moderately indented, aperture moderately elongate, terminating in a moderately broad canal, no callus; protoconch of medium size, high, and sculptured with sharp, raised axial riblets; sculpture consisting of low broad spiral ribs and shallow roundbottomed interspaces.

This genus is known from several Miocene species, both European and American, but from only two Oligocene species. Possibly *"Fusinus" wetherelli* Wrigley (1925, p. 241, figs. 8a-c; 1940, p. 14, fig. 19) from the London Clay (early Eocene) of England is either congeneric or ancestral to it.

Both *Chrysodomus pedemontanus* Bellardi (1872, p. 154, pl. 15, figs. 15a-b) from supposed early Miocene beds of Italy, and *Euthriofusus clandestinus* (Grateloup) (see Cossmann and Peyrot, 1909-1932, p. 266, pl. 9, figs. 40, 41) from the Tortonian of Saint Jean de Marsacq, Aquitaine, are very closely related to *P. vicksburgensis.* Two American species, *Halia americana* Olsson (1922, p. 79, pl. 4, fig. 7) from the Gatun Formation (middle Miocene) of Panama, and *Neptunea? alaquaensis* Mansfield (1935, p. 33, pl. 3, fig. 13) from the *Arca* zone of the Choctawhatchee Formation (middle Miocene) of Florida are likewise close.

Until this paper, no protoconch has been described on this or any related species. The known protoconchs are incomplete, but they seem to be definitely fusinoid and are similar to the protoconch of *Falsifusus? apicalis* (Johnson) (see Grabeau, 1904, pl. 18, fig. 2) from the middle Eocene of Texas.

The systematic position of this genus is still conjectural. Two of its species have been described as neptuniids. Although I have some doubts that the Neptuniidae [placed in the Buccinidae in this paper], as the family is commonly delimited, is monophylitic, there is a distinct possibility that *Pseudofulgur* is ancestral to the late Tertiary to Recent genus *Clinopegma* (type, *Buccinum unicum* Pilsbry, Recent from Japan). This genus includes thin-shelled, tabulate species with moderately strong basal spirals such as *Chrysodomus stantoni* Arnold (1908, p. 386, pl. 37, fig. 4) and *Neptunea (Sulcosipho) eatoni* Grant and Quale (1934, p. 92, text figs. 1, 2). A suite of the latter species collected by J.G. Vedder shows it to be extremely variable in shape, ranging from nearly globular to moderately slender.

Pseudofulgur lirata Dockery n. sp.

Plate 32, figure 4; Plate 52, figures 11-12

Description: Shell of moderate size, thin, fusiform; protoconch with two smooth whorls followed by one and one half elevated whorls with axial ribs, demarcation between protoconch and teleoconch sharp; teleoconch with four and one half lirate whorls with lirae slightly beaded at intersection with growth lines; first one and one half whorls with inclined subsutural ramp with four spiral lirae below; the next one and one half to two and one half whorls with an additional small lira between the upper two; the following whorls with a subsutural collar and seven spiral lirae above the aperture and sixteen below; aperture elongate, canal moderately long and slightly twisted and with a slight columellar fasciole; no parietal or columellar callus; no umbilical chink.

Discussion: This species can be readily distinguished from *P. vicksburgensis* by its less inflated whorls and lirate sculpture.

Type: Holotype 376670 USNM from the Byram Formation, MGS locality 106 (Plate 52, figures 11-12).

Occurrence: Byram Formation, USGS locality 14683, MGS locality 106.

Pseudofulgur vicksburgensis (Conrad)

Plate 32, figures 5, 11; Plate 52, figure 13

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 5 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Fusus vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 286.
1848b. *Fusus vicksburgensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser, v. 1, p. 117, pl. 11, fig. 33. Plates reprinted in Dockery, 1982, Appendix I.

Original Description: Conrad, 1848a.

Fusiform; whorls convex; with revolving raised lines alternated in size, and fine longitudinal wrinkled lines; large whorl ventricose; beak somewhat bent. Length 1 1/4.

Discussion: This species differs from *P. lirata* in that its whorls expand more rapidly with successive volutions and its lirae are more subdued, especially over the shoulder. It has a subsutural ramp but no subsutural collar. The shell is thin, very fragile, and only preserved when the internal matrix is lithified.

Inasmuch as the present treatment is the first to bring together the known species constituting the genus here described, its relatives and their distribution were discussed under the genus.

All of the known undoubted relatives of this species are from Miocene beds. The single European Oligocene species referred to *Neptunea* thus far is *Fusus erraticus* Koninck (see Glibert, 1957, p. 65, pl. 5, fig. 6) from the Argile de Boom (Rupelian). This species is much more slender, its spire higher, the smooth subsutural slope is more sloping and broader, and the spiral ribs are fewer and coarser. Its protoconch is unknown. While there may be a connection between *F. erraticus* and *P. vicksburgensis* through some Eocene species, I am inclined to believe these species represent different lineages, and I hesitate to refer *F. erraticus* to *Pseudofulgur.*

Type: Holotype 13475 ANSP from the Byram Formation judging from its matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 32, figure 11).

Occurrence: Byram Formation, USGS locality 259, MGS localities 109, 115.

Family COLUMBELLIDAE Swainson, 1840

Genus MITRELLA Risso, 1826

Mitrella Risso, Histoire naturelle des principales productions de l'Europe Meridionale, v. 4, p. 247, 1826.

Type (by subsequent designation, Cox, Report on the Paleontology of the Zanzibar Protectorate, Neogene and Quaternary, p. 28, 1927): *Mitrella flaminea* Risso [= *M. scripta* (Linné)]. Recent, Mediterranean.

Woodring (1928, p. 273) designated the same species at nearly the same time. Presumably Woodring's rejection of a designation of *Columbella scripta* (Linné) by Bucquoy, Dautzenberg and Dollfus (1882, p. 73) is based on the fact that *M. flaminea* Risso is not mentioned, and not on the wording, "L'espèce suivante peut être considérée comme type."

The moderate constriction at the base of the whorl in the species here described makes them referable to the subgenus *Columbellopsis.*

Subgenus COLUMBELLOPSIS Bucquoy, Dautzenberg and Dollfus, 1882

Columbellopsis Bucquoy, Dautzenberg and Dollfus, Mollusques marins du Rousillon, v. 1, p. 77, 1882.

Type (by monotypy): *Columbella minor* Scacchi. Recent, Mediterranean.

The exact origin of *Columbellopsis* is not clear, but some of the earliest apparent relatives of it are *Metula*-like, or *Phos*-like. One of the earliest species referred to the subgenus, *Mitrella* (*Columbellopsis*) *mississippiensis meyeri* Palmer (1937, p. 279; Harris, 1899, p. 60, pl. 7, fig. 14), from the Bashi Marl Member of the Hatchetigbee Formation (early Eocene) of Alabama could well be the predecessor of *M.* (*C.*) *mississippiensis* Aldrich and Meyer (see Palmer, 1937, p. 278, pl. 38, figs. 16, 17), a species known from the middle part of the Claiborne Group (middle Eocene) from Louisiana to South Carolina. A still younger Claiborne species, *Mitrella* (*Columbellopsis*) *parva* (H.C. Lea) (see Palmer, 1937, pl. 37, figs. 2,3), from the Gosport Sand (late middle Eocene) of Alabama is a typical *Columbellopsis* in all respects, and it is one of the earliest true representatives of a group that has persisted with little change until Recent time.

Another Wilcox species, *Astyris subfraxa* Harris (1899, p. 58, pl. 7, fig. 11), also from the Bashi Marl member of the Hatchetigbee Formation, is very similar to the type species of the subgenus *Bastropia*, *Mitrella* (*Bastropia*) *bastropensis* (Harris), a species reported from the middle Claiborne from Texas to South Carolina.

Mitrella (Columbellopsis) fuscicava MacNeil n. sp.
Plate 19, figure 1

Description: Shell small, spire moderately high, whorls weakly and evenly convex, sutures weakly indented and appressed, body whorl constricted below to form a moderately slender but short columella, aperture narrow and constricted to form a short canal, outer lip with a moderately sharp edge but thickening to form a varix-like swelling back of the edge, inside of outer lip with a row of small denticles (about 10), inner lip thickened and detached except in the posterior part of the parietal region where it forms a thin flush callus, columellar wall with a narrow sharp row of denticles (about eight) that is separated from the edge of the inner lip by a narrow, moderately deep sulcus; protoconch small, not set off sharply from early whorls but at least the first whorl is slightly bulbous and slightly tilted, the next three whorls have a less incised suture than the succeeding whorls; adult whorls smooth or with an indistinct spiral microsculpture; columella with about eight moderately strong rounded spiral threads; the columella is very weakly twisted to form a weak siphonal fasciole along which the cleft behind inner lip forms a narrow umbilical chink.

Discussion: No species of this genus have been described from the Jackson Group to date.

M. (*C.*) *fuscicava* is slightly more slender than *M.* (*C.*) *parva* from the Gosport Sand and the spiral threads on the columella appear to be finer. However, these species are very closely related.

The Alum Bluff Group (Miocene) of Florida contains many described species of this group (see Gardner, 1947, pl. 52). Whether or not most of them are merely variants of one or two species remains to be seen. Although there are specimens with higher and lower spires, and specimens that are more inflated and less inflated than the holotype of *M.* (*C.*) *fuscicava*, the Alum Bluff specimens seem, at least in the figures in which the feature shows, to have more elongate denticles on the inside of the outer lip.

While there are differences in the height, inflation, prominence of the shoulder, thickness of the parietal callus, shape of the aperture, and shape and number of the apertural denticles in this genus, its species are, nevertheless, remarkably similar, and it seems futile at the present time to draw any stratigraphic conclusions from any of them.

While the persistance of *Columbellopsis* is obvious, the subsequent history of *Bastropia* is not; either it became extinct or it gave rise to a group as yet undetermined.

Type: Holotype 498228 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 19, figure 1).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 7671.

Mitrella (Columbellopsis) cf. M. (C.) fusicava MacNeil
Plate 6, figure 7

Discussion: Three specimens were obtained from the Red Bluff Formation that might not be distinguishable from the Mint Spring species. All of them are younger individuals than the holotype, and they show considerable range in the depth of the basal constriction. The intermediate of the three is figured. One specimen has an even sharper basal angle while the third is more like the holotype. None of the Red Bluff specimens has a thick, detached inner lip like the holotype, but this may be a function of maturity. All other characters seem to be identical.

Occurrence: Red Bluff Formation, USGS locality 5264.

Mitrella (Columbellopsis) aff. M. (C.) oryzoides Gardner
Plate 32, figure 2

Discussion: *M.* (*C.*) *oryzoides* Gardner (1947, p. 504, pl. 52, fig. 19) was described from the Chipola Formation (late early Miocene) of Florida. It is stated to be by far the most abundant of the numerous species of *Mitrella* in the formation.

The Byram specimen is small, moderately inflated, there are only about 5 to 6 spiral threads on the columella, and the posterior denticle on the inner lip is much stronger than the others; *M.* (*C.*) *oryzoides* is similar. The other species described by Gardner have more columellar threads, some as many as 12.

This species has a shorter spire and a shorter columella than *M.* (*C.*) *fuscicava*. The latter has more (eight) spiral threads on the columella, and the posterior denticle is no larger than others. The protoconch and first postnuclear whorls are more rounded on the Byram specimen and the sutures more indented; on *M.* (*C.*) *fuscicava* the early sutures are more flush.

Occurrence: Byram Formation, USGS locality 7376.

Family MELONGENIDAE Gill, 1867
Subfamily MELONGENINAE Gill, 1867

Genus **MELONGENA** Schumacher, 1817

Melongena Schumacher, Essais d'un nouveau systeme des habitations des vers testacés, p. 212, 1817.

Type (by monotypy and tautonymy): *Murex melongena* Linné. Recent, West Indies.

Galeodes Roeding, which both Wenz and Thiele used for this genus, is preoccupied by *Galeodes* Oliver 1791, and arachnid.

Some rather diverse species have been included in *Melongena* and it is by no means certain that even the less contestable ones like *M. corona* (Gmelin), here referred to the subgenus *Myristica*, will always be considered congeneric with the type species. However, Abbott (1954, p. 234-235, fig. 52a-c) ascribes great variability to *M. corona*, and he does not believe, moreover, that any of the numerous subspecific names applied to its Recent variants have any taxonomic significance. One of the extremes figured by Abbott (fig. 52b) is not far removed from *M. crassicornuta* Conrad.

Melongena crassicornuta was one of three species (along with *Murex minax* Solander in Brander, and *Monoceras armigera* Conrad) in the original list of *Cornulina* Conrad. Both Dall (1890, p. 118) and Gardner (1945, p. 202) regarded *M. crassicornuta* as a true *Melongena*. This certainly seems to be a logical conclusion on the basis of its heavy suprafasciolar spines; these are not present in *Cornulina*. However, not all *Melongena* have the basal row of spines (Abbott, 1954, p. 235, fig. 52a). The two rows of spines in both *C. minax* and *C. armigera* (for both see Gardner, 1945, pl. 20, figs. 5, 7, 8) probably are homologous with the peripheral rows only of *M. corona* (see Abbott, 1954, p. 235, fig. 52c).

Most authors seem to regard *Cornulina* as the ancestor of *Melongena*. If the relationship is not successional, probably they had an immediate common ancestor. It certainly seems that *M. crassicornuta* is much more closely related to both *Cornulina minax* and *Melongena corona* that it is to *Melongena melongena*.

Subgenus **MYRISTICA** Swainson, 1840

Myristica Swainson, Treatise on malacology, p. 86, 1840.

Type (by monotypy): *Pyrula myristica* Lamarck (= *Myristica coronata* Swainson = ? *Pyrula galeodes* Lamarck). Recent, Indo-Pacific.

If *P. myristica* should prove not to be related to *M. corona* and *M. crassicornuta*, *Rexmela* Olsson and Harbison, 1953, (type, *Melongena subcoronata* Heilprin, ?Pliocene of Florida) probably is the valid subgeneric name for the group in question.

I am not convinced that *Pugilina* Schumacher, 1817, (type, *Murex morio* Linné, Recent, east and west sides of the South Atlantic) is related subgenerically to *Melongena*, as many authors have thought. It has a moderately slender columella, and there is very little swelling or curving of the siphonal fasciole. *Hemifusus* Swainson, as generally used, is similar.

Melongena (Myristica) crassicornuta Conrad
Plate 32, figures 14-15

1848a. *Melongena crassi-cornuta* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v.3, p. 286.
1848b. *Melongena crassi-cornuta* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 116, pl. 11, fig. 31. Plates reprinted in Dockery, 1982, Appendix I.
1853. *Cornulina crassi-cornuta* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 6, p. 321.
1865. *Cornuliria crassi-cornuta* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 21 (error for *Cornulina*).
1890. *Melongena crassicornuta* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 118.
1945. *Melongena crassicornuta* (Conrad). Gardner, Geol. Soc. America, Mem. 11, p. 202.

Original Description: Conrad, 1848a.

Fusiform; whorls concave above, and having a series of thick prominent nodes on the angle of the whorls; on the body whorl they are large and thick, becoming spines towards the mouth, that nearest the margin a very thick long recurved spine; towards the base is a series of thick short spines; revolving lines coarse, unequal, not very prominent, waved; longitudinal wrinkles coarse and distinct. Length of fragment 3.

Discussion: *Melongena* (*Myristica*) *crassicornuta* is the oldest known species of *Melongena* in the United States. It has been found in beds in Louisiana that are believed to be equivalent to the Mint Spring Formation.

Inasmuch as *Melongena* is an inhabitant of shallow semi-enclosed bays, it is rarely found associated with the more common shallow open-sea faunas.

A Peruvian Eocene species which Olsson described as *Melongena* (*Purgilina*) *aedicnema* (Olsson, 1928, p.

85, pl. 17, fig. 2) may be a precursor of *M.* (*M.*) *crassicornuta*, but if so it either represents an evolutionary stage before the development of the basal spines, or it is a very young shell. The Peruvian species could well be ancestral to both *Melongena* (*Myritrica*) and *Pugilina* (= ?*Hemifusus*), and, if so, would indicate that these two groups diverged at least as far back as late Eocene time.

Mansfield (1940, p. 209, pl. 27, fig. 27) figured a fragment of a *Melongena* from the Chickasawhay Limestone (late Oligocene) of Mississippi that is very closely related to *M.* (*M.*) *crassicornuta.*

The exact relationship of *Melongena* (*Melongena*) to *M.* (*Myristica*) is not clear. Possibly typical *Melongena* is more closely related to *Volema. M.* (*M.*) *melongena* is almost certainly descended from the common Caribbean Miocene species, *M.* (*M.*) *consors* (Sowerby) (see Maury, 1917, p. 85, pl. 14, fig. 5; Olsson, 1922, p. 112, pl. 9, fig. 1). The *M.* (*M.*) *consors* stock seems also to have reached the eastern Pacific where it is represented by *M.*(*M.*) *californica* Anderson and Martin, a species now known from numerous localities of Temblor Age (middle Miocene) of California, and by *M. patula* (Broderip and Sowerby), a Pleistocene to Recent species from the Gulf of California (see Durham, 1950, p. 107, pl. 35, fig. 4; Keen, 1958, p. 407, fig. 567).

In gross aspect *M.* (*M.*) *consors* is intermediate between the two Oligocene species figured here, *Volema hopkinsi* and *M.* (*Myristica*) *crassicornuta*. However, the extreme diversity of these Oligocene forms suggests a much earlier time of divergence. Morphologically *M.* (*Myristica*) is probably more primitive than *M.* (*Melongena*) and *Volema.*

Aside from *Turbinella wilsoni* Conrad, the species of *Melongena* and *Volema* are the largest known gastropods from the Gulf Coast Oligocene. They are also among the rarest. Their rarity may be due to the fact that the intracoastal facies, in which they would normally be found, is not preserved.

Type: Holotype 13496 ANSP from the Byram Formation judging from its preservation, Vicksburg, Mississippi (Conrad) (Plate 32, figures 14-15).

Occurrence: Mississippi: Byram Formation, Vicksburg; ?Chickasawhay Limestone, USGS locality 14288. Louisiana: Mosley Hill Formation, USGS locality 14852.

Genus **VOLEMA** Roeding, 1798

Volema Roeding, Museum Boltenianum, p. 57, 1798.

Type (by subsequent designation, Iredale, 1917): *Volema paradisiaca* Roeding. Recent, Red Sea and west Indian Ocean.

Some authors believe *V. paradisiaca* includes the form for which Lamarck later used the name *Pyrula nodosa* of Chemnitz.

Volema hopkinsi MacNeil n. sp.

Plate 33, figure 1

?1945. *Melongena* sp. Gardner, Geol. Soc. America, Mem. 11, p. 201, pl. 19, fig. 5.

Description: Shell large, subpyriform, spire low, upper part of whorl strongly convex, lower part concave, columella thick, umbilicus closed, siphonal fasciole broad and rounded, no spines; protoconch unknown; early whorls with the shoulder slightly above the suture, and bearing weak broad axial ribs (about nine to the whorl) which are bluntly pointed along the shoulder; shoulder and short subperipheral area bearing moderately sharp raised spiral threads; trace of anal notch forming a moderately deep groove with a sharp raised outer rim, growth lines curving strongly backwards with the apex of curvature in the groove; early whorls with the suture appressed below the shoulder, body whorl with a callus covering the lower half of the subsutural slope and thus making the suture fall halfway up the slope; body whorl sculptured only by crude faint but broad spiral threads and well defined growth lines.

Discussion: Aside from the spire fragment figured by Gardner from "post Vicksburg" beds of Tamaulipas, Mexico, no other occurrence of this species is known. According to Gardner the Mexican fossil is from beds equivalent to the Chickasawhay Limestone, but they could be of Byram Age.

Type: Holotype 376553 USNM from the Byram Formation, Park road leading up hill from Walterville, three miles north of Vicksburg, Mississippi (O.B. Hopkins), USGS locality 7473 (Plate 33, figure 1).

Occurrence: Mississippi: Byram Formation, USGS locality 7473. ?Mexico: late Oligocene sandstone, USGS locality 13581.

Family FASCIOLARIIDAE Gray, 1853

Genus **LATIRUS** Montfort, 1810

Latirus Montfort, Conchyliol. Syst., t. 2, p. 531, 1810.

Type (by original designation): *Latirus aurantiacus* Montfort (= *Fusus filosus* Lamarck, 1822, = *M. gibbulus* Gmelin, 1791). Recent, New Holland.

Latirus mississippiensis (Conrad)

Plate 6, figure 9?; Plate 33, figures 5-6

1929. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 16 (no name). Printed in Dockery, 1982, Appendix II.

1848a. *Fusus Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 286.
1848b. *Fusus mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 117, pl. 11, fig. 34. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Fusus mississippiensis* Conrad. Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 16.
1866. *Fusus mississippiensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, art. 6, p. 30.
1903. *Latirus mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 267.

Original Description: Conrad, 1848a.

Narrow-fusiform; volutions eight or nine, convex, with distant profound, rounded ribs, and fine regular ornamental wrinkles; canal much larger than the aperture; labrum striated within; beak narrow, produced, slightly bent. Length 1 3/4.

Discussion: This species differs from the other species of *Latirus* in the Vicksburg Group in its higher spire, stronger axial ribs, and weaker columellar folds. *L. mississippiensis* has two, weak, closely spaced folds that are situated near the base of the columella. These folds are recessed behind the aperture so that they cannot be viewed on a complete specimen. This is probably the reason that Conrad assigned this species to the genus *Fusus*. On a mature specimen of *L. mississippiensis,* the body whorl and its longitudinal ribs are significantly larger than those of the spire (see Plate 33, figure 6).

Type: Holotype 13465 ANSP from the Byram Formation, Vicksburg, Mississippi (Conrad) (Plate 33, figure 5).

Occurrence: ?Red Bluff Formation, USGS locality 309; Byram Formation, MGS localities 106, 109, 113b, 114.

Latirus protractus (Conrad)

Plate 6, figure 10; Plate 19, figures 18-19; Plate 33, figures 2-4; Plate 53, figure 7

1829. *Turbinella obsoleta* Lesueur, Walnut Hill fossil shells, pl. 6, fig. 18. Printed in Dockery, 1982, Appendix II.
1848a. *Turbinella protracta* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 290.
1848b. *Turbinella protractus* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 120, pl. 12, fig. 7. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Cordieria protracta* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 16.
1866. *Cordieria protracta* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, art. 6, p. 30.
1903. *Latirus protracta* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 267.
1940. *Latirus protractus* (Conrad). Mansfield, Jour. Paleont., v. 14, No. 3, p. 209.
1945. *Latirus protractus* (Conrad). Gardner, Geol. Soc. America, Mem. 11, p. 213.

Original Description: Conrad, 1848a.

Fusiform, with about nine volutions, with thick, prominent, longitudinal ridges, and revolving, thick, prominent lines, with a fine intervening line; longitudinal wrinkles distinct; whorls concave above; spire elevated, acute; columella with four plaits, the lower one dentiform; canal long; labrum striated within. Length 1 5-10.

Discussion: This species attains a rather large size (50 mm in height) and has a thick shell with a moderately high spire, a straight anterior canal, and a modest siphonal fasciole. It can be readily distinguished from other species of *Latirus* in the Vicksburg Group by its coarse spiral sculpture, which consists of a subsutural collar followed by alternating narrow and broad spiral lirae.

Type: Lectotype 13472 ANSP and paratype 13471 ANSP both probably from the Byram Formation, Vicksburg, Mississippi (Conrad).

Occurrence: Red Bluff Formation, USGS locality 5263, MGS locality 38; Mint Spring Formation, MGS localities 75b, 89, 99; Byram Formation, MGS localities 93, 106, 109, 112c, 114, 115.

Latirus aldrichi Dockery n. sp.

Plate 6, figures 3-6; Plate 53, figures 4-6

Description: Shell moderate size for genus; protoconch with two smooth whorls followed by two slightly shouldered whorls with faint, closely set, opisthocline ribs; teleoconch with six and one half whorls; first whorl with three spiral lirae nodose at intersection with longitudinal ribs; second and third whorls with subsutural collar and three primary spiral lirae (the basal one being the largest) and with intervening secondary lirae; fourth whorl with four and fifth whorl with five primary spiral lirae and intervening secondary lirae; body whorl with seven primary spiral lirae and intervening secondary lirae above aperture, and ten primary spiral lirae and intervening secondary lirae below; aperture ovate, anterior canal straight and not constricted by columellar callus or outer lip; inner lip with parietal and columellar callus and two modest columellar folds; outer lip with spiral lirae inside.

Discussion: This species is similar to *L. protracta* in its straight and open anterior canal. It differs in its ribbed protoconch (as opposed to a smooth and glossy protoconch in *L. protracta*) and in its finer spiral sculpture. This species is named in honor of T.H. Aldrich.

Type: Holotype 376671 USNM from the Red Bluff Formation, MGS locality 38 (Plate 53, figure 4).

Occurrence: Red Bluff Formation, MGS localities 38, 39, 40; Mint Spring Formation, MGS localities 75b, 99.

Latirus indistinctus Aldrich, 1884

Plate 6, figures 11-13; Plate 53, figures 1-3

1884. *Latirus indistinctus* Aldrich, Nautilus, v. 7, No. 9, p. 99, pl. 4, fig. 6.

Original Description: Aldrich, 1884.

Shell fusiform, whorls nine, rounded; apical whorl smooth, the remaining ones transversely ribbed, crossed by raised lines that on the body whorl are alternately coarse and fine; suture distinct, whorls appressed to it anteriorly. Canal long, twisted strongly to the right and then to the left. Striations continue to the end of canal. Aperture oblong-oval, toothed posteriorly and shouldered anteriorly. Outer lip striated internally; inner lip covered with a thin callus, definitely delineated and running to end of canal. No teeth on the inner lip, but some of the striations show through the callus. Alt. 42 mm.; diam. 14 mm.

This handsome species is strongly Fusoid in appearance, and does not possess plications on the inner lip like some of the genus, but it evidently belongs there from its other characters.

Type in the National Museum. One example in my collection.

Discussion: This species has a protoconch similar to that of *L. aldrichi* with the last two of four whorls bearing opisthocline ribs. However, these ribs are somewhat finer on the latter species. *L. indistinctus* can be readily distinguished from *L. aldrichi* and *L. protracta* by its twisted anterior canal.

Type: Holotype 135158 USNM from the Red Bluff Formation, USGS locality 309 (Plate 6, figure 12).

Occurrence: Red Bluff Formation, USGS localities 309, 5263, MGS localities 38, 39, 40.

Genus **DOLICHOLATIRUS** Bellardi, 1884

Dolicholatirus Bellardi, Molluschi de terreni terziarii del Piemonte e della Liguria, pt. 4, p. 38, 1884.

Type (by subsequent designation, Cossmann, 1901): *Turbinella Bronni* Michelotti, 1847. Miocene, Italy.

Dolicholatirus perexilis (Conrad)

Plate 19, figures 20-21; Plate 33, figure 7;
Plate 53, figures 11-12

1829. *Turbinella rostrata* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 16. Printed in Dockery, 1982, Appendix II.

1848a. *Turbinella protracta* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 290.

1848b. *Turbinella protracta* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 121, pl. 13, fig. 12. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Cordieria perexilis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 23.

1866. *Cordieria perexilis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, art. 6, p. 30.

1977. *Dolicholatirus perexilis* (Conrad). E.H. Vokes, Tulane Studies Geol. Paleont., v. 13, No. 4, p. 195.

Original Description: Conrad, 1848a.

Narrow-fusiform, with convex volutions, having large, rounded, longitudinal ribs, about six on the large whorl; revolving lines strong, prominent, distant, with a fine intermediate line; longitudinal wrinkles minute and ornamental; aperture narrow; labrum striated within, columella with two large plaits; beak long and narrow. Length 1.

Distinguished from the preceding by its narrower outline, fewer and larger plaits on the pillar, &c. It is probably a much smaller species, but as I have one specimen only, its greatest size cannot be determined.

Discussion: The description of Conrad (1848a) is based on an incomplete specimen, so the following description is given based on the complete specimen figured in Plate 53, figure 11. Protoconch with one and one half smooth whorls having a blunt apex followed by one whorl with closely spaced opisthocline ribs; teleoconch with eleven whorls bearing spiral lirae and longitudinal ribs, growth lines are prominent in interspaces between lirae; first three whorls with slight subsutural collar and four spiral lirae; whorls four through six with collars above and below suture, four, strong, primary, spiral lirae and intervening weak, secondary lirae; the following whorls as before but with stronger secondary lirae and with some tertiary lirae; body whorl with six longitudinal ribs; aperture ovate; inner lip with parietal callus and two strong columellar folds; anterior canal long and straight.

Type: Holotype 13474 ANSP probably from the Byram Formation, Vicksburg, Mississippi (Conrad).

Occurrence: Mint Spring Formation, USGS localities 7671a, 14071a; Byram Formation, USGS locality 3729, MGS locality 106.

Dolicholatirus cervicrassus Dockery n. sp.

Plate 6, figure 8; Plate 53, figure 10

Discussion: The protoconch and spiral sculpture (number of spiral lirae) of this species are like that described earlier for *D. perexilis*. The differences in sculpture between these species are that the longitudinal ribs are more subdued and the spiral lirae are accentuated (being broader and more elevated) in *D. cervicrassus*. This species also differs from *D. perexilis* in the following ways: (1) the suture is recessed behind prominent collars above and below, (2) the aperture has more prominent spiral lirations inside the outer lip, (3) the inner lip and columella have a callus shield with the edge elevated, and (4) the anterior canal (or neck) is much thicker. The name refers to the shell's thick neck: L.*cervix* - neck; *crassus* - thick.

The holotype of *D. cervicrassus* has a height of 74.7 mm and is probably the largest specimen of *Dolicholatirus* reported of Eocene or Oligocene age.

Type: Holotype 498093 USNM from the Red Bluff Formation, USGS locality 309 (Plate 6, figure 8).

Occurrence: Red Bluff Formation, USGS locality 309, MGS locality 38.

Dolicholatirus exilis confertus Dockery n. subsp.

Plate 33, figures 8-9; Plate 53, figures 8-9

Description: Protoconch with two smooth and two axially ribbed whorls; teleoconch with eleven compressed whorls, sculptured with closely spaced longitudinal ribs, a strong subsutural collar, and three elevated spiral lirae with smaller intervening lirae; body whorl with ten longitudinal ribs and two apertural varices; aperture ovate; inner lip with two strong columellar folds and callus shield with upturned edge; outer lip with spiral lirations inside.

Discussion: This subspecies has the same spiral scuplture and general form as that of well preserved specimens of *D. exilis* s. s. from the Chipola Formation, which are illustrated by E.H. Vokes (1977, Tulane Studies Geol. Paleont., v. 13, No. 3, p. 197, text fig. 1). It differs in having more longitudinal ribs per whorl with ten on the body whorl as opposed to five or six as stated by Gabb (1873, Amer. Phil. Soc., Trans., v. 15, p. 217) for *D. exilis* s. s. The name refers to the crowded longitudinal ribs: L. *confertus* - pressed together, crowded.

Type: Holotype 376672 USNM from the Byram Formation, MGS locality 106 (Plate 53, figure 9).

Occurrence: Byram Formation, USGS localities 13286, 14682, MGS localities 93, 106.

Genus **CLAVILITHES** Swainson, 1840

Clavilithes Swainson, Treatise on Malacology, p. 304, 1840.

Type (by subsequent designation, Herrmannsen, 1846): *Fusus noae* (Chemnitz). Eocene, Paris Basin and England.

Clavilithes, a genus that is common in the Eocene of Europe and North America, is well represented in the Vicksburg Group with five species. These species are the latest geologic occurrence recorded for the genus. None of them seem to be closely related with any of the Eocene species of the Gulf Coastal Plain.

Clavilithes vicksburgensis (Conrad)

Plate 6, figures 16-18; Plate 19, figure 23;
Plate 20, figures 1-3; Plate 53, figure 14;
Plate 54, figure 1

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 11-12 (no name). Printed in Dockery, 1982, Appendix II.
1849. *Clavella vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 207; v. 2, pl. 1, fig. 5.
1865. *Clavella Vicksburgensis* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 18.

Discussion: The lectotype and three paratypes of Conrad are all badly worn. The following description is taken from the well preserved specimens figured in plates 6, 19, 20, and 54: Protoconch with about two smooth whorls; teleoconch with nine or more whorls; first five whorls of teleoconch expanding rapidly in successive volutions and with longitudinal ribs, subsutural collar, and a fine reticulate sculpture of spiral lirae and growth lines; latter whorls expanding less rapidly and without longitudinal ribs, with more subdued reticulate sculpture, and with shallow sulcus below subsutural collar; aperture large, ovate; inner lip and columella with callus shield; anterior canal tapering and pointed.

This species occurs frequently in the Red Bluff and Mint Spring formations and attained a large size as is indicated by the partial specimen figured in Plate 20, figure 3.

Type: Lectotype 13477 ANSP and three paratypes 13498 ANSP all are from the Mint Spring Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 53, figure 14 - lectotype).

Occurrence: Red Bluff Formation, USGS localities 309, 5263, 14721, MGS localities 37, 38, 39; Mint Spring Formation, USGS localities 259, 14071a, 14162, 14241, MGS locality 99.

Clavilithes sp. A.

Plate 19, figure 22

Discussion: This species is known only from the figured specimen and may prove to be a subspecies or variation of *C. vicksburgensis.* It differs from other specimens of the latter species in having weak longitudinal ribs on only the first three whorls, in having a strong subsutural collar that envelopes the lower half of the previous whorl, and in having a strong basal angulation on the body whorl. The incomplete specimen at hand consists of seven whorls and shows little evidence of a change in the rapid rate of expansion begun in the juvenile shell. If this expansion rate is not diminished at some stage of growth, the adult of this species will prove to be much wider than that of *C. vicksburgensis.*

Occurrence: Mint Spring Formation, USGS locality 14071a.

Clavilithes longiformis Dockery n. sp.

Plate 6, figures 14-15; Plate 53, figure 13

Description: Shell of moderate size for genus, slender and with a high spire; protoconch smooth, glossy, and with prominent smooth and glossy varix at the terminus (number of whorls not known); teleoconch of eight whorls with longitudinal ribs, ribs strongest on first six or seven whorls; reticulate sculpture of growth lines and stronger spiral lirae prominent only on first six whorls; body whorl rounded and modestly inflated; aperture elongate-ovate; callus shield of inner lip and columella with an outward flexure from the columella at base of aperture; columella with a modest fasciole and with a slight umbilicus between fasciole and columellar shield (the type specimen with a second umbilical opening below flexure of columellar shield).

Discussion: The slender form of *C. longiformis* recalls that of *C. kennedyanus* of the Claiborne Group, but it lacks the prominent subsutural sulcus of that species on the adult whorls and has a much shorter anterior canal. It can easily be distinguished from *C. vicksburgensis* with which it occurs by its more persistent longitudinal ribs and its slender shell. The name refers to the conch's elongate form.

Type: Holotype 376455 USNM from the Red Bluff Formation, USGS locality 309 (Plate 6, figure 15).

Occurrence: Red Bluff Formation, USGS locality 309, MGS localities 34b, 37, 38.

Clavilithes lesueuri Dockery n. sp.

Plate 33, figure 13

1829. *Fusus brogniartii* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 17. Printed in Dockery, 1982, Appendix II.

Description: Shell large; teleoconch with nine whorls (apex missing); first six whorls with longitudinal ribs, a bilirate subsutural collar, and six spiral lirae; latter whorls sulcate below the subsutural collar, without longitudinal ribs, and with more numerous and less prominent spiral lirae; body whorl with sharply rounded shoulder below sulcus; anterior canal of modest length for genus, tapering and with slight fasciole.

Discussion: This species is known only from the holotype and the specimen illustrated by Lesueur (1829) in whose honor it is named. The strong subsutural sulcus of the adult whorls distinguishes it from other species of *Clavilithes* in either the Oligocene or Eocene of North America.

Type: Holotype 376563 USNM from the Byram Formation, USGS locality 3722 (Plate 33, figure 13).

Occurrence: Byram Formation, USGS locality 3722.

Clavilithes sp. B

Plate 33, figure 10

Discussion: This species is known only from the fragment that is figured, which consists of a parietal body whorl and the last whorl of the spire. The suture is channeled, and the whorls have a short, inclined, subsutural ramp. The parietal callus shield is massive and is folded inward around the columella and away from the aperture. As is *C. lesueuri*, this species is distinct from other Eocene or Oligocene *Clavilithes* in North America.

Occurrence: Byram Formation, USGS locality 259.

Genus **LEVIFUSUS** Conrad, 1865

Levifusus Conrad, Amer. Jour. Conch., v. 1, p. 17, 1865.

Type (by subsequent designation, Cossmann, 1901): *Fusus trabeatus* Conrad. Eocene, United States.

The two Vicksburg species included in this genus, *L. spiniger* and *L. nodulatum*, superficially resemble *Busycon*, and were so placed by earlier workers such as Conrad (1865, 1866), Dall (1890, p. 109, *Fulgur* = *Busycon*), and Gardner (1944). They differ from *Busycon* in the important aspect of their nuclear whorls. *Busycon* has a consistent protoconch of two large whorls with the first globose and folded over the second, while the two species assigned to *Levifusus* have a smaller, more conical protoconch typical of that genus (Plate 54, figures 8, 10).

Levifusus spiniger (Conrad)

Plate 6, figures 1-2; Plate 19, figures 16-17;

Plate 32, figures 1, 3, 6-7; Plate 54, figures 5-13.

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 9 (no name). Printed in Dockery, 1982, Appendix II.

1848a. *Fusus spiniger* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 286.

1848b. *Fusus spiniger* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., p. 117, pl. 11, fig. 32. Plates reprinted in Dockery, 1982, Appendix I.

1849. *Fulgur spiniger* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., p. 207.

1865. *Busycon spiniger* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 23.

1866. *Busycon spiniger* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 30.

1867. *Busycon spiniger* (Conrad). Conrad, Amer. Jour. Conchology, v. 3, p. 184.

1890. *Fulgur spiniger* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 109-111.

1903. *Fulgur spiniger* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 281-282.

1909. *Fulgur spiniger* (Conrad). Maury, Amer. Jour. Sci., v. 27, p. 335.
1944. *Busycon spiniger* (Conrad). Gardner, U.S. Geol. Survey, Prof. Paper 142-G, p. 449, 454.

Original Description: Conrad, 1848a.

Fusiform, with revolving lines, and a series of elevated acute spines on the angle of the large whorl; the series continued on the whorls of the spire near the suture; two upper whorls entire; sides above the tubercles flattened, with the revolving lines fine and indistinct; volutions seven; beak produced; labrum striated within. Length 1 3/4. Very rare.

It belongs to the genus *Hemisfusus* of Swainson.

Description: Shell large with angulate shoulder bearing spines; protoconch with two smooth whorls, the first whorl significantly smaller than the second and with a small, rounded apex; teleoconch with six whorls; spire with subsutural ramp and angulate, spinose shoulder and with fine spiral lirae, the lirae below the shoulder being the strongest; body whorl finely lirate with angulate shoulder bearing large spines and with a rounded angulation at base; spiral lirae strongest below shoulder on body whorl but absent over basal angulation; aperture large, tapered at anterior canal; inner lip and columella with modest fasciole.

Discussion: Three stratigraphically restricted varieties are placed within this species. The variety of the type, variety A (Plate 54, figures 7, 8-12), is from the Byram Formation and has an elevated spire, prominent spines on the shoulder, and weak spiral lirae. Variety B (Plate 54, figure 6) occurs in the Mint Spring Formation and differs from variety A in having stronger spiral lirae, a more gently rounded shoulder, and more subdued spines (especially on the spire). Variety C (Plate 54, figure 5) occurs in the Red Bluff Formation. The large shells of this variety have angulate and strongly spinose shoulders with the spines of the body whorl being larger than those of the previous varieties. Also it has a low spire and more rapidly expanding whorls that envelop the previous whorls up to the base of the shoulder spines. This variety is one of the largest gastropods occurring in its horizon. All three varieties have a smooth zone on the basal angulation of the body whorl that is free of spiral lirae.

L. spiniger has also been found to occur in the upper Eocene Yazoo Formation at the Miss Lite clay pit north of Jackson at Cynthia (MGS locality 15). Oddly enough, specimens from this locality belong to variety A (Plate 54, figure 13), which otherwise occurs in the Byram Formation. Variety A, besides having the longest geologic record for the species, is very similar to *L. fulguriparens* Maury from the Moodys Branch Formation. Maury named this latter species for its similarity to *Fulgur* (= *Busycon*). He recognized it as intermediate between *Levifusus* and *Fulgur* and stated that "it might almost be taken as one of the many varietal forms of *Fulgur spiniger.*" The relationship of *Levifusus* and *Fulgur* had been suggested earlier by Dall (1890, p. 109), who recognized several varieties of *"Fulgur" spiniger* in the Miocene of Florida. Gardner (1944) later placed these varieties as separate species of *Busycon.*

Type: Lectotype 13466 ANSP and two paratypes 13467 ANSP all from the Byram Formation judging by the preservation, Vicksburg, Mississippi (Conrad) (Plate 32, figure 7 - lectotype, figure 1 - paratype A, figure 3 - paratype B).

Occurrence: Red Bluff Formation, USGS localities 6456, 13288, MGS localities 38, 39; Mint Spring Formation, USGS localities 13287, 14241, MGS locality 99; Byram Formation, USGS locality 13286, MGS localities 106, 112c, 115.

Levifusus nodulatum (Conrad)

Plate 19, figures 14-15; Plate 55, figures 1-5

1849. *Fulgur nodulatum* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 207; v. 2, p. 41, pl. 1, fig. 6-7.
1854. *Fulgur nodulatum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 6, p. 317.
1865. *Busycon nodulatum* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 23.
1867. *Busycon (Sycopsis) nodulatum* (Conrad). Conrad, Amer. Jour. Conchology, v. 3, p. 184.
1890. *Fulgur nodulatum* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 109-110.
1903. *Fulgur nodulatum* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 281-282.
1944. *Busycon nodulatum* (Conrad). Gardner, U.S. Geol. Survey, Prof. Paper 142-G, p. 454-456.

Discussion: This species differs from *L. spiniger* in having nodes rather than spines on the shoulder. The lectotype (Plate 55, figures 3-5) differs from the paratype (Plate 55, figures 1-2) and all other specimens of this species viewed by the writer. It has a flattened, more nearly horizontal subsutural ramp, a channeled suture, and a more regularly tapered body whorl with only a slight basal angulation, which is not delineated by a zone of smoothness (spiral lirae continue over the basal angulation). The paratype has a low spire with the suture at the shoulder of the previous whorl rather than below it as on the holotype.

Specimens of this species having the form of the paratype are similar to *L. moodianus* Cooke from the Moodys Branch Formation.

Type: Lectotype 13468 ANSP and paratype 13495 ANSP both from the Mint Spring Formation judging from the preservation, Vicksburg, Mississippi. (Plate 55, figure 3-5 - lectotype, figures 1-2 - paratype).

Occurrence: Mint Spring Formation, USGS locality 3140, MGS locality 99.

Superfamily VOLUTACEA Rafinesque, 1815
Family VOLUTIDAE Rafinesque, 1815
Subfamily LYRIINAE Pilsbry and Olsson, 1954

Genus **LYRIA** Gray, 1847

Lyria Gray, Zool. Soc. London, Proc., p. 141, 1847.

Type (by original designation): *Voluta nucleus* Lamarck, 1811. Recent, Indo-Pacific.

Subgenus **LYRIA** Gray, 1847

Lyria (Lyria) nestor Casey
Plate 7, figure 21

1890. *Lyria costata* Sowerby. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 85, pl. 6, fig. 2 (not of Sowerby).
1903. *Lyria mississippiensis nestor* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, pt. 1, p. 282.
1905. *Lyria costata* (Sowerby). Schuchert, et al., U.S. Nat. Museum, Bull. 53, p. 378 ("Red Bluff, Mississippi" - not of Sowerby).
1978. *Lyria* (*Lyria*) *nestor* Casey. Hoerle, Tulane Studies Geol. Paleont., v. 14, No. 3, p. 109, pl. 1, fig. 1.
1980. *Lyria* (*Lyria*) *nestor* Casey. Dockery, Mississippi Bureau Geol., Bull. 122, p. 119-120, pl. 76, fig. 7.

Original Description: Casey, 1903.

The *Lyria mississippiensis*, of Conrad, moderately abundant in the Upper Vicksburg marl, is represented in the Red Bluff bed by this form which must be regarded as at least subspecifically distinct. It is much more elongate in outline than the Vicksburg species, and is more distinctly sculptured. The longitudinal ribbing is more obtusely rounded and less distinct. The length of a moderately large specimen is about 43 mm., with a maximum width of 18 mm. It is accurately figured by Dall (*Trans. Wag. Inst.*, III, Pl. 6) under the name *Lyria costata* Sowerby, and, in his opinion, both this and the Vicksburg form are varieties of that European species. The Vicksburg and Red Bluff forms are, however, distinctly differentiated in facies and each holds to its own type through very extended series, without exhibiting much variability.

Description and discussion of Hoerle, 1978.

Discussion: Lyria nestor was not recognized as a distinct species by Dall (1890, p. 85, pl. 6, fig. 2), who confused it with *L. mississippiensis* and *L. costata* (Solander *in* Brander, 1776) of the Barton beds, upper Eocene of southern England. Although the latter bears a superficial resemblance to *L. nestor*, the two species can be readily separated by the higher, more rounded whorls, narrower, less oblique aperture, and less constricted outer lip of the British species. *Lyria mississippiensis* has a proportionately shorter spire, more numerous and sharply-rounded axial costae, and a different arrangement of the plications and lirations on the columella area, thus differentiating the species from *L. nestor*.

The species of *Lyria* that occurs in the Oligocene of Germany, *L. decora* Beyrich, 1853, bears a marked resemblance to *L. nestor;* however, the illustrations given by von Koenen (1890, pl. 37, figs. 9, 10) indicate that the adult shell is more elongate.

Under ultraviolet light *L. nestor* shows the basic spiral lines of color that are typical of the genus *Lyria*.

Type: Lectotype 480042 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Casey) (Plate 7, figure 21).

Occurrence: Red Bluff Formation, MGS localities 37, 38, 39, 40.

Lyria (Lyria) mississippiensis (Conrad)
Plate 21, figures 4, 7;
Plate 34, figures 9-11, 14-15

1829. *Voluta harpoides* Lesueur, Walnut Hills fossil shells, pl. 8, fig. 13. Printed in Dockery, 1982, Appendix II.
1848a. *Fulgoraria mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 288.
1848b. *Fulgoraria mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 119, pl. 13, fig. 1. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Otocheilus mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, p. 24.
1903. *Lyria mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, pt. 1, p. 282.
1937. *Lyria mississippiensis* (Conrad)? Mansfield, Florida Geol. Survey, Bull. 15, p. 108, pl. 3, fig. 3.
1940. *Lyria* sp. cf. *L. mississippiensis* (Conrad). Mansfield, Jour. Paleont., v. 14, No. 3, p. 208, pl. 27, fig. 41.
1978. *Lyria* (*Lyria*) *mississippiensis* (Conrad). Hoerle, Tulane Studies Geol. Paleont., v. 14, No. 3, p. 109-110, pl. 1, fig. 2.

Original Description: Conrad, 1848a.

Elliptical, volutions nine, fluted, the ridges distant, acute, and generally one or two of them large, thick and very remote from each other, on the body whorl; spire conical, acute; aperture auriform; columella with nearly equal plaits, not oblique; labrum thick, with a sharp margin.

Description and discussion of Hoerle, 1978.

Shell fusiform; spire about one-third total height; axially costate throughout. Adult specimens consisting of six teleoconch whorls plus a small smooth nucleus of three and one-half whorls. Suture impressed but not channeled, undulated by the axial ribs. Fourteen to seventeen sinuous, sharply-rounded axial costae, separated by slightly wider interspaces on final whorl. Aperture lenticular; outer lip thickened by terminal varix, smooth within, margin sharp and reflected; parietal wall heavily callused and lirate, anteriorly three strong plications, abapical two oblique, third a little weaker and horizontal, seven to nine horizontal lirations on remainder of columella. Weakly developed siphonal fasciole; shallow, broad siphonal notch. Close-set, fine, wavy, spiral threads throughout the extent of the shell, becoming wider-spaced and coarser anteriorly.

Discussion: As discussed above, *L. mississippiensis* was thought by Dall (1890, p. 85) to be synonymous with *L. costata* (Solander *in* Brander). *Lyria mississippiensis* is distinct, but there was no justification for Conrad (1865) to erect a new genus, *Otocheilus,* to accommodate this species. Conrad listed two species, *O. nereidis* and *O. mississippiensis,* but did not designate which of the two was the genotype. Since the first listed, *O. nereidis,* is "an unfigured and unidentifiable" specimen (Dall, 1890, p. 85) it is assumed he had *L. mississippiensis* in mind. The new genus is unnecessary for, if *L. mississippiensis* is considered the genotype, that species, without question, is a *Lyria.* The slender, smooth nucleus, axially ribbed early whorls, plicated and lirated columella, weakly developed siphonal fasciole, and broad siphonal notch are all features indicative of the genus.

Apparently conditions of preservation were not conducive to retaining any trace of a color pattern: none could be brought out under ultraviolet light.

Type: Lectotype 13453 ANSP and paratypes 13454 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 34, figure 15 - lectotype, figure 11 - paratype).

Occurrence: Mississippi: Mint Spring Formation, USGS locality 14849, MGS locality 99; Byram Formation, USGS localities 3140, 13286, MGS localities 93, 106, 112c, 115. Alabama: Chickasawhay Limestone, stream one quarter mile north of Perdue Hill, Monroe County. Florida: Suwannee Limestone, Suwannee County.

Subgenus ENAETA H. and A. Adams

Enaeta H. and A. Adams, The genera of Recent Mollusca, v. 1, p. 167.

Type (by subsequent designation, Cossmann, 1899): *Voluta harpa* Barnes, 1824 [non Mawe, 1823 = *Voluta barnesii* Gray, 1825 (as *barnsii*)]. Recent, eastern Pacific.

Lyria (Enaeta) isabellae modesta
Dockery n. subsp.
Plate 55, figures 6-10

Description: Protoconch with three smooth whorls, teleoconch with five or six whorls having irregular axial ribs and a shallow subsutural sulcus above a broadly rounded shoulder; axial ribs within sulcus overlain by spiral lirae; body whorl modestly inflated with longitudinal ribs terminating at siphonal fasciole; aperture elongate and only moderately constricted at the reflected anterior canal; inner lip with slight callus shield and four columellar folds, outer lip thickened by a varix and with a blunt tooth about one third down from top of aperture.

Discussion: This subspecies differs from *L.* (*E.*) *isabellae* (Maury, 1910, Bull. Amer. Paleont., v. 4, No. 21, p. 17, pl. 4, fig. 7) s. s. in its less inflated body whorl and in having strong axial ribs on the adult whorls. A variation of this subspecies (Plate 55, figures 9-10), and the only specimen found outside of the Forest Hill Formation, has finer and more closely spaced axial ribs. One specimen of this variety was found in the Byram Formation at MGS locality 106. All other specimens of this subspecies were found in sand lenses of the upper Forest Hill Formation at MGS locality 75a. Unfortunately, the specimens from this locality tend to be worn and fragile. *L.* (*E.*) *isabellae modesta* is the earliest record of the subgenus *Enaeta.* The name modesta refers to the modestly inflated shell.

Type: Holotype 376673 USNM from the Forest Hill Formation, MGS locality 75a (Plate 55, figures 6-7).

Occurrence: Forest Hill Formation, MGS locality 75a; Byram Formation, MGS locality 106.

Subfamily SCAPHELLINAE
H. and A. Adams, 1858

Genus CARICELLA Conrad, 1835

Caricella Conrad, Fossil shells Tertiary formations North America, p. 44, 1835.

Type (by subsequent designation, Cossmann 1899): *Turbinella piruloides* (sic) Conrad (=T. *Pyruloides* Conrad). Eocene, Claiborne Group, Alabama.

Dall (1890, p. 63-64, 78) regarded *Caricella* to be a subgenus of *Scaphella* and stated that it was "the direct ancestral line of *Scaphella* proper as typified by *S. junonia.*" He also recognized the similarity of the coloration of *Caricella* when sometimes preserved to that of the Recent species *Scaphella junonia* (Lamarck, 1804) and described this coloration as "dark (red?), squarish spots in spiral series on a lighter ground." The Vicksburg species of *Caricella* have this same color pattern. Dockery (1977, p. 82, pl. 12, fig. 2-3, 5-6, 9) described and illustrated this coloration for the Eocene species *Caricella subangulata* Conrad and *Caricella polita* Conrad. It seems that a color pattern of squarish spots in spiral series is a conservative feature for the *Caricella* - *Scaphella* line of volutes.

Subgenus ATRAKTUS Gardner, 1937

Atraktus Gardner, U.S. Geol. Survey, Prof. Paper 142-F, p. 405, 1937.

Type (by original designation): *Cariella leana* Dall. Paleocene, Midway Group, Alabama.

Reticulacella Dockery, Mississippi Bureau Geol., Bull. 120, p. 84, 1977.

Type (by original designation): *Caricella* (*Reticulacella*) *fenestra* Dockery, 1977.

Gardner (1937) erected this subgenus for those

Caricella with small, slender, fusiform shells having a finely cancellate sculpture; she included within it the Vicksburg species *C. demissa* Conrad and *C. reticulata* Aldrich.

Caricella (Atraktus) demissa Conrad

Plate 34, figures 19-21; Plate 55, figures 11-12

1829. *Turbinella eburnea* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 15. Printed in Dockery, 1982, Appendix II.
1848a. *Caricella demissa* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 8, p. 289.
1848b. *Caricella demissa* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 120, pl. 12, fig. 5. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Caricella demissa* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 24.
1866. *Caricella demissa* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 30.
1885. *Caricella demissa* Conrad. Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 154.
1890. *Caricella demissa* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 64, 70, 79, 86.
Not 1892. *Caricella demissa* Conrad. Harris *in* Lerch, A preliminary report upon the hills of Louisiana, p. 29 [= *Caricella demisa texana* (Gabb, 1860) from the Cook Mountain Formation in Texas and Louisiana.].
?1899. *Caricella demissa* Conrad "var." Harris, Bull. Amer. Paleont., v. 3, No. 11, pl. 4, fig. 6 (occurs in the Greggs Landing Member, Tuscahoma Formation).
1937. *Caricella (At~aktus) demissa* Conrad. Gardner, U.S. Geol. Survey, Prof. Paper 142-F, p. 405.
1937. *Caricella demissa* Conrad. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 395-396.
1980. *Caricella demissa* Conrad. Dockery, Mississippi Bureau Geol., Bull. 122, p. 118.

Original Description: Conrad, 1848a.

Subfusiform; whorls six, convex, one or two whorls near the apex distinctly striated longitudinally, and with minute revolving lines; upper part of the whorls slightly concave; apex papillated, first and second volutions smooth, entire; beak striated; aperture about two-thirds the length of the shell; columella 4-plaited. Length 1 2/3.

Description: Shell of moderate size for genus and with elevated spire; protoconch of about one whorl without sutures and forming a large, bluntly pointed, swirled, dome-shaped apex; teleoconch with four whorls; the first whorl largely enveloped by the second; the first two whorls moderately to slightly cancellate with strong axial ribs and small spiral lirae, the spiral lirae prominent only in the interspaces between axial ribs; the third whorl nearly smooth or with faint cancellate sculpture; body whorl moderately inflated with slight sulcus below suture and with spiral lirae on anterior canal; aperture elongate and narrow for genus; inner lip with four strong, oblique columellar folds; anterior canal slightly reflected.

Discussion: This species shows considerable variation in its cancellate sculpture and moderate variation in the elevation of its spire. The description given above is of the weakly cancellate form that includes the lectotype. A strongly cancellate form is designated variety A. Shells of variety A with the strongest cancellate sculpture appear to be of a different species from the lectotype of *C. (A.) demissa* (compare figures 16 and 19 of Plate 34). However, there is a continuum in the degree of cancellation between these forms as is shown by numerous intermediate specimens from several localities in the Byram Formation. A variety in the Mint Spring Formation designated variety B is nearly devoid of cancellate sculpture and has fine spiral lirae. The subspecies *C. (A.) demissa texana* (Gabb, 1860) from the Cook Mountain Formation in Texas and Louisiana and the variety recognized by Harris (1899) from the Greggs Landing Member of the Tuscahoma Formation in Alabama have slightly cancellate early whorls and more closely fit the form of *C. (A.) demissa* s.s. rather than that of variety A or B.

Type: Lectotype 13455 ANSP and paratype 13456 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 34, figure 19 - lectotype).

Occurrence: Byram Formation, USGS localities 3722, 13286, MGS localities 106, 115.

Caricella (Atraktus) demissa Conrad var. A

Plate 34, figures 16-17; Plate 56, figures 1-6

Discussion: This variety is coarsely cancellate in the early whorls with the axial ribs nodose at intersections with spiral lirae. The cancellate sculpture often continues onto the body whorl.

Occurrence: Byram Formation, USGS localities 5615, 6455, MGS localities 93, 106, 109.

Caricella (Atraktus) demissa Conrad var. B.

Plate 20, figures 13, 16, 24; Plate 21, figure 3

Discussion: This variety has a moderately to highly elevated spire and has a sculpture of fine spiral lirae rather than being cancellate.

Occurrence: Mint Spring Formation, USGS localities 6452, 14071a.

Caricella (Atraktus) reticulata (Aldrich)

Plate 7, figures 22-25; Plate 20, figures 17, 22-23

1885. *Turbinella (Caricella) reticulata* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 147, pl. 2, fig. 4a, 4b, 4c.
1890. *Caricella reticulata* Aldrich. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 70, 79.
1937. *Caricella (Atraktus) reticulata* Aldrich. Gardner, U.S. Geol. Survey, Prof. Paper 142-F, p. 405.
1937. *Caricella reticulata* Aldrich. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 393-394, 397, pl. 65, fig. 12-13.
1980. *Caricella (Atraktus) reticulata* Aldrich. Dockery, Mississippi Bureau Geol., Bull. 122, p. 118-119, pl. 77, fig. 3.

Original Description: Aldrich, 1885.

Shell, pyriform, variable, moderately thin, with revolving raised lines covering the whole surface, crossed longitudinally by finely raised lines of growth; lines alternately fine and coarse: suture, impressed; spire, cancellated; apex, decorticated in all the specimens.

Whorls varying from roundly globose (Fig. 4 a.) through the form (4 b.) to a constricted form (Fig. 4 c.), the upper part concave, making the body whorl obtusely angular; base, prolonged, strongly twisted; aperture, oblong; labium, curved, with four equidistant plaits about the center; outer lip, sharp, smooth within. Length, 1 4/10 inches; breadth, variable.

Locality, Red Bluff and Shubuta, Miss.

Discussion: This species is characterized by its weakly cancellate sculpture with prominent spiral lirae and fine growth lines. It has a thinner shell than does *C. (A.) demissa* and shows a considerable variation in spire height and in the inflation of the last whorl (compare figures 22-25 of Plate 7). Those slender forms with modestly inflated body whorl and elevated spire generally have a prominent subsutural sulcus (Plate 7, figure 25).

Type: Three figured syntypes 645083- 645085 USNM all from the Red Bluff Formation, Red Bluff and Shubuta, Mississippi (Aldrich).

Occurrence: Red Bluff Formation, USGS localities 2632, 2633, 5264, MGS localities 37, 38, 39, 40, 46; Mint Spring Formation, USGS localities 6647, 14203, MGS locality 89.

Caricella (Atraktus) sp.

Plate 21, figures 1-2

Discussion: This species has the form of the elongate variety of *C. (A.) reticulata* with an elevated spire, slender body whorl, subsutural sulcus, and prominent spiral lirae but differs in having prominent axial ribs. It is known only from the figured specimen.

Occurrence: Mint Spring Formation, USGS locality 14203.

Subfamily VOLUTOMITRINAE Gray, 1854

Genus CONOMITRA Conrad, 1865

Conomitra, Amer. Jour. Conchology, v. 1, p. 25, 1865.

Type (by subsequent designation, Dall, 1899): *Mitra fusoides* Lea. Claiborne Group (Eocene), United States.

Species of *Conomitra* in the Vicksburg Group have similar fusiform shells and sculpture to those of the genus *Vexillum* in the family Mitridae. *Conomitra* can be distinguished from *Vexillum* in that it has columellar folds of similar strength while the upper fold (posterior fold) is strongest in *Vexillum.*

Conomitra staminea (Conrad)

Plate 34, figures 6-7

1848a. *Mitra staminea* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.
1848b. *Mitra staminea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 120, pl. 12, fig. 4. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Conomitra staminea* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 25.
1866. *Fusimitra staminea* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 30.
Not 1890. *Conomitra staminea* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 94-95, pl. 4, fig. 2 (= *Conomitra apalachee* Gardner, 1937).
1903. *Conomitra staminea* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, pt. 1, p. 282-283.
1937. *Conomitra staminea* (Conrad). Gardner, U.S. Geol. Survey, Prof. Paper 142-F, p. 420.
1970. *Conomitra staminea* (Conrad). Cernohorsky, Auckland Inst. and Museum, Bull. 8, p. 112.

Original Description: Conrad, 1848a.

Elliptical, whorls eight, slightly turreted, longitudinally ribbed; ribs small, numerous; whorls with distinct impressed revolving lines; body whorl ventricose; aperture about half the length of the shell; pillar 4-plaited, the three upper ones nearly equal. Length 4-10.

Discussion: *C. staminea* differs from *C. vicksburgensis* in having spiral lirations.

Type: Holotype 13457 ANSP from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 34, figure 7). All that remains of the type is a small portion of the apex. A note with the specimen dated 5/13/58 indicates that it was broken before that time.

Occurrence: Byram Formation, Vicksburg, USGS locality 6455.

Conomitra vicksburgensis (Conrad)

Plate 34, figures 5, 13

1848a. *Mitra Vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.

1848b. *Mitra vicksburgensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 120.

1865. *Conomitra Vicksburgensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 25.

1866. *Conomitra vicksburgensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 30.

Not 1890. *Conomitra staminea* (Conrad). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 94.

1903. *Mitra vicksburgensis* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, pt. 1, p. 283.

Not 1970. *Conomitra staminea* (Conrad). Cernohorsky, Auckland Inst. and Museum, Bull. 8, p. 112.

Original Description: Conrad, 1848a.

Elliptical, small; whorls slightly convex, with fine longitudinal ribs, obsolete towards the suture inferiorly and wanting on the lower half of the body; suture profound; aperture more than half the length of the shell; pillar 4-plaited, the three upper ones nearly or quite equal in size.

Distinguished from the preceding by wanting the revolving lines, and in being wider in proportion to its length. 3-10.

Description: Shell of moderate size for genus; protoconch large with one and one half, conical, smooth and glossy whorls with blunt apex; terminus of protoconch not clearly delineated; teleoconch with five or six rather inflated, axially ribbed whorls; aperture elongate; inner lip with four columellar folds decreasing in strength toward the anterior.

Discussion: Cernohorsky (1970) followed Dall (1890) in placing *C. vicksburgensis* in synonymy under *C. staminea*. The two species are readily distinguished by the absence of spiral lirations on the former and their presence on the latter.

Type: Lectotype 13458 ANSP and paratype 13459 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 34, figure 5 - lectotype).

Occurrence: Byram Formation, Vicksburg, USGS locality 13286, MGS locality 106.

Conomitra vicksburgensis laevigata

Dockery, n. subsp.

Plate 7, figure 14; Plate 20, figure 12;

Plate 56, figures 9-11

Description: Shell of moderate size for genus; protoconch with two smooth, conical whorls; terminus of protoconch not strongly delineated; teleoconch with five moderately inflated whorls and with smooth sculpture except for faint axial ribs below suture, axial ribs most evident on early whorls; aperture elongate; inner lip with four columellar folds, the posterior two being the strongest.

Discussion: This subspecies has the same protoconch and the same degree of inflation to the whorls as does *C. vicksburgensis* s.s. It differs in the smooth sculpture of the shell as is suggested by the name *laevigata:* L. *laevigatus* - smooth. A variation of this subspecies from the Forest Hill Formation has a slender form and elevated spire (Plate 56, figures 9-11).

Type: Holotype 498194 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 20, figure 12).

Occurrence: Red Bluff Formation, USGS locality 2860, MGS locality 39; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 13287, MGS locality 90.

Conomitra crenulata Dockery n. sp.

Plate 7, figures 6-7

Description: Shell of moderate size for genus; protoconch mammillate with two smooth and glossy whorls, the first whorl moderately inflated and elevated with rounded apex; protoconch sharply delineated from teleoconch; teleoconch with six and one half whorls; spire elevated and with coarse axial ribs; first three whorls with subsutural collar, axial ribs continue onto collar; body whorl moderately inflated, lacking axial ribs, and smooth except for growth lines; aperture elongate; inner lip with five columellar folds, the posterior two being strongest and the anterior one being small.

Discussion: This species differs from *C. vicksburgensis* s.s. and *C. vicksburgensis laevigata* in that its protoconch has an inflated and elevated first whorl rather than being conical, it generally has a less inflated body whorl, and it has a subsutural collar on the early whorls. The name *crenulata* refers to the crenulate appearance of the subsutural collar.

Type: Holotype 498057 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 7, figure 7).

Occurrence: Red Bluff Formation, USGS localities 2860, 5264, MGS locality 38.

Conomitra crenulata modesta

Dockery n. subsp.

Plate 20, figure 9; Plate 56, figures 7-8

Description: Shell small; protoconch large and bluntly mammillate with two smooth whorls, the first whorl sculptured with axial ribs and subsutural collar, axial ribs continue onto collar; body whorl with shallow sulcus below subsutural collar and sculptured with axial ribs on the upper half and spiral lirae on the anterior canal; aperture elongate; inner lip with four folds decreasing in strength toward the anterior.

Discussion: This subspecies differs from *C. crenulata* s.s. in that it is smaller in size, its axial ribs and subsutural collar continue to the body whorl, it has a larger protoconch, it has fairly prominent spiral lirations on the anterior canal, and it has four rather than five columellar folds. The name *modesta* refers to the subspecies' small size.

Type: Holotype 498195 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 20, figure 9).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 7671, MGS locality 90.

Family HARPIDAE Troschel, 1848

The species of this family occurring in the Eocene of Mississippi (Moodys Branch Formation) belongs to the genus *Eocithara* - *E. jacksonensis* (Harris, 1896). *Eocithara* according to Rehder (1973, p. 223) is recognized by the following characteristics: (1) a bluntly mammillate to broadly conical protoconch with impressed sutures and no peripheral keel, (2) spire with whorls lacking a callus band formed by the fusing of successive apertural varices, and (3) a distinctly marginate parietal callus. All but one aspect of these characteristics are true for *E. jacksonensis;* the protoconch is broadly conical but has a peripheral keel just above the suture. The mature whorls of *E. jacksonensis* have a narrow band above the suture that is formed by the imbrication of successive apertural varices. However, this band differs from that of *Harpa* in that the varices are not fused to form a callus glaze and the band remains narrow on the penultimate whorl. The first postnuclear whorl of *E. jacksonensis* differs from that of the *Harpa* species of the Vicksburg Group in being much larger than the protoconch and in being sculptured with spiral lirae only and lacking axial ribs.

Rehder (1973, p. 237) attributes the following distinguishing characters to the genus *Harpa:* (1) a large body whorl, (2) a rather extensive parietal and columellar callus that is not sharply marginated abaperturally, (3) a partial covering of the latter whorls of the spire with a glaze formed by the fusion of expanded axial ribs (varices), and (4) an elevated - conic protoconch with a distinct keel at the periphery, just visible above the suture. *H. vicksburgiana* fits all of these criteria.

Genus **HARPA** Roeding, 1798

Harpa Roeding, Museum Boltenianum, p. 149, 1798.

Type (by tautonymy): *Harpa harpa* Linné. Recent, East Africa to Tonga.

Harpa vicksburgiana Dockery n. sp.

Plate 56, figure 12; Plate 67, figure 8

Description: Shell of moderate size for the genus; protoconch large, conical with two smooth whorls having a faint peripheral keel just above suture and a sharply delineated juncture with teleoconch; teleoconch with four and one half rapidly expanding, axially ribbed whorls; first two whorls with strong varical ribs and cancellate interspaces with fine axial ribs and stronger spiral lirae; latter whorls as before but with the axial ribs in the interspaces increasing in strength over the spiral lirae and with a callus glaze above suture formed by fusion of varical ribs; callus glaze of spire increasing in strength toward the aperture and covering lower half of penultimate whorl; aperture large and posteriorly expanded; inner lip with broad parietal callus shield extending for two varices past aperture but not sharply marginated abaperturally; anterior canal dorsally reflected.

Discussion: The relationship of *H. vicksburgiana* to other species of *Harpa* is not apparent at present. It represents the earliest geologic record for the genus and in some aspects of its exterior sculpture is similar to *E. jacksonensis.* However, these two species differ in other important morphologic characteristics, some of which are used as a basis for distinguishing between their genera, and are probably not related.

Type: Holotype 376675 USNM from the Byram Formation, MGS locality 93 (Plate 56, figure 12; Plate 67, figure 8).

Occurrence: Byram Formation, MGS localities 93, 106.

Family TURBINELLIDAE Swainson, 1840

Genus **TURBINELLA** Lamarck, 1799

Xancus Roeding, Museum Boltenianum, p. 134, 1798 (placed on Official Index of Rejected and Invalid Generic Names, ICZN Opinion 489, 1957).

Type (by subsequent designation, Dall, 1906): *Voluta pyrum* Linné.

Turbinella Lamarck, Mem. Soc. Hist. Nat. Paris, v. 1, p. 73, 1799.

Type (by monotypy): *Voluta pyrum* Linné. Recent, India and Ceylon.

Turbinella wilsoni Conrad

Plate 34, figures 18, 22

1829. *Turbinella cliffordia* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 14. Printed in Dockery, 1982, Appendix II.
1848a. *Turbinella wilsoni* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 290.
1848b. *Turbinella wilsoni* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 120, pl. 12, fig. 12. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Mazza wilsoni* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 23.
1890. *Turbinella wilsoni* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 96.
1902. *Xancus wilsoni* (Conrad). Maury, Bull. Amer. Paleont., v. 3, No. 15, p. 73.
1917. *Xancus wilsoni* (Conrad). Maury, Bull. Amer. Paleont., v. 5, No. 29, p. 83.
1925. *Xancus wilsoni* (Conrad). Maury, Serv. Geol. Min. Brasil, Mon. 4, p. 154-155.
Not 1916. *Xancus wilsoni* (Conrad). Dall, U.S. Nat. Museum. Proc., v. 51, p. 505 (= *T. polygonata* Heilprin).
1917. *Xancus wilsoni* (Conrad). Pilsbry and Johnson, Acad. Nat. Sci. Philadelphia, Proc., v. 69, p. 167.
1921. *Xancus wilsoni* (Conrad). Hubbard, N.Y. Acad. Sci., Sci. Survey Porto Rico and Virgin Islands, v. 3, pt. 2, p. 155.
1922. *Xancus wilsoni* (Conrad). Cooke, U.S. Geol. Survey, Prof. Paper 129-E, p. 83.
1923. *Turbinella wilsoni* Conrad. Vredenburg, Geol. Survey India, Records, v. 55, pt. 2, p. 126.
1928. *Xancus wilsoni* (Conrad). Woodring, Carnegie Inst. Washington, Pub. 385, p. 252.
1928. *Xancus wilsoni* (Conrad). Olsson, Bull. Amer. Paleont., v. 14, No. 52, p. 89.
1930. *Xancus wilsoni* (Conrad). Olsson, Bull. Amer. Paleont., v. 17, No. 62, p. 47.
Not 1933. *Xancus wilsoni* (Conrad). Tucker and Wilson, Bull. Amer. Paleont., v. 18, No. 66, p. 10, pl. 1, fig. 10 (= *T. regina* Heilprin).
1937. *Xancus wilsoni* (Conrad). Mansfield, Florida Geol. Survey, Bull. 15, p. 112.
1944. *Turbinella wilsoni* Conrad. Gardner, U.S. Geol. Survey, Prof. Paper 142-G, p. 440.
1964. *Turbinella wilsoni* Conrad. E.H. Vokes, Tulane Studies Geol., v. 2, No. 2, p. 44-46, pl. 1, fig. 1a, 1b.

Original Description: Conrad, 1848a.

Fusiform; spire elevated, acute, volutions ten, angular, nodose, the larger volutions somewhat concave above; the upper volutions with revolving lines, obsolete or wanting on the lower ones; beak with coarse, slightly raised revolving lines; aperture narrow; columella with three rather distant compressed plaits, the middle one largest; canal long. Length 5 inches.

The young of this species has distinct lines on every part of the shell, except on the large portion of the body whorl, where they are indistinct and remote. This species is named to commemorate the scientific zeal of Dr. Thomas B. Wilson. It is rare, and generally very imperfect.

Discussion of E.H. Vokes, 1964.

This species from the Vicksburg beds differs from its southern ancestor, *T. peruviana*, in the greater elongation of the shell, and in having a more sloping shoulder. Although it has been reported from post-Vicksburg localities, these reports seem all to be misidentifications and it apparently is confined to the middle Oligocene.

T. wilsoni is the oldest species of which the nature of the nuclear whorls is known. It is assumed that the older form was comparable. The nucleus of *T. wilsoni* is much smaller than either the slender *"laevigata"* type or the larger *"angulata"* type. The smooth nucleus consists of only one and one-half turns followed by several small ornamented post-nuclear whorls, about eight in 20 mm of length. The total number of post-nuclear whorls in an adult shell is about 12. Because of the extreme difference in the early development these older species are not included in either the *"laevigata"* or *"angulata"* lineage but are placed in an "ancestral" position. Presumably the slender *"laevigata"* line is more nearly a direct descendant of the ancestral type than the *"angulata"* line which would seem to be a distinct side development.

Type: Lectotype 13476 ANSP and paratype 13497 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 7941, 13286, MGS localities 106, 109, 112c, 115.

Family OLIVIDAE Swainson, 1840

Subfamily OLIVINAE Swainson, 1840

Genus **OLIVA** Bruguière, 1789

Oliva Bruguière, Encycl. Meth. (vers), v. 1, p. 15 (genus without named species).

Type (by tautonymy and monotypy): *Voluta oliva* Linné (= *O. ispidula* of authors, not of Linné). Recent, Indo-Pacific.

Subgenus **STREPHONELLA** Dall, 1909

Strephonella Dall, U.S. Geol. Survey, Prof. Paper 59, p. 32.

Type (by original designation): *S. undatella* Lamarck, 1810. Recent, Gulf of California.

This subgenus is characterized by low-spired shell with an incised line around the middle of the body whorl, which delineates a band between it and the fasciole that differs in coloration and texture (Keen, 1971, p. 625). Drez (1981, p. 106) states that *Oliva mississippiensis* Conrad is the earliest known species of *Strephonella*.

Oliva (Strephonella) mississippiensis Conrad

Plate 33, figures 17-18; Plate 56, figures 13-14; Plate 57, figures 1-2

1848a. *Oliva Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.
1848b. *Oliva mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 119, pl. 13, fig. 6, 38. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Lamprodoma Mississippiensis* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 22.
1866. *Lamprodoma mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 30.
1903. *Olivella mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 281.
1922. *Olivella mississippiensis* (Conrad). Cooke, U.S. Geol. Survey, Prof. Paper 129-E, p. 83.
1937. *Oliva mississippiensis* Conrad (= *Agaronia*). Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 432-434.
1945. *Oliva mississippiensis* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 216-217.
Not 1947. cf. *Agaronia mississippiensis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 408-410. [= *Oliva (Strephonella) affluens* (Casey)].
Not 1966. *Agaronia mississippiensis* (Conrad). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 487 [= *Oliva (Strephonella) affluens* (Casey)].
Not 1977. *Agaronia mississippiensis* (Conrad). Dockery, Mississippi Geol. Survey, Bull. 120, p. 79-80, pl. 11, fig. 3A, 3B [= *Oliva (Strephonella) affluens* (Casey)].
1981. *Strephonella mississippiensis* (Conrad). Drez, Tulane Studies Geol. Paleont., v. 16, No. 3, p. 106.

Original Description: Conrad, 1848a.

Subelliptical; volutions six and a half; on the middle of the body whorl is a slightly impressed revolving line. Length 1 1-10. Usual size 3/4. Abundant.

Discussion: *O. (S.) mississippiensis* differs from *O. (S.) affluens* (Casey) with which it occurs in that it has a broadly dome-shaped protoconch with only one large whorl visible and in that its whorls are not excavated above the suture (see Plate 57, figures 1-2). According to Casey (1903, p. 281), the protoconch of *O. (S.) mississippiensis* is multiwhorled with "the nucleal sutures obliterated." *O. (S.) affluens* has a large protoconch of three whorls with the suture continuing onto the flattened apex for about one and one half volutions and has an excavated groove above the suture on the whorls of the spire (see Plate 57, figures 3-4). Casey (1903) believed that these differences were significant enough to justify the separation of these species on the subgeneric level. Adult specimens of these species are very similar in their general appearance and have a similar range in variation from individuals with an inflated body whorl and short spire to individuals with modestly inflated body whorls and moderately high spires.

Harris and Palmer (1947) identified specimens of *Oliva* occurring in the Moodys Branch Formation as *mississippiensis* and placed this species in the genus *Agaronia*. These specimens have whorls that are channeled above the suture and are a slender variety of *O. (S.) affluens* (see Plate 57, figure 6). *Agaronia* is similar to *Strephonella* in having a line on the body whorl that delineates a band between it and the fasciole that differs in coloration and texture. However, *Agaronia* has a much higher spire than does *Strephonella* (see Plate 57, figure 13).

Type: Lectotype 13450 ANSP and five paratypes 13452 ANSP all from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 33, figure 18; Plate 56, figures 13-14 - lectotype).

Occurrence: Mint Spring Formation, MGS localities 89, 90; Byram Formation, USGS locality 13286, MGS localities 93, 106, 109, 112c, 114, 115, 116.

Oliva (Strephonella) affluens (Casey)

Plate 20, figures 4-5; Plate 33, figures 12, 14-16; Plate 57, figures 3-5, 7-10

Not 1890. *Oliva platonica* de Gregorio, Ann. Geol. Paleont., v. 7, p. 53, pl. 3, fig. 53-54.
1903. *Olivella affluens* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 281.
1940. *Olivella* sp. cf. *O. affluens* Casey. Mansfield, Jour. Paleont., v. 14, No. 3, p. 207-208, pl. 27, fig. 16.
1947. *Agaronia mississippiensis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 408-409 (not *O. mississippiensis* Conrad).
1977. *Agaronia mississippiensis*. (Conrad). Dockery, Mississippi Geol. Survey, Bull. 120, p. 79-80, pl. 11, fig. 3A, 3B.

Original Description: Casey, 1903.

There are two very distinct species of *Olivella* occurring abundanty in the Vicksburg strata. One of these, which may be assumed to be the typical *mississippiensis*, has the nucleus small, of very few whorls and the nucleal sutures obliterated. The whorls of the spire are completely unexcavated along the anterior edge. The other species, named as above, is as common as *mississippiensis;* it is rather smaller, the nucleus being, however, much larger, very obtuse, composed of about three whorls having the sutures all distinct and impressed. Each whorl of the spire has a deep and clearly defined revolving groove at the lower margin, which is entirely wanting in *mississippiensis*. The anterior folds of the columella are less oblique than in that species. Length of a moderately large specimen, having four body whorls beside the nucleus, 14.5 mm., width 5.7 mm. The aperture is somewhat narrow, and is rather less than two-thirds the total length of the shell. The differences between these two species are at least subgeneric.

Discussion: This species is common at most Byram localities and is frequent at Mint Spring localities in western Mississippi. *Oliva* specimens have not as yet been found in the Red Bluff Formation.

De Gregorio (1890), who described and figured several Vicksburg species in his monograph on the Eocene of Alabama, illustrated a new species *Oliva platonica*, which resembles *O.* (*S.*) *affluens* in its inflated body whorl, short spire and excavated groove above the suture. This species is distinct from the several species of *Agaronia* figured by de Gregorio, most of which were recognized by Palmer (1937, p. 431) as various growth stages of *Agaronia alabamensis* (Conrad). Palmer (1937, p. 436) did not find the type of *O. platonica* in the de Gregorio collection and did not recognize its occurrence in the Eocene of Alabama except for that of the original citation. There is a strong possibility that this species is from a later geologic horizon. However, the illustrations of *O. platonica* differ significantly from *O.* (*S.*) *affluens* in that the incised line of the body whorl follows the whorl's midline, and the longitudinal lines of the whorl continue across it.

O. (*S.*) *affluens* somewhat resembles *O. dufresnei* Basterot, 1825, (see Plate 57, figures 11-12) from the Oligocene of France in the inflation of its body whorl, its spire height, and its channeled suture.

Type: Location of type not known, Vicksburg Group, Vicksburg, Mississippi (Casey).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 13287, 14071a, MGS locality 99; Byram Formation, USGS localities 5615, 13286, MGS localities 93, 106, 109, 112c, 114, 115, 116; cf. Chickasawhay Limestone, USGS localities 14204, 14362.

Genus OLIVELLA Swainson, 1831

Olivella Swainson, Zoological illustrations, v. 2, pl. 58 and text, 1831.

Type (by subsequent designation, Dall, 1909): *Olivella purpurata* Swainson (= *Olivella dama* Mawe). Recent, west coast of Mexico.

Subgenus CALLIANAX H. and A. Adams, 1853

Callianax H. and A. Adams, Genera Recent Mollusca, v. 1, 1853.

Type (by subsequent designation): *Olivella* (*Callianax*) *biplicata* (Sowerby, 1825). Recent, Vancouver Island to Baja California.

The following Vicksburg *Olivella* species is placed in this subgenus because it has a smooth columella except for an anterior fold and because of its similarity to *Olivella* (*Callianax*) *johnsoni* Olsson, 1956, from the Chipola Formation.

Olivella (Callianax) vicksburgensis
Dockery n. sp.
Plate 20, figure 6

Description: Shell small; protoconch with two whorls, the first whorl very small with its suture situated on top of flattened apex, juncture between protoconch and teleoconch indistinct; teleoconch of four and one half whorls; spire elevated, glossy, and with excavated groove above suture; boundary of spire and body whorl marked by extension of glossy parietal callus up to the suture; body whorl with microscopically fine longitudinal lines and fine longitudinal color bands separated from glossy siphonal fasciole by an incised line; aperture short, extending only half way up body whorl; inner lip with smooth parietal callus and a columellar fold split by a median groove forming its lower margin.

Discussion: This species is similar to *O.* (*C.*) *johnsoni* Olsson, 1956, from the Chipola Formation but differs in its slender spire and deeply grooved suture.

Type: Holotype 498191 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 20, figure 6).

Occurrence: Mint Spring Formation, USGS locality 13287.

Olivella (Callianax) vicksburgensis
Dockery var.
Plate 33, figure 11

Discussion: This variety differs from *O.* (*C.*) *vicksburgensis* s.s. in having a larger protoconch, a higher spire, and a less inflated body whorl.

Occurrence: Byram Formation, USGS locality 3729.

Family MARGINELLIDAE Fleming, 1828

Genus MARGINELLA Lamarck, 1799

Marginella Lamarck, Soc. Hist. Nat. Paris, Mem, p. 70, 1799.

Type (by monotypy): *Voluta glabella* Linné. Recent, west coast of Africa.

Marginella sp.?
Plate 35, figures 4-5

Discussion: This species resembles *Marginella*

(Egouena) apalachee Gardner, 1937, from the Chipola Formation. It differs from this species in its less inflated body whorl and thinner outer lip. Roth (1973) renamed a species of Gardner *Marginella (Egouena) lipara lepta* Gardner, 1938, (not *Marginella lepta* Bartsch, 1915) to *Prunum liparum leprochilus.* It is possible that the Vicksburg species of *"Marginella"* may also belong to the genus *Prunum* Herrmannsen, 1852.

Occurrence: Byram Formation, USGS localities 13286, 14683.

Genus **PERSICULA** Schumacher, 1817

Persicula Schumacher, Essai d'un nouveau système des habitations des vers testaces, p. 235, 1817.

Type (by monotypy): *Persicula variabilis* Schumacher (= *Voluta persicula* Linné). Recent, west coast of Africa and Indo-Pacific.

Persicula vicksburgensis Dockery n. sp.

Plate 21, figure 5-6

Description: Shell small, glossy; body whorl enveloping all but a small portion of the flattened spire; greatest inflation of shell toward the posterior end; aperture almost as long as shell; inner lip with six columellar folds, only the anterior two extend out from aperture; outer lip crenulate; anterior canal strongly notched.

Discussion: This species is closely related to *Persicula semen jacksonensis* (Meyer, 1885) from the Moodys Branch Formation but differs from that species in the following ways: (1) the columellar folds are weaker and only the anterior two extend outside of aperture, (2) the spire is flatter and more enveloped by the body whorl, and (3) the shell is more inflated toward the posterior end. Also, *P. semen jacksonensis* has a callus band on the dorsal side above the siphonal fasciole. This band is a constricted extension of the columellar callus at and below the fourth columellar fold from the anterior, and does not occur on *P. vicksburgensis.* The specimen figured in Plate 21, figure 6, has an immature outer lip, which is thin edged and smooth.

Type: Holotype 498192 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 21, figure 5).

Occurrence: Mint Spring Formation, USGS localities 3727, 14162.

Superfamily MITRACEA Swainson, 1831
Family MITRIDAE Swainson, 1831
Subfamily MITRINAE Swainson, 1831

Genus **MITRA** Lamarck, 1798

Mitra Lamarck, Tabl. Encycl. Méth., pl. 369, 1798.

Type (by tautonymy): *Voluta mitra* Linné, 1758. Recent, Indo-Pacific. (Opinion 885 of I.C.Z.N.).

Subgenus **FUSIMITRA** Conrad, 1855

Fusimitra Conrad, Proc. Acad. Nat. Sci. Philadelphia, v. 7, No. 7, p. 261, 1855.

Type (by subsequent designation, Grant and Gale, 1931): *Mitra mellingtoni* (sic) Conrad (= *M. millingtoni* Conrad *in* Wailes, 1854). Eocene, Jackson Group, Mississippi and Louisiana.

Mitra (Fusimitra) conquisita Conrad

Plate 7, figures 1, 3-5; Plate 20, figures 18-21
Plate 34, figure 1; Plate 57, figure 14;
Plate 58, figure 1

1829. Lesueur, Walnut Hill fossil shells, pl. 9, fig. 2 (no name). Printed in Dockery, 1982, Appendix II.

1848a. *Mitra conquisita* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.

1848b. *Mitra conquisita* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 119, pl. 12, fig. 1. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Fusimitra conquisita* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 25 (Synonymized *F. millingtoni* with *F. conquisita*).

1866. *Fusimitra conquisita* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29; not p. 25 (Jackson Group) = *M. (F.) millingtoni.*

1903. *Mitra conquisita* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 283 (Synonymized *M. mississippiensis* with *M. conquisita*).

1922. *Mitra conquisita* Conrad. Cooke, U.S. Geol. Survey, Prof. Paper 129-E, p. 83.

1945. *Mitra (Fusimitra) conquisita* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 222.

1947. *Fusimitra conquisita* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 399-401 in part, pl. 55, fig. 8; not pl. 55, fig. 1-6, 9, 11 = *Mitra (Fusimitra) millingtoni* Conrad; not pl. 55, fig. 7, 10 = *Mitra (Fusimitra) mississippiensis* Conrad.

1966. *Fusimitra conquisita* (Conrad). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 683.

1970. *Cancilla (Fusimitra) conquisita conquisita* (Conrad). Cernohorsky, Auckland Inst. Museum, Bull. 8, p. 48; not pl. 7, fig. 3 = *Mitra (Fusimitra) millingtoni* Conrad.

1976. *Mitra (Fusimitra) conquisita* Conrad. Cernohorsky, Indo-Pacific Mollusca, v. 3, No. 17, p.

384 in part, pl. 325, fig. 2 (Synonymized *M.* (*F.*) *millingtoni* and *M.* (*F.*) *mississippiensis* with *M.* (*F.*) *conquisita*).

1980. *Mitra* (*Fusimitra*) *conquisita* Conrad. Dockery, Mississippi Bureau Geol., Bull. 122, p. 124, pl. 77, fig. 6.

Original Description: Conrad, 1848a.

Fusiform, slender, smooth and polished; whorls eleven, slightly convex; penultimate whorl entire, except at the summit, where there are two impressed lines forming a raised line between them; the other whorls of the spire with revolving lines, and towards the apex the intervening spaces transversely wrinkled; apex acute; body whorl above the aperture, except the lines near the suture, without striæ; inferiorly striated; sperture narrow, labium 3-plaited. Length 1 4-10. Very rare.

Discussion: Several workers, including Conrad (1865), Harris and Palmer (1947), and Cernohorsky (1970, 1976), have synonymized *M.* (*F.*) *millingtoni* Conrad, an Eocene species, under *M.* (*F.*) *conquisita*. These species differ in that *M.* (*F.*) *millingtoni* is more elongate and has a narrower spire with higher whorls and more inclined sutures. Also the adult of this species is more than twice the size of the largest specimens of *M.* (*F.*) *conquisita*, which occurs throughout the Vicksburg Group. Casey (1903) and Cernohorsky (1970, 1976) also synonymized *M.* (*F.*) *mississippiensis* Conrad with *M.* (*F.*) *conquisita*. This synonymy has more merit as these "species" occur together throughout the Vicksburg Group, and the former has the appearance of a strongly ribbed variety of the latter. Both species are spirally ribbed in the early whorls, but the adult whorls of *M.* (*F.*) *conquisita* become smooth except for spiral grooves below the suture and on the anterior canal while the adult whorls of *M.* (*F.*) *mississippiensis* remain covered by spiral ribs with the interspaces increased in size. These two forms are maintained as separate species in this paper with reservations. Based on the material available there seems to be a gap between the strongly ribbed specimens of *M.* (*F.*) *conquisita* and the form named *M. mississippiensis* by Conrad.

Type: Lectotype 13462 ANSP from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 34, figure 1).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 2632, MGS localities 34b, 35b, 37, 38, 39, 40, 46; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 7671, 14071a, MGS localities 89, 99; Byram Formation, Vicksburg, MGS locality 106. Mexico: Oligocene sandstone, see Gardner (1945) for localities.

Mitra (Fusimitra) mississippiensis Conrad

Plate 7, figure 2; Plate 33, figures 19-20; Plate 34, figures 2-3; Plate 57, figure 15

1829. Lesueur, Walnut Hills fossil shells, pl. 9, fig. 1 (no name). Printed in Dockery, 1982, Appendix II.

1848a. *Mitra mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.

1848b. *Mitra mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 119, pl. 12, fig. 2. Plates reprinted in Dockery, 1982, Appendix I.

1866. *Fusimitra mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.

Not 1890. *Mitra missipiensis* (sic) (Conrad). de Gregorio, Ann. Geol. Paleont., v. 7, p. 76, pl. 5, fig. 50, 51 (Claiborne Group).

1903. *Mitra mississippiensis* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 283 (Synonymized with *M. conquisita*).

1945. *Mitra* (*Fusimitra*) *mississippiensis* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 222 (Synonymized with *M.* (*F.*) *conquisita*).

1947. *Fusimitra mississippiensis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 401, pl. 55, fig. 10.

1970. *Mitra* (*Fusimitra*) *mississippiensis* Conrad. Cernohorsky, Auckland Inst. Museum, Bull. 8, p. 48 (Synonymized with *M.* (*F.*) *conquisita conquisita* Conrad).

1976. *Mitra* (*Fusimitra*) *mississippiensis* Conrad. Cernohorsky, Indo-Pacific Mollusca, v. 3, No. 17, p. 384 (Synonymized with *M.* (*F.*) *conquisita* Conrad).

Original Description: Conrad, 1848a.

Narrow-fusiform, with eight whorls, flattened at the sides and slightly scalariform; whole surface with revolving unequal lines and longitudinal fine wrinkles, obsolete on the lines but distinct on the intervening spaces; aperture more than half the length of the shell; columella 3-plaited. Length 1 7/8. Rare.

In the young shell the striæ are prominent over the whole surface, but in adult specimens they become slightly impressed lines on the ventricose portion of the body.

Discussion: This species differs from *M.* (*F.*) *conquisita* in that the adult whorls are covered with spiral ribs.

Type: Lectotype 13460 ANSP and two paratypes 13461 ANSP all from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 33, figure 20 - lectotype; Plate 34, figure 2 - paratype A, figure 3 - paratype B).

Occurrence: Red Bluff Formation, USGS locality 2633, MGS locality 39; Byram Formation, Vicksburg, USGS locality 5615, MGS locality 106.

Subfamily VEXILLINAE Thiele, 1929

This subfamily is distinguished from the subfamily Mitrinae in having labral lirae as opposed to the labrum being smooth (Cernohorsky, 1970, p. 5, 32, 50). With one exception, well developed labral lirae have been observed on all of the following Vicksburg mitrid species, including *Mitra lintoidea* Aldrich which Cernohorsky (1970, p. 41) placed in the Mitrinae genus *Dentimitra*. The one exception, *Vexillum* (*Costellaria*) *multicostata* s.s., is known only from imperfect specimens in which the outer lip is incomplete. In its other aspects, this species closely resembles the Vicksburg mitrids included in this subfamily and so is also included.

Genus **VEXILLUM** Roeding, 1798

Vexillum Roeding, Mus. Bolten., p. 138, 1798.

Type (by subsequent designation, Woodring, 1928): *V. plicatum* Roeding, 1798 (= *Voluta plicaria* Linné, 1758). Recent, Indo-Pacific.

Subgenus **COSTELLARIA** Swainson, 1840

Costellaria Swainson, Treat. Malac., p. 130, 320, 1840.

Type (by monotypy): *Mitra rigida* Swainson, 1821 (= *Mitra semifasciata* Lamarck, 1811). Recent, Indo-Pacific.

Cernohorsky (1970, p. 54) placed *Mitra cellulifera* Conrad in this subgenus. The other Vicksburg mitrids having labral lirae are similar to *M. cellulifera* in their smooth, glossy, elevated, conical protoconch and in the general form of the teleoconch and are placed here as well. These species differ largely in their sculpture, which generally consists of axial ribs and spiral lirae.

Vexillum (Costellaria) lintoidea (Aldrich)

Plate 7, figures 8-13, 15-20

1894. *Mitra lintoidea* Aldrich, Nautilus, v. 7, No. 9, p. 97-98, pl. 4, fig. 1.
1970. *Dentimitra lintoidea* (Aldrich). Cernohorsky, Auckland Inst. Museum, Bull. 8, p. 41.

Original Description: Aldrich, 1894.

Shell fusiform, whorls nine, somewhat turrited, densely but coarsely longitudinally ribbed, a transverse impressed line behind the suture gives the upper whorls the appearance of being beaded; aperture narrow, elongate; outer lip sharp, slightly incurved, striated within, labium four plaited; canal open, rather short, curved, a number of impressed lines showing upon the lower part of body whorl. Alt. 27 mm.; diam. 8mm.

This species differs from *Fusimitra cellulifera* Con. by its lack of impressed revolving punctures and by being broader and much heavier.

Discussion: This species shows considerable variation in sculpture. The early whorls are sculptured with strong axial ribs and weaker spiral lirae, the upper one of which is the strongest and forms a subsutural collar. The body whorl varies from having strong axial ribs, as in the type (Plate 7, figure 12), to having spiral lirae without axial ribs (Plate 7, figure 19), to being smooth except for the subsutural collar and lirate anterior canal (Plate 7, figure 20). The aperture has well developed labral lirae and four columellar folds. *V.* (*C.*) *lintoidea* is common in the Red Bluff Formation and seems to be restricted to this horizon.

Type: Holotype 341411 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 7, figure 12).

Occurrence: Red Bluff Formation, USGS localities 309, 659A, 2633, 5264, 13288, MGS localities 37, 38, 39, 40.

Vexillum (Costellaria) cellulifera (Conrad)

Plate 34, figures 4, 8

1829. Lesueur, Walnut Hills fossil shells, pl. 9, fig. 3 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Mitra cellulifera* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.
1848b. *Mitra cellulifera* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 119, pl. 12, fig. 3. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Fusimitra cellulifera* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, p. 25.
1866. *Fusimitra cellulifera* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.
1890. *Mitra cellulifera* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, No. 1, p. 94.
1903. *Fusimitra cellulifera* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, pt. 1, p. 282.
1970. *Vexillum* (*Costellaria*) *cellulifera* (Conrad, 1848). Cernohorsky, Auckland Inst. Museum, Bull. 8, p. 54.

Original Description: Conrad, 1848a.

Elevated-subfusiform; slender; whorls slightly turreted; longitudinally ribbed; interstices with transverse impressed lines, resembling punctæ or cells; beak produced; labium 4-plaited, the second one from the top divided by a slightly impressed line. Length 3/4. Rare.

Discussion: *Vexillum* (*Costellaria*) *cellulifera* is the Byram counterpart of the previously discussed Red Bluff species. It differs from this latter species in its narrower shell, flat-sided whorls, and consistent sculpture of narrow axial ribs with spiral lirae confined to the interspaces.

Type: Lectotype 13463 ANSP and paratype 13464 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS locality 13286, MGS localities 106, 114.

Vexillum (Costellaria) laevicostata
Dockery n. sp.
Plate 20, figure 14; Plate 58, figures 2-5

Description: Shell small; protoconch elevated, conical, with four smooth whorls; teleoconch with seven whorls sculptured with broad, smooth, axial ribs and with a subsutural collar; body whorl with axial ribs, subsutural collar, and lirate anterior canal, the stronger upper lira extending from the posterior columellar fold; inner lip with slight callus and four columellar folds, the posterior one being the largest and the anterior one being significantly smaller than the rest; outer lip with labral lirae.

Discussion: This species differs from *V.* (*C.*) *lintoidea* and *V.* (*C.*) *cellulifera* in lacking spiral lirae on the spire and upper part of the body whorl. The name refers to the smooth axial ribs.

Type: Holotype 498337 USNM from the Mint Spring Formation, USGS locality 6647 (Plate 20, figure 14).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 6647.

Vexillum (Costellaria) multicostata
Dockery n. sp.
Plate 20, figure 15; Plate 58, figures 6, 8

Description: Shell small; protoconch elevated, conical with five smooth whorls; teleoconch with three whorls sculptured with narrow, closely spaced, axial ribs; body whorl with closely spaced axial ribs terminating at the upper spiral lira of the lirate anterior canal, the upper lira extending from the posterior columellar fold; inner lip with slight callus and four columellar folds, the posterior one being the largest and the anterior one being small and following the anterior margin of the inner lip; outer lip smooth.

Discussion: This species is similar to *V.* (*C.*) *laevicostata* in lacking spiral lirae on the spire and upper part of the body whorl. It differs in its more elevated protoconch, in lacking a subsutural collar, in its more crowded axial ribs, and in its smooth inner lip. The name refers to the crowded and numerous axial ribs or costae.

Type: Holotype 376676 USNM from the Forest Hill Formation, MGS locality 75a (Plate 58, figure 8).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 7671.

Vexillum (Costellaria) multicostata Dockery var.?
Plate 20, figures 8, 10-11

Discussion: This variety or possibly new species is similar to *V.* (*C.*) *multicostata* s.s. in its general form and elevated protoconch but differs in its larger and more inflated shell, its coarser axial ribs, and its lirate inner lip. It also is variable in its sculpture with some specimens having spiral lirae crossing the axial ribs.

Occurrence: Mint Spring Formation, USGS locality 7671.

Vexillum (Costellaria) cervilirata
Dockery n. sp.
Plate 58, figures 7, 9-11

Description: Shell small, fusiform, slender; protoconch elevated with four or more smooth whorls; teleoconch with five smooth whorls; body whorl smooth except for growth lines and spiral lirae on the anterior canal, the upper lira extending from the posterior columellar fold; inner lip with very slight callus if any and four columellar folds that decrease in strength toward the anterior, the anterior fold small and following the anterior margin of inner lip; outer lip with short labral lirae.

Discussion; Of the species previously mentioned, *V.* (*C.*) *cervilirata* most closely resembles the narrow fusiform shell of *V.* (*C.*) *multicostata* s.s. It differs from this species and the other Vicksburg species of this genus in lacking spiral or axial ornamentation except for the lirate anterior canal. One specimen illustrated in Plate 58, figure 7, has faint axial ribs. The name refers to the lirate anterior canal (or neck): L. *cervix* - neck, *lira* - ridge.

Type: Holotype 376677 USNM from the Forest Hill Formation, MGS locality 75a (Plate 58, figure 9).

Occurrence: Forest Hill Formation, MGS locality 75a.

Vexillum (Costellaria) tallahalaensis
Dockery n. sp.
Plate 58, figure 12

Description: Shell small; protoconch with two smooth conical whorls and sharply delineated from teleoconch; teleoconch with five whorls; the first whorl with axial ribs only; the latter whorls with axial ribs nodose at intersections with four strong spiral lirae, the upper lira forming a subsutural collar and separated from the lower three by a moderately broad interspace; a fifth spiral lira is partially visible above the suture; body whorl with axial ribs and seventeen spiral lirae that decrease in size on anterior canal; inner lip with two columellar folds; outer lip with nine labral lirae.

Discussion: This species is known only from the holotype, which resembles the type of *Mitra quemadica* Maury, 1917, (= *Mitra rudis* Gabb, 1873), a young specimen from the Miocene of Santo Domingo. However, Cernohorsky (1970, p. 464) placed this latter species as *Mitra* (*Nebularia*) in the subfamily Mitrinae, a statement to the effect that *M. rudis* has no labral lirae. More specimens of both species will have to be examined before their relationship can be ascertained. The name is in reference to the type locality on West Tallahala Creek.

Type: Holotype 376674 USNM from the Byram Formation, MGS locality 93 (Plate 58, figure 12).

Occurrence: Byram Formation, MGS locality 93.

Family CANCELLARIIDAE Forbes and Hanley, 1853

Genus **OLSSONELLA** Petit, 1970

Olssonella Petit, Tulane Studies Geol. Paleont., v. 8, No. 2, p. 83, 1970.

Type (by original designation): *Cancellaria smithii* Dall, 1888. Recent, tropical western Atlantic.

Olssonella elongata Dockery n. sp.

Plate 21, figures 10, 12

Description: Shell small with elongate spire, protoconch with two inflated smooth whorls, the last whorl with a fine spiral lira above suture; protoconch and teleoconch separated by a zone of fine, closely spaced, axial ribs; teleoconch with four and one half whorls sculptured with large arched ribs and spiral lirae; body whorl with eleven axial ribs; umbilicus partially covered by callus shield; inner lip with two columellar folds; outer lip with labral lirae.

Discussion: This species is similar to *Olssonella williamsi* Petit, 1976, from the Yorktown Formation (Pliocene) in its elongate spire, but differs in that its suture is not deeply sunken. The holotype of *O. elongata* has a greater inflation to the whorls than does the paratype, indicating that this aspect is variable for the species.

Type: Holotype 498118 USNM and paratype 376483 USNM both from the Mint Spring Formation, USGS locality 3727 (Plate 21, figures 10 and 12 respectively).

Occurrence: Mint Spring Formation, USGS locality 3727, MGS localities 89, 90.

Olssonella elongata Dockery var.?

Plate 59, figure 1

Discussion: A juvenile specimen of *Olssonella* from the Red Bluff Formation has an elevated spire similar to that of *O. elongata* but differs in its finer axial ribs. This specimen is listed here as a possible variety of that species.

Occurrence: Red Bluff Formation, MGS locality 37.

Genus **AGATRIX** Petit, 1967

Agatrix Petit, Tulane Studies Geol, v. 5, No. 4, p. 218, 1967.

Type (by original designation): *Trigonostoma agassizii* Dall, 1889. Recent, North Carolina to Gulf of Mexico.

Agatrix mississippiensis (Conrad)

Plate 7, figures 26-27; Plate 21, figure 11; Plate 35, figures 1-3; Plate 58, figures 13-15

1848a. *Cancellaria Mississippiensis* Conrad, Acad., Nat. Sci. Philadelphia, Proc., v. 3, p. 289.
1848a. *Cancellaria funerata* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289.
1848b. *Cancellaria mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 118, pl. 11, fig. 38. Plates reprinted in Dockery, 1982, Appendix I.
1848b. *Cancellaria funerata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 118, pl. 11, fig. 39.
1865. *Cancellaria* (*Babylonella*) *funerata* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 32.
1865. *Cancellaria* (*Babylonella*) *Mississippiensis* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 32.
1866. *Cancellaria funerata* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.
1866. *Cancellaria mississippiensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.
1903. *Cancellaria mississippiensis* Conrad. Aldrich, Nautilus, v. 16, No. 9, p. 101.
1940. *Cancellaria mississippiensis* Conrad. Mansfield, Jour. Paleont., v. 14, No. 3, p. 207.

Original Description of *C. mississippiensis:* Conrad, 1848a.

Subovate; whorls five or six, turreted; ribs prominent, ten or eleven on the large volution, one or two considerably larger than the others; revolving lines raised, distinct, alternated in size on the lower half of the body whorl; labrum striated within; columella concave, three-plaited. Length ½.

Original Description of *C. funerata:* Conrad, 1848a.

Oblong-ovate, with large longitudinal ribs and prominent revolving lines; spire rather elevated, turreted, whorls six, convex; two from the apex entire; ribs on the body whorl profound, unequal; labrum with nine prominent lines within not extending to the margin; columella three plaited. Length ½. Very rare.

Discussion: *Cancellaria mississippiensis* shows a large variation in the elevation of its spire, the inflation of the body whorl, and in the sculpture. *C. funerata* is synonymized with it as a variation (compare the types of *C. mississippiensis* and *C.*

funerata in Plate 58, figures 13-15). The general sculpture of *C. mississippiensis* consists of strong axial ribs, some of which are enlarged, and spiral lirae. A form common in the Red Bluff Formation has a large body whorl, sharply defined and regularly spaced axial ribs, and fine primary, secondary, and tertiary spiral lirae (see Plate 7, figure 27). The body whorl of this form has two or three enlarged axial ribs. The form common in the Byram Formation has an elevated spire, irregularly spaced axial ribs, and usually only primary spiral lirae.

Type of *C. mississippiensis:* Lectotype 13447 ANSP and paratype 13448 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 58, figure 13 - paratype). Type of *C. funerata:* Syntypes A and B 13449 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 58, figure 14 - syntype B).

Occurrence: Red Bluff Formation, USGS localities 5263, 6456, MGS localities 37, 38, 39; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS locality 13287, MGS localities 89, 90, 99.

Genus **ADMETULA** Cossmann, 1889

Admetula Cossmann, Ann. Soc. Roy. Malac. Belg., v. 24, p. 228.

Type (by subsequent designation): *Cancellaria evulsa* (Solander) (=*Buccinum evulsa* Solander, 1766). Eocene, England.

Admetula regularia Dockery n. sp.
Plate 58, figure 16

Description: Protoconch with three smooth inflated whorls; teleoconch with three and one half cancellate whorls and with narrowly incised suture; first and second whorls with axial and four spiral lirae, the upper lira formed by two closely spaced lirae; body whorl with sixteen axial ribs, two of which are enlarged, and with twelve primary spiral lirae having secondary lirae in the interspaces; inner lip with very slight parietal callus and with notch above two prominent columellar folds and prominent columellar keel; outer lip coarsely denticulate.

Discussion: This species resembles the Recent species *Ademtula bayeri* Petit, 1976, in its sculpture of closely spaced axial ribs and strong spiral lirae. It differs in its higher spire and less inflated body whorl. *Admetula regularia* can be readily distinguished from *Agatrix mississippiensis* by its regularly formed and closely spaced axial ribs, its strong spiral lirae, its notched inner lip, and its strong columellar folds and keel. The name refers to the regularity of the cancellate sculpture.

Type: Holotype 376682 USNM from the Byram Formation, MGS locality 114 (Plate 58, figure 16).

Occurrence: Byram Formation, MGS locality 114.

Admetula inflata Dockery n. sp.
Plate 21, figures 8-9

Description: Protoconch large with three smooth inflated whorls, last one half whorl with four fine spiral lirae; teleoconch with three rapidly expanding whorls and sculptured with broad axial ribs and spiral lirae; first whorl with four spiral lirae; second whorl with four primary spiral lirae and secondary lirae in interspaces; body whorl with fourteen axial ribs, three of which are enlarged, and with twelve primary spiral lirae with secondary and tertiary lirae in interspaces; inner lip with small notch above two columellar folds and columellar keel; outer lip ventricose.

Discussion: This species differs from *A. regularia* in its inflated body whorl, broad axial ribs, secondary and tertiary spiral lirae, and weaker columellar folds and keel.

Type: Holotype 498186 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 21, figure 9).

Occurrence: Mint Spring Formation, USGS locality 13287.

Superfamily CONACEA Rafinesque, 1815
Family CONIDAE Rafinesque, 1815

Genus **CONUS** Linné, 1758

Conus Linné, Systema Naturae, 10th ed., p. 712.

Type (by subsequent designation, Children, 1823): *Conus marmoreus* Linné.

Conus alveatus Conrad
Plate 9, figures 16-17; Plate 23, figures 17, 20-21, 28;
Plate 38, figures 4-5, 8-17, 19-21, 26;
Plate 59, figures 5-8

1829. *Conus peronii* Lesueur, Walnut Hills fossil shells, pl. 8, figure 15. Printed in Dockery, 1982, Appendix II.
1829. *Conus nonperditus* Lesueur, Walnut Hills fossil shells, pl. 8, fig. 16.
1829. *Conus defrancii* Lesueur, Walnut Hills fossil shells, pl. 8, fig. 18.
1829. Lesueur, Walnut Hills fossil shells, pl. 9, fig. 14-18, 20 (no name).
1865. *Conus alveatus* Conrad, Amer. Jour. Conchology, v. 1, p. 30, 186.
1866. *Conus alveatus* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.
1903. *Conus scopularis* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, pt. 1, p. 279.

1922. *Conus alveatus* Conrad. Cooke, U.S. Geol. Survey, Prof. Paper 129-E, p. 81, 83.
1937. *Conus alveatus* Conrad. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 458, 461, pl. 71, fig. 6 (Synonymized with *Conus (Lithoconus) sauridens* Conrad, 1833).
1945. *Conus (Leptoconus) alveatus* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 254, pl. 26, fig. 3, 11.

Discussion: This species shows variation in the elevation of its spire, the angulation and nodose or smooth sculpture of its shoulder (compare figures 9 and 10 of Plate 38), and in the number of spiral grooves on the body whorl (compare figures 11 and 12 of Plate 38). Casey (1903, p. 279) named a new species *Conus scopularis* in the Red Bluff Formation and stated that it differed from *Conus alveatus* in its more depressed spire and sculpture. However, specimens of the Red Bluff species show the same variation in the elevation of the spire and angulation of the body whorl (compare figures 5 and 6 of Plate 59) as do those of *C. alveatus* in the Byram Formation. Lesueur in his unpublished manuscript on the "Walnut Hills fossil shells" gave three different names to various forms of *C. alveatus*. One form, which he named *Conus defrancii* (see Dockery, 1982, Appendix II, pl. 8, fig. 18), has a slender shell with a rounded shoulder and evenly sloped, elevated spire. This form has been found to occur in both the upper Forest Hill Formation and the Byram Formation (see Plate 59, figures 7-8).

Type: Lectotype of *Conus alveatus* Conrad 13446 ANSP and paratype 13494 ANSP both from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad) (Plate 38, figure 26 - lectotype). Holotype of *Conus scopularis* Casey 481664 USNM from the Red Bluff Formation, USGS locality 13288 (Plate 9, figures 16-17).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 13288, MGS localities 34b, 37, 38; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 7671, 13287, 14162, MGS locality 99; Byram Formation, USGS localities 7941, 13286, MGS localities 93, 106, 109, 112c, 114, 115. Mexico: middle Oligocene sandstone, USGS localities 13539, 141444.

Conus alveatus spiralis Dockery n. subsp.

Plate 59, figures 3-4

Description: Shell small, elongate, protoconch with three, highly elevated, smooth whorls; teleoconch with six and one half whorls; spire elevated with cancellate ramp having fine spiral lines and growth lines concave toward aperture, shoulder elevated above suture and strongly noded; body whorl with strong, narrow, spiral grooves continuing to nodes on shoulder.

Discussion: This subspecies can be distinguished from high spired forms of *C. alveatus* s.s. in that the spiral grooves cover the body whorl. It can be distinguished from *C. protractus* in having spiral lines on the ramp.

Type: Holotype 376678 USNM from the Byram Formation, MGS locality 93 (Plate 59, figure 3).

Occurrence: Byram Formation, MGS locality 93.

Conus protractus Meyer, 1885

Plate 9, figure 18; Plate 23, figures 18-19;
Plate 38, figures 6-7; Plate 59, figure 2

1829. Lesueur, Walnut Hills fossil shells, pl. 9, fig. 19 (no name). Printed in Dockery, 1982, Appendix II.
1885. *Conus protractus* Meyer, Amer. Jour. Sci., 3rd ser., v. 29, p. 466.
1886. *Conus protractus* Meyer. Meyer, Geol. Survey Alabama, Bull. 1, pt. 2, p. 75, pl. 2, fig. 7.
1890. *Conus (Conospira) granopsis* de Gregorio, Ann. Geol. Paleont., v. 7, p. 21, pl. 1, fig. 66-67.
1922. *Conus protactus* Meyer. Cooke, U.S. Geol. Survey, Prof. Paper 129-E, p. 83.
1937. *Conus (Lithoconus) protractus* Meyer. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 463-464, pl. 73, fig. 18.
1945. *Conus (Leptoconus?) protractus* Meyer. Gardner, Geol. Soc. Amer., Mem. 11, p. 254-255, pl. 10, fig. 22?

Original Description: Meyer, 1886.

Spire nearly a third of the entire length; four smooth, rounded, embryonic whorls are followed by seven carinated volutions; the carina is somewhat crenulated; base with numerous broad, depressed lines.

Localities.—Vicksburg, Miss., Red Bluff, Miss.

Young specimens of *Conus sauridens*, Con., resemble the species, but their spires are concave and covered with revolving lines, which are absent in *C. protractus*.

Discussion: *Conus protractus* has an elevated, conical spire and an elongate body whorl that has an angulate and drawn out anterior canal. The elevated, smooth protoconch is similar to that of *C. alveatus* as is the nodose shoulder of the early or sometimes the adult whorls. Adult specimens of *C. protractus* are smaller than those of *C. alveatus*. They may readily be distinguished from the high-spired young of the latter species in that the ramp of *C. protractus* has only concave growth lines and lacks spiral lines.

Type: Holotype 644576 USNM from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Meyer) (Plate 38, figure 6).

Occurrence: Mississippi: Red Bluff Formation, USGS locality 5264, MGS locality 38; Mint Spring Formation, USGS localities 13287, 14162; Byram Formation, locality 13286, MGS locality 114. ?Mexico: lower marine Oligocene sandstone, USGS localities 13505, 14056.

Family TEREBRIDAE H. and A. Adams, 1854

Genus **TEREBRA** Brugiuère, 1789

Terebra Bruguière, Encyclopédie Méthodique, v. 1, Table Systematique, p. 15, genre 47, 1789 (no species listed).

Type (by subsequent designation, Lamarck, 1799): *Buccinum subulatum* Linne. Recent, Indo-Pacific.

No species referable to *Terebra* s.s. have been reported from America. The Vicksburg species are referred to the subgenera *Terebrellina* Werz, *Strioterebrum* Sacco, and a new subgenus, *Laeviterebrum.*

Subgenus **Terebrellina** Wenz, 1943

Terebrella Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 466, 1937.

Type for *Terebrella* (by original designation). *Terebra mirula* de Gregorio. Eocene, Claiborne Group, Alabama.

Terebrellina Wenz, Handbuck der palaozoologie, Bd. 6, abt. 1, Teil 6, p. 1486, 1943 (new name for *Terebrella* Palmer, 1937, not Maltzau, 1886).

Palmer (1937) regarded *T. andrega* and *T. inula* of de Gregorio (1890, p. 17-18) and *T. texagyra* of Harris (1895, p. 54) as synonyms of *T. mirula,* the designated type of *Terebrellina. Terebra jacksonensis* Cooke (1926, p. 133) from the Moodys Branch Formation (Upper Eocene) of Jackson, Mississippi, is another related species. An examination of the upper Eocene species of *Terebra* in the U.S. National Museum has convinced me that possibly as many as 8 or 9 valid species exist in Alabama and Texas, but that any attempt to identify the species of American authors with those of de Gregorio must wait until someone has refigured or at least reexamined de Gregorio's types. For that reason the names given them by American authors are used for all Eocene Terebras here compared with Vicksburg species. *Terebra mirula* de Gregorio, however, is the type of *Terebrellina,* and although Palmer's generic characters were taken mainly from *T. texagyra* Harris, there is reason to believe that the two species are at least congeneric.

Terebrella, now *Terebrellina,* was proposed for shells having discrepant sculpture in young and old shells, the axial sculpture being better developed in juveniles, but becoming obsolete in adults and the subsutural band being absent on the first few whorls, but well developed in adults. The aperture and columella of *Terebrellina* compares more with that of *Strioterebrum* and *Paraterebra,* there being a well developed siphonal canal and a prominent siphonal fasciole. The base of the body whorl is strongly constricted with a depressed area between the main part of the body whorl and the fasciole. It thus differs from *Subula* and *Hastula* in which there is no canal and only a narrow groove between the broad, more vertical fasciole and the main part of the body whorl. *Terebrellina* differs from *Paraterebra* in sculpture, however, the latter having a strong, subsutural band with a narrower band just below it, and with the approximate lower half of the exposed portion of the whorl depressed. Both the bands and the depressed region of *Paraterebra* bear strong axial sculpture, particularly in the younger stages.

Considerable range is seen in the stage at which the axials disappear and the subsutural band appears in *Terebrellina.* In the Oligocene species, especially the more extreme Byram varieties, the subsutural band appears on the latter portion of the first post nuclear whorl, and the strong axials continue without diminishing throughout the life of the shell. In the Mint Spring form, however, the axials become obsolete on the later adult whorls. The later species of *Terebrellina* differ from *Strioterebrum* mainly in the absence of spiral sculpture. The young stages of the Eocene *Terebrellina* probably represent one of the most primitive types of *Terebra.*

Terebra (Terebrellina) divisura Conrad

Plate 38, figures 18, 22-25

1829. *Cerithium undulatum* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 7. Printed in Dockery, 1982, Appendix II.

1848a. *Terebra divisurum* Conrad, Acad. Nat. Sci. Philadelphia, Proc. v. 3, p. 283.

1848b. *Terebra divisurum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 13. Plates reprinted in Dockery, 1982, Appendix I.

1865. *Terebra divisura* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 28.

1866. *Terebra divisura* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.

1890. *Terebra (Acus) divisura* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, No. 1, p. 24.

1937. *Terebra (Terebrella) divisura* Conrad. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 467-469.

Original Description: Conrad, 1848a.

Subulate, with nineteen flattened volutions, obscurely turreted; polished and with lontitudinal curved ribs, dislocated by an impressed line above the middle of each whorl; ribs obsolete on the body whorl below the impressed line. Length 2 inches. Common.

The ribs are sometimes obsolete on the larger whorls, or replaced by coarse wrinkles, which are generally distinct on the body whorl.

Description: Shell of medium size for the genus, moderately inflated; protoconch consisting of 4 smooth whorls, the first two expanding more rapidly than the last two; aperture relatively narrow, strongly constricted at about the lower third to form a well developed siphonal canal; columella strongly twisted, bearing a pair of closely set folds, the lower slightly stronger inside the aperture; parietal callus moderately heavy; siphonal fasciole strong, bordered above by a raised thread, which within the aperture becomes the upper columellar fold, a broad constricted area separating it from the main part of the body whorl; suture strongly indented, subtended by a strong subsutural band of over one third the width of the exposed portion of the whorls; sculpture consisting of moderately coarse, curved, axial ribs below the revolving groove, and corresponding nodes on the subsutural band, the axials exhibiting some range in strength, sometimes becoming weaker or obsolete in adults as on the lectotype, or continuing with undiminished strength.

Discussion: *Terebra divisura* is related to *T. texagyra* Harris from the Yegua Formation of Texas, to *T. jacksonensis* Cooke, and to the species from the Claiborne of Louisiana identified as *T. mirula* by Palmer (1937, pl. 72, fig. 10). The latter species is well represented in the Texas collections in the National Museum and does not appear to intergrate with *T. texagyra*. *Terebra mirula* de Gregorio, supposedly from Claiborne, Alabama, is, according to de Gregorio, about 50 mm. in height, whereas *T. texagyra* probably does not much exceed 25 mm. in height so that it is doubtful that they are the same species. So far as I have been able to trace, no subsequent author has reported a *Terebra* as large as *T. mirula* from Claiborne. Harris has suggested that some of de Gregorio's material may have come from Vicksburg, and indeed, judging from de Gregorio's figure it could well be in the Byram species.

Typical *T. divisura* from the Byram Formation differs from *T. jackonensis* in being much larger, in having a stronger subsutural groove and band, especially on the first two or three whorls, deeper sutures, and in having stronger axial ribs. The axials on the first whorls of *T. jacksonensis* are more bowed outwards giving the early whorls a more inflated appearance. The depressed area between the siphonal fasciole and the body whorl is less pronounced in *T. jacksonensis*. The selected lectotype of *T. divisura*, although the largest and best of Conrad's types, has smoother adult whorls than is common, comparing in this respect with the Mint Spring subspecies and *T. texagyra* Harris (Palmer, 1937, pl. 72, figs. 16-18). The axial ribs on both the Mint Spring and Eocene forms are finer, however, and the subsutural band is less prominent and more appressed, usually not appearing on *T. texagyra* until about the third whorl.

Terebra (*Paraterebra*) *odopoia* Gardner (1926-1950, p. 280, 1937) from the Chipola Formation (lower Miocene) of western Florida is not a *Paraterebra* as its lack of a second subsutural groove clearly shows. *Terebra haitensis* Dall (1896, p. 35) with which Gardner compared *T. odopoia* is a *Paraterebra*, however, so that their similarity is only subgeneric at best. *Terebra odopoia* has more flattened whorls and a wider, less incised spiral groove than *T. divisura*. The whorls immediately following the protoconch are slenderer and expand less rapidly, and the adult whorls of some specimens bear a suggestion of fine, spiral threads. The columellar folds are better developed than on *T. divisura*. A similar, large, undescribed *Terebra* occurs in the Trent marl (lower Miocene) of North Carolina.

Type: Lectotype 13416 ANSP and paratype 13417 ANSP both from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 38, figures 22 and 23 respectively).

Occurrence: Byram Formation, USGS localities 259, 3722, 3724, 3729, 6449, 7372, 7376, 7941, 10400, 12174, 12175, 13286, 14682, MGS localities 93, 106, 109, 112c, 114, 115.

Terebra (Terebrellina) divisura clearyensis
MacNeil n. subsp.
Plate 23, figures 22-23

Discussion: This is the Mint Spring analog of *T. divisura*. It is distinguished from the typical form by its weaker and slenderer axials which are generally more numerous and always become obsolete on the later whorls of adults. *Terebra* (*Terebrellina*) *divisura clearyensis* has a higher spire so that the distance between the subsutural band and the suture below is relatively greater. The columella is somewhat longer, making the attitude of the fasciole somewhat more vertically inclined. Typical *T. divisura* is somewhat more inflated and has a more rapidly expanding spire in the juvenile stages. Both the suture and the spiral groove of the Mint Spring subspecies are less incised and the subsutural band is less in relief giving the spire a less stepped appearance.

Type: Holotype 498151 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 23, figure 22).

Occurrence: Mint Spring Formation, USGS localities 3723, 3726, 3727, 6447, 6452, 6647, 7671, 13287, 14071, 14162, 14849, MGS locality 99; ?Red Bluff Formation, locality 2631.

Terebra (Terebrellina) hiwanneensis
MacNeil n. sp.
Plate 9, figures 15, 20-22; Plate 59, figure 10

Description: Shell moderately small and slender; protoconch consisting of 4 smooth whorls; aperture small, produced anteriorly to form a well developed canal; columella twisted, bearing 2 well defined folds; parietal callus light; siphonal fasciole not raised but bordered above by a raised thread, which within the aperture becomes the upper columellar fold, a moderately broad constriction separating the thread from the base of the body whorl; suture strong, subtended by a subsutural band of slightly less than a third of the width of the exposed portion of the whorl; subsutural band strong on adults but weak on the first 2 to 3 whorls; sculpture on the more flattened adult whorls consisting of relatively coarse, slightly curved, axial ribs below the spiral groove and corresponding narrow nodes on the subsutural band, but on the juvenile whorls the axials and nodes are more continuous due to the weaker spiral groove and less developed subsutural band, axials below the band in juveniles more outwardly bowed than in adults, axials exhibiting some range in spacing, but not becoming noticeably weaker in adults.

Discussion: *Terebra* (*Terebrellina*) *hiwanneensis* is most closely related to *T. jacksonensis* Cooke from the Moodys Branch Formation (upper Eocene) of Mississippi, and to an undescribed species from the Yegua Formation (upper middle Eocene) of Texas, probably the species figured as *T. mirula* by Palmer (1937, pl. 72, fig. 10). It differs from *T. jacksonensis* in being slenderer, more elongate, and in having a sharper spiral groove and a better developed subsutural collar, especially on the first 5 to 6 whorls. Specimens of the Yegua species in the National Museum from Orell's crossing, Elm Creek, 5.2 miles northwest of Giddings, Lee County, Texas, locality 10730, compare more with the Red Bluff species in shape, but like *T. jacksonensis* have a weaker subsutural collar and an even more weakly incised spiral groove. The axials on the early whorls of *T. jacksonensis* are relatively thinner and frequently fewer in number than on the adult whorls, whereas in the Yegua and Red Bluff species the axials are of the same relative strength on both young and adult whorls. *Terebra* (*Terebrillina*) *hiwanneensis* has a larger protoconch than either of the Eocene species mentioned.

Terebra (*Terebrellina*) *hiwanneensis* differs from *T.* (*T.*) *divisura* and the subspecies *clearyensis* in being much smaller and in having a narrower apical angle and a relatively slender shell. The subsutural band of the Red Bluff species is narrower but more elevated and nodose, and the spiral groove is somewhat wider. The axials of *T.* (*T.*) *hiwanneensis* are more crowded and straighter.

Type: Holotype 140752 USNM, paratype A 498028 USNM, and paratype B 560921 USNM all from the Red Bluff Formation, USGS locality 2633 (Plate 9, figures 15, 20, and 22 respectively).

Occurrence: Red Bluff Formation, USGS localities 2633, 5263, 6456, MGS localities 37, 38.

Subgenus **STRIOTEREBRUM** Sacco, 1891

Strioterebrum Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 10, p. 33, 1891.

Type (by original designation): *Terebra basteroti* Nyst. Miocene, Mediterranean region.

Strioterebrum is characterized mainly by its well developed spiral sculpture. It is closely related to *Terebrellina* and may have been derived from some early type of *Terebrellina*. Like *Terebrellina* and *Paraterebra* it has a well developed canal, a twisted columella and a prominent siphonal fasciole.

Terebra (Strioterebrum) tantula Conrad

Plate 39, figures 1-4; Plate 59, figure 9

1848a. *Terebra tantula* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 283.
1848b. *Terebra tantula* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 15. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Terebra tantula* Conrad. Conrad, Amer. Jour. Conchology, v. 1, p. 28.
1866. *Terebra tantula* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 29.
1890. *Terebra* (*Acus*) *tantula* Conrad. Dall, Wagner Free Inst. Sci., Trans., v. 3, No. 1, p. 24.
1937. *Terebra* (*Terebrella*) *divisura* Conrad. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 468.

Original Description: Conrad, 1848a.

Subulate, with longitudinal ribs dislocated by an impressed line; whorls with minute revolving lines. Length 2/3. Rare.

Very similar to the preceding, but narrower, far less in size, and distinguished by the revolving lines and by the ribs on the body whorl, which extend to the beak.

Description: Shell moderately small and slender; protoconch consisting of 4 smooth whorls; aperture moderately narrow, produced anteriorly to form a well developed siphonal canal, moderately curved in profile; columella moderately twisted, bearing a weak basal fold and an upper fold mostly concealed by callus; parietal callus well developed; siphonal fasciole slightly rounded or flat, bordered above by a raised thread which in the aperture becomes the mostly concealed upper fold, separated from the body whorl by a broad, depressed area; suture strongly indented, subtended by a strong subsutural band and a spiral groove, the band being about a third the width of the exposed portion of the whorls; both the band and groove appearing on the first post-nuclear whorl; sculpture consisting of numerous, fine or moderately coarse, incised, spiral lines with raised interspaces ranging from broad and flattened to fine and thread like on both the subsutural band and the lower portion of the whorl, and coarse axial ribs which are not crossed by the spiral sculpture, the axials usually made discontinuous by the deeply incised subsutural groove.

Discussion: This species can hardly be confused with the larger Byram species *T.* (*T.*) *divisura* from which it differs in being much smaller and slenderer and in having well developed spiral sculpture. *Terebra* (*Strioterebrum*) *tantula* is slenderer and the spiral sculpture is more thread-like than in most of the Miocene and later species of *Strioterebrum* from America. *T.* (*S.*) *tantula* is closely related to the Mint Spring species *T.* (*S.*) *alaba* described below. Some specimens of the Mint Spring species approach *T.* (*S.*) *tantula* in the strength of the axial ribs but differ in having weaker spiral lines and a weaker subsutural band. The axials on *T.* (*S.*) *alaba* generally are not severed by the subsutural groove. Specimens can be selected of these two species that are very close, but the end members are quite distinct.

Terebra (*Strioterebrum*) *tantula* may be related through the forms with coarse spiral sculpture to *T. langdoni* Dall from the Chipola Formation (lower Miocene) of Florida. However, the spiral grooves of *T. langdoni* are coarser and the species has fewer axial ribs and deeper punctations along the subsutural groove.

The closest known relative of *T.* (*S.*) *tantula is T. ballista* Mansfield (1937, p. 77), a species which was identified as *T. tantula* by Dall, from the Tampa Limestone (lower Miocene) of Florida. The type of the Tampa species differs in having a slightly greater diameter than shells of *T.* (*S.*) *tantula* of equal height, and in having a weaker subsutural groove with a less sharply defined collar. The spiral sculpture of *T. ballista* is indistinguishable from that of typical *T.* (*S.*) *tantula.*

The relationships of this species are further discussed under *T.* (*S.*) *alaba.*

Type: Lectotype 13418 ANSP and paratypes 13419 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 259, 3722, 3729, 5615, 5623, 6454, 6455, 6978, 7295, 7372, 7376, 7385, 7440, 7457, 7460, 7941, 13286, 14682, 14683, 14772, MGS localities 93, 106, 109, 112c, 114, 115.

Terebra (Strioterebrum) alaba MacNeil n. sp.

Plate 9, figure 19; Plate 23, figures 24-27;

Plate 24, figures 1-7

Description: Shell moderately small, moderately inflated; protoconch consisting of 4 smooth whorls; aperture moderately narrow, produced anteriorly to form a short canal, gently curved in profile; columella moderately twisted, bearing a weak basal fold and a rounded callus above; parietal callus well developed; siphonal fasciole weakly raised or flat, bordered above by a raised thread which in the aperture becomes covered by callus, separated from the body whorl by a moderately broad depressed area; suture weak and appressed, subtended by a weak subsutural band of about a third the width of the exposed portion of the whorl; spiral groove and subsutural band not appearing until about the third or fourth whorl; sculpture consisting of numerous, very fine, incised, spiral lines and thin, gently curved axial ribs, the axials stronger in juveniles, weaker and sometimes obsolete in adults, the spiral lines present only between the axials in juveniles, but continuous over the weak axials in adults.

Discussion: *Terebra* (*Strioterebrum*) *alaba* differs from *T.* (*S.*) *tantula* from the Byram in being relatively stouter and in having weaker sculpture. The axials of *T.* (*S.*) *tantula* are stronger and do not show any tendency to become weaker in adults as in typical *T.* (*S.*) *alaba.* The spiral sculpture of *T.* (*S.*) *tantula* is much coarser, the grooves are wider, and the spaces between them are flattened, raised bands, whereas in *T.* (*S.*) *alaba* the spirals are fine, incised lines. The subsutural band in *T.* (*S.*) *tantula* is more in relief and the subsutural groove is stronger. The spiral sculpture of *T.* (*S.*) *alaba* crosses the axials whereas in *T.* (*S.*) *tantula* it does not. However, some of the more coarsely sculptured specimens of *T.* (*S.*) *alaba* approach *T.* (*S.*) *tantula* in both the persistence of the axials and in the failure of the spirals to cross the axials.

A single specimen of an apparently undescribed species from the Moodys Branch Formation (upper Eocene) of Jackson, Mississippi, USGS locality 4250, may be related to *T.* (*S.*) *alaba* and *T.* (*S.*) *tantula* but it has a much weaker subsutural band than either of the Vicksburg species. However, its axial ribs are moderately coarse and curved as in the Vicksburg species rather than fine, straight, and closely spaced as in the Claiborne species *T. venusta* Lea, 1833. The Jackson species has more weakly incised spiral sculpture than typical *T.* (*S.*) *alaba,* but compares with the more coarsely sculptured variety.

A typical specimen of *T.* (*S.*) *alaba* is in the Red Bluff collection, from USGS locality 309. If the label accompanying this specimen is correct, there does not appear to be any difference between the Red Bluff and Mint Spring forms.

Type: Holotype 498145 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 24, figure 3).

Occurrence: Red Bluff Formation, USGS locality 309; Mint Spring Formation, USGS localities 3723, 3727, 3728, 6648, 6451, 6452, 7268, 7384, 13287, 14071, 14072, 14162.

Terebra (Strioterebrum) vincta MacNeil n. sp.

Plate 24, figure 8; Plate 39, figure 5

Description: Shell moderately small, moderately inflated; protoconch not present on the specimens at hand; aperture narrow, produced anteriorly to form a well developed canal, gently curved in profile; columella strongly twisted, bearing a very weak basal fold; parietal callus heavy; siphonal fasciole flattened, bounded above by a blunt, raised thread which in the aperture becomes covered with callus, separated from the inflated portion of the body whorl by a shallow, depressed area of only moderate width; suture strong, subtended by a strong subsutural band of about a third the width of the exposed portion of the whorl; subsutural groove consisting of a series of pits between the axial ribs; sculpture consisting of strong axial ribs and strong spiral threads giving the shell a cancellate appearance, the axials only slightly constricted at the subsutural groove, which forms moderately deep pits between them, and the spiral sculpture finer and more crowded on the subsutural band, several very fine threads sometimes present between the larger spiral threads on the whorl proper.

Discussion: This species is closely related to an undescribed species from the Bowden Formation (middle Miocene) of Jamaica figured by Woodring (1928, p. 140, pl. 3, fig. 15) as *Terebra (Strioterebrum)* sp. *b*. The Bowden species is somewhat larger than either of the Vicksburg specimens at hand, and the axials are more cut off by the subsutural groove. The portion of the axials on the subsutural band of the Bowden species are stronger and somewhat offset to the left.

Type: Holotype 560927 USNM from the Byram Formation, USGS locality 3722 (Plate 39, figure 5).

Occurrence: Mint Spring Formation, USGS locality 7671; Byram Formation, USGS locality 3722.

Terebra (Strioterebrum) sp.

Plate 39, figures 6-7

Discussion: A fragment from the Byram Formation is of a species of *Strioterebrum* not yet found elsewhere in the formations of the Vicksburg Group. It has a considerably greater apical angle than *T.* (*S.*) *tantula* or *T.* (*S.*) *alaba* and although a narrow band just below the suture is devoid of spiral sculpture and the axials make a short twist to the left in this region, there is no spiral groove to sharply set off a subsutural band. The axials are moderately strong and sharp, gently curved and inclined to the left below the indistinct subsutural band, thus contrasting with *T.* (*S.*) *tantula* in which the axials incline to the right. The spiral grooves do not cross the axials and have the appearance of neat gougings of about the same width as the flat, polished interspaces. In contrast to *T.* (*S.*) *tantula* in which the interspaces are rounded, irregular and thread-like, the interspaces between the spiral grooves of this species appear to be elements of the same regularly curved surface.

Occurrence: Byram Formation, USGS locality 3729.

Subgenus **LAEVITEREBRUM** MacNeil n. subgen.

Type: *Terebra (Laeviterebrum) spinula* MacNeil n. sp. Oligocene, Mint Spring Formation, Mississippi.

Shell small, slender. Protoconch consisting of five, smooth whorls. Aperture narrow, constricted below and produced to form a well defined siphonal canal. Columella weakly twisted, without folds. Siphonal fasciole well defined but not prominent. Sculpture consisting of weak axial ribs on the first 3 or 4 whorls, usually becoming obsolete thereafter, but sometimes persisting weakly somewhat longer, frequently with a weak suggestion of a subsutural band.

At first glance the type of *Laeviterebrum* appears to be a *Hastula*. It differs from *Hastula*, however, in being considerably slenderer and in having a well defined canal. *Hastula* has no canal and the flaring anterior portion of the lip usually extends beyond the base of the columella. *Laeviterebrum* is much smaller and slenderer than *Terebrellina* and has much weaker sculpture. It also has a less twisted columella and a less developed siphonal fasciole. The protoconch of *Laeviterebrum* is larger and has another full turn.

Terebra (Laeviterebrum) spinula MacNeil n. sp.

Plate 23, figure 15

Description: Shell small, slender; protoconch consisting of 5 whorls, the first three rapidly expanding, the last two subequal in size; aperture narrow, produced anteriorly to form a siphonal canal, outer lip gently curved in profile; columella weakly twisted, no folds visible; parietal callus weak; siphonal fasciole flattened or with a slight swelling in the middle, bounded above by a weak, raised thread, separated from the inflated portion of the body whorl by a moderately narrow, shallow depressed or gently sloping area; suture weak, subtended by a weak suggestion of a subsutural band; sculpture consisting of weak axial ribs on the first postnuclear whorls, becoming obsolete on the third whorl of the type, but sometimes persisting until the fourth whorl, and smooth thereafter except for fine lines of growth.

Discussion: No species comparable to *T.* (*L.*)

spinula has been described from America. A small, undescribed *Hastula* from the Cercado Formation (middle Miocene) of Jamaica is almost identical in sculpture, but its aperture is typical of *Hastula* whereas *T.* (*L.*) *spinula* has a well developed canal.

Type: Holotype 498144 USNM from the Mint Spring Formation, USGS locality 3727 (Plate 23, figure 15).

Occurrence: Mint Spring Formation, USGS localities 3725, 3727, 12176, 13287, 14071.

Family TURRIDAE Swainson, 1840

Treatment of the Turridae is difficult due to the extreme diversification of this group. A large number of genera has been set up within the Turridae, based, for the most part, on modifications in the shape and sculpture of the protoconch, the aperture including the anal sinus and siphonal canal, and the anal and siphonal fascioles. Many of these genera seem to be justified even though they are based on morphological differences that in other groups would be of specific importance only. Because of the significance of the protoconch in generic determination, protoconchs of several turrid species are illustrated by SEM photographs on plates 59-62.

Subfamily TURRINAE Swainson, 1840

Genus **GEMMULA** Weinkauff, 1875

Gemmula Weinkauff, Jahrb. Deutschen Malakozoologischen Gesellschaft, v. 2, p. 287, 1875.

Type (by subsequent designation, Cossmann, 1896): *Pleurotoma gemmata* Hinds *in* Reeve. Recent, "Gulf of Magdalena, California."

Cossmann's proposal of *Hemipleurotoma* (1886-1913, p. 264, 1889) was apparently based on his later expressed assumption (1895-1925, p. 62, 1896) that *Gemmula* Weinkauff was a synonym of *Pleurotoma* s.s. The figure published by Harris (1937, pl. 1, fig. 33) of the type of *Pleurotoma gemmata* Hinds (1843, p. 37) clearly shows the relationships of Hinds' species to the type of *Hemipleurotoma, P. archimedis* Bellardi (1872-1887, p. 30, 1877) from the Miocene of Italy.

As pointed out by Hedley (1922, p. 217), *Pleurotoma gemmata* was published by Reeve in April, 1843, whereas Hinds' description was not published until October, 1843. His paper was presented to the Zoological Society in March, 1843. Reeve unequivocably credits this species to Hinds, however.

Gemmula rotaedens Conrad

Plate 35, figure 10

1848a. *Pleurotoma rotaedens* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 285.
1848b. *Pleurotoma rotaedens* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 116, pl. 11, fig. 26. Plates reprinted in Dockery, 1982, Appendix I.
1904. *Gemmula rotaedens* (Conrad). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 134.

Original Description: Conrad, 1848a.

Narrow-subfusiform, small, with a profound deeply crenulated carina on the body whorl and in the middle of each whorl of the spire; suture margined with a prominent line below and a minute one above; large volution with distinct revolving lines and minute longitudinal wrinkles; beak slightly produced, narrow, straight. Length ½. Rare.

Description: Shell moderately small, elongate, slender; protoconch consisting of five whorls. The first two smooth, small and subequal, the last two and a quarter bearing sharp axial riblets, strongly inclined when first appearing, but becoming nearly vertical and more widely spaced on the last quarter turn, the third and fourth rapidly expanding, the fifth enlarging less rapidly; aperture narrow, about .40 the height of the shell, produced anteriorly to form a moderately elongate, straight canal; anal canal forming a moderately deep, subsymmetrical notch along the peripheral keel; suture appressed, usually closed; parietal callus moderately heavy; columella moderately long and straight, narrowing to a sharp edge near the base; sculpture consisting of a strong, bicarinately noded peripheral keel, a strong subsutural spiral lira or collar above and three spiral lirae below the peripheral keel which are weak on the early whorls, becoming as strong as or stronger than the subsutural spiral on the adult whorls, the sharp sloping concavity between the peripheral keel and the subsutural collar commonly bearing two, but occasionally as many as five or six fine spiral threads, surface between prominent spirals marked by raised thread-like or wrinkled growth lines; columella sculptured by spiral lirae, the strength and regularity of which varies among individuals, but which are considerably weaker than the lirae on the body whorl, a single moderately strong lirae at the base of the body whorl, separated from the stronger ones above by two weak secondary lirae.

Discussion: This species from the Byram and Bucatunna formations appears to culminate a series of closely related species represented by *G. mediosa* MacNeil n. sp. in the Mint Spring Formation, *G. amica* Casey in the Red Bluff Formation, and possibly by the species figured by Harris (1937, pl. 1, fig. 24, 24a) as *G. conjuncta?* Casey in the Jackson Group (upper Eocene) of Danville Landing, Louisiana, which, judging from a comparison of the figure with the type of *G. conjuncta,* is a distinct species.

Gemmula nucleata Casey (1904, p. 135) from the "Lower Claiborne Eocene of St. Maurice, La." is also related.

The three Oligocene species form a perfect series showing decreasing inflation, the Red Bluff species being the most inflated and the Byram species the slenderest. According to Casey, *G. amica* is dintinguished from *G. rotaedens,* aside from its greater inflation, by having only two or three fine threads on the surface between the subsutural collar and the peripheral keel, whereas *G. rotaedens* has from three to seven, usually five or six, threads in the same region. This distinction does not always hold, for occasional specimens of the Red Bluff species are found with as many as five or six weak threads below the subsutural collar (Pl. 8, fig. 4). Both the Red Bluff and Byram species show considerable range in the nature of the constriction at the base of the body whorl, which in some specimens curves uniformly to the pillar and bears spiral threads of gradually decreasing strength, whereas in other specimens there is an abrupt truncation at the third subperipheral spiral below which there may be a steep, smooth slope, or one with fine threads only, before the normal sculpture of the pillar is resumed. The protoconch of this species is discussed under *G. mediosa.*

Gemmula rotaedens is much smaller and much more slender than any of the Miocene species described from America such as *Hemipleurotoma eileta* Gardner and *Hemipleurotoma bitropis* Gardner (1926-1950, p. 290, 1937) from the Shoal River Formation (middle Miocene) of Florida, *Pleurotoma (Gemmula) vaningeni* Brown and Pilsbry (1911-1912, p. 505, 1912) from the Gatun Formation (middle Miocene) of Panama, or *Turris brassoensis* Mansfield (1925, p. 14) from the Miocene of Trinidad.

Type: Lectotype 13422 ANSP and paratypes 13423 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 3722, 6449, 6453, 6454, 6978, 7460, 14031, 14772, MGS locality 106; Bucatunna Formation, USGS locality 14368.

Gemmula mediosa MacNeil n. sp.

Plate 21, figure 14

Description: Shell of medium size, moderately elongate and slender; protoconch consisting of at least five whorls, the very tip missing on the type, one small, smooth whorl remaining, followed by three evenly expanding whorls bearing numerous, vertical, closely set, axial riblets; aperture narrow, about .40 the height of the shell, produced anteriorly to form a moderately elongate, straight canal; anal canal forming a subsymmetrical notch of medium depth along the peripheral keel; suture appressed, closed; parietal callus light, stronger on the columella; columella moderately long and straight, narrowing to a sharp edge near the base; sculpture consisting of a moderately strong, bicarinately noded peripheral keel, and a strong subsutural lira above and other moderately strong spirals below the periphery, two visible on the whorls of the spire, three prominent lirae on the body whorl followed by others which become progressively weaker on the columella, the concavity between the subsutural lira and the peripheral keel bearing 5 or 6 spiral threads; columella sculptured by moderately fine, spiral threads diminishing towards the base.

Gemmula mediosa differs from *G. rotaedens* in being larger, more inflated, and with a less prominent peripheral keel. Its protoconch is larger, expands more uniformly, and has closely set, nearly straight, vertical, axial riblets on the last three full turns, comparing more with the Red Bluff species *G. amica. G. rotaedens* has axials on the last two turns only, the axials being curved and inclined until the last quarter turn when they become more vertical.

The type of *G. mediosa* compares with the specimen of *G. amica* (Pl. 8, fig. 5) in the nature of its basal constriction, the base of the body whorl curving evenly without any break in the spiral sculpture, rather than being abruptly truncate as in the specimen figured on Pl. 21, fig. 14. Since the Byram species *G. rotaedens* has approximately the same range in this respect as the Red Bluff species, it is to be expected that more truncate specimens of *G. mediosa* will be found.

Type: Holotype 498158 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 21, figure 14).

Occurrence: Mint Spring Formation, USGS locality 7671.

Gemmula amica (Casey)

Plate 8, figures 4-5; Plate 59, figure 11

1903. *Pleurotoma amica* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 270.
1904. *Gemmula amica* (Casey). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 134.
1937. *Gemmula amica* (Casey). Harris, Paleont. Amer., v. 2, No. 7, p. 13, pl. 1, fig. 26-28.
1964. *Gemmula amica* (Casey). Powell, Indo-Pacific Mollusca, v. 1, No. 5, p. 244.

Original Description: Casey, 1903.

Of the species allied to *rotœdens* and *tenella,* there are several forms in the Red Bluff stratum. One of these, named as above, is somewhat stout, sculptured nearly like *rotœdens,* excepting that the concave and rapidly expanded surface immediately below the sutural collar scarcely ever acquires more than about two fine threads which occupy its median parts, while in *rotædens* there are numerous fine threads at this part of the larger whorls. The nucleus in *amica* is larger than in *rotædens*, and there are generally about three of its whorls covered with fine acutely raised riblets, instead of about two whorls, as in *rotædens*. The strongly elevated median revolving keel is similar to that of *rotædens*, and double, but the nodules are coarser. Length 14.5 mm., width 4.5 mm. The corresponding dimensions of an equally well-grown specimen (that is, of six body whorls) of *rotædens*, from the Upper Vicksburg, are 11 by 2.8 mm. *Amica* may be regarded as a probable ancestor of *rotædens*.

Description: Shell of medium size, moderately elongate, medium inflated; protoconch moderately large, consisting of five, regularly expanding whorls, the first two smooth, the last three bearing fine, nearly straight, vertical axial riblets; aperture of moderate width, about .41 the height of the shell, produced anteriorly to form a canal of moderate length; anal canal forming a subsymmetrical notch of medium depth along the peripheral keel; suture appressed, closed; parietal callus moderately heavy; columella of medium length, slightly curved, narrowing to a sharp edge near the base; sculpture consisting of a strong, bicarinately noded peripheral keel, a well developed subsutural collar above the periphery and moderately coarse lirae below on the body whorl, the three uppermost being strongest, the constriction at the base of the body whorl ranging from truncate with a break in the strength of the lirae below, to evenly rounded with lirae of gradually decreasing strength below, the concavity between the subsutural carina and the peripheral keel usually with two or three weak threads, but occasionally with as many as five or six; columella with fine spirl lirae which diminish in strength towards the base.

Discussion: *Gemmula amica* differs from *G. mediosa* in being more inflated with a wider aperture and a more prominent peripheral keel. The protoconch of the two species is nearly identical so that *G. amica* differs from *G. rotaedens* in the same respects as were described for *G. mediosa*.

Whether *G. amica* is related to *G. conjuncta?* Casey (Harris, 1937, pl. 1, figs. 24, 24a) from the upper Eocene remains to be seen. The sculpture and general aspect of the two species are similar but the protoconch according to Harris' figure appears to be different. The type of *G. conjuncta* from the Jackson Group (upper Eocene) of Montgomery Landing Louisiana has a much weaker peripheral keel, a weaker subsutural lira, a less sunken suture, more wrinkled growth lines, and the protoconch consists of at least five, evenly expanding whorls, only the last whorl and a quarter of which bear the thin, vertical, axial riblets.

The holotype of *G. amica* is an individual with a moderately developed constriction at the base of the body whorl. The least constricted variety (Pl. 8, fig. 5) compares most with the type of *G. mediosa*. So great is the range in the basal constriction, however, that the type with extreme constriction is described next as a variety. The variety also has less numerous peripheral nodes.

Type: Holotype 494346 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Casey).

Occurrence: Red Bluff Formation, USGS localities 315, 2631, 2632, 2633, 2860, 5263, 5264, 14367, 14524, 14720, 14721, 14732, MGS localities 37, 38, 39.

Gemmula amica (Casey) var. A

Plate 8, figure 6

Discussion: Occurring with typical *G. amica* and apparently forming a perfectly intergrading series with in, although of much rarer occurrence, is a variety characterized by an extreme truncation at the base of its body whorl, below which is a steep or even undercut slope devoid of spiral lines. The columella bears a few weak spiral lines. The truncation is located at the third subsutural lirae, and along the aperture the angle of truncation forms a moderately pointed lobe on the outer lip.

There is some indication on the specimens at hand that the number of nodes on the peripheral keel decreases with greater constriction of the body whorl, the figured specimen of *G. amica* var. A having nine nodes visible on its last whorl, the shell having four and one half postnuclear whorls. The type of *G. amica* has twelve nodes visible at the same stage whereas the specimen with an evenly rounded base figured on Pl. 8, fig. 5, has 14 nodes at an equivalent stage.

Occurrence: Red Bluff Formation, USGS localities 2634, 5264.

Genus **CORONIA** de Gregorio, 1890

Coronia de Gregorio, Mon. Faune éocénique de l'Alabama, p. 23, 1890.

Type (by subsequent designation, Gardner, 1935): *Pleurotoma childreni* Lea, 1833. Eocene, Claiborne Group, Alabama.

Coronia was regarded as a synonym of *Hemipleurotoma* by Cossmann (Essais Paleoconch. Comp. vol. 2, p. 78, 1896) and as a distinct genus by Gardner, the latter opinion being here adopted. Cossmann's statement (op. cit.), "attendu que notre confrère sicilien a pris comme type de son sous-genre *P. acutirostra* Conr." is not regarded as a designation as he only states that de Gregorio designated a type, which he did not do. As pointed out by Gardner, *Coronia* is available for a compact group of Gulf Eocene turrids in which the axial and spiral sculpture are both strongest on the periphery of the whorl and the anal notch is broad but not deep. Probably *Coronia* is an older group than *Gemmula*, having given rise to true *Gemmula* in the Eocene, and surviving in the subgenus *Coroniopsis* in the Oligocene.

Subgenus CORONIOPSIS MacNeil n. subgen.

Type: *Pleurotoma tenella* Conrad. Oligocene, Byram Formation, Mississippi.

Shell elongate, medium to moderately inflated. Protoconch consisting of three and a half to four and a half whorls of which only the last one and one half whorls or a portion thereof bears axial sculpture. Whorls rounded. Anal notch broad, subsymmetrical, and moderately shallow. Columella moderately short, considerably thicker above than below. Periphery not elevated or carinate, bearing elongate, moderately coarse, non-bicarinate axials. Subsutural collar single, double or irregularly divided. Spiral sculpture coarser below the axial sculpture, finer or irregular on the periphery and above.

Conrad suggested that *P. tenella* probably belonged to *Clavicantha* Swainson. De Gregorio did not associate this species with his subgenus *Coronia* in which he included, in addition to species referable to *Coronia* as now restricted, the type of Cossmann's *Hemipleurotoma, P. archimedes* Bellardi, and other species closely allied to the type of *Gemmula* Weinkauff, but treated it separately as *Pleurotoma* "sensu lato". Later, however, Casey (1904, p. 137) listed this species and the related *P. ancilla* Casey from the Red Bluff together with the upper Eocene species from the Moodys Branch Formation of Mississippi, *Gemulla nodulina* Casey, under *Gemmula*, but distinguished them as a group characterized by long axial costulations which become less distinct in adults, and with a peripheral band broader and less elevated than in other species referred to this genus. Harris (1937, p. 14) treated it with undoubted Eocene and Oligocene species of *Gemmula* without reservations.

Coroniopsis is undoubtedly related to and possibly descended from the Eocene genus *Coronia* through which it is related to *Gemmula*. It differs from *Coronia*, however, in its protoconch, having only one or less whorls bearing axial riblets, *Coronia* having more than one, often three, and in its low periphery which bears strong, elongate, usually curved axials, without any tendency for the periphery or the axials to be bicarinate as in *Coronia* and more particularly in *Gemmula*.

Coronia (Coroniopsis) tenella (Conrad)

Plate 35, figures 11-12

1829. *Pleurotoma fusiformis* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 13. Printed in Dockery, 1982, Appendix II.
1848a. *Pleurotoma tenella* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.
1848b. *Pleurotoma tenella* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 22. Plates reprinted in Dockery, 1982, Appendix I.
?1890. *Pleurotoma tenella* Conrad. De Gregorio, Mon. Faune éocénique Alabama, p. 44, pl. 3, fig. 6-7.
1904. *Gemmula tenella* (Conrad) Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 137.
1937. *Gemmula tenella* (Conrad). Harris, Palaeont. Amer., v. 2, No. 7, p. 14, pl. 2, fig. 3.
1964. *Gemmula tenella* (Conrad). Powell, Indo-Pacific Mollusca, v. 1, No. 5, p. 244.

Original Description: Conrad, 1848a.

Fusiform; volutions nine, whorls slightly contracted above, with longitudinal prominent curved lines, and a prominent revolving line near and below the suture; between this and the suture an impressed line; body whorl with strong prominent revolving lines, commencing in a line with the upper end of the aperture, and sometimes alternated in size; ribs frequently obsolete on the body whorl, and terminating at the striated space; beak narrow, somewhat produced. Length 8-10.

It probably belongs to Swainson's genus *Clavicantha*.

Description: Shell of medium size, moderately inflated; protoconch consisting of about four evenly and rapidly expanding whorls, smooth and polished except for a portion ranging from the last to as little as a quarter of the last turn, which bears axial riblets, the axials weak and inclined when first appearing, the last few stronger and nearly vertical; aperture of moderate width, about .44 the height of the shell, produced anteriorly to form a moderately elongate canal; siphonal fasciole weakly defined; anal canal forming a broad, subsymmetrical, moderately shallow notch on the periphery; suture weakly appressed and moderately deep; parietal callus weaker than callus on columella; columella of moderate length, considerably thicker above than below; sculpture consisting of a broad peripheral band of low relief, and a subsutural lira of moderate strength, the peripheral band bearing elongate axials which on the young whorls are straight and relatively stronger, but which become relatively weaker and crescent shaped on the later whorls, the axials curving to the left above the peripheral band and on the early whorls forming a distinct beading on the subsutural lira, the slope between the peripheral band and the subsutural lira bearing one or two well defined secondary threads, and frequently a single poorly defined secondary occurs between the subsutural lira and the suture, the lower portion of the body whorl and the columella bearing revolving lirae of gradually decreasing strength, often alternating with weaker secondaries, siphonal fasciole bearing finer, equisized, rounded threads.

Discussion: This species is distinguished from the Red Bluff species, *C. ancilla* (Casey), by its larger size, greater inflation, wider and less elevated peripheral band, single subsutural lira, and less concave region between the peripheral band and the subsutural lira on which are found one or two poorly defined, spiral threads rather than three to five sharp threads as in *C. ancilla*. The peripheral band of *C. tenella* often bears a faint suggestion of fine, spiral striae, whereas in *C. ancilla* these striae are more pronounced, and sometimes equal in strength to the striae in the supraperipheral concavity, merging with them without a break (Pl. 8, fig. 7). The axials of *C. ancilla* are confined to the peripheral band, whereas in *C. tenella* they curve to the left above the peripheral band, cross the subsutural lira, frequently with the formation of a node or bead, and extend to the suture above.

Type: Lectotype 13490 ANSP and paratypes 13428 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 35, figure 11 - lectotype).

Occurrence: Byram Formation, USGS localites 3722, 3724, 3729, 7379, 10400, 12175, 13286, 14031, MGS localities 93, 106, 112c, 114, 115.

Coronia (Coroniopsis) tenella antetenella MacNeil n. subsp.

Plate 21, figure 15

Discussion: The Mint Spring analog of *C.* (*C.*) *tenella* is somewhat slenderer and more elongate. The last full turn of the protoconch of *C.* (*C.*) *tenella antetenella* bears axial riblets. Its peripheral band is narrower and the axials are shorter and confined to it rather than extending above it to the subsutural lira or suture as in the Byram species. The subsutural lira is not beaded as is frequently the case in *C.* (*C.*) *tenella*. The supraperipheral concavity is relatively wider due to the narrower band, and usually bears two or three spiral threads, *C.* (*C.*) *tenella* usually having one but sometimes two in the same region. As in *C.* (*C.*) *tenella* there is only one strong subsutural lira rather than two as in *C.* (*C.*) *ancilla* from the Red Bluff, the slope to the suture being either smooth or bearing a weak secondary thread. The peripheral band is devoid of spiral sculpture or bears only a suggestion of spiral threads.

Type: Holotype 498159 USNM from the Mint Spring Formation, USGS locality 14071 (PLate 21, figure 15).

Occurrence: Mint Spring Formation, USGS localities 3723, 3727, 6447, 6448, 7268, 7671, 13287, 14071, 14162.

Coronia (Coroniopsis) ancilla (Casey)

Plate 8, figures 7, 12

1903. *Pleurotoma ancilla* Casey, Acad. Nat. Sci. Philadelphia, Proc., p. 271.
1904. *Gemmula ancilla* (Casey). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 137.
1937. *Gemmula ancilla* (Casey). Harris, Palaeont. Amer., v. 2, No. 7, p. 13, pl. 1, fig. 30-31.
1964. *Gemmula ancilla* (Casey). Powell, Indo-Pacific Mollusca, v. 1, No. 5, p. 244.

Original Description: Casey, 1903.

The archetype of *tenella* in the Red Bluff may be thus named. It is nearly similar in form to *tenella* but smaller, the nucleus large and well developed, of nearly five whorls, approximately the last two having numerous fine acute riblets; it is higher than wide and acute. The subsequent whorls have a broadly obtuse revolving prominence just below the middle, which is closely ribbed, the ribs longitudinal and rounded; collar below the suture consisting of two approximate subequal and slightly uneven revolving lyræ; space between the collar and median ribbed tumidity moderately expanding and having three or four fine subequal lines; just below the median tumidity there is a fine irregular line. Aperture and canal together short, scarcely more than a third the length of the shell. Length 13 mm., width 4 mm. The specimens measured has about six body whorls.

Description: Shell of medium size, medium inflated; protoconch moderately slender, consisting of 5 whorls of which about the last turn and a half bear fine axial riblets, riblets very weak on the first half turn, inclined except for the last few which become nearly vertical; aperture of moderate width, about .42 the height of the shell, produced anteriorly to form a moderately elongate canal; siphonal fasciole very weakly defined; anal canal forming a moderately broad, subsymmetrical notch of medium depth on the peripheral band; suture weakly appressed and moderately deep; parietal callus weaker than callus on columella; columella considerably thicker above than below; sculpture consisting of a moderately narrow peripheral band of moderate relief, and a subsutural collar bearing two spiral lirae of subequal strength, the peripheral band bearing short, curved axials which are relatively stronger on the early whorls, the concavity between the peripheral band and the subsutural collar bearing three to five sharp, spiral threads, and sometimes five to six additional threads of the same series continue with undiminished strength onto the peripheral band itself, although more usually the peripheral band is marked by about three to four broader but weaker spiral threads; the lower portion of the body whorl and columella bearing coarse, spiral threads of gradually diminishing strength, usually but not always alternating with weaker secondary threads; siphonal fasciole with fine, very weak threads or smooth.

Discussion: A comparison of *C.* (*C.*) *ancilla* with the Byram species *C.* (*C.*) *tenella* has already been made under the latter species. *Coronia* (*Coroniopsis*) *ancilla* differs from both *C.* (*C.*) *tenella* and *C.* (*C.*) *antetenella* in having a double subsutural lira, the upper of the two lirae being obsolete or present as a weak secondary only in the Mint Spring and Byram forms. Its short axials restricted to the peripheral band compare with those of *C.* (*C.*) *antetenella* more than those of *C.* (*C.*) *tenella* in which they extend beyond the peripheral band to the suture above. The last turn and a half of the protoconch of *C.* (*C.*) *ancilla* bears axial riblets whereas in *C.* (*C.*) *antetenella* and *C.* (*C.*) *tenella* they rarely, if ever, precede the last full turn. Aside from the doubled subsutural collar, the most outstanding feature of *C.* (*C.*) *ancilla* which distinguishes it from the two later forms is the presence of well defined spiral lines on the peripheral band. These may be as sharp as the lines on the supraperipheral concavity on some specimens (Pl. 8, fig. 7).

The type of *Coronia* s.s., *C. childreni* (Lea) from Claiborne, differs from *C.* (*C.*) *ancilla* in having a subperipheral lira as well as a lirate subsutural collar, weaker and shorter axials on the periphery, and a narrower and less defined peripheral band on which two of the spiral threads are stronger than the rest, thus giving the periphery a bicarinate appearance as in *Gemmula.*

The relationship of *"Gemmula" nodulina* Casey from the Moodys Branch Formation (Eocene) of Jackson, Mississippi, to *C.* (*C.*) *ancilla* is not clear. Its general features are similar but more exaggerated in detail. The axials are stronger and more elongate, the peripheral keel more in relief and the supraperipheral concavity deeper and narrower. Its subsutural collar is strong and single, rather than bicarinate as in *C.* (*C.*) *ancilla.*

Type: Holotype 494354 USNM from the Red Bluff Formation, USGS locality 13288.

Occurrence: Red Bluff Formation, USGS localities 315, 2631, 2632, 2633, 2860, 5263, 5264, 6456, 13288, 13383, 14367, MGS localities 37, 38.

Genus **PLEUROLIRIA** de Gregorio, 1890

Pleuroliria de Gregorio, Mon. Faune éocénique de l'Alabama, p. 38, 1890.

Type (by subsequent designation, Cossmann, 1893): *Pleurotoma supramirifica* de Gregorio, 1890 (= *Pleurotoma cochlearis* Conrad, 1848). Oligocene, Byram Formation, Mississippi.

Woodring (1925-1928, p. 145, 1928) and Harris (1937, p. 7) both regarded *P. supramirifica* de Gregorio as type of *Pleuroliria* by original designation, but de Gregorio's statement is equivocal and might be construed as a list for he says, "Je réfère a ce groupe pour type la *Pl. supramirifica* de Greg., *tizis* De Greg., décrites ci-apres, et les espèces suivantes: . . . etc." The words "la *Pl.*" might easily be understood to precede *tizis,* just as "décrites ci-apres" follows both, so that this does not definitely constitute a type designation. Cossmann's designation of the same species in 1893, however, settles the question. Casey (1904, p. 131) in his designation of *P. cochlearis* Conrad from Vicksburg as type of *Pleuroliria* was clearly of the opinion, as evidenced by his statements on pages 128 and 132, that *P. supramirifica* actually came from Vicksburg and was therefore a synonym of Conrad's species.

Pleuroliria is very similar to, and, as suggested by Woodring, may be ancestral to *Polystira* Woodring (1925-1928, p. 145, 1928: Type, by original designation, following Dall in the identification of the species, *Pleurotoma albida* Perry, Recent, "West Indies and Florida"). As pointed out by Bartsch (1934, p. 8-9), however, *P. albida* Perry is from "New Zealand and Lord Howe's Island" so that the West Indian form Woodring had in mind is a different species. Bartsch corrected the type to *Murex virgo* Wood = *Polystira albida* Woodring, not Perry. According to the rules of nomenclature, misidentified types must not be corrected, but the type must remain the species cited if it is available and valid, even though by so doing the author's concept of the genus may be changed. In this case no change would result, the species in question being nearly identical.

Casey (1904. p. 131) described two species, *P. simplex* and *P. crenulosa* (figured by Harris, 1937, pl. 1, figs. 6, 8-8a) from the lower Claiborne Eocene of St. Maurice, Louisiana, under *Pleuroliria* but set them off in his key as having "lines of growth less pronounced, uneven and never deeply incised". If these species are actually referable to *Pleuroliria* they should probably be set aside as a distinct subgenus. *Pleuroliria jacksonella* Casey (1904, p. 131) from the Jackson Group of Montgomery Landing, Louisiana, is a true *Pleuroliria,* however, and if *P. supramirifica* should prove to be the Vicksburg *P. cochlearis* Conrad, *P. jacksonella* is the earliest true *Pleuroliria* from America.

Woodring(1925-1928, p. 145, 1928) pointed out that a species from the Shoal River Formation (middle Miocene) of Florida, since described as *Polystira* (*Pleuroliria*) *tenagos* Gardner (1926-1950, p. 288, 1937 (1938)) and the Recent *"Pleurotoma" picta* Beck (Reeve 1843-1865, p. 16, 1843) and *"Pleurotoma" albicarinata* Sowerby (1870, p. 253) from the West Coast of America are referable to *Pleuroliria,* possibly as a new subgenus. Later Gardner (1945, p. 246) proposed the name *Josephina* as a section of *Pleuroliria* with *P. tenagos* as type. Probably most writers would place the Recent West Coast species *picta* and *albicarinata* in the genus *Lophiotoma.*

Pleuroliria cochlearis (Conrad)

Plate 35, figures 8-9; Plate 59, figure 12

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 4 (no name). Printed in Dockery, 1982, Appendix II.

1848a. *Pleurotoma cochlearis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.

1848b. *Pleurotoma cochlearis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 23. Plates reprinted in Dockery, 1982, Appendix I.
1890. *Pleurotoma (Pleuroliria) supramirifica* de Gregorio, Annales de Geologie et de Paleontologie, Palerme, p. 38, pl. 2, fig. 46-48.
1890. *Pleurotoma albida* Perry, 1811. Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 1, p. 28 in part.
1915. *Turris albida* (Perry). Dall, U.S. Nat. Museum, Bull. 90, p. 38 in part, pl. 5, fig. 13.
1937 *Pleuroliria cochlearis* (Conrad). Harris, Palaeont. Amer., v. 2, No. 7, p. 7, pl. 1, fig. 2.
1937. *Pleuroliria supramirifica* (de Gregorio) "an. var. *cochlearis* Conrad." Harris, Palaeont. Amer., v. 2, No. 7, p. 8.
1964. *Pleuroliria cochlearis* (Conrad). Powell, Indo-Pacific Mollusca, v. 1, No. 5, p. 315.
1964. *Pleuroliria supramirifica* (de Gregorio). Powell, Indo-Pacific Mollusca, v. 1, No. 5, p. 315.

Original Description: Conrad, 1848a.

Subfusiform, with elevated revolving lines, alternated with fine lines, the interstices with fine longitudinal wrinkled lines; spire elevated, acute; beak narrow, straight. Length 1 2/3. Very rare.

The specimen figured is more than twice the size of any other specimen found, though it is an abundant species.

Description: Shell of medium size, moderately inflated, protoconch consisting of four whorls, the first one and a half rapidly expanding and smooth, the last two and a half more nearly equal and bearing numerous closely set, curved axial riblets, strongly inclined when first appearing, but becoming nearly vertical on the last quarter turn; aperture moderately narrow, about .43 the height of the shell, produced anteriorly to form a moderately long, straight canal, terminated above by a canaliculate notch; anal canal forming a moderately deep, nearly symmetrical notch along the peripheral keel; outer lip thin and crenulated at the edge, but thickened farther back and bearing from four to six internal folds; suture usually closed, situated on or just below the subperipheral lira; parietal callus moderately heavy; columella moderately long and straight, narrowing to a knife edge near the base; sculpture consisting of strong, spiral lirae, the peripheral lira broad and flat-topped, one prominent spiral above the periphery in juveniles and another below the periphery on about the fifth whorl, five or six additional spiral lirae on the lower part of the body whorl in full grown adults, the interspaces between the lirae U-shaped and without other spiral markings on the first few whorls, but with secondary and tertiary spiral lines on the adult whorls, slightly irregular, closely set, raised, rounded growth lines in the interspaces but not crossing the prominent spirals; columella sculptured by spiral, somewhat irregular threads of about the magnitude of the secondary lirae of the spire, a single strong thread just below the base of the body whorl.

Discussion: *Pleuroliria cochlearis* is distinguished from *P. subsimilis* Casey from the Red Bluff by its more widely separated peripheral and subsutural lirae, and usually stronger and more closely set axial riblets on the protoconch. As expressed by Casey, *P. cochlearis* has a "prominent subsutural carina separated from the still stronger peripheral carina by a concave space having several fine spiral threads, this surface being subequal to or slightly shorter than the interval separating the subsutural carina from the peripheral carina of the whorl above," whereas *P. subsimilis* is distinguished by "a strong and rather more acutely elevated subsutural carina separated from the coarser peripheral carina by a relatively much shorter concave space, which is always very much shorter than the interval between the subsutural carina and the peripheral keel of the whorl above." The subsutural lira of *P. cochlearis* tends to be nearer the suture, frequently without any secondary lira above it, whereas in *P. subsimilis* the subsutural lira is farther from the suture and a well developed secondary lira occurs above it. The sculpture of the protoconch of the two species exhibits a varietal series ranging from the stronger, more nearly vertical, and more closely set axial riblets of most specimens of *P. cochlearis* to the weaker, more inclined, and more widely spaced riblets most common in *P. subsimilis,* although protoconchs of either species can be selected which approach the sculpture of the other.

Pleuroliria cochlearis is not closely related to *P. tenagos* Gardner from the Shoal River Formation (middle Miocene) of western Florida, although judging from the protoconch of the latter it is a true *Pleuroliria.* The Shoal River species has a much stronger peripheral lira and only three widely spaced lirae below on the body whorl of a large specimen.

Two poorly preserved young specimens from the Mint Spring Formation are doubtfully referred to *P. cochlearis* s.s., but the majority of specimens from the Mint Spring Formation are referred to the subspecies *P. cochlearis vetula,* described below.

Type: Lectotype 13420 ANSP and paratype 13421 ANSP both from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 2664, 3140, 3722, 5615, 6453, 6454, 6978, 7372, 7376, 7446, 7453, 10400, 12175, 13286, 14772, 14682, MGS localities 93, 106, 109, 112c, 114, 115; ?Mint Spring Formation, USGS locality 7671.

Pleuroliria cochlearis vetula
MacNeil n. subsp.
Plate 21, figure 13

Discussion: Aside from the doubtful identification of two immature specimens from the Brown's cave in central Mississippi as *P. cochlearis* s.s., all other Mint Spring specimens, all of which are from western Mississippi, are referred to the subspecies *vetula*. Typical *P. cochlearis* has two prominent spirals until about the fifth whorl at which time an equally strong spiral develops below the periphery spiral making the adult whorls trilirate. The subperipheral spiral does not develop on the subspecies *vetula* until the eighth whorl, and commonly never does become as prominent as the peripheral and supraperipheral spirals. The protoconch of the subspecies is slenderer with more widely spaced axial riblets than the typical form.

Type: Holotype 498157 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 21, figure 13).

Occurrence: Mint Spring Formation USGS localities 3724, 3727, 6452, 6647, 7384, 7445, 13287, 14071, 14162, 14524, 14849.

Pleuroliria subsimilis Casey

Plate 8, figure 2

1904. *Pleuroliria subsimilis* Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 132.
1937. *Pleuroliria subsimilis* Casey. Harris, Palaeont., Amer., v. 2, No. 7, p. 8, pl. 1, fig. 3-4.
1964. *Pleuroliria subsimilis* Casey. Powell, Indo-Pacific Mollusca, v. 1, No. 5, p. 315.

Description: Shell of medium size, moderately elongate, medium inflated; protoconch consisting of 4 whorls, the first one and a half whorls smooth and expanding slightly more rapidly than the last two and a half whorls, the latter bearing numerous moderately spaced, curved, axial riblets, strongly inclined when first appearing, but more nearly vertical on the last quarter turn; aperture narrow, about .48 the height of the shell produced anteriorly to form an elongate, straight canal, terminated above by a canaliculate notch; anal canal forming a moderately deep, unsymmetrical notch along the peripheral keel; suture usually open, situated below the subperipheral lira; parietal callus moderately heavy; columella long and straight, narrowing to a sharp edge near the base; sculpture consisting of strong spiral lirae with many fine, raised, threadlike or wrinkled growth lines between the lirae, the peripheral lira broader and flatter than the others, one primary lira above and one below the periphery on the early whorls, but another appearing both above and below the periphery and becoming equal in size to the primary lirae on about the sixth whorl, about six to seven lirae of about equal size on the body whorl of full grown adults, the interspaces below the peripheral keel without sculpture other than the wrinkled growth lines mentioned on the early whorls, but with strong secondary and tertiary spiral lines on the adult whorls; columella sculptured by spiral threads, every other one stronger above, but more uniform and finer below, a single strong thread just below the base of the body whorl.

Discussion: As quoted from Casey under *P. cochlearis*, this species is best distinguished from the Byram species by its relatively greater distance from the subsutural lira to the peripheral keel of the whorl above. It is slenderer than *P. cochlearis* and has a relatively longer canal. *Pleuroliria subsimilis* has better developed secondary lirae above and below the primary subsutural lira than *P. cochlearis*.

The Mint Spring subspecies, *P. cochlearis vetula*, has much less developed growth lines with finer and neater secondary and tertiary spiral threads, in addition to the differences which distinguish typical *P. cochlearis* from *P. subsimilis*.

Pleuroliria jacksonella from the Jackson Group of Louisiana and the Moodys Branch Formation of Mississippi is quite distinct from the Red Bluff species. It is known to date only from small shells, probably juveniles, the largest of which is 5.4 mm. in height. It differs from both *P. cochlearis* and *P. subsimilis* in having a shorter, more rapidly and evenly expanding protoconch with axial riblets on the last half turn only, rather than on the last two and a half turns. The spire has a considerably greater angle, the whorls are more submerged, and the subsutural lira and peripheral keel are relatively stronger and more nearly equal in size.

Type: Holotype 494345 USNM from the Red Bluff Formation, "Red Bluff" (Casey).

Occurrence: Red Bluff Formation, USGS localities 315, 2631, 2632, 2633, 2860, 5264, 6456, 13288, 15058, MGS localities 37, 38.

Pleuroliria tenuis MacNeil n. sp.

Plate 8, figure 3

Description: Shell of medium size, elongate, slender for the genus; protoconch unknown; aperture narrow, about .40 the height of the shell, produced anteriorly to form a canal of moderate length, terminated above by a canaliculate notch; anal canal forming a symmetrical, somewhat expanded notch along the peripheral lira, suture appressed and closed, situated on or below the second subperipheral lira; parietal callus moderately heavy; columella of medium length, narrowing to a sharp edge near the base; sculpture consisting of moderately strong spiral lirae with many fine, raised, thread-like or wrinkled growth lines between the lirae, the peripheral lira not noticeably larger than the others, three or four lirae of equal strength visible on the adult whorls, depending on the position of the suture, but only two are prominent on very young whorls, six well spaced lirae present on the body whorl of the type, with three finer lirae below, interspaces between the larger lirae bearing a single fine thread; columella sculptured by moderately fine, spiral threads with a single stronger thread at the base of the body whorl.

Discussion: *Pleuroliria tenuis* is distinguished from the other Red Bluff species, *P. subsimilis*, by its slenderer and more elongate spire, shorter columella, and weaker and more widely spaced spiral lirae which are subequal in strength. If *P. tenuis* is merely a variety of *P. subsimilis*, there is no evidence of any intergradation in any of the three specimens at hand.

In the details of its sculpture, *P. tenuis* compares most favorably with *Polystira tampensis* Mansfield, 1937, p. 82, from the Tampa Limestone of Florida, but the spire is thinner and less rapidly expanding. The protoconch of the Tampa species is not known, but if it is really a *Polystira* rather than a *Pleuroliria*, the similarity is probably homeomorphic.

Type: Holotype 136501 USNM from the Red Bluff Formation, USGS locality 309.

Occurrence: Red Bluff Formation, USGS locality 309.

Subfamily TURRICULINAE Powell, 1942

Genus **TURRICULA** Schumacher, 1817

Turricula Schumacher, Essais d'une nouveau systeme des habitations des vers testaces, p. 217, 1817.

Type (by monotype): *Turricula flammea* Schumacher (=*Murex javanus* Chemnitz, non Linné, 1767 =*Murex tornatus* Dillwyn, 1817). Recent, East Indies.

Casey treated *Turricula* Schumacher as a synonym of *Surcula* H. and A. Adams (Type, *Pleurotoma nodifera* Lamarck = *Murex javanus* Linné, non Keiner) because of his belief that they were congeneric and that *Turricula* was preoccupied by *"Turriculae"* Hermann 1783. Because of this he regarded *Orthosurcula* Casey as a distinct genus. Iredale (1915, p. 294), however, satisfactorily disposed of *Turriculae* Hermann as not having been used in a generic sense. Cossmann (1906, p. 222) also regarded *Turricula* as a homonym and stated that he saw no difference between *Orthosurcula* and *Surcula*. More recently Grant and Gale (1931, p. 487) regarded both *Surcula* and *Orthosurcula* as synonyms of *Turricula*, whereas Woodring (1928, p. 166), who had no interest in *Orthosurcula*, apparently regarded *Turricula* and *Surcula* as distinct genera. Powell (1969, p. 231), placed *Surcula* as a synonym of *Turricula* and regarded *Orthosurcula* as a separate genus but stated that it closely resembled *Turricula* (p. 392).

The status of *Surcula* is of no direct interest to this report, but on the basis of its sculpture, the depth of its canal sinus, and its shorter, twisted canal it would seem to be as much entitled to generic separation from *Turricula* as many other widely endorsed turrid generic separations. Certain differences are recognized between *Turricula* and *Orthosurcula*, but the major aspects, unless they can someday be proved to be homeomorphic, are so similar that I can see no more than subgeneric difference at best.

Subgenus **ORTHOSURCULA** Casey, 1904

Orthosurcula Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 151, 1904.

Type (by subsequent designation, Gardner, 1936): *Pleurotoma longiforma* Aldrich. Oligocene, Red Bluff Formation, Mississippi.

Orthosurcula was regarded as a valid genus by Casey, being distinguished from *Turricula* mainly by its long, straight siphonal canal without any trace of a ridge or swelling along the siphonal fasciole. The difference between a straight and a twisted canal does not appear to be of great importance, especially since some range in the degree of twisting is to be found among specimens of *Turricula tornata*.

It is doubtful whether the species from the Midway Group of Texas referred to *Orthosurcula* by Gardner (1936, p. 216-218) actually belong to the same genus.

Harris' treatment (1937, p. 43) of *Orthosurcula* as a "genus" of *Turricula* sensu lato is unsatisfactory.

Orthosurcula is probably descended from the Eocene genus *Protosurcula* Casey (type, by original designation, *Surcula gabbi* Conrad, middle Eocene Texas) with which it compares in shape and in having a similar type of spiral sculpture. In the opinion of some *Orthosurcula* should probably be regarded as a subgenus of *Protosurcula*, or possibly both as subgenera of *Turricula*. I prefer, however, to regard *Protosurcula* as a distinct genus and to treat *Orthosurcula* as a subgenus, probably the ancestral subgenus, of *Turricula*.

Turricula (Orthosurcula) longiforma (Aldrich)

Plate 8, figure 1

1885. *Pleurotoma (Surcula) longiforma* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 146, pl. 2, fig. 10a, 10b.

1886. *Pleurotoma (Surcula) longiforma* Aldrich. Aldrich, Geol. Survey Alabama, Bull. 1, pt. 1, p. 30, pl. 2, fig. 10a, 10b.

1904. *Orthosurcula longiforma* (Aldrich). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 151.

1942. *Orthosurcula longiforma* (Aldrich). Powell, Auckland Inst. Museum, Bull. 2, p. 18.

1969. *Orthosurcula longiforma* (Aldrich). Powell, Indo-Pacific Mollusca, v. 2, No. 10, p. 392.
1980. *Orthosurcula longiforma* (Aldrich). Dockery, Mississippi Bureau Geol., Bull. 122, p. 131, pl. 76, fig. 6.

Original Description: Aldrich, 1885.

Shell, fusiform; volutions, eleven to twelve, convex beneath, subangulated and constricted above; suture, plainly marked; the indented space convex in some specimens, in others flat, and covered with close revolving lines; a prominent line bounding the periphery, sometimes minutely beaded; revolving lines on the lower part of each volution fainter, obsolete on center of body whorl, rather prominent and alternate on the beak, which is long and straight nearly half the length of the shell; lines of growth rather prominent; slit in lip profound (Fig. 10 b). Length, 2 8/10 inches.

Localities, Carson's Creek, Red Bluff, and Vicksburg, Miss.

This species has the form and markings of *Surcula Gabbi Con.* from Texas, but a comparison with the type of that species shows it to be different in the number of whorls, shape of the upper part of the volutions, and general form.

Description: Shell large and elongate; protoconch consisting of about 3 1/4 whorls, the first smooth and subnaticoidal, the second and third smooth and inverted bowl-shaped with a fine, sharp thread at the periphery just above the suture, the last quarter turn bearing moderately coarse, axial riblets, the fine basal thread becoming obsolete before the beginning of the adult sculpture; aperture moderately narrow, about 0.54 to 0.57 the height of the shell, produced anteriorly to form a long, straight, moderately slender canal; anal canal forming a deep, broad sinus on the depressed region just above the shoulder, the portion of the outer lip forming the lower edge of the sinus much more rounded and retractive than the upper edge which is nearly straight and extends much more vertically to the suture; anal fasciole marked by growth lines only, situated at the base of the truncation above the shoulder; shoulder usually sharply rounded, but occasionally forming a sharp projecting edge in full grown adults; periphery rounded and nearly smooth, curving more rapidly above than below; suture closed and appressed, subtended by a broad, nearly flat collar-like area; parietal callus thin, slightly thicker on the columella below; columella moderately slender, long; sculpture consisting of fine, polished threads, present all over the whorls and stronger on the periphery in juveniles, but extremely weak or obsolete on the broad periphery of adults, the first four juvenile whorls bearing weak, inclined, axial nodes.

Discussion: No earlier species are known from America which are referable to *Orthosurcula*. The type of *Protosurcula, P. gabbi* Conrad, from the lower Claiborne, has spiral lines all over the whorls in adults as well as juveniles, those on the periphery being strongest, a higher subsutural collar bearing two or three strong spiral threads, and a larger protoconch of which the last three full turns bear fine axial riblets and fine spiral threads. In *T. longiforma* only the last quarter turn bears axial riblets. The whorl preceding the sculptured whorls of *P. gabbi*, however, is inverted bowl-shaped and has a single fine thread just above the suture comparing with the second and third whorls of the protoconch of *T. longiforma*.

Turricula (*Orthosurcula*) *longiforma* is identified with certainty only from the Red Bluff Formation. Three specimens in the Museum collections and one in the Casey collection from the Byram Formation are a different species and are described below. *Turricula* (*Orthosurcula*) has not yet been collected from the Mint Spring Formation. The two specimens figured by Aldrich are labelled "Red Bluff" in his collection. In all probability the specimen mentioned from Vicksburg is from the Byram marl.

Type: Figured syntypes 645081 and 645082 USNM from the Red Bluff Formation, "Red Bluff" (Aldrich).

Occurrence: Red Bluff Formation, USGS localities 309, 315, 319, 2631, 2632, 2633, 2634, 2860, 5263, 5264, 6456, 13288, 13383, MGS localities 34b, 35b, 37, 38, 39, 40.

Turricula (Orthosurcula) byramensis MacNeil n. sp.

Plate 35, figures 7, 14-15

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 1 (no name). Printed in Dockery, 1982, Appendix II.

Description: Shell moderately large and moderately slender; protoconch not complete on any of the specimens at hand, but the last two whorls are inverted bowl-shaped with a fine, sharp thread at the base just above the suture, axial riblets indistinct and eroded, but apparently only three or four in number; aperture narrow, about 0.55 the height of the shell, produced anteriorly to form a long, straight, slender canal; anal sinus broad, deep, and unsymmetrical; anal fasciole marked by growth lines only, situated at the base of the shoulder truncation; shoulder weakly truncate, often merging with the flattened subsutural area with only an abrupt termination of curvature; periphery broadly rounded, only moderately inflated, nearly smooth, suture closed and appressed, subtended by a broad, flattened collar-like area; parietal callus weak, thicker on the collumella; columella slender, long; sculpture consisting of fine, rounded threads, present all over the whorls and stronger on the periphery in juveniles, becoming broader and finally obsolete on the periphery of adults, the first four juvenile whorls bearing weak, inclined axial nodes.

Discussion: This species differs from the Red Bluff *T. longiforma* in being slenderer with a less inflated periphery and a shallower shoulder truncation. The difference in the inflation of the periphery is especially noticeable on the juvenile whorls. The axial nodes on the first whorl of the teleoconch persist longer in the Byram species than in the Red Bluff species, but there are fewer axial riblets on the last of the protoconch in the Byram species.

A specimen from Byram is made the type of this species because its locality and horizon are definitely known, although it is not as large nor as complete a specimen as the paratype from "Vicksburg", which judging from its matrix and preservation is also from the Byram Formation.

So far as known this is the last species of *Turricula* (*Orthosurcula*) in America.

Type: Holotype 376583 USNM from the Byram Formation, USGS locality 6455 (Plate 35, figure 15), and paratype 376582 USNM from the Byram Formation, USGS locality 3730 (Plate 35, figure 14).

Occurrence: Byram Formation, USGS localities 3722, 3730, 6455, 13286, MGS locality 106.

Genus **PLEUROFUSIA** de Gregorio, 1890

Pleurofusia de Gregorio, Mon. Faune éocénique de l'Alabama, p. 33, 1890.

Type (by original designation): *Pleurotoma* (*Pleurofusia*) *longirostropsis* de Gregorio (= *Pleurotoma vicksburgensis* Casey). Oligocene, Byram Formation, Mississippi.

The identity of the type of *Pleurofusia* has been in doubt since the time of its description due to the exaggeration of its features in the original drawing and to the supposition that it came from Claiborne. In an attempt to identify it three possibilities suggest themselves; first, that *P. longirostropsis* did actually come from Claiborne, but has not since been found; second, that the species is from Claiborne, but is at present known by some other name; and third, that *P. longirostropsis* is really a Vicksburg species, as has been demonstrated for other of de Gregorio's species, in which case it is either *P. servata* Conrad or *P. vicksburgensis* Casey, more likely the latter due to the much closer resemblance of its sculpture to that of de Gregorio's figure. With regard to the second possibility, two specimens from Claiborne bearing the label *P. longirostropsis* are in the National Museum, one collected by Schuchert and the other acquired in the Casey collection. They are both the species now known as *Lyrosurcula dalli* (Cossmann). Woodring (1928, p. 166) disposed of the Schuchert specimen with the remark, "No specimens of *longirostropsis* are in the collections of the United States National Museum, specimens so labeled representing a short canaled "*Drillia*" - like turrid with fusoid sculpture." Casey presumably acquired his specimen after his last published word as he says (1904, p. 152), "Nothing very similar [to *P. longirostropsis*] is known to me from the Upper Claiborne ferruginous sand, but there is a specimen in the cabinet of Mr. Aldrich, from the Lower Claiborne, which greatly resembles the figure referred to." The specimen thus referred to was acquired from Aldrich and bears a manuscript name, but the species has since been described by Harris (1937, p. 83, pl. 13, fig. 44-46) as *Lyrosurcula dalli*, var. *quadrivaricata* Harris.

In view of the fact that several other of de Gregorio's specimens are now definitely known to have come from Vicksburg, however, it seems probable that the third alternative is correct. Although de Gregorio believed his specimen of *P. longirostropsis* came from Claiborne, he described it as a variety of the Vicksburg *P. servata*, the characters of which he well knew, and took pains to distinguish it from *P. servata*, which has subequal spiral lines distributed more or less evenly over the whorls, by stating that it has three prominent spiral lines, two at the periphery and one just below the suture. These are the principal characters which distinguish *P. servata* from *P. vicksburgensis* Casey and they are most pronounced in shells of about the dimensions that de Gregorio gave for his specimen of *P. longirostropsis*. Casey believed de Gregorio's species came from Vicksburg, but he regarded it as a synonym of *P. servata* Conrad, and not an earlier description of his own *P. vicksburgensis*.

Of the species referred to *Pleurofusia* by Casey two distinct types of protoconchs are present, one characterized by a sharp, conical, multispiral nucleus, and the other by a blunt, inclined, naticoidal protoconch. Although this condition was well known to Casey, he did not regard it as a matter of generic significance but rather as proof that the protoconch may vary markedly within the same genus. His views are best expressed in his own words, "Of the inconstant type of embryo I have in mind three striking illustrations... . The second instance is that of *Pleurofusia* de Gregorio, the type of which is the American Oligocene *servata* of Conrad [of which he believed *P. longirostropsis* to be a synonym], containing many species having the embryo typically multispiral, conical, pointed, and closely coiled, but in such forms as *collaris* and *hilgardi* Csy., of the Jacksonian Eocene and *declivis* Conrad, of the Vicksburg Oligocene, the embryo becomes obtuse as to appear swollen owing to the very large nucleus or posterior tip of the embryo - following the terminology of Cossmann. It appears unwarrantable to separate these paucispiral forms from the others, as in general habitus, type of sculpture and all other features they seem to be perfectly congeneric."

Woodring (1928) regarded the sharp, conical protoconch of *P. servata* as typical of *Pleurofusia*. *Fusiturricula* Woodring (type, *Turris* (*Surcula*) *fusinella* Dall, Recent, Gulf of Panama) was regarded as generically distinct from *Pleurofusia* on the basis of the characteristics of its protoconch. Woodring must have emphasized the protoconch of the Bowden species, *F. iole* Woodring and *F. panola* Woodring in this statement, however, as they have a blunt, paucispiral protoconch, that of the latter being particularly large, inclined and naticoidal and similar to that of *P. decliva*, whereas the slender, uniformly enlarging protoconch which he described for *Turris fusinella*, I find upon comparison, has fewer whorls but is not unlike that of *P. servata*. It is even more like that of the type, *P. longirostropsis* (=*P. vicksburgensis*).

One new subgenus under *Pleurofusia*, *Xestosurcula*, is described beyond. Of the remaining species referred to *Pleurofusia* it is recognized that at least one other subgenus may exist, although it is not named at present. This group referred to beyond as the group of *P. servata* appears closely related to and possibly has a common origin with *Xestosurcula* but more closely resembles typical *Pleurofusia* in sculpture.

Pleurofusia longirostropsis de Gregorio

Plate 35, figures 16-18, 22-24

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 2 (no name). Printed in Dockery, 1982, Appendix II.
1890. *Pleurotoma* (*Pleurofusia*) *longirostropsis* de Gregorio, Mon. Faune éocénique de l'Alabama, p. 34.
1893. *Surcula longirostropsis* (de Gregorio). Cossmann, Notes complémentaires sur la Faune éocénique de l'Alabama, p. 43.
1903. *Pleurotoma vicksburgensis* Casey, Acad. Nat. Sci. Philadelphia, Proc., p. 268.
1904. *Pleurofusia vicksburgensis* (Casey). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 152.
1937. *Pleurofusia longirostropsis* (de Gregorio). Harris, Palaeont. Amer., v. 2, No. 7, p. 51, pl. 10, fig. 6.
1937. *Pleurofusia vicksburgensis* (Casey). Harris, Palaeont. Amer., v. 2, No. 7, p. 51, pl. 10, fig. 3.
1969. *Pleurofusia longirostropsis* (de Gregorio). Powell, Indo-Pacific Mollusca, v. 2, No. 10, p. 302.
1969. *Pleurofusia vicksburgensis* (Casey). Powell, Indo-Pacific Mollusca, v. 2, No. 10, p. 302.

Original Description of *P. vicksburgensis*: Casey, 1903.

This species occurs plentifully in the Vicksburgian beds, accompanying *servata* and generally confounded with it. It usually attained a little larger size and stouter form, and may be distinguished at once by the fact that the whorl immediately adjoining the nucleus has a strong revolving line below the middle, thickened on the ribs and accompanied by a close-set smaller revolving line immediately above it. The larger whorls generally acquire two other coarse, though much smaller revolving lines, one above and one below the two mentioned and also finer intermediate threads. Just below the suture the elevated collar is not quite so prominent as in *servata*, and, instead of the abrupt concavity adjoining, the surface is almost evenly concave and rapidly expanded to the system of coarse revolving lines referred to, this surface being also finely, evenly lyrate. The nucleus is much shorter than in *servata*, consisting of between two and three whorls, and is not higher than wide. The aperture and canal are nearly as in *servata*. One of the larger specimens before me measures 27mm. in length by 7 mm. in width. The double carina of the nepionic whorls remains throughout the most conspicuous feature of the revolving sculpture, the lines becoming gradually more nearly equal and more widely spaced, with the dilatations on the ribs much more pronounced than in *servata*; the ribs, also, are much more broadly rounded than in that species and become obsolete in the posterior concave area of the whorls. A specimen in the Conrad collection is marked "*servata* var.?"; it is deprived of the nucleus and adjoining whorls. Both this species and *servata* occur also in the Lower Vicksburg but in slightly modified forms.

Description: Shell moderately large and of medium inflation; protoconch moderately small and conical, consisting of about three and a half evenly expanding whorls, the first two and a half of which are smooth, the last full turn bearing a thread at the lower two thirds, weak when first appearing, but strong and sharp with fine, crescent-shaped axials above it on the last half turn; aperture moderately narrow, about .50 to .52 the height of the shell, produced anteriorly to form a canal of medium length, somewhat twisted in full grown adults; inner side of outer lip bearing moderately strong spiral lines, short and opposite the nodes in juveniles but becoming elongate and continuous in large individuals; anal sinus moderately broad, subsymmetrical, and of moderate depth; anal fasciole moderately broad and concave, separated from the suture by a prominent but moderately narrow collar; whorls sloping abruptly to the concave fasciole above the periphery, but more evenly rounded below; suture closed, more appressed in juveniles than in adults; parietal callus weak, columellar callus moderately strong; sculpture consisting of a single strong spiral on the collar and two prominent spirals along the periphery in juveniles but supplemented by additional spirals in larger individuals, usually one appearing between the primary spirals and two below, weaker spiral lines continuing below on the body whorl and diminishing in strength on the columella, the interspaces bearing from one to five, fine sharp threads with several (6-10) strong, elevated, closely-set spiral threads covering the anal fasciole, axial sculpture not sharp, consisting of broad, undulating nodes of which four are in full view at any angle.

Discussion: Closely related to *P. longirostropsis* are *P. longirostropsis bicollaris* MacNeil n. subsp. from the Mint Spring and *P. hiwanneensis* MacNeil n. sp. from the Red Bluff, next described. In addition a smaller species, *P. wythei* MacNeil n. sp., also occurs in the Mint Spring but differs from both *P. longirostropsis* and *P. hiwanneensis* in having weaker sculpture, both spiral and axial, the axials being nearly obsolete in adults.

Occurring with *P. longirostropsis* in the Byram Formation are two similarly sculptured forms, *P. decliva* Conrad and its subspecies, *P. decliva asper* MacNeil n. subsp. These differ from *P. longirostropsis* in having a more sharply incised anal fasciole, without or with much weaker spiral sculpture thereon, and in having a protoconch with a swollen, inclined, naticoidal tip, thus differing from the sharp, conical protoconch of *P. longirostropsis*. In the Mint Spring is a species, *P. menthafons* MacNeil n. sp., related to *P. decliva* in the characters of its protoconch, but not confusable with *P. longirostropsis bicollaris* with which it occurs.

It is difficult to say how the above species are interrelated, but the writer is inclined to agree with Casey that the size of the embryonic tip is not a matter of profound importance, especially in view of the fact that the latter stages of the embryo do not differ in the general pattern of sculpture or the position of the carina. It may be that some such simple explanation as the amount of yolk in the egg accounts for the size of the protoconch's tip. Tentatively, however, the forms with large and small embyros are treated as separate genetic groups.

Superficially *P. longirostropsis* bears strong resemblance to *Knefastia glypta* Gardner from the Chipola, but the juvenile stages are quite distinct, the double spiralled periphery of *K. glypta* originating as a single carina just above the suture below and sloping evenly to the suture above, the slope bearing 3 to 4 fine threads. The double spiral of *P. longirostropsis*, however, occupies a central position on the juvenile whorls with fine lines appearing both above and below it on the latter part of the first whorl.

A *Pleurofusia, P.* sp. cf. *P. vicksburgensis* Casey, was reported by Mansfield (1940, p. 203, pl. 27, fig. 6) from the Chickasawhay Limestone of Wayne Co., Mississippi, and Escambia Co., Alabama. This form is still not represented by well enough preserved material to make its identification certain, but in the writer's opinion the differences pointed out by Mansfield are not justified. *Knefastia? brooksvillensis* Mansfield from the Suwannee Limestone is closely related but likewise is represented by poor material.

Drillia fusinus Brown and Pilsbry from the Gatun Formation of Panama is a true *Pleurofusia* and closely related to *P. longirostropsis*, differing mainly in a stronger pair of peripheral lirae and a narrower and more impressed anal fasciole. The characters of the protoconchs are very similar.

Type: Type of *P. longirostropsis* de Gregorio: Type formerly in de Gregorio Collection, University Palermo, Palermo, Sicily - lost; type was probably from the Byram Formation, Vicksburg, Mississippi. Type of *P. vicksburgensis* Casey: Holotype 481670 USNM from the Byram Formation, USGS locality 13286.

Occurrence: Byram Formation, USGS localities 259, 3722, 7376, 7440, 7941, 12175, 12179b, 13286, 14368, 14683, MGS localities 106, 112c, 115.

Pleurofusia longirostropsis bicollaris
MacNeil n. subsp.

Plate 21, figures 20-21, 28

Discussion: This subspecies is probably the form to which Casey (1903, p. 269) referred in the remark, "both this species [*P. vicksburgensis*] and *servata* occur in the Lower Vicksburg, but in slightly modified forms." The form is so named because it commonly bears two moderately strong spiral lines on the subsutural collar instead of a single strong spiral characteristic of typical *P. longirostropsis*, but, although the double collared form is the more abundant, it really forms the end member of a series in which the upper spiral may be very weak or absent as in the typical form. No specimens of *P. longirostropsis* from the Byram Formation have been seen with a double spiral on the collar, however. The anal fasciole is less sunken than is common for the Byram form, and the spiral threads on the fasciole are generally fewer (4-7) and weaker, no specimens having been seen on which they are as strong as on the type of *P. vicksburgensis*. There is also some range in the apical angle in this subspecies.

Both the typical form and the Red Bluff form, *P. hiwanneensis*, have a single spiral on the collar, so that the single spiralled variety of the Mint Spring subspecies may be the connecting form, with the double spiralled form an end member which was not perpetuated.

Type: Holotype 376486 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 21, figures 20-21).

Occurrence: Mint Spring Formation, USGS localities 6448a, 6452, 8240, 13287, 14162.

Pleurofusia hiwanneensis MacNeil n. sp.

Plate 8, figure 14; Plate 59, figure 13

Description: Shell of medium inflation; protoconch moderately small and conical, consisting of three and a half evenly expanding whorls, the first two and a half smooth, the last full turn bearing a thread-like keel at the lower two thirds, weak when first appearing, but strong and sharp with weak, crescent-shaped axials above it on the last half turn; aperture moderately narrow, probably about .50 the height of the shell, produced anteriorly to form a canal of medium length, base of canal broken on the type; inner side of outer lip bearing moderately strong spiral lines; anal sinus moderately broad, subsymmetrical and of moderate depth; anal fasciole broad and concave, separated form the suture by a prominent collar; slope from periphery to anal fasciole not abrupt; suture closed, slightly appressed in juveniles; parietal callus and columellar callus weak; sculpture consisting of a strong spiral on the collar, two prominent spirals on the periphery and a weaker spiral line just above the suture, similar spirals continuing below on the body whorl and diminishing in strength on the columella, the interspaces bearing from 1 to 5 fine, sharp threads and the anal fasciole bearing from 6 to 7 slightly stronger threads, axial sculpture consisting of broad undulating nodes of which 4 are visible at any angle.

Discussion: This species is undoubtedly the forerunner of *P. longirostropsis* in the Byram. Its protoconch is almost identical with that of *P. longirostropsis* although the crescent-shaped axials may be slightly weaker. The type and two other imperfect specimens are the only ones known so that the differences here pointed out are not known to be consistent, but they differ from any specimens of the Byram species thus far seen in having weaker, usually fewer and less crowded spiral threads on the anal fasciole, and in having somewhat weaker peripheral spiral lirae. Only occasional specimens of *P. longirostropsis* are found in which only one primary spiral occurs between the peripheral pair and the suture below and then it is usually farther removed from the suture than in the Red Bluff species. The anal fasciole in *P. longirostropsis* is usually more concave and the slope from the periphery to the fasciole is more abrupt.

Type: Holotype 498043 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 8, figure 14).

Occurrence: Red Bluff Formation, USGS localities 2633, 5264, 13383, MGS localities 37, 38.

Pleurofusia wythei MacNeil n. sp.

Plate 21, figures 25-26

Description: Shell small to medium size and of medium inflation; protoconch moderately small and conical, about 3 1/2 evenly expanding whorls, the first two and a half smooth, the last turn bearing a carinate thread at the lower two thirds, weak when first appearing but strong and sharp with crescent-shaped axials above it on the last half turn or less; aperture of medium width, about .45 the height of the shell, produced anteriorly to form a slightly twisted canal of medium length; inner side of outer lip bearing moderately strong, disconnected spiral lirae opposite the external nodes; anal sinus moderately broad, subsymmetrical, moderately deep; anal fasciole broad and concave, separated from the suture by a well defined collar; slope from periphery to anal fasciole not abrupt; suture closed; parietal callus thin, columellar callus only slightly thicker; sculpture consisting of a single, moderately strong spiral line on the collar, two moderately strong spirals on the periphery, and two weaker spirals between the periphery and the suture below, similar spirals continuing below on the base of the body whorl and the upper part of the columella but becoming weaker, more numerous and more crowded on the poorly defined siphonal fasciole, interspaces between the primary spirals bearing from 1 to 3 raised threads, and the anal fasciole bearing from 3 to 5 weak threads, axial sculpture consisting of weak undulating nodes of which usually 4 and part of a 5th are visible from any angle, nodes much weaker in adults.

Discussion: This species although closely related to *P. longirostropsis* and the subspecies *bicollaris* is distinguished from either by its smaller size and weaker sculpture. It never has a double spiralled collar as in *bicollaris* and the axial nodes are not nearly so strong. The height of the spire is relatively greater than the height of the aperture in all specimens measured, and the apical angle is narrower.

Type: Holotype 376491 USNM from the Mint Spring Formation, USGS locality 7467 (Plate 21, figure 26).

Occurrence: Mint Spring Formation, USGS localities 2664, 7467, 13287.

Pleurofusia decliva (Conrad)

Plate 35, figure 19

1848a. *Pleurotoma decliva* Conrad, Acad. Nat. Sci. Philadelphia, Proc., p. 285.

1848b. *Pleurotoma decliva* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 116, pl. 11, fig. 27. Plates reprinted in Dockery, 1982, Appendix I.

1904. *Pleurofusia declivis* (Conrad). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 152.

Original Description: Conrad, 1848a.

Fusiform, with subangular volutions, with strong prominent revolving lines on the body whorl, alternated in size; the whorl flattened and oblique above the angle, with four unequal revolving lines; lower whorls of the spire with three prominent revolving lines on the lower half, and a fine intermediate line; upper half with three minute revolving lines, and a larger prominent one below and near the suture; aperture and canal half the length of the shell. Length 1.

Allied to *P. servata*, but wants the longitudinal ribs of that species. Rare.

Description: Shell of medium size and inflation; protoconch moderately small, consisting of about two full turns, the first turn smooth, rounded, swollen and inclined, the second turn less swollen than the first, not inclined and having a carina at about the lower two thirds on the last half turn, weak when first appearing but well developed on the last quarter turn, no other sculpture visible until the appearance of the subsutural collar marking the beginning of the juvenile stage; aperture of medium width, about .48 the height of the shell, produced anteriorly to form a canal of moderate length; inner side of outer lip having raised spiral crenulations ranging from strong, elongate and nearly continuous to short and weak and situated opposite the feeble suggestions of axial nodes or at intervals at which nodes might be expected to occur; anal sinus moderately broad, subsymmetrical, moderately deep; anal fasciole flat, having the appearance of being impressed with a roller, separated from the suture above by a well developed collar; suture closed; parietal callus thin, columellar callus slightly thicker; sculpture consisting of a strong spiral on the collar with occasionally a weaker one above adjoining the suture, a pair of moderately strong spirals on the periphery of which the upper one is weaker in juveniles but usually of equal strength in adults, with two weaker spirals below between the peripheral spirals and the suture, similar spirals continuing below on the body whorl and becoming more crowded on the columella, full grown adults usually developing a secondary spiral at the lower margin of the anal fasciole, interspaces between the principal spirals, including the peripheral pair, developing a single thread in adults, anal fasciole smooth except for the curved growth lines of the sinus or bearing 2-3 very weak spiral threads, axial sculpture consisting of weak undulations of constrictions of the periphery in the juvenile, particularly the late juvenile stage, but usually entirely absent in adults.

Discussion: *Pleurofusia decliva* is readily distinguished from *P. longirostropsis* by its lack of broad axial nodes, smooth or nearly smooth, flat anal fasciole, and its fewer whorled protoconch with its swollen tip and lack of crescent-shaped axials on the last whorl. The subspecies *P. decliva asper*, next described, approaches *P. longirostropsis* much more closely in gross sculpture.

Pleurofusia menthafons MacNeil n. sp. from the Mint Spring has the same type of protoconch as *P. decliva*, with the exception that weak crescent-shaped axials are developed, but differs considerably in sculpture, full comparison being made under that species.

Knefastia waltonia Gardner from the Shoal River Formation of western Florida is probably descended from this species. It has no suggestion of the axial nodes but is similar in general details. The protoconch is almost identical.

Type: Holotype 13429 ANSP from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS locality 13286.

Pleurofusia decliva asper MacNeil n. subsp.

Plate 35, figures 20-21

Discussion: Occurring with typical *P. decliva* but so far not known to form a completely grading series with it is a form identical in the characters of the protoconch but differing in having stronger sculpture. The anal fasciole is noticeably concave rather than flat or nearly so as in typical *P. decliva* and bears from 4 to 5 moderately strong spiral threads. The axial nodes are also well developed in *P. decliva asper*. This form greatly resembles *P. longirostropsis* with which it likewise occurs, but differs from it in having a blunt rather than conical tip on the protoconch and in having somewhat weaker peripheral lirae. Five axial nodes are visible at any angle in this subspecies, whereas only 4 are visible in *P. longirostropsis*.

Type: Holotype 376589 USNM from the Byram Formation, USGS locality 12175 (Plate 35, figure 20).

Occurrence: Byram Formation, USGS localities 12175, 14683.

Pleurofusia menthafons MacNeil n. sp.

Plate 21, figure 27; Plate 22, figures 4-5

Description: Shell moderately large and inflated; protoconch moderately small, consisting of about two turns, the first smooth, rounded, swollen and inclined, the second turn less swollen than the first, not inclined and having a carina at about the lower two thirds on the last half turn, weak when first appearing but well developed with from 3 to 4 weak crescent-shaped axials above it on the last quarter turn; aperture moderately wide, about .47 the height of the shell, produced anteriorly to form a slightly twisted canal of moderate length; inner side of the outer lip sometimes bearing short, obscure crenulations opposite the nodes but not consistently; anal sinus moderately broad and deep, subsymmetrical; anal fasciole ranging from slightly concave to slightly convex, separated from the suture by a broad collar, well defined in juveniles but generally poorly defined in adults; suture closed; parietal callus thin, columellar callus somewhat stronger; sculpture not constant, the collar usually having a pair of weak spirals but sometimes having three or only one, the periphery usually having a single spiral stronger than the others, particularly in juveniles, but sometimes having the one above or both the one above and the one below of equal strength, other moderately strong spirals continuing below on the body whorl and columella, interspaces between primary spirals in adults bearing 3 to 4 finer threads, anal fasciole bearing from 4 to 6 fine threads, both the primary spirals and the fasciolar threads beginning as subequal threads sloping away from the more elevated periphery both above and below on the early juvenile whorls, axial sculpture consisting of blunt undulations on the periphery of which from 4 to 6 are visible at any angle.

Discussion: *Pleurofusia menthafons* is somewhat more variable than any of the other species referred to this genus above. The range of variation is particularly noticeable in sculptural details, but individuals also differ in the degree of inflation.

On the basis of its protoconch this species would seem to be related to *P. decliva* from the Bryam Formation, but it differs from typical *decliva* in having weaker peripheral spirals of which frequently only one is strong, in having stronger spiral sculpture on the anal fasciole and usually well developed axial nodes, and in being more inflated. The difference in spiral sculpture is even more noticeable in the juvenile stage in which *P. decliva* has a pair of well developed peripheral lirae of which the lower is usually the stronger, with no other spirals either above or below. *P. menthafons* usually has a single strong or at least more elevated spiral in the early juvenile stage with the spirals of the fasciole and the spirals below the periphery well and subequally developed. The subspecies *P. decliva asper* has much stronger peripheral spirals than *P. menthafons*, but in the juvenile stage has a smooth or nearly smooth anal fasciole. The anal fasciole of *P. decliva asper* is also more concave.

No other lower or middle Oligocene species from the Gulf region appears to be very closely related to *P. menthafons*, but a form figured by Mansfield (1940, p. 204, pl. 27, fig. 5) from the Chickasawhay Limestone of Wayne Co., Mississippi, appears to be related to this species. The Chickasawhay species is represented by such poor material, however, that accurate comparison cannot be made.

Type: Holotype 498162 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 22, figure 5).

Occurrence: Mint Spring Formation, USGS localities 7671, 13287, 14071a, 14162.

Pleurofusia menthafons MacNeil var. A

Plate 22, figure 6

Discussion: One specimen of *P. menthafons* is so extreme that it is designated as variety A. It is characterized by a greater apical angle than is found in the typical form and the periphery is less rounded with the anal fasciole not sunken. The spire is relatively shorter so that the suture approaches closer to the periphery. This combination of characters gives the spire a nearly straight outline, which together with its long canal gives the shell the appearance of a miniature *Clavilithes*. The inner side of the outer lip of this specimen has much stronger spiral crenulations than have been seen in any specimen of typical *P. menthafons*.

Occurrence: Mint Spring Formation, USGS locality 3727.

Pleurofusia trichorda MacNeil n. sp.

Plate 36, figure 8

Description: Shell of medium size, moderately slender; protoconch not wholly preserved but having two smooth whorls, the first appearing somewhat inclined, no carina on the last whorl, juvenile sculpture appearing abruptly as coarse, smooth axial undulations; aperture narrow, about .39 the height of the shell, produced anteriorly to form a moderately short, twisted canal; inner side of outer lip with internal varices bearing elongate denticulations opposite the external nodes; anal sinus of medium depth, subsymmetrical; anal fasciole of medium width and concave, separated from the suture by a strong collar; suture not tightly appressed; parietal callus thin, columellar callus moderately thick; sculpture consisting of a strong spiral on the collar and three strong spirals on the periphery of the whorls with additional spirals continuing below on the body whorl and columella, interspaces between the primary spirals bearing from 3 to 4 fine threads in the adult stage but smooth in the juvenile stage, anal fasciole bearing 3 to 4 moderately strong threads, axial sculpture consisting of broad, undulating nodes which begin as sharper, slightly inclined nodes in juveniles.

Discussion: This species is unique among other middle and lower Oligocene Pleurofusias in its short canal and consequently relatively higher spire. The lack of a carina on the nucleus and the absence of a double peripheral carina in the early juvenile stage stresses its relationship with the group of *P. servata* rather than with *P. longirostropsis*.

Type: Holotype 13436 ANSP with the type of *P. servata* in the Conrad collection so presumably from the Byram Formation, Vicksburg, Mississippi.

Occurrence: Byram Formation, Vicksburg, Mississippi.

Pleurofusia servata (Conrad)

Plate 21, figures 22-23; Plate 22, figures 1-2;
Plate 35, figures 25-26; Plate 36, figures 1-5, 9-10

1848a. *Pleurotoma servata* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.

1848b. *Pleurotoma servata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 18. Plates reprinted in Dockery, 1982, Appendix I.

1890. *Pleurotoma (Pleurofusia) servata* Conrad. De Gregorio, Mon. Faune éocénique de l'Alabama, p. 34.

1904. *Pleurofusia servata* (Conrad). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 152.
1937. *Pleurofusia servata* (Conrad). Harris, Palaeont. Amer., v. 2, No. 7, p. 50, pl. 10, fig. 4-5.
1969. *Pleurofusia servata* (Conrad). Powell, Indo-Pacific Mollusca, v. 2, No. 10, p. 302.

Original Description: Conrad, 1848a.

Fusiform; whorls ten, with rounded longitudinal ribs and prominent strong revolving lines, a fine intermediate line on the body whorl; volutions concave above, with a carinated revolving line below the suture; beak narrow, elongated, slightly bent, acuminate; aperture and canal rather more than half the length of the shell. Length 9-10.

Description: Shell of medium size and inflation; protoconch small, conical and pointed, consisting of about 4 evenly expanding whorls, smooth and rounded except for the last quarter turn which bears well defined crescent-shaped axial riblets, juvenile stage beginning with the appearance of the prominent subsutural collar; aperture moderately narrow, about .52 the height of the shell; canal moderately long and slightly twisted; outer lip frequently having smooth internal varices opposite the external nodes and more rarely a blunt denticle just below the anal fasciole; anal sinus moderately deep, subsymmetrical; anal fasciole of medium width and concave, separated from the suture by a strong collar; suture not tightly appressed; parietal callus and columellar callus thin; sculpture consisting of a strong spiral on the subsutural collar and almost equally strong primary spirals below, starting at the lower edge of the fasciole and continuing to the columella, a secondary and occasionally two secondary spirals and frequently weak tertiary threads appearing between the primary spirals on the periphery and lower part of the body whorl, anal fasciole bearing 5 to 6 fine to moderately coarse threads, axial sculpture consisting of prominent, elongate axial nodes, sharper in juveniles than in adults, and extending across the anal fasciole nearly to the collar, either 4 or 5 visible from any angle.

Discussion: The lectotype (height 29.1 mm) of this species is the largest specimen the writer has seen. It has weak secondary and tertiary spirals and is one of the more extreme specimens in this respect. Conrad stated in his description that this species has "prominent strong revolving lines, a fine intermediate line on the body whorl," but none of the syntypes answers this description. The specimen mentioned above as lacking most of its canal has both single and double threads between different coarse spirals on the body whorl although it is the only specimen on which single threads occur in any of the interspaces. There is always the possibility that Conrad may have added to his type lots, or even to have substituted better specimens for less complete ones, and for this reason uncertainty might always persist as to the identity of his types. For this reason the fixation of this name on the splendid specimen here designated as Lectotype is thought to be the best course.

This species is recognized in both the Byram Formation and Mint Spring Formation, but the varietal series do not overlap and two varieties, *P. servata* var. B from the Mint Spring and *P. servata* var. A from the Byram are described. Casey (1903, p. 269) stated that *P. servata* occurs in the lower Vicksburg in slightly modified form but in the writer's opinion only the variety here discussed is distinct. Specimens of typical *P. servata* here figured show the entire range from the form in which the secondary spirals early become as strong as the primaries to the form having weak secondary and tertiary spirals.

Pleurofusia servata is easily distinguished from *P. longirostropsis* and related species by its lack of a prominent peripheral keel in the early stages. *Fusiturricula paraservata* Gardner, from the Chipola Formation, although similar is not definitely related. A specimen of this species was figured by Dall (1915, p. 39, pl. 5, fig. 16) as an example of *P. servata*, the range of which he gave as Vicksburg and Tampa Limestone. Actually the Chipola species differs from forms in either the Vicksburg or Tampa. It is distinguished from *P. servata* in having more prominent axial nodes, in having much weaker secondary and tertiary spirals, although the primaries are as strong or stronger, in having very weak spirals on the anal fasciole, and in having a swollen, inclined nuclear tip comparing with that of *P. decliva* rather than with that of *P. servata*. As reported by Mansfield (1937, p. 86) one specimen from the Tampa Limestone at Ballast Point, Tampa Bay, Florida, USNM Cat. no. 112085, has sculpture similar to that of *P. servata*, but lacks the protoconch with which further comparison could be made. This specimen has more pronounced axial nodes than *P. servata*, and in addition has a spiral microsculpture on the subsutural collar that has not been observed for *P. servata*. Also occurring in the Tampa Limestone is *P. condominia* (Dall) and two subspecies, *severina* (Dall), and *silicata* (Mansfield). The tip of the protoconch of all three of these forms is swollen and naticoidal. Six axial nodes are visible from any angle in contrast to 4 to 5 for *P. servata*.

Type: Lectotype 13431 ANSP and two paratypes 13491 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 36, figure 2 - lectotype, figure 3 - paratype A).

Occurrence: Mint Spring Formation, USGS localities 3727, 7671, 14162; Byram Formation, USGS localities 1042, 2664, 3722, 3729, 6449, 6454, 7372, 7456, 7941, 12175, 13286, 14031, 14683, 14772, MGS localities 106, 112c.

Pleurofusia servata (Conrad) var. A

Plate 36, figure 11

Discussion: Occurring with typical *P. servata* in the Byram Formation, and probably forming a uniformly grading series with it, is a form in which the primary spirals are widely spaced and the secondary and tertiary spirals are both weak and subequal in size until about the fifth or sixth whorl. In the typical form the secondary spirals outgrow the tertiary spirals at an early age and often are as strong as the primary spirals on the fifth or sixth whorl. In this subspecies there may be as many as 5 or 6 fine threads between the large primary spirals, the uneven number being due to the fact that the tertiary lines may be doubled or trebled.

This variety has not been found in the Mint Spring Formation and presumably is an extreme form not found in the series at that time.

Occurrence: Byram Formation, USGS localities 3729, 7378, 14683.

Pleurofusia servata (Conrad) var. B

Plate 22, figure 3

This variety represents the opposite extreme in variation to *P. servata* var. A and has been found only in the Mint Spring Formation. The spiral lines are weaker and more crowded than in the typical form and the secondaries are nearly as large as the primary lines on the sixth whorl. Tertiary threads are not commonly developed. The primary spirals are more nearly of the same size and strength as the spirals on the anal fasciole than in the typical form. Aside from the differences in spiral sculpture, *P. servata* var. B has weaker axial nodes and a weaker subsutural collar which does not have as strong undulations as in the typical form due to the weaker axials on the whorl above. Occasional specimens from the Byram referred to typical *servata* (Pl. 35, fig. 26) approach this subspecies in sculpture, but they have 5 visible axial nodes whereas 6 are visible in *P. servata* var. B.

Occurrence: Mint Spring Formation, USGS localities 7268, 14071a.

Pleurofusia clarkeana (Aldrich)

Plate 8, figures 15-16, 21

1894. *Pleurotoma clarkeana* Aldrich, Nautilus, v. 7, No. 9, p. 98, pl. 4, fig. 3.

Original Description: Aldrich, 1894.

Shell rather solid, fusiform, whorls about nine, spire smooth (?), whorls with about eleven strongly raised and rounded ribs crossed by coarse revolving lines; somewhat alternate. The finer lines between often being double, especially upon the body whorl. Suture appressed, bordered by a corded thread, and this in turn by a concave space. Aperture oblong-oval. Canal short. Sinus semicircular, and well up in the aperture. Length 31 mm.; breadth 11 mm.

Description: Shell moderately large and somewhat inflated; protoconch small, conical, pointed, consisting of about 4 evenly expanding whorls, the first 3 turns smooth and polished, the last full turn or slightly less bearing inclined, crescent-shaped axial riblets, weak when first appearing but strong on the last half turn, becoming straighter and shorter with the appearance of the subsutural collar at the beginning of the juvenile stage and bearing fine spiral sculpture; aperture of moderate width, about .47 the height of the shell, canal of moderate length and somewhat twisted; outer lip smooth within; anal sinus broad and moderately shallow, sloping back more sharply above than below; anal fasciole not well defined, convex, bordered above by a narrow but well defined subsutural collar; suture impressed; parietal callus and columellar callus moderately developed; sculpture consisting of moderately strong spiral lines made somewhat irregular by coarse growth lines, especially on the base of the body whorl, periphery bearing primary, secondary and tertiary spirals, the secondary and tertiary lines being inconstant in number, sometimes 2 or 3 secondaries occurring between the primaries and from 1 to 4 tertiaries between the secondaries, anal fasciole bearing primary spirals, weaker and more closely spaced than the primary peripheral spirals, and weak secondary lines between them, axial sculpture consisting of elongate axial ribs extending to the subsutural collar, 7 being visible on the young whorls but occasionally only 6 on the later whorls.

Discussion: *Pleurofusia clarkeana* is readily distinguished from *P. servata* by its poorly defined and convex anal fasciole, and in its longer and more abundant axial ribs. This species may be related to *P. servata* but the latter is probably not directly descended from it since a subspecies of *P. clarkeana* existed concurrently with *P. servata* in the Mint Spring Formaton.

The relationship of *P. clarkeana* to Eocene species is obscure.

Type: Holotype 644623 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 8, figure 15).

Occurrence: Red Bluff Formation, USGS localities 315, 2634, 5264, MGS localities 38, 40.

Pleurofusia clarkeana juba MacNeil n. subsp.

Plate 22, figures 8-13

Discussion: The form so named occurs in the Mint Spring Formation of Mississippi. It is very closely related to typical *P. clarkeana* and differs from it mainly in having a higher shoulder to the whorls and more numerous axial ribs, from 7 to 9 being visible from an angle. The ribs extend nearly to the collar so that the shoulder accentuates the axial ribs. The anal fasciole is even less distinct than in the typical form. The spiral sculpture is somewhat more uniform than in the typical form, with usually only a single secondary and two tertiary spirals between each pair of primary spirals.

Type: Holotype 376495 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 22, figure 8).

Occurrence: Mint Spring Formation, USGS localities 6647, 7671, 14071.

Pleurofusia clarkeana fascia MacNeil n. subsp.

Plate 22, figures 13-14

Discussion: Occurring with the preceding is another subspecies of *P. clarkeana* which differs from *juba* in that the anal fasciole tends to become more distinct than in the typical form. The fasciole is moderately broad and convex, and bears weak spiral lines that tend to become weaker in adults. The axial ribs are weaker than in *juba* but still extend onto the fasciole so that they have a short upper segment that has much weaker lines crossing it than the portion below.

Type: Holotype 376498 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 22, figure 14).

Occurrence: Mint Spring Formation, USGS locality 7671.

Pleurofusia elegantula MacNeil n. sp.

Plate 36, figures 6-7, 12

Description: Shell moderately large and slender; protoconch small, conical and pointed, consisting of about 4-1/2 turns, the first 4 smooth and polished, the last half turn bearing inclined, crescent-shaped axial riblets, the first 1 or 2 weaker than the succeeding, becoming shorter with the appearance of the subsutural collar at the beginning of the juvenile stage; aperture moderately narrow, about .47 the height of the shell, produced anteriorly to form a moderately elongate canal; outer lip smooth within; anal sinus moderately broad, sloping away more sharply above than below; anal fasciole broad and slightly concave, separated from the suture by a collar of medium strength; suture closed and slightly appressed; parietal callus thin, columellar callus slightly thicker; sculpture consisting of moderately strong spiral lines, usually 4 and sometimes 5 on the spiral whorls and continuing below on the body whorl and columella, interspaces with fine spirals, 5 to 7 in number, and usually of equal stength although commonly divided into secondary and tertiary threads of slightly different strength, anal fasciole bearing 10 to 15 fine spiral threads, axial sculpture consisting of prominent elongate nodes extending nearly to the subsutural collar above, usually 6 visible from any angle.

Discussion: This is one of the most elegant of the Vicksburg turrids. It is difficult to say whether it is more closely related to *P. servata* or to *P. clarkeana*, but in gross appearance it resembles the latter more closely. *P. elegantula* is a slenderer species than either, however, and its axial ribs are thinner and sharper, almost invariably 6 being visible from any angle in contrast to 4 or 5 for *P. servata* and usually 7 for *P. clarkeana*. The anal fasciole is a conspicuous feature of this species in contrast to the weak fasciole of *P. clarkeana*, and it is broader but less concave than that of *P. servata*. The fasciole bears about 10 to 15 spiral threads which is about twice to three times as many as on *P. servata*. In the juvenile stages the spirals on the periphery and those on the anal fasciole become subequal in size, comparing in this respect with the other two species. The numerous fine threads between the primary spirals on the adult whorls recall the condition in *P. servata* var. A, but they are more numerous and the spacing of the primary spirals is more uniform in that variety.

Two fragments comparing with this species have been found in the Mint Spring Formation of Mississippi, but neither is sufficiently well preserved to say definitely whether they are identical or represent a subspecies.

Type: Holotype 376597 USNM from the Byram Formation, USGS locality 12175 (Plate 36, figure 7).

Occurrence: ? Mint Spring Formation, USGS localities 14071a, 14524; Byram Formation, USGS localities 5623, 7941, 12174a, 12175, 13286, 14683.

Pleurofusia oblivia (Casey)

Plate 8, figures 17-18

1903. *Pleurotoma oblivia* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 269.
1904. *Pleurofusia oblivia* (Casey). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 152.

Original Description: Casey, 1903.

This is a Red Bluff species somewhat allied to *servata*. It resembles *servata* in general form and conformation of the nucleus, nepionic whorls, aperture and canal, the elevated smooth nucleus of three or four whorls and nepionic spire whorls being formed in the same way, but the ribs are narrower, more strongly rounded, much more elevated and only about six in number, strongly marked throughout the length of the whorl and only becoming extinct at the rather fine sinuous collar just below the suture. The revolving sculpture consists of eight or nine coarse lyræ, more dilated on the ribs, the first three less coarse and subequal, those in anterior two-thirds of the whorl generally with one fine thread intermediate. Length 22 mm., width 6.5 mm. It may be readily distinguished from *servata* by the fewer, narrower and more elevated ribs, more equal revolving lines throughout the length of the whorls and absence of any defined posterior flattened or concave area on the latter.

Description: Shell moderately large and medium inflated; protoconch small, pointed, conical, consisting of 4-1/2 evenly expanding whorls, smooth and polished except for the last quarter turn or less which bears 3 or 4 weak, inclined, crescent-shaped, axial riblets, becoming straighter and shorter with the appearance of the subsutural collar at the beginning of the juvenile stage; aperture of medium width, about .48 the height of the shell, produced anteriorly to form a moderately elongate, straight canal; outer lip smooth within; anal sinus moderately deep and subsymmetrical; anal fasciole obscure, not conspicuously set off in either sculpture or relief; subsutural collar weak to very weak; suture impressed; parietal and columellar callus weak; sculpture consisting of moderately coarse spiral lines, the juvenile whorls with primary and weak secondary lines, the adult whorls with primary and secondary lines of equal strength and weak tertiary lines between some of the larger spirals, usually 12 to 14 combined primary and secondary lines on the adult whorls including those on the anal fasciolar region; axial sculpture consisting of strong, well separated axial ribs of which usually 4 but occasionally 5 are visible from an angle.

Discussion: This species is not confusable with any other middle or lower Gulf Oligocene turrid. It appears to be closely related to *Turricula fluctuosa* Harris from the Jackson Eocene of Bunker Hill, Louisiana, but is somewhat slenderer than that species. It is readily separated from *P. clarkeana* with which it occurs by its slenderer spire, fewer, stronger, and more widely spaced axial ribs and weaker anal fasciole and collar. Casey compared this species with *P. servata* which has a strong, concave anal fasciole. It could only be related to *P. servata* through some much earlier Eocene type.

Type: Holotype 481628 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Casey).

Occurrence: Red Bluff Formation, USGS localities 309, 320, 2631, 2632, 2633, 2860, 5264, 6456, 13383, 14367, 14720, 14721, MGS localities 34b, 37, 38, 39.

Subgenus **XESTOSURCULA** (Casey MS.) MacNeil n. subgen.

Type: *Pleurotoma plutonica* Casey, 1903. Oligocene, Mint Spring Formation, Mississippi.

Shell small, moderately slender with a moderately long, straight canal slightly shorter than the spire. Protoconch homeostrophous, slightly higher than wide and consisting of four, smooth whorls. First sculptured whorl bearing about 8 low, rounded, slightly oblique, axial ribs which in the later whorls become more rounded and wider. Aperture narrow. Anterior canal long, open and straight, slightly expanded at the base. Anal sinus moderately wide and retractive, not constricted or calloused. Sculpture, in addition to axial ribs, consisting of fine spiral lines which may be present on the canal and lower portion of the body whorl or present all over the whorls, crossing axial ribs and interspaces alike, but usually weaker in the concave anal fasciole.

Casey (1904, p. 158) classed the type of this subgenus among his "Pleurotomini" and made the following notes: "There are some other genera among our fossil species which are not further dwelt upon at present, principally because of lack of material. Among these types of more or less isolated genera may be mentioned *Drillia prosseri* Harris and *Pleurotoma plutonica* Casey, which are congeneric. . . etc." At some later time Casey apparently decided to name this genus as a specimen in his collection bears the label "*Xestosurcula* Csy. *plutonica* Csy." but there are no notes available nor any evidence that he ever prepared any. The subgenus is here described as new, and the name applied to it by Casey is perpetuated.

The affinities of this subgenus are almost certainly with the group of *Pleurofusia servata*. The protoconch is similar to that of *Pleurofusia* but the sculpture tends to become obsolete rather than accentuated as in the Vicksburg species of *Pleurofusia*, and the anal fasciole tends to become indistinct rather than well defined. *Xestosurcula plutonica* may be descended from the Red Bluff species, *X. fessa*, but the latter appears to be related to *P. servata* var. B as well. It may be that *Xestosurcula* and the group of *P. servata* had a common origin in some such species as "*Pleurotoma (Drillia)*" *prosseri* Harris from the lower Claiborne.

The affinities of this genus are undoubtedly with *Pleurofusia* de Gregorio and *Fusiturricula* Woodring, and it is here regarded as a subgenus of *Pleurofusia*. It is difficult to say just how much emphasis should be placed on the form of the protoconch in these groups for it seems probable that there is evolution in this part of the shell as in the adult stages. The two-whorled protoconch of *Fusiturricula panola* Woodring is more like the protoconch of the specimen of *Pleurofusia longirostropsis* de Gregorio in the Casey-Aldrich collection than it is like that of *Pleurofusia servata* Conrad which it resembles much more in adult sculpture. The protoconch of *Pleurofusia menthafons* MacNeil n. sp. is almost identical with that of *Fusiturricula panola*. Another type of protoconch consisting of three or four smooth whorls is found in the Vicksburg species *Pleurofusia servata, P. decliva* Conrad, *P oblivia* Casey and *P. vicksburgensis* Casey, *P. (Xestosurcula) plutonica* and *P. (X.) prosseri* have a similar but more inflated protoconch. If a phylogeny based upon protoconchs is accepted, homeomorphy of adult sculpture must be admitted and *vice versa*. Assuming the criteria of the protoconch to be the more reliable, the typical form of *Pleurofusia* might be regarded as giving rise to *Fusiturricula* with change in sculpture but without substantial change in protoconch, on the one hand, and to a series of forms with three or four whorled protoconchs and typical or aberrant sculpture or sculpture similar to that of *Fusiturricula*, on the other hand.

Pleurofusia (Xestosurcula) plutonica (Casey)

Plate 21, figure 24; Plate 22, figure 7

1903. *Pleurotoma plutonica* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 271.
1937. *Turricula plutonica* (Casey). Harris, Palaeont. Amer., v. 2, No. 7, p. 58, pl. 10, fig. 31.

Original Description: Casey, 1903.

Not rare in the Lower Vicksburg limestones. This species is rather slender, perfectly smooth and polished throughout, with scarcely a trace of revolving sculpture except on the beak, where there are some oblique widely spaced striæ. The nucleus is smooth, acutely ogival, higher than wide and of about four whorls. The subsequent whorls have each about eight low rounded oblique ribs, which become obsolete in a revolving concavity below the suture. The first three, or thereabouts, of the body whorls have a rather pronounced, though obtusely rounded, swelling adjoining the suture beneath, but this is gradually lost on the larger whorls, these having but feeble traces of a raised band at the suture, the latter being a very fine, slightly sinuose and feebly impressed line. The canal is well differentiated from the aperture, and the two combined constitute about three-sevenths of the total length of the shell. Length 12 mm., width 3.7 mm. Another specimen represented by the spire alone, indicates that the species may attain a length of fully 15 mm. or more. There is no trace of this species in the upper marls.

Description: Shell of medium size and moderately inflated; protoconch small and pointed, consisting of about 4 evenly expanding whorls, the first 3-1/2 turns smooth and polished, the last 1/2 turn bearing from 4 to 7 moderately weak, inclined, crescent-shaped axial riblets, becoming shorter and much broader and only slightly inclined with the appearance of the subsutural collar; aperture of moderate width, about .45 the height of the shell, produced anteriorly to form a stout, straight canal of medium length; outer lip thin, smooth within; anal sinus broad and of moderate depth, more retractive above than below; anal fasciole not defined but situated in a concave depressed area just below the low subsutural collar and partly transgressed by the ribs; suture appressed; parietal callus weak, columellar callus somewhat stronger; sculpture consisting of weak to moderately distinct incised spirals on the lower portion of the whorls and more prominently on the columella, separated by broad, polished interspaces crossed by fine growth lines, often a single, fine incised line on the collar, axial sculpture consisting of blunt, moderately short axial nodes, 5 visible from any angle.

Discussion: This species can be distinguished readily from any of the Gulf Oligocene Pleurofusias by its nearly smooth surface, and from similarly sculptured species referred to *Elaeocyma* by its *Pleurofusia*-like aperture.

Neither this species nor a related species has yet been found higher than the Mint Spring Formation. It is related, however, to *P.* (*X.*) *fessa* from the Red Bluff Formation, next described, and will be compared with it under that species.

Type: Holotype 481635 USNM from the Mint Spring Formation, presumably from Vicksburg, Mississippi, "Lower Vicksburg" (Casey).

Occurrence: Mint Spring Formation, USGS localities 3727, 6452, 7268, 7467, 7671, 13287, 14071a, 14162, 14524.

Pleurofusia (Xestosurcula) fessa MacNeil n. sp.

Plate 9, figures 4-5

Description: Shell of medium size and moderately inflated; protoconch small, pointed, consisting of about 4-1/2 evenly expanding whorls, the first 4 smooth and polished, the last half turn bearing 5 to 6 inclined, crescent-shaped axial riblets, becoming shorter and heavier with the appearance of the subsutural collar at the beginning of the juvenile stage; aperture of moderate width, about .49 the height of the shell, produced anteriorly to form a straight canal of medium length; outer lip bearing weak smooth internal varices opposite the external ribs; anal sinus of moderate depth and subsymmetrical; anal fasciole weakly defined, situated in a strongly concave area just below the subsutural collar and partly transgressed by the upper ends of the ribs; suture appressed; parietal callus weak, columellar callus somewhat stronger; sculpture consisting of weak spiral raised threads on the periphery and continuing below on the columella, those on the periphery more widely separated and having from 1 to 3 finer threads in the interspaces, anal fasciole bearing 6 to 7 very weak spiral lines, axial sculpture consisting of blunt, elongate, slightly inclined nodes, usually 5 but sometimes 6 visible from an angle.

Discussion: This species compares with *P.* (*X.*) *plutonica* in size and form and at first glance might be mistaken for it. It differs from *P.* (*X.*) *plutonica*, however, in the details of its sculpture, that of the latter consisting of weakly incised lines with broad smooth interspaces on the columella and lower part of the body whorl, but usually smooth except for weak growth lines on the upper part of the whorls. *P.* (*X.*) *fessa*, however, has weak but distinct raised primary, secondary, and rarely tertiary threads on the periphery of the whorls, primary with occasional secondary lines on the columella, and weak, broad threads on the anal fasciole. The sculpture of *P. servata*, even of the less coarsely sculptured variety *P.*

servata var. B, is considerably coarser than that of *P.* (*X.*) *fessa*, but the pattern of the sculpture is similar.

It is not certain that *P.* (*X.*) *plutonica* is descended from this Red Bluff species. Some specimens that appear to be this species are present in the Museum collections from an unknown locality near Heidelberg, Jasper Co., Mississippi, the associated fauna being Mint Spring, so that it is possible that this species also occurs in the Mint Spring Formation.

Type: Holotype 376459 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 9, figure 4).

Occurrence: Red Bluff Formation, USGS localities 5264, 7218, 7221, 14721, MGS locality 38; ? Mint Spring Formation, USGS locality 337.

Genus **TROPISURCULA** Casey, 1904

Tropisurcula Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 153, 1904.

Type (by subsequent designation, Cossmann, 1906): *Drillia caseyi* Aldrich, 1903. Oligocene, Red Bluff Formation, Mississippi.

Cossmann (1906, p. 222) corrected this name to *Tropidosurcula* and so referred to it later (p. 224) in the same paper, but this procedure is not sustained. Casey included only one species, *T. crenula* Casey from the lower Claiborne of St. Maurice, La., besides the type of this genus, and to date only one additional form, *T. crenula sabines* Harris, also from the lower Claiborne, has been added to the list.

The affinities of this genus appear to be with *Pleurofusia*, but the writer does not follow Grant and Gale (1931, p. 489) in placing it in the synonomy of *Pleurofusia*.

Tropiscurcula caseyi (Aldrich)

Plate 9, figures 1-3; Plate 22, figures 20-21;
Plate 36, figures 16-17

1903. *Pleurotoma* (*Drillia*) *caseyi* Aldrich, Nautilus, v. 16, No. 9, p. 97, pl. 3, fig. 1-2.
1904. *Tropisurcula caseyi* (Aldrich). Casey Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 153.
1937. *Tropisurcula caseyi* (Aldrich). Harris, Palaeont. Amer., v. 2, No. 7, p. 57, pl. 10, fig. 25-26.
1969. *Pleurofusia caseyi* (Aldrich). Powell, Indo-Pacific Mollusca, v. 2, No. 10, p. 302.

Original Description: Aldrich, 1903.

Shell fusiform, whorls ten to eleven, first four smooth, apex pointed, the balance of the whorls nodular with a connecting line situated at the periphery. About nine nodes on each whorl. The balance of the spiral sculpture consisting of close-set, rounded lines, which are stronger on the lower part of each whorl; suture nearly concealed by a strongly raised and rounded band which is wavy and closely appressed. On the humeral area the spiral lines are cut by fine curved lines formed by the former retral sinus, sinus nearly semi-circular. Canal open and slightly spatulate.

Length 11 mm., width 3 mm.

Localities: Red Bluff, Miss., Byrams Ferry, Pearl Rv., Miss., and Vicksburg, Miss.

Resembles *Drillia texanopsis* Harris, but is carinated at the periphery, more strongly striated and with a deeper retral sinus. Maj. Thos. L. Casey, U. S. Engineers, has sent me examples from the upper part of the bluff at Vicksburg. The shell is named in his honor.

Description: Shell moderately small, medium inflated; protoconch small, conical, consisting of about 3 smooth, polished whorls, the last quarter turn bearing a weak, blunt peripheral carina but with no other sculpture until the appearance of strong, bluntly pointed median nodes simultaneously with the subsutural collar at the beginning of the juvenile stage; aperture of moderate width, about .46 the height of the shell, produced anteriorly to form a canal of medium length; outer lip bearing internal varices within opposite the larger external nodes, the varices divided into a larger upper segment and a smaller lower segment; anal sinus of moderate depth and subsymmetrical; anal fasciole well defined, concave, made irregular by the upper ends of the axial ribs; suture slightly appressed; parietal callus and columellar callus light; sculpture consisting of a discontinuous peripheral keel at the lower margin of the anal fasciole with moderately coarse spiral lines below the keel and continuing to the columella, rarely with weak secondaries in the interspaces, anal fasciole bearing similar but more closely spaced spirals, axial sculpture not constant, more regular with the ribs forming sharp nodes along the peripheral keel in juveniles but in adults a stronger and a weaker node are usually confluent with a break in the peripheral keel between each pair, the node preceding the break being the stronger and corresponding to the internal varix.

Discussion: This species has been reported continuously from the Red Bluff to the Byram, and in all formations the form so identified is a common element of the fauna. Mansfield (1940, p. 205, pl. 27, fig. 3) figured a form, *Tropisurcula* sp. cf. *T. caseyi* (Aldrich) from the Chickasawhay Limestone of Mississippi and Alabama. This form compares with *T. caseyi* in all of its details that are preserved.

Some forms from the Byram appear to be slightly slenderer than the average specimen from the Red Bluff, and there is also less tendency for the nodes to form confluent pairs in the Byram forms. These differences are regarded as too obscure and not consistent enough for subspecies distinction.

Aldrich gave the range as this species as Red Bluff, Miss., Byrams Ferry, Pearl River, Miss., and Vicksburg, Mississippi, without stating from which locality his type was obtained. The label with the holotype reads, "Red Bluff, Mississippi."

Type: Holotype 644631 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 9, figure 1).

Occurrence: Red Bluff Formation, USGS localities 2633, 2860, 5263, 5264, 6456, 7218, 7221, 7222, 14367, 14720, 14721, MGS localities 37, 38; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 6452, 7671, 13287, MGS localities 89, 90, 99; Byram Formation, USGS localities 1042, 6454, 6978, 7376, 7385, 7450, 7460a, 12175a, 13286, 14368, 14682, 14683, 14772, MGS localities 106, 109.

Genus **FUSITURRICULA** Woodring, 1928

Fusiturricula, Woodring, Carnegie Inst. Washington, Pub. 385, p. 165, 1928.

Type (by original designation): *Turris (Surcula) fusinella* Dall. Recent, Gulf of Panama.

Although *Turris (Surcula) fusinella* was made the type of this genus because its type has a well preserved protoconch, the description was based partly on *Turris (Surcula) armilda* Dall, a striking species living off California and in the Gulf of California.

Woodring regarded *Fusiturricula* as a Miocene to Recent genus, replaced in the Eocene and Oligocene by *Pleurofusia* of which he regarded *P. servata* as an example. Several subsequent workers have used *Fusiturricula* for Miocene forms closely allied to *P. servata* and *Knefastia* for forms closely allied to *P. longirostropsis* (= *P. vicksburgensis*). In the writer's opinion, however, such forms as *Knefastia glypta* Gardner and *Fusiturricula paraservata* Gardner, both from the Chipola Formation, *Knefastia*? *brooksvillensis* Mansfield and *Fusiturricula condominia* (Dall) Mansfield from the Suwannee Limestone and Tampa Limestone, respectively, are more closely related to the type of *Pleurofusia* than to the type of *Fusiturricula* and should probably all be referred to that genus pending further subdivision. None of these species is closely related to the type of *Knefastia* Dall.

If *Pleurofusia* and *Fusiturricula* are related, however, they are still distinct genera as far back as Mint Spring time. *Fusiturricula ichusa* MacNeil n. sp. occurs in the Mint Spring Formation of eastern Mississippi and is closely related to the living West Coast species. The Mint Spring species has a more distinct anal fasciole and stronger subsutural collar with the result that the anal sinus is farther removed from the suture, but this difference is not regarded as fundamental, especially in view of the fact that the collar is stronger in the young stages of *F. armilda*. In both gross aspect and details other than those mentioned *F. ichusa* and *armilda* are closely related. *Fusiturricula ichusa* more closely resembles *F. armilda* than any Gulf Tertiary species yet described, although *F. iole* Woodring from the Bowden Formation probably resembles the type, *F. fusinella*, more closely. The other Bowden species referred to *Fusiturricula* by Woodring, *F. panola* Woodring, has more of the characters of the *servata* group of *Pleurofusia* and may be more closely related to that group.

Fusiturricula ichusa MacNeil n. sp.

Plate 22, figure 15

Description: Shell of medium size and inflation; protoconch unknown; aperture narrow, about .50 the height of the shell, produced anteriorly to form an elongate, narrow, twisted canal; outer lip bearing very weak crenulations within, strongly recurving in outline from the anal sinus; anal sinus deep, recurving more sharply above than below; anal fasciole moderately broad and concave, separated from the suture by a well defined collar; suture closed, not conspicuous; parietal callus thin, columellar callus somewhat thicker; sculpture consisting of strong spiral threads, 3 on the spire whorls and 2 more below on the body whorl with weaker spirals continuing below on the columella, one strong spiral with a weaker spiral above and weak thread between them on the subsutural collar, interspaces bearing fine spiral threads divisible in some interspaces into a stronger secondary and weaker tertiary threads, anal fasciole bearing 6 to 7 moderately weak spiral threads, not uniform in size, axial sculpture consisting of weak, narrow riblets, about 9 visible from any angle.

Discussion: This species is unique among Gulf Oligocene turrids. It resembles the Recent *F. armilda* from the coast of California more than any other known species. It differs from *F. armilda*, however, in having a much stronger subsutural collar, a narrower, more concave and sunken anal fasciole, and in having the spirals, especially the lower of the 3 spirals, on the spire whorls stronger. *Fusiturricula iole* Woodring from the Miocene Bowden Formation of Jamaica has a less developed anal fasciole than either and longer, fewer and heavier axial ribs.

Type: Holotype 376499 USNM from the Mint Spring Formation, USGS locality 14849a. (Plate 22, figure 15).

Occurrence: Mint Spring Formation, USGS locality 14849a.

Genus **AMYSSODROPA** MacNeil n. gen.

Type: *Amyssodropa clearyensis* MacNeil n. sp. Oligocene, Mint Spring Formation, Mississippi.

Shell of medium size and inflation. Protoconch consisting of about 4 whorls, sculptured with fine crescent-shaped axials and microspirals. Aperture of moderate length. Anterior canal twisted. Siphonal notch shallow, siphonal fasciole raised but not distinguished by peculiar sculpture. Anal sinus very shallow and broad, well removed from the suture. Whorls flattened with very little sutural indentation, terebriform. Sculpture faint, both axial and spiral in juveniles, spiral only in adults.

This genus superficially resembles *Hemisurcula* Casey (Type, *H. silicata* (Aldrich), from the Wilcox Group of Alabama), but differs in having a shorter, twisted canal, and lacks the subsutural collar characteristic of the young stages of *Hemisurcula*.

Possibly the relationships of this genus are with the species described by Harris (1937, p. 73, pl. 13, fig. 24) as *Raphitoma liddlei* from the lower Claiborne of Texas. The type of *R. liddlei* is an immature specimen 6.5 mm in length and compares in outline and sculpture with a specimen of *A. clearyensis* of about equal size. No mention of microspirals on the nucleus of *R. liddlei* is made in its description, however, and its outer lip bears raised spiral crenulations within.

Amyssodropa clearyensis MacNeil n. sp.

Plate 22, figure 33; Plate 23, figure 4

Description: Shell of medium size and inflation, whorls flattened in adults making the shell outline nearly straight; protoconch small, conical, expanding rather rapidly, consisting of about 3-3/4 turns, the first without visible sculpture, the succeeding whorls bearing very fine, closely set, crescent-shaped axial riblets, and numerous, irregular, microspiral threads which are perpendicular to the crescentic axials throughout and apparently do not cross them, the last quarter turn also bearing spiral threads of much greater magnitude which are continuous with the spirals in the juvenile stage, axials becoming much coarser, more widely spaced, and straight at the beginning of the juvenile stage; aperture of medium width, about .41 the height of the shell, constricted anteriorly to form a short, twisted canal; outer lip smooth within, weakly indented at the constriction; anal sinus very shallow and broad; anal fasciole or collar not distinguishable; suture shallow and appressed; parietal callus weak, columellar callus somewhat heavier; columella twisted; sculpture consisting of fine spiral threads, about 5 visible on the first whorl, but finer interstitial threads soon appearing which are subequal in strength with the primary spirals in adults and evenly distributed all over the whorls; about 6 weak, rounded axials visible on the juvenile whorls, but becoming obsolete on about the third whorl.

Type: Holotype 376510 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 23, figure 4).

Occurrence: Mint Spring Formation, USGS locality 14071.

Genus COCHLESPIRA Conrad, 1865

Cochlespira Conrad, Amer. Jour. Conchology, v. 1, No. 1, p. 19, 1865.

Type (by monotypy): *Pleurotoma cristata* Conrad. Oligocene, Byram Formation, Mississippi.

The original list included another name, *C. engonata* Conrad, which was regarded by Woodring (1928, p. 164) and by Grant and Gale (1931, p. 505) as the type according to the remarks of Cossmann (1890, p. 68) and which would transfer the name to a different group. Cossmann was merely expressing de Gregorio's opinion, however, that *C. engonata* was the monotype of *Cochlespira* on the assumption that the name first appeared with the description of *C. engonata* on page 142 of part 2 of vol. 2 of the American Journal of Conchology (April 15, 1865). Both Cossmann and de Gregorio overlooked the fact that Conrad first used *Cochlespira* on page 19 of part 1 of the same volume (February 25, 1865), and included under it both *Pleurotoma cristata* Conrad and *C. engonata* Conrad, the latter being a nude name at the time and not described until over a month and a half later, so that *P. cristata* becomes the type by monotypy. The fact that *Turris cristata*, Gabb, which happens to be *C. engonata* Conrad, was listed as a synonym of *C. cristata* in the original list further complicates the picture but has no actual bearing on the determination of the type, unless the lines are transposed and *Turris cristata* Gabb is really an indication of *C. engonata*, something that could hardly be proved.

Cochlespira engonata is the valid type for *Cochlespiropsis* Casey (1904, p. 143), however, by virtue of Cossmann's designation (1906, p. 221).

In the opinion of several workers, *Ancistrosyrinx* Dall (type, by original designation, *A. elegans* Dall, Recent, West Indies) would be a synonym if the latter were used in the sense used here. Woodring (1928, p. 164) suggested, however, that *Ancistrosyrinx* might be retained for a minor division of *Cochlespira*, being characterized by the absence of the beaded subsutural collar and a more inflated protoconch of fewer whorls. Harris (1937, p. 44-45) regarded *Ancistrosyrinx* as a valid subgenus of *Cochlespira* and referred to it a series of middle Eocene to Recent forms having "funnel-shaped whorls, fine subcarinal beading, and often one or more spiral beaded lines above or within the serrate carina", whereas to *Cochlespira* s. s. he referred "species with the sides of the whorls often nearly vertical and subparallel, and with a strong tendency to become bicarinate at times, and to grow large beads or even spines [?] and then again to suppress such ornamentation."

There can be but little doubt that the type of *Cochlespira* with the beaded subsutural collar, a strong secondary carina below the peripheral carina, and a peripheral carina bearing beads, not spines, with a horizontal or only weakly upturned edge, situated well below the suture with a moderately steep slope upwards to the suture, is the older and certainly the more abundant type in the older Tertiary. Examples of this type are *C. greggi* Harris from the Wilcox Group of Alabama, *C. bella* Conrad from the Claiborne of Texas and a closely related form from the Wilcox of Alabama, *C. hoplites* Harris from the Claiborne of Orangeburg, South Carolina, *C. planata* Harris from the Claiborne of Texas, and *C. polita* Harris from the Jackson of Louisiana. The species discussed next from the Vicksburg Group also belong to this type, but no species of this type are known from deposits younger than Vicksburg.

Also in the middle Eocene, however, and existing until the Recent, are species characterized by funnel-shaped whorls with upturned peripheries, or when the edge of the carina is not actually upturned it bears strong spines, usually without any of the subperipheral ribs stronger than the others, with the slope from the periphery to the suture nearly horizontal or sometimes deeply concave, and without any trace of a beaded, subsutural collar. Examples of this type are *C. petropolis* Harris from the Claiborne of Texas, *C. columbaria* Aldrich from the Jackson of Mississippi and Louisiana, and several Miocene species related to the living West Indian species, *C. elegans* Dall and *C. radiata* Dall from Jamaica, the Dominican Republic, Panama, and Tehuantepec.

Cochlespira cristata Conrad from the Byram Formation approaches *Ancistrosyrinx* in some respects, but is clearly more closely related to the older forms having a subsutural collar, so that its resemblance to the funnel-shaped forms is probably homeomorphic.

Cochlespira cristata (Conrad)

Plate 35, figure 6

1829. Lesueur, Walnut Hills fossil shells, pl. 7, fig. 8 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Pleurotoma cristata* Conrad, Acad. Nat. Sci. Philadelphia, Proc. v. 3, p. 284.
1848b. *Pleurotoma cristata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 20. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Cochlespira cristata* (Conrad). Conrad, Amer. Jour. Conchology, v. 1, pt. 1, p. 19.
1904. *Cochlespira cristata* (Conrad). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 143-144
1937. *Cochlespira cristata* (Conrad). Harris, Palaeont. Amer., v. 2, No. 7, p. 45, pl. 9, fig. 1.
1969. *Cochlespira cristata* (Conrad). Powell, Indo-Pacific Mollusca, v. 2, No. 10, p. 393-395, pl. 302, fig. 1.

Original Description: Conrad, 1848a.

Fusiform, whorls ten, angulated in the middle, except the two from the apex, and with a reflected finely dentate carina; revolving lines distinct, finely crenulated; spire scalariform; from the upper end of the aperture runs a prominent revolving line, much larger than the others: lines on the body whorl below the angle minutely granulated; beak narrower, produced. Length 3/4. Rare.

Description: Shell of medium size, medium inflated; protoconch small, narrow, consisting of two and a half smooth, rounded whorls, followed by an interval of a half to three quarters of a turn during which the periphery developed from a feeble crease to a sharp, finely beaded carina; aperture moderately narrow, about 0.52 the height of the shell, produced anteriorly to an elongate, straight, narrow canal; anal sinus broad, subsymmetrical and moderately shallow; anal fasciole broad and flat, sculptured by growth lines only, separated from the suture by only a narrow, diagonally beaded collar, separated from the periphery by a concave, spirally sculptured area almost as wide as the fasciole; periphery sharp and projecting, distinctly upturned and bearing moderately fine, sharp beads at the edge which continue as raised growth varices for a short distance above the periphery; suture tightly closed; parietal callus well developed, stronger on the columella than on the parietal wall; columella slender, moderately long; sculpture consisting of moderately fine, sharply beaded, spiral, thread-like ribs with squared interspaces below the periphery, one just at the suture on the spire whorls and at about the lower two thirds of the body whorl being stronger than the rest, ribs becoming weaker and sharper towards the base of the columella; the concavity just above the periphery between the periphery and the anal fasciole bearing weak, smooth, spiral lines, crossed at a low angle by coarse, smooth, growth lines, a single, narrow, diagonally beaded collar subtending the suture.

Discussion: This species is identified with certainty only from the Byram Formation, but some juvenile specimens from the Bucatunna Formation of Alabama may be identical. It may be that *C. cristata* is not directly descended from the much more coarsely sculptured *C. cookei* MacNeil n. sp. from the Mint Spring and Red Bluff Formations, but rather represents an independent development from the Eocene *C. bella* Conrad. It is not an ancestral *Ancistrosyrinx*, however, as that subgenus was already typically developed in both the Claiborne and Jackson stages of the Eocene.

A detailed comparison of *C. cristata* with *C. cookei* will be found under the description of the latter. It differs from *C. bella* in having more numerous and more neatly beaded spiral ribs below the periphery, and a narrower and weaker subsutural collar. Specimens from the Wilcox of Woods Bluff, Alabama, referred to *C. bella* "approaching *greggi*," by Harris, have weakly beaded spirals and coarse, crescent-shaped growth varices on the anal fasciole, whereas the anal fasciole of *C. cristata* has no spiral markings and comparatively weak growth lines. Specimens that are probably typical *C. bella* from the Claiborne of Texas, however, do not have spiral lines on the anal fasciole. The slope from the carina to the suture is somewhat steeper in *C. bella*.

Type: Lectotype 13427 ANSP and paratype 13428 ANSP both from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 3722, 7372, 7376, 13286, MGS localities 106, 115; ? Bucatunna Formation, USGS locality 14368.

Cochlespira cookei MacNeil n. sp.
Plate 21, figure 19

Description: Shell of medium size, medium inflated; protoconch small, narrow, consisting of two and a half smooth, rounded whorls, followed by an interval of from three quarters to a full turn during which the periphery develops from a feeble crease to a sharp carina; aperture moderately narrow, about 0.53 the height of the shell, produced anteriorly to an elongate, straight slender canal; anal sinus broad, subsymmetrical and moderately shallow; anal fasciole broad and flat, sculptured by growth lines only, separated from the suture by a moderately strong, diagonally beaded collar, separated from the periphery by an irregular area, marked by oblique growth lines, of about half the width of the fasciole; periphery projecting but blunt, not upturned, bearing coarse beads which are sometimes axially elongate with the upper end sharper than the lower giving the periphery a slightly upturned appearance; suture tightly closed; parietal callus weak, stronger on the columella than on the parietal wall; columella slender, moderately long; sculpture below the periphery consisting of moderately coarse, beaded, revolving ribs, becoming weaker towards the base of the columella with secondary and even tertiary ribs intervening in adults, the rib below the peripheral carina forming a weaker, secondary carina in juveniles, but less pronounced in adults and separated from the periphery by a strong, secondary or even a tertiary rib, usually three strong ribs on the body whorl but four or even five may be present on full grown adults.

Discussion: *Cochlespira cookei* differs from *C. cristata* in having a heavier, blunt peripheral carina with coarse, axial beads rather than a moderately sharp carina, distinctly upturned and bearing fine, sharp beads as in *cristata*, and in having much coarser and fewer, beaded, spiral lines below the periphery, *C. cookei* having from three to five on the body whorl and about ten on the pillar, whereas *C. cristata* has from ten to twelve on the body whorl and about sixteen on the pillar. The subsutural collar of *C. cookei* is also considerably heavier.

Although the Red Bluff and Mint Spring forms are identical in the details of sculpture and are referred to the same species, the Red Bluff form has a somewhat more inclined slope from the carina to the suture and is regarded as a subspecies.

Type: Holotype 498161 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 21, figure 19).

Occurrence: Mint Spring Formation, USGS localities 6452, 7671, 13287, 14071a, MGS localities 89, 99.

Cochlespira cookei rubracollis MacNeil n. subsp.
Plate 8, figures 13, 19

Discussion: The analog of *C. cookei* in the Red Bluff is distinguished from the typical form in having a steeper, less concave slope from the suture to the periphery. The fine spiral thread that marks the lower border of the anal fasciole stands well above the carina in full view, whereas in typical *C. cookei* the same thread is about level with and behind the upper sharp end of the peripheral nodes in full view. The beads on the peripheral carina of the subspecies *rubracollis* are slightly finer than on typical *C. cookei* and the carina has the appearance of being slightly downturned rather than slightly upturned as in the Mint Spring form.

Both *C. cookei* and the subspecies *rubracollis* differ from *C. bella* from the Texas Claiborne in having much less precisely beaded ribs, periphery, and subsutural collar, and in having a relatively weaker secondary or subperipheral carina. The sharp beads and carina of *C. bella* are distinctly upturned, and the anal fasciole is relatively wider with the thread marking the outer margin of the fasciole weaker, and the space between the fasciole and the periphery narrower than in *C. cookei*.

As stated above, *C. columbaria* Aldrich from the Moodys Branch Formation belongs to the subgenus *Ancistrosyrinx* and is not closely related.

Type: Holotype 498039 USNM from the Red Bluff Formation, USGS locality 5263 (Plate 8, figure 19).

Occurrence: Red Bluff Formation, USGS localities 2631, 2632, 2633, 5263, 5264, 6456, 14367, MGS localities 37, 38, 39.

Genus **MICROSURCULA** Casey, 1904

Microsurcula Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 154, 1904.

Type (by original designation): *Microsurcula nucleola* Casey. Eocene, Claiborne Group, Louisiana.

The species here referred to this genus were included in the original list by Casey (1904, p. 156) with the remark, "*Microsurcula* will include, in addition, the Upper Claiborne *Fusus vetustus* of Lea, and two species from the Vicksburg Oligocene, one of which I recently described under the name *P. intacta*." In a more recent treatment, Harris (1937, p. 80) questionably referred *P. intacta* to *Microsurcula* which he regarded as a subgenus of *Raphitoma*. In the writer's opinion *Microsurcula* is sufficiently distinct from the type of *Raphitoma* (*Pleurotoma hystrix* Jan, Pliocene, Europe) to stand as a distinct genus.

The species here treated are referred to *Microsurcula* without reservations, although it is recognized that they have a less elaborately sculptured protoconch than *M. nucleola*, but in size, form, and type the protoconchs are similar.

Microsurcula intacta (Casey)

Plate 36, figures 23-24, 27, 29

1903. *Pleurotoma intacta* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 271.
1904. *Microsurcula intacta* (Casey). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 156.
1937. *Raphitoma* (*Microsurcula*?) *intacta* (Casey). Harris, Palaeont. Amer., v. 2, No. 7, p. 80, pl. 13, fig. 29.

Original Description: Casey, 1903.

Another species, equally well defined, may be named as above. It is small, moderately stout, fusiform, the aperture and canal, which are not very strongly differentiated, together constituting nearly half the entire length of the shell. The nucleus is as wide as high, consisting of about three whorls, smooth but gradually acquiring the fine riblets which become the eight or nine rather narrow and subacutely elevated oblique ribs of the subsequent whorls, the latter short, about four in number in the largest specimen before me, the ribs angular in profile from base to apex of the whorl, with point of maximum elevation just below the middle of the length and becoming obsolete just below the pronounced uneven and closely duplex collar margining the suture beneath. Each whorl has six or seven coarse, subequal and closely approximate flattened or slightly convex lyræ, those in lower half slightly coarser than the posterior three, and that at the middle slightly thickened at the summits of the ribs. Length of the largest in an extended series 7mm., width 2.5 mm. This species occurs only in the upper marls at Vicksburg and is common.

Description: Shell small, medium inflated to moderately inflated; protoconch consisting of about 4 evenly but rapidly expanding whorls, the first whorl very small but prominent, sharply inclined (about 55°) from the plane of the later whorls, the first 3 whorls smooth and polished except for a fine subsutural collar beginning at about midway of the second turn and becoming larger on successive turns, fine, crescent-shaped axials appearing at about the beginning of the fourth whorl which become shorter and straighter with the appearance of the much stronger adult subsutural collar, the change from nuclear to juvenile sculpture being well defined; aperture of moderate width, about .50 the height of the shell, canal not well defined; outer lip smooth within; anal sinus shallow and subsymmetrical; anal fasciole marked by recurving growth lines but otherwise not well defined; suture appressed; parietal callus weak; sculpture consisting of moderately coarse spiral lines, ranging from equal in size all over the whorl to very weak and widely spaced just below the periphery, usually with a single, strong incised line on the collar, the peripheral keel ranging from well defined to weak in different individuals or different whorls of the same individual, axial sculpture consisting of moderately sharp axial ribs which form moderately sharp nodes along the peripheral keel.

Discussion: This species varies in inflation, the strength of the spiral lines below the periphery, and in the prominence of the peripheral keel. One form in which the peripheral keel becomes obsolete in full grown adults is recognized as a variety, next described. Another form, *M. intacta jayensis* n. subsp., from Alabama is consistent in the strong development of the peripheral keel.

Microsurcula is represented in the Mint Spring Formation by *M. mentha* MacNeil n. sp., but this species is present in the U. S. National Museum collections from one Byram locality in central Mississippi so that it is not certain that *M. intacta* is descended from the Mint Spring form.

Type: Holotype 481666 USNM from the Byram Formation, "Upper marls," Vicksburg, Mississippi (Casey) (Plate 36, figure 29).

Occurrence: Byram Formation, USGS localities 3722, 3729, 5615, 6454, 6978, 7376, 7446, 7460a, 12175a, 13286, 14031, 14772, MGS locality 106.

Microsurcula intacta (Casey) var. A

Plate 36, figure 25; Plate 37, figures 8-10

Discussion: Occurring with typical *M. intacta* and presumably forming a completely intergrading series with it is a form in which the peripheral carina tends to become obsolete in full grown individuals. This form may be much more common than is supposed but due to the preponderance of juvenile individuals in all collections the unkeeled stage is not commonly seen.

Occurrence: Byram Formation, USGS locality 7376.

Microsurcula intacta jayensis MacNeil n. subsp.

Plate 36, figures 26, 28

Discussion: This form is described as a subspecies rather than a variety because of the fact that it appears to be consistent at its type locality. It differs from typical *intacta* in having a keel as sharp or sharper than the most extreme ever seen in the typical form, with usually 2 but sometimes 3 strong spiral lines immediately subtending the keel, in having weaker, or less commonly no suggestion of spirals on the anal fasciole. In addition the subsutural collar of the protoconch is continuous with that of the adult whorls in *M. intacta jayensis*, whereas in the typical form the adult collar appears below and rapidly smothers out the fine, appressed collar of the protoconch.

Type: Holotype 376609 USNM from the Bucatunna Formation, USGS locality 14368.

Occurrence: Alabama: Bucatunna Formation, USGS locality 14368.

Microsurcula mentha MacNeil n. sp.

Plate 22, figures 17-19

Description: Shell small, medium inflated; protoconch consisting of about 4 evenly but rapidly expanding whorls, the first whorl very small but prominent, sharply inclined, smooth and polished except for the last quarter turn which bears about 7 to 8 fine, crescent-shaped axial riblets which become shorter and straighter with the appearance of the subsutural collar at the beginning of the juvenile stage, the last whorl bearing a very faint collar; aperture of moderate width, about .50 the height of the shell, canal not well defined; outer lip smooth within; anal sinus moderately shallow and subsymmetrical; anal fasciole marked by recurving growth lines, but otherwise not well defined; suture appressed; subsutural collar well defined; parietal callus weak; sculpture consisting of moderately fine spiral lines all over the whorl, sometimes with fine secondary threads in several of the interspaces just below the periphery, collar usually bearing a single incised spiral, the peripheral keel ranging from well defined to weak, axial sculpture consisting of moderately sharp axial ribs which may be accentuated where they cross the periphery, usually from 5 to 8 visible from an angle.

Discussion: This species is readily distinguished from *M. intacta* of the Byram by its finer and more regular sculpture. The protoconch has axial riblets on only about the last quarter turn of the last whorl in contrast to the last full turn in *M. intacta*. Both species thus differ from the type, *M. nucleola*, which has fine axials on the last 3 complete turns of the protoconch. The axial ribs of *M. mentha* are more rounded and form a less pointed promontory on the periphery than is common in *M. intacta*.

Microsurcula mentha is probably the undescribed species that Casey included with *M. intacta* in *Microsurcula* in the remark quoted in the generic discussion.

Brachycythara gibba Guppy figured by Woodring (1928, p. 176, pl. 6, fig. 18) appears to be generically distinct from *M. mentha*, but a general similarity suggests that *Brachycythara* may have been derived from *Microsurcula*.

Type: Holotype 376503 USNM from the Mint Spring Formation, USGS locality 7671.

Occurrence: Mint Spring Formation, USGS localities 2664, 3727, 6452, 7671, 13287, MGS localities 89, 90, 99, ? Byram Formation, USGS locality 7376.

Microsurcula mentha MacNeil var. A

Plate 22, figures 16, 18

Discussion: Occurring with typical *M. mentha* at its type locality and apparently forming a perfectly intergrading series with it is a form differing in being somewhat stouter with a very weak peripheral carina, a very weak or obsolete subsutural collar in the adult whorls, and fewer, broader, weaker, and more widely spaced axial ribs, 4 or 5 usually being visible from an angle.

This form has not been found with typical *M. mentha* in western Mississippi.

Occurrence: Mint Spring Formation, USGS locality 7671.

Genus **VARICOBELA** Casey, 1904

Varicobela Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 162, 1904.

Type (by original designation): *Strombus smithii* Aldrich. Oligocene, Red Bluff Formation, Mississippi.

It is surprising that the relationships of this striking genus are so obscure. Casey stated that the protoconch is of the same general type as in *Pseudotoma*, but the sculpture is aberrent for the turridae, if it is a turrid at all. *Varicobela smithii* bears considerable resemblance, if only superficial, to *Siphonalia* (*Pseudoneptunea*) *scalarina* (Lamarck) from the Lutetian (Cossmann and Pissarro, 1910-1913, pl. 38, fig. 186-12).

Because of Casey's comparison of the protoconch (see Pl. 60, fig. 3) with that of *Pseudotoma*, which according to Powell (1969, p. 382) is a synonym of *Acamptogenotia*, this genus is tentatively placed in the subfamily Turriculinae.

Varicobela smithii (Aldrich)

Plate 8, figure 20; Plate 60, figures 1-3

1885. *Strombus* (*Canarium*) *smithii* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 148, pl. 2, fig. 6.
1886. *Strombus smithii* Aldrich. Aldrich, Geol. Survey Alabama, Bull. 1, p. 32, pl. 2, fig. 6.
1904. *Varicobela smithi* (Aldrich). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 162.
1942. *Varicobela smithi* (Aldrich). Powell, Auckland Inst. Museum, Bull. 2, p. 22.

Original Description: Aldrich, 1885.

Shell, oblong-ovate, whorls six, longitudinally ribbed and crossed by numerous fine equidistant revolving lines, with alternating finer ones between each; very fine longitudinal lines between the nodes; concave above and slightly shouldered at the suture; suture distinct; apex blunt, smooth; body whorl showing a large rib on the opposite side from the aperture, probably a former lip; aperture oblong; outer lip inflected, smooth inside; inner lip showing the revolving lines on the upper part; a thin callus spreading out over the body whorl; canal moderate, open, slightly recurved. Length, 7/10 of an inch; breadth, 4/10.

Locality, Red Bluff, Miss.

Living forms are tropical. Named in honor of Dr. Eug. A. Smith, State Geologist of Alabama.

Description: Shell moderately large and much inflated; protoconch large and bluntly conical, consisting of about 4 turns, the first 3 smooth except for a weak lira at the periphery immediately above the suture, the last with regularly squared *Ficus*-like sculpture and weak but easily distinguishable raised growth lines, the spiral lines continuing on in the adult stage and multiplied by secondary and tertiary lines of nearly equal strength, the slightly curved axial lines giving way at the beginning of the juvenile stage to much heavier, curved axial undulations; aperture moderately wide, constricted below to form a short canal twisted back from the aperture, about .60 the height of the shell; outer lip smooth within, broadly S-shaped in outline; anal sinus shallow, situated in the posterior angle of the aperture; anal fasciole and collar not defined, but a row of irregular, short, raised varices occurs just below the suture; suture crude, slightly appressed; parietal callus well defined but thin, reflecting the pattern of spiral sculpture, columellar callus somewhat thicker; canal twisted back from the aperture, bringing the siphonal fasciole into moderate relief; sculpture consisting of numerous spiral threads, stronger and more widely spaced on the lower part of the whorl, with interstitial threads divided into secondaries and tertiaries above, but tending to be of the same order in the interspaces on the lower half of the whorls, siphonal fasciole bearing more closely set spirals, the raised growth lines and interstitial spiral lines producing a microreticulated surface, axials of 2 orders, large, *Bursa*-like varices occurring at every half turn, and smaller but still strong varices (usually 5 to 6) between the larger varices, varices roughly S-shaped, strongest on the periphery, weakest in the concavity just above.

Discussion: Other than the following species, no other species related to this form are at present known from the Tertiary of North America, or elsewhere.

Type: Holotype 645086 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich).

Occurrence: Red Bluff Formation, USGS localities 315, 319, 2633, 2860, 5264, 13288, MGS localities 37, 38, 39; cf. Mint Spring Formation, MGS locality 75b.

Varicobela aldrichi Dockery n. sp.
Plate 60, figures 4-5

Discussion: This species is known from a single specimen, the holotype, from the Byram Formation, and is only the second species recorded for this genus. Its protoconch and the general form of its teleoconch are like that described for the type species, *V. smithii*. However, it differs very noticeably from this species in its flat sided whorls and reduced axial ribs (compare figures 1-2 and figures 4-5 of Plate 60).

Type: Holotype 376679 USNM from the Byram Formation, MGS locality 93 (Plate 60, figures 4-5).

Occurrence: Byram Formation, MGS locality 93.

Genus **CLAVIDRUPA** MacNeil n. gen.

Type: *Pleurotoma anita* Aldrich, 1885. Oligocene, Red Bluff Formation, Mississippi.

Shell moderately large and inflated. Protoconch not completely known, but a strong carina exists at about the lower 2/3 of at least the last whorl. Aperture broad and of medium length. Siphonal notch shallow, siphonal fasciole prominent, forming a well defined umbilical depression. Anal sinus shallow and broad, close to the suture. Whorls rounded with very coarse spiral threads and prominent axial ribs. Surface sculptured with fine spiral threads and many thin, closely set, upturned growth varices.

This genus is closely related to *Knefastia* Dall (Type, *Pleurotoma olivacea* Sowerby, 1833, not Reeve, 1843, Recent, west coast of Central America) from which it differs mainly in having a shorter, less pronounced siphonal canal and in its characteristic microsculpture. *Knefastia* does not have the fine spiral sculpture and thin crenulated growth varices of *Clavidrupa*.

Knefastia has been used for several Gulf Tertiary species by recent authors, but in the writer's opinion the species so treated are more allied to *Pleurofusia*.

Clavidrupa anita (Aldrich)
Plate 8, figures 22-24

1885. *Pleurotoma anita* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 147, pl. 2, fig. 3.

1886. *Pleurotoma anita* Aldrich. Aldrich, Geol. Survey Alabama, Bull. 1, p. 29, pl. 2, fig. 3.

Original Description: Aldrich, 1885.

Shell, bucciniform, elevated, carinate, contracted above the shoulder; whorls of the spire ornamented with a series of longitudinal nodes, crossed at irregular intervals with raised lines; apex, smooth, pointed; sculpture, coarse; body whorl, shouldered, shoulder bordered by a series of several fine transverse lines between the heavy raised ones; lines of growth, fine and numerous; aperture, oblong-ovate; canal, short, rather open, and slightly twisted; labrum, smooth inside, wavy in outline; sinus, deep, broad, and rounded; labium, smooth, reflected below. Length, 1 1/10 inches.

Locality, Red Bluff, Miss.

This species resembles *P. Heilprini*, nobis, but differs from it by the lack of the constriction of the whorls, its coarser sculpture, and strong nodes upon the body whorl.

Description: Shell moderately large and inflated; protoconch known only from the last half turn on the holotype, bearing a prominent carina at about the lower 2/3 of the whorl, with 3 to 4 faint crescent-shaped axials above it just preceding the juvenile stage, short, sharp, well spaced axials beginning abruptly at beginning of the juvenile stage, with 2 or 3 prominent spiral threads beginning at the second or third axial; aperture moderately wide, about .50 the height of the shell, canal broad, not definitely constricted; outer lip smooth within; anal sinus broad and shallow, subsymmetrical, separated from the suture by a narrow strip; anal fasciole flattened and undulating, not definitely marked except by recurving growth varices; suture impressed or slightly appressed; parietal callus and columellar callus forming a well defined inner lip, detached below to form a shallow umbilicus, swollen above just below the suture; columella short, thick, and straight; sculpture consisting of very coarse spiral threads, usually 2, sometimes 3 visible on the spiral whorls, continuing below on the body whorl and columella, becoming nearly obsolete with growth lines more conspicuous on the siphonal fasciole, frequently with strong secondary spirals in the interspaces on the lower part of the body whorl, axial ribs strong and straight, surface bearing a microsculpture of thin upturned growth varices and very fine, irregular spiral threads, which are perpendicular to the growth varices and form a crinkled margin on their upturned edges.

Discussion: Like *Varicobela smithii*, this is another of the elegant Red Bluff species with very uncertain relationships. In gross aspect it recalls the Recent *Knefastia olivacea* Sowerby from the West Coast, as was mentioned in the generic discussion. A similar microsculpture is found in the Gurabo Miocene species from the Dominican Republic, *Drillia squamosa* Gabb, but that species has more the form of *Cymatosyrinx*.

Type: Holotype 644609 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 8, figure 24).

Occurrence: Red Bluff Formation, USGS localities 309, 2632, MGS locality 34b.

Subfamily CLAVINAE Powell, 1942

Genus SYNTOMODRILLIA Woodring, 1928

Syntomodrillia Woodring, Carnegie Inst. Washington, Pub. 385, p. 160, 1928.

Type (by original designation): *Drillia lissotropis* Dall (According to Bartsch, 1934, it is *D. lissotropis* Dall, 1889, = *Syntomodrillia woodringi* Bartsch, not *D. lissotropis* Dall, 1881). Recent, West Indies.

Woodring described *Syntomodrillia* as having fine spiral lines in the interspaces between the axial ribs, but Bartsch (1934, p. 25-26) pointed out that the specimens with fine inter-axial spirals which Woodring had before him when he wrote the description were some identified by Dall in 1889 as *Drillia lissotropis*, but were not the species described by him in 1881 which he characterized as "shining with the lustre of paraffine," and, "whorls with transverse, stout, shouldered ribs (on the last whorl eleven) becoming obsolete anteriorly, and succeeded by a few (four or five) revolving riblets at the anterior extreme of the canal." If Dall's (1890, p. 36) conception of *D. lissotropis* changed after his description of the species, he probably never realized it as evidenced by his remarks under the description of *Drillia lissotropis perpolita*, "This shell differs from the Recent *D. lissotropis* in the entire absence of the fine spiral striation which in nearly all specimens of *lissotropis* is visible between the ribs." Bartsch named the form with spiral lines as *S. woodringi* Bartsch and substituted it for *D. lissotropis* as the genotype of *Syntomodrillia*. This procedure has never been definitely ruled on by the commission, but it has recommended that such cases of misidentified genotypes be submitted separately for consideration.

Bartsch further regarded the presence or absence of the fine spiral lines as the difference between *Syntomodrillia* and *Leptadrillia* and referred *D. lissotropis* Dall to the latter. As originally defined, however, *Leptadrillia* is distinguished from *Syntomodrillia* by having a considerably longer and narrower siphonal canal and a heavier parietal callus. In the writer's opinion the presence or absence of microspirals is a matter of specific difference only, and insofar as all other characters are concerned *S. woodringi* and *D. lissotropis* are congeneric. This is substantiated in two of the Vicksburg species here referred to *Syntomodrillia*, *S. tantula* Conrad (not *S. tantula* Bartsch, a Recent species), and the new Mint Spring species, *S. funis*, in which complete series can be seen from specimens having no spiral lines except for coarse threads on the columella to specimens having microspirals well developed all over the whorls.

Syntomodrillia is here used in its original sense for "very small slender 'Drillias' that have a short, relatively wide aperture, short canal, shallow siphonal notch, relatively thin callus on the parietal wall, and very shallow stromboid notch on the outer lip." The sculpture consists of regular axial ribs and fine to coarse spiral threads on the columella, but fine spiral lines or threads frequently occur over the entire whorl as well.

Casey (1904, p. 160) mentioned *P. tantula* Conrad under his genus *Eodrillia* with the remark, "It is possible that such forms as *tantula* Con., of the Vicksburg Oligocene, may also be included, although in that species there is no well-defined subsutural collar and the ribs attain the suture above." At some future time he intended to propose a new genus for this form as a manuscript name occurs with a specimen in his collection, but this name is regarded as anticipated by *Syntomodrillia*.

Syntomodrillia tantula (Conrad)

Plate 36, figures 13-15, 18-19

1848a. *Pleurotoma tantula* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.

1848b. *Pleurotoma tantula* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 21. Plates reprinted in Dockery, 1982, Appendix I.

Not 1934. *Syntomodrillia tantula* (Conrad). Bartsch, Smithsonian Misc. Coll., v. 91, No. 2, p. 25-26.

?1940. *Syntomodrillia* ? sp. cf. *S. tantula* (Conrad). Mansfield, Jour. Paleont., v. 14, No. 3, p. 206, pl. 27, fig. 15.

Original Description: Conrad, 1848a.

Slender; volutions nine, convex, with longitudinal rounded, slightly curved ribs; spire elevated and acute; suture margined by an indistinct raised line; beak short, narrow. Length 4-10. Rare.

A member of subgenus *Clavatula*, Lam.

Description: Shell moderately small and slender; protoconch small and conical, consisting of about 3-1/2 turns, smooth and polished throughout, juvenile sculpture beginning abruptly as moderately coarse axial ribs; aperture of moderate width, about .32 the height of the shell, moderately constricted at about the lower 2/3 to form a short canal; outer lip moderately thick, smooth within and bearing a well defined stromboid notch at the point of constriction; anal sinus shallow, subsymmetrical, and slightly flaring; anal fasciole obscure except for recurving growth lines; suture tightly closed, slightly appressed; no definite subsutural collar, but rarely a weak swelling is present below the suture; parietal callus and columellar callus form a well defined inner lip with a slight thickening just behind the anal sinus; sculpture consisting of moderately coarse spiral lines on the columella which may diminish greatly in size and continue above to the suture, or be absent on the face of the whorl altogether, axial sculpture consisting of moderately sharp axial ribs, straight except for a slight forward bend just below the suture.

Discussion: This species differs from the type of *Syntomodrillia* in having a protoconch of 3-1/2 whorls instead of only 2, but the protoconchs of both species consist of rounded, unsculptured whorls.

There is some range in the amount of forward curvature of the upper end of the axial ribs, some specimens having a strong curve while in others it is hardly perceptible. The alinement of the ribs is also variable, ranging from even straight rows in some specimens to forms in which the axials are staggered about half the width of the interspaces in successive whorls. In addition to the variation in axial sculpture all stages from that in which very fine axials cover the whorls to that in which the surface is smooth except for growth lines can be seen.

Probably the closest Eocene relatives of the species of *Syntomodrillia* here treated are certain of the species of *Eodrillia* such as *E. texana* (Conrad) and *E. texana educata* (Harris) from the lower Claiborne of Texas. The Eocene species have less developed axials which are usually strongest along a weak shoulder, and a better developed anal fasciole and collar.

Mansfield (1940, p. 206, pl. 27, fig. 15) figured a specimen identified as *Syntomodrillia*? sp. cf. *S. tantula* (Conrad) from the Chickasawhay Limestone of Wayne Co., Mississippi. As stated, his specimen is crushed, immature, and not definitely identifiable.

Syntomodrillia espyra Woodring from the Bowden Formation of Jamaica is related to *S. tantula* but differs from it in having a less constricted base to the body whorl and more crowded axial ribs. The Bowden species is even more like the Mint Spring form.

Type: Lectotype 13433 ANSP and three paratypes 13434 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 1042, 3722, 3729, 6454, 6978, 7372, 7376, 7385, 7446, 7460a, 12179a, 13286, 14031, 14368, 14683, 14772, 14850, MGS locality 106.

Syntomodrillia tantula (Conrad) var. A

Plate 36, figures 20-22

Discussion: A form occurring rarely with typical *S. tantula* in western Mississippi but occurring to the exclusion of other forms at the Jay Branch locality in Alabama is here designated as var. A. It differs from typical *S. tantula* in having a weak but well defined shoulder with a distinct accentuation of the ribs as they cross the shoulder. Spiral sculpture in specimens referred to this subspecies is very faint or absent.

None of the specimens is as large as those of the more abundant typical form but this may be a coincidence.

Occurrence: Alabama: Byram Formation, USGS locality 14368. Mississippi: Byram Formation, USGS localities 6978, 13286, 14368.

Syntomodrillia funis MacNeil n. sp.

Plate 22, figures 22-26

Description: Shell moderately small, medium inflated; protoconch small and conical, consisting of 3 smooth, evenly expanding whorls, juvenile sculpture beginning abruptly as coarse axial ribs; aperture of moderate width, about .38 the height of the shell, weakly constricted at about the lower 2/3 to form a short canal; outer lip smooth within, stromboid notch not well developed; anal sinus shallow, subsymmetrical and slightly flaring; anal fasciole not well defined except for recurving growth lines and slight depressions between the axial ribs; suture closed, slightly appressed; subsutural collar weak; parietal callus and columellar callus form a well defined inner lip with a slight callus just behind the anal sinus; sculpture consisting of fine, sharp, raised spiral threads all over the whorls, moderately coarse on the columella and diminishing uniformly in strength and more closely spaced passing upwards to the suture, often very weak on the anal fasciole; axials thin, sharp and inclined to the right with usually a slight left twist at the upper end, 7 axials visible from an angle.

Discussion: This species and its variety *S. funis* var. A both occur commonly at the Brown's Cave locality on Leaf River but have been found nowhere else. *Syntomodrillia funis* is not particularly close to the Byram *S. tantula* and is not believed to connect it with the Red Bluff species, *S. collarubra*, which is probably more closely related to *S. tantula* than is *S. funis*. It differs from *S. tantula* in being stouter and shorter with finer, sharper, more inclined axial ribs of which one more is visible, 7, nearly 8 being visible in *S. funis*, whereas 6, nearly 7, are visible in *S. tantula*.

Syntomodrillia funis differs from *S. espyra* Woodring from the Bowden Formation in being more inflated with more curved axials and a larger anal sinus.

Type: Holotype 498172 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 22, figure 22).

Occurrence: Mint Spring Formation, USGS locality 7671, MGS locality 89.

Syntomodrillia funis MacNeil var. A

Plate 22, figures 29-32

Discussion: Occurring with typical *S. funis* and believed to form a completely grading series with it is a form agreeing with it in all details except that the spiral sculpture is very faint or absent from the face of the whorls, being restricted to from 3 to 6 well developed threads on the columella. This form thus compares with *S. tantula* more in micro-details of the surface, but differs from it is the same manner as does the typical form.

Occurrence: Mint Spring Formation, USGS locality 7671, MGS locality 89.

Syntomodrillia collarubra MacNeil n. sp.

Plate 9, figures 9-10

Description: Shell moderately small and moderately inflated; protoconch small and conical, consisting of 3-1/2 smooth and polished whorls, axial ribs appearing abruptly at the beginning of the juvenile stage; aperture moderately broad, about .36 the height of the shell, constricted at about the lower 2/3 to form a short canal that curves slightly towards the aperture; outer lip smooth within, with a well developed stromboid notch at the constriction; anal sinus shallow, moderately broad and subsymmetrical; anal fasciole obscure except for recurving growth lines; suture closed, slightly appressed; subsutural collar absent or represented by only a slight swelling; parietal callus and columellar callus form a weak but well defined inner lip; sculpture consisting of moderately fine spiral lines on the columella becoming fainter above and obsolete at or just above the constriction at the base of the body whorl, fine growth lines usually visible on the face of the whorls, axial sculpture consisting of moderately heavy, slightly inclined, rounded axial ribs, usually 5 but commonly 6 visible from an angle, in full grown adults one just behind the aperture much larger than the preceding and forming a broad varix.

Discussion: This species is sculptured similarly to the smoother specimens of *S. tantula* but differs from it in being more inflated and in having a shorter curve toward the aperture. The protoconch also has a half turn more.

This species may be the progenitor of *S. tantula*, but if so the Mint Spring form, *S. funis*, probably does not represent the intermediate form. Both typical *S. funis* and *S. funis* var. A have finer and more numerous axials and the typical form has much coarser axial sculpture than is found in either the Byram or Red Bluff species.

Type: Holotype 498047 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 9, figure 10).

Occurrence: Red Bluff Formation, USGS localities 5263, 5264, 7218, 7221, 14367, 14720, MGS locality 38.

Genus **VETIDRILLIA** MacNeil n. gen.

Type: *Vetidrillia palmerae* MacNeil n. sp. Oligocene, Mint Spring Formation, Mississippi.

This genus is proposed for shells of the type referred to *Eodrillia* Casey by Harris (1937, p. 86, pl. 14). Casey included *Pleurotoma depygis* Conrad in the original list of *Eodrillia* (1904, p. 160), which, unfortunately, Cossmann designated as type (1906, p. 223). Cossmann regarded *Eodrillia* as a synonym of *Eopleurotoma* Cossmann and he had earlier referred *P. depygis* to *Eopleurotoma*. Harris followed him in thus placing *P. depygis*, but he did not regard it as congeneric with such forms as *P. lonsdalei* Lea, which he took to be typical of *Eodrillia*. Whether or not *Eodrillia* is a synonym of *Eopleurotoma* is beyond the scope of this report, but it does appear certain that the group of *P. lonsdalei* can have no further association with the name *Eodrillia* and is therefore unnamed. This group is probably referable to *Vetidrillia*; however, the Mint Spring species is made the type of this new genus.

Vetidrillia is characterized by both axial and weak radial sculpture, a strong anal sinus, a weak but well defined short canal and no stromboid notch in the outer lip. It compares in general form with *Elaeocyma* Dall (type, *Drillia empyrosia* Dall, Recent, California) but that genus has a moderately deep siphonal notch and a strong stromboid notch.

Vetidrillia palmerae MacNeil n. sp.
Plate 22, figures 27, 34

Description: Shell moderately slender and medium small; protoconch small and conical, consisting of 4 whorls of which the first two expand at a lesser rate than the last 2, the first whorl slightly inclined, all whorls smooth and polished except for about 3 to 4 weak crescent-shaped axials immediately preceding and merging into the coarser and straighter axials of the juvenile sculpture; aperture of medium width, about .39 the height of the shell, slightly constricted anteriorly to form a short weak canal; outer lip smooth within, arcuate in outline; anal sinus subsymmetrical, moderately strong and slightly flaring; anal fasciole flat, marked by recurving growth lines and separated from the suture by a weak collar; suture closed, somewhat appressed; parietal callus and columellar callus forming a weak inner lip, with a slight thickening just behind the anal sinus; sculpture consisting of weak raised spiral threads all over the whorls, stronger on the columella and becoming gradually weaker passing upwards, those on the anal fasciole being somewhat finer and more closely spaced, one weakly incised line usually present on the subsutural collar, axials elongate, moderately narrow, closely spaced and slightly inclined, ending at the lower margin of the anal fasciole, about 10 or 11 visible from an angle, more irregular on the body whorl of full grown adults.

Discussion: This species is related to *P. lonsdalei* Lea and may be descended from it. It is larger than *P. lonsdalei* and has more numerous and more crowded axial ribs with a less pronounced swelling at the upper ends of the ribs. The anal sinus has a slight upward twist and is entrenched slightly behind the upper swelling of the parietal callus, whereas in *V. palmerae* the anal sinus is slightly twisted outwards and is closed behind the parietal callus.

No analog of this species is known from either the Red Bluff or the Byram formations.

Type: Holotype 498174 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 22, figure 34).

Occurrence: Mint Spring Formation, USGS localities 7671, 13287, 14071a, MGS locality 99.

Genus **PLEUROTOMA** Lamarck, 1799

Pleurotoma eboroides Conrad
Plate 39, figures 29-32

1848a. *Pleurotoma eboroides* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 285.
1848b. *Pleurotoma eboroides* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 24. Plates reprinted in Dockery, 1982, Appendix I.

Original Description: Conrad, 1848a.

Turreted; whorls nine, smooth, flattened above, obscurely nodulous or subcostate below; beak short. Length 6-10.

Discussion: *Pleurotoma eboroides* was described by Conrad (1848a, 1848b) along with material from Vicksburg and was supposed likewise to have come from Vicksburg. The matrix filling the type specimens is not similar to any matrix thus far seen from any of the Gulf Oligocene formations, nor has this species since been reported from the Gulf Oligocene. In attempting to identify this species, however, it was found to be identical with and to occur in the same matrix as specimens of *Pleurotoma dissimilis* Conrad (1829, p. 224, pl. 9, fig. 11) from the St. Marys Formation of Maryland in the U. S. National Museum. There is no doubt in the writer's mind that the types of *P. eboroides* came from the St. Marys and were combined with Conrad's Vicksburg collection through an error.

The Casey collection contains two specimens of this species with the same matrix, and were probably obtained by Casey from the Conrad collection at the time he wrote his "Notes on the Conrad Collection of Vicksburg Fossils with Descriptions of New Species." A label in Casey's hand says, "*Eoclavus eboroides* Con., Vicks.," the generic name probably one that Casey had in mind to describe.

Type: Lectotype 13439 ANSP and five paratypes 13430 ANSP probably from the St. Marys Formation of Maryland judging from the matrix (Plate 39, figures 31-32 — lectotype, figures 29-30 — paratype A).

Occurrence: Uncertain.

Pleurotoma mississippiensis Conrad
Plate 39, figures 33-34

1848a. *Pleurotoma Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.
1848b. *Pleurotoma mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 17. Plates reprinted in Dockery, 1982, Appendix I.

Original Description: Conrad, 1848a.

Turreted; volutions eight, concave above and plain below, with longitudinal distant rounded ribs; body whorl with revolving lines, commencing in a line with the summit of the aperture; beak short, a little curved. Length 2/3.

Discussion: Like *P. eboroides*, this species is also believed to be extraneous, but so far it has not been definitely identified as to origin.

Type: Holotype 13445 ANSP, origin uncertain.

Occurrence: Uncertain.

Subfamily CRASSISPIRINAE Morrison, 1966

Genus **CRASSISPIRA** Swainson, 1840

Crassispira Swainson, Treatise on Malacology, p. 313, 1840.

Type (by subsequent designation, Herrmannsen, 1847): *Pleurotoma bottae* Valenciennes. Recent, west coast of Mexico.

The acceptance of *Pleurotoma bottae* Valenciennes as the *P. bottae* Auct. given by Swainson in the original list has been well discussed by both Woodring (1928, p. 147-148) and Grant and Gale (1931, p. 580-581). Both authors accepted the designation of Herrmannsen but at the same time admitted that it is equivocal. It seems probable that no difference would result in the generic concept if Swainson's other species, *C. fasciata* Swainson, were regarded as the monotype. However, there is such confusion in the identity *C. fasciata* itself, that the rules should actually be waived in favor of *P. bottae* in case it should be decided that Herrmannsen's designation as such is not acceptable.

Subgenus **CRASSISPIRELLA**
Bartsch and Rehder, 1939

Crassispira (*Crassispirella*) Bartsch and Rehder, U. S. Nat. Museum, Proc., v. 87, p. 135, 1939.

Type (by original designation): *Turris rugitecta* Dall. Recent, Lower California.

This subgenus differs from typical *Crassispira* in having stronger sculpture, both axial and radial, and a weaker siphonal notch with a less conspicuous siphonal fasciole. The anal fasciole is well developed and the collar is strong. It properly includes many of the smaller forms formerly placed under *Crassispira* s.l. and is a larger group from the standpoint of the number of species.

Casey did not mention *Pleurotoma abundans* in his notes on the Pleurotomidae, but apparently he regarded this Vicksburg species as distinct from *Crassispira* as a specimen in his collection bears a manuscript generic name. This name is regarded as anticipated by *Crassispirella.*

Crassispira (Crassispirella) abundans (Conrad)
Plate 37, figures 1-2

1829. *Pleurotoma costata* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 8. Printed in Dockery, 1982, Appendix II.
1848a. *Pleurotoma abundans* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 285.
1848b. *Pleurotoma abundans* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 115, pl. 11, fig. 25 (left, not fig. 25 right). Plates reprinted in Dockery, 1982, Appendix I.

Original Description: Conrad, 1848a.

Turreted; whorls ten, concave above, with a crenulated prominent revolving line just below the suture; convex portion of the whorls with prominent, acute, nearly straight ribs and regular revolving lines; concave portion with minute revolving lines; beak narrow, slightly produced. Length 3/4.

It belongs to subgenus *Clavatula*, Lam.

Description: Shell of medium size, moderately slender; protoconch small and conical, consisting of about 4 whorls, the first broken on all specimens seen, but apparently slightly swollen, the first 3-1/2 smooth and polished, the last 1/2 turn bearing crescent-shaped axials, becoming shorter and straighter with the appearance of the subsutural collar and spiral sculpture at the beginning of the juvenile stage; aperture of medium width, about .37 the height of the shell, constricted near the base to form a short canal; outer lip smooth within, with an incipient indentation at the constriction; anal sinus of medium depth, narrow and constricted, pointing outwards; anal fasciole moderately narrow and concave, separated from the suture by a well developed collar; suture appressed; parietal callus and columellar callus forming a weak inner lip, thickened perceptably just below the suture; columella practically straight; sculpture consisting of moderately coarse spiral threads on the face of the whorl and extending below to about midway on the columella, usually with finer secondary and frequently tertiary lines between the primary lines, often 1 or 2 interspaces broader than the rest at the base of the body whorl, finer, closely set primary lines on the siphonal fasciolar region, anal fasciole bearing 2 to 6 weak spiral threads, subsutural collar usually with 2 or 3 weak incised lines on the upper side, axials straight, narrow and sharp, cut off abruptly at the lower margin of the anal fasciole, usually 10 or 11 visible from an angle.

Discussion: Conrad figured both the narrow ribbed form to which the name is here fixed and the form with more widely spaced ribs, described next as *C. lyopleura*, under this species. The specimen of *C. lyopleura* in Conrad's collection has been given ANSP no. 13493.

This species less resembles the Mint Spring species of *Mitodrillia* than does *C. lyopleura*. Perhaps its nearest know relative, stratigraphically, is *C. eupora* (Dall) from the Tampa Limestone which differs in being less inflated, with sharper axial ribs, a broader anal fasciole, weaker spiral threads which do not cross the axials as in *abundans*, and in lacking the finer secondary spiral threads.

Crassispira calligona paraconsors Gardner from the Chipola Formation of Florida, although farther removed stratigraphically, is probably more closely related to *C. abundans*, differing from it mainly in being larger and having a stronger subsutural collar and coarser spiral sculpture on the anal fasciole.

An immature, slender specimen with smooth interspaces between the spirals from Jay Branch (USGS locality 14368) may be a subspecies.

Type: Lectotype 13437 ANSP and paratype 13438 ANSP both from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, USGS localities 2664, 3140, 3722, 3724, 3729, 6449, 6453, 7372, 7376, 7941, 10399, 10400, 12174a, 12175, 14368, 14682, 14683, 14772, MGS localities 93, 106, 109, 112c.

Crassispira (Crassispirella) lyopleura MacNeil n. sp.

Plate 37, figures 3-4

1848b. *Pleurotoma abundans* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd. ser., v. 1, pl. 11, fig. 25 (right, not 25 left). Plates reprinted in Dockery, 1982, Appendix I.

Description: Shell of medium size, moderately slender; protoconch unknown; aperture of medium width, about .34 the height of the shell, constricted near the base to form a short canal; outer lip smooth within, a weak indentation at the constriction; anal sinus of medium depth, narrow, constricted; pointing outwards; anal fasciole moderately narrow and concave, moderately deep to deep, separated from the suture by a well developed collar; suture appressed; parietal callus and columellar callus forming a well defined inner lip; columella straight; sculpture consisting of moderately coarse spiral threads, more closely set just below the anal fasciole, becoming gradually more separated passing downwards as far as the siphonal fasciolar region, closely set thereon, interspaces above bearing from 2 to 4 very fine, equisized secondary threads, rarely divisible into secondary and tertiary series, anal fasciole with several weak threads, collar frequently with several very fine irregular threads in the sutural slope, axials straight, of medium width and blunt, terminating abruptly at the anal fasciole, usually 7 to 8 visible from an angle.

Discussion: *Crassispira* (*Crassispirella*) *lyopleura* differs from *C.* (*C.*) *abundans* in having broader, blunter, and more widely separated axial ribs, a more concave and deeper anal fasciole, and usually has the fine threads in the interspaces between the primary spirals subequal in size, rather than of secondary and tertiary magnitide as in *C.* (*C.*) *abundans*. This species is less abundant than *C.* (*C.*) *abundans* and although many specimens of *C.* (*C.*) *abundans* are at hand there does not appear to be a perfect gradation between the two species. It is obvious, however, that they are very closely related.

At first glance *C.* (*C.*) *lyopleura* closely resembles *Mitodrillia pharus*, but differs from it in having a strongly developed anal fasciole in contrast to the very weak fasciole in *M. pharus*, the axials terminate abruptly at the fasciole rather than continue nearly to the collar, and the spiral lines gradually become more widely spaced passing downwards from the anal fasciole rather than maintain nearly the same spacing on the face of the whorls and suddenly become widely spaced in the concavity at the base of the whorl.

Type: Holotype 376613 USNM from the Byram Formation, USGS locality 13286 (Plate 37, figure 3).

Occurrence: Byram Formation, USGS localities 12175, 13286, 14683, MGS locality 115.

Genus **MITODRILLIA** MacNeil n. gen.

Type: *Drillia harmonica* Casey, 1903. Oligocene, Mint Spring Formation, Mississippi.

Shell slender to moderately stout. Protoconch consisting of 4 to 5 whorls, the first few smooth, the last sculptured with thin, crescent-shaped axials. Aperture of moderate length. Anterior canal short to moderately short, slightly constricted. Siphonal notch shallow and nearly symmetrical, siphonal fasciole flat. Inner lip thin and attached or tending to become detached. Anal sinus moderately deep and removed from the suture by a thin, appressed subsutural collar. No constriction of anal sinus. Parietal wall slightly calloused adjacent to the suture in adults. Sculpture consisting of neat spiral threads with smaller interstitial lines covering the whorls, usually more widely spaced at the base of the body whorl and on the pillar, axials rounded and extending practically to the collar. Anal fasciole flattened or slightly concave, not a strong feature.

This genus is related to *Crassipira*, particularly to the subgenus *Crassipirella* Bartsch and Rehder (1939, p. 135), (type, *Turris rugitecta* Dall, Recent, Lower California), to which a large number of the smaller species with strong sculpture formerly referred to *Crassipira* s. l. should probably be referred. It differs from *Crassipirella* in having more fusiod sculpture and lacks the strong anal fasciole. The protoconch and sculpture of the spire whorls strongly recalls *Pleurofusia*, but the aperture is distinctly drillid.

Two species, both from the Mint Spring Formation, are referred to this genus and there can be but little doubt that they are congeneric. The species besides the type, *M. pharus*, is more elongate than *M. harmonica* and has a broader subsutural collar and an incipient anal fasciole suggestive of *Crassipirella*, and it seems highly probable that the latter may have been derived from *Mitodrillia*.

Mitodrillia harmonica (Casey)

Plate 23, figure 11

1903. *Drillia harmonica* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 273.
1937. "*Drillia harmonica*" Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 88, p. 14, fig. 23.

Original Description: Casey, 1903.

A well-defined new species, quite rare in the Lower Vicksburg, and not yet found in the upper marls. It is rather stout, the spire apparently narrowing somewhat more rapidly toward apex. Nucleus simple and composed of three or four whorls. The subsequent whorls are rather short, each with some eight or nine strongly marked rounded ribs, longitudinal in direction or nearly so, and generally in line from one whorl to the next; they extend nearly throughout the length of the whorl, becoming obsolete only in the narrow revolving concavity below the ante-sutural elevated collar, which is rather thick and conspicuous and marked posteriorly with one or two striæ. Each whorl has some seven or eight nearly equal revolving lyræ, those near the middle mutually separated as a rule by a finer line. The aperture is rather wide, the canal very short, the two together but little more than a third of the total length, the callus near the posterior angle of the aperture tumid and conspicuous. Length 11 mm., width 3.7 mm. I had confounded this species with *mississippiensis*, of Conrad, until a recent inspection of the type of the latter shows that it is very different; *mississippiensis* is very stout much larger, with the revolving concavity below the sutural collar very wide, constituting about half the entire length of the whorl; the short, broadly rounded ribs are confined to anterior half of the whorls and are obsolete in the posterior concavity. The specimen is somewhat water-worn, so that the sculpture is not distinct, but there are apparently revolving raised lines which distinguish the species at once from the smooth and otherwise very different *eboroides*. The type seems to be unique.

Description: Shell moderately small and medium inflated; protoconch consisting of 5 whorls, the first missing on all specimens seen, the last 2 expanding more rapidly than the first 3, smooth and polished except for the last whorl which bears elongate, crescent-shaped axial riblets, weak when first appearing and becoming shorter and straighter with the appearance of the subsutural collar at the beginning of the juvenile stage, spiral lines between the axials on the last quarter turn, which in the juvenile stage immediately cross the axials as well; aperture moderately wide, about .43 the height of the shell, slightly constricted below to form a very short canal; outer lip smooth within, with a weak stromboid indentation; anal sinus broad, shallow, recurving more abruptly above than below; anal fasciole obscure, marked by recurving growth lines, separated from the suture by a moderately strong subsutural collar; suture appressed; parietal callus and columellar callus forming a weak inner lip, with a slight tumidity just below the suture; columella weakly twisted below; sculpture consisting of well developed spiral threads, single and more crowded on the anal fasciole, more separated with single secondary lines in the interspaces on the face of the whorls, widely separated with several secondary and tertiary lines between them in the concave region at the base of the body whorl and upper part of the columella, and becoming single again on the siphonal fasciolar region, axials rounded and well spaced, extending nearly to the subsutural collar above and causing undulations in the collar below where it crosses them, 6 visible from an angle on the type.

Discussion: The antecedents of this species are obscure but it may have been derived from one of the more elongate forms referred to *Eodrillia* by Harris, such as *E. texanopsis* (Harris) from the lower Claiborne of Texas.

Comparison with the related species, *M. pharus*, is made under that species.

Mitodrillia harmonica is rare, only one specimen being known to Casey at the time of his description, although his collection now contains another, and one specimen is present in an old collection from Vicksburg in the National Museum. The writer obtained one other specimen, the one from which the protoconch is described, from the Lime Creek locality.

Type: Holotype 481665 USNM from the Mint Spring Formation, "Lower Vicksburg," Vicksburg, Mississippi (Casey) (Plate 23, figure 1).

Occurrence: Mint Spring Formation, USGS localities 3727, 14071.

Mitodrillia pharus MacNeil n. sp.
Plate 23, figures 13-14

Description: Shell moderately slender to medium inflated, elongate; protoconch identical with that of *M. harmonica*; aperture of moderate width, about .30 the height of the shell, weakly constricted below to form a moderately short canal; outer lip smooth within, with an incipient indentation at the constriction; anal sinus of medium depth, moderately narrow, subsymmetrical; anal fasciole not strong, but marked by both a difference in spiral sculpture and recurving growth lines, slightly concave and made undulatory by the upper ends of the axials, separated from the suture by a broad, low collar; suture appressed; parietal callus and columellar callus forming a well defined inner lip, swollen just below the suture; columella practically straight; sculpture consisting of one or two spirals on the collar, closely set spirals on the anal fasciole, coarser and more widely spaced spirals with secondary and rarely tertiary lines on the face of the whorls, much more widely spaced at the base of the body whorl and columella with several weak, fine, secondary and tertiary lines between the primary spirals, single, equisized spirals resuming on the siphonal fasciolar region, axials well spaced and rounded, terminating above nearly at the collar, 6, nearly 7, visible from an angle.

Discussion: *Mitodrillia pharus* differs from *M. harmonica* in being much more elongate with a longer canal and less constricted base to the body whorl, a broader subsutural collar, and a slightly better defined anal fasciole. The anal sinus of the type of *M. harmonica* is broader and less symmetrical than that of the type of *pharus*, but the former may not be a full grown individual. The axial ribs of the two species are similar in size and spacing, although those of *M. pharus* appear longer due to the more elongate spire. A subspecies of *M. pharus*, next described, has narrower and more crowded ribs, however.

Type: Holotype 498176 USNM, from the Casey collection, is filled with typical Mint Spring matrix and presumably was collected at Vicksburg (Plate 23, figures 13-14).

Occurrence: Mint Spring Formation, Vicksburg and possibly USGS locality 7671.

Mitodrillia pharus crassispiropsis MacNeil n. subsp.
Plate 23, figure 12

Discussion: Also occurring in the Mint Spring Formation is a form closely related to *M. pharus*, differing from it mainly in being stouter and in having sharper, narrower, and more closely set axial ribs, 8, rarely 9, being visible from an angle. Not enough specimens are at hand to say whether the two forms actually grade into one another or are distinct, but at least one specimen occurring with the variety at the Brown's Cave locality appears to be the typical form.

Mitodrillia pharus crassispiropsis most nearly approaches in appearance the Mint Spring species of *Crassispirella*, previously considered, particularly, *C. lyopleura* MacNeil n. sp., but can be distinguished from it readily by its weak anal fasciole as opposed to the well developed fasciole of *Crassispirella*, and by the longer columella with more widely separated spirals at the base of the body whorl.

Type: Holotype 498175 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 23, figure 12).

Occurrence: Mint Spring Formation, USGS localities 7671, 14071.

Subfamily BORSONIINAE Bellardi, 1875

Genus **MICRODRILLIA** Casey, 1903

Microdrillia Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 276.

Type (by subsequent designation, Cossmann, 1906): *Pleurotoma cossmanni* Meyer, 1887, (not *Purpura cossmanni* de Raincourt, 1884) (= *Oligotoma meyeri* Cossmann, 1889). Eocene, Moodys Branch Formation, Mississippi.

Casey proposed this genus for a group of Eocene to lower Miocene species, "very small and characterized by a well-developed, multispiral closely coiled embryo, having one to three of its basal whorls costulate, few body whorls which are wholly devoid of costae but spirally carinate, the retral sinus relatively large, circularly rounded and close to the suture, the aperture oblique, columella callous, with or without plications, and the canal short or subobsolete."

Shells referred to this genus range from slender to inflated, and in additon to the columellar plications, the outer lip may be with or without internal spiral lirations. The strength of the columellar plications and lirations of the outer lip appears to be interdependent, both being strong, weak, or absent in any one specimen or species.

It is difficult to decide how many valid species of *Microdrillia* occur in the Gulf Oligocene on the basis of present collections due to the fact that only one specimen, usually an immature one, of some lineages is known from one or more of the formations, so that it is impossible to say whether it is identical with more numerous or better preserved adult specimens from another formation.

Woodring (1928, p. 197) pointed out that *Microdrillia* is still living in the Persian Gulf and possibly elsewhere in the Orient.

Microdrillia vicksburgella Casey

Plate 9, figure 6; Plate 23, figures 3, 16;
Plate 37, figures 13, 20; Plate 60, figures 6-12;
Plate 61, figures 1-2

1903. *Microdrillia vicksburgella* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 277.
1903. *Microdrillia biplicatula* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 278.
1937. *Microdrillia vicksburgella* Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 93, pl. 14, fig. 37.
1937. *Microdrillia biplicatula* Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 93, pl. 14, fig. 36.

Original Description of *M. vicksburgella*: Casey, 1903.

Embryo nearly one-half higher than wide, subcylindrical, rapidly pointed at tip, with three smooth and nearly three coarsely costulate whorls, the latter strongly and more medially convex; subsequent whorls not exceeding four in number, the fasciolar surface with a fine revolving thread; shell much more slender and elongate than in *infans*. Length of embryo alone 1.4 mm., width .8 mm. Upper Vicksburg Oligocene.

Original Description or *M. biplicatula*: Casey, 1903.

Revolving carinæ fine as in *elongatula*, the shell similarly slender, differing in having two costulate embryonic whorls, a fine revolving thread in the fasciolar surface and but two columellar folds; body whorls but two in number in the type. Length 2.3 mm., width 1 mm. Red Bluff Eocene.

Description: Shell small, slender; protoconch consisting of about 5 whorls of which the first 2-1/2 to 3 are smooth and less rapidly expanding than the last 2 to 2-1/2, the last 2 to 2-1/2 whorls bearing many closely spaced crescent-shaped axial riblets, transition from protoconch to teleoconch not abrupt, the spiral threads appearing gradually and the protoconch's axials disappearing gradually; aperture narrow, about .38 the height of the shell, anterior end forming a short, narrow canal; outer lip bearing 4 short spiral lirations within; anal sinus shallow and broad, recurving more sharply above than below; anal fasciole concave and marked by recurving raised growth lines; suture slightly open to tightly closed, slightly appressed; parietal callus thin, columellar callus somewhat thicker and bearing 2 weak, short, folds, slightly detached, especially below to form a weak inner lip; columella short and thick; sculpture consisting of raised, sharp, spiral threads, one forming a thin subsutural collar, one in the anal fasciolar concavity of variable strength, as strong as the others on the type, but frequently weak, usually 3, sometimes only 2, spirals visible below on the spire whorls and continuing below on the body whorl to the tip of the columella, interstitial threads frequently appearing which soon become as strong as the primary spirals, interspaces sculptured with thin, raised growth varices, somewhat variable in spacing in different individuals.

Discussion: *Microdrillia vicksburgella* is located in Casey's key along with species having no columellar plaits but the lectotype, one of Casey's labelled specimens, and the majority of specimens referable to this species have 2 small columellar crenulations.

Individuals of this species vary considerably in sculpture, particularly in the strength of the anal fasciolar spiral, the strength or weakness of which may make the fasciole obscure or distinctly marked as a spiral concavity. The raised growth lines vary in spacing in different specimens and there are minor differences in the strength and spacing of individual spiral lines.

No means is apparent to the writer for separating the Mint Spring forms from typical *M. vicksburgella* although larger specimens are common in Mint Spring collections, the largest measuring 6.7 mm. in height.

Microdrillia biplicatula Casey from the Red Bluff Formation is a synonym of *M. vicksburgella* and has the spiral line on the anal fasciole that is characteristic of that species (compare SEM photographs on Plate 60, figures 6-12, and Plate 61, figures 1-2).

Microdrillia vicksburgella can be distinguished from *M. robustula* Casey from the "Lower Claiborne Eocene, St. Maurice, La." by the spiral line on the anal fasciole area, and by the pair of crenulations on the columella usually present in *M. vicksburgella* but not found in the Eocene species. *Microdrillia meyeri* Cossmann also lacks the fasciolar spiral and is a heavier shell with a more pronounced siphonal fasciole. It has 2 to 3 crenulations on the inner surface or the outer lip but lacks crenulations on the columella.

Microdrillia tersa Woodring from the Bowden Formation of Jamaica differs from *M. vicksburgella* in having stronger spiral lines and a shorter aperture. The Chipola species, *M. hebetika* Gardner, has a much narrower anal sinus and fasciole.

Type of *Microdrillia vicksburgella* Casey: Lectotype 481645 USNM and paratype 644574 USNM both from the Byram Formation, "Upper Vicksburg," Vicksburg, Mississippi (Casey) (Plate 37, figures 20 and 13 respectively). Type of *Microdrillia biplicatula* Casey: Holotype 481629 USNM from the Red Bluff Formation, "Red Bluff" (Casey) (Plate 9, figure 6).

Occurrence: Red Bluff Formation, MGS localities 34b, 37, 38; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 3727, 7671, 13287, 14071a, 14849, MGS localities 89, 90, 99; Byram Formation, USGS localities 5615, 6454, 6978, 7376, 14368, MGS locality 106.

Microdrillia infans (Meyer)
Plate 9, figure 7

1886. *Pleurotoma infans* Meyer, Geol. Survey Alabama, Bull. 1, p. 75, pl. 2, fig. 9.
1903. *Microdrillia infans* (Meyer). Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 277.
1937. *Microdrillia infans* (Meyer). Harris, Palaeont. Amer., v. 2, No. 7, pl. 14, fig. 33.

Original Description: Meyer, 1886.

Small; aperture and canal about one-third of the entire length; the pointed apex is formed by two and a half small, smooth, embryonic whorls; three rather large, transversely ribbed, embryonic whorls complete the nucleus; the largest specimen has three adult whorls—they are strongly carinated in the middle; the upper part has only one revolving line near the suture, the lower part three elevated spirals; the upper part indicates the position of the large, regularly rounded sinus; the lines of growth are almost rib-like.

Localities.—Red Bluff, Miss., Newton, Miss. Claiborne ? Ala., Vicksburg, Miss. (var.).

Description: Shell small, slender; protoconch pointed, consisting of about 5 whorls, the first 2 smooth and expanding less rapidly than the last 3, the last 3 whorls bearing closely-set, crescent-shaped axial riblets, transition from protoconch to teleoconch not abrupt, two spiral threads first appearing just above the suture, then a stronger peripheral thread and a weaker subsutural thread appearing with the axial riblets becoming obsolete simultaneously; aperture moderately narrow, about .40 the height of the shell, canal short; outer lip smooth within on the type; anal sinus shallow and broad; anal fasciole flat or slightly concave, marked by recurving raised growth lines; suture open to closed and appressed; parietal callus thin, columellar callus somewhat stronger, not detached, no folds visible on the columella of the type; sculpture consisting of sharp, raised, spiral threads, one forming a thin subsutural collar, one on and two below the shoulder on the spire whorls, about 8 on the body whorl, diminishing in strength on the columella, anal fasciole developing a very weak spiral on the body whorl of the type, interspaces sculptured by thin, raised growth varices.

Discussion: Meyer stated, "The type-specimen is from Red Bluff, where the species is not rare; it is much larger than others of this locality, which have only two adult whorls." However, only the type was found by the writer in the Aldrich collection.

The type of *M. infans* lacks any suggestion of folds on the columella or of internal spiral lirations on the outer lip, thus comparing with some specimens of *M. vicksburgella*. This species has been stated to differ from *M. vicksburgella* in the absence of a spiral thread on the anal fasciole, but the type has a faint thread on the fasciole of the body whorl, and in view of the fact that the fasciolar thread is variable in *M. vicksburgella*, very weak in some specimens, this character does not seem to be diagnostic.

Microdrillia robustula Casey from the "Lower Claiborne" at St. Maurice, La., differs from *M. infans* mainly in having a narrower anal fasciole with the subsutural spiral separated from the suture by a narrow flat area, whereas in *M. infans* the uppermost spiral adjoins the suture.

Although the Red Bluff species just described, *M. infans*, appears on the basis of the type to be well founded, the characters which distinguish it are seen to be inconstant in the larger known suite of *M. vicksburgella*, and it may prove that these two forms are conspecific. If this should prove to be the case, *infans* would be the older and valid name.

Type: Holotype 644593 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 9, figure 7).

Occurrence: Red Bluff Formation, "Red Bluff."

Microdrillia brevis (Meyer)
Plate 37, figures 21-23

1886. *Pleurotoma infans* "var. *brevis*" Meyer, Geol. Survey Alabama, Bull. 1, p. 76.

Original Description: Meyer, 1886.

The type-specimen is from Red Bluff, where the species is not rare; it is much larger than the others of this locality, which have only two adult whorls. The only specimen from Vicksburg, which I have, however, is of the same size, and has also three adult whorls; though otherwise agreeing with the Red Bluff form, it is so decidely stouter that a varietal name may be properly applied to it—"var. *brevis*." As the same species occurs also in Newton, I have little doubt that it is identical with that Claiborne form which is described by Lea as *Fusus nanus*. If this is so, it is one of the most generally distributed forms of *Pleurotoma* of the Southern Tertiary.

Description: Shell small, inflated; protoconch pointed, consisting of about 5-1/2 whorls, the first 3 whorls expanding less rapidly than the later whorls, the first 4 turns smooth and polished, the last 1-1/2 turns bearing moderately spaced, crescent-shaped axial riblets, transition from protoconch to teleoconch abrupt, a subsutural spiral, a strong peripheral spiral, and a well developed anal fasciole taking form immediately following the last axial of the protoconch; aperture of moderate width, about .42 the height of the shell, canal short and broad; outer lip perfectly smooth within; anal sinus shallow and subsymmetrical; anal fasciole flattened and neatly impressed, bounded above by a strong subsutural thread and below by a strong spiral thread forming the shoulder of the whorl, marked by neat, closely set, raised, crescent-shaped growth varices; suture impressed; parietal callus weak, columellar callus slightly stronger, no evidence of folds, detached below to form a narrow umbilical chink; columella short and thick; sculpture consisting of well developed spiral threads, those bounding the anal fasciole the strongest, the thread above not tightly pressed against the suture, one or 2 weaker threads below the shoulder spiral on the spire whorls, continuing below and diminishing in strength on the body whorl and columella, interstitial lines usually present on the body whorl, growth lines not strong.

Discussion: Meyer cautiously made this form from the Byram a variety of his *M. infans* from the Red Bluff, but this form is easily distinguishable from the *infans-vicksburgella* group and furthermore is represented by analogs in both the Mint Spring and Red Bluff formations.

Microdrillia brevis is more closely related to *M. meyeri*, the genotype, than to the other Gulf Oligocene species. It differs from *M. meyeri* in being a little more inflated with a shorter spire, in having a shallower anal fasciole, and in having a smaller umbilical chink.

Type: Holotype 644594 USNM from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Meyer) (Plate 37, figure 21).

Occurrence: Byram Formation, USGS locality 6978, MGS locality 106.

Microdrillia brevis gemma MacNeil n. subsp.

Plate 23, figures 9-10

Discussion: A single specimen from the Mint Spring Formation at Brown's Cave differs from typical *M. brevis* in having a slightly slenderer spire, a protoconch of the same number of whorls, but with the last 2 whorls less inflated, and with axial riblets on the last 2-1/2 whorls of the protoconch instead of only the last 1-1/2 whorls. The type of the Mint Spring form, at least, has stronger spirals, stronger raised growth lines, and more widely spaced crescentic lines on the anal fasciole, although the latter may not be consistent. The base of the body whorl is more constricted making the columella slenderer.

Type: Holotype 498179 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 23, figures 9-10).

Occurrence: Mint Spring Formation, USGS locality 7671.

Microdrillia brevis allo MacNeil n. subsp.

Plate 9, figure 8; Plate 61, figures 3-5

Discussion: The Red Bluff analog of *M. brevis* has a protoconch with about 4-1/4 whorls, thus differing from both *M. brevis* and *M. brevis gemma* which have 5-1/2. Of these the last 2-1/4 have axial costae as compared with 2-1/2 in *M. brevis gemma* and only 1-1/2 in typical *M. brevis*. The difference first observed in comparing the Red Bluff form with the others is that it has a shorter point to its protoconch.

As with *M. brevis gemma* the base of the body whorl is more constricted making the columella slenderer than in the typical form, and the spiral sculpture is even stronger than in *M. brevis gemma*. Neither *M. brevis gemma* nor *M. brevis allo* have the interstitial spirals as strongly developed as in typical *M. brevis*.

Type: Holotype 376461 USNM from the Red Bluff Formation, USGS locality 14367 (Plate 9, figure 8).

Occurrence: Red Bluff Formation, USGS locality 14367, MGS localities 34b, 37.

Genus **SCOBINELLA** Conrad, 1848

Scobinella Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 289, 1848.

Type (by monotypy): *Scobinella caelata* Conrad, 1848. Oligocene, Byram Formation, Mississippi.

The genus *Scobinella* is represented in the Gulf Oligocene by several very unlike species. *Scobinella* occurs in the Miocene in South America and in the Bowden Formation, but so far the genus has not been found above the Oligocene in the United States.

Scobinella caelata Conrad

Plate 9, figures 12-13; Plate 37, figures 29-30

1829. Lesueur, Walnut Hills fossil shells, pl. 8, fig. 14 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Scobinella caelata* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 209.
1848b. *Scobinella caelata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser, v. 1, p. 120, pl. 12, fig. 8-9. Plates reprinted in Dockery, 1982, Appendix I.
1937. *Scobinella caelata* Conrad. Harris, Palaeont. Amer., v. 2, No. 7, p. 70, pl. 12, fig. 18.
1942. *Scobinella caelata* Conrad. Powell, Auckland Inst. Museum, Bull. 2, p. 20.
1980. *Scobinella caelata* Conrad var. Dockery, Mississippi Bureau Geol., Bull. 122, p. 135-136, pl. 76, fig. 4.

Original Description: Conrad, 1848a.

Subfusiform; volutions eleven, slightly scalariform; with longitudinal irregular ribs and revolving impressed lines; ribs interrupted on the spire by a tuberculated convex space; suture margined by a row of fine tubercles or grains; labium with four, rarely five plaits. Length 1 3-10.

This singular shell is perhaps more nearly related to *Pleurotoma* than to *Mitra*. The plaits in most specimens resemble those of the latter genus, but in one instance where there are five plates, the middle is the largest and thickest, the lowest one being minute.

Description: Shell moderately large and inflated; protoconch small and bluntly conical, consisting of about 3 whorls, the first 2-1/4 turns smooth and polished, the last 3/4 turn bearing well spaced, crescent-shaped axial riblets, transition to juvenile stage sharp, a well developed subsutural collar subtended by a moderately broad revolving concavity taking form abruptly, and the axials becoming shorter simultaneously, the upper ends somewhat truncate and forming a broken shoulder just below the mid-point of the exposed part of the whorls; aperture moderately narrow, about .50 the height of the shell, produced anteriorly to form a short, broad canal of about the same width as the upper part of the aperture; outer lip bearing strong spiral crenulations within; anal sinus of moderate depth, recurving much more abruptly below than above; anal fasciole concave, separated from the suture by a broad collar which in turn has a weak concavity on its upper slope; suture appressed; parietal callus very weak, columellar callus strong and bearing from 3 to 5 folds; sculpture consisting of a weak but broad, incipiently beaded spiral on the subsutural collar, a neatly beaded spiral in the anal fasciole with weaker beaded or more rarely smooth spirals above and below it, the face of the whorl below sculptured by coarse, strongly-beaded spirals, separated by moderately narrow, deep grooves, usually 2, rarely 3, spirals visible on the spire whorls, continuing below on the body whorl, and becoming weaker and less beaded on the columella.

Discussion: This species shows some range in the nature and number of the spirals on the anal fasciole; in some individuals they may number as many as 7 or 8 and may not have one spiral decidedly stronger than the others, while on the other extreme, a strong beaded spiral may have only one weak thread above and below. Less commonly 3 of the coarse beaded spirals of the lower part of the whorl may rise above the suture, the individuals so characterized assuming more of the appearance of *S. pluriplicata* which commonly has 4 spirals visible.

This species is common in the Byram Formation and a few specimens are in the U. S. National Museum collections from the Red Bluff, but so far it has not been seen from the Mint Spring Formation. No basis can be detected for separating the Red Bluff specimens from the Byram specimens, even as a subspecies.

Type: Lectotype 13441 ANSP and two paratypes 13442 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad) (Plate 37, figure 30 - lectotype).

Occurrence: Red Bluff Formation, USGS localities 309, 2632, 2860, 5263, 7218, MGS localities 35b, 37, 38; Byram Formation, USGS localities 2664, 3140, 3724, 3729, 3772, 5623, 6449, 6453, 6454, 6455, 6978, 7372, 7376, 7460a, 12174a, 13286, 14368, 14683, MGS localities 93, 106, 109, 112c, 114, 115.

Scobinella pluriplicata Casey

Plate 9, figure 11

1903. *Scobinella pluriplicata* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 273-274.

1937. *Scobinella pluriplicata* Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 70, pl. 12, fig. 16-17.

1980. *Scobinella pluriplicata* Casey. Dockery, Mississippi Bureau Geol., Bull. 122, p. 135, pl. 76, fig. 3.

Original Description: Casey, 1903.

In the genus *Scobinella*, of Conrad, it should be stated that the species occurring at Red Bluff is distinct from *cœlata* of the Upper Vicksburg marls, and I would propose the above name for it. This species is much larger than *cœlata*, with a relatively more elongate and less rapidly acuminate spire, and differs also in sculpture. In *caelata* there is a broad flattened duplex collar extending from suture anteriorly for about a fifth the length of the whorl, the surface then concave to well below the middle, generally with about three revolving lines at the bottom of the concavity, the middle one of which is nodulose; the surface from the concavity to the lower limit of the whorl is more prominent, flattened and divided into two coarsely nodose sections by a fine stria. In *pluriplicata* the whorls are relatively much more elongate, and, from the suture for about one-sixth of the length, are flattened; the next sixth of the length is occupied by a small concavity containing a nodulose line, which is even more prominent than the preceding flattened collar; the surface thence to the anterior limit of the whorl, occupying fully two-thirds of the length, is still more elevated but flattened, cylindrical and divided into about four nodose rings by three rather coarse equidistant revolving grooves. The canal is more prolonged and more obconic than in *cœlata*, and the plications of the columella number some four to five. Length of a specimen of about seven body whorls 35 mm., width 9.5 mm. Length of a specimen of *cœlata* of the same number of whorls 21 mm., width 6.5 mm. *Pluriplicata* occurs also at Byram's Ferry. The Lower Vicksburgian at Vicksburg has not yet yielded a trace of the genus.

Description: Shell moderately large and inflated; protoconch small and blunt, about 2-1/2 turns, the first 1-3/4 turns smooth and forming a nearly perfect hemisphere, the last 3/4 turn bearing straight or slightly crescentic axial riblets, transition from protoconch to teleoconch not abrupt, the subsutural collar appearing as a fine sharp thread on the last 1/4 turn of the protoconch and gradually increasing in size, the anal fasciolar concavity developing through the successive shortening of 3 to 4 axial riblets, the first juvenile whorls having sharp axial nodes predominating over the spiral sculpture; aperture moderately narrow, about .45 the height of the shell, produced anteriorly with little constriction to form a canal of moderate length; outer lip with strong internal spiral lirations; anal sinus of moderate depth, recurving somewhat more sharply below than above; anal fasciole narrow and concave, bounded below by a sharply truncated but low shoulder, containing a single, strongly beaded spiral thread, and separated from the suture above by a well developed collar; collar a flattened band, crinkled above as in the holotype, but frequently flaring and crispate nearest the suture; suture appressed; parietal callus thin, columellar callus heavier and bearing about 6 folds; sculpture consisting of a fluted or crispate upper margin to the undercut or flaring subsutural collar, a strongly beaded spiral in the anal fasciole, and strong, beaded spiral threads, separated by narrow deep grooves, below the fasciole, 4 visible on the spire whorls and continuing below on the body whorl and columella, thinner and less beaded on the columella, the young whorls having the spiral grooves less developed and the beads continuous across the grooves to form closely set axial riblets.

Discussion: *Scobinella pluriplicata* differs from *S. caelata* in having 4, as compared with 2 or rarely 3, beaded spirals visible above the suture on the spire whorls, in having a much more truncated lower border to the anal fasciole, a single beaded spiral in the anal fasciolar concavity, as compared with several spirals of variable strength in *S. caelata*, and in having an undercut or flaring subsutural collar with the upper edge fluted or crispate rather than a low broad collar with low or incipient beads as in *S. caelata.*

Scobinella pluriplicata subpluriplicata approaches *S. pluriplicata* in general aspect but differs in having usually only 3, although rarely 4, beaded spirals exposed on the spire whorls, and in having the same type of subsutural collar as *S. caelata.*

The specimen from Byram reported to be this species by Casey is the form here described as *S. pluriplicata subpluriplicata*.

Type: Holotype 481663 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Casey).

Occurrence: Red Bluff Formation, USGS localities 309, 315, 319, 2631, 2632, 2633, 2860, 5264, 6456, 13288, 14720, MGS localities 37, 38, 40.

Scobinella pluriplicata subpluriplicata MacNeil n. subsp.

Plate 23, figure 7; Plate 37, figure 28

Discussion: *S. pluriplicata subpluriplicata* differs from *S. caelata* in having a narrower anal fasciole, the lower margin of which is much more truncate, and usually contains only a single sharply beaded spiral with rarely a much weaker spiral above. There are commonly 3 of the coarsely beaded spirals exposed on the spire whorls and rarely a part of a 4th, as compared with 2 and rarely 3 in *S. caelata*. The subsutural collar bears somewhat heavier beads, but they are not as sharp as those on the lower spirals.

This form, though named as a subspecies of *S. pluriplicata*, with which it is compared under the discussion of that species, probably represents an intermediate form between *S. pluriplicata* and *S. caelata*. However, both *S. pluriplicata* and *S. caelata* occur in the Red Bluff Formation whereas *S. pluriplicata subpluriplicata* is not known until the Mint Spring Formation. Casey stated that *S. pluriplicata* occurred at Byram's Ferry, but the specimens so labelled in his collection are of this subspecies.

Type: Holotype 498181 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 23, figure 7).

Occurrence: Mint Spring Formation, USGS localities 7671, 14071, MGS localities 75b, 99; Byram Formation, USGS localities 6453, 6455, 7376, MGS localities 93, 106, 109, 112c, 114, 115.

Scobinella macer Casey

Plate 37, figures 31-35

1903. *Scobinella macer* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 274.
1937. *Scobinella macer* Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 70, pl. 12, fig. 19-20.

Original Description: Casey, 1903.

Upper Vicksburg. This species resembles the preceding in general form and sculpture but has only two folds on the columella. These folds are strong, subequal and do not seem to be attended by any adventitious plicæ. This species is elongate and very slender, the nucleus simple and of about three whorls. Each of the subsequent whorls has a broad, moderately elevated double collar subjacent to the suture and a strongly elevated, obtuse and nodose double carina at a third of the length from the anterior margin, the deeply concave intermediate surface having a single strongly beaded line along the middle and a few other very faint and obscurely irregular revolving threads. The lower margin is moderately elevated, the surface thence to the large double carina concave. The spire before me consists of seven body whorls and is 10 mm. in length and about 3.5 mm. in width at base. The remainder of the shell is missing, it being very rare and represented thus far only by fragments.

Description: Shell of medium size, moderately slender; protoconch small, bluntly conical, consisting of about 3-3/4 whorls, the first 3 whorls smooth and polished, the last 3/4 turn bearing straight or slightly crescentic axial riblets, transition to juvenile stage abrupt, the axials becoming short and bluntly pointed, and a well developed collar subtended by a moderately broad spiral concavity taking form simultaneously; aperture narrow, about .48 the height of the shell, closing in a narrow V above, canal of moderate length and of about the width of the aperture proper; outer lip bearing inner spiral lirations arranged in pairs; anal sinus of moderate depth, recurving much more sharply below than above; anal fasciole deeply concave, bounded below by a strongly truncated low shoulder, separated from the suture above by a broad, swollen collar; parietal callus very thin, columellar callus thicker and bearing 5 to 6 folds; sculpture consisting of a moderately strong smooth spiral on the collar, although it may be weak or absent, a moderately strong beaded spiral with 1 or

2 weaker spirals below it in the anal fasciolar concavity, a strong shoulder spiral, sometimes divided into 2 parts by an incised line, strongly beaded in the juvenile whorls, but becoming smooth in adults, and strong, smooth spirals continuing below on the body whorl, diminishing in strength on the columella, the spirals separated by spiral grooves of nearly equal width which frequently bear incipient secondary spirals.

Discussion: This species differs from *S. caelata* in being slenderer, in having a deeper anal fasciolar concavity, a more inflated subsutural collar, in having additional spirals below the strong spiral in the concavity only rather than both above and below as in *S. caelata*, and in having a narrower, more elevated, *Gemmula*-like shoulder spiral. The spirals below the periphery on the body whorl are not beaded as in *S. caelata*. *Scobinella taylorensis* Mansfield from the Chickasawhay Limestone has unbeaded spirals below the periphery, but is more inflated, and compares more with *S. caelata* in the characters of the fasciole and collar. It has a sharper, more truncate shoulder than either *S. caelata* or *S. macer*, however.

Scobinella macer cannot be confused with either *S. pluriplicata* or *S. pluriplicata subpluriplicata* which have four and three spirals visible above the suture on the spire whorls, respectively.

Type: Holotype 481661 USNM from the Byram Formation, "Upper Vicksburg," Vicksburg, Mississippi (Casey) (Plate 37, figure 34).

Occurrence: Byram Formation, USGS localities 3722, 14683, MGS locality 106.

Scobinella famelica Casey

Plate 37, figures 24-27

1903. *Scobinella famelica* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 274.
1937. *Scobinella famelica* Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 71, pl. 12, fig. 22-23.

Original Description: Casey, 1903.

Very slender and elongate, the aperture narrow, scarely at all wider than the canal, from which it is but feebly differentiated, both together constituting but little more than a third of the total length of the shell. The nucleus is rather small, of about three whorls, with its summit obtuse. Subsequent whorls each with a prominent double collar subjacent to the suture and a broad obtuse and strongly elevated revolving keel, fully a third as wide as the length of the whorl and divided into two subequal rings by a revolving groove, situated below the middle of the whorl; this duplex ring is obliquely and coarsely nodose. In the concavity between the collar and the elevated keel there are two or three fine revolving lines, the posterior of which is finely and more or less evenly nodulose. The anterior margin is a fine line on a level with the duplex ring and separated therefrom by a narrow deep concavity. Columella with six or seven rather unequal, close-set oblique folds, forming a slightly tumid columellar band as wide as the distance separating it from the posterior angle of the aperture. Length about 25 mm., width 4.5 mm. It occurs exclusively in the Upper Vicksburg marl and is rare.

Description: Shell of medium size, slender; protoconch small and bluntly conical, consisting of about 3-1/4 whorls, the first 2-3/4 smooth and polished, the last 1/2 turn bearing about 6 to 7 crescent-shaped axial riblets, transition from protoconch to teleoconch abrupt, a well developed subsutural collar and a broad, concave anal fasciole developing simultaneously with a shortening of the axials to sharp, elongate nodes; aperture narrow, about .40 the height of the shell, produced anteriorly to form a canal of moderate length and of about the same width as the aperture proper; outer lip bearing moderately strong, usually paired spiral lirations within; anal sinus of moderate depth, recurving more sharply below than above; anal fasciole deeply concave, bounded below by a strong, peripheral keel, separated from the suture above by a moderately narrow but prominent subsutural collar; parietal callus thin, columellar callus thicker, bearing about 6 folds; sculpture consisting of a moderately strong smooth spiral accentuating the collar, one specimen at hand having a pair of spirals, anal fasciole with weak, raised, crescent-shaped growth lines in the young stages but ranging from smooth to sculptured with 3 fine, weakly beaded threads in adults, periphery bearing a double, beaded, *Gemmula*-like keel in young shells which diverge and become smoother in adults, one weaker smooth spiral below usually visible on the spire whorls, similar spirals continuing below on the body whorl, diminishing in strength on the columella, spirals separated by deep grooves of about the same width as the spirals.

Discussion: This is easily recognized as the slenderest of the Gulf Oligocene Scobinellas. It can be distinguished from *S. macer*, aside from being slender, in having a less swollen collar, a more prominent *Gemmula*-like periphery, and in having a less sculptured anal fasciole concavity, usually without spirals, but when spirals are present they are not as strong as in *S. macer*.

Harris (1937, pl. 12, fig. 23) figured a specimen in the collections of the Paleontological Research Institution labelled "Montgomery, La.", which appears to be this species, but at the same time raised the question of its locality being incorrectly given. It might be possible to determine from the preservation and matrix, if any is present in the aperture, whether or not it came from the Byram Formation.

Type: Holotype 481662 USNM from the Byram Formation, "Upper Vicksburg," Vicksburg, Mississippi (Casey) (Plate 37, figure 26).

Occurrence: Byram Formation, USGS localities 3140, 3722, 13286.

Genus BATHYTOMA Harris and Burrows, 1891

Bathytoma Harris and Burrows, Eocene and Oligocene of the Paris Basin, p. 113, 1891 (new name for *Dolichotoma* Bellardi, 1875, not Hope, 1839).

Type (by monotypy): *Murex cataphractus* Brocchi, 1814. Pliocene, Italy.

Bathytoma congesta (Conrad)
Plate 35, figure 13

1829. *Pleurotoma undulata* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 10. Printed in Dockery, 1982, Appendix II.
1848a. *Pleurotoma congesta* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 284.
1848b. *Pleurotoma congesta* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 26, pl. 4, fig. 6. Plates reprinted in Dockery, 1982, Appendix I.
?1890. *Pleurotoma (Dolichotoma) congesta* var. *refervens* de Gregorio, Mon. faune éocénique de l'Alabama, p. 41, pl. 2, fig. 58-60.
1904. *Bathytoma congesta* (Conrad). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 147.
1937. *Pleurotoma congesta* Conrad. Harris, Palaeont. Amer., v. 2, No. 7, p. 26, pl. 4, fig. 6.
?1937. *Pleurotoma (Dolichotoma) congesta* var. *refervens* de Gregorio. Harris, Palaeont. Amer., v. 2, No. 7, p. 26, pl. 4, fig. 4-5.

Original Description: Conrad, 1848a.

Short-fusiform, volutions nine or ten, with revolving raised lines and longitudinal wrinkles; spire conical-acute; whorls slightly contracted in the middle, with longitudinal curved irregular striæ, interrupted in the middle of each whorl; aperture half as long as the shell; beaks slightly twisted. Length 1-10th. Very abundant.

It approaches the genus *Brachytoma*, Swainson.

Description: Shell moderately large, inflated, spire of medium length; protoconch consisting of about 4 rapidly expanding turns, smooth and polished except for the last half to one quarter turn on which weak, inclined axials appear and which pass imperceptibly into the adult sculpture with the formation of a supraperipheral sulcus in the next quarter turn or less; aperture of moderate width, about .47 the height of the shell, produced anteriorly to form a moderately short but heavy canal; anal canal forming a moderately deep, broad, subsymmetrical notch just above the rounded periphery; anal fasciole situated just above the periphery of the shell on the concave slope to the suture in adults, but more inflated and convex in juveniles with a well defined concavity above it; suture closed, weakly appressed; parietal callus light, thickening downwards on the columella; columella stout, considerably thicker above than below; sculpture consisting of moderately fine, spiral threads all over, more uniform and usually alternating with weaker secondaries below the periphery, more irregular above the periphery with usually finer and more crowded lines in the concavity just above the anal fasciole, weak, crescent-shaped axials on the anal fasciole in young to medium grown shells, but usually obsolete in full grown adults, the axials curving weakly to the left above the fasciole and becoming stronger again as they approach the suture.

Discussion: *Bathytoma congesta* is similar to the Recent species *Bathytoma viabrunnea* (Dall, 1889) from southeast Florida and the West Indies. It has been reported from the Red Bluff Formation to the Byram Formation, but the Red Bluff form appears to be distinct as well as considerably more variable than *B. congesta*. Apparently Casey had intended to describe the Red Bluff forms as new for two extreme specimens in his collection bear the labels "*rhomboidea* Csy" and "*lyrata* Csy," both of which names are described below as new.

The Byram species is characterized by a shorter and more inflated form with less contrast between the sculpture of the upper and lower portions of the whorls than in the Red Bluff species. In addition the periphery of *B. congesta* is usually more rounded.

The form of *B. congesta* occurring in the Mint Spring Formation and the upper part of the Forest Hill Formation is regarded as a subspecies.

Type: Lectotype 13425 ANSP and paratypes 13426 ANSP all from the Byram Formation judging from the matrix and preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation: USGS localities 259, 3722, 3724, 3729, 5623, 6449, 6454, 6455, 7372, 7453, 10400, 12174b, 13286, 14031, MGS localities 106, 109, 112c, 114, 115.

Bathytoma congesta fontis MacNeil n. subsp.
Plate 21, figures 16-17, 18

Discussion: The analog of typical *B. congesta* in the Mint Spring Formation and the upper part of the Forest Hill Formation does not possess marked differences from the Byram form but is sufficiently distinct to be recognized as a subspecies. It has a protoconch similar in shape and in the number of turns but the axials appear somewhat earlier, being present from the last half to the last full turn. The columella of the Byram form is slightly heavier. The most noticeable difference is in the spiral threads which in the Byram form are rather blunt and polished, but which in the Mint Spring subspecies are distinctly sharper and more numerous, especially above the periphery.

Type: Holotype 498160 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 21, figure 16).

Occurrence: Forest Hill Formation, USGS locality 6647, MGS locality 75a; Mint Spring Formation, USGS localities 3727, 6452, 7671, 13287, 14071, MGS localities 89, 99.

Bathytoma rhomboidea MacNeil n. sp.
Plate 8, figures 8, 11

Description: Shell moderately large, medium inflated, medium to moderately elongate; protoconch moderately narrow, consisting of about four and one half whorls, smooth and polished except for the last full turn which bears curved axial riblets, very weak when first appearing but becoming moderately strong on the last half turn; aperture of moderate width, ranging from about 0.44 to 0.52, averaging about 0.48, the height of the shell, produced anteriorly to form a canal of moderate length; anal canal forming a broad, moderately deep, subsymmetrical sinus just above the periphery; anal fasciole inconspicuous, concave in adults, but convex in juveniles, situated immediately above the sharp periphery; periphery usually truncated above, sometimes actually undercut; suture closed, weakly appressed; parietal callus light, thickening downwards on the columella; columella stout, merging with only a shallow constriction with the body whorl; sculpture consisting of moderately strong spiral threads alternating with secondary and even tertiary threads below the periphery, and of numerous fine threads, usually subequal in strength above the periphery, weak axials present on the convex anal fasciole of juveniles, connected by growth lines with inclined axials on the subsutural collar, only the subsutural axials persisting into the adult stage.

Discussion: Casey had apparently intended to name this species as a specimen in his collection bears the label "*rhomboidea* Csy". This name is here perpetuated and described as new, although a somewhat larger and better specimen in the U. S. National Museum collections is selected as type.

This species differs from *B. congesta* in having more discrepent sculpture, finer above and coarser below the periphery, in having a sharper periphery with a straighter slope above it to the suture, and in being more variable in height, but averaging slenderer and higher than *B. congesta*. The protoconch of *B. rhomboidea* is slenderer, has about a half turn more, and bears axial riblets on the last full turn or more, rather than on only the last half turn as in *B. congesta*.

The Mint Spring subspecies, *B. congesta fontis*, compares more with *B. rhomboidea* in the nature of the spiral threads, but like *B. congesta* is more inflated and has a blunter or more rounded periphery. In addition it does not go through the varietal series exhibited by *B. rhomboidea* and forms comparing with the variety *B. rhomboidea lyrata* next described are unknown in the Mint Spring.

Type: Holotype 498036 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 8, figure 8).

Occurrence: Red Bluff Formation, USGS localities 309, 315, 319, 2631, 2632, 2633, 2860, 5263, 5264, 6456, 13288, 14367, 14522, MGS localities 37, 38, 39.

Bathytoma rhomboidea lyrata MacNeil n. subsp.
Plate 8, figures 9-10

Discussion: Occurring with typical *B. rhomboidea* is a shorter, stouter form characterized by much stronger, widely separated spiral threads below the periphery, doubly accentuated by the very weak secondary and tertiary threads, and by a conspicuously inflated subsutural collar and a raised, rounded, anal fasciole of about the same strength as the collar. The anal fasciole itself forms the periphery of the shell on usually all but the last whorl of fully grown adults and then is at least equal in relief to the uppermost of the spiral threads forming the periphery. The axials on the anal fasciole and subsutural collar are stronger and persist longer in the adult stage than in typical *B. rhomboidea*.

Apparently Casey had intended to name this form as evidenced by a specimen bearing the label "*lyrata* Csy" in the Casey collection, but whether he intended it as a variety or a distinct species is uncertain. Due to the fact that the exact locality from which Casey's collection was obtained is not known, a nearly identical specimen from Red Bluff is selected as the type.

Type: Holotype 498038 USNM from the Red Bluff Formation, USGS locality 319 (Plate 8, figure 9).

Occurrence: Red Bluff Formation, USGS localities 309, 315, 319, 2631, 2632, 2633, 2860, 5263, 5264, 6456, 13288, MGS localities 37, 38, 39.

Subfamily CLATHURELLINAE
McLean *in* Keen, 1971

Genus **CLATHURELLA** Carpenter, 1857

Clathurella Carpenter, Catalogue Reigen collection of Mazatlan Mollusca in the British Museum, p. 399, 1857.

Type (by subsequent designation, Cossmann, 1896): *Clavatula rava* Hinds. Recent, Philippines.

The species here referred to *Clathurella* differ from *Eoclathurella* Casey (type, by subsequent designation, Harris, 1937, *Eoclathurella jacksonica* Casey, upper Eocene of Louisiana) in having a longer, narrower, and twisted siphonal canal, an undetached inner lip, an appressed rather than a strongly impressed suture, and subcarinate rather than rounded whorls with stronger sculpture, both axial and radial.

One of these species, the one from Red Bluff, here described as *Clathurella meyeri*, has been associated with *Eoclathurella* because Meyer used both this species and one from Claiborne in drawing up the diagnosis of *Mangelia meridionalis* Meyer, which name was included in the original list of *Eoclathurella* by Casey. The Red Bluff form is not regarded as conspecific with the Claiborne species, the specimen from Claiborne used by Meyer in describing *M. meridionalis* having been definitely stated to be the type, nor are the Oligocene species here treated regarded as congeneric with *Eoclathurella jacksonica*. There is some doubt in the writer's mind that any two of the three species included in *Eoclathurella* by Casey are congeneric.

Clathurella meyeri MacNeil n. sp.

Plate 9, figure 14

1886. *Mangelia meridionalis* Meyer, Geol. Survey Alabama, Bull. 1, p. 76 in part, (not pl. 1, fig. 14).
1904. *Eoclathurella meridionalis* (Meyer). Casey, Acad. Sci. St. Louis, Trans., v. 14, No. 5, p. 167 (in part; remarks about the protoconch probably refer to this species).
1937. *Eoclathurella meridionalis* (Meyer). Harris, Palaeont. Amer., v. 2, No. 7, p. 75-76 in part, (not pl. 13, fig. 2).

Description: Shell small, moderately inflated; protoconch small, conical, consisting of about 4 whorls, of which only the last 3 are known, the last 2-1/2 turns bearing a pair of carinae, the upper just below the middle, the lower just above the suture, slope from the upper carina to suture above flat, transition from protoconch to teleoconch not abrupt, from 2 to 3 short, oblique axials first appearing above the carinae, followed by axials of increasing strength, becoming straighter and crossing the carinae, spiral threads appearing at about the first axial to cross the carinae, one just below the upper carina stronger than the others, it and the upper carina continuing as the strongest spiral lines for a short distance, but subequal in strength with other spirals thereafter, the lower carina dipping below the suture; aperture narrow, about .50 the height of the shell, produced anteriorly to form a narrow, short canal, twisted slightly to the right and away from the aperture; outer lip smooth within, or very weakly denticulate, the type probably representing a stage between varices; anal sinus moderately shallow, flaring below, constricted; anal fasciole obscure; suture tightly appressed; parietal callus thin with a denticle forming the parietal portion of the constriction of the anal sinus, columellar callus weak, not detached; columella of moderate length, twisted slightly below; sculpture consisting of prominent spiral threads, of which 3 on the periphery are more prominent in juveniles, the uppermost forming a weak shoulder, increasing in number by new threads appearing in the interspaces and quickly becoming as large as the primaries, axials moderately thin and closely set, curved, extending to the suture above, 8 visible from an angle.

Discussion: The type of this species was acquired by Aldrich from Meyer and sent to Dall in 1890. Aldrich stated in his correspondence that he was keeping Meyer's types, and presumably he kept the specimen from Claiborne and sent Dall the Red Bluff specimen as a duplicate. The specimen has typical Red Bluff ferruginous clay adhering to it and is labelled "*Mangelia meridionalis* Mr., Red Bluff" in a hand, presumably Meyer's. The writer was unable to find any specimens so labelled from Red Bluff in the Aldrich-Meyer collection at Johns Hopkins University, and it is believed, therefore, that the specimen here made the type of *C. meyeri* is the specimen from which Meyer described the protoconch of *Mangelia meridionalis*, since he stated that the Claiborne specimen lacked the protoconch.

Harris (1937, p. 77) made the following contribution concerning the identity of *M. meridionalis*:

> It would seem from the above statement [From Claiborne I have only the figured type specimen, without preserved nucleus] that Meyer must have drawn his conclusions regarding the character of the nucleus from his Red Bluff specimen. There is therefore reason to doubt whether the specimens were really conspecific.
>
> Specimen in the Phil. Academy's collection, (No. 9525), (see fig. 16); labelled *Mang. meridionalis* is clearly but a slight varient of *venusta*, having the characteristic two or three rapidly expanding smooth embryonic whorls followed by a considerably larger obliquely costate whorl. There would seem to be a reasonable possibility of Meyer's specimen being only a pathologic form of the common Claiborne species.

As stated in the description, the type of this species is not denticulate, either on the outer lip or on the columella, whereas most specimens of the closely related species from the Mint Spring and Byram are strongly denticulate. It may be that this is an abnormal specimen, or as suggested above, represents a stage between varices when the denticles, if a characteristic of this species, would be most highly developed.

Type: Holotype 124889 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 9, figure 14).

Occurrence: Red Bluff Formation, "Red Bluff."

Clathurella meyeri sylvarenensis MacNeil n. subsp.

Plate 23, figures 1-2

Discussion: This Mint Spring form differs from the typical Red Bluff species in being a little more slender and with finer spiral threads which have less tendency for those on the periphery to be stronger than the others. There is some difference in the number of axials in the Mint Spring subspecies, the number visible from an angle ranging from 6 to 8.

The denticles on the columella and inner lip are very irregular, some specimens lacking them altogether, some showing only two or three weak denticles on the columella and outer lip, while others have as many as 8 strong denticles on the columella, which may be regularly arranged or divided into upper and lower sets, and numerous irregular denticles of different sizes and shapes on the outer lip, some of which may be elongate spirally and others elongate axially.

Type: Holotype 498178 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 23, figure 2).

Occurrence: Mint Spring Formation, USGS locality 7671.

Clathurella blakneyensis MacNeil n. sp.

Plate 37, figures 6-7

Description: Shell small and moderately slender; protoconch small and conical, about 4 whorls, the first half turn minute and inclined, the next 2 whorls rounded and polished, the last whorl and a half bearing a pair of carinae, the upper carina just below the middle, the lower just above the suture, the upper carina weaker at first, stronger than the lower on the last whorl, slope from the upper carina to the suture above rounded, short, inclined axial riblets appearing above upper carina on the last quarter turn, the last 2 or 3 causing undulations of the upper carina, transition from protoconch to juvenile stage moderately abrupt, the first axial to cross the carinae simultaneous with the appearance of a spiral thread below and of the same size as the upper carina, the lower carina of the protoconch dipping below the suture at the same point; aperture moderately narrow, about .49 the height of the shell, produced anteriorly to form a short canal twisted to the right and away from the aperture; outer lip irregularly denticulated within; anal sinus of moderate depth, constricted; anal fasciolar region flattened, fasciole not definitely marked; suture tightly appressed; parietal callus thin with a prominent denticle forming the parietal part of the constriction of the anal sinus, columellar callus well defined, weakly detached, with usually about 4 weak denticles; columella of moderate length, twisted slightly below; sculpture consisting of about 6 fine threads on the anal fasciolar region, 2 prominent carinate spirals on the periphery of the younger whorls, less prominent with an interstitial thread on later whorls, continuing below with decreasing strength on the body whorl, usually only the first 1 or 2 interspaces below the periphery with an interstitial thread, those at the base of the body whorl made granular by the base of the axials, axials moderately strong and well spaced, about 5 to 6 visible from an angle.

Discussion: This species differs from typical *C. meyeri* in having fewer, more widely spaced and straighter axial ribs, a stronger pair of peripheral spirals, particularly in the young stages, and a more pronounced periphery. The first two whorls of the protoconch are noticeably smaller than the last two in *C. blakneyensis*, whereas in *C. meyeri* the enlargement of the protoconch is more uniform. In addition the whorls of the protoconch above the carinae are rounded in *C. blakneyensis* in contrast to being flat in *C. meyeri*. *Clathurella meyeri sylvarenensis* has even less distinction between the peripheral and other spirals than typical *C. meyeri*.

Such species as *Glyphostoma xeston* Gardner from the Chipola Formation are not particularly related, being considerably larger than the *Clathurella* in the Oligocene, and having a more glabrous surface, particularly on the anal fasciolar region. *Glyphostoma exopitatum* Woodring from the Bowden Formation is also much larger.

A specimen from the Jay Branch locality does not have a varix developed so that the apertural characters are not known, but its sculpture is coarser than that of the type, and the shoulder is somewhat stronger. It may represent a distinct subspecies but it cannot be described on the basis of the specimen at hand.

Type: Holotype 376617 USNM from the Byram Formation, USGS locality 7376 (Plate 37, figure 7).

Occurrence: Mississippi: Byram Formation, USGS locality 7376. ? Alabama: Byram Formation, USGS locality 14368.

Clathurella sp.

Plate 37, figure 5

Discussion: A single, eroded specimen from the Byram Formation at station 14772 on the Big Black River represents a heavier, thick shelled, more inflated species, with coarser sculpture. The specimen at hand is figured (Pl. 37, fig. 5) but is not regarded as well enough preserved for a species description.

Occurrence: Byram Formation, USGS locality 14772.

Subfamily MANGELIINAE Fischer, 1887

Genus **KURTZIELLA** Dall, 1918

Kurtziella Dall, Biol. Soc. Washington, Proc. v. 31, p. 137, 1918.

Type (by original designation): *Pleurotoma cerina* Kurtz and Stimpson. Recent, east coast of the United States.

Gardner (1937, p. 326) gives the following emended characterization:

Shell small, slender, with an elevated spire and short body; protoconch of 3 to 5 slender but rapidly increasing whorls, the final turn reticulately sculptured; outer surface crowded with spiral filaments shagreened by the incrementals and rippled by the axials; posterior fasciole rarely conspicuous; aperture narrow, obliquely clavate, feebly notched at the posterior sinus; anterior canal rather short.

At least from the Oligocene to the Recent this genus has undergone little change as the species here described is very closely related to one living off the Florida West Coast. If this genus exists in the Eocene it has not been reported, but unless the protoconch and microsculpture were adequately described it would be difficult to recognize in the literature.

Cryoturris Woodring (type, *Cryoturris engonia* Woodring, from the Bowden Formation of Jamaica) has the same microsculpture as *Kurtziella* but has a smaller protoconch which lacks the last, reticulately sculptured whorl. In the writer's opinion, *Cryoturris* is a subgenus of *Kurtziella*.

Kurtziella protatrostyla MacNeil n. sp.
Plate 23, figure 6

Description: Shell small, known only from an immature specimen; protoconch small but rapidly expanding, consisting of about 4 whorls of which only the last 2½ are preserved on the type, the next to the last turn smooth and polished, the last turn neatly reticulated by regularly spaced spirals and crescent-shaped axials, passage from protoconch to juvenile sculpture not abrupt, the axials gradually becoming more widely spaced, a single median spiral becoming much stronger than the others to form the periphery, those below becoming more widely spaced, those above becoming finer, nuclear whorls rounded, adult whorls angulated; aperture moderately short, produced anteriorly to form a short, narrow canal; outer lip smooth within; anal sinus shallow; anal fasciole not apparent; suture impressed; parietal and columellar callus thin; columella slightly twisted, slender; sculpture consisting of primary, secondary and tertiary spiral lines, those above the peripheral spiral more crowded and of more nearly the same size, those below the periphery more separated and of greatest difference in size, becoming more crowded towards the columella and consisting of primary lines only on the columella, axials thin, about 7 visible from an angle, the surface shagreened by minute projections on all spiral lines.

Discussion: This species is closely related to the Recent *Kurtziella atrostyla* (Dall) from the West coast of Florida. It differs from the Recent species in having a slightly weaker peripheral spiral, and in having somewhat stronger sculpture above the periphery, but these differences are less than exist between *K. atrostyla* and any other Recent species in the National Museum collections, or between *K. protatrostyla* and the species described from the Chipola Formation by Gardner.

Kurtziella atrostyla compares in shape with *Saccharoturris centrodes* Gardner, more so than with the true *Kurtziella*, *K. prionota* Gardner, but the species of *Saccharoturris* have a conspicuous keel on the protoconch. *Cryoturris euengonia* Woodring from the Bowden Formation has a more sharply keeled periphery than *K. protatrostyla*, and of course lacks the reticulately sculptured protoconch of *Kurtziella*.

Type: Holotype 376513 USNM from the Mint Spring Formation, USGS locality 3727 (Plate 23, figure 6).

Occurrence: Mint Spring Formation, USGS locality 3727.

Subfamily DAPHNELLINAE Casey, 1904

Genus **PHANDELLA** Casey, 1903

Phandella Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 272.

Type (by monotypy): *Phandella nepionica* Casey, 1903. Oligocene, Byram Formation, Mississippi.

This genus was proposed by Casey for some minute shells occurring in the Byram Formation characterized by relatively large protoconchs, "evenly conical, pointed, consisting of from five to six whorls which are exquisitely sculptured in two systems of very minute lines crossing each other at an angle of about 45°, producing an appearance very much like the engine-turning frequently engraved upon a watch" (see SEM photograph in Plate 61, figure 7). No specimens with more than 1½ adult whorls were known to Casey as he expressed the opinion that the "animal apparently existed the greater part of its life in the nuclear stage."

To date no specimens are known to the writer of more than 2½ adult whorls, the specimens still decidedly juveniles in which the apertural characters are incompletely formed. It does not seem likely, however, that these were individuals of breeding age, and adults are probably still to be found.

Casey mentioned that three species are known to him from the "Upper Vicksburg marls," but only one species, the type, *P. nepionica*, is represented by specimens in the Casey collection. Two other species are here described, one from the Bucatunna Formation at the Jay Branch locality in Alabama (USGS locality 14368), and one from the Red Bluff and Mint Spring formations.

Adequate descriptions cannot yet be given for the species here recognized, but the brief diagnoses given are sufficient to distinguish them.

This genus is probably related to some of the Daphnellids, particularly the genus *Pleurotomella* Verrill.

Phandella nepionica Casey

Plate 37, figures 15-19; Plate 61, figures 6-7

1903. *Phandella nepionica* Casey, Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 272.
1937. *Phandella nepionica* Casey. Harris, Palaeont. Amer., v. 2, No. 7, p. 89, pl. 14, fig. 26.
1942. *Phandella nepionica* Casey. Powell, Auckland Inst. Museum, Bull. 2, p. 18.

Original Description: Casey, 1903.

This species has about one and a half body whorls, which are together about twice as long as the nucleus, polished and completely devoid of revolving sculpture, having, however, about ten sharply elevated longitudinal or slightly oblique ribs, which become abruptly declivous posteriorly and obsolete near the suture. The nucleus has about five whorls; the canal is rather short and there is fine raised collar marininig the suture beneath, which line may also be observed to mutually separate the larger of the nuclear whorls. Length 2.25 mm., width 1.2 mm. Many specimens.

Description: Shell small, known only from juvenile specimens; protoconch small, consisting of about 5 whorls, the first 2 minute and expanding less rapidly than the last 3, no sculpture discernible, the last 3 whorls sculptured by two sets of diagonal lines crossing each other at an angle of about 45°, the set inclining to the right reaching the suture above, the set inclining to the left dying out at about the upper quarter of the whorl and becoming obsolete at about the last ¼ turn of the protoconch, the last turn developing a prominent rounded peripheral keel sloping more abruptly below than above, the upper inclined lines not crossing the periphery on the last ¼ turn, transition from protoconch to teleoconch abrupt, the peripheral keel stopping abruptly with the appearance of the first of the adult ribs; adult sculpture consisting of weak spiral lines on the lower part of the columella but no trace of spirals on the whorls above, anal fasciolar concavity bearing fine, raised, cresent-shaped growth lines, axials slightly curved and slightly inclined, slender and rounded, strongest where they cross the weak shoulder of the whorl and dying out about midway across the anal fasciolar concavity, 7, nearly 8, visible from an angle; aperture in juvenile stage simple and featureless, about half the height of the shell.

Discussion: If Casey had "many specimens" of this species, he must have disposed of them as there are only two specimens in his collection today. Aldrich, who might be presumed to have received the best of what Casey had available for exchange, has only two minute specimens, scarcely more than protoconchs, which he received from Casey as "cotypes".

There is no evidence in the Casey collection of the other two species of this genus that Casey declared he had from the Byram.

Following are the descriptions of two other species of this genus, and comparison with this species is made under them.

Type: Holotype 645103 USNM and paratype 376627 USNM both from the Byram Formation, "Upper Vicksburg," Vicksburg, Mississippi (Casey) (Plate 37, figures 18 and 19 respectively).

Occurrence: Byram Formation, Vicksburg, auger hole at Key's Mill Creek, USGS locality 5615, MGS locality 106.

Phandella monroensis MacNeil n. sp.

Plate 37, figure 14

Description: Shell small, whorls moderately inflated, known only from a juvenile specimen, protoconch small, consisting of 4½ whorls, evenly expanding, the first whorl without visible sculpture, the next 3¼ whorls sculptured by 2 sets of diagonal lines crossing at about 45°, the set inclining to the left dying out at about the upper quarter of the whorl, the last turn developing a strong peripheral keel, sloping more abruptly below than above and having a sharp lower edge on the last ¼ turn, the lower set of lines obsolete and the upper set not crossing the sharp edge of the keel on the last ¼ turn, transition from protoconch to teleoconch abrupt, the keel terminating suddenly and followed by a strong axial rib, several spiral lines appearing simultaneously; sculpture of teleoconch consisting of shallow spiral grooves with moderately broad flat interspaces, strongest just below the shoulder, weakest at the base of the whorl and continuing as stronger more closely set spirals on the columella, anal fasciolar region with one weak spiral groove which accentuates the collar, and with numerous fine, raised, crescent-shaped growth lines, axial ribs strong and well spaced, 6 visible from an angle, strongest where they cross the periphery, dying out in the anal fasciolar concavity above and in the basal concavity below.

Discussion: This species differs from *P. nepionica* in having a stronger and more sharply truncated keel on the last ¼ turn of the protoconch, in having well developed spiral lines on the face of the whorls, in being more inflated, and in having one less visible axial rib even though the shell is more inflated. The ribs nearest to the outline of the shell have the appearance of being distinctly less arcuate in *P. nepionica* due to the lesser inflation.

Phandella monroensis is known only from the type.

Type: Holotype 376623 USNM from the Bucatunna Formation, USGS locality 14368 (Plate 37, figure 14).

Occurrence: Alabama: Bucatunna Formation, USGS locality 14368.

Phandella transemma MacNeil n. sp.

Plate 23, figure 5; Plate 61, figures 8-9; Plate 62, figures 6-7

Description: Shell small, known only from immature specimens; protoconch consisting of about 5 whorls, the first 2 without visible sculpture, the last 3 whorls sculptured by 2 sets of diagonal lines crossing each other at about 45°, the set inclining to the right reaching the suture above, the set inclining to the left not extending much above the mid point of the whorl, the last turn developing a strong truncation at about the lower two thirds and a keel of variable strength and height above the suture, the concavity below the truncation devoid of sculpture or with a weak reticulate sculpture, transition from protoconch to teleoconch moderately abrupt, the truncation not becoming entirely suppressed until the second axial rib, 4 to 5 strong raised spiral threads appearing en echelon, the uppermost first, simultaneously with the suppression of the truncation; adult sculpture consisting of strong, raised spiral threads starting at the shoulder and continuing below to the columella, slightly weaker and more closely set on the columella, anal fasciolar concavity bearing fine, raised, crescent-shaped growth lines only, axials strong and moderately closely set, 7 visible from an angle, dying out above at or just above the shoulder, continuing below to the concavity at the base of the whorl; aperture produced anteriorly to form a short canal but other characters not maturely formed.

Discussion: *Phandella transemma* differs from both of the previous species in having strong, raised, spiral threads, *P. nepionica* being devoid of spirals except on the columella and *P. monroensis* having weak spiral grooves. The protoconch of *P. transemma* has a keel of variable strength and variable elevation above the suture. The keel of the specimen figured in Plate 61, figures 8-9, has a bilirate keel, while the holotype (Plate 23, figure 5) has a low indistinct keel. The anal fasciole is more conspicuous in *P. transemma* due to the absence of strong spiral sculpture thereon. The axial ribs are more closely set than in *P. monroensis* and stronger than in *P. nepionica*.

Type: Holotype 498177 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 23, figure 5).

Occurrence: Red Bluff Formation, MGS localities 34b, 37, 38; Mint Spring Formation, USGS locality 7671.

Phandella sp.

Plate 62, figures 1-2

Discussion: This species differs from *Phandella transemma*, with which it occurs in the Red Bluff Formation, in having a smaller protoconch and a slenderer spire.

Occurrence: Red Bluff Formation, USGS localities 34b, 37.

Genus **SPIRADAPHNE** MacNeil n. gen.

Type: *Spiradaphne lowei* MacNeil n. sp. Oligocene, Byram Formation, Mississippi.

Shell small and slender. Protoconch small slender and evenly tapering, full number of whorls not known but probably 4 or 4½, sculptured by two series of diagonal lines either intersecting each other at an angle of about 45° to form a reticulate pattern or weaker so that the upper series and the lower series meet each other at about the mid point of the shell in a series of zig-zag chevrons pointing towards the aperture. Aperture moderately broad, constricted anteriorly and produced to form a narrow canal of moderate length. Anal fasciole moderately to deeply concave. Shoulder truncate. Sculpture consisting of neat crescent-shaped raised lines in the anal fasciolar concavity and strong narrow spiral lines. No axial sculpture.

This genus differs from *Phandella* in having a smaller, more evenly tapering protoconch without the development of a keel on the last whorl of the protoconch, and in having spiral sculpture only. The type of sculpture recalls that in the *Microdrillia brevis* group, but the latter is probably not genetically related, having a different type of protoconch.

An undescribed species which may be referable to or at least related to this genus is in the Henderson collection in the National Museum from Florida. It compares in the characters of the protoconch and in form, and the sculpture differs only in that the anal fasciole is sculptured by minute pustules.

The species figured by Cossmann and Pissarro (1913, pl. 53, fig. 229-3) as *Peratotoma striarella* (Lamarck) from the Lutetian and Bartonian appears to be congeneric although previous references to this species do not describe its protoconch.

MacNeil named this genus *Microdaphne* in his manuscript. That name is now preoccupied by *Microdaphne* McLean, 1971, so it is replaced with *Spiradaphne*, a name referring to the prominent spiral sculpture of the genus.

Spiradaphne lowei MacNeil n. sp.

Plate 37, figures 11-12

Description: Shell small, slender; protoconch small and slender, evenly expanding, probably about 4 to 4½ whorls, 3 preserved on the type, sculpture faint but consisting of 2 series of diagonal lines coming together at an angle of about 45° along the midpoint to form crude chevrons pointing to the left, transition to juvenile stage not abrupt, 2 weak spiral threads first appearing fairly low on the whorl, rising perceptably and becoming fairly strong in somewhat less than a quarter turn; aperture of moderate width, about .38 the height of the shell, produced anteriorly to form a narrow, somewhat twisted canal of moderate length; outer lip smooth within; anal sinus broad and shallow, adjoining the suture; anal fasciole broad and concave, no collar between it and the suture, the lowest part at the suture and most steeply sloping where it adjoins the shoulder; suture impressed; parietal callus and columellar callus moderately strong with a well defined inner lip, no folds; columella twisted below, uncallussed below the twist; sculpture consisting of fine, raised, crescent-shaped growth lines on the anal fasciole, sharp spiral threads below the fasciole, usually 3 on the spire whorls, continuing below with diminishing strength on the body whorl and columella, interspaces smooth and concave or with very faint microspirals.

Discussion: No species is at present known from the American Tertiary with which *M. lowei* can be compared. As already stated it appears to be congeneric with *Peratotoma striarella* (Lamarck) from the Eocene of the Paris Basin, but no accurate comparison can be made from figures of the latter alone.

Spiradaphne lowei is apparently rare, being known only from the holotype and one other specimen from the same locality.

Type: Holotype 376621 USNM from the Byram Formation, USGS locality 6978 (Plate 37, figure 11).

Occurrence: Byram Formation, USGS locality 6978.

Spiradaphne lowei refugium MacNeil n. subsp.
Plate 23, figure 8; Plate 62, figures 4-5

Discussion: Two specimens from USGS locality 3727 and two from MGS locality 89 are probably conspecific with *M. lowei,* but differ sufficiently to justify a subspecific name. The Mint Spring form is slightly slenderer than typical *M. lowei* and has a slightly more depressed anal fasciole. The protoconch differs somewhat more, however, in that the two series of diagonal lines cross each other to form a finely reticulate pattern rather than a series of zig-zag chevrons. One of the Mint Spring specimens has a fine secondary spiral thread in the interspaces after the third whorl.

Type: Holotype 376514 USNM from the Mint Spring Formation, USGS locality 3727 (Plate 23, figure 8).

Occurrence: Mint Spring Formation, USGS locality 3727, MGS locality 89.

Spiradaphne lowei refugium MacNeil var.
Plate 62, figure 3

Discussion: This variety, which occurs in the Red Bluff Formation, differs from *S. lowei refugium* s.s. in its more inflated whorls.

Occurrence: Red Bluff Formation, USGS locality 37.

Subfamily CONORBINAE Powell, 1942.

Genus **CONORBIS** Swainson, 1840

Conorbis Swainson, Cabinet Cyclopaedia of Natural History, p. 312, 1840.

Type (by monotypy): *Conus dormitor* Solander, 1766. Eocene (Bartonian), England.

Conorbis porcellanus (Conrad)
Plate 38, figures 1-3

1829. *Pleurotoma semserricta* ? Lesueur, Walnut Hills fossil shells, pl. 6, fig. 12. Printed in Dockery, 1982, Appendix II.
1848a. *Pleurotoma porcellana* Conrad, Acad. Nat. Sci. Philadelphia, Trans., v. 3, p. 283-284.
1848b. *Pleurotoma porcellana* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 114, pl. 11, fig. 16. Plates reprinted in Dockery, 1982, Appendix I.
1866. *Conorbis porcellanus* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 30.

Original Description: Conrad, 1848a.

Fusiform; smooth and polished; whorls eleven, convex, with two revolving lines near the upper margin; the interstices transversely striated; body whorl with revolving impressed lines, commencing near the upper angle of the aperture; volution contiguous to the apex papillated; labium striated; aperture rather more than half the length of the shell; beak perfectly straight. Length 1¼.

This shell may perhaps appertain to *Brachytoma,* Swainson.

Description: Protoconch with two, smooth, elevated, convex whorls with impressed suture; teleoconch with eight whorls; first whorl with subsutural collar and spiral grooves; second whorl with subsutural collar having a punctate groove above and below, whorl smooth or with one incised line below subsutural collar and associated grooves; latter whorls of spire with punctate sulcus above and below the subsutural collar and smooth below or with one or more incised spiral lines; the upper sulcus bears a medial spiral lira, the sulci broadening toward the aperture and the punctae becoming axially elongate; punctae apparently correspond to growth lines of the upper anal fasciole; body whorl with primary and secondary spiral lirae below top of aperture, growth lines prominent in interspaces of lirae; aperture elongate and slightly bent at anterior canal, outer lip smooth within, inner lip lirate within and with callus ridge along margin of anterior canal.

Discussion: This species differs from *Conorbis alatoideus* Aldrich, 1885, from the Moodys Branch Formation in its narrower shell and in the smooth band above the suture on the spire and upper part of body whorl.

Type: Lectotype 13443 ANSP and paratypes 13444 ANSP all from the Byram Formation judging from the preservation, Vicksburg, Mississippi (Conrad).

Occurrence: Byram Formation, MGS localities 106, 109, 112c, 115.

Subclass OPISTHOBRANCHIA
Order ENTOMOTAENIATA
Superfamily PYRAMIDELLACEA Gray, 1840
Family PYRAMIDELLIDAE Gray, 1840

Genus **PYRAMIDELLA** Lamarck, 1799

Pyramidella Lamarck, Mem. Soc. Hist. Nat. Paris, v. 1, p. 76, 1799.

Type (by monotypy): *Trachus dolabratus* Linné. Recent, West Indies.

Subgenus **VOLUSPA** Dall and Bartsch, 1904

Voluspa Dall and Bartsch, Biol. Soc. Washington, Proc., v. 17, p. 4, 1904.

Type (by original designation): *Pyramidella auricoma* Dall. Recent, Gulf of California.

Pyramidella (Voluspa) chavanoidea MacNeil n. sp.

Plate 15, figure 1

Description: Shell subangulate, moderately large for the genus, apical angle wide, whorls flat-sided, sutures strongly incised, columella with three folds; protoconch decorticated; spire whorls sculptured by faint growth lines and indistinct spiral striations; base broadly rounded and set off by a moderately sharp basal angle, sculptured by spiral striations which are slightly stronger than those on the face of the whorls; sutures with a strongly inclined upper wall corresponding to the underslope of the basal angle, and a narrow tabulate lower wall; aperture inflated lenticular, produced anteriorly to form a short siphonal canal; outer lip thin; inner lip tightly attached, parietal callus very thin; columella with a moderately strong siphonal fasciole which curves towards the uppermost, more horizontal, and strongest of three columellar folds, lowest fold forming border of siphonal notch, middle fold weak on inner lip, stronger within aperture; no umbilicus.

Discussion: This species is distinguished from other Vicksburg pyramidellids by its flattened whorls, strong basal angle and sharp sutures. It resembles *P.* (*Ulfa*) *chavani* Palmer (1937, p. 73, pl. 8, figs. 2, 5, 6, 12, 19, 20) most in shape, especially in the basal angle, but only one columellar fold is described for the Alabama middle Eocene species and it is thicker and more inclined than the equivalent fold on *P.* (*V.*) *chavanoidea*. A similar species, *P. calvimontana* Deshayes (see Glibert, 1933, p. 16, pl. 1, fig. 8) occurs in the middle Eocene of Belguim.

Type: Holotype 498247 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 15, figure 1).

Occurrence: Mint Spring Formation, USGS locality 13287.

Pyramidella (Voluspa) leafensis MacNeil n. sp.

Plate 15, figures 2-4; Plate 40, figure 4

Description: Shell subangulate, of medium size for the genus, apical angle very wide, whorls broadly rounded, sutures moderately incised, columella with three folds; protoconch heterostrophic and overturned, the first visible turn appearing to come out of the top of the spire, less than a full turn visible; adult whorls sculptured by faint growth lines and faint incised spiral lines which continue to the columella with equal strength; base rounded with a faint basal angularity which may be absent on some specimens; sutures incised, upper wall curving evenly, lower wall sharply rounded, not tabulate; aperture broadly lenticular with a short siphonal canal; outer lip thin, inner lip weakly raised to form a short straight columella, parietal callus thin and tightly appressed; columella with a low rounded siphonal fasciole which curves to the uppermost of three folds, upper fold nearly horizontal, two lower folds subequal in strength and more inclined, the lowest bordering the canal; umbilicus a shallow chink.

Discussion: This species can be distinguished at once from *P.* (*V.*) *chavanoidea* by its rounded whorls and by its rounded rather than angulate upper suture wall. Its closest living American relative appears to be *P. cerrosana* Dall and Bartsch (1909, p. 20, pl. 1, fig. 1) from lower California.

Type: Holotype 648903 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 40 , figure 4).

Occurrence: Mint Spring Formation, USGS locality 7671.

Pyramidella (Voluspa?) microcosta
MacNeil n. sp.
Plate 15, figures 5-6

Description: Shell of medium size, spire gently convex, whorls weakly rounded, sutures incised, columella with three folds; protoconch unknown; adult whorls sculptured with coarse crude nearly vertical growth lines, no spiral striations; base rounded and not set off by an angularity or sulcus, growth lines continuing across base to the siphonal fasciole; sutures with an upper broadly rounded wall and a lower sharply rounded wall; aperture incomplete on known specimens but subquadrate to broadly lenticular; outer lip thin at the edge, thickening rapidly, inner wall with an axial ridge bearing three or four short, sharp, spiral ridges about a half turn back from the plane of the aperture; inner lip thin, detached, and turned back to partly cover the umbilical chink, parietal callus thin, smooth, and appressed on rough surface of body whorl; columella with three folds, the uppermost stronger and more horizontal, the lower two subequal and more inclined, the lowest bordering the siphonal canal; no open umbilicus but with a moderate chink.

Discussion: The spiral folds on the inside of the outer lip (not visible in figures) distinguish this from other Oligocene species. They resemble those in *Odostomia boettgeri* and *O. byramensis* except that there are about two less in *P. microcosta*. The present species is distinguished also by the very coarse irregular growth lines.

Spiral folds or ridges on the inside of the inner lip are reported on some individuals of the type species, *P. dolabrata* Linné, but that species is definitely umbilicate.

I can find nothing very closely related to this species.

Type: Holotype 479994 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 15, figure 5).

Occurrence: Mint Spring Formation, USGS locality 13287.

Pyramidella (Voluspa) n. sp.
Plate 27, figure 31

Discussion: A single specimen with an incomplete aperture and columella was obtained from the Byram Formation. It has a wider apical angle than *P.* (*V.*) *chavanoides*. Its suture is more like that of *P.* (*V.*) *leafensis*. The body whorl has a strong basal angle, a character of *P.* (*V.*) *chavanoides* and some variants of *P.* (*V.*) *leafensis*. It is not known on the basis of the material at hand whether this is a new species or a subspecies of *P.* (*V.*) *leafensis*.

Occurrence: Byram Formation, USGS locality 3725.

Genus **ODOSTOMIA** Fleming, 1817

Odostomia Fleming, Edinburgh Encycl., v. 7, pt. 1, p. 76, 1817.

Type (by subsequent designation, Gray, 1847): *Turbo plicatus* Montagu. Recent, England.

Subgenus **ODOSTOMIA** Fleming, 1817
Odostomia (Odostomia) boettgeri Meyer
Plate 15, figures 19-21; Plate 62, figure 8

1887. *Odostomia Boettgeri* Meyer, Acad. Nat. Sci. Philadelphia, Proc., v. 39, p. 51, pl. 3, fig. 4.

Original Description: Meyer, 1887.

Subulate, polished. Nucleus sinistral, vertical, partly hidden. Adult whorls eight, with an impressed line below the suture. Suture distinct. Mouth subelliptical. Inner lip with a strong, nearly horizontal fold. At some distance from the outer lip there are within six raised revolving lines.
Vicksburg, Miss. "Lower Vicksburgian."

Discussion: Shell small, apical angle moderately large, base of whorl sharply rounded, whorls moderately rounded, sutures loosely appressed, aperture broad, columella with one strong fold; protoconch heterostrophic and inclined over 90°, minute and about half submerged, slightly over one full turn, smooth; adult whorls smooth except for a weakly incised subsutural groove; aperture rounded anteriorly, angulate posteriorly; outer lip thin at the edge but thickening well inside and reinforced with 5 to 6 raised spiral ridges; inner lip slightly thickened with the outer edge upturned and sharp; recurring sharply to form a single, moderately strong columellar fold, parietal callus thin with its edge retreating well inside the aperture; no umbilicus but some specimens with a short chink.

Discussion: Four specimens were obtained at Lime Creek (USGS locality 14071a); all are smaller than the holotype and all are better preserved. The holotype lacks a protoconch but the other four specimens have perfectly preserved protoconchs.

Odostomia (*Odostomia*) *boettgeri* was listed in the synonymy of *O.* (*O.*) *laevis* Lea, a Claiborne species, by de Gregorio (1890, p. 157) but it is a stouter, shorter spired species than *O.* (*O.*) *laevis*. If anything, *O.* (*O.*) *boettgeri* is more closely related to another Claiborne species, *O.* (*O.*) *trapaquara* (Harris) (see Palmer, 1937, pl. 7, fig. 27), than to *O.* (*O.*) *laevis* but it is more elongate than *O.* (*O.*) *trapaquara*. It resembles this species in the strength and nearly horizontal strike of its columellar fold more than it does *O.* (*O.*) *conoidea* (Brocchi) (Martin, 1904, pl. 54, fig. 4) from the middle Miocene of Maryland; in the latter the fold is weak and more inclined. Pliocene species from Florida figured by Bartsch (1955, pls. 17, 18) also have thinner, more inclined folds. The same is true of the living west coast species (Dall and Bartsch, 1909, pls. 21-30).

Type: Holotype 644602 USNM from the Mint Spring Formation, "Lower Vicksburgian," Vicksburg, Mississippi (Plate 15, figure 19).

Occurrence: Red Bluff Formation, MGS locality 37; Mint Spring Formation, Vicksburg, USGS locality 14071a.

Odostomia (Odostomia) aff. O. (O.) angularis
Dall and Bartsch
Plate 40, figures 7-11; Plate 62, figures 15-16
Plate 63, figure 9

Discussion: The Casey collection contains five specimens of a small *Odostomia* that resembles this west coast species (see Oldroyd, 1927, pt. 2, p. 183, pl. 66, fig. 2). It has minute spiral striae and a weak basal angularity although the latter is variable and some specimens are without it. Both this and the following species have the sinistral stage of the protoconch totally overturned and immersed, the first visible turn appearing to come out of the apex of the spire. I am not describing this species or attempting to identify it further.

Occurrence: Mint Spring Formation, "Lower Vicksburg," Vicksburg, Mississippi (Casey), USGS locality 13287.

Odostomia (Odostomia) byramensis
MacNeil n. sp.
Plate 27, figures 25-26, 32-35;
Plate 63, figure 1

Description: Shell small, pupoid, apical angle of medium width, base broadly rounded, whorls moderately round, sutures loosely appressed, aperture of moderate width, columella with a single moderately strong fold; protoconch heterostrophic, minute, smooth, inclined well over 90°, slightly over one full turn; adult whorls smooth or with faint growth line irregularities; aperture of moderate width rounded anteriorly, subangulate posteriorly; outer lip thin at edge, thicker and with 5 raised spiral ridges well inside the aperture; inner lip slightly thickened, curving to a single fold at the umbilical position; parietal wall weakly to well callussed in different individuals; no umbilicus but with a short curved chink.

Discussion: This species is readily distinguished from *O.* (*O.*) *boettgeri* by its smaller size, more pupoid shape and lack of a subsutural incised spiral line. In addition, the protoconch of *O.* (*O.*) *byramensis* appears to be even more overturned.

The Byram species is here referred to *Odostomia*. It appears to be related to a Claiborne species, *Pyramidella* (*Syrnola*) *propeacicula* (Cossmann) from the Claiborne (see Palmer, 1937, p. 79, pl. 7, figs. 1-3, 10, 11) which Cossmann (1921, p. 230) placed in a new section, *Puposyrnola*. According to Palmer (1937, p. 80), Chavan believes *propeacicula* is a true *Syrnola*. Palmer in comparing *Odostomia* (*Odostomia*) *trapaquara* and *Pyramidella* (*Syrnola*) *propeacicula* concluded that the generic distinction between them was not apparent although she tentatively followed Cossmann in their assignment. I cannot see any reason for placing these species, or *O.* (*O.*) *byramensis*, in different genera.

Type: Holotype 498353 USNM from the Byram Formation, USGS locality 7376 (Plate 27, figure 32).

Occurrence: Byram Formation, USGS localities 5615, 7376, MGS locality 106.

Odostomia (Odostomia) byramensis MacNeil var. ?
Plate 40, figures 12, 13; Plate 62, figures 9-14

Discussion: This small, smooth pupoid *Odostomia* occurs in the Red Bluff and Mint Spring formations. It is similar to *O.* (*O.*) *byramensis* in its smooth, pupiform shell, which lacks a subsutural incised spiral line, and is tentatively placed as a variety of that species. It differs from *O.* (*O.*) *bryamensis* s.s. in having a more cylindrical shell with the whorls more longitudinally compressed and in lacking spiral ridges inside the outer lip.

Occurrence: Red Bluff Formation, MGS localities 34b, 37, 38; Mint Spring Formation, USGS locality 7671, MGS locality 89.

Odostomia (Odostomia) vicksburgella
Dockery n. sp.
Plate 27, figures 29-30; Plate 41, figures 10-16

Description: Shell small, short, somewhat pupiform; protoconch dome-shaped with three, smooth, strongly convex, rapidly expanding whorls; teleoconch with two, axially ribbed, slowly expanding whorls; axial ribs low and rounded; suture impressed and with slight subsutural collar along which the axial ribs may be slightly noded; aperture large, ovate, and smooth within; outer lip thin and fragile.

Discussion: This minute species occurs in both the Red Bluff and Byram formations and is common at Red Bluff locality 38. It differs from the previously described Vicksburg *Odostomia* species in its short, pupiform shell and low rounded axial ribs.

Type: Holotype 376660 USNM from the Red Bluff Formation, MGS locality 38 (Plate 41, figure 15).

Occurrence: Red Bluff Formation, MGS localities

38, 39; Byram Formation, USGS locality 5615, MGS locality 106.

Odostomia (Odostomia) sp.

Plate 63, figure 2

Discussion: This elegant species is known only from a single specimen from the Red Bluff Formation. It does not resemble any of the other Vicksburg *Odostomia* species. The shell has a conical spire, an inflated body whorl, and a sculpture of prominent, straight, axial ribs and fine, closely spaced, spiral lirae.

Occurrence: Red Bluff Formation, MGS locality 37.

Subgenus **MIRALDA** A. Adams, 1863

Miralda A. Adams, Linn. Soc. London, Jour., v. 7, p. 3, 1863.

Type (by subsequent designation, Dall and Bartsch, 1909): *Parthenia diadema* A. Adams. Recent, Japan.

Bartsch (1955, p. 80) described a new genus, *Fargoa,* in which he placed two species, one of which seems to be closely related to the one here described under *Miralda. Fargoa* is not, in my opinion, distinct from *Miralda* as the latter genus was used by Pilsbry (1917a, p. 318, 319). Bartsch also proposed a new subgenus of *Miralda, Miraldella,* for a juvenile shell; its value is dubious.

Odostomia (Miralda) menthafons MacNeil n. sp.

Plate 40, figure 16

Description: Shell small, spire of medium height, whorls rounded, sutures strongly incised, short axials below suture, strong spirals centrally, weak spirals on base, aperture subovate; protoconch heterostrophic, nearly completely overturned, only the last whorl showing but probably less than a turn obscured; smooth, minute; first whorl of teleoconch with a strong median rounded spiral rib and a roughened area above it; succeeding whorls with two strong spiral ribs on the lower part of the whorl, a third spiral partly concealed by the lower suture, and a nodular spiral below the suture which is crossed by a short blunt axial at each node, a weaker second noded spiral closer to the suture above on the last whorls; base with smooth round spiral threads decreasing rapidly in strength towards the columella; sutures strongly impressed; aperture subovate but more angulate posteriorly; outer lip thin but thickening rapidly, wavy in conformance with spiral ribs at the edge; inner lip weakly upturned, bearing a single weak columellar fold, parietal callus thin and retreating; no umbilicus but with a well formed chink.

Discussion: *Odostomia* (*Miralda*) *menthafons* has no known American early Tertiary relatives. *Fargoa archeri* Bartsch (1955, p. 81, pl. 16, fig. 4) from the Caloosahatchee Formation north of St. Petersburg, Florida, has longer axials and stronger basal spirals than *Odostomia* (*M.*) *menthafons.* The other species included by Bartsch under *Fargoa, F. calesi* Bartsch (1955, pl. 16, fig. 2), has equally strong spiral ribs all over the whorl; this species might better be referred to *Chrysallida. Miralda* (*Miraldella*) *gordonae* Bartsch (1955, pl. 16, fig. 3) is a juvenile and it is difficult to make comparison with it. Aside from these Florida Pliocene or early Pleistocene species I can find no related fossil American species.

Odostomia scopulorum Watson (1885-86, p. 485, pl. 31, fig. 5; Pilsbry, 1917a, p. 319, fig. 13), a Recent Hawaiian shell which Pilsbry placed in the subgenus *Miralda,* is the most closely related species I can find. The living species is smaller, more pupoid and the axials are stronger.

Type: Holotype 498256 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 40, figure 16).

Occurrence: Mint Spring Formation, USGS locality 14071a.

Genus **EULIMELLA** Forbes, 1846

Eulimella Forbes, Ann. Mag. Nat. Hist., v. 14, p. 412, 1846.

Type (by subsequent designation, Dall and Bartsch, 1909): *Eulimella crassula* Forbes (= *E. scillae* Scacchi). Recent, Europe.

The assignment of the following two species to this genus is tentative and they may not even be congeneric. The described species, at least, might be referable to *Syrnola.* Shells which include similar species were referred to *Eulimella* by Thiele (1925, pls. 25, 26, 27) in his report on the mollusks of the Deutschen Tiefsee - Expedition.

The two specimens figured in plates 2 and 15 were broken after they were photographed and the upper part of their spires is lost. The Red Bluff species (*Eulimella* sp.) is known only from the three figured specimens and only the body whorl of the specimen figured in Plate 2 remains. The Mint Spring species is represented by other specimens, several of them with perfect protoconchs.

Palmer (1936, p. 78) pointed out that the reference to Forbes, 1846, seems to be an error. Neave (1939, vol. 2, p. 331) indicates that it is an emendation of *Erilimella* Forbes and McAndrew, 1846, by Jeffreys, 1847.

Eulimella clearyensis MacNeil n. sp.

Plate 15, figure 14; Plate 63, figures 3-8

Description: Shell small, slender, spire very high, aperture short and moderately broad, whorls flattened; protoconch heterostrophic, inclined over 90°, less than one third submerged, smooth, nearly two whorls; adult whorls smooth and polished except for an occasional faint growth line, nearly straight sided but the lower part of the whorls has a very slightly greater inflation than the upper part; aperture rounded anteriorly, angulate posteriorly, moderately broad; outer lip thin; inner lip thickened and with a weak flare, passing to a thin, appressed regressive parietal callus and bearing a single moderate columellar fold and a faint suggestion of a second fold above it, at least well inside the aperture; no umbilical chink.

Discussion: The most likely American early Tertiary species with which this might be compared is one from the Bashi Formation (early Eocene) of Alabama which Harris (1899, p. 97, pl. 12, fig. 16) identified as *Eulimella tenua* (Gabb). Palmer (1937, p. 81, pl. 8, fig.7) described this species as *Turbonilla (Ptycheulimella) sabina,* stating that Harris had placed it under *Eulima,* a melanellid, but that its columellar fold and protoconch indicate it is a *Turbonilla.* Actually Harris had called it a *Eulimella,* a pyramidellid, as is *Turbonilla.*

Type: Holotype 498250 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 15, figure 14).

Occurrence: Red Bluff Formation, MGS locality 38; Mint Spring Formation, USGS locality 14071a, MGS locality 99; Byram Formation, MGS locality 106.

Eulimella sp.

Plate 2, figure 14; Plate 63, figures 10-11

Discussion: The tiny shell so figured has a heterostrophic protoconch which is inclined about 90° and is only about one third submerged. The succeeding whorls are smooth, broadly rounded and moderately wide although the shell is slender and expands very little at each whorl. The columella is simple and without folds. The inner lip is weakly raised anteriorly but is flush where it meets the parietal wall. There is no noticeable parietal callus and the outer lip has the appearance of passing directly to the columellar axis; no umbilical chink.

This species could be related to *"Aclis" modesta* Meyer (see Palmer, 1937, p. 111, pl. 8, fig. 8) from Claiborne, Alabama, another species whose type is lost.

Occurrence: Red Bluff Formation, "Red Bluff, Mississippi," collected by Aldrich and in the Casey collection, USGS locality 13288, MGS locality 38.

Genus **TURBONILLA** Risso, 1826

Turbonilla Risso, Histoire naturelle des principles productions de l'Europe meridionale etc., v. 4, p. 224, 1826.

Type (by subsequent designation, Hermannsen, 1852): *Turbonilla costulata* Risso. "Fossile a Saint-Jean", Pliocene, southern France.

Dall and Bartsch (1904, p. 7) designated *T. typica* Dall and Bartsch (= *T. plicatula* Risso, non Brocchi) as type of *Turbonilla* but they overlooked the earlier designation by Herrmannsen (1852, p. 136). Both *plicatula* and *costulata* were reported by Risso (1826, p. 122) from "La Trinite" at a horizon nearly the same as that at "Saint Jean", both localities being within 2 kilometers of Nice. According to Haug (1920, p. 1629) these localities are Plaisancian or Astian.

Turbonilla mississippiensis Meyer

Plate 2, figures 22-25; Plate 63, figure 12

1886. *Turbonilla mississippiensis* Meyer, Geol. Survey Alabama, Bull. 1, pt. 2, p. 70, pl. 2, fig. 5.

Original Description: Meyer, 1886.

Subulate; the sinistral nucleus consists of three smooth convex whorls, which very rapidly increase in size; its axis is horizontal. Seven convex adult whorls are covered with elevated, tranverse ribs, about twelve on each whorl. Suture distinct, aperture oval, base smooth.

Locality.—Red Bluff, Miss.

Differs from the preceding species [*Turbenilla neglecta* Meyer] mainly by its convex whorls.

Description: Shell small, spire high, aperture subquadrate, whorls moderately rounded, sculptured by moderately inclined axial riblets, no spiral sculpture; protoconch heterostrophic, consisting of about two smooth well rounded whorls, high spired in itself and *Physa*-like, and set atop the shell spire at about 90°; adult sculpture consisting of moderately narrow axial riblets (about 7 visible from an angle) which incline to the right posteriorly with a slight curve, extending nearly from the suture above to the basal angularity, no spiral sculpture; base smooth, no well defined basal disc; aperture subquadrate; outer lip thin, inner lip slightly overturned and forming a slender vertical columella; parietal callus very faint; no umbilicus.

Discussion: I hesitate to compare this species with any other Tertiary fossils from the United States. Forms which appear to be its most likely fossil relatives were described by Brown and Pilsbry (1912, p. 509-510, text figs. 4a-c) from probable middle Tertiary beds at Gatun locks, Panama, as *Turbonilla (Chemnitzia) bartschiana* and *T. (C.) gatunensis.* There might be some doubt that the latter are really two species.

Type: Holotype 644586 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer) (Plate 2, figure 23).

Occurrence: Red Bluff Formation, USGS locality 2632, MGS locality 34b.

Turbonilla leafensis MacNeil n. sp.
Plate 15, figure 16; Plate 27, figure 24;
Plate 40, figure 15; Plate 63, figures 13-16

Description: Shell small, glabrous, whorls moderately rounded, no spiral sculpture, axials sharp and moderately inclined, regularly spaced on juvenile whorls, irregular on adult whorls with areas of crowding and areas without axials which nevertheless are not varices; protoconch small and *Physa*-like, situated at about right angles to the spire, about 2½ whorls, smooth, only about one third immersed; adult whorls with nearly straight thin axial ribs (about 8 to 9 visible from an angle, as many as 12 where crowded) which incline to the right posteriorly and which may hook weakly to the left just below the suture; base smooth, set off by a sharper rounding at the lower part of the body whorl, not a definite angulation; sutures moderately incised; aperture subquadrate; outer lip thin, inner lip weakly upturned and straight; parietal callus faint; no umbilicus.

Discussion: This species has thinner, stronger and longer axials than *T. mississippiensis* from the Red Bluff. The holotype and smallest specimen does not show any irregularities in sculpture but two incomplete larger specimens have areas on the last whorls where the axials become crowded as well as areas that are smooth. The smooth areas are swollen as well; they are not narrow and sharply bounded varices but broad areas of nearly an eighth of a turn on which the axials may be weakly present at the top or bottom of the whorl or absent.

I cannot find another species with which I would compare this species closely; it does not appear to be related to *T. mississippiensis.*

Type: Holotype 498252 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 15, figure 16).

Occurrence: Mint Spring Formation, USGS locality 7671, MGS locality 89; Byram Formation, USGS locality 5615, MGS locality 106.

Turbonilla caseyi MacNeil n. sp.
Plate 15, figure 15

Description: Shell small, moderately inflated, whorls flattened above and moderately curved on lower part and base, the flat and curved areas divided by a moderate angulation, weak axial riblets on flattened part of whorls; protoconch subnaticoidal and heterostrophic, inclined over 90°, smooth, not deeply immersed; adult whorls flattened or weakly concave above the basal angularity, sculptured by low, weak axial riblets (about 9 to 12 visible from an angle), no spiral sculpture; base smooth; aperture moderately elongate, rounded anteriorly, attenuated posteriorly; outer lip thin, inner lip weakly upturned and weakly curving into a single columellar fold; parietal callus thin and tightly appressed; no umbilicus.

Discussion: This species is represented by four specimens in the Casey collection but is otherwise unknown. It has finer axial ribs than either of the preceding species and also differs from them in having a short subnaticoidal protoconch rather than an elongate *Physa*-like protoconch; the protoconch is also more overturned.

The only American fossil *Turbonilla* I can find that appears to be related to *T. caseyi* was figured by Martin (1904, p. 223, pl. 54, fig. 12) as *Turbonilla (Chemnitzia) nivea* Stimpson var. The latter came from the St. Marys Formation (middle Miocene) of Maryland. It has a wider apical angle than the Mint Spring species and the axial riblets incline to the right posteriorly rather than to the left.

Type: Holotype 498251 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 15, figure 15).

Occurrence: Mint Spring Formation, "Lower bed," Vicksburg, Mississippi (Casey), USGS locality 13287.

Order CEPHALASPIDEA P. Fischer, 1883
Superfamily ACTEONACEA d'Orbigny, 1842
Family ACTEONIDAE d'Orbigny, 1842

Genus **ACTEON** Montfort, 1810

Acteon Montfort, Conchyliologie systematique, v. 2, p. 315, 1810.

Type (by monotypy): *Voluta tornatilis* Gmelin (= *Voluta tornatilis* Linné). Recent, Europe.

The genus *Aceton* embraces species with a variety of sculpture and considerable range in the strength of the columellar fold. The umbilicus ranges from closed to partially open, forming a moderately wide umbilical chink, but the species with an open or unobscured umbilicus should probably not be included in *Acteon* s.s. The protoconch is always heterostrophic, but it is usually so reduced and turned over that it has the appearance of being homeostrophic and naticoidal. In the related genus *Rictaxis* and in the genus *Crenilabium*, especially its subgenus *Lissacteon*, the protoconch is more inclined, often perpendicular to the spire, so that its heterostrophic condition is more readily seen. The columella of *Acteon* merges directly with the outer lip without any suggestion of a canal, whereas in *Rictaxis* the columella is truncate anteriorly forming a canaliculate notch between it and the anterior portion of the outer lip.

Subgenus ACTEON Montfort, 1810

Acteon (Acteon) meyeri MacNeil n. sp.

Plate 24, figures 10-15; Plate 64, figures 1, 3

Description: Shell large, comparatively thin, cylindrical; spire of medium height; protoconch heterostrophic, subnaticoidal, inclined; aperture comparatively narrow, nearly two thirds the height of the shell; parietal wall with a well defined callus, emerging more at the base; columella bearing a single, moderately weak fold; umbilical groove closed; sculpture consisting of numerous closely set, spiral grooves made punctate by regularly spaced cross bars, additional grooves appearing medially as incised lines dividing the interspaces into two equal parts, giving them a doubled appearance.

Discussion: This species differs from the other large, many grooved Vicksburg *Acteon, A. (A.) pretextilis,* in that its shell is thinner, more cylindrical, the columellar fold is much weaker, and there is a tendency for secondary grooves to appear medially.

In the writer's opinion no reliable means for separating Eocene and Oligocene species of *Acteon* of this type into intelligible lineages or groups has been devised, and the interpretations of different authors seem to be at variance. The tendency for new grooves to appear as incised lines along the interspaces has been mentioned for several species, among them, *A. (A.) idoneus* Conrad, 1833 (Claiborne), *A. (A.) punctatus* Lea, 1833 (Claiborne), and *A. (A.) inflatior* Meyer, 1886 (Claiborne), the latter regarded as a synonym of *A. (A.) punctatus* by Palmer (1937, p. 499). Palmer treated *A. (A.) punctatus* as a subspecies of *A. (A.) pomilius* Conrad which is supposed not to have this character. The truncation of the anterior end of the columella of *A. (A.) pomilius* and the vertical position of the first whorl of its teleoconch suggests that it is a *Rictaxis* rather than an *Aceton,* however, and therefore not related to *A. (A.) punctatus. Acteon (Acteon) meyeri* has a larger and thinner shell than any of these species.

Type: Holotype 560795 USNM from the Mint Spring Formation, USGS locality 14072 (Plate 24, figure 12), and paratype 498117 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 24, figure 15).

Occurrence: Red Bluff Formation, MGS locality 38; ? Forest Hill Formation, USGS locality 14524; Mint Spring Formation, USGS localities 3727, 7671, 13287, 14071, 14072, 14849, MGS localities 89, 90, 99; Byram Formation, MGS locality 93.

Acteon (Acteon) pretextilis MacNeil n. sp.

Plate 24, figures 9, 21?, 22

Description: Shell large, thick, and inflated; spire moderately low; protoconch heterostrophic, subnaticoidal, slightly inclined; aperture of moderate width, nearly two thirds the height of the shell; parietal wall with a well developed callus; columella bearing a single, strong fold; umbilical groove moderately wide; sculpture consisting of strong, evenly spaced grooves with conspicuous cross bars' giving the grooves a coarsely punctate appearance; new grooves appearing along the raised interspaces on the early whorls, but rarely on the later whorls.

Discussion: This species is closely related to *A. (A.) textilis* (Guppy, 1873), from the Miocene of Jamaica and to *A. (A.) subtornatilis* Pilsbry and Johnson, 1917, from the Miocene of the Dominican Republic but differs from both in having a somewhat shorter body whorl with fewer spiral grooves and somewhat wider interspaces. The grooves of *A. textilis* are wider with the cross bars closer together, giving them the effect of being latticed rather than coarsely punctate. The type of *A. textilis* has 33 spiral grooves and that of *A. subtornatilis* has 35. A specimen of *A. pretextilis* from Vicksburg comparable in size to either of these specimens has only 28 spiral grooves on the body whorl. *Acteon eurystoma* Woodring, 1928, from the Miocene of Bowden, Jamaica, may prove to be the young of *A. textilis,* although as pointed out by Woodring, the spiral grooves on specimens identified as *A. eurystoma* appeared finer than those on the early whorls of the type of *A. textilis.* Woodring regarded *A. costaricensis* Olsson, 1922, as a synonym of *A. texilis.*

Acteon (Acteon) pretextilis is readily distinguished from *A. (A.) meyeri* with which it occurs by being a much heavier shell, more ovate than cylindrical, showing much lesc tendency for secondary spiral grooves to appear on the flattened interspaces, and having a much more strongly developed fold on its columella. *Acteon (Acteon) annectens* Meyer, 1886, from the Jackson Group may be related but differs in having much finer spiral sculpture on the first whorl of the teleoconch and very coarse sculpture on the subsequent whorls.

Type: Holotype 498132 USNM from the Mint Spring Formation, "Lower bed at Vicksburg," USGS locality 13287 (Plate 24, figure 9).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 3725, 3727, 6448, 7671, 13287.

Acteon (Acteon) aldrichi MacNeil n. sp.

Plate 24, figures 19-20

Description: Shell moderately large, bulbous; spire low; protoconch heterostrophic, subnaticoidal, slightly inclined, aperture large, about two thirds the height of the shell; parietal wall with a moderately strong callus; columella bearing a single, strong fold; umbilical groove moderately wide; sculpture consisting of weak, non-punctate, spiral grooves which are strongest on the lower part of the whorl but which become more widely spaced or die out centrally, and usually a single moderately strong spiral groove just below the suture.

Discussion: This species and a closely related one from the Red Bluff Formation may be related to *A. tampae* Dall, 1915, from the Tampa Limestone of lower Miocene age of Florida. The Tampa species has rather stronger and more evenly spaced lirations on the lower half of the whorls, and two subsutural grooves instead of one. The umbilical groove of the type of *A. tampae* is closed, and it appears to have a relatively thicker shell. *Acteon shilohensis* Whitfield, 1894, from the Kirkwood Formation of middle Miocene age of New Jersey has stronger sculpture, running higher up on the whorls, and squared, subsutural shoulders giving its somewhat higher spire a stepped appearance. *Acteon claibornicola* de Gregorio, 1890, a species not recognized since it was described, may belong to this same group. It is possible that de Gregorio's specimen came from Vicksburg and not Claiborne in which case it may be an older name for this species.

Acteon (Acteon) aldrichi appears to belong to the group of *A. (A.) punctulatus* (Ferussac) from the lower Miocene of the Mediterranean region as figured by Basterot (1825, p. 25, pl. 1, fig. 24) and Sacco (1897, pt. 22, p. 32, pl. 3, figs. 12-15).

Aside from the species mentioned, no other *Acteon* of this type have been reported fossil from America, and although a few Recent species have been described that compare with this species in inflation, they have a considerably higher spire, a weaker less developed fold on the columella, and usually well spaced and stronger spiral lines on the upper part of the whorls. An undescribed Recent species from Long Island South with lirations only along the base may represent the same group.

Type: Holotype 498215 USNM from the Mint Spring Formation, USGS locality 6448 (Plate 24, figure 19).

Occurrence: Mint Spring Formation, USGS localities 3727, 6447, 6448, 13287, 14074.

Acteon (Acteon) subaldrichi MacNeil n. sp.

Plate 9, figures 25-26; Plate 64, figures 4-5

Description: Shell moderately large, inflated; spire moderately low; protoconch heterostrophic, subnaticoidal, slightly inclined; aperture large, over half the height of the shell; parietal wall with a well defined basal callus; columella bearing a single, strong fold; umbilical groove moderately wide; sculpture consisting of a strong subsutural groove and moderately strong, non-punctate, spiral grooves on the middle and lower portion of the whorls, becoming about twice as closely set towards the base, a second set of very fine lines present on the wide interspaces medially and continuing over the otherwise unsculptured upper portion of the whorls below the subsutural groove.

Discussion: This species is probably the predecessor of *A. (A.) aldrichi* from which it differs in having a higher spire, a shorter aperture, and somewhat heavier basal lirations. The inflation of the shell and the general details of sculpture are similar in the two species. *Acteon (Acteon) claibornicola* de Gregorio from Claiborne may be related.

Type: Holotype 140822 USNM from the Red Bluff Formation, USGS locality 2634, and paratype 560797 USNM from the Red Bluff Formation, USGS locality 5264 (Plate 9, figures 26 and 25 respectively).

Occurrence: Red Bluff Formation, USGS localities 2634, 2860, 5264, MGS locality 38.

Acteon (Acteon) preluculi MacNeil n. sp.

Plate 24, figures 16-18

Description: Shell small, subovate, moderately thin; spire of medium height; protoconch heterostrophic, subnaticoidal, slightly inclined; aperture moderately narrow, about half the height of the shell; parietal wall bearing a slight callus which is usually shed; columella thin with hardly any evidence of a fold; umbilical groove very small and closed; sculpture consisting of strong, equispaced, incised spiral lines all over the whorls, the incised lines weakly latticed by weak raised bars on some individuals.

Discussion: The only analog of this species known from the American Tertiary is *Acteon (Acteon) luculi* Maury, 1910, from the Oak Grove Formation of middle Miocene age of Florida. Specimens identified as *A. (A.) luculi* by Gardner in the Burns collection are larger, the largest fragment having a diameter of 2.7 mm., slightly more inflated, and with stronger cross bars in the revolving grooves, but in general aspect they are very similar.

Type: Holotype 498121 USNM from the Mint Spring Formation, USGS locality 3727 (Plate 24, figure 16).

Occurrence: Mint Spring Formation, USGS localities 3727, 7671, 13287, 14071.

Acteon (Acteon) menthafons MacNeil n. sp.

Plate 24, figures 23, 25; Plate 39, figure 16

Description: Shell small, thin, subovate; spire of medium height; protoconch heterostrophic, subnaticoidal, slightly inclined; aperture relatively large and wide, slightly over one half the height of the shell; parietal wall usually with a thin callus; columella not strongly curved and bearing a single, weak fold; umbilical groove narrow; sculpture consisting of finely punctate, incised spiral lines on the lower two thirds of the whorls and a stronger, non-punctate subsutural groove.

Discussion: This species belongs to the group of *A.* (*A.*) *riomaensis* Maury, 1917, from the Cercado Formation (middle Miocene) of the Dominican Republic, and *A.* (*A.*) *chipolanus* Dall, 1896, from the Chipola Formation (lower Miocene) and *A.* (*A.*) *hamadryados* Maury, 1910, from the Oak Grove Formation (middle Miocene) of Florida. *Acteon* (*Acteon*) *punctostriatus* C.B. Adams, 1840, from the Atlantic and Gulf coasts of North America is probably the Recent analog.

The always present subsutural groove recalls *A.* (*A.*) *riomaensis* more than any other of the Miocene species, although this character is sometimes weakly developed in *A.* (*A.*) *hamadryados*. *Acteon menthafons* probably compares most with *A.* (*A.*) *riomaensis* but differs in having a shorter and more rounded aperture with a consequently lower body whorl and higher spire. The spiral lirations are somewhat weaker and more uniformly confined to the lower two thirds of the shell. *Acteon* (*Acteon*) *hamadryados* is larger with more squared shoulders and a stronger columellar fold. The spiral lines on *A.* (*A.*) *chipolanus* are restricted to the lower third of the whorl and the subsutural groove is absent. An undescribed species closely related to *A.* (*A.*) *menthafons* is in the Casey collection from the Jackson Group near Montgomery, Louisiana. *Acteon* (*Acteon*) *idoneus* Conrad, 1833, a somewhat related species from the Claiborne Eocene, is probably ancestral or related, although it is probably equally related to *A.* (*A.*) *meyeri*.

Type: Holotype 498213 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 24, figure 25).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 3727, 7671, 14071, MGS localities 89, 90, 99; ?Byram Formation, USGS localities 5615, 6978, 14031.

Acteon (Acteon) sp. A

Plate 24, figure 24

Discussion: Another *Acteon*, apparently undescribed, was obtained from the Mint Spring Formation at Vicksburg. Only the body whorl is at hand, but it has a moderately elongate whorl and aperture, an extremely weak columellar fold, and well defined, neatly punctate, spiral lines on the lower half of the whorl, the upper half being perfectly smooth with no subsutural groove.

Occurrence: Mint Spring Formation, USGS locality 3727.

Acteon (Acteon) sp. B

Plate 64, figure 2

Discussion: The specimen illustrated in Plate 64, figure 2, is a juvenile with a teleoconch of one whorl that has numerous, closely spaced, impressed spiral lines. It is possible that this specimen is a juvenile of the previously discussed species, *Acteon* (*Acteon*) sp. A.

Occurrence: Byram Formation, MGS locality 106.

Subgenus **KLEINACTEON** Vokes, 1939

Kleinacteon Vokes, New York Acad. Sci., Ann., v. 38, p. 108, 1939.

Type (by original designation): *Acteon moodyi* Dickerson, 1916. Eocene, Domengine Formation, California.

Kleinacteon was proposed for *Acteon moodyi* Dickerson, 1916, on the basis of its well defined umbilicus, poorly defined columellar plait, and supposedly homeostrophic protoconch. Because of its protoconch Vokes regarded it as doubtfully referable to the Acteonidae. The Mint Spring species, described below, shows marked resemblance to *A. moodyi* and possesses all the characters described for *Kleinacteon* except the homeostrophic protoconch, its protoconch being subnaticoidal but definitely heterostrophic. Vokes may have failed to recognize the obscurely heterostrophic nature of the protoconch of *Acteon* when he proposed *Kleinacteon*.

Semiacteon Cossmann (1889, p. 308) (type by original designation, *Tornatella sphaericula* Deshayes, 1864, Eocene, Calcaire grossier, Paris Basin) resembles *Kleinacteon* and may actually be an older name for the same group. The type species of *Semiacteon*, however, is a smaller shell, has a wider and more flaring columellar lip and a more appressed and expanded callus than the type of *Kleinacteon*.

Acteon (Kleinacteon) puteatus

MacNeil n. sp.

Plate 24, figure 31

Description: Shell large, comparatively thin, inflated; spire of medium height; protoconch heterostrophic, subnaticoidal, slightly inclined, not prominent; aperture of medium width, over half the length of the shell; parietal wall with a well defined but thin callus, mostly shed on the type; columellar lip thin and nearly straight; columella bearing only a weak suggestion of a fold; umbilicus open but small; sculpture consisting of numerous, wide, incised spiral grooves with thin, raised interspaces; grooves very coarsely punctate or pitted by fine, unevenly spaced cross bars, the cross bars on the younger whorls widely spaced, making the pits square or even elongate, but more crowded on the body whorl making the pits narrow or latticed in appearance.

Discussion: This species is characterized by its strong sculpture, open umbilicus, and somewhat angulated anterior apertural extremity. The columella is slender and bears little suggestion of a fold. No analog of *A.* (*K.*) *puteatus* appears to have been described from the Tertiary of the Atlantic or Gulf coasts or the Caribbean region. The Recent species *Acteon* (*Kleinacteon*) *perforatus* Dall, 1881, from the Gulf of Mexico has a strongly perforated umbilicus but a much broader and flaring columellar lip and a deep notch in the lip just below its juncture with the broad parietal callus. Its sculpture is weaker and the shell shorter and more bulbous. *Acteon* (*Kleinacteon*) *puteatus* differs from the genotype of *Kleinacteon, A.* (*K.*) *moodyi,* in being slenderer and more elongate with wider spiral grooves. The umbilicus of *A.* (*K.*) *moodyi* may be slightly larger and more open, at least judging from the published figures.

Type: Holotype 560803 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 24, figure 31).

Occurrence: Mint Spring Formation, USGS locality 14071, MGS locality 90.

Genus **RICTAXIS** Dall, 1871

Rictaxis Dall, Amer. Jour. Conchology, v. 7, p. 136, 1871.

Type (by monotypy): *Tornatella puncto-coelata* Carpenter. Recent, Pacific Coast of America-California, Lower California, and Mexico.

This genus is distinguished from *Acteon* by the anterior truncation of the columella which forms a weak, canaliculate notch. *Rictaxis* was described as a subgenus of *Acteon* and is frequently used in that sense.

Monoptygma elegans Lea, 1833, and *Acteon pomilius* Conrad, 1833, which Palmer (1937, p. 496) regarded as synonyms, should probably be referred to *Rictaxis,* and if so are the earliest known species in the American Tertiary.

Rictaxis andersoni (Conrad)

Plate 24, figures 26-30; Plate 39, figures 9-10

1848a. *Actaeon andersoni* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 287.
1848b. *Actaeon andersoni* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 117, pl. 11, fig. 37. Plates reprinted in Dockery, 1982, Appendix I.
1887. *Tornatella volutata* Meyer, Acad. Nat. Sci. Philadelphia, Proc., p. 52, pl. 3, fig. 11.

Original Description of *Actaeon andersoni*: Conrad, 1848a.

Oblong subovate; whorls six, with regular impressed revolving lines, interstices minutely striato-punctate; spire acutely conical, whorls convex; lines on the shoulder indistinct; aperture about equal to half the length of the shell. Length 4-10.

Original Description of *Tornatella volutata*: Meyer, 1887.

Oval-elongate. The nucleus consists of one and a half smooth volutions, the first volution standing almost vertical and being partly hidden. Five adult whorls are slightly convex and covered with impressed revolving lines. These lines are slightly punctuate; number about six on each whorl, the body whorl excepted, where they are numerous and towards the base increase in distinctness and become closer. Mouth rather narrow. Outer lip sharp. Inner lip with a strong fold below the middle, and slightly covered by callus. Suture impressed.

Vicksburg, Miss. "Higher Vicksburgian."

I found only the figured specimen. The species is considerably cylindrical and approaches the subgenus *Actaeonidea* Gabb, from the Tertiary of the West Indies. It lacks, however, the anterior truncation of the columella of *Actaeonidea.*

Description: Shell elongate ovate, whorls tending to become flattened in adults; spire moderately high; protoconch heterostrophic, first whorl standing nearly perpendicular to the spire; aperture of moderate width, over half the height of the shell; outer lip crenulated within, especially along the anterior margin, nearly straight medially but curving abruptly to join the flattened periphery of the preceding whorl; lower part of the parietal wall bearing a narrow callus; columellar fold sharp and well defined within but not strong in full apertural view, merging with the columella to form a shallow arc terminated by the anterior truncation of the columella; umbilical groove narrow but well defined; sculpture consisting of moderately coarse, evenly spaced, spiral lines, made punctate by cross bars at regular intervals.

Discussion: Unlike most of Conrad's specimens, the horizon of the type of this species is not definitely determinable from its preservation and the bits of matrix adhering to it. The matrix in the aperture is a hard, dark gray limestone and could be some of the nodular concretionary limestone found occasionally in the Mint Spring Formation. More likely, however, the specimen came from the overlying limestone but whether from the part referable to the Marianna Limestone or the part referable to the Glendon Limestone is uncertain. A single specimen in the Casey collection, labelled "lower Vicksburg," also came from limestone. Three specimens in the U.S. National

Museum, stated to be duplicates from the Isaac Lea collection at the Academy of Natural Sciences, Philadelphia, are in all probability from the Mint Spring Formation. The type specimen of *Tornatella volutata* Meyer undoubtedly came from a soft bed of the Byram Formation. The only specimen of *Rictaxis* in the writer's collections was obtained from the Mint Spring Formation. It is a more inflated shell than the type.

Rictaxis andersoni is the only species of *Rictaxis* known thus far from the Oligocene of America. It differs from *R. oryza* (Gabb, 1873, p. 245) a Miocene species from the Dominican Republic, in having a shorter and wider aperture, a shorter body whorl, and a relatively higher spire. The periphery of the body whorl of the type of *R. oryza*, at least, is not flattened as in *R. andersoni*. Pilsbry's figure of *R. oryza* (Pilsbry, 1922, pl. 23, fig. 12) shows the spiral grooves to be rather coarser than those of *R. andersoni*, although on *R.* cf. *oryza* (Gabb) Mansfield (1937, p. 608) from the Choctawhatchee Formation of upper Miocene age of western Florida they are of more nearly the same texture. *Rictaxis myakkensis* Dall, 1896, from the Caloosahatchee Formation of Pliocene age of Florida is similar in shape to *R. oryza*. *Rictaxis fusulus* Dall, 1896, from the Chipola Formation of lower Miocene age of western Florida is considerably more slender. Several specimens of *R. elegans* (Lea) in the Casey collection of Claiborne fossils compare with Palmer's reproduction of Meyer's drawing of Lea's type (Palmer, 1937, pl. 90, fig. 14). The Claiborne species is even shorter and more inflated than the Vicksburg species. *Acteon pomilius* Conrad, if a *Rictaxis*, is the most inflated of all. It is certainly intermediate between the two genera and may represent the stage from which typical *Rictaxis* was derived.

Type: Holotype of *Actaeon andersoni* Conrad 13411 ANSP, Vicksburg Group - formation uncertain, Vicksburg, Mississippi (Conrad) (Plate 24, figure 26). Holotype of *Tornatella volutata* Meyer 644604 USNM from the Byram Formation judging from the matrix, Vicksburg, Mississippi.

Occurrence: Mint Spring Formation, USGS localities 2664, 14162, MGS locality 99; Glendon Limestone, USGS locality 13287; Byram Formation, Vicksburg.

Genus **CRENILABIUM** Cossmann, 1889

Crenilabium Cossmann, Catalogue illustre des coquilles fossiles de l'Eocene, de Paris, v. 4, p. 306, 1889.

Type (by original designation): *Acteon aciculatus* Cossmann. Lower Eocene, Cuisian, Paris Basin, France.

Lissacteon Monterosato, Naturalista Siciliano, v. 9, p. 188, 1890.

Crenilabium was proposed as a subgenus of *Acteon* and as originally defined is characterized by transverse crenulations on the columellar lip. Crenulations are present on both the type species and on *C. elongatus* (Sowerby, 1825) from the Bartonian, the only fossil European species seen by the writer. *Lissacteon* Monterosato is supposed to differ from *Crenilabium* by not having columellar denticles. No specimens of *Acteon exilis* Jeffreys, 1870, the type of *Lissacteon*, in the Jeffreys collection have columellar denticles. Cossmann (1895-1925, p. 53, 1895) thought he saw microscopic crenulations on the columella of *C. exilis*, however, and concluded that *Crenilabium* and *Lissacteon* are synonyms. Of the species found in the Oligocene beds, one has columellar denticulations and the other has not. Both species, as well as the type of both *Crenilabium* and *Lissacteon*, are so much alike in other characters, however, that it is doubtful if the columellar denticles have any supraspecific significance. *Acteon cossmanni* Aldrich, 1897, from the lower Eocene Wilcox Group of Alabama, the only American species previously assigned to *Crenilabium*, has an irregular microsculpture on its columella.

The protoconch of *Crenilabium* is strongly heterostrophic. On some species it appears as a single, small, nearly submerged whorl turned slightly more than 90 degrees so that its apex is hidden by the first whorl of the teleoconch. On other species it stands at about 90 degrees so that the tiny apex is partly visible above the suture of the first whorl of the teleoconch. This slight amount of tilting of the protoconch is not regarded as of any more than specific importance, and it may prove to be merely a matter of individual variation.

A species identified as *Tornatina* ? *elongata* was reported from the lower middle and upper Oligocene of Germany by Von Koenon (1867, p. 70). Another species, *Acteon basteroti* Benoist, 1889, referable to *Crenilabium* was described and recorded from several localities within the Burdigalian (lower Miocene) in the region of the Gironde and Adour rivers of southwestern France. Some other species were assigned to *Crenilabium* by Cossmann.

Crenilabium paucicrenulatus MacNeil n. sp.

Plate 24, figures 32-36

Description: Shell slender and elongate; spire high; protoconch heterostrophic, standing nearly perpendicular to the spire, apex visible above the suture; aperture narrow, slightly less than half the height of the shell; parietal wall with a thin basal callus, often broken or shed; columellar lip bearing 3 or 4 weak denticulations; columella with only a weak suggestion of a fold which may even be lacking in some specimens; umbilical groove very narrow; sculpture consisting of fine, spiral grooves on the face of the whorls but becoming considerably coarser at the base, grooves non-punctate.

Discussion: The crenulations on the columellar lip are much weaker on this species than on the European species *C. aciculatus* (Cossmann, 1889) and *C. elongatus*, some specimens showing no evidence of crenulations at all. *Acteon cossmanni* Aldrich, 1897, from the lower Eocene of Alabama is similar but somewhat slenderer. No well defined crenulations are visible on the columella of the type of *A. cossmanni.*

Type: Holotype 498126 USNM from the Mint Spring Formation, USGS locality 14071, and paratype 560808 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 24, figures 33 and 36 respectively).

Occurrence: Mint Spring Formation, USGS localities 7671, 14071.

Crenilabium altispira MacNeil n. sp.

Plate 9, figures 27-28; Plate 64, figure 6

Description: Shell slender and elongate; spire high; protoconch heterostrophic, standing nearly perpendicular to the spire; aperture moderately narrow, a little more than a third the height of the shell; a thin callus covering the basal part of the parietal wall; columellar lip smooth; columella bearing a single, weak fold; umbilical groove moderately narrow; sculpture consisting of fine, incised non-punctate spiral lines, coarser at the base and very weak or absent on the upper quarter of the whorls, some suggestion of a weak subsutural collar.

Discussion: This species differs from *C. paucicrenulatus*, the species with which it is most likely to be confused, in lacking the faint columellar crenulations. It has a higher spire, a shorter aperture and a more pronounced columellar fold. The boundary between the well incised sculpture at the base and the weakly sculptured central part of the whorl is less gradual in *C. altispira.*

Crenilabium altispira is somewhat more slender than the Recent *C. exilis*, has a shorter aperture, a considerably higher spire, and a stronger columellar fold.

Type: Holotype 140749 USNM from the Red Bluff Formation, USGS locality 2633 (Plate 9, figures 27-28).

Occurrence: Red Bluff Formation, USGS locality 2633, MGS locality 37; Forest Hill Formation, MGS locality 75a.

Genus **TORNATELLAEA** Conrad, 1860

Tornatellaea Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 4, p. 294, 1860.

Type (by monotypy): *Tornatellaea bella* Conrad. Lower Eocene, Alabama and Mississippi.

Tornatellaea has been reported at almost every stage from the Jurassic to the lower Tertiary, but some of the earliest forms may represent other genera. The genus is well represented in the Ripley Formation of Upper Cretaceous age at Coon Creek, Tennessee, however. It has also been reported from the Eocene of the Sind and Peru but figures of the latter, at least, are of a specimen too poorly preserved to be sure of generic affinities.

The sculpture of *Tornatellaea* consists of spiral grooves which are present all over the adult whorls in the eastern North American and European species, but in some Upper Cretaceous and Paleocene species from California and New Zealand (Wangaloan beds) the shoulders of the whorls are devoid of spiral lines. In form the grooves range from flat-bottomed channels crossed at regular intervals by raised axial threads to deep grooves which undermine the interspaces so as to make them T-shaped in cross section.

Tornatellaea brevispira MacNeil n. sp.

Plate 24, figures 37-38

Description: Shell heavy and much inflated; spire short, rapidly expanding; protoconch heterostrophic, subnaticoidal, about one full turn visible, slightly inclined; aperture large, between two thirds and three quarters the height of the shell; inside of outer lip bearing thickened varices at wide intervals, and numerous spiral lirations which become stronger on the varices; parietal wall bearing a moderately thick but loosely attached callus, frequently shed; columella bearing two strong folds, the upper somewhat stronger and more horizontal; umbilical groove well defined, partly obscured in apertural view by the columella; sculpture consisting of rather coarse, spiral grooves, made coarsely punctate by constrictions at regular intervals.

Discussion: The spire of *T. brevispira* is very short, compared with other known species. It is considerably shorter and more inflated than *T. bella* Conrad, 1860, from the Wilcox of Alabama and the Aquia and Nanjemoy formations of Maryland and Virginia. The Bartonian species *T. simulata* (Brander, 1766) is similar to *T. bella* but, in spite of differences between these two Eocene species and the Vicksburg form, the three appear to be more closely interrelated than to any other known forms.

The type of *Acteon latus* Conrad, 1865, (non d'Orbigny) at the Academy of Natural Sciences of Philadelphia, described from an unknown locality, is similar to *T. brevispira* and may have come from Vicksburg. Palmer (1937, p. 501) regarded *A. latus* as the *Tornatellaea bella* of the Sabine Eocene, but later Palmer and Brann (1966, p. 953-954) recognized

Tornatellaea lata as a separate species occurring in the Claiborne and Jackson groups. At any rate, the name as originally proposed is a homonym. A specimen from the Moody's Branch Formation of Jackson, Mississippi, is very close to the Vicksburg species.

In *Tornatellaea parisiensis* (Deshayes, 1860-1866, p. 604, 1864) from the Thanetian of France, the lower columellar fold is the stronger. Two species, *T. globosa* (Beyrich) (Sandberger, 1858-1863, p. 264, 1862) and *T. nystii* (Duchastel) (Sandberger, 1858-1863, p. 263, 1862) have been described from the Rupelian (Oligocene) of the Mainz Basin. Both of the German species, judging from specimens in the National Museum, have much lighter and less inflated shells with longer and fatter spires than *T. brevispira*. A species from the Stampian (=Rupelian) of Gaas, similar to *T. nystii,* was identified as *T. simulata* by Benoist (1889, p. 67). The Vicksburg species appears to be more related to the American and European Eocene species, *T. bella* and typical *T. simulata,* than to the European Oligocene species and possibly different lineages are involved.

Type: Holotype 498127 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 24, figure 38).

Occurrence: Mint Spring Formation, USGS localities 12176, 13287, 14162.

Tornatellaea sp.?

Plate 64, figures 7-12

Discussion: Minute, juvenile gastropods of an unnamed species from the Red Bluff Formation are tentatively placed in this genus for lack of better identification. Their shells consist of three or four rapidly expanding whorls, which are smooth except for growth lines and a narrow, subsutural, impressed, spiral line. This species has two columellar folds as does *Tornatellaea,* but lacks spiral sculpture and has sinuous growth lines (see Plate 64, figure 8).

Occurrence: Red Bluff Formation, MGS localities 38, 39.

Family RINGICULIDAE Philippi, 1853

Genus **RINGICULA** Deshayes, 1838

Ringicula Deshayes *in* Lamarck, Histoire naturelle des animaux sans vertèbres, 2nd ed., v. 8, p. 342, 1838.

Type (by subsequent designation, Gray, 1847): *Auricula ringens* Lamarck. Eocene, Paris Basin.

The species of *Ringicula* in the Mint Spring Formation lack the denticulate outer lip characteristic of *Ringicula* s.s. and are probably referable to the subgenus *Ringiculella* Sacco to which the majority of the species of the world belong.

Subgenus **RINGICULELLA** Sacco, 1892

Ringiculella Sacco, Molluschi dei terreni terziarii de Piemonte e della Liguria, pt. 12, p. 16, 1892.

Type (by subsequent designation, Cossmann, 1895): *Marginella auriculata* Menard. Miocene to Recent, Mediterranean Sea.

Ringicula (Ringiculella) mississippiensis Conrad

Plate 39, figures 22-24, 26-27;

Plate 65, figures 1-2

1848a. *Ringicula mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 287.

1848b. *Ringicula mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 117, pl. 11, fig. 36. Plates reprinted in Dockery, 1982, Appendix I.

Original Description: Conrad, 1848a.

Ovate acute, whorls five or six, convex, with minute revolving lines; suture profound, margin carinated by a submarginal impressed line; columella two-plaited. Length 1-10. Abundant on Dr. Smith's plantation near Vicksburg.

Description: Shell of medium size, subovate; spire of medium height; protoconch obscurely heterostrophic, subnaticoidal, slightly inclined; aperture ear-shaped, extending to about the upper third of the body whorl; outer lip with a moderately heavy callus, often flattened below, emarginate or depressed above; parietal callus moderately heavy, the thickest part adjoining the anal groove, bearing a single, median plait; columella bearing two strong horizontal folds, terminated by the lowermost; umbilical region completely obscured by callus; sculpture consisting of incised, spiral lines on the lower half or two thirds of the whorl, frequently with a subsutural line.

Discussion: The types of *R.* (*R.*) *mississippiensis,* judging from their matrix and preservation, are from the Byram Formation. The type lot consists of five specimens, the largest and best of which was selected as lectotype. Two of the types are slenderer with a higher spire and are referred to the new subspecies, *R.* (*R.*) *mississippiensis petila.* These two forms probably intergrade with each other in the Byram Formation, but thus far only the subspecies has been found in the Mint Spring Formation. A short, inflated form in the Mint Sprint Formation has a much heavier callus on the parietal wall and differently shaped folds on the columella and is obviously a different species. The division between typical *R.* (*R.*) *mississippiensis* and the subspecies *petila* is not sharp, but the name is here restricted to the much inflated individuals agreeing with the best preserved of the types, whereas the more numerous individuals of the medium inflated to elongate type are regarded as constituting the subspecies. The typical form is not common in any of the collections at hand, and, biologically, may be the end member of a varietal series of which the subspecies *petila* is close to the normal mean.

Ringicula (Ringiculella) mississippiensis is much larger than any of the American Miocene species thus far described. The columellar folds are better developed and more horizontal. It does not have the spiral lines all over the whorls nor the rectangular projection of the columellar callus of *R. (R.) claibornensis* Aldrich, 1897, from the upper Eocene of Claiborne, Alabama, nor does it have the denticulate outer lip of *R. biplicata* (Lea, 1833) also from Claiborne.

One specimen from USGS locality 7440 (Plate 39, figure 27) has about 20 very fine, neatly incised lines over the lower three quarters of the body whorl, and is an extreme in both the number and fineness of the spiral lines.

Type: Lectotype 13414 ANSP and paratype 13415 ANSP both from the Byram Formation, "Smith Plantation, about 6 miles northeast of Vicksburg" (Conrad).

Occurrence: Byram Formation, USGS localities 6454, 7376, 7440, 12175, 14031, 14683, MGS locality 106.

Ringicula (Ringiculella) mississippiensis petila MacNeil n. subsp.

Plate 9, figure 23?; Plate 25, figures 14-15; Plate 39, figure 25; Plate 64, figures 13-17; Plate 65, figures 3-4

Discussion: The subspecies *petila* differs from typical *R. (R.) mississippiensis* in being slenderer with a higher and thinner spire. The aperture of the typical form is somewhat wider and the outer lip is usually thinner, although the latter difference is not constant. The sculpture of the subspecies is rather more variable than has been observed for the typical form, and ranges from as many as fifteen lines on the lower two thirds of the body whorl, extending right down to the base, with an upper, subsutural line as well, to as few as three spiral lines centered at about the lower third with both the base and upper portion of the whorl smooth and polished. Some stratigraphic difference is noted in this character in that a much higher percentage of individuals in the Mint Spring Formation tends to have fewer lirations and an unsculptured base than in the Byram Formation.

Type: Holotype 560912 USNM from the Byram Formation, USGS locality 6978 (Plate 39, figure 25).

Occurrence: Red Bluff Formation, USGS locality 5264, MGS localities 34b, 38; Forest Hill Formation, USGS locality 14851; Mint Spring Formation, USGS localities 3727, 3728, 6452, 7268, 7671, 14071, 14849, MGS localities 89, 99; Byram Formation, USGS localities 5615, 6454, 6978, 7376, 7440, 10399, 12175, 14031, 14682, 14772, MGS locality 106.

Ringicula (Ringiculella) mississippiensis nuda MacNeil n. subsp.

Plate 39, figure 28

Discussion: This form, known only from the type specimen, occurs with both typical *R. (R.) mississippiensis* and the subspecies *petila* at Jackson Creek. It is inflated like the typical form, but differs in lacking the incised, spiral lines. The surface of the whorls is made irregular by several flattened or beveled, spiral bands. The columellar callus and outer lip are not as thick on the holotype of this subspecies as on typical *R. (R.) mississippiensis,* but the same is true of a number of species referred to the typical form from this locality. This may be due to the fact that the collection contains a high percentage of immature individuals.

Type: Holotype 560916 USNM from the Byram Formation, USGS locality 14031 (Plate 39, figure 28).

Occurrence: Byram Formation, USGS locality 14031.

Ringicula (Ringiculella) mississippiensis subsp. ?

Plate 25, figure 17

Discussion: A single, small specimen from the Mint Spring has the shape and aperture of a medium elongate specimen of *R. (R.) mississippiensis petila,* but has very fine, revolving lines all over the whorls. This may represent another subspecies of *R. (R.) mississippiensis,* but it will not be described on the basis of a single, immature specimen.

Occurrence: Mint Spring Formation, USGS locality 6647.

Ringicula (Ringiculella) crassata MacNeil n. sp.

Plate 25, figures 8-13; Plate 65, figure 5

1887. *Ringicula mississippiensis* Conrad. Meyer, Acad. Nat. Sci. Philadelphia, Proc., p. 54, pl. 3, fig. 12.

Description: Shell of medium size, subovate to elongate-ovate; spire moderately short to moderately elongate; protoconch obscurely heterostrophic, subnaticoidal, slightly inclined; aperture moderately wide, ear shaped, extending to about the upper third of the body whorl; outer lip heavily callussed, often flattened below and with a canaliculate constriction above; parietal callus heavy, extending straight across the parietal wall, and bearing a single median plait with a heavily thickened base; columella bearing two oblique folds, not well defined across the thick portion of the callus; umbilical region completely obscured by callus; sculpture consisting of incised, spiral lines on the lower two thirds of the whorl, often a subsutural line as well.

Discussion: *Ringicula (Ringiculella) crassata* differs from *R. (R.) mississippiensis* in having a much heavier callus on both the parietal wall and columella, and in having more oblique columellar folds. No intermediates have been found between the two species. Although most individuals are low spired, there is some range in the height of the spire. No individuals have been seen, however, with a spire as high as that of *R. (R.) mississippiensis petila.* This, together with the existence of specimens of *R. (R.) crassata* down to less than 2.0 millimeters in height seems to rule out the possibility that *R. (R.) crassata* is merely a mature stage of *R. (R.) mississippiensis.*

The specimen figured by Meyer is one of the higher spired individuals of *R. (R.) crassata.*

Type: Holotype 560917 USNM and paratype 560918 USNM from the Mint Spring Formation, USGS locality 7467 (Plate 25, figures 8, 13 - holotype, 9-10 - paratype).

Occurrence: Mint Spring Formation, USGS localities 2664, 3727, 6448, 6452, 7268, 7384, 7452, 7467, 13287, 14071, MGS locality 99; Glendon Limestone, USGS locality 13287.

Ringicula (Ringiculella) irrasa MacNeil n. sp.

Plate 25, figure 16

Description: Shell of medium size, subovate; spire of medium height; protoconch obscurely heterostrophic, subnaticoidal, inclined; aperture earshaped, terminating at about the upper third of the body whorl; outer lip heavily callussed with a rounded edge, depressed above to form a canaliculate notch; parietal wall with a well defined callus and bearing a single, median plait; columella moderately thick and well rounded, bearing two folds, neither of which is discernable on the outermost portion of the columella, the lower fold weak, but producing a slight bulge at the base of the columella; umbilical region completely obscured by callus; sculpture consisting of spiral grooves all over the whorls, wider towards the base.

Discussion: This species differs from the other Vicksburg species of *Ringicula (Ringiculella)* in having moderately coarse lines all over the whorls. It has a thicker and more callussed columella than *R. (R.) mississippiensis* with more oblique and weaker folds, and a much narrower and thinner callus and columella than *R. (R.) crassata. Ringicula (Ringiculella) irrasa* is closely related to *R. (R.) floridana* Dall, 1890, from the Caloosahatchee Formation (Pliocene) of Florida, and even more so to a form identified as *R. floridiana* by Dall from Natural Well (Duplin marl, upper Miocene), North Carolina. It is larger than either of these forms, however, and has relatively thinner columellar teeth. *Ringicula (Ringiculella) boyntoni* Gardner, 1937, from the Chipola Formation (lower Miocene) of Florida which is not definitely distinguishable from *R. (R.) chipolana* Dall, 1896, from the same formation, is smaller and slenderer with a somewhat higher spire than *R. (R.) irrasa.*

Type: Holotype 498140 USNM from the Mint Spring Formation, USGS locality 13287 (Plate 25, figure 16).

Occurrence: Mint Spring Formation, USGS locality 13287.

Superfamily BULLACEA Rafinesque, 1815

Family HAMINOEIDAE Pilsbry, 1895

Genus ATYS Montfort, 1810

Atys Montfort, Conchyliologie systématique, v. 2, p. 343, 1810.

Type (by monotypy): *Atys cymbulus* Montfort (= *Bulla naucum* Linné). Recent, Indo-Pacific.

Of the two species referred to this genus, one has an inflated shell with the open umbilicus and deep anal emargination of *Atys* s.s., while the other is cylindrical with the umbilicus more covered, the columella slightly truncate anteriorly and bearing a low fold, and no anal emargination, all of which characterize the subgenus *Roxaniella.* Shells of the type here referred to *Atys* s.s. have been referred to *Aliculastrum* Pilsbry (1896, p. 237) (new name for *Alicula* Ehrenberg, preoccupied), but the type of *Aliculastrum, Bulla cylindrica* (Helbling), Recent from the Indo-Pacific, has a curved and flattened columella that fits snugly against the umbilical region, completely obscuring the umbilical opening.

Subgenus ATYS Montfort, 1810

Atys (Atys) pinguis MacNeil n. sp.

Plate 25, figures 18-19

Description: Shell moderately small for the genus, inflated, thin; spire involute, apical perforation small, partially obscured by a rim of callus, enclosing shoulder rounded; aperture long, crescent shaped, extending well above the shoulder of the preceding whorl, wider below with a slight canaliculate constriction near the base of the columella; parietal callus probably absent; columella frail, tending to form a weak basal fold or truncation; umbilicus perforate but not large; sculpture consisting of incised, spiral lines on the lower quarter of the whorl and about three or four below the shoulder, central portion smooth.

Discussion: *Atys (Atys) pinguis* superficially resembles *Atys (Aliculastrum) obscuratus* Dall, 1896, from the Chipola Formation (lower Miocene) of western Florida, but is more inflated, has an open umbilical perforation, and a more truncate columella. The same characters distinguish them subgenerically. The Recent *Atys caribbea* d'Orbigny, 1841, is closely related, differing mainly in being less inflated with a constricted region below the shoulder. *Atys sandersoni* Dall, 1881, another Recent species from Florida, is very similar, but differs in having a deeper anal emargination and a relatively lower projection of the upper end of the lip above the shoulder of the preceding whorl. Both of the Recent species mentioned have been placed by some authors in *Aliculastrum,* but neither of them has the umbilical and columellar characteristics of *Aliculastrum.*

Type: Holotype 498135 USNM from the Mint Spring Formation, "Lower bed at Vicksburg," USGS locality 13287 (Plate 25, figure 18).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 13287, 14071, MGS locality 89.

Subgenus **ROXANIELLA** Monterosato, 1884

Roxaniella Monterosato, Nomenclatura generica e specifica di alcune conchiglie mediterranee, p. 145, 1884.

Type (by monotypy): *Cylichna jeffreysi* Weinkauff. Recent, Mediterranean.

Compared with specimens of *Cylichna jeffreysi* identified by Weinkauff in the Jeffreys collection, the Mint Spring species has even less of an anal emargination and a higher shoulder.

Atys (Roxaniella) caseyi MacNeil n. sp.

Plate 25, figures 20-21

1829. Lesueur,* Walnut Hills fossil shells, pl. 5, fig. 8-9 (no name). *Printed in Dockery, 1982, Appendix II.

Description: Shell moderately small for the genus, subcylindrical, moderately thin; spire involute, apical perforation large, apical rim sharply rounded; aperture long, extending well above the shoulder of the preceding whorl, somewhat dilated below with a slight canaliculate constriction near the base of the columella; parietal callus thin, easily shed; columella tending to develop a weak basal fold or truncation; umbilical chink ranging from closed and partly concealed by a columellar callosity, to moderately perforate; sculpture consisting of spiral, incised lines basally, becoming weaker and usually dying out near the periphery, upper portion usually with from one to four spiral lines below the apical rim; a narrow band just below the apical rim often dilated to form a weak collar or fasciole.

Discussion: The nearest known relative of this species in the American Tertiary is *A. (R.) gracilis* Dall, 1896, from the Chipola Formation (lower Miocene), reported by Gardner from the Oak Grove and Shoal River formations (middle Miocene) of western Florida. *Atys (Roxaniella) gracilis* differs principally in having a more curved, shorter, and more callussed columella. The canaliculate constriction is not as evident, making the anterior end of the aperture a more uniform curve. *Atys (Roxaniella) gracilis* has a less perforate umbilicus than *A. (R.) caseyi.*

Type: Holotype 498136 USNM from the Mint Spring Formation, USGS locality 14162, and paratype 560810 USNM from the Mint Spring Formation, USGS locality 3725 (Plate 25, figures 20 and 21 respectively).

Occurrence: Mint Spring Formation, USGS localities 3725, 14162, MGS locality 89.

Atys (Roxaniella) caseyi MacNeil var.

Plate 25, figures 22, 24

Discussion: A *Roxaniella* regarded as a variety of *A. (Roxaniella) caseyi,* but not definitely known to intergrade with it, is represented in the National Museum collections by two specimens from two localities around Vicksburg. This form differs from the typical form in being heavier and in having a shorter and much more truncated columella, and a more inflated basal portion.

Occurrence: Mint Spring Formation, USGS localities 3727, 3728.

Family RETUSIDAE Thiele, 1926,

Genus **VOLVULELLA** R.B. Newton, 1891

Volvulella R.B. Newton, British Oligocene and Eocene Mollusca, p. 268, London, 1891 (new name for *Volvula* A. Adams, 1850, not Gistel, 1848).

Type (for *Volvula* by subsequent designation, Bucquoy, 1886): *Volvula rostrata* A. Adams. Recent, Australia.

Volvulella subspinosa MacNeil n. sp.

Plate 25, figure 26; Plate 39, figure 8

Description: Shell thin, elongate, subcylindrical, sharp posteriorly but not produced in an elongate tip; spire involute, completely concealed; aperture long, about two to three times as wide anteriorly as posteriorly, terminating in a shallow posterior canal that lies in the same plane as the aperture; outer lip thin, slightly flared at the anal termination; parietal callus thin; columella short, without folds, but with a slightly flared columellar lip; umbilical chink open and moderately wide; sculpture consisting of fine, spiral lines at both ends of the shell, usually more numerous basally, and considerably finer and less distinct lines medially.

Discussion: This species is closely related to *V. oxytata* Bush, 1885, a species that has been identified from the Miocene to Recent of America. It differs in having its anal canal more in the plane of the aperture rather than behind the whorl and mostly obscured in full apertural view as in *V. oxytata.* The posterior end of *V. subspinosa,* although sharp, is not actually drawn into a projecting tip, but rather the outer lip flares slightly at the posterior end.

Type: Holotype 498133 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 25, figure 26).

Occurrence: Forest Hill Formation, USGS locality 14851, MGS locality 75a; Mint Spring Formation, USGS localities 7671, 14071a, MGS locality 99; Byram Formation, USGS localities, 5615, 12175, 14772.

Genus **PYRUNCULUS** Pilsbry, 1894

Pyrunculus Pilsbry, Man. Conchology, 1st ser., v. 15, p. 299, 1894.

Type (by original designation): *Sao pyriformis* A. Adams (= *Bulla* (*Atys*) *pyriformis* A. Adams). Recent, China Sea.

Sao was regarded as a subgenus of *Atys* by H. and A. Adams, but, if the group is not given generic standing, it is probably as closely related to *Coleophysis* Fischer (type, by monotypy, *Bulla truncatula* Bruguière). Pilsbry's treatment of *Pyrunculus* as a subgenus of *Retusa* Brown was based on his interpretation of *Bulla truncatula* Bruguière, a species not in the original list, as type of *Retusa.* According to several recent writers, the three species mentioned by Brown, *R. plicata* Brown, *R. discors* Brown, and *R. obtusa* Montagu, if not conspecific are at least congeneric, so that there is no question as to the type of shell to which *Retusa* refers. The shell of *Pyrunculus* is deeply umbilicate and has a deep apical perforation, whereas *Retusa* has an exposed, *Acteocina*-like spire. For this reason they are regarded as distinct generically. *Retusa* is also discussed under *Acteocina.*

Pyrunculus laevipyrum MacNeil n. sp.

Plate 39, figure 14

Description: Shell small, moderately thick, narrow above, much inflated below; spire involute, apical perforation deep with the enclosing rim rounded; aperture long, narrow above, extending well above the shoulder of the preceding whorl, dilated below with a slight canaliculate constriction near the base of the columella; parietal callus thin, easily shed; columella perforate, without folds, thickened basally; umbilicus open and deep; sculpture consisting of a few very weak, spiral lines at the base and just below the apical rim, smooth and polished medially.

Discussion: The holotype of *P. laevipyrum* is the only specimen of this genus known from the Vicksburg Group, and apparently from the American Tertiary. It is somewhat less constricted anteriorly than the genotype, *P. pyriformis* (Adams 1850, p. 589), or the related *P. pellyi* E.A. Smith, 1872, both from the Gulf of Oman. The Recent *P. ovata* (Jeffreys) (see Pilsbry, 1888-1898, p. 232, 1893) from the North Atlantic differs in having a closed umbilicus, a less constricted anterior region, and a shorter outer lip. Some specimens of an undescribed species from off Cape Hatteras in the National Museum collections compare more with the Vicksburg species in umbilical and outer lip characters, but are larger and more evenly inflated with a less pear-shaped outline.

Type: Holotype 560908 USNM from the Byram Formation, USGS locality 7376 (Plate 39, figure 14).

Occurrence: Byram Formation, USGS locality 7376.

Superfamily CYLICHNACEA A. Adams, 1850

Family CYLICHNIDAE A. Adams, 1850

Genus **CYLICHNA** Lovén, 1846

Cylichna Lovén, Index molluscorum litora Scandivaviae occidentalia habitantium, p. 10, 1846.

Type (by subsequent designation, Herrmannsen, 1852): *Bulla cylindracea* Pennant. Recent, Europe.

Cylichnina Monterosato 1884 (type, *Bulla umbilicata* Montagu non Roeding = *Cylichna strigella* Lovén) has been used for the species with apical perforations and *Cylichna* for those in which the apex is closed or callussed over. Palmer (1937, p. 479) found, however, that this distinction is not consistent among individuals of the same species.

Cylichna nida MacNeil n. sp.

Plate 25, figure 23; Plate 39, figures 17-21

1829. *Bulla oviformis elongata* Lesueur, Walnut Hills fossil shells, pl. 6, fig. 1. Printed in Dockery, 1982, Appendix II.

Description: Shell of medium size for the genus, subcylindrical, moderately thin; spire involute, apical perforation nest shaped, apical rim ranging from moderately rounded to moderately sharp; aperture long and narrow, extending well above the shoulder of the preceding whorl; outer lip thin, rounded anteriorly; anal emargination higher on individuals with rounded apical rims, lower on acutely rimmed individuals; parietal callus thin, usually shed; columella bearing only the suggestion of a fold; umbilical groove narrow but deep; sculpture consisting of fine, closely spaced incremental lines on the lower portion of the whorl, and a few stronger, weakly incised, more widely spaced lines below the shoulder.

Discussion: *Cylichna galba* (Conrad, 1833) from the Gosport Formation of middle Eocene age of Alabama is related to *C. nida*, but seems to be constricted rather than inflated centrally, and the columella is heavier and more appressed.

Cylichna nida is most closely related to *C. decapitata* (Dall, 1896) from the Chipola Formation (lower Miocene), and to *C. quercenensis* (Dall, 1896) from the Oak Grove Formation (middle Miocene) of western Florida. Of the two, *C. decapitata* most closely approximates it in shape but is a slightly heavier shell. *Cylichna quercenensis* is somewhat shorter. Neither of the Miocene species has been observed to show any suggestion of the incised lines on the upper portion of the whorls, although the fine incrementals at the base are similar.

Some range in the curvature of the apical rim is exhibited by the Miocene species, but no specimens have been observed with as acute rims as in the more extreme of the Vicksburg species. Specimens of *C. nida* from the Byram Formation are commonly sharply rimmed whereas those from the Mint Spring Formation show a greater range in variation, the sharply rimmed type being the end member of a varietal series. The holotype of *C. decapitata* compares with the more roundly rimmed specimens of *C. nida* from the Mint Spring Formation. The apical perforation of *C. nida* is deeper, and the slope from the apical rim is steeper.

This is by far the most prolific and widespread of the Vicksburg *Cylichna*.

Type: Holotype 498138 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 25, figure 23).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 3727, 3728, 6452, 7268, 7384, 7671, 13287, 14071, 14849, MGS locality 89; Byram Formation, USGS localities 3722, 3729, 5615, 6454, 6455, 6978, 7376, 14031, 14772.

Cylichna acutiscapulae MacNeil n. sp.

Plate 25, figure 25

Description: Shell of medium size for the genus, subcylindrical with the greatest diameter at the middle, moderately thin; spire involute, apical perforation large; apical rim sharply keeled along the outer edge, rim of penultimate whorl not concealed by body whorl but visible along suture within the apical depression; outer lip thin, rounded anteriorly, terminating at the carina of the apical rim posteriorly; anal emargination rounded, midway between carina and apical perforation; parietal callus very thin, usually shed; columella bearing a very weak fold; umbilical groove narrow, usually closed; sculpture consisting of fine, incised, spiral lines at base, polished above.

Discussion: No analog of this species has been reported in any other American Tertiary deposit. It is characterized by its sharply keeled apical rim, a character which in the opinion of some might warrant distinguishing it as a subgenus.

Although some specimens of *C. nida* have a somewhat acutely rounded apical rim, it is not sharply keeled as in *C. acutiscapulae*. Furthermore, the apex of the anal emargination of *C. nida* is located nearly a quarter of a turn behind the outer lip, whereas in *C. acutiscapulae* it is just a little behind the plane of the aperture. Both species occur abundantly at USGS locality 7671, but there is no suggestion of intergradation.

Type: Holotype 498139 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 25, figure 25).

Occurrence: Mint Spring Formation, USGS localities 7671, 14071, MGS locality 89.

Cylichna acutiscapulae corrugata
MacNeil n. subsp.

Plate 25, figures 30-31

Discussion: Occurring with typical *C. acutiscapulae*, and possibly intergrading with it, is a form having a sharply keeled apical rim, but having weaker spiral sculpture at the base, and a weakly corrugated surface above rather than a polished surface. It differs further in that the greatest diameter is nearer the base, at about the latitude of the base of the parietal wall, rather than at about the center of the whorl.

The subspecies is known only from the type locality.

Type: Holotype 560910 USNM from the Mint Spring Formation, USGS locality 7671 (Plate 25, figure 30).

Occurrence: Mint Spring Formation, USGS locality 7671.

Cylichna sp.

Plate 65, figures 7-9

Discussion: Three juvenile specimens from the Red Bluff Formation, which are too young for species determination, are figured to illustrate the protoconch and early development of the genus.

Occurrence: Red Bluff Formation, USGS localities 37, 38.

Genus ACTEOCINA Gray, 1847

Acteocina Gray, Proc. Zool. Soc. London, pt. 15, p. 160, 1847.

Type (by original designation): *Acteon wetherellei* Lea. Miocene, New Jersey.

This name seems to take priority over *Tornatina* A. Adams (type by subsequent designation, Pilsbry, 1893, p. 181, *Bulla voluta* Quoy and Gaimard, Recent, Guam). *Tornatina* is not a synonym of *Retusa* as supposed by Iredale (1915, p. 300-301) since the former has a columellar fold, thus agreeing with *Acteocina* and not with *Retusa* in which it is lacking. Pilsbry's figure of *Bulla voluta* does not show the fold, but specimens of this species in the U.S. National Museum from various stations in the south Pacific possess a fairly well developed fold.

Bullina leai (Aldrich, 1895, p. 7) from the Wilcox Group of Alabama appears to be a true *Acteocina* and if so is the earliest record in America. The shell figured by Gardner (1933, pl. 20, fig. 3) as *Acteocina* ? sp. from the Midway Group of Texas has certain features such as the straight columella and axial markings on the shoulders of the whorls that do not suggest *Acteocina*. From the middle Oligocene on this genus is abundant in America.

Acteocina crassiplica (Conrad)

Plate 25, figures 1-5; Plate 39, figure 13;
Plate 65, figure 6 ?

1829. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 5-6 (no name). Printed in Dockery, 1982, Appendix II.
1848a. *Bulla crassiplica* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 282.
1848b. *Bulla crassiplica* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 113, pl. 11, fig. 5. Plates reprinted in Dockery, 1982, Appendix I.
1887. *Tornatina crassiplica* (Conrad). Meyer, Acad. Nat. Sci. Philadelphia, Proc., p. 54, pl. 3, fig. 9.

Original Description: Conrad, 1848a.

Cylindrical, narrowing towards the base, smooth and entire; fold at base thick and prominent. Length 2-10.

Abundant on Dr. Smith's plantation, six miles N.E. of Vicksburg.

Description: Shell of medium size, subcylindrical, relatively heavy; spire low to slightly submerged; protoconch small, perpendicular to the spire; aperture long, ranging from slightly less to greater than the height of the shell; parietal callus emerging slightly more at the base and thickening somewhat at the anal notch where it merges with the outer lip; suture moderately wide and U-shaped, sculptured by the fasciole-like backwards swinging growth lines of the callus-outer lip juncture; columella bearing a single, heavy fold, somewhat flaring and partially obscuring the umbilical groove; sculpture consisting of fine, spiral lines, usually about 7, on the lower third or less of the whorls, upper portion smooth and polished.

Discussion: *Acteocina crassiplica* belongs to the group of *A. incisula* (Dall, 1896) and the extremely involute *A. fischeri* (Dall, 1896) from the Chipola Formation (lower Miocene) of western Florida, and *A. myrmecoon* (Dall, 1896) form the Duplin Formation (upper Miocene) of North Carolina. Probably *A. coixlacryma* (Guppy, 1867) from the Bowden beds (middle Miocene) of Jamaica belongs to the same group.

Acteocina crassiplica is a heavier and more rounded shell than *A. incisula*, and has a narrower and shallower suture and a stronger columellar fold. The shape of *A. myrmecoon* is similar to that of the Vicksburg species but it has a weaker columellar fold, a deeper suture and a larger and thinner shell. *Acteocina coixlacryma* is readily distinguished by its rapidly expanded base.

The types of *A. crassiplica* are from the Byram Formation, judging from their matrix and preservation, but the species also occurs abundantly at certain localities in the Mint Spring Formation and Glendon Limestone at Vicksburg. The subspecies *A. crassiplica altispira* occurs commonly in the Mint Spring Formation, and different collections have yielded mostly either the typical form or the subspecies. Whether this is due to gregarious habits or to geographic or minor stratigraphic zones within the Mint Spring Formation has not been satisfactorily determined. On the basis of present collections, however, typical *A. crassiplica* occurs mostly in the region north of Vicksburg, whereas the subspecies *altispira* predominates in the latitude of Vicksburg and east. Thus far typical *A. crassiplica* has not been found in the Mint Spring Formation of central and eastern Mississippi.

Type: Lectotype 13412 ANSP and paratype 13413 ANSP both from the Byram Formation, "Smith Plantation, about 6 miles northeast of Vicksburg," Warren County, Mississippi (Conrad).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 2664, 3727, 6448, 6452, 6647, 7268, 7384, 13287, MGS locality 99; Glendon Limestone, Vicksburg; Byram Formation, USGS localities 3722, 3729, 7372, 7385, 7440, 7456, 7460, 12175, 14683, 14772, MGS localities 106, 112c.

Acteocina crassiplica involuta
MacNeil n. subsp.
Plate 39, figures 11-12, 15

1829. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 7, pl. 9, fig. 13, b, c, d (no name). Printed in Dockery, 1982, Appendix II.

Discussion: Occurring with typical *A. crassiplica* in the Byram Formation is a subspecies characterized by a more rounded outline, a small, nearly concealed spire of which usually only the protoconch is visible, and a gently curved outer lip. It thus differs from the typical form in which the shell is more cylindrical, the spire wider and exposed, often slightly elevated, and the outer lip straighter with an abrupt, squared posterior end.

The subspecies *involuta* most closely approaches the Chipola species *A. fischeri* Dall, the latter differing in being smaller (about 2.7 mm. in height), relatively more inflated, and having a smaller and more uniform, flat topped spire.

This form is common locally in the Byram Formation. Collection 3727 from the Mint Spring Formation at Vicksburg contains one specimen, but it is more oxidized than other specimens in the collection and may have come from the Byram Formation.

Type: Holotype 560812 USNM from the Byram Formation, USGS locality 7440 (Plate 39, figure 11).

Occurrence: ? Red Bluff Formation, MGS locality 38; ? Mint Spring Formation, USGS locality 3727; Byram Formation, USGS localities 3722, 7376, 7385, 7440, 12175, 14772.

Acteocina crassiplica altispira
MacNeil n. subsp.
Plate 25, figures 6-7

1829. Lesueur, Walnut Hills fossil shells, pl. 5, fig. 10-11 (no name). Printed in Dockery, 1982, Appendix II.

Description: Shell moderately small, subcylindrical, moderately thin; spire very low to very high, exhibiting a complete series; protoconch small, perpendicular to the spire; aperture long to medium in length, ranging from nearly the entire height to less than three quarters the height of the shell; parietal callus moderately thin and evenly developed; suture moderately narrow and deep in unworn specimens; columella bearing a single, moderately weak fold; umbilical groove narrow but well defined; sculpture consisting of several weak, spiral lines on the lower quarter of the whorl which may be obliterated on even slightly worn specimens, upper portion polished.

Discussion: The distinguishing feature of this subspecies is its high spire. It has a smaller and thinner shell than typical *A. crassiplica*, and a weaker columellar fold. The typical form seems to be connected with the subspecies by a series of intermediate forms, but most collections contain mostly one or the other. The subspecies has not been found in the Byram Formation, whereas the typical form occurs in both the Mint Spring Formation and the Byram Formation.

Probably *A. altispira* is related most closely to *A. incisula curtoides* Gardner, 1939, from the Chipola Formation (lower Miocene) of western Florida, although no specimens of the Chipola species have been seen that compare with the higher spired individuals of the Vicksburg species.

As has been stated, *A. altispira* is rare and apparently replaced by typical *A. crassiplica* in the Mint Spring Formation north of Vicksburg, but below Vicksburg and east it predominates.

Type: Holotype 498131 USNM and paratype 498132 USNM both from the Mint Spring Formation, USGS locality 3727, (Plate 25, figures 6 and 7 respectively).

Occurrence: Mississippi: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 3727, 3728, 3729, 6447, 6448, 6452, 6647, 7268, 7384, 7452, 7671, 13287, 14071, 14162, 14852, MGS locality 99. Louisiana: Sandel Sand, USGS locality 14852.

Genus **SCAPHANDER** Montfort, 1810

Scaphander Montfort, Conchyliologie systématique, v. 2, p. 235, 1810.

Type (by monotypy): *Bulla lignaria* Linné. Recent, Europe.

Scaphander is represented in the Vicksburg group by two species, one referred to *Scaphander* s.s. and the other to *Coeloscapha*, new subgenus, described below. Typical *Scaphander* is characterized by a closed apex and a well developed callus which obscures most of the apical features, although some range is seen in the strength of the callus and in the degree of involution of the spire.

Subgenus **SCAPHANDER** Montfort, 1810

Scaphander (Scaphander) primus Aldrich
Plate 9, figures 24, 30-31

1885. *Scaphander primus* Aldrich, Cincinnati Soc. Nat. History, Jour., v. 8, No. 2, p. 148, pl. 2, fig. 7a, 7b.

1886. *Scaphander primus* Aldrich. Aldrich, Alabama Geol. Survey, Bull. 1, pt. 1, p. 35, pl. 2, fig. 7a, 7b.

Description: Shell ovate, moderately thick for the genus; spire involute, apical perforation completely concealed by anal callus, enclosing shoulder well rounded; aperture large, moderately wide, extending above the shoulder of the preceding whorl; anal emargination moderately deep, originating within the callus at about the exact center of the apical depression; parietal callus thin, usually shed, not covering the umbilical region; columella smooth, columellar lip moderately thick and wide, somewhat less appressed than is common for the genus, making a narrow umbilical chink; sculpture consisting of moderately coarse, obscurely punctate, spiral grooves all over the whorl, new grooves appearing regularly on the polished interspaces.

Discussion: *Scaphander (Scaphander) primus* from the Red Bluff is quite distinct from the form identified as *S. primus* by Aldrich (1895, p. 6, pl. 2, figs. 1, 1a = *S. jacksonensis* Palmer, 1947, p. 449-450) from the Jackson Group (upper Eocene) of Mississippi. The Eocene species *S. (S.) jacksonensis* has an open apical perforation, and expands more rapidly, making the aperture appear larger and the penultimate whorl smaller and slenderer in full apertural view. It also has considerably fewer and more widely spaced spiral grooves. Fragments of the *S. (S.) jacksonensis* in the National Museum show it to have been quite large, probably greater than 40 mm. in height. The Red Bluff species has its apical perforation completely concealed by callus, and the anal notch appears to originate at the center of the apical callus, whereas in the Jackson species, which has no callus over the apical depression, the anal notch is located beneath the shoulder, and is not visible from directly above the apex.

Type: Holotype 644611 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Aldrich) (Plate 9, figures 24, 31).

Occurrence: Red Bluff Formation, USGS localities 5264, 6456, MGS localities 37, 38.

Subgenus **COELOSCAPHA** MacNeil n. subgen.

Type: *Scaphander (Coeloscapha) hilgardi* MacNeil n. sp. Oligocene, Mint Spring Formation, Mississippi.

Shell like that of typical *Scaphander* in shape and sculpture. Spire involute. Apical perforation moderately wide and open, not callussed. Apical rim slightly undercut, suture outside and below the apical rim of the penultimate whorl rather than atop or inside as in *Scaphander* s.s. Anal notch moderately broad, one side formed by the apical rim of the penultimate whorl and the other side by the edge of a callus filling the underside of the apical rim of the body whorl, the undercut surface of the apical rim being the trace of this callus.

Coeloscapha is at once distinguished from *Scaphander* s.s. by its open and uncallussed apical perforation. Its apical rim is sharper and undercut rather than rounded and sloping towards the center as in typical *Scaphander.* The anal notch and anal fasciole are scarcely visible from full apical view, whereas in *Scaphander* s.s. the heavily callussed notch and fasciole ranges from a close spiral to a heavy central callus with the apex of the anal notch situated at about the exact center of the apical depression. The Jackson species *S. (S.) jacksonensis* Palmer, 1947, which was identified as *S. (S.) primus* by Aldrich has an open apical perforation, but the anal callus is well developed and the apical rim is well rounded as in *Scaphander* s.s.

Scaphander (Coeloscapha) hilgardi MacNeil n. sp.
Plate 25, figures 27-29

Description: Shell elongate-ovate, thin; spire involute, apical perforation wide and open, uncallussed, enclosing rim sharply rounded and slightly undercut; aperture of about medium width for the genus, extending above the rim of the preceding whorl; anal emargination deep, located on the undercut side of the apical rim, followed by a fasciole-like callus; parietal callus thin, usually shed; columella smooth, rounded, columellar lip thin, narrow, appressed; umbilicus obscured; sculpture consisting of moderately fine, neatly punctate spiral lines all over the whorl, new lines appearing as sharply incised lines between the previously appearing lines.

Discussion: In addition to its uncallussed apical perforation, this species differs from *S. (S.) primus* in being lighter, more slender and elongate, and has a much lighter and narrower columellar lip. The spiral lines of *S. (C.) hilgardi* are finer and more neatly punctate, and the apical rim is sharper and more undercut. *Scaphander langdoni* Dall from the Chipola Formation (lower Miocene) of Florida is decidedly more inflated with a wider aperture. The two species differ considerably in the characters of the apical perforation, that of *S. langdoni* being wider and shallower, with the apical rim sloping inwards rather than being slightly undercut. The Chipola species also has a moderate anal fasciolar callus, and is therefore referable to *Scaphander* s.s.

Type: Holotype 498134 USNM from the Mint Spring Formation, USGS locality 14071 (Plate 25, figures 27-29).

Occurrence: Forest Hill Formation, MGS locality 75a; Mint Spring Formation, USGS localities 7671, 14071, 14072, 14849, MGS localities 75b, 90; ? Byram Formation, MGS locality 93.

Order THECOSOMATA Blainville, 1824
Suborder EUTHECOSOMATA Meisenheimer, 1905
Family CAVOLINIIDAE H. and A. Adams, 1854

Genus **CRESEIS** Rang, 1828

Creseis Rang. Ann. Sci. Nat., n.s.,t. 13, p. 305, 1828.

Type (by subsequent designation, Pelseneer, 1888): *Creseis acicula* Rang, 1828. Recent, Atlantic and Pacific (50° N to 40° S).

Creseis hastata (Meyer)
Plate 66, figures 6-13, 15-18

1829. Lesueur, Walnut Hills fossil shells, pl. 1, fig. 11, 12, a, b, c (no name). Printed in Dockery, 1982, Appendix II.
1886. *Styliola hastata* Meyer, Geol. Survey Alabama, Bull. 1, pt. 2, p. 78, pl. 3, fig. 11.
1890. *Styliola hastata* Meyer. de Gregorio, Ann. Geol. Paleont., 7 liv., p. 15, pl. 17, fig. 56, 57.
1892. *Creseis hastata* (Meyer). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 430, 432.
1934. *Cleodora (Creseis) hastata* (Meyer). Collins, Johns Hopkins Univ. Studies Geol., No. 2, p. 204, pl. 9, fig. 1, pl. 13, fig. 1-2.
1944. *Clio (Creseis) hastata* (Meyer). Shimer and Shrock, Index Fossils North America, p. 517.
1947. *Clio (Creseis) hastata* (Meyer). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 463-464.
1965. *Clio (Creseis)* hastata (Meyer). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 357.

Original Description: Meyer, 1886.

Shell subulate, nearly straight; section circular; closed end inflated.

Localities.—Vicksburg, Miss. (Higher and Lower Vicksburgian) Red Bluff, Miss.

Seems to be of smaller size than the preceding species [*Styliola simplex*]. The type specimen is from the Lower Vicksburgian.

Discussion: *Creseis hastata* differs from *Creseis simplex* (Meyer, 1886) (see Plate 66, figure 14) from the Moodys Branch Formation in its smaller size and prominent apical swelling. It is common throughout the Vicksburg Group and was reported by Collins (1934) to occur in the Moodys Branch Formation at Jackson, Mississippi, and at Garland Creek in Clarke County, Mississippi. Lozouet and Maestrati (1982) reported *C. hastata* from the Stampian of the Aquitaine Basin in southern France. Three specimens from the Stampian at Gaas, Aquitaine Basin, France, are illustrated in Plate 66, figures 11-13.

Type: Holotype 644595 USNM from the Mint Spring Formation, "Lower Vicksburgian," Vicksburg, Mississippi (Meyer).

Occurrence: Mississippi: Moodys Branch Formation, Jackson and Garland Creek in Clarke County; Red Bluff Formation, MGS localities 37, 38; Mint Spring Formation, Vicksburg, MGS locality 89; Byram Formation, Vicksburg, MGS locality 106. France: Stampian, Gaas, Aquitaine Basin.

Creseis cf. **C. corpulenta** (Meyer)
Plate 66, figures 19-21

Discussion: *Creseis corpulenta* (Meyer, 1887) from the Moodys Branch Formation at Jackson, Mississippi, is characterized by a strongly developed bulb-like area at the tip beyond which the shell increases rapidly and evenly in size (Collins, 1934, p. 206, pl. 9, fig. 4, pl. 13, fig. 3). The three specimens figured from the Byram Formation lack the apical swelling but have a rapidly expanding shell like that of *C. corpulenta.*

Occurrence: Byram Formation, MGS locality 112c.

Genus **BOVICORNU** Meyer

Bovicornu Meyer, Geol. Survey Alabama, Bull. 1, pt. 2, p. 79, 1886.

Type (by original designation): *Bovicornu eocenense* Meyer, 1886. Oligocene, Red Bluff Formation, Mississippi.

Bovicornu of Meyer is a genus that at present is known only from two species, *B. eocenense* Meyer and *B. gracile* Meyer, from the Oligocene and Eocene of Mississippi. It has an apical swelling like that of *Creseis hastata* but differs in its spirally twisted shell - "twisted like a cow's horn" (Collins, 1934, p. 213). Collins (1934, p. 166) suggested that *Bovicornu* might prove to be a synonym of *Euchilotheca* Fischer, 1882, from the Eocene (Lutetian) of the Paris Basin. Curry (1965, p. 360) stated that *Bovicornu* resembled the early stages of *Camptoceratops* Wenz, 1923, and seemed to be closely related if not identical with that genus. Cossmann (1893, p. 51) suggested that *Bovicornu* was probably a spirally twisted specimen of *Creseis hastata,* and Collins (1934, p. 165) stated that this suggestion could not be disregarded entirely. The specimens of *Bovicornu eocenense* illustrated in Plate 66, figures 22-25, show a large variation to the degree of coiling in the shell, with figure 25 having a slight twist while figures 22 and 23 are strongly coiled. This variation in coiling gives some support to Cossmann's suggestion, though a continuous series from strongly coiled to straight shells has not been observed at present.

Bovicornu eocenense Meyer
Plate 66, figures 22-25; Plate 67, figures 1-6

1886. *Bovicornu eocenense* Meyer, Geol. Survey Alabama, Bull. 1, pt. 2, p. 79, pl. 3, fig. 12.

1892. *Meioceras eocenense* (Meyer). Dall, Wagner Free Inst. Sci., Trans., v. 3, pt. 2, p. 302 in part.
1893. *Bovicornu eocenense* Meyer. Cossmann, Annales de Geol. et de Paléont., 12 Liv., p. 51.
1934. *Bovicornu eocenense* Meyer. Collins, Johns Hopkins Univ. Studies Geol., No. 2, p. 212-213, pl. 9, fig. 3, pl. 13, fig. 5.

Original Description: Meyer, 1886.

BOVICORNU, n. gen.

Shell minute, subulate pointed, spirally contorted.

BOVICORNU EOCENENSE, n. sp. Pl. 3, fig. 2.

Smooth, somewhat inflated at the closed end; section circular.

Locality.—Red Bluff, Miss.

Discussion: *Bovicornu eocenense* has an apical swelling like that of *Creseis hastata* but differs in its coiled shell as previously mentioned under the discussion of the genus.

Type: Holotype 644596 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer).

Occurrence: Red Bluff Formation, MGS locality 38.

Family LIMACINIDAE Blainville, 1823

Genus **LIMACINA** Bosc, 1817

Type: *Limacina helicina* (Phipps, 1774). Recent, Arctic seas to the Gulf of Maine.

Limacina cf. **L. inflata** (d'Orbigny)
Plate 65, figure 13

Discussion: This small species of *Limacina* from the Red Bluff Formation is similar to the Recent species *Limacina inflata* (d'Orbigny, 1847), which has a world wide occurrence. It has a depressed spire and low angle of coiling as does *L. inflata* but differs in being more compressed in the plane of coiling.

Occurrence: Red Bluff Formation, MGS locality 38.

Limacina sp.
Plate 65, figures 10-12, 14-18; Plate 66, figures 1-5

Discussion: This species differs from the previously mentioned species *L.* cf. *L. inflata* in having an elevated spire that is visible from the apertural view, in having a higher angle of coiling, and in having more inflated whorls. The angle of coiling for this species is much lower than that of the Eocene species *L. choctavensis* (Aldrich, 1887) and *L. elongatoidea* (Aldrich, 1887) from the Bashi Formation of Alabama, but is similar to that of *L. pygmaea* (Lamarck, 1804) from the Eocene (Lutetian) of the Paris Basin (England and France).

Occurrence: Red Bluff Formation, MGS localities 38, 39.

Order NOTASPIDEA
Superfamily UMBRACULACEA Dall, 1889
Family UMBRACULIDAE Dall, 1889

Genus **UMBRACULUM** Schumacher, 1817

Umbraculum Schumacher, Essais Nouveau Syst. Hab. Vers. Test., p. 177, 1817.

Type (by monotypy): *Umbrella chinensis* Martini (= *Patella sinica* Gmelin). Recent, East Africa to Hawaii.

Umbraculum sp.
Plate 2, figures 32-33

Discussion: Two specimens of an *Umbraculum* were obtained from the Red Bluff Formation. One is nearly complete but worn. The other, here figured, is about two-thirds complete and well preserved. The protoconch is sinistral and consists of about 1 1/4 smooth whorls which expand rapidly. The axis of the top surface of the protoconch is vertical to the plane of the adult shell. The protoconch and early part of the shell stand above the later more flattened part as an asymetrical protuberance with the beak closely coiled and slightly overhanging. The adult portion is smooth but with concentric growth markings and weak radial ripples. The interior has a recessed circular attachment band between a central and a peripheral smooth area. The band has a broader area on one side towards the end opposite the apex; the other side is missing but this may be paired.

Umbraculum planulatum Conrad (see Harris and Palmer, 1947, p. 461, pl. 64, figs. 17, 18, and Dockery, 1977, pl. 18, fig. 11A, 11B) from the Moodys Branch Formation of Mississippi and Louisiana seems to have a more irregular attachment band than the present form. Furthermore the area inside the band is crudely radially plicate and the area outside the band is much broader. Another *Umbraculum, U. sylvaerupis* Harris (1899, p. 10, pl. 1, figs. 17a-b), from the Bashi Formation (early Eocene) of Alabama, appears to be much more like the present species. *Umbraculum* is so rare that the amount of variation is not known. The Red Bluff specimens could well be conspecific with the Jackson species.

Occurrence: Red Bluff Formation, USGS locality 15058.

Class SCAPHOPODA Bronn, 1862
Family DENTALIIDAE Gray, 1834

Genus **DENTALIUM** Linné, 1758

Dentalium Linné, Systema Naturae, 10th ed., p. 785, 1758.

Type (by subsequent designation, Montfort, 1810): *Dentalium elephantinum* Linné, 1758. Recent, Philippines.

Six species of *Dentalium* are reported from the Vicksburg Group, all of which show a strong stratigraphic control to their distribution. Two species are common in each of the three major fossiliferous horizons. The occurrence of these are as follows; (1) Red Bluff Formation - *D. zephyrinum* Casey, 1903, and *D. polygonuum* Casey, 1903; (2) Mint Spring Formation - *D. opaculum* Casey, 1903, and *D. varicostata* Dockery n. sp.; (3) Byram Formation - *D. mississippiense* Conrad, 1848a, and *D. strenuum* Casey, 1903. Two species also occur in sand lenses in the upper Forest Hill Formation at MGS locality 75a. One of these, *D. varicostata,* also occurs in the overlying Mint Spring Formation at that locality; the other is tentatively identified as *D. mississippiense.*

Dentalium, as are other scaphopods, is a burrowing mollusk that lives below the sediment surface with only the apex of its tusk-like shell protruding above the sediment. While this infaunal habitat protects it from many marine predators, it is particularly susceptible to attack by naticid gastropods, which crawl below the sediment surface and bore a hole through the shell of their prey. Yochelson et al. (1983) examined three hundred specimens of *D. mississippiense* in the collections of the U.S. National Museum for naticid bore holes and reported a predation rate of five to fifteen percent.

Dentalium mississippiense Conrad
Plate 68, figures 1-4, 7; Plate 69, figures 8, 10

1848a. *Dentalium Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 3, p. 282.
1848b. *Dentalium mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 112-113, pl. 11, fig. 1. Plates reprinted in Dockery, 1982, Appendix I.
1865. *Dentalium Mississippiense* Conrad. Conrad, Amer. Jour. Conchology, v. 1, pt. 1, p. 34.
1866. *Denatlium mississippiense* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28.
1903. *Dentalium mississippiense* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 266.
1937. *Dentalium mississippiense* Conrad. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 15.
1940. *Dentalium mississippiense* Conrad. Mansfield, Jour. Paleont., v. 14, No. 3, p. 202.
1945. *Dentalium mississippiense* Conrad. Gardner, Geol. Soc. America, Mem. 11, p. 142 in part (those from the "Jackson formation" are probably *D. mississippiense jacksonense* Palmer, 1947).
1947. *Dentalium (Antalis) mississippiense* Conrad. Harris and Palmer, 1947, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 212.
1983. *Dentalium (Dentalium) mississippiensis* (Conrad). Yochelson, Dockery, and Wolf, U.S. Geol. Survey, Prof. Paper 1282, p. 9.

Original Description: Conrad, 1848a.

Curved, attenuated above, longitudinally striated, the lines alternated in size. Length 2 1-10. Abundant. It differs from *D. thalloides*, nob., in having more numerous and much less prominent lines. It is very abundant.

There is another species which occurs in fragments. It is small, rare, and is smooth, polished and curved.

Discussion: This species, which is common in the Byram Formation, has also been reported by Gardner (1945, p. 142) from the Oligocene of Mexico. Casey (1903, p. 266) recognized two species of *Dentalium* in the Byram Formation at Vicksburg, one of which he named as new - *Denatlium strenuum. Dentalium mississippiense* differs from *D. strenuum* in its thinner shell (compare figure 7 with figures 8-9 of Plate 68) and in becoming smooth toward the aperture on the exterior of the shell (compare figure 1 and figure 12 of Plate 68). Fragments of these species are difficult to distinguish. Adult specimens of *D. strenuum,* though difficult to obtain unbroken, are much larger than those of *D. mississippiense.*

Harris and Palmer (1947, p. 212) recognized a form of *D. mississippiense* in the Jackson Group, which Palmer named *D. mississippiense jacksonense.* This subspecies is like *D. mississippiense* s.s. in the taper of its shell, but differs in having weaker longitudinal ribs.

Type: Holotype and paratype 30659 ANSP both probably from the Byram Formation, Vicksburg, Mississippi (Conrad).

Occurrence: Mississippi: ?Forest Hill Formation, MGS locality 75a; Byram Formation, MGS localities 94, 106, 109, 112c, 114, 115.

Dentalium strenuum Casey
Plate 68, figures 5-6, 8-14

1903. *Dentalium strenuum* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 266.

Original Description: Casey, 1903.

In the Upper Vicksburg there are two large species of *Dentalium;* one—*D. mississippinse* of Conrad—is moderately large, gradually tapering throughout its length, feebly, evenly arcuate, having about 12 well-marked raised threads which become doubled or sometimes quadrupled in number anteriorly, but generally almost effaced at the mouth. A moderately large specimen measures 47 mm. in length by 4.6 mm. in maximum diameter. The other species, which may be named *strenuum*, is much larger, nearly straight, but becoming more rapidly arcuate and also more distinctly tapering in form near the posterior end. The ribs are some ten in number at the smaller end, becoming generally quadrupled in number at the mouth, where they still remain very distinct. The substance of the shell is much thicker, being frequently 1.2 mm. through the walls near the middle. The notch at the smaller end is nearly as in *mississippiense*, but generally deeper and more acute. The largest entire specimen in my cabinet measures 67 mm. in length by 6.3 mm. in maximum diameter, but I have seen fragments measuring more than 7 mm. in diameter and which represented examples probably not much less than 90 mm. in length.

Discussion: This species is known only from the Byram Formation and is probably the largest Paleogene *Dentalium* species occurring in the northern Gulf Coastal Plain. Large specimens are nearly straight along the central and anterior portion of the shell with longitudinal ribs continuing to the aperture (see figure 10 of Plate 68).

Type: The type is not listed by Richards (1968) as being at the ANSP and could not be found at the USNM. Casey (1903, p. 266) stated that it occurred in the "Upper Vicksburg," which is equivalent to the Byram Formation.

Occurrence: Byram Formation, MGS localities 106, 109, 112c, 114, 115.

Dentalium opaculum Casey

Plate 68, figures 15-16; Plate 69, figures 1-7

1903. *Dentalium opaculum* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 266-267.

Original Description: Casey, 1903.

Occurs in the Lower Vicksburg in very great numbers. It is smaller than *mississippiense*, somewhat less arcuate, gradually tapering, notably uneven in growth and frequently more or less contorted at various points in its extent, smooth but dull in luster, devoid of any trace of elevated ribs or threads except toward the smaller end, where some 12 to 16 faintly raised subequal lines become visible. The posterior notch is very feeble and broadly angulate, much feebler than in either of the preceding species. A moderately large example measures 40 mm. in length by 4 mm. in diameter, but the latter dimension occasionally attains 4.5 mm., which would represent a rather large individual.

Discussion: This species is somewhat similar to *Dentalium strenuum* in the taper of its shell and in becoming nearly straight in the anterior half of the adult shell (see figure 15 of Plate 68). It differs in having longitudinal ribs only in the posterior region with the rest of the shell having a smooth, dull surface. A smaller variety of this species occurs in the Mint Spring Formation in eastern Mississippi at MGS locality 90 (Plate 69, figures 5-7).

It is interesting that Casey noticed and named this species from his collections at Vicksburg, Mississippi, which he stated as occurring in very great numbers, but did not find the following, strongly costate and striking species, which is also common in the Mint Spring Formation at Vicksburg.

Type: The type is not listed by Richards (1968) as being at the ANSP and could not be found at the USNM. Casey (1903, p. 266) stated that it occurred in the "Lower Vicksburg" which is equivalent to the Mint Spring Formation.

Occurrence: Mint Spring Formation, Vicksburg, MGS localities 90, 99.

Dentalium varicostata Dockery n. sp.

Plate 69, figures 9, 11-16; Plate 70, figures 1-6

1829. Lesueur, Walnut Hills fossil shells, pl. 1, fig. 13 (no name). Printed in Dockery, 1982, Appendix II.

Description: Posterior slit not observed; posterior region with ten to thirteen primary longitudinal costae and usually with secondary costae in interspaces; posterior costae double, triple, or quadruple toward aperture; costae strongly elevated and U-shaped in cross section; costae and interspaces overlain by a fine, reticulate, textile-like sculpture of fine annular lines and even finer longitudinal striae; shell rapidly expanding and moderately to weakly curved in posterior region, and nearly straight in the central and anterior region; costae on adult shell variable in size and number, with 23 (Plate 69, figure 12) to 42 (Plate 70, figure 5) costae at aperture.

Discussion: This species is common in the Mint Spring Formation across its outcrop belt in Mississippi, occurring at Vicksburg and along the Chickasawhay River in Wayne County. It closely parallels some specimens of *D. opaculum* in its rapidly expanding and moderately curved apical region and in the nearly straight central and anterior region of the shell. It stands out among the other Vicksburg *Dentalium* species in its elevated, U-shaped, longitudinal costae and especially in its fine, textile-like sculpture that overlies both the costae and interspaces. This reticulate sculpture is similar to that of the Recent species *D. laqueatum* Verrill, 1885, which lives along the east coast of North America from North Carolina to south Florida and the West Indies. The number of costae on specimens of *D. varicostata* varies within the population at each locality; however, specimens from the Mint Spring Formation in its calcareous facies in Wayne County characteristically have a large number of costae. The type has ten primary costae at the apex, which quadruple to forty costae at the aperture. The name refers to the variability of the number and size of the longitudinal costae.

Type: Holotype 376680 USNM from the Mint

Spring Formation, MGS locality 99 (Plate 70, figure 1).

Occurrence: Mint Spring Formation, MGS localities 74b, 75b, 89, 99, 100, 108.

Dentalium zephyrinum Casey

Plate 67, figures 9, 14-16

1903. *Dentalium zephyrinum* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 267.

Original Description: Casey, 1903.

The commonest species at Red Bluff, closely resembling the preceding in general size, form and slight irregularity of growth, but the longitudinal threads are distinct throughout the length and of a different form, being wider and flat, equal, about 16 in number, very strong posteriorly, becoming finer and feebler anteriorly where one or two feebler intermediate threads become visible. The posterior notch is well marked, not broadly angulate but generally rather deeper than wide. The length of the largest individual before me is 41 mm., with a maximum diameter of 4.2 mm.

Discussion: This species, along with the following one, is abundant in lenses of glauconitic sand associated with diastems in the Red Bluff Formation. Casey (1903) compared it to *D. opaculum* in its general form, but stated that it differed in its longitudinal "threads" which continue the length of the shell. *D. zephyrinum* also differs from *D. opaculum* in its smaller and narrower shell. The juvenile shell of this species is illustrated in Plate 67, figure 9. This figure shows the posteror tip to be smooth and to have a protruding rim around the anal aperture. The smooth posterior tip is followed by a slightly constricted zone with annular ribs. Faint longitudinal ribs appear past the zone of constriction as the annular ribs diminish and terminate.

Type: Holotype 481672 USNM from the Red Bluff Formation, USGS locality 13288 (Plate 67, figure 14).

Occurrence: Red Bluff Formation, USGS locality 13288, MGS localities 37, 38, 39.

Dentalium polygonuum Casey

Plate 67, figures 10-13

1903. *Dentalium polygonuum* Casey, Acad. Nat. Sci. Philadelphia, Proc., v. 55, p. 267.

Original Description: Casey, 1903.

This species also, from Red Bluff, is still more slender, and is peculiar in being a perfect heptagon in cross-section near the smaller end, the angles of the polygon being minutely elevated, forming fine but conspicuous longitudinal threads, which remain distinct to the larger end; the intervals soon acquire two to four finer threads which never become as conspicuous as the primary ribs. The notch is not present on the truncated apex of the only specimen before me. Length 33 mm., width 3.2 mm.

Discussion: *Dentalium polygonuum* has the narrowest shell of the Vicksburg *Dentalium* species. It occurs with *D. zephyrinum* in glauconitic sand lenses above diastems in the Red Bluff Formation, but is readily distinguished from that species by the seven prominent longitudinal ribs on its early shell, which diminish and terminate in the central region of the adult shell. The anterior portion of the adult shell is smooth and sometimes glossy. The juvenile shell is illustrated in Plate 67, figure 10. As in *D. zephyrinum*, the longitudinal ribs appear below a subapical zone of constriction. In both *D. polygonuum* and *D. zephyrinum*, these early longitudinal ribs remain constant in number as the shell matures and do not increase by intercalation as in *D. mississippiense*.

Type: The type is not listed by Richards (1968) as being at the ANSP and could not be found at the USNM. Casey (1903, p. 267) stated that it is from "Red Bluff, Mississippi."

Occurrence: Red Bluff Formation, MGS localities 37, 38, 39.

Genus **FUSTIARIA** Stoliczka, 1868

Fustiaria Stoliczka, Mem. Geol. Survey India, Palaeontologica Indica, v. 2, p. 439.

Type (by subsequent designation, Pilsbry and Sharp, 1897): *Dentalium circinatum* Sowerby, 1823. Eocene, Paris Basin.

Subgenus **FUSTIARIA** Stoliczka, 1868

Fustiria s.s. is characterized by its slender, slightly arched, smooth shell with a linear slit extending from the anal aperture for about one fourth the shell's length down the convex side of the shell.

Fustiaria (Fustaria) sp.

Plate 70, figures 7-11

Discussion: This species is known from fragmentary specimens that occur frequently in the Mint Spring Formation and are common at MGS localities 89 and 90. The surface of the shell is smooth and glossy and lacks the annular sculpture of the type species *F.* (*F.*) *circinatum* Sowerby, 1823, from the Eocene of the Paris Basin. Its smooth surface and posterior slit are like that of the Recent species *F.* (*F.*) *stenoschizum* (Pilsbry and Sharp, 1897) from the Florida Keys and Barbados. It is also about the same size as *F.* (*F.*) *stenoschizum* but differs in having a shell that is less strongly curved and less tapered toward the posterior.

Occurrence: Mint Spring Formation. MGS localities 89, 90, 99, 108b.

Subgenus RHABDUS Pilsbry and Sharp, 1897

Rhabdus Pilsbry and Sharp, Tryon's Manual of Conchology; Scaphopoda, 1st ser., v. 17, p. 112, 1897.

Type (by original designation): *Dentalium rectius* Carpenter, 1865. Miocene - Recent, Pacific.

Fustiaria (Rhabdus) sp.

Plate 70, figures 12-14

Discussion: This species has a straight or nearly straight, smooth, long and very narrow, very slightly tapering, needle-like shell, as is typical of the subgenus *Rhabdus*. Its shell is straighter and narrower than that of the Recent species *F.* (*R.*) *dalli* (Pilsbry and Sharp, 1897) from the eastern Pacific, Bering Sea to Peru.

Occurrence: Red Bluff Formation, MGS locality 38; Mint Spring Formation, MGS locality 99.

Subgenus EPISIPHON Pilsbry and Sharp, 1897

Episiphon Pilsbry and Sharp, Tryon's Manual of Conchology; Scaphododa, 1st ser., v. 17, p. 117, 1897.

Type (by subsequent designation, Suter, 1913): *Dentalium sowerbyi* Guilding, 1834. Recent, Southeastern United States and West Indies.

Fustiaria (Episiphon) menthifonta

Dockery n. sp.

Plate 71, figures 1-3

Description: Shell small, very slender and only slightly tapering, gently bowed, ovate in cross section with long axis in plane of curvature; sculpture smooth except for fine, slightly inclined, annular lines; anal aperture with apical plug penetrated by a short, subcentrally located pipe.

Discussion: *Fustiaria* (*Episiphon*) *menthifonta* is similar to the type species *F.* (*E.*) *sowerbyi* (Guilding, 1834) from the Recent of the Southeastern United States and West Indies in its oval cross section and annular lines. It differs from this species in having a smaller and narrower shell.

Type: Holotype 376681 USNM from the Mint Spring Formation, MGS locality 90 (Plate 71, figure 2).

Occurrence: Mint Spring Formation, MGS localities 90, 99.

Family SIPHONODENTALIIDAE Simroth, 1894

Genus CADULUS Philippi, 1844

Cadulus Philippi, Enumeratio mulluscorum Siciliae, Halle, v. 2, p. 209, 1844.

Type (by monotypy): *Dentalum ovulum* Philippi, 1844 (= *Cadulus* (*Cadulus*) *ovulum* Philippi). Recent, Mediterranean.

Subgenus POLYSCHIDES Pilsbry and Sharp, 1898

Polyschides Pilsbry and Sharp, Tryon's Manual of Conchology; Scaphopoda, 1st ser., v. 17, p. 208, 1898.

Type (by original designation): *Cadulus grandis* Verrill, 1884. Recent, western Atlantic, north of Cape Hatteras.

Cadulus (Polyschides) vicksburgensis Meyer

Plate 71, figures 4-7

1885. *Cadulus Vicksburgensis* Meyer, Amer. Jour. Sci., v. 29, p. 463.
1886. *Cadulus Vicksburgensis* Meyer. Meyer, Geol. Survey Alabama, Bull. 1, pt. 1, p. 65, pl. 3, fig. 6.
Not 1892. *Cadulus vicksburgensis* Meyer. Dall, Wagner Free Inst. Sci. Trans., v. 3, pt. 2, p. 444 [=*Cadulus* (*Polyschides*) *lobion* Gardner, 1947].
1940. *Cadulus vicksburgensis* Meyer. Mansfield, Jour. Paleont., v. 14, No. 3, p. 202.
1947. *Cadulus vicksburgensis* Meyer. Gardner, U.S. Geol. Survey, Prof. Paper 142-H, p. 628.

Original Description: Meyer, 1886.

Inflation very faint near the end, somewhat compressed; smaller aperture with four turret-like appendages, one opposite pair of which is broader than the other pair.

Locality.—Vicksburg, Red Bluff, Miss.

The type specimen is of the "Higher Vicksburgian." The species is distinctly compressed, but less than Cadulus depressus, Mr., from Claiborne.

Discussion: This species can be distinguished from other Vicksburg *Cadulus* species by its long, slender shell, which lacks a prominent zone of inflation. In this aspect it is similar to *Cadulus* (*Polyschides*) *jacksonensis* Meyer, 1885, from the Moodys Branch Formation. It differs from *C.* (*P.*) *jacksonensis* in its smaller size and in having a more compressed ovate cross section. Only juveniles of this species have been illustrated (by SEM photographs) in the plates. These illustrations (Plate 71, figures 4-7) show a fine annular sculpture of inclined growth lines.

Type: "Type" 644575 USNM from the Byram Formation, "Higher Vicksburgian," Vicksburg, Mississippi (Meyer).

Occurrence: Red Bluff Formation, MGS locality 38; Mint Spring Formation, MGS locality 99; Byram Formation, Vicksburg, MGS locality 106.

Cadulus (Polyschides) quadriturritus Meyer

Plate 71, figures 9, 11-13

1886. *Cadulus quadriturritus* Meyer, Geol. Survey

Alabama, Bull. 1, pt. 1, p. 65, pl. 3, fig. 7, 7a.
1937. *Cadulus (Polyschides) quadriturritus* Meyer. Palmer, Bull. Amer. Paleont., v. 7, No. 32, p. 23 in part.
1947. *Cadulus (Polyschides) quadriturritus* Meyer. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 2, p. 217-218.

Original Description: Meyer, 1886.

Not compressed; inflation near the end distinct but gradual; smaller aperture with four equal rounded appendages, divided by notches of the same shape.

Locality.—Red Bluff, Miss.

Discussion: This species is most common in the Mint Spring Formation, though the type is from the Red Bluff Formation. *Cadulus (Polyschides) quadriturritus* Meyer is very similar to *C. (P.) margarita* Palmer *in* Harris and Palmer, 1947, from the Moodys Branch Formation in having a localized swelling centered just below the shell's midpoint. However, this swelling is less inflated in *C. (P.) quadriturritus.*

Type: Holotype 644578 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer).

Occurrence: Red Bluff Formation, MGS locality 38; Forest Hill Formation, MGS locality 75a; Mint Spring Formation, MGS localities 89, 99, 100.

Cadulus (Polyschides) corpulentus Meyer

Plate 71, figures 8, 10

1886. *Cadulus corpulentus* Meyer, Geol. Survey Alabama, Bull. 1, pt. 1, p. 66, pl. 3, fig. 5.

Original Description: Meyer, 1886.

Small; inflation near the middle, short and stout, not compressed; smaller aperture elliptical with simple margin.

Locality.—Red Bluff, Miss.; common.

Discussion: *Cadulus (Polyschides) corpulentus* is the smallest of the Vicksburg *Cadulus* species. It is short, circular in outline, and has a centrally located area of inflation.

Type: Holotype 644579 USNM from the Red Bluff Formation, "Red Bluff, Mississippi" (Meyer).

Occurrence: Red Bluff Formation, MGS locality 38.

Class CEPHALOPODA
Subclass NAUTILOIDEA Agassiz, 1847
Order NAUTILIDA Agassiz, 1847
Superfamily NAUTILACEA de Blainville, 1825
Family ATURIIDAE Chapman, 1857

Genus **ATURIA** Bronn, 1838

Aturia Bronn, Lethaea Geognostica, v. 2, p. 1122-1123, pl. 42, fig. 17a-c, 1838.

Type (by subsequent designation, Herrmannsen, 1846): *Nautilus aturi* Basterot, 1825. Lower Miocene (Burdigalian), France.

Autria berryi Stenzel

1886. *Nautilus* - sp. ? Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, p. 257.
1940. *Aturia (Aturia) berryi* Stenzel, Univ. Texas Publ. 3945, p. 764-770, text fig. 125-8, pl. 40, fig. 1-3.

Original Description: Stenzel, 1940.

Description of monotype.—Shell involute, compressed, discoidal. Cross section of whorl high and narrow, widest near the middle of the lateral zones. Umbilical shoulder very indistinct or absent; umbilical zones merging imperceptibly into the lateral zones and occupying approximately one-fifth or one-sixth of the total height of the whorl. Umbilicus closed, forming merely a shallow dell. Lateral zones gently arched, converging at an angle of 25 degrees; venter narrow and rounded.

Septa convex apicad, broadly invaginated at the lateral lobes and the siphuncle. Septa 12 in the last preserved whorl. Sutures slightly wavy across the venter so that there is a very shallow ventral lobe in the center flanked on either side by a very shallow ventral saddle; a small and narrow, but prominent saddle at the ventral corner of the base of the lateral lobe; lateral lobes slender, tapering abruptly to a pinched-in and only very slightly recurved end; lateral saddle highly arched with the sharpest curvature at the turning point to the lateral lobe. Successive sutures touch with the point of the lateral lobe onto the preceding saddle at the base of the lateral lobe.

Dimensions.—Greatest preserved diameter 2.8 cm.; greatest thickness 1.15 cm.; larger radius 1.74 cm.; smaller radius 1.06 cm.; whorl increase ratio 2.69; ratio thickness over diameter 0.411.

Remarks.—This species is the stratigraphically youngest *Aturia* known from the Gulf and Atlantic Coastal Plain of North America. Its young stratigraphic age is shown by its "advanced" evolution. The features which indicate its "advanced" evolution are the

narrow and high cross section
shallow dell-like umbilici
fairly large siphuncular invaginations
shallow ventral lobe of the suture

The cross sections of the various species of *Aturia* show considerable differences. (Compare fig. 125.) As a rule early Eocene Aturias are broader and have deeper umbilici than late Eocene and Miocene Aturias. *Aturia berryi* is one of the more compressed forms of the genus and has very shallow umbilici; it is in these respects a very advanced form.

Another feature of the evolution of the genus *Aturia* is the progressive increase in size of the siphuncular invaginations. Eocene species, that is, those belonging to the subgenus *Brazaturia,* have only moderately large siphuncular invaginations. Among the Miocene species, that is, those belonging to *Aturia,* s.s., large invaginations of the septa around the siphuncle are the rule. *Aturia berryi* is in that respect advanced but has not reached the extreme stage of Miocene species.

The suture of this species has a very shallow yet distinct lobe at the venter. This lobe occupies the same position as the ventral lobe of *Aturia narica* Cox non Vredenburg. However, in the latter species the ventral lobe is quite large and conspicuous. This type of suture is very unusual for Aturias. It has so far been described only in *Aturia narica* Cox non Vredenburg and *Aturia berryi* Stenzel, n. sp. This difference is in the writer's opinion important enough to segregate *Aturia narica* Cox non Vredenburg from the other Aturias as a separate subgenus. However, pending a direct study of the type material the writer refrains from proposing a formal name for this subgenus.

A further characteristic of *Aturia berryi* is the position of the thickest place in the shell. Aturias are usually thickest at or near the umbilical shoulder. However, *Aturia berryi* has its greatest thickness about halfway between venter and umbilicus.

Discussion: This species is distinguished from *Aturia alabamensis* (Morton) of the Jackson Group by its narrower cross section, shallower and broader umbilicus, larger siphuncular invaginations, and shallower ventral lobe of the suture. It is known only from the holotype.

Type: The holotype could not be located at the USNM. Stenzel (1940, p. 769) stated that it was collected by Aldrich from the Vicksburg Group at Vicksburg, Mississippi. Judging from its preservation as indicated by Stenzel's illustration (1940, pl. 40, fig. 1) and statement that the shell was entirely replaced by calcite, the type probably came from the Glendon Limestone.

Aturia cf. A. alabamensis (Morton)

Plate 71, figures 14-15

1980. *Aturia* cf. *A. alabamensis* (Morton). Dockery, Mississippi Bureau Geol., Bull. 122, p. 143-144, pl. 77, fig. 7A, 7B.

Discussion: One small specimen of this *Aturia* was found in the Red Bluff Formation at MGS locality 38. It is too young for a more positive identification, but it compares well with the young of *Aturia alabamensis* (Morton, 1834) from the Moodys Branch Formation. A slightly crushed, juvenile specimen of *A. alabamensis* is illustrated in Plate 71, figures 16-17 for comparison.

Occurrence: Red Bluff Formation, MGS locality 38.

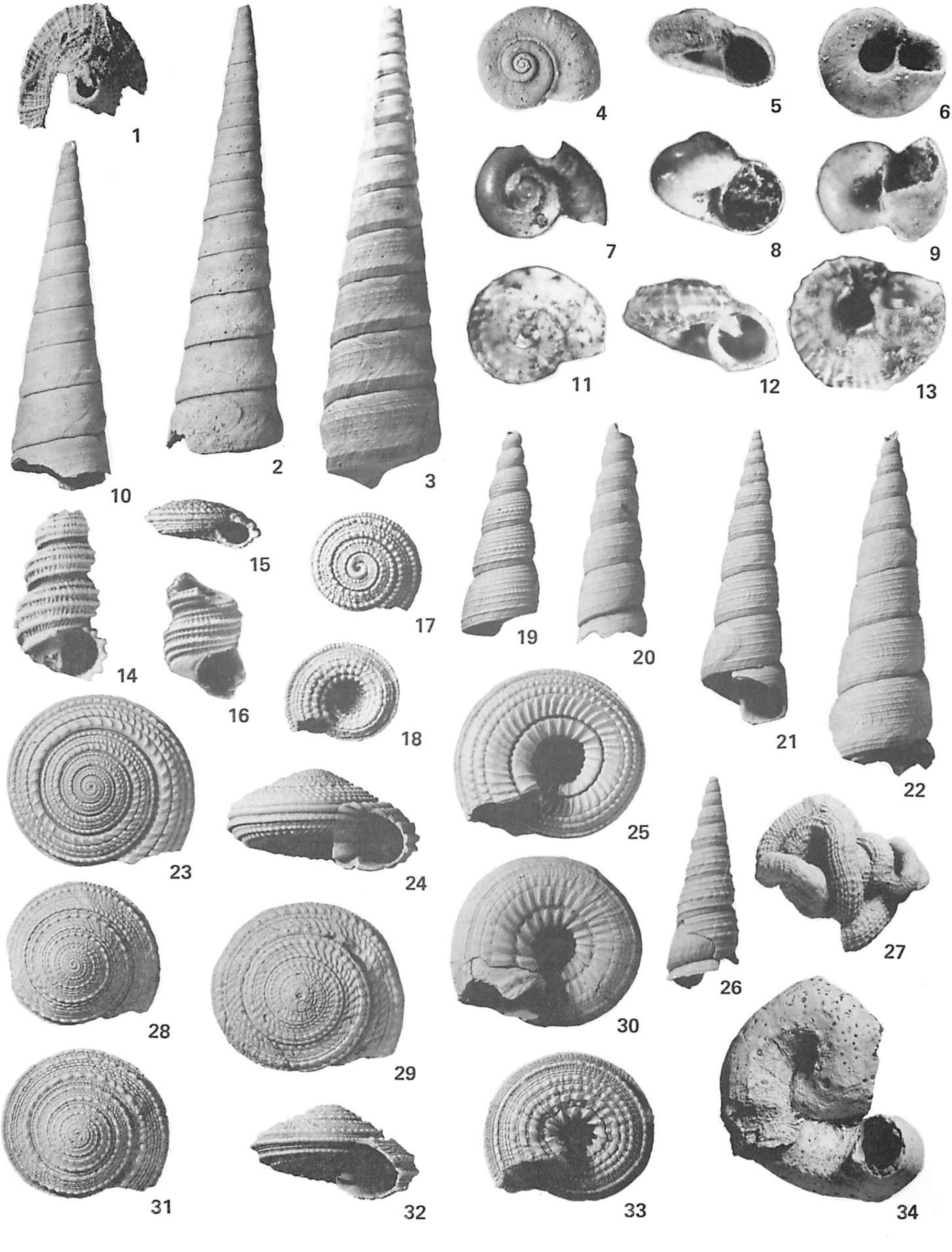
PLATE EXPLANATIONS

EXPLANATION PLATE 1

Red Bluff Formation

Figure		Page
1	**Diodora mississippiensis** (Conrad, 1848) Figured specimen 481035 USNM (x3). USGS locality 5264.	32
2-3, 10	**Turritella rubricollis** MacNeil n. sp. 2. Figured specimen 498099 USNM (x2). USGS locality 15058. 3. Holotype 648840 USNM (x2). Height 45.5 mm, width 12.0 mm; USGS locality 15058. 10. Figured specimen 498100 USNM (x2). USGS locality 15058.	52
4-6	**Vitrinella (Vitrinella) laevis** (Meyer, 1886) Holotoype 644580 USNM (x12). Diameter 1.9 mm; "Red Bluff," Mississippi (Meyer).	37
7-9	**Vitrinella (Vitrinellops)** sp. Figured specimen 480062 USNM (x34). Diameter 0.7 mm; USGS locality 13288.	38
11-13	"**Cyclostremiscus**" sp. Figured specimen 480061 USNM (x35). Diameter 0.8 mm; USGS locality 13288.	39
14	**Mathilda regularis** (Meyer, 1886) Holotype 644583 USNM (x12). Height 2.8 mm, width 1.5 mm; "Red Bluff," Mississippi (Meyer).	55-56
15, 17-18	**Architectonica (Granosolarium) hargeri** (Meyer, 1886) Holotype 644582 USNM (x6). Height 1.4 mm, width 3.6 mm; "Red Bluff," Mississippi (Meyer).	47
16	**Mathilda inaequistriata** (Meyer, 1886) Holotype 644584 USNM (x10). Width 1.5 mm; "Red Bluff," Mississippi (Meyer).	56
19-22	**Turritella aff. T. premimetes** MacNeil n. sp. 19. Figured specimen 498104 USNM (x3). USGS locality 2633. 20. Figured specimen 498102 USNM (x3). USGS locality 315. 21. Figured specimen 648841 USNM (x3). USG locality 2633. 22. Figured specimen 498103 USNM (x3). Height 21.0 mm, width 7.1 mm; USGS locality 315.	54
23-25	**Architectonica (Architectonica) fuscicava** MacNeil var.? Figured specimen 481022 USNM (x3). Height 8.5 mm, width 15.3 mm; USGS locality 5263.	45
26	**Turritella caseyi** MacNeil n. sp. Figured specimen 648842 USNM (x5). USGS locality 2633.	54-55
27, 34	**Serpulorbis** sp. 27. Figured specimen 136604 USNM (x2). USGS locality 320. 34. Figured specimen 136603 USNM (x1.5). USGS locality 319.	56
28, 31-33	**Architectonica (Architectonica) textilina caseyi** MacNeil n. subsp. 28. Figured specimen 498105 USNM (x3). USGS locality 2633. 31-33. Holotype 498106 USNM (x3). Height 7.7 mm, width 13.7 mm; USGS locality 2633.	45-46
29-30	**Architectonica (Architectonica)** sp. Figured specimen 498107 USNM (x3). Height 7.4 mm, width 12.7 mm; USGS locality 5263.	45

Red Bluff Formation **Plate 1**



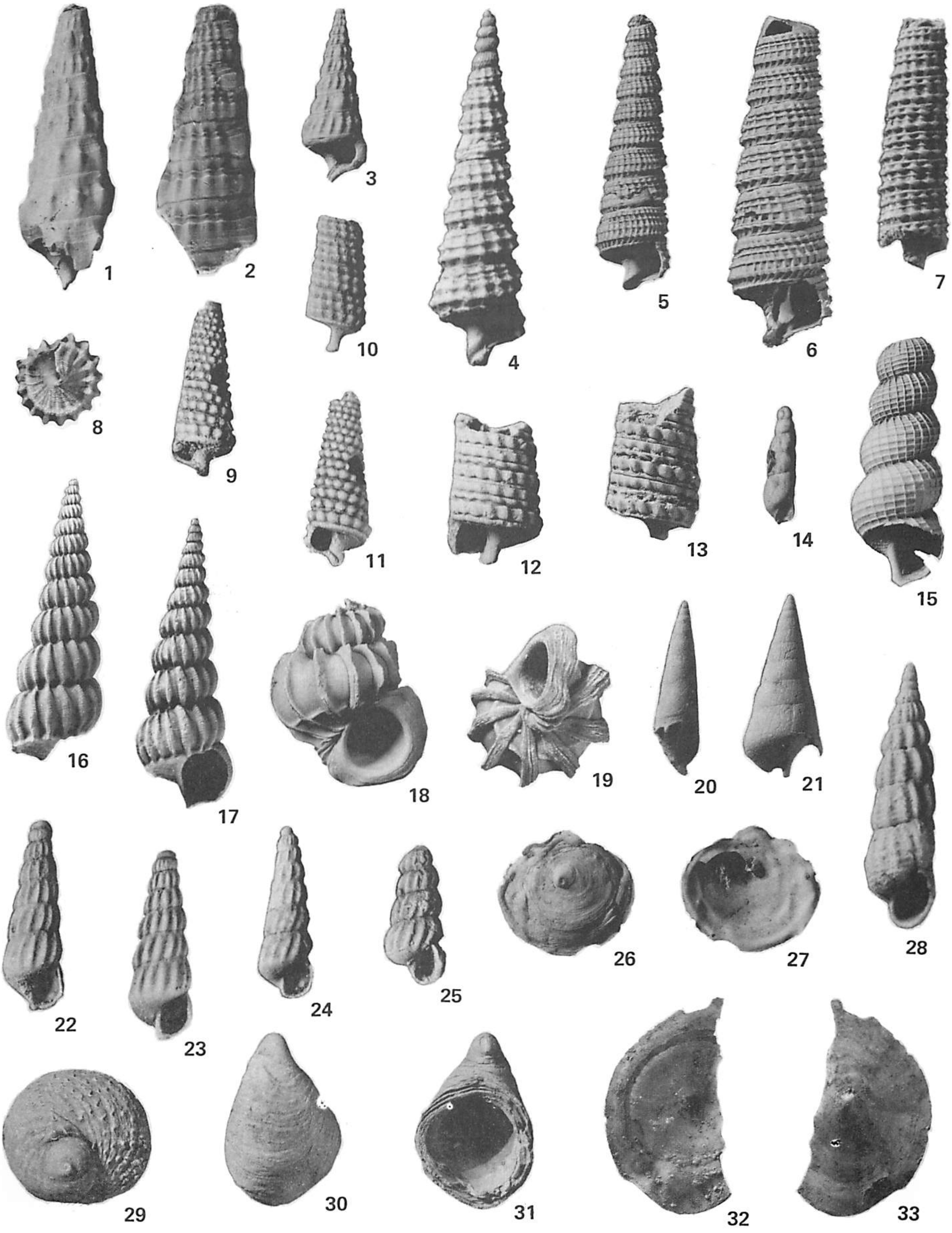
EXPLANATION PLATE 2

Red Bluff Formation

Figure		Page
1-3	**Melanatria serratoides** (Aldrich, 1894) 1. Holotype 135156 USNM (x1.5). Height 36.0 mm; USGS locality 309. 2. "Cotype" 644624 USNM (x2). USGS locality 309. 3. Figured specimen 140518 USNM (x2.5). USGS locality 309.	68
4-6	**Cerithiella langdoni** (Aldrich, 1885) 4. Holotype of *C. aldrichi* 644589 USNM (x10). Five protoconch whorls and eight juvenile whorls; height 6.7 mm, width 1.8 mm; USGS locality 320. 5. Figured specimen 498098 USNM (x2.5). USGS locality 320. 6. Holotype of *C. langdoni* 644615 USNM (x3). Six adult whorls; height 21.0 mm, width 6.0 mm; USGS locality 320.	60-61
7	**Eumetula vicksburgella** MacNeil n. sp. Holotype 481015 USNM (x8). Height (incomplete) 6.0 mm, width 1.8 mm; USGS locality 5364.	59
8, 16-17	**Confusiscala (Funiscala) durhami** MacNeil n. sp. Holotype 648844 USNM (x2.5). Height 21.2 mm, width 7.0 mm; USGS locality 15058.	76-77
9-11	**Triphora (Triphora) bilineata** (Meyer, 1886) 9, 11. Holotype 644591 USNM (x12). Height 2.7 mm, width 1.0 mm; USGS locality 2632. 10. Figured specimen 140665 USNM (x10). USGS locality 2632.	64-65
12-13	**Triphora (Triphora) meridionalis** (Meyer, 1886) Holotype 644590 USNM (x8). Width 2.3 mm; "Red Bluff," Mississippi (Meyer).	65-66
14	**Eulimella** sp. Figured specimen 480059 USNM (x12). Width 0.5 mm; USGS locality 13288.	226
15	**Scalina rubricollis** MacNeil n. sp. Holotype 136554 USNM (x3). Height 16.0 mm, width 6.0 mm; USGS locality 309.	75-76
18-19	**Epitonium (Sthenorytis) whitfieldi** (Aldrich, 1885) Holotype 644616 USNM (x1.5). Height (incomplete) 14.6 mm. width 11.4 mm; "Red Bluff," Mississippi (Aldrich).	71-72
20	**Strombiformis caseyi** MacNeil n. sp.? Figured specimen 481002 USNM (x8). USGS locality 5264.	81
21	**Niso fuscicava** MacNeil n. sp.? Figured specimen 140751 USNM (x8). USGS locality 2633.	81-82
22-25	**Turbonilla mississippiensis** Meyer, 1886 22. Specimen missing ? 23. Holotype 644586 USNM (x12). Height 3.0 mm, width 0.9 mm; USGS locality 2632. 24. Figured specimen 140610 USNM (x10). USGS locality 2632. 25. Figured specimen 648845 USNM. USGS locality 2632.	226-227
26-27	**Calyptraea (Trochita)** sp. Figured specimen 481025 USNM (x3). Height 1.8 mm, width 8.7 mm; USGS locality 5264.	85
28	**"Bittium" acuta** (Meyer, 1886) Holotype 644587 USNM (x12). Height 4.0 mm, width 1.1 mm; "Red Bluff," Mississippi (Meyer).	57-58
29	**Calyptraea (Trochita) cf. C. (T.) aperta** (Solander, 1766) Figured specimen 140625 USNM (x2.5). USGS locality 2632.	84-85
30-31	**Capulus (Capulus) americanus** Conrad, 1854 Figured specimen 136590 USNM (x1.5). Height 22.4 mm, width 15.4 mm, elevation 10.8 mm; USGS locality 320.	86-87
32-33	**Umbraculum** sp. Figured specimen 648846 USNM (x2). USGS locality 15058.	244

Red Bluff Formation

Plate 2



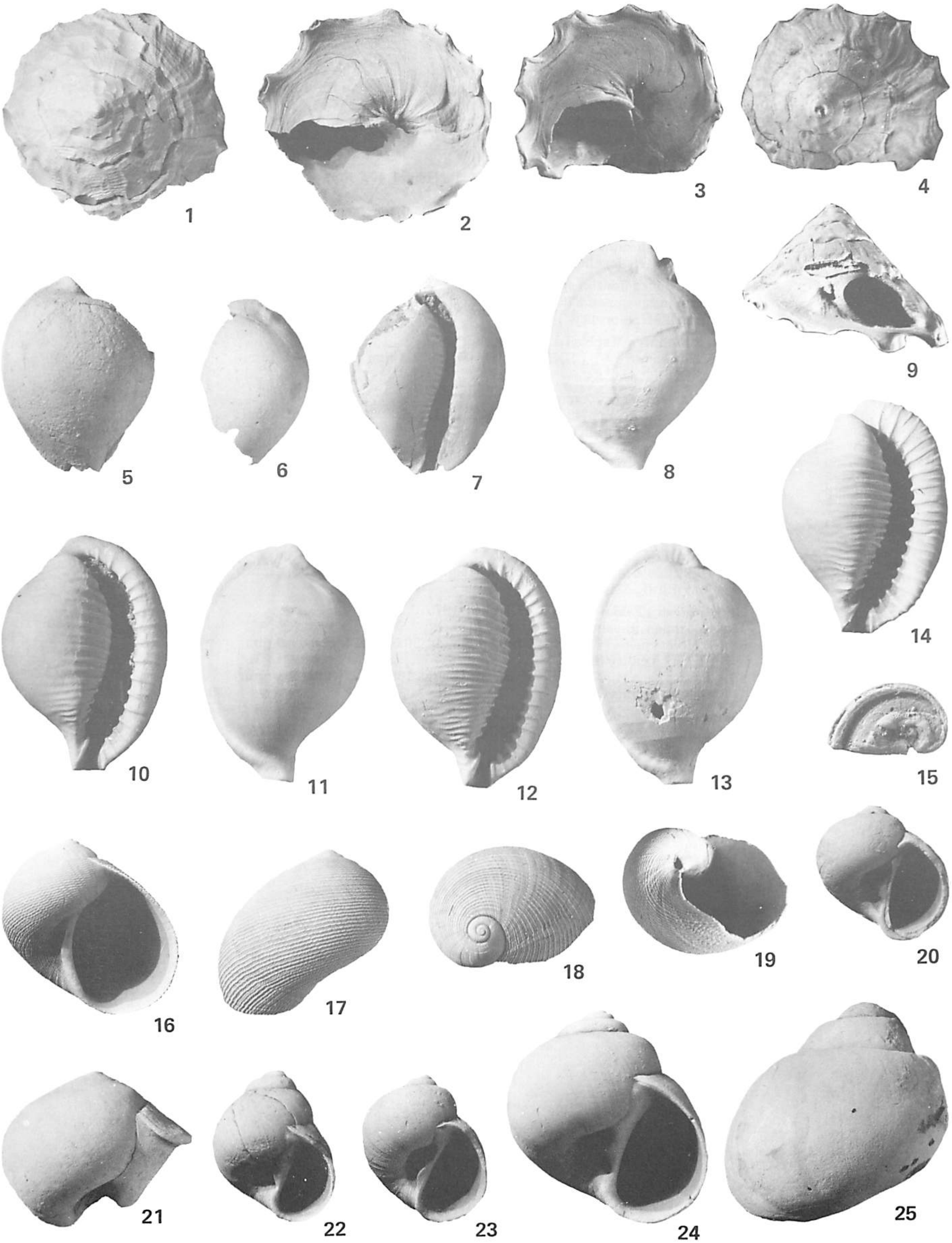
EXPLANATION PLATE 3

Red Bluff Formation

Figure		Page
1-4, 9	**Xenophora (Stellaria) conica Dall, 1892** 1-2. Holotype 481074 USNM (x2). Height 22.6 mm, diameter 16.8 mm; USGS locality 2633. 3-4, 9. Paratype 498108 USNM (x2). USGS locality 2633.	89-90
5, 7	**Cypraeorbis sp. ?** Holotype 140713 USNM (x2.5). Height 15.1 mm, width 11.5 mm, elevation 9.3 mm; USGS locality 2633.	99
6	**Cypraeorbis aff. C. ventripotens (Cossmann, 1903)** Figured specimen 136572 USNM (x1.5). USGS locality 315.	98-100
8, 10-14	**Sulcocypraea healeyi (Aldrich, 1923)** 8, 14. Holotype 135157 USNM (x2.5). Height 19.0 mm, width 12.0 mm; USGS locality 319. 10-11. Figured specimen 481069 USNM (x2.5). USGS loclity 6456. 12-13. Figured specimen 480058 USNM (x2.5). USGS locality 13288.	101
15, 20	**Natica (Naticarius) acuticallosa MacNeil n. sp.?** 15. Operculum, figured specimen 498115 USNM (x4). USGS locality 2632. 20. Figured specimen 140664 USNM (x6). USGS locality 2633.	91-92
16-17	**Sinum (Sigaretotrema) cf. S. (S.) danvillense Harris and Palmer, 1947** Figured specimen 498110 USNM (x4). Height 8.4 mm, width 8.3 mm; USGS locality 5264.	96
18-19	**Sinum (Sinum) aff. S. (S.) beatricae Palmer, 1937** Figured specimen 498109 USNM (x4). USGS locality 5264.	95
21	**Euspira sp. ?** Figured specimen 498111 USNM (x2). Width (incomplete) 18.7 mm; USGS locality 2633.	94
22	**Euspira vicksburgensis (Conrad, 1848)** Figured specimen 498113 USNM (x4). USGS locality 5264.	93
23	**Natica (Naticarius) aff. N. (N.) alazana Cooke, 1928** Figured specimen 498114 USNM (x4). USGS locality 5264.	92
24	**Natica (Natica) caseyi MacNeil n. sp.** Figured specimen 498112 USNM (x4). USGS locality 2632.	90-91
25	**Ampullinopsis mississippiensis (Conrad, 1848)** Figured specimen 140621 USNM (x1). Height 45.5 mm, width 41.6 mm; USGS locality 2632.	97

Red Bluff Formation

Plate 3



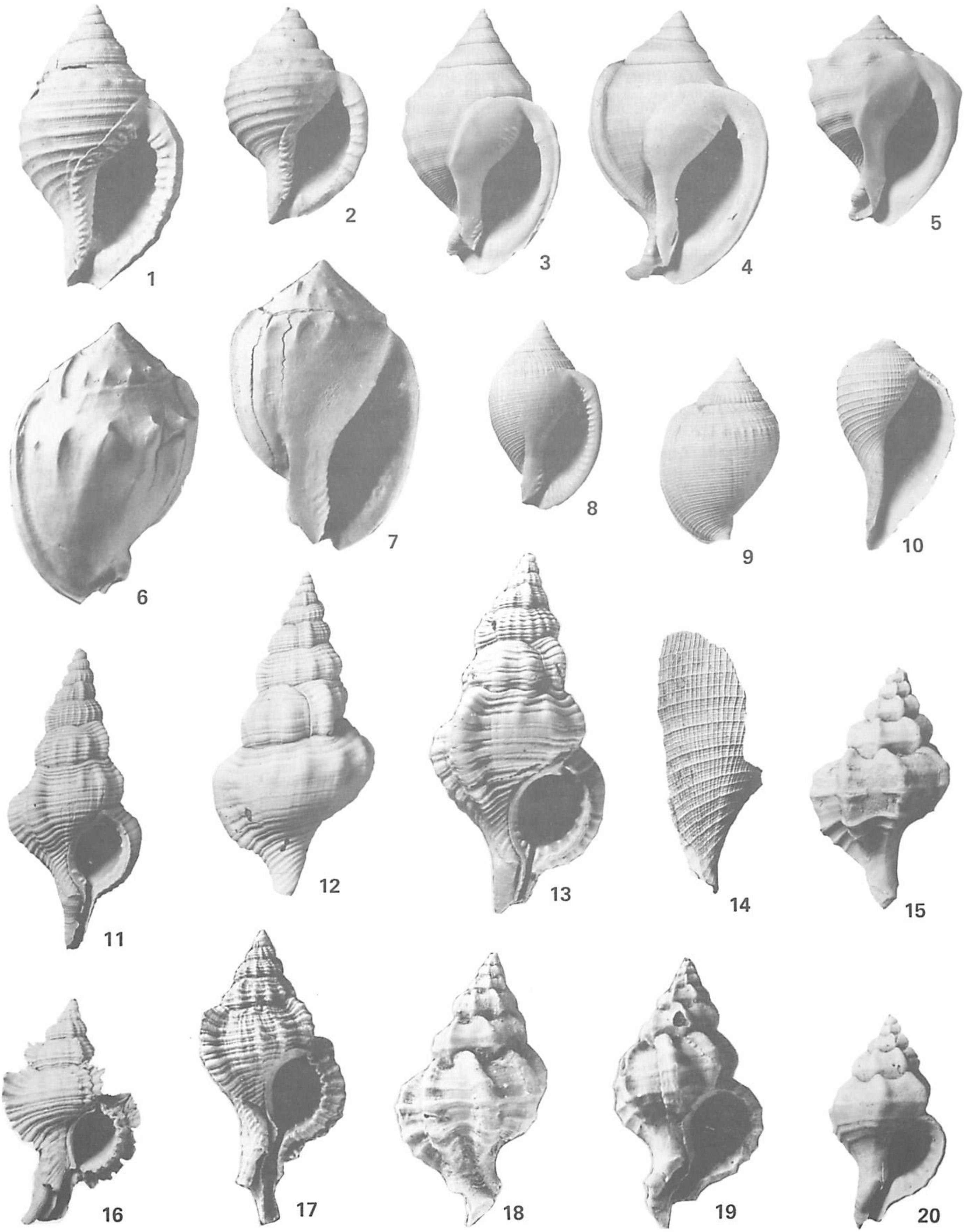
EXPLANATION PLATE 4

Red Bluff Formation

Figure		Page
1-2	**Galeodaria shubutensis** (Aldrich, 1885)	107-108
	1. Holotype 644610 USNM (x2.5). Height 21.6 mm, width 12.8 mm; "Red Bluff," Mississippi (Aldrich).	
	2. Figured speicmen 480057 USNM (x2). Height 20.6 mm, width 18.7 mm; USGS locality 13288.	
3-5	**Mambrinia brevidentata** (Aldrich, 1885)	105-106
	3. Figured specimen 136562 USNM (x1). Height 49.7 mm, width 31.4 mm; USGS locality 309.	
	4. Holoype 644617 USNM (x1.5). Height 35.0 mm, width 23.5 mm; "Red Bluff," Mississippi (Aldrich).	
	5. Figured specimen 136560 USNM (x1). Height 39.6 mm, width 29.4 mm; USGS locality 309.	
6-7	**Phalium (Menthafontia)** sp.	112
	Figured specimen 376454 USNM (x1). Height 55.3 mm, width 35.5 mm, USGS locality 14720.	
8-9	**Sconsia prelintea** MacNeil n. sp.	110
	Holotype 481067 USNM (x1.5). Height 24.3 mm, width 14.8 mm; USGS locality 6456.	
10, 14	**Ficus mississippiensis** Conrad, 1848	114-115
	10. Figured specimen 498096 USNM (x2). Height 20.2 mm, width 11.7 mm; USGS locality 5264.	
	14. Figured specimen 498097 USNM (x1.5). Height (fragment) 33.0 mm; USGS locality 309.	
11-13	**Sassia (Sassia) conradiana** (Aldrich, 1885)	117
	11. Figured specimen 481006 USNM (x1.5). Height 38.5 mm, width 17.3 mm; USGS locality 5264.	
	12. Figured specimen 136535 USNM (x1.5). Height 41.4 mm, width 20.3 mm; USGS locality 309.	
	13. Holotype 644612 USNM (x1.5). Height 47.0 mm, width 22.0 mm; Red Bluff, Mississippi.	
15, 18-20	**Dermomurex (Takia) cookei** E. H. Vokes, 1975	127
	15. Specimen missing ?	
	18-19. Holotype 647449 USNM (x2.5). Height 20.5 mm, width 11.0 mm; USGS locality 15058.	
	20. Paratype A 498087 USNM (x2.8). Height 13.7 mm, width 7.8 mm; USGS locality 5263.	
16-17	**Chicoreus (Phyllonotus) stetopus** (de Gregorio, 1890)	123
	16. Figured specimen 498090 USNM (x2). Height 22.1 mm, width 13.6 mm; USGS locality 13288.	
	17. Figured specimen 498091 USNM (x2). Height 21.9 mm, width 10.8 mm; USGS locality 5264.	

Red Bluff Formation

Plate 4



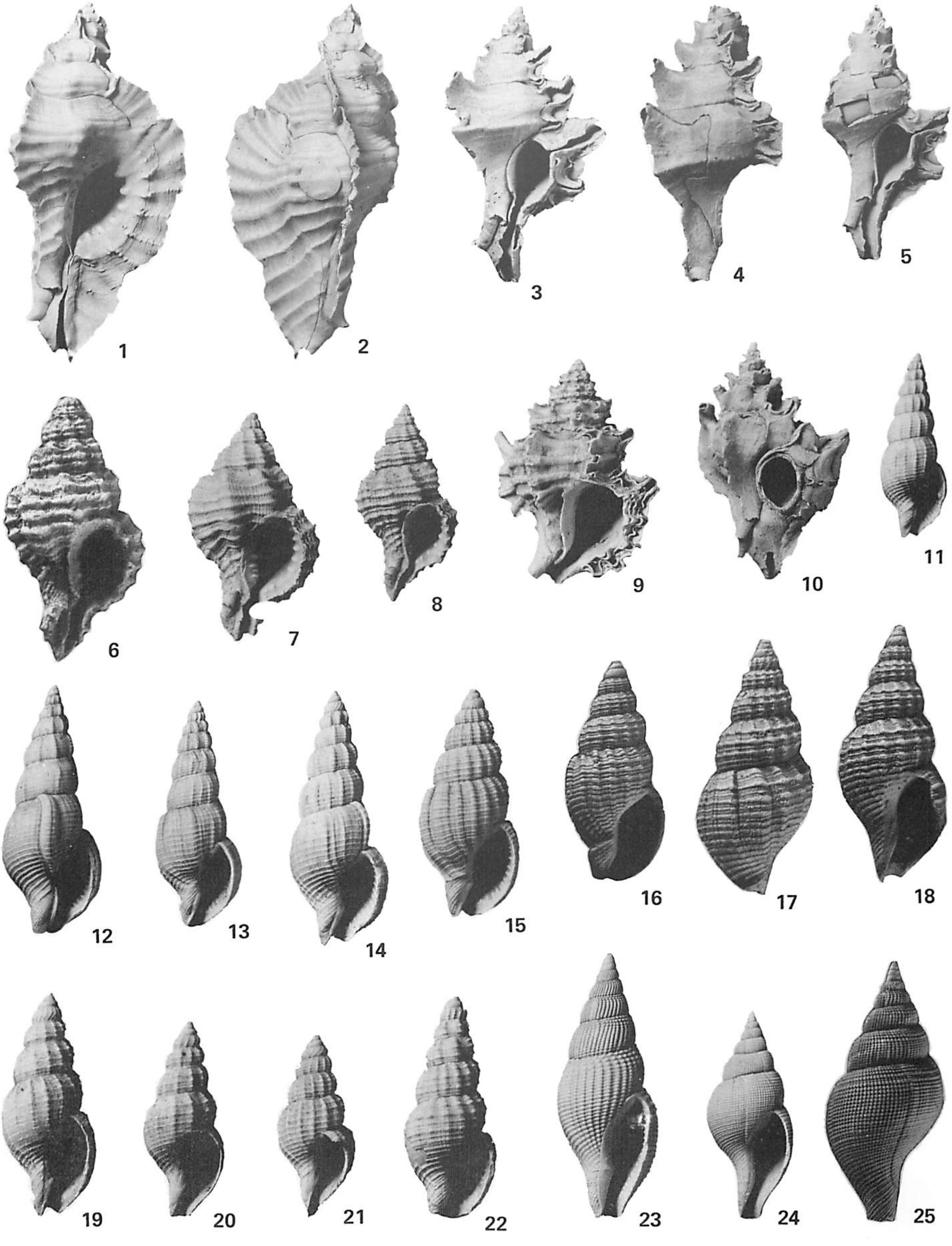
EXPLANATION PLATE 5

Red Bluff Formation

Figure		Page
1-2	**Pterynotus (Pterynotus) burnsii** (Aldrich, 1894) Holotype 135155 USNM (x1). Height 67.5 mm, width 33.0 mm; Carson's Creek, 1-1/2 to 2 miles west of Red Bluff, Wayne County, Mississippi.	124-125
3-5	**Pterynotus (Pterochelus) angelus** (Aldrich, 1886) 3. Holotype 644608 USNM (x2). Height 26.0 mm, width 14.0 mm; "Red Bluff," Mississippi (Aldrich). 4. Figured specimen 140738 USNM (x2). Height 26.7 mm, width (incomplete) 13.4 mm; USGS locality 2633. 5. Figured specimen 136552 USNM (x2). Height 24.2 mm, width 11.9 mm; USGS locality 309.	125-126
6-8	**Urosalpinx ? aspinosus** (Meyer, 1886) 6. Holotype 644592 USNM (x4). Height 12.5 mm, width 6.5 mm; "Red Bluff," Mississippi (Meyer). 7. Figured specimen 498093 USNM (x3). Height 14.6 mm, width 8.8 mm; USGS locality 2633. 8. Figured specimen 498092 USNM (x3). Height 12.5 mm, width 6.4 mm; USGS locality 5263.	127
9	**Murexiella (Murexiella) vaughani** MacNeil n. sp. Holotype 498089 USNM (x4). Height 10.8 mm, width 8.2 mm; USGS locality 5263.	124
10	**Typhis (Typhina) mississippiensis** Gertman, 1969 Figured specimen 498095 USNM (x3). Height 15.1 mm, width 9.4 mm; USGS locality 6456.	128
11, 17-21	**Tritiaria macilenta** (Casey, 1903) 11. "Syntype" 481660 USNM (x2.5). Height 14.0 mm, width 5.0 mm; USGS locality 13288. 17-18. Holotype 481632 USNM (x4). Height 12.2 mm, width 5.1 mm; USGS locality 13288. 19. Figured specimen 498079 USNM (x4). Height 10.6 mm, width 4.5 mm; USGS locality 2633. 20. Figured specimen 498078 USNM (x4). Height 9.2 mm, width 3.7 mm; USGS locality 5264. 21. Figured specimen 498080 USNM (x4). Height 8.2 mm, width 3.4 mm; USGS locality 5264.	135
12-14	**Tritiaria falsus** (Casey, 1903) 12. Holotype 481659 USNM (x2.5). Height 19.1 mm, width 7.5 mm; "Red Bluff," Mississippi (Casey). 13. Figured specimen 498076 USNM (x2.5). Height 17.0 mm, width 6.3 mm; USGS locality 5264. 14. Figured specimen 498077 USNM (x3). Hieght 16.0 mm, width 6.1 mm; USGS locality 5264.	133
15-16	**Tritiaria scapulistriata** MacNeil n. sp. 15. Holotype 498081 USNM (x4). Height 10.8 mm, width 4.9 mm; USGS locality 5263. 16. Figured specimen 140748 USNM. Missing?	137
22	**Tritiaria meyeri** MacNeil n. subsp. ? Figured specimen 140509 USNM (x4). Height 10.6 mm, width 4.3 mm; USGS locality 2860.	138
23	**Metula (Metula) fastidiosa** Casey, 1903 Figured specimen 498084 USNM (x3). Height 16.9 mm, width 6.3 mm; USGS locality 5264.	130-131
24-25	**Metula (Caseyella) neptuneiformis** MacNeil n. sp. 24. Holotype 498085 USNM (x1.5). Height 26.9 mm, width 11.2 mm; USGS locality 5264. 25. Figured specimen 481060 USNM (x2.5). Height 19.9 mm, width 8.7 mm; USGS locality 6456.	132

Red Bluff Formation

Plate 5

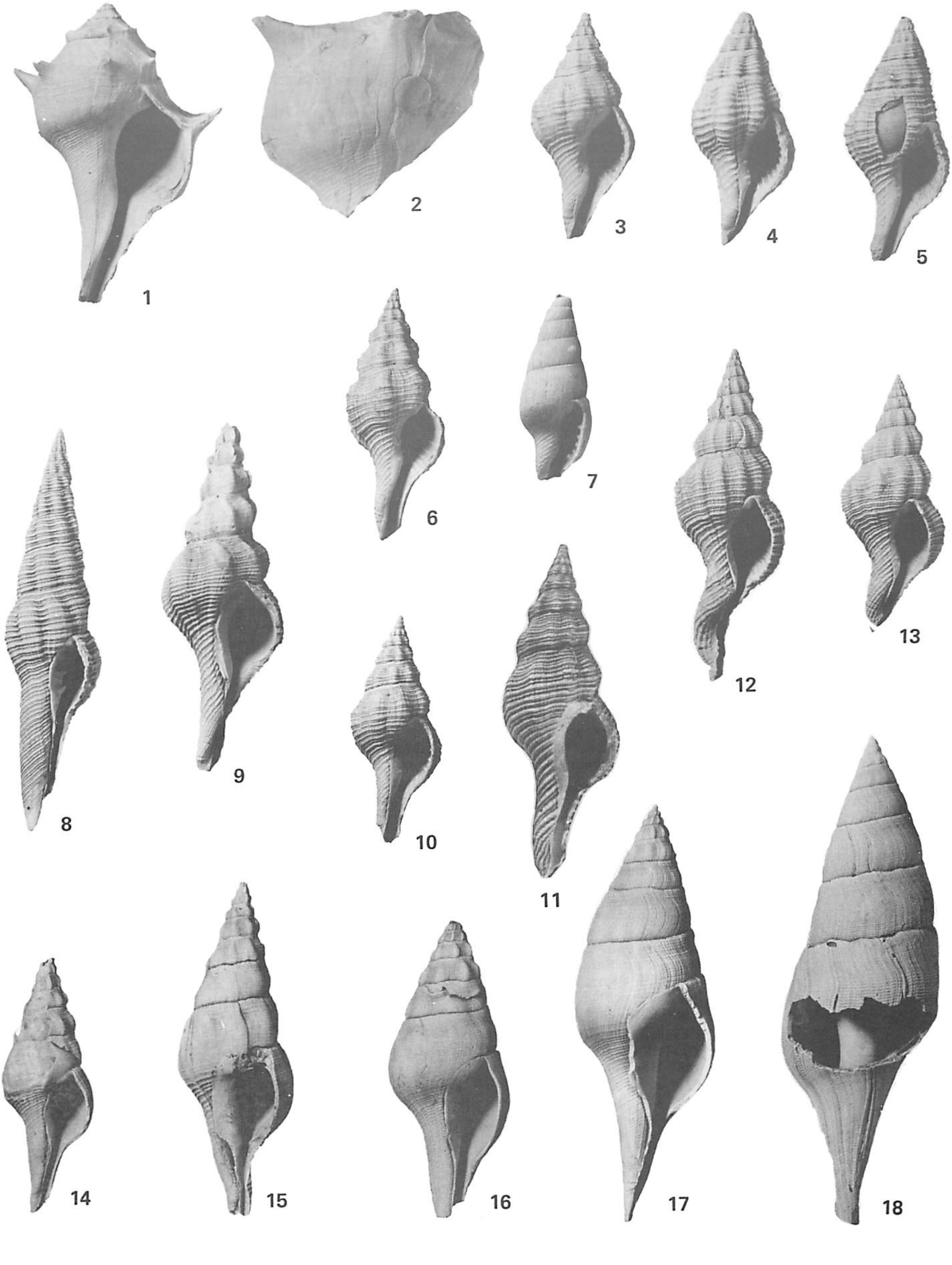


EXPLANATION PLATE 6
Red Bluff Formation

Figure		Page
1-2	**Levifusus spiniger** (Conrad, 1848)	148-149
	1. Figured specimen 481058 USNM (x1). Height 56.2 mm, width (including spines) 40.9 mm; USGS locality 6456.	
	2. Figured specimen 480050 USNM (x1). Height (fragment) 40.0 mm, width 44.0 mm, USGS locality 13288.	
3-6	**Latirus aldrichi** Dockery n. sp.	145-146
	3. Figured specimen 498073 USNM (x2.5). Height 17.7 mm, width 8.1 mm; USGS locality 2633.	
	4. Figured specimen 140737 USNM (x2.5). Height 18.0 mm, width 8.2 mm; USGS locality 2633.	
	5. Figured specimen 498074 USNM (x2). Height 23.6 mm, width 10.5 mm; USGS locality 5263.	
	6. Figured specimen 498072 USNM (x2.5). Height 19.2 mm, width 8.0 mm; USGS locality 2633.	
7	**Mitrella (Columbellopsis) cf. M. (C.) fuscicava** MacNeil n. sp.	142
	Figured specimen 498082 USNM (x8). Height 4.2 mm, width 1.6 mm; USGS locality 5264.	
8	**Dolicholatirus cervicrassus** Dockery n. sp.	146-147
	Holotype 498083 USNM (x1). Height 74.7 mm, width 18.9 mm; USGS locality 309.	
9	**Latirus mississippiensis** (Conrad, 1848) ?	144-145
	Figured specimen 136530 USNM (x1.5). Height 44.5 mm, width 16.4 mm; USGS locality 309.	
10	**Latirus protractus** (Conrad, 1848)	145
	Figured specimen 498071 USNM (x2.5). Height 17.3 mm, width 6.8 mm; USGS locality 5263.	
11-13	**Latirus indistinctus** Aldrich, 1884	146
	11. Figured specimen 498070 USNM (x2.5). Height 25.2 mm, width 9.0 mm; USGS locality 5263. Young specimen with straight canal.	
	12. Holotype 135158 USNM (x1.5). Height 42.7 mm, width 14.0 mm; USGS locality 309.	
	13. Figured specimen 480047 USNM (x1.5). Height 32.8 mm, width 13.2 mm; USGS locality 13288.	
14-15	**Clavilithes longiformis** Dockery n. sp.	148
	14. Figured specimen 136591 USNM (x1). Height 48.3 mm, width 18.2 mm; USGS locality 309.	
	15. Holotype 376455 USNM (x1). Height 63.1 mm, width 21.0 mm; USGS locality 309.	
16-18	**Clavilithes vicksburgensis** (Conrad, 1849)	147
	16. Figured specimen 498075 USNM (x1). Height 56.0 mm, width 22.3 mm; USGS locality 5263.	
	17. Figured specimen 376456 USNM (x1). Height 79.1 mm, width 26.8 mm; USGS locality 14721.	
	18. Figured specimen 498094 USNM (x1). Height 92.3 mm, width 29.2 mm; USGS locality 309.	

Red Bluff Formation

Plate 6



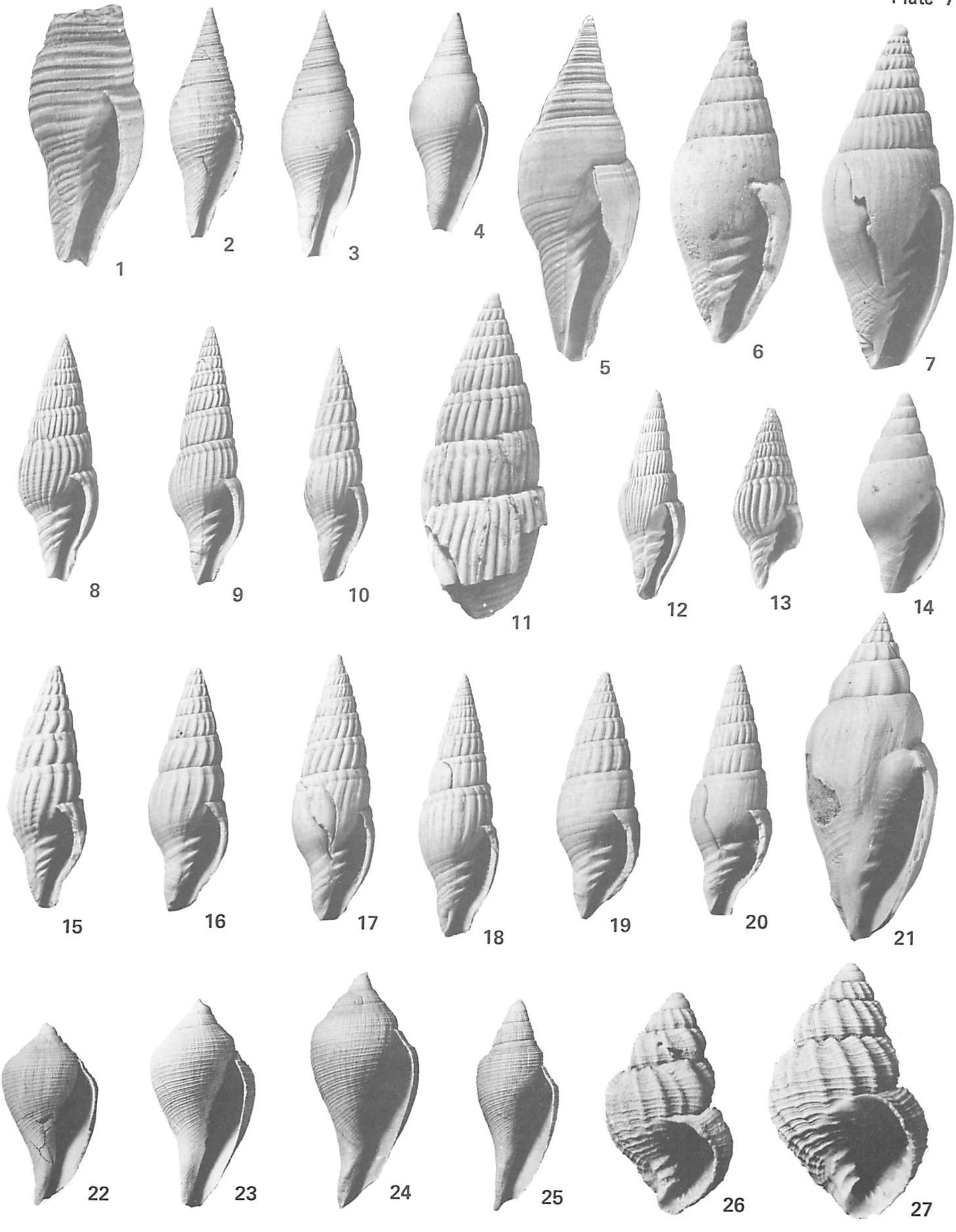
EXPLANATION PLATE 7

Red Bluff Formation

Figure		Page
1, 3-5	**Mitra (Fusimitra) conquisita** Conrad, 1848	159-160
	1. Figured specimen 498059 USNM (x2.5). Height (incomplete) 20.1 mm, width 8.7 mm; USGS locality 2632.	
	3. Figured specimen 498060 USNM (x1.5). Height 31.9 mm, width 10.0 mm; USGS locality 309.	
	4. Figured specimen 498063 USNM (x1.5). Height 28.2 mm, width 10.1 mm; USGS locality 2633.	
	5. Figured specimen 498061 USNM (x2). Height 32.9 mm, width 11.7 mm; USGS locality 2632.	
2	**Mitra (Fusimitra) mississippiensis** Conrad, 1848	160
	Figured specimen 498058 USNM (x1.5). Height 29.5 mm, width 9.5 mm; USGS locality 2633.	
6-7	**Conomitra crenulata** Dockery n. sp.	154
	6. Figured specimen 140528 USNM (x6). Height 10.8 mm, width 4.0 mm; USGS locality 2860.	
	7. Holotype 498057 USNM (x6). Height 11.5 mm, width 4.2 mm; USGS locality 5264.	
8-13, 15-20	**Vexillum (Costellaria) lintoidea** (Aldrich, 1894)	161
	8. Figured specimen 498068 USNM (x3). Height 15.7 mm, width 5.2 mm; USGS locality 2633.	
	9. Figured specimen 498066 USNM (x2.5). Height 20.3 mm, width 5.7 mm; USGS locality 309.	
	10. Figured specimen 498069 USNM (x2.5). Height 18.0 mm, width 4.9 mm; USGS locality 2633.	
	11. Figured specimen 498069 USNM (x6). Height (incomplete) 10.9 mm, width (incomplete) 5.0 mm; USGS locality 2633.	
	12. Holotype 341411 USNM (x1.5). Height 27.3 mm, width 8.7 mm; "Red Bluff," Mississippi (Aldrich).	
	13. Figured specimen 498064 USNM (x4). Height 8.7 mm, width 3.0 mm; USGS locality 2633.	
	15. Figured specimen 498067 USNM (x3). Height 15.4 mm, width 5.0 mm; USGS locality 5264.	
	16. Figured specimen 498065 USNM (x4). Height 11.6 mm, width 3.8 mm; USGS locality 2633.	
	17. Figured specimen 480041 USNM (x4). Height 12.6 mm, width 3.7 mm; USGS locality 13288.	
	18. Figured specimen 376457 USNM (x3). Height 16.9 mm, width 5.1 mm; USGS locality 13288.	
	19. Figured specimen 376458 USNM (x4). Height 11.8 mm, width 3.9 mm; USGS locality 2633.	
	20. Figured specimen 140753 USNM (x4). Height 11.9 mm, width 3.7 mm; USGS locality 659A.	
14	**Conomitra vicksburgensis laevigata** Dockery n. subsp.	154
	Figured specimen 140525 USNM (x6). Height 6.6 mm, width 2.8 mm; USGS locality 2860.	
21	**Lyria (Lyria) nestor** Casey, 1903	150
	Lectotype 480042 USNM (x1.5). Height 43.0 mm, width 18.0 mm; "Red Bluff," Mississippi (Casey).	
22-25	**Caricella (Atraktus) reticulata** (Aldrich, 1885)	152-153
	22. Figured specimen 498054 USNM (x1.5). Height 14.7 mm, width 12.8 mm; USGS locality 2633.	
	23. Specimen missing ?	
	24. Figured specimen 498055 USNM (x1.5). Height 31.4 mm, width 14.4 mm; USGS locality 2632.	
	25. Figured specimen 498056 USNM (x1.5). Height 27.9 mm, width 11.2 mm; USGS locality 5264.	
26-27	**Agatrix mississippiensis** (Conrad, 1848)	163-164
	26. Figured specimen 498053 USNM (x4). Height 10.6 mm, width 6.1 mm; USGS locality 6456.	
	27. Figured specimen 498052 USNM (x4). Height 12.3 mm, width 7.5 mm; USGS locality 5263.	

Red Bluff Formation

Plate 7

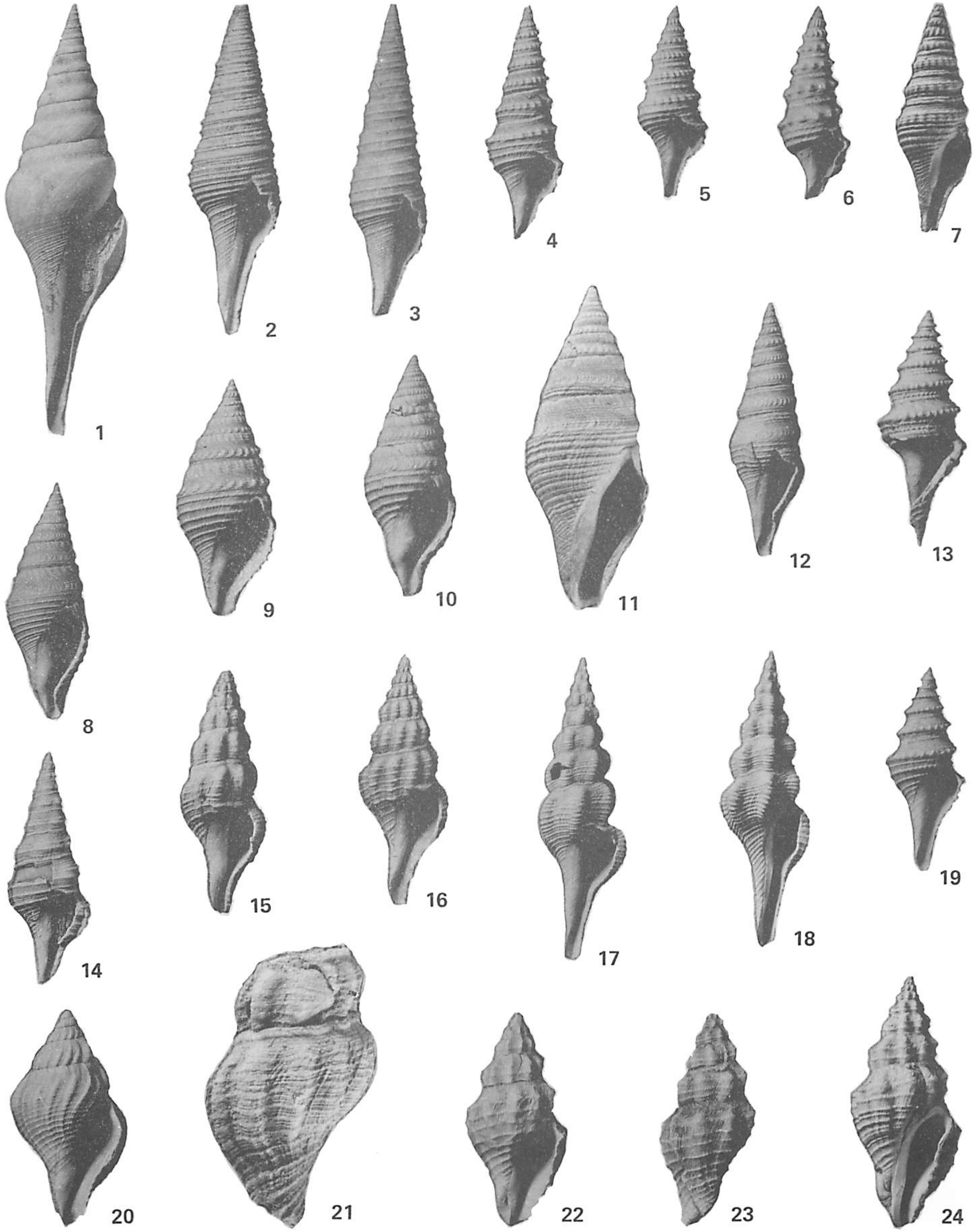


EXPLANATION PLATE 8
Red Bluff Formation

Figure		Page
1	**Turricula (Orthosurcula) longiforma** (Aldrich, 1885) . . . . Figured specimen 136508 USNM (x1.5). Height 54.1 mm, width 16.0 mm; USGS locality 309.	179-180
2	**Pleuroliria subsimilis** Casey, 1937 . . . . Figured specimen 498029 USNM (x2). Height 31.2 mm, width 8.5 mm; USGS locality 315.	178
3	**Pleuroliria tenuis** MacNeil n. sp. . . . . Holotype 136501 USNM (x2). Height 29.5 mm, width 7.4 mm; USGS locality 309.	178-179
4-5	**Gemmula amica** (Casey, 1903) . . . . 4. Figured specimen 498031 USNM (x2.5). Height 17.8 mm, width 5.9 mm; USGS locality 2633. 5. Figured specimen 498032 USNM (x3). Height 11.9 mm, width 4.3 mm; USGS locality 5264.	172-173
6	**Gemmula amica** (Casey, 1903) var. A . . . . Holotype 498030 USNM (x4). Height 9.0 mm, width 3.2 mm; USGS locality 5264.	173
7, 12	**Coronia (Coroniopsis) ancilla** (Casey, 1903) . . . . 7. Figured specimen 498034 USNM (x4). Height 10.5 mm, width 3.3 mm; USGS locality 5264. 12. Figured specimen 498035 USNM (x2.5). Height 19.4 mm, width 5.9 mm; USGS locality 6456.	175-176
8, 11	**Bathytoma rhomboidea** MacNeil n. sp. . . . . 8. Holotype 498036 USNM (x1.5). Height 29.9 mm, width 10.8 mm; USGS locality 5264. 11. Figured specimen 498037 USNM (x2). Height 29.8 mm, width 10.2 mm; USGS locality 5263.	215
9-10	**Bathytoma rhomboidea lyrata** MacNeil n. subsp. . . . . 9. Holotype 498038 USNM (x2.5). Height 18.0 mm, width 7.3 mm; USGS locality 319. 10. Figured specimen 481626 USNM (x2). Height 23.0 mm, width 8.7 mm; USGS locality 13288.	215
13, 19	**Cochlespira cookei rubracollis** MacNeil n. subsp. . . . . 13. Figured specimen 498040 USNM (x3). Height 14.6 mm, width 5.6 mm; USGS locality 5264. 19. Holotype 498039 USNM (x3). Height 12.6 mm, width 4.8 mm; USGS locality 5263.	196
14	**Pleurofusia hiwanneenis** MacNeil n. sp. . . . . Holotype 498043 USNM (x2.5). Height 17.6 mm, width 6.5 mm; USGS locality 5264.	183-184
15-16, 21	**Pleurofusia clarkeana** (Aldrich, 1894) . . . . 15. Holotype 644623 USNM (x1.5). Height 30.5 mm, width 11.7 mm; "Red Bluff," Mississippi (Aldrich). 16. Figured specimen 498044 USNM (x2.5). Height 19.2 mm, width 6.7 mm; USGS locality 5264. 21. Figured specimen 140819 USNM (x2.5). Height (incomplete) 21.9 mm, width 22.0 mm; USGS locality 2634.	188
17-18	**Pleurofusia oblivia** (Casey, 1903) . . . . 17. Figured specimen 498041 USNM (x2). Height 28.7 mm, width 9.0 mm; USGS locality 2633. 18. Figured specimen 498042 USNM (x3). Height 18.2 mm, width 5.7 mm; USGS locality 5264.	189-190
20	**Varicobela smithii** (Aldrich, 1885) . . . . Figured specimen 498050 USNM (x1.5). Height 27.4 mm, width 14.9 mm; USGS locality 2633.	198-199
22-24	**Clavidrupa anita** (Aldrich, 1885) . . . . 22. Figured specimen 140649 USNM (x1.5). Height 27.4 mm, width 13.0 mm; USGS locality 2632. 23. Figured specimen 140632 USNM (x1.5). Height 27.5 mm, width 11.1 mm; USGS locality 2632. 24. Holotype 644609 USNM (x1.5). Height 32.7 mm, width 14.7 mm; "Red Bluff," Mississippi (Aldrich).	199-200

Red Bluff Formation

Plate 8



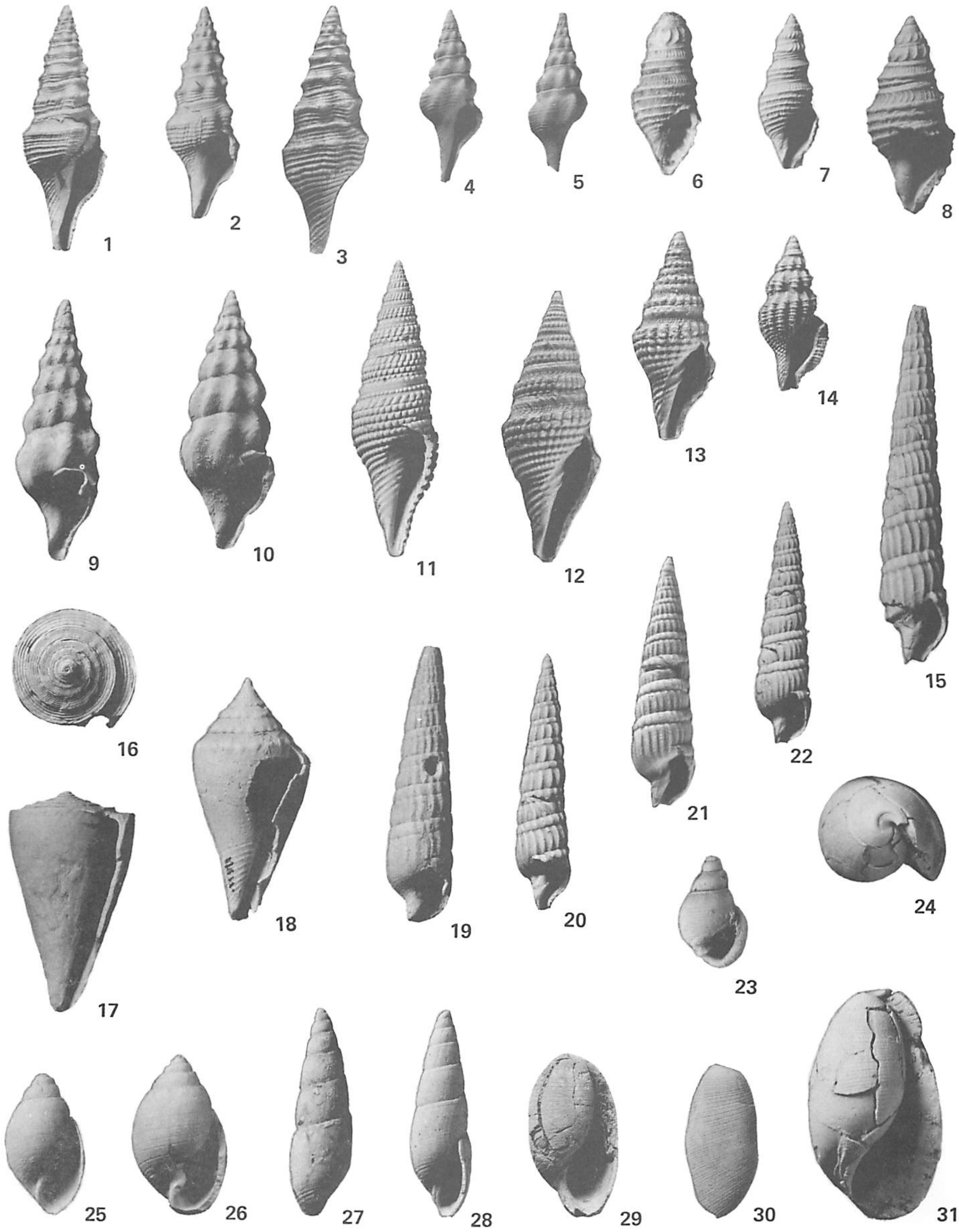
EXPLANATION PLATE 9

Red Bluff Formation

Figure		Page
1-3	**Tropisurcula caseyi** (Aldrich, 1903)	192-193
	1. Holotype 644631 USNM (x4). Height 11.7 mm, width 4.1 mm; "Red Bluff," Mississippi (Aldrich).	
	2. Figured specimen 498045 USNM (x3). Height 13.3 mm, width 4.5 mm; USGS locality 2633.	
	3. Figured specimen 498046 USNM (x4). Height 11.7 mm, width 3.7 mm; USGS locality 6456.	
4-5	**Pleurofusia (Xestosurcula) fessa** MacNeil n. sp.	191-192
	4. Holotype 376459 USNM (x3). Height 10.9 mm, width 3.9 mm; USGS locality 5264.	
	5. Figured specimen 376460 USNM (x2). USGS locality 7218.	
6	**Microdrillia vicksburgella** Casey, 1903	208
	Holotype of *M. biplicatula* Casey, 1903, 481629 USNM (x14). Height 2.3 mm; "Red Bluff," Mississippi (Casey).	
7	**Microdrillia infans** (Meyer, 1886)	209
	Holotype 644593 USNM (x6). Height 4.7 mm, width 1.9 mm; "Red Bluff," Mississippi (Meyer).	
8	**Microdrillia brevis allo** MacNeil n. subsp.	210
	Holotype 376461 USNM (x10). Height 10.9 mm, width 3.9 mm; USGS locality 14367.	
9-10	**Syntomodrillia collarubra** MacNeil n. sp.	202
	9. Figured specimen 376462 USNM (x6). Height 8.5 mm, width 2.6 mm; USGS locality 5264.	
	10. Holotype 498047 USNM (x6). Height 8.3 mm, width 2.8 mm; USGS locality 5204.	
11	**Scobinella pluriplicata** Casey, 1903	211-212
	Figured specimen 498048 USNM (x2). Height 28.4 mm, width 8.1 mm; USGS locality 5263.	
12-13	**Scobinella caelata** Conrad, 1848	210-211
	12. Figured specimen 376463 USNM (x2.5). Height 20.0 mm, width 7.1 mm; USGS locality 5264.	
	13. Figured specimen 376464 USNM (x4). Height 9.7 mm, width 3.7 mm; USGS locality 5264.	
14	**Clathurella meyeri** MacNeil n. sp.	216
	Holotype 124889 USNM (x6). Height 4.9 mm, width 2.0 mm; "Red Bluff," Mississippi (Meyer).	
15, 20-22	**Terebra (Terebrellina) hiwanneensis** MacNeil n. sp.	167-168
	15. Holotype 140752 USNM (x4). Height 16.9 mm, width 3.0 mm; USGS locality 2633.	
	20. Paratype A 498028 USNM (x4). Height 12.0 mm, width 2.5 mm; USGS locality 5263.	
	21. Figured specimen 481042 USNM (x4). Height 11.9 mm, width 2.8 mm; USGS locality 6456.	
	22. Paratype B 560921 USNM (x4). Height 11.4 mm, width 2.5 mm; USGS locality 5253.	
16-17	**Conus alveatus** Conrad, 1865	164-165
	Holotype of *C. scopularis* Casey, 1903, 481664 USNM (x1.5). Height 28.4 mm, width 16.8; USGS locality 13288.	
18	**Conus protractus** Meyer, 1885	165-166
	Figured specimen 498051 USNM (x2.5). Height 18.6 mm, width 9.1 mm; USGS locality 5264.	
19	**Terebra (Strioterebrum) alaba** MacNeil n. sp.	169-170
	Figured specimen 136486 USNM (x4). Height 12.9 mm, width 3.0 mm; USGS locality 309.	
23	**Ringicula (Ringiculella) mississippiensis petila** MacNeil n. subsp. ?	235
	Figured specimen 498027 USNM (x12). USGS locality 5264.	
24, 29-31	**Scaphander (Scaphander) primus** Aldrich, 1885	241-242
	24, 31. Holotype 644611 USNM (x3). Height 15.0 mm, width 8.5 mm; "Red Bluff," Mississippi (Aldrich).	
	29. Specimen missing ?	
	30. Figured specimen 498026 USNM (x4). Height 7.3 mm, width incomplete, only back side of outer whorl present; USGS locality 5264.	
25-26	**Acteon (Acteon) subaldrichi** MacNeil n. sp.	229
	25. Paratype 460797 USNM (x6). Height 4.1 mm, width 2.5 mm; USGS locality 5264.	
	26. Holotype 140822 USNM (x5). Height 6.0 mm, width 3.4 mm; USGS locality 2634.	
27-28	**Crenilabium altispira** MacNeil n. sp.	233
	Holotype 140749 USNM (x6). Height 6.9 mm, width 1.9 mm; USGS locality 2633.	

Red Bluff Formation

Plate 9

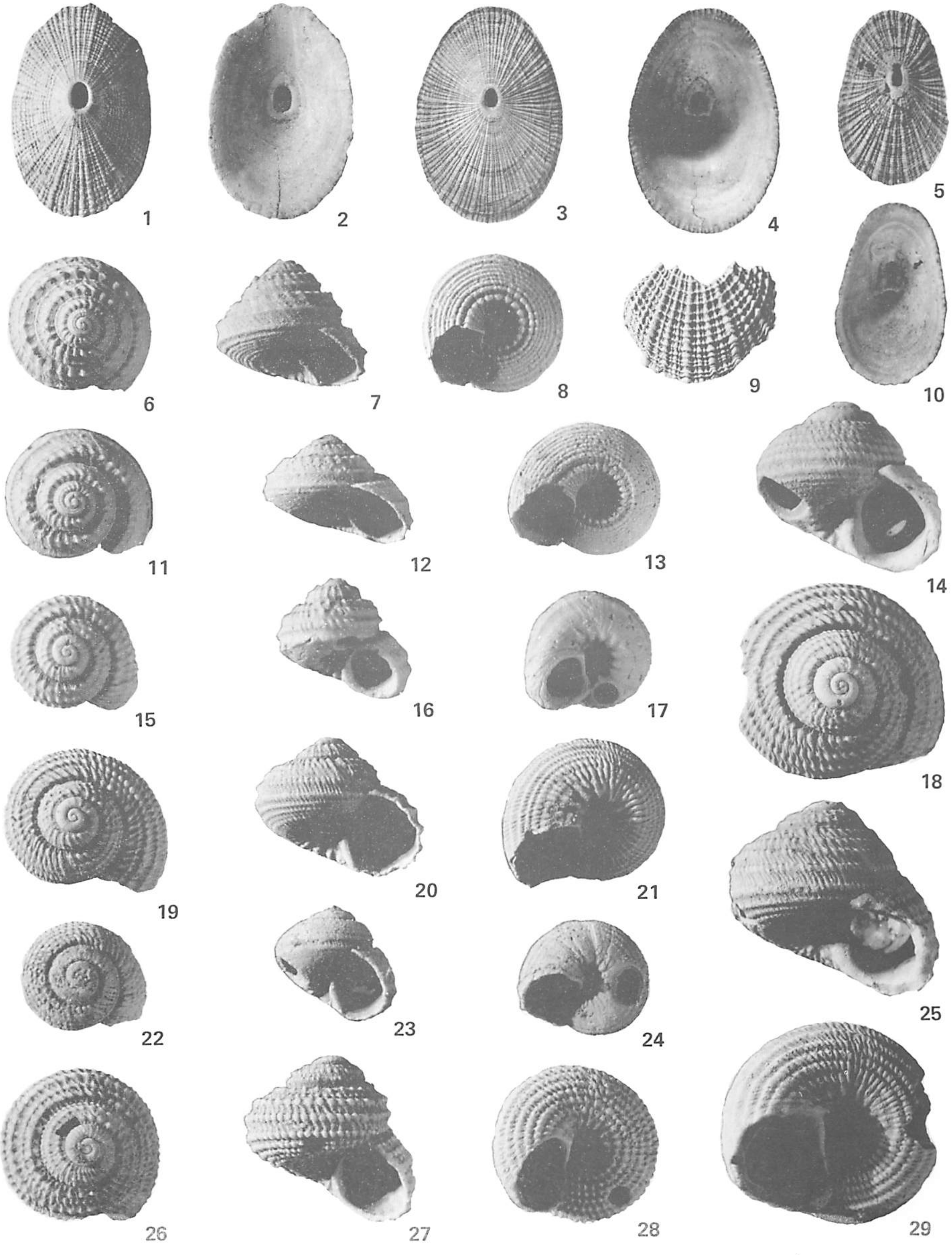


EXPLANATION PLATE 10

Mint Spring Formation

Figure		Page
1-4	**Diodora mississippiensis** (Conrad, 1848)	32
	1-2. Figured specimen 498330 USNM (x3). USGS locality 14071a.	
	3-4. Figured specimen 648848 USNM. USGS locality 14071a.	
5, 9, 10	**Diodora postantica** MacNeil n. sp.	32-33
	5, 10. Holotype 648849 USNM (x1.5). Height 22.9 mm, width 14.0 mm, elevation 8.2 mm; USGS locality 14071a.	
	9. Figured specimen 498331 USNM (x3). USGS locality 14071a.	
6-8, 11-13	**Solariella menthafontis** MacNeil n. sp.	33-34
	6-8. Holotype 498304 USNM (x8). Height 3.2 mm, width 3.5 mm; USGS locality 14071a.	
	11-13. Paratype 648847 USNM (x8). USGS locality 14071a.	
14?, 18-21, 22-24?, 25, 29	**Solariella fragum** MacNeil n. sp.	35
	14? Figured specimen 498303 USNM (x8). USGS locality 3727.	
	18, 25, 29. Figured specimen 498306 USNM (x8). USGS locality 6448.	
	19-21. Holotype 498302 USNM (x8). Height 3.4 mm, width 4.1 mm; USGS locality 14071.	
	22-24? Figured specimen 498307 USNM (x8). USGS locality 14071a.	
15-17	**Solariella laevifunda** MacNeil n. sp.	34-35
	Holotype 498308 USNM (x8). Height 2.8 mm, width 3.3 mm; USGS locality 3737.	
26-28	**Solariella clearyensis** MacNeil n. sp.	35
	Holotype 498305 USNM (x8). Height 3.8 mm, width 4.5 mm; USGS locality 14071a.	

Mint Spring Formation **Plate 10**



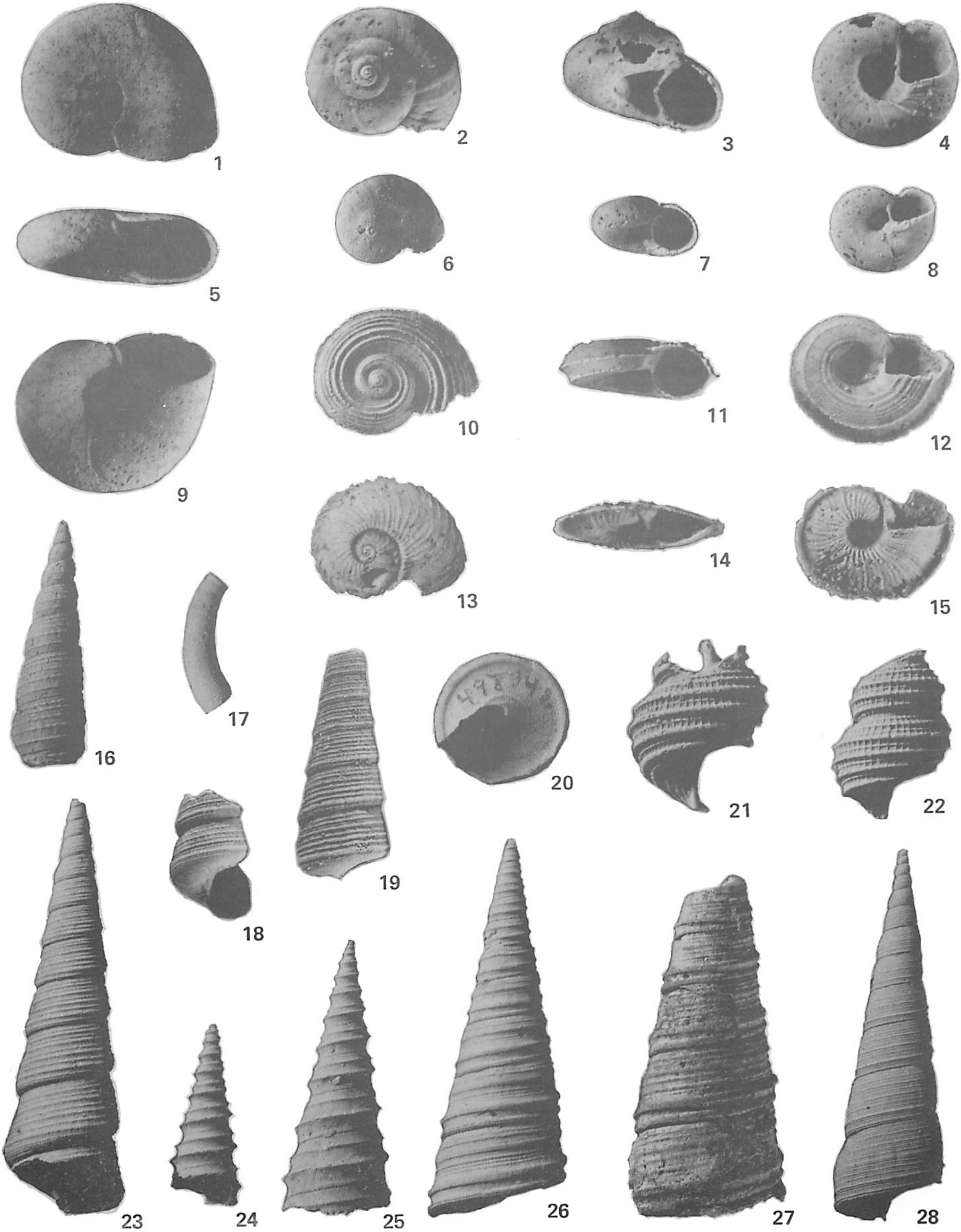
EXPLANATION PLATE 11

Mint Spring Formation

Figure		Page
1, 5, 9	**Teinostoma (Teinostoma) caseyi** MacNeil n. sp. Holotype 498311 USNM (x10). Height 1.5 mm, diameter 3.8 mm; USGS locality 6448.	40-41
2-4	**Vitrinella (Vitrinella) meyeri** MacNeil n. sp. Holotype 498313 USNM (x12). Diameter 2.5 mm; USGS locality 13287.	38
6-8	**Vitrinella (Vitrinella) vicksburgensis** (Meyer, 1886) Figured specimen 498312 USNM (x12). USGS locality 13287.	37-38
10-12	**Cyclostremiscus menthafons** MacNeil n. sp. Holotype 648850 USNM (x10). Height 1.0 mm, diameter 3.0 mm; USGS locality 7671.	38-39
13-15	**Discopsis pilsbryi** MacNeil n. sp. Holotype 498310 USNM (x12). Diameter 2.5 mm; USGS locality 14071a.	39-40
16	**Turritella caseyi** MacNeil n. sp. Figured specimen 498296 USNM (x5). USGS locality 7671.	54-55
17	**Caecum solitarium** Meyer, 1886 Holotype 644585 USNM (x12). Length 2.2 mm, diameter 0.6 mm; "Lower Vicksburgian," Vicksburg, Mississippi (Meyer).	42-43
18-19, 23	**Turritella carota** MacNeil n. sp. 18. Figured specimen 15091 UC (x2). UC locality A1050. 19. Figured specimen 15094 UC (x1.5). UC locality A1050. 23. Holotype 498294 USNM (x3). Height 26.6 mm, width 7.9 mm; USGS locality 14162.	53
20, 24-27	**Turritella boycensis** MacNeil n. sp. 20, 26. Holotype 498342 USNM (x1.5). Height 50.0 mm, width 12.5 mm; USGS locality 6647a. 24. Figured specimen 498340 USNM (x4). USGS locality 6647a. 25. Paratype 648851 USNM (x5). A juvenile; height 10.5 mm; USGS locality 2664. 27. Figured specimen 498343 USNM (x1.5). USGS locality 14203.	50-51
21-22	**Mathilda aff. M. plexita** Dall, 1896 21. Figured specimen 479993 USNM (x8). Width 3.2 mm; USGS locality 13287. 22. Figured specimen 498288 USNM (x8). USGS locality 7671.	56
28	**Turritella premimetes** MacNeil n. sp. Holotype 498295 USNM (x3). Height 20.0 mm, width 7.1 mm; USGS locality 7671.	54

Mint Spring Formation

Plate 11

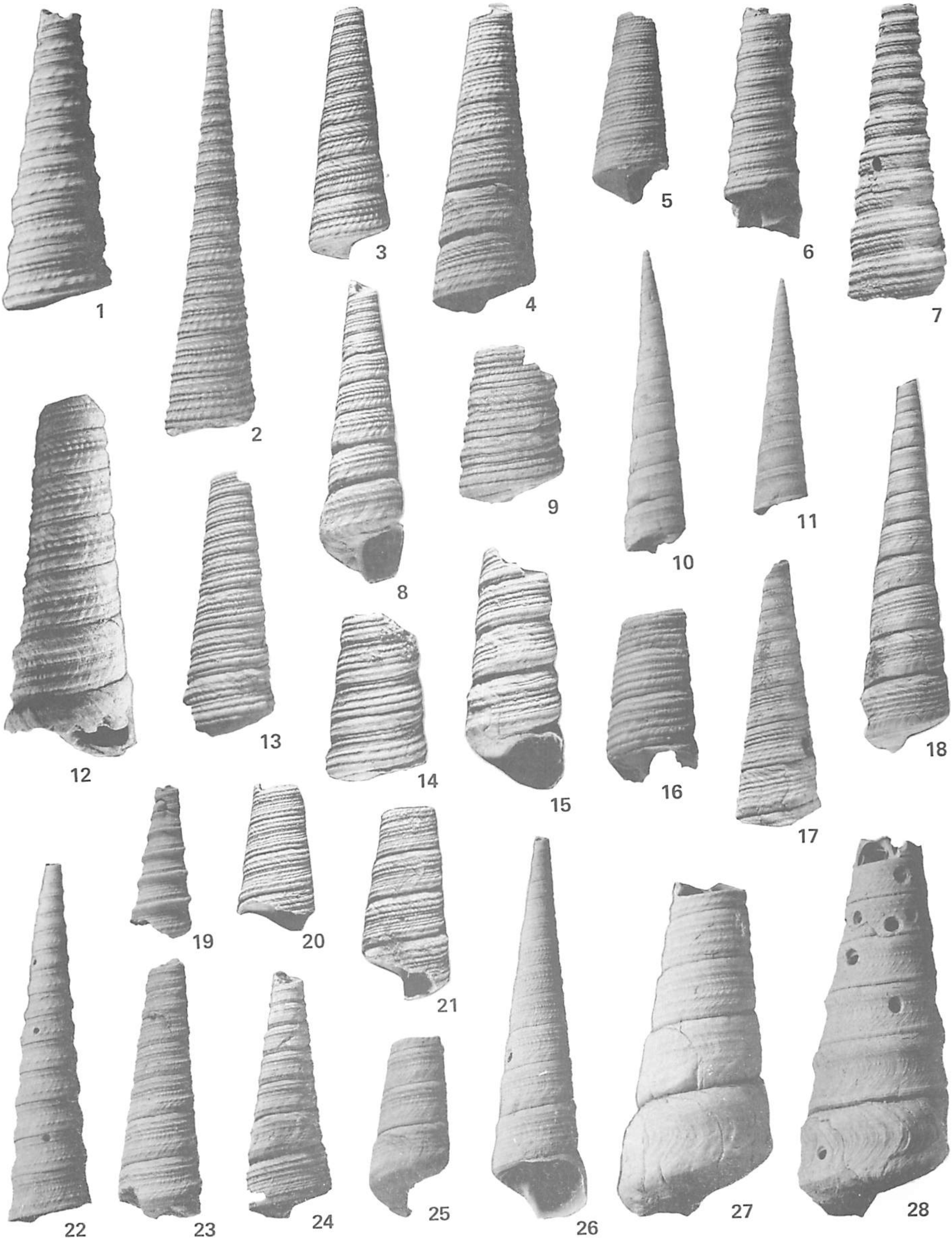


EXPLANATION PLATE 12
Mint Spring Formation

Figure		Page
1-21, 23-24	**Turritella caelatura** Conrad, 1848	51-52
	1. Figured specimen 648852 USNM (x3). USGS. locality 6647.	
	2. Figured specimen 648853 USNM (x1.5). USGS locality 14524.	
	3. Figured specimen 16096 UC (x1.5). UC locality A1050.	
	4. Figured specimen 648854 USNM (x1.5). USGS locality 2664.	
	5. Figured specimen 15097 UC (x1.5). UC locality A1050.	
	6. Figured specimen 648855 USNM (x1.5). USGS locality 6647.	
	7. Figured specimen 498344 USNM (x1.5). USGS locality 14162.	
	8. Figured specimen 15098 UC (x1.5). UC locality A1050.	
	9. Figured specimen 648856 USNM (x1.5). USGS locality 14162.	
	10. Figured specimen 648857 USNM (x3). USGS locality 13287.	
	11. Figured specimen 498292 USNM (x3). UGS locality 13287.	
	12. Holotype 13518 ANSP (x2). Height (incomplete) 34.5 mm; Vicksburg, Mississippi (Conrad).	
	13. Figured specimen 136878 USNM (x1.5). USGS locality 2664.	
	14. Figured specimen 15099 UC (x1.5). UC locality A1050.	
	15. Figured specimen 15100 UC (x1.5). UC locality A1050.	
	16. Figured specimen 15101 UC (x1.5). UC locality A1050.	
	17. Figured specimen 648858 USNM (x2). USGS locality 2664.	
	18. Figured specimen 15102 UC (x1.5). UC locality A1050.	
	19. Figured specimen 15103 UC (x1.5). UC locality A1050.	
	20. Figured specimen 15104 UC (x1.5). UC locality A1050.	
	21. Figured specimen 15105 UC (x1.5). UC locality A1050.	
	23. Figured specimen 15106 UC (x1.5). UC locality A1050.	
	24. Figured specimen 644859 USNM (x2). USGS locality 2664.	
22, 25?, 26-28	**Turritella caelatura** Conrad, 1848 var.	52
	22. Figured specimen 498289 USNM (x2.5). USGS locality 14071a.	
	25.? Figured specimen 15107 UC (x1.5). UC locality A1050.	
	26. Figured specimen 498291 USNM (x2). Height 37.0 mm, width 9.0 mm; USGS locality 7941.	
	27. Figured speicmen 498290 USNM (x2). USGS locality 13287.	
	28. Figured specimen 498293 USNM (x2). Height (incomplete) 36.6 mm, width 14.4 mm; USGS locality 14071a.	

Mint Spring Formation

Plate 12



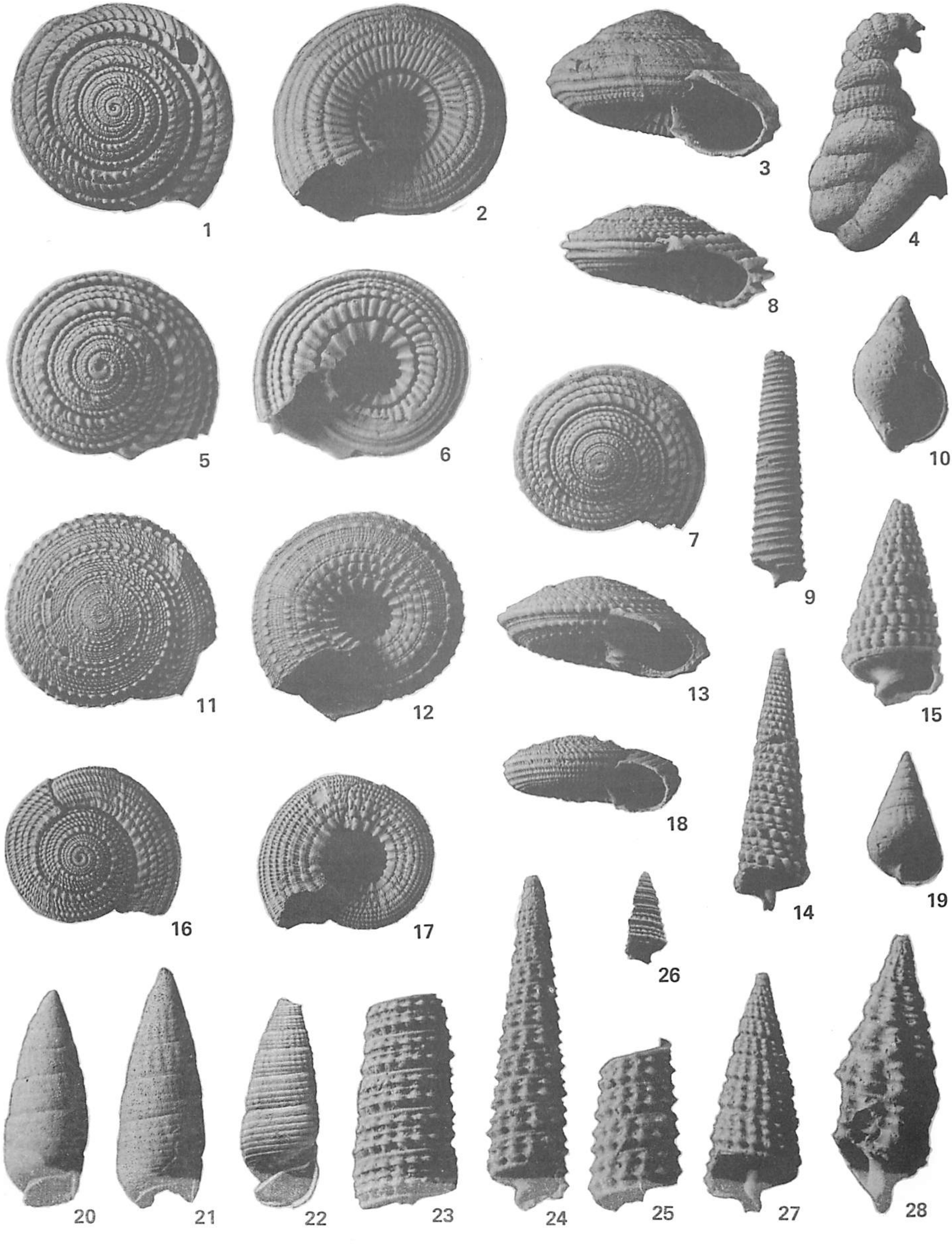
EXPLANATION PLATE 13

Mint Spring Formation

Figure		Page
1-3	**Architectonica (Architectonica) trilirata palmeri** MacNeil n. subsp.	44
	1. Paratype 648860 USNM (x4). USGS locality 14071a.	
	2-3. Holotype 498297 USNM (x3). Height 9.9 mm, width 15.5 mm; USGS locality 14071a.	
4	**Serpulorbis sp.**	56
	Figured specimen 498345 USNM (x1.5). USGS locality 14203.	
5-8	**Architectonia (Architectonica) fuscicava** MacNeil n. sp.	45
	5-6, 8. Holotype 498298 USNM (x6). Height 3.5 mm, width 7.1 mm; USGS locality 7671.	
	7. Figured specimen 498346 USNM (x3). USGS locality 6647a.	
9	**Seila aff. S. constricta** (H. C. Lea, 1841)	62
	Figured specimen 498341 USNM (x4). USGS locality 14203.	
10	**Litiopa meyeri** MacNeil n. sp.	64
	Holotype 498277 USNM (x10). Height 3.0 mm, width 1.8 mm; USGS locality 14071a.	
11-13	**Architectonica (Architectonica) menthafontis** MacNeil n. sp.	46
	Holotype 498299 USNM (x3). Height 6.7 mm, width 13.8 mm; USGS locality 7671.	
14	**Triphora (Triphora) meridionalis** (Meyer, 1886)	65-66
	Figured specimen 498347 USNM (x8). Height 6.3 mm, width 1.8 mm; USGS locality 6647a.	
15	**Telescopium leafensis** MacNeil n. sp.	68-69
	Holotype 498264 USNM (x10). Height 3.9 mm, width 1.9 mm; USGS locality 7671.	
16-18	**Architectonica (Pseudoterinia) julia** MacNeil n. sp.	48
	Holotype 498300 USNM (x4). Height 3.6 mm, width 8.9 mm; USGS locality 13287.	
19?, 20-22	**Semivertagus menthafontis** MacNeil n. sp.	57
	19.? Paratype 498266 USNM (x8). Height 3.3 mm, USGS locality 14071a.	
	20. Figured specimen 648861 USNM (x3). USGS locality 14071a.	
	21. Figured specimen 498267 USNM (x3). USGS locality 14071a.	
	22. Holotype 648862 USNM (x2.5). Height (incomplete) 15.6 mm, width 5.7 mm; USGS locality 14071a.	
23-25	**Eumetula vicksburgella** MacNeil n. sp.	59
	23. Figured specimen 648863 USNM (x10). USGS locality 7671.	
	24. Figured specimen 648864 USNM (x8). USGS locality 7671.	
	25. Figured specimen 648865 USNM (x10). USGS locality 7671.	
26-27	**Triphora (Triphora) mentahfons** MacNeil n. sp.	66
	26. Paratype 648843 USNM (x12). USGS locality 7671.	
	27. Holotype 498268 USNM (x8). Height 5.8 mm, width 2.3 mm; USGS locality 7671.	
28	**Triphora (Euthymella) fuscicava** MacNeil n. sp.	66-67
	Holotype 498269 USNM (x8). Height 6.8 mm, width 2.5 mm; USGS locality 7671.	

Mint Spring Formation

Plate 13



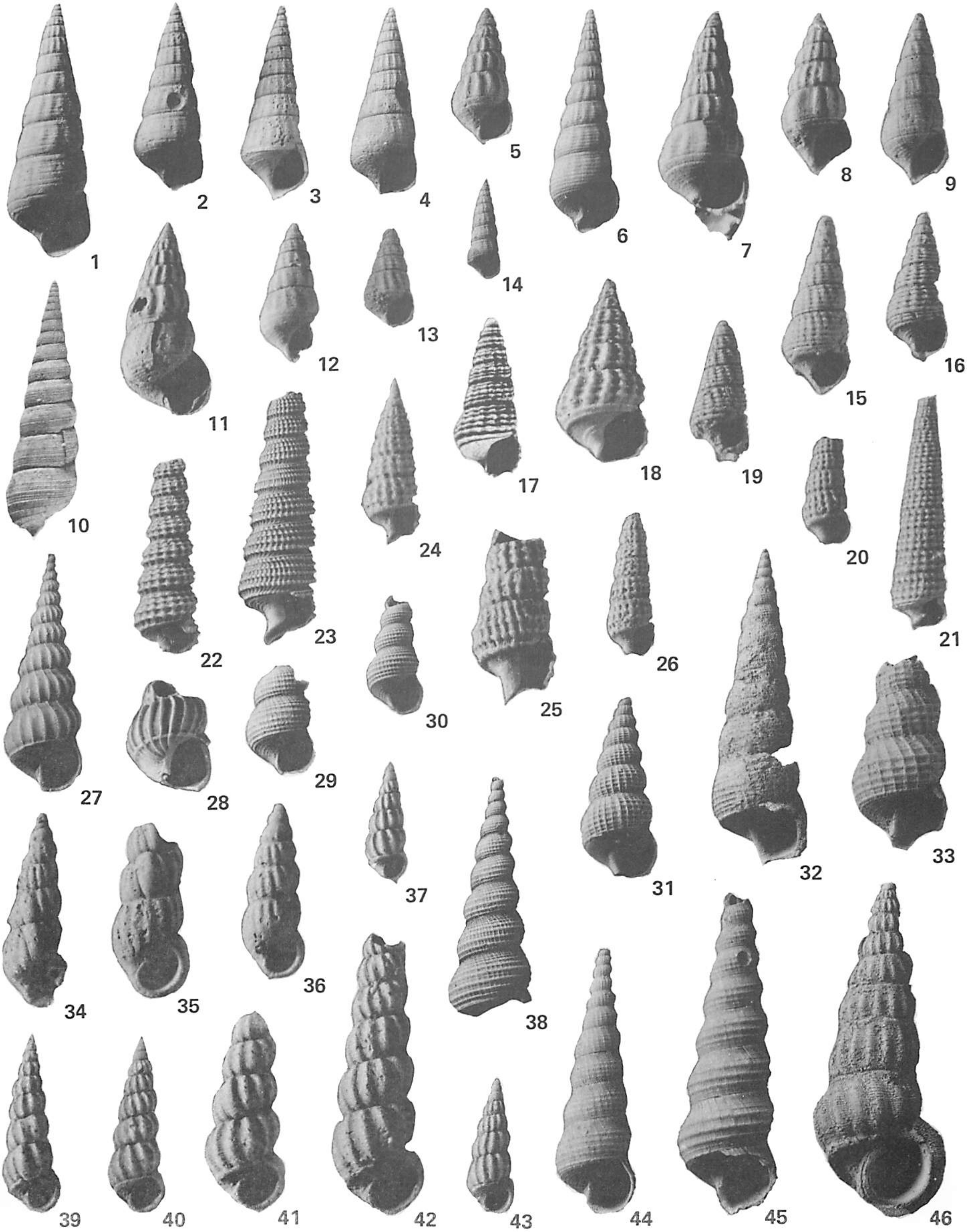
EXPLANATION PLATE 14

Mint Spring Formation

Figure		Page
1-10 12-14	**Alabina menthafontis** MacNeil n. sp. .... 1. Holotype 498273 USNM (x8). Height 6.2 mm, width 2.0 mm; USGS locality 14071a. 2. Figured specimen 648866 USNM (x8). USGS locality 14071a. 3. Figured specimen 648867 USNM (x5). USGS locality 13287. 4. Figured specimen 648868 USNM (x5). USGS locality 13287. 5. Figured specimen 648869 USNM (x10). USGS locality 13287. 6. Figured specimen 648870 USNM (x5). USGS locality 14071a. 7. Figured specimen 648871 USNM (x10). USGS locality 13287. 8. Figured specimen 648872 USNM (x10). USGS locality 13287. 9. Figured specimen 648873 USNM (x10). USGS locality 13287. 10. Figured specimen 648874 USNM (x2.5). USGS locality 14071a. 12. Figured specimen 648876 USNM (x10). USGS locality 13287. 13. Figured specimen 648875 USNM (x10). USGS locality 13287. 14. Figured specimen 648870 USNM (x5). USGS locality 14071a.	63-64
11	**Alabina aff. A. menthafontis** MacNeil n. sp. .... Figured specimen 498275 USNM (x10). USGS locality 13287.	64
15-16, 17, 19	**Bittium (Argyropeza?) caseyi** MacNeil n. sp. .... 15. Figured specimen 648877 USNM (x10). USGS locality 13287. 16. Figured specimen 648878 USNM (x10). USGS locality 13287. 17. Holotype 648879 USNM (x10). Height 3.0 mm, width 1.3 mm; USGS locality 14071a. 19. Figured specimen 479987 USNM (x10). USGS locality 13287.	59
18	**Bittium (Argyropeza?) ottoi** MacNeil n. sp. .... Holotype 498265 USNM (x10). Height 3.5 mm, width 2.9 mm; USGS locality 13287.	58-59
20? 24-25, 26?	**Cerithiella nassuloides** MacNeil n. sp. .... 20? Figured specimen 479988 USNM (x10). USGS locality 13287. 24. Holotype 498263 USNM (x10). Height 3.0 mm, width 1.2 mm; USGS locality 14162. 25. Paratype 498262 USNM (x10). USGS locality 14017a. 26? Figured specimen 648881 USNM (x10). USGS locality 13287.	61
21	**Cerithiella leafensis** MacNeil n. sp. .... Holotype 648882 USNM (x10). Height (incomplete) 4.5 mm, width 1.1 mm; USGS locality 7671.	61-62
22-23	**Cerithiella langdoni** (Aldrich, 1885) .... 22. Figured specimen 648880 USNM (x6). USGS locality 7671. 23. Figured specimen 498270 USNM (x3). USGS locality 7671.	60-61
27	**Acrilla (Acrilloscala) palmerae** MacNeil n. sp. .... Holotype 498280 USNM (x4). Height 11.3 mm, width 3.8 mm; USGS locality 14071a.	72-73
28	**Epitonium (Gryoscala)** n. sp. .... Figured specimen 498281 USNM (x10). USGS locality 13287.	72
29, 31-33	**Scalina trigintanaria** (Conrad, 1848) var. ? .... 29. Figured specimen 136919 USNM (x6). USGS locality 2664. 31. Figured specimen 498286 USNM (x2). USGS locality 14071a. 32. Figured specimen 498285 USNM (x5). USGS locality 14162. 33. Figured specimen 498284 USNM (x4). USGS locality 14162.	74
30, 38	**Scalina trigintanaria hopkinsi** MacNeil n. subsp. .... 30. Holotype 648883 USNM (x6). Height (incomplete) 3.9 mm, width 1.9 mm; USGS locality 7467. 38. Paratype 136910 USNM (x5). Height 9.3 mm, width 3.2 mm; USGS locality 2664.	74-75
34-36	**Pliciscala (Nodiscala?)** n. sp. .... 34. Figured specimen 648884 USNM (x10). USGS locality 13287. 35. Figured specimen 648885 USNM (x10). USGS locality 13287. 36. Figured specimen 498278 USNM (x10). USGS locality 13287.	78
37, 39-43	**Pliciscala (Nodiscala?) caseyi** MacNeil n. sp. .... 37. Figured specimen 648886 USNM (x10). USGS locality 13287. 39. Figured specimen 648888 USNM (x10). USGS locality 13287. 40. Holotype 498279 USNM (x10). Height (incomplete) 3.3 mm, width 1.0 mm; USGS locality 13287. 41. Figured specimen 648880 USNM (x10). USGS locality 13287. 42. Figured specimen 648889 USNM (x10). USGS locality 13287. 43. Figured specimen 648887 USNM (x10). USGS locality 13287.	78
44-45	**Scalina menthafontis** MacNeil n. sp. .... 44. Paratype 498282 USNM (x3). Height 17.3 mm, width 5.3 mm; USGS locality 14071a. 45. Holotype 498283 USNM (x2.5). Height (incomplete) 25.0 mm, width 7.8 mm; USGS locality 14162.	75
46	**Pliciscala (Punctiscala) cookei** MacNeil n. sp. .... Holotoype 498287 USNM (x3). Height 21.6 mm, width 8.4 mm; USGS locality 14071a.	77

Mint Spring Formation

Plate 14



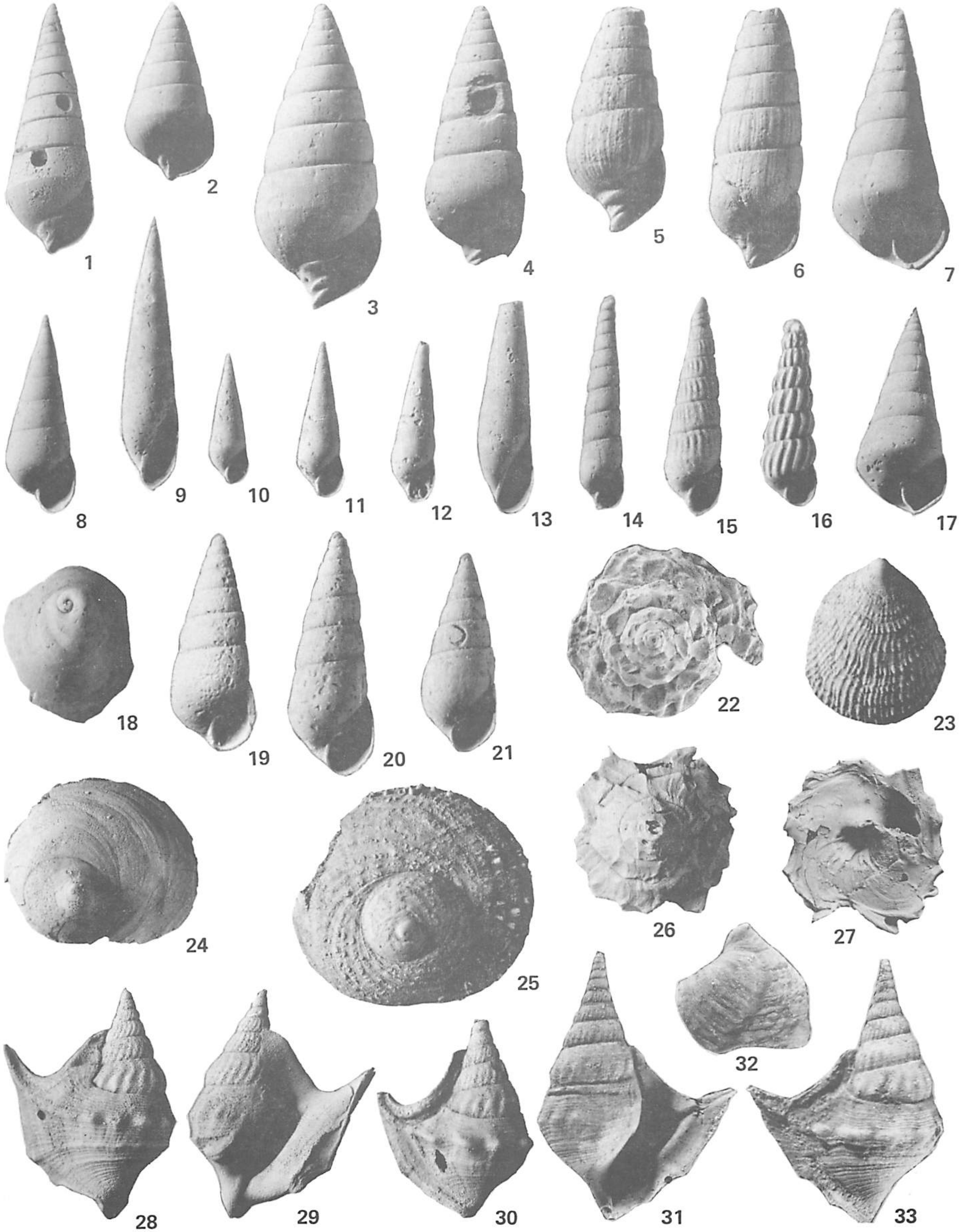
EXPLANATION PLATE 15

Mint Spring Formation

Figure		Page
1	**Pyramidella (Voluspa) chavanoidea** MacNeil n. sp.	222
	Holotype 498247 USNM (x4.) Height 12.2 mm, width 4.2 mm; USGS locality 13287.	
2-4	**Pyramidella (Voluspa) leafensis** MacNeil n. sp.	222
	2. Figured specimen 498248 USNM (x8). USGS locality 7671.	
	3. Figured specimen 648904 USNM (x8). USGS locality 7671.	
	4. Figured specimen 648905 USNM (x8). USGS locality 7671.	
5-6	**Pyramidella (Voluspa?) microcosta** MacNeil n. sp.	223
	5. Holotype 479994 USNM (x8). Height (incomplete) 6.2 mm, width 2.2 mm; USGS locality 13287.	
	6. Figured specimen 648906 USNM. USGS locality 13287.	
7, 17	**Niso fuscicava** MacNeil n. sp.	81-82
	7. Holotype 498261 USNM (x8). Height 6.3 mm, width 2.7 mm; USGS locality 7671.	
	17. Figured specimen 648907 USNM (x8). USGS locality 7671.	
8	**Melanella postnotata** MacNeil n. sp.	79-80
	Holotype 498258 USNM (x8). Height 4.6 mm, width 1.8 mm; USGS locality 7671.	
9, 13	**Strombiformis caseyi** MacNeil n. sp.	81
	9. Holotype 498259 USNM (x8). Height 6.5 mm, width 1.6 mm; USGS locality 13287	
	13. Figured specimen 498260 USNM (x8). USGS locality 14071a.	
10-12	**Melanella amnicreta** MacNeil n. sp.	80
	10. Figured specimen 648893 USNM (x10). USGS locality 14071a.	
	11. Holotype 498257 USNM (x10). Height 3.0 mm, width 1.0 mm; USGS locality 14071a.	
	12. Figured specimen 648894 USNM (x10). USGS locality 7671a.	
14	**Eulimella clearyensis** MacNeil n. sp.	225-226
	Holotype 498250 USNM (x8). USGS locality 14071a.	
15	**Turbonilla caseyi** MacNeil n. sp.	227
	Holotype 498251 USNM (x10). Height 4.1 mm, width 1.4 mm; USGS locality 13287.	
16	**Turbonilla leafensis** MacNeil n. sp.	227
	Holotype 498252 USNM (x10). Height 3.4 mm, width 1.2 mm; USGS locality 7671.	
18, 24	**Calyptraea (Trochita) conradi** MacNeil n. sp.	85
	18. Figured specimen 498315 USNM (x2.5). Diameter 15.0 mm; USGS locality 6452.	
	24. Figured specimen 498315 USNM (x2.5). USGS locality 13287.	
19-21	**Odostomia (Odostomia) boettgeri** Meyer, 1887	223-224
	19. Holotype 644602 USNM (x8). Height 5.1 mm, width 2.0 mm; Vicksburg, Mississippi (Meyer).	
	20. Figured specimen 648895 USNM (x10). USGS locality 14071a.	
	21. Figured specimen 498249 USNM (x10). USGS locality 14071a.	
22	**Xenophora (Xenophora) cf. X. (X.) reclusa** (Conrad, 1854)	89
	Figured specimen 648910 USNM (x1). Height 35.0 mm, width 38.0 mm; USGS locality 14071a.	
23	**Hipponix pigmaeus** Lea, 1833	82-83
	Figured specimen 498318 USNM (x8). Height 4.0 mm, width 3.3 mm, elevation 1.4 mm; USGS locality 6452.	
25	**Calyptraea (Trochita) cf. C. (T.) aperta** (Solander, 1766)	84-85
	Figured specimen 498314 USNM (x2). Height 9.0 mm, diameter 23.0 mm; USGS locality 14071a.	
26-27	**Xenophora (Stellaria) conica** Dall, 1892	89-90
	Figured specimen 498301 USNM (x2). Height 13.0 mm, width 17.0 mm; USGS locality 13287.	
28-31, 33	**Aporrhais (Goniocheila) menthafontis** MacNeil n. sp.	70-71
	28-29. Holotype 498245 USNM (x2). Height 22.3 mm, width 16.3 mm; USGS locality 3723.	
	30. Figured specimen 498246 USNM (x2). USGS locality 14071a.	
	31, 33. Paratype 648911 USNM (x2). Height (incomplete) 24.5 mm; USGS locality 14071a.	
32	**Crucibulum (Dispotaea) hyalonama** MacNeil n. sp.	86
	Holotype 648909 USNM (x2.5). Height 12.0 mm, diameter 13.0 mm; USGS locality 6448a.	

Mint Spring Formation

Plate 15

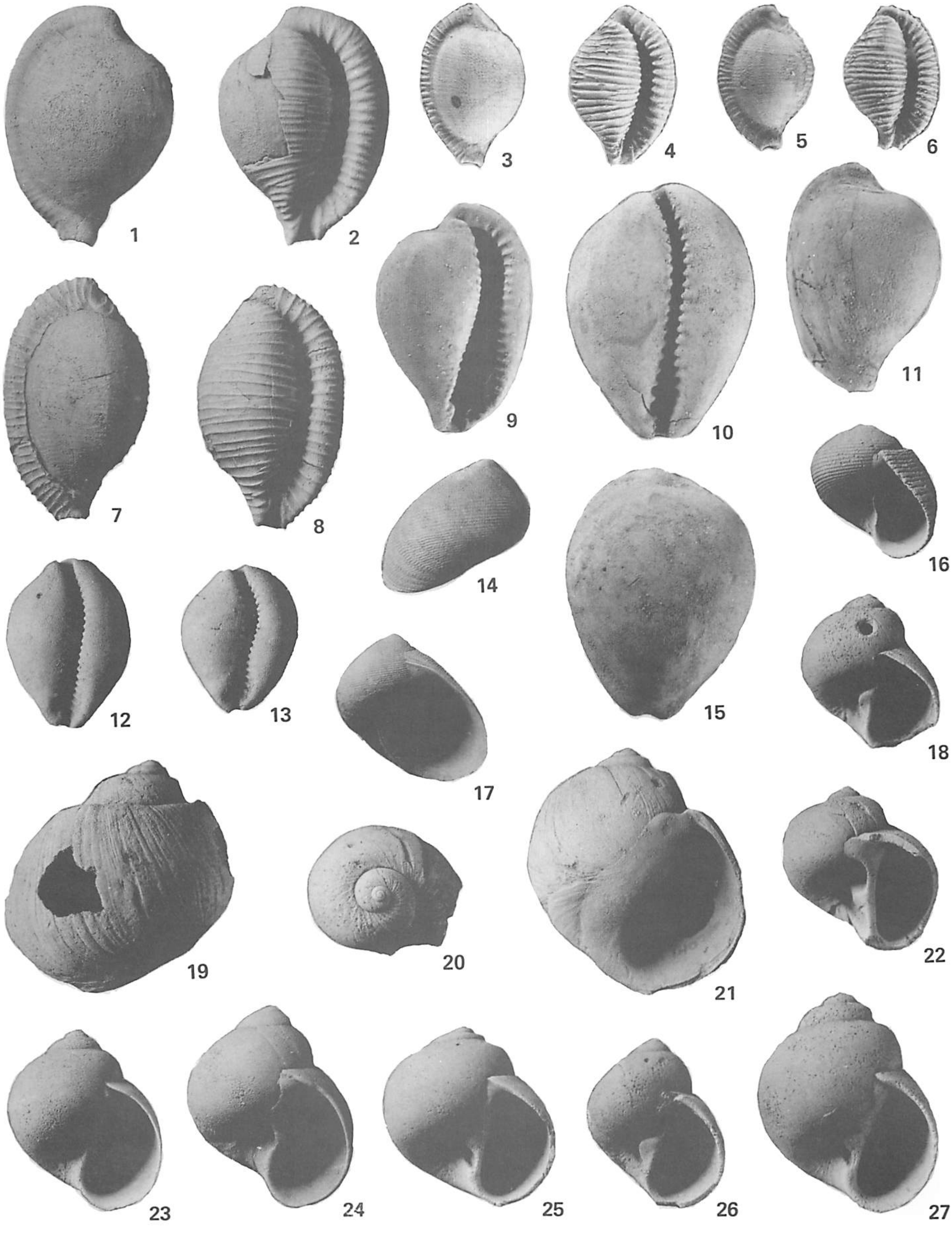


EXPLANATION PLATE 16
Mint Spring Formation

Figure		Page
1-2	**Sulcocypraea healeyi** (Aldrich, 1923)	101
	Figured specimen 498243 USNM (x2.5). USGS locality 14071a.	
3-8	**Sulcocypraea lintea menthafons** MacNeil n. subsp.	100-101
	3-4. Holotype 648912 USNM (x2). Height 15.3 mm, width 9.9 mm, elevation 7.6 mm; USGS locality 14071a. 5-6. Figured specimen 648913 USNM (x2.5). USGS locality 14071a. 7-8. Figured specimen 479984 USNM (x3). Height 15.7 mm, width 9.3 mm, elevation 7.5 mm; USGS locality 13287.	
9, 11	**Sulcocypraea** cf. **S. healeyi** (Aldrich, 1923)	101
	Figured specimen 648914 USNM (x2). Height 21.8 mm, width 14.4 mm, elevation 11.3 mm; USGS locality 14071a.	
10, 12, 15	**Cypraeorbis** aff. **C. ventripotens** (Cossmann, 1903)	98-100
	10, 15. Figured specimen 648916 USNM (x2). Height 24.6 mm, width 17.7 mm; USGS locality 14071a. 12. Figured specimen 498244 USNM (x1.5). USGS locality 14162.	
13	**Cypraeorbis** cf. **C. sphaeroides** (Conrad, 1848)	98
	Figured specimen 648915 USNM (x1.5). USGS locality 14162.	
14, 17	**Sinum (Sigaretotrema) mississippiensis** (Conrad, 1848)	95-96
	Figured specimen 498322 USNM (x1.5). Height 19.5 mm, width 19.3 mm; USGS locality 14071a.	
16	**Sigatica conradii** (Dall, 1892)	94-95
	Figured specimen 498321 USNM (x4). USGS locality 7671.	
18, 26	**Natica (Naticarius)** aff. **N. (N.) alazana** Cooke, 1928	92
	18. Figured specimen 498327 USNM (x4). Height 8.2 mm, width 6.9 mm; USGS locality 3727. 26. Figured specimen 498328 USNM (x4). USGS locality 13287.	
19, 21	**Ampullinopsis mississippiensis** (Conrad, 1848)	97
	Figured specimen 498319 USNM (x1.5). USGS locality?	
20, 22	**Natica (Naticarius) acuticallosa** MacNeil n. sp.	91-92
	Figured specimen 498329 USNM (x4). USGS locaLity 3727.	
23	**Euspira vicksburgensis cookei** MacNeil n. subsp.	93-94
	Holotype 498324 USNM (x4). Height 8.7 mm, width 7.7 mm; USGS locality 3727.	
24	**Euspira vicksburgensis** (Conrad, 1848)	93
	Figured specimen 498323 USNM (x3). USGS locality 6448.	
25, 27	**Natica (Natica) caseyi** MacNeil n. sp.	90-91
	25. Figured specimen 498325 USNM (x4). USGS locality 7671. 27. Figured specimen 498326 USNM (x4). USGS locality 13287.	

Mint Spring Formation

Plate 16



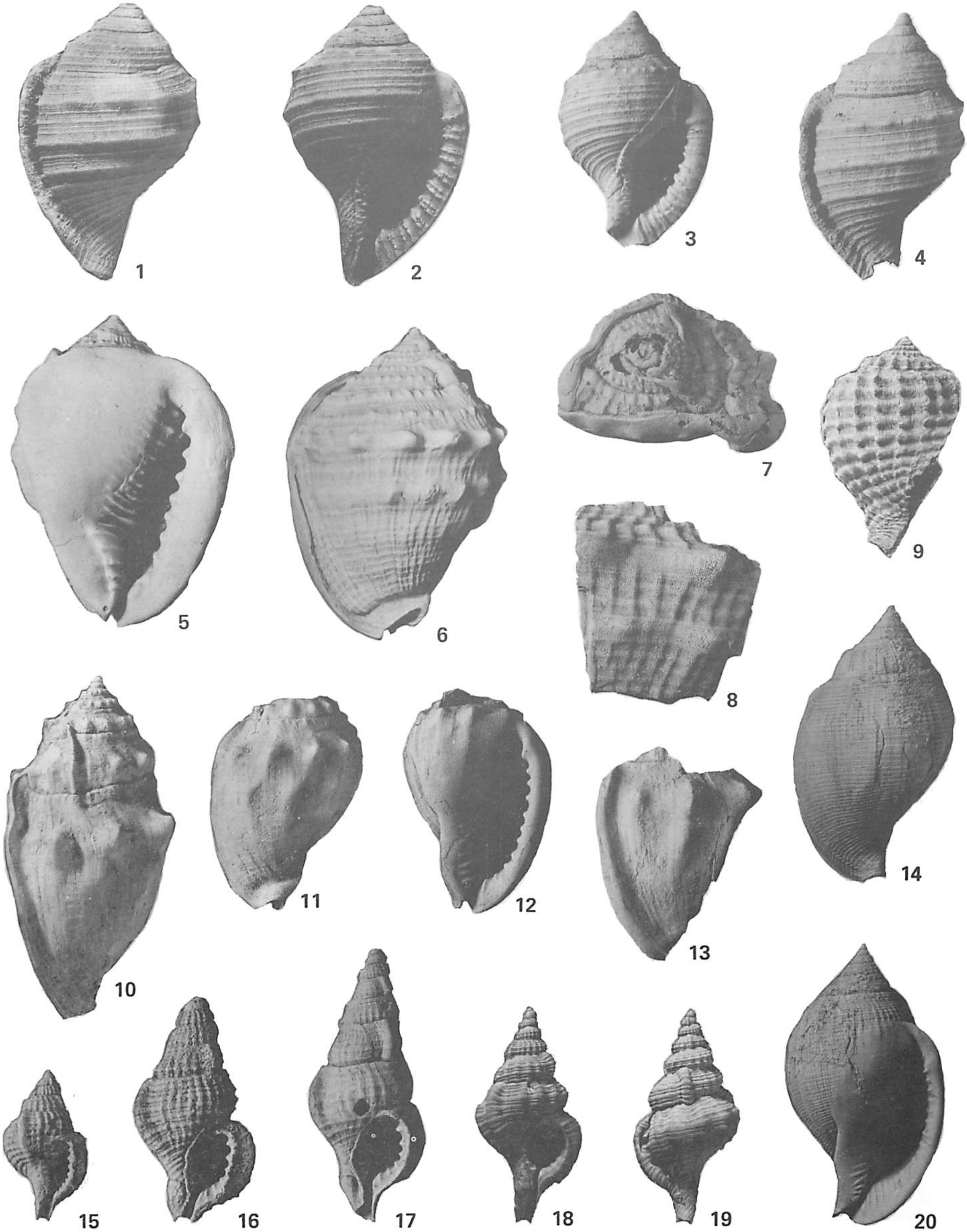
EXPLANATION PLATE 17

Mint Spring Formation

Figure		Page
1-4	**Galeodaria shubutensis gardnerae** MacNeil n. subsp.	108
	1-2. Holotype 376465 USNM (x2). Height 26.2 mm, width 16.9 mm; USGS locality 14071a.	
	3. Figured specimen 498237 USNM (x1.5). Height 30.1 mm, width 19.6 mm; USGS locality 14071a.	
	4. Figured specimen 376466 USNM (x2). Height 25.4 mm, width 15.6 mm; USGS locality 14071a.	
5-8	**Cassis flintensis** Mansfield, 1940	103-104
	5-6. Figured specimen 376467 USNM (x1). Height 58.6 mm, width 46.0 mm; USGS locality 12176a.	
	7. Specimen missing?	
	8. Figured specimen 498238 USNM (x1.5). Height (fragment) 25.6 mm, width 25.0 mm; USGS locality 12176.	
9	**Oniscidia harpula** (Conrad, 1848)	113-114
	Figured specimen 376468 USNM (x1.5). Height 28.2 mm, width 18.7 mm; USGS locality 14071a.	
10-13	**Phalium (Menthafontia) menthafons** MacNeil n. sp.	112
	10. Holotype 376469 USNM (x1). Height 66.5 mm, width (incomplete) as seen in illustration 32.0 mm; USGS locality 14071a.	
	11-12. Paratype 498240 USNM (x1.5). Height (incomplete) 29.1 mm, width 20 mm; USGS locality 14071a.	
	13. Figured specimen 376470 USNM (x1). Height (fragment) 41.3 mm, width 28.0 mm; USGS locality 14071a.	
14, 20	**Sconsia lintea** (Conrad, 1848)	109-110
	Figured specimen 4498241 USNM (x1.5). Height 36.5 mm, width 21.1 mm; USGS locality 14017a.	
15	**Sassia (Byramia) abbreviata** (Conrad, 1848) var.	119
	Figured specimen 498230 USNM (x2). Height 14.4 mm, width 8.5 mm; USGS locality 6452.	
16	**Sassia (Byramia) caseyi** MacNeil n. sp.	120
	Holotype 498232 USNM (x4). Height 10.7 mm, width 5.7 mm; USGS locality 14162.	
17	**Sassia (Cymatiella) fuscicava** MacNeil n. sp.	118
	Holotype 498233 USNM (x4). Height 13.0 mm, width 5.1 mm; USGS locality 7671.	
18-19	**Sassia (Sassia) conradiana menthafons** MacNeil n. subsp.	117-118
	Figured specimen 498229 USNM (x1.5). Height 28.2 mm, width 13.7 mm; USGS locality 7941.	

Mint Spring Formation

Plate 17

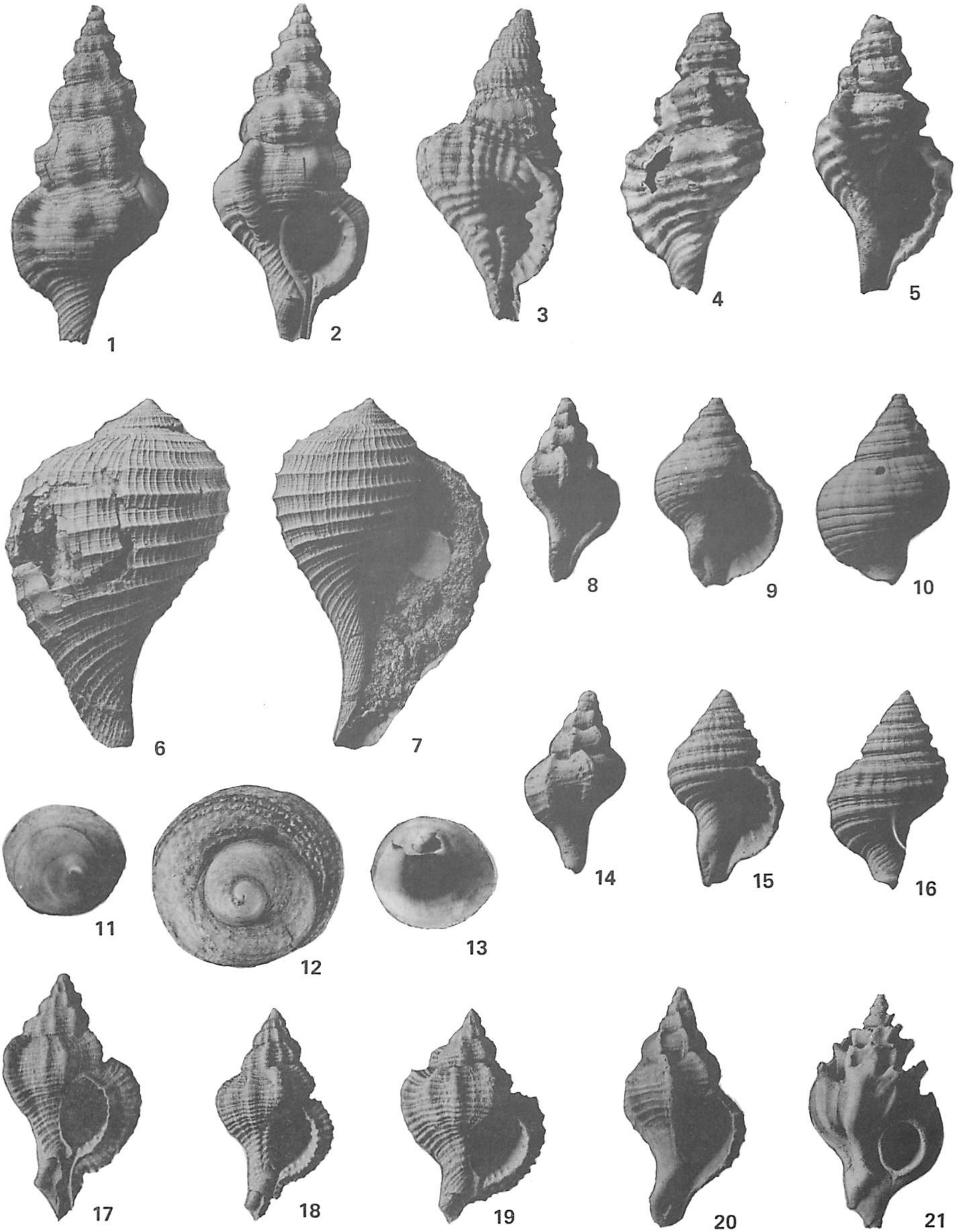


EXPLANATION PLATE 18
Mint Spring Formation

Figure		Page
1-2	**Sassia (Sassia) conradiana menthafons** MacNeil n. subsp.	117-118
	Holotype 498338 USNM (x1.5). Height 43.1 mm, width 19.6 mm; USGS locality 6647a.	
3	**Distorsio (Distorsio) crassidens** (Conrad, 1848)	121
	Figured specimen 498231 USNM (x1.5). Height 36.3 mm, width 19.6 mm; USGS locality 14071a.	
4-5	**Cymatium (Septa) amnicretum** MacNeil n. sp.	116
	Holotype 376471 USNM (x1.5). Height 36.8 mm, width 18.2 mm; USGS locality 14071a.	
6-7	**Ficus mississippiensis** Conrad, 1848	114-115
	Figured specimen 498242 USNM (x1.5). Height 45.6 mm, width 28.0 mm; USGS locality 14162.	
8, 14, 20	**Dermomurex (Takia) cookei** E. H. Vokes, 1975	127
	8, 14. Specimen missing? 20. Paratype B 498209 USNM (x4). Height 11.6 mm, width 7.3 mm; USGS locality 7671.	
9-10, 15-16	**Cymia (Tritonopsis) subalveata** (Conrad, 1848)	129
	9-10. Figured specimen 498210 USNM (x1.5). Height 24.2 mm, width 16.9 mm; USGS locality 259. 15-16. Figured specimen 498211 USNM (x1.5). Height 25.4 mm, width 15.1 mm; USGS locality 14162.	
11, 13	**Calyptraea (Trochita) conradi** MacNeil n. sp.	85
	Holotype 498316 USNM (x2). Diameter 11.4 mm, elevation 4.0 mm; USGS locality 13287.	
12	**Calyptraea (Trochita) cf. C. (T.) aperta** (Solander, 1766)	84-85
	Figured specimen 648908 USNM (x2). Diameter 24.0 mm, elevation 8.3 mm; USGS locality 14071a.	
17-19	**Chicoreus (Phyllonotus) mississippiensis** (Conrad, 1848)	122
	17. Figured specimen 498234 USNM (x2). Height 23.9 mm, width 13.4 mm; USGS locality 7671. 18. Figured specimen 376472 USNM (x2). Height 20.1 mm, width 11.1 mm; USGS locality 13287. 19. Figured specimen 498253 USNM (x2). Height 20.7 mm, width 14.1 mm; USGS locality 13287.	
21	**Siphonochelus (Laevityphis) curvirostratus** (Conrad, 1848)	128-129
	Figured specimen 498236 USNM (x3). Height 15.0 mm, width 8.6 mm; USGS locality 14162.	

Mint Spring Formation

Plate 18



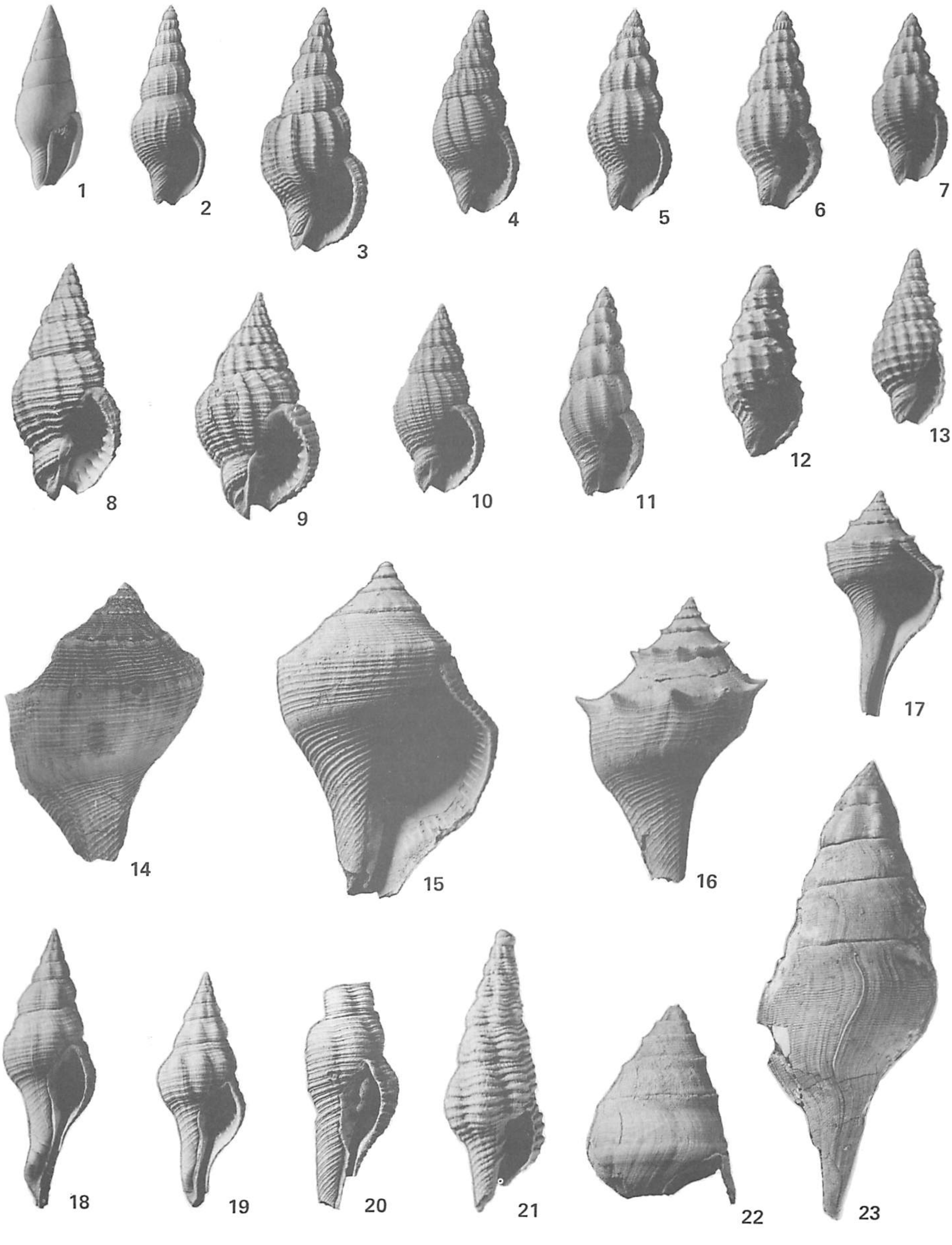
EXPLANATION PLATE 19

Mint Spring Formation

Figure		Page
1	**Mitrella (Columbellopsis) fuscicava** MacNeil n. sp. Holotype 498228 USNM (x6). Height 6.0 mm, width 2.1 mm; USGS locality 7671.	142
2, 3, 5?	**Tritiaria mississippiensis cookei** MacNeil n. subsp. 2. Figured specimen 498218 USNM (x3). Height 12.6 mm, width 4.6 mm; USGS locality 7671. 3. Holotype 498219 USNM (x3). Height 15.5 mm, width 6.7 mm; USGS locality 7671. 5? Figured specimen 498223 USNM (x3). Height 12.8 mm, width 5.3 mm; USGS locality 14071a.	134-135
4	**Tritiaria meyeri** MacNeil n. sp. Holotype 498220 USNM (x3). Height 13.0 mm, width 5.7 mm; USGS locality 13287.	137-138
6-7	**Tritiaria refugensis** MacNeil n. sp. 6. Holotype 498221 USNM (x4). Height 9.1 mm, width 3.9 mm; USGS locality 13287. 7. Figured specimen 498222 USNM (x4). Height 8.1 mm, width 3.5 mm; USGS locality 3727.	135-136
8, 10	**Phos (Strongylocera) vicksburgensis** (Aldrich, 1885) 8. Holotype 644613 USNM (x2). Height 22.8 mm, width 10.5 mm; Vicksburg, Mississippi (Aldrich). 10. Figured specimen 498226 USNM (x2). Height 18.2 mm, width 8.7 mm; USGS locality 14071a.	139-140
9	**Phos (Strongylocera) caseyi** MacNeil n. sp. Holotype 498227 USNM (x2). Heigth 21.9 mm, width 11.7 mm; USGS locality 6452.	140
11	**Tritiaria menthafons** MacNeil n. sp. Holotype 498225 USNM (x4). Height 9.9 mm, width 3.7 mm; USGS locality 14071a.	136
12	**Tritiaria cf. T. vaughani** MacNeil n. sp. Figured specimen 498224 USNM (x6). Height 6.2 mm, width 2.4 mm; USGS locality 3727.	137
13	**Phos (Antillophos) hopkinsi** MacNeil n. sp. Holotype 376473 USNM (x4). Height 8.2 mm, width 3.2 mm; USGS locality 7467.	138-139
14-15	**Levifusus nodulatum** (Conrad, 1849) 14. Specimen missing? 15. Figured specimen 498208 USNM (x2). Height 32.3 mm, width 21.1 mm; USGS locality 3140.	149-150
16-17	**Levifusus spiniger** (Conrad, 1848) 16. Figured specimen 498207 USNM (x2). Height 27.5 mm, width (including spines) 17.7 mm; USGS locality 14241. 17. Figured specimen 479967 USNM (x2). Height 21.3 mm, width 11.0 mm; USGS locality 13287.	148-149
18-19	**Latirus protractus** (Conrad, 1848) 18. Figured specimen 498213 USNM (x1.5). Height 36.5 mm, width 12.2 mm; USGS locality 14071a. 19. Figured specimen 498212 USNM (x1.5). Height 30.6 mm, width 11.5 mm; USGS locality 7671.	145
20-21	**Dolicholatirus perexilis** (Conrad, 1848) 20. Figured specimen 498196 USNM (x1.5). Height (incomplete) 29.4 mm, width (incomplete) 11.0 mm; USGS locality 14071a. 21. Figured specimen 376474 USNM (x6). Height (incomplete) 9.2 mm, width 3.0 mm; USGS locality 7671a.	146
22	**Clavilithes** sp. A Figured specimen 498217 USNM (x1). Height (incomplete) 39.0 mm, width (incomplete) 29.0 mm; USGS locality 14071a.	147
23	**Clavilithes vicksburgensis** (Conrad, 1849) Figured specimen 376475 USNM (x1). Height 93.7 mm, width 33.2 mm; USGS locality 14241.	147

Mint Spring Formation

Plate 19



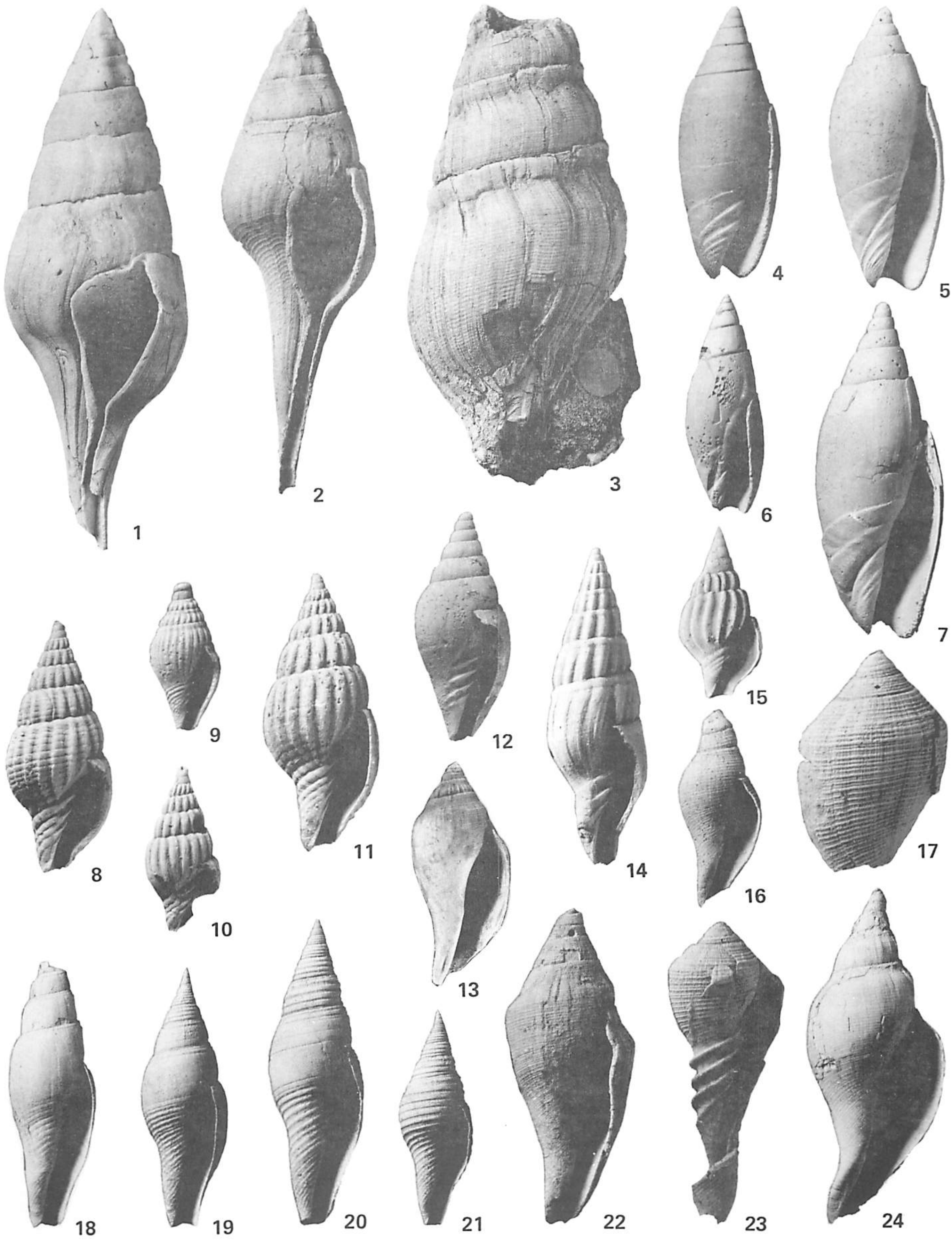
EXPLANATION PLATE 20

Mint Spring Formation

Figure		Page
1-3	**Clavilithes vicksburgensis** (Conrad, 1849)	147
	1. Figured specimen 498214 USNM (x1). Height 101.5 mm, width 36.4 mm; USGS locality 259.	
	2. Figured specimen 498216 USNM (x1.5). Height 61.5 mm as figured (present height 48.7 mm with half of canal missing), width 20.8 mm; USGS locality 14071a.	
	3. Specimen missing?	
4-5, 7	**Oliva (Strephonella) affluens** (Casey, 1903)	157-158
	4. Figured specimen 498189 USNM (x3). Height 17.0 mm, width 6.6 mm; USGS locality 14071a.	
	5. Figured specimen 498190 USNM (x3). Height 17.5 mm, width 7.7 mm; USGS locality 13287.	
	7. Figured specimen 376476 USNM (x3). Height 21.2 mm, width 8.1 mm; USGS locality 14071a.	
6	**Olivella (Callianax) vicksburgensis** Dockery n. sp.	158
	Holotype 498191 USNM (x4). Height 10.3 mm, width 3.7 mm; USGS locality 13287.	
8, 10-11	**Vexillum (Costellaria) multicostata** Dockery var.?	162
	8. Figured specimen 498207 USNM (x6). Height 8.0 mm, width 3.3 mm; USGS locality 7671.	
	10. Figured specimen 498204 USNM (x6). Height 5.3 mm, width 2.3 mm; USGS locality 7671.	
	11. Figured specimen 498205 USNM (x6). Height 8.9 mm, width 3.6 mm; USGS locality 7671.	
9	**Conomitra crenulata modesta** Dockery n. subsp.	154-155
	Holotype 498195 USNM (x6). Height 4.7 mm, width 2.1 mm; USGS locality 7671.	
12	**Conomitra vicksburgensis laevigata** Dockery n. subsp.	154
	Holotype 498194 USNM (x6). Height 7.5 mm, width 3.0 mm; USGS locality 13287.	
13, 16, 24	**Caricella (Atraktus) demissa** Conrad, 1848 var. B	152
	13. Figured specimen 376477 USNM (x1.5). Height 28.5 mm, width 12.5 mm; USGS locality 14071a.	
	16. Figured specimen 498198 USNM (x3). Height 12.6 mm, width 5.3 mm; USGS locality 6452.	
	24. Figured specimen 498197 USNM (x1.5). Height 42.0 mm, width (outer lip broken after photographed) 17.0 mm; USGS locality 14071a. Specimen is flattened in the plane of view.	
14	**Vexillum (Costellaria) laevicostata** Dockery n. sp.	162
	Holotype 498337 USNM (x6). Height 10.4 mm, width 3.2 mm; USGS locality 6647.	
15	**Vexillum (Costellaria) multicostata** Dockery n. sp.	162
	Figured specimen 498203 USNM (x10). Height 3.1 mm, width 1.4 mm; USGS locality 7671.	
17, 22-23	**Caricella (Atraktus) reticulata** (Aldrich, 1885)	152-153
	17. Figured specimen 498334 USNM (x3). Height (incomplete) 14.1 mm, width 9.0 mm; USGS locality 6647.	
	22. Figured specimen 498336 USNM (x2.5). Height 24.3 mm, width 10.0 mm; USGS locality 14203.	
	23. Figured specimen 376478 USNM (x3). Height 19.5 mm, width (incomplete) 7.3 mm; USGS locality 6647.	
18-21	**Mitra (Fusimitra) conquisita** Conrad, 1848	159-160
	18. Figured specimen 376479 USNM (x1.5). Height (incomplete) 33.0 mm; USGS locality 14071a.	
	19. Figured specimen 498202 USNM (x2). Height 24.6 mm, width 8.3 mm; USGS locality 14071a.	
	20. Figured specimen 148200 USNM (x1.5). Height 39.4 mm, width 12.0 mm; USGS locality 14071a.	
	21. Figured specimen 498199 USNM (x2). Height 21.0 mm, width 7.2 mm; USGS locality 7671.	

Mint Spring Formation

Plate 20



EXPLANATION PLATE 21

Mint Spring Formation

Figure		Page
1-2	**Caricella (Atraktus) sp.** Figured specimen 498335 USNM (x3). Height 21.0 mm, width (flattened in plane of view) 9.0 mm; USGS locality 14203.	153
3	**Caricella (Atraktus) demissa** Conrad, 1848 var. B. Figured specimen 376480 USNM (x1). Height 53.2 mm, width (flattened normal to plane of view) 18.7 mm; USGS locality 14071a.	152
4, 7	**Lyria (Lyria) mississippiensis** (Conrad, 1848). Figured specimen 376481 USNM (x2). Height 29.1 mm, width 13.7 mm; USGS locality 14849.	150-151
5-6	**Persicula vicksburgensis** Dockery n. sp. 5. Figured specimen 498192 USNM (x6). Height 5.3 mm, width 3.4 mm; USGS locality 14162. 6. Figured specimen 498193 USNM (x6). Height 5.4 mm, width 3.2 mm; USGS locality 3727.	159
8-9	**Admetula inflata** Dockery n. sp. 8. Figured specimen 376482 USNM (x4). Height 11.1 mm, width 8.1 mm; USGS locality 13287. 9. Figured specimen 498186 USNM (x4). Height 10.3 mm, width 7.6 mm; USGS locality 13287.	164
10, 12	**Olssonella elongata** Dockery n. sp. 10. Figured specimen 498188 USNM (x6). Height 7.6 mm, width 3.7 mm; USGS locality 3727. 12. Figured specimen 376483 USNM (x6). Height 6.1 mm, width 2.8 mm; USGS locality 3727.	163
11	**Agatrix mississippiensis** (Conrad, 1848). Figured specimen 498187 USNM (x4). Height 8.4 mm, width 5.0 mm; USGS locality 13287.	163-164
13	**Pleuroliria cochlearis vetula** MacNeil n. sp. Holotype 498157 USNM (x2). Height 19.1 mm, width 5.5 mm; USGS locality 14162.	177-178
14	**Gemmula mediosa** MacNeil n. sp. Holotype 498158 USNM (x3). Height 16.0 mm, width 4.7 mm; USGS locality 7671.	172
15	**Coronia (Coroniopsis) tenella antetenella** MacNeil n. subsp. Holotype 498159 USNM (x2). Height 27.0 mm, width 8.1 mm; USGS locality 14071a.	175
16-18	**Bathytoma congesta fontis** MacNeil n. subsp. 16. Holotype 498160 USNM (x2). Height 26.3 mm, width 10.5 mm; USGS locality 13287. 17. Figured specimen 376484 USNM (x1.5). Height 33.9 mm, width 11.9 mm; USGS locality 6448a. 18. Figured specimen 376485 USNM (x2.5). Height 15.8 mm, width 6.9 mm; USGS locality 14071a.	214-215
19	**Cochlespira cookei** MacNeil n. sp. Holotype 498161 USNM (x2.5). Height 18.4 mm, width 7.3 mm; USGS locality 14071a.	196
20-21, 28	**Pleurofusia longirostropsis bicollaris** MacNeil n. subsp. 20-21. Holotype 376486 USNM (x2). Height 22.8 mm, width 8.1 mm; USGS locality 14162. 28. Figured specimen 376486 USNM (x2). Height 29.0 mm, width 9.6 mm; USGS locality 6448a.	183
22-23	**Pleurofusia servata** (Conrad, 1848) 22. Figured specimen 376488 USNM (x3). Height 12.5 mm, width 4.5 mm; USGS locality 13287. 23. Figured specimen 376489 USNM (x3). Height 11.3 mm, width 4.2 mm; USGS locality 13287.	186-187
24	**Pleurofusia (Xestosurcula) plutonica** (Casey, 1903). Figured specimen 498166 USNM (x4). Height 8.7 mm, width 3.0 mm; USGS locality 7671.	191
25-26	**Pleurofusia wythei** MacNeil n. sp. 25. Figured specimen 376490 USNM (x3). Height 6.6 mm, width incomplete; USGS locality 7467. 26. Figured specimen 376491 USNM (x3). Height 9.6 mm, width 3.2 mm; USGS locality 7467.	184
27	**Pleurofusia menthafons** MacNeil n. sp. Figured specimen 498163 USNM (x1.5). Height 36.9 mm, width incomplete; USGS locality 14162.	185-186

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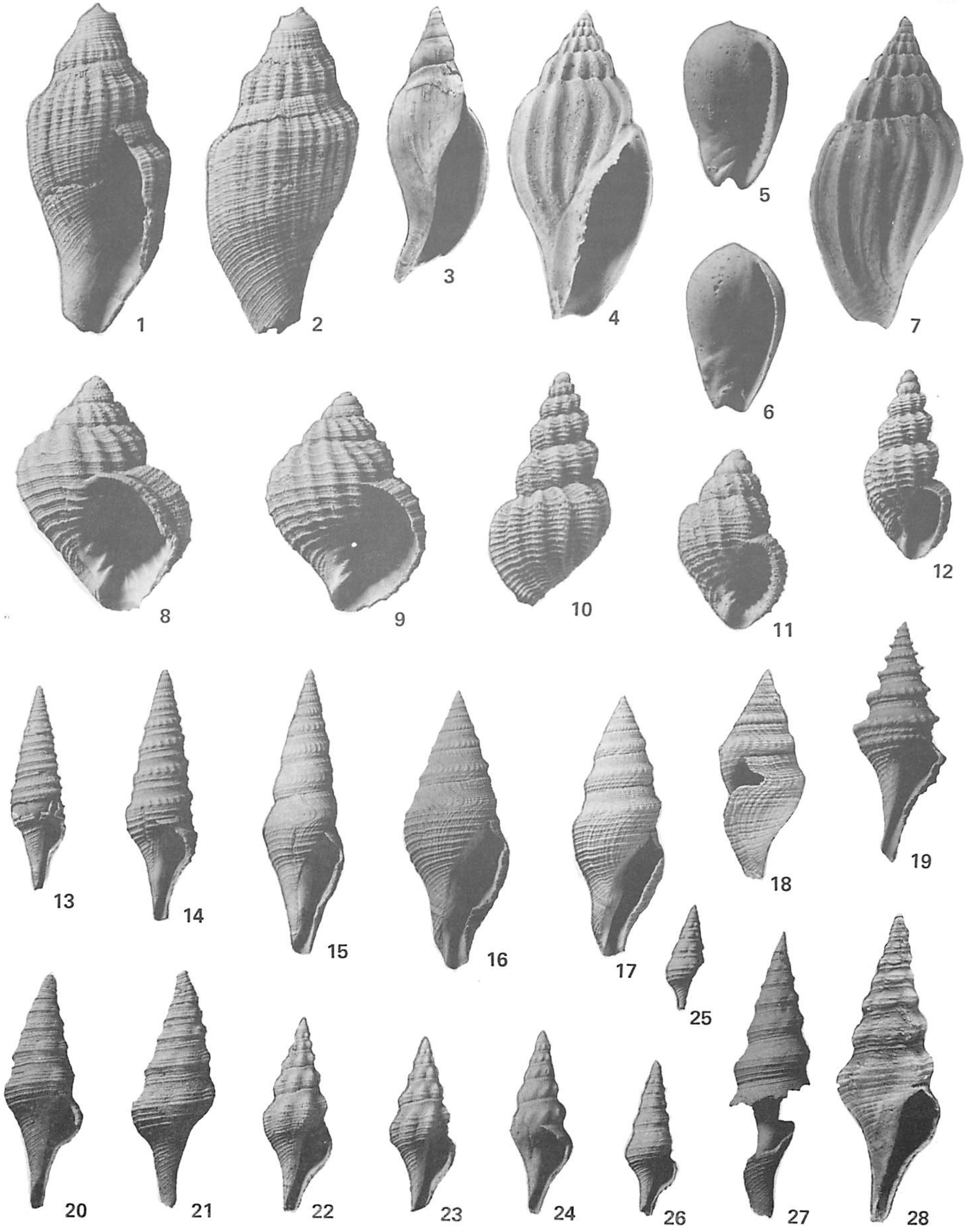

EXPLANATION PLATE 22

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Figure		Page
1-2	**Pleurofusia servata** (Conrad, 1848) Figured specimen 498164 USNM (x2.5). Height 17.8 mm, width 6.0 mm; USGS locality 14162.	186-187
3	**Pleurofusia servata** (Conrad, 1848) var. B Holotype 376492 USNM (x3). Height 17.7 mm, width 5.7 mm; USGS locality 14071a.	188
4-5	**Pleurofusia menthafons** MacNeil n. sp. 4. Figured specimen 376493 USNM (x3). Height (canal broken) 14.3 mm, width 5.8 mm; USGS locality 7671. 5. Holotype 498162 USNM (x2). Height 24.3 mm, width 8.5 mm; USGS locality 14162.	185-186
6	**Pleurofusia menthafons** MacNeil var. A Figured specimen 376494 USNM (x3). Height 16.6 mm, width 6.1 mm; USGS locality 3727.	186
7	**Pleurofusia (Xestosurcula) plutonica** (Casey, 1903) Figured specimen 498165 USNM (x3). Height 13.9 mm, width 5.0 mm; USGS locality 3727.	191
8-12	**Pleurofusia clarkeana juba** MacNeil n. subsp. 8. Holotype 376495 USNM (x3). Height 14.9 mm, width 5.7 mm; USGS locality 7671. 9. Figured specimen 376496 USNM (x3). Height 10.9 mm, width 3.9 mm; USGS locality 7671. 10. Figured specimen 376497 USNM (x3). Height 10.5 mm, width (incomplete) 4.8 mm; USGS locality 7671. 11-12. Figured specimen 498333 USNM (x3). Height (about 1.5 mm of canal broken off after photographed) as broken 12.3 mm, width 5.5 mm; USGS locality 6647a.	188-187
13-14	**Pleurofusia clarkeana fascia** MacNeil n. subsp. 13. Specimen missing? 14. Holotype 376498 USNM (x3). Height 15.4 mm, width 5.1 mm; USGS locality 7671.	189
15	**Fusiturricula ichusa** MacNeil n. sp. Holotype 376499 USNM (x2). Height 35.1 mm, width 9.3 mm; USGS locality 14849a.	193
16, 28	**Microsurcula mentha** MacNeil var. A 16. Figured specimen 376500 USNM (x3). Height 9.7 mm, width 3.5 mm; USGS locality 7671. 28. Figured specimen 376501 USNM (x3). Height 13.5 mm, width 4.6 mm; USGS locality 7671.	198
17-19	**Microsurcula mentha** MacNeil n. sp. 17. Figured specimen 376502 USNM (x6). Height 6.1 mm, width 2.3 mm; USGS locality 7671. 18. Holotype 376503 USNM (x6). Height 6.5 mm, width 2.5 mm; USGS locality 7671. 19. Figured specimen 376504 USNM (x6). Height 6.0 mm, width 2.8 mm; USGS locality 3727.	198
20-21	**Tropisurcula caseyi** (Aldrich, 1903) 20. Figured specimen 498167 USNM (x4). Height 10.0 mm, width 3.3 mm; USGS locality 7671. 21. Figured specimen 376505 USNM (x4). Height 11.3 mm, width 4.1 mm; USGS locality 7671.	192-193
22-26	**Syntomodrillia funis** MacNeil n. sp. 22. Holotype 498172 USNM (x6). Height 7.6 mm, width 2.5 mm; USGS locality 7671. 23-24. Figured specimen 376506 USNM (x6). Height 7.5 mm, width 2.4 mm; USGS locality 7671. 25-26. Figured specimen 376507 USNM (x6). Height 5.9 mm, width 2.2 mm; USGS locality 7671.	202
27, 34	**Vetidrillia palmerae** MacNeil n. sp. 27. Figured specimen 376508 USNM (x3). Height 11.0 mm, width 4.5 mm; USGS locality 7671. 34. Holotype 498174 USNM (x3). Height 13.5 mm, width 4.7 mm; USGS locality 7671.	203
29-32	**Syntomodrillia funis** MacNeil var. A 29-30. Figured specimen 376509 USNM (x6). Height 6.0 mm, width 2.2 mm; USGS locality 7671. 31-32. Figured specimen 498170 USNM (x6). Height 6.8 mm, width 2.6 mm; USGS locality 7671.	202
33	**Amyssodropa clearyensis** MacNeil n. sp. Figured specimen 376510 USNM (x6). Height 6.1 mm, width 1.8 mm; USGS locality 14071a.	194

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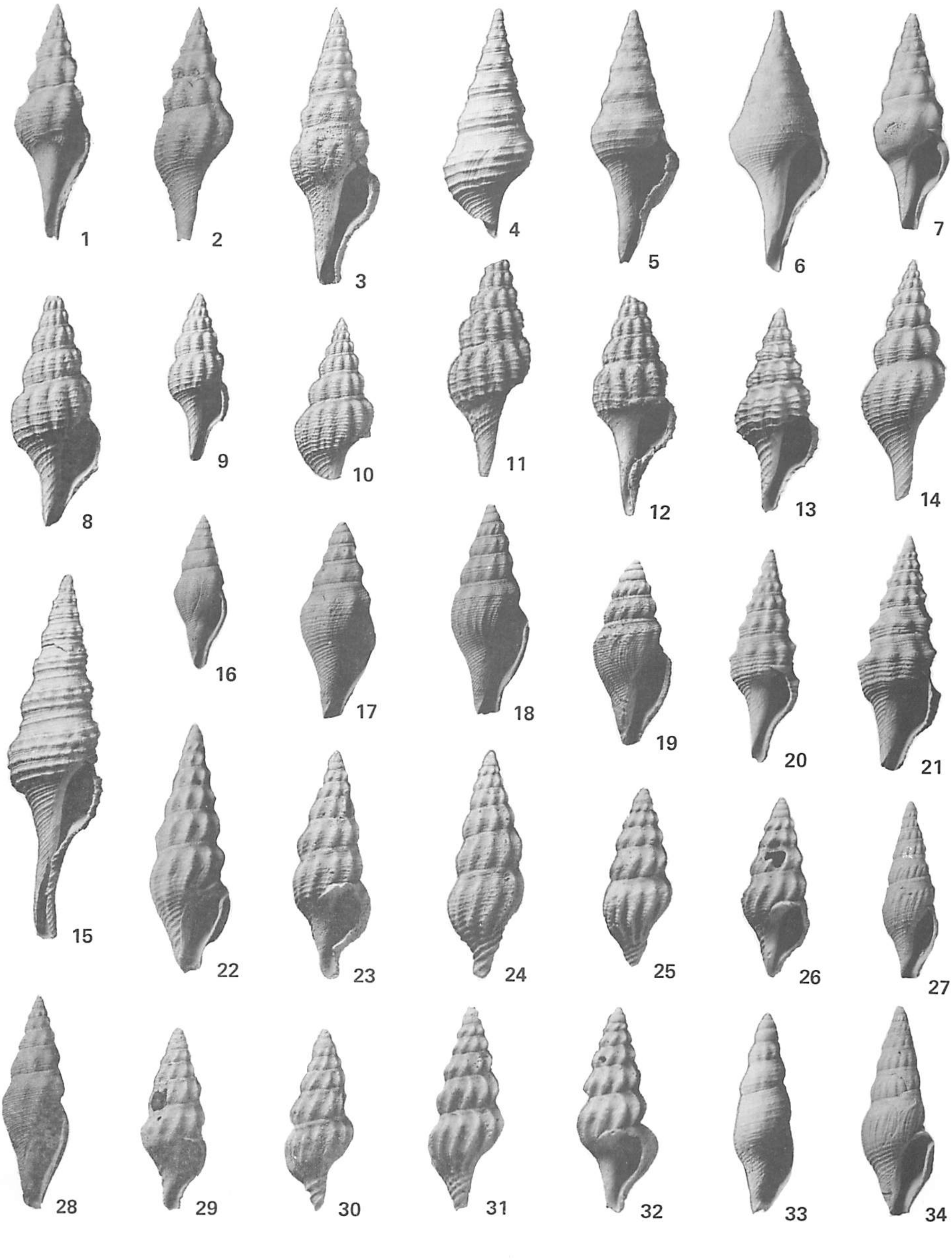

EXPLANATION PLATE 23

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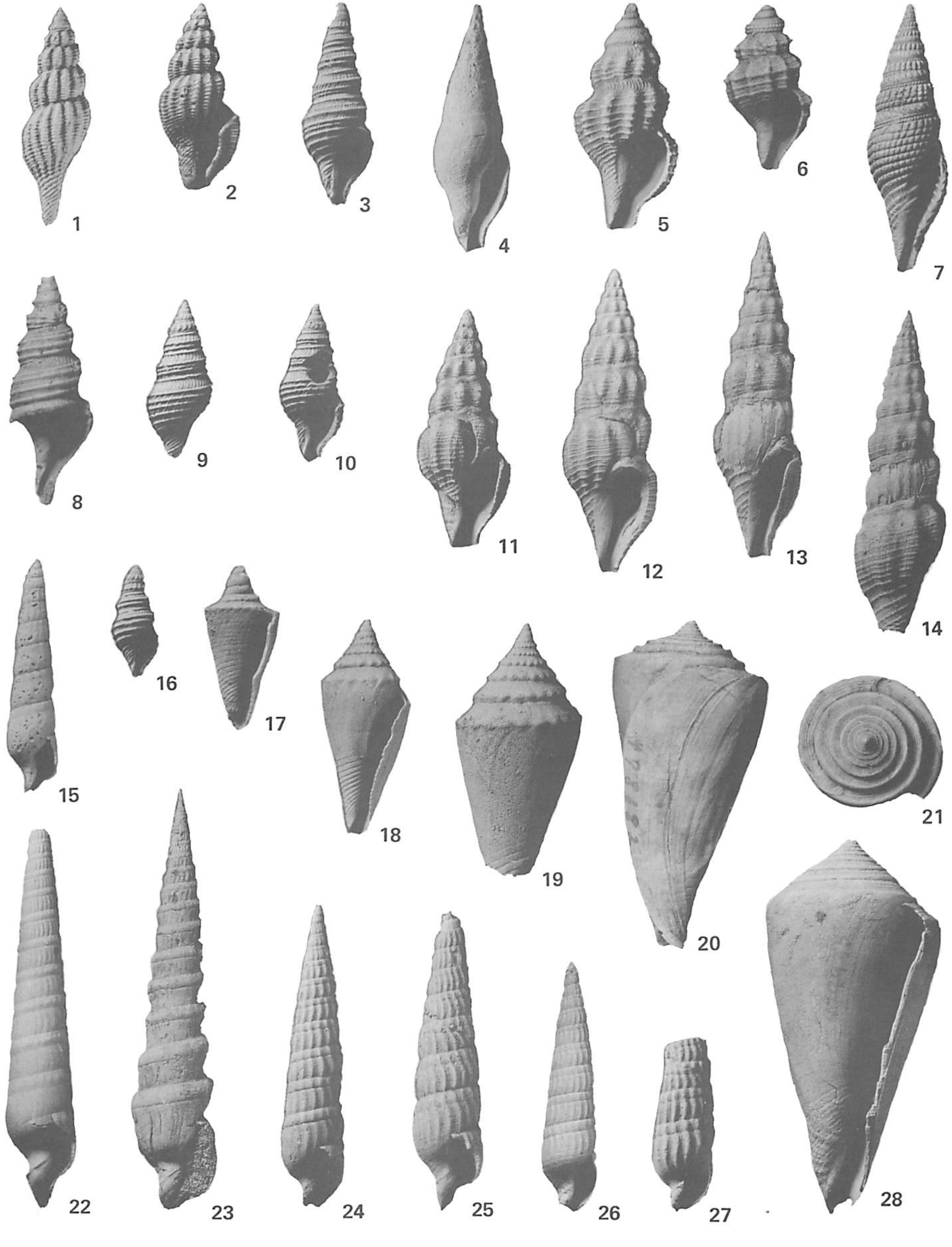
Figure		Page
1-2	**Clathurella meyeri sylvarenensis** MacNeil n. subsp.	216-217
	1. Figured specimen 376511 USNM (x6). Height 7.1 mm, width 2.3 mm; USGS locality 7671.	
	2. Holotype 498178 USNM (x6). Height 6.0 mm, width 2.5 mm; USGS locality 7671.	
3, 16	**Microdrillia vicksburgella** Casey, 1903	208
	3. Figured specimen 498180 USNM (x6). Height 6.7 mm, width 2.2 mm; USGS locality?	
	16. Specimen missing?	
4	**Amyssodropa clearyensis** MacNeil n. sp.	194
	Holotype 376512 USNM (x3). Height 15.9 mm, width 4.8 mm; USGS locality 14071a.	
5	**Phandella transemma** MacNeil n. sp.	220
	Holotype 498177 USNM (x12). Height 3.5 mm, width 1.5 mm; USGS locality 7671.	
6	**Kurtziella protatrostyla** MacNeil n. sp.	218
	Holotype 376513 USNM (x12). Height 2.7 mm, width 1.4 mm; USGS locality 3727.	
7	**Scobinella pluriplicata subpluriplicata** MacNeil n. subsp.	212
	Holotype 498181 USNM (x2). Height 25.2 mm, width 8.0 mm; USGS locality 14071.	
8	**Spiradaphne lowei refugium** MacNeil n. subsp.	221
	Holotype 376514 USNM (x12). Height 3.6 mm, width (incomplete) 1.4 mm; USGS locality 3727.	
9-10	**Microdrillia brevis gemma** MacNeil n. subsp.	210
	Holotype 498179 USNM (x6). Height 5.1 mm, width 2.0 mm; USGS locality 7671.	
11	**Mitodrillia harmonica** (Casey, 1903)	206-207
	Holotype 481665 USNM (x4). Height 11.2 mm, width 4.2 mm; "Lower Vicksburg," Vicksburg, Mississippi (Casey).	
12	**Mitodrillia pharus crassispiropsis** MacNeil n. subsp.	207
	Holotype 498175 USNM (x3). Height 19.1 mm, width 6.0 mm; USGS locality 7671.	
13-14	**Mitodrillia pharus** MacNeil n. sp.	207
	Holotype 498176 USNM (x3). Height 20.5 mm (present height 19.1 mm due to loss of early whorls), width 5.6 mm; USGS locality 13287.	
15	**Terebra (Laeviterebrum) spinula** MacNeil n. sp.	170-171
	Holotype 498144 USNM (x6). Height 7.5 mm, width 1.6 mm; USGS locality 3727.	
17, 20-21, 28	**Conus alveatus** Conrad, 1865	164-165
	17. Figured specimen 498183 USNM (x6). Height 5.3 mm, width 2.4 mm; USGS locality 7671.	
	20. Figured specimen 498182 USNM (x1.5). Height 40.6 mm, width (flattened in plane of view) 19.9 mm, small diameter 18.9 mm; USGS locality 14162.	
	21. Figured specimen 376515 USNM (x1). Height incomplete, width 28.1 mm; USGS locality 13287.	
	28. Figured specimen 479935 USNM (x1.5). Height 47.9 mm, width 23.2 mm; USGS locality 13287.	
18-19	**Conus protractus** Meyer, 1885	165-166
	18. Figured specimen 498185 USNM (x3). Height 13.7 mm, width 6.9 mm; USGS locality 13287.	
	19. Figured specimen 498184 USNM (x3). Height (incomplete) 16.4 mm, width 8.1 mm; USGS locality 14162.	
22-23	**Terebra (Terebrellina) divisura clearyensis** MacNeil n. subsp.	167
	22. Holotype 498151 USNM (x1.5). Height 48.1 mm, width 9.3 mm; USGS locality 14071a.	
	23. Figured specimen 498149 USNM (x1.5). Height 54.5 mm, width (flattened in plane of view and incomplete on opposite side) 10.6 mm; USGS locality 14162.	
24-27	**Terebra (Strioterebrum) alaba** MacNeil n. sp.	169-170
	24. Figured specimen 498148 USNM (x4). Height 14.4 mm, width 2.9 mm; USGS locality 7671.	
	25. Figured specimen 498147 USNM (x4). Height 14.3 mm, width 3.3 mm; USGS locality 13287.	
	26. Figured specimen 560926 USNM (x4). Height 11.9 mm, width 2.6 mm; USGS locality 7671.	
	27. Figured specimen 376516 USNM (x4). Height 8.2 mm, width 2.8 mm; USGS locality 7671.	

Mint Spring Formation **Plate 23**

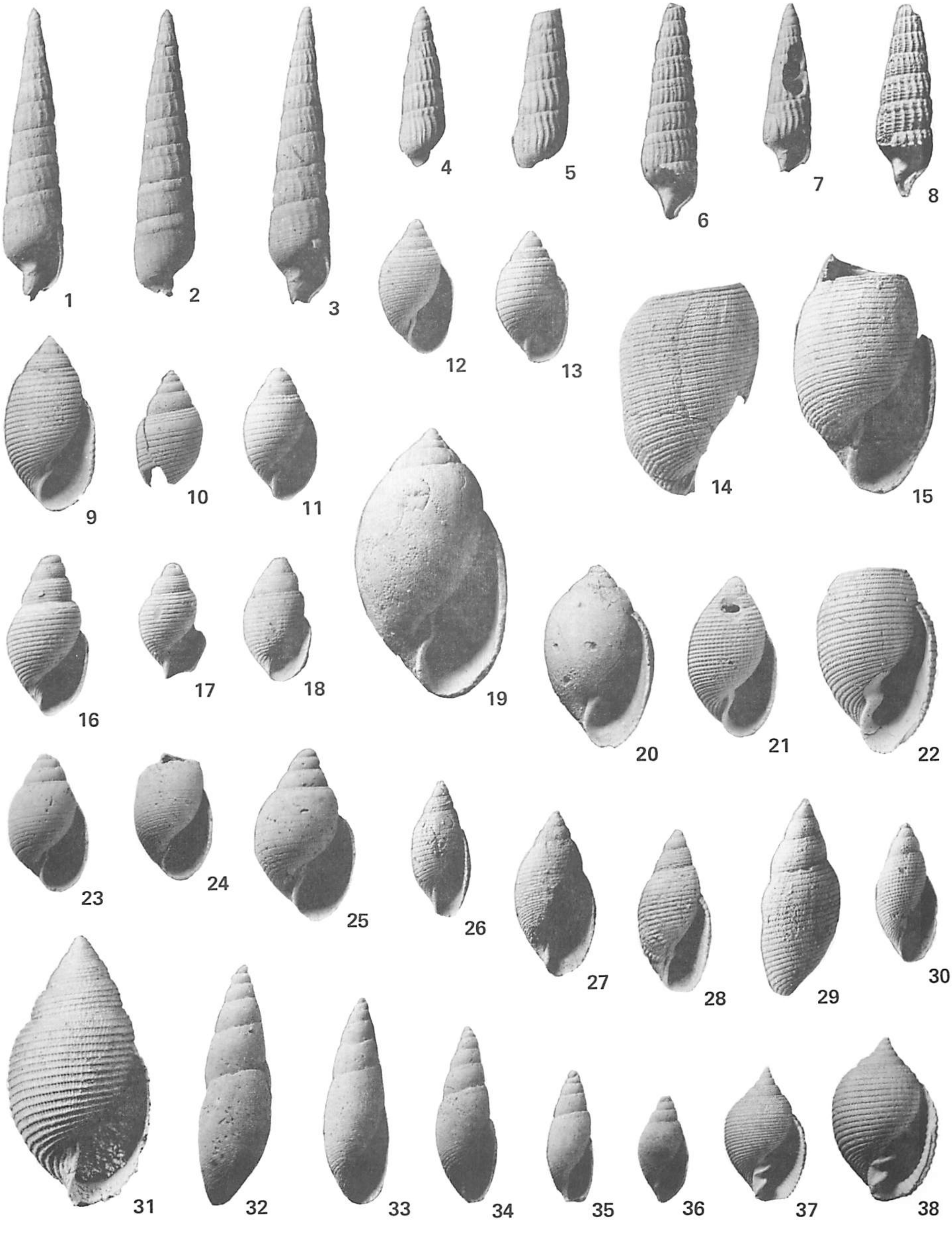


EXPLANATION PLATE 24
Mint Spring Formation

Figure		Page
1-7	**Terebra (Strioterebrum) alaba** MacNeil n. sp.	169-170
	1-2. Figured specimen 498146 USNM (x4). Height 13.6 mm, width 3.0 mm; USGS locality 14071.	
	3. Holotype 498145 USNM (x4). Height 14.2 mm, width 2.9 mm; USGS locality 7671.	
	4. Figured specimen 479937 USNM (x6). Height 5.1 mm, width 1.4 mm; USGS locality 13287.	
	5. Figured specimen 376517 USNM (x6). Height (incomplete) 5.0 mm, width 1.9 mm; USGS locality 13287.	
	6. Figured specimen 498148 USNM (x4). Height (incomplete) 10.4 mm, width 2.6 mm; USGS locality 7671.	
	7. Figured specimen 376518 USNM (x6). Height 5.4 mm, width 1.5 mm; USGS locality 13287.	
8	**Terebra (Strioterebrum) vincta** MacNeil n. sp.	170
	Figured specimen 560928 USNM (x5). Height (incomplete) 7.2 mm, width 2.2 mm; USGS locality 7671.	
9, 21?, 22	**Acteon (Acteon) prextextilis** MacNeil n. sp.	228
	9. Holotype 498122 USNM (x5). Height 6.6 mm, width 3.4 mm; USGS locality 13287.	
	21? Figured specimen 560798 USNM (x6). Height 5.2 mm, width 2.9 mm; USGS locality 7671.	
	22. Paratype 560796 USNM (x3). Height (incomplete) 11.9 mm, width 7.9 mm; USGS locality 3725.	
10-15	**Acteon (Acteon) meyeri** MacNeil n. sp.	228
	10? Figured specimen 498120 USNM (x6). Height (incomplete, with part of body whorl broken after being photographed) at present 3.7 mm; USGS locality 3727.	
	11? Figured specimen 376519 USNM (x8). Height 3.0 mm, width 1.8 mm; USGS locality 7671.	
	12. Holotype 560795 USNM (x6). Height 4.3 mm, width 2.4 mm; USGS locality 14072.	
	13. Specimen missing?	
	14. Figured specimen 498118 USNM (x4). Height (fragment) 10.1 mm, width 6.6 mm; USGS locality 3727.	
	15. Paratype 498117 USNM (x4). Height (incomplete) 11.5 mm, width 6.8 mm; USGS locality 13287.	
16-18	**Acteon (Acteon) preluculi** MacNeil n. sp.	229
	16. Holotype 498121 USNM (x8). Height 3.9 mm, width 1.9 mm; USGS locality 3727.	
	17. Figured specimen 376520 USNM (x8). Height (incomplete) 2.9 mm, width (incomplete) 1.0 mm; USGS locality 13287.	
	18. Figured specimen 560799 USNM (x10). Height 2.4 mm, width 1.3 mm; USGS locality 7671.	
19-20	**Acteon (Acteon) aldrichi** MacNeil n. sp.	228-229
	19. Holotype 498125 USNM (x4). Height 13.0 mm, width 7.4 mm; USGS locality 6448.	
	20. Paratype 498124 USNM (x5). Height incomplete at present (early whorls have broken and fallen into shell after being photographed), width 4.2 mm; USGS locality 3727.	
23, 25	**Acteon (Acteon) menthafons** MacNeil n. sp.	230
	23. Figured specimen 560800 USNM (x8). Height 3.4 mm, width 1.9 mm; USGS locality 7671.	
	25. Holotype 498123 USNM (x8). Height 4.0 mm, width 2.4 mm; USGS locality 7671.	
24	**Acteon (Acteon) sp. A**	230
	Figured specimen 560802 USNM (x6). Height (incomplete) 4.1 mm, width 2.5 mm; USGS locality 3727.	
26-30	**Rictaxis andersoni** (Conrad, 1848)	231-232
	26. Figured specimen 560804 USNM (x6). Height (outer lip broken off after photographed) at present 4.5 mm; USGS locality 2664.	
	27. Figured specimen 498119 USNM (x4). Height 8.0 mm, width 3.8 mm; USGS locality 14162.	
	28. Figured specimen 498116 USNM (x6). Height 5.4 mm, width 2.4 mm; USGS locality 13287.	
	29. Figured specimen 560805 USNM (x6). Height 6.3 mm, width 2.5 mm; USGS locality 2664.	
	30. Figured specimen 376521 USNM (x6). Height 4.5 mm, width 2.0 mm; USGS locality 2664.	
31	**Acteon (Kleinacteon) puteatus** MacNeil n. sp.	230-231
	Holotype 560803 USNM (x4). Height 12.8 mm, width 6.9 mm; USGS locality 14071.	
32-36	**Crenilabium paucicrenulatus** MacNeil n. sp.	232-233
	32. Figured specimen 560806 USNM (x6). Height 8.0 mm, width 2.4 mm; USGS locality 14071a.	
	33. Holotype 498126 USNM (x6). Height 6.4 mm, width 2.0 mm; USGS locality 14071a.	
	34. Figured specimen 376522 USNM (x6). Height 5.9 mm, width 1.9 mm; USGS locality 14071a.	
	35. Paratype 560808 USNM (x6). Height 4.5 mm, width 1.6 mm; USGS locality 7671a.	
	36. Paratype 560807 USNM (x6). Specimen broken after photographed; USGS locality 14071a.	
37-38	**Tornatellaea brevispira** MacNeil n. sp.	233-234
	37. Paratype 498128 USNM (x2). Height 12.9 mm, width 8.2 mm; USGS locality 13287.	
	38. Holotype 498127 USNM (x2). Height 15.6 mm, width 10.5 mm; USGS locality 14162.	

Mint Spring Formation

Plate 24

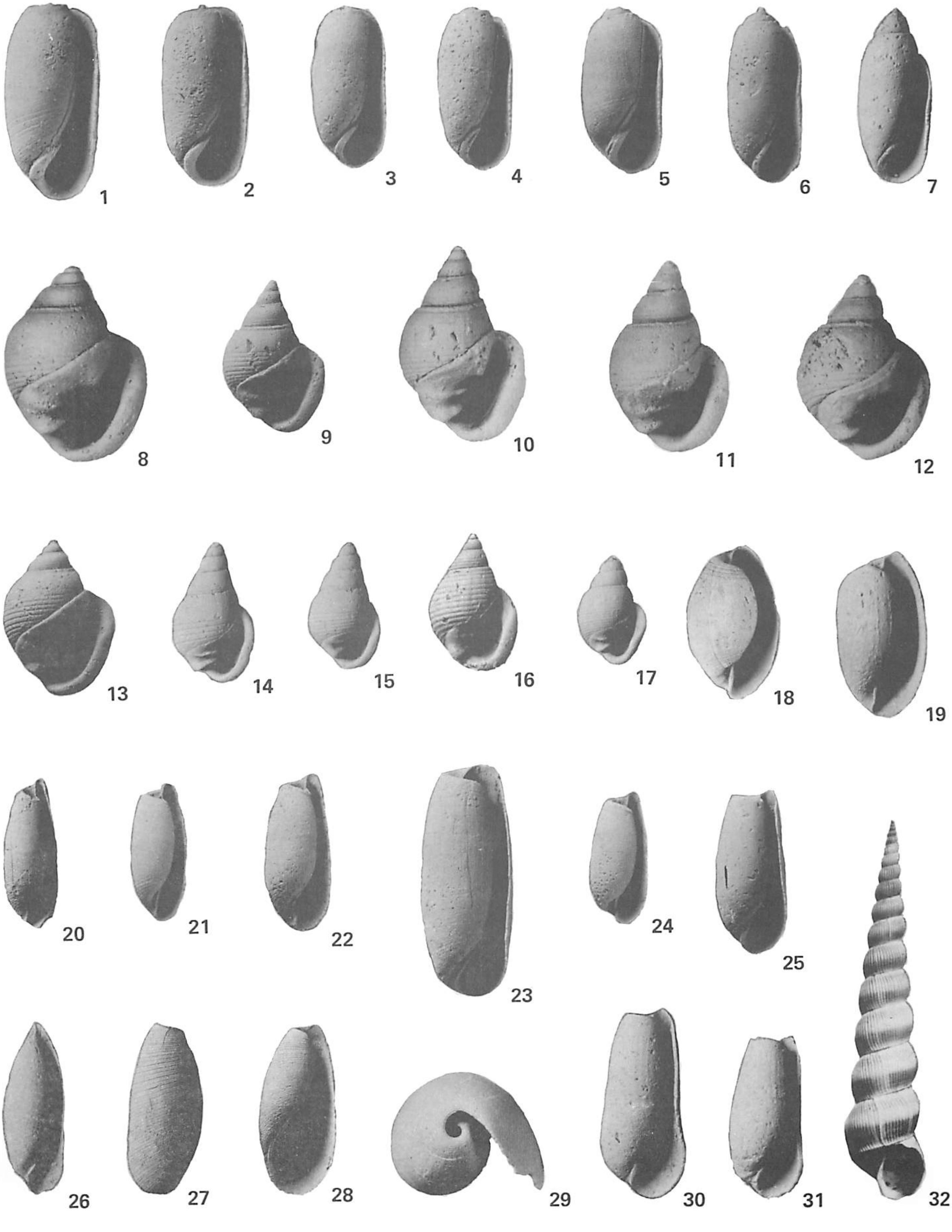


EXPLANATION PLATE 25
Mint Spring Formation

Figure		Page
1-5	**Acteocina crassiplica (Conrad, 1848)**	240
	1. Figured specimen 498129 USNM (x8). Height 4.6 mm, width 2.3 mm; USGS locality 2664.	
	2. Figured specimen 560809 USNM (x8). Height 4.2 mm, width 2.3 mm; USGS locality 2664.	
	3. Specimen missing?	
	4. Specimen missing?	
	5. Figured speicmen 376523 USNM (x8). Height 4.4 mm, width 1.9 mm; USGS locality 7467.	
6-7	**Acteocina crassiplica altispira** MacNeil n. subsp.	241
	6. Holotype 498131 USNM (x8). Height 4.4 mm, width 1.9 mm; USGS locality 3727.	
	7. Paratype 498132 USNM (x8). Height 4.4 mm, width 1.7 mm; USGS locality 3727.	
8-13	**Ringicula (Ringiculella) crassata** MacNeil n. sp.	235-236
	8, 13. Holotype 560917 USNM (x10). Height 3.8 mm, width 2.7 mm; USGS locality 7467.	
	9-10. Paratype 560918 USNM (x10). Height 3.6 mm, width 2.4 mm; USGS locality 7467.	
	11. Figured specimen 376524 USNM (x10). Height 3.5 mm, width 2.3 mm; USGS locality 7467.	
	12. Figured specimen 376525 USNM (x10). Height 3.7 mm, width 2.5 mm; USGS locality 7467.	
14-15	**Ringicula (Ringiculella) mississippiensis petila** MacNeil n. subsp.	235
	14. Figured specimen 498143 USNM (x10). Height 2.7 mm, width 1.5 mm; USGS locality 14071a.	
	15. Figured specimen 560915 USNM (x10). Height 2.5 mm, width 1.4 mm; USGS locality 14071a.	
16	**Ringicula (Ringiculella) irrasa** MacNeil n. sp.	236
	Holotype 498140 USNM (x10). Height 2.7 mm, width 1.7 mm; USGS locality 13287.	
17	**Ringicula (Ringiculella) mississippiensis** Conrad, 1848 subsp?	235
	Figured specimen 498332 USNM (x12). Height 1.8 mm, width 1.0 mm; USGS locality 6647.	
18-19	**Atys (Atys) pinguis** MacNeil n. sp.	236-237
	18. Holotype 498135 USNM (x12). Height 2.5 mm, width 1.4 mm; USGS locality 13287.	
	19. Figured specimen 376526 USNM (x10). Height 3.2 mm, width 1.7 mm; USGS locality 14071a.	
20-21	**Atys (Roxaniella) caseyi** MacNeil n. sp.	237
	20. Holotype 498136 USNM (x4). Height 7.1 mm, width 2.6 mm; USGS locality 14162.	
	21. Paratype 560810 USNM (x6). Height 4.5 mm, width 1.8 mm; USGS locality 3725.	
22, 24	**Atys (Roxaniella) caseyi** MacNeil var.	237
	22. Figured specimen 560907 USNM (x6). Height 5.2 mm, width 2.0 mm; USGS locality 3728.	
	24. Figured specimen 376527 USNM (x6). Height 4.3 mm, width 2.0 mm; USGS locality 3727.	
23	**Cylichna nida** MacNeil n. sp.	238-239
	Holotype 498138 USNM (x8). Height 5.6 mm, width 2.2 mm; USGS locality 14071.	
25	**Cylichna acutiscapulae** MacNeil n. sp.	239
	Holotype 498139 USNM (x8). Height 4.0 mm, width 1.6 mm; USGS locality 7671.	
26	**Volvulella subspinosa** MacNeil n. sp.	237-238
	Holotype 498133 USNM (x10). Height 3.3 mm, width 1.2 mm; USGS locality 14071a.	
27-29	**Scaphander (Coeloscapha) hilgardi** MacNeil n. sp.	242
	Holotype 498134 USNM (x3). Height (outer lip partially broken after photographed) at present 11.5 mm, width 5.4 mm; USGS locality 14071a.	
30-31	**Cylichna acutiscapulae corrugata** MacNeil n. subsp.	239
	30. Holotype 560910 USNM (x8). Height 4.7 mm, width 2.0 mm; USGS locality 7671.	
	31. Figured specimen 376528 USNM (x8). Height 4.0 mm, width 1.7 mm; USGS locality 7671.	
32	**Acrilla acuminata** (Sowerby, 1844)	72
	Lectotype, British Museum. This is the first published photograph of the type species of *Acrilla*.	

Mint Spring Formation

Plate 25

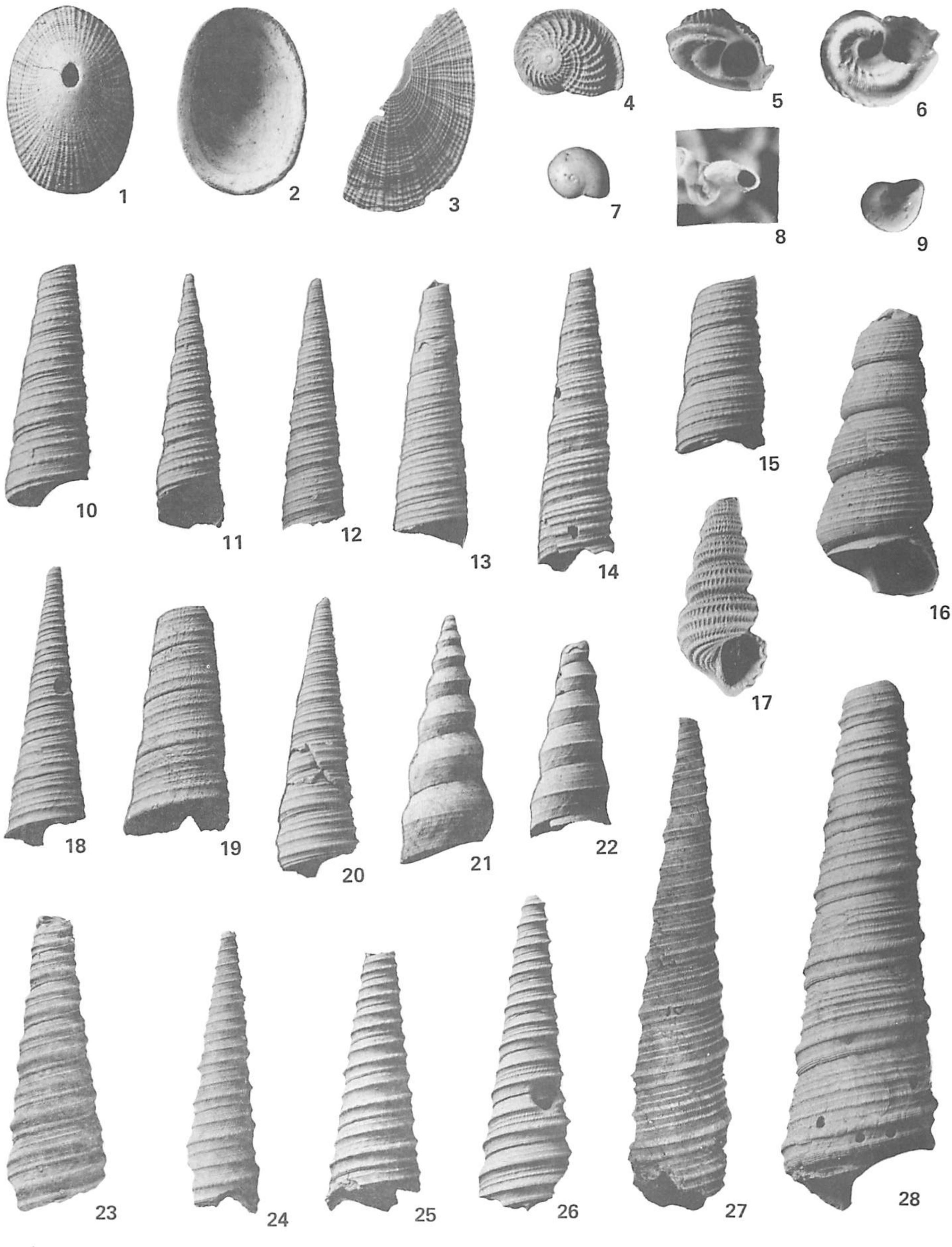


EXPLANATION PLATE 26
Byram Formation

Figure		Page
1-3	**Diodora mississippiensis** (Conrad, 1848)	32
	1-2. Figured specimen 498387 USNM (x2). USGS locality 7372.	
	3. Figured specimen 136830 USNM (x2). USGS locality 259.	
4-6	**Anticlimax byramensis** MacNeil n. sp.	42
	Holotype 648919 USNM (x12). Diameter 1.8 mm; USGS locality 5615.	
7-9	**Teinostoma (Idioraphe) minuta** MacNeil n. sp.	41
	Holotype 648918 USNM (x12). Diameter 0.9 mm; USGS locality 5615.	
10-15	**Turritella caseyi** MacNeil n. sp.	54-55
	10. Holotype 498364 USNM (x4). Height (incomplete) 11.9 mm, width 4.1 mm; USGS locality 13286.	
	11. Paratype 498364a USNM (x4). USGS locality 13286.	
	12. Figured specimen 648922 USNM (x4). USGS locality 13286.	
	13. Figured specimen 648923 USNM (x4). USGS locality 13286.	
	14. Paratype 498365 USNM (x5). USGS locality 13286.	
	15. Figured specimen 648924 USNM (x4). USGS locality 13286.	
16	**Turritella carota** MacNeil n. sp.	53
	Figured specimen 498363 USNM (x3). USGS locality 3729.	
17	**Mathilda regularis** (Meyer, 1886)	55-56
	Figured specimen 648925 USNM (x4). USGS locality 14682.	
18-19?, 23-28	**Turritella mississippiensis** Conrad, 1848	49-50
	18-19? Figured specimen 648920 USNM. USGS locality 13286.	
	23. Figured specimen 648921 USNM (x2). USGS locality 259.	
	24. Figured specimen 136805 USNM (x2.5). USGS locality 259.	
	25. Figured specimen 498366 USNM (x5). USGS locality 13286.	
	26. Figured specimen 498368 USNM (x4). USGS locality 13286.	
	27. Lectotype 13516 ANSP (x1.2). Height (incomplete) 69 mm; Vicksburg, Mississippi (Conrad).	
	28. Figured specimen 136823 USNM (x1.5). USGS locality 259.	
20	**Turritella mundula** MacNeil n. sp.	52-53
	Holotype 498362 USNM (x4). Height 13.6 mm, width 4.0 mm; USGS locality 13286.	
21-22	**Turritella aff. T. planigyrata** Guppy, 1867	53-54
	21. Figured specimen 498367 USNM (x6). Height 7.0 mm; USGS locality 13286.	
	22. Figured specimen 376529 USNM (x6). USGS locality 13286.	

Byram Formation

Plate 26

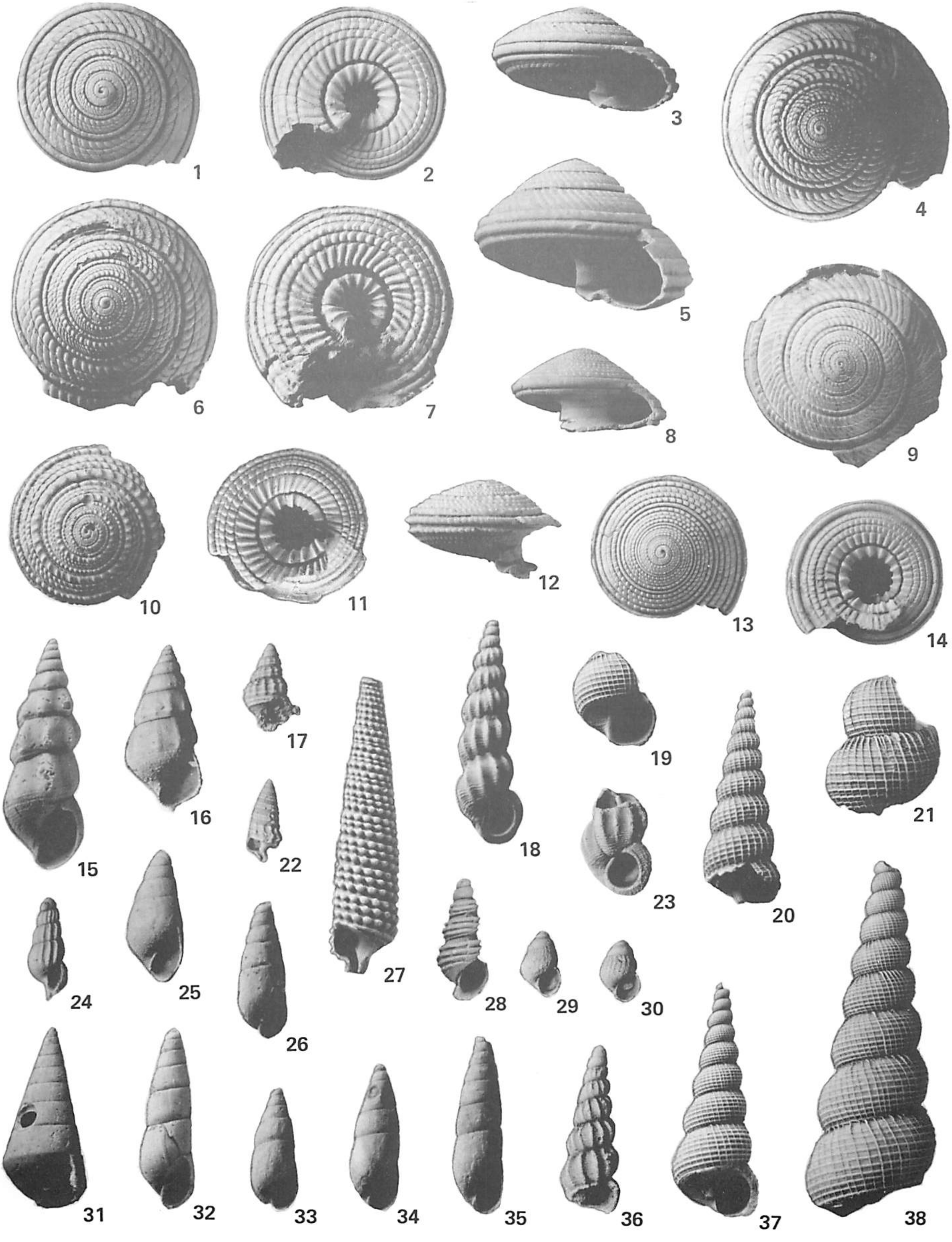


EXPLANATION PLATE 27
Byram Formation

Figure		Page
1-7, 9	**Architectonica (Architectonica) trilirata** (Conrad, 1848) 1-3. Figured specimen 498370 USNM (x3). USGS locality 13286. 4. Lectotype 13519 ANSP (x2.5). Diameter 17.3 mm; Vicksburg, Mississippi (Conrad). 5. Figured specimen 648926 USNM (x2.5). USGS locality 13286. 6-7. Figured specimen 498371 USNM (x3). USGS locality 3722. 9. Figured specimen 498369 USNM (x2). USGS locality 5623.	43-44
8, 13-14	**Architectonica (Architectonica) vicksburgensis** (Dall, 1892) Figured specimen 498372 USNM (x3). USGS locality 3722.	44-45
10-12	**Architectonica (Architectonica) fuscicava** MacNeil n. sp. Figured specimen 498373 USNM (x3). Height 3.5 mm, width 7.1 mm; USGS locality 3722.	45
15	**Alaba blakneyensis** MacNeil n. sp. Holotype 648927 USNM (x10). Height 4.4 mm, width 1.6 mm; USGS locality 14682.	62-63
16	**Alaba cf. A. blakneyensis** MacNeil n. sp. Figured specimen 648928 USNM (x12). USGS locality 14682.	63
17	**Bittium (Argyropeza?) ottoi** MacNeil n. sp. Figured specimen 648929 USNM (x12). USGS locality 5615.	58-59
18, 23, 36	**Pliciscala (Nodiscala?) byramensis** MacNeil n. sp. 18. Holotype 498360 USNM (x10). Height 4.3 mm, width 1.3 mm; USGS locality 7376. 23. Figured specimen 648932 USNM (x12). USGS locality 5615. 36. Figured specimen 648933 USNM (x12). USGS locality 5615.	78
19, 21, 37-38	**Scalina trigintanaria** (Conrad, 1848) 19. Figured specimen 479760 USNM (x2). USGS locality 7376. 21. Figured specimen 648931 USNM (x2). USGS locality 13286. 37. Figured specimen 498357 USNM (x5). USGS locality 13286. 38. Figured specimen 498359 USNM (x2.5). Height 28.0 mm, width 9.8 mm; USGS locality 13286.	73-74
20	**Scalina trigintanaria** (Conrad, 1848) var? Figured specimen 498358 USNM (x5). USGS locality 13286.	74
22, 27	**Triphora (Triphora) bilineata** (Meyer, 1886) 22. Figured specimen 648930 USNM (x12). USGS locality 5615. 27. Figured specimen 498356 USNM (x8). Height (incomplete) 7.0 mm, width 1.7 mm; USGS locality 7376.	64-65
24	**Turbonilla leafensis** MacNeil n. sp. Figured specimen 648941 USNM (x12). USGS locality 5615.	227
25-26, 32-35	**Odostomia (Odostomia) byramensis** MacNeil n. sp. 25. Figured specimen 648935 USNM (x12). USGS locality 5615. 26. Figured specimen 498354 USNM (x10). USGS locality 5615. 32. Holotype 498353 USNM (x10). Height 3.4 mm, width 1.1 mm; USGS locality 7376. 33. Figured specimen 648936 USNM (x10). USGS locality 5615. 34. Figured specimen 648937 USNM (x10). USGS locality 5615. 35. Figured specimen 648938 USNM (x10). USGS locality 5615.	224
28	**Aclis matsoni** MacNeil n. sp. Holotype 648934 USNM (x12). Height 1.9 mm, width 0.8 mm; USGS locality 5615.	82
29-30	**Odostomia (Odostomia) vicksburgella** Dockery, n. sp. 29. Figured specimen 648939 USNM (x12). USGS locality 5615. 30. Figured specimen 648940 USNM (x12). USGS locality 5615.	224-225
31	**Pyramidella (Voluspa)** n. sp. Figured specimen 498355 USNM (x5). Height 6.8 mm, width 3.5 mm; USGS locality 3725.	223

Byram Formation

Plate 27



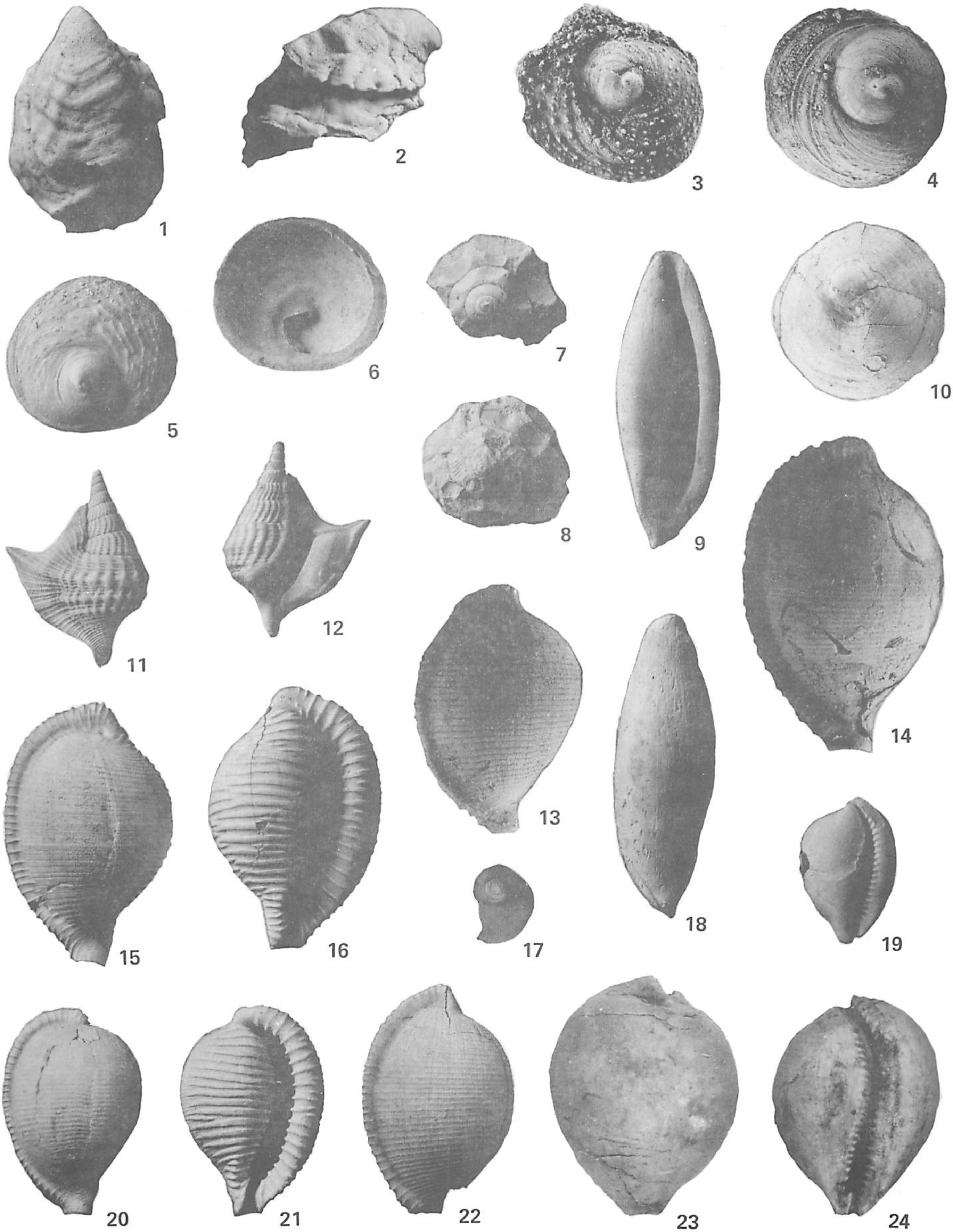
EXPLANATION PLATE 28

Byram Formation

Figure		Page
1-2	**Capulus (Brocchia) langdoni** MacNeil n. sp. Holotype 479766 USNM (x4). Height 10.9 mm, width 7.9 mm; USGS locality 13286.	87
3-6	**Calyptraea (Trochita)** cf. C. (T.) **aperta** (Solander, 1766) 3. Figured specimen 13522 ANSP (x3). Diameter 14.5 mm; Vicksburg, Mississippi (Conrad). 4. Figured specimen 13524 ANSP (x3). Vicksburg, Mississippi (Conrad). 5-6. Figured specimen 498376 USNM (x2.5). USGS locality 6455.	84-85
7-8	**Xenophora (Xenophora) humilis** (Conrad, 1848) 7. Figured specimen 498374 USNM (x1.5). Height 9.0 mm, width 19.0 mm; USGS locality 13286. 8. Figured specimen 498375 USNM (x5). USGS locality 3722.	88-89
9, 18	**Simnia (Calpurna) cookei** MacNeil n. sp. Holotype 498348 USNM (x6). Height 9.9 mm, width 3.4 mm; USGS locality 7376.	
10	**Calyptraea (Trochita) conradi** MacNeil n. sp.? Figured specimen 13523 ANSP. Vicksburg, Mississippi (Conrad).	85
11-12	**Aporrhais (Goniocheila) lirata** (Conrad, 1848) Figured specimen 498352 USNM (x2). Height 8.7 mm, width 13.7 mm; USGS locality 3722.	69-70
13-16, 20-22	**Sulcocypraea lintea** (Conrad, 1848) 13. Figured specimen 13511 ANSP (x3). Vicksburg, Mississippi (Conrad). 14. Lectotype 13510 ANSP (x3). Height 16.7 mm, width 11.1 mm, elevation 8.8 mm; Vicksburg, Mississippi (Conrad). 15-16. Figured specimen 648942 USNM (x3). Height 16.7 mm, width 11.1 mm, elevation 8.8 mm; USGS locality 12175. 20-21. Figured specimen 644620 USNM (x2.5). Vicksburg, Mississippi (Conrad). 22. Figured specimen 498349 USNM (x3). USGS locality 13286.	99-100
17, 19, 23-24	**Cypraeorbis sphaeroides** (Conrad, 1848) 17. Figured specimen (protoconch) 648943 USNM (x5.5). USGS locality 5615. 19. Figured specimen 498351 USNM (x1). Height 27.0 mm, width 18 mm; USGS locality 6455. 23-24. Holotype 13512 ANSP (x1.5). Height 32.5 mm; Vicksburg, Mississippi (Conrad).	97-98

Byram Formation

Plate 28



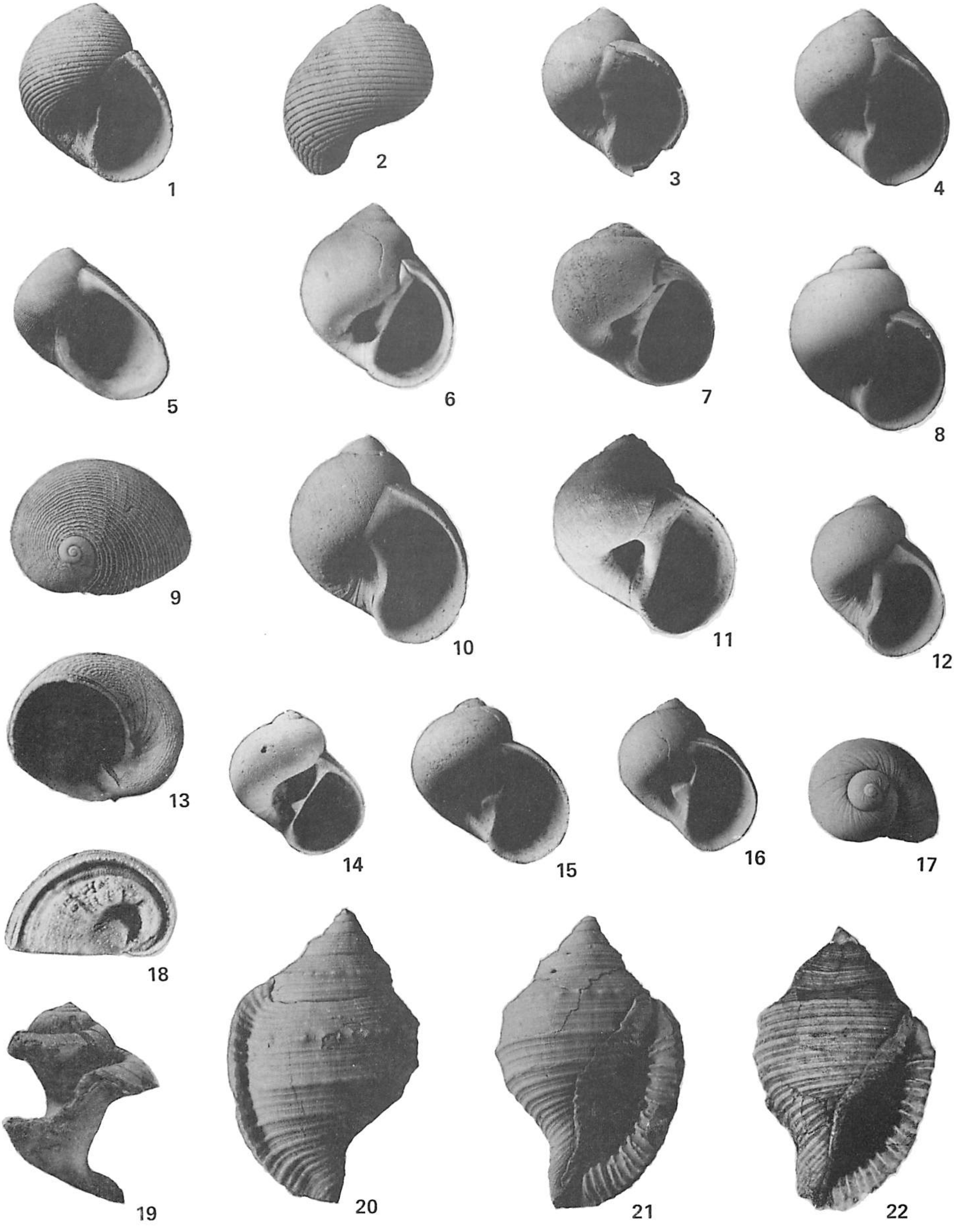
EXPLANATION PLATE 29

Byram Formation

Figure		Page
1-2	**Sigatica conradii** (Dall, 1892) Figured specimen 498378 USNM (x3). Height 11.3 mm, width 10.1 mm; USGS locality 3722.	94-95
3-4, 6, 10-12	**Euspira vicksburgensis** (Conrad, 1848) 3. Figured specimen 479769 USNM (x2.5). USGS locality 13286. 4. Holotype of *Polinices* (*Euspira*) *byramensis* Cooke, 1928, 352706 USNM (x2.5). Height 13.4 mm, width 12.7 mm, USGS locality 3722. 6. Figured specimen 498386 USNM (x4). USGS locality 13286. 10. Figured specimen 498381 USNM (x3). Height 13.5 mm, width 12.0 mm; USGS locality 13286. 11. Lectotype 13531 ANSP (x2.5). Height 15.1 mm; Vicksburg, Mississippi (Conrad). 12. Figured specimen 648945 USNM (x3). USGS locality 13286.	93
5	**Sinum (Sigaretotrema) mississippiensis** (Conrad, 1848) Figured specimen 498380 USNM (x2). USGS locality 13286.	95-96
7-8	**Natica (Natica) caseyi** MacNeil n. sp. 7. Holotype 648944 USNM (x4). Height 8.8 mm, width 8.0 mm; USGS locality 13286. 8. Figured specimen 498382 USNM (x4). USGS locality 13286.	90-91
9, 13	**Sinum (Sinum) aff. S. (S.) beatricae** Palmer, 1937 Figured specimen 498379 USNM (x4). Height 7.4 mm, width 8.4 mm; USGS locality 3722.	95
14-18	**Natica (Naticarius) acuticallosa** MacNeil n. sp. 14. Figured specimen 498384 USNM (x4). USGS locality 3722. 15. Paratype 498383 USNM (x3.5). USGS locality 3722. 16-17. Holotype 498385 USNM (x3). Height 10.0 mm, width 8.7 mm; USGS locality 13286. 18. Figured specimen (operculum) 376530 USNM (x10). USGS locality?	91-92 97
19	**Ampullinopsis mississippiensis** (Conrad, 1848) Figured specimen 479770 USNM (x1.5). USGS locality 13286.	97
20-22	**Galeodaria tricarinata** (Conrad, 1848) 20-21. Figured specimen 376531 USNM (x1.5). Height 38.5 mm, width 24.7 mm; USGS locality 13286. 22. Lectotype 13503 ANSP (x1.5). Height 39.5 mm; Vicksburg, Mississippi (Conrad).	108-109

Byram Formation

Plate 29

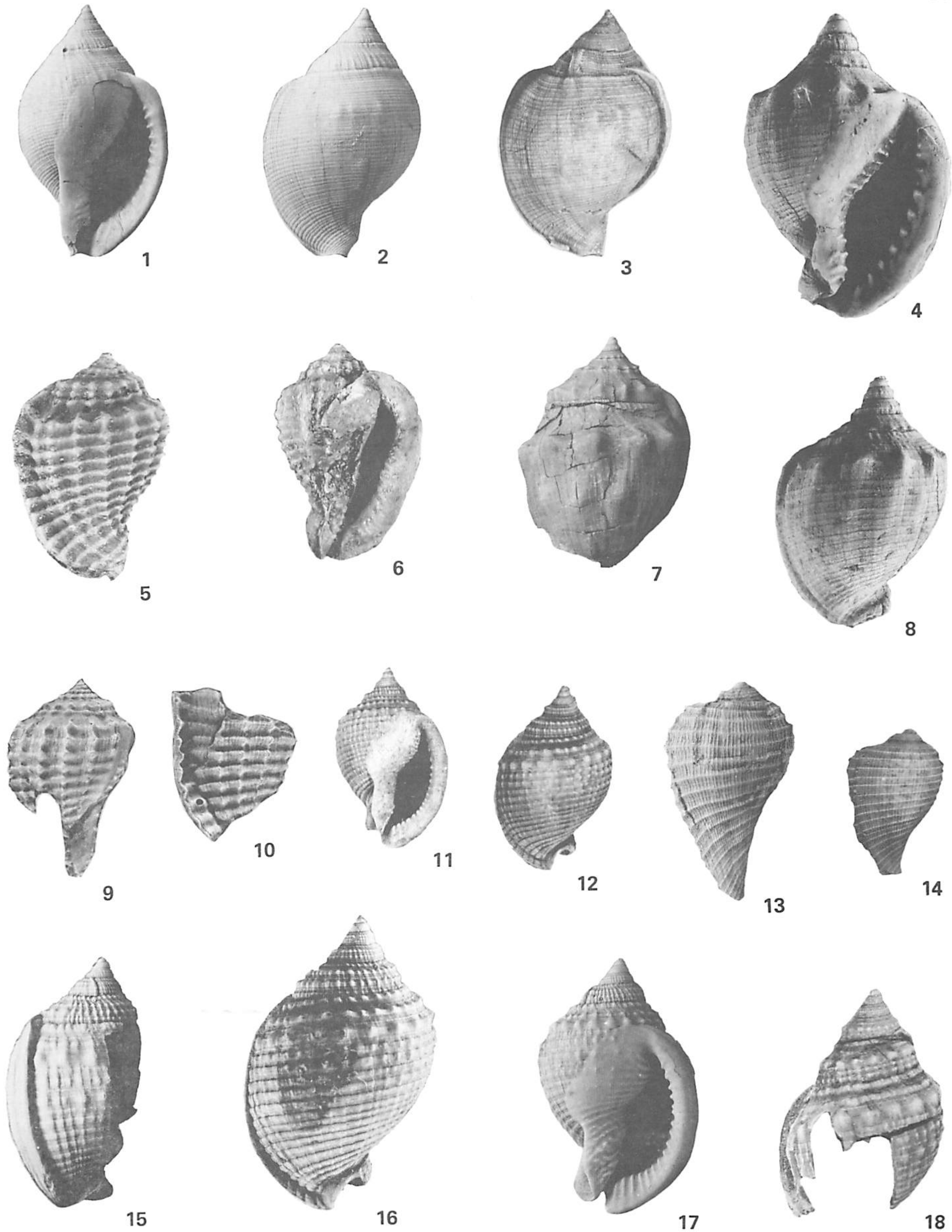


EXPLANATION PLATE 30

Byram Formation

Figure		Page
1-3	**Sconsia lintea** (Conrad, 1848)	109-110
	1-2. Figured specimen 376532 USNM (x1.5). Height 32.1 mm, width 19.8 mm; USGS locality 13286.	
	3. Lectotype 13506 ANSP (x1.5). Height 35.0 mm; Vicksburg, Mississippi (Conrad).	
4, 7-8	**Phalium (Menthafontia) mississippiensis** (Conrad, 1848)	111-112
	4, 8. Paratype 13502 ANSP (figure 4 x2.5; figure 8 x2). Height 23.5 mm; Vicksburg, Mississippi (Conrad).	
	7. Figured specimen 479748 USNM (x1). Height (incomplete) 44.8 mm, width (incomplete) 32.5 mm; USGS locality 13286.	
5-6, 9-10	**Oniscidia harpula** (Conrad, 1848)	113-114
	5-6. Holotype 13505 ANSP (x1.5). Height 30.0 mm; Vicksburg, Mississippi (Conrad).	
	9. Figured specimen 479749 USNM (x1.5). Height (incomplete) 25.8 mm, width (incomplete) 16.9 mm; USGS locality 13286.	
	10. Figured specimen 376533 USNM (x1.5). Height (fragment of outer lip) 19.7 mm, width 15.7 mm; USGS locality 13286.	
11-12, 15-18	**Semicassis caelatura** (Conrad, 1848)	104-105
	11-12. Paratype 13500 ANSP (x1). Vicksburg, Mississippi (Conrad).	
	15, 17. Figured specimen 376534 USNM (x2). Height 25.0 mm, width (almost complete) 15.7 mm; USGS locality 13286.	
	16. Lectotype 13499 ANSP (x2.3). Height 24.5 mm; Vicksburg, Mississippi (Conrad).	
	18. Paratype 13500 ANSP (x1.3). Vicksburg, Mississippi (Conrad).	
13-14	**Ficus mississippiensis** Conrad, 1848	114-115
	13. Figured specimen 376535 USNM (x1.5). Height 28.1 mm, width 16.4 mm; USGS locality 3722.	
	14. Lectotype 13508 ANSP (x1.2). Height 23.0 mm; Vicksburg, Mississippi (Conrad).	

Byram Formation **Plate 30**



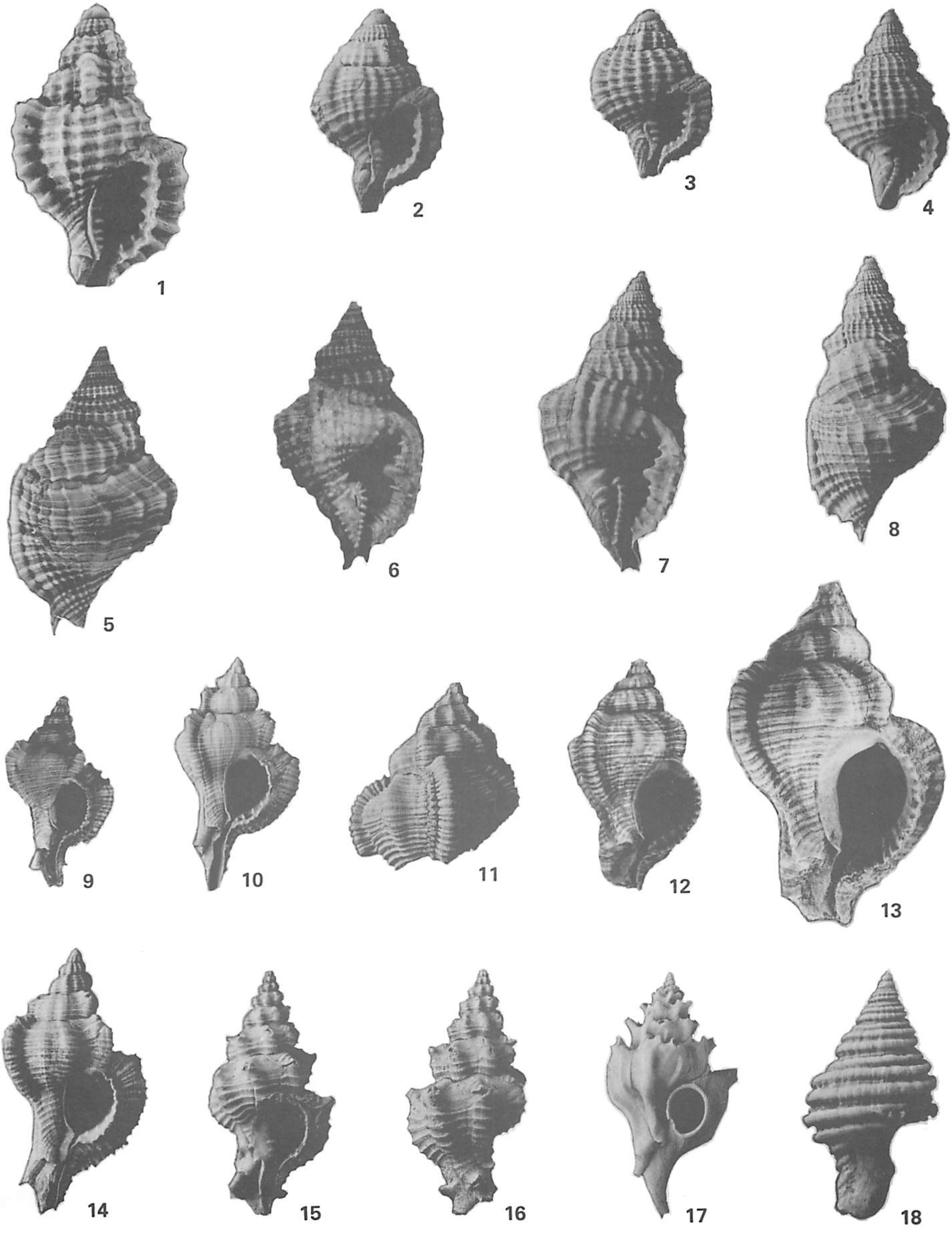
EXPLANATION PLATE 31

Byram Formation

Figure		Page
1	**Sassia (Byramia) mississippiensis** (Conrad, 1848) .... Holotype 13488 ANSP (x5). Height 11.0 mm; Vicksburg, Mississippi (Conrad).	119-120
2	**Sassia (Byramia) abbreviata** (Conrad, 1848) var. .... Figured specimen 376536 USNM (x4). Height 9.6 mm, width 6.3 mm; USGS locality 13286.	119
3.	**Sassia (Byramia) abbreviata** (Conrad, 1848) .... Figured specimen 376537 USNM (x4). Height 7.9 mm, width 5.9 mm; USGS locality 3727.	119
4-8	**Distorsio (Distorsio) crassidens** (Conrad, 1848) .... 4. Figured specimen 376538 USNM (x3). Height 12.7 mm, width 7.8 mm; USGS locality 13286. 5-6. Lectotype 13486 ANSP (x1.3). Height 39.0 mm; Vicksburg, Mississippi (Conrad). 7. Figured specimen 376539 USNM (x1.5). Height 38.8 mm, width (incomplete, back of last whorl missing) 19.2 mm; USGS locality 13286. 8. Figured specimen 376540 USNM (x1.5). Height 36.8 mm, width 18.3 mm; USGS locality 3722.	121
9-11	**Chicoreus (Phyllonotus) dormani** (E. H. Vokes, 1963) .... 9. In type lot of *C.* (*P.*) *mississippiensis* (Conrad, 1848) 13483 ANSP (x1.5). Height 24.7 mm, width 15.0 mm; Vicksburg, Mississippi (Conrad). 10. Figured specimen 376541 USNM (x2). Height 22.8 mm, width 12.0 mm; USGS locality 13286. 11. Figured specimen 376542 USNM (x1.5). Height (incomplete) 25.3 mm, width 22.7 mm; USGS locality 13286.	123-124
12-14	**Chicoreus (Phyllonotus) mississippiensis** (Conrad, 1848) .... 12- 13. Lectotype 13482 ANSP (figure 12 x1.3; figure 13 x2). Height 33.0 mm, width 21.0 mm; Vicksburg, Mississippi (Conrad). 14. Figured specimen 376543 USNM (x2). Height 26.2 mm, width 15.0 mm; USGS locality 13286.	122
15-16	**Poirieria (Panamurex) macneili** E. H. Vokes, 1970 .... Figured specimen 646432 USNM (x2). Height 23.5 mm, width 12.3 mm; USGS locality 7895.	126
17	**Siphonochelus (Laevityphis) curvirostratus** (Conrad, 1848) .... Figured specimen 376544 USNM (x2). Height 24.0 mm, width (including spines) 13.4 mm; USGS locality 13286.	128-129
18	**Cymia (Tritonopsis) subalveata** (Conrad, 1848) subsp.? .... Figured specimen 376545 USNM (x4). Height 12.0 mm, width (incomplete) 6.3 mm; USGS locality 13286.	129-130

Byram Formation

Plate 31



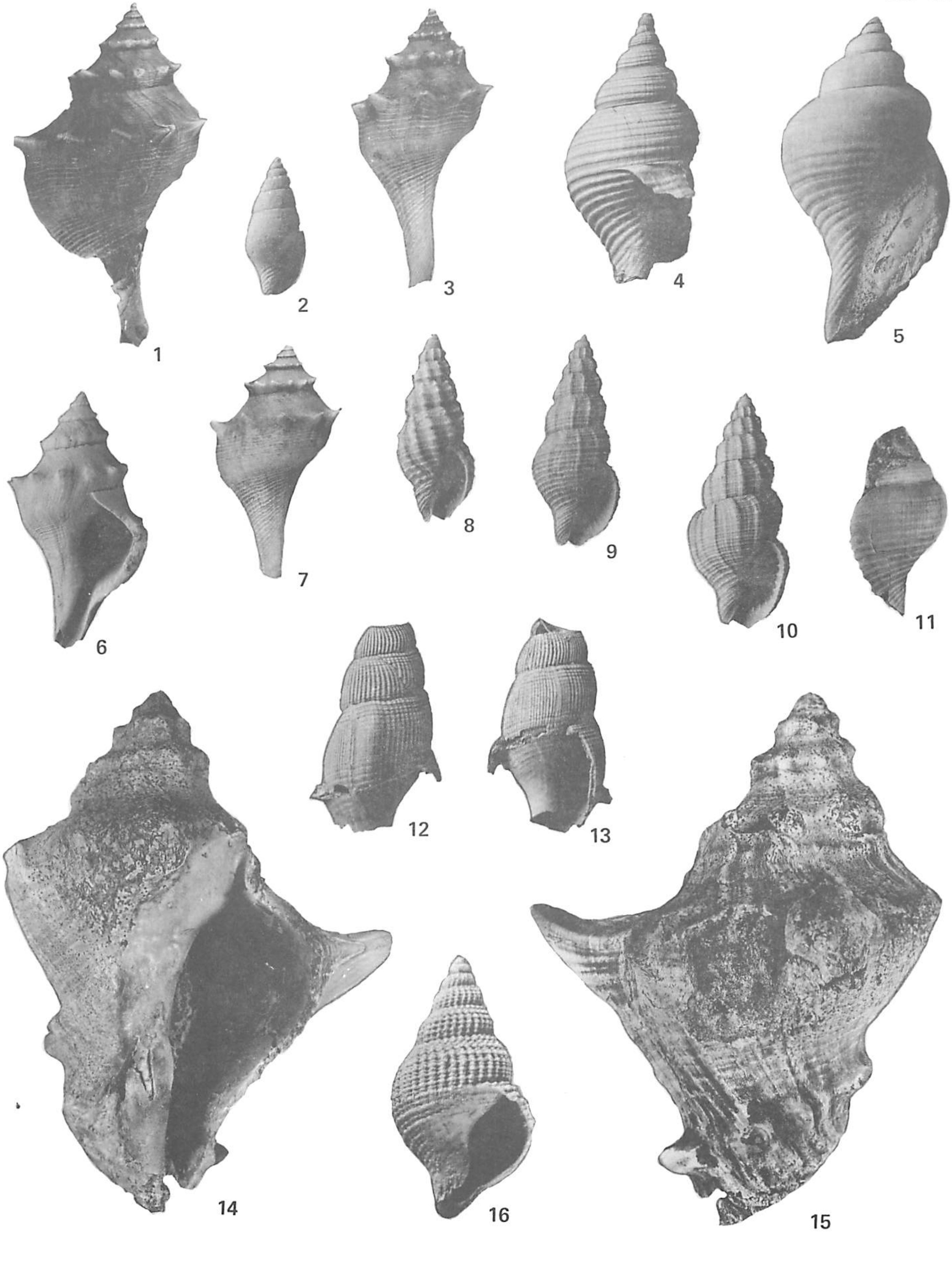
EXPLANATION PLATE 32

Byram Formation

Figure		Page
1, 3, 6-7	**Levifusus spiniger** (Conrad, 1848)	148-149
	1. Paratype A 13467 ANSP (x1.4). Height 47.7 mm, width (incomplete) 25.8 mm; Vicksburg, Mississippi (Conrad).	
	3. Paratype B 13467 ANSP (x1.4). Height 38.2 mm, width (including spines) 20.2 mm; Vicksburg, Mississippi (Conrad).	
	6. Figured specimen 376546 USNM (x1.5). Height 33.2 mm, width 19.2 mm; USGS locality 13286.	
	7. Lectotype 13466 ANSP (x1.4). Height 33.5 mm, width (including spines) 16.2 mm; Vicksburg, Mississippi (Conrad).	
2.	**Mitrella (Columbellopsis) aff. M. (C.) oryzoides** Gardner, 1947	142-143
	Figured specimen 376547 USNM (x8). Height 3.2 mm, diameter 1.3 mm; USGS locality 7376.	
4.	**Pseudofulgur lirata** Dockery n. sp.	141
	Figured specimen 376548 USNM (x3). Height (incomplete) 17.0 mm, width (incomplete) 9.4 mm; USGS locality 14683.	
5, 11	**Pseudofulgur vicksburgensis** (Conrad, 1848)	141
	5. Figured specimen 136798 USNM (x1.5). Height 42.2 mm, width 21.9 mm; USGS locality 259.	
	11. Holotype 13475 ANSP (x1.5). Height (incomplete) 21 mm; Vicksburg, Mississippi (Conrad).	
8	**Tritiaria vaughani** MacNeil n. sp.	136-137
	Figured specimen 376549 USNM (x4). Height 8.9 mm, width 3.6 mm; USGS locality 3722.	
9-10	**Tritiaria mississippiensis** (Conrad, 1848)	133-134
	9. Figured specimen 376550 USNM (x3). USGS locality 3722.	
	10. Figured specimen 376551 USNM (x3). Height 14.9 mm, width 6.3 mm; USGS locality 3722.	
12-13	**Metula (Metula) fragilis** Casey, 1903	131
	Holotype 479758 USNM (x4). Height (incomplete) 10.1 mm, width (incomplete) 5.5 mm; USGS locality 13286.	
14-15	**Melongena (Myristica) crassicornuta** Conrad, 1848	143-144
	Holotype 13496 ANSP (x1.5). Height 73 mm; Vicksburg, Mississippi (Conrad).	
16	**Metula (Caseyella) blakneyensis** MacNeil n. sp.	132
	Holotype 376552 USNM (x6). Height (incomplete) 8.7 mm, width 4.5 mm; USGS locality 14682.	

Byram Formation

Plate 32



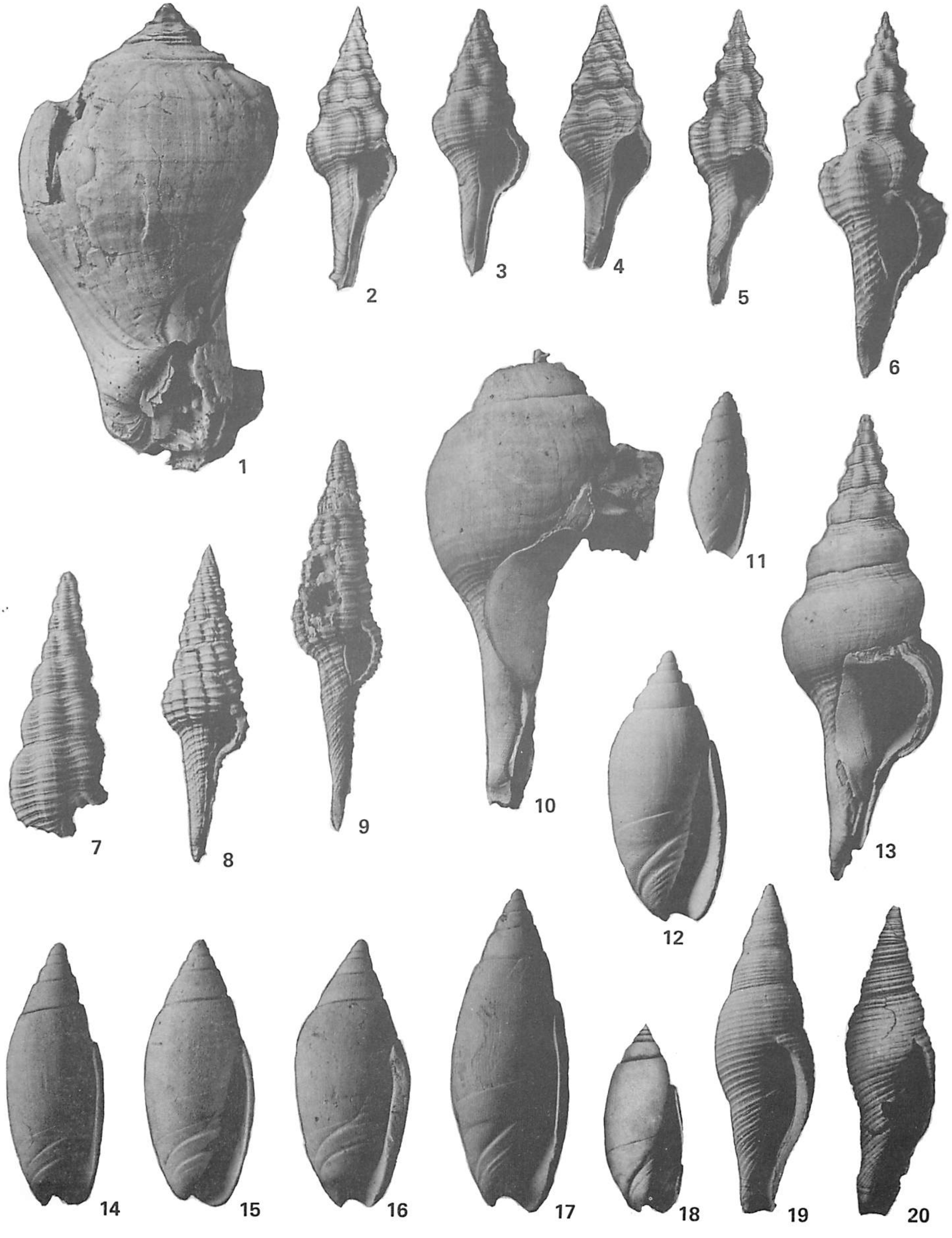
EXPLANATION PLATE 33

Byram Formatoon

Figure		Page
1	**Volema hopkinsi** MacNeil n. sp. Holotype 376553 USNM (x1). Height 91.4 mm, width (incomplete) 49.0 mm; USGS locality 7473.	144
2-4	**Latirus protractus** (Conrad, 1848) 2. Lectotype 13472 ANSP (x1.4). Height 37.1 mm; width 12.3 mm; Vicksburg, Mississippi (Conrad). 3. Figured specimen 376554 USNM (x1.5). Height 34,5 mm, width 12.4 mm; USGS locality 13286. 4. Specimen from Aldrich Collection. USNM - missing?	145
5-6	**Latirus mississippiensis** (Conrad, 1848) 5. Holotype 13465 ANSP (x1.5). Height 38.5 mm, width 11.6 mm; Vicksburg, Mississippi (Conrad). 6. Figured specimen 376555 USNM (x1.5). Height 47.3 mm, width 16.5 mm; USGS locality 13286.	144-145
7	**Dolicholatirus perexilis** (Conrad, 1848) Figured specimen 376556 USNM (x1.5). Height (incomplete) 34.5 mm, width (incomplete) 12.9 mm; USGS locality 3729.	146
8-9	**Dolicholatirus exilis confertus** Dockery n. subsp. 8. Figured specimen 376557 USNM (x1.5). Height 41.3 mm, width 10.3 mm; USGS locality 14682. 9. Figured specimen 376558 USNM (x2). Height 37.9 mm, width 8.9 mm; USGS locality 13286.	147
10	**Clavilithes** sp. B Figured specimen 136802 USNM (x1). Height (incomplete) 89.3 mm, width (incomplete) 45.5 mm; USGS locality 259.	148
11	**Olivella (Callianax) vicksburgensis** Dockery var. Figured specimen 376559 USNM (x4). Height 7.8 mm, width 2.9 mm; USGS locality 3729.	158
12, 14-16	**Oliva (Strephonella) affluens** (Casey, 1903) 12. Figured specimen 376560 USNM (x3). Height 17.3 mm, width 17.9 mm; USGS locality 5615. 14. Figured specimen 376561 USNM (x3). Height 17.0 mm, width 6.5 mm; USGS locality 13286. 15. Figured specimen 376562 USNM (x3). Height 17.3 mm, width 7.3 mm; USGS locality 13286.	157-158
13	**Clavilithes lesueuri** Dockery n. sp. Figured specimen 376563 USNM (x1). Height 88.4 mm, width 31.4 mm; USGS locality 3722.	148
17-18	**Oliva (Strephonella) mississippiensis** Conrad, 1848 17. Figured specimen 376564 USNM (x3). Height 21.0 mm, width 8.0 mm; USGS locality 13286. 18. Lectotype 13450 ANSP (x1.4). Height 26.5 mm, width 11.6 mm; Vicksburg, Mississippi (Conrad).	157
19-20	**Mitra (Fusimitra) mississippiensis** Conrad, 1848 19. Figured specimen 376565 USNM (x1.5). Height 43.2 mm, width 13.2 mm; USGS locality 5615. 20. Lectotype 13460 ANSP (x1.5). Height 41.2 mm, width 12.0 mm; Vicksburg, Mississippi (Conrad).	160

Byram Formation

Plate 33



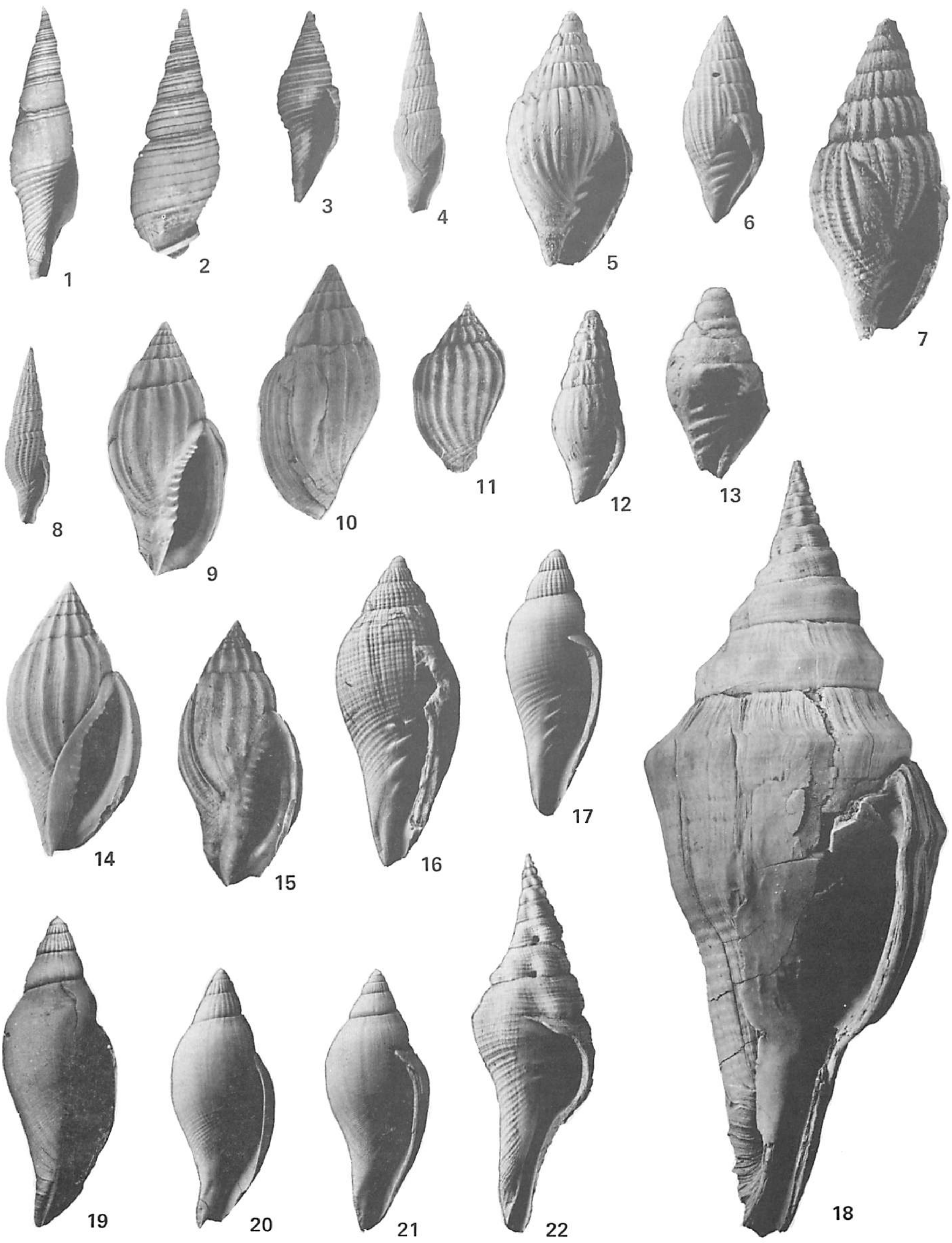
EXPLANATION PLATE 34

Byram Formation

Figure		Page
1	**Mitra (Fusimitra) conquisita** Conrad, 1848	159-160
	Holotype 13462 ANSP (x1.5). Height 35.1 mm, width 9.2 mm; Vicksburg, Mississippi (Conrad).	
2-3	**Mitra (Fusimitra) mississippiensis** Conrad, 1848	160
	2. Paratype A 13461 ANSP (x1.5). Height (incomplete) 31.9 mm, width 11.6 mm; Vicksburg, Mississippi (Conrad).	
	3. Paratype B 13461 ANSP (x1.3). Height 27.1 mm, width 8.9 mm; Vicksburg, Mississippi (Conrad).	
4, 8	**Vexillum (Costellaria) cellulifera** (Conrad, 1848)	161-162
	4. Figured specimen 376566 USNM (x2). Height 19.3 mm, width 5.0 mm; USGS locality 13286.	
	8. Figured specimen 376567 USNM (x2). Height 16.8 mm, width 4.3 mm; USGS locality 13286.	
5, 13	**Conomitra vicksburgensis** (Conrad, 1848)	154
	5. Lectotype 13458 ANSP (x6). Height 7.5 mm, width 3.8 mm; Vicksburg, Mississippi (Conrad).	
	13. Figured specimen 479727 USNM (x10). Height (incomplete) 3.3 mm, width (incomplete) 1.9 mm; USGS locality 13286.	
6-7	**Conomitra staminea** (Conrad, 1848)	153
	6. Figured specimen 376568 USNM (x2.5). Height 15.7 mm, width 6.2 mm; USGS locality 6455.	
	7. Holotype 13457 ANSP. Vicksburg, Mississippi (Conrad).	
9-11, 14-15	**Lyria (Lyria) mississippiensis** (Conrad, 1848)	150-151
	9-10. Figured specimen 479734 USNM (x1.5). Height 32.9 mm, width 10.4 mm; USGS locality 13286.	
	11. Paratype 13454 ANSP (x1.4). Height 24.2 mm, width 12.5 mm; Vicksburg, Mississippi (Conrad).	
	14. Figured specimen 376569 USNM (x2). Height 26.0 mm, width 13.0 mm; USGS locality 3140.	
	15. Lectotype 13453 ANSP (x2). Height 37.2 mm, width 16.5 mm; Vicksburg, Mississippi (Conrad).	
12	**Vexillum (Costellaria)** sp. ?	
	Figured specimen 479742 USNM (x6). Height 6.3 mm, width 2.3 mm; USGS locality 13286.	
16-17	**Caricella (Atraktus) demissa** Conrad, 1848 var. A	152
	16. Figured specimen 376570 USNM (x1.5). Height 39.9 mm; width (flattened in the plane of view) 15.8 mm, small diameter 10.6 mm; USGS locality 6455.	
	17. Figured specimen 376571 USNM (x1.5). Height 33.9 mm, width 13.0 mm; USGS locality 5615.	
18, 22	**Turbinella wilsoni** Conrad, 1848	156
	18. Figured specimen 479733 USNM (x1). Height 148.5 mm, width 58.5 mm; USGS locality 13286.	
	22. Figured specimen 376572 USNM (x1.5). Height 48.5 mm, width (incomplete) 16.3 mm; USGS locality 7941.	
19-21	**Caricella (Atraktus) demissa** Conrad, 1848	152
	19. Lectotype 13455 ANSP. Vicksburg, Mississippi (Conrad).	
	20. Figured specimen 376573 USNM (x1.5). Height 33.7 mm, width 13.4 mm; USGS locality 3722.	
	21. Figured specimen 376574 USNM (x1.5). Height 33.8 mm, width 13.4 mm; USGS locality 13286.	

Byram Formation

Plate 34



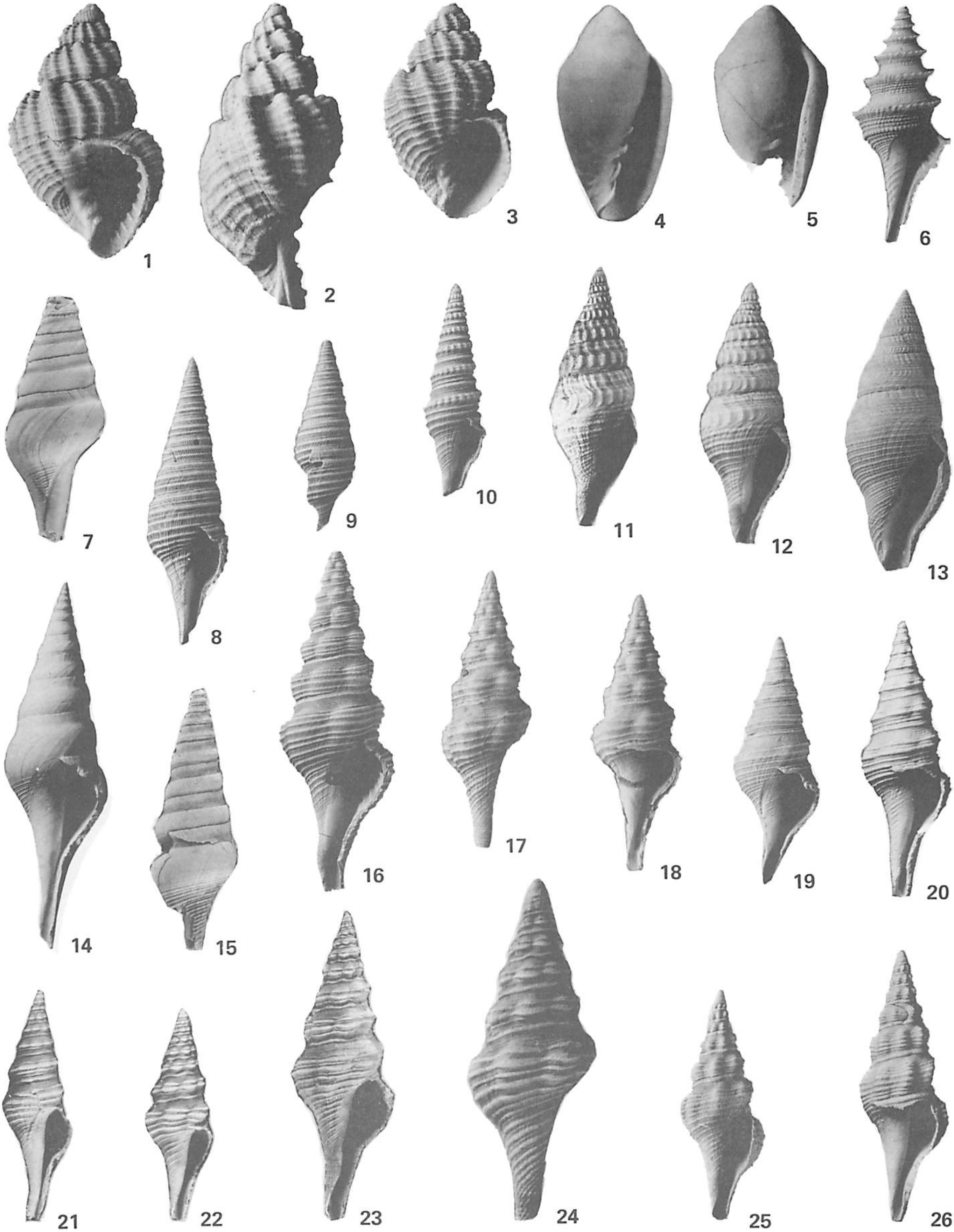
EXPLANATION PLATE 35

Byram Formation

Figure		Page
1-3	**Agatrix mississippiensis** (Conrad, 1848)	163-164
	1. Figured specimen 376575 USNM (x4). Height 12.1 mm, width 7.3 mm; USGS locality 13286.	
	2. Figured specimen 376577 USNM (x4). Height 14.5 mm, width (incomplete) 8.0 mm; USGS locality 13286.	
	3. Figured specimen 376576 USNM (x4). Height 10.2 mm, width 6.2 mm; USGS locality 13286.	
4-5	**Marginella** sp.?	158-159
	4. Figured specimen 376578 USNM (x4). Height 10.1 mm, width 5.4 mm; USGS locality 14683.	
	5. Figured specimen 479721 USNM (x4). Height (incomplete) 9.4 mm, width 5.7 mm; USGS locality 13286.	
6	**Cochlespira cristata** (Conrad, 1848)	195-196
	Figured specimen 376580 USNM (x2.5). Height 18.3 mm, width 7.3 mm; USGS locality 13286.	
7, 14-15	**Turricula (Orthosurcula) byramensis** MacNeil n. sp.	180-181
	7. Figured specimen 376581 USNM (x1.5). Height (incomplete) 30.9 mm, width (incomplete) 12.5 mm; USGS locality 3722.	
	14. Paratype 376582 USNM (x1.5). Height 47.2 mm, width 13.2 mm; USGS locality 3730.	
	15. Holotype 376583 USNM (x1.5). Height (incomplete) 33.0 mm, width 11.1 mm; USGS locality 6455. Shell is eroded on opposite side of view.	
8-9	**Pleuroliria cochlearis** (Conrad, 1848)	176-177
	8. Figured specimen 561408 USNM (x2). Height 27.3 mm, width 7.8 mm; USGS locality 13286.	
	9. Figured specimen 561409 USNM (x2). Height (incomplete) 18.2 mm, diameter as viewed 6.7 mm; USGS locality 3724.	
10	**Gemmula rotaedens** (Conrad, 1848)	171-172
	Figured specimen 561410 USNM (x3). Height 13.4 mm, width 3.9 mm; USGS locality 3722.	
11-12	**Coronia (Coroniopsis) tenella** (Conrad, 1848)	174-175
	11. Lectotype 13490 ANSP (x3). Height 17.0 mm; Vicksburg, Mississippi (Conrad).	
	12. Figured specimen 376584 USNM (x3). Height 16.5 mm, width 5.9 mm; USGS locality 7372.	
13	**Bathytoma congesta** (Conrad, 1848)	214
	Figured specimen 376585 USNM (x2). Height 26.7 mm, width 10.1 mm; USGS locality 13286.	
16-18, 22-24	**Pleurofusia longirostropsis** de Gregorio, 1890	182-183
	16. Figured specimen 376586 USNM (x2). Height 32.3 mm, width 10.9 mm; USGS locality 13286.	
	17-18. Figured specimen 376587 USNM (x3). Height 17.6 mm, width (incomplete) 5.6 mm; USGS locality 3722.	
	22. Specimen missing?	
	23. Figured specimen 376588 USNM (x2). Height 28.7 mm, width 9.4 mm; USGS locality 14683.	
	24. Paratype of *P. vicksburgensis* Casey, 1903, 481670 USNM. USGS locality 13286.	
19	**Pleurofusia decliva** (Conrad, 1848)	184-185
	Figured specimen 479715 USNM (x3). Height 15.7 mm, width 5.5 mm; USGS locality 13286.	
20-21	**Pleurofusia decliva asper** MacNeil n. subsp.	185
	20. Holotype 376589 USNM (x3). Height 17.4 mm, width 5.6 mm; USGS locality 12175.	
	21. Figured specimen 376590 USNM (x2.5). Height 18.4 mm, width 5.8 mm; USGS locality 14683.	
25-26	**Pleurofusia servata** (Conrad, 1848)	186-187
	25. Figured specimen 376591 USNM (x2.5). Height 17.7 mm, width 6.6 mm; USGS locality 3722.	
	26. Specimen missing?	

Byram Formation

Plate 35



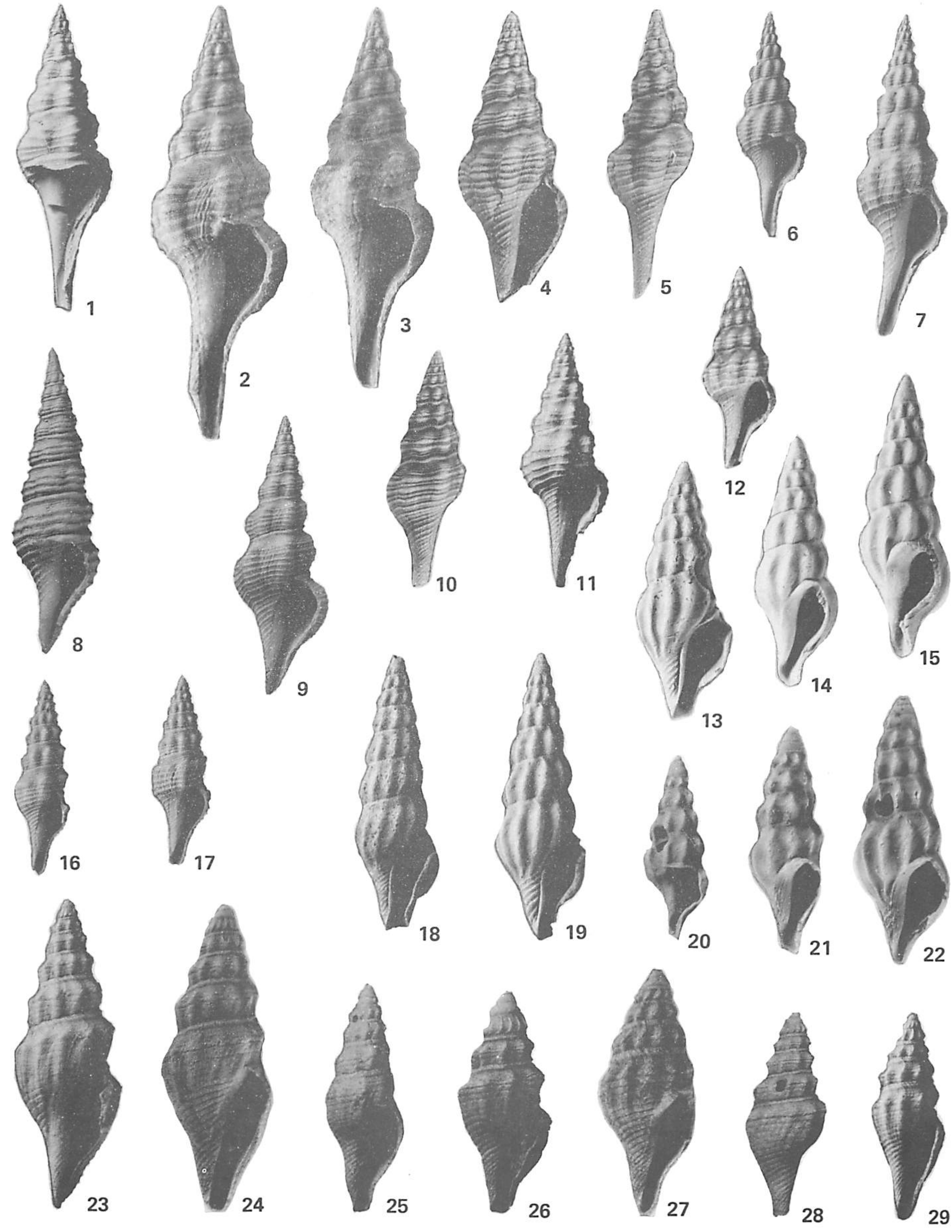
EXPLANATION PLATE 36

Byram Formation

Figure		Page
1-5, 9-10	**Pleurofusia servata** (Conrad, 1848)	186-187
	1. Figured specimen 376592 USNM (x3). Height 19.5 mm, width (incomplete) 6.0 mm; USGS locality 3729.	
	2. Lectotype 13431 ANSP (x3). Height 29.1 mm, width 9.2 mm; Vicksburg, Mississippi (Conrad).	
	3. Paratype 13491 ANSP (x3). Height 25.1 mm, width 7.7 mm; Vicksburg, Mississippi (Conrad).	
	4. Figured specimen 376593 USNM (x2.5). Height 21.6 mm, width 8.2 mm; USGS locality?	
	5. Figured specimen 376594 USNM (x2.5). Height 22.0 mm, width (incomplete) 6.8 mm; USGS locality 14683a.	
	9. Figured specimen 376595 USNM (x2). Height 26.8 mm, width 9.3 mm; USGS locality 13286.	
	10. Figured specimen 376596 USNM (x2.5). Height 17.8 mm, width 6.1 mm; USGS locality 14683a.	
6-7, 12	**Pleurofusia elegantula** MacNeil n. sp.	189
	6. Specimen missing?	
	7. Holotype 376597 USNM (x2). Height 31.0 mm, width 8.7 mm; USGS locality 12175.	
	12. Figured specimen 479712 USNM (x2.4). Height 16.2 mm, width 5.9 mm; USGS locality 13286.	
8	**Pleurofusia trichorda** MacNeil n. sp.	186
	Holotype 13436 ANSP (x2.5). Height 23.0 mm, width 6.8 mm; Vicksburg, Mississippi (Conrad). The type was with the type of *P. servata* in the Conrad collection at the ANSP. The apex was broken after being photographed, and the present height is 21.5 mm with eight whorls remaining.	
11	**Pleurofusia servata** (Conrad, 1848) var. A	188
	Figured specimen 376598 USNM (x3). Height 16.3 mm, width 5.5 mm; USGS locality 7372.	
13-15, 18-19	**Syntomodrillia tantula** (Conrad, 1848)	201
	13. Figured specimen 376599 USNM (x6). Height 8.2 mm, width 3.0 mm; USGS locality 7440.	
	14. Figured specimen 376600 USNM (x6). Height 8.0 mm, width 2.6 mm; USGS locality 3722.	
	15. Figured specimen 376601 USNM (x6). Height 9.0 mm, width 2.8 mm; USGS locality 3722.	
	18. Figured specimen 376602 USNM (x5). Height 10.5 mm, width 3.2 mm; USGS locality 3729.	
	19. Figured specimen 376603 USNM (x6). Height 9.4 mm, width 2.8 mm; USGS locality 13286.	
20-22	**Syntomodrillia tantula** (Conrad, 1848) var. A	201-202
	Figured specimens in figures 20-22 were not found in MacNeil's figured specimen collection at the USNM.	
16-17	**Tropisurcula caseyi** (Aldrich, 1903)	192-193
	16. Figured specimen 376604 USNM (x3). Height 12.5 mm, width 3.5 mm; USGS locality 13286.	
	17. Figured specimen 376605 USNM (x3). Height 12.2 mm, width 3.7 mm; USGS locality 13286.	
23-24, 27, 29	**Microsurcula intacta** (Casey, 1903)	197
	23. Figured specimen 376606 USNM (x5). Height 11.9 mm, width 4.2 mm; USGS locality 3729.	
	24. Figured specimen 376607 USNM (x8). Height 7.4 mm, width 2.4 mm; USGS locality 14772.	
	27. Specimen missing?	
	29. Holotype 481666 USNM (x6). Height 6.7 mm, width 2.4 mm; USGS locality 13286.	
25	**Microsurcula intacta** (Casey, 1903) var. A	197
	Figured specimen 376608 USNM (x6). Height 7.0 mm, width 2.4 mm; USGS locality 7376.	
26, 28	**Microsurcula intacta jayensis** MacNeil n. subsp.	197-198
	26. Holotype 376609 USNM (x10). Height 4.3 mm, width 1.5 mm; USGS locality 14368.	
	28. Figured specimen 376610 USNM (x7). Height 6.6 mm, width 2.4 mm; USGS locality 14368.	

Byram Formation

Plate 36

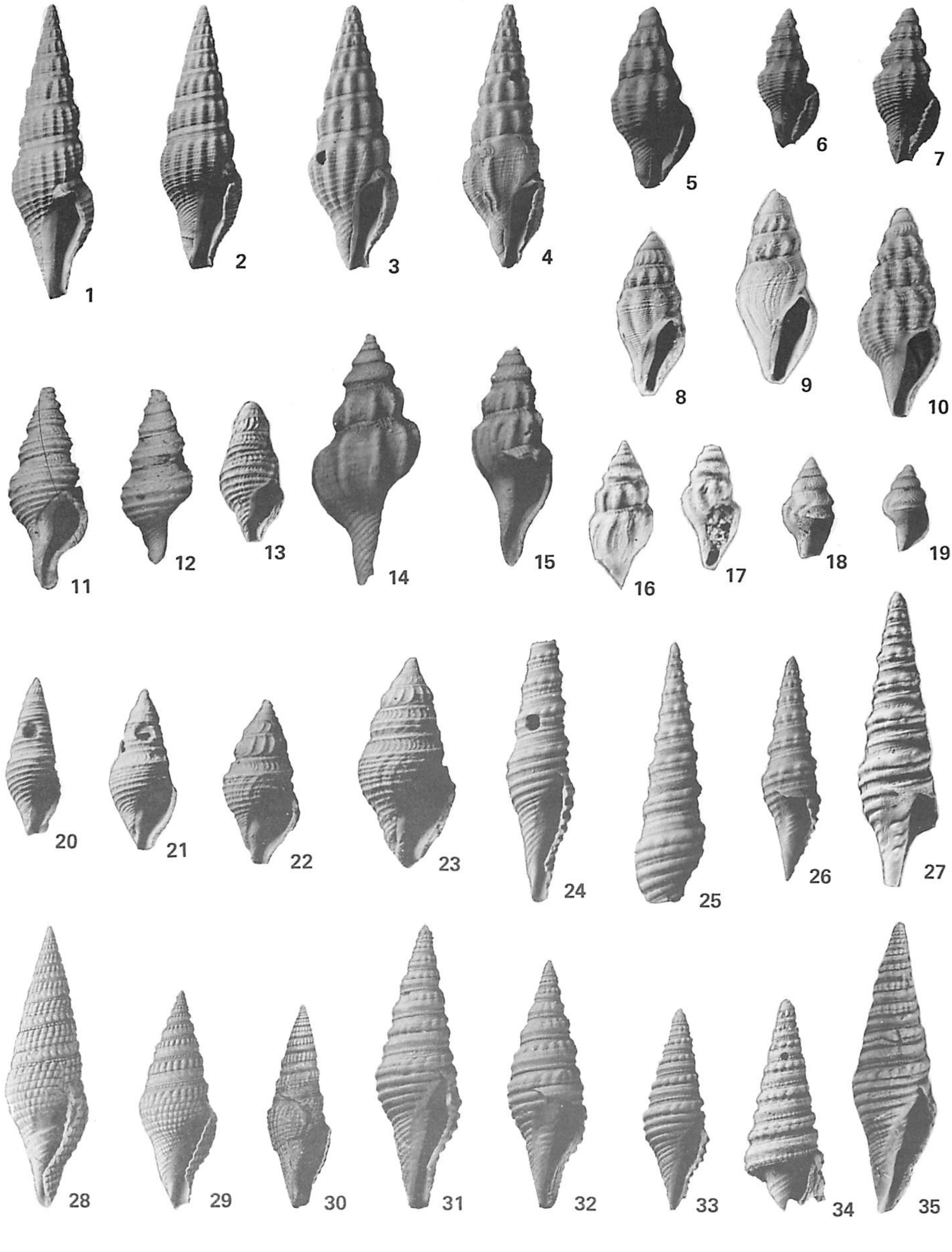


EXPLANATION PLATE 37

Byram Formation

Figure		Page
1-2	**Crassispira (Crassispirella) abundans (Conrad, 1848)**	204-205
	1. Figured specimen 376611 USNM (x3). Height 22.6 mm, width 6.2 mm; USGS locality 13286.	
	2. Figured specimen 376612 USNM (x3). Height 16.7 mm, width 5.0 mm; USGS locality 13286.	
3-4	**Crassispira (Crassispirella) lyopleura MacNeil n. sp.**	205
	3. Holotype 376613 USNM (x2.5). Height 20.4 mm, width 6.8 mm; USGS locality 13286.	
	4. Figured specimen 376614 USNM (x2.5). Height 20.2 mm, width 6.5 mm; USGS locality 13286.	
5	**Clathurella sp.**	217
	Figured specimen 376615 USNM (x6). Height 5.5 mm, width 2.6 mm; USGS locality 14772.	
6-7	**Clathurella blakneyensis MacNeil n. sp.**	217
	6. Figured specimen 376616 USNM (x5). Height 5.0 mm; USGS locality 7376.	
	7. Holotype 376617 USNM (x6). Height 4.9 mm; width 4.9 mm; USGS locality 7376.	
8-10	**Microsurcula intacta (Casey, 1903) var. A**	197
	8. Figured specimen 376618 USNM (x8). Height 3.9 mm, width 1.5 mm; USGS locality 7376.	
	9. Figured specimen 376619 USNM (x8). Height 4.7 mm, width 1.8 mm; USGS locality 7376.	
	10. Figured specimen 376620 USNM (x8). Height 4.9 mm, width 1.9 mm; USGS locality 7376.	
11-12	**Spiradaphne lowei MacNeil n. sp.**	220-221
	11. Holotype 376621 USNM (x12). Height 3.2 mm, width 1.3 mm; USGS locality 6978.	
	12. Figured specimen 376622 USNM. USGS locality 6978.	
13, 20	**Microdrillia vicksburgella Casey, 1903**	208
	13. Paratype 644574 USNM (x10). Height 2.6 mm, width 1.0 mm; Vicksburg, Mississippi (Casey).	
	20. Lectotype 481645 USNM (x6). Height 4.7 mm, width 1.5 mm; USGS locality 13286.	
14	**Phandella monroensis MacNeil n. sp.**	219-220
	Holotype 376623 USNM (x12). Height 4.0 mm, width 1.7 mm; USGS locality 14368.	
15-19	**Phandella nepionica Casey, 1903**	219
	15. Figured specimen 376624 USNM (x12). Height 3.4 mm, width (incomplete) 1.3 mm; USGS locality 5615.	
	16. Figured specimen 376625 USNM (x10). Height 2.9 mm, width 1.1 mm; auger hole at Keys Mill Creek, Smith County, Mississippi.	
	17. Figured specimen 376626 USNM (x10). Height 2.4 mm, width 1.0 mm; auger hole at Keys Mill Creek, Smith County, Mississippi.	
	18. Holotype 645103 USNM (x11). Height 1.7 mm; Vicksburg, Mississippi (Casey).	
	19. Paratype 376627 USNM (x12). Height 1.4 mm; Vicksburg, Mississippi (Casey).	
21-23	**Microdrillia brevis (Meyer, 1886)**	209-210
	21. Holotype 644594 USNM (x6). Height 5.0 mm, width 2.2 mm; Vicksburg, Mississippi (Meyer).	
	22. Figured specimen 376628 USNM (x10). Height 3.0 mm, width 1.4 mm; USGS locality 6978.	
	23. Figured specimen 376629 USNM (x10). Height 3.9 mm, width 1.8 mm; USGS locality 6978.	
24-27	**Scobinella famelica Casey, 1903**	213
	24. Figured specimen 479738 USNM (x2.5). Height (incomplete) 20.3 mm, width 5.4 mm; USGS locality 13286.	
	25. Figured specimen 155369 USNM (x2.5). Height (incomplete) 20.2 mm, width (incomplete) 5.5 mm; USGS locality 3140.	
	26. Holotype 481662 USNM (x3). Height 14.5 mm, width 3.8 mm; Vicksburg, Mississippi (Casey).	
	27. Figured specimen 376630 USNM (x4). Height 13.8 mm, width 3.6 mm; USGS locality 3722.	
28	**Scobinella pluriplicata subpluriplicata MacNeil n. subsp.**	212
	Figured specimen 479736 USNM (x2). Height 22.4 mm, width 8.0 mm; USGS locality 13286.	
29-30	**Scobinella caelata Conrad, 1848**	210-211
	29. Figured specimen 376631 USNM (x2). Height 21.2 mm, width 7.6 mm; USGS locality 13286.	
	30. Lectotype 13441 ANSP (x1.3). Height 29 mm; Vicksburg, Mississippi (Conrad).	
31-35	**Scobinella macer Casey, 1903**	212-213
	31. Figured specimen 376632 USNM (x3). Height 18.3 mm, width 5.7 mm; USGS locality 14683.	
	32. Figured specimen 376633 USNM (x3). Height 15.7 mm, width 5.2 mm; USGS locality 14683a.	
	33. Figured specimen 376634 USNM (x3). Height 13.0 mm, width 4.2 mm; USGS locality 3722.	
	34. Holotype 481661 USNM (x4). Height (incomplete) 10.1 mm, width (incomplete) 3.7 mm; USGS locality 13286.	
	35. Specimen missing?	

Byram Formation **Plate 37**



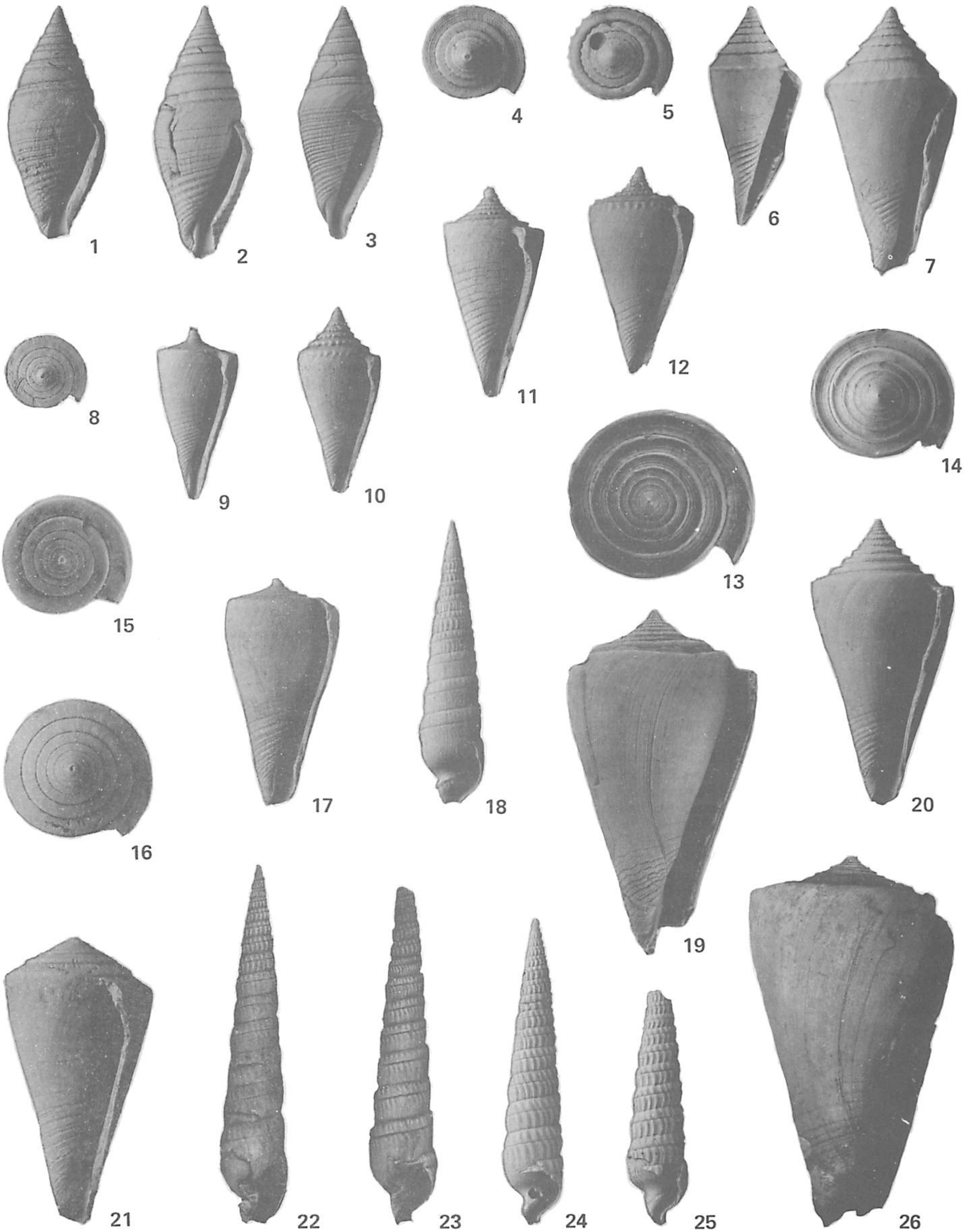
EXPLANATION PLATE 38

Byram Formation

Figure		Page
1-3	**Conorbis porcellanus** (Conrad, 1848)	221-222
	1. Figured specimen 376635 USNM (x2). Height 22.2 mm, width 9.5 mm; USGS locality 5615.	
	2. Figured specimen 376636 USNM (x2). Height 23.9 mm, width 9.4 mm; USGS locality 7376.	
	3. Figured specimen 376637 USNM (x1.5). Height 29.7 mm, width 10.6 mm; USGS locality 259.	
4-5, 8-17, 19-21, 26	**Conus alveatus** Conrad, 1865	164-165
	4, 11. Figured specimen 376638 USNM (x3). Height 12.3 mm, width 6.7 mm; USGS locality 13286.	
	5, 12. Figured specimen 376639 USNM (x3). Height 13.0 mm, width 6.6 mm; USGS locality 13286.	
	8-9. Figured specimen 376640 USNM (x3). Height 10.8 mm, width 5.2 mm; USGS locality 13286.	
	10. Figured specimen 376641 USNM (x3). Height 11.6 mm, width 5.4 mm; USGS locality 13286.	
	13, 19. Figured specimen 376642 USNM (x1.5). Height 41.3 mm, width 24.2 mm; USGS locality 7941.	
	14, 20. Figured specimen 376643 USNM (x1.5). Height 36.7 mm, width 18.4 mm; USGS locality 13286.	
	15. Figured specimen 376644 USNM (x1.7). Height (incomplete, only top half present) 15.3 mm, width 16.7 mm; USGS locality 13286.	
	16, 21. Figured specimen 376645 USNM (x1.5). Height 37.0 mm, width 19.5 mm; USGS locality 13286.	
	17. Figured specimen 376646 USNM (x2). Height 21.6 mm, width 10.8 mm; USGS locality 13286.	
	26. Lectotype 13446 ANSP (x1.3). Height 52.0 mm, width 28.5 mm; Vicksburg, Mississippi (Conrad).	
6-7	**Conus protractus** Meyer, 1885	165-166
	6. Holotype 644576 USNM (x2.5). Height 16.1 mm, width 6.6 mm; Vicksburg, Mississippi (Meyer).	
	7. Figured specimen 376647 USNM (x2.5). Height 20.4 mm, width 10.2 mm; USGS locality 13286.	
18, 22-25	**Terebra (Terebrellina) divisura** Conrad, 1848	166-167
	18. Figured specimen 560919 USNM (x1.5). Height 36.1 mm, width 8.3 mm; USGS locality 7941.	
	22. Lectotype 13416 ANSP (x1.3). Height 50.4 mm, width 9.4 mm; Vicksburg, Mississippi (Conrad).	
	23. Paratype A 13417 ANSP (x1.4). Height (incomplete) 46.0 mm, width 9.5 mm; Vicksburg, Mississippi (Conrad).	
	24. Figured specimen 560920 USNM (x1.5). Height 38.0 mm, width 7.9 mm; USGS locality 7941.	
	25. Figured specimen 376648 USNM (x1.5). Height (incomplete) 30.0 mm, width 7.8 mm; USGS locality 3727.	

Byram Formation

Plate 38



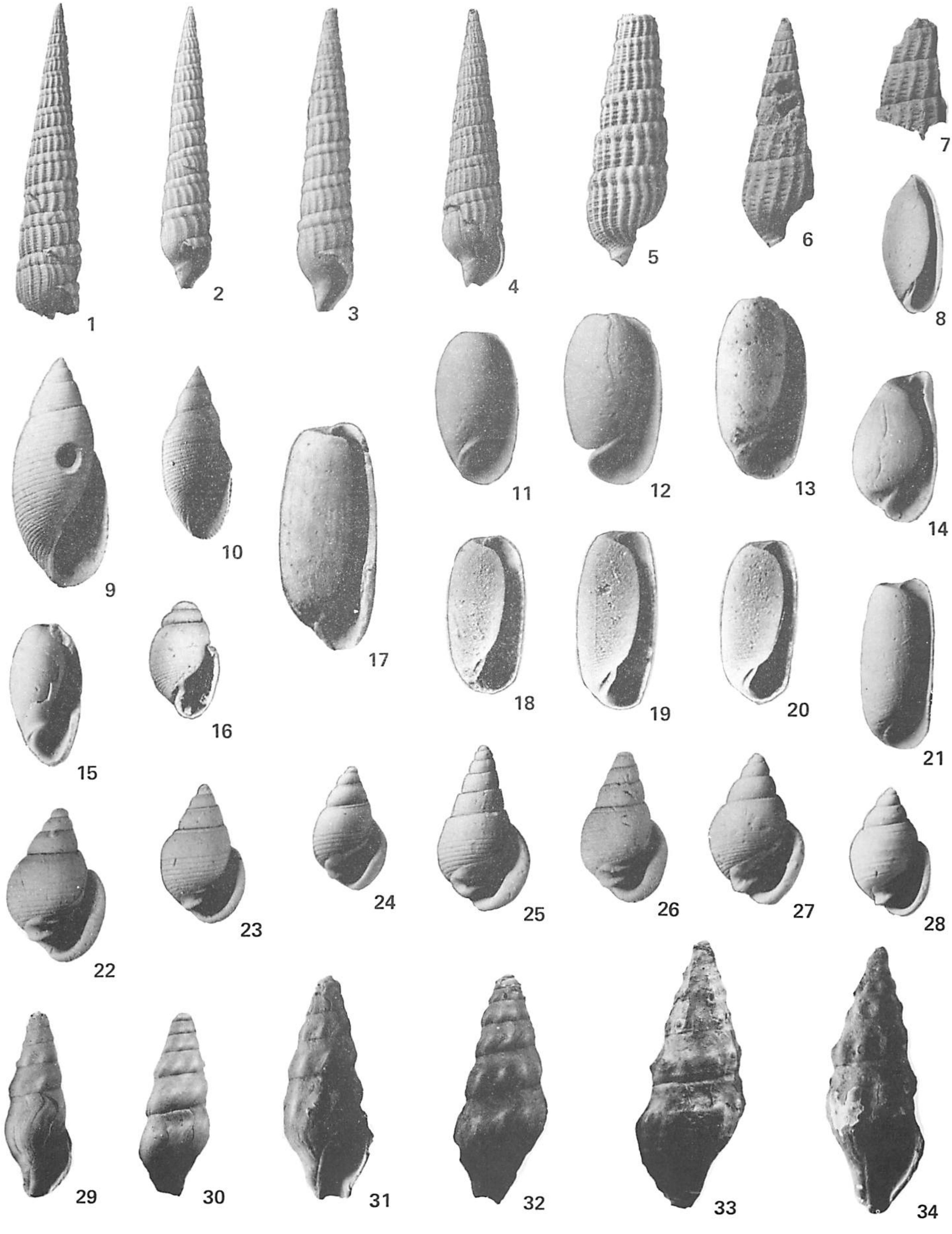
EXPLANATION PLATE 39

Byram Formation

Figure		Page
1-4	**Terebra (Strioterebrum) tantula** Conrad, 1848	168-169
	1. Figured specimen 560923 USNM (x3). Height (incomplete) 20.4 mm, width 4.2 mm; USGS locality 3722.	
	2. Figured specimen 560922 USNM (x3). Height 18.5 mm, width 3.3 mm; USGS locality 3722.	
	3. Figured specimen 560924 USNM (x3). Height 19.6 mm, width 3.6 mm; USGS locality 13286.	
	4. Figured specimen 560925 USNM (x3). Height 17.9 mm, width 4.1 mm; USGS locality 13286.	
5	**Terebra (Strioterebrum) vincta** MacNeil n. sp.	170
	Holotype 560927 USNM (x5). Height (incomplete) 9.4 mm, width 3.0 mm; USGS locality 3722.	
6-7	**Terebra (Strioterebrum) sp.**	170
	6. Figured specimen 560929 USNM (x5). Height (incomplete) 8.7 mm, width 2.7 mm; USGS locality 3729.	
	7. Figured specimen 376649 USNM (x5). Height (fragment) 4.4 mm, width (incomplete) 2.6 mm; USGS locality 3729.	
8	**Volvulella subspinosa** MacNeil n. sp.	237-238
	Figured specimen 376650 USNM (x12). Height 2.3 mm, width 0.9 mm; USGS locality 5615.	
9-10	**Rictaxis andersoni** (Conrad, 1848)	231-232
	9. Holotype of *Tornatella volutata* Meyer, 1887, 644604 USNM (x5). Height 8.9 mm, width 3.8 mm; Vicksburg, Mississippi (Meyer).	
	10. Holotype of *Acteon andersoni* Conrad, 1848, 13411 ANSP (x3). Height 10.5 mm, width 4.0 mm; Vicksburg, Mississippi (Conrad).	
11-12, 15	**Acteocina crassiplica involuta** MacNeil n. subsp.	241
	11. Holotype 560812 USNM (x8). Height 3.8 mm, width 1.8 mm; USGS locality 7440.	
	12. Figured specimen 376651 USNM (x8). Height 4.4 mm, width 2.2 mm; USGS locality 7440.	
	15. Figured specimen 376652 USNM (x8). Height 3.1 mm, width 1.5 mm; USGS locality 3722.	
13	**Acteocina crassiplica** (Conrad, 1848)	240
	Specimen missing?	
14	**Pyrunculus laevipyrum** MacNeil n. sp.	238
	Holotype 560908 USNM (x12). Height 2.5 mm, width 1.3 mm; USGS locality 7376.	
16	**Acteon (Acteon) menthafons** MacNeil n. sp.	230
	Figured specimen 560801 USNM (x12). Height 1.9 mm, width 0.9 mm; USGS locality 5615.	
17-21	**Cylichna nida** MacNeil n. sp.	238-239
	17. Figured specimen 376653 USNM (x8). Height 5.7 mm, width 2.4 mm; USGS locality 3722.	
	18. Figured specimen 376654 USNM (x8). Height 4.0 mm, width 1.6 mm; USGS locality 7376.	
	19. Figured specimen 376655 USNM (x8). Height 4.5 mm, width 1.8 mm; USGS locality 7376.	
	20. Figured specimen 376656 USNM (x8). Height 4.0 mm, width 1.7 mm; USGS locality 7376.	
	21. Figured specimen 560909 USNM (x8). Height 4.2 mm, width 1.6 mm; USGS locality 5615.	
22-24, 26-27	**Ringicula (Ringiculella) mississippiensis** Conrad, 1848	234-235
	22. Figured specimen 560911 USNM (x10). Height 3.0 mm, width 1.7 mm; USGS locality 7376.	
	23. Figured specimen 560913 USNM (x10). Height 2.6 mm, width 1.6 mm; USGS locality 14031.	
	24. Specimen missing?	
	26. Figured specimen 376657 USNM (x10). Height 2.9 mm, width 1.7 mm; USGS locality 7376.	
	27. Figured specimen 560914 USNM (x10). Height 2.8 mm, width 1.7 mm; USGS locality 7440.	
25	**Ringicula (Ringiculella) mississippiensis petila** MacNeil n. subsp.	235
	Holotype 560912 USNM (x10). Height 3.1 mm, width 1.8 mm; USGS locality 6978.	
28	**Ringicula (Ringiculella) mississippiensis nuda** MacNeil n. subsp.	235
	Holotype 560916 USNM (x10). Height 2.5 mm, width 1.5 mm; USGS locality 14031.	
29-32	**Pleurotoma eboroides** Conrad, 1848	203-204
	29-30. Paratype A 13430 ANSP (x3). Height 10.8 mm, width 4.2 mm; Vicksburg, Mississippi? (Conrad).	
	31-32. Lectotype 13439 ANSP (x3). Height 13.6 mm, width 5.6 mm; Vicksburg, Mississippi? (Conrad).	
33-34	**Pleurotoma mississippiensis** Conrad, 1848	204
	Holotype 13445 ASNP (x3). Height 16.2 mm, width 6.2 mm; Vicksburg, Mississippi? (Conrad).	

Byram Formation

Plate 39



EXPLANATION PLATE 40

Figure		Page
1-3	**Turritella carota** MacNeil n. sp. 1. Figured specimen 15095 UC (x2). Mint Spring Fm., UC locality A1050. 2. Figured specimen 15092 UC (x2). Mint Spring Fm., UC locality A1050. 3. Figured specimen 15093 UC (x2). Mint Spring Fm., UC locality A1050.	53
4	**Pyramidella (Voluspa) leafensis** MacNeil n. sp. Holotype 648903 USNM (x4). Height 5.8 mm, width 2.4 mm; Mint Spring Fm., USGS locality 7671.	222
5-6	**Melanella amnicreta** MacNeil n. sp. 5. Figured specimen 648891 USNM (x12). Mint Spring Fm., USGS locality 7671a. 6. Figured specimen 648892 USNM (x12). Mint Spring Fm., USGS locality 14071a.	80
7-11	**Odostomia (Odostomia) aff. O. (O.) angularis** Dall and Bartsch, 1904 7. Figured specimen 498254 USNM (x12). Mint Spring Fm., USGS locality 13287. 8. Figured specimen 648896 USNM (x12). Mint Spring Fm., USGS locality 13287. 9. Figured specimen 648897 USNM (x12). Mint Spring Fm., USGS locality 13287. 10. Figured specimen 648898 USNM (x12). Mint Spring Fm., USGS locality 13287. 11. Figured specimen 648899 USNM (x12). Mint Spring Fm., USGS locality 13287.	224
12-13	**Odostomia (Odostomia) byramensis** MacNeil var.? 12. Figured specimen 498253 USNM. Mint Spring Fm., USGS locality 7671. 13. Figured specimen 648900 USNM. Mint Spring Fm., USGS locality 7671.	224
14	**Onoba ? sp.** Figured specimen 498255 USNM (x12). Mint Spring Fm., USGS locality 13287.	36-37
15	**Turbonilla leafensis** MacNeil n. sp. Figured specimen 648902 USNM (x10). Mint Spring Fm., USGS locality 7671.	227
16	**Odostomia (Miralda) menthafons** MacNeil n. sp. Holotype 498256 USNM (x12). Height 2.4 mm, width 0.9 mm; Mint Spring Fm., USGS locality 14071a.	225
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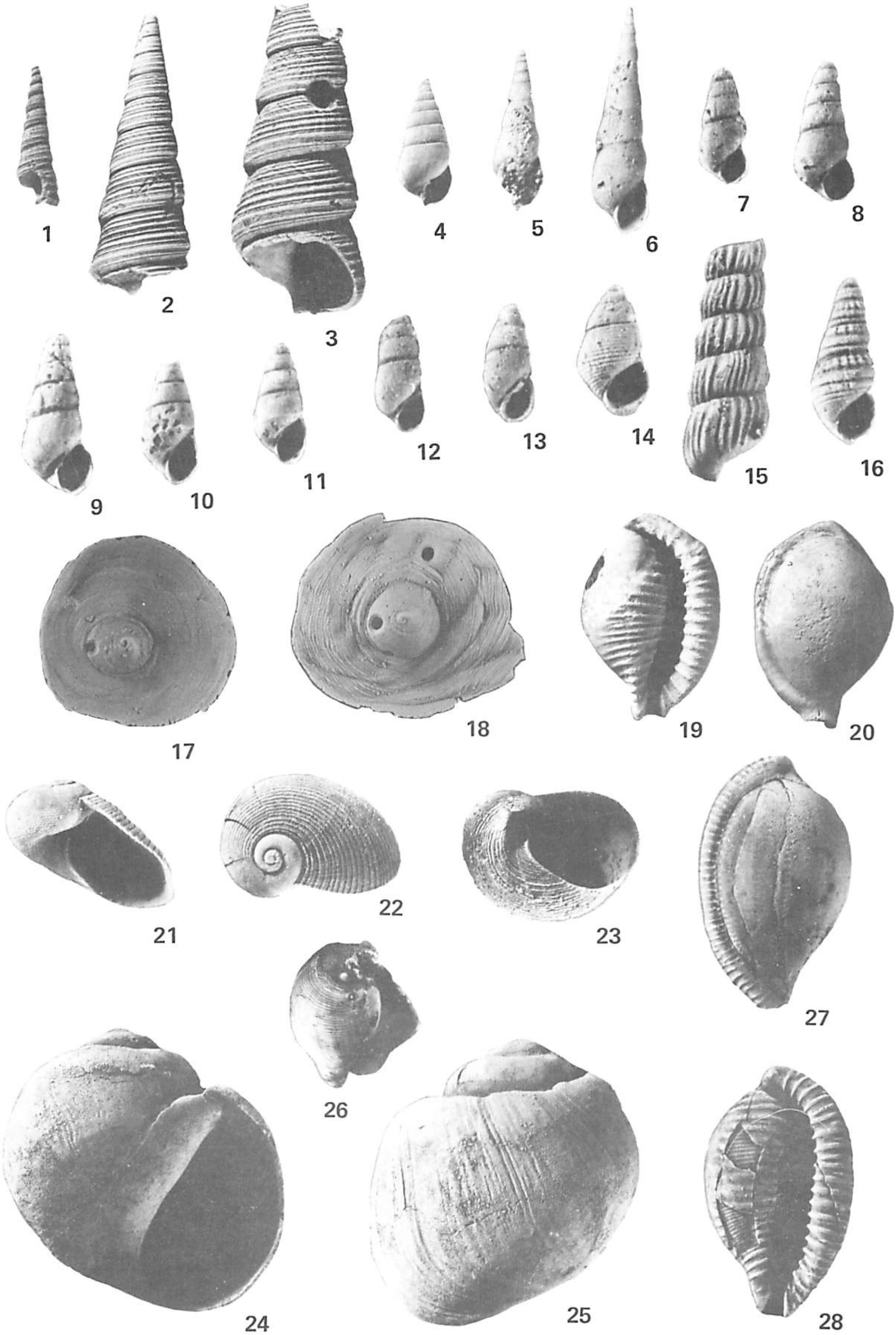
19-20	**Sulcocypraea healeyi** (Aldrich, 1923) Figured specimen 498339 USNM (x3). Mint Spring Fm., USGS locality 6647.	101
21-23	**Sinum (Sinum) aff. S. (S.) beatricae** Palmer, 1937 Figured specimen 648917 USNM (x6). Mint Spring Fm., USGS locality 7671a.	95
24-25	**Ampullinopsis mississippiensis** (Conrad, 1848) Figured specimen 498320 USNM (x1.5). Height 35.0 mm, width 33.0 mm; Mint Spring Fm., USGS locality 7671a.	97
26-28	**Sulcocypraea lintea** (Conrad, 1848) Figured specimen 498350 USNM (x2.5). Byram Fm., USGS locality 13286. Figure 26 is the juvenile whorls of figures 28-29.	99-100

Plate 40



EXPLANATION PLATE 41

Figure		Page
1-3	**Arene (Arene) nodosa** Dockery n. sp. Holotype 376658 USNM (x6). Height 6.6 mm, width 6.6 mm; Byram Fm., MGS locality 93.	36
4-5	**Solariella tallahalaensis** Dockery n. sp. Holotype 376659 USNM (x6). Height 5.1 mm, width 5.6 mm; Byram Fm., MGS locality 93.	35-36
6	**Solariella menthafontis** MacNeil n. sp Figured specimen 1105 MGS (x11). Height 2.0 mm, width 3.5 mm; Byram Fm., MGS locality 93.	33-34
7	**Calliostoma** sp. ? Figured specimen 1106 MGS (x6). Height 6.7 mm, width 4.6 mm; Mint Spring Fm., MGS locality 90.	36
8-9	Unidentified mesogastropod protoconch Figured specimen 1107 MGS (Fig. 8 x109, Fig. 9 x53). Red Bluff Fm., MGS locality 39. SEM photographs by W. H. Johnson.	
10-16	**Odostomia (Odostomia) vicksburgella** Dockery n. sp. 10. Figured specimen 1108 MGS (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell. 11. Figured specimen 1109 MGS (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell. 12. Figured specimen 1110 MGS - Stub No. 7 (x35). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 13. Figured specimen 1111 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 14. Figured specimen 1112 MGS - Stub No. 7 (x45). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 15. Holotype 376660 USNM (x50). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 16. Figured specimen 1113 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	224-225

Plate 41

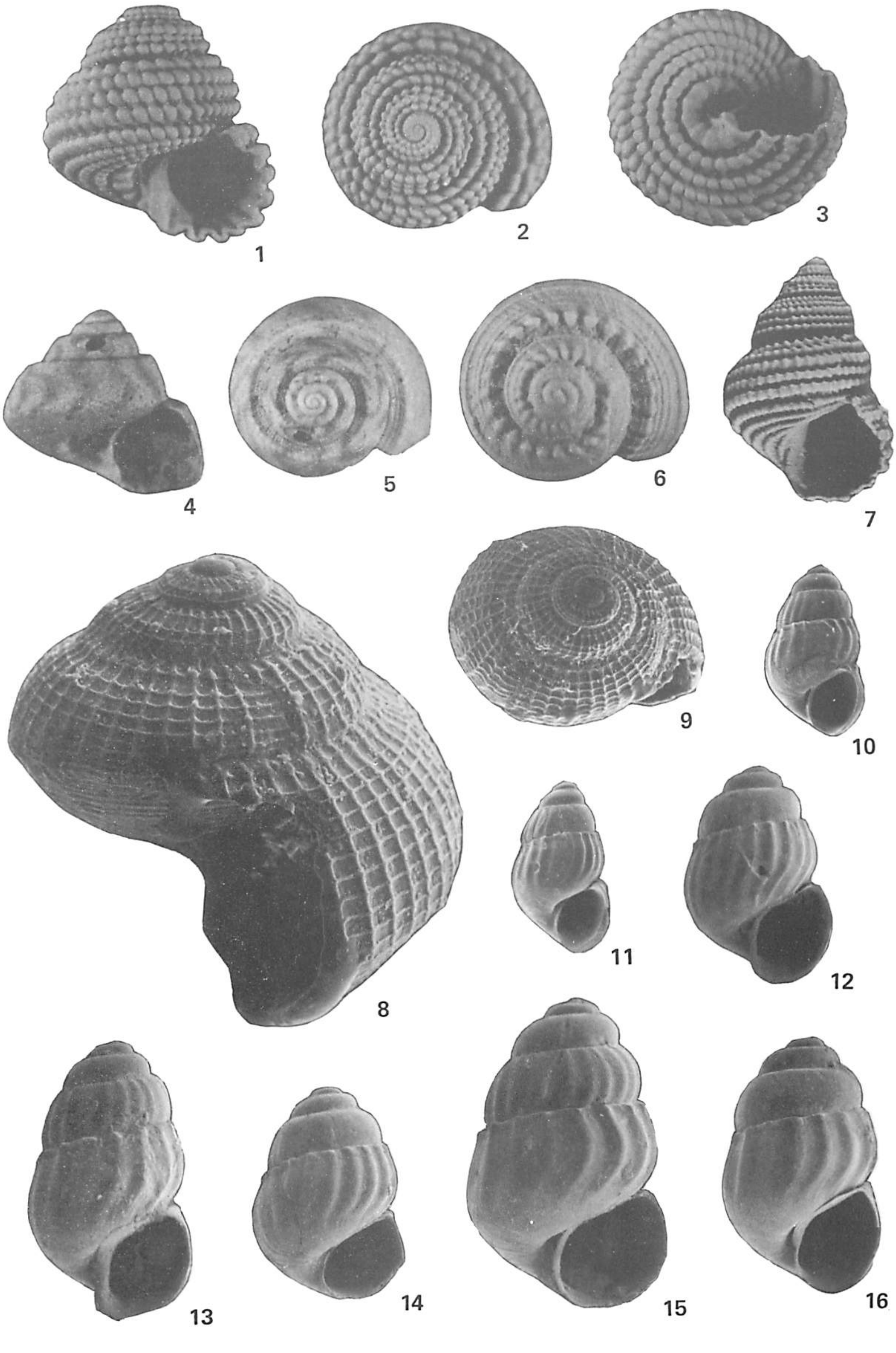


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Figure		Page
1	**Solariorbis sp.** Figured specimen 1114 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	38
2-5	**Vitrinella (Vitrinella) laevis** (Meyer, 1886) 2. Figured specimen 1115 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell. 3. Figured specimen 1116 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell. 4. Figured specimen 1117 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell. 5. Figured specimen 1118 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	37
6	**Cyclostremiscus quadracordata** Dockery n. sp. Holotype 376661 USNM (x6). Diameter 4.4 mm; Byram Fm., MGS locality 93. See Plate 67, figure 7, for umbilical view.	39
7	**Cyclostremiscus menthafons** MacNeil n. sp. Figured specimen 1119 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	38-39
8	**Discopsis pilsbryi** MacNeil n. sp. Figured specimen 1120 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 99. SEM photograph by E. E. Russell.	39-40
9-10	**Tornus infraplicatus** (Johnson, 1899) 9. Figured specimen 1121 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell. 10. Figured specimen 1122 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	40
11	**"Cyclostremiscus" sp.** Figured specimen MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	39
12	**Teinostoma (Idioraphe) verrilli** Meyer, 1885 Figured specimen 1124 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	41-42
13-14	**Teinostoma (Idioraphe) minuta** MacNeil n. sp. 13. Figured specimen 1125 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell. 14. Figured specimen 1126 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	41
15-16	**Caecum solitarium** Meyer, 1886 15. Figured specimen 1127 MGS - Stub No. 5 (x75). Glendon Ls., MGS locality 112b. Juvenile specimen with planispiral protoconch still attached. SEM photograph by W. H. Johnson. 16. Figured specimen 1128 MGS - Stub No. 5 (x75). Glendon Ls., MGS locality 112b. SEM photograph by W. H. Johnson.	42-43

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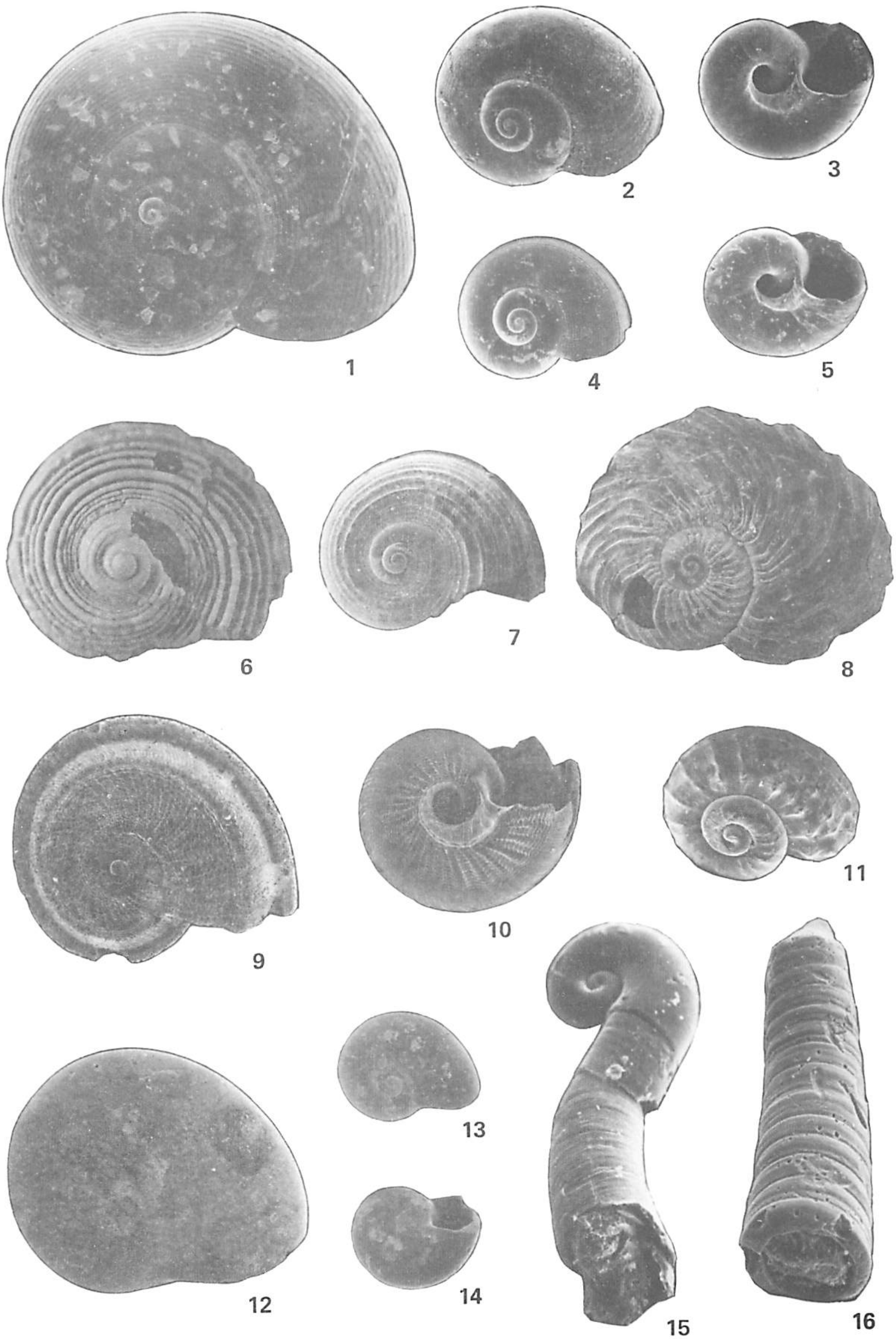

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Figure		Page
1-4	**Architectonica (Architectonica) textilina caseyi** MacNeil n. subsp.	45-46
	1. Figured specimen 1129 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. Umbilical view of juvenile specimen. SEM photograph by G. S. Zumwalt.	
	2. Figured specimen 1130 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. Apical view of juvenile specimen. SEM photograph by G. S. Zumwalt.	
	3. Figured specimen 1131 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. Apertural view of protoconch. SEM photograph by G. S. Zumwalt.	
	4. Figured specimen 1132 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. Apical view of protoconch. SEM photograph by G. S. Zumwalt.	
5-6	**Mathilda regularis** (Meyer, 1886)	55-56
	5. Figured specimen 1133 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	
	6. Figured specimen 1134 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell.	
7	**Serpulorbis** sp.	56
	Figured specimen 1135 MGS (x1.8). Mint Spring Fm., MGS locality 74b. Specimen attached to a rounded, calcareous, sandstone clast from the basal Mint Spring Fm.	
8-9	**Semivertagus silvacollinis** Dockery n. sp.	57
	8. Figured specimen 1136 MGS (x7). Height 7.4 mm, width 2.6 mm; Forest Hill Fm., MGS locality 75a.	
	9. Holotype 376662 USNM (x7). Height 8.3 mm, width 2.5 mm; Forest Hill Fm., MGS locality 75a.	
10-17	**Bittium (Argyropeza?) ottoi** MacNeil n. sp.	58-59
	10. Figured specimen 1137 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by G. S. Zumwalt.	
	11. Figured specimen 1138 MGS - Stub No. 5 (x61). Red Bluff Fm., MGS locality 38. SEM photograph by W. H. Johnson.	
	12. Figured specimen 1139 MGS - Stub No. 7 (x35). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	13. Figured specimen 1140 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	14. Figured specimen 1141 MGS - Stub No. 7 (x35). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	15. Figured specimen 1142 MGS (x23). Forest Hill Fm., MGS locality 75a. SEM photograph by E. E. Russell.	
	16. Figured specimen 1143 MGS - Stub No. 7 (x28). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	17. Figured specimen 1144 MGS (x23). Forest Hill Fm., MGS locality 75a. SEM photograph by E. E. Russell.	

Plate 43

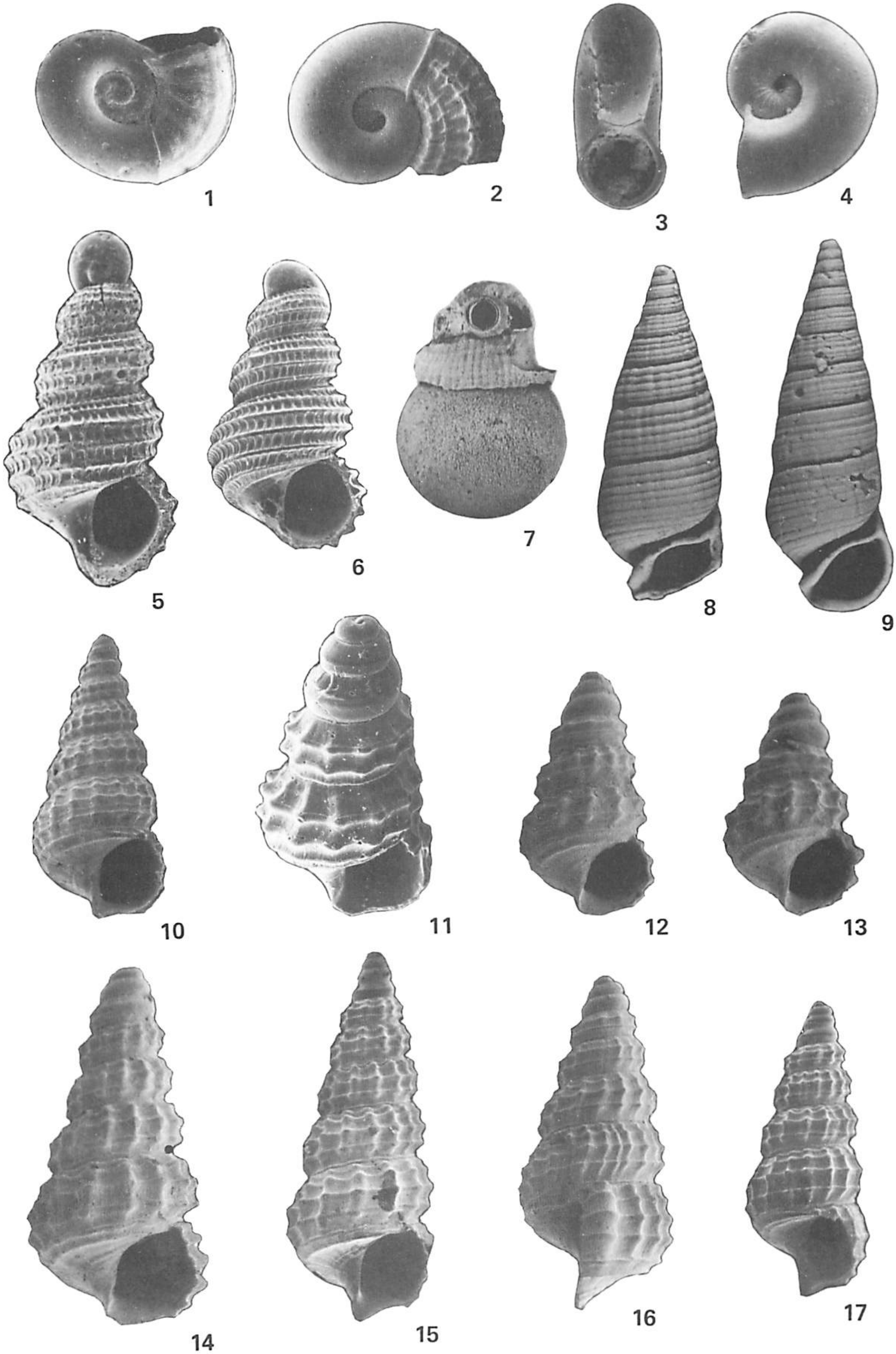

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Figure		Page
1, 6	**Cerithiella nassuloides MacNeil n. sp.**	61
	1. Figured specimen 1145 MGS - Stub No. 7 (x50). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	6. Figured specimen 1146 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	
2-3	**Cerithiella langdoni** (Aldrich, 1885) var.	61
	2. Figured specimen 1147 MGS - Stub No. 7 (x50). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	3. Figured specimen 1148 MGS - Stub No. 6 (x179). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
4	**Cerithiella langdoni** (Aldrich, 1885)	60-61
	Figured specimen 1149 MGS (x23). Protoconch sculptured as in *C. langdoni* s.s. Forest Hill Fm., MGS locality 75a. SEM photograph by E. E. Russell.	
5	**Cerithiella sp.**	62
	Figured specimen 1150 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	
7-8	**Alabina menthafontis MacNeil n. sp.**	63-64
	7. Figured specimen 1151 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	
	8. Figured specimen 1152 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	
9	**Alaba macneili Dockery n. sp.**	63
	Holotype 376663 USNM (x3.5). Height 17.1 mm, width (incomplete) 6.1 mm; Byram Fm., MGS locality 106.	
10	**Triphora (Triphora) meridionalis** (Meyer, 1886)	65-66
	Figured specimen 1153 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	
11	**Triphora (Triphora) bilineata** (Meyer, 1886)	64-65
	Figured specimen 1154 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	

Plate 44

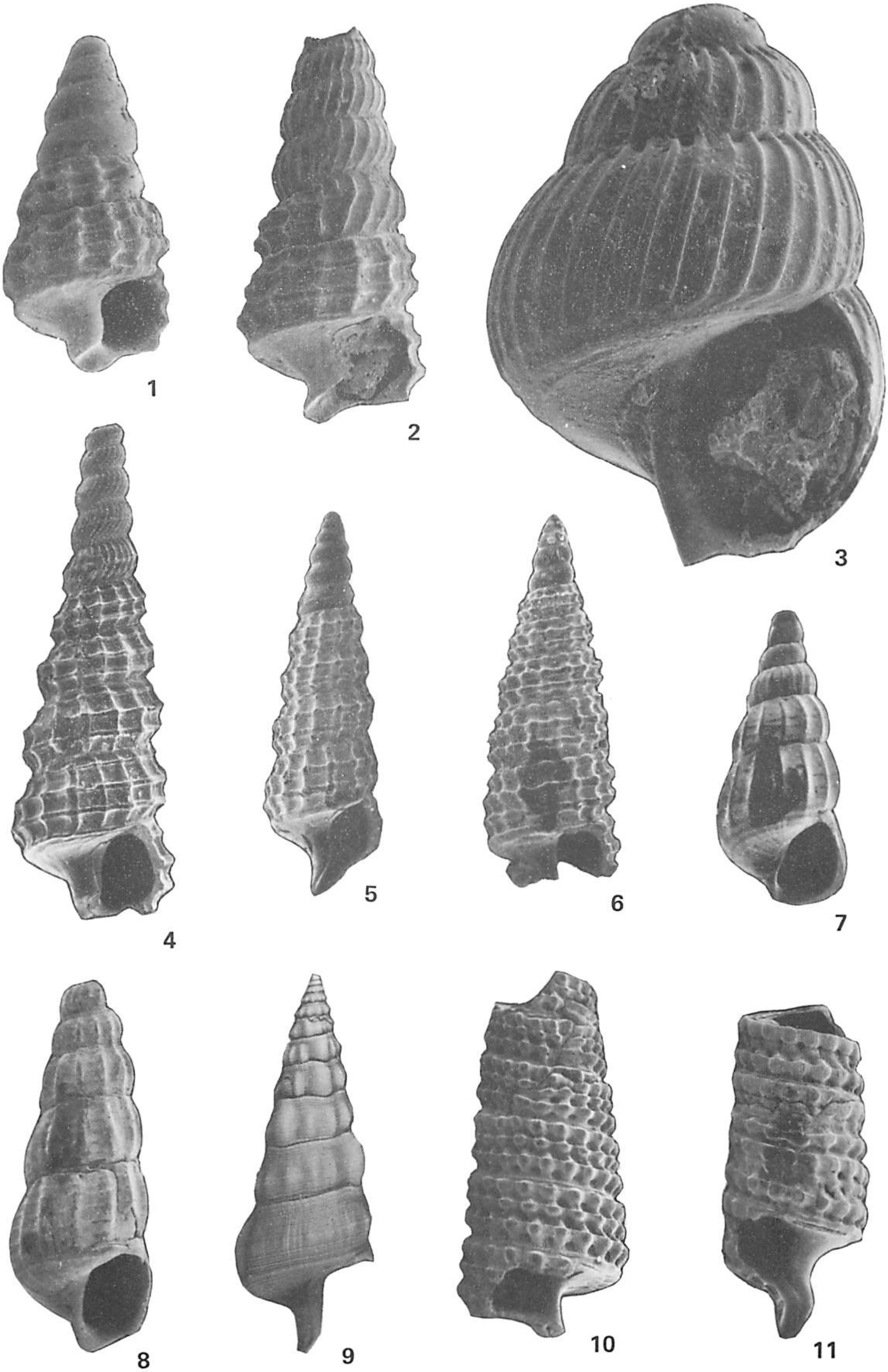

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Figure		Page
1-11	**Triphora (Triphora) bilineata** (Meyer, 1886)	64-65
	1. Figured specimen 1155 MGS (x23). Forest Hill Fm., MGS locality 75a. SEM photograph by E. E. Russell.	
	2. Figured specimen 1156 MGS (x23). Forest Hill Fm., MGS locality 75a. SEM photograph by E. E. Russell.	
	3. Figured specimen 1157 MGS (x23). Red Bluff Fm., MGS locality 34b. SEM photograph by E. E. Russell.	
	4. Figured specimen 1158 MGS - Stub No. 7 (x59). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	5. Figured specimen 1159 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	6. Figured specimen 1160 MGS - Stub No. 5 (x35). Byram Fm., MGS locality 112c. SEM photograph by W. H. Johnson.	
	7. Figured specimen 1161 MGS - Stub No. 7 (x60). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	8. Figured specimen 1162 MGS - Stub No. 7 (x60). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	9. Figured specimen 1163 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	10. Figured specimen 1164 MGS - Stub No. 5 (x61). Red Bluff Fm., MGS locality 38. SEM photograph by W. H. Johnson.	
	11. Figured specimen 1165 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by W. H. Johnson.	
12-14	**Epitonium** sp. ?	72
	12. Figured specimen 1166 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	
	13. Figured specimen 1167 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	
	14. Figured specimen 1168 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	
15	**Seila** sp.	62
	Figured specimen 1169 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	
16	**Scalina rubricollis** MacNeil n. sp.	75-76
	Figured specimen 1170 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell.	
17	**Scalina trigintanaria** (Conrad, 1848)	73-74
	Figured specimen 1171 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	
18-19	**Pliciscala (Nodiscala ?) caseyi** MacNeil n. sp.	78
	18. Figured specimen 1172 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell.	
	19. Figured specimen 1173 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	

Plate 45

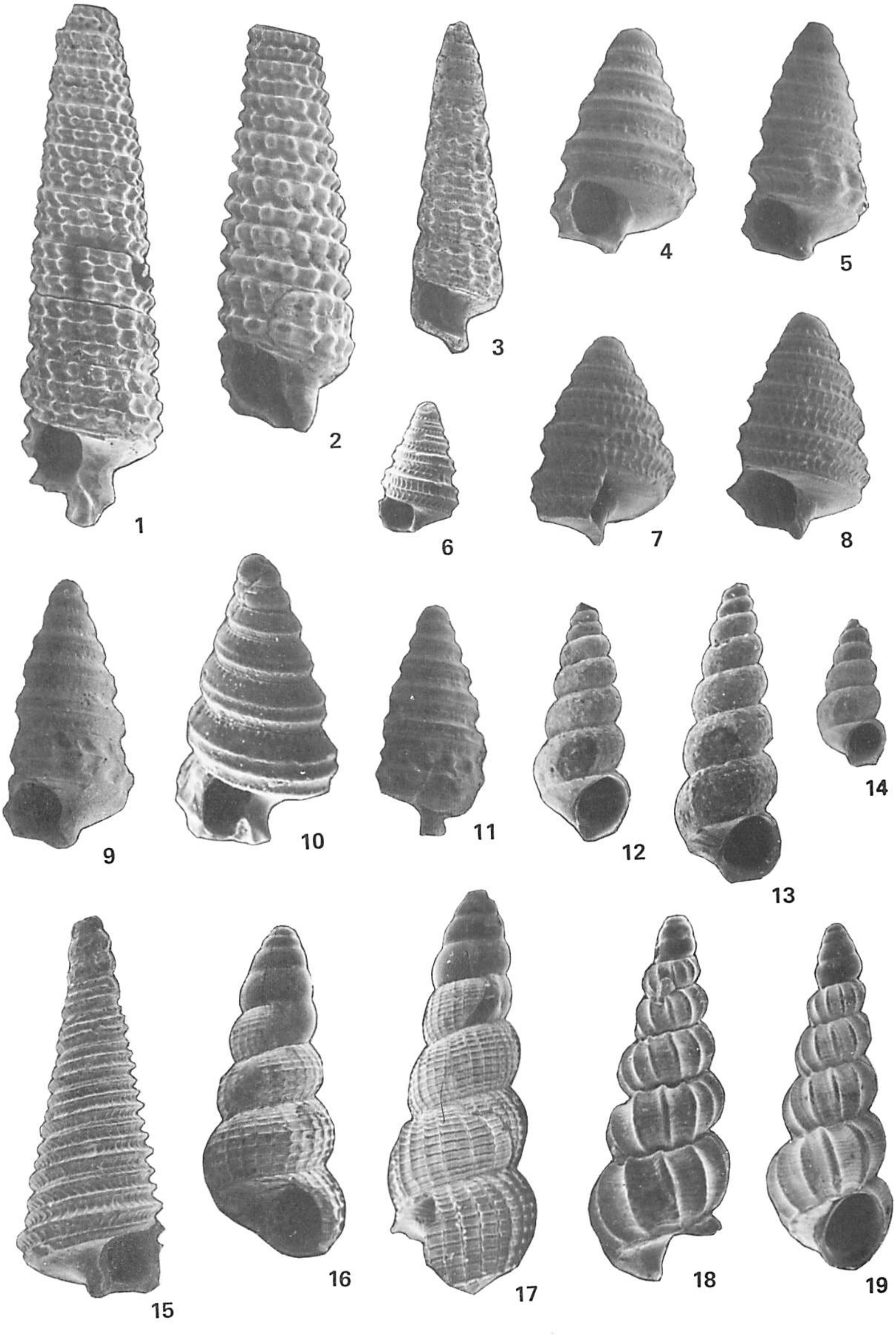

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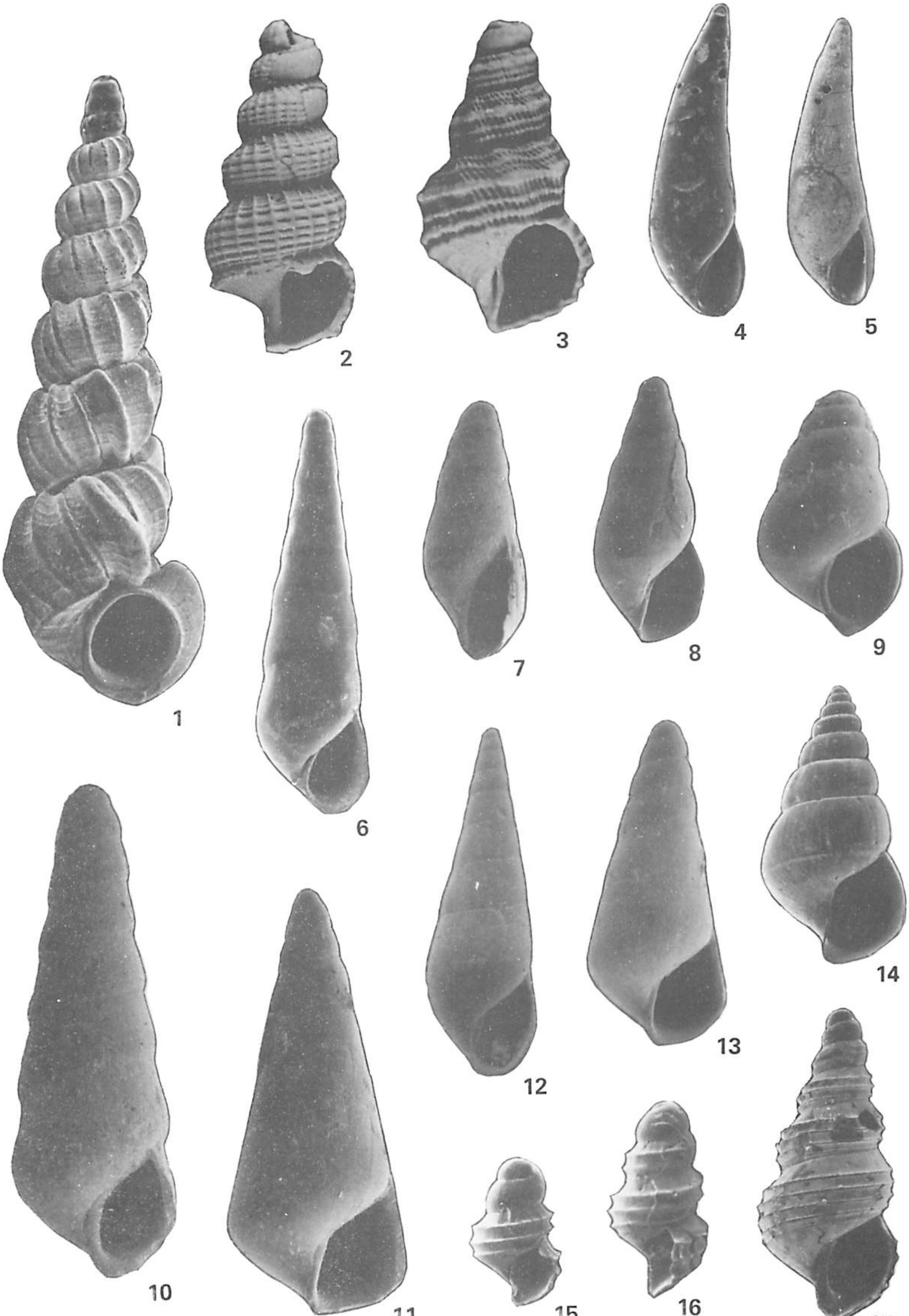
Figure		Page
1	**Pliciscala (Nodiscala?) caseyi MacNeil n. sp.** Figured specimen 1174 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell.	78
2	**Scalina trigintanaria (Conrad, 1848)** Figured specimen 1175 MGS (x10). Height 5.2 mm, width 2.1 mm; Byram Fm., MGS locality 106.	73-74
3	**Cerithioderma sp?** Figured specimen 1176 (x12). Height 4.1 mm; Forest Hill Fm., MGS locality 75a.	67
4-5	**Mellanella sp.** 4. Figured specimen 1177 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell. 5. Figured specimen 1178 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	80
6-8, 10, 12	**Mellanella amnicreta MacNeil n. sp.** 6. Figured specimen 1179 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell. 7. Figured specimen 1180 MGS - Stub No. 7 (x41). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 8. Figured specimen 1181 MGS - Stub No. 7 (x41). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 10. Figured specimen 1182 MGS - Stub No. 7 (x41). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 12. Figured specimen 1183 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	80
9, 11, 13	**Mellanella postnotata MacNeil n. sp.** 9. Figured specimen 1184 MGS - Stub No. 7 (x60). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 11. Figured specimen 1185 MGS - Stub No. 7 (x41). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 13. Figured specimen 1186 MGS - Stub No. 7 (x41). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	79-80
14	**Aclis sp. A** Figured specimen 1187 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. SEM photograph by E. E. Russell.	82
15-16	**Aclis matsoni MacNeil n. sp.** 15. Figured specimen 1188 MGS - Stub No. 5 (x35). Byram Fm., MGS locality 112c. SEM photograph by W. H. Johnson. 16. Figured specimen 1189 MGS - Stub No. 5 (x35). Byram Fm., MGS locality 112c. SEM photograph by W. H Johnson.	82
17	**Aclis matsoni MacNeil var. ?** Figured specimen 1190 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	82

Plate 46



EXPLANATION PLATE 47

Figure		Page
1-2	**Vitrinella (Vitrinella) laevis** (Meyer, 1886)	37
	1. Figured specimen 1191 MGS - Stub No. 9 (x21). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	2. Figured specimen 1192 MGS - Stub No. 9 (x21). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
3-4	**Architectonica (Architectonica) textilina caseyi** MacNeil n. subsp.	45-46
	3. Figured specimen 1193 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. Umbilical view of juvenile. SEM photograph by G. S. Zumwalt.	
	4. Figured specimen 1194 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. Apical view of juvenile. SEM photograph by G. S. Zumwalt.	
5-11	**Capulus planus** Dockery n. sp.	87-88
	5-6. Figured specimen 1195 MGS (x2). Height 16.4 mm, width 19.5 mm; Red Bluff Fm., MGS locality 38.	
	7-8. Figured specimen 1196 MGS (x3). Height 11.6 mm, width 6.4 mm; Red Bluff Fm., MGS locality 38.	
	9-11. Holotype 376664 USNM (Fig. 9-10 x2, Fig. 11 x6). Height 26.8 mm, width 15.8 mm; Red Bluff Fm., MGS locality 38.	
12-14	**Sablea minuta** Allen, 1970	33
	12. Figured specimen 1471 MGS (x8). Height 3.2 mm, width 1.4 mm; elevation 1.9 mm; Mint Spring Fm., MGS locality 90.	
	13. Figured specimen 1197 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37. SEM photograph by E. E. Russell.	
	14. Figured specimen 1198 MGS - Stub No. 5 (x108). Red Bluff Fm., MGS locality 38. Oblique view of aperture. SEM photograph by W. H. Johnson.	
15-16	**Xenophora (Xenophora) cf. X. (X.) reculsa** (Conrad, 1854)	89
	Figured specimen 648910 USNM (x1). Height 35.0 mm, width 38.0 mm; USGS locality 14701a. Same specimen as figured in Plate 15, figure 22.	

Plate 47

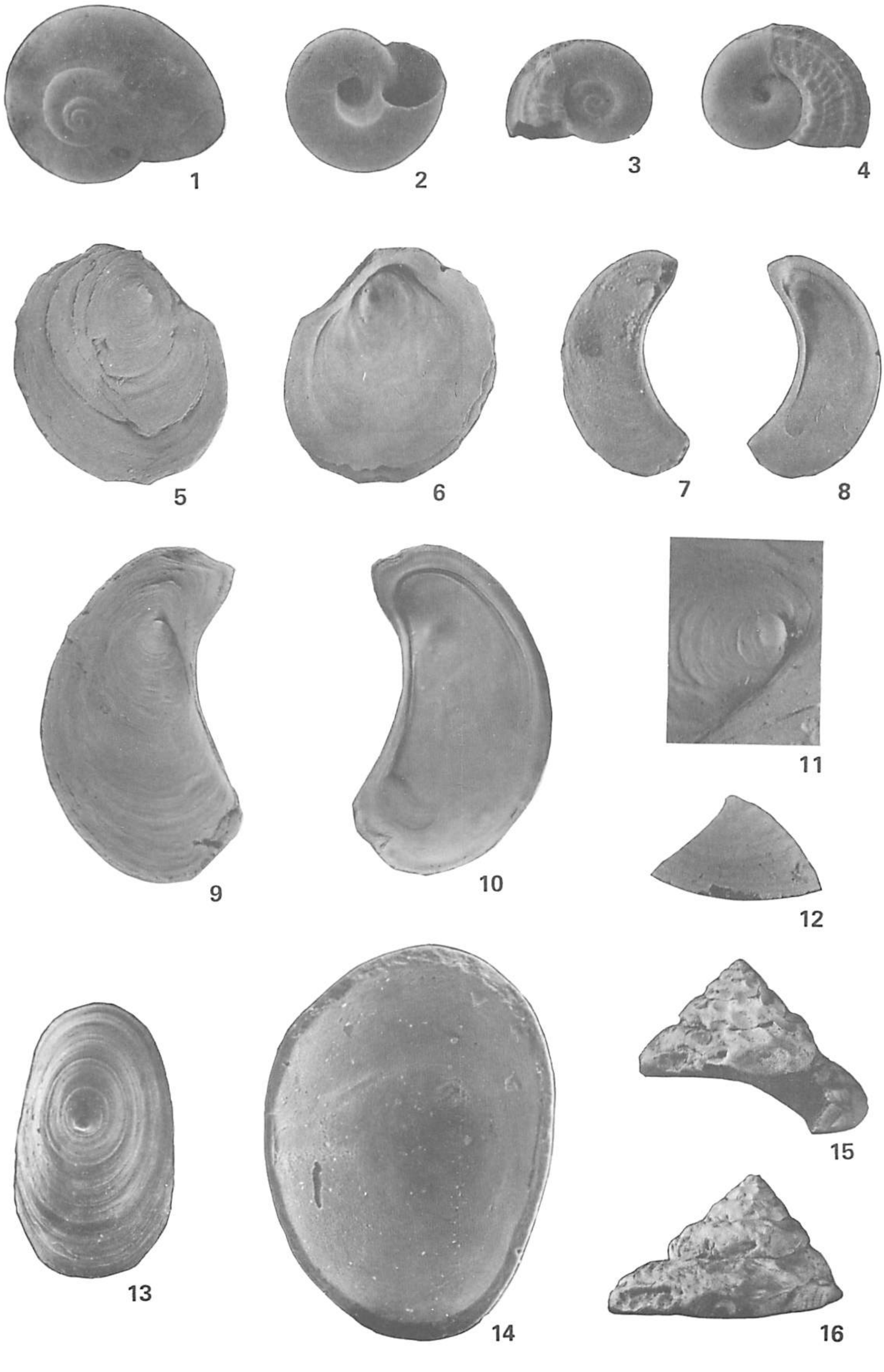


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Figure		Page
1-3	**Xenophora (Stellaria) testigera digitata** Martens, 1878 .... Figured specimen 664198 USNM (x1). Height (including digits of flange) 51.0 mm, diameter (including digits of flange) 61.0 mm; collected alive off the coast of West Africa (off Gabon) on August 31, 1963, at 161 fm.	90
4-7	**Xenophora (Stellaria) conica** Dall, 1892 .... Holotype 112830 USNM (x2). Height 13.5 mm, diameter 18.2 mm; Red Bluff Fm., USGS locality 315.	89-90
8-9	**Xenophora (Xenophora) cf. X. (X.) reclusa** (Conrad, 1854) .... Figured specimen 376666 USNM (x1). Height 18.0 mm, diameter 43.0 mm; Mint Spring Fm., USGS locality 14071a. Specimen has rock fragments of lithified sands from the Mint Spring Fm. agglutinated to the shell. One such fragment is a gastropod steinkern.	89

Plate 48

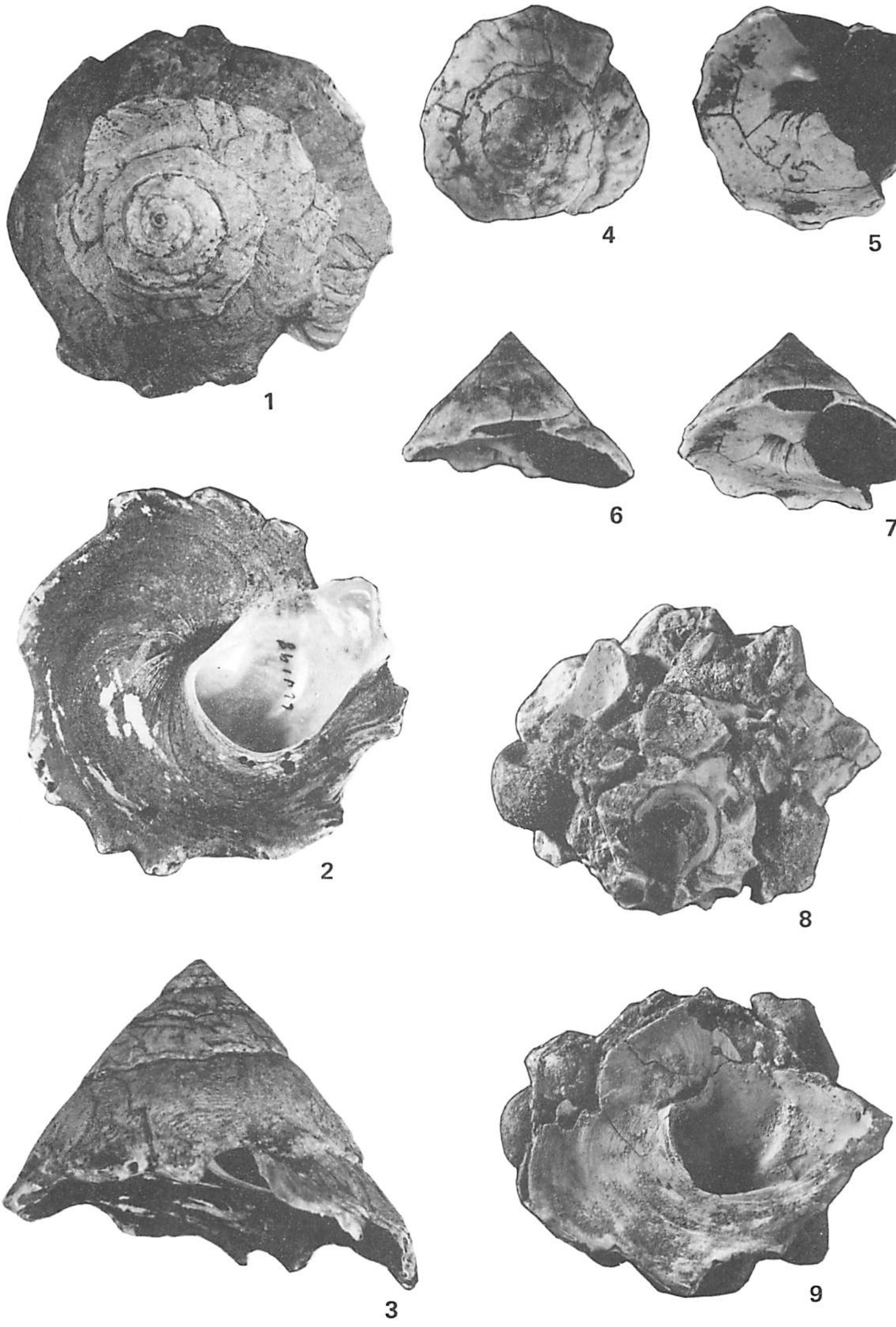

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Figure		Page
1-3	**Sinum (Sigaretotrema) cf. S. (S.) danvillense Harris and Palmer, 1947** ... 1. Figured specimen 1199 MGS - Stub No. 7 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. Protoconch. 2. Figured specimen 1200 MGS - Stub No. 9 (x21). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. Protoconch. 3. Figured specimen 1201 MGS - Stub No. 9 (x21). Red Bluff Fm., MGS locality 38. SEM photograph by Zumwalt. Protoconch.	96
4-5	**Natica (Naticarius) acuticallosa MacNeil n. sp. ?** ... 4. Figured specimen 1202 MGS - Stub No. 9 (x21). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt. 5. Figured specimen 1203 MGS - Stub No. 9 (x21). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	91-92
6	**Cassis flintensis** Mansfield, 1940 ? ... Figured specimen 1204 MGS (x1). Specimen incomplete, largest dimension 50.5 mm; Mint Spring Fm., MGS locality 99.	103-104
7-8	**Cassis elegans** Grateloup ... Height 54.8 mm, width 38.0 mm; Oligocene, Espibos district of Gaas, Aquitaine Basin, France (x1). Specimen collected by Pierre Lozouet.	103
9-10	**Galeodaria shubutensis** (Aldrich, 1885) ... Figured specimen 1205 MGS (x2). Height 29.7 mm, width 17.1 mm; Red Bluff Fm., MGS locality 37.	107-108
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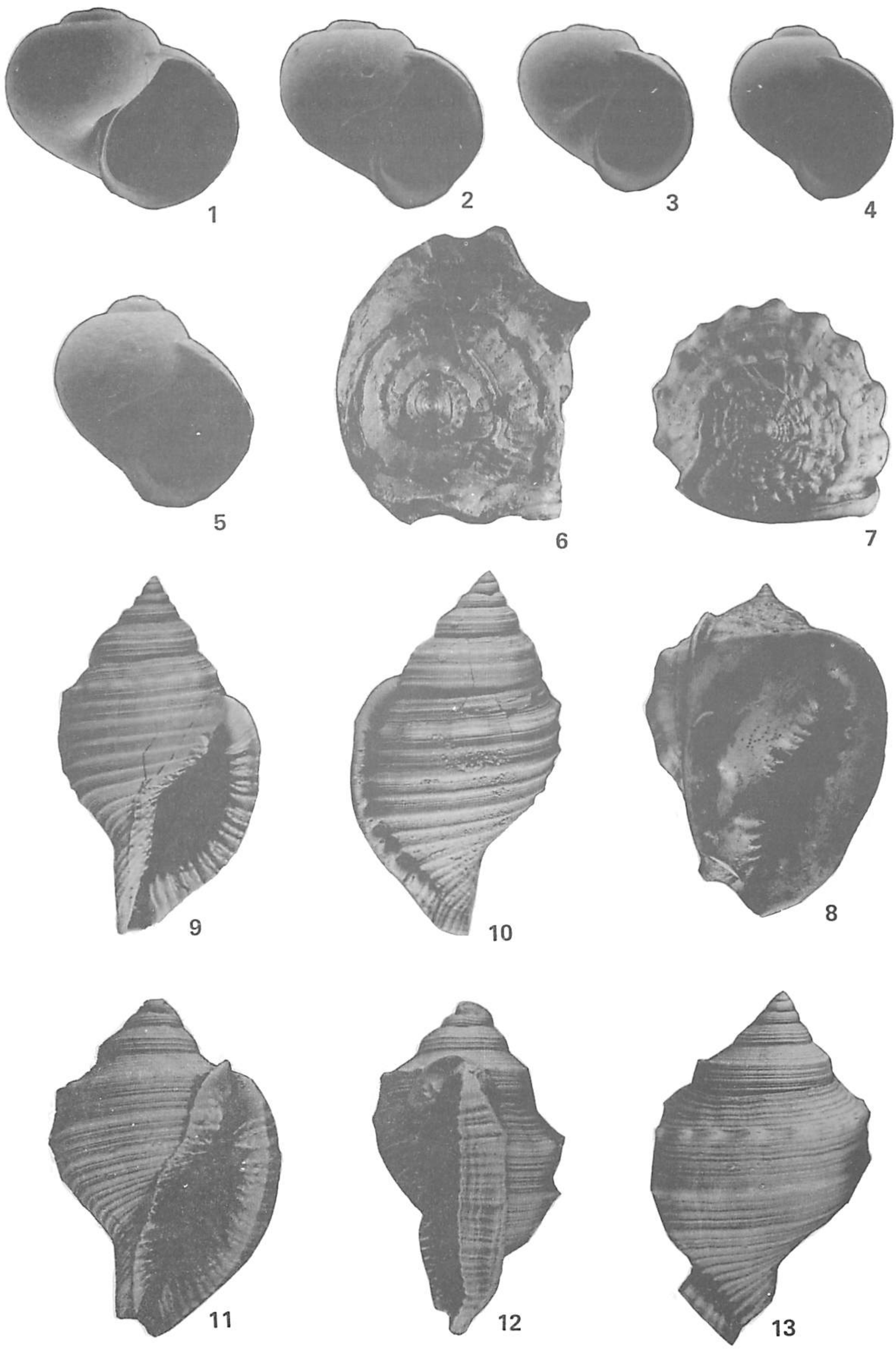
Plate 49



EXPLANATION PLATE 50

Figure		Page
1-2	**Sconsia prelintea** MacNeil n. sp. Figured specimen 1208 MGS (x2). Height 25.7 mm, width 15.5 mm; Red Bluff Fm., MGS locality 39.	110
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7-8	**Semicassis caelatura** (Conrad, 1848) Figured specimen 1212 MGS (x2). Height 23.2 mm, width 15.1 mm; Byram fm., MGS locality 106.	104-105
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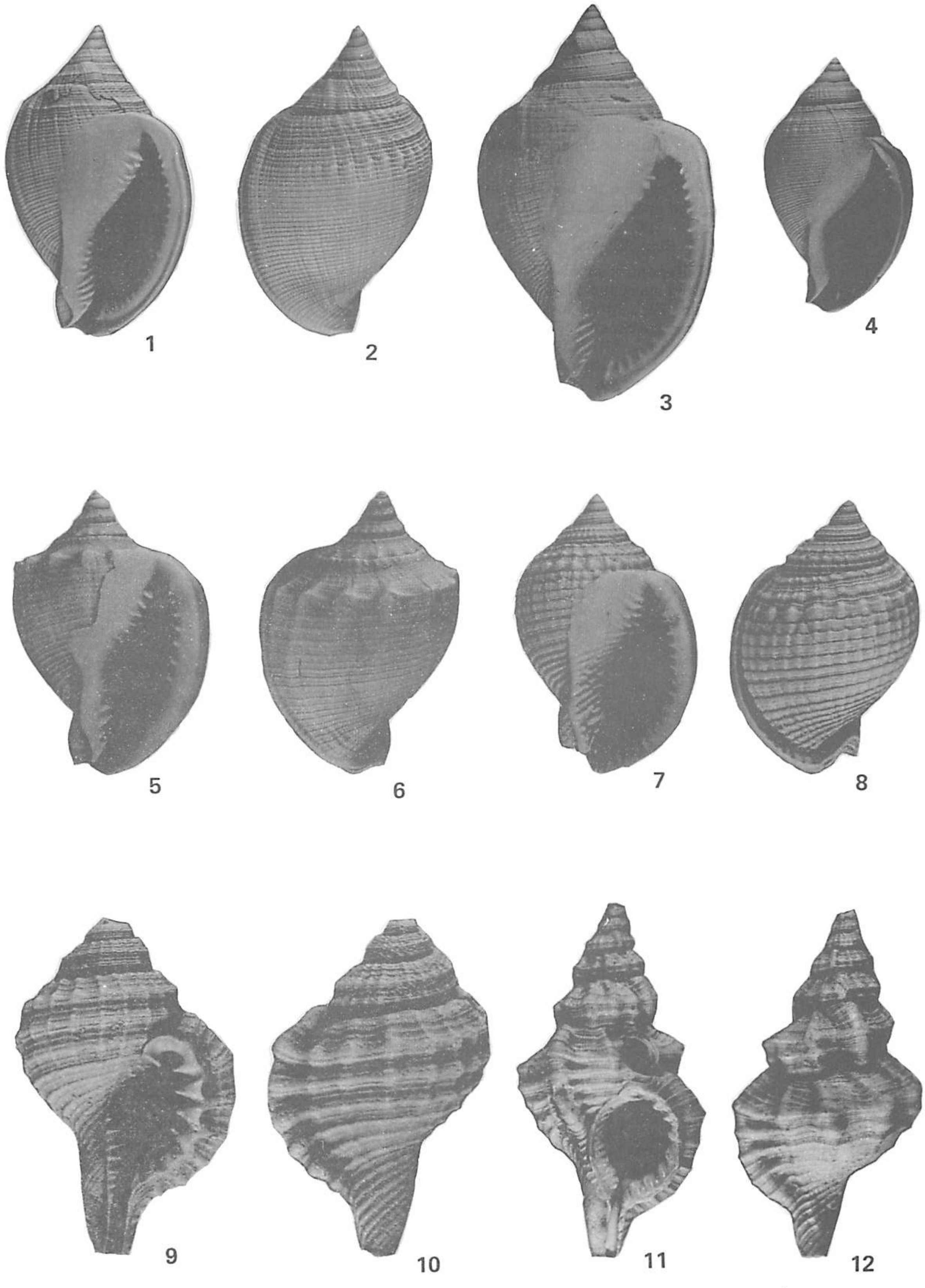
Plate 50



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1-2, 5-6	**Distorsio (Distorsio) crassidens** (Conrad, 1848) 1-2. Figured specimen 1213 MGS (x1.4). Height 46.5 mm, width 26.7 mm; Byram Fm., MGS locality 109. 5-6. Figured specimen 1214 MGS (x2). Height 30.9 mm, width 17.0 mm; Byram Fm., MGS locality 106.	121
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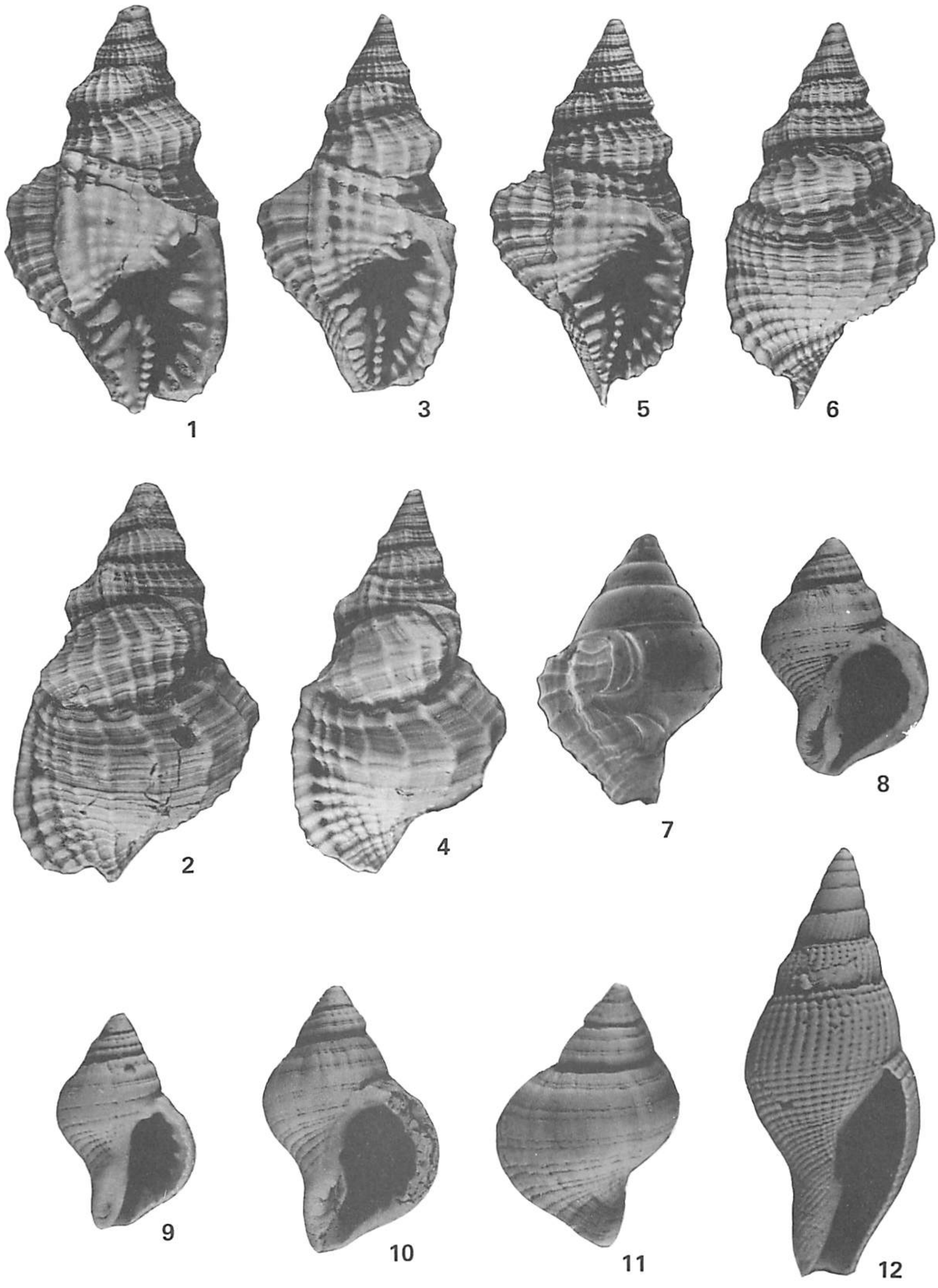
Plate 51



EXPLANATION PLATE 52

Figure		Page
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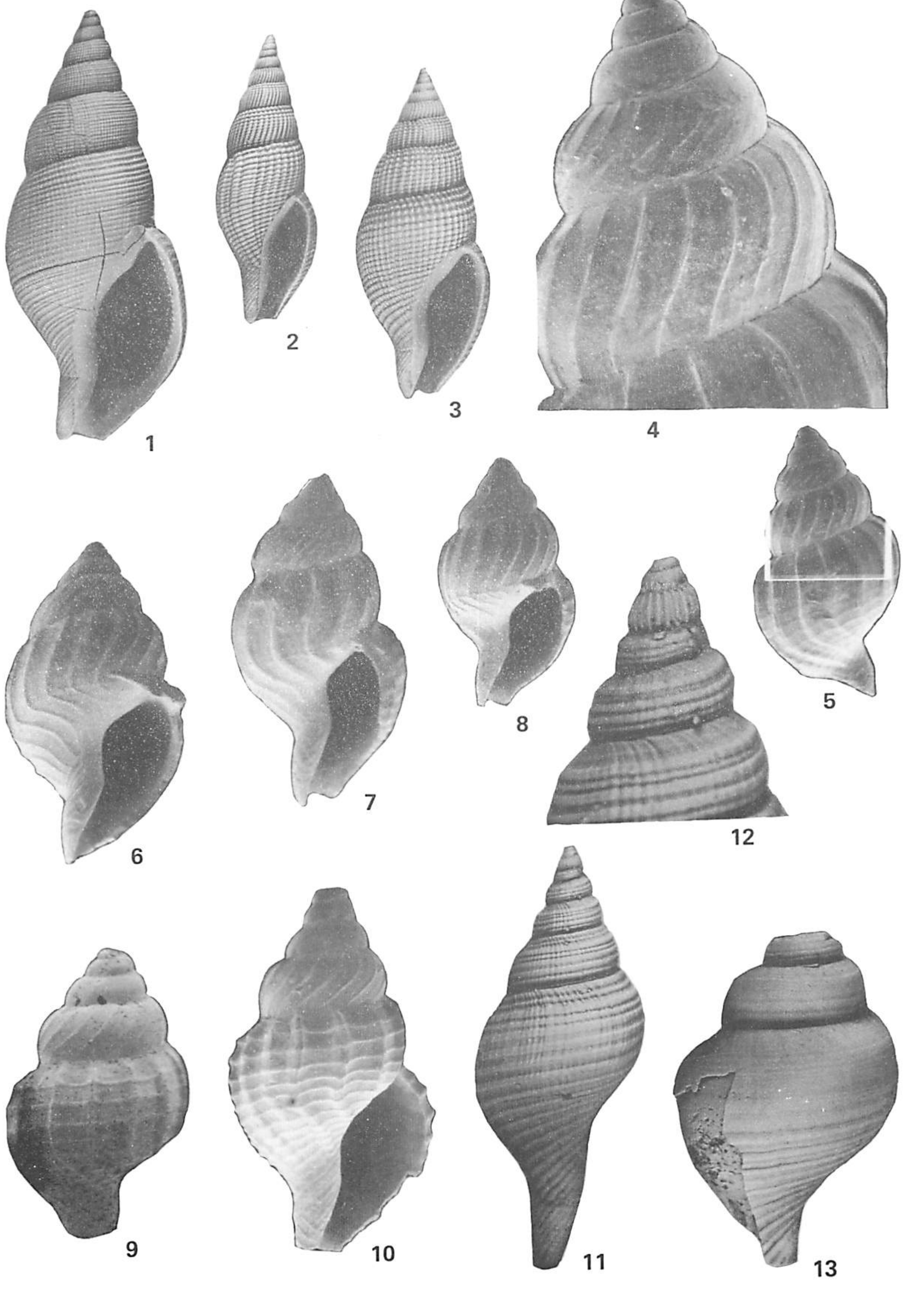
Plate 52



EXPLANATION PLATE 53

Figure		Page
1-3	**Latirus indistinctus** Aldrich, 1884	146
	1. Figured specimen 1228 MGS (x2.5). Height 23.4 mm, width 8.9 mm; Red Bluff Fm., MGS locality 40.	
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	3. Figured specimen 1230 MGS (x2.5). Height (incomplete) 21.6 mm, width (incomplete) 9.2 mm; Red Bluff Fm., MGS locality 38.	
4-6	**Latirus aldrichi** Dockery n. sp.	145-146
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	5. Figured specimen 1231 MGS (x2.5). Height 19.7 mm, width 7.3 mm; Red Bluff Fm., MGS locality 38.	
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7	**Latirus protractus** (Conrad, 1848)	145
	Figured specimen 1233 MGS (x2). Height 30.8 mm, width 12.2 mm; Red Bluff Fm., MGS locality 38.	
8-9	**Dolicholatirus exilis confertus** Dockery n. subsp.	147
	8. Figured specimen 1234 MGS (x3). Height 23.7 mm, width 6.4 mm; Byram Fm., MGS locality 106.	
	9. Holotype 376672 USNM (x1.8). Height 31.3 mm, width 9.2 mm; Byram Fm., MGS locality 106.	
10	**Dolicholatirus cervicrassus** Dockery n. sp.	146-147
	Figured specimen 1236 MGS (x1.8). Height 40.8 mm, width 11.2 mm; Red Bluff Fm., MGS locality 38.	
11-12	**Dolicholatirus perexilis** (Conrad, 1848)	146
	11. Figured specimen 1235 MGS (x1.4). Height 53.3 mm, width 13.0 mm; Byram Fm., MGS locality 106.	
	12. Figured specimen 1237 MGS (x1.8). Height 37.3 mm, width 10.2 mm; Byram Fm., MGS locality 106.	
13	**Clavilithes longiformis** Dockery n. sp.	148
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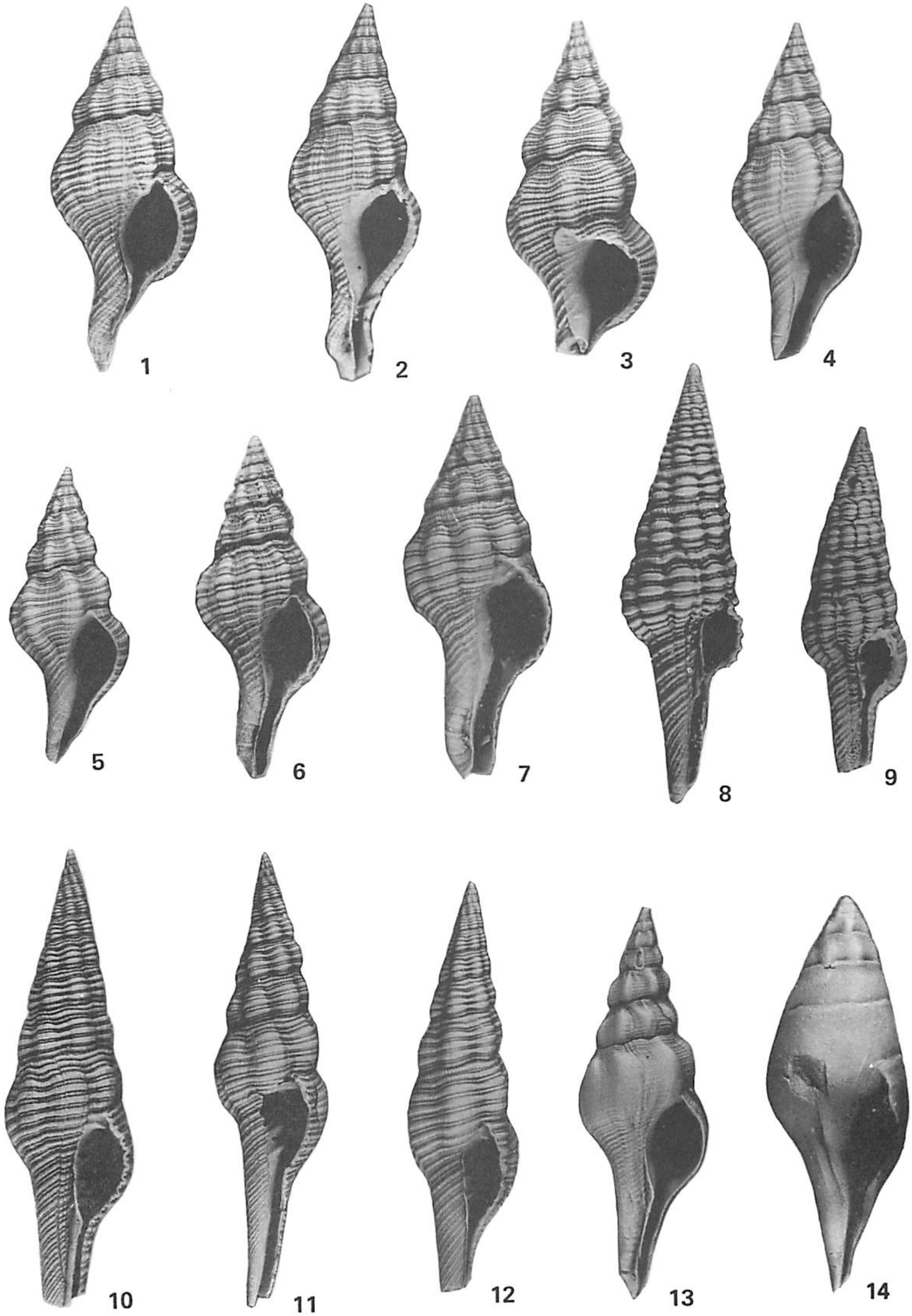
14	**Clavilithes vicksburgensis** (Conrad, 1849)	147
	Lectotype 13477 ANSP (x1.2). Height 54.6 mm, width 18.9 mm; probably from the Mint Spring Fm., Vicksburg, Mississippi.	

Plate 53

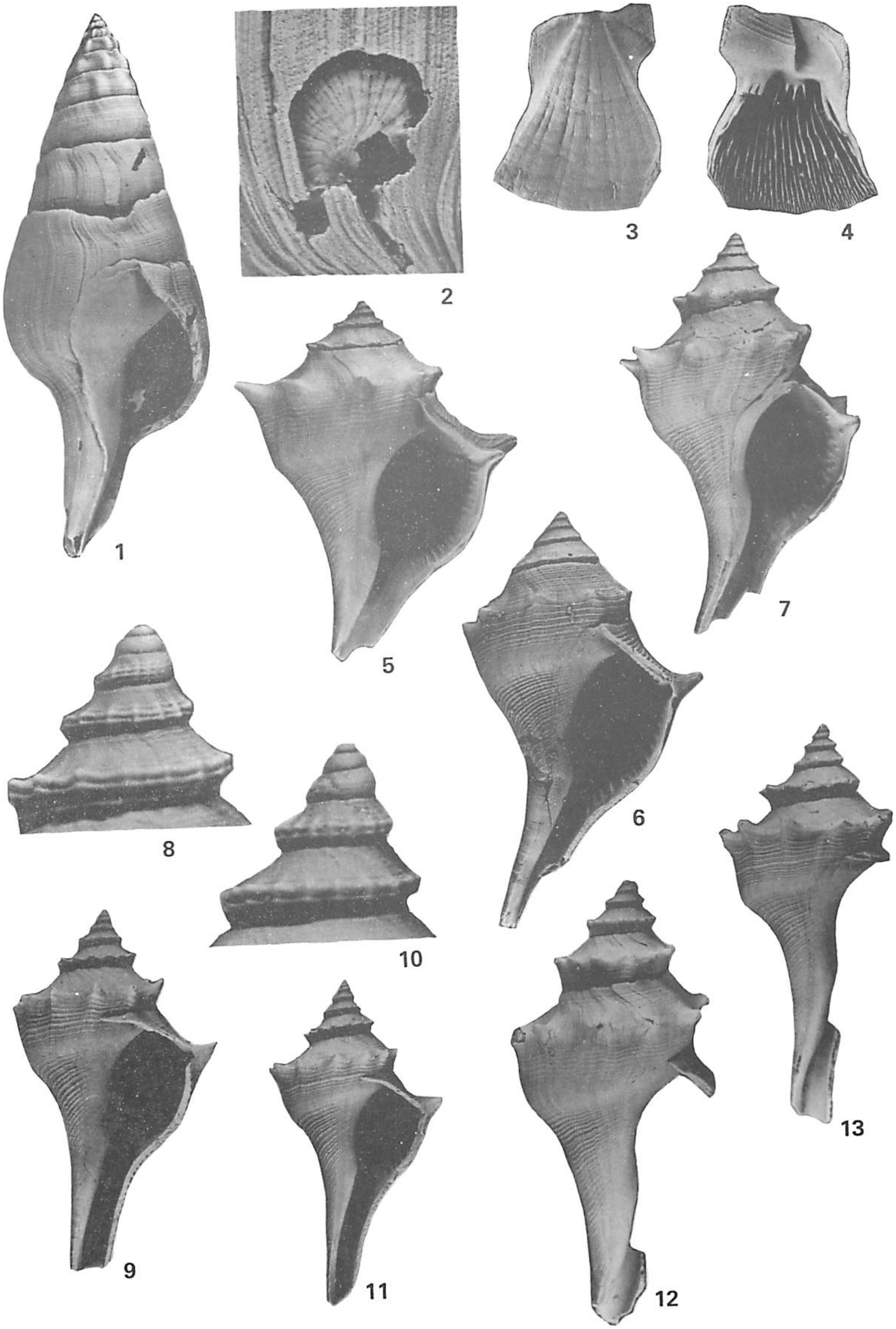


1 2 3 4 5 6 7 8 9 10 11 12 13 14

EXPLANATION PLATE 54

Figure		Page
1-2	**Clavilithes vicksburgensis** (Conrad, 1849)	147
	Figured specimen 1239 MGS (Fig. 1 x1, Fig. 2 x2.5). Height 89.7 mm, width 34.0 mm; Red Bluff Fm., MGS locality 38. Figure 2 is an enlargement of the outer whorl (x2.5) showing the scar left by a boring barnacle. According to V. A. Zullo (personal communication) this scar was probably made by one of a group of barnacles, the Acrothoracica, that do not form their own shell, but bore into calcareous substrata for protection. A favorite substrata for these barnacles is the inside of the outer whorl of gastropod shells occupied by hermit crabs. The scar illustrated on this specimen closely resembles that of the extant genus *Trypetesa.*	
3-4	**Chelonibia melleni** Zullo, 1982	
	Figured specimen 1240 MGS (x2). Height 18.0 mm, width 14.0 mm; Red Bluff Fm., MGS locality 38. Valve of the turtle barnacle *Chelonibia melleni.* Extant species of *Chelonibia* are occassionally ectocommensal on gastropods as well as turtles, manatees, and crabs.	
5-13	**Levifusus spiniger** (Conrad, 1848)	148-149
	5. Figured specimen 1241 MGS (x1). Height 59.4 mm, width (including spines) 48.8 mm; Red Bluff Fm., MGS locality 38.	
	6. Figured specimen 1242 MGS (x1.4). Height 49.0 mm, width (including spines) 29.4 mm; Mint Spring Fm., MGS locality 99.	
	7. Figured specimen 1243 MGS (x1.4). Height 47.3 mm, width (including spines) 28.9 mm; Byram Fm., MGS locality 109.	
	8-9. Figured specimen 1244 MGS (Fig. 8 x10, Fig. 9 x2). Height 30.4 mm, width (including spines) 17.3 mm; Byram Fm., 112c.	
	10-11. Figured specimen 1245 MGS (Fig. 10 x10, Fig. 11 x2). Height 27.0 mm, width (including spines) 14.3 mm; Byram Fm., MGS locality 112c.	
	12. Figured specimen 1246 MGS (x1.4). Height 54.5 mm; Byram Fm., MGS locality 106.	
	13. Figured specimen 1247 MGS (x2). Height 33.5 mm; upper Yazoo Fm., MGS locality 15.	

Plate 54



EXPLANATION PLATE 55

Figure		Page
1-5	**Levifusus nodulatum** (Conrad, 1849)	149-150
	1-2. Paratype 13495 ANSP (x1.4). Height 39.5 mm, width 22.0 mm; probably from the Mint Spring Fm., Vicksburg, Mississippi.	
	3-5. Lectotype 13468 ANSP (Fig. 3-4 x1.4, Fig. 5 x1.6). Height 33.5 mm, width 22.4 mm; Vicksburg Group, Vicksburg, Mississippi.	
6-10	**Lyria (Enaeta) isabellae modesta** Dockery n. subsp.	151
	6-7. Holotype 376673 USNM (x2.5). Height 19.4 mm, width 9.2 mm; Forest Hill Fm., MGS locality 75a.	
	8. Figured specimen 1248 MGS (x2.5). Height (incomplete) 21.9 mm, width 11.0 mm; Forest Hill Fm., MGS locality 75a.	
	9-10. Figured specimen 1249 MGS (x4). Height 12.3 mm, width 6.0 mm; Byram Fm., MGS locality 106.	
11-12	**Caricella (Atraktus) demissa** Conrad, 1848	152
	11. Figured specimen 1250 MGS (x1.6). Height 39.0 mm, width 16.7 mm; Byram Fm., MGS locality 115.	
	12. Figured specimen 1251 MGS (x1.6). Height 42.3 mm, width (specimen flattened in plane of view) 17.3 mm; Byram Fm., MGS locality 106.	

Plate 55

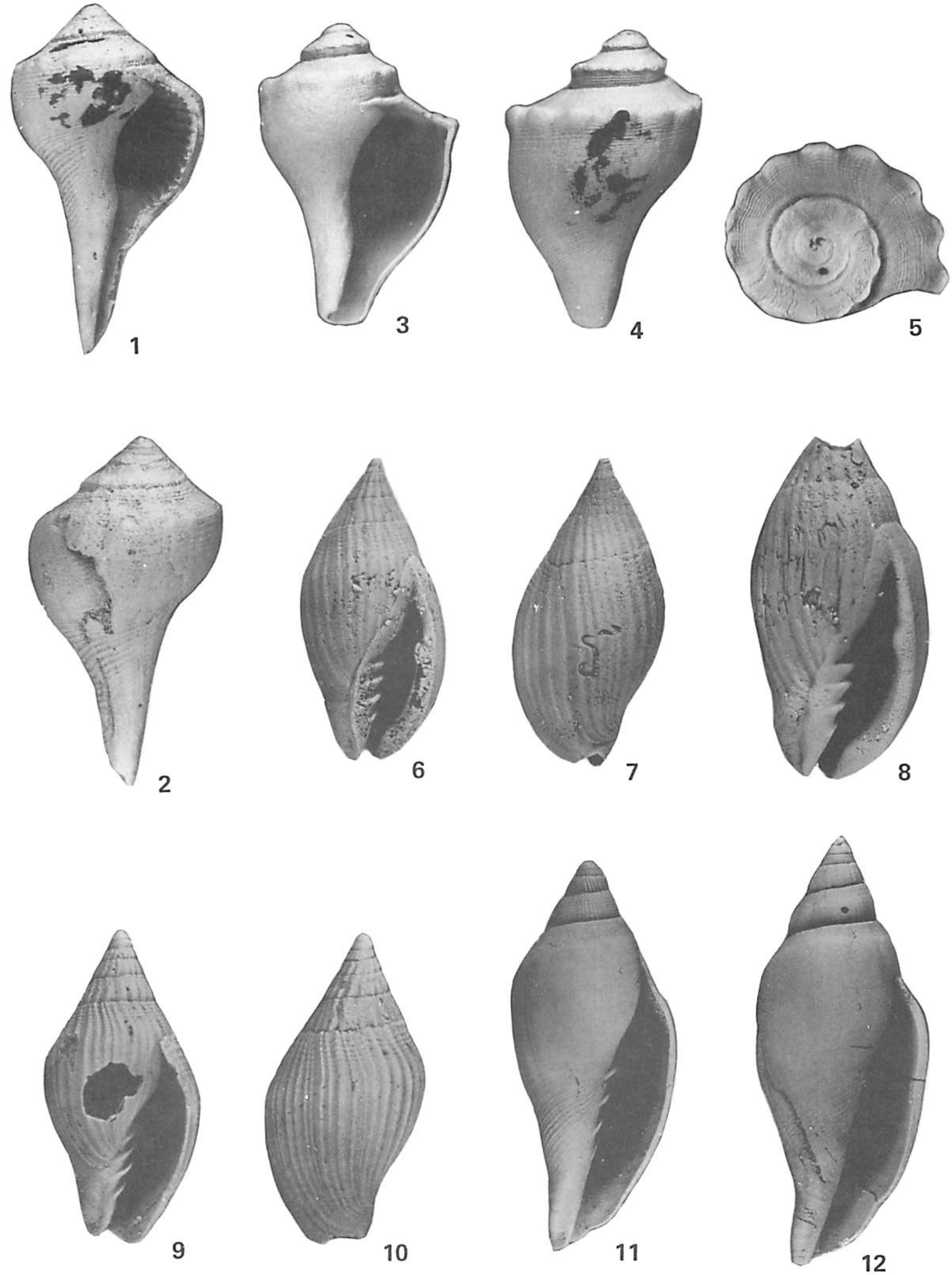


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Figure		Page
1-6	**Caricella (Atraktus) demissa** Conrad, 1848 var. A	152
	1. Figured specimen 1471 MGS (x2). Height 30.0 mm, width 11.3 mm; Byram Fm., MGS locality 106.	
	2. Figured specimen 1252 MGS (x1.6). Height 34.2 mm, width (incomplete) 13.5 mm; Byram Fm., MGS locality 106.	
	3. Figured specimen 1253 MGS (x1.6). Height (incomplete) 30.2 mm, width 16.6 mm; Byram Fm., MGS locality 106.	
	4. Figured specimen 1254 MGS (x2.5). Height 20.0 mm, width 8.1 mm; Byram Fm., MGS locality 93.	
	5. Figured specimen 1255 MGS (x4). Height 11.3 mm, width 5.7 mm; Byram Fm., MGS locality 93.	
	6. Figured specimen 1256 MGS (x4). Height 9.0 mm, width 4.8 mm; Byram Fm., MGS locality 93.	
7-8	**Conomitra crenulata modesta** Dockery n. subsp.	154-155
	7. Figured specimen 1257 MGS (x12). Height 3.4 mm; Forest Hill Fm., MGS locality 75a.	
	8. Figured specimen 1258 MGS (x11). Height 4.8 mm, width 2.0 mm; Forest Hill Fm., MGS locality 75a.	
9-11	**Conomitra vicksburgensis laevigata** Dockery n. subsp.	154
	9. Figured specimen 1259 MGS (x8). Height 5.8 mm, width 2.3 mm; Forest Hill Fm., MGS locality 75a.	
	10. Figured specimen 1260 MGS (x8). Height 6.8 mm, width 2.6 mm; Forest Hill Fm., MGS locality 75a.	
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12	**Harpa vicksburgiana** Dockery n. sp.	155
	Holotype 376675 USNM (x1.5). Height 39.3 mm, width 22.2 mm; Byram Fm., MGS locality 93. See Plate 67, figure 8, for apertural view.	
13-14	**Oliva (Strephonella) mississippiensis** Conrad, 1848	157
	Lectotype 13453 ANSP (Fig. 13 x2, Fig. 14 x6). Height 26.5 mm, width 11.6 mm; probably from the Byram Fm., Vicksburg, Mississippi.	

Plate 56

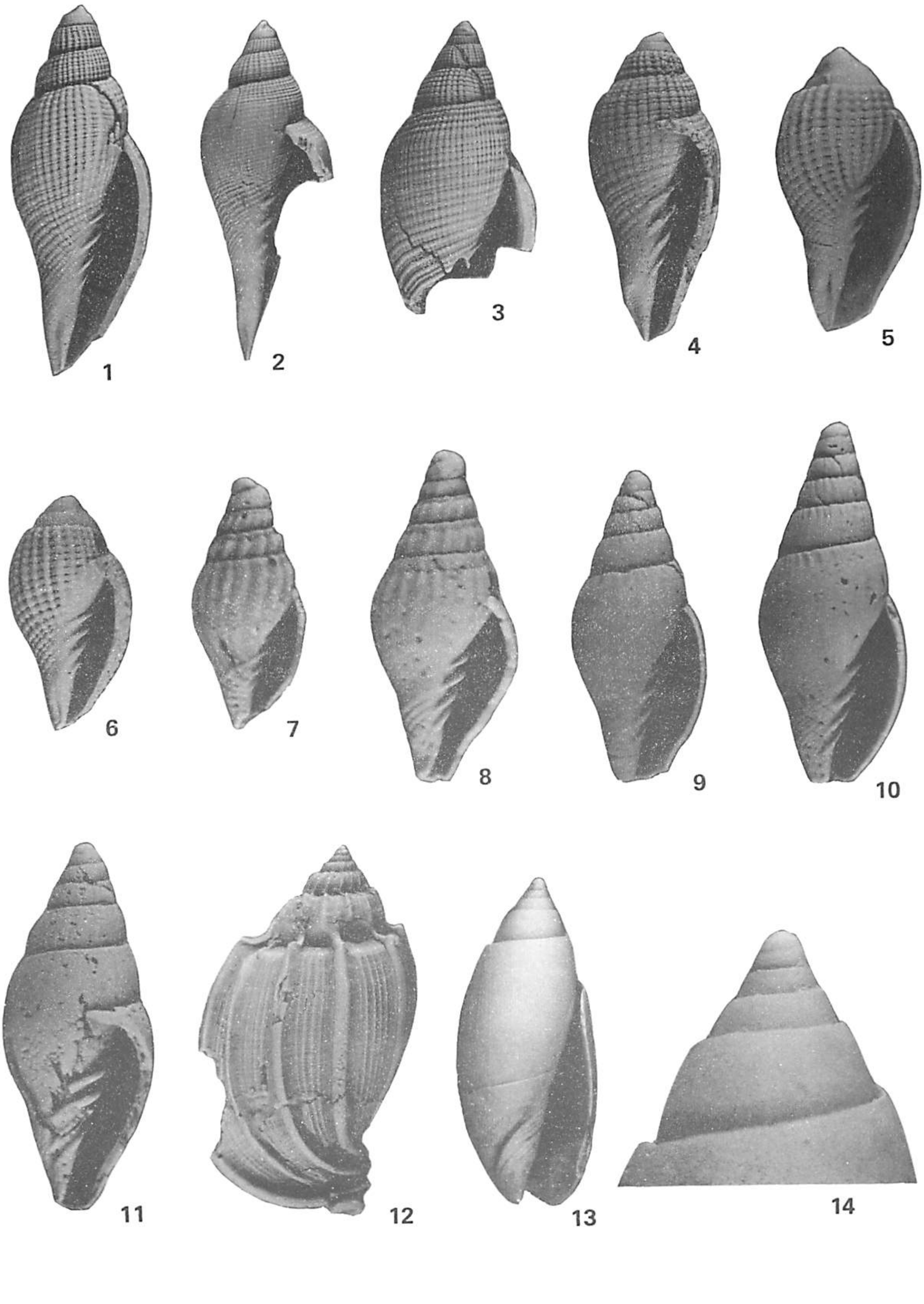

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Figure		Page
1-2	**Oliva (Strephonella) mississippiensis** Conrad, 1848	157
	1. Figured specimen 1262 MGS (x8). Height 6.1 mm, width 2.9 mm; Byram Fm., MGS locality 106. Juvenile.	
	2. Figured specimen 1263 MGS (x8). Height 5.7 mm, width 2.7 mm; Byram Fm., MGS locality 106. Juvenile.	
3-10	**Oliva (Strephonella) affluens** (Casey, 1903)	157-158
	3. Figured specimen 1264 MGS (x8). Height 5.7 mm, width 2.4 mm; Byram Fm., MGS locality 106. Juvenile.	
	4. Figured specimen 1265 MGS (x8). Height 5.7 mm, width 2.4 mm; Byram Fm., MGS locality 106. Juvenile.	
	5. Figured specimen 1266 MGS (x2.5). Height 17.0 mm, width 7.2 mm; Byram Fm., MGS locality 106. Specimen showing color pattern.	
	6. Figured specimen 1476 MGS (x3). Height 18.5 mm, width 7.5 mm; Moodys Branch Fm., MGS locality 11. Also figured in Dockery, 1977, pl. 11, fig. 3.	
	7. Figured specimen 1267 MGS (x3). Height 16.4 mm, width 7.2 mm; Byram Fm., MGS locality 93.	
	8. Figured specimen 1268 MGS (x3). Height 15.4 mm, width 7.1 mm; Byram Fm., MGS locality 93.	
	9. Figured specimen 1269 MGS (x3). Height 15.0 mm, width 6.5 mm; Byram Fm., MGS locality 93.	
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11-12	**Oliva dufresnei** Basterot, 1825	158
	11. Figured specimen 1271 MGS (x3). Height 15.8 mm, width 6.3 mm; upper Oligocene, Estoti district of Dax, Aquitaine Basin, France.	
	12. Figured specimen 1272 MGS (x3). Height 18.7 mm, width 7.8 mm; upper Oligocene, Estoti district of Dax, Aquitaine Basin, France.	
13	**Agaronia media** (Meyer, 1885)	157
	Figured specimen 1472 MGS (x3). Height 17.3 mm, width 6.6 mm; Moodys Branch Formation, MGS locality 1.	
14	**Mitra (Fusimitra) conquisita** Conrad, 1848	159-160
	Figured specimen 1273 MGS (x1.2) Height 55.5 mm, width 15.3 mm; Red Bluff Fm., MGS locality 39.	
15	**Mitra (Fusimitra) mississippiensis** Conrad, 1848	160
	Figured specimen 1274 MGS (x1.4). Height 42.8 mm, width 12.6 mm; Byram Fm., MGS locality 106.	

Plate 57

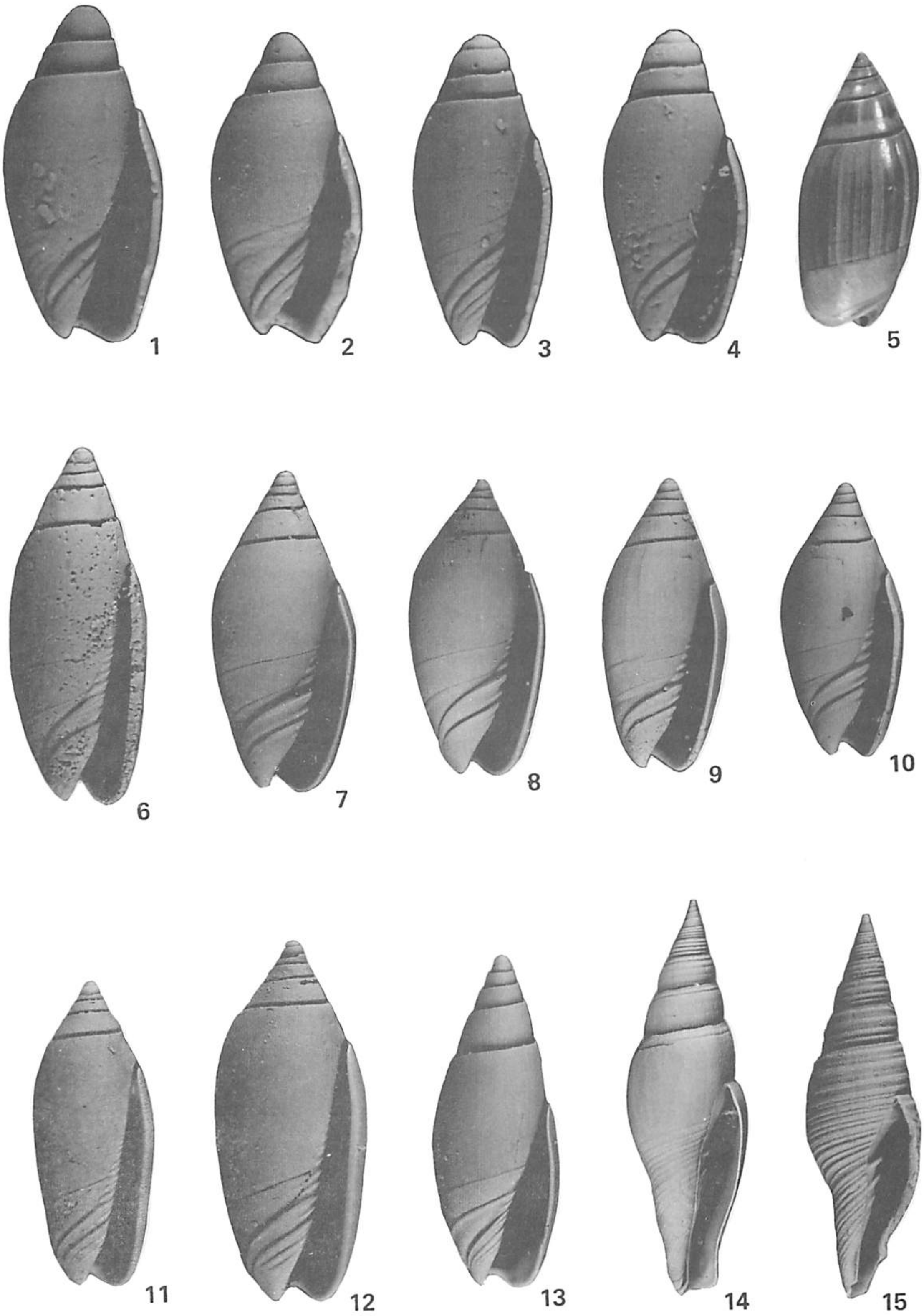

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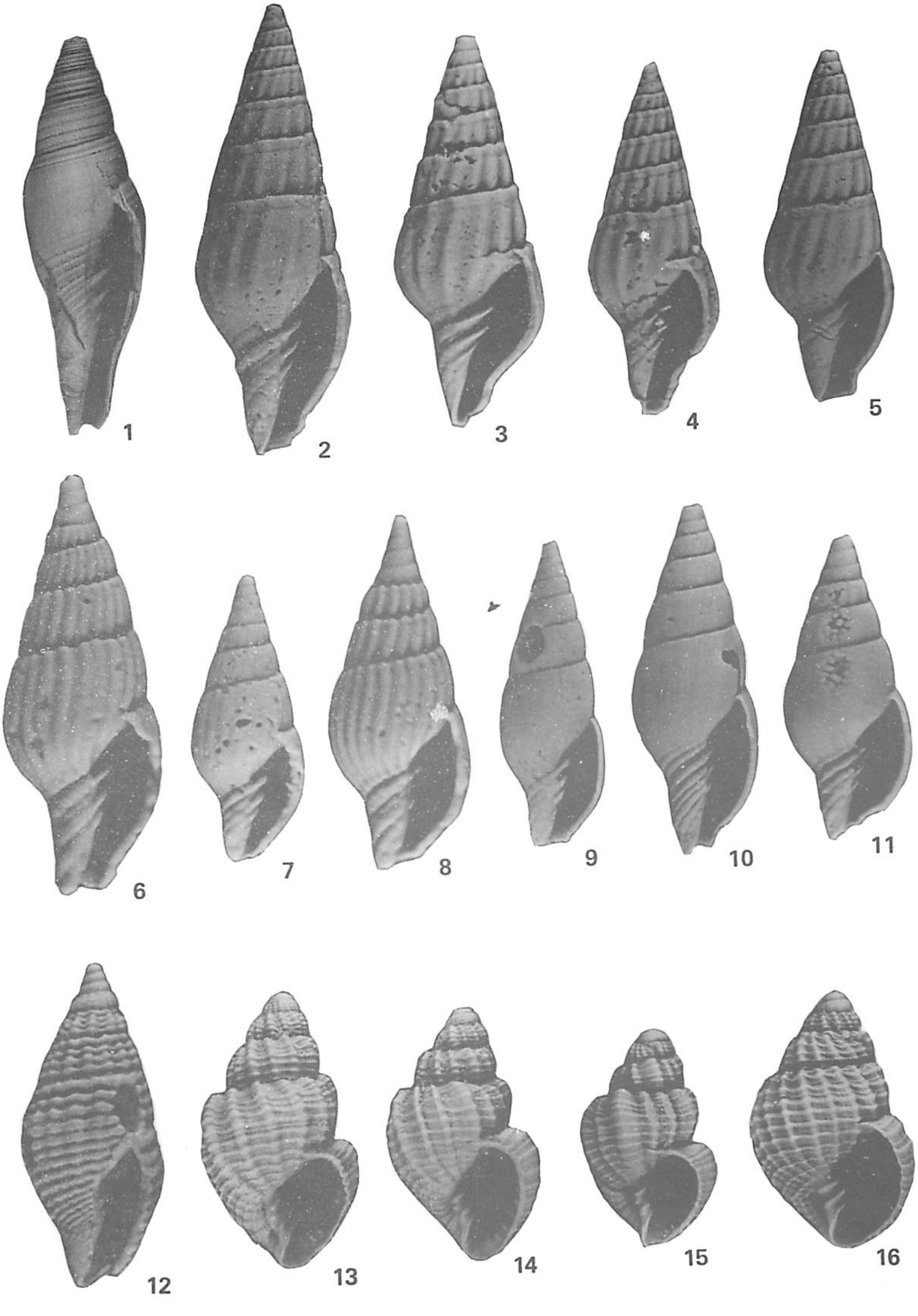
Figure		Page
1	**Mitra (Fusimitra) conquisita Conrad, 1848** Figured specimen 1275 MGS (x1.2). Height (incomplete) 53.6 mm, width 16.9 mm; Forest Hill Fm., MGS locality 75a.	159-160
2-5	**Vexillum (Costellaria) laevicostata Dockery n. sp.** 2. Figured specimen 1276 MGS (x7). Height 10.0 mm, width 3.3 mm; Forest Hill Fm., MGS locality 75a. 3. Figured specimen 1277 MGS (x8). Height 7.6 mm, width 2.8 mm; Forest Hill Fm., MGS locality 75a. 4. Figured specimen 1278 MGS (x8). Height 6.8 mm, width 2.4 mm; Forest Hill Fm., MGS locality 75a. 5. Figured specimen 1279 MGS (x7). Height 7.8 mm, width 2.7 mm; Forest Hill Fm., MGS locality 75a.	162
6,8	**Vexillum (Costellaria) multicostata Dockery n. sp.** 6. Figured specimen 1280 MGS (x12). Height 5.4 mm, width 1.9 mm; Forest Hill Fm., MGS locality 75a. 8. Holotype 376676 USNM (x12). Height 4.4 mm, width 1.7 mm; Forest Hill Fm., MGS locality 75a.	162
7, 9-11	**Vexillum (Costellaria) cervilirata Dockery n. sp.** 7. Figured specimen 1281 MGS (x11). Height 4.1 mm, width 1.5 mm; Forest Hill Fm., MGS locality 75a. 9. Holotype 376677 USNM (x8). Height 5.8 mm, width 1.8 mm; Forest Hill Fm., MGS locality 75a. 10. Figured specimen 1282 MGS (x8). Height 6.7 mm, width 2.3 mm; Forest Hill Fm., MGS locality 75a. 11. Figured specimen 1283 MGS (x11). Height 4.4 mm, width 1.7 mm; Forest Hill Fm., MGS locality 75a.	162
12	**Vexillum (Costellaria) tallahalaensis Dockery n. sp.** Holotype 376674 USNM (x10). Height 5.0 mm, width 2.0 mm; Byram Fm., MGS locality 93.	162-163
13-15	**Agatrix mississippiensis (Conrad, 1848)** 13. Paratype 13448 ANSP (x4). Height 12.3 mm, width (outer lip broken) 7.1 mm; Vicksburg Group, Vicksburg, Mississippi. 14. Holotype of *Cancellatia funerata* Conrad, 1848, 13449 ANSP (x4). Height 11.0 mm, width 6.3 mm; Vicksburg Group, Vicksburg, Mississippi. 15. Figured specimen 1285 MGS (x4). Height 8.6 mm, width 5.0 mm; Byram Fm., MGS locality 109.	163-164
16	**Admetula regularia Dockery n. sp.** Holotype 381587 USNM (x4). Height 10.3 mm, width 6.3 mm; Byram Fm., MGS locality 114.	164

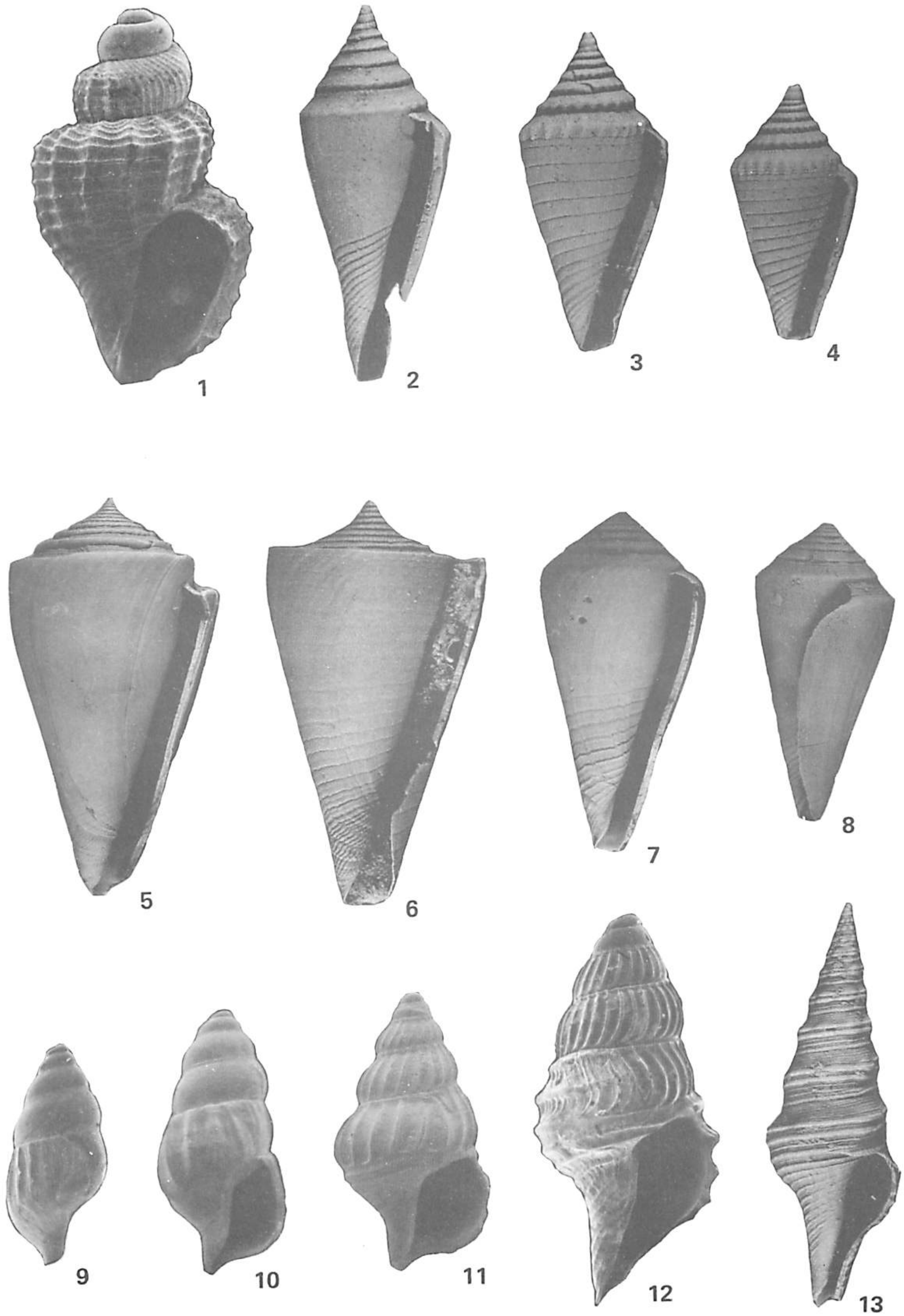
Plate 58



EXPLANATION PLATE 59

Figure		
1	**Olssonella elongata** Dockery var. ? .... Figured specimen 1287 MGS - Stub No. 3 (x23). Red Bluff Fm., MGS locality 37.	163
2	**Conus protractus** Meyer, 1885 .... Figured specimen 1288 MGS (x3.5). Height 17.1 mm, width 6.7 mm; Byram Fm., MGS locality 114.	165-166
3-4	**Conus alveatus spiralis** Dockery n. subsp. .... 3. Holotype 376678 USNM (x3.5). Height 14.5 mm, width 6.6 mm; Byram Fm., MGS locality 93. 4. Figured specimen 1289 MGS (x3.5). Height 11.4 mm, width 5.5 mm; Byram Fm., locality 93.	165
5-8	**Conus alveatus** Conrad, 1865 .... 5. Figured specimen 1290 MGS (x1.2). Height 53.3 mm, width 28.1 mm; Red Bluff Fm., MGS locality 37. 6. Figured specimen 1291 MGS (x2). Height 32.6 mm, width 17.8 mm; Red Bluff Fm., MGS locality 38. 7. Figured specimen 1292 MGS (x1.4). Height 39.2 mm, width 18.9 mm; Byram Fm., MGS locality 114. 8. Figured specimen 1293 MGS (x1.2). Height 40.5 mm, width 20.2 mm; Forest Hill Fm., MGS locality 75a.	164-165
9	**Terebra (Strioterebrum) tantula** Conrad, 1848 .... Figured specimen 1294 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. Juvenile. SEM photograph by E. E. Russell.	168-169
10	**Terebra (Terebrellina) hiwanneensis** MacNeil n. sp. .... Figured specimen 1295 MGS - Stub No. 9 (x25). Red Bluff Fm., MGS locality 38. Juvenile. SEM photograph by G. S. Zumwalt.	167-168
11	**Gemmula amica** (Casey, 1903) .... Figured specimen 1296 MGS - Stub No. 9 (x25). Red Bluff Fm., MGS locality 38. Protoconch. SEM photograph by G. S. Zumwalt.	172-173
12	**Pleuroliria cochlearis** (Conrad, 1848) .... Figured specimen 1297 MGS - Stub No. 1 (x23). Byram Fm., MGS locality 106. Juvenile. SEM photograph by E. E. Russell.	176-177
13	**Pleurofusia hiwanneensis** MacNeil n. sp. .... Figured specimen 1298 MGS (x2). Height 32.5 mm, width 10.5 mm; Red Bluff Fm., MGS locality 38.	183-184

Plate 59



EXPLANATION PLATE 60

Figure		Page
1-3	**Varicobela smithii** (Aldrich, 1885) Figured specimen 1299 MGS (Fig. 1-2 x2, Fig. 3x5). Height 27.5 mm, width 14.1 mm; Red Bluff Fm., MGS locality 39.	198-199
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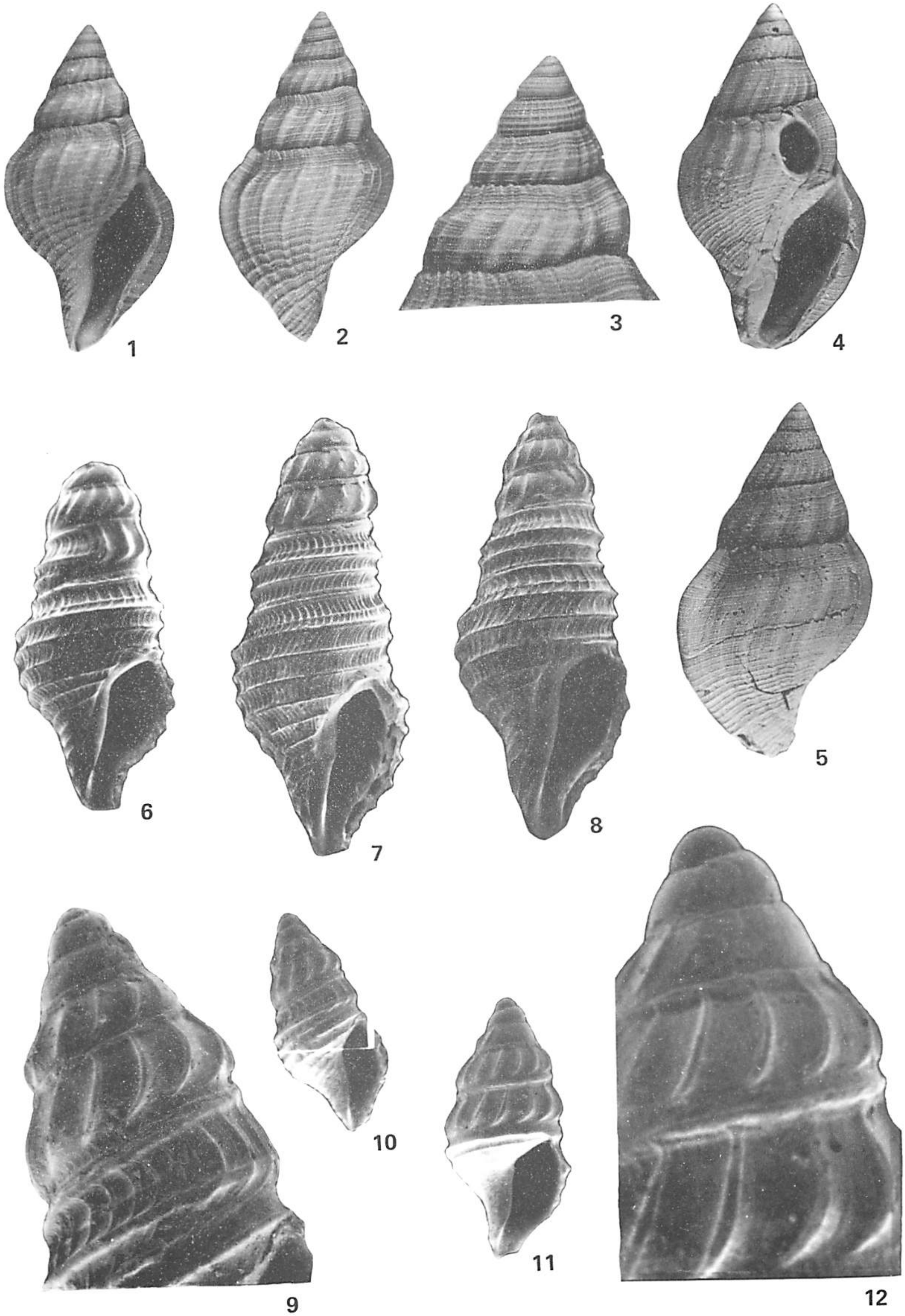

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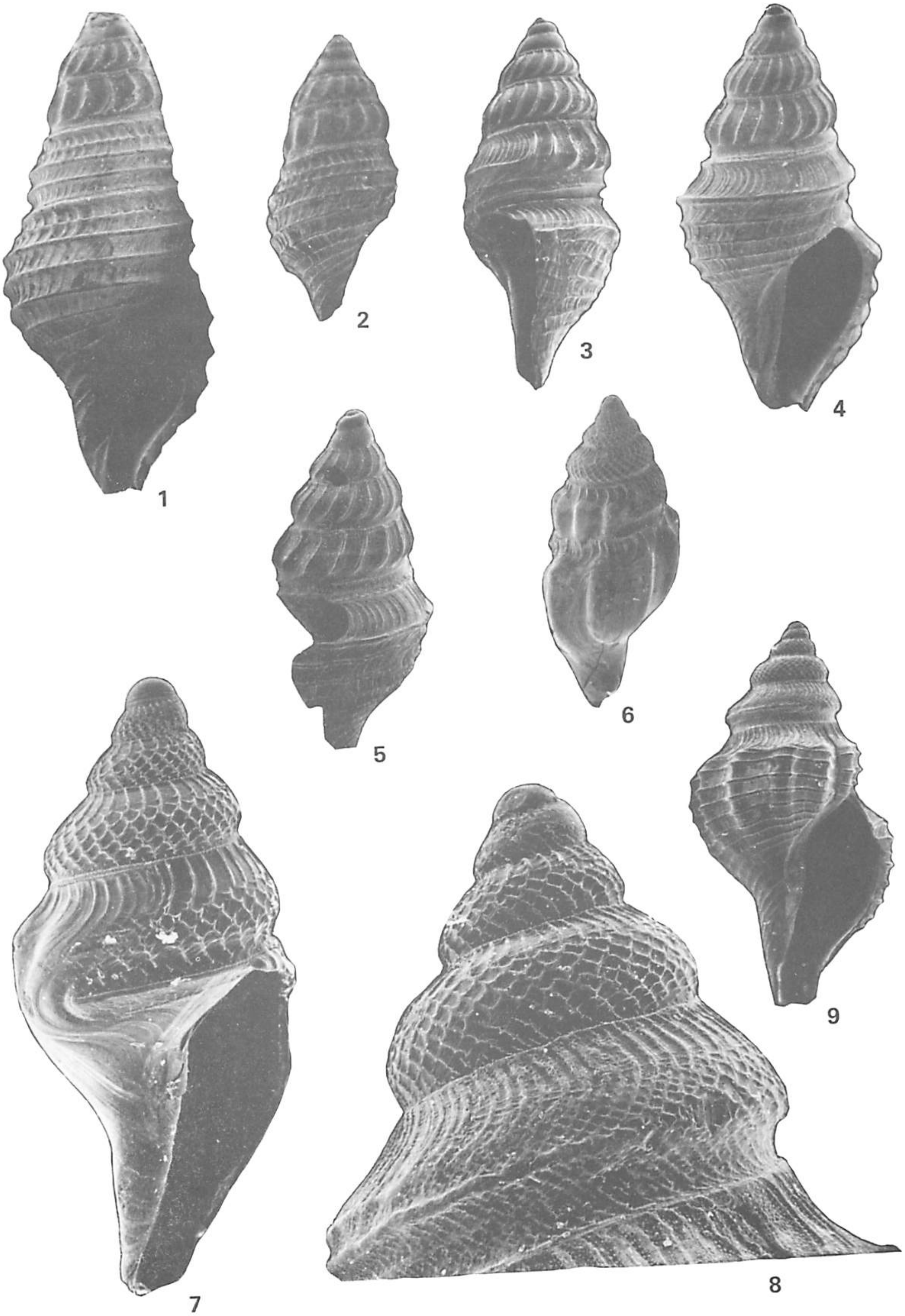

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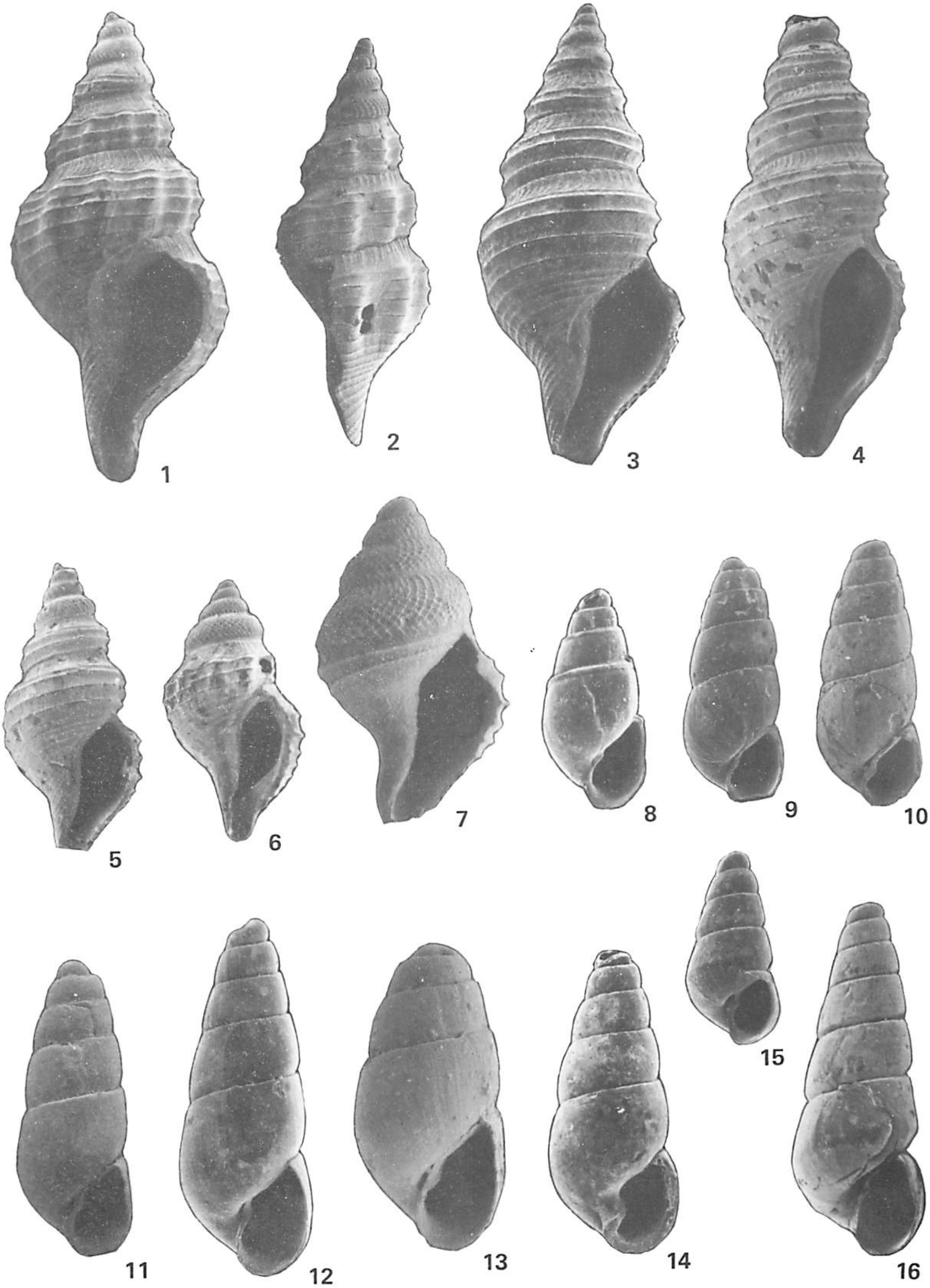

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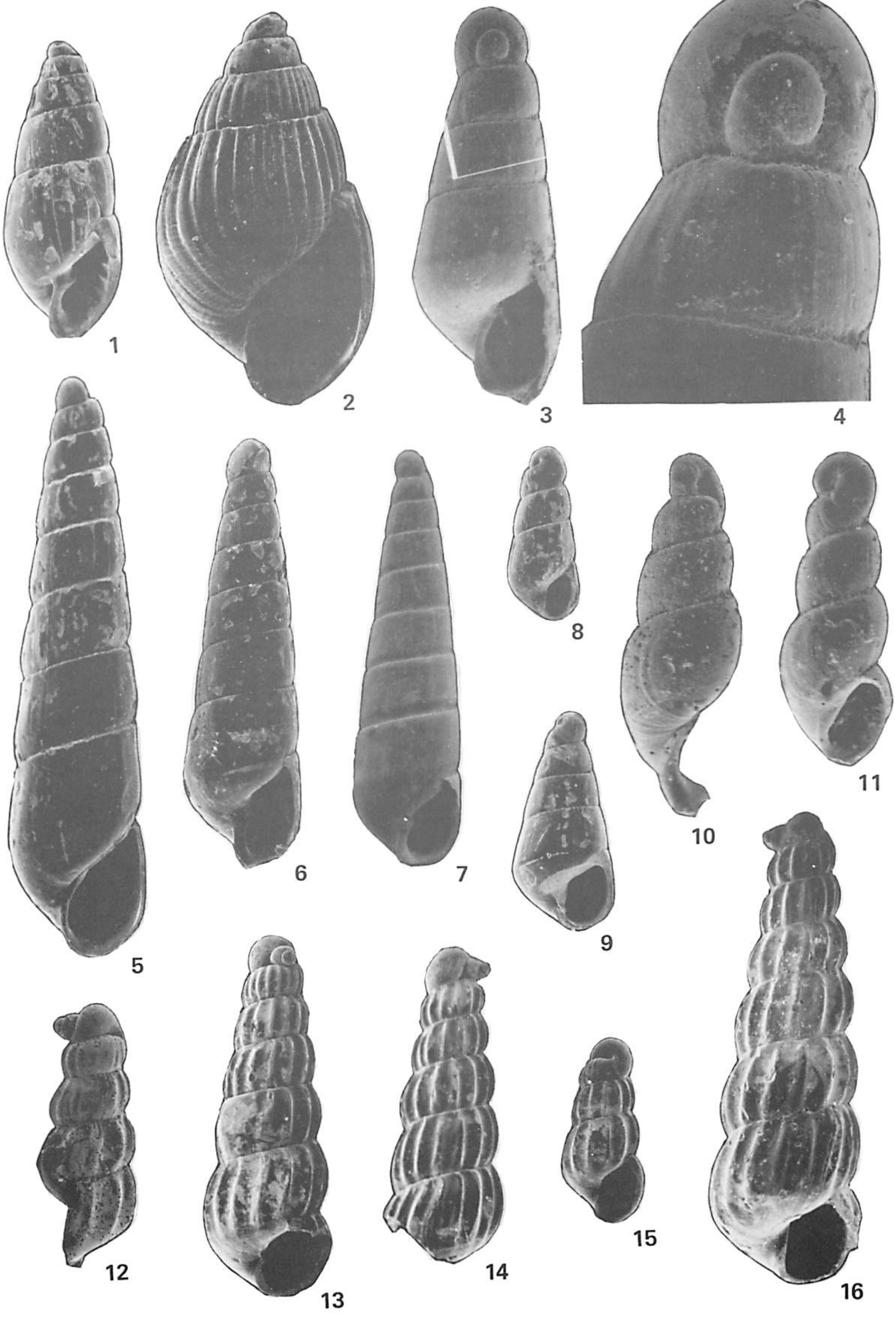

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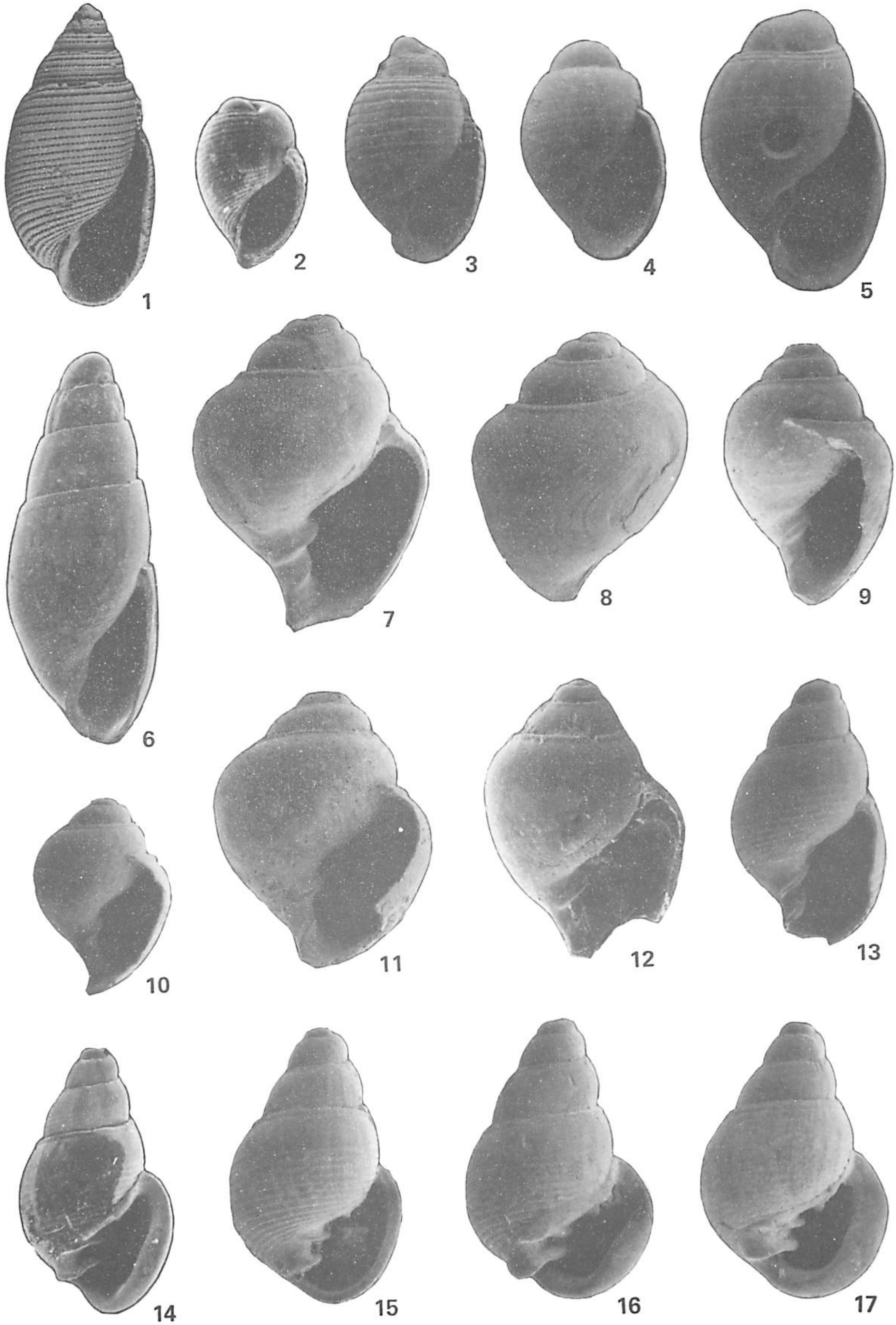

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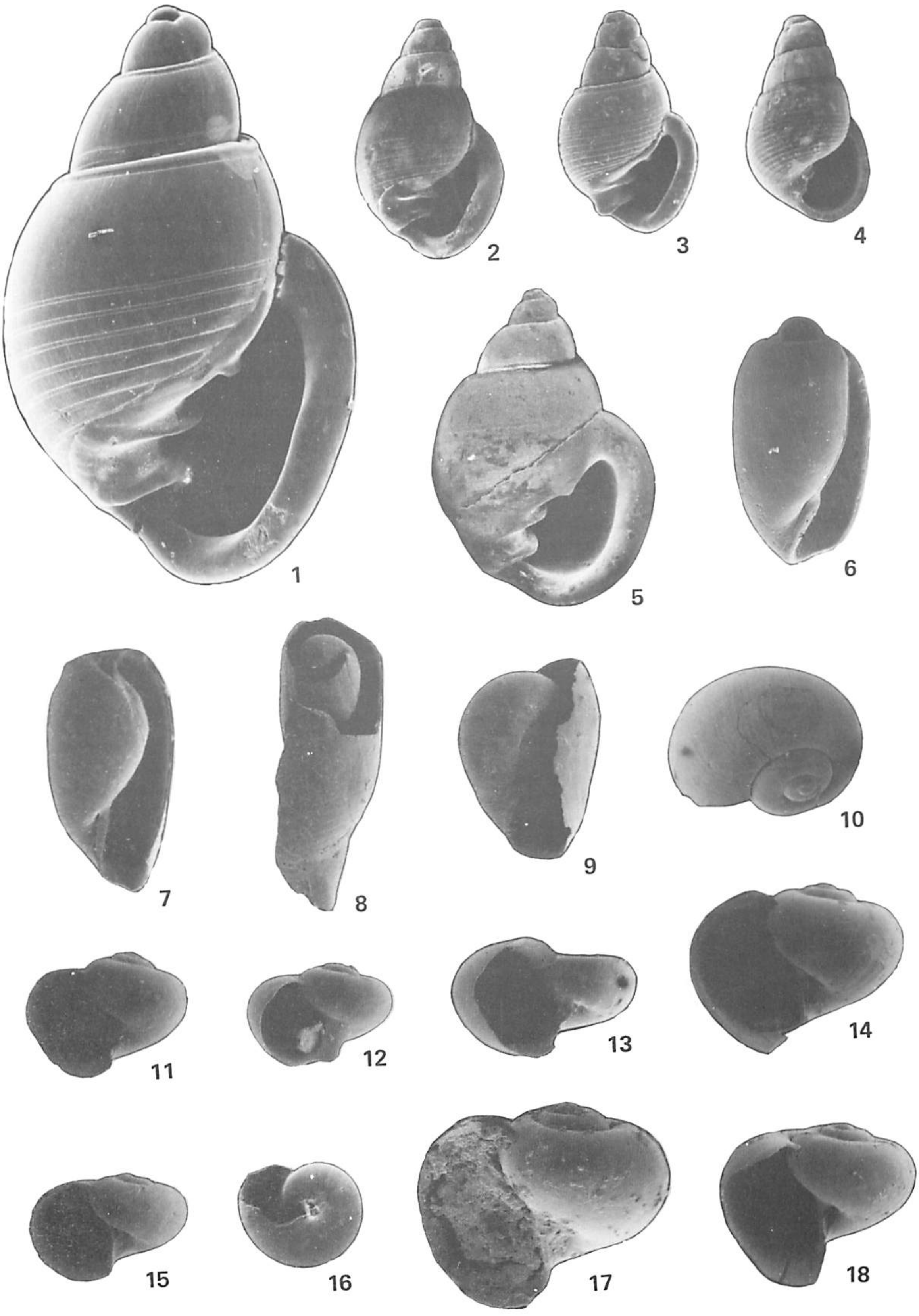

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	13. Figured specimen 1391 MGS - Stub No. 6 (x40). Stampian (Oligocene), Gaas, Aquitaine Basin, France. SEM photograph by G. S. Zumwalt.	
	15. Figured specimen 1392 MGS - Stub No. 6 (x35). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	16. Figured specimen 1393 MGS - Stub No. 4 (x23). Mint Spring Fm., MGS locality 89. SEM photograph by E. E. Russell.	
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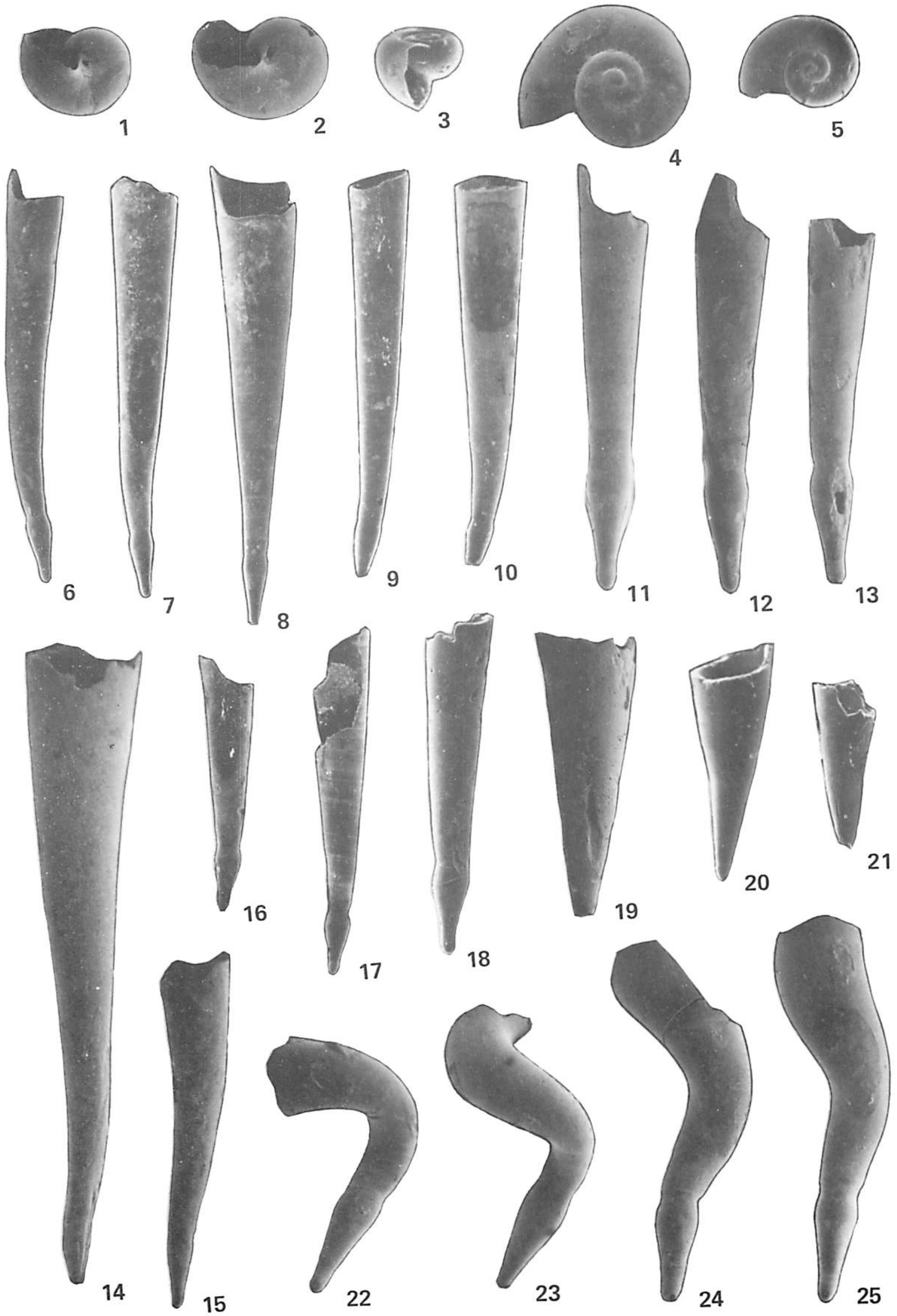
	24. Figured specimen 1402 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	25. Figured specimen 1403 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	

Plate 66



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	2. Figured specimen 1405 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	3. Figured specimen 1406 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	4. Figured specimen 1407 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	5. Figured specimen 1408 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
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	14. Holotype 481672 USNM (x2). Height 41.2 mm, diameter at aperture 4.0 mm, diameter at apex 0.9 mm; Red Bluff Fm., USGS locality 13288.	
	15. Figured specimen 1411 MGS (x2). Height 36.6 mm, diameter at aperture 4.0 mm; Red Bluff Fm., MGS locality 39.	
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10-13	**Dentalium polygonuum** Casey, 1903	247
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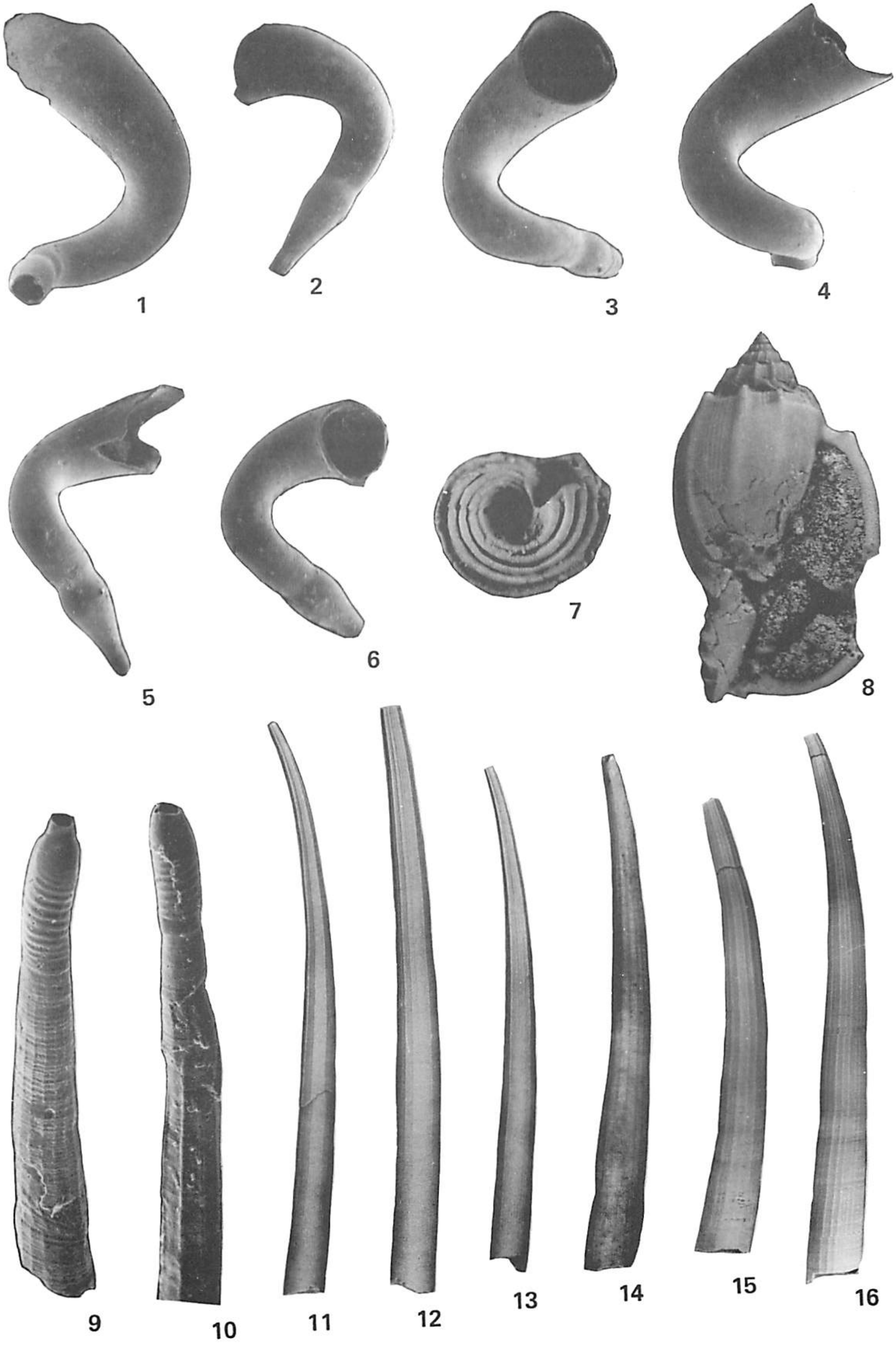

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	1. Figured specimen 1417 MGS (x2). Height 45.1 mm, diameter at aperture 4.4 mm; Byram Fm., MGS locality 115.	
	2. Figured specimen 1418 MGS (x2). Height 46.0 mm, diameter at aperture 4.9 mm; Byram Fm., MGS locality 115.	
	3. Figured specimen 1419 MGS (x2). Height 45.8 mm, diameter at aperture 4.7 mm; Byram Fm., MGS locality 115.	
	4, 7. Figured specimen 1420 MGS (Fig. 4 x2, Fig. 7 x4). Height (fragment) 26.9 mm, diameter at aperture 5.5 mm; Byram Fm., MGS locality 115.	
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	10. Figured specimen 1423 MGS (x2). Height (fragment) 55.5 mm, diameter at aperture 6.2 mm; Byram Fm., MGS locality 115.	
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	12. Figured specimen 1425 MGS (x2). Height 48.7 mm, diameter at aperture 5.6 mm; Byram Fm., MGS locality 114.	
	13. Figured specimen 1426 MGS (x2). Height 46.5 mm, diameter at aperture 5.4 mm; Byram Fm., MGS locality 114.	
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15-16	**Dentalium opaculum** Casey, 1903	246
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	16. Figured specimen 1429 MGS (x2). Height 40.8 mm, diameter at aperture 5.1 mm; Mint Spring Fm., MGS locality 99.	

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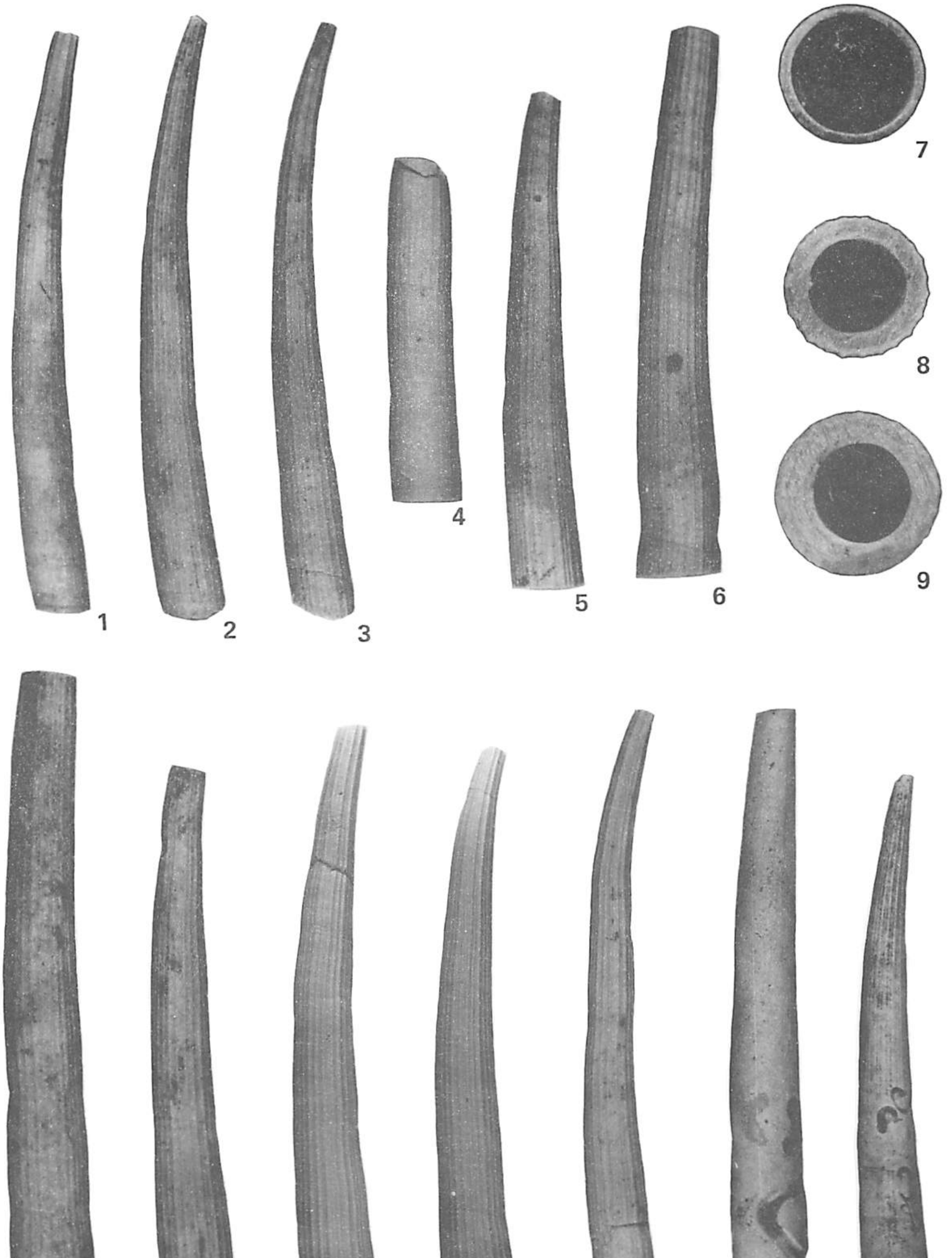

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Figure — Page

1-7 **Dentalium opaculum** Casey, 1903 246

1. Figured specimen 1430 MGS (x2.5). Height 23.9 mm, diameter at aperture 2.3 mm; Mint Spring Fm., MGS locality 99.
2. Figured specimen 1431 MGS (x2). Height (fragment) 30.4 mm, diameter at aperture 5.3 mm; Mint Spring Fm., MGS locality 99.
3. Figured specimen 1432 MGS (x3). Height 21.0 mm, diameter at aperture 3.2 mm; Mint Spring Fm., MGS locality 99.
4. Figured specimen 1433 MGS (x3). Height 19.8 mm, diameter at aperture 2.6 mm; Mint Spring Fm., MGS locality 99.
5. Figured specimen 1434 MGS (x7). Height 9.4 mm, diameter at aperture 0.9 mm; Mint Spring Fm., MGS locality 90.
6. Figured specimen 1435 MGS (x7). Height 9.4 mm, diameter at aperture 1.0 mm; Mint Spring Fm., MGS locality 90.
7. Figured specimen 1436 MGS (x7). Height 12.6 mm, diameter at aperture 1.4 mm; Mint Spring Fm., MGS locality 90.

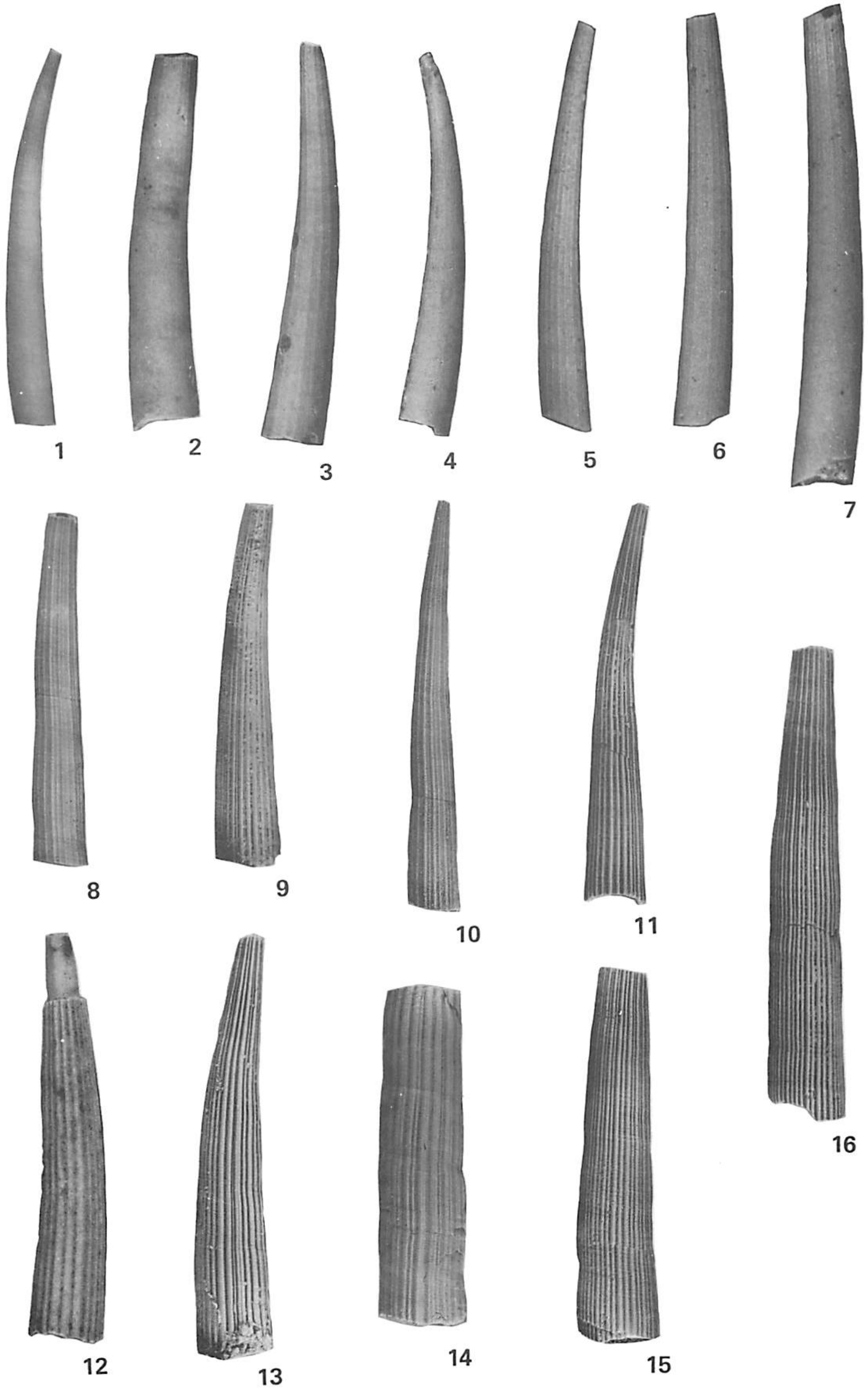
8, 10 **Dentalium mississippiense** Conrad, 1848 245

8. Figured specimen 1437 MGS (x2). Height (incomplete) 27.3 mm, diameter at aperture 4.0 mm; Forest Hill Fm., MGS locality 75a.
10. Figured specimen 1438 MGS (x2). Height 32.4 mm, diameter at aperture 4.0 mm; Mint Spring Fm., MGS locality 74b.

9, 11-16 **Dentalium varicostata** Dockery n. sp. 246-247

9. Figured specimen 1439 MGS (x2). Height (incomplete) 28.7 mm, diameter at aperture 5.1 mm; Forest Hill Fm., MGS locality 75a.
11. Figured specimen 1440 MGS (x2). Height 32.0 mm, diameter at aperture 4.8 mm; Mint Spring Fm., MGS locality 74b.
12. Figured specimen 1441 MGS (x2). Height (incomplete) 33.0 mm, diameter at aperture 6.2 mm; Mint Spring Fm., MGS locality 100.
13. Figured specimen 1442 (x2). Height (incomplete) 33.7 mm, diameter at aperture 6.0 mm; Mint Spring Fm., MGS locality 89.
14. Figured specimen 1443 MGS (x2). Height (fragment) 27.3 mm, diameter at aperture 7.1 mm; Mint Spring Fm., MGS locality 99.
15. Figured specimen 1444 MGS (x2). Height (fragment) 30.5 mm, diameter at aperture 6.9 mm; Mint Spring Fm., MGS locality 75b.
16. Figured specimen 1445 MGS (x2). Height (incomplete) 38.0 mm, diameter at aperture 6.4 mm; Mint Spring Fm., MGS locality 74b.

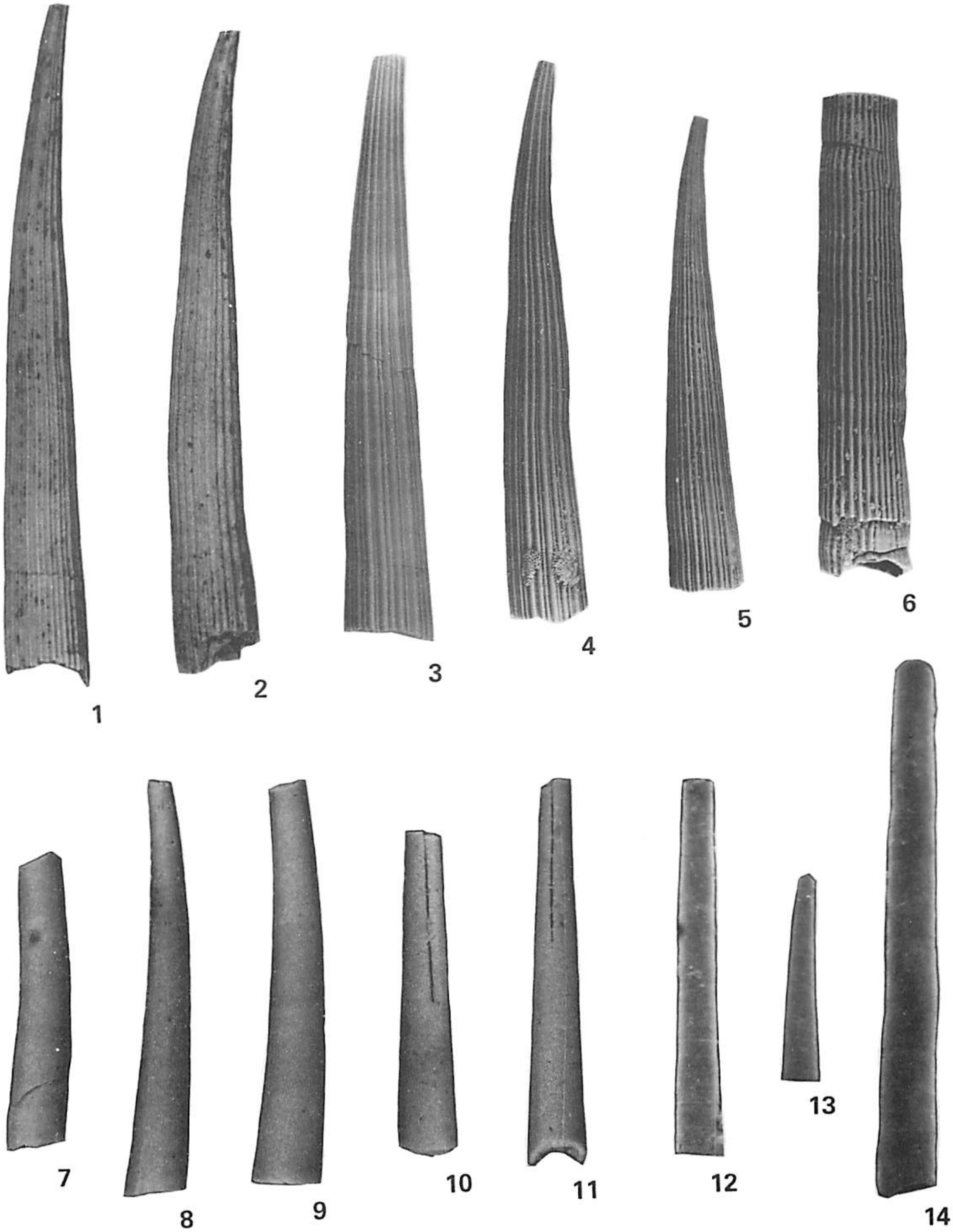
Plate 69



EXPLANATION PLATE 70

Figure		Page
1-6	**Dentalium varicostata** Dockery n. sp.	246-247
	1. Holotype 376680 USNM (x2). Height 51.6 mm, diameter at aperture 6.0 mm, diameter at apex 1.4 mm; Mint Spring Fm., MGS locality 99.	
	2. Figured specimen 1446 MGS (x2). Height 48.3 mm, diameter at aperture 6.2 mm; Mint Spring Fm., MGS locality 99.	
	3. Figured specimen 1447 MGS (x2). Height 43.0 mm, diameter at aperture 6.3 mm; Mint Spring Fm., MGS locality 99.	
	4. Figured specimen 1448 MGS (x2). Height 42.0 mm, diameter at aperture 5.8 mm; Mint Spring Fm., MGS locality 89.	
	5. Figured specimen 1449 MGS (x2). Height 35.1 mm, diameter at aperture 5.4 mm; Mint Spring Fm., MGS locality 75b.	
	6. Figured specimen 1450 MGS (x2). Height (fragment) 36.0 mm, diameter at aperture 6.6 mm; Mint Spring Fm., MGS locality 75b.	
7-11	**Fustiaria (Fustiaria)** sp.	247
	7. Figured specimen 1451 MGS (x3). Height (fragment) 14.5 mm, diameter at aperture 2.7 mm; Mint Spring Fm., MGS locality 90.	
	8. Figured specimen 1452 MGS (x5). Height 12.2 mm, diameter at aperture 1.5 mm; Mint Spring Fm., MGS locality 90.	
	9. Figured specimen 1453 MGS (x5). Height 11.8 mm, diameter at aperture 1.9 mm; Mint Spring Fm., MGS locality 90.	
	10. Figured specimen 1454 MGS (x6). Height 8.0 mm; Mint Spring Fm., MGS locality 90.	
	11. Figured specimen 1455 MGS (x7). Height 8.3 mm; Mint Spring Fm., MGS locality 90.	
12-14	**Fustiaria (Rhabdus)** sp.	248
	12. Figured specimen 1456 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	13. Figured specimen 1457 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	14. Figured specimen 1458 MGS - Stub No. 6 (x39). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	

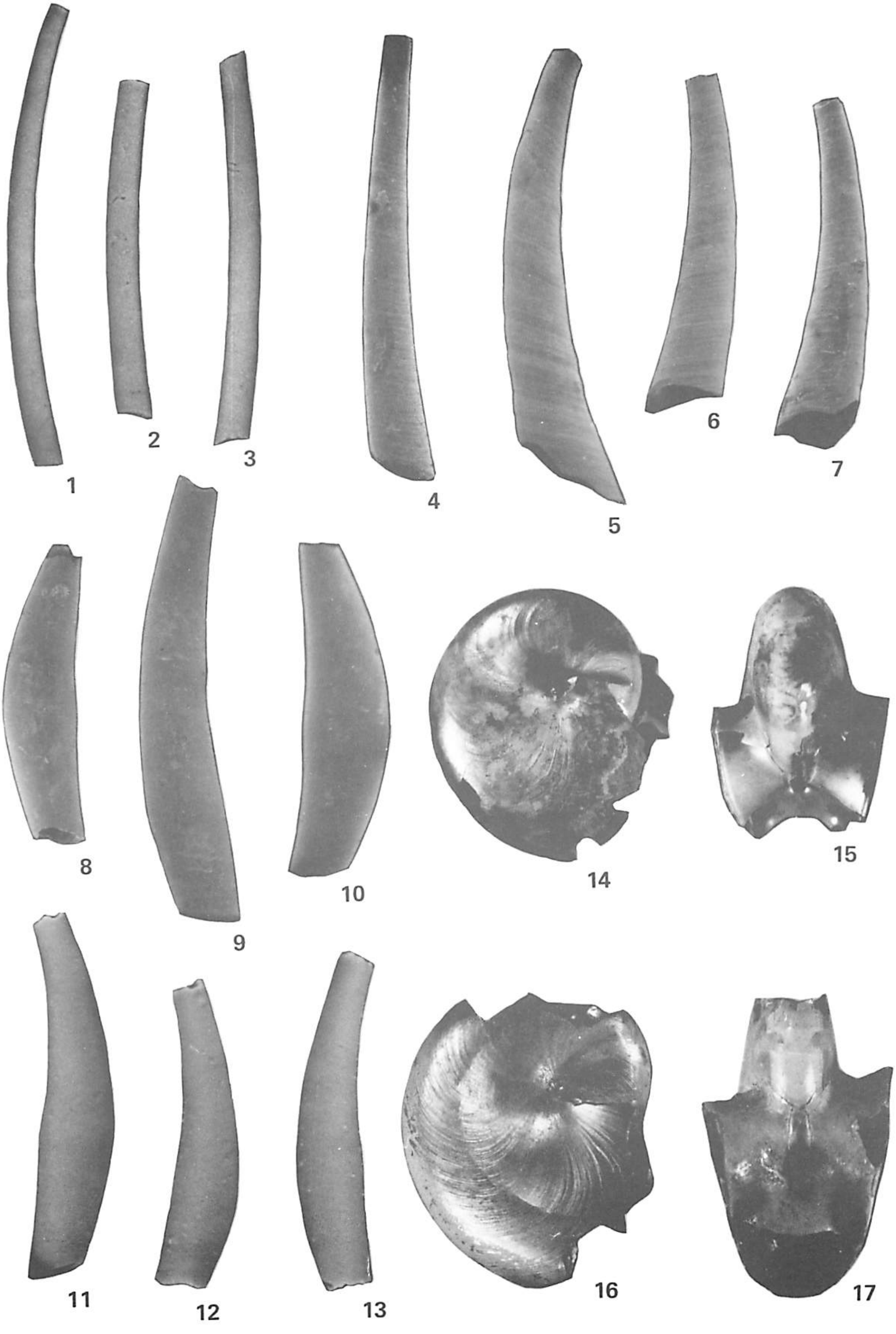
Plate 70



EXPLANATION PLATE 71

Figure		Page
1-3	**Fustiaria (Episiphon) menthifonta** Dockery n. sp.	248
	1. Figured specimen 1459 MGS (x8). Height 9.5 mm; Mint Spring Fm., MGS locality 99.	
	2. Holotype 376681 USNM (x8). Height 7.3 mm; Mint Spring Fm., MGS locality 90.	
	3. Figured specimen 1460 MGS (x8). Height 8.4 mm; Mint Spring Fm., MGS locality 90.	
4-7	**Cadulus (Polyschides) vicksburgensis** Meyer, 1885	248
	4. Figured specimen 1461 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	5. Figured specimen 1462 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	6. Figured specimen 1463 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	7. Figured specimen 1464 MGS - Stub No. 6 (x40). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
8, 10	**Cadulus (Polyschides) corpulentus** Meyer, 1886	249
	8. Figured specimen 1465 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	10. Figured specimen 1466 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
9, 11-13	**Cadulus (Polyschides) quadriturritus** Meyer, 1886	248-249
	9. Figured specimen 1467 MGS - Stub No. 9 (x20). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
	11. Figured specimen 1468 MGS (x12). Height 4.7 mm; Forest Hill Fm., MGS locality 75a.	
	12. Figured specimen 1469 MGS (x12). Height 4.0 mm; Forest Hill Fm., MGS locality 75a.	
	13. Figured specimen 1470 MGS (x12). Height 4.5 mm; Forest Hill Fm., MGS locality 75a.	
14-15	**Aturia cf. A. alabamensis** (Morton, 1834)	250
	Figured specimen 378 MGS (x2). Greatest diameter 23.2 mm, width 14.3 mm; Red Bluff Fm., MGS locality 38.	
16-17	**Aturia alabamensis** (Morton, 1834)	250
	Figured specimen 1473 MGS (x1.2). Greatest diameter of broken shell 40.0 mm, width 25.0 mm; Moodys Branch Fm., MGS locality 8. Also figured in Dockery, 1977, pl. 19, fig. 3.	

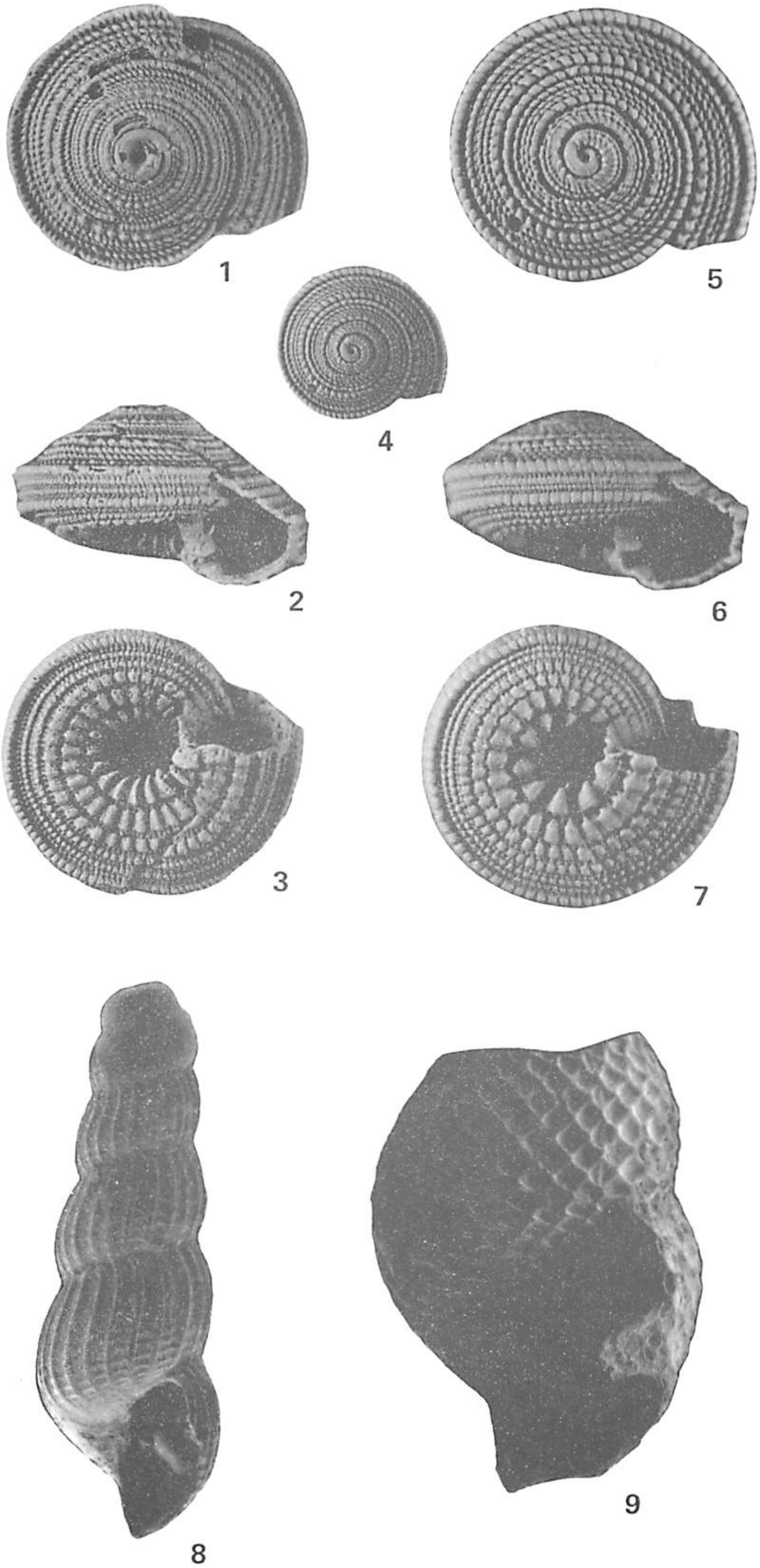
Plate 71



EXPLANATION PLATE 72

Figure		Page
1-7	**Architectonica (Architectonica) meliconae Robinson and Dockery, 1981**	46-47
	1-3. Figured specimen 638 MGS (x4). Height 5.6 mm, width 9.7 mm; Mint Spring Fm., MGS locality 99.	
	4-7. Holotype 30044 PRI (fig. 4 x4, fig. 5-7 x7). Height 3.2 mm, width 5.8 mm; Moodys Branch Fm., excavation of Town Creek behind the Russell C. Davis Planetarium, Jackson, Mississippi.	
8	**Aclis sp. ? B**	82
	Figured specimen 1474 - Stub No. 6 (x67). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	
9	Unidentified turrid protoconch	
	Figured specimen 1475 - Stub No. 6 (x57). Red Bluff Fm., MGS locality 38. SEM photograph by G. S. Zumwalt.	

Plate 72



LOCALITIES

U.S. Geological Survey Cenozoic Localities

This list of U.S. Geological Survey Cenozoic localities is taken from part 1 of MacNeil's manuscript on the Vicksburg gastropods and does not include all the USGS localities cited in this publication.

259. Top of bluff, Vicksburg, Warren County, Mississippi. Byram Formation (Marl Member). Collector: F. Burns, date unknown.

309. Banks of Chickasawhay River, 1 1/2 to 2 1/2 miles west of Old Red Bluff station on Mobile and Ohio Railroad. Wayne County, Mississippi. Red Bluff Clay. Collector: F. Burns, date unknown.

315. Carson's Creek, 5 miles south of Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collector: F. Burns, date unknown.

319. Chickasawhay River near railroad bridge, 1 1/2 miles south of Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collector: F. Burns, date unknown.

320. Eucutta Creek, 2 to 4 1/2 miles west of Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collector: F. Burns, date unknown.

2632. Old Red Bluff station on the Mobile and Ohio railroad, 3 1/2 miles south of Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collector: F. Burns, 1894.

2633. Carson's Creek, 5 to 6 miles southeast of Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collector: F. Burns, 1894.

2664. Vicksburg, Warren County, Mississippi. Exact locality unknown. Mint Spring Marl Member of the Marianna Limestone. Horizons mixed. Collector: C. W. Johnson, 1894.

2860. Red Bluff, Wayne County, Mississippi. Red Bluff Clay. Collector: Charles Schuchert, 1896.

3722. Near top of bluff up-river from Vicksburg, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone-Byram Formation. Horizons mixed. Collector: T. W. Vaughan, 1900.

3723. Mint Spring Bayou, beneath waterfall near National Cemetery, Vicksburg, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: T. W. Vaughan, 1900.

3725. Evidently near top of bluff, Vicksburg, Warren County, Mississippi. Byram Formation (Marl Member). Horizons mixed. Collector: W. J. Vanhorn, 1900.

3727. Refuge Oil Mill, Vicksburg, Warren County, Mississippi. Probably same as USGS loc. 14162. Mint Spring Marl Member of the Marianna Limestone. Collector: T. W. Vaughan, 1900.

3729. Top of bluff, Vicksburg, Warren County, Mississippi. Byram Formation (Marl Member). Collector: T. W. Vaughan, 1900.

3737. Bluff below power line just north of Mississippi River bridge, Vicksburg, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone.

5263. Chickasawhay River, one mile below Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collectors: T. W. Vaughan and E. A. Smith, 1910.

5264. Chickasawhay River at Hiwannee, Wayne County, Mississippi. Red Bluff Clay. Collector: T. W. Vaughan, 1909.

5615. West bank of Leaf River, three-fourths mile southeast of Blakney, Smith County, Mississippi. May be same as USGS locs. 7376 and 14682. Byram Formation (Marl Member). Collector: Matson, 1910.

5623. West bank of Pearl River, Byram, Hinds County, Mississippi. Byram Formation (Marl Member). Collector: Matson, 1910.

6448. Sandy Marl at foot of high waterfall in Glass Bayou, Vicksburg, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: C. W. Cooke, 1912.

6448a. Same as USGS loc. 6448. Collector: F. S. MacNeil, 1940.

6452. Shell and sand bed at foot of high waterfall, Mint Spring Bayou, Vicksburg, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: C. W. Cooke, 1912.

6454. Pearl River just above bridge at Byram, Hinds County, Mississippi. Byram Formation (Marl Member). Collector: C. W. Cooke, 1912.

6455. Pearl River at bridge at Byram, Hinds County, Mississippi. Byram Formation (Marl Member). Collector: E. N. Lowe, 1912.

6456. Hiwannee, Chickasawhay River, 3 1/2 miles south of Shubuta, Wayne County, Mississippi. Red Bluff Clay. Collectors: E. N. Lowe and C. W. Cooke, 1912.

6647. Bend in Chichasawhay River about at northeast corner of the SW 1/4, SW 1/4 of sec. 23, T. 9 N., R. 7 W., about 1 1/4 miles northwest of mouth of Limestone Creek, 4 miles north of Waynesboro and 1 1/4 miles southwest of Boyce, Wayne county, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: C. W. Cooke, 1913.

6647a. Same as USGS loc. 6647. Collectors: W. H. Monroe and F. S. MacNeil, 1937.

7074. Hale Landing, on the west bank of Flint River, 7 miles southeast of Bainridge, Decatur County, Georgia. Residual chert of Byram Age. Collectors: T. W. Vaughan, C. W. Cooke, and W. C. Mansfield, 1914.

7372. Old Yazoo road north of National Cemetery, Vicksburg, Warren County, Mississippi. Byram Formation (Marl Member). Collector: C. W. Cooke, 1915.

7376. West bank of Leaf River one mile below abandoned bridge over Leaf River on old Taylorsville-Sylvarena road, about 4 miles southwest of Sylvarena, Smith County, Mississippi. Probably same as USGS loc. 14282. Byram Formation (Marl Member). Collectors: E. N. Lowe and C. W. Cooke, 1915.

7467. Under the waterfall on Mint Spring Bayou, Vicksburg, Wayne County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: O. B. Hopkins, date unknown.

7671. Brown's Cave, east bluff of Leaf River, one-half mile above the bridge on Bay Springs-Raleigh road in sec. 13, T. 2 N., R. 8 E., Smith County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: C. W. Cooke, 1916.

7671a. Same as USGS loc. 7671. Mint Spring Marl Member of the Marianna Limestone. Collectors: F. S. MacNeil and W. H. Monroe, 1937.

7941. Glass Bayou, Vicksburg, Warren County, Mississippi. This lot is a mixture of Byram and Mint Spring Marls. Collector: W. C. Clark, 1917.

10400. Vicksburg, Warren County, Mississippi. According to Cooke's notes he visited Mint Spring Bayou and the road north of the National Cemetery on this date (see below). This collection is probably from the Cemetery road. Byram Formation (Marl Member). Collector: C. W. Cooke, Nov. 5, 1922.

12175. Old Yazoo road, north of National Cemetery, north of Vicksburg, Warren County, Mississippi. Byram Formation (Marl Member). Collector: R. Stewart, 1930.

13286. "Upper Vicksburg," Vicksburg, Warren County, Mississippi. Byram Formation (Marl Member). Collector: T. L. Casey, date unknown.

13287. "Lower Vicksburg," Vicksburg, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: T. L. Casey, date unknown.

13288. Red Bluff (? Hiwannee), Wayne County, Mississippi. In Casey collection and stated to have been obtained from Aldrich. Red Bluff Clay.

13522. In large arroyo at old road crossing just north of Rancho Llanitos, General Bravo, Nuevo León, Mexico.

13529. In small arroyo on road to Rancho Max Rodriguez, 500 meters east of Rancho El Rucio, General Bravo, Nuevo León, Mexico.

13535. Four hundred fifty-eight meters southwest of Rancho Miralejos, Carlos Cantu, General Bravo, Nuevo León, Mexico.

14023. On a high hill 3,750 meters, 5.68° W. from Zacate well No. 1; Zacate, General Bravo, Nuevo León, Mexico.

14071. Bed of Lime Creek, SW 1/4, NW 1/4, sec. 22, T. 4 N., R. 1 E., about 0.8 miles northwest of Cleary, Rankin County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collectors: W. H. Monroe and C. W. Cooke, 1931.

14071a. Same as USGS loc. 14071. Mint Spring Marl Member of the Marianna Limestone. Collectors: W. H. Monroe and F. S. MacNeil, 1937.

14074. Below waterfall, one-half mile south of Haynes bluff, 11 miles north of National Cemetery, Warren County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collector: C. W. Cooke, 1934.

14162. Bluff below high power line, just north of Mississippi River bridge, Vicksburg, Warren County, Mississippi. Probably same as USGS loc. 3727. Mint Spring Marl Member of the Marianna Limestone. Collectors: W. H. Monroe and F. S. MacNeil, 1937.

14203. Horton's Mill Creek, about 4 miles north of Waynesboro, Wayne County, Mississippi. Mint Spring Marl Member of the Marianna Limestone. Collectors: F. S. MacNeil and W. C. Mansfield, 1938.

14204. Taylor Mill Creek, 1 1/2 miles north of Waynesboro, Wayne County, Mississippi. Lower Chickasawhay Limestone. Collectors: F. S. MacNeil and W. C. Mansfield, 1938.

14524. Same as USGS loc. 6647. Mint Spring Marl Member of the Marianna Limestone. Collectors: F. S. MacNeil and W. C. Mansfield, date unknown.

14682. Right bank of Leaf River at bend about one mile SSE of bridge on abandoned Sylvarena-Taylorsville road. South center sec. 31, T. 2 N., R. 9 E., Smith County, Mississippi. Probably same as USGS loc. 7376. Byram Formation (Marl Member). Collector: F. S. MacNeil, 1939.

14852. Near Derry, Natchitoches Parish, Louisiana, sec. 5, T. 6 N., R. 6 W. Sandel Formation. Collector: R. T. Hazzard, 1939.

14853. Near Derry, Natchitoches Parish, Louisiana, sec. 5, T. 6 N., R. 6 W. Sandel Formation. Collector: R. T. Hazzard, 1939.

15058. Chickasawhay River, about 100 yards below bend just north of 28-29-32-33 sec. cor., T. 10 N., R. 7 W. About one mile southwest of Hiwannee, Wayne County, Mississippi. Collector: F. S. MacNeil, 1941. Red Bluff Clay.

University of California (Berkeley) Locality

UC A1050. Falls 100 yards east of gate to National Cemetery, 3 miles north of the City of Vicksburg, Mississippi. At base of falls. Collectors: B. L. Clark and F. E. Turner, 1932.

Mississippi Geological Survey Localities

1. Moodys Branch Formation: Town Creek along a northwest-southeast stretch in the SE/4, SW/4, Section 10, T.5 N, R.1 E., Jackson, Hinds County, Mississippi.

2. Moodys Branch Formation: Riverside Park, ravine along valley wall of the Pearl River flood plain and behind the old Riverside swimming pool, NE/4, NW/4, NW/4, Section 36, T.6 N., R.1 E., Jackson, Hinds County, Mississippi.

3. Moodys Branch Formation: Moodys Branch, S/2, SW/4, Section 35, T.6 N., R.1 E., Jackson, Hinds County, Mississippi.

4. Moodys Branch Formation: ". . . the first bluff below the first bridge east of the Institution For The Blind, SW/4, Section 35, T.6 N., R.1 E." Jackson, Mississippi. Palmer and Brann, 1966, Bull. Amer. Paleont., v. 48, No. 218, pt. 2, p. 913.

5. Moodys Branch Formation: ". . . in R.R. cut of G.M. and N.R.R., first cut northeast of freight station." Harris and Palmer, 1946, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 12. Probably in NW/4, NW/4, NE/4, Section 2, T.5 N., R.1 E., Jackson, Hinds County, Mississippi.

6. Moodys Branch Formation: "The highly bryozoal layer in the cut along the railway between the city water works and Jackson." Bull. Amer. Paleont., v. 30, No. 117, p. 17; NE/4, SE/4, Section 35, T.6 N., R.1 E., Jackson, Hinds County, Mississippi.

7. Moodys Branch Formation: Sewer excavation across Town Creek, W/2, SE/4, Section 10, T.5 N., R.1 E., Jackson, Hinds County, Mississippi.

8. Moodys Branch Formation: Tunnel excavations for sewer, SE/4, NE/4, Section 10, T.5 N., R.1 E., Jackson, Hinds County, Mississippi.

9. Moodys Branch Formation: Garland Creek, NW/4, NW/4, NW/4. Section 28, T.1 N., R.16 E., Clarke County, Mississippi, and about one mile upstream along the right fork.

10. Moodys Branch Formation: "Sims Siding about 8 miles north of Yazoo City, Miss." Harris and Palmer, 1946, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 13.

11. Moodys Branch Formation: Techeva Creek SW/4, SW/4, Section 32, T.13 N., R.1 E., and Sections, 5, 4, 9, and 10, T.12 N., R.1 E., Yazoo County, Mississippi.

12. Moodys Branch Formation: Tinnin locality (J. W. Tinnin property), along deep ravine, NW/4, NE/4, Section 20, T.13 N., R.1 W., Yazoo County, Mississippi.

13. Moodys Branch Formation: Perry Creek, SW cor. NW/4, Section 13, T.10 N., R.3 W., Yazoo County, Mississippi.

14. Moodys Branch Formation: Thompson Creek, Section 12, T.10 N., R.3 W., Yazoo County, Mississippi.

15. Yazoo Formation: Miss-Lite clay pit at Cynthia, SE/4, SW/4, Section 25, T.7 N., R.1 W., Hinds County, Mississippi.

16. Moodys Branch Formation: East bank of the Chickasawhay River below a hunting lodge NW/4, NE/4, SE/4, Section 30, T.1 N., R.16 E., Clarke County, Mississippi.

17. Moodys Branch Formation: Trench behind Getty Oil Co. Well #1 J. Blanks 21-6; NE/4, SW/4, NW/4, Section 21, T.2 N., R.14 E., Clarke County, Mississippi.

18. Moodys Branch Formation: Bluff on southeast side of Chickasawhay River below the old Heard Cemetery; S/2, NE/4, SE/4, NE/4, Section 30, T.1 N., R.16 E., Clarke County, Mississippi.

19. Bashi Formation: Bluff behind the Red Hot Truck Stop parking lot, Meridian, Mississippi; NE/4, NW/4, Section 20, T.6 N., R. 16 E., Lauderdale County, Mississippi.

20. Bashi Formation: Concretions placed along the 31st Street exit south of I-20, Meridian, Mississippi; SE/4, Section 24, T.6 N., R.15 E., Lauderdale County, Mississippi.

21. Bashi Formation: Road cut on Highway 19, 1.2 miles from the State line; NE/4, SW/4, Section 22, T.5 N., R.18 E., Lauderdale County, Mississippi.

22. Winona Formation: East bank of Chickasawhay River about one-half mile south of bridge at Enterprise, Mississippi; SW/4, NE/4, SE/4, Section 24, T.4 N., R.14 E., Clarke County, Mississippi.

23. Winona Formation: Bluff on Allen Branch below Enterprise Cemetery in the NW/4, NE/4, NW/4, Section 24, T.4 N., R.14 E., Clarke County, Mississippi.

24. Upper part of the Basic City Shale Member, Tallahatta Formation: Drainage ditch on west side of road 50 feet south of Dunn's Falls; SE/4, NE/4, SW/4, Section 36, T.5 N., R.14 E., Lauderdale County, Mississippi.

25. Weathered Archusa Marl with silicified fossils in a 2- to 3-inch zone above the basal contact with nonfossiliferous, well-sorted, cross-bedded Kosciusko sand; roadcut on south side, SW/4, NE/4, SW/4, NW/4, Section 21, T.4 N., R.15 E., Clarke County, Mississippi.

26a. Archusa Marl Member, Cook Mountain Formation: Dobys Bluff, east side of Chickasawhay River; center of north line, NW/4, SW/4, NW/4, Section 18, T.2 N., R.16 E., Clarke County, Mississippi.

26b. Fossiliferous marine beds in the top of the Kosciusko Formation below the basal contact of the Archusa Marl: Dobys Bluff, east side of Chickasawhay River; center of north line, NW/4, SW/4, NW/4, Section 18, T.2 N., R.16 E., Clarke County, Mississippi.

27. Archusa Marl Member, Cook Mountain Formation: Road cut on east side just south of entrance to Archusa Creek Water Park; NE/4, NW/4, SW/4, Section 7, T.2 N., R. 16 E., Clarke County, Mississippi.

28. Gosport Sand: Claiborne Bluff on the Alabama River, Claiborne, Alabama.

29. Gosport Sand: Little Stave Creek, Jackson, Alabama.

30. Moodys Branch Formation: Little Stave Creek, Jackson, Alabama.

31. Cocoa Sand, Yazoo Formation: Stream bed of Shubuta Creek below and just upstream of bridge 205; SW/4, SW/4, NW/4, Section 35, T.1 N., R.15 E., Clarke County, Mississippi.

32. Pachuta Marl, Yazoo Formation: Road cut; SE/4, SE/4, SE/4, Section 29, T.10 N., R.5 W., Wayne County, Mississipi.

33. Pachuta Marl, Yazoo Formation: NW/4, NW/4, Section 21, T.1 N., R.14 E., Clarke County, Mississippi.

34. Shubuta Clay, Yazoo Formation: Bluff along west bank of the Chickasawhay River; E/2, NE/4, NW/4, NW/4, Section 28, T.10 N., R.7 W., Wayne County, Mississippi.

35. Shubuta Clay, Yazoo Formation: Bluff along east bank of the Chichasawhay River; SW/4, SW/4, SW/4, Section 28, T.10 N., R.7 W., Wayne County, Mississippi.

36. Shubuta Clay, Yazoo Formation: Bluff on the east and southeast side of a horse-shoe bend in the Chickasawhay River; N/2, SE/4, NE/4, Section 16, T.10 N., R.7 W., Wayne County, Mississippi.

37. Red Bluff Formation: Type locality, bluff on the east and southeast side of a horse-shoe bend in the Chickasawhay River; N/2, SE/4, NE/4, Section 16, T.10 N., R.7 W., Wayne County, Mississippi.

38. Red Bluff Formation: East bank of Chickasawhay River west of Hiwannee; NE/4, SE/4, NE/4, Section 28, T.10 N., R.7 W., Wayne County, Mississippi.

39. Red Bluff Formation: South bank of Chickasawhay River southwest of Hiwannee; NE/4, SE/4, NE/4, SE/4, Section 28, T.10 N., R.7 W., Wayne County, Mississippi.

40. Red Bluff Formation: Stream bed of a tributary to Sand Branch; NW/4, SE/4, NE/4, SE/4, Section 24, T.10 N., R.7 W., Wayne County, Mississippi.

41. Marianna Limestone: Roadcut at intersection of dirt road leading to the Shell Oil Company Goodwater Plant; NE/4, SW/4, SW/4, Section 8, T.10 N., R.8 W., Clarke County, Mississippi.

42. Glendon Limestone: Roadcut at intersection of dirt road leading to the Shell Oil Company Goodwater Plant; NE/4, SW/4, SW/4, Section 8, T.10 N., R.8 W., Clarke County, Mississippi.

43. Marianna Limestone: Gully on west side of dirt road; NW/4, NE/4, NW/4, Section 10, T.10 N., R.8 W., Clarke County, Mississippi.

44. Marianna Limestone: Roadcut on south side across from the intersection of dirt road leading to locality 43; NW/4, SE/4, NE/4, Section 10, T.10 N., R.8 W., Clarke County, Mississippi.

45. Glendon Limestone: Agricultural lime plant quarry north of Waynesboro; NE/4, Section 23, and W/2, NW/4, Section 24, T.9 N., R.7 W., Wayne County, Mississippi.

46. Red Bluff Formation: Gullies in a power line right of way crossing Eucutta Creek below Lyle Cashion Company Oil well #13-1 of North Yellow Creek field; NW/4, NE/4, NE/4, NE/4, Section 13, T.10 N., R.8 W., Clarke County, Mississippi.

47. Yazoo Formation (probably Pachuta Marl): Locality is locally known as the "Bone Yard"; gullies in north side of ridge near the center of SE/4, Section 11, T.1 N., R.17 E., Clarke County, Mississippi.

48. Moodys Branch Formation: Cut for oil well on top of Prairie Hill facing west; NE/4, SW/4, Section 33, T.3 N., R.15 E., Clarke County, Mississippi.

49. Archusa Marl, Cook Mountain Formation: Forms waterfall in Souinlovey Creek at bridge; SE/4, SE/4, NW/4, Section 19, T.2 N., R.15 E., Clarke County, Mississippi.

50. Archusa Marl, Cook Mountain Formation: Limestone forms a bench on the east side of the Chickasawhay River just south of bridge at DeSoto; SE/4, SW/4, NW/4, Section 31, T.2 N., R.16 E., Clarke County, Mississippi.

51. Archusa Marl, Cook Mountain Formation: Limestone forms waterfall at bridge over Fallen Creek; SE/4, SW/4, NW/4, Section 31, T.2 N., R.16 E., Clarke County, Mississippi.

52. Archusa Marl, Cook Mountain Formation: Titanothere locality; bed of an intermittent branch of a tributary on the Chickasawhay River; SW/4, SE/4, SW/4, Section 24, T.2 N., R.15 E., Clarke County, Mississippi. Information on stratigraphy and location is from the notes of Survey Geologist Alvin R. Bicker who visited the site on December 3, 1969.

53. Winona Formation: Stream bed of Weir Creek just south of the old Enterprise Cemetery; SE/4, NW/4, NW/4 and N/2, SW/4, NW/4 of Section 24, T.4 N., R.14 E., Clarke County, Mississippi.

54. Potterchitto Member, Cook Mountain Formation: Roadcut on north side of Highway 513; SE/4, NW/4, NE/4, Section 29, T.4 N., R. 14 E., Clarke County, Mississippi.

55. Gordon Creek Shale, Cook Mountain Formation: A complete section of the Gordon Creek Shale showing the upper and lower contacts with the Cockfield sand above and Potterchitto glauconitic sand below is exposed in a railroad cut at the U.S. Highway 11 bridge; NE/4, NE/4, NW/4, Section 10, T.3 N., R.14 E., Clarke County, Mississippi.

56. Cockfield Formation: The contact between the upper shaly part and lower sandy part of the Cockfield Formation is exposed in an excavation behind an animal hospital on Highway 511 just west of the south intersection of road leading to the Archusa Creek Water Park; E/2, SW/4, SW/4, Section 6, T.2 N., R.16 E., Clarke County, Mississippi.

57a. Shubuta Clay, Yazoo Formation: Type locality, gully 100 feet north of dirt road and east of bridge over the Chickasawhay River; S/2, SW/4, SE/4, SW/4, Section 3, T.10 N., R.7 W., Clarke County, Mississippi.

57b. Pachuta Marl, Yazoo Formation: Lower stretch of gully referenced in 57a; SE/4, SE/4, SW/4, SW/4, Section 3, T.10 N., R.7 W., Clarke County, Mississippi.

58. Pachuta Marl, Yazoo Formation: Type locality, south side of Pachuta Creek 1 1/2 miles south-southeast of Pachuta; SE/4, SW/4, Section 8, T.2 N., R.14 E., Clarke County, Mississippi.

59. Archusa Marl, Cook Mountain Formation: Type locality, bluff on south side of Chickasawhay River below the old Highway 45 bridge; center of N/2, SW/4, SE/4, Section 14, T.2 N., R.16 E., Clarke County, Mississippi.

60. Basic City Shale Member, Tallahatta Formation: Type locality at a cut on the Gulf, Mobile, and Ohio Railroad north of Basic City in the NE/4, NE/4, NW/4, Section 4, T.4 N., R.15 E., Clarke County and SE/4, SE/4, SW/4, Section 33, T.4 N., R.15 E., Lauderdale County, Mississippi.

61. Archusa Marl Member, Cook Mountain Formation: Cuts on both sides of the Southern Railroad north of Wautubbee in the N/2, SE/4, NW/4, NE/4, Section 3, T.3 N., R.14 E., Clarke County, Mississippi.

62. Archusa Marl Member, Cook Mountain Formation: Cut on west side of the Southern Railroad north of Wautubbee in the NE/4, SW/4, NE/4, Section 3, T.3 N., R.14 E., Clarke County, Mississippi.

63. Cook Mountain Formation: "Roadcut on county road 4 miles northeast of Rose Hill, Jasper County, Mississippi" (Tulane Locality Register, locality 85). Probably in Section 26, T.4 N., R.13 E., Jasper County, Mississippi.

64. Cook Mountain Formation: "Roadcut on east side of Mississippi Highway 15, 0.8 mile north of junction with U.S. Highway 80, Newton Co., Mississippi. (Note: Interstate 20 has subsequently covered this locality, and it is no longer available.)" (Tulane Locality Register, locality 86). SE/4, SW/4, SW/4, SE/4, SE/4, Section 22, T.6 N., R.11 E., Newton County, Mississippi.

65. Cook Mountain Formation: Cut behind gas station on the southwest corner of junction of Highway 15 and Interstate 20, just northeast of Newton in the NE/4, NW/4, NE/4, T.6 N., R.11 E., Newton County, Mississippi (Tulane locality 907).

66. Cook Mountain Formation: "Fill behind Sinclair Truck Stop, northwest corner of intersection of Mississippi Highway 15 and Interstate 20 (material probably from cut for I-20); just north of Newton" (Tulane Locality Register, locality 921). NE/4, SW/4, SW/4, SE/4, SE/4, Section 23, T.6 N., R.11 E., Newton County, Mississippi.

67. Cook Mountain Formation: "Newton, Mississippi—Cut on I.C. Railroad about 3 miles east of town—200 yards west of milepost 27 (from Meridian)—[same as "Indian Mound" of Palmer]" (Tulane Locality Register, locality 921; P.R.I. locality 726). Probably in the SE/4, Section 31, T.6 N., R.12 E., Newton County, Mississippi.

68. Cook Mountain Formation: "Hill on south side of county road paralleling Interstate 20 along north side, 0.3 mile west of Mississippi Highway 15, just north of Newton" (Tulane Locality Register, locality 923). NE/4, SW/4, SE/4, Section 23, T.6 N., R.11 E., Newton County, Mississippi.

69. Cook Mountain Formation: "Roadcut 2.7 miles east of Mississippi Highway 15 at Newton, on road to Poplar Springs Church" (Tulane Locality Register, locality 924). NW/4, NW/4, SE/4, SE/4, Section 36, T.6 N., R.11 E., Newton County, Mississippi.

70. Cook Mountain Formation: "I-20—cuts both sides of road just west of Mississippi 15, about 2 miles north of Newton" (Tulane Locality Register, locality 925). SW/4, SE/4, T.6 N., R.11 E., Newton County, Mississippi.

71. Cook Mountain Formation: "Road cut on top of second hill—1 mile west of Mississippi 503 on county road 1 mile south of Hickory" (Tulane Locality Register, locality 928). SE/4, NW/4, SW/4, Section 2, T.5 N., R.12 E., Newton County, Mississippi.

72. North Twistwood Creek Clay Member, Yazoo Formation: South bank of the Chickasawhay River below a bridge north of Shubuta in the SW/4, NW/4, SW/4, Section 32, T.1 N., R.16 E., Clarke County, Mississippi.

73. Contact of the Red Bluff and Forest Hill Formations: West bank of the Chickasawhay River on the outside of a sharp bend; NW/4, NW/4, NE/4, SE/4, Section 9, T.9 N., R.7 W., Wayne County, Mississippi.

74. Forest Hill Formation (74a), Mint Spring Formation (74b), and Marianna Limestone (74c): Southwest bank of the Chickasawhay River just downstream from a right angle bend; center of north line of NW/4, SE/4, Section 22, T.9 N., R.7 W., Wayne County, Mississippi.

75. Forest Hill Formation (75a), Mint Spring Formation (75b), and Marianna Limestone (75c): Northeast bank of the Chickasawhay River below a power line; N/2, SE/4, SE/4, SE/4, Section 22, T.9 N., R.7 W., Wayne County, Mississippi.

76. Marianna Limestone: Southwest bank of the Chickasawhay River; exposure is continuous for about 1/2 mile; N/2, NW/4, Section 26, T.9 N., R.7 W., Wayne County, Mississippi.

77. Marianna Limestone (77a) and Glendon Limestone (77b): East bluff of the Chickasawhay River at and below a railroad bridge crossing Limestone Creek; E/2, SW/4, SE/4, NE/4, Section 26, T.9 N., R.7 W., Wayne County, Mississippi.

78. Glendon Limestone (base is exposed at low water level): East bank of the Chickasawhay River; S/2 NE/4, NE/4, SW/4, Section 35, T.9 N., R.7 W., Wayne County, Mississippi.

79. Glendon Limestone (cavernous): West bank of the Chickasawhay River; SE/4, SW/4, SW/4, Section 35, T.9 N., R.7 W., Wayne County, Mississippi.

80. Bucatunna Formation (one foot of the upper part exposed above low water level) (80a) and Chickasawhay Limestone (80b): West bank of the Chickasawhay River; SE/4, NW/4, SE/4, NE/4, Section 3, T.8 N., R.7 W., Wayne County, Mississippi.

81. Chickasawhay Limestone: West bank of the Chichasawhay River above the Highway 84 bridge; SW/4, SE/4, SW/4, of Section 3 and NW/4, NE/4, NW/4, Section 10, T.8 N., R.7 W., Wayne County, Mississippi.

82. Chickasawhay Limestone: West bank of the Chickasawhay River just above power line crossing; NW/4, SW/4, NW/4, SE/4, Section 10, T.8 N., R.7 W., Wayne County, Mississippi.

83. Paynes Hammock Formation: East bank of Chickasawhay River at the corner of a right angle bend; SE/4, NW/4, SE/4, Section 14, T.8 N., R.7 W., Wayne County, Mississippi.

84. Catahoula Formation: West bank of the Chickasawhay River; NW/4, NW/4, SW/4, SE/4, Section 23, T.8 N., R.7 W., Wayne County, Mississippi.

85. Paynes Hammock Formation: Northeast bank of the Chickasawhay River; SE/4, SW/4, NW/4, SW/4, Section 24, T.8 N., R.7 W., Wayne County, Mississippi.

86. Paynes Hammock Formation: South bank of the Chickasawhay River just below bridge; SW/4, NE/4, and SE/4, NW/4, of SE/4, SW/4, Section 24, T.8 N., R.7 W., Wayne County, Mississippi.

87. Bucatunna Formation: Type locality, along Bucatunna Creek; Sections 5, 6 and N/2 of 8, T.8 N., R.5 W., Wayne County, Mississippi.

88. Forest Hill Formation (88a), Mint Spring Formation (88b), and Marianna Limestone (88c): Roadcut on the south side of Highway 84; SE/4, Section 18, T.9 N., R.5 W., Wayne County, Mississippi.

89. Mint Spring Formation (89a) and Marianna Limestone (89b): Wadell Cave (Brown's Cave); NW/4, SW/4, NE/4, Section 13, T.2 N., R.8 E., Smith County, Mississippi.

90. Mint Spring Formation: Ichusa Creek: SW/4, SE/4, SW/4, Section 19, T.2 N., R.9 E., Smith County, Mississippi.

91. Marianna Limestone (91a) and Glendon Limestone (91b): Abandoned quarry on the northeast side of Highway 18; NE/4, SE/4, Section 22, T.2 N., R.9 E., Smith County, Mississippi.

92. Marianna Limestone (92a) and Glendon Limestone (92b): Smith County Lime Plant quarry (for agricultural lime); NW/4, NE/4, Section 27, T.2 N., R.9 E., Smith County, Mississippi.

93. Byram Formation: Stream bed of West Tallahala Creek east of bridge; SE/4, NW/4, NW/4, SW/4, Section 33, T.2 N., R.9 E., Smith County, Mississippi.

94. Upper Byram Formation: Stream bed of West Tallahala Creek at wooden bridge; E/2, SE/4, NW/4, Section 5, T.1 N., R.9 E., Smith County, Mississippi.

95. Bucatunna Formation: Eason Mineral Clay Mine (Bucatunna clay is used to make mineral water); NE/4, SE/4, Section 26, T.2 N., R.9 E., Smith County, Mississippi.

96. *Crassostrea blanpiedi* "reef" (possibly equivalent to the Paynes Hammock Formation): Stream bed; NE/4, NW/4, NE/4, NW/4, Section 4, T.1 N., R.9 E., Smith County, Mississippi.

97. Mint Spring Formation: Dredge piles in the Marquette Cement Mfg. Co. quarry at Brandon; SE/4, NW/4, NE/4, Section 19, T.5 N., R.3 E., Rankin County, Mississippi.

98. Marianna Limestone (98a), Glendon Limestone (98b), Byram Formation (98c), and Bucatunna Formation (98d): Marquette Cement Mfg. Co. quarry at Brandon; central and northeast part of Section 19, T.5 N., R.3 E., Rankin County, Mississippi.

99. Mint Spring Formation (99a) and Marianna Limestone (99b): Stream bed and bluffs north of Cleary on the Andrew W. Rees property; SE/4, SE/4, SW/4, NW/4, Section 22, T.4 N., R.1 E., Rankin County, Mississippi.

100. Mint Spring Formation (100a) and Marianna Limestone (100b): Stream bed north of Cleary; N/2, NW/4, NW/4, SE/4, and SW/4, SW/4, NE/4, Section 22, T.4 N., R.1 E., Rankin County, Mississippi.

101. Mint Spring Formation (101a) and Marianna Limestone (101b): Stream bed and bluffs north of Cleary; NW/4, NE/4, NW/4, SE/4, Section 22, T.4 N., R.1 E., Rankin County, Mississippi.

102. Byram Formation: Type locality, west bank of the Pearl River below the old swinging bridge at Byram; NW/4, SW/4, NW/4, Section 19, T.4 N., R.1 E., Hinds County, Mississippi.

103. Forest Hill Formation: Type locality, road cut on State Highway 18, 1/4 mile northeast of Forest Hill School; NE/4, Section 22, and NW/4, Section 23, T.5 N., R.1 W., Hinds County, Mississippi.

104. Glendon Limestone: R. E. Floyd Lime Quarry; NW/4, Section 23, T.7 N., R.4 W., Hinds County, Mississippi.

105. Marianna Limestone (105a) and Glendon Limestone (105b): Southcentral Lime, Inc., Quarry; SW/4, Section 23, T.7 N., R.4 W., Hinds County, Mississippi.

106. Byram Formation (106a) and Bucatunna Formation (106b): East and south bank of the Big Black River at sharp bend; NE/4, Section 29, T.6 N., R.4 W., Hinds County, Mississippi.

107. Forest Hill Formation (107a), Mint Spring Formation (107b), Marianna Limestone (107c), and Glendon Limestone (107d): East bank of the Mississippi River north of the I-20 bridge; Section 32 and the south part of Section 31, T.16 N., R.3 E., Warren County, Mississippi.

108. Forest Hill Formation (108a), Mint Spring Formation, type locality (108b), Marianna Limestone (108c), and Glendon Limestone (108d): Waterfall on Mint Spring Bayou: NW/4, SE/4, Section 12, T.16 N., R.4 E., Warren County, Mississippi.

109. Byram Formation: Roadcut on the old road to Waltersville just east of Highway 61 intersection; NE/4 of Section 12, T.16 N., R.4 E., Warren County, Mississippi.

110. Mint Spring Formation: Excavation for culvert along Bliss Creek at the Highway 61 Business and Highway 61 Bypass intersection; Section 28, T.17 N., R.4 E., Warren county, Mississippi.

111. Mint Spring Formation: Ditch draining the Mississippi Valley Portland Cement Company quarry north of Redwood on Highway 3; NW/4, Section 26, T.18 N., R.4 E., Warren County, Mississippi.

112. Marianna Limestone (112a), Glendon Limestone (112b), and Byram Formation (112c): Mississippi Valley Portland Cement Company quarry north of Redwood on Highway 3; NW/4, Section 26, T.18 N., R.4 E., Warren County, Mississippi.

113. Glendon Limestone (113a), and Byram Formation (113b): Roadcut across from the International Paper Plant and east of Highway 3; SE/4, Section 23, T.18 W., R.4 E., Warren County, Mississippi.

114. Byram Formation: Railroad cut across from the International Paper Plant and east of Highway 3; SE/4, Section 23, T.18 N., R.4 E., Warren County, Mississippi.

115. Byram Formation: East side of Highway 61 across from the Anderson-Tully Lumber Company at the boundary of Sections 12 and 35, T.16 N., R.3 E., Warren County, Mississippi (collected by F. F. Mellen in January, 1939).

116. Byram Formation: High cut on east side of Highway 61 at property of Eliza McGraw, Section 33, T.17 N., R.4 E., Warren County, Mississippi (collected by F. F. Mellen in January, 1939).

117. Forest Hill Formation (117a), Mint Spring Formation (117b), and Marianna Ls. (117c): along Hortons Mill Creek just below and above the Highway 45 bridge; SW/4, Section 13, T.9 N., R.7 W., Wayne County, Mississippi (= USGS locality 14203).

118. Chickasawhay Formation, a basal calcareous, sandy, clay unit (118a) overlain by the *Chione* limestone (118b): in Taylor Creek just below and above the Highway 45 bridge; SE/4, Section 36, T.9 N., R.7 W., Wayne County, Mississippi (= USGS locality 14204).

Paleontological Research Institution Localities

1. Bunker Hill Landing, Ouachita River, Caldwell Parish, Louisiana.

2. Wyant Bluff, Caldwell Parish, Louisiana.

6. Danville Landing, Ouachita River, Catahoula Parish, Louisiana.

7. One mile above Gibson Landing, Ouachita River, Caldwell Parish, Louisiana.

8. One-half mile below Gibson Landing, Ouachita River, Louisiana.

10. Montgomery Landing, Red River, Grant Parish, Louisiana.

11. Upper bed, Montgomery Landing, Red River, Grant Parish Louisiana.

15. Montgomery Landing, lower bed, Red River, Grant Parish, Louisiana.

693. Jackson, Mississippi. Coll. Dr. J. M. Sullivan, 1925.

725. Sabine River, Texas side, opposite SW corner of SE/4 Section 35, T.5 N., R.13 W., Sabine Parish, Louisiana.

726. Indian Mound, 3 miles east of Newton, on the A. and V. Railroad, Newton County, Mississippi.

727. Little Brazos River, 2 and 1/2 miles above Stone City, Brazos County, Texas.

728. Hickory, Newton County, Mississippi.

729. About 8 miles west of Enterprise, Clarke County, Mississippi.

731. Wautubbee, Clarke County, Mississippi.

803. Two miles northeast of Newton, on Highway 15, Newton County, Mississippi.

883. Montgomery, about one-half mile below the ferry, on the Red River, Grant Parish, Louisiana.

912. Gibson Landing, Ouachita River, at the water's edge 3/4 mile below the landing, Caldwell Parish, Louisiana.

913. Wyant Bluff, west bank of Ouachita River, about 15 miles south of Columbia on Highway 106, Caldwell Parish, Louisiana.

P1119. Bunker Hill bluff on Ouachita River, Caldwell County, Louisiana.

P1121. One mile below Robinson's Ferry, Sabine River, Sabine County, Texas.

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