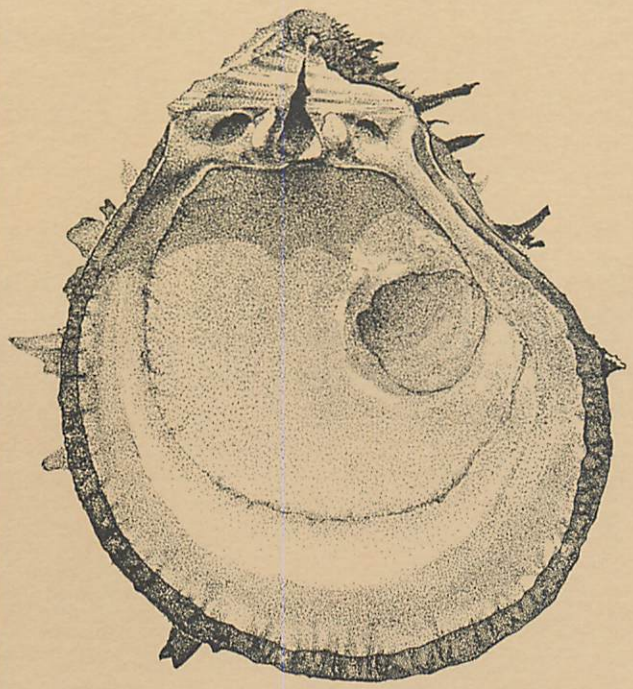
LOWER OLIGOCENE BIVALVIA OF THE VICKSBURG GROUP IN MISSISSIPPI

David T. Dockery III



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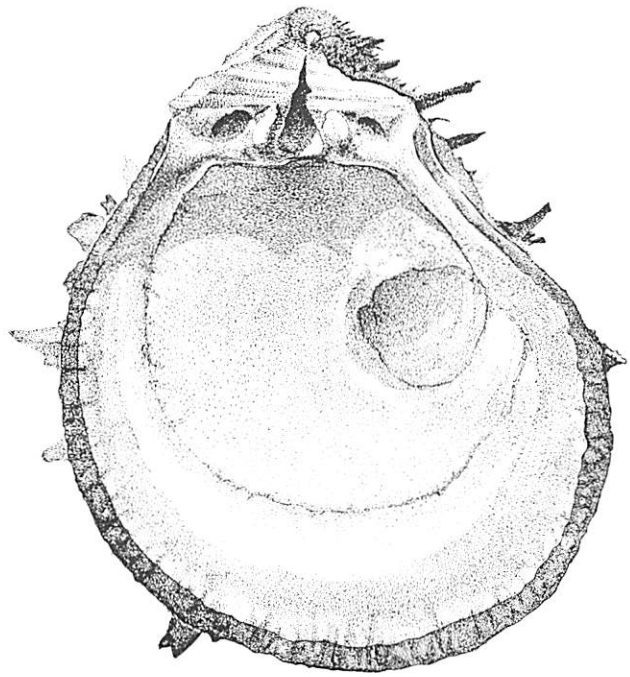

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LETTER OF TRANSMITTAL

Mississippi Department of Natural Resources

Bureau of Geology

Mr. Jolly McCarty, Chairman, and
Members of the Commission
Department of Natural Resources

Commissioners:

The Bureau of Geology is pleased to transmit to you Bulletin 123, entitled "Lower Oligocene Bivalvia of the Vicksburg Group in Mississippi" by David T. Dockery, III.

This bulletin reports on the bivalves and stratigraphy of the lower Oligocene Vicksburg Group in Mississippi. Fossil bivalves from seven formations are illustrated and their occurrences recorded. One hundred and forty-four species are discussed systematically and forty-five new species are named. The photographic plates are of excellent quality and will be a valuable aid in the comparison of the Mississippi fauna with Oligocene fauna from locations worldwide.

Fossils of the Vicksburg Group in Mississippi are unique in being the best preserved lower Oligocene fauna in North America. Many workers use the Mississippi Oligocene sequence as a standard for stratigraphic correlation. Many of the identified new species are of small size which should enable their use in subsurface correlation by the petroleum industry. This publication is the first major report on Vicksburg fauna since Conrad's work in 1848. Its use should contribute immensely to geologic mapping and stratigraphic correlations and should be an important reference for professionals working in this field. Amateur collectors will also find the bulletin useful in the identification of their fossils.

Respectfully submitted,

Alvin R. Bicker, Jr.
Director and State Geologist

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LOWER OLIGOCENE BIVALVIA OF THE VICKSBURG GROUP IN MISSISSIPPI

DAVID T. DOCKERY III

ABSTRACT

A study of the bivalve fauna of the lower Oligocene Vicksburg Group in Mississippi showed that numerous bivalve species range throughout the State's lower Oligocene sequence, although few of these species range into the upper Eocene units below or the upper Oligocene units above. For this reason, together with stratigraphic evidence, the Vicksburg Group is expanded, by the addition of the Red Bluff and Forest Hill formations, to include all the lower Oligocene strata in Mississippi. Formations within the Vicksburg Group as redefined include the: (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.

One hundred forty-four bivalve species from the Vicksburg Group are discussed systematically in this work and are illustrated in numerous text figures and in a series of sixty-two plates. The stratigraphic ranges and occurrences of these species are given in a check list. Forty-five species are described as new. The stratigraphy and depositional systems of the Vicksburg Group are discussed and shown to include two regressive marine cycles and an intervening transgressive marine cycle. Stratigraphic cross sections and photographs of localities for the Vicksburg Group are included. Reproductions of the previously unpublished twelve plates of Lesueur (1829) and the three plates of Conrad (1848b) on the Vicksburg fauna are given as appendices.

INTRODUCTION

The Vicksburg Group of lower Oligocene age is a major stratigraphic division in the northern Gulf Coastal Plain and is a standard section for world wide correlations. At its type locality in Mississippi, it consists of sand, clay, and limestone units, all of which, at least in part, contain a marine fauna. These units are exposed across central Mississippi in a west/northwest to east/southeast trend from Vicksburg to Waynesboro (see Figure 1). The major part of this sequence was deposited on the shallow marine shelf of the fluctuating lower Oligocene seaway in the northern Gulf of Mexico. To the west, in Louisiana and Texas, the Vicksburg Group becomes less marine with the only outcropping marine strata being the Rosefield Formation in Catahoula Parish, Louisiana. To the east in Alabama, Florida, and Georgia, the Vicksburg Group becomes more calcareous and a majority of the marine fauna is poorly preserved as molds and casts within a limestone matrix. Possibly the best-preserved lower Oligocene marine fauna in North America occurs within the Vicksburg Group in Mississippi.

The purpose of this work is to provide a reference for the following uses: (1) for the identification of Vicksburg bivalve species, (2) for further research in Tertiary Gulf Coastal Mollusca, and (3) for detailed geologic mapping and stratigraphic correlations of lower Oligocene units within Mississippi and neighboring states. As the most recent monograph on the Vicksburg fauna was that of Timothy Abbott Conrad in 1848, much revision and additional work was needed. Stratigraphic information on the Vicksburg fauna not given by Conrad is provided in this report. Because the Vicksburg fauna is well preserved in Mississippi, this monograph will be useful for comparisons with Oligocene marine faunas elsewhere. It should also prove useful to future studies of Miocene marine faunas, as many of the Vicksburg species are similar to species in the Alum Bluff Group in Florida.

ACKNOWLEDGMENTS

The writer gratefully acknowledges Harold E. and Emily H. Vokes, Tulane University, for their direction and advice in this work. Druid Wilson, U. S. National Museum, graciously lent his reference file on Conrad's Vicksburg species. F. Stearns MacNeil provided a list of bivalve species described from the Vicksburg Group and a card file of U.S.G.S. Vicksburg localities. Type specimens illustrated in this work were borrowed from both the Philadelphia Academy of Natural Sciences and the U. S. National Museum. S.E.M. photographs are by Ernest E. Russell, Mississippi State University, and Jerry P. Burkes, U. S. Army Corps of Engineers, Waterways Experiment Station. Lloyd N. Glawe, Northeast Louisiana University, assisted in the identification of the pectens, and Ruth D. Turner, Museum of Comparative Zoology, Harvard University, helped in the generic placement of *Jouannetia* (*Pholadopsis*) *triquetra* (Conrad). Text figures were drawn by Randall Bissell and Julia H. Suits. Some specimens illustrated in this work were collected by Frederic F. Mellen, Andrew W. Rees, John E. Robinson, William Davison Easom, and geology students from Millsaps College. The index is by Michele Morphis.

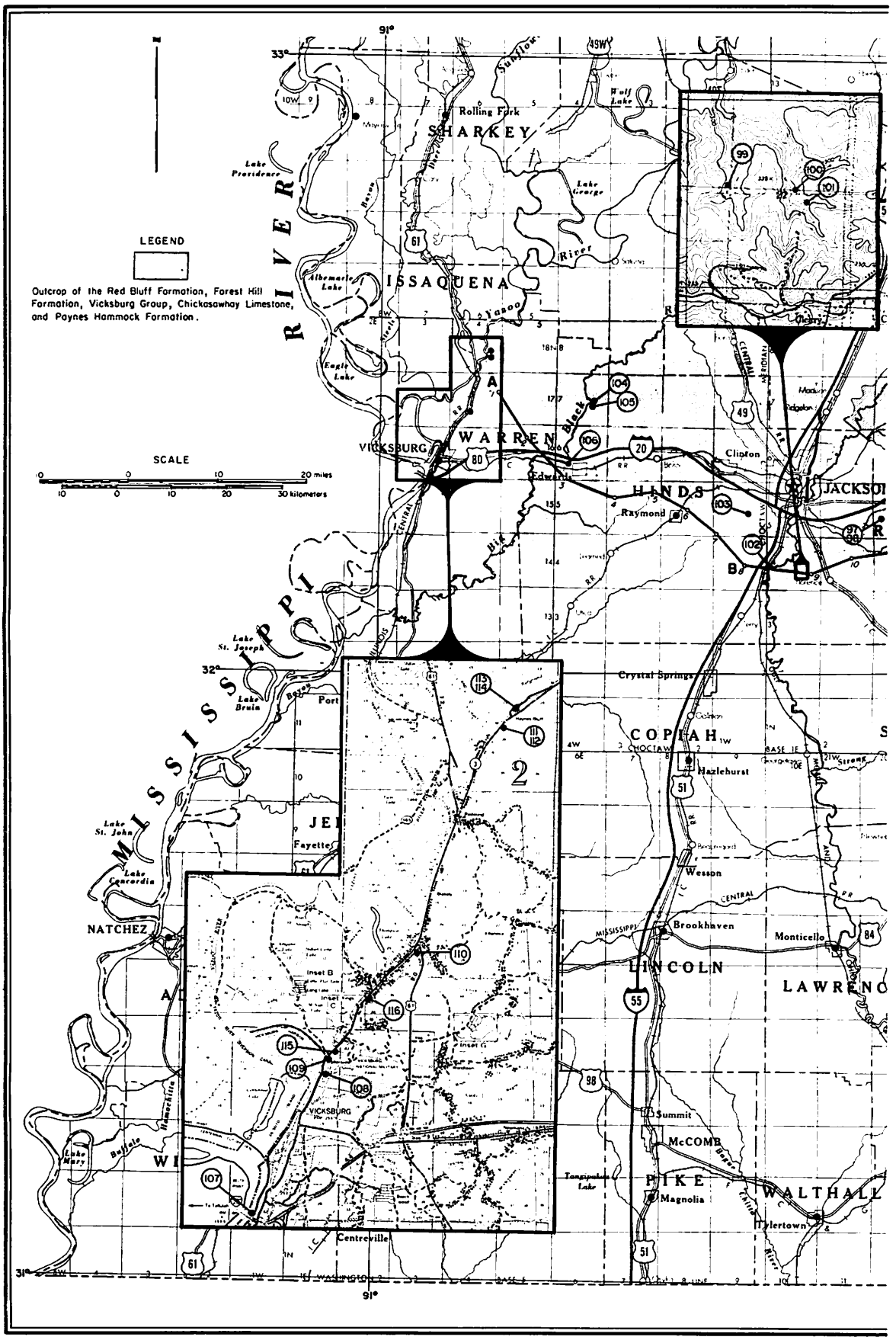
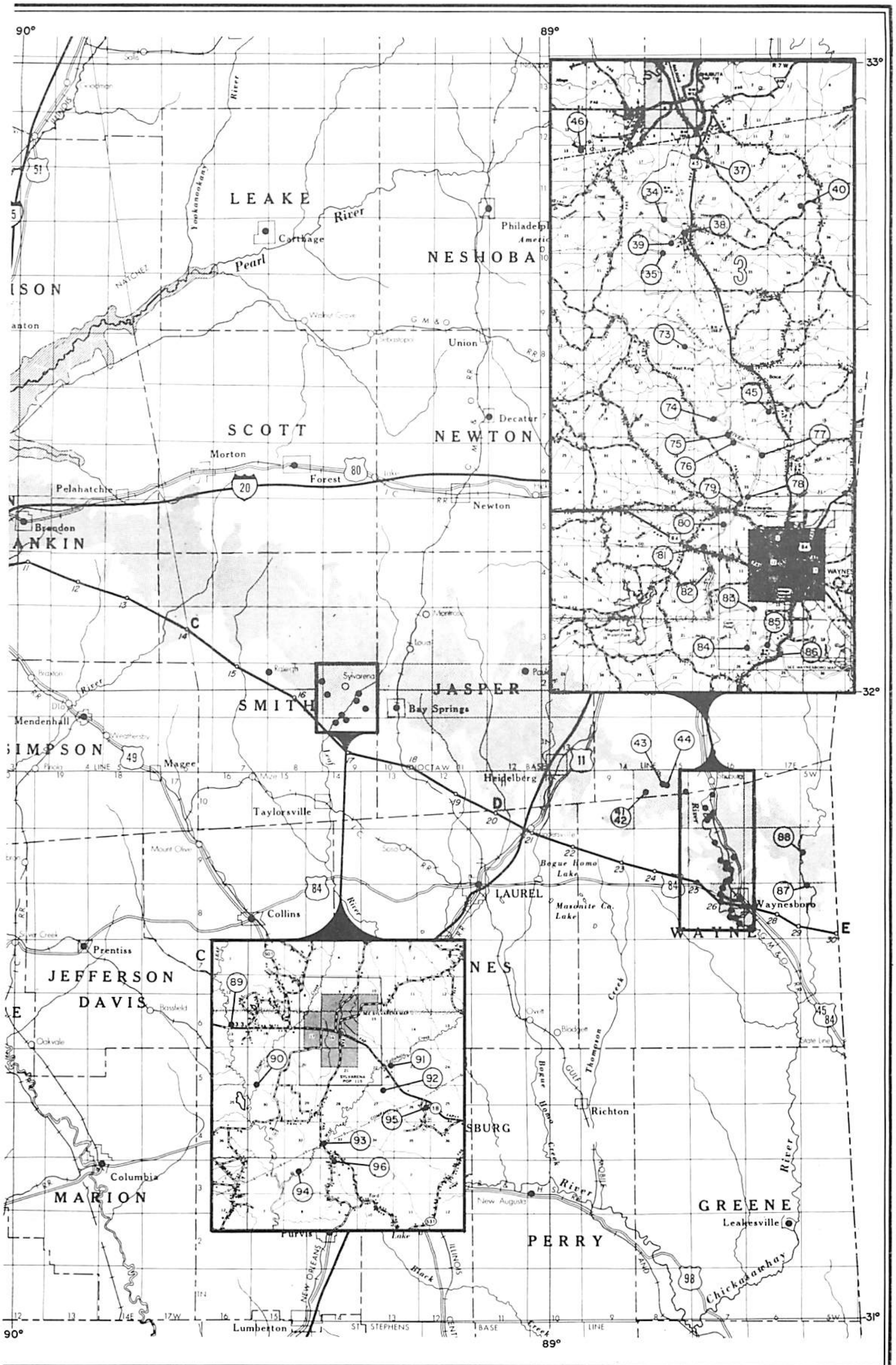


Figure 1 — Oligocene localities and outcrop belt in Mississippi and location of cross sections.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NESHOBA
SCOTT
NEWTON
SMITH
JASPER
SIMPSON
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MARION
PERRY
GREENE
WAYNE
Carthage
Philadelphia
Union
Decatur
Morton
Forest
Newton
Pelahatchie
Brandon
Mendenhall
Magee
Taylorsville
Heidelberg
Bay Springs
Sylvarena
Collins
Prentiss
Columbia
LAUREL
Bogue Homo Lake
Masonite Co. Lake
Waynesboro
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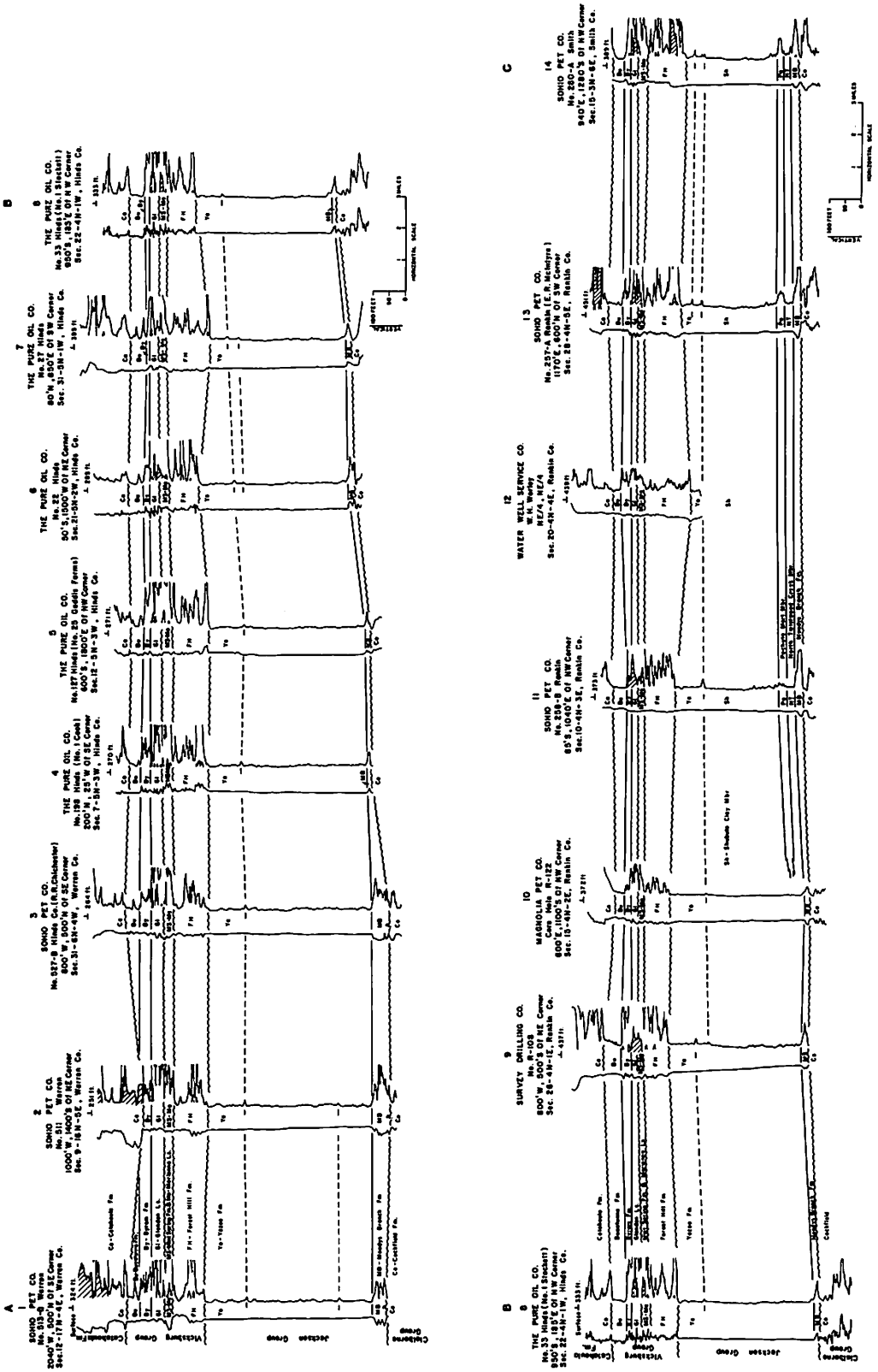


Figure 2 — Cross sections A-B and B-C showing the Jackson (upper Eocene) and Vicksburg (lower Oligocene) groups near the outcrop belt from Warren to Scott counties.

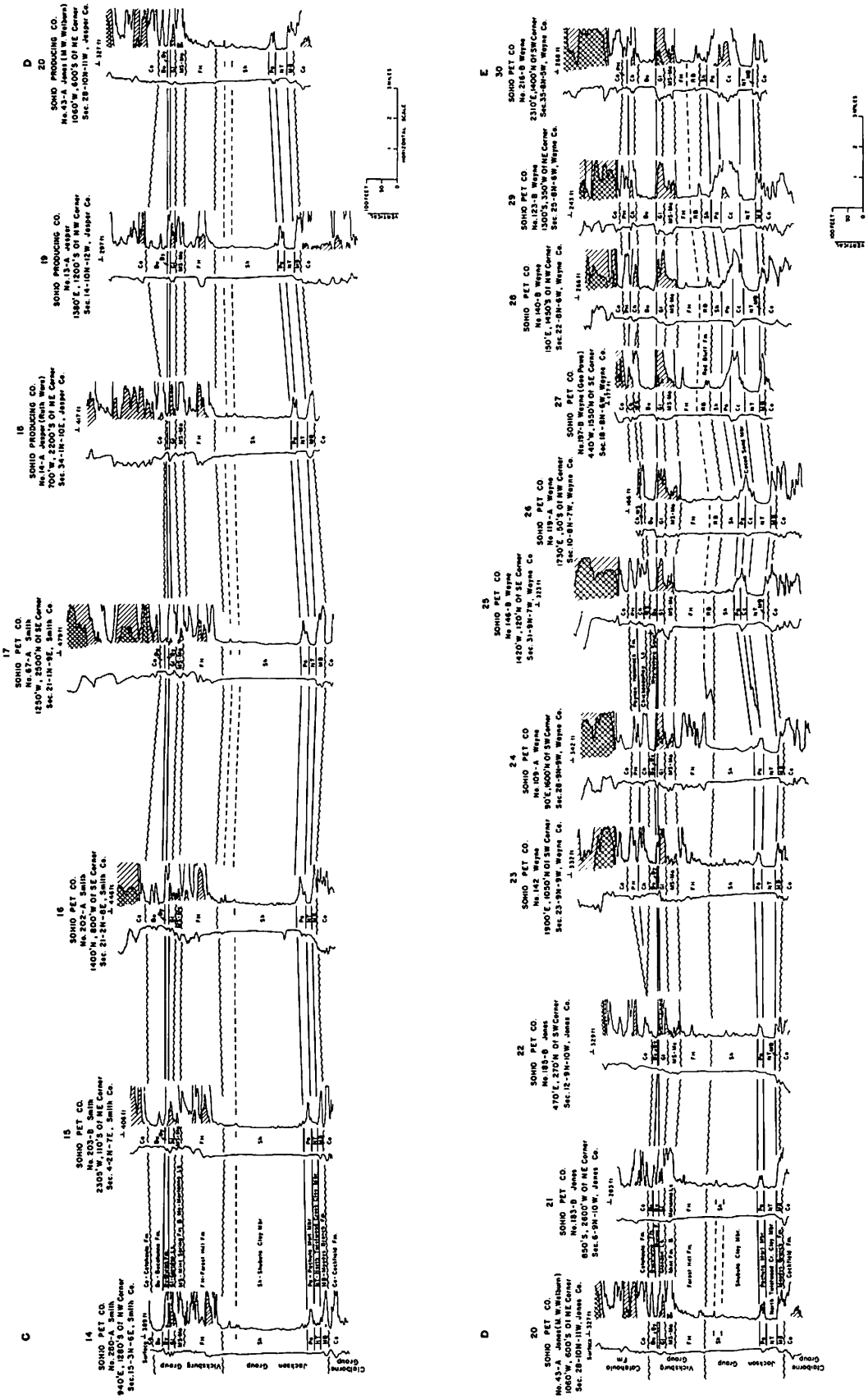


Figure 3 — Cross sections C-D and D-E showing the Jackson (upper Eocene) and Vicksburg (lower Oligocene) groups near the outcrop belt from Scott to Wayne counties and the Chickasawhay and Paynes Hammock formations (upper Oligocene) in Wayne County.

PREVIOUS WORK

The lower Oligocene fossils of Mississippi were first studied in 1828 by the French naturalist Charles Alexander Lesueur while en route to New Orleans on a flatboat from the settlement of New Harmony, Indiana. During a stopover of several days at Walnut Hills, now Vicksburg, Mississippi, he noticed the fossiliferous beds of the Vicksburg Group at the base of the bluffs along the east bank of the Mississippi River. Lesueur collected a large number of fossils from these beds, some of which he illustrated in a series of twelve plates. Lesueur's plates and his accompanying manuscript were never published. These plates, dated 1829, are shown in Appendix II.

Timothy Abbott Conrad traveled to Vicksburg in the spring of 1844 for the purpose of collecting from the beds which Lesueur had visited earlier. In 1847, he described one hundred five new species from that locality in the Proceedings of the Philadelphia Academy of Natural Sciences. Three plates illustrating these species were published in the Academy's Journal in 1848 and are reproduced here in Appendix I. Conrad correctly correlated the Vicksburg beds with the "white limestone" (Marianna and Glendon limestones) of St. Stephens and the upper bluff along the Alabama River at Claiborne, Alabama. He also noted similarities between the Vicksburg fossils and those from certain Eocene and Miocene deposits. Based on these observations he placed the Vicksburg beds as intermediate between the Claiborne Eocene and the Miocene and assigned their age as upper Eocene. Later, in 1856, after studying the fossiliferous beds at Jackson, Mississippi, he recognized the Claiborne, Jackson, and Vicksburg as formal stratigraphic units within the Gulf Coast Eocene and placed them in their proper sequence. Conrad's astute observations and stratigraphic correlations are contrasted by those of Meyer (1885) who made a futile attempt to reverse Conrad's stratigraphic sequence.

Hilgard (1860) in his "Report on the Geology and Agriculture of the State of Mississippi" accurately mapped the outcrop of the Vicksburg Group across central Mississippi. In this work he also noted the fossiliferous beds (Red Bluff Formation) that overlie the clays of the Jackson Group near Red Bluff Station in Wayne County, Mississippi. Hilgard recognized these beds as intervening between the Jackson and Vicksburg groups and stated that the fauna seemed to approach more nearly that of the Vicksburg Group. In his geological map of Mississippi, Hilgard placed Red Bluff Station within the Vicksburg outcrop belt. Several new species from the Red Bluff beds were later described by Meyer (1886, 1887), Aldrich (1903), and Casey (1903).

Divisions within the Vicksburg Group in Mississippi were given by Casey (1903), who, in his description of new species, recognized a Lower and Upper Vicksburg. Cooke (1918) correlated the Vicksburg limestones in Mississippi with the Glendon and Marianna limestones of Alabama and Florida. Cooke also defined and named Casey's Lower and Upper Vicksburg divisions. He named the fossiliferous sand of the Lower Vicksburg the Mint Spring Calcareous Marl Member of the Marianna Limestone and gave its stratigraphic position as being between the Forest Hill Sand (below) and the Glendon Limestone (above). The fossiliferous sand of the Upper Vicksburg was named the Byram Calcareous Marl. Cooke believed the Byram to be in part a facies of the Glendon Limestone and gave its stratigraphic interval as being above the Marianna Limestone and below the Catahoula Sand. Today the Byram is restricted to the fossiliferous sand above the Glendon Limestone.

Blanpied (1934) described a sequence of bentonitic clays and cross-bedded sands in Wayne County, Mississippi, which he named the Bucatunna Member of the Catahoula Group. Today the Bucatunna Formation is recognized as the upper unit of the Vicksburg Group.

STRATIGRAPHY

The Vicksburg Group in Mississippi is considered herein to contain seven formations: (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. These units may be grouped into an initial regressive sequence containing the Red Bluff and Forest Hill formations, a transgressive sequence containing the Mint Spring Formation and Marianna Limestone, and a final regressive sequence containing the Glendon Limestone, Byram Formation, and Bucatunna Formation. A correlation of Vicksburg units is given in Figures 2 and 3. Wells used in these correlations are located near the outcrop belt and show a complete section through the Vicksburg Group. Most wells also include a complete section of the underlying Jackson Group so that comparisons in thickness and facies changes can be made between the Jackson and Vicksburg sediments.

The Red Bluff — Forest Hill Regressive Sequence

The Red Bluff Formation as exposed in Clarke and Wayne counties, Mississippi, consists of fossiliferous, dark gray, silty clay with zones of ironstone concretions in the lower part. These sediments dis-

Figure 4 -- Type locality of the Red Bluff Formation (MGS locality 37) on bluff on the east and southeast 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. Arrow indicates the contact of the Shubuta Clay Member of the Yazoo Formation (upper Eocene) and the Red Bluff Formation (lower Oligocene). The dark basal zone of the Red Bluff Formation is the most fossiliferous horizon at this locality.

Figure 5 — Contact of the Shubuta Clay Member of the Yazoo Formation and the Red Bluff Formation at MGS locality 34 along the west bank of the Chickasawhay River in the E/2, NE/4, NW/4, NW/4, Section 28, T. 10 N., R. 7 W., Wayne County, Mississippi. Quarter indicates the contact.

Figure 6 — Contact of the Shubuta Clay Member of the Yazoo Formation and the Red Bluff Formation at MGS locality 39 on the south bank of the Chickasawhay River southwest of Hiwannee in the NE/4, SE/4, NE/4, SE/4, Section 28, T. 10 N., R. 7 W., Wayne County, Mississippi. Ironstone concretions from the Red Bluff Formation lie in the foreground. Arrow indicates the contact.

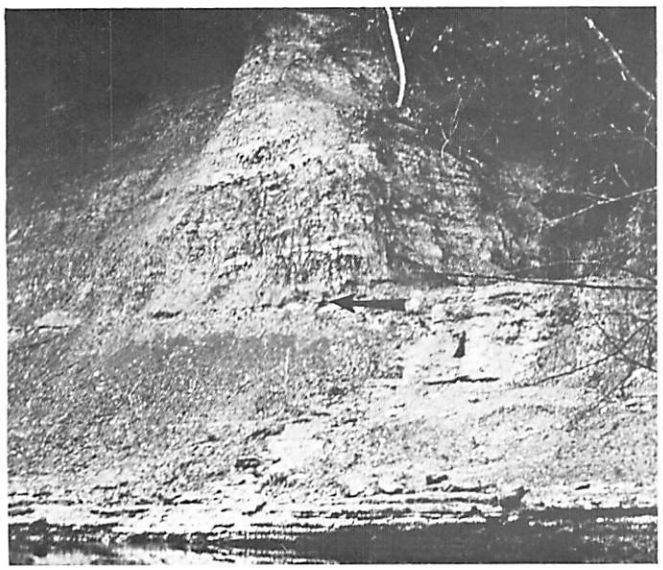


Figure 7 — Contact of the Red Bluff and Forest Hill formations at MGS locality 73 on the west bank of the Chickasawhay River in the NW/4, NW/4, NE/4, SE/4, Section 9, T. 9 N., R. 7 W., Wayne County, Mississippi. Here the marine shelf and prodelta silty clay of the Red Bluff Formation is overlain by the distal delta front bedded silts and sands of the Forest Hill Formation. Arrow indicates the contact.

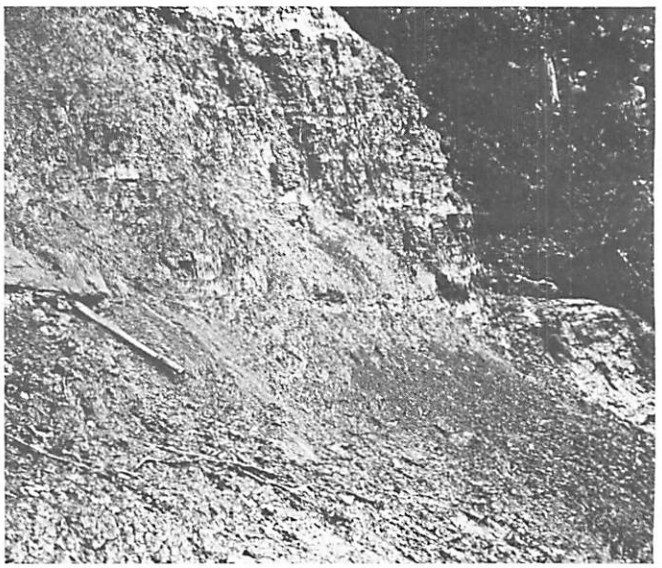


Figure 8 — Sand lens in the base of the Forest Hill Formation at MGS locality 73 as indicated by machete.

conformably overlie the blue-gray, blocky, marine clay of the Shubuta Clay Member of the Yazoo Formation (Figures 5 and 6) and were deposited in shallow marine shelf, prodelta, and marginal delta bay environments. Along the Chickasawhay River in Wayne County, the lower portion of the Red Bluff Formation is very fossiliferous. Well-preserved fossils in this basal zone occur in abundance in narrow, glauconitic, sand lenses within the clay. Dominating the fauna of these lenses are the coral *Balanophyllia*, the scaphopod *Dentalium*, and the bivalve *Astarte*. Otoliths are also common in the lenses. This fauna seems to have been transported and deposited during times of high current energy. At the top of the fossiliferous zone is a bed dominated by the bivalve *Corbula*. Bivalves within this bed commonly have articulated valves and probably represent the population that once lived within these sediments (biocoenosis). Irregular ironstone concretions occur along fossiliferous zones in the lower Red Bluff Formation (Figure 6) and show up on electric logs as one or two "kicks" on the resistivity curve at the base of the formation. These "kicks" are shown in well numbers 25-30 in section D-E of Figure 3.

The Red Bluff Formation grades upward into the deltaic, silty clays and sands of the Forest Hill Formation. As the Forest Hill Formation consists largely of thinly-bedded, silty clays in Clarke and Wayne counties, the Red Bluff — Forest Hill contact is difficult to determine on electric logs. This contact was observed at locality 73 along the Chickasawhay River (Figures 7 and 8) where a small stream had cut through the thinly-bedded, silty clay of the Forest Hill Formation and formed a bench on the more resistant and massive clays of the Red Bluff Formation.

The Red Bluff Formation pinches out to the west as it grades into the basal fluvial and deltaic sediments of the Forest Hill Formation. A core taken from the Forest Hill type locality in central Mississippi (Mississippi Bureau of Geology Core C-549) shows the dark gray, lignitic, basal clay of the Forest Hill Formation to be in sharp contact with the blocky, blue-gray, marine clay of the Yazoo Formation. At this location the top of the Yazoo clay contains benthic and planktonic foraminifers as well as lignitized roots which extend downward from the Forest Hill Formation. The Yazoo — Forest Hill contact has an irregular surface due to channeling of Forest Hill stream systems.

The upper part of the Forest Hill Formation consists of estuarine clays and sands (Figure 15), which locally contain a marine fauna (Figure 9). In Wayne County at localities 75a and 88a, numerous, well-preserved fossils were collected from sand lenses in this interval. Also present in this interval are leaf fossils, which occur along bedding planes in the clay. These estuarine and marine sediments are the initial stage in the marine transgression of the Mint Spring seaway.

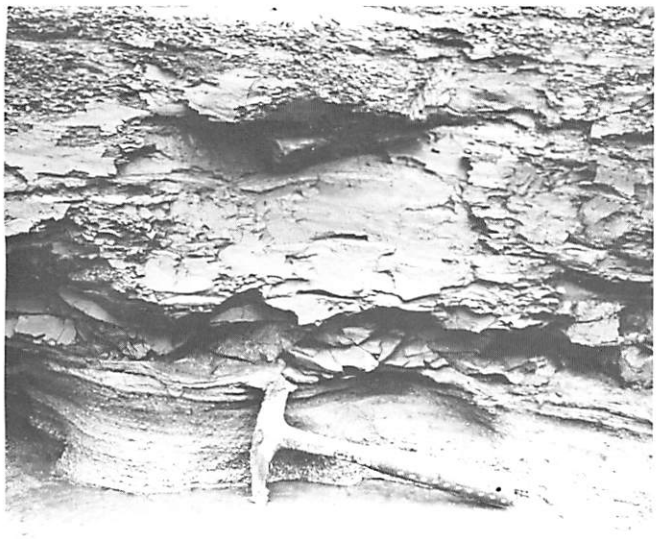


Figure 9 — Fossiliferous sand lens in the upper part of the Forest Hill Formation at MGS locality 107 on the east bank of the Mississippi River at Vicksburg north of the I-20 bridge in Section 32 and the south part of Section 31, T. 16 N., R. 3 E., Warren County, Mississippi. Picture was taken during low river level. Rock hammer indicates position of the fossiliferous sand.

Figure 10 — Shell gravels at the base of the Mint Spring Formation at MGS locality 107. The shells consist largely of *Callista* (*Callista*) *sobrina* (Conrad). A dark gray clay clast is at the upper right of the rock hammer.

Figure 11 — Contact of the Marianna and Glendon limestones at MGS locality 107. Geologist James May is holding a rock hammer against the bottom ledge of the Glendon Limestone. Arrow also indicates the contact.

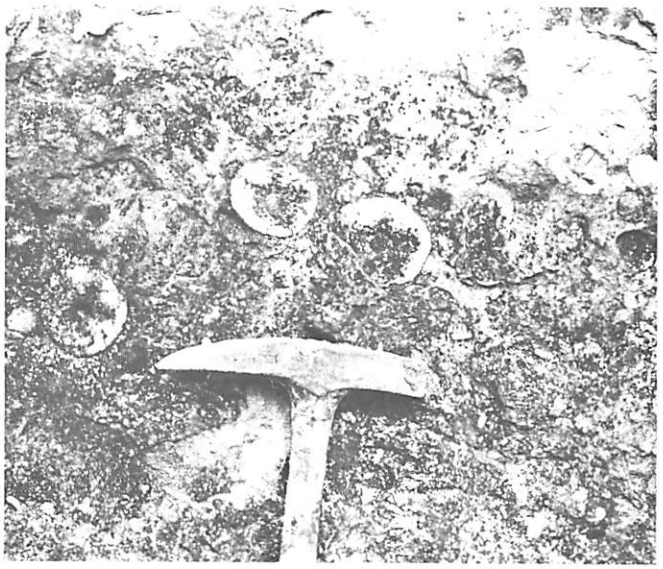


Figure 12 — Echinoids [*Clypeaster rogersi* (Morton)] occurring on the Marianna — Glendon contact surface at locality 107.

Figure 13 — Type locality of the Mint Spring Formation at waterfall on Mint Spring Bayou (MGS locality 108) in the NW/4, SE/4, Section 12, T. 16 N., R. 4 E., Warren County, Mississippi. The lower arrow indicates the Mint Spring — Marianna contact, and the upper arrow indicates the Marianna — Glendon contact.

The initial Lower Oligocene depositional systems in Mississippi include the fluvial and deltaic systems of the Forest Hill Formation and the marine shelf and delta margin systems of the Red Bluff Formation. Forest Hill deltas prograded south and southeastward across western and central Mississippi above the eroded surface of the Jackson Group. Log jams in fluvial channels that fed these deltas formed the Mississippi Petrified Forest at Flora, Mississippi. Fringing the Forest Hill deltas to the south and east were the Red Bluff delta margin and shelf systems. The fine-grained sediments in these environments were derived from prodelta muds of the Forest Hill deltas. The lenticular nature of fossiliferous zones in the Red Bluff Formation is probably due to changes in water turbidity as a result of seasonal variation of deltaic sediment output and of variation in the proximity of the deltas due to abandonment and progradation.

Continued eastward progradation of Forest Hill deltas eventually covered the Red Bluff delta margin and shelf environments with prodelta, delta front, and delta plain sediments. Forest Hill channel sand facies were best developed in western and central Mississippi. Channel sands have a sporadic occurrence in eastern Mississippi as is shown by a comparison of well numbers 24 and 25 on section D-E, Figure 3.

After abandonment of the Forest Hill delta systems, estuarine environments formed above the Forest Hill delta plains. Marine invertebrates were probably carried into these estuaries by storm currents.

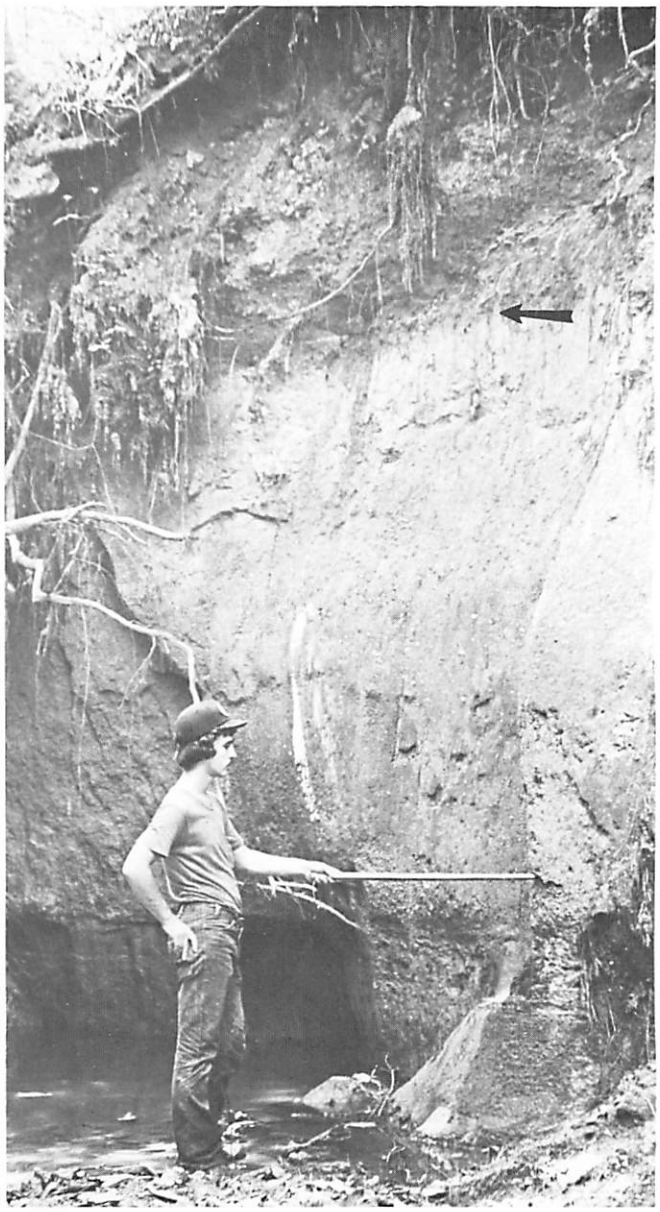


Figure 14 — Forest Hill Formation, Mint Spring Formation, and weathered Marianna Limestone at MGS locality 99 in the SE/4, SE/4, SW/4, NW/4, Section 22, T. 4 N., R. 1 E., Rankin County, Mississippi. Geologist Dave Easom points to the Forest Hill — Mint Spring contact. Arrow indicates the Mint Spring — Marianna contact.

The Mint Spring — Marianna Transgressive Sequence

The Mint Spring Formation consists of fossiliferous sands that lie disconformably above the estuarine clays and sands of the Forest Hill Formation. This contact is characterized by shell gravels that are largely comprised of the bivalve *Callista* (Figure 10), by lithified clay clasts bored by the bivalve *Jouannetia* (Figure 18), and by shark and ray teeth. Lithified clay clasts are especially common at the base of the

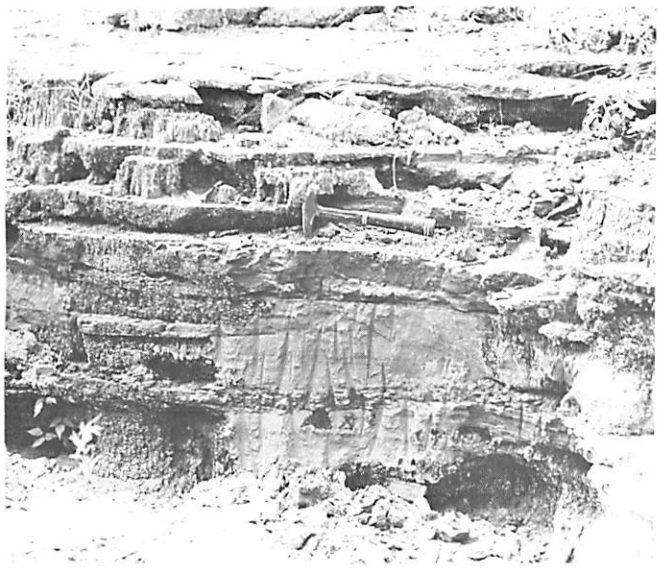


Figure 15 — Sands and clays in the upper Forest Hill Formation at MGS locality 74 on the southwest bank of the Chickasawhay River in the center of the north line of the NW/4, SE/4, Section 22, T. 9 N., R. 7 W., Wayne County, Mississippi.

Figure 16 — Forest Hill Formation, Mint Spring Formation, Marianna Limestone, and terrace sand at MGS locality 74. Machete indicates the Forest Hill — Mint Spring contact. The lower arrow indicates the Mint Spring — Marianna contact at the base of a hard white limestone unit. The upper arrow indicates the Marianna — terrace sand contact.

Figure 17 — Clay clast cobbles in the base of the Mint Spring Formation at locality 74. Cobbles are exposed on an overturned block of limestone.

Figure 18 — Clay clasts in the Mint Spring Formation at locality 74 bored by the bivalve *Jouannetia*.

Figure 19 — Forest Hill Formation, Mint Spring Formation, and Marianna Limestone along Hortons Mill Creek at MGS locality 117 near the Highway 45 bridge in the SW/4, Section 13, T. 9 N., R. 7 W., Wayne County, Mississippi. The lower arrow indicates the Forest Hill — Mint Spring contact, and the upper arrow indicates the Mint Spring — Marianna contact.

Mint Spring Formation along the Chickasawhay River in Wayne County (Figures 16-18). Here clay clasts are numerous enough to have produced a cobble bottom on the Mint Spring sea floor. These clasts formed a hard substrate utilized by a variety of encrusting organisms.

The sands of the Mint Spring Formation are moderately clean and often show cross-bedding. These sands indicate a near-shore shelf environment and have a macrofauna dominated by bivalves. This marine sand facies has well-preserved fossils at the type locality at Mint Spring Bayou (Figure 13), at localities 99-101 in Rankin County (Figure 14), and at localities 89-90 in Smith County. In Wayne County at localities 74b, 75b, and 117b (Figure 19), the Mint Spring Formation is only one to two feet in thickness, is very calcareous, and is slightly indurated.

The Mint Spring Formation grades upward into the more calcareous sediments of the Marianna Limestone. Above the Mint Spring — Marianna contact, aragonitic shells generally have been leached leaving only the molds. The Marianna Limestone is only about two feet thick at Vicksburg, Mississippi, (Figures 11, 13) and thickens eastward to forty-seven feet in Wayne County. In the latter area it is a soft limestone (lime mudstone and wackestone) with hard ledges in the lower part. In central and eastern Mississippi it contains significant beds of calcareous sand.

The Mint Spring — Marianna transgressive sequence began with the subsidence of Forest Hill delta systems. As the northern Gulf waters transgressed inland over the delta plain and estuarine environments, the Mint Spring Formation was deposited as a destructional shelf sand in the near-shore environments. Carbonates of the Marianna Limestone were deposited above this sand in the deeper waters of an offshore carbonate shelf.

The Glendon — Byram — Bucatunna Regressive Sequence

The Glendon Limestone consists of hard, ledge-forming limestones (calcarenites) and some intervening sands and clays, and disconformably overlies the softer Marianna Limestone (Figures 11-12). Some major constituents of the coarse-grained Glendon limestones include the foraminifers *Nummulites* and *Lepidocyclina*. The bivalve *Pecten* is locally abundant. Resistant ledges in the Glendon Limestone produce prominent "kicks" on electric log resistivity curves as shown in Figures 2 and 3.

Conformably overlying the Glendon Limestone are the fossiliferous, clayey sands of the Byram Formation. Fossils present in these sands are well preserved at Vicksburg, along the Big Black River at Edwards (Figures 22-24), and along West Tallahala Creek in Smith County. Although bivalves dominate the Byram macrofauna, gastropods are abundant, especially turrids. The Byram Formation has an unusual calcareous facies at the Marquette Cement Mfg. Co. quarry at Brandon, Mississippi (Figures 25-26). Here the Byram consists largely of calcium carbonate and fossils are poorly preserved.

The Bucatunna Formation consists of thin-bedded, mineral-rich, dark brown clay with some sand units. Clays from the Bucatunna are mined in Smith County for mineral water production and as a mineral additive for cattle feed. The Bucatunna Formation conformably overlies the Byram Formation except in eastern Mississippi where a fluvial sand facies, the Waynesboro Sand Lentil, is present. Locally in Wayne County fluvial channels of the Waynesboro Sand Lentil cut through the Byram Formation and Glendon Limestone into the Marianna Limestone. The Bucatunna Formation is generally nonfossiliferous but locally contains some marine invertebrate fossils.

The Glendon — Byram — Bucatunna regressive sequence began with a shallowing of the Marianna

Figure 20 — Type locality of the Byram Formation (MGS locality 102) along the west bank of the Pearl River below the swinging bridge at Byram in the NW/4, SW/4, NW/4, Section 19, T. 4 N., R. 1 E., Hinds County, Mississippi.

Figure 21 — Limestone unit in the Byram Formation at its type locality (MGS locality 102).

carbonate shelf and deposition of the coarser grained Glendon Limestone in a shallower, higher energy, shelf environment. As the northern Gulf waters regressed, the terrigenous clastic, near-shore, shelf sediments of the Byram Formation were deposited on the Glendon carbonate shelf. With continued regression, the mineral-rich lagoonal clays of the Bucatunna Formation were deposited on the Byram shelf sediments. During the maximum regression of the northern Gulf waters, fluvial systems of the Waynesboro Sand Lentil in Wayne County cut through portions of the earlier Vicksburg marine sequence.

At the close of Vicksburg time, another marine transgression occurred, resulting in deposition of the upper Oligocene Chickasawhay and Paynes Hammock formations. This transgression extended only into eastern Mississippi, with its apparent farthest westward extension along the outcrop belt to include an oyster reef in Smith County (Figures 27-28).

THE VICKSBURG BIVALVE FAUNA

This work records 144 bivalve species in the Vicksburg Group. However, 6 of these are either uncertain as to their identity or were not found in the collection of the Mississippi Bureau of Geology. The check list in Table I indicates the number of valves for each species that were collected from the various Mississippi Geological Survey (MGS) localities. The extensive collections of the U. S. National Museum are not included in this list although several specimens from these collections are figured in the plates. If one hundred or more valves of a species were collected at a locality, it is listed under that locality as A for abundant.

The Vicksburg Group has few species in common with either the Jackson Group below or the Chickasawhay and Paynes Hammock formations above. Yet the formations which comprise this group have numerous species in common with each other. The faunal similarities of the Red Bluff and Forest Hill formations with other Vicksburg units and their dissimilarities from the Jackson fauna are the reason that, in this work, these formations are included in the Vicksburg Group.

The Red Bluff Formation contains 44 bivalve species of which 22 continue into the Byram Formation, 7 extend only into the Mint Spring Formation, 2 extend only into the Forest Hill Formation, and 13 are restricted to the Red Bluff Formation. Collections from the Forest Hill Formation contain 41 bivalve species of which 23 are first occurrences. Of these 23, 11 extend into the Byram Formation, one extends only into the Glendon Limestone, 8 extend only into the Mint Spring Formation, and 3 are restricted to the Forest Hill Formation. Collections from the Mint Spring Formation contain 94 bivalve species of which 51 are first occurrences. Of these 51, 28 extend into

Figure 22 — Byram Formation along the east bank of the Big Black River at MGS locality 106 near Edwards in the NE/4, Section 29, T. 6 N., R. 4 W., Hinds County, Mississippi.

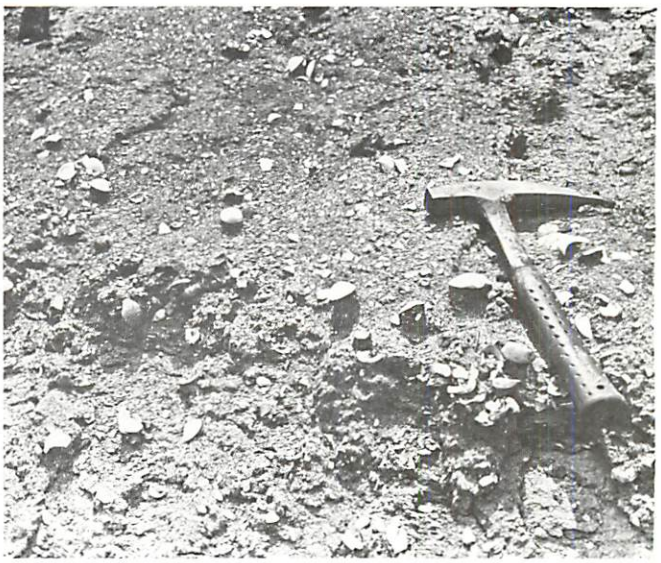


Figure 23 — Fossils weathering from a sand unit in the Byram Formation at MGS locality 106. This sand unit is rich in bivalves.

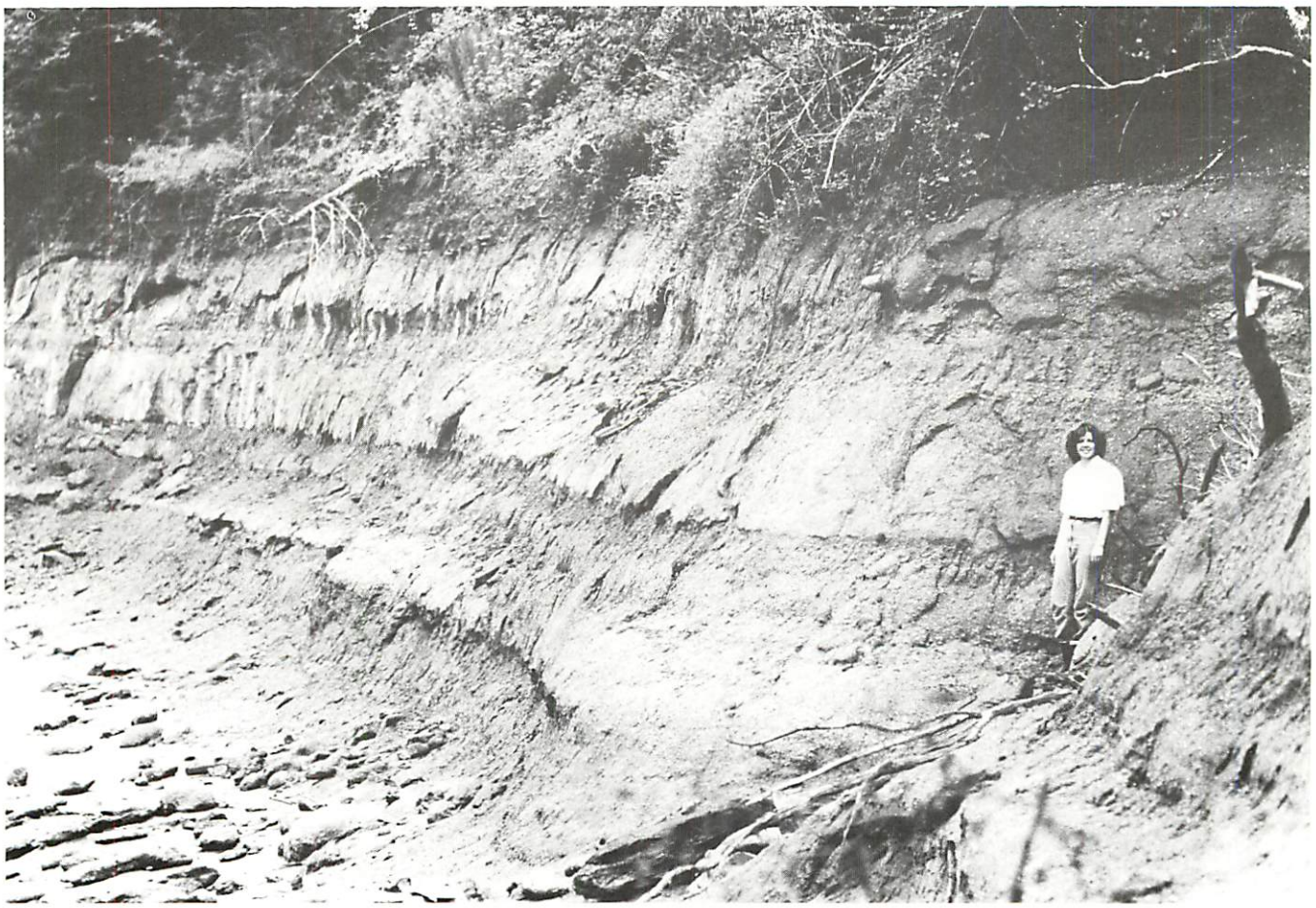


Figure 24 — Byram Formation on the Big Black River near Edwards showing three resistant sand units and softer, intervening, clayey sand units. Mary Dockery is standing on the lower sand unit (illustrated in Figure 23), which is rich in bivalves.

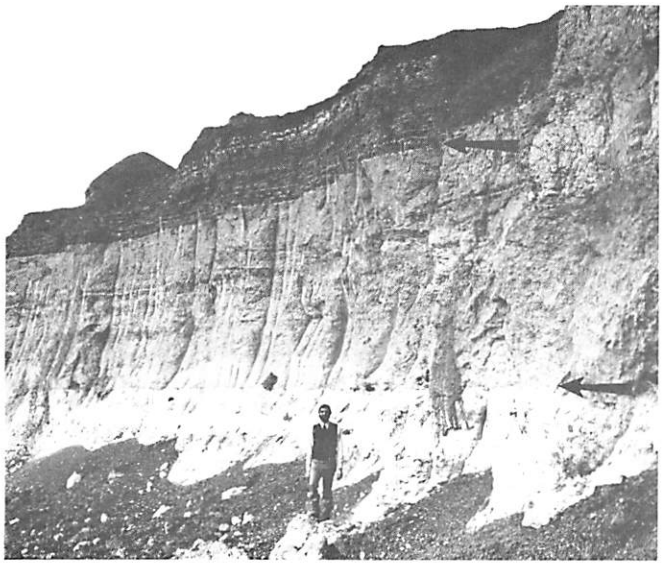


Figure 25 — Glendon Limestone, Byram Formation, and Bucatunna Formation at the Marquette Cement Mfg. Co. quarry near Brandon (MGS locality 98) in the central and northeast part of Section 19, T. 5 N., R. 3 E., Rankin County, Mississippi. Lower arrow indicates the Glendon — Byram contact, and the upper arrow indicates the Byram — Bucatunna contact.

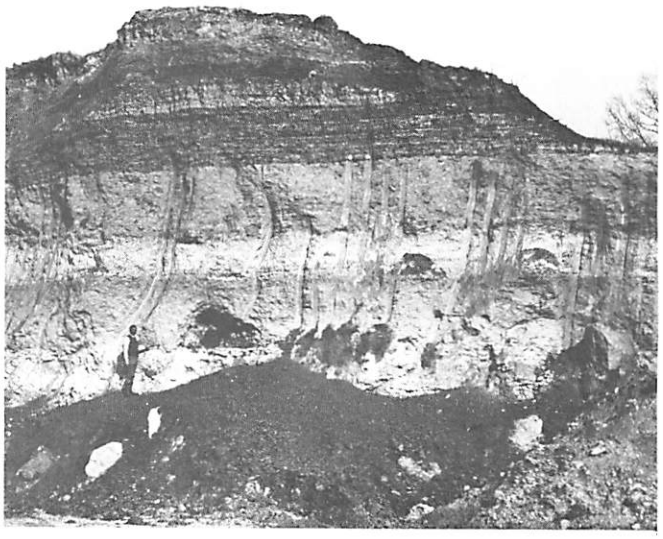


Figure 26 — Cave in the lower Byram Formation at the Marquette Cement Mfg. Co. quarry near Brandon. Cave is to the right of Bureau geologist Michael B. E. Bograd.

the Byram Formation, 3 extend only into the Marianna Limestone, and 20 are restricted to the Mint Spring Formation. Only 5 species were collected from the Marianna Limestone, of which one is restricted to that formation. Collections from the Glendon Limestone contain 7 species of which 3 are first occurrences. Of these 3, one extends into the Byram Formation, and 2 are restricted to the Glendon. Many bivalves observed as molds in the Marianna and Glendon limestones are not included in the numbers given above as no positive determination was made as to their species identity. Collections from the Byram Formation contain 78 species of which 16 are first occurrences.

The bivalve fauna of the Red Bluff Formation is dominated by *Corbula* (*Vokesula*) *rufaripa* n. sp. and *Astarte triangulata* Meyer. Other species that are abundant at various Red Bluff localities include *Yoldia clydoniona* n. sp., *Scapharca* (*Scapharca*) *invidiosa* (Casey), *Dimya rufaripa* H. E. Vokes, *Myrtea* (*Myrtea*) *scopularis* Casey, and *Corbula* (*Caryocorbula*) *engonata* Conrad. All of the previously mentioned genera, with the exception of *Dimya*, have living species that are burrowers common in shallow marine waters. *Dimya* lives above the sediment surface attached to shells or other hard objects and often occurs in deep waters. The low diversity of bivalve species in the Red Bluff Formation is largely a result of muddy bottom conditions, as many bivalves prefer a slightly sandy bottom. The muddy sediments of the shallow Red Bluff marine shelf, prodelta, and delta margin environments favored near-shore, shallow-burrowing species.

Species that are abundant in the Forest Hill Formation include *Scapharca* (*Scapharca*) *delicatula* (Casey) and *Evilia exterolaevis* n. sp. Both of these genera have living species common in near-shore, shallow, marine environments. As the fossiliferous sands of the upper Forest Hill Formation are interbedded with clays bearing carbonized, fossil leaves, it is probable that these sands were transported from a shallow marine shelf into estuarine environments. This would explain the low diversity of the Forest Hill bivalve fauna.

The Mint Spring Formation contains the most diverse bivalve fauna within the Vicksburg Group. Also, the ratio of bivalves to gastropods is the largest seen in the Mississippi Bureau of Geology collections from the Vicksburg formations. Especially noticeable are the abundance and diversity of the Lucinidae, Cardiidae, and Veneridae, all of which commonly prefer a shallow water, sandy environment. The relatively clean sands of the transgressive, Mint Spring, marine, destructional shelf environment were ideal for many bivalve species. The bivalve *Donax funerata* Conrad is abundant at Mint Spring locality 110 and indicates a shoreline environment.

Few species were collected from the Marianna and Glendon limestones. This is largely due to the

	Red Bluff Fm.							Forest Hill Fm.		Mint Spring Fm.												Marianna La.				Glendon La.				Byram Fm.								
	34b	35b	37	38	39	40	46	75a	88a	74b	75b	89a	90	97	99a	100a	101a	107b	108b	110	111	117b	75b	91a	98a	99b	45b	92b	98b	112b	93	94	102	106a	109	112c	113b	114	115	116
Nucula vicksburgensis Conrad	41		6	1		1		23	11			8	16	1	A	A			70	2											43	A	2	3						
Nucula tallahalaensis n. sp.	1								2																						5									
Brevinucula pseudopunctata n. sp.	8					30																																		
Nuculana triangulata (Meyer)																																								
Nuculana akidota n. sp.																															A		3	14	1					
Yoldia clydoniona n. sp.	65		A	12	7	37		2	2																															
Yoldia serica (Conrad)															A	51			4	2												5	1	3	22					
Arca (Arca) subprotracta (Heilprin)								1																																
Barbatia mississippiensis (Conrad)															1	1				1											5			5	4	3		7	8
Barbatia paradiagona n. sp.						5						2		3																									
Barbatia (Cucullaearca) lima (Conrad)																			1	1														6			1	1	9
Scapharca (Scapharca) invidiosa (Casey)	A	2	A	9	3	A	7																																
Scapharca (Scapharca) delicatula (Casey)								A	30			7	11	1	85	73			11	2																			
Scapharca (Scapharca) chordicosta n. sp.															1																2								
Scapharca (Scapharca) sp.			1																																				
Scapharca (Scapharca) lesueuri Dall																															87	A	17	A	A	A	A	7	A	6
Trinacria menthifontis n. sp.			1									2			1				9																				
Limopsis (Limopsis) sp.															1																								
Glycymeris suwannensis Mansfield										1	3	1	18	3	3	3			1			1																	
Glycymeris mississippiensis (Conrad)																																		12						
Glycymeris intercostata (Gabb)	4		5	2	3	14	8			1	14		10																										
Glycymeris arctata (Conrad)												3		4	11	11	1		13	14											1		2		6	1		2	13	
Brachidontes mississippiensis (Conrad)												1																				1			7	10				
Septifer (Septifer) probolus n. sp.	3					7																																	
Crenella fenestra n. sp.								1				3	21		18	4			A												1		6		1				
Arcoperna linteata n. sp.														1	2																								
Atrina argentea (Conrad)												1			2	6															1			10	2				2
Pteria argentea (Conrad)			3	1						1	1	3		1	1	4			2												17		2	1					
Eburneopecten (Eburneopecten) subminutus (Aldrich)	34					73		14	8			19	20		44	28															16	1	1	5					
Chlamys (Aequipecten) cocoana Dall			1	3	2																																		
Chlamys (Aequipecten) redwoodensis n. sp.								64																							7				3				
Chlamys (Anatipopecten) anatipes (Morton)								1					1										1				8												
Chlamys (Lyropecten) duncanensis Mansfield																											22	10											
Chlamys (Lyropecten) menthifontis Glawe													1	5		A	A				1			4															
Pecten (Pecten) perplanus Morton	3		13	15	3	9	14	16																															
Pecten (Pecten) poulsoni Morton										34	28	51		14	A	A			75		15		A	A	A	A													
Pecten (Pecten) byramensis Gardner																											A	A	A	A	A	9	A	A	A	A	1	10	A	A
Pecten sp.																																								
Plicatula variplicata n. sp.	2					1		78																							9									
Spondylus (Spondylus) dumosus (Morton)	9			3	4	10																																	
Spondylus (Spondylus) sp.																								1															
Spondylus (Spondylus) granulocostatus n. sp.																																							
Spondylus (Spondylus) filiaris Dall								1	1	2	2			1								2					1				1								
Dimya rufaripa H. E. Vokes	44	A	4			A																																	
Amonia microstriata n. sp.										1			2	1	2	10																							
Limaria (Limaria) staminea (Conrad)															2	1																		1					
Limaria sp.								1																															
Crassostrea sp.																																							
Ostrea paroxis Lesueur	3		10		7			61		40	32		2	10	20	4															1			36		1		10	A
Ostrea sp.	4		1	1								1	1		4				2											3	6							
Lopha (Lopha) vicksburgensis (Conrad)	2		4	4	1	46		13	3	4	12	1			2	2															84			6		7		3	11
Lucina (Lucina) fimbripallium n. sp.														16		1																		4					
Lucina (Callucina) choctavensis Meyer															35	12			2												2								
Lucina (Parvilucina) posteocurta n. sp.								2					9		A	40			15	3											24		2	A	1				
Lucina sp.															1																								
Lucina (Cavilinga) imbricolamella n. sp.												2	27	1	36	20			45																				
Lucina (Cavilinga) triloba n. sp.												3			2																				1				
Lucina (Lucinisca) varisculpta n. sp.														1	80	13				32											1	A			3				2
Myrtea (Myrtea) scopularis Casey	A		A	5	1	41	2																																
Myrtea (Myrtea) vicksburgensis Casey								A	12			45	54	3	A	A			93	4											1								
Anodontia (Andontia) mississippiensis (Conrad)				1										2	A	A																							
Divaricella (Divalinga) subrigaultiana (Meyer)														2	6	3																							
Diplodonta (Diplodonta) eburnea (Conrad)								1	1			3	8		11	4			12												6			1					
Diplodonta (Diplodonta) elatia n. sp.																			4												2								
Felaniella (Felaniella) compacta n. sp.																					1																		
Timothynus turgida (Conrad)							1		1							2			4												3			1		2			
Chama (Chama) pappiladerma n. sp.	2		5	3	1																																		
Chama sp.								1																															
Chama (Psilopus) mississippiensis Conrad						59		39	3	1	19	6			2				1												29								
Bornia tallahalaensis n. sp.																															1	1		1					
Sportella oblonga (Conrad)												2	4		20	2			18												5			1	1				
Carditella aldrichi (Casey)																			77												1								

Table 1 — Check list of occurrences of bivalve species in the Vicksburg Group in Mississippi. The number of valves in the Mississippi Bureau of Geology collection for each species is given under the respective locality number. If more than 99 valves of a species were collected at a locality, an A for abundant is given below that locality number.

	Red Bluff Fm.							Forest Hill Fm.		Mint Spring Fm.												Marianna Ls.				Glendon Ls.			Byram Fm.								
	34b	35b	37	38	39	40	46	78a	84a	74b	78b	85a	90	97	99a	100a	101b	107b	108b	110	111	117b	73b	81a	94a	99b	43b	92b	96b	112b	93	94	102	106a	108	112c	113b	114	115	116
Venericardia (Rotundicardia) carsonensis Dall	1		13	3	3	8	2	33				2	42	3	4	4			50																				
Astarte triangulata Meyer	A	A	A	43	33	A	2																								2	2	1							
Astarte menthilfontis n. sp.								13				12	42	1	A	66			1														50	6	1	1					
Astarte planilamella n. sp.															11	5			A	1																				
Crassatella (Crassatella) mississippiensis Conrad																															11		6	A	2	5	1	9	70	A
Crassatella (Crassatella) mississippiensis megacosta n. subsp.														1	7	5			1	1																				
Crassatella (Crassatella) linsculpta n. sp.										11	4											1																		
Crassinella variabilis n. sp.								8				4			15	5				12											92	A		A						
Tellidorella interlacinia n. sp.												7																												
Agnocardia gleboeum (Conrad)	1			3	3	2	1		1			5	1		4	3															1		1							
Trachycardium eversum (Conrad)								4	1			2	2							1											11									
Trachycardium planicostata n. sp.														4	11	21			8																				
Trigoniocardia (Americardia) silvacottina n. sp.								37				3	1																										
Nemocardium (Nemocardium) eocenense (Meyer)	1		6	29	13	12	3																																
Nemocardium (Nemocardium) diversum (Conrad)									2			2	3		A	A			10												41		2	18	8	5			60	
Laevicardium leptorimum n. sp.													6	2	20	2			1																				
Dinocardium vicksburgense (Conrad)																															38	2		13					1	
Spisula inaequilateralis (Meyer)								56	1					1	70	25			9	40																				
Spisula funerata (Conrad)																															1	2		4						
Spisula sp.																																				2				
Spisula (Mactromeris) mississippiensis (Conrad)															1	4			1										10		6									
Ervilia exterolaevis n. sp.								A	18			4	1		50	17			25	6																				
Ervilia lamellocostaria n. sp.																															A	13	1	A	2					
Tellina limites (Conrad)	1		2					1	1			3	1																		3		2							
Tellina subprotexta n. sp.								11	2			15	57	1	A	A			75	1	1																			
Tellina vicksburgensis Conrad															1																84	2	10	63		1				1
Tellina serica Conrad																															5									
Tellina perovata Conrad																																								
Donax funerata Conrad								11				2		1	1	1			3	A																				
Donax sp.?																																								
Gari (Gari) papyria (Conrad)															4	1															5									
Gari mississippiensis (Conrad)																																								
Semele mississippiensis (Conrad)														1	1				4												36		1							
Semele staminea (Conrad)												3			3	5																		2							
Abra pectorosa (Conrad)			3	5	1	3																									13									
Semelina pilabryi (Casey)								3				1	2		58	80			A														1		1	2	3				
Solecurtus vicksburgensis Aldrich												1																			3									
Kellielia rufaripa n. sp.	24		6									3	3																											
Corallophaga (Corallophage) corrugata n. sp.														2																										
Ventricolaria ucultana (Dall)	2		8	5	4																										2		1							
Pitar (Hyphantosoma) semipunctata (Conrad)																															A			3		1				
Pitar (Lamelliconcha) imitabilis (Conrad)																															10	2	5	37		3		2	19	
Pitar (Lamelliconcha) protena n. sp.														1		1			13	16														2						
Pitar (Lamelliconcha) megacostata n. sp.								10	1			2			1	2																								
Pitar (Lamelliconcha) calcanea (Dall)												4	7	3		1			33																				
Pitar (Lamelliconcha) silicifluvia (Dall)																																								
Pitar (Lamelliconcha) astartiformis (Conrad)																2																						1	4	
Pitar (Lamelliconcha) perbrevis (Conrad)																																		6						
Pitar aldrichi n. sp.			18	20	5	1	15	20	11			9	10		4	6																								
Callista (Callista) sobrina (Conrad)				1				2	1		4	4		15	A	A			42	A	5											10		A	43	A		3	A	
Callista (Callista) goniaplethus n. sp.												2			15	6																								
Chione (Chione) crespedonta Dall								8		1	3				1	1			8	1																				
Chione (Chione) perbrevisformis n. sp.																																		2		1				14
Chione (Chione) bainbridgensis Dall																															8			7						1
Chione (Lirophora) victoria Dall		1										4	3	1	7	3			21	4																				
Chamelea mississippiensis (Conrad)																															4	20	2	8	4					11
Corbula (Caryocorbula) engonata Conrad	4		A	3	1	24	1		5			25	12		A	78			13	18											68	A	7	24	A	1				2
Corbula (Varicorbula) lequesta Casey												11	63	1	A	A			35	12											50	14	34	A						
Corbula (Vokesula) rufaripa n. sp.	A		A	A	A	A	A	99	8						10																									
Tiza alta (Conrad)												1		3	7	13	7		24	A															3					
Tiza sp.				1																																				
Sphenopsis mississippiensis (Meyer)	47		3									1	13																					1						
Panopea (Panopea) oblongata Conrad													1		8				1												2		1	4	2			2	2	
Jouannetia (Pholadopsea) triquetra (Conrad)	1				1					A	A					1						A									1									
Teredo sp.															3									2																
Pholadomya sp.																											4													
Periploma macneili n. sp.															1																	4								
Thracia (Thracia) vicksburgiana (Dall)												1		2																										
Cuspidaria (Tropidomya?) sp.																															1									
Plectodon intastrata (Conrad)	4											1	5		3	2																								
Verticordia (Verticordia) delliana Aldrich	60		36			4		9				13	29		18	4			9												2	1	1	4	1					
Haliris (Haliris) quadrangularis (Aldrich)	24		5			7																																		

Figure 27 — Oyster "reef" (possibly equivalent to the Paynes Hammock Formation) containing the large oyster *Crassostrea blanpiedi* in stream bed (MGS locality 96) in the NE/4, NW/4, NE/4, NW/4, Section 4, T. 1 N., R. 9 E., Smith County, Mississippi. Picture is by Edwin E. Luper.

Figure 28 — Oyster "reef" in Smith County stream bed (MGS locality 96).

dissolution of aragonitic shells from the carbonate matrix. The calcitic pectens and oysters, which are preserved in these limestones, indicate a moderate to shallow water depth.

The Byram Formation is second to the Mint Spring Formation in the diversity of bivalve species. Locally within this formation the bivalve fauna is dominated by a few opportunistic species. At locality 122c north of Vicksburg a zone within the formation contains an abundance of *Scapharca* (*Scapharca*) *lesueuri* Dall with few other species occurring. Fluctuating environments on the regressive Byram marine shelf produced near-shore, possibly brackish water, conditions in which this arcid species flourished. At locality 106 (Figures 22-24) *Callista* (*Callista*) *sobrina* (Conrad) and *Crassatella* (*Crassatella*) *mississippiensis* Conrad were abundant in sandy layers of the Byram Formation. These species are characteristic of a near-shore, marine shelf environment. The greatest bivalve species diversity within the Byram Formation is at locality 93 in Smith County. This large diversity indicates a more offshore shelf environment.

Species from the Bucatunna Formation were not included in the check list in Table I, as the formation is sparsely fossiliferous and specimens are not well preserved. The Bucatunna generally consists of dark lagoonal clays that lack marine fossils. *Pecten* (*Pecten*) *byramensis* Gardner does occur in lenses within the Bucatunna Formation at locality 98d.

SYSTEMATICS

Class BIVALVIA
Subclass PALAEOTAXODONTA Korobkov, 1954
Order NUCULOIDA Dall, 1889
Superfamily NUCULACEA Gray, 1824
Family NUCULIDAE Gray, 1824
Genus NUCULA Lamarck, 1799

Nucula vicksburgensis Conrad

Plate 1, figures 1-5; Text Figures 29, 1-2

1848a. *Nucula Vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.
1848b. *Nucula vicksburgensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 26.
1865. *Nucula Vicksburgensis* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 13 (Catalog).
1866. *Nucula vicksburgensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1885. *Nucula Vicksburgensis* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, p. 467 (List).
1921. *Nucula vicksburgensis* Conrad. Cooke, U.S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in the Byram Marl, Mint Spring Marl, and Red Bluff Clay).
1962. *Nucula Vicksburgensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 108 (Possible holotype 30674).
1968. *Nucula vicksburgensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 94 (30645 - Type).

Original Description: Conrad, 1848a.

"Obliquely subtriangular, convex, with minute obsolete radiating lines about the base; lunule elliptical, very large and impressed. Length 1/3. Rare."

Discussion: Contrary to Conrad's description *Nucula vicksburgensis* is common at most localities in the Vicksburg Group which contain a marine fauna. However it is a small species that might be missed while surface collecting. Conrad's type with a length of 6.7 mm is the largest specimen encountered so far. This species is similar to *Nucula chipolana* of the Alum Bluff Group in Florida but is less elevated and larger in size.

Type: Holotype 30674 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 1, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 40; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90a, 99a, 100a, 108b, 110; Byram Formation, localities 93, 94, 102, 106a.

Nucula tallahalaensis n. sp.

Plate 1, figures 6-8; Plate 57, figure 1

Description: Shell ovate; rounded anteriorly and sharply rounded posteriorly with the escutcheon clearly differentiated and set off by a sulcus that produces an angular posterior margin; ventral margin broadly rounded with the greatest elevation anterior to the beak; interior margin crenulate; anterior hinge slightly convex dorsally; posterior hinge straight; umbonal angle 115° to 118°; exterior covered with concentric laminations except for the umbonal region which is generally smooth except for faint radial striae.

Discussion: The umbonal angles were measured at the intersection of lines passing through the top of the resilifer and the distal hinge teeth. This species is similar to *Nucula vicksburgensis* except for the strong concentric laminations. The name is taken from the locality of the type.

Type: Holotype 340419 USNM from the Byram Formation, locality 93 (Plate 1, figure 7).

Occurrence: Mississippi: Red Bluff Formation, locality 34b; Byram Formation, localities 93, 102.

Genus BREVINUCULA Thiele, 1934

Brevinucula pseudopunctata n. sp.

Plate 1, figures 9-12; Text Figures 29, 3-4

Description: Shell triangular, elevated; beak opisthogyrate; anterior and posterior margins sharply rounded, ventral margin broadly rounded; no well defined lunule or escutcheon; interior margin crenulate; anterior hinge convex dorsally and more strongly so toward the beak, posterior hinge slightly convex dorsally; umbonal angle 91° to 95°; exterior smooth except for faint growth lines, radial and concentric structures give a pitted texture on weathered surfaces.

Discussion: This species is similar to the type species *Brevinucula guineensis* (Thiele) from the Recent of West Africa in its elevated beak and triangular form but differs in being less elevated and in having a less convex ventral margin. The name refers to the pitted appearance of the exterior in weathered specimens.

Type: Holotype 340420 USNM from the Red Bluff Formation, locality 40 (Plate 1, figure 10).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 40.

Superfamily NUCULANACEA
H. Adams and A. Adams, 1858

Family NUCULANIDAE
H. Adams and A. Adams, 1858

Genus NUCULANA Link, 1807

Nuculana triangulata (Meyer)

Plate 2, figure 17

1886. *Leda triangulata* Meyer, Geol. Survey Alabama, Bull. No. 1, p. 80, pl. 3, fig. 14.

Original Description: Meyer, 1886.

"Triangular; ventral margin rounded; near equilateral; ventricose; hinge-plate long and broad; surface nearly smooth, with indistinct concentric lines; margin entire. Locality.-Red Bluff, Miss. I found only the figured specimen."

Discussion: This species is known only from the two syntypes. Syntype A is missing part of the anterior hinge, and syntype B is missing the complete hinge.

Type: Two syntypes (A and B) 644597 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Syntype A; Plate 2, figure 17).

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

Nuculana akidota n. sp.

Plate 1, figures 13-15; Plate 2, figure 1

1829. Lesueur, Walnut Hills fossil shells, pl. 12, fig. 1 (no name).

Description: Shell strongly inflated, especially at the umbo; posterior constricted, pointed, and turned slightly upward; width of hinge teeth broad in the central region of the anterior and posterior hinge and tapered toward the proximal and distal ends; anterior hinge slightly convex dorsally, posterior hinge slightly concave dorsally; pallial sinus moderately large, rounded; escutcheon distinct; escutcheon ridge somewhat polished; exterior with thin, closely spaced, concentric lamellae that fade over the escutcheon ridge and reappear on the escutcheon.

Discussion: This species differs from *Yoldia sevica* in its constricted and pointed posterior margin, in its greater inflation, in its finer concentric lamellae, and in its broader escutcheon. It is similar to *Nuculana proteracuta* Gardner from the Alum Bluff Group in Florida but is larger in size. The name refers to the pointed posterior margin.

Type: Holotype 340421 USNM from the Byram Formation, locality 93 (Plate 2, figure 1).

Occurrence: Mississippi: Byram Formation, localities 93, 102, 106a, 109.

Genus YOLDIA Moller, 1842

Yoldia clydoniona n. sp.

Plate 2, figures 10, 12-16; Text Figure 30, 1

Description: Shell modestly inflated; anterior and posterior margins broadly rounded in the adult and even more so in the young; hinge long and narrow; exterior polished and with fine, concentric lamellae that become less prominent over the posterior slope; surface often with broad, radial undulations, especially on the posterior and anterior slopes; escutcheon very narrow and bordered by a groove.

Discussion: This species differs from *Yoldia serica* in its narrow escutcheon and more broadly rounded posterior margin. The name refers to the broad radial undulations that produce a wavy appearance on the anterior and posterior slopes.

Type: Holotype 340422 USNM from the Red Bluff Formation, locality 38b (Plate 2, figure 12).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38b, 39b, 40; Forest Hill Formation, localities 75a, 88a.

Yoldia serica (Conrad)

Plate 2, figures 2-9, 11

1829. Lesueur, Walnut Hills fossil shells, pl. 12, fig. 2, 3, 4 (no name).
1848a. *Nucula serica* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.
1848b. *Nucula serica* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 29.
1854. *Leda serica* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, No. 2, p. 29 (List).
1865. *Nuculana serica* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 13 (Catalog).
1866. *Nucula serica* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1921. *Yoldia serica* (Conrad). Cooke, U.S. Geol. Survey Prof. Paper 129, p. 84 (Check list).
1962. *Nucula serica* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 95 (5 possible syntypes 30675).

Original Description: Conrad, 1848a.

"Subelliptical, with minute regular concentric closely-arranged lines; anterior end acutely angular; posterior end acutely rounded; posterior side shortest. Length 1/2. Common."

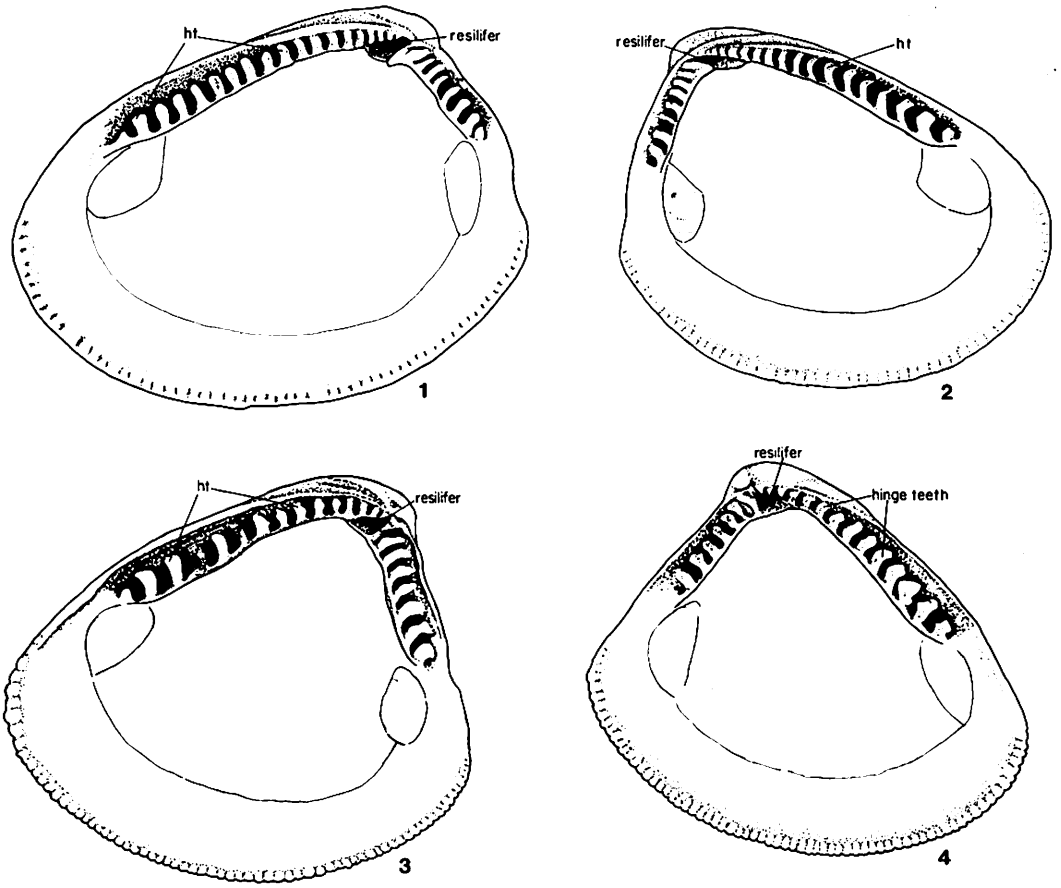


Figure 29 — 1- right valve, 2- left valve, *Nucula vicksburgensis* (Conrad); 3- right valve, 4- left valve, *Brevinucula pseudopunctata* n. sp. ht = hinge teeth. Illustrations by Randall Bissell.

Discussion: This species has a polished exterior with low, broad concentric lamellae and is similar to *Yoldia frater* Dall from the Alum Bluff Group in Florida. The posterior margin is more sharply rounded than that of *Yoldia clydoniona* and the escutcheon is broader and is bordered by a narrow groove. The larger specimens have been collected from the Mint Spring Formation where the species is most common.

Type: Five syntypes (A through E) 30675 ANSP from the Vicksburg Group, Mississippi (Syntypes A, B, D, E; Plate 2, figures 2, 5, 6, 3).

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 100a, 108b, 110; Byram Formation, localities 102, 106a, 109.

Subclass PTERIOMORPHIA Beurlen, 1944
Order ARCOIDA Stoliczka, 1871
Superfamily ARCACEA Lamarck, 1809
Family ARCIDAE Lamarck, 1809
Subfamily ARCINAE Lamarck, 1809
Genus ARCA Linné, 1758
Subgenus ARCA Linné, 1758

Arca (Arca) subprotracta Heilprin

Plate 3, figure 1; Text Figure 30, 8

1848a. *Byssoarca protracta* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.

1848b. *Byssoarca protracta* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 126, pl. 13, fig. 36.

1854. *Navicula protracta* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, No. 2, p. 29 (List).

1865. *Arca protracta* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 11 (Catalog).

1882. *Arca subprotracta* Heilprin, Acad. Nat. Sci., Proc. 1881, v. 33, p. 449 (New name for *Arca protracta* (Conrad); specific name preoccupied by Rogers, 1837, Amer. Philos. Soc., Trans., new ser., v. 5, p. 332).

1916. *Arca subprotracta* Heilprin. Dall, U. S. Natl. Mus., Proc., v. 51, No. 2162, p. 490 (Present in the Oligocene beds along the Flint River, Georgia).

1923. *Arca subprotracta* Heilprin. Cooke, U. S. Geol. Survey Prof. Paper 133, p. 5, 8 (Listed from the Oligocene cherts of Brainbridge, Georgia).

1962. *Byssoarca protracta* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 91 (Probable holotype 30649).
1968. *Byssoarca protracta* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 78 (Holotype 30649).

Original Description: Conrad, 1848a.

"Trapezoidal, elongated, with numerous radiating lines, some of which are double, and others alternated in size and finely crenulated; dorsal margin, parallel with the base; anterior margin truncated, posterior a little concave, oblique, end very acutely rounded or subangular; basal margin slightly contracted; hinge line long, rectlinear, very regular and gradually increasing in width towards the extremities from the apex; cardinal area wide, depressed concave, with a few fine impressed angular lines. Length 1 1/3. Height 1/2 nearly.

"A pretty species of which I found one valve only."

Discussion: Only one additional specimen of this species was collected in this work. It is an incomplete left valve from the Forest Hill Formation.

Type: Holotype 30649 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 3, figure 1).

Occurrence: Mississippi: Vicksburg Group, Vicksburg; Forest Hill Formation, locality 75a. Georgia: Flint River Formation, Bainbridge.

Genus BARBATIA Gray, 1842

Barbatia mississippiensis (Conrad)

Plate 3, figures 2-3, 5-6; Text Figure 30,4

1829. *Arca fragilis* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 9 (unpublished manuscript).
1848a. *Byssoarca Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 295.
1848b. *Byssoarca mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, 2nd ser., v. 1, pt. 2, p. 125-126, pl. 13, fig. 32.
1854. *Navicula mississippiensis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, No. 2, p. 29 (List).
1860. *Cibota Mississippiensis* (Conrad). Gabb, Acad. Nat. Sci., Jour., 2nd ser., v. 4, pt. 4, p. 387, pl. 67, fig. 58.
1865. *Cucullaearca Mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 11 (Catalog).
1866. *Cucullarca* (sic) *mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1882. *?Arca lima* (Conrad). Heilprin, Acad. Nat. Sci., Proc. 1881, v. 33, p. 448 (Listed in the Jacksonian of Texas: *Arca* (*Byssoarca*) *Mississippiensis* Conrad listed in synonymy).
1885. *Arca* (*Byssoarca*) *Mississippiensis* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, p. 467 (List).
1898. *Arca* (*Barbatia*) *mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 615, 625, 626.
1921. *Barbatia mississippiensis* (Conrad). Cooke, U.S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in the Byram Marl and Mint Spring Marl).
1962. *Byssoarca Mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 75 (2 probable syntypes 30648).
1968. *Byssoarca mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Holotype and paratypes 30648).

Original Description: Conrad, 1848a.

"Trapezoidal, with numerous closely-arranged radiating lines, crenulated by fine concentric lines, the crenulation most distinct anteriorly, when the radii are largest; anterior end truncated or a little convex, direct; posterior margin obliquely truncated above; basal margin widely and profoundly arched; hinge line long, linear, minutely crenulated, expanded towards the extremities, and with prominent teeth; cardinal area with fine very closely-arranged lines, angulated under the apex. Length 16-10.

"Differs from the preceding in having a longer hinge, finer radii, & c., and is a much smaller species and more abundant."

Discussion: This species has a narrow cardinal area with fine, closely spaced ligament grooves and has small hinge teeth. The exterior is covered with fine radial ribs.

Type: Holotype and paratype 30648 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 3, figures 2, 3).

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 100a, 110; Byram Formation, localities 93, 106a, 109, 112c, 115, 116.

Barbatia paradiagona n. sp.

Plate 3, figure 4; Plate 4, figures 3-4

Description: Shell strongly inflated; hinge and ventral margin straight and nearly parallel, anterior and posterior margins sloping posteriorly away from hinge and nearly parallel; beak prosogyrate; cardinal area small; hinge teeth small and numerous; exterior nodose at intersections of radial ribs and growth lines; radial ribs stronger on the posterior shoulder.

Discussion: This species can be distinguished from *Barbatia mississippiensis* in its greater inflation, smaller cardinal area, and nodose exterior. The name refers to the shell's outline which resembles a parallelogram.

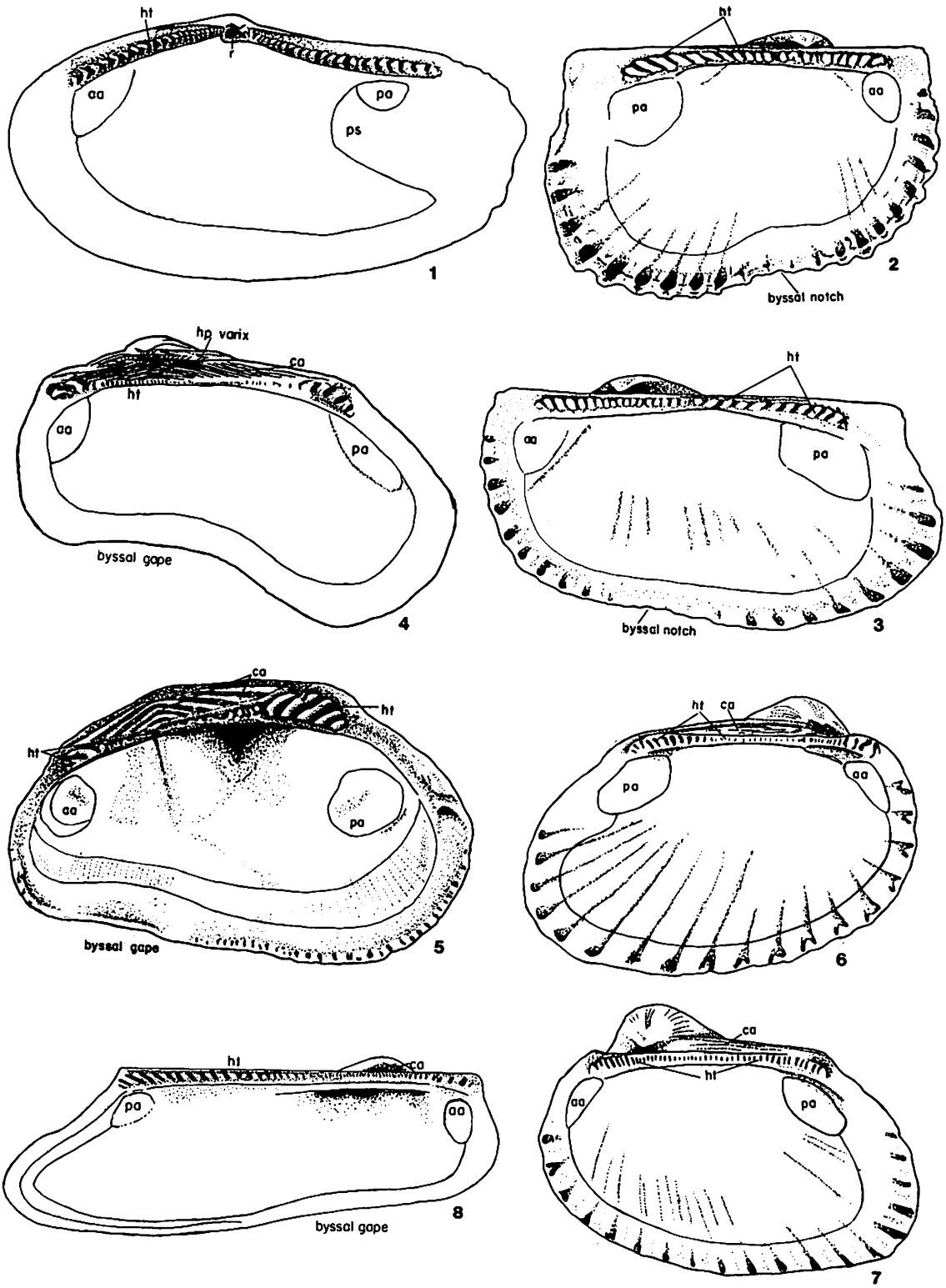


Figure 30 — 1- right valve, *Yoldia clydoniona* n. sp.; 2- left valve, 3- right valve, *Scapharca* (*Scapharca*] *invidiosa* (Casey); 4- right valve (holotype), *Barbatia mississippiensis* (Conrad); 5- right valve, *Barbatia* (*Cucullaearca*) *lima* (Conrad); 6- left valve, 7- right valve, *Scapharca* (*Scapharca*) *lesueuri* Dall; 8- left valve (holotype), *Arca* (*Arca*) *subprotracta* Heilprin. ht = hinge teeth, r = resilifer, hp = hinge plate, ca = cardinal area, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

Type: Holotype 340424 USNM from the Mint Spring Formation, locality 99a (Plate 3, figure 4).

Occurrence: Mississippi: Red Bluff Formation, locality 40; Mint Spring Formation, localities 89a, 99a.

Subgenus CUCULLAEARCA Conrad, 1865

Barbatia (Cucullaearca) lima (Conrad)

Plate 3, figure 7; Plate 4, figures 1-2;
Text Figure 30, 4

1848a. *Byssoarca lima* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 295.

1848b. *Byssoarca lima* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 23.

1854. *Navicula lima* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, No. 2, p. 29 (List).

1865. *Cucullaearca lima* (Conrad). Conrad, Amer. Jour. Conch., v. 1, p. 11 (Catalog).

1882. *Arca lima* (Conrad). Heilprin, Acad. Nat. Sci., Proc. 1881, v. 33, p. 449: ?*Arca lima* (Conrad), p. 448 (Listed in the Jackson of Texas).

1898. *Barbatia (Calloarca) cuculloides* (Conrad) Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 624-626 (*Byssoarca lima* Conrad is listed in synonymy).

1916. *Barbatia (Calloarca) cuculloides* (Conrad). Dall, U. S. Natl. Mus., Proc., v. 51, No. 2162, p. 490 (Present in the Oligocene beds along the Flint River, Georgia: *Byssoarca lima* listed in synonymy).

1962. *Byssoarca lima* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 70 (2 probable syntypes).

1968. *Byssoarca lima* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 61 (Holotype and paratype 30642).

Original Description: Conrad, 1848a.

"Trapezoidal, cancellated and granulated; radii largest on anterior and posterior slopes, but becoming obsolete towards the posterior extremity; end angular, margin above obliquely truncated; anterior end widely truncated, nearly direct; basal margin undulated, irregular and very variable in outline; hinge line crenulated under the beaks, profoundly toothed towards the extremities; cardinal area with lines strongly defined and angulated under the apex. Length 20-10. Rare."

Discussion: This species is similar to *Barbatia (Cucullaearca) cuculloides* (Conrad) of the Jackson Group but differs in its shorter hinge, broader cardinal area, finer radial ribs, and more strongly cancellate exterior. It differs from *Barbatia mississippiensis* by its larger cardinal area with more broadly spaced ligament grooves, its larger anterior and posterior hinge teeth, and its coarser radial ribs. The cardinal area in *B. (C.) lima* is inclined slightly from the plane of commissure while in *B. mississippiensis* it is generally inclined at an angle greater than 45°.

Type: Holotype and paratype 30642 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 3, figure 7, Plate 4, figure 1).

Occurrence: Mississippi: Byram Formation, localities 106a, 114, 115, 116.

Family ANADARINAE Reinhart, 1934

Genus SCAPHARCA Gray, 1847

Subgenus SCAPHARCA Gray, 1847

Scapharca (Scapharca) invidiosa (Casey)

Plate 4, figures 6-7, 10;
Plate 5, figures 1-2;
Plate 57, figure 2; Text Figures 30, 2-3

1903. *Arca invidiosa* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 264-265 (No illustration).

1938. *Anadara (Scapharca) invidiosa* (Casey). Schenck and Reinhart, Memoires Musée Royal d'History Naturelle Belgique, deuxième séries, fasc. 14, p. 58-62 (in part).

1968. *Arca invidiosa* Casey. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 58 (Type 990).

Original Description: Casey, 1903.

"From the Red Bluff formation of Mississippi I have before me specimens of a small *Arca*, probably allied somewhat to the Claibornian *rhomboidella* of Lea. It is subrhomboidal, very inequilateral, moderately inflated, broadly rounded ventrally, the anterior and posterior sides oblique, the former rounded, the latter longer and nearly straight. The beaks are rather broad, moderately elevated above the hinge-line, bisected by a feeble depression which becomes obsolete ventrally.

"The hinge-line is straight externally, broadly feebly arcuate internally, the line of teeth more than three-fourths as long as the shell, the lateral teeth becoming longer and strongly oblique. The space between the beaks and hinge-line is flattened, nearly smooth except some fine, close-set parallel lines of growth, but at the posterior end there are some coarser parallel and feebly oblique lines. The radial ribs are 28 to 31 in number, rather coarse and separated by much less than their own widths, except in the feebly depressed area radiating from the middle of the beaks where they become finer and relatively much more widely separated, and generally with one fine intermediate rib between them in this region toward the ventral margin only; the ribs also become smaller but very close-set posteriorly in the flattened area toward the hinge-line. The surface posteriorly at an angle of about 30 degrees with the hinge-line is convex, becoming rapidly declivous and explanate to the latter. The muscular scars are rather deep. Lines of growth produce feeble transverse and rather widely separated nodules on the ribs generally becoming obsolete posteriorly. The length of a moderately large individual of this species is 11.5 mm., the height 6 mm."

Description of Schenck and Reinhart, 1938, p. 59.

"DESCRIPTION OF TOPOTYPES OF INVIDIOSA. — The

following notes are based upon two detached, well-preserved valves, one left, one right (not from same individual), Cat. N° 2633, U. S. Nat. Mus. These shells are from Carson's Creek, Wayne C°, Mississippi, Red Bluff formation.

"Shell elongate, with rather prominent medial sulcus extending from beak to anterior third of ventral margin; ribs 28 in number; on *left valve*: the six ribs within medial sulcus area fairly thin; the five ribs just anterior to and the two ribs just posterior to this sulcus dichotomize, the dichotomizing apparently having started when shell was 2/3 its present size; anterior and posterior ribs plain and rounded, much wider than interspaces; ribs within sulcus area only ca. 1/3 as wide as interspaces; on *right valve*: about 6 ribs within sulcus area, with interspaces; on right valve: about 6 ribs within sulcus area, with interspaces 3 to 4 times as wide as ribs; just anterior to sulcus, 4 ribs are dichotomous, the dichotomizing starting when shell was *ca.* 3/4 its present size; posterior to sulcus, ribs do not dichotomize, are wider than interspaces, rounded and plain; on left valve, a distinct trace of beading, which is not present on right; teeth of right valve numerous, small, granular; anterior 9 teeth larger than granular medial ones; slightly converging; the posterior 9 or 10 teeth likewise larger than medial ones, and converging ventrally; ligamental area narrow, nearly flat; numerous wavy ligamental grooves, especially on larger left valve; beaks slightly prosogyrate; pallial line and muscle scars indistinct; interior of shell furrowed in harmony with external ribbing; inner margin of shell crenulated; apparently no byssal gape."

Discussion: Casey's type for *Scapharca (Scapharca) invidiosa* is unusually large for the species and is incomplete. As this species is common in the Red Bluff Formation, he may have chosen the type specimen to emphasize his differentiation of the species from *S. (S.) delicatula* of the Mint Spring Formation due to its larger size.

The genus *Scapharca* contains species of Anadarinae having discordant valves with the left valve being larger and overlapping the margin of the right valve. This is seen in the articulated specimen of *S. (S.) invidiosa* illustrated in Plate 4, figure 6C.

Type: Holotype 990 ANSP from the Red Bluff Formation, Red Bluff, Mississippi (Plate 57, figure 2).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 35b, 37, 38, 39, 40, 46.

Scapharca (Scapharca) delicatula (Casey)

Plate 5, figures 3-7; Plate 57, figures 3-7, 9

1903. *Arca delicatula* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 265 (No illustration).

1938. *Anadara (Scapharca) invidiosa* (Casey). Schenck and Reinhart, Memoires Musée Royal d'History Naturelle Belgique, deuxième séries, fasc. 14, p. 60-62, pl. 1, figure 2.

1968. *Arca delicatula* Casey. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 44 (Types 997).

Original Description: Casey, 1903.

"Occurs in the Lower Vicksburg limestone in great abundance. It may be regarded as a homologue of *invidiosa* and is doubtless one of the smallest known members of the family. It is elongate, very inequilateral, obliquely parallogramic, moderately inflated, becoming flattened posteriorly toward the hinge-line, the latter long, thin and straight, the teeth small. The space between the hinge-line and the beaks rather low, flat and smooth or nearly so, narrowing very gradually posteriorly. The umbonal impression, with its diminished ribs, is nearly as in *invidiosa* and many other species. The ribs are some 28 in number, relatively moderately coarse, being generally separated by nearly their own widths, flattened. Length of a moderately large valve 6 mm., height 2.6-2.8 mm.

Description of Schenck and Reinhart, 1938, p. 60-62.

"NOTES ON U.S. NATIONAL MUSEUM TOPOTYPES OF DELICATULA. — Cat. N° 13287: two detached valves, one right, one left (not from the same individual); preservation good; locality, "Lower bed, Vicksburg, Miss." (This is the type locality of *delicatula*). These specimens may be described as follows:

"Same shape and proportions as *invidiosa*, but smaller; elongate beaks located anterior to center; prominent medial sulcus extends from tip of beak to ventral margin, striking this margin anterior to center of shell; ribs 25 to 27 in number; on *left valve*: all ribs definitely beaded except those on posterior slope, which are plain; no dichotomizing in any ribs; about 4 ribs in medial sulcus area are narrower than interspaces; anterior ribs about as wide as interspaces, posterior ribs wider; on *right valve*; no trace of beading or dichotomizing: about 6 ribs in region of sulcus very fine, but anterior and posterior ribs about as wide as interspaces; posterior ribs (on posterior slope) wider than interspaces; anterior series of teeth only one-half as long as posterior series; all teeth small; granular at and near center of hinge; anterior teeth somewhat converging; posterior teeth strongly converging ventrally (*ca.* 45°); ligamental area very narrow, nearly flat, bearing faint longitudinal growth lines; beaks prosogyrate; pallial line and muscle scars indistinct; interior of shell: right valve faintly grooved internally in harmony with external ribbing; left valve distinctly grooved internally, these grooves joining the crenulations at shell margin without interruption; shell material of both valves thin.

"Dimensions of U.S.N.M. specimens, Cat. N° 13287, are given in Table XIII.

"REASONS FOR SYNONYMIZING INVIDIOSA AND DELICATULA. — These names were applied to specimens of different size, *invidiosa* being the larger. The smaller forms (*delicatula*) lack the dichotomous ribs present on the anterior half of the larger forms (*invidiosa*). However, the ribs of *invidiosa* do not begin to dichotomize until the shell attains a size greater than that of the topotypes of *delicatula*. The crowding of the concentric growth rings at the ventral margin of the specimens of *invidiosa* suggests maturity, whereas the specimens of *delicatula* seem to be the shells of immature animals. Because *invidiosa* and *delicatula* are so similar in all other respects, it is reasonable to consider them conspecific, and to adopt the name having page preference.

"COMPARISON. — The above-mentioned resemblance of this species to *"Diluvarca" mikkula* Gardner (U.S. Geol. Survey Prof. Paper 142A, 1926, p. 29, pl. 5, figs. 8,9), from the Chipola formation, "lower Miocene", of Florida, is a striking one. *"Diluvarca" mikkula* differs from *delicatula* by having shallower medial sulcus and fewer ribs [23]; *mikkula* is described as slightly inequivalved and therefore likewise probably belongs to *Scapharca*.

"SYSTEMATIC POSITION OF INVIDIOSA. — Our reason for placing *invidiosa* (and its synonym, *delicatula*) in *Scapharca* is

the discrepancy of sculpture of the left and right valves. The obliquity of the teeth, such as shown in the figure 2b, plate I (of a topotype of *delicatula*), seems to mark, as it does in *sulcicosta* Nyst and other species, merely an immature stage. For example, we have before us a large series of specimens of *sulcicosta* from very small ones (fig. 1, pl. II) to the larger adults, and it is evident from a study of this series that the teeth of the very small shells are oblique and become progressively less oblique as the shell approaches maturity. Finally, although we have not had a specimen of *invidiosa* with the valves in the attached position and hence cannot determine whether the species is inequivalve, nevertheless we assign it to *Scapharca* not only because of the discrepant sculpture, mentioned above, but also because of the marked resemblance of this species to *Anadara* (*Scapharca*) *mikkula* (Gardner)."

Discussion: Though Schenck and Reinhart placed *Scapharca* (*Scapharca*) *delicatula* as a synonym of *S.* (*S.*) *invidiosa*, it is considered a separate species in this work. The basis of this differentiation is that the former species is: (1) smaller in the adult stage and (2) in shells of equal size has a thinner hinge. As Schenck and Reinhart noted, this species is similar to *Scapharca* (*Scapharca*) *mikkula* (Gardner) from the Alum Bluff Group in Florida.

Type: Six syntypes 997 ANSP from the Mint Spring Formation, Vicksburg, Mississippi.

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108b, 110.

Scapharca (Scapharca) chordicosta n. sp.

Plate 4, figures 5, 8-9

Description: Shell solid, strongly inflated and with medial sulcus; beak prosogyrate; umbo elevated above hinge; anterior margin pointed at hinge, posterior margin squared; inner margin with strong crenulations corresponding to the large exterior ribs; hinge narrow at center and abruptly swollen at anterior and beyond the beak; cardinal area small and concave below the beak; exterior with prominent radial ribs and fine, concentric, growth lamellae.

Discussion: This species differs from both *Scapharca* (*Scapharca*) *invidiosa* and *S.* (*S.*) *delicatula* in its prominent and projecting umbo and strong radial ribs. Specimens from the Byram Formation have 23 to 25 radial ribs; an incomplete specimen from the Mint Spring Formation (Plate 4, figure 8) has smaller and more numerous ribs. The name refers to the prominent chord-like ribs.

Type: Holotype 340425 USNM from the Byram Formation, locality 93.

Occurrence: Mississippi: Mint Spring Formation, locality 99a; Byram Formation, locality 93.

Scapharca (Scapharca) sp.

Plate 57, figure 8

Description: Shell solid, very strongly inflated and with a shallow medial sulcus; cardinal area large; interior margin with large crenulations; exterior with 25 broadly spaced radial ribs and fine, concentric, growth lamellae.

Discussion: Only one specimen of this species has been found. It is more inflated than the previously mentioned *Scapharca* species.

Occurrence: Mississippi: Red Bluff Formation, locality 37.

Scapharca (Scapharca) lesueuri Dall

Plate 5, figures 8-14; Text Figures 30, 6-7; 31

1829. *Arca bifasciata* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 8 (unpublished manuscript).

1848a. *Arca Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.

1848b. *Arca mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 11, 15.

1865. *Anomalocardia Mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 11 (Catalog).

1866. *Arca mississippiensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1882. *Arca mississippiensis* Conrad. Heilprin, Acad. Nat. Sci., 3rd ser., v. 30, No. 175, p. 71 (Lower Vicksburgian characterized by absence of *Arca Mississippiensis*, which is abundant in the upper Vicksburgian).

1886. *Arca mississippiensis* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, p. 205 (Present at Byram, Mississippi).

1898. *Arca* (*Scapharca*) *Lesueuri* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 643 (New name for *Arca Mississippiensis* Conrad, 1848).

1918. *Scapharca lesueuri* Dall. Cooke, U. S. Geol. Survey Prof. Paper 120-C, p. 197 (Appears to be restricted to the Byram marl horizon).

1921. *Scapharca lesueuri* Dall. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 79, 81, 82, 84 (Check list; in Byram Marl, p. 84).

1923. *Scapharca lesueuri* Dall. Cooke, U. S. Geol. Survey Prof. Paper 133, p. 7.

1938. *Anadara* (*Scapharca*) *lesueuri* (Dall). Schenck and Reinhart, Memoires Musée Royal d'History Naturelle Belgique, deuxième series, fasc. 14, p. 7, 20.

1944. *Arca lesueuri* Dall. MacNeil, Amer. Assoc. Petr. Geol., Bull., v. 28, No. 9, p. 1332-1335, 1339-1340 (Marl member and Bucatunna clay member of Byram Fm. = *Arca lesueuri* zone, p. 1332).

1962. *Arca Mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 75 (Probable syntypes 30682. Six-

teen single specimens and one block of rock with fragments).

1968. *Arca mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (syntypes 30682).

Original Description: Conrad, 1848a.

"A species of *Arca* occurs in great abundance at Vicksburg, which Lesueur obtained many years since and named it, but I have forgotten the name, and know not whether he published it in Europe or not. It is rhomboidal, ventricose, with rather distant ribs in the right valve, slightly grooved in the middle; in the left valve ribs double and granulated; inner margin profoundly toothed. Length 8-10."

Discussion: Dall (1898) mistakenly listed *Byssoarca mississippiensis* Conrad, 1848, in his synonymy under *A. mississippiensis* Conrad, and proposed a new name because (according to Dall) the same specific name had been used twice in the same genus. The new name was given in honor of Charles A. Lesueur "the excellent naturalist who was first to call attention to it" (Dall, 1898, p. 643). Dall's name has remained in common use since his publication date in 1898 and according to the rules of zoological nomenclature should be continued. Article 59 of the International Code of Zoological Nomenclature states that "A junior secondary homonym rejected before 1961 is permanently rejected and cannot be restored unless the use of the replacement name is contrary to existing usage" (Amendments to the International Code of Zoological Nomenclature adopted since the XVI International Congress of Zoology, Washington, 1963: Bull. Zoological Nomenclature, v. 31, pt. 2, 1974, p. 83).

Scapharca (*Scapharca*) *lesueuri* is common in the Byram Formation and is an important guide fossil to that horizon. It is most abundant in the Vicksburg area.

Type: Syntypes include sixteen specimens free from matrix and five specimens together in one block of matrix, 30682 ANSP from the Byram Formation, Vicksburg, Mississippi. One articulate specimen is designated as the lectotype (Plate 5, figure 8) and three other syntypes are illustrated (Plate 5, figures 9-11).

Occurrence: Mississippi: Byram Formation, localities 93, 94, 102, 106a, 109, 112c, 113b, 114, 115, 116. Alabama: Byram Formation, St. Stephens Quarry, St. Stephens, Washington County.

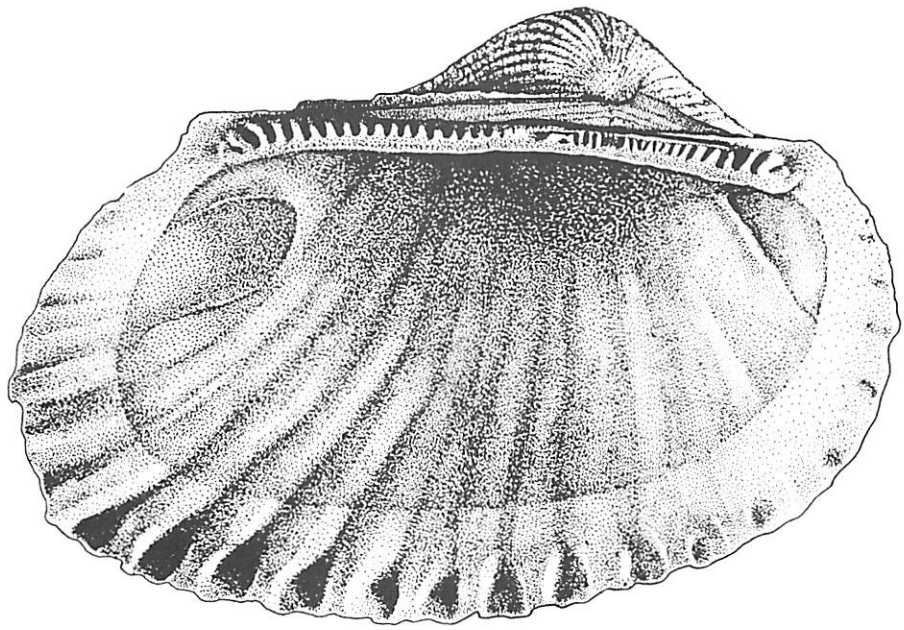


Figure 31 — *Scapharca* (*Scapharca*) *lesueuri* Dall, left valve. Illustration by Julia H. Suits.

Family NOETIIDAE Stewart, 1930
Subfamily TRINACRIINAE MacNeil, 1937
Genus TRINACRIA Mayer, 1868

Trinacria menthifontis n. sp.
Plate 6, figures 1-4

Description: Shell small, slightly inflated; posterior margin broadly rounded, anterior more sharply rounded; beak protruding slightly above hinge; resilifer small and shallow; hinge below resilifer without teeth; teeth v-shaped; anterior hinge with 3 teeth, posterior hinge with 4 teeth; exterior smooth except for fine concentric growth lines.

Discussion: This species is similar to *Trinacria meekii* Dall of the Alum Bluff Group in Florida, but differs in its smaller size, fewer hinge teeth, and less angular anterior margin. The Vicksburg and Alum Bluff species of *Trinacria* form a group that differs from the Eocene species in that the former are less triangular in outline, less inflated, and have a broader resilifer which clearly separates the anterior and posterior hinge teeth. The name *menthifontis* is taken from the locality (Mint Spring Bayou) where the species is most abundant.

Type: Holotype 340426 USNM from the Mint Spring Formation, locality 108.

Occurrence: Mississippi: Red Bluff Formation, locality 37; Mint Spring Formation, localities 89a, 99a, 108b.

Superfamily LIMOPSACEA Dall, 1895
Family LIMOPSIDAE Dall, 1895
Genus LIMOPSIS Sassi, 1827
Subgenus LIMOPSIS Sassi, 1827

Limopsis (Limopsis) sp.
Text Figure 32, 1

Description: Shell small, moderately inflated; hinge with narrow cardinal area and small, posteriorly directed, triangular resilifer; anterior hinge with 3 teeth of high relief, posterior hinge with 4 teeth of moderate relief; interior margin smooth except for 3 prominent crenulations on the posterior ventral margin opposite the posterior shoulder and for faint crenulations on the rounded anterior ventral margin; beak orthogyrate; posterior area low, weakly inflated; exterior sculptured with closely-spaced, impressed, concentric lines having crenulations along their ventral side.

Discussion: This species is known only from a single specimen (MGS specimen 1093) from the Mint Spring Formation. It differs from *Limopsis* (*Pectunuculina*) *radiata* Meyer of the Jackson Group in lacking radial ribs and in having a strong concentric sculpture. Crenulations below the concentric lines in *Limopsis* (*Limopsis*) sp. give these lines a punctate appearance. The dimensions of the specimen at hand are: height 3.3 mm, length 3.3 mm, inflation 1.0 mm.

Occurrence: Mississippi: Mint Spring Formation, locality 99a.

Family GLYCYMERIDIDAE Newton, 1922
Subfamily GLYCYMERIDINAE Newton, 1922
Genus GLYCYMERIS da Costa, 1778

Glycymeris suwannensis Mansfield
Plate 6, figures 5, 7; Text Figure 32, 1

1916. *Glycymeris mississippiensis* (Conrad). Dall, U. S. Natl. Mus. Proc., v. 51, No. 2162, p. 488.
1937. *Glycymeris suwannensis* Mansfield, Florida Geol. Survey, Bull. No. 15, p. 192-193, pl. 10, fig. 2, 14.
1940. *Glycymeris* sp. cf. *G. suwanneenis* Mansfield. Mansfield, Jour. Paleont., v. 14, No. 3, p. 174, pl. 25, fig. 4.

Original Description: Mansfield, 1937.

"Shell of moderate size, inflated, circular in outline. Beaks rather low. Sides rounded, not keeled. Sculpture consisting of fine, even, closely spaced radial threads of about the same strength over the whole shell and fine concentric growth lines, producing with the radials a faint cancellate ornamentation. Cardinal area narrow. Hinge teeth rather strong, about 10 on each side of medial line.

"Cotypes (U. S. National Museum, no. 495969) measure: Larger valve showing outline of shell but with external surface corroded: Length, 22 mm.; height 21.8 mm.; diameter, 12.5 mm. Smaller valve revealing external sculpture, but with ventral portion of shell missing: Length, about 17 mm.; diameter, 9 mm.

"Type locality: Station 6774, rock island, in Suwannee River, about half a mile above highway bridge at White Springs, Fla. T. W. Vaughan and C. W. Cooke, collectors.

"Horizon: Suwannee limestone, Oligocene.

"None of the specimens from the type locality are perfect.

"*G. suwannensis* differs from *G. jamaicensis* Dall in lacking the weak keel on the posterior side and the shallow depression in front of it, and in having much finer radial threads on the umbonal area.

"Other occurrences: Station 12762, 2 3/4 miles south of Zephyrhills, Pasco County, Fla.; station 11109, 1 1/2 miles north of Live Oak, Suwannee County, Fla.; station 12766, Blackwater Creek at crossing of Seaboard Air Line Railway, Hillsborough County."

Description of Mansfield, 1940, for *Glycymeris* sp. cf. *G. suwanneensis* from the Chickasawhay Formation.

"Specimens of *Glycymeris* displaying the general form and finely cancellate sculpture of *G. suwanneensis* Mansfield, 1937, are recorded in molds and in the original shell at a few localities in the lower part of the Chickasawhay marl. The beaks seem a little more full at the extreme tips in the forms from Alabama, but the relationship to the species from the upper Oligocene of Florida is

certainly close. The Flint River specimens referred by Dall, 1916, to *Glycymeris mississippiensis* are triple the size of Conrad's type and close to *G. suwanneensis*. In Conrad's brief description he includes as one of the characteristics "series of teeth uninterrupted." This, together with the samll size, about 10 mm, according to the figure, indicates a young shell, but no adult topotypic material certainly referable to *mississippiensis* has been observed in the collections of the U. S. National Museum. Apparently there was, in the upper Oligocene of the Gulf province, a widespread group characterized by a subcircular outline; a shell broadly inflated and full even to the tips of the beaks, closely but somewhat obscurely threaded radially, and closely lirate concentrically, the minute interspaces giving a somewhat punctate aspect to the surface. The distal teeth are coarse and oblique, the subumbonal dentition finer and vertical. The line is, perhaps, continued in *Glycymeris americana* Defrance of the later Tertiary and Recent faunas of the East Coast and West Indian faunas.

"Figured specimens (U. S. Nat. Mus. 498511) measures: Height 25.5 mm; width, 27.0 mm; convexity of single valve, 8 mm.

"From station 14205, in soft marl under limestone ledge in gully about one-fourth mile north of Perdue Hill, Monroe County, Ala. A closely related if not identical species is recorded in the Mint Spring marl member of Marianna limestone at station 14203 on Horton's Mill Creek and at station 6647a, 1 1/3 miles southwest of Boyce, Wayne County, Miss.

"*Occurrence*. - Lower part of Chickasawhay marl. ALABAMA: Station 14205, one-fourth mile north of Perdue Hill, Monroe County; station 14323?, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station (internal mold); station 7166?, east side of Tombigbee River, just south of Payne's Hammock, Clarke County (internal mold). MISSISSIPPI: Station 14283?, "Chione limestone" at top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro, (external mold). A few other internal molds from the lower Chickasawhay of western Alabama and eastern Mississippi may be conspecific with the Perdue Hill specimens."

Discussion: This species is characterized by its large size and by fine radial and concentric lines that form a finely cancellate sculpture on the exterior. In the larger specimens the hinge teeth in the central region are obliterated by subsidence of the cardinal area.

Type: Two syntypes 495969 USNM from the Suwannee Limestone, rock island in the Suwannee River about half a mile above highway bridge at White Springs, Florida.

Occurrence: Mississippi: Mint Spring Formation, localities 74b, 75b, 89a, 90, 97, 99a, 100a, 108b; Chickasawhay Formation, Wayne County. Alabama: Chickasawhay Formation, Monroe and Clarke Counties. Florida: Suwannee Limestone, Pasco, Suwannee, and Hillsborough Counties. Georgia: Flint River Formation, Flint River near Bainbridge, Decatur County.

Glycymeris mississippiensis (Conrad)

Plate 6, figures 6, 8-9; Text Figure 32, 4

1829. *Pectunuculus minutus* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 10 (unpublished manuscript).

1848b. *Pectunculus Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 25.

1854. *Axinae Mississippiensis* (Conrad). Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 287, 288.

1865. *Axinaea Mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 12 (Catalog).

1866. *Axinaea Mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1898. *Glycymeris mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 608 (Comparison with the rounded form of the Eocene *G. trigonella* from the Gosport Sand in Alabama).

1916. Not *Glycymeris mississippiensis* (Conrad). Dall, U. S. Natl. Mus., Proc., v. 51, No. 2162, p. 488, 491 (Present in the Oligocene beds along the Flint River, Georgia = *Glycymeris suwannensis* Mansfield).

1945. *G.* sp. cf. *Glycymeris mississippiensis* (Conrad). Gardner, Geol. Soc. Amer. Memoir 11, p. 51 (Present in the Oligocene of Mexico at USGS sta. 13518, Nuevo Leon, Mexico).

1962. *Pectunculus Mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 77 (Holotype 30667).

1968. *Pectunculus mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66.

Original Description: Conrad, 1848b.

"Orbicular, ventricose; length and height equal; disk with slightly prominent fine radii, minutely crenulated; series of teeth uninterrupted; inner margin finely crenulated."

Discussion: This species has a cancellate exterior sculpture similar to *Glycymeris suwannensis* Mansfield but with slightly more elevated radial ribs. *G. mississippiensis* differs from this latter species in that: (1) it is characteristically smaller with the largest specimen found having a height of 23 mm, (2) it is strongly inflated in the umbonal region just above the hinge, and (3) in adult specimens the cardinal area is small and does not obliterate the central hinge teeth by subsidence.

Type: Holotype 30667 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 6, figure 8; Text Figure 32, 4).

Occurrence: Mississippi: Byram Formation, locality 106b, Vicksburg.

Glycymeris intercostata (Gabb)

Plate 7, figures 2-3, 5-7; Plate 58, figure 1; Text Figure 32, 1

1860. *Axinaea intercostata* Gabb, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 4, pt. 4, art. 14, p. 402, pl. 68, fig. 2.
1898. *Axinaea intercostata* Gabb. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 607 [placed as a synonym of *Glycymeris arctata* (Conrad)].
1965. *Glycymeris intercostata* (Gabb). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 152-153.
1968. *Axinea intercostata* Gabb. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 58.

Original Description: Gabb, 1860.

"Orbicular: beaks small, incurved; surface marked by numerous, compound ribs, composed generally of three, sometimes four, smaller ones and with smaller, transverse markings between these ribs; area very small, hinge teeth large, lower part of the internal edge crenulated.

"*Locality*. - Eocene. Alabama. Dr. Spillman."

Discussion: This species is circular in outline and is characterized by an exterior sculpture of narrow, radial ribs and concentric lamellae that are most prominent in the interspaces. The radial ribs increase in number with shell growth by the splitting of primary ribs into 2 or 3 ribs and by addition of intercalary ribs in the interspaces along the margins of the primary ribs. Secondary ribs tend to be clustered about the primary ribs, which have the most prominent elevation. *Glycymeris intercostata* differs from *G. arctatus* in its circular outline, its narrow radial ribs, and its stronger concentric lamellae. Gabb's published locality for the type is "Eocene Alabama"; however, the label with the type states the locality as "Eocene, Mississippi." The type specimen contains limestone matrix in the interior and was possibly collected from the Mint Spring Formation in Mississippi or the Red Bluff Formation in Alabama.

Type: Holotype 31431 ANSP, horizon and locality uncertain (Plate 58, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 40, 46; Mint Spring Formation, localities 74b, 75b, 90.

Glycymeris arctata (Conrad)

Plate 7, figures 1, 4, 8, 11, 13

1848a. *Pectunculus arctatus* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.
1848b. *Pectunculus arctatus* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 24.
1854. *Axinaea arctatus* (Conrad). Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 287, 288.
1865. *Axinaea arctatus* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 12 (Catalog).
1866. *Axinaea arctata* (Conrad). Conrad. Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1898. *Glycymeris arctata* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 607 (Places *Axinaea intercostata* Gabb and *Axinaea bellasculpta* Conrad in synonymy under *G. arctata*).
1915. *Glycymeris arctata* (Conrad). Dall, U. S. Natl. Mus. Bull. 90, p. 122 (Compared with *Glycymeris lamyi* Dall from the Tampa silex beds Ballast Point, Tampa Bay, Florida, in its radial structure).
1922. *Glycymeris arctata* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in Byram Marl).
1962. *Pectunculus arctatus* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 39 (Possible holotype 30647).
1968. *Pectunculus arctatus* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 33.

Original Description: Conrad 1848a.

"Short-ovate, convex depressed, with little prominate flattened radii, divided by a longitudinal impressed line towards the base; anterior margin truncated; posterior margin nearly rectilinear. Length 2/3. Height 6-10.

"Rare, and occurs on the bank of Yazoo River, about 14 miles from Vicksburg. There is in the collection a valve of another species of *Pectunculus*, which is small, and resembles the young of *P. pulvinatus*."

Discussion: This species has somewhat of a triangular outline due to the truncation of the anterior and posterior dorsal margins. The ribs are more flat-topped and with more narrow interspaces than those in *Glycymeris intercostata* (Gabb). A variety of *G. arctatus* that occurs in the Mint Spring Formation has broader and less divided ribs and has a more circular outline than that of the type which occurs in the Byram Formation. This variety resembles *Glycymeris cookei* Dall of the Flint River Formation in Georgia (See Plate 58, figures 2-4).

Type: Holotype 30647 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 7, figure 13).

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 97, 99a, 100a, 101a, 108b, 110; Byram Formation, localities 93, 102, 109, 112c, 114, 115. Also occurs in the Rosefield Formation in Louisiana.

Order MYTILOIDA Ferussac, 1822

Superfamily MYTILACEA Rafinesque, 1815

Family MYTILIDAE Rafinesque, 1815

Subfamily MYTILINAE Rafinesque, 1815

Genus BRACHIDONTES Swainson, 1840

Brachidontes mississippiensis (Conrad)

Plate 7, figure 12

1829. Lesueur, Walnut Hills fossil shells, pl. 12, fig. 6 (no name).
1848a. *Modiola Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 295.
1848b. *Modiola mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 126, pl. 12, fig. 19.
1866. *Perna mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1898. *Modiolus* (*Brachydontes*) *mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 796.
1922. *Modiolus mississippiensis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in the Byram Marl).
1923. *Modiolus mississippiensis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 133, p. 8 (Listed from the Oligocene cherts of Bainbridge, Georgia).
1945. *Brachidontes mississippiensis* (Conrad). Gardner, Geol. Soc. Amer. Memoir 11, p. 38, 56 (Present in the Oligocene of Mexico at USGS sta. 13510 and 13535; a related species occurs in the upper Jackson at USGS sta. 13535).
1962. *Modiola Mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 77 (Probable holotype 30646).
1968. *Modiola mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Holotype 30646).

Original Description: Conrad, 1848a.

"Slightly arched, elongated, ventricose, with rather fine closely-arranged radiating lines wanting on the anterior side; region of umbonial slope inflated posterior end acutely rounded; beak angulated posteriorly; substance of shell silvery and perlaceous. 2-10th from beak to base. Rare, except in one spot, where I obtained several specimens and fragments."

Discussion: *Brachidontes mississippiensis* has a fragile shell and occurs most frequently as fragments in screened samples. It is common at one locality (112c) along the Glendon and Byram contact where the articulated valves are filled with a limestone matrix.

Type: Holotype 30646 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 7, figure 12).

Occurrence: Mississippi: Mint Spring Formation, locality 89a; Byram Formation, localities 94, 109, 112c.

Genus SEPTIFER Recluz, 1848
Subgenus SEPTIFER Recluz, 1848

Septifer (Septifer) probolus n. sp.
Plate 7, figures 9-10; Text Figure 32, 5

Description: Shell nacreous, moderately inflated, elongate in a posterior-ventral direction; umbo projecting above hinge with beak prosogyrate and nearly terminal; hinge at 90° angle below beak with anterior margin sloping in a posterior-ventral direction; hinge elevated above a curved internal septum and with dysodont teeth; internal margin crenulate; exterior with radial ribs which increase by bifurcation and addition of intercalary ribs.

Discussion: The umbo of *Septifer* (*Septifer*) *probolus* is much more prominent in elevation than that of the type species *S.* (*S.*) *bilocularis* (Linne) from the Recent of Indo-Pacific region. The name refers to the elevated umbo.

Type: Holotype 340429 USNM from the Red Bluff Formation, locality 35b (Plate 7, figure 10).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 35b, 40.

Subfamily CRENELLINAE Adams & Adams, 1857
Genus CRENELLA Brown, 1827

Crenella fenestra n. sp.
Plate 8, figures 1-6

Description: Shell small, nacreous, strongly inflated, ovate and elevated; beak prosogyrate; resilifer short and sunken; hinge striated; interior margin crenulate; exterior cancellate with strong radial ribs and concentric lamellae; radial ribs increase by bifurcation and addition of intercalary ribs.

Discussion: The characteristic exterior sculpture of this species is strongly cancellate as is suggested by the name. Radial ribs are straight along the dorsal-ventral, medial line of the exterior but are curved anteriorly and posteriorly in front of and behind this line. *Crenella minuscula* Dall of the Alum Bluff Group in Florida differs from this species in its smaller size and weaker exterior sculpture.

Type: Holotype 340430 USNM from the Mint Spring Formation, locality 108b (Plate 8, figure 1).

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108b; Byram Formation, localities 93, 102, 109.

Genus ARCOPERNA Conrad, 1865

Arcoperna linteata n. sp.
Plate 7, figure 14

Description: Shell nacreous, strongly inflated, ovate; beak prosogyrate and terminal; umbo strongly inflated and elevated above hinge; exterior cancellate with fine bifurcating and intercalary radial ribs and concentric growth lines.

Discussion: The fine radial ribs and concentric lines of the exterior produce a fabric-like texture for which this species is named. *Arcoperna linteata* is similar to *A. inflata* Dall (see Plate 58, figure 10) from the Flint River Formation in Georgia but differs in having a coarser exterior sculpture. The species is fragile, and the interior has not been examined.

Type: Holotype 340431 USNM from the Mint Spring Formation, locality 99a (Plate 7, figure 14).

Occurrence: Mississippi: Mint Spring Formation, localities 97, 99a.

Superfamily PINNACEA Leach, 1819
Family PINNIDAE Leach, 1819
Genus ATRINA Gray, 1842

Atrina argentea (Conrad)
Plate 9, figures 9, 11; Plate 59, figures 8-9

1829. *Pinna radiata* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 5 (unpublished manuscript).
1848a. *Pinna argentea* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 295-296.
1848b. *Pinna argentea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 126, pl. 13, fig. 31.
1865. *Pinna argentea* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 11 (Catalog).
1866. *Pinna argentea* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 23 (Listed in the Jackson Group).
1898. *Atrina argentea* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 662 (Abundant as impressions in brownish clay at Vicksburg, Mississippi: Conrad and Worthen).
1922. *Pinna (Atrina) argentea* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in the Byram Marl and Mint Spring Marl).
1962. *Pinna argentea* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 108, p. 40 (Holotype missing).

Original Description: Conrad, 1848a.

"Triangular, with straight margins and acute summit; compressed: substance highly polished and silvery; valves with longitudinal radii on more than half the disc, about thirteen in number; anterior side with rugose, obtuse, oblique, finer and more approximate lines. Length 2 3/4. Rare."

Discussion: This species is locally abundant in the Byram Formation but because it is fragile good specimens are difficult to obtain. *Atrina argentea* resembles *A. jacksonina* Dall of the Jackson Group but has stronger radial ribs on the dorsal region of shell's exterior.

Type: Probable syntypes 10222 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 59, figures 8, 9).

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 99a, 100a; Byram Formation 93, 106a, 109, 116.

Order PTERIOIDA Newell, 1965
Suborder PTERIINA Newell, 1965
Superfamily PTERIACEA Gray, 1847
Family PTERIIDAE Gray, 1847
Genus PTERIA Scopolli, 1777

Pteria argentea (Conrad)
Plate 9, figures 1-5, 7

1829. Lesueur, Walnut Hills fossil shells, pl. 12, fig. 6 (No name).
1848a. *Avicula argentea* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.
1848b. *Avicula argentea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 126, pl. 12, fig. 10.
1865. *Avicula argentea* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 11 (Catalog).
1866. *Avicula argentea* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1898. *Pteria argentea* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 699.
1922. *Pteria argentea* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in the Byram Marl, Mint Spring Marl, and Red Bluff Clay).
1945. *Pteria argentea* (Conrad). Gardner, Geol. Soc. Amer. Memoir 11, p. 59 (*Pteria* sp. may = *P. argentea*; Oligocene, USGS sta. 14056 and 14147, Nuevo Léon, Mexico).
1951. *Pteria* cf. *argentea* (Conrad). Harris, Bull. Amer. Paleont., v. 38, No. 138, p. 13, pl. 6, fig. 6 (Ocala Limestone, Florida).
1962. *Avicula argentea* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 40 (3 syntypes 30644. Labelled by Conrad?; one subsequently figured).
1968. *Avicula argentea* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 33 (Types 30644).

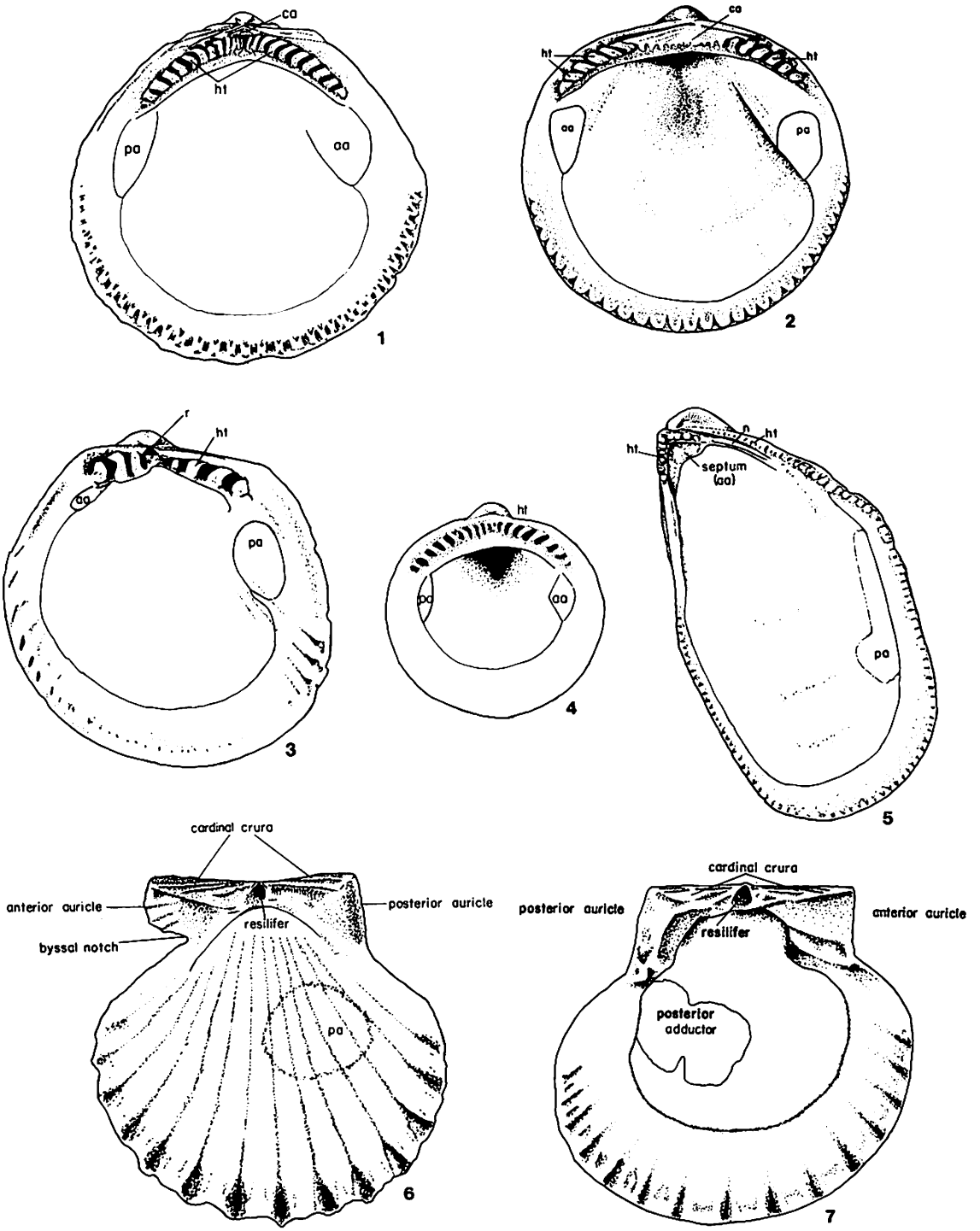


Figure 32 — 1- left valve, *Glycymeris intercostata* (Gabb); 2- right valve, *Glycymeris suwannensis* Mansfield; 3- right valve, *Limopsis* (*Limopsis*) sp.; 4- left valve (holotype), *Glycymeris mississippiensis* (Conrad); 5- right valve (holotype), *Septifer* (*Septifer*) *probolus* n. sp.; 6- right valve, *Pecten* (*Pecten*) *perplanus* Morton; 7- left valve, *Chlamys* (*Lyropecten*) *menthifontis* Glawe. ht = hinge teeth, ca = cardinal area, r = resilifer, n = nymph, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

Original Description: Conrad, 1848a.

"Ovate-subquadrangular, thin and fragile, ventricose above, smooth and entire? anterior wing sharply angular; posterior wing not produced, rectangular at the extermity; posterior end angular, extending beyond the hinge line and much above the line of the base; anterior margin and base form a regular rounded outline. Height 1 1/2. Length 1 4-10. Not common."

Discussion: The larger specimens of this species occur in the Mint Spring Formation, which is the probable horizon of the type. Some well preserved specimens that retain the outer shell layer show radial color rays (Plate 9, figure 2) and irregular concentric growth lines. This species is similar in size and shape to *Pteria limula vanwinkleae* Harris of the Jackson Group but the latter species has not been found to retain the outer shell layer.

Type: Holotype 30644 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 9, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 37, 38; Mint Spring Formation, localities 74b, 75a, 89a, 97, 99a, 100a, 108b; Byram Formation, localities 93, 102, 106a.

Superfamily PECTINACEA Rafinesque, 1815
Family PECTINIDAE Rafinesque, 1815
Genus EBURNEOPECTEN Conrad, 1865
Subgenus EBURNEOPECTEN Conrad, 1865

Eburneopecten (Eburneopecten) subminutus (Aldrich)

Plate 9, figures 6, 8, 10

1903. *Pecten (Pseudamusium) subminutus* Aldrich, Nautilus, v. 16, No. 9, p. 100, pl. 4, fig. 16-17.
1938. *Amusium (Pseudamussium) subminutus* Aldrich. Tucker-Rowland, Mus. Royal Hist. Nat. Belgique, Mem., Ser. 2, fasc. 13, p. 67, pl. 6, fig. 16.
1965. *Eburneopecten subminutus* (Aldrich). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 136.

Original Description: Aldrich, 1903.

"Shell minute, thin, surface smooth, not polished, valves rather flat, ears small, subequal in the right valve and unequal in the left. Fine rugose striae on the ears of the right valve, vertical to the hinge line but not reaching it, but they run down over the submargin. One ear in the left valve with five or six radiating ribs, the other smooth; interior smooth, the cardinal margin cross striated.

"Alt. 3 mm., lat. 3 mm. of the largest specimen.

"Localities: Red Bluff, Miss., Jackson, Miss.

"This little shell is evidently adult. It is probably found at Vicksburg also. It is not rare, closely resembles *Pecten Guppyi* Dall in form, but is smaller."

Discussion: This small *Eburneopecten* is common throughout the Vicksburg Group. Some of the larger specimens have been found in the Mint Spring Formation.

Type: Two syntypes 644632 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Plate 9, figure 8).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 40; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 99a, 100a; Byram Formation, localities 93, 94, 102, 106a.

Genus CHLAMYS Röding, 1798
Subgenus AEQUIPECTEN Fischer, 1886

Chlamys (Aequipecten) cocoana Dall, 1898

Plate 10, figure 6

1898. *Pecten (Chlamys) cocoanus* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, p. 738, pl. 34, fig. 23.
1936. *Chlamys (Chlamys) cocoanus* Dall. Tucker-Rowland, Amer. Midland Nat., v. 17, p. 1001, pl. 7, fig. 7, 8.
1946. *Chlamys cocoana* Dall. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 32, pl. 8, fig. 10.
1952. *Chlamys cocoana* (Dall). Cooke and MacNeil, U. S. Geol. Survey Prof. Paper 243-B, p. 27.
1965. *Chlamys cocoana* Dall. Harris and Palmer, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 82.
1974. *Chlamys (Aequipecten) cocoana* Dall. Glawe, Geol. Survey Georgia, Information Circular No. 46, p. 6-7, pl. 2, fig. 1-5, 7, 8, 10, 11.

Original Description: Dall, 1898.

"Jacksonian Eocene of Red Bluff, Mississippi, and Cocoa Post Office, Choctaw County, Alabama; Burns.

"Shell small, thin, flattish, oblique, produced behind, with about twenty-five small, low entire ribs, rounded above, and about fourteen interstitial single smaller threads, the tops of all of which are somewhat sparsely concentrically imbricated, the interspaces showing only incremental lines; ears quite unequal, small, the posterior smaller, each with five or six low, hardly scaly radii; inside of the valve obsoletely channeled, the cardinal crura developed. Alt. 23, lat. 23 mm.

"This shell differs from *P. membranosus* by its entire and less numerous ribs, and from *P. wahtubbeanus* by its greater obliquity, its entire, less conspicuous, and less densely imbricated ribs."

Discussion of Glawe, 1974.

"The above description by Dall is based solely on the holotype, a small, worn left valve. Throughout Alabama this species is usually small and worn, generally having a height of less than 20 mm. In left valves at a growth stage of 10 mm from the beak, there are about 19 to 30 low, primary ribs and 10 to 20 smaller ribs that are added by intercalation. At a distance of 10 mm from the beak in right valves, there are 23 to 30 primary ribs of which 3 to

13 of these ribs have increased by bifurcation. Well preserved, unworn specimens have imbricated external ribs.

"OCCURRENCE IN GEORGIA. - *Chlamys cocoana* is common and unusually large in the Clinchfield Sand at Area 22 kaolin pit, Huber (locality 35); common in Clinchfield Sand at Rich Hill, 4.7 miles SE of Knoxville (locality 34); rare and usually as molds in the Twiggs Clay in a ditch along Interstate 75, about 4 miles south of Perry (locality 28); common in the Twiggs Clay at a kaolin mine near Clear Creek, about 5 miles south of Gordon (locality 37); common in the Cooper Marl at a road cut 4 miles northeast of Hayneville (locality 33) (Locality 7 - Pickering, 1970); and common in Cooper Marl at Sugar Hill about 6 miles northeast of Unadilla (locality 30) (Locality 25 - Pickering, 1970).

"DISTRIBUTION ELSEWHERE IN THE SOUTHEASTERN UNITED STATES. - *Chlamys cocoana* is known from Upper Eocene and Oligocene localities in Alabama and Mississippi: Cocoa Post Office, Chocktaw County, Alabama, Type; rare in Moodys Branch Marl, 3.9 miles west of Gilbertown (locality 6); and west bank of Tombigbee River, 100 yards north of quarry at St. Stephens, Alabama (locality 9); common in Cocoa Sand, 2.9 miles north of Grove Hill, Alabama (locality 12); common in upper Ocala Limestone, 1.6 miles southwest of Perdue Hill, Alabama (locality 14); and very rare in the basal Red Bluff at Hiwannee, Mississippi (locality 3), and at Little Stave Creek, Jackson, Alabama (locality 10).

"*Chlamys cocoana* has been reported from the Cooper Marl (Oligocene) of South Carolina (Cooke and MacNeil, 1952). My collection from the Cooper Marl at the Carolina Giant Cement Corporation quarry 2 miles north of Harleyville, South Carolina (locality 38) contains a small species of *Chlamys* similar to *Chlamys cocoana* but is probably an unnamed species. More study on this South Carolina species is needed.

"REMARKS. - Thirty-nine specimens of *Chlamys cocoana* from the Clinchfield Sand near Huber, Georgia, and one nearly complete specimen from the Cooper Marl at Sugar Hill near Unadilla, Georgia, are unusually large and well preserved. These specimens are particularly meaningful because they provide new information on the late stages of external rib development.

"Of the 21 left valves from Huber (height 20 to 32 mm), many specimens exhibit a rib development that is more complex than that observed on the holotype (height 23 mm). On left-valve specimens, there are 20 to 27 (avg. 24.6) prominent primary ribs and 13 to 24 (avg. 19.6) less prominent secondary ribs. The secondary ribs form between the primary ribs by intercalation. However, in some of the larger left valves, the primary ribs may also branch either into two ribs of the same height and width or add low secondary ribs at their sides, or the valves may exhibit both branching of primary ribs and addition of secondary ribs at the sides of the primary ribs. On 7 of 19 left valves, some (1 to 14, avg. 7.7) of the primary ribs have branched before the 20 mm in height growth state. However, 11 of 19 left valves have 2 to 31 (avg. 9.9) low, secondary ribs that develop at the sides of some of the primary ribs.

"On 17 specimens of right valves from near Huber, Georgia, (height 20 to 28 mm) the number of primary ribs ranges from 23 to 27 (avg. 24.4). Most of the primary ribs in the central portion of the disk branch into two ribs of the same height and width at about the 10 mm-in-height growth state. However, low secondary ribs may be added by either intercalation between primary ribs (5 of 17 specimens) or at the side of primary ribs (13 of 17 specimens) or by both means (5 of 17 specimens). The one large right valve from the Cooper Marl near Unadilla, Georgia, has rib ornamentation similar to the ornamentation just described for the right-valve specimens from the Clinchfield Sand near Huber, Georgia.

"*Chlamys cocoana* and *Chlamys membranosa* (Morton) are similar in internal structure (elevated margins of chondrophore, crenulated ventral margin of the disk) and general features of rib ornamentation. The two species may be distinguished, however, by differences of rib ornamentation. *C. cocoana* has fewer external ribs than *C. membranosa*, and right valves of *C. cocoana* exhibit a characteristic branching of the primary ribs, a feature not observed in *C. membranosa*."

Discussion: This species is easily distinguished from other *Chlamys* in the Vicksburg Group by its high elevation, its bifurcating ribs, and its shallow inflation.

Type: Holotype 141025 USNM from the Red Bluff Formation, Cocoa Post Office, Choctaw County, Alabama.

Occurrence: Mississippi: Red Bluff Formation, localities 37, 38, 39. For other localities in the Upper Eocene of Alabama, Georgia, and South Carolina see Cooke and MacNeil (1952).

Chlamys (Aequipecten) redwoodensis n. sp.

Plate 11, figure 1; Plate 58, figures 5, 6

Description: Shell inequilateral, slightly produced posteriorly, weakly inflated; valves equally convex; right anterior ear deeply notched, sculptured with 6 to 7 strong radials, right posterior ear with 5 radials of moderate strength; left anterior ear with 5 weak radials, left posterior ear with 7 strong radials; disk with 21 to 24 narrow unilirate ribs and slightly narrower U-shaped or flat-bottomed interspaces, and with fine concentric lamellae.

Discussion: The simple unicarate ribs, the general shell outline, and the convexity of this species is similar to that of *Chlamys* (*Aequipecten*) *nupera* (Conrad) of the Jackson Group. It differs from the latter species in having interspaces that are U-shaped or flat-bottomed rather than V-shaped and in having a thinner shell. One specimen from locality 93 has fine intercalary ribs. Though the type and the better preserved specimens of this species are from the Byram Formation, it is most abundant in the Forest Hill Formation at locality 75a.

Type: Holotype 340434 USNM from the Byram Formation, locality 112c (Plate 11, figure 1).

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Byram Formation localities 93, 112c.

Subgenus ANATIPOPECTEN Hertlein, 1936

Chlamys (Anatipopecten) anatipes (Morton)

Plate 12, figures 1-7

1833. *Pecten anatipes* Morton, Amer. Jour. Sci., 1st ser., v. 23, No. 2, p. 293, pl. 5, fig. 4.

1865. *Pecten anatipes* Morton. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 14 (Catalog).

1882a. *Pecten anatipes* Morton. Heilprin, Acad. Nat. Sci., Proc. 1881, v. 33, p. 417 (Catalog; in the Oligocene of Alabama).

1886. *Pecten anatipes* Morton. Aldrich, Geol. Survey Alabama, Bull., No. 1, p. 43 (Check list; vicinity of Claiborne, Alabama).

1898. *Pecten (Nodipecten) anatipes* Morton. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 730 (Present in the Oligocene at Heidelberg in Jasper County, Mississippi).

1916. *Pecten anatipes* Morton. Dall, U. S. Natl. Mus. Proc., v. 51, No. 2162, p. 492 (Vicksburgian at Heidelberg and Jasper Co., Mississippi; at Red Bluff on the Flint River, Bainbridge, Georgia).

1936. *Chlamys (Chlamys) anatipes* (Morton): Tucker-Rowland, Amer. Midland Nat., v. 17, p. 1004, pl. 7, fig. 2; pl. 10, fig. 13.

1944. *Pecten anatipes* Morton. MacNeil, Amer. Assoc. Petr. Geol., Bull., v. 28, No. 9, p. 1324, 1330 (In *Lepidocyclina fragilis* zone, base of Marianna Limestone, Marianna, Florida; p. 1324: in coquina bed above Marianna Limestone, Clarke Co., Alabama; p. 1330).

1951. *Chlamys anatipes* (Morton). Harris, Bull. Amer. Paleont., v. 33, No. 138, p. 10, pl. 5, fig. 2.

1965. *Flexopecten anatipes* (Morton). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 464, pl. 1, fig. 1, 2 (Drawings by Otto Meyer for T. H. Aldrich).

1968. *Pecten anatipes* Morton. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 31.

1969. *Chlamys (Anatipopecten) anatipes* (Morton). Hertlein, Family PECTINIDAE: Treatise Invert. Paleont., pt. N, v. 1 of 3, p. N355, fig. C78, 2.

1974. *Chlamys (Anatipopecten) anatipes* (Morton). Glawe, Geol. Survey Georgia Information Circular No. 46, p. 8, pl. 4, fig. 2, 4-6.

Original Description: Morton, 1833.

"With four or five broad convex ribs, longitudinally striated; at the sides large striae replace the ribs. Rarely more than half an inch in diameter. From the overlying limestone of Claiborne, Alabama."

Discussion of Glawe, 1974

"Shell suborbicular, thick, small, maximum height 31.2 mm, maximum length 29.2 mm; both valves convex; ribs broad, rounded, increase in width ventrally, wider than interspaces; 4 to 7 strong ribs on the central portion of the disk and a smaller one on either side; lirae on ribs, interspaces, and submargins; concentric lamellae closely spaced. Ears fairly large, nearly equal, with numerous radial striations; byssal notch deep; ctenolium in right valve with 3 or 4 teeth exposed. Hinge with provinculum, one pair of cardinal crura, and a resilial pit; broad internal ribs fluted along ventral margin.

"DIMENSIONS. - Holotype, fragmentary specimen from near Claiborne, Alabama.

"OCCURRENCE IN GEORGIA. - Rare in Marianna Limestone on the west bank of the Ocmulgee River at Lower City Park, Hawkinsville (locality 32). Also reported from the Oligocene beds at Red Bluff, seven miles above Bainbridge and on the west bank of Flint River, opposite Little Horseshoe Point, 0.5 mile below Mascot Point and 4.5 miles below Bainbridge, Georgia (Vaughan, Cook, Mansfield; in Dall, 1916).

"DISTRIBUTION ELSEWHERE IN THE SOUTHEASTERN UNITED STATES. - *Chlamys anatipes* is found in the Oligocene formations of Mississippi (Glendon), Alabama (Red Bluff, Marianna, Glendon, Byram), and Florida (Bumpnose); but its presence is always rare.

"REMARKS. - Palmer and Brann (1965, p. 144) list the geologic range of *Chlamys anatipes* from Upper Eocene (type) to Oligocene. They apparently consider the type to be from the Upper Eocene because Morton reported it "from the overlying limestone of Claiborne, Alabama." However since Morton (1833, p. 293) also found *Pecten perplanus* Morton (now *Pecten perplanus perplanus*) in the same beds as *C. anatipes* and I have found *P. p. perplanus* only in Oligocene beds (Glawe, 1969), I conclude that the type of *C. anatipes* (if found in place) came from the Oligocene beds near Claiborne, Alabama."

Discussion: In Mississippi, this species is most abundant at the base of the Glendon Limestone at locality 45b. It is easily recognized by its broad ribs and interspaces and is the type species for the subgenus *Anatipopecten.*

Type: Holotype 12575 ANSP from Claiborne, Alabama (horizon uncertain). The locality given by Richards (1968, p. 31) is St. Stephens, Alabama.

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, locality 89a; Marianna Limestone, locality 75c; Glendon Limestone, locality 45b. Also occurs in the Red Bluff, Marianna, Glendon, and Byram Formations of Alabama, the Bumpnose Limestone of Florida, and the Marianna and Flint River Formations of Georgia.

Subgenus LYROPECTEN Conrad, 1862

Chlamys (Lyropecten) duncanensis Mansfield

Plate 11, figures 4-5, 8-10, 12

1934. *Pecten (Lyropecten) duncanensis* Mansfield, Washington Acad. Sci., Jour., v. 24, p. 332, fig. 1-3.

1938. *Chlamys (Lyropecten) duncanensis* (Mansfield). Tucker-Rowland, Mus. Royal Hist. Nat. Belgique Mem., ser. 2, fasc. 13, p. 7, pl. 5, fig. 22.

1974. *Chlamys (Lyropecten) duncanensis* Mansfield. Glawe, Geol. Survey Georgia, Information Circular No. 46, p. 9, pl. 3, fig. 4-6, 9.

Original Description: Mansfield, 1934.

"Shell small, rather thin, inequilateral, weakly inflated, the left valve more convex than the right. Right anterior ear with a moderately deep notch and sculptured with five rather strong radials,

the innermost of which lies close to the submargin, and with transverse closely-spaced imbrications; right posterior ear with six strong, imbricated radials. Disk of right valve sculptured with 23 to 25 (24 on holotype) squarish, scabrous and imbricated ribs, separated by intervals of about the same width as the ribs. The early portion of each rib is narrowly rounded and the later portion nearly square; the latter is undercut on the sides and is ornamented on the top with three scabrous threads, the medial one of which is the strongest. The interradial spaces on the smaller specimens are either without a radial or, if present, it is only faintly indicated. A fragment of a larger shell (Fig. 1, U.S.N.M. No. 373056) shows one interradial thread of moderate strength in each space. Ribs and interspaces crossed by imbrications whose edges are about one millimeter apart. Left valve sculptured similarly to the right, except that the interradial thread appears to be more strongly developed. Submargins low and marked with faint radials."

Discussion of Glawe, 1974.

"DIMENSIONS. - Holotype, right valve; height 23 mm, length, 22.5 mm, convexity, 4 mm, from Duncan Church, Washington County, Florida.

"OCCURRENCE IN GEORGIA. - *Chlamys duncanensis* is common in the upper beds at the Dixie Lime and Stone Company quarry (Oligocene) near Bridgeboro (locality 27), rare and small in the Marianna Limestone along the west bank of the Ocmulgee River at Lower City Park in Hawkinsville (locality 32), and possibly occurs in the Bainbridge area. According to Mansfield (1934, p. 33), *Pecten duncanensis* (now *Chlamys duncanensis*) is closely allied to, if not the same as, specimens figured and incorrectly referred by Dall (1916, p. 492) to *Pecten suwaneensis* Dall (now *Chlamys suwaneensis*) from the Glendon Chert (Limestone) at Bainbridge, Georgia.

"DISTRIBUTION ELSEWHERE IN THE SOUTHEASTERN UNITED STATES. - *Chlamys duncanensis* is common in the Glendon Limestone near Heidelberg (locality 2) and rare in the Byram Marl near "old" Byram, Mississippi (locality 1); common in the Glendon Limestone near Millry (locality 8), rare in the Glendon Limestone near St. Stephens (locality 9), Glendon Flat Station (locality 11), and Frisco City (locality 15), and rare in the Byram Marl at Hart's Bridge on Five Runs Creek, Alabama (locality 18); and common in the Suwannee Limestone at Natural Bridge, Walton County (locality 21) and near Duncan Church (type locality), Washington County, Florida (locality 22).

"REMARKS. - *Chlamys duncanensis* has a trilirate rib development similar to the rib development of *Pecten perplanus byramensis* Gardner that also occurs in the northern Gulf Coast Oligocene formations. However *C. duncanensis* differs from *P. p. byramensis* by having interspace lirations, a convex left valve, a valve shape that is slightly produced in the posterior, and a ctenolium present in even the largest specimens - features not observed in *P. p. byramensis*."

Discussion: Glawe (1974) points out the superficial resemblance of *Chlamys duncanensis* to *Pecten byramensis* Gardner because of its trilirate ribs. However, it differs from the latter species in: (1) being equivalved, (2) being assymetrical and produced posteriorly, and (3) having intercalary ribs.

Type: Holotype USNM from the Suwannee Limestone near Duncan Church, Washington County, Florida.

Occurrence: Mississippi: Glendon Limestone, localities 45b, 92. For other localities see Glawe, 1974.

Chlamys (Lyropecten) menthifontis Glawe

Plate 10, figures 2-4, 7-9; Plate 11, figures 2-3, 11; Text Figure 32, 7

1970. *Chlamys menthifontis* Glawe, Jour. Paleont., v. 44, No. 5, p. 858-866, pl. 121, fig. 1-4, 6, 7.

Original Description: Glawe, 1970.

"Diagnosis.-*Chlamys* having medium-sized, highly inflated, and nearly equally convex valves; a thick shell; external ribs with lirae; anterior ear only slightly longer than posterior ear; and a disc that is produced posteriorly in large specimens. Differs from *C. deshayesii* (Lea) in having greater size, thickness, and convexity of the valves and in having a disc that is produced posteriorly in large specimens.

"Description. - Shell suborbicular in small specimens, produced posteriorly in large specimens, thick; medium-sized, maximum height 51.0 mm, maximum length 54.0 mm; highly inflated, right valves slightly more convex than left valves except in the largest specimens which are generally equally convex; hinge line nearly straight in both valves; ribs high, rounded; left and right valve with 16 to 23 ribs; top of ribs in central portion of disc at the ventral margin of largest specimens with 3 to 5 lirae; interspaces about the same width as the ribs; interspaces in the central portion of the disc at the ventral margin of the largest specimens with 4 to 8 lirae; lirae increase by intercalation and are fewer on the ribs and interspaces of the lateral margins of the disc than on the central part of the disc; number of lirae between consecutive mid-interspaces on the middle of the disc is variable, but lirae on specimens larger than 20 mm in height increase at an average rate of one lira per 6 mm in height (Text-fig. 3); concentric growth increments coarse, largest specimens with 0 to 6 prominent growth-rings; ears medium size, unequal, anterior slightly longer than posterior, prominently striated with 5 to 10 radial threads on the anterior ear and 4 to 11 radial threads on the posterior ear of left valves and 2 to 6 radial threads on the anterior ear and 3 to 10 radial threads on the posterior ear of right valves; byssal notch deep, ctenolium generally with 3 teeth. Hinge with provinculum, one pair of cardinal crura, two rudimentary anterior crura, and one rudimentary posterior crus; resilial pit medium size, triangular, and inclined slightly to the posterior. Adductor muscle scars large, probably a single scar in the left valve, a divided scar in the right valve with the dorsal portion larger; interior of valve with fluted internal ribs along ventral margin."

Discussion: This is the largest species of Pectinacea that occurs in the Vicksburg Group. It is particularly common in the Mint Spring Formation near Cleary, Mississippi, and is characterized by broad ribs and interspaces that are covered by fine radial lirations (see Plate 11, figure 11B).

Type: Holotype 8295 LSUGM and Paratype 8297 LSUGM from the Mint Spring Formation, Rees property near Cleary, Mississippi; Paratype 8296 LSUGM from the Mint Spring Formation, MGS locality 107b.

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 90, 99a, 97, 100a, 107b, 110; Marianna Limestone, locality 91a.

Genus PECTEN Muller, 1776

Subgenus PECTEN Muller, 1776

Pecten (Pecten) perplanus Morton

Plate 10, figures 1, 5; Plate 12, figures 8-9; Plate 59, figures 1-4; Text Figure 32, 6

1833. *Pecten perplanus* Morton, Amer. Jour. Sci., ser. 1, v. 23, p. 293, pl. 5, fig. 5.

1834. *Pecten perplanus* Morton. Morton, Synop. organic remains, Cretaceous Gr., p. 58, pl. 5, fig. 5; pl. 15, fig. 8.

1850. *Pecten perplanus* Morton. d'Orbigny, Prodrome de stratigraphique universelle . . . : Paris, v. 2, p. 393.

1890. *Pecten perplanus* Morton. de Gregorio, Ann. Geol. et Paléont., livr. 7 et 8, p. 182, pl. 21, fig. 30, 31 (Copy Morton).

1933. *Pecten perplanus* Morton. Cooke, Amer. Assoc. Petroleum Geologist Bull., v. 17, No. 11, p. 1388 (*P. perplanus* Morton was originally applied to the flat valve of *P. poulsoni* Morton and is therefore a synonym of *P. poulsoni*).

1938. Not *Chlamys* (*Aequipecten*) *perplanus* (Morton). Tucker-Rowland, Mus. Royal Hist. Nat. Belgique, Mem., ser. 2, fasc. 13, p. 31, pl. 6, fig. 6. [= *Chlamys* (*Aequipecten*) *spillmani* (Gabb)].

1944. Not *Pecten* (*Aequipecten*) *perplanus* Morton. Shimer and Shrock, Index fossils of North America, p. 407.

1945. *Pecten perplanus* Morton. Gardner, Geol. Soc. Amer. Memoir 11, p. 62 (Exact locality for *P. poulsoni* and *P. perplanus* are not known; figures by Lesueur and Morton are inadequate reproductions).

1946. *Pecten perplanus* Morton. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 27, pl. 7, fig. 5-9, not fig. 10, 11.

1951. *Pecten perplanus* Morton, var. Harris, Bull. Amer. Paleont., v. 33, No. 138, p. 8, pl. 3, fig. 5-8 (Upper Eocene; Bumpnose Limestone, Florida).

1965. *Aequipecten perplanus* (Morton). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 25 (part), not pl. 1, fig. 8, 9.

1969. *Pecten perplanus perplanus* Morton. Glawe, Geol. Survey Alabama, Bull., No. 91, p. 40-44, pl. 2, fig. 1-10 (Occurrence: Red Bluff Clay and lower Marianna Limestone of eastern Mississippi and western Alabama; Bumpnose Limestone, Florida; p. 42).

1980. *Pecten perplanus* Morton. Dockery, Miss Bureau Geol., Bull. No. 122, p. 156-157, pl. 78, fig. 3.

Original Description: Morton, 1833.

"Depressed, with about twenty simple-costae, transversely striated. Diameter less than an inch. Found with the preceding species."

Discussion of Glawe, 1969.

"DIAGNOSIS: *Pecten perplanus* having ribs of the right valve fairly low, rounded in transverse profile, and smooth in the dominate form.

"DESCRIPTION: Shell orbicular, thin to moderately thick; small; maximum height 36.4 mm (mean height 20.37 mm), maximum length 37.5 mm (mean length 20.85 mm); unequally biconvex, the right valve moderately to greatly convex (mean I:H = 0.25), the left slightly to moderately convex (mean I:H = 0.16); hinge line slightly concave in right valve, nearly straight in left valve; ribs fairly low, rounded, and usually smooth or occasionally unilirate or trilirate in the adult portion of the disc; ribs slightly wider than interspaces; right valve with 15 to 21 ribs (mean 17.9); left valve with 15 to 22 ribs (mean 18.0); concentric lamellae widely spaced with ventrally directed imbrications on the ribs in the younger portion of the disc to slightly sinuous in the adult portion. Ears fairly large, subequal, faintly to prominently striated with 2 to 6 radial threads on the anterior ear, 2 to 9 radial threads on the posterior ear; byssal notch moderately deep; ctenolium visible in small specimens. Hinge with provinculum, 1 or 2 pairs of cardinal crura, and one pair of distinct ridgelike auricular denticles; resilial pit rather small and narrow, fringed with lateral ridges in the right valve. Adductor muscle scars large, a single scar in the left valve and a divided scar in the right valve with the dorsal portion being larger; interior of valves with faint internal ribs fluted along the ventral margin.

"REMARKS: As the type of *P. perplanus* Morton appears to be lost (*fide* Harris and Palmer, 1946, p. 27; the statement in Palmer and Brann, 1965, p. 25, to the contrary is an error according to Palmer, 1965, personal communication), it is desirable to designate a neotype. Although Morton in his original description writes, "Found with the preceding species (i.e., *Chlamys anatipes*) in overlying limestone of Claiborne, Alabama," subsequent investigations have failed to turn up true pectens in the vicinity of Claiborne, Alabama. Harris and Palmer (1946) assigned material from St. Stephens, Alabama, to *P. perplanus*, and therefore the neotype locality is here precisely designated as the top of the Red Bluff Clay at the Lone Star Cement Company quarry at St. Stephens bluff, Alabama (section 08)."

Discussion: A succession of three similar *Pecten* species occurs in the Vicksburg Group. These are: (1) *Pecten perplanus* of the Red Bluff and Forest Hill Formations and the lower Marianna Limestone, (2) *Pecten poulsoni* of the Mint Spring Formation, the Marianna Limestone, and the lower Glendon Limestone, and (3) *Pecten byramensis* of the Glendon Limestone and the Byram and Bucatunna Formations. The preceding species are the most useful bivalve guide fossils in the Lower Oligocene of the Gulf Coastal Plains.

There is some uncertainty as to the identity of Morton's type for *Pecten perplanus* which is missing. Cooke (1933) thought the type to have been a flat left valve of *Pecten poulsoni*. Morton stated that *P. perplanus* occurred with *Chlamys* (*Anatipopecten*) *anatipes* in the overlying limestone at Claiborne. As this latter species occurs throughout the Vicksburg Group, it is of little help in determining the horizon of Morton's type. Glawe (1969) designated a neotype from the Red Bluff Formation.

Pecten perplanus is distinguished from the other *Pecten* of the Vicksburg Group by its simple, rounded, low ribs, by the moderate convexity of the right valve, and by its smaller size. A variation of this spe-

cies has intercalary lirae and trilirate ribs (see Plate 12, figure 8b and Plate 59, figures 5-7).

Type: Neotype 8053 LSUGM from the Red Bluff Formation, St. Stephens quarry, St. Stephens, Alabama.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 40, 46; Forest Hill Formation, locality 75a. Also from Red Bluff Formation and lower Marianna Limestone in Alabama and the Bumpnose Limestone in Florida. For additional localities see Glawe, 1969.

Pecten (Pecten) poulsoni Morton

Plate 12, figures 10-12

1829. *Pecten unicarinata* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 4 (unpublished manuscript).
1834. *Pecten poulsoni* Morton, Synop. organic remains, Cretaceous Gr., p. 59, pl. 19, fig. 2.
1890. *?Pecten (Janira) promens* de Gregorio, Ann. Geol. et Paleont., livr. 7 et 8, p. 182, pl. 21, fig. 17-25.
1890. *?Pecten (Janira) poulsoni* Morton. de Gregorio, *Ibid*, p. 182, pl. 21, fig. 27.
1898. *Pecten (Pecten) poulsoni* Morton. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, p. 719 (part).
1926. *Pecten poulsoni* Morton. Cooke, in Geol. Survey Alabama Spec. Rept. 14, p. 97, fig. 1a, 1b.
1929. *Pecten poulsoni* Morton. Cooke and Mossom, Florida Geol. Survey, 20th Ann. Rept., p. 62, pl. 7, fig. 1a, 1b.
1936. *Pecten (Pecten) poulsoni* Morton. Tucker, Amer. Midland, Nat., v. 17, p. 476 (part).
1945. *?Pecten (Pecten)* sp. cf. *P. (P.) poulsoni* Morton. Gardner, Geol. Soc. Amer. Memoir 11, p. 62 (Oligocene, Mexico).
1957. *Pecten poulsoni* Morton. Ivey, Alabama Geol. Survey, Bull., No. 66, pl. 10, fig. 5, pl. 11, fig. 4.
1963. *Pecten (Pecten) poulsoni* Morton. Delaney, Jour. Paleont., v. 37, No. 6, p. 1267 (part), pl. 178, fig. 1-4, 7-8, 10-11.
1968. *Pecten poulsoni* Morton. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 77 (Type lot? 274).
1969. *Pecten perplanus poulsoni* Morton. Glawe, Geol. Survey Alabama, Bull., No. 91, p. 44, 48-51, pl. 1, fig. 3, 5; pl. 3, fig. 1, 3, 4, 6 (Occurrence: Mint Spring Marl, Marianna Limestone, and lower Glendon Limestone of Mississippi; and upper Marianna and lower Glendon Limestone of southwestern Alabama).
1980. *Pecten poulsoni* Morton. Dockery, Miss. Bureau Geol., Bull. No. 122, p. 157, pl. 80, fig. 8; pl. 81, fig. 1-8; pl. 82, fig. 3.

Original Description: Morton, 1834.

"Specific character. Suborbicular; superior valve flat; ribs fourteen, not profoundly elevated, with crowded wrinkled striae; inferior valve ventricose, with prominent rounded ribs, the intervals striated; ears subequal.

"Common in the newer cretaceous deposits near Claiborne, Alabama.

"I have much pleasure in naming this shell after my friend Charles A. Poulson, Esq., of this city."

Description of Glawe, 1968.

"DIAGNOSIS: *Pecten perplanus* having ribs of the right valve of medium height, rounded to square in transverse profile and unilirate in the adult portion of the disc of the dominant form.

"DESCRIPTION: Shell orbicular, thin to moderately thick, small; maximum height 34.3 mm (mean height 20.17 mm), maximum length 37.2 mm (mean length 20.88 mm); unequally biconvex, the right valve moderately to very deeply convex (mean I:H =0.31), the left slightly to moderately convex (mean I:H =0.14); hinge line slightly concave in right valve, nearly straight in left valve; ribs of medium height, rounded to square shouldered and smooth, unilirate, or trilirate in the adult portion of the disc; ribs slightly wider than interspaces; right valve with 16 to 21 ribs (mean 18.5); left valve with 15 to 22 ribs (mean 18.4); concentric lamellae widely spaced with ventrally directed imbrications over the ribs. Ears rather large, subequal, prominently striated with 3 to 6 radial threads on each; byssal notch moderately deep; ctenolium visible in small individuals. Hinge with provinculum, two pairs of cardinal crura (occasional specimens have a rudimentary third posterior crus); one pair of auricular crura terminating distally in a rounded, oblong ridge; resilial pit rather small, fringed with lateral ridges in the right valve. Adductor muscle scars large; a single scar in the left valve; scar in right valve observable but structure (i.e., whether divided or not) not discernible; interior valves with faint internal ribs which are fluted along the ventral margin.

"REMARKS: The syntypes of *Pecten poulsoni* Morton are labeled Acad. Nat. Sci. Philadelphia, no. 274 from St. Stephens, Alabama (*fide* Tucker-Rowland, 1936). They consist of five right valves and nine left valves mounted on a card. The third specimen from the top in the right hand column is here designated the lectotype."

Discussion: *Pecten poulsoni* can be distinguished from *P. perplanus* and *P. byramensis* by the prominent, unilirate ribs and the strongly inflated umbo of the right valve (see Plate 12, figures 10b and 10c). The left valves in some specimens are slightly concave. *P. poulsoni* is very common in the Mint Spring Formation and Marianna Limestone.

Type: Lectotype 274 ANSP probably from the Marianna Limestone, St. Stephens, Alabama.

Occurrence: Mississippi: Mint Spring Formation, localities 74b, 75a, 89a, 97, 99a, 100a, 108a, 111; Common at most localities for the Marianna Limestone. Also occurs in the Marianna and lower Glendon Limestones in Alabama.

Pecten (Pecten) byramensis Gardner

Plate 11, figures 6-7; Plate 13, figures 1-4, 6-7

1829. *Pecten limatula* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 2-3 (unpublished manuscript).

1898. *Pecten (Pecten) poulsoni* Morton. Dall, Wagner Free Inst. Sci., Philadelphia, Trans., v. 3, p. 719 (part).

1917. *Pecten poulsoni* Morton. Hopkins, U. S. Geol. Survey Bull. 66-H, p. 27, fig. 3, 3a.

1922. *Pecten poulsoni* Morton. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (part).

1933. *?Pecten poulsoni* Morton. Shreveport Geol. Soc., Guidebook, 10th Ann. Field Trip, pl. 2, fig. 1-4.

1936. *Pecten (Pecten) poulsoni* Morton. Tucker, Amer. Midland Nat., v. 17, p. 476 (part), pl. 1, fig. 5, 6.

1945. *Pecten (Pecten) byramensis* Gardner, Geol. Soc. Amer. Memoir 11, p. 62-63, pl. 10, fig. 1-4 (Types not illustrated).

1946. *Pecten perplanus* Morton. Harris and Palmer, Bull. Amer. Paleont., v. 30, pl. 7, fig. 10, 11.

1957. *Pecten byramensis* Gardner. Ivey, Geol. Survey Alabama, Bull., No. 66, pl. 12, fig. 1-6, 10-14.

1963. *Pecten (Pecten) poulsoni* Morton. Delaney, Jour. Paleont., v. 37, No. 6, p. 1267 (part), pl. 178, fig. 5, 6, 9, 12, 14.

1969. *Pecten perplanus byramensis* Gardner. Glawe, Geol. Survey Alabama, Bull., No. 91, p. 51-54, pl. 1, fig. 7; pl. 3, fig. 2, 5, 7, 8; pl. 4, fig. 3, 6.

1980. *Pecten byramensis* Gardner. Dockery, Miss. Bureau Geol., Bull. No. 122, p. 157-158, pl. 82, fig. 5-6.

Original Description: Gardner, 1945.

"The specimens from the Oligocene at U. S. G. S. sta. 13581 (P-25), Rancho Gigante, Escondido, Mendez, Tamaulipas, agree essentially with those figured by Hopkins, 1917, except for the flattening toward the umbones, and are tentatively referred to that species. The right valve illustrated in Hopkins' report is from Pearl River, just above the bridge at Byram, Hinds County, Mississippi; the left is from the Byram marl as it is exposed at Vicksburg, Mississippi. The following descriptive notes are based upon the Byram and Vicksburg specimens as the cotypes.

"The right valve is inflated and slightly wider than it is high; the left valve is flattened, and the apical angle 115° or more. About 18 ribs spring from the umbones of the right valve. They are narrow, rounded, regular in size and spacing at their inception and though they become increasingly broader and higher they remain simple for more than half the distance from the umbones to the ventral margin. A pronounced resting stage is indicated; dorsal to the break, the ribs are simple except for exceedingly faint and fine lirations upon the crests; ventral to it, a medial secondary follows the crest, and the edges of the ribs tend to be pinched so that at the ventral margin of the disk, in some individuals, there are 3 fairly well defined secondaries upon the summit of each primary. The channels between the radials are of approximately the same width as the radials and are evenly and sharply laminated by the incrementals.

"The number of radials upon the left valve may be lower by one, the secondary sculpture is more obscure or absent altogether, and the concentric imbrication decidedly sharper. The submargins on both valves are narrow, steep, and barbed by the incrementals. The auricles are of moderate size. There is no sharply defined byssal notch or ctenolium but a slight constriction at the base of the right anterior auricle. The usual number of radials both on the right and the left anterior and posterior auricles is 5 or 4; they are distinct but by no means prominent and are overridden by the sharp and crowded growth laminae. The dorsal margins of the right valve are turned inward and are slightly higher than those of the left. There is a small trigonal subumbonal ligament pit and a marginal ligament groove extending the length of the dorsal margins. The two pairs of cardinal crurae as well as strong radial sculpture ally both *Pecten poulsoni* and *Pecten byramensis* with *Pecten (Pecten)* rather than with *Pecten (Euvola)* Dall. The single muscle impression is large and is contained, for the most part, within the posterior dorsal quadrant. The ribbing pattern crenulates the margin and is reflected over the entire ventral portion of the inner surface. The specimens figured in the Hopkins' report are designated as the cotypes.

"*Pecten byramensis* differs from *Pecten poulsoni* in the lower convexity of the right valve, the higher rib count, and the development of a secondary liration on the adult primaries. Because of these constant differences and its later appearance in Vicksburg time, *Pecten byramensis* is considered closely related to *Pecten poulsoni* but distinct from it."

Description of Glawe, 1968.

"DIAGNOSIS: *Pecten perplanus* having ribs of the right valve of medium height, typically square shouldered and trilirate in the adult portion of the disc of the dominant form.

"DESCRIPTION: Shell orbicular, moderately to very thick, small; maximum height 38.8 mm (mean height 22.05 mm), maximum length 39.0 mm (mean length 22.67 mm); unequally biconvex, the right valve moderately to deeply convex (mean I:H = 0.29), the left slightly to moderately convex (mean I:H = 0.15); hinge line slightly concave in right valve, nearly straight in left valve; ribs of medium height, round to square shouldered, unilirate or trilirate in the adult portion of the disc; ribs wider than interspaces; right valve with 17 to 23 ribs (mean 19.4); left valve with 17 to 22 ribs (mean 19.6); concentric lamellae coarse; ears large, subequal, prominently striated with 3 to 7 radial threads on anterior ear and 3 to 8 radial threads on posterior ear; byssal notch rather shallow; ctenolium visible only in small specimens. Hinge with provinculum and two pairs of cardinal crura, occasionally a rudimentary third posterior crus, and one pair of auricular crura terminating distally in a strong rounded, oblong ridge; resilial pit rather small, fringed with distinct lateral ridges in the right valve. Adductor muscle scars large, a single scar in the left valve, a divided scar in the right valve with the dorsal portion larger; interior of valve with faint internal ribs which are fluted along the ventral margin."

Discussion: *Pecten byramensis* has the broadest distribution of the Vicksburg *Pecten* series with an occurrence around the Gulf from Tamaulipas, Mexico, to Florida. It is easily distinguished from the other *Pecten* species by its square-shouldered, trilirate ribs. Because of the diagnostic ribs, this species can be easily identified from shell fragments and is a useful tool in paleostratigraphic work.

Types: Lectotype 370818 USNM from the Byram Formation, MGS locality 102, and paralectotype 370819 USNM from the Byram Formation, Vicksburg, Mississippi.

Occurrence: Mississippi: Glendon Limestone, localities 42, 91b, 92b, 98b, 104, 105b, 112b; Byram Formation, localities 93, 94, 102, 106a, 109, 112c, 113b, 114, 115, 116; Bucatunna Formation, locality 98d. Also occurs in the Oligocene beds of Tamaulipas, Mexico; Rosefield Formation of Louisiana; Glendon Limestone and Byram Formation of Alabama; and Suwannee Limestone of Florida.

Pecten sp.

1848a. *Pecten* sp. Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 296.
1848b. *Pecten* sp. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 11, 15.

Original Description: Conrad, 1848a.

"A valve of a small species was obtained. It is orbicular and entire, and resembles *P. calvatus*, (Morton)."

Discussion: The identity of this species is uncertain.

Occurrence: Mississippi: Vicksburg Group, Vicksburg.

Family PLICATULIDAE Watson, 1930
Genus PLICATULA Lamarck, 1801

Plicatula variplicata n. sp.
Plate 13, figures 5, 8-11

Description: Shell outline irregular or produced posteriorly; hinge teeth strong and laterally striated; inequivalved, right valve more inflated and most strongly convex along the anterior margin; right valve with large attachment scar, left valve often showing positive replica of substrate; some valves crenulate with small irregularly spaced scales or nodes just inside shell margin; adductor muscle scar large but not strongly impressed; exterior smooth to strongly plicate.

Discussion: Left valves of this species occur more commonly than do right valves. When the valves are articulated the teeth interlock so strongly that the teeth and hinge of the right valve are broken if the valves are pried apart. This species differs from *Plicatula filamentosa* of the Claiborne Group in that it lacks fine radial striations and has plications of variable strength. It resembles *Plicatula densata* in its irregular plications but is much smaller. The name refers to the species' variable plications.

Type: Holotype 340435 USNM from the Byram Formation, locality 93.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 40; Forest Hill Formation, locality 75a; Byram Formation, locality 93.

Family SPONDYLIDAE Gray, 1826
Genus SPONDYLUS Linné, 1758
Subgenus SPONDYLUS Linné, 1758

Spondylus (Spondylus) dumosus (Morton)
Plate 14, figures 1-9; Text Figures 33; 32, 1

1834. *Plagiostoma dumosum* Morton, Syncp. organic remains, Crectaceous Gr., p. 59, pl. 16, fig. 8, text fig. p. 60.
1834. *Plagiostoma dumosum* Morton. Conrad, App. in Morton, Ibid, p. 6.
1842. *Plagiostoma dumosum* Morton. Morton, Acad. Nat. Sci. Philadelphia, Jour., 1st ser., v. 8, pt. 2, p. 216.
1850. *Lima dumosa* (Morton). d'Orbigny, Prodrome de paleontogie stratigraphique universelle . . ., Paris, v. 2, p. 392.
1865. *Spondylus dumosus* (Morton). Conrad, Amer. Jour. Conch., v. 1, No. 1, p. 14.
1866. *Spondylus dumosus* (Morton). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 23.
1890. *Spondylus dumosus* (Morton). de Gregorio, Ann. Geol. et Paleont., livr. 7 et 8, p. 179 (in subgenus *Plagiostoma*).
1893. *Spondylus dumosus* (Morton). Cossmann, Ann. Geol. et Paleont., livr. 12, p. 18.
1898. *Spondylus dumosus* (Morton). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 758.
1917. *Spondylus dumosus* (Morton). Hopkins, U. S. Geol. Sur., Bull. 66-H, p. 299, fig. 5.
1946. *Spondylus dumosus* (Morton). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 25, pl. 6, fig. 2, 2a (Figured specimens were associated with *Zeuglodon* remains south of Melvin, Alabama. They may be from remnants of weathered Red Bluff beds in the area.).
1960. *Spondylus dumosus* (Morton). Brann and Kent, Bull. Amer. Paleont., v. 40, No. 184, p. 816.
1965. *Spondylus dumosus* (Morton). Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 300 (Range: upper Eocene, Moodys Branch Fm.; lower Oligocene, Red Bluff Fm. Type is from the Red Bluff Fm. at St. Stephens Bluff, Tombigbee River, Alabama.).

1974. *Spondylus dumosus* (Conrad). May, Mississippi Geol. Survey Bull., No. 117, p. 52, 56, fig. 16.

1980. *Spondylus* (*Spondylus*) *dumosus* (Morton). Dockery, Miss. Bureau Geol., Bull. No. 122, p. 159, pl. 78, fig. 1, 2, 5; pl. 80, fig. 1-3.

Original Description: Morton, 1834.

"Shell obovate, slightly ventricose, with nine or ten slightly elevated ribs, armed with long spines on each valve; spines flattened, and with a longitudinal groove beneath; intervals beneath the ribs, with two or three slightly prominent longitudinal lines.

"The annexed cut represents the most perfect specimen, of the natural size: but the largest measures, from beak to base, three inches; from anterior to posterior margins, two inches and a half, and was associated with numbers of nearly the same size in a mass of limestone. Mr. Conrad observed a stratum of this species, in company with OSTREA *panda*, near low water mark, in the interesting bluff at St. Stephens, on the Tombeckbe (sic); and it is a characteristic species of the newer cretaceous deposits of the southern states.

"It has a considerable general resemblance to *P. spinosum* of Sowerby; but differs from the latter in having spines on *each valve*, those on *P. spinosum* being confined to the upper valve, as is beautifully illustrated in Cuvier and Brongniart's *Geologie des Environs de Paris*, pl. iv, fig. 2."

Discussion: This species is characterized by its flat, rather narrow, elongate spines. The purpose of these long spines was probably to anchor the valves in the muddy sediments of the Red Bluff near-shore, marine shelf environment. Large valves of this species are locally abundant at locality 40, but are rare at most Red Bluff localities in Mississippi.

Type: Holotype missing, from the Red Bluff Formation, Tombigbee River, St. Stephens, Alabama.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 38, 39, 40. Also in the Red Bluff Formation in Alabama.

Spondylus (Spondylus) sp.

Plate 14, figure 10

Description: Shell thin, moderately inflated, exterior with 13 rows of short spines, interspaces with 4 to 6 lirae having fine spines.

Discussion: Only one incomplete right valve, which is missing the hinge, has been found of this species. It differs from *Spondylus* (*Spondylus*) *dumosus* in having: (1) a thinner shell, (2) smaller spines, and (3) fine, spinose, intervening lirae between spine rows.

Occurrence: Mississippi: Marianna Limestone, from a foot-thick layer of glauconitic sand near the top at locality 98a.

Spondylus (Spondylus) granulocostatus n. sp.

Plate 15, figures 4-5

Description: Shell thick, moderately inflated; right and left valves similarly sculptured with 6 broadly spaced rows of upturned spines and intervening nodose lirae.

Discussion: The broadly spaced spine rows and the nodose intervening lirae distinguish this species from *Spondylus* (*Spondylus*) *dumosus* with which it occurs. The names refer to the granular texture produced by the nodose lirae. This species is known from the two figured specimens and four additional fragments collected by Harold and Emily Vokes from the Red Bluff Formation at St. Stephens quarry, Alabama.

Type: Holotype 340439 USNM from the Red Bluff Formation, Pelham Hill, St. Stephens quarry, St. Stephens, Washington County, Alabama.

Occurrence: Alabama: Red Bluff Formation, Pelham Hill, St. Stephens quarry, St. Stephens, Washington County, Alabama.

Spondylus (Spondylus) filiaris Dall

Plate 15, figures 1-3, 6-7; Plate 58, figures 7-8, 11-12

1916. *Spondylus filiaris* Dall, U. S. Natl. Mus., Proc., v. 51, No. 2162, p. 493, pl. 83, fig. 5-6.

Original Description: Dall, 1916.

"Shell large, thin, more or less irregular from its attachment to irregular surfaces which its growth follows, sculptured with small low radiating rounded threads without spiny processes, arranged in groups of five to eight, with the interspaces averaging subequal; these groups separated by larger but similar single threads; the inner margin of the valves slightly crenulated; concentric sculpture of inconspicuous incremental lines; beak of upper valve rather pointed, with a small and narrow inconspicuous auricle on each side, the lower valve not obtained; the hinge as usual in the genus, but narrow with a small resilifer. Height of large upper valve, approximately, 65; breadth, 57; depth, 18 mm. The small valve figured is about 20 mm. in height.

"*Locality.* - Station 7078, on the east bank of Flint River, near the lower end of Smith's Reach, about one-quarter of a mile below Hale Landing, Decatur County, Georgia; collected by Dr. C. Wythe Cooke and W. C. Mansfield, 1914. Also with *Spondylus bostrychites* Guppy, in the Tampa silex beds at Ballast Point, Tampa Bay, Florida, by W. H. Dall in 1886. U. S. Nat. Mus. Cat. No. 166712.

"This species is represented by a defective specimen in the Tampa collection which was supposed, when studied, to be a worn variant of *S. bostrychites*. But the more complete material obtained on the Flint River shows that its sculpture does not take on the spinose character of the latter species and the sculpture is finer and more regular. Between perfect shells the distinctiveness should be complete."

Discussion: The syntypes of the species are incomplete casts from the Flint River Formation in Georgia (see Plate 58, figures 11-12). Specimens with much better preservation occur in the Mint Spring Formation along the Chickasawhay River in Wayne County, Mississippi (Plate 15, figures 1-3). This species is

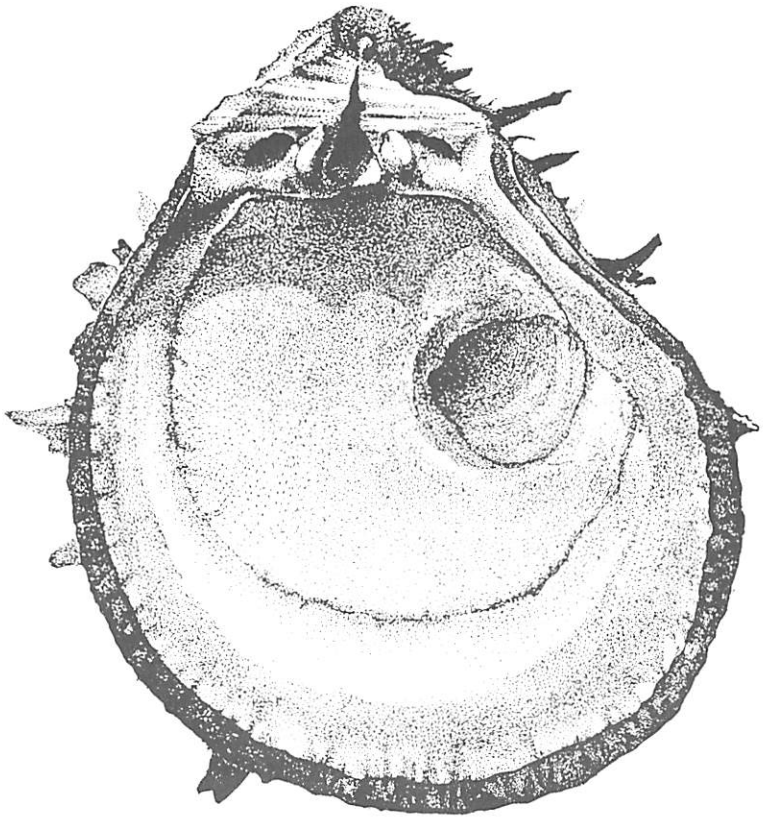


Figure 33 — *Spondylus* (*Spondylus*) *dumosus* (Morton), right valve. Illustration by Julia H. Suits.

characterized by radial lirae and the lack of prominent spines. Strong concentric laminae are developed in some variations (see Plate 58, figures 7-8). These laminae probably served the same function of anchoring the right valve to the substrate as do spines in other species.

Type: Two syntypes A-B 166712 USNM from the Flint River Formation, Flint River, Decatur County, Georgia.

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 74b, 75b, 117b; Byram Formation, locality 93. Georgia: Flint River Formation, Decatur County.

Superfamily DIMYACEA Fischer, 1886

Family DIMYIDAE Fischer, 1886

Genus DIMYA Rouault, 1850

Dimya rufaripa H. E. Vokes

Plate 16, figures 1-3, 5

1979. *Dimya rufaripa* H. E. Vokes, Tulane Studies Geol. Paleont., v. 15, No. 2, p. 39-40, pl. 1, fig. 6-9.

Original Description: H. E. Vokes, 1979.

"*Description:* Shell small, averaging about 5 mm in height - the largest specimen being 7.2 mm high and 8.3 mm long; round to roundly ovate, attached by the right valve; left valve smaller, fitting inside the outer edges of the right. Both valves, outside of the area of attachment, ornamented by fine, rounded, divaricating radial ribs with round-bottomed interspaces of almost equal width; the individual ribs essentially of equal strength from their first appearance at the edge of the attachment area to the valve margin, with each rib divaricating repeatedly to accommodate the increased width toward the marginal area. The attachment area of the right valve tending to mirror the surface ornament of the object to which it was cemented; that of the left smooth and generally somewhat raised to form a boss-like elevation from the lower, outer edges of which the radial ornament trends across a lower and flatter marginal area. The shell material having, especially in the marginal areas, a distinctly micaceous appearance. Hingeline variable in length, depending upon nature of attachment, generally short, with a small umbonal angle immediately above the triangular capping of the small, ovate resilial pit. Visceral area with a white, porcellaneous coating, strongest inside of the entire pallial line; unlike the other species here discussed, in the area between the pallial line and the row of pits or low ridges seemingly not covered with the porcellaneous coating, the area being almost dark gray to black in color and smooth except for widely spaced, low rounded, irregularly radial riblets that cross from the outer row of ridges and pits to the inner edge of the coated portion of the visceral area. The riblets becoming much more numerous and closely adjacent as they enter upon the raised crura-like dorsal margins of the area. In the left valve the outer row characteristically appearing to have been marked by narrow grooves that divide a small raised area into two closely approximate ridges, the crests of the ridged margins of the right being received in the inter-ridge grooves of the left. External to the outer row of ridges

the shell margins smooth in the right valve up to the extreme outer edge, where the thinned shell material becomes slightly corrugated by the ends of the external ribs; in the left valve the ventral margins beyond the outer row of ridges and grooves tending to be reflexed to fit inside the more concave interior of the right. Anterior adductor scar elongate-elliptical, located on the pallial line moderately high on the valve and well impressed; posterior scar duplicate, the two units being dorso-ventral to each other, both situated well within the pallial line.

"*Remarks: Dimya rufaripa*, n. sp. may be distinguished by its small size and the relatively fine, divaricate external radial ribbing. The older *D. alleni*, although similarly small, is almost smooth externally and *D. tigrina*, which is a little larger, has a somewhat more irregular radial ornament that is frilled by raised, concentric growth lamellae. The European lower Oligocene *D. fragilis* von Koenen (1893, p. 1065, pl. 69, figs. 5a-c, 6a-c), similarly small, is almost smooth, lacking the divaricate radial ornament.

"The above description is based upon 679 specimens from five localities in the Red Bluff Clay, lower Oligocene of eastern Mississippi. It is of interest to note that of the 250 specimens in which the right valve was found attached to identifiable shell substrate, 240 were on valves or fragments of valves of pelecypod species; only ten were on fragments of a weakly ornamented gastropod and not one specimen was found attached to any of the rather abundant corals. Almost one-half of those attached to pelecypods (122 of 250) were found on the relatively smooth upper valves of ostreids, the remainder were on species of *Spondylus*, *Astarte*, *Corbula*, *Protocardia*, etc.

"The specific name is in reference to its occurrence in the Red Bluff Clay (*rufus* = red; *ripa* = river bank). Specimens in the collection are from TU localities 226, 642, 1288, and 1289, on the Chickasawhay River near Hiwannee and from Sand Branch Creek, Wayne Co., Mississippi, TU locality 1291."

Discussion: Generally this species has an exterior sculpture of radial ribs past the point of attachment on the right valve and past the positive replica of the attachment substrate on the left valve. A variation illustrated in Plate 16, figure 5 has a smooth exterior.

Type: Holotype 263965 USNM, paratype A 263964 USNM, paratype B 263966 USNM, and paratype C 263967 USNM, all from the Red Bluff Formation, Tulane locality 226, MGS locality 35b.

Occurrence: Mississippi: Red Bluff Fm., localities 34b, 35b, 37, 40.

Superfamily ANOMIACEA Rafinesque, 1815
Family ANOMIIDAE Rafinesque, 1815
Genus ANOMIA Linné, 1758

Anomia microstriata n. sp.

Plate 16, figures 4, 6, 8; Plate 58, figure 9

Description: Shell irregular; muscle scars indistinct, hinge thickening or infolded at margins of resilifer; shell thin and fragile at beak above resilifer; exterior with fine, closely-spaced, wavy lirations.

Discussion: Only left valves of this species have been found, and they show considerable variation in form. Because the muscle scars are indistinct, their number and form is uncertain. *Anomia micrograma*ta Dall from the Alum Bluff Group in Florida is similar to this species in its irregular shell and wavy striations but lacks the strongly impressed resilifer.

Type: Holotype 340440 USNM from the Mint Spring Formation, locality 99a.

Occurrence: Mississippi: Mint Spring Formation, localities 75b, 90, 99a, 100a.

Family LIMIDAE Rafinesque, 1815
Genus LIMARIA Link, 1807
Subgenus LIMARIA Link, 1807

Limaria (Limaria) staminea (Conrad)

Plate 17, figures 1-4

1829. *Lima parvula* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 6 (unpublished manuscript).
1848a. *Lima staminea* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 296.
1848b. *Lima staminea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 126, pl. 13, fig. 30.
1865. *Radula staminea* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 13 (Catalog).
1866. *Radula staminea* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1898. *Lima staminea* Conrad. Dall. Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 766 (Compared with *Lima* (*Lima*) *vicksburgiana* Dall of Levy Co., Florida).
1962. *Lima staminea* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 70 (3 probable syntypes 30656).
1968. *Lima staminea* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 86 (Syntypes 30656).

Original Description: Conrad, 1848a.

"Subovate, oblique, inflated, with fine radiating lines; ears very small, scarcely defined; posterior margin rectilinear. Height 4-10.

"Very similar in outline to the Miocene species, *L. papyria*, but it is much smaller, and has more numerous lines anteriorly. Rare."

Discussion: This species is similar to *Limaria* (*Limaria*) *carolinensis* (Dall) from the Duplin Formation in South Carolina and the Alum Bluff Group in Florida.

Type: Three syntypes A-C 30656 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 17, figures 2-4).

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 100a, Vicksburg.

Limaria sp.

Plate 17, figure 6

Description: Shell small, moderately inflated, auricles small, interior margin crenulate at intersection of ribs; exterior with 14 strong radial ribs.

Discussion: This species differs from the young of *Limaria* (*Limaria*) *staminea* (Conrad) in that: (1) it is less elevated, (2) it has weaker auricles, and (3) it has coarser and fewer radial ribs (14 rather than 28). It is known only from the specimen illustrated.

Occurrence: Mississippi: Forest Hill Formation, locality 75a.

Suborder OSTREINA Ferussac, 1822

Superfamily OSTREACEA Rafinesque, 1815

Family OSTREIDAE Rafinesque, 1815

Subfamily OSTREINAE Rafinesque, 1815

Genus CRASSOSTREA Sacco, 1897

Crassostrea sp.

1829. Lesueur, Walnut Hills fossil shells, pl. 12, fig. 7-9 (no name).

Discussion: Large, thick, and usually badly worn oyster shells occur frequently in the Mint Spring Formation. The best preserved specimens of these shells are illustrated by Lesueur (1829), and he did not give a name to this species. His illustration in Plate 12, figure 8, shows a highly elevated shell with an elevated ligament area. Specimens of this species may have been included by Gabb in his species *Ostrea mauricensis* Gabb, 1860, as the species was reported from the beds at Vicksburg, Mississippi. Dall, 1916, also reported this latter species from: (1) the Oligocene of southern New Jersey, (2) the layers above the Altamaha grit of Georgia, (3) the *Orthaulax pugnax* zone at Ballast Point, Tampa Bay, Florida, and (4) the Flint River Formation at Bainbridge, Decatur County, Georgia.

Occurrence: Mississippi: Mint Spring Formation, Vicksburg.

Genus OSTREA Linné, 1758

Ostrea paroxis Lesueur, n. sp.

Plate 17, figure 13; Plate 59, figure 10; Plate 60, figures 1-3

1829. *Ostrea paroxis* Lesueur, Walnut Hills fossil shells, pl. 8, fig. 17 (unpublished manuscript).

Description: Shell large, thick, modestly inflated, circular to highly elevated, attached by major portion of left valve; right valve smooth or with broad radial folds; adductor muscle scar ovate; ligament area modest, curved toward the posterior; chomata generally restricted to vicinity of hinge.

Discussion: This species differs from *Lopha* (*Lopha*) *vicksburgensis* with which it is associated by having a broad attachment area on the left valve and in lacking strong radial folds or plications. It is commonly attached to indurated clay clasts or other oyster shells. The specimen figured in Plate 17, figure 13, appears to have been attached to a large *Aturia* shell. Specimens from the Mint Spring Formation in Wayne County are commonly attached to clay clasts and are highly elevated (see Plate 60, figures 2 and 3).

Type: Holotype 340441 USNM from the Mint Spring Formation, locality 99a.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 39; Forest Hill Formation, locality 75a; Mint Spring Formation, localities 74b, 75a, 90, 97, 99a, 100a; Byram Formation, localities 93, 106a, 112c, 115, 116.

Ostrea sp.

Plate 16, figures 7, 9-10

Description: Shell small, thin; left valve moderately inflated; right valve slightly inflated; ligament area small, triangular; anterior and posterior hinge margins generally straight on right valve producing a triangular outline; exterior smooth except for growth ridges.

Discussion: This species is small and fragile. The shell is thin, transluscent, and brown in color.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38; Mint Spring Formation, localities 89a, 90, 99a, 108b; Byram Formation, localities 93, 94.

Subfamily LOPHINAE Vyalov, 1936

Genus LOPHA Roding, 1798

Subgenus LOPHA Roding, 1798

Lopha (Lopha) vicksburgensis (Conrad)

Plate 17, figures 7-12; Text Figure 34, 2

1829. *Ostrea pseudofoliata* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 1 (unpublished manuscript).

1848a. *Ostrea Vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, pp. 296.

1848b. *Ostrea vicksburgensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 126, pl. 13, fig. 5, 37.

1862. *Ostrea vicksburgensis* Conrad. Gabb, Amer. Philos. Soc., Proc. 1861, v. 13, p. 329 (Compared with *O. mortonii* Gabb, Eocene of Alabama and S. Carolina).

1866. *Ostrea vicksburgensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1884. *Ostrea vicksburgensis* Conrad. Heilprin *in* White, U. S. Geol. Survey, Ann. Rept., v. 4, p. 312, pl. 63, fig. 2, 3.

1886. *Ostrea vicksburgensis* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, Art. 20, p. 205 (Present in the Byram Marl at Byram, Mississippi).

1886. Not *Ostrea vicksburgensis?* Conrad. Aldrich, Geol. Survey Alabama, Bull., No. 1, p. 50 (Listed from the Eocene beneath the Buhrstone (Tallahatta Fm.) at Hatchetigbee Bluff, Tombigbee River, Alabama).

1898. *Ostrea vicksburgensis* Conrad. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 682 (*Ostrea panda* Morton, 1834, and *Ostrea mortoni* Gabb, 1861, are listed in synonymy; Dall states "... this species is probably an offshoot of *O. trigonalis*").

1906. *Ostrea vicksburgensis* Conrad. Veatch, U. S. Geol. Survey Prof. Paper 46, pl. 23, fig. 1, 1a-b.

1916. *Ostrea vicksburgensis* Conrad. Dall, U. S. Natl. Mus., Proc.; v. 51, No. 2162, p. 491 (Present on the west bank of Flint River at Hale Landing (Oligocene), Decatur Co., Georgia).

1917. *Ostrea vicksburgensis* Conrad. Hopkins, U. S. Geol. Survey Bull. 661-H, p. 299, pl. 27, fig. 2.

1918. *Ostrea vicksburgensis* Conrad. Cooke, Washington Acad. Sci., Jour., v. 8, p. 195 (Present in the Glendon Limestone).

1922. *Ostrea vicksburgensis* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 81, 82, 84 (Check list; in the Byram Marl, Mint Spring Marl, and Red Bluff Clay; p. 84).

1923. *Ostrea vicksburgensis* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 133, p. 4, 5, 7 (Listed in the Oligocene chert in Holmes Co., Florida; p. 4, and in Washington Co., Florida; p. 7: Check list - in Eocene and Vicksburg Gr.).

1926. *Ostrea vicksburgensis* Conrad. Cooke, *in* Geol. Survey Alabama, Spec. Rept. 14, p. 279-280, 283-285, 288, 290, 292, p. 97, fig. 4.

1944. *Ostrea vicksburgensis* Conrad. MacNeil, Amer. Assoc. Petr. Geol., Bull., v. 28, No. 9, p. 1319, 1330 (Present in borings in Forest Hill Fm., Jasper Co., Mississippi; p. 1319).

1945. *Ostrea vicksburgensis* Conrad. Gardner, Geol. Soc. Amer. Memoir 11, p. 38, 83-84 (Check list; p. 38; present in the Oligocene of Mexico).

1946. *Ostrea vicksburgensis* Conrad vars. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 17-19, pl. 2, fig. 1-7 (Jackson Eocene, Shubuta, Mississippi, St. Stephen's Bluff, Alabama, and Bunker Hill, Ouachita River, Louisiana).

1962. *Ostrea vicksburgensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 108 (Remaining syntype? 30645. Subsequently figured; specimen figured pl. 13, fig. 37, is missing).

1965. *Alectryonia vicksburgensis* (Conrad) variation. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 27 (In the lower Jackson Group).

1968. *Ostrea vicksburgensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 94 (Type 30645).

1974. *Alectryonella vicksburgensis* (Conrad). May, Mississippi Geol. Survey Bull. No. 117, p. 54, 56, 61, 69, 80, 85, 96 (Present in the Red Bluff Fm., upper part of the Forest Hill Fm., Marianna Limestone, Glendon Limestone, Byram Fm. and Chickasawhay Limestone).

1980. *Lopha* (*Lopha*) *vicksburgensis* (Conrad). Dockery, Miss. Bureau Geol., Bull. No. 122, p. 163, pl. 78, fig. 4; pl. 80, fig. 4-5, 9.

Original Description: Conrad, 1848a.

"Plicated; very irregular and adhering, the upper valve not flat, but swelling in an irregular manner. Height 1 3/4.

"There is nothing peculiar about this shell, yet it is clearly distinct from any other species of the American Tertiary hitherto described. Common."

Discussion: Radial plications on the right and left valves distinguish this species from *Ostrea paroxis*. Both species are common throughout the Vicksburg Group. *Lopha* (*Lopha*) *vicksburgensis* has also been reported from the Jackson Group (Harris and Palmer, 1946) and from the Chickasawhay Formation (May, 1974). Specimens from the latter unit differ from those in the Vicksburg Group in that they: (1) are larger and (2) have narrower and higher plications.

Type: Holotype 30645 USNM from the Vicksburg Group, Vicksburg, Mississippi (Plate 17, figure 7).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 46; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 74b, 75a, 89a, 90, 97, 99a, 100a; common in the Mari-

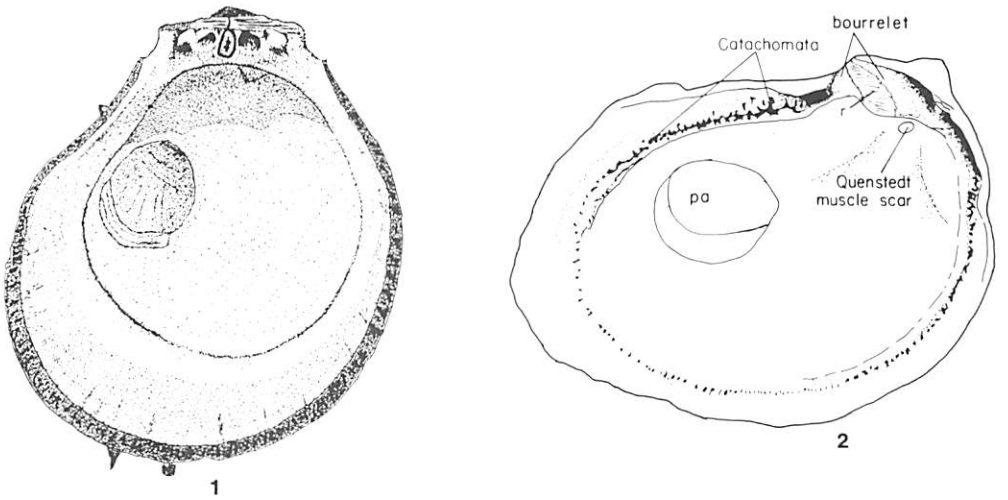


Figure 34 — 1- left valve, *Spondylus* (*Spondylus*) *dumosus* (Morton); 2- left valve (holotype), *Lopha* (*Lopha*) *vicksburgensis* (Conrad). pa =posterior adductor muscle scar. Illustrations by Randall Bissell.

anna and Glendon Limestones; Byram Formation, localities 93, 106a, 112c, 115, 116. Also occurs in the Vicksburg Group in Alabama, the Oligocene of Florida, the Flint River Formation in Georgia; variations reported from the Jackson Group in Louisiana, Mississippi and Alabama, and the Chickasawhay Limestone in Mississippi and Alabama.

Subclass HETERODONTA Neumayr, 1884
Order VENEROIDA H. Adams and A. Adams, 1856
Superfamily LUCINACEA Fleming, 1828
Family LUCINIDAE Fleming, 1828
Subfamily LUCININAE Fleming, 1828
Genus LUCINA Bruguieré, 1797
Subgenus LUCINA Bruguieré, 1797

Lucina (Lucina) fimbripallium n. sp.
Plate 19, figures 1-3; Text Figure 35, 3

Description: Shell thick, moderately inflated, slightly higher than long; hinge with prominent ligament groove, modest cardinal teeth and prominent lateral teeth; anterior adductor scar broad and moderately elongate, posterior adductor scar ovate; pallial line fringed with short radial grooves; interior margin finely crenulate; exterior with strong concentric lamellae; posterior dorsal area bordered by a groove; lunule small, smooth, extends from beak to above the anterior lateral tooth.

Discussion: The thinnest place on this thick-shelled species is at the lunule. Many specimens show naticid borings at that point. This species is similar to the Recent species of North America *Lucina* (*Lucina*) *pensylvanica* (Linné). It differs from the latter species in its smaller size, greater elevation, and smaller anterior dorsal and posterior dorsal areas. The name refers to the fringed pallial line.

Type: Holotype 340442 USNM from the Mint Spring Formation, USGS locality 14071a.

Occurrence: Mississippi: Mint Spring Formation, localities 97, 100a; Byram Formation, locality 106b.

Subgenus CALLUCINA Dall, 1901

Lucina (Callucina) choctavensis Meyer, 1886
Plate 21, figures 1-5

1886. *Lucina Choctavensis* Meyer *in* Smith, Geol. Survey Alabama, Bull. No. 1, p. 80, pl. 1, fig. 28.
1976. *Lucina* (*Callucina*) *choctavensis* Meyer. Bretsky, Palaeont. Amer., v. 8, No. 50, p. 235, 258, 261.

Original Description: Meyer, 1886.

"Small, suborbicular; convex; lunule semilunar, well defined; cardinal and lateral teeth; anterior muscular impression relatively small; covered with concentric lines of growth.

"*Locality.* - Vicksburg, Miss.

"*Lucina papyracea*, Lea, from Claiborne, is similar, but the lateral teeth are obsolete."

Discussion: It is difficult to ascertain from Meyer's illustration and description the identity of this species. According to Blow (personal communication, 1982), the type is missing from the U. S. National Museum. Bretsky (1976) placed this species in the subgenus *Callucina* and stated that the holotype, a left valve, closely resembles both *Lucina* (*Callucina*) *prunoides* Maury from the Alum Bluff Group in Flor-

ida and *Lucina (Parvilucina) sabelli* Gardner from the Wilcox Group in Texas. Meyer's illustration more closely resembles *Lucina (Parvilucina) posteocurta* in having moderately strong lateral teeth. However, his description of the semilunar and well defined lunule best applies to the species illustrated in Plate 21, figures 1-5. This species also differs from *L. [P.] posteocurta* in being more inflated and in having a smooth interior margin.

Type: Holotype 644600 USNM from the Vicksburg Group, Vicksburg, Mississippi (missing).

Occurrence: Mississippi: Mint Spring Formation, locality 99a, 100a, 108b; Byram Formation, locality 93.

Subgenus PARVILUCINA Dall, 1901

Lucina (Parvilucina) posteocurta n. sp.

Plate 20, figures 1-7

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 11 (no name).

Description: Shell small, moderately inflated, produced anteriorly and shortened posteriorly; hinge thin with modest cardinal and lateral teeth; anterior adductor scar short; interior margin crenulate; beaks prosogyrate; lunule small, indistinct; anterior dorsal area small, bordered by a fine impressed line, posterior dorsal area bordered by a shallow sulcus; exterior covered with fine concentric lamellae which are strongest over the posterior dorsal area.

Discussion: Small individuals of this species are common in screened sediments from the Mint Spring and Byram Formations. The holotype (Plate 20, figure 7) probably represents the maximum size of the species. *Lucina (Parvilucina) sabelli* Gardner from the Wilcox Group in Texas is similar to this species in its shell outline and concentric sculpture on the exterior but differs in having a more solid shell and stronger hinge. *Lucina (Parvilucina) sphaeriolus* Dall of the Alum Bluff Group in Florida differs in having radial ornamentation. The name refers to the shell's short posterior.

Type: Holotype 340443 USNM from the Mint Spring Formation, locality 99a (Plate 20, figure 7).

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, localities 90, 99a, 100a, 108b, 110; Byram Formation, localities 93, 102, 106a, 109.

Lucina sp.

Plate 20, figure 8

Description: Shell subcircular, longer than high; hinge with one cardinal tooth and a weak anterior lateral and posterior lateral tooth; lunule small, indistinct; anterior dorsal area bordered by a narrow groove; posterior dorsal area bordered by a shallow sulcus; exterior sculptured with concentric lines.

Discussion: This species is known only from the figured specimen. It is possible that this specimen is an extremely large individual of *Lucina (Parvilucina) posteocurta.*

Occurrence: Mississippi: Mint Spring Formation, locality 99a.

Subgenus CAVILINGA Chavan, 1937

Lucina (Cavilinga) imbricolamella n. sp.

Plate 20, figures 11-12

Description: Shell small, strongly inflated, thick, fragile, produced posteriorly; beak strongly prosogyrate; hinge short with strong cardinal teeth and small lateral teeth; posterior adductor scar ovate, anterior adductor scar short to moderately long turning inward at junction with pallial line; interior margin finely crenulate; anterior dorsal and posterior dorsal areas small and bordered by shallow sulci; lunule small and indistinct; exterior sculptured by coarse lamellae.

Discussion: This species is similar to *Lucina (Cavilinga) pomilia* Conrad of the Claiborne Group in Alabama but differs in having much weaker lateral teeth. The name refers to the imbricated lamellae of the exterior.

Type: Holotype 340444 USNM from the Mint Spring Formation, locality 100a (Plate 20, figure 11).

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108b.

Lucina (Cavilinga) triloba n. sp.

Plate 19, figure 4

Description: Shell small, solid, strongly inflated, elevated; hinge with strong cardinal and lateral teeth, base of hinge more highly elevated posterior to the beak; shell distinctively trilobed with deep sulci bordering large anterior dorsal and posterior dorsal areas; lunule large, extending beyond the anterior lateral tooth and bordered by a strong groove; beak strongly prosogyrate; adductor muscle scars indistinct, anterior adductor scar short, broad, and extending onto the ridge formed by the anterior sulcus; margin finely crenulate in unworn specimens; exterior covered with strong concentric lamellae.

Discussion: The name of this species refers to the trilobed shape of the exterior, which is produced by two prominent sulci bordering the anterior dorsal and posterior dorsal areas. This species is similar to *Lucina (Cavilinga) trisulcata* Conrad from the Alum Bluff Group in Florida but differs in its higher eleva-

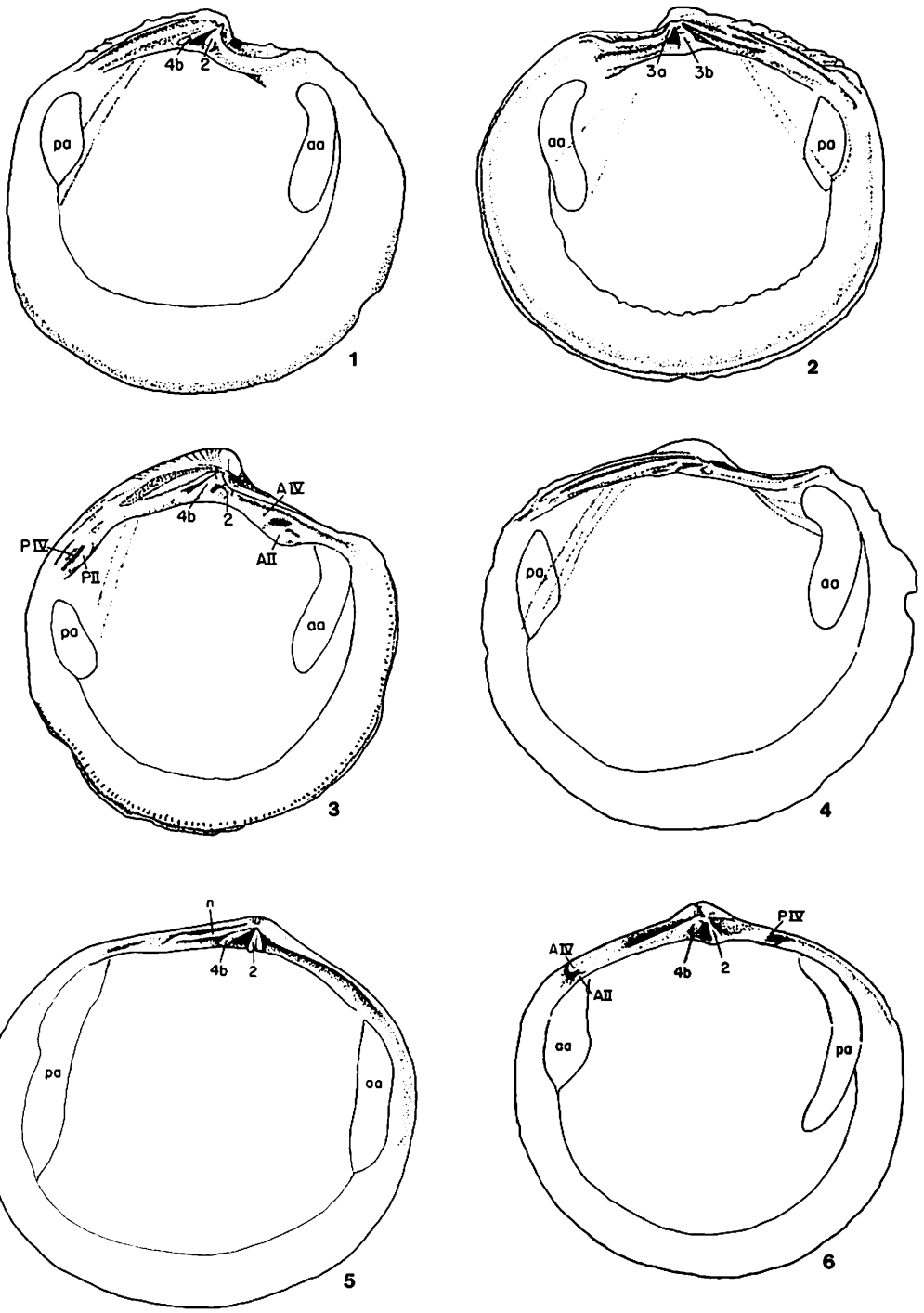


Figure 35 — 1- left valve, 2- right valve, *Myrtea* (*Myrtea*) *vicksburgensis* (Casey); 3- left valve, *Lucina* (*Lucina*) *fimbripallium* n. sp.; 4- left valve, *Anodontia* (*Anodontia*) *mississippiensis* (Conrad); 5- left valve, *Diplodonta* (*Diplodonta*) *eburnea* (Conrad); 6- right valve, *Divaricella* (*Divalinga*) *subrigaultiana* (Meyer). 2, 4b = cardinal teeth; AII, AIV = anterior lateral teeth; PII, PIV = posterior lateral teeth; n = nymph, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

tion and more prominent sulci. In this latter respect, it resembles *Lucina (Pleurolucina) quadricostatus* Dall from the Bowden Formation in Jamaica. The Bowden species, however, has four rather than two strong sulci.

Type: Holotype 340445 USNM from the Mint Spring Formation, locality 99a (Plate 19, figure 4).

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 99a.

Subgenus LUCINISCA Dall, 1901

Lucina (Lucinisca) varisculpta n. sp.

Plate 19, figures 5-12

Description: Shell small, solid, circular; hinge strong with large cardinal and lateral teeth; anterior adductor scar long and narrow, posterior adductor scar ovate; interior margin crenulate; anterior dorsal area small, bordered by a shallow groove; posterior dorsal area bordered by a shallow sulcus; lunule small, distinct; exterior sculpture with concentric and radial ornamentation of greatly varying strength.

Discussion: The strength of the exterior sculpture in this species is greatly varied as is indicated by the name. The specimen illustrated in Plate 19, figure 6, has strong concentric and radial ribs while the specimen illustrated in Plate 19, figure 8, has weak radial ribs and faint concentric lines. This species is similar to *Lucina (Lucinisca) calhounensis* Dall from the Alum Bluff Group in Florida but differs in having finer radial ribs and a smaller lunule.

Type: Holotype 340446 USNM from the Mint Spring Formation, locality 99a (Plate 19, figure 9).

Occurrence: Mississippi: Mint Spring Formation, localities 97, 99a, 100a, 110; Byram Formation, localities 93, 94, 112c, 116.

Genus MYRTEA Dall, 1901

Subgenus MYRTEA Dall, 1901

Myrtea (Myrtea) scopularis (Casey)

Plate 18, figures 1-5

1903. *Lucina scopularis* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 263-264.

Original Description: Casey 1903.

"Red Bluff formation. Approaches *vicksburgensis* very closely, being orbicular and only moderately convex, but it is a little smaller and the concentric lines are finer, relatively less close-set and more lamelliform, becoming still more strongly so on the anterior and posterior dorsal declivities, though relatively less strongly so than on the corresponding parts of *vicksburgensis*. It differs principally from the latter in the form of the anterostral sinus, which is longer and more transverse in outline, in the form of the lunule, which is larger and very much more elongate, and in the cardinal tooth of the right valve, which is here scarcely at all oblique, being most perpendicular to the hinge line. In both species the laterals are moderately developed and the ventral edges smooth internally without trace of crenulation. Length of a moderately large specimen 7 mm., height 6.2 mm. The anterior and posterior sides are almost equally and very broadly rounded. This species is very slightly more inflated than *vicksburgensis*. There is a variety which is very abundant in the Jacksonian of Moody's Branch."

Discussion: The variety Meyer refers to in the Moodys Branch Formation probably includes both *Lucina (Callucina?) curta* (Conrad) and *Lucina (Callucina?) subcurta* (Harris). *Myrtea (Myrtea) scopularis* is very close to *M. (M.) vicksburgensis* (Casey) which occurs in the Forest Hill and Mint Spring Formations. These species are considered as separate in this report on the basis of the fine distinctions given by Casey in the above description and because of the much larger size attained by the latter species.

Type: Holotype USNM 481671 from the Red Bluff Formation, Red Bluff, Mississippi (Plate 18, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 40, 46.

Myrtea (Myrtea) vicksburgensis Casey

Plate 18, figures 6-11; Plate 61, figures 1-2; Text Figures 35, 1-2

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 10 (no name).

1848a. *Lucina perlevis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293 (*nomen dubium*).

1848b. *Lucina perlevis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124 (Not Plate 12, figure 22, which is labeled as *Lucina perlevis* but is listed under *Lucina mississippiensis* in the text).

1854. *Cyclas perlevis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, No. 2, p. 30 (List).

1865. *Cyclas perlevis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 8 (Catalog).

1866. *Lucina perlevis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List), p. 24 (List, in Jackson Group).

1885. *Lucina perlevis* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, Art. 59, p. 467 (Listed in Vicksburg and Jackson groups).

1903. *Lucina vicksburgensis* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 263; *Lucina perlevis* Conrad, p. 264 (Specimen in Conrad collection labeled *L. perlevis* is described in text as *L. mississippiensis*).

1962. *Lucina perlevis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 86 (Missing).

1968. Not *Lucina perlevis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 74 (*Lucina perlevis* type 30658 = *Anodontia* (*Anodontia*) *mississippiensis*).

1976. *Myrtea* (*Myrtea*) *vicksburgensis* (Casey). Bretsky, Palaeont. Amer., v. 8, No. 50, p. 241; Not *Anodontia* (*Anodontia*) *perlevis* Conrad, p. 303, 305 = *Anodontia* (*Anodontia*) *mississippiensis* (Conrad).

Original Description: Casey, 1903.

"Occurs in the Lower Vicksburg in great abundance. This species is subequilateral, suborbicular, rather compressed, the beaks somewhat high and acute, the adjacent anterior sinus small and deep, the lunule small and deep-set and but little more than twice as long as high as a rule. The surface is covered throughout with strong concentric raised lines which are close-set and low, but becoming strongly lamelliform on the anterior and posterior dorsal declivities, the dorsal edge being rendered rough spiculose and uneven thereby. Cardinal tooth of right valve very oblique. Length 7 1/2 mm.; height 7 1/2 mm. It grew somewhat larger than the type above described, but never exceeded this length by more than about 2 mm. It might be considered closely allied to the Jacksonian *Cyclas curtus* of Conrad (*Am. Journ. Conc.*, I, p. 139), as the posterior side is noticeably more truncate than the anterior, were it not for the fact that *curtus* is described as "ventricose," a term which could not possibly be applied to *vicksburgensis*."

Original Description of *Lucina perlevis*: Conrad, 1848a.

"Orbicular, with lamellaeform concentric lines, and very minute obsolete radiating lines, closely arranged; beaks medial; posterior end direct; cardinal teeth small. Length 4-10. Height rather less. Very rare.

"The shells of this subgenus are orbicular, generally punctate within, often very thin and ventricose; cardinal teeth small and compressed, sometimes obsolete or wanting; lateral teeth none. *Lucina radula*, and *L. edentula*, among recent species, belong to this group."

Discussion: Conrad never figured the species he described as *Lucina perlevis* but instead placed the name in the plate explanations for his figure of *Lucina mississippiensis*. The syntypes of *L. mississippiensis* were also mislabeled as *L. perlevis*. These mistakes have caused confusion as to the real identity of both of these lucinid species of Conrad. Casey (1903), uncertain as to the identity of *L. perlevis*, gave a new name for the species. His types have been found recently in the collection of the Philadelphia Academy of Natural Sciences and are figured in Plate 61, figures 1-2.

Bretsky (1976) states that *Myrtea* (*Myrtea*) *vicksburgensis* is the earliest species definitely assignable to *Myrtea* s.s. She made no mention of *M.* (*M.*) *scopularis* which has an earlier occurrence. Both of these species differ from the Chickasawhay *Myrtea* species *M.* (*M.*) *taylorensis* Mansfield (see Plate 61, figures 3-6) in that the anterior hinge is shorter and curved and the margins of the anterior dorsal and posterior dorsal areas are not as strongly truncated. *M.* (*M.*) *vicksburgensis* is especially abundant in the Mint Spring Formation at localities 99a and 100a.

Type: Two syntypes 994 ANSP from the Mint Spring Formation, Vicksburg, Mississippi (Plate 61, figures 1-2).

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108b, 110; Byram Formation, locality 93.

Genus ANODONTIA Link, 1807
Subgenus ANODONTIA Link, 1807

Anodontia (Anodontia) mississippiensis (Conrad)

Plate 21, figures 6-10; Text Figure 35,4

1848a. *Lucina Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293.

1848. *Lucina mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 12, fig. 22 (Figure 22 is labeled as *Lucina perlevis*).

1854. *Cyclas mississippiensis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 30 (List).

1865. *Cyclas Mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 8 (Catalog).

1866. *Lucina mississippiensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 24 (List; listed only under the Jackson Group, Mississippi).

1885. *Lucina Mississippiensis* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, Art. 59, p. 461, 467 (Listed in the Vicksburg and Jackson groups; p. 467).

1903. *Lucina mississippiensis* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 264 (Discussed under *Lucina scopularis* Casey).

1922. *Lucina mississippiensis* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 85 (Check list; in the Byram Marl and Mint Spring Marl).

1962. *Lucina mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 72 (Missing. Cooke, in notebook, found three valves in type lot).

1976. *Anodontia* (*Anodontia*) *perlevis* Conrad. Bretsky, Paleont. Amer., v. 8, No. 50, p. 303, 305.

Original Description: Conrad, 1848a.

"Orbicular, thin and fragile, with minute obsolete radiating lines; anterior side shortest, the margin obliquely truncated, angular above and elevated; inferior margins rounded; posterior end obtusely rounded; lunule profound; cardinal and lateral teeth wanting. Length 9-10. Height 3/4.

"This species very much resembles *L. subvexa* of Claiborne, but wants the impressed line on the posterior side. Rare."

Discussion of Casey, 1903.

"In the Conrad collection the only species of *Lucina* that I could discover is the largest form occurring at Vicksburg-moderately convex, very thin in substance, with feeble hinge and nearly smooth surface. The label attached states that this is *Lucina perlevis*. This is, however, the species which was subsequently described under the name *mississippiensis*. There is some confusion here."

Discussion: Conrad's description of *Lucina mississippiensis* stating that the teeth are wanting obviously refers to this species of *Anodontia*. As previously discussed under *Myrtea* (*Myrtea*) *vicksburgensis* (Casey), the mislabelling of Conrad's figure and types as *Lucina perlevis* has caused confusion to the species identity. This species is very common in the Mint Spring Formation at localities 99a and 100a.

Type: Three syntypes A-C 30658 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 21, figures 6, 8-9).

Occurrence: Mississippi: Red Bluff Formation, locality 38; Mint Spring Formation, localities 97, 99a, 100a; Byram Formation, locality 102.

Subfamily DIVARICELLINAE Gilbert, 1967
Genus DIVARICELLA Von Martens, 1880
Subgenus DIVALINGA Chavan, 1951

Divaricella (Divalinga) subrigaultiana (Meyer)
Plate 22, figures 1-3;
Text Figure 35, 6

1886. *Lucina* (*Cyclas*) *subrigaultiana* Meyer *in* Smith, Geol. Survey Alabama, Bull. No. 1, p. 81, pl. 3, fig. 13, 13a.
1940. *Divaricella subrigaultiana* (Meyer). Mansfield, Jour. Paleont., v. 14, No. 3, p. 192.
1976. *Divaricella* (*Divalinga*?) *subrigaultiana* (Meyer). Bretsky, Palaeont. Amer., v. 8, No. 50, p. 309.

Original Description: Meyer, 1886.

"Orbicular, very regularly rounded; hinge teeth, two; laterals small; margin entire; surface covered with regular concentric waving lines, crossed occasionally by orbicular lines of growth.

"*Locality.* - Vicksburg, Miss. Lower Vicksburgian.

"Resembles very much *Lucina rigaultiana*, Desh. A deep but extremely small lunule is in front of the beak. The lines of ornamentation are less distinct at their convex summit, thus creating a somewhat erased zone, which radiates from the umbo toward the posterior side of the ventral margin. The ornamentation looks as if produced by *'petits plans glissant les uns au dessous des autres.'* "

Discussion: This species is similar to *Divaricella* (*Divalinga*) *chipolana* Dall from the Alum Bluff Group in Florida. An undescribed species of *Divaricella* (Mansfield, 1940, p. 192) occurs in the Chickasawhay Limestone. Bretsky (1976) compares this latter species to small individuals of *Divaricella* (*Divalinga*) *quadrisulcata* d'Orbigny from the Recent of the East Coast of North America.

Type: Holotype 644599 USNM from the Mint Spring Formation, Vicksburg, Mississippi (Plate 22, figure 1).

Occurrence: Mississippi: Mint Spring Formation, localities 97, 99a, 100a.

Family UNGULINIDAE Adams & Adams, 1857
Genus DIPLODONTA Brann, 1831
Subgenus DIPLODONTA Brann, 1831

Diplodonta (Diplodonta) eburnea (Conrad)
Plate 22, figures 4-9, 11-13; Plate 61, figures 7-9;
Text Figure 35, 5

1848a. *Loripes eburnea* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293-294.
1848b. *Loripes eburnea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 12, fig. 11, 24.
1854. *Diplidonta* (sic) *eburnea* (Conrad). Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 287, 288.
1865. *Mysia eburnea* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 9 (Catalog).
1866. *Mysia eburnea* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 24 (Listed in Jackson Group), p. 27 (List).
1900. *Diplodonta*? *eburnea* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 5, p. 1182.
1962. *Loripes eburnea* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 57 (Missing).
1968. *Loripes eburnea* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 47 (Type lot).

Original Description: Conrad, 1848a.

"Suborbicular, slightly oblique, convex, with minute closely arranged concentric lines, and a few larger impressed lines; posterior margin truncated, direct; anterior end and anterior basil margins regularly rounded; posterior basal margin obliquely truncated; beaks nearest the posterior end. Length 6-10. Height 6-10 nearly."

Discussion: Large specimens of this species are strongly produced along the posterior ventral margin. In this respect the species resembles *Diplodonta paralta* from the Alum Bluff Group in Florida.

Type: Lectotype and two syntypes B-C 53836 ANSP from the Vicksburg Group, Vicksburg, Mississippi.

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108b; Byram Formation, locality 93.

Diplodonta (Diplodonta) elatia n. sp.

Plate 23, figures 1-3

Description: Shell small, thin, shortened anteriorly, elevated; greatest inflation near the umbo; hinge short, narrow; base of posterior hinge plate recessed below the posterior dorsal margin; hinge teeth as characteristic of genus; nymph short; lunule small, impressed, bordered by a strong ridge; muscle scars indistinct; exterior smooth except for concentric growth lines.

Discussion: This species is similar to *Diplodonta (Diplodonta) homalostriata* Woodring from the Bowden Formation in Jamaica but differs in being shortened anteriorly. It is easily distinguished from the young of *D. (D.) eburnea* by its greater elevation.

Type: Holotype 340447 USNM from the Byram Formation, locality 93.

Occurrence: Mississippi: Mint Spring Formation, locality 108b; Byram Formation, locality 93.

Genus FELANIELLA Dall, 1899

Subgenus FELANIELLA Dall, 1899

Felaniella (Felaniella) compacta n. sp.

Plate 22, figure 10

Description: Shell small, thick, elevated, moderately inflated; umbo elevated; hinge triangular; cardinal teeth with 4b oblique and 2 verticle; nymph prominent and bordered by a strong external groove; anterior and posterior adductor scars elongate with the anterior scar longer, both scars tapering dorsally and rounded ventrally; pallial line double and connecting ventral margins of adductor scars; exterior smooth except for growth lines.

Discussion: This species is known from one specimen from the Mint Spring Formation at locality 111. It differs from the type species *Felaniella (Felaniella) usta* (Gould) from the Recent of Japan in its greater elevation and regularly rounded margins. The name refers to the species' thick shell.

Type: Holotype 340448 USNM from the Mint Spring Formation, locality 111 (Plate 22, figure 10).

Occurrence: Mississippi: Mint Spring Formation, locality 111.

Genus TIMOTHYNUS Harris and Palmer, 1946

Timothynus turgida (Conrad)

Plate 23, figures 4-6; Text Figures 36, 1-2

1848a. *Loripes? turgida* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293.

1848b. *Loripes? turgida* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 12, fig. 23.

1854. *Diplidonta* (sic) *turgida* (Conrad). Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 287, 288.

1865. *Sphaerella turgida* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 9 (Catalog).

1866. *Sphaerella turgida* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1900. *Diplodonta turgida* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 5, p. 1181-1182.

1946. *Timothynus turgida* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 86.

1962. *Loripes? turgida* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 105 (2 probable syntypes - 30680, 30681).

1968. *Loripes? turgida* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 92 (Holotype 30680, Paratype 30681).

Original Description: Conrad, 1848a.

"Suborbicular, very thin and fragile, with minute concentric lines; beaks medial; umbo and summit prominent; margins regularly rounded. Height 6-10. Length rather more than 5-10."

Discussion: This species is very similar to the type species *Timothynus bulla* (Conrad) from the Jackson Group. The dentition of the two syntypes is illustrated in Text Figures 36, 1-2.

Type: Holotype 30680 and paratype 30681 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 23, figures 5-6; Text Figures 36, 1-2).

Occurrence: Mississippi: Red Bluff Formation, locality 46; Forest Hill Formation, locality 88a; Mint Spring Formation, localities 100a, 108b; Byram Formation, localities 93, 106a, 112c.

Superfamily CHAMACEA Lamarck, 1809

Family CHAMIDAE Lamarck, 1809

Genus CHAMA Linné, 1758

Subgenus CHAMA Linné, 1758

Chama (Chama) pappiladerma n. sp.

Plate 23, figures 14; Plate 24, figures 1-3

Description: Shell small, attached by left valve with moderate sized attachment scar; left valve mod-

erately inflated; right valve slightly inflated; hinge of left valve with a strong, horizontal cardinal tooth and narrow ligament groove; dentition of right valve indistinct; shell dextrally or sinistrally coiled; exterior with strong, broadly spaced, undulate, concentric lamellae having extentions of flat spines; interlamella areas with irregular surface or with nodes.

Discussion: This species is similar to *Chama (Chama) involuta* Guppy from the Bowden Formation in Jamaica in its exterior sculpture of concentric sinuous foliaceous lamellae and intervening granular surface. It differs in that its concentric lamellae are less spinose. Dextrally and sinistrally coiled specimens are illustrated, respectively, in Plate 24, figures 3 and 1. The name refers to the interlamellar nodose sculpture.

Type: Holotype 340449 USNM from the Red Bluff Formation, locality 37 (Plate 24, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 40.

Chama sp.

Plate 23, figure 13

Description: Shell moderately thick and moderately inflated; exterior sculptured with concentric lamellae having vertical columns extending from their base.

Discussion: The exterior sculpture of this species is similar to that of *Chama calcarata* Lamarck from the Eocene of France. The species is known only from the worn left valve illustrated in Plate 23, figure 13.

Occurrence: Mississippi: Forest Hill Formation, locality 75a.

Subgenus PSILOPUS Poli, 1795

Chama (Psilopus) mississippiensis Conrad

Plate 23, figures 7-11

1848a. *Chama Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.
1848b. *Chama mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 13, fig. 21, 27.
1865. *Chama Mississipiensis* (sic) Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 7 (Catalog).
1866. *Chama mississippiensis* Conrad. Conrad. Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1903. *Chama mississippiensis* Conrad. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 6, p. 1397-1398.
1946. *Chama mississippiensis* Conrad? Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 92, pl. 20, fig. 14-15.
1962. *Chama mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 75 (Syntype 30655).
1965. *Chama* sp. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 79.
1968. *Chama mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Type 30655).
1977. *Chama (Cipliacella) radiata* Dockery, Miss. Geol. Survey, Bull. No. 120, p. 121-122, pl. 23, fig. 12-13, 15.

Original Description: Conrad, 1848a.

"Suboval, irregular, adhering; larger valve ventricose, with numerous irregular radiating lines, squamose inferiorly; upper valve with numerous concentric lines, with numerous small scales. Length 3/4. Height 6-10.

"Rare, and occurs on Dr. Smith's plantation, 6 miles N. E. of Vicksburg."

Discussion: The type specimen for this species is worn and the exterior appears to have a stronger concentric rather than radial sculpture. Better preserved specimens show radially arranged spines on both the left and right valves. In this and other respects it is similar to the Jackson species *Chama (Cipliacella) radiata* Dockery which in this report is placed in synonymy.

Type: Holotype 30655 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 23, figure 8).

Occurrence: Mississippi: Red Bluff Formation, locality 40; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 74b, 75a, 89a, 108b; Byram Formation, locality 93.

Superfamily LEPTONACEA Gray, 1847

Family KELLIIDAE Forbes & Hanley, 1848

Genus BORNIA Phillippi, 1836

Bornia tallahalaensis n. sp.

Plate 24, figure 11

Description: Shell small, fragile, triangular and elevated, slightly inflated; hinge of right valve with one cardinal and one lateral tooth separated by deeply impressed resilifer; exterior smooth.

Discussion: The hinge of this species closely resembles that of *Bornia dodona* Dall from the Alum Bluff Group in Florida. The latter species differs in its more elongate and triangular outline. This species is known from three right valves, all from different localities in the Byram Formation. The name is taken from the locality of the type.

Type: Holotype 340451 USNM from the Byram Formation, locality 93.

Occurrence: Mississippi: Byram Formation, localities 93, 94, 106a.

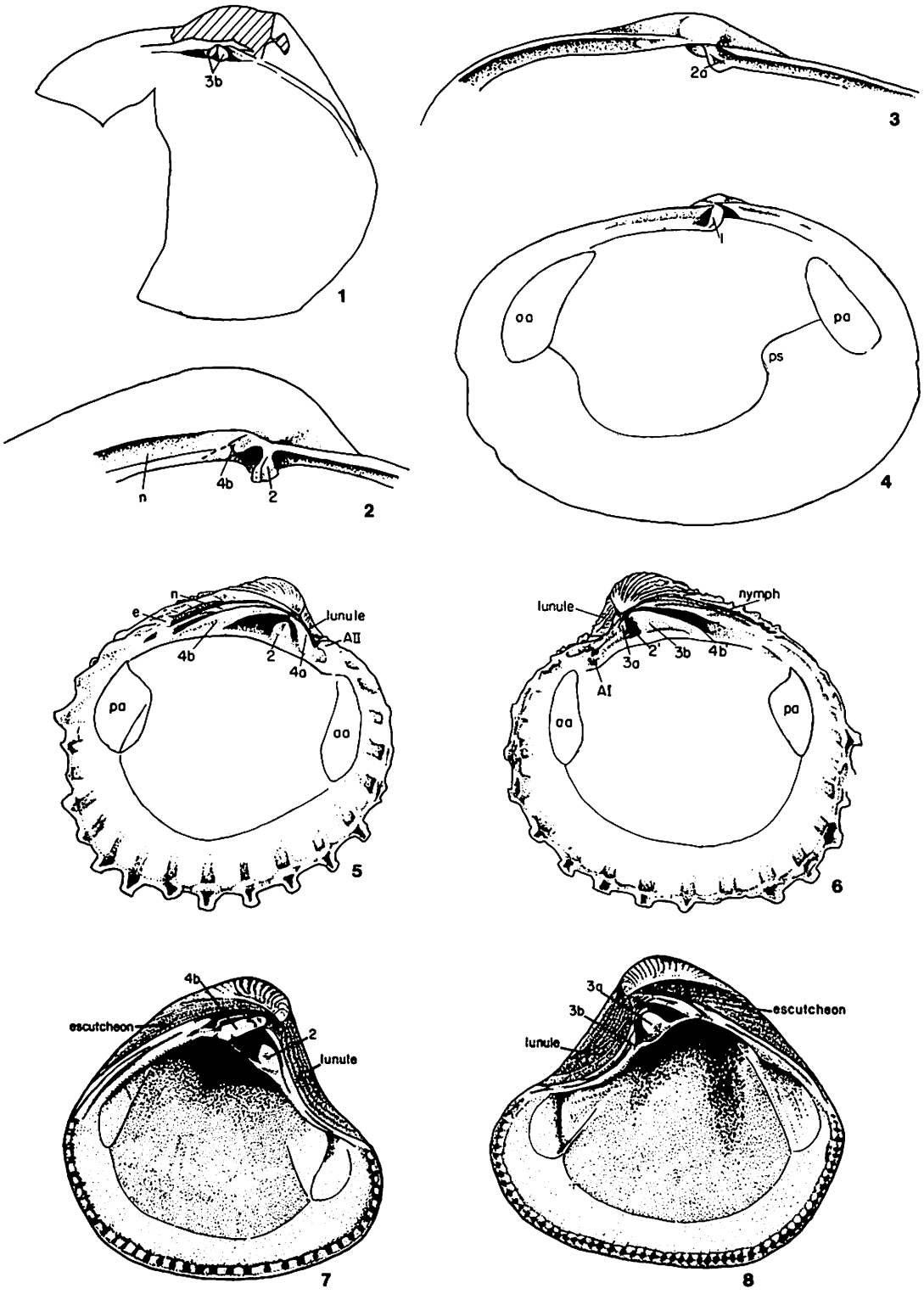


Figure 36 — 1- right valve (paratype), 2- left valve (holotype), *Timothynus turgida* (Conrad); 3- left valve (holotype), 4- right valve, *Sportella oblonga* (Conrad); 5- left valve, 6- right valve, *Venericardia* (*Rotundicardia*) *carsonensis* Dall; 7- left valve, 8- right valve, *Astarte triangulata* Meyer. 1, 2, 2a, 3a, 3b, 4a, 4b = cardinal teeth; 2', 4b' = sockets; AII = anterior lateral tooth; n = nymph, ps = pallial sinus, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

Superfamily CHLAMYDOCONCHACEA Dall, 1884
Family SPORTELLIDAE Dall, 1899
Genus SPORTELLA Deshayes, 1858

Sportella oblonga (Conrad)

Plate 24, figures 4-10; Text Figures 36, 3-4

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 4, 13 (no name).
1848b. *Kellia oblonga* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 28.
1865. *Scintilla oblonga* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 9 (Catalog).
1866. *Scintilla oblonga* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1962. *Kellia oblonga* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 81 (Holotype 30678).
1968. *Kellia oblonga* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 70 (Holotype 30678).

Original Description: Conrad, 1848b.

"Oblong, convex, very thin, smooth, inequilateral; anterior side longest; anterior extremity regularly rounded; posterior extremity truncated; base rounded. Length 3-10. Rare."

Discussion: This species is similar to *Sportella lioconcha* Dall from the Alum Bluff Group in Florida.

Type: Holotype 30678 ANSP from the Vicksburg Group, Vicksburg, Mississippi.

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 90, 99a, 100a, 108b; Byram Formation, localities 93, 106a, 109.

Superfamily CARDITACEA Fleming, 1820
Family CARDITIDAE Fleming, 1828
Subfamily CARDITAMERINAE Chavan, 1969
Genus CARDITELLA Smith, 1881

Carditella aldrichi (Casey)

Plate 24, figures 12-13; Plate 25, figures 1-5, 7

1903. *Cardita aldrichi* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 264.

Original Description: Casey, 1903.

"Lower limestone at Vicksburg occurring in considerable abundance. It is only moderately convex, inequilateral, with about 15 broad, feebly convex, approximate radiating ribs. The longer ribs, behind the middle, are more notably wide and separated throughout their length by scarcely half of their own width. The anterior lateral hinge tooth is distinct. The length of a specimen rather more than half grown is 5.5 mm., the height 4.5 mm."

Discussion: This species shows considerable variation in the ornamentation of its ribs. The ribs may be broad and smooth (Plate 25, figure 5) or narrow and nodose (Plate 25, figure 4). A young specimen of *Venericardia (Rotundicardia) vicksburgensis* Casey is illustrated in Plate 25, figure 6, for comparison. It lacks the well developed lateral teeth of *Carditella aldrichi*. This species is most abundant in the Mint Spring Formation at locality 108b.

Type: Holotype 646501 USNM from the Mint Spring Formation, Vicksburg, Mississippi.

Occurrence: Mississippi: Mint Spring Formation, locality 108b; Byram Formation, locality 93.

Subfamily VENERICARDIINAE Chavan, 1969
Genus VENERICARDIA Lamarck, 1801
Subgenus ROTUNDICARDIA Heaslip, 1968

Venericardia (Rotundicardia) carsonensis Dall

Plate 25, figures 6, 8-11; Text Figures 36, 5-6

1903. *Venericardia vicksburgensis* Casey, Acad. Nat. Sci. Philadelphia, Proc. January 1903, v. 55, p. 264 (*nomen dubium*).
1903. *Venericardia carsonensis* Dall, Wagner Free Inst. Sci. Philadelphia, Trans. October 1903, v. 3, pt. 6, p. 1427-1428, pl. 56, fig. 9.
1919. *Venericardia carsonensis* Dall. Harris, Bull. Amer. Paleont., v. 6, No. 31, p. 81, 84, 85.
1945. *Venericardia carsonensis* Dall. Gardner, Geol. Soc. America, Memoir 11, p. 94.
1946. *Venericardia carsonensis* Dall. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 70-73, not pl. 17, fig. 9a.
1968. *Venericardia (Rotundicardia) carsonensis* Dall. Heaslip, Palaeont. Amer., v. 6, No. 39, p. 97-98, text fig. 26, pl. 23, fig. 9a, 9b, 10a-10c.
1980. *Venericardia (Rotundicardia) carsonensis* Dall. Dockery, Miss. Bureau Geol., Bull. No. 122, p. 169, pl. 77, fig. 2.

Original Description: Dall, 1903.

"Carson's Creek and Red Bluff Eocene of Wayne County, Mississippi; Burns.

"Shell somewhat squarish, rounded, moderately inflated, thin, with about nineteen to twenty-one very narrow, elevated radial ribs, separated by much wider interspaces; sculpture imbricate-nodulous, the nodules in perfect specimens becoming irregularly spinose in the posterior third of the shell; the nodules are not so close to each other as in *V. tetrica;* and *V. pracisa* as a rule, especially in the young; lunule small and impressed; the beaks are lower and the whole form less oblique than in *V. tetrica;* hinge normal, more delicate than in the other species mentioned. Length of a moderate-sized specimen 17.0, height 16.5, diameter 11.0 mm.

"While the spinosity of the posterior ribs is frequently worn away in adult individuals it is quite noticeable in the younger perfect ones, and the relative sparseness of the ribs with their wide interspaces immediately distinguishes it from *V. tetrica* and other

near allies. It reaches, judging by fragments, a length of twenty or twenty-two millimetres when fully grown."

Description of *Venericardia vicksburgensis:* Casey, 1903.

"The larger *Venericardia* of the Vicksburg differs specifically from the one occurring so abundantly in the Jackson-named *diversidentata* by Meyer-and also *rotunda* of the Claiborne, in having very much fewer radiating ribs, these being only 19-20 in number. It is found only in the lower limestone, and attained a length of 22 mm. or more. It occurs also at Red Bluff."

Discussion of Heaslip, 1968.

"*Distinguishing characters.* Most similar to *V.* [*R.*] *diversidentata* and *V.* [*R.*] *rotunda* in general shape and convexity but distinguishable from those species by ornamentation which consists of a thin, elevated cord with obscure traces of paracostal threads. Nodes are closely spaced, somewhat elevated rounded transverse ridges becoming somewhat spinose on the anterior ribs. Nodes not flattened as in *V.* [*R.*] *diversidentata* but not nearly so pronounced as in *V.* [*R.*] *rotunda.* Costals slope into broadly U-shaped, comparatively wide intercostals. Low rib number (18-22) similar to that of *V.* [*R.*] *diversidentata.* Dental pattern similar to those species but differs in triangular projection on commissural face of lunule formed by the prominent anterior cardinal (3a)of the right valve and the lunule face, below which lunule is excavated to the ventral margin of hinge plate. Face of lunule on left valve correspondingly indented and ridge joins anteroventral corner of the anterior cardinal (2) to the anterior lateral tooth.

"*Discussion and diagnosis.* Casey's name *V. vicksburgensis*, is rejected as *nomen dubium* because of inadequate description and lack of identifiable specimen which might be a holotype, even though his publication (February, 1903) pre-dates Dall's (October, 1903). A left valve in the Casey collection at the U. S. National Museum may be the specimen that the author planned to use as the type.

"The high degree of similarity in shape to the Eocene rotundicards, as well as dentition and ornamentation, makes it apparent that *V.* [*R.*] *carsonensis* is the Oligocene descendent of *V.* [*R.*] *diversidentata*, which was recognized by Harris (in Harris and Palmer, 1946). The similarity in rib number to the subspecies, *V.* [*R.*] *diversidentata vicksburgiana* seems to indicate descent from that form, rather than the Mississippi populations, although geographic occurrence might imply the opposite interpretation.

"*V.* [*R.*] *carsonensis* is the last rotundicard species recorded in coastal plain sediments, and its lineage seems to have come to an end in the early Oligocene. The only species of *Venericardia* known from sediments of middle Oligocene (?) age is *V.* [*Claibornicardia*] *nasuta* Dall, possibly from the Glendon Limestone in Alabama, indicating at least that the claibornicards were still extant at that time, and most likely gave rise to the late Oligocene glyptoactids."

Type: Holotype, a right valve, 140693 USNM from the Red Bluff Formation, Carson's Creek, five to six miles southeast of Shubuta, Wayne County, Mississippi.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 40, 46; Forest Hill Formation, locality 75a; Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108a; Byram Formation, locality 102.

Superfamily CRASSATELLACEA Ferussac, 1822
Family ASTARTIDAE d'Orbigny, 1844
Subfamily ASTARTINAE d'Orbigny, 1844
Genus ASTARTE J. Sowerby, 1816

Astarte triangulata Meyer

Plate 26, figures 1-7; Text Figures 36, 7-8

1886. *Astarte triangulata* Meyer *in* Smith, Geol. Survey Alabama, Bull. No. 1, p. 80, pl. 3, fig. 21, 21a.
1893. *Astarte triangulata* Meyer. Cossmann, Ann. Soc. roy. Malacol. Belgique., App. No. 1, p. 28, p. 13.
1903. *Astarte triangulata* Meyer. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 1488.
1922. *Astarte* cf. *A. triangulata* Meyer. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 85 (Check list; Byram Marl).
1946. *Astarte triangulata* Meyer. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 76, pl. 18, fig. 14; ? fig. 11-13 (From the Jackson Eocene of Alabama).
1960. *Astarte triangulata* Meyer. Brann and Kent, Bull. Amer. Paleont., v. 40, No. 184, p. 95.
1966. "*Astarte*" *triangulata* Meyer. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, p. 95.
1980. *Astarte triangulata* Meyer. Dockery, Miss. Bureau Geol., Bull. No. 122, p. 173, pl. 77, fig. 4-5.

Original Description: Meyer, 1886.

"Trigonal, solid; pedal scar of anterior adductor distinct; lunule long and flat; surface closely covered with concentric ribs; margin crenulate.

"*Locality*. Red Bluff, Miss. Common.

"The concentric ribs vary in size, in different specimens, and in some become obsolete toward the ventral margin."

Discussion: The size and number of the exterior concentric lamellae varies within the species (compare figures 3 and 6 on Plate 26). Also the interior margin varies from smooth to crenulate.

This species has its acme zone in the Red Bluff Formation where it is abundant at most localities in Mississippi. It has a rare occurrence in the Byram Formation. Harris and Palmer (1946) also give occurrences in the Jackson Group in Alabama.

Type: Holotype 644598 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Plate 26, figure 7).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 35b, 37, 38, 39, 40, 46; Byram Formation, localities 93, 94, 106a. Also reported from the Jackson Group in Alabama.

Astarte menthifontis n. sp.

Plate 26, figures 8-10

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 16 (no name).

Description: Shell small, solid, slightly inflated, triangular; hinge teeth typical for genus, anterior lateral tooth of right valve straight; lunule and escutcheon flat and smooth; exterior with concentric lamellae.

Discussion: This species differs from *Astarte triangulata* Meyer in the following respects: (1) the umbo is flat and not depressed, (2) the anterior hinge and lateral tooth are straight rather than curved, (3) the cardinal teeth are smaller, and (4) the interior margin is consistently smooth. Lesueur's illustration of this species accurately depicts the right valve interior, but he shows the exterior (left valve) to be smooth. The specimen he illustrated was probably worn. The species' name is taken from the horizon of the type (Mint Spring Formation) in which the species is especially common.

Type: Holotype 340454 USNM from the Mint Spring Formation, locality 99a (Plate 26, figure 8).

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108b; Byram Formation, localities 102, 106a, 109, 112c.

Astarte planilamella n. sp.

Plate 26, figures 11-13

Description: Shell small, elevated, triangular, slightly inflated; hinge teeth typical for genus; lunule and escutcheon smooth and slightly depressed; interior margin smooth to strongly crenulate; exterior with broad, flat, concentric lamellae.

Discussion: This species has a flatter and more elevated shell than does *Astarte triangulata* or *Astarte menthifontis*. It is similar to *Astarte wagneri* Dall from the Alum Bluff Group in Florida in its exterior, broad, flat lamellae but differs in being more elevated and more strongly rounded on the ventral margin. This species is particularly abundant in the Mint Spring Formation at locality 108b. The name refers to the flat lamellae of the exterior.

Type: Holotype 340455 USNM from the Mint Spring Formation, locality 108b.

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 100a, 108b, 110.

Family CRASSATELLIDAE Ferussac, 1822

Subfamily CRASSATELLINAE Ferussac, 1822

Genus CRASSATELLA Lamarck, 1799

Subgenus CRASSATELLA Lamarck, 1799

Crassatella (Crassatella) mississippiensis Conrad

Plate 27, figures 1-4; Plate 28, figures 1-6; Plate 29, figure 3; Text Figures 37; 38, 1-4

1829. *Crassatella tellinoides* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 15 (unpublished manuscript).

1848a. *Crassatella Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 291.

1848b. *Crassatella mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122, pl. 13, fig. 7, 10.

1865. *Crassatella Mississippiensis* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 10 (Catalog).

1866. *Crassatella mississippiensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1885. *Crassatella Mississippiensis* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, p. 467 (Check list).

1886. *Crassatella Mississippiensis* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, p. 205 (List).

1903. *Crassatella mississippiensis* Conrad. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 6, p. 1471.

1916. *Crassatellites mississippiensis* (Conrad). Dall, U. S. Natl. Museum, Proc. 1916, v. 51, No. 2162, p. 496 (Compared with *Crassatellites paramesus* Dall from the Flint River beds near Bainbridge, Georgia).

1922. *Crassatellites mississippiensis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 85 (Check list; in Byram and Mint Spring marls).

1923. *Crassatellites mississippiensis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 133, p. 5 (List ; = *C. paramesus* Dall).

1926. *Crassatellites mississippiensis* (Conrad). Kellum, U. S. Geol. Survey Prof. Paper 143, p. 13 (Compared with *C. mississippiensis* var. *silverdalensis* Kellum from the Trent Marl (lower Miocene) in Silverdale, North Carolina).

1962. *Crassatella mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 76 (Probable syntypes 30664).

1968. *Crassatella mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Holotype 30664, paratypes 30665).

Original Description: Conrad, 1848a.

"Ovate-trigonal, inequilateral, thick and ponderous; surface coarsely striated; summits flattened, sulcated; umbo plano-convex, with numerous sulci, obsolete behind the umbonial slope, which is angulated and subcarinated above; posterior extremity

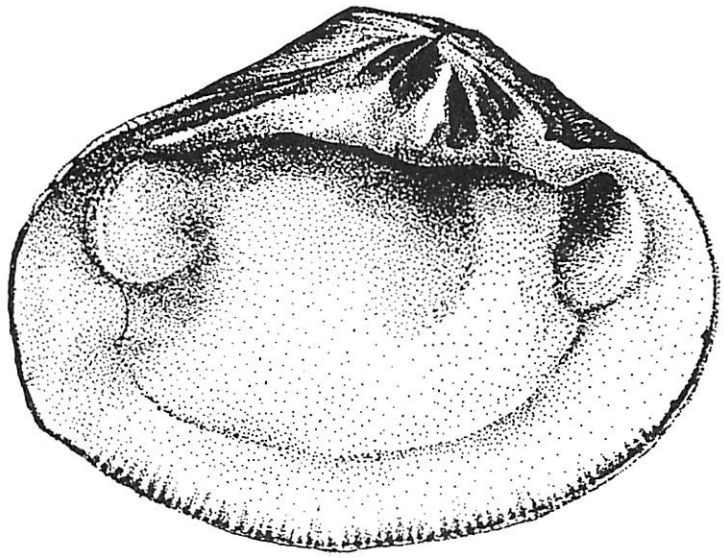


Figure 37 — *Crassatella (Crassatella) mississippiensis* Conrad, left valve. Illustration by Julia H. Suits.

truncated, direct; basal margin slightly contracted anterior to the umbonial slope; inner margin crenulated. Length 3. Common.

"This species is variable in outline, and allied to *C. tumida* of the Paris Basin."

Discussion: This species is closer in form to the type species *Crassatella (Crassatella) ponderosa* (Gmelin) from the Middle Eocene of the Paris Basin than are any of the North American Eocene species. It is very common in the Byram Formation.

Type: Holotype 30664 and five paratypes B-F 30664 ANSP (Plate 27, figures 1-4; Plate 28, figure 4).

Occurrence: Mississippi: Byram Formation, localities 93, 102, 106a, 109, 112c, 113b, 114, 115, 116.

Crassatella (Crassatella) mississippiensis megacosta n. subsp.

Plate 28, figure 7-9

Description: Shell large, solid, in general form like *Crassatella (Crassatella) mississippiensis*; beak moderately elevated; umbo gently rounded and sculptured with coarse concentric costatae; ventral margin broadly rounded.

Discussion: This subspecies is restricted to the Mint Spring Formation and differs from *Crassatella (Crassatella) mississippiensis* s.s. in having coarser concentric costatae in the umbonal region.

Type: Holotype 340456 USNM from the Mint Spring Formation, locality 100a.

Occurrence: Mississippi: Mint Spring Formation, localities 97, 99a, 100a, 108a, 110.

Crassatella (Crassatella) lirasculpta n. sp.

Plate 29, figures 1-2, 4-6; Text Figures 38, 5-6

Description: Shell large, solid, somewhat quadrate, produced at posterior ventral margin; hinge as typical of genus; posterior ridge angular at umbo; escutcheon depressed, escutcheon ridge angular; exterior sculptured with coarse concentric lirae.

Discussion: This species differs from *Crassatella (Crassatella) mississippiensis* in its: (1) more angular posterior and escutcheon ridges, (2) produced posterior ventral margin, (3) quadrate outline, and (4) exterior sculpture of strong concentric lirae. *Crassatella (Crassatella) paramesus* Dall (see Plate 60, figures 5-7) from the Flint River Formation in Georgia has a similar exterior sculpture and an angular posterior ridge. It differs from *C. (C.) lirasculpta*, however, in being less produced at the posterior ventral margin. This species is restricted to the Mint Spring Formation in its more calcareous facies at localities along the Chickasawhay River in Wayne County, Mississippi.

Type: Holotype 340457 USNM from the Mint Spring Formation, locality 74b.

Occurrence: Mississippi: Mint Spring Formation, localities 74b, 75b.

Subfamily SCAMBULINAE Chavan, 1952

Genus CRASSINELLA Guppy, 1874

Crassinella variablis n. sp.

Plate 30, figures 1-5

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 12, 14 (no name).

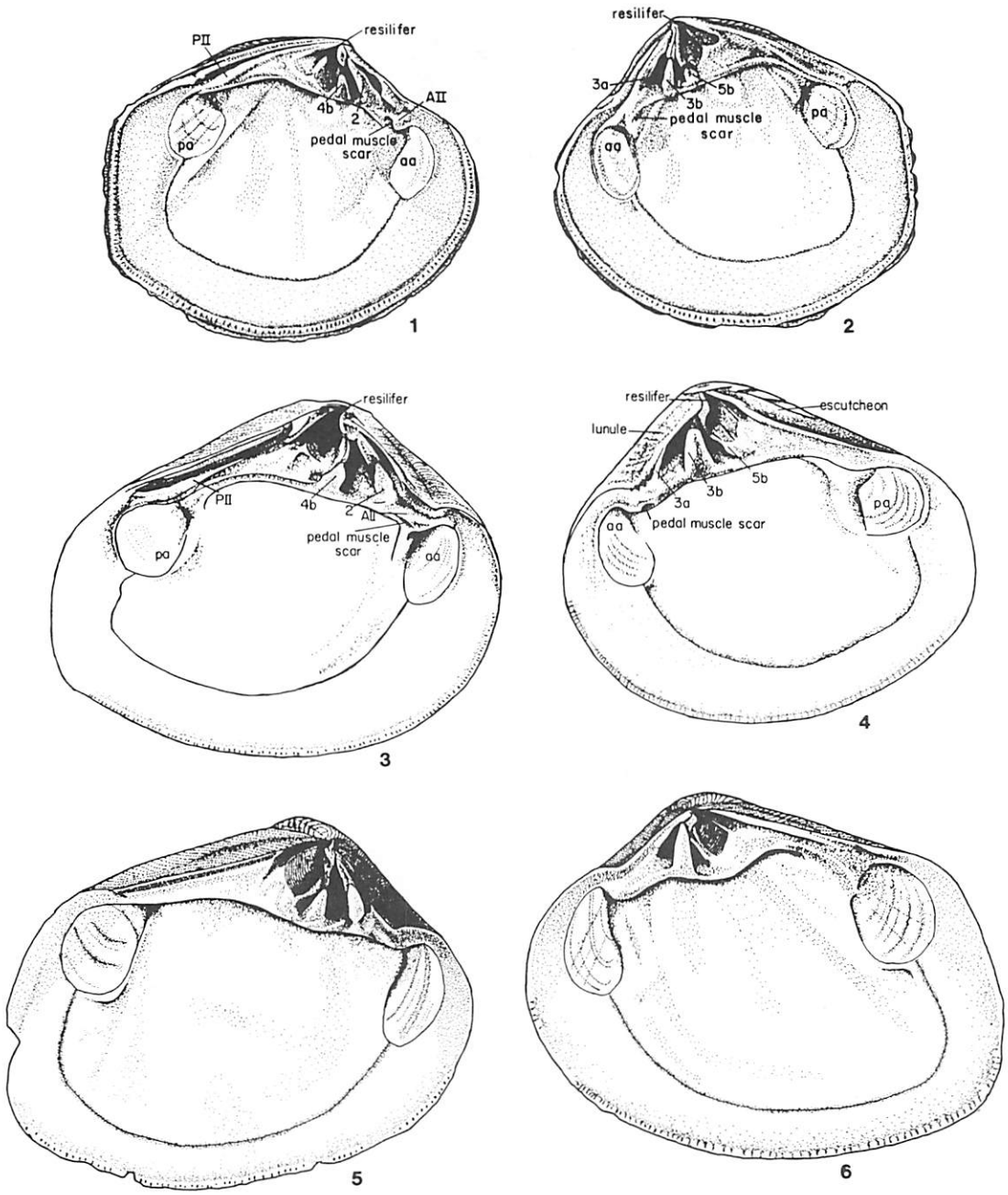


Figure 38 — 1- juvenile left valve, 2- juvenile right valve, 3- left valve, 4- right valve (holotype), *Crassatella* (*Crassatella*) *mississippiensis* Conrad; 5- left valve, 6- right valve (holotype), *Crassatella* (*Crassatella*) *lirasculpta* n. sp. 2, 3a, 3b, 4b, 5b = cardinal teeth; AII = anterior lateral tooth; PII = posterior lateral tooth; aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

Description: Shell small, triangular, modestly inflated; beak slightly ophisthogyrous; hinge typical for genus, long anterior and posterior laterals extending to beak; right valve with one large cardinal tooth between the anterior lateral and resilifer; left valve with two cardinal teeth in front of the resilifer, the first one being smaller; lunule narrow, smooth, slightly depressed; escutcheon broad, flat, smooth; escutcheon ridge angular; exterior with concentric costae at umbo or extending to ventral margin.

Discussion: The species name refers to the variable development of the exterior costae. Costae may be restricted to the umbo (Plate 30, figure 4) or extend to the ventral margin (Plate 30, figure 5). This species is similar to *Crassinella tanicus* Dall from the Alum Bluff Group in Florida but differs in its smaller size and more varied sculpture.

Type: Holotype 340459 USNM from the Byram Formation, locality 94.

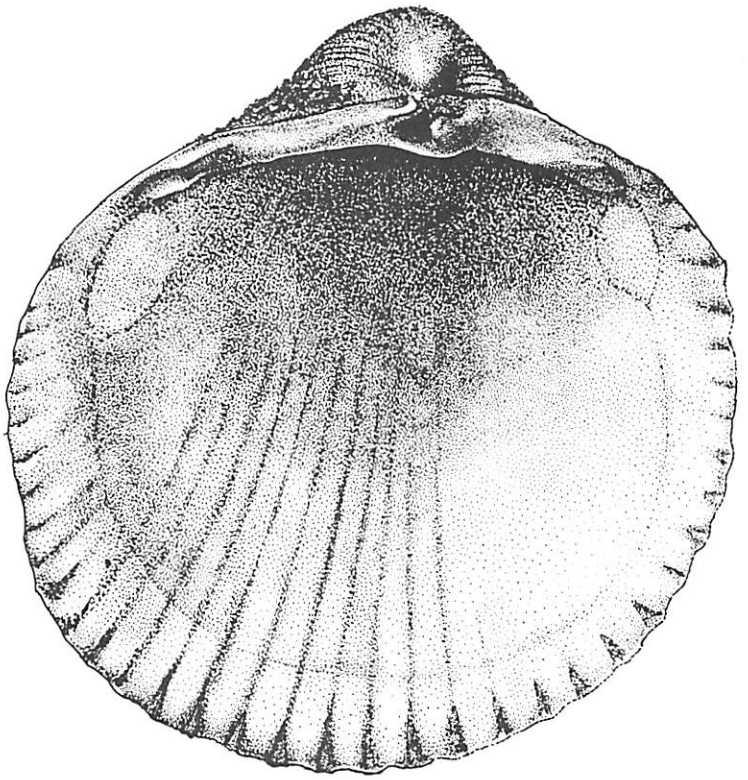


Figure 39 — *Agnocardia glebosum* (Conrad), left valve. Illustration by Julia H. Suits.

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, localities 89a, 99a, 100a, 110; Byram Formation, localities 93, 94, 106a.

Family CARDINIIDAE Zittel, 1881

Genus TELLIDORELLA Berry, 1963

Tellidorella interlacinia n. sp.

Plate 20, figures 9-10

Description: Shell small, slightly inflated; hinge of right valve with one cardinal tooth; lateral teeth consist of prominent AI and PI and weak AIII and PIII; AIII' and PII' sockets pronounced; hinge of left valve with two low rounded cardinal teeth forming as swellings at the ends of long AII and PII lateral teeth, a second pair of weak short laterals forming below the AII and PII and above the adductor muscle scars, the anterior one being stronger; anterior adductor scar long, bilobed, interior margin smooth; lunule smooth, concave along hinge line; escutcheon smooth, convex along hinge line; exterior sculptured with strong, broadly spaced, upturned, concentric lamellae and intervening radial striae.

Discussion: This species differs from the type species *Tellidorella cristulata* (Récluz) from the Recent of North America in its smaller size and more pronounced radial striae. It has been found only at locality 90 in the Mint Spring Formation where it is fairly common. The name refers to the fringed appearance of the interspaces which is produced by the radial striae.

Type: Holotype 340460 USNM from the Mint Spring Formation, locality 90.

Occurrence: Mississippi: Mint Spring Formation, locality 90.

Superfamily CARDIACEA Lamarck, 1809

Family CARDIIDAE Lamarck, 1809

Subfamily CARDIINAE Lamarck, 1809

Genus AGNOCARDIA Stewart, 1930

Agnocardia glebosum (Conrad)

Plate 32, figures 1-5; Text Figure 39; 40, 1

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 26 (no name).

1848a. *Cardium glebosum* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 291.

1848b. *Cardium glebosum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122.

1865. *Cardium* (*Trachycardium*) *globosum* (sic) Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 7 (Catalog).
1866. *Cardium* (*Trachycardium*) *globosum* (sic) Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1916. *Cardium* (*Trachycardium*) *glebosum* Conrad. Dall, U. S. Natl. Museum, Proc., v. 51, No. 2162, p. 498.
1921. *Cardium glebosum* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 85 (Check list; in Byram and Mint Spring marls and Red Bluff Clay).
1923. *Cardium glebosum* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 133, p. 58 (Occurs in the Glendon Chert near Bainbridge, Georgia).
1962. *Cardium glebosum* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 108 (Probable syntypes 30650. Cooke, in manuscript, found three fragmentary specimens in type lot. Conrad said he had only fragments).
1968. *Cardium glebosum* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 53 (Types ? 30650).

Original Description: Conrad, 1848a.

"Ovate, ventricose, with numerous flat ribs, slightly carinated on the margins and numerous approximate, prominent arched scales. Height 1 1/4.

"Rare, and obtained only in fragments."

Discussion: Lesueur (1829) gives beautiful illustrations of the interior and exterior of a left valve of this species in Plate 11, figure 26, of his unpublished plates. Conrad's material was fragmentary (see Plate 32, figure 1) and was never figured. This species is similar to *Agnocardia acrocome* (Dall) from the Alum Bluff Group in Florida but differs in having A-shaped spines of equal strength on its radial costae rather than alternating rows of strong and weak spines. The young of this genus is much more asymmetrical than the adult (see Text Figure 40, 1).

Type: Holotype and paratype (fragment) 30650 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 32, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 38, 39, 40, 46; Forest Hill Formation, locality 88a; Mint Spring Formation, localities 89a, 90, 99a, 100a; Byram Formation, localities 93, 102.

Subfamily TRACHYCARDIINAE Stewart, 1930

Genus TRACHYCARDIUM Mörch, 1853

Trachycardium eversum (Conrad)

Plate 31, figures 1-6; Text Figure 40, 2

1848a. *Cardium eversum* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 291.
1848b. *Cardium eversum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122, pl. 12, fig. 18.
1865. *Cardium* (*Cerastoderma*) *eversum* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 7 (Catalog).
1866. *Cardium* (*Cerastoderma*) *eversum* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1916. *Cardium eversum* Conrad. Dall, U. S. Natl. Museum, Proc., v. 51, No. 2162, p. 492 (Occurs in the Flint River beds below Bainbridge, Georgia).
1962. *Cardium glebosum* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 59 (Probable syntypes 30653, 30654. 30653 subsequently figured).
1968. *Cardium eversum* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 50 (Holotype 30653 and paratype 30654).

Original Description: Conrad, 1848a.

"Ovate, elevated, subequilateral; ventricose, thin with numerous approximate, slender, rounded ribs distinctly crenulated anteriorly towards the margins; umbonial slope subangulated; posterior extremity subtruncated, direct; summit very prominent; ribs crenulated on the sides, in the middle of the valves, or finely aculeated. Height 1 2-10. Length not quite as much. Rare."

Discussion: This species shows considerable variation in the size and number of its exterior costae. The holotype has 54 costae while the smaller paratype has 64. These costae have rounded tops and only those near the anterior and posterior margins have scales.

Type: Holotype 30653 and paratype 30654 ANSP from the Vicksburg Group, Vicksburg, Mississippi.

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 110; Byram Formation, locality 93.

Trachycardium planicostata n. sp.

Plate 31, figures 7-10; Text Figure 40, 3

Description: Shell large, moderately inflated; hinge with strong lateral teeth; interior with radial grooves opposite exterior costae; exterior with 31 to 37 square-shouldered, flat-topped radial costae with imbricated sides and narrow flat-bottomed interspaces; anterior and posterior costae with low scales developing from imbrications, scales more prominent on posterior; posterior margin digitate at intersection of costae.

Discussion: This species is particularly common in the Mint Spring Formation at localities 99a and 100a. It is easily distinguished from *Trachycardium ever-*

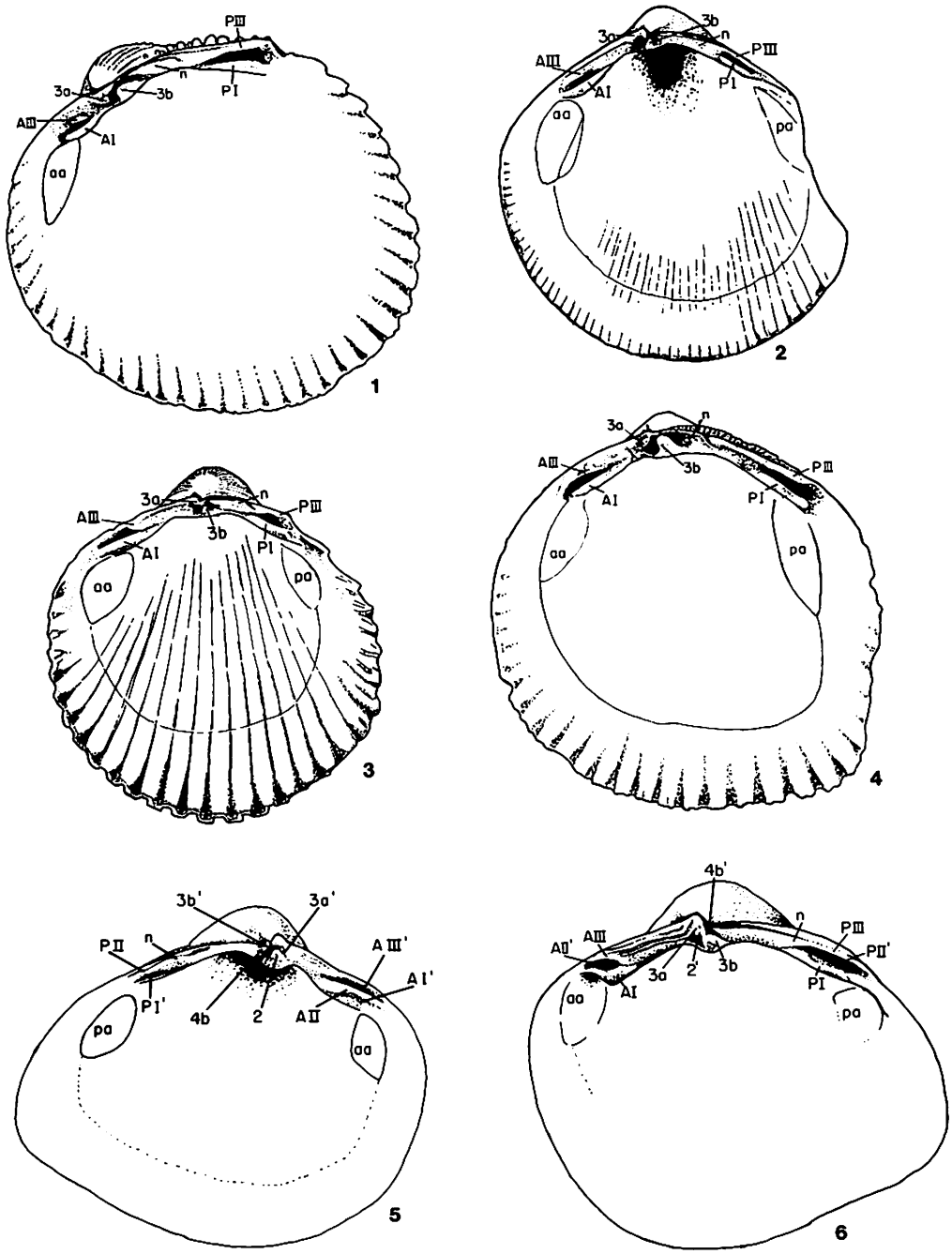


Figure 40 — 1- juvenile right valve, *Agnocardia glebosum* (Conrad); 2- right valve (paratype), *Trachycardium eversum* (Conrad); 3- right valve (holotype), *Trachycardium planicostata* n. sp.; 4- right valve, *Trigoniocardium* (*Americardia*) *silvacollina* n. sp.; 5- left valve (paratype), 6- right valve (holotype), *Nemocardium* (*Nemocardium*) *diversum* (Conrad). 2, 3a, 3b, 4b = cardinal teeth; AII, AIII = anterior lateral teeth; PI, PII, PIII = posterior lateral teeth; 2', 3a', 3b', AI', AII', AIII' PI', PII' = sockets; n = nymph, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

sum by its fewer and flat-topped costae. The name refers to planar costae.

Type: Holotype 340462 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 31, figure 7).

Occurrence: Mississippi: Mint Spring Formation, localities 97, 99a, 100a, 108a.

Subfamily FRAGINAE Stewart, 1930
Genus TRIGONIOCARDIA Dall, 1900
Subgenus AMERICARDIA Stewart, 1930

Trigoniocardia (Americardia) silvacollina n. sp.
Plate 32, figures 9-10; Text Figure 40, 4

Description: Shell small, fragile, quadrate, moderately inflated; hinge teeth of right valve with strong 3b, AI, and PI and weak 3a, AII and PIII; hinge teeth of left valve with strong 2 and AII and weak 4b and PII; exterior with 35 to 40 square-shouldered, flat-topped, finely threaded costae (10 or 11 of these occurring on the posterior slope) and narrow interspaces; umbonal ridge angular.

Discussion: This species is similar to *Trigoniocardia (Americardia) decidu* H. E. Vokes from the Alum Bluff Group in Florida but differs in its smaller size and more numerous ribs. It has only been found in the upper part of the Forest Hill Formation where it is common. The name of this species is derived from the Latin *silva*, forest, and *collis*, hill, which refers to its horizon.

Type: Holotype 340465 USNM from the Forest Hill Formation, locality 75a.

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a.

Subfamily PROTOCARDIINAE Keen, 1951
Genus NEMOCARDIUM Meek, 1876
Subgenus NEMOCARDIUM Meek, 1876

Nemocardium (Nemocardium) eocenense (Meyer)
Plate 34, figures 1-9

1887. *Unicardium ? eocenense* Meyer, Acad. Nat. Sci. Philadelphia, Proc. 1887, p. 53, pl. 3, fig. 14, 14a.
1969. *Cordiula eocenense* (Meyer). Moore, ed., Treatise Invert. Paleont., pt. N, v. 2, p. 511.

Original Description: Meyer, 1887.

"Small, tumid, solid. Margin subquadrangular, rounded anteriorly, truncate posteriorly. Beak turned anteriorly, before it a small cordate lunule. Lunular edge in front of the beak somewhat expanded. Below the beak one tubercular cardinal tooth (left valve), lateral teeth nearly obsolete. Anterior muscular impression elongated elliptical, posterior impression cordate-elliptical. Pallial impression not entire. Inside rough. Margin entire. Surface with indistinct concentric impressed lines, crossed by more distinct radiating lines. This ornamentation is wanting on the umboneal part and more distinct near the margin. The radiating lines are slightly more distinct on the posterior slope. Red Bluff, Miss.

"The only found specimen, a left valve, shows three sinuations of pallial line behind. -I have little doubt that this species belongs either to *Unicardium* d'Orbigny, or *Fimbriella* Stoliczka, or is to be placed in their neighbourhood. These two genera, however, are not known from the Tertairy formation, and if the Red Bluff form should prove to be a different and new genus I propose the name of *Cordiula* for it."

Discussion: The new generic name proposed by Meyer, *Cordiula*, is accepted in the *Treatise on Invertebrate Paleontology*, pt. N, v. 2, p. 511, where it is placed in the family Mactromyidae. Meyer's type species for this genus was known only from the type specimen. Additional specimens show the type to be a young *Nemocardium*, thus proving *Cordiula* to be an invalid genus. Meyer's species name *eocenense* is misleading as the Red Bluff Formation is presently considered to be of Lower Oligocene age.

Nemocardium (Nemocardium) eocenense is similar to *N. (N). diversum* (Conrad) but is much smaller in size.

Type: Holotype 644605 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Plate 34, figure 1).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 39, 40, 46.

Nemocardium (Nemocardium) diversum (Conrad)
Plate 33, figures 1-12; Text Figures 40, 5-6

1829. *Cardita semiradiata* Lesueur, Walnut Hills fossil shells, p. 10, fig. 12 (unpublished manuscript).
1848a. *Cardium diversum* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.
1848b. *Cardium diversum* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 125, pl. 13, fig. 8.
1862. *Protocardia diversa* (Conrad). Gabb, Acad. Nat. Sci., Philadelphia, Proc. 1861, v. 13, p. 370 (Occurs in Texas).
1865. *Protocardia diversa* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 7 (Catalog).
1866. *Protocardia diversa* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).
1885. *Cardium diversum* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, p. 467 (List).
1886. *Cardium diversum* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, Art. 20,

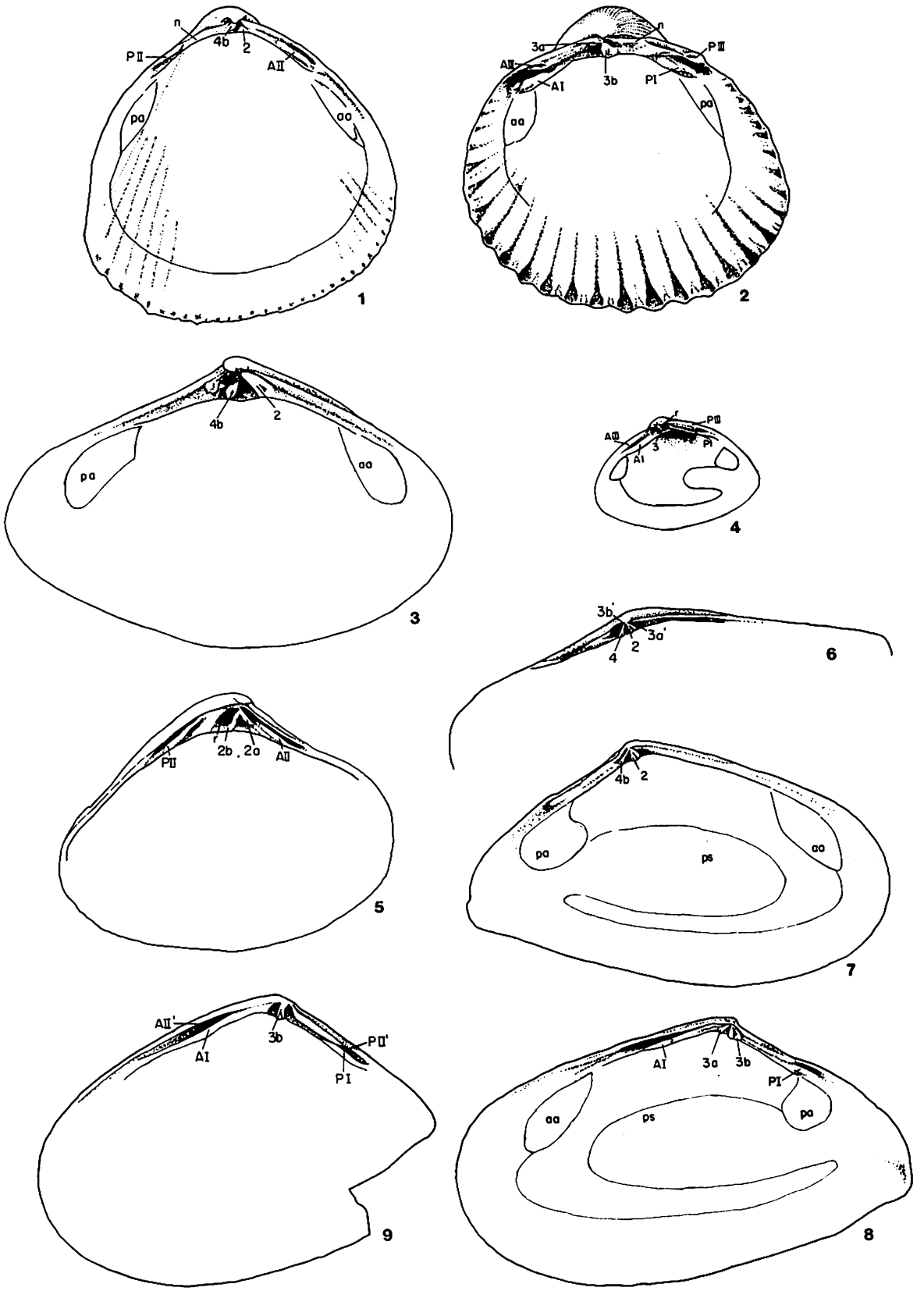


Figure 41 — 1- left valve (holotype), *Laevicardium leptorimum* n. sp.; 2- right valve (neotype), *Dinocardium vicksburgensis* (Conrad); 3- left valve, *Ervilia exterolaevis* n. sp.; 4- right valve (holotype), *Spisula funerata* (Conrad); 5- left valve (holotype), *Spisula* (*Mactromeris*) *mississippiensis* (Conrad); 6- left valve (syntype A), *Tellina serica* Conrad; 7- left valve, 8- right valve, *Tellina subprotexta* n. sp.; 9- right valve (syntype B), *Tellina vicksburgensis* Conrad. 2, 3, 3a, 3b, 4, 4b = cardinal teeth; AI, AII, AIII = anterior lateral teeth; PI, PII, PIII = posterior lateral teeth; 3a', 3b', AII' PII' = sockets; n = nymph, ps = pallial sinus, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

p. 205 (Occurs in the Byram Marl at Byram, Mississippi).

1890. *Cardium (Protocardium) diversum* Conrad. de Gregorio, Ann. Geol. et Paleont., livr. 7 et 8, p. 216, pl. 33, fig. 5-6.

1922. *Protocardium diversa* (Conrad). Cooke, U.S. Geol. Survey Prof. Paper 129, p. 81, 85 (Check list; occurs in the Byram, Mint Spring, and Red Bluff Formations).

1923. *Protocardia diversa* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 133, p. 5 (Listed from the cherts near Goodman, Alabama).

1945. *Nemocardium diversum* (Conrad). Gardner, Geol. Soc. Amer. Memoir 11, p. 105 (Internal molds occur at numerous Oligocene horizons in Mexico).

1962. *Cardium diversum* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 55 (Probable syntypes 30651, 30652. Labelled by Conrad; 30651 subsequently figured).

1968. *Cardium diversum* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. 8, p. 46 (Holotype 30651, paratype 30652).

Original Description: Conrad, 1848a.

"Trigonal, ventricose, subequilateral, thin, with concentric lines and more approximate, fine, but obtuse radiating lines; umbonial slope rounded, and the posterior space from the umbonial slope with profound radiating striae; posterior side slightly waved or contracted; summits very prominent; basal margin rounded in the middle, contracted posteriorly: posterior extremity subtruncated; inner margin densely crenate. Height 1 2-10. Length 1 3-10. Abundant.

"Allied to *C. Nicolleti*, nob. When viewed through a magnifier, the interstices of the concentric lines have a singular imbricated appearance."

Discussion: The types for this species and specimens from the Byram Formation in western Mississippi are produced posteriorly, while specimens from the Mint Spring Formation are more symmetrical in outline. Specimens from the Byram Formation in eastern Mississippi (locality 93) are somewhat intermediate between these two forms.

Type: Holotype 30651 and two paratypes 30652 ANSP from the Byram Formation, Vicksburg, Mississippi.

Occurrence: Mississippi: Forest Hill Formation, locality 88a; Mint Spring Formation, localities 89a, 90, 99a, 100, 108a; Byram Formation, localities 93, 102, 106a, 109, 112c, 115. Also reported from the Oligocene of Alabama and Mexico.

Subfamily LAEVICARDIINAE Keen, 1936

Genus LAEVICARDIUM Swainson, 1840

Laevicardium leptorimum n. sp.

Plate 32, figures 6-8; Text Figure 41, 1

Description: Shell small, thin, fragile, quadrate, moderately inflated; hinge weak and teeth small, the AI, PI, and AII being moderately pronounced; exterior with smooth anterior and posterior slopes and with low relief, smooth, radial costae on central portion; costae about same width as interspaces and strongest before posterior slope.

Discussion: This species is fragile and good specimens are difficult to obtain. It differs from *Laevicardium compressum* (Dall) from the Alum Bluff Group in Florida in its flattened ventral margin and quadrate outline. The name refers to the species thin shell.

Type: Holotype 340466 USNM from the Mint Spring Formation, locality 100a, (Plate 32, figure 6).

Occurrence: Mississippi: Mint Spring Formation, localities 90, 97, 99a, 100a, 108b.

Genus DINOCARDIUM Dall, 1900

Dinocardium vicksburgense (Conrad)

Plate 34, figures 10-14; Text Figure 41, 2

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 21, (no name).

1848a. *Cardium Vicksburgense* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.

1848b. *Cardium vicksburgense* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122, pl. 12, fig. 16.

1865. *Cardium (Cerastoderma) vicksburgense* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 7 (Catalog).

1866. *Cardium (Cerastoderma) vicksburgense* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1886. *Cardium vicksburgense* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, Art. 20, p. 204 (Occurs in the Byram Marl at Byram, Mississippi).

1922. *Cardium vicksburgense* Conrad. Cooke, U. S. Geol. Survey Prof. 129, p. 85 (Check list: Byram Fm.).

1962. *Cardium vicksburgense* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 107 (Missing).

Original Description: Conrad, 1848a.

"Cordate, ventricose, with about twenty-four ribs; angular and profound; towards the anterior margin obsolete; summit prominent; nearest the anterior end; anterior margin straight and direct; posterior end subtruncated. Height 3-10. Length 4-10 nearly. Rare."

Discussion: This species is characterized by its elevated and sharply rounded (almost V-shaped) costae. Large specimens of this species are rare but the young (see Plate 34, figures 12-14) occur commonly in screened sediments from some localities in the Byram Formation. As the type is missing (Moore, 1962), a

neotype is designated from the Byram Formation at locality 106a.

Type: Neotype 340467 USNM from the Byram Formation, locality 106a (Plate 34, figure 10; Text Figure 41, 2).

Occurrence: Mississippi: Byram Formation, localities 93, 94, 106a, 115.

Superfamily MACTRACEA Lamarck, 1809
Family MACTRIDAE Lamarck, 1809
Genus SPISULA Gray, 1837

Spisula inaequilateralis (Meyer)
Plate 36, figures 3-6

1886. *Mactra inaequilateralis* Meyer *in* Smith, Geol. Survey Alabama, Bull. No. 1, p. 82, pl. 1, fig. 18.
1898. *Spisula inequilateralis* (sic) (Meyer). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 896.
1903. *Mactra inaequilateralis* Meyer. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 264 (A small *Mactra* is abundant in the Lower Vicksburg and may be *M. inaequilateralis* Meyer).

Original Description: Meyer, 1886.

"Substance of the shell thick; inequilateral; triangular; anteriorly rounded; posterior slope carinated; covered with indistinct concentric lines, which are distinct on the extremities.

"*Locality*. -Vicksburg, Miss.

"As Conrad describes and figures *Mactra funerata* as equilateral, I am unable to refer the figured specimen to his species."

Discussion: This species is restricted to the Forest Hill and Mint Spring Formations. It differs from *Spisula funerata* (Conrad) of the Byram Formation in being more produced posteriorly.

Type: Holotype 644601 USNM from the Mint Spring Formation, Vicksburg, Mississippi (Plate 36, figure 3).

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 97, 99a, 100a, 108b, 110.

Spisula funerata (Conrad)
Plate 35, figure 10; Plate 36, figures 1-2;
Text Figure 41, 4

1848a. *Mactra funerata* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, pl. 291.
1848b. *Mactra funerata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 121, pl. 12, fig. 13.
1885. *Mactra funerata* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, Art. 59, p. 461 (Similar to a species occurring at Jackson, Mississippi).
1898. *Spisula funerata* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 896.
1903. *Mactra funerata* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262 (Occurs only in the upper marl of the Vicksburg Group).
1922. *Spisula funerata* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list: Byram and Mint Spring marls).
1946. *Spisula funerata* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 108.
1962. *Mactra funerata* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 72 (Probable holotype 30668).
1968. *Mactra funerata* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 52 (Holotype 30668).

Original Description: Conrad, 1848a.

"Triangular, small, convex; much longer than high, equilateral; posterior end angular. Length 3-10. Rare."

Discussion: This species is similar to *Spisula jacksonensis* Cooke from the Jackson Group but is smaller, less inflated and more sharply rounded on the anterior and posterior margins. It differs from *S. inaequilateralis* in being more equilateral. *S. funerata* appears to be restricted to the Byram Formation.

Type: Holotype 30668 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 35, figure 10; Text Figure 41, 4).

Occurrence: Mississippi: Byram Formation, localities 93, 94, 106a, and Vicksburg.

Spisula sp.

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 5 (no name).

Discussion: This species is moderately inflated and triangular in outline. It is larger in size than *S. funerata* or *S. inaequilateralis* and smaller than *S. (Mactromeris) mississippiensis*. The dimensions of the one complete specimen on hand are: height 17.0 mm, length 21.0 mm, and inflation 5.6 mm. Lesueur (1829) beautifully illustrates this species in his drawings, which include the interior and exterior of the left valve and the cross sectional outline of articulated valves (Plate 11, figure 5).

Occurrence: Mississippi: Mint Spring Formation, locality 100a; Byram Formation, locality 112c.

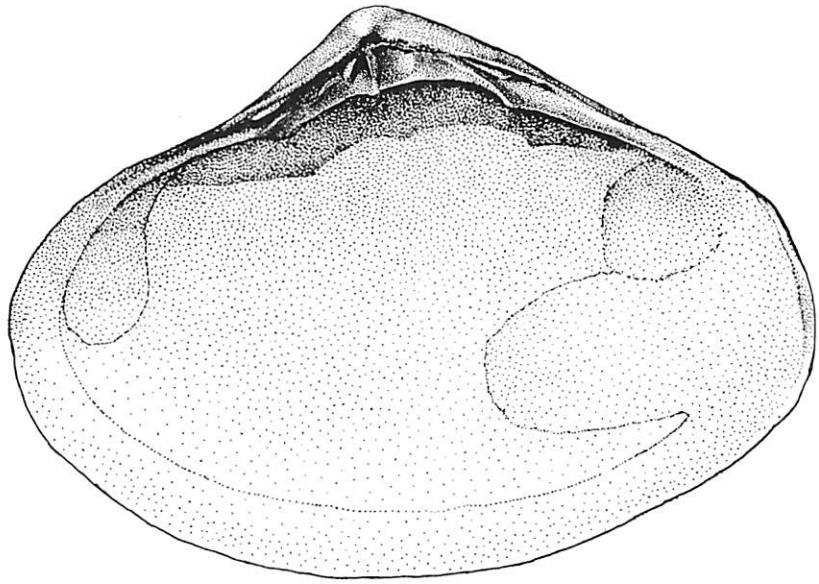


Figure 42 — *Spisula* (*Mactromeris*) *mississippiensis* (Conrad), right valve. Illustration by Julia H. Suits.

Subgenus MACTROMERIS Conrad, 1868

Spisula (Mactromeris) mississippiensis (Conrad)

Plate 35, figures 1-7, 9; Text Figures 41, 5; 42

1848a. *Mactra Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 290-291.

1848b. *Mactra mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 121, pl. 12, fig. 14.

1865. *Mactra Mississippiensis* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 13 (Catalog).

1866. *Mactra mississippiensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 27 (List).

1898. *Spisula mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 896.

1916. *Mactra mississippiensis* Conrad. Dall, U. S. Natl. Mus., Proc., v. 51, No. 2162, p. 489, 502 (Occurs in the lower Flint River beds on the Flint River, below Bainbridge, Georgia).

1923. *Mactra mississippiensis* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 133, p. 5 (Check list).

1946. Not *Spisula mississippiensis* (Conrad). Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 106 (Probably = *Spisula* (*Symmorphomactra*) *praetenuis* (Conrad). Dockery, 1980, Miss. Bureau Geol., Bull. No. 122, p. 178-179, pl. 68, fig. 6, 7).

1962. *Mactra mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 76 (Figured syntype 30669. Labelled by Conrad; 30669 subsequently figured. Lots originally together. Syntypes, 30670).

1968. *Mactra mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Holotype 30669, paratypes 30670).

Original Description: Conrad, 1848a.

"Subtriangular, equilateral, very thin, and fragile, plano-convex, dorsal margin very oblique, nearly straight, extremity acutely rounded, much above the line of the base, which is regularly curved; summit prominent; lunule elongated, defined by an impressed line; umbonial slope nearly terminal, angulated and carinated by a thin line. Length 1 8-10. Height 1 4-10.

"Proportionally more elevated than *M. praetenuis*, of Claiborne, Alabama, and a much larger species. Rare."

Discussion: Harris and Palmer (1946) report this species from the Moodys Branch Formation at Jackson, Mississippi. The Moodys Branch species differs from *Spisula* (*Mactromeris*) *mississippiensis* in that: (1) the posterior is more produced, (2) the posterior slope is narrow and restricted to the almost vertical posterior dorsal margin, and (3) the posterior arm overhangs the resilifer. This species is identified as *Spisula praetenuis* of the Claiborne Group and placed in the subgenus *Symmorphomactra.*

Type: Holotype 30669, paratype 30670 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 35, figure 1; Text Figure 41, 5).

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 100a, 108b; upper Glendon Limestone, locality 112b; Byram Formation, locality 93.

Family MESODESMATIDAE Gray, 1839
Subfamily ERVILIINAE Dall, 1895
Genus ERVILIA Turton, 1822

Ervilia exterolaevis n. sp.
Plate 37, figures 1-6; Text Figure 41, 3

Description: Shell small, elongate, somewhat produced posteriorly, moderately inflated; hinge of right valve with one large cardinal tooth and long, narrow, lateral sockets; hinge of left valve with a less pronounced, bifid cardinal tooth and long lateral teeth; adductor muscle scars about equal; pallial sinus small; exterior smooth; posterior ridge rounded; lunule and escutcheon unpronounced.

Discussion: This species differs from the type species *Ervilia nitens* (Montagu) from the Recent of North America in its lesser elevation and smooth exterior. It is restricted to the Forest Hill and Mint Spring Formations. The name refers to the smooth exterior.

Type: Holotype 340469 USNM from the Forest Hill Formation, locality 75a (Plate 37, figure 5).

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108b, 110.

Ervilia lamelloexteria n. sp.
Plate 37, figures 7-11

Description: Shell small, elongate, moderately inflated; hinge of right valve protruding downward below the large cardinal tooth, lateral sockets long and narrow; hinge of left valve with a less pronounced bifid cardinal tooth and long lateral teeth; adductor muscle scars about equal; pallial sinus small; exterior with concentric lamellae; posterior ridge broadly rounded; lunule and escutcheon small and indistinct.

Discussion: This species differs from *Ervilia exterolaevis* in that it: (1) is more elevated, (2) is less produced posteriorly, (3) has a greater downward protrusion of the right valve hinge below the cardinal tooth, (4) is more inflated at the umbo, and (5) is sculptured on the exterior with concentric lamellae. It is restricted to the Byram Formation where it is abundant at some localities. The name refers to the exterior sculpture of concentric lamellae.

Type: Holotype 340470 USNM from the Byram Formation, locality 93 (Plate 37, figure 9).

Occurrence: Mississippi: Byram Formation, localities 93, 94, 102, 106a, 109.

Superfamily TELLINACEA de Blainville, 1814
Family TELLINIDAE de Blainville, 1814
Subfamily TELLINAE de Blainville, 1814
Genus TELLINA Linné, 1758

Tellina lintea (Conrad)
Plate 39, figures 1-8; Text Figure 43, 1-2

1848a. *Psammobia lintea* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 291.
1848b. *Psammobia lintea* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122, pl. 12, fig. 25.
1865. *Gari lintea* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 4 (Catalog).
1866. *Gari lintea* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1921. *Psammobia lintea* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in Byram and Mint Spring marls).
1962. *Psammobia lintea* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 71 (5 probable syntypes 30671. Labelled by Conrad).
1968. *Psammobia lintea* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 62 (Syntypes 30671).

Original Description: Conrad, 1848a.

"Oblong, compressed, with rather fine, very regular concentric lines closely arranged; anterior margin acutely rounded, the extremity in a line above the middle of the valve; posterior side shortest; hinge line rectilinear, oblique; posterior side with acute lines larger and more prominent than those of the middle and anterior side; umbonial slope subangular, Length 1 1/4. Rare."

Discussion: This species is similar to *Tellina linifera* Conrad from the Jackson Group in its strong concentric sculpture on the exterior. However, *Tellina lintea* is less produced posteriorly and more equilateral. It ranges throughout the Vicksburg Group.

Type: Five syntypes A-E 30671 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 39, figures 1-4; Text Figures 1-2).

Occurrences: Mississippi: Red Bluff Formation, localities 34b, 37; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90; Byram Formation, localities 93, 102.

Tellina subprotexta n. sp.
Plate 38, figures 5, 7, 9-10; Text Figures 41, 7-8

1903. *Tellina protexta* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262-263.

Description: Shell slightly inflated, elongate posteriorly; hinge of right valve with bifid 3b, small 3a,

long AI, short PI, and prominent AII' and PII' sockets, ligament suture impressed and intersecting hinge in front of the PI; hinge of right valve with slightly bifid 2, small 4b, and indistinct laterals; interior with faint radial grooves between the midline and posterior margin; pallial sinus large; anterior margin broadly rounded, posterior margin truncate and sharply rounded; posterior slope with shallow central sulcus; exterior sculptured with fine, impressed concentric lines.

Discussion: Casey (1903) identified this species as *Tellina protexta* (Conrad) from a comparison with Conrad's illustration. He stated that the species is "near" *T. vicksburgensis* Conrad and is very abundant in the "Lower" Vicksburg (= Mint Spring Formation), "to which it is entirely confined." The type of *T. protexta* (Plate 62, figure 4) shows the species to be a synonym of *T. serica* Conrad, which occurs in the Byram Formation. This latter species differs from the *Tellina* in the Mint Spring Formation in its: (1) more broadly rounded posterior margin, (2) larger size, (3) less angular hinge, and (4) more strongly depressed ligament (see Text Figures 41, 6-8). Conrad's name *protexta* is modified here and used for the common *Tellina* species of the Mint Spring Formation.

Type: Holotype 340472 USNM and paratype 340473 USNM from the Mint Spring Formation, localities 108b and 100a, respectively (Plate 38, figures 9, 5).

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108b, 110, 111.

Tellina vicksburgensis Conrad

Plate 38, figures 1-4, 6, 8; Text Figure 41, 9

1848a. *Tellina Vicksburgensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.

1848b. *Tellina vicksburgensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 12, fig. 32.

1865. *Tellina Vicksburgensis* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 4 (Catalog).

1866. *Tellina vicksburgensis* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 4 (List).

1885. *Tellina vicksburgensis* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, Art. 59, p. 461, 467 (a variety "*robusta*" Meyer, occurs at Jackson, Mississippi. Not *T. robusta* Hanley, 1844). Meyer, *Ibid*, v. 30, No. 175, Art. 10, p. 72.

1903. *Tellina vicksburgensis* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262-263.

1922. *Tellina vicksburgensis* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list; in Byram and Mint Spring marls).

1926. *Tellina vicksburgensis* Conrad. Cooke, Washington Acad. Sci. Jour., v. 16, No. 5, p. 137 (a variety "*moodiana*" occurs at Moodys Branch, Jackson, Mississippi, figures 15a, b).

1946. *Tellina vicksburgensis* Conrad. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 101-102, pl. 22, fig. 9-12.

1962. *Tellina vicksburgensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 72 (3 possible syntypes 30684. Labelled by Conrad).

1968. *Tellina vicksburgensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 95 (Type? 30684).

Original Description: Conrad, 1848a.

"Triangular, small, with regular minute concentric lines; anterior end rounded; posterior submargin angular or obscurely carinated, the end obliquely truncated; posterior side shortest, and slightly bent or waved; lateral teeth in the right valve only. Length 3-10. Height 1/4."

Discussion: The hinge of this species is like that of *Tellina subprotexta*. This latter species, however, is larger and more elongate. *T. vicksburgensis* is common only in the Byram Formation, while *T. subprotexta* appears to be restricted to the Forest Hill and Mint Spring Formations. A subspecies, *T. vicksburgensis moodiana* Cooke, is common in the Moodys Branch Formation of the Jackson Group.

Type: Three syntypes A-C 30684 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 38, figures 1-3; Text Figure 41, 9).

Occurrence: Mississippi: Mint Spring Formation, locality 99a; Byram Formation, localities 93, 94, 102, 106a, 112c, 116.

Tellina serica Conrad

Plate 38, figures 11-17; Plate 62, figure 4; Text Figure 41, 6

1829. Lesueur, Walnut Hills fossil shells, pl. 10, fig. 11? (no name).

1848a. *Tellina serica* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.

1848b. *Tellina serica* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 12, fig. 28.

1865. *Tellina serica* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 4 (Catalog: = *T. euryterma* Gabb, A. N. S. P., 1861, p. 396).

1871. *Abra protexta* Conrad, Amer. Jour. Conch., v. 6, No. 3, p. 199, pl. 11, fig. 4.

1903. Not *Tellina protexta* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262-263 (= *Tellina subprotexta* n. sp., this paper).
1962. *Tellina serica* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 95 (5 possible syntypes 30686. Labelled by Conrad).
1968. *Tellina serica* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Paper No. 8, p. 84 (Holotype? 30686 and paratypes).

Original Description: Conrad, 1848a.

"Elliptical, inequivalved; beaks nearest the posterior end; concentric lines very minute and closely arranged; anterior side slightly bent or reflected. Length 7-10."

Conrad's (1871) description of *Abra protexta.*

"Elliptical, elongated, inequilateral, compressed, sinuous; disk widely contracted.

"*Locality*. Vicksburg. Oligocene.

"Of this species one valve, the left , is all that I have seen. It is remarkable for its length."

Discussion: This species is similar in outline to *Tellina subprotexta* but differs significantly in its hinge. As the species is fragile, only the hinge of the left valve has been observed in good detail. The escutcheon of *T. serica* is depressed so that the prominent ligament suture forms a medial line between the dorsal margin and the posterior hinge (see Plate 38, figures 14A, 16A and Text Figure 41, 6). In *T. subprotexta*, the escutcheon is less depressed and the ligament suture is on the dorsal margin. Alsc the hinge is more angular about the beak. A variety of *T. serica* from locality 93 has a strongly truncated posterior (see Plate 38, figures 16-17).

Type: Five syntypes A-E 30686 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 38, figures 12-15; Text Figure 41, 6). Holotype for "*Abra*" *protexta* Conrad 30704 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 62, figure 4).

Occurrence: Mississippi: Byram Formation, Vicksburg and locality 93.

Tellina perovata Conrad

1848b. *Tellina perovata* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, p. 262, pl. 12, fig. 29.
1865. *Tellina perovata* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 8 (Catalog: in the Claiborne).
1866. *Tellina perovata* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 8 (Medial Eocene, Alabama), p. 28 (List: Oligocene, Vicksburg).
1903. *Tellina perovata* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262 (Could not find Conrad's type or this species in his own collection).
1962. *Tellina perovata* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 86 (Missing. Cooke, in notebook, found one badly broken specimen).

Original Description: Conrad, 1848b.

"Ovate, very thin, very inequilateral, compressed, smooth; posterior side subcuneiform, extremity acutely rounded; lunule very narrow, elongated, lanceolate."

Discussion: Conrad does not mention the hinge or the shell's interior in his short description. This description and Conrad's figure of the shell's exterior are probably inadequate for a determination of this species if additional specimens are found. The type is missing.

Type: Missing from ANSP.

Occurrence: Mississippi: Vicksburg Group, Vicksburg, Mississippi.

Family DONACIDAE Fleming, 1828
Genus DONAX Linné, 1758

Donax funerata Conrad

Plate 36, figures 7-12

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 9, 17 (no name).
1848a. *Donax funerata* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.
1848b. *Donax funerata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 13, fig. 9.
1865. *Egeria funerata* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 5 (Catalog).
1866. *Donax funerata* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1900. *Donax funerata* Conrad. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 5, p. 966 (Earliest true *Donax* from U. S. Tertiary).
1922. *Donax funerata* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list: in Byram and Mint Spring marls).
1962. *Donax funerata* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 62 (Probable holotype 30683).
1968. *Donax funerata* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 52 (Holotype 30683).

Original Description: Conrad, 1848a.

"Triangular, small, convex, with obsolete radiating lines; anterior side short, end truncated, direct; margin within finely crenulated; lateral teeth none. Length 3-10.

"Very rare. I found it about 8 miles N. E. of Vicksburg."

Discussion: This species has a thick shell and a smooth exterior with the exception of worn specimens that show the internal radial structure. Two varieties of this species occur in the Mint Spring Formation north of Vicksburg, Mississippi. The first variety (A) includes the holotype and has an elevated shell, a thick hinge, and a protruding umbo (see Plate 36, figure 10). The second variety (B) has an elongate shell, narrow hinge, and low umbo (see Plate 36, figure 12). These two varieties, A and B, are illustrated by Lesueur (1829) in Plate 11, figures 9 and 17, respectively. *Donax funerata* has a rare occurrence in the Forest Hill and Mint Spring Formations, except at Mint Spring locality 110 where it is common. Here it is associated with worn shell fragments and probably indicates a surf zone environment. Dall (1900) states that this species is the earliest occurrence of true *Donax* in the North American Tertiary.

Type: Holotype 30683 ANSP from the Mint Spring Formation, north of Vicksburg, Mississippi (Plate 36, figure 7).

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 97, 99a, 100a, 108a, 110.

Donax sp. ?

Plate 36, figure 13

Description: Shell small, moderately inflated; hinge with two cardinal teeth and one anterior lateral tooth; anterior margin sharply truncated, posterior margin broadly rounded; lunule bordered by steep anterior slope; exterior sculptured with fine concentric lamellae.

Discussion: This species is known from a single worn specimen. Additional material should shed more light on the species' generic placement.

Occurrence: Mississippi: Mint Spring Formation, USGS locality 14163.

Family PSAMMOBIIDAE Fleming, 1828

Subfamily PSAMMOBIINAE Fleming, 1828

Genus GARI Schumacher, 1817

Subgenus GARI Schumacher, 1817

Gari (Gari) papyria (Conrad)

Plate 39, figures 9-14; Text Figure 43, 4

1848a. *Psammobia papyria* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 291.

1848b. *Psammobia papyria* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 121, pl. 12, fig. 15, 17.

1865. *Gari papyria* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 8 (Catalog).

1866. *Gari papyria* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).

1962. *Psammobia papyria* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 83 (4 probable syntypes 30672. Labelled by Conrad).

1968. *Psammobia papyria* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 72 (Syntypes 30672).

Original Description: Conrad, 1848a.

"Oblong-oval, or somewhat rhomboidal; very thin, compressed; posterior side rather wider than anterior; and posterior to the umbonial slope, which is undefined, there are concentric lamellaeform lines; anterior margin obliquely rounded; dorsal margin parallel with the base. Length 1 1/2. Rare."

Discussion: This species differs from *Gari* (*Gari*) *jacksonense* in its greater elevation and stronger concentric structure. It is moderately common in the Mint Spring Formation at localities 99a and 100a and in the Byram Formation at locality 93. However, complete specimens are difficult to obtain because of the species' fragility.

Type: Four syntypes A-D 30672 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 39, figures 9, 10, 12, 13).

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 100a; Byram Formation, locality 93; Vicksburg Group, Vicksburg.

Gari mississippiensis (Conrad)

1848b. *Psammobia mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122, pl. 12, fig. 26.

1865. *Gari mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 4 (Catalog).

1866. *Gari mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).

1903. *Gari mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262.

1962. *Psammobia mississippiensis* Conrad, Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 77 (Missing).

Original Description: Conrad, 1848b.

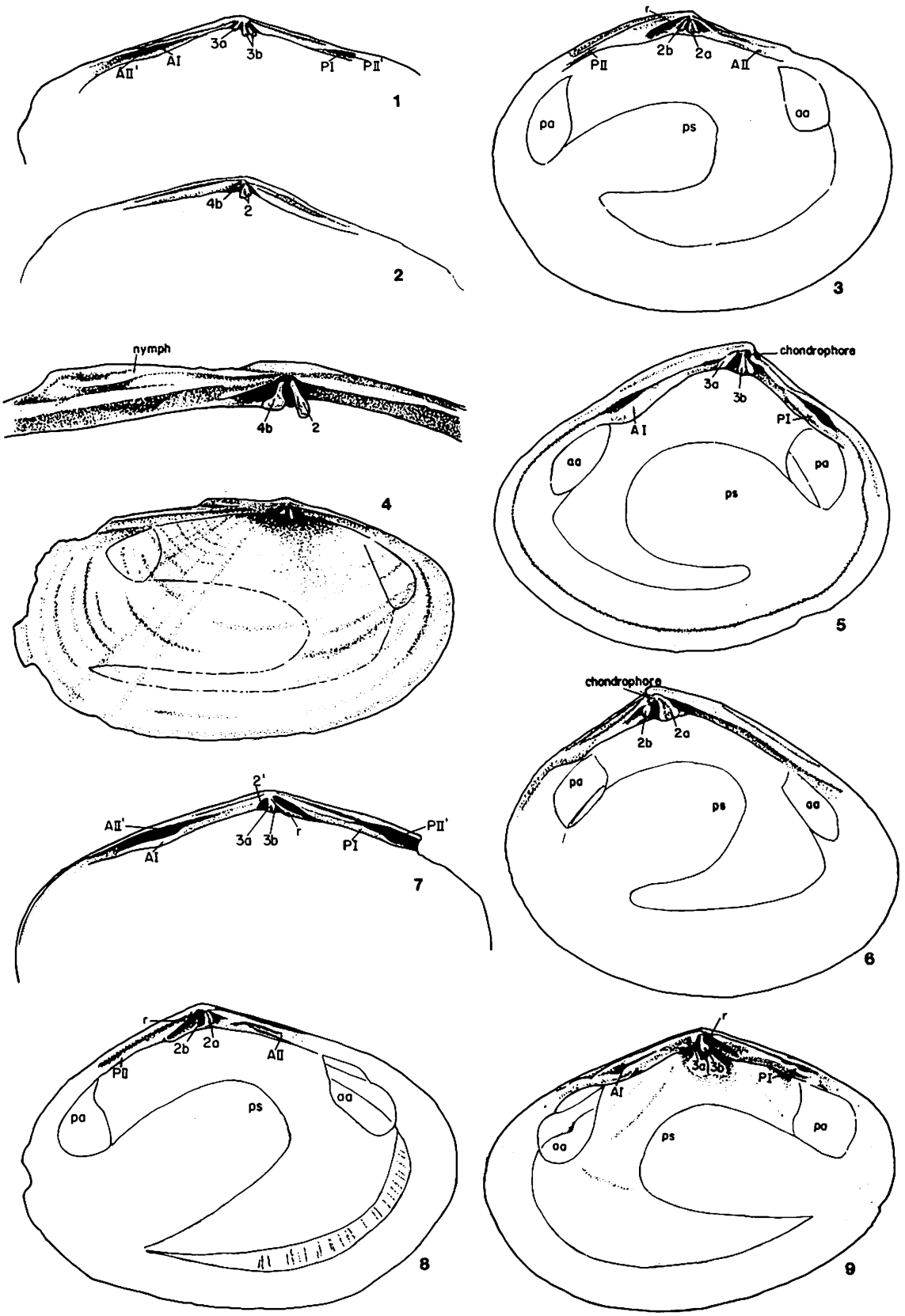


Figure 43 — 1- right valve (syntype C), 2- left valve (syntype B), *Tellina lintea* (Conrad); 3- left valve, *Semele staminea* (Conrad); 4- left valve, *Gari* (*Gari*) *papyria* (Conrad); 5- right valve, 6- left valve, *Semelina pilsbryi* (Casey); 7- right valve (holotype), 8- left valve, 9- right valve, *Semele mississippiensis* (Conrad). 2, 2a, 2b, 3a, 3b, 4b = cardinal teeth; AI, AII = anterior lateral teeth; PI, PII = posterior lateral teeth; 2', AII', PII' = sockets; r = resilifer, ps = pallial sinus, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

"Oblong-ovate, inequilateral, compressed; disk flattened and with slight concentric lines; posterior side with lamellaeform lines; dorsal margin oblique; posterior end sub-truncated; umbonial slope undefined; anterior hinge margin slightly more oblique than the posterior; end acutely rounded."

Discussion of Casey, 1903.

"In the Conrad Catalogue (*Am. Journ. Conc.*, 1865) there are two species which appear to have been originally named *Psammobia mississippiensis*, one under the genus *Gari*, on page 4, the other under the genus *Abra*, on page 5; the references seem to show that they were separately described and figured. The species *Abra mississippiensis* is the only one of which I can find the type. It is broadly oval, but slightly inequilateral and of moderately large size, relatively higher in form than *Abra perovata*, with which it occurs very abundantly in some parts of the Lower Vicksburg. The *Gari mississippiensis* [*l.c.*, p.4) I cannot place and there appears to be no type in the Conrad collection."

Type: Missing from the ANSP.

Occurrence: Mississippi: Vicksburg Group, Vicksburg, Mississippi.

Family SEMELIDAE Stoliczka, 1870

Genus SEMELE Schumacher, 1817

Semele mississippiensis (Conrad)

Plate 40, figures 7-13; Plate 41, figures 1-3; Text Figures 43, 7-9

1848a. *Amphidesma Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 291.

1848b. *Amphidesma mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 121, pl. 12, fig. 20. *Amphidesma perovata* Conrad, *Ibid*, p. 121, pl. 12, fig. 21.

1854. *Syndosmya mississippiensis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, No. 2, p. 29 (List).

1865. *Abra mississippiensis* (Conrad). Conrad, Amer. Jour. Conch. v. 1, pt. 1, p. 5 (Catalog: listed by mistake as = *Psammobia mississippiensis* Conrad, but referenced as J.A.N.S., 2nd ser., p. 121, pl. 12, fig. 20, which is *Amphidesma mississippiensis*). *Abra perovata* (Conrad). Conrad, *Ibid*, p. 5 (Catalog).

1866. *Abra mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List). *Abra perovata* (Conrad). Conrad, *Ibid*, p. 28 (List).

1903. *Abra mississippiensis* (Conrad). Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 262. *Abra perovata* (Conrad). Casey, *Ibid*, p. 262 (Occurs in the Lower Vicksburg with *Abra mississippiensis*).

1962. *Amphidesma mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 75 (Probable holotype 30677. Labelled by Conrad). *Amphidesma perovata* Conrad. Moore, *Ibid*, p. 86 (5 probable syntypes 30679. Labelled by Conrad; figured specimen not recognized. Cooke, in notebook, found 6 specimens in type lot).

1968. *Amphidesma mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Holotype 30677). *Amphidesma perovata* Conrad. Richards, *Ibid*, p. 75 (Types ? 30679).

Original Description: Conrad, 1848a.

"Oblong-oval, somewhat compressed, inequilateral, smooth, with a few distant concentric impressed lines; posterior side with a slight fold, end obtusely rounded; anterior end rounded; cartilage pit very narrow, elliptical; lateral teeth in the right valve distinct, in the left wanting? Length 11-10. Height 7-10."

Conrad's (1848b) description of *Amphidesma perovata.*

"Ovate, inequilateral, plano-convex, smooth; anterior end subtruncated; ligament margin oblique, curving regularly towards the extremity, which is acutely rounded; basal margin rounded; lateral teeth in the left valve; right valve unknown."

Discussion: Casey (1903) stated that "*Abra*" *mississippiensis* (Conrad) is "broadly oval, but slightly inequilateral and of moderately large size, relatively higher in form than *Abra perovata*, with which it occurs very abundantly in some parts of the Lower Vicksburg." The type material (see Plate 40, figures 7-10) shows little difference between these "two" species. *Amphidesma perovata* is considered here to be a synonym of *A. mississippiensis*, which is placed in the genus *Semele.*

Semele mississippiensis has a distinctively divided anterior adductor scar where the scar is intersected by the pallial line. The left valve of this species generally has a stronger concentric sculpture than the right valve. *Semele sellardsi* Gardner of the Alum Bluff Group in Florida is similar to *S. mississippiensis* but differs in its smaller size and more elevated beak.

Type: Holotype 30677 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 40, figure 10; Text Figure 43, 7). Types of *Amphidesma perovata* Conrad include four syntypes A-D 30679 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 40, figures 7-9).

Occurrence: Mississippi: Mint Spring Formation, localities 97, 99a, 108a; Byram Formation, localities 93, 102.

Semele staminea (Conrad)

Plate 40, figure 1-6; Text Figure 43, 3

1848a. *Corbis staminea* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293.
1848b. *Corbis staminea* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 13, fig. 20.
1854. *Fimbria staminea* (Conrad). Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 287, 288.
1865. *Abra staminea* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 5 (Catalog).
1866. *Abra staminea* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1962. *Corbis staminea* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 97 (3 probable syntypes 30666).
1968. *Corbis staminea* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 85 (Syntypes 30666).

Original Description: Conrad, 1848a.

"Suboval, convex, thin, with lamellaeform concentric striae, about thirty-seven in number; posterior side with a slight fold; beaks medial. Length 1. Rare."

Discussion: This species is similar to *Semele chipolana* Dall from the Alum Bluff Group in Florida but differs in its smaller size.

Type: Three syntypes A-C 30666 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 40, figures 1-2).

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 99a, 100a; Byram Formation, locality 106a; Vicksburg Group, Vicksburg.

Genus ABRA Lamarck, 1818

Abra pectorosa (Conrad)

Plate 41, figures 4-7

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 6 (no name).
1848a. *Tellina pectorosa* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.
1848b. *Tellina pectorosa* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 122, pl. 12, fig. 27.
1865. *Tellina pectorosa* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 4 (Catalog).
1962. *Tellina pectorosa* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 72 (2 probable syntypes 30685. Labelled by Conrad; Cooke, in notebook, found three specimens in type lot).
1968. *Tellina pectorosa* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 74 (Types ? 30685).

Original Description: Conrad, 1848a.

"Subtriangular, elevated, smooth and polished; ventricose; beaks medial; anterior end obtuse, rounded; posterior side somewhat cuneiform, with a slight wave or fold; basal margin profoundly rounded. Length 6-10. Height 5-10."

Discussion: This species is similar to *Abra nitens jacksonica* Harris from the Jackson Group in its produced and broadly rounded anterior margin, its sharply rounded posterior margin, and its elevated and sharply rounded umbo. These features, however, are more pronounced in the Vicksburg species.

Type: Two syntypes A-B 30685 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 41, figures 4, 6).

Occurrence: Mississippi: Red Bluff Formation, localities 37, 38, 39, 40; Byram Formation, locality 93; Vicksburg Group, Vicksburg.

Genus SEMELINA Dall, 1900

Semelina pilsbryi (Casey)

Plate 41, figures 8-14; Plate 62, figures 1-3; Text Figures 43, 5-6

1903. *Tellina pilsbryi* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 263.

Original Description: Casey, 1903.

"There is a undescribed *Tellina* occurring in large numbers in the Lower Vicksburg, to which I take pleasure in giving the above name in honor of Dr. H. A. Pilsbry, of Philadelphia. It is strongly inequilateral, trigonal, with the ventral edge rounded, rather thick in substance, compressed, the anterior and posterior sides broadly rounded, the surface equally declivous and convex toward the edges and not more abruptly declivous along the anterior edge; it is strongly marked with fine, very close-set concentric striae throughout. The lateral teeth of the left valve are large and strongly developed, those of the right obsolescent. The larger cardinal of the left valve is subbifid. The length of a nearly full-grown valve is 9 mm.; height about 7 mm.; beak about 2 mm. in front of the median line. The lunule is small and slender."

Discussion: Casey (1903) in his description mistook the anterior for the posterior of the shell and reversed the valves as to which was right and left. This is probably due to the fact that the beak of this species points posteriorly. However, the type specimens of Casey show a large, well defined, pallial sinus directed toward the short posterior margin as is the beak (see Plate 62, figures 1-3). This species is similar to *Semelina cytheroidea* Dall from the Alum Bluff Group in Florida.

Type: Three syntypes A-C 1002 ANSP from the Mint Spring Formation, Vicksburg, Mississippi.

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108a; Byram Formation, localities 94, 106a, 109, 112c.

Family SOLECURTIDAE d'Orbigny, 1846
Subfamily SOLECURTINAE d'Orbigny, 1846
Genus SOLECURTUS de Blainville, 1824

Solecurtus vicksburgensis Aldrich
Plate 42, figures 1-2

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 1 (no name).
1885. *Solecurtus Vicksburgensis* Aldrich, Cincinnati Soc. Nat. Hist., Jour., v. 8, No. 2, p. 145, pl. 2, fig. 1.
1886. *Macha Vicksburgensis* (Aldrich). Aldrich, Geol. Survey Alabama, Bull. No. 1, p. 37, pl. 2, fig. 1.
1900. *Psammosolen vicksburgensis* (Aldrich). Dall, Wagner Free Inst. Sci. Philadelphia, v. 3, pt. 5, p. 960.
1925. *Psamosolen vicksburgensis* (Aldrich). Woodring, Carnegie Inst. Washington, Pub. No. 366, p. 183 (Compared with *Psamosolen santidominici* Maury from the Bowden Formation of Jamaica).
1928. *Psamosolen vicksburgensis* Aldrich. Gardner, U. S. Geol. Survey, Prof. Paper No. 142-E, p. 216.

Original Description: Aldrich, 1885.

"Shell, transversely-oblong; surface, obliquely grooved nearly all over; anterior end smooth; posterior, with grooves meeting those on the posterior and dorsal margin at an obtuse angle; angular along the umbonial slope; anterior, truncated; posterior, rounded; ventral part, concave, lines of growth showing distinctly; beak, slightly raised, rounded, striated, on the anterior side of the shell. Two indistinct lines run across the center of the shell from the beak to the ventral margin; posterior tooth in left valve prominent. Height, 5/10 of an inch; width, 1 1/10.

"*Locality*. Vicksburg, Miss.

"Only the left valve of the species is known. The interior being filled with matrix, no description can be made."

Discussion of Dall (1900) for *Psammosolen vicksburgensis* Aldrich.

"Oligocene of the Vicksburgian horizon at Vicksburg, Mississippi; of the Chipolan on the Chipola River, Florida, and of the Bowden beds, Jamaica.

"The species of this group are variable and all very similar in general appearance. The incised lines vary in strength with the individual, and are sharper and closer together in the young than in the adult. While I cannot be absolutely certain that the specimens from the Chipolan horizon are specifically identical with those from the Vicksburgian, I cannot, in the material before me, find characters by which to separate them. The best preserved specimens from Bowden are nearer the European *P. strigilatus* than to the existing recent American species."

Discussion of Gardner (1928) under *Psamosolen aldrichi* Gardner.

"The type of *P. vicksburgensis* Aldrich (PI. XXXIII, fig. 1) has been kindly loaned by John Hopkins University. It represents a smaller, more compressed species, more elongated transversely. The surface is much worn, and the details of the sculpture are rather obscure. The anterior area is, however, much narrower than in the Alum Bluff form. The oblique groovings are certainly continued well over the anterior basal angle, whereas in *P. aldrichi* they disappear abruptly along a line which falls almost horizontally from the umbones. This character is constant in all the individuals examined. The Bowden form, which has also been included under *P. vicksburgensis*, is apparently closer to the Vicksburg than to the Alum Bluff species."

Type: Holotype 644607 USNM from the Vicksburg Group, Vicksburg, Mississippi (Plate 42, figure 2).

Occurrence: Mississippi: Mint Spring Formation, locality 89a; Byram Formation, locality 93; Vicksburg Group, Vicksburg.

Superfamily ARCTICACEA Newton, 1891
Family KELLIELLIDAE Fischer, 1887
Genus KELLIELLA M. Sars, 1870

Kelliella rufaripa n. sp.
Plate 42, figures 3, 5-6, 8

Description: Shell small, ovate, modestly inflated; hinge of right valve with short cardinal and anterior lateral teeth; hinge of left valve with short cardinal and moderately long, sinuous, anterior lateral tooth; lunule circumscribed by an impressed line; exterior sculptured with fine concentric lamellae.

Discussion: This species is similar to *Kelliella boettgeri* Meyer from the Jackson Group but differs in its slightly smaller size and finer concentric lamellae on the exterior (compare figures 7 and 8 on Plate 42). Living species of *Kelliella* inhabit the deep waters of the Mediterranean Sea and the Atlantic Ocean. *Kelliella boettgeri* is common in the upper Moodys Branch Formation at Jackson in a zone that Elder and Hansen (1981, p. 8) interpret as an inner middle shelf environment. *Kelliella rufaripa* occurs in the *Corbula* bed of the Red Bluff Formation along the Chickasawhay River and probably indicates a similar offshore or deep water environment. The Red Bluff Formation, with the exception of the *Corbula* bed, is considered to have been deposited under nearshore and shallow water conditions. The name refers to the stratigraphic horizon of the Red Bluff Formation.

Type: Holotype 340475 USNM from the *Corbula* bed of the Red Bluff Formation, locality 34b (Plate 42, figure 3).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37; Mint Spring Formation, localities 89a, 90.

Family TRAPEZIIDAE Lamy, 1920
Genus CORALLIOPHAGA de Blainville, 1824
Subgenus CORALLIOPHAGA de Blainville, 1824

Coralliophaga (Coralliophaga) corrugata n. sp.
Plate 42, figures 9-11; Text Figures 44, 1, 3

Description: Shell elongate posteriorly, moderately inflated; anterior and posterior margins rounded; hinge of each valve with cardinal teeth parallel to the posterior hinge and with a long nymph; posterior adductor scar large; pallial sinus sharply rounded; escutcheon and lunule indistinct; exterior smooth except for concentric rugae.

Discussion: This species is similar to the type species *Coralliophaga (Coralliophaga) coralliophaga* (Gmelin) from the Recent of the West Indies. It differs in lacking radial ornamentation and in having stronger concentric rugae. The name refers to the rugose exterior.

Type: Holotype 340476 USNM from the Mint Spring Formation, USGS locality 6647a.

Occurrence: Mississippi: Mint Spring Formation, locality 99a, USGS locality 6647a.

Superfamily VENERACEA Rafinesque, 1815
Family VENERIDAE Rafinesque, 1815
Subfamily VENERINAE Rafinesque, 1815
Genus VENTRICOLARIA Keen, 1954

Ventricolaria ucuttana (Dall)
Plate 43, figures 1-4; Text Figure 44, 2

1903. *Cytherea (Ventricola) ucuttana* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 6, p. 1276-1277, pl. 57, fig. 14.

Original Description: Dall, 1903.

"Red Bluff horizon of the lower Oligocene of Mississippi on Ucutta Creek, Clarke County, Carson's Creek, and at Red Bluff, Wayne County; Johnson, Burns, and others.

"Shell small, moderately convex, rotund, with low, inconspicuous, prosogyrate beaks; lunule small, slightly impressed, bounded by an impressed line; escutcheon very narrow, defined by a radial ridge sharper in the left valve; surface sculptured with numerous low, even gently rounded, wavelike concentric ridges and by fine, close, regular, low concentric threads which cover the whole surface; hinge solid, normal, well developed, the anterior lateral distinct; inner margins, except the posterior margin, finely crenulate; pallial sinus very small, triangular; outer edges of the adductor scars usually a little raised. Length 19.0, height 16.5, diameter 8.0 mm.

"This neat little shell grows to a somewhat larger size, as fragments indicating individuals one-third larger than the measurements given are in the collection. It is from this stem that the upper Oligocene and Miocene *Artena* seems to be derived."

Discussion: This species has a characteristic exterior sculpture of large concentric ribs overlain by fine concentric lamellae. It is moderately common in the Red Bluff Formation and rare in the Byram Formation.

Type: Holotype 136468 USNM from the Red Bluff Formation, Eucutta Creek, Clarke County, Mississippi (Plate 43, figure 1; Text Figure 44, 2).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39; Byram Formation, localities 93, 102.

Subfamily PITARINAE Stewart, 1930
Genus PITAR Romer, 1857
Subgenus HYPHANTOSOMA Dall, 1902

Pitar (Hyphantosoma) semipunctata (Conrad)
Plate 46, figures 5-13; Text Figure 44, 8

1848b. *Cytherea semipunctata* Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 134 (Plate explanation), pl. 13, fig. 19 (No description).

1854. *Meretrix semipunctata* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 30 (List).

1927. *Pitaria (Hyphantosoma) semipunctata* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, p. 55, 1929. Palmer, *Ibid*, pl. 10, fig. 5, 9.

1962. *Cytherea semipunctata* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 95 (Holotype 30658. One specimen agrees with figure; illustrated only. Three remaining specimens, same number).

1968. *Cytherea semipunctata* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 84 (Holotype 30658 and paratypes).

Discussion of Palmer, 1927.

"Shell small, inequilateral, ovate; beaks small; posterior and anterior ends rounded nearly equally; lunule large for the size of the shell, elongate and bounded by an impressed line; teeth of *Pitaria*; pallial sinus rounded; margin entire; sculpture of fine but well developed concentric ribs with interspaces equal to the width of the ribs; the concentric ribs are crossed by a series of punctuations in zigzag formation. The punctuations are best developed posteriorly and ventrally. The young shells do not show the punctuated surface. This species represents a form in the initial stage of the character of *Hyphantosoma*.

"Conrad figured this species and gave the name in the explanation of the plate but did not include the description in the text of the report on the Vicksburg fossils. The collection of the type specimens of Conrad, at the Academy of Natural Sciences at Philadelphia, contains a tray with specimens labelled *C. perbrevis*. The specimens are not *C. perbrevis* and on examination reveal the beautiful sculpture which we have determined that Conrad must have meant when he called the species *semipunctata*. The speci-

men of *perbrevis* is in the tray of *C. asrartiformis* which it resembles but from which it may be differentiated readily.

"*Dimensions*. -14 mm., length; 12 mm., height; 4mm., semidiameter.

"*Plesiotype*. -Academy of Natural Sciences, Philadelphia, Pa.

"*Occurrence*. -Oligocene. Vicksburg, Miss. (Acad. Nat. Sci., Phil., Cornell Univ. Pal. Lab.)"

Discussion: This species is similar to *Pitar aldrichi* of the Red Bluff and Mint Spring Formations but differs in its zigzag sculpture that overlies the fine concentric lamellae. Some specimens have this sculpture more strongly developed than others. Specimens from the Byram Formation at Vicksburg have a triangular outline with sharply rounded anterior and posterior margins, while at locality 93 they have a more circular outline with broadly rounded anterior and posterior margins.

Type: Holotype and three paratypes B-C 30658 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 46, figures 5-8; Text Figure 44, 8).

Occurrence: Mississippi: Byram Formation, localities 93, 106, 112c.

Subgenus LAMELLICONCHA Dall, 1902

Pitar (Lamelliconcha) imitabilis (Conrad)

Plate 43, figures 5-7; Text Figures 45, 1-2

1829. *Cytherea circulifera* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 13 (unpublished manuscript).
1848a. *Cytherea imitabilis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.
1848b. *Cytherea imitabilis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 13, fig. 14.
1854. *Meretrix imitabilis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 30 (List); *Ibid*, 1855, v. 7, p. 257.
1865. *Dione imitabilis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 6 (Catalog).
1866. *Dione imitabilis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1886. *Cytherea imitabilis* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, p. 205 (Occurs at Byram, Mississippi).
1903. *Pitaria* (*Lamelliconcha*) *imitabilis* (Conrad). Dall, Wagner Free Inst. Sci., Philadelphia Trans., v. 3, pt. 6, p. 1268.
1922. *Pitaria* (*Lamelliconcha*) *imitabilis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 81, 85 (Check list: Occurs in Byram and Mint Spring Marl).
1927. *Pitaria* (*Lamelliconcha*) *imitabilis* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, p. 40, 43. 1929. Palmer, *Ibid*, not pl. 8, fig. 6, 15, 23, 33 = *Pitar* (*Lamelliconcha*) *protena*.
1962. *Cytherea imitabilis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 65 (4 probable syntypes 20172. Cooke, in notebook, found 5 specimens in type lot).
1968. *Cytherea imitabilis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 56 (Holotype and paratypes 20172).

Original Description: Conrad, 1848a.

"Cordate, inequilateral, plano-convex, with numerous concentric prominent acute ribs; extremities rounded; basal margin regularly curved; lunule ovate, defined by an impressed line. Length 1 7-10. Height 1 3-10. Common."

Discussion: This species is restricted to the Byram Formation and is very similar to *Pitar* (*Lamelliconcha*) *protena*, which occurs in the Mint Spring and Byram Formations. *Pitar* (*Lamelliconcha*) *imitabilis* differs from this latter species in the following ways: (1) the posterior dorsal slope is not as steep, and the posterior dorsal margin extends above the posterior shoulder in the exterior view, (2) the greatest flexure or convexity of the ventral margin is behind the beak rather than below it, and (3) the pallial sinus is broad and with angulations rather than evenly rounded (see Text Figures 45, 1-2).

Type: Holotype 20172 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 43, figure 5; Text Figure 45, 2).

Occurrence: Mississippi: Byram Formation, localities 93, 94, 102, 106a, 112c, 115, 116.

Pitar (Lamelliconcha) protena n. sp.

Plate 43, figures 8-13; Plate 44, figures 1-3; Text Figures 45, 3-4

1929. *Pitaria* (*Lamelliconcha*) *imitabilis* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, pl. 8, fig. 6, 15, 23, 33.

Description: Shell moderately inflated, greatly elevated near the anterior margin and tapering toward the posterior; anterior margin broadly rounded, posterior margin sharply rounded; hinge as typical of genus; pallial sinus rather narrow, evenly tapering and sharply rounded on the anterior margin; lunule circumscribed by an impressed line; posterior shoulder close to the posterior dorsal margin; exterior sculptured with strong concentric lamellae.

Discussion: This species is fairly common in the Mint Spring Formation at Vicksburg, Mississippi. A coarse ribbed variety (see Plate 44, figure 3) has been found at one locality in the Byram Formation (locality 106a). Here this species is easily distinguished from *Pitar* (*Lamelliconcha*) *imitabilis* with which it occurs by its coarser ribs. Generally, the differences between the Mint Spring specimens of *P.* (*L.*) *protena* and specimens of *P.* (*L.*) *imitabilis* from the Byram

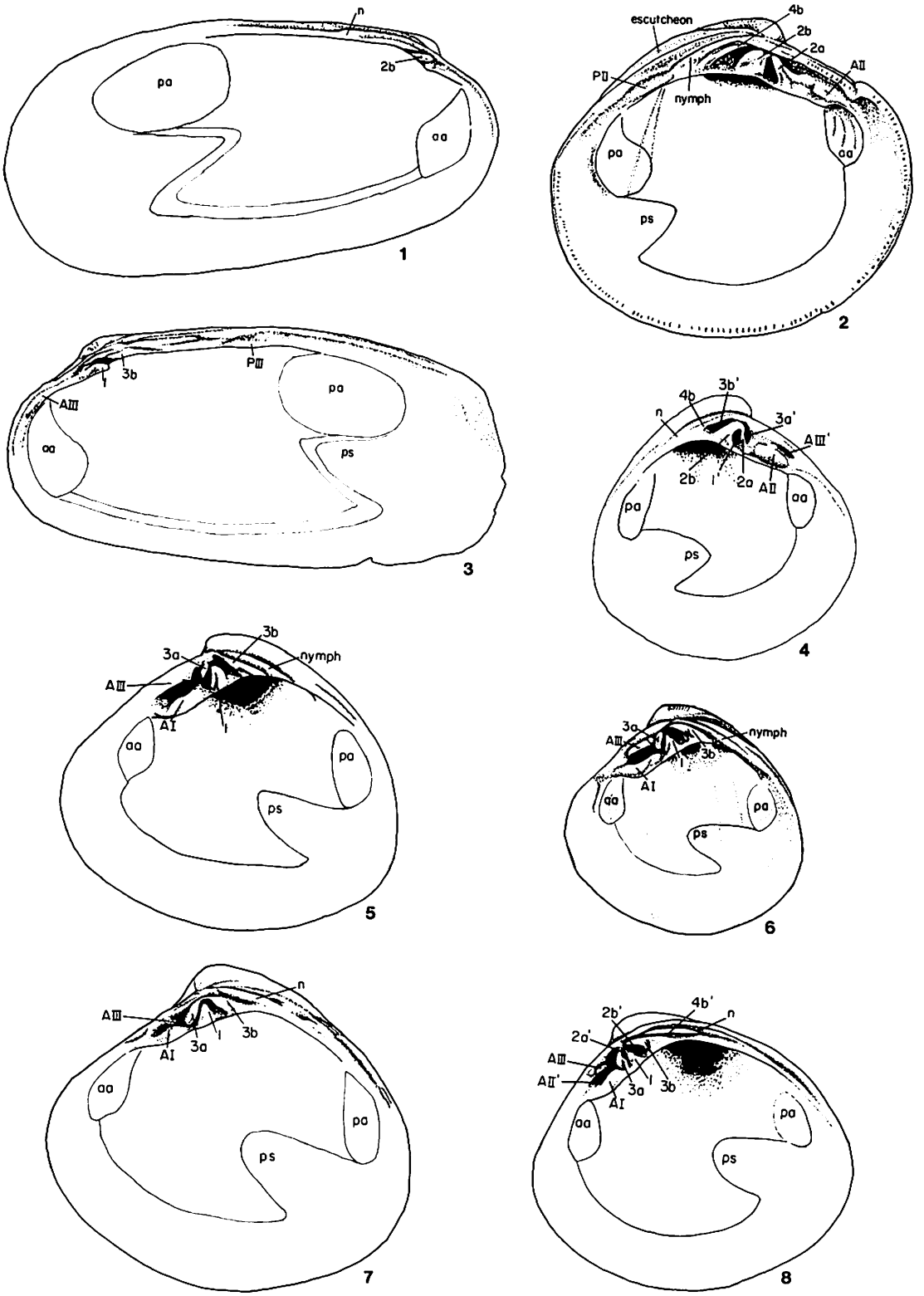


Figure 44 — 1- left valve (holotype), 3- right valve, *Coralliophaga* (*Coralliophaga*) *corrugata* n. sp.; 2- left valve (holotype), *Ventricolaria ucuttana* (Dall); 4- left valve (holotype), 6- right valve, *Pitar* (*Lamelliconcha*) *perbrevis* (Conrad); 5- right valve (holotype), *Pitar* (*Lamelliconcha*) *astartiformis* (Conrad); 7- right valve, *Pitar aldrichi* n. sp.; 8- right valve (holotype), *Pitar* (*Hyphantosoma*) *semipunctata* (Conrad). 1, 2a, 2b, 3a, 3b, 4b = cardinal teeth; AI, AII, AIII = anterior lateral teeth; PII, PIII = posterior lateral teeth; 1', 2a', 2b', 3a, 3b, = sockets; n = nymph, ps = pallial sinus, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

Formation are more subtle. *P. (L.) protena* differs from this latter species in the following ways: (1) it has a steeper posterior dorsal slope, (2) the greatest elevation of the shell is closer to the beak giving the beak the appearance of having a more terminal position, and (3) the pallial sinus is more narrow, regularly tapered, and evenly rounded at the posterior end. The name refers to the forward position of the shell's greatest elevation.

Type: Holotype 340477 and paratype 340478 USNM from the Mint Spring Formation, USGS locality 7941 (Plate 43, figures 11-12; Text Figures 45, 3-4).

Occurrence: Mississippi: Mint Spring Formation, localities 97, 100a, 108b, 110; Byram Formation, locality 106a.

Pitar (Lamelliconcha) megacostata n. sp.

Plate 44, figures 4-6; Text Figure 45, 5

Description: Shell large, modestly inflated, elongate; hinge with large AII in left valve and AII' socket in right valve, otherwise typical for genus; pallial sinus large; lunule mostly smooth except for a few concentric grooves, circumscribed by a strongly impressed line; posterior shoulder low; exterior with broad concentric costae; costae do not continue onto lunule.

Discussion: This elegant species is larger than *Pitar (Lamelliconcha) imitabilis* and *Pitar (Lamelliconcha) protena* and has larger concentric ribs. The name refers to the large concentric ribs (costae) of the exterior.

Type: Holotype 340480 USNM from the Mint Spring Formation, USGS locality 14071a (Plate 44, figure 6; Text Figure 45, 5).

Occurrence: Mississippi: Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 99a, 100a.

Pitar (Lamelliconcha) calcanea (Dall)

Plate 44, figures 8-11; Text Figures 45, 6-7

1903. *Pitaria (Lamelliconcha) calcanea* Dall, Wagner Free Inst. Sci., Philadelphia, v. 3, pt. 6, p. 1270, pl. 55, fig. 19.
1916. *Pitaria (Lamelliconcha) calcanea* Dall. Dall, U. S. Natl. Museum, Proc. v. 51, No. 2162, p. 501 (in the Flint River Formation, Station 7096, Decatur County, Georgia).
1927. *Pitaria (Lamelliconcha) calcanea* Dall. Palmer, Palaeont. Amer., v. 1, No. 5, p. 40, 44-45. 1929. Palmer, *Ibid*, pl. 8, fig. 18, 25.

Original Description: Dall, 1903.

"Oligocene of Vicksburg, Mississippi; Johnson and Crutcher.

"Shell small, solid, subtrigonal, elevated, with prominent anteriorly twisted beaks; lunule impressed, obscurely limited by an impressed line, rather large, cordate; an obscure ridge extends from the beaks backward and downward to the lower posterior end of the shell; anterior end attenuated, rounded; posterior end broader and more bluntly rounded; base arcuate; sculpture of thick, adjacent, low rounded concentric ribs, smooth except for the ribbing; when partly eroded showing fine, thread-like, concentric structure; nymphs short; hinge solid, concentrated, the teeth entire, the posterior left cardinal slender, the anterior lateral stout and prominent; internal margins entire; palial sinus linguiform, slightly ascending, not reaching the middle of the shell. Length 17, height 15, diameter 10 mm.

"This shell is somewhat rude and individuals differ somewhat in form, but all show the elevated and twisted beaks and the broad, low, thick ribs, differing from *P. astartiformis*, which has narrow ribs terminally acute, separated by deep channels."

Discussion: This species differs considerably from *Pitar (Lamelliconcha) astartiformis* (Conrad) of the Byram Formation with which it was compared by Dall (1903), but is very close to *Pitar (Lamelliconcha) silicifluvia* (Dall). It differs from this latter species in its broader concentric ribs.

Type: Holotype 136750 USNM from the Mint Spring Formation, Vicksburg, Mississippi.

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 90, 97, 100a, 108a. Georgia: Flint River Formation, Decatur County.

Pitar (Lamelliconcha) silicifluvia (Dall)

Plate 44, figure 7

1916. *Pitaria (Lamelliconcha) silicifluvia* Dall, U. S. Natl. Museum, Proc., v. 51, No. 2162, p. 500-501, pl. 85, fig. 2, 3.
1927. *Pitaria (Lamelliconcha) silicifluvia* Dall. Palmer, Palaeont. Amer., v. 1, No. 5, p. 40, 45. 1929. Palmer, *Ibid*, pl. 8, fig. 1, 4.

Original Description: Dall, 1916.

"Shell small, inflated, arcuate, moderately thick; valves slightly inequilateral, rounded in front and behind with a prominently arcuate base, the inner margins smooth; beaks prominent, inflated, small, conspicuously incurved and prosocoelous, with an impressed and broadly heart-shaped lunule bordered by an impressed line; sculpture of small concentric waves with narrower interspaces; the crests of the waves, at first rounded, become more sharp-edged and crowded toward the basal margin; in the left valve there is no escutcheon; pallial line obscure, but the sinus is apparently small and triangular; the hinge is strongly developed, the middle cardinal largest, the anterior left lateral strong and subconic. Height of valve, 16; length, 19; length behind the vertical from the beaks, 14; double diameter of left valve, 16 mm.

"*Locality*. -Station 7096, at Red Bluff, west bank of Flint River, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166718. Also from the Oligocene of Vicksburg Mississippi."

Discussion: Dall (1916) in his description of this species made no comparisons with other species. He lists the species as occurring at Vicksburg, Mississip-

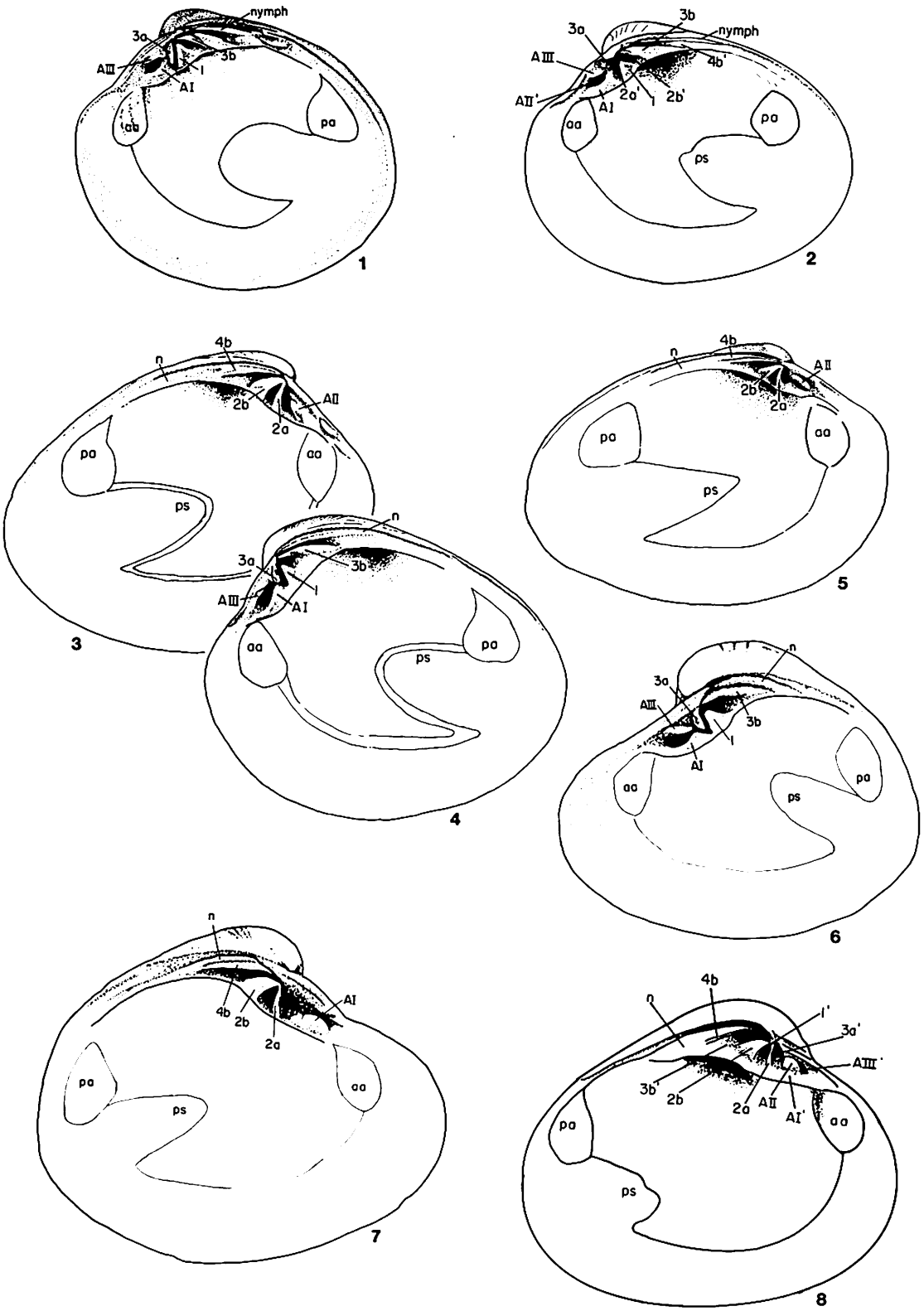


Figure 45 — 1- young right valve, 2- right valve (holotype), *Pitar* (*Lamelliconcha*) *imitabilis* (Conrad); 3- left valve (paratype), 4- right valve (holotype), *Pitar* (*Lamelliconcha*) *protena* n. sp.; 5- left valve (holotype), *Pitar* (*Lamelliconcha*) *megacostata* n. sp.; 6- right valve, 7- left valve, *Pitar* (*Lamelliconcha*) *calcanea* (Dall); 8- left valve (holotype), *Callista* (*Callista*) *sobrina* (Conrad). 1, 2a, 2b, 3a, 3b, 4b = cardinal teeth; AI, AII, AIII = anterior lateral teeth; 1', 2a', 2b', 3a', 3b', 4b', AI' AII' AIII' = sockets; n = nymph, ps = pallial sinus, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

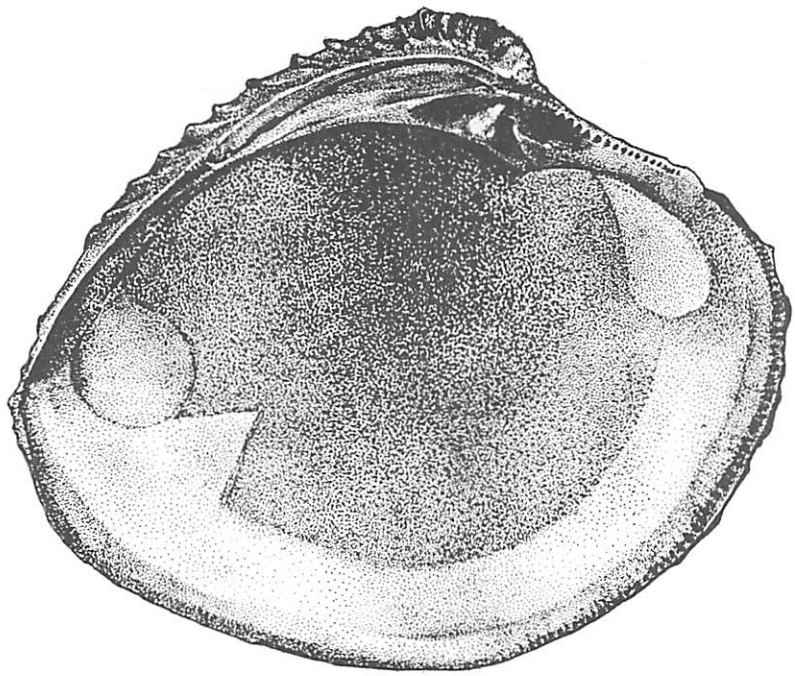


Figure 46 — *Chamelea mississippiensis* (Conrad), left valve. Illustration by Julia H. Suits.

pi, but may have had a variation of *Pitar* (*Lamelliconcha*) *calcanea* in mind as these two species have a similar and distinctive morphology. Both species are thick shelled and have strongly elevated and twisted umbos. *P.* (*L.*) *silicifluvia* has finer concentric ribs on the exterior.

Type: Holotype 166718 USNM from the Flint River Formation, USGS locality 7096, Flint River, Decatur County, Georgia (Plate 44, figure 7).

Occurrence: Mississippi: Mint Spring Formation, Vicksburg? Georgia: Flint River Formation, Decatur County.

Pitar (Lamelliconcha) astartiformis (Conrad)

Plate 45, figures 4-7; Text Figure 44, 5

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 13 (no name).
1848a. *Cytherea Astartiformis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 292.
1848b. *Cytherea astartiformis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 13, fig. 13.
1854. *Meretrix astartiformis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 29 (List).
1865. *Dione Astartiformis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 6 (Catalog).
1866. *Dione astartiformis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1903. *Pitaria* (*Lamelliconcha*) *astartiformis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 6, p. 1269.
1922. *Pitaria astartiformis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 85 (Check list: Byram Marl, Vicksburg).
1927. *Pitaria* (*Lamelliconcha*) *astartiformis* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, p. 40, 43-44. 1929. Palmer, *Ibid*, pl. 8, fig. 2, 3, 24.
1962. *Cytherea astartiformis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 40 (3 syntypes 4144. Labelled by Conrad).
1968. *Cytherea astartiformis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 33 (Holotype and paratypes 4144).

Original Description: Conrad, 1848a.

"Trigonal, elevated, ventricose, subequilateral, with numerous regular concentric grooves and obtuse ridges; lunule not defined; summits prominent; umbo flattened. Length 6-10. Height 1/2.

"This shell has a remarkable resemblance on the exterior to some species of *Astarte*. Rare."

Discussion of Palmer, 1927.

"Shell somewhat flattened; concentric ribs prominent, and undulating; the paratypes of Conrad are worn in the lunular region so that probably shells in perfect condition would show the lunule defined faintly. The anterior lateral is large. This species differs from *P. silicifluvia* of Dall in being very much flatter, in having a

more elongate, lunular region and in the ribs being broader. The concentric ribs of the two species are alike in being rounded and undulating.

"*P. astartiformis* differs from *P. perbrevis* in being less elevated and having larger, concentric ribs with the interspaces wider.

"*Dimensions*.- (Largest specimen) 15 mm., length; 13 mm., height; 4 mm., semidiameter.

"*Holotype and Paratype*.- Academy of Natural Sciences, Philadelphia, Pa.

"*Occurrence*.- Oligocene. (Type) Vicksburg, Miss.; Mint Spring Bayou, Layer N, Vicksburg Miss. (Cornell Univ. Pal. Lab.). Lower Miocene. Chipola beds at Alum Bluff and on the Chipola River, Calhoun county, Florida. (Dall)."

Discussion: This species differs considerably from *Pitar* (*Lamelliconcha*) *calcanea* (Dall) and *Pitar* (*Lamelliconcha*) *silicifluvia* (Dall) with which it has been compared. Both of the latter species have much higher elevated and twisted umbos. It differs from *Pitar* (*L.*) *perbrevis* in its broader concentric ribs.

Type: Holotype and two paratypes B-C 4144 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 45, figures 4-6; Text Figure 44, 5).

Occurrence: Mississippi: Mint Spring Formation, locality 100a; Byram Formation, localities 115, 116.

Pitar (Lamelliconcha) perbrevis (Conrad)

Plate 45, figures 1-3; Text Figures 44, 4, 6

1848a. *Cytherea perbrevis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293.

1848b. *Cytherea perbrevis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 13, fig. 18.

1854. *Meretrix perbrevis* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 30 (List).

1854. *Meretrix perbrevis* (Conrad). Conrad *in* Wailes, Rept. Agr. Geol. Mississippi, p. 287, 288.

1865. *Dione perbrevis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 6 (Catalog; Virginia only).

1866. *Dione perbrevis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 7 (List: only under Lower Eocene, Virginia).

1903. *Pitaria* (*Lamelliconcha*) *perbrevis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 6, p. 1266.

1927. *Pitaria* (*Lamelliconcha*) *perbrevis* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, p. 40, 44. 1929. Palmer, *Ibid*, pl. 8, fig. 16.

1962. *Cytherea perbrevis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 85 (Probably holotype 30657. Subsequently figured).

1968. *Cytherea perbrevis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 74 (Holotype 30657)

Original Description: Conrad, 1848a.

"Ovate-triangular, elevated, ventricose: the posterior and anterior margins equally declining and very oblique, the anterior one straight, the posterior slightly curved; beaks medial; surface with numerous regular impressed lines;basal margin rounded. Length and height 6-10.

"It is of the size, and has somewhat the form of *V. Astartiformis*, but the greater elevation, convex umbo, numerous impressed lines, and more rounded base, distinguish it from that species. Rare."

Discussion of Palmer, 1927.

"The specimens of the Conrad types of the Vicksburg species described as *Cytherea* have been mixed. The shells of *C. semipunctata* which Conrad figured but did not describe were labelled *C. perbrevis*. The holotype of *perbrevis* has been in the tray with the paratypes of *C. astartiformis*. *Pitaria perbrevis* is like *P. astartiformis* in being high and short but it is more elevated and the ribs are much smaller, flatter and closer together."

Type: Holotype 30657 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 45, figure 1; Text Figure 44, 4).

Occurrence: Mississippi: Byram Formation, locality 106a, Vicksburg.

Pitar aldrichi n. sp.

Plate 45, figures 8-14; Plate 46, figures 1-4; Plate 57, figures 10-11; Text Figure 44, 7

Description: Shell moderately inflated; hinge as typical of genus, 3b strongly bifid, 3a and 1 vertical below beak; pallial sinus broadly rounded; anterior and posterior margins rounded, ventral margin broadly rounded; posterior shoulder broadly rounded; lunule circumscribed by a faint impressed line, concentric sculpture of exterior continuing onto lunule; exterior with fine concentric lamellae.

Discussion: This species occurs in the Red Bluff, Forest Hill, and Mint Spring Formations and resembles *Pitar* (*Hyphantosoma*) *semipunctata* (Conrad) in its general form but lacks the zigzag pattern on the exterior. The largest specimens occur in the Mint Spring Formation. This species is named in honor of Truman Hemingway Aldrich who described several molluscan species from the Red Bluff Formation.

Type: Holotype 340481 USNM from the Red Bluff Formation, locality 37 (Plate 45, figure 12).

Occurrence: Mississippi: Red Bluff Formation, localities 37, 38, 39, 40, 46; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 89a, 90, 99a, 100a.

Genus CALLISTA Poli, 1791

Subgenus CALLISTA Poli, 1791

Callista (Callista) sobrina (Conrad)

Plate 47, figures 1-7; Text Figure 45, 8

1829. *Cytherea mortonia* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 14 (unpublished manuscript).
1848a. *Cytherea sobrina* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293.
1848b. *Cytherea sobrina* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. I, pt. 2, p. 123, pl. 13, fig. 17.
1854. *Meretrix sobrina* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 6 (Catalog).
1855. *Meretrix sobrina* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc., v. 7, p. 257.
1865. *Dione sobrina* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 6 (Catalog).
1866. *Dione sobrina* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 6 (List).
1885. *Cytherea sobrina* Conrad. Meyer, Amer. Jour. Sci., 3rd ser., v. 29, No. 174, p. 467.
1886. *Cytherea sobrina* Conrad. Langdon, Amer. Jour. Sci., 3rd ser., v. 31, No. 183, p. 205.
1903. *Macrocallista* (*Chionella*) *sobrina* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 1279.
1922. *Macrocallista* (*Chionella*) *sobrina* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 129, p. 81 (Byram Fm., Vicksburg), 85 (Check list: in Byram and Mint Spring marls, and Red Bluff Clay).
1923. *Macrocallista* (*Chionella*) *sobrina* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 133, p. 8 (Occurs in the Glendon Chert at Bainbridge, Georgia).
1926. *Macrocallista sobrina* (Conrad). Kellum, U. S. Geol. Survey Prof. Paper 143, p. 13 (Close affinity to *Macrocallista tia* Kellum from the Trent Marl, North Carolina).
1927. *Callista* (*Callista*) *sobrina* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, p. 73, 76. 1929. Palmer, *Ibid*, pl. 9, fig. 4, 5, 13.
1929. *Macrocallista* (*Chionella*) *sobrina* (Conrad). Cooke, U. S. Natl. Museum, Proc., p. 2 (Occurs in the Alazan Clay, Mexico).
1945. *Macrocallista sobrina* (Conrad). Gardner, Geol. Soc. Amer. Memoir 11, p. 115 (Compared with *Macrocallista* (*Chionella*?) sp. from Tamaulipas, Mexico).
1968. *Cytherea sobrina* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 85 (Holotype 30661 and paratypes 30662).

Original Description: Conrad, 1848a.

"Subovate, ventricose, polished; with rather obtuse irregular distant, concentric, impressed lines; umbo entire; extremities rounded; base regularly curved. Length 11-10. Height 9-10.

"Very abundant. Almost always with disunited valves. It is quite thick on the anterior side towards the summit."

Discussion of Palmer, 1929.

"This species presents variability in shape. In all, the umbones are very full. Some individuals shorten posteriorly until the shell is only about two-thirds of the average length. The anterior and posterior ends are amost blunt. The shell is thick, but thin specimens are found in the collection and other specimens are found which have an excess of material in the mid-region of the valve. The species differs from *C. annexa* of the Jackson in being shorter, the posterior end not pointed and the umbones much fuller. This species may have come from the stock of *C. perovata* of the St. Maurice-Claiborne Eocene thru var. *subvitrea* and *C. annexa*."

Discussion: This species is usually thick shelled, elevated and with an inflated and thickened umbo as are the type specimens. A thinner shelled and more elongate variety occurs in the Mint Spring Formation (see Plate 47, figures 5-7). The thick shelled variety is common in the upper Forest Hill Formation in Wayne County, Mississippi, and the Byram Formation in eastern Mississippi and forms the major constituent in the basal shell gravels above the lower contact of the Mint Spring Formation. This species is abundant in the Byram Formation at locality 106a where a large percentage of the shells indicated predation by boring gastropods of the family Naticidae. A majority of the bored shells at this locality have borings penetrating the shell in the region of the pallial sinus.

Type: Holotype 30661 and six paratypes B-G 30662 from the Vicksburg Group, Vicksburg, Mississippi (Plate 47, figures 1-4; Text Figure 45, 8).

Occurrence: Mississippi: Red Bluff Formation, locality 38; Forest Hill Formation, localities 75a, 88a; Mint Spring Formation, localities 75a, 89a, 99a, 100a, 108a, 110, 111; Byram Formation, localities 94, 106a, 109, 112c, 114, 115. Also occurs in the Rosefield Formation of Louisiana, the Flint River Formation of Georgia, and the Alazan Clay of Mexico.

Callista (Callista) goniopisthus n. sp.

Plate 47, figures 8-10

Description: Shell thick, elevated, moderately inflated, drop-shaped with broadly rounded anterior and sharply rounded posterior margin; hinge typical for the genus; pallial sinus large, angular at anterior margin; umbo low; lunule circumscribed by a groove; posterior shoulder sharply rounded; posterior dorsal slope steep; exterior smooth except for irregular concentric growth rugae.

Discussion: This species has been found only in the Mint Spring Formation, and specimens of it on hand, except for a few from locality 89, are all worn. It differs greatly from *Callista* (*Callista*) *sobrina* in its low umbo and angular posterior margin. The name refers to the angular posterior margin.

Type: Holotype 340482 USNM from the Mint Spring Formation, locality 99a (Plate 47, figure 9).

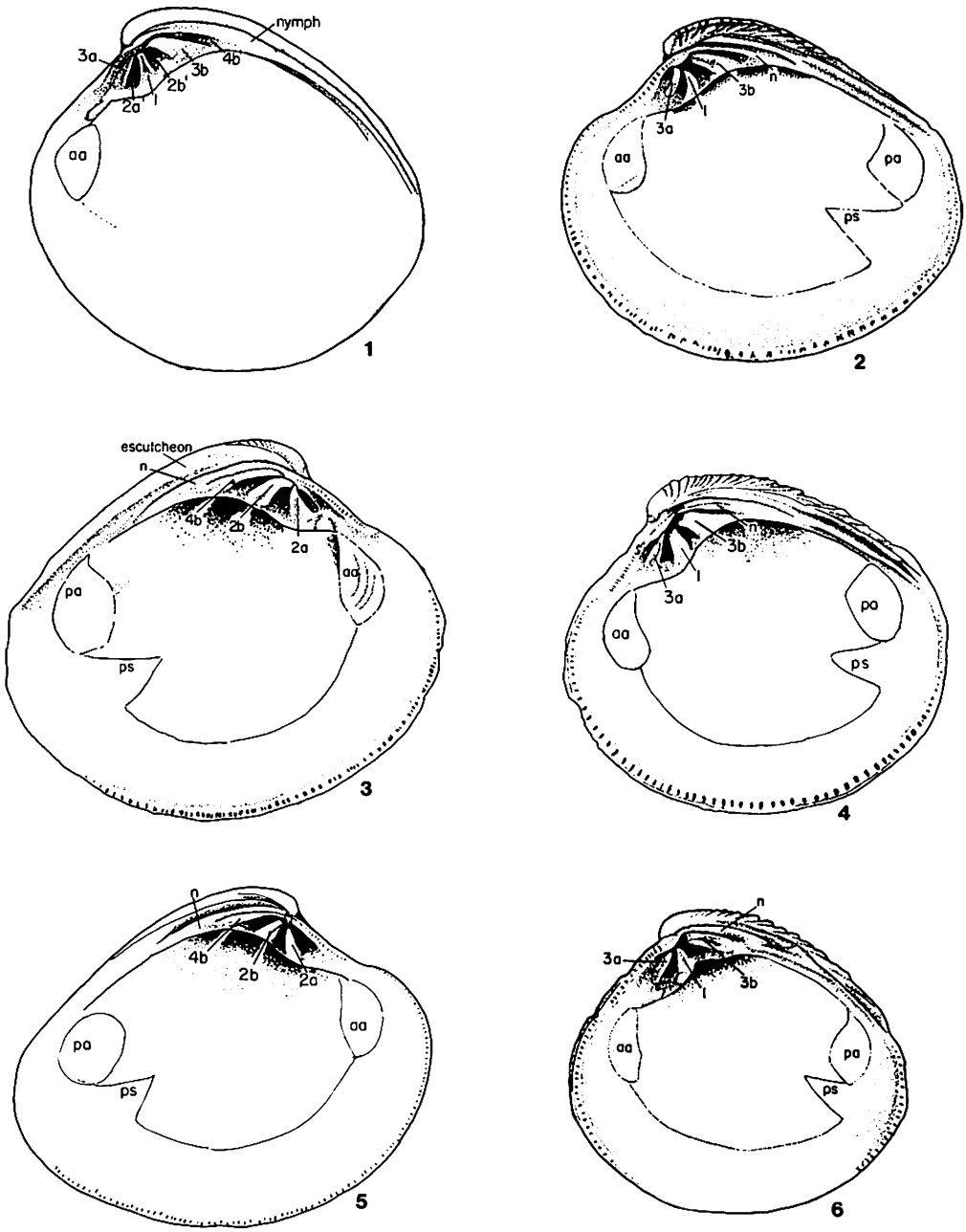


Figure 47 — 1- right valve (holotype), *Chamelea mississippiensis* (Conrad); 2- right valve, *Chione* (*Chione*) *bainbridgensis* Dall; 3- left valve (holotype), 4- right valve, *Chione* (*Chione*) *craspedonia* Dall; 5- left valve, *Chione* (*Lirophora*) *victoria* Dall; 6- right valve, *Chione* (*Chione*) *perbrevisformis* n. sp. 1, 2a, 2b, 3a, 3b, 4b = cardinal teeth; 2a', 2b', 4b' = sockets; n = nymph, ps = pallial sinus, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

Occurrence: Mississippi: Mint Spring Formation, localities 89, 99a, 100a.

Subfamily CHIONINAE Frizzell, 1936

Genus CHIONE Megerle von Muhlfeld, 1811

Subgenus CHIONE Megerle von Muhlfeld, 1811

Chione (Chione) craspedonia Dall

Plate 48, figures 4-9; Text Figures 47, 3-4

1903. *Chione* (?*Chamelea*) *craspedonia* Dall, Wagner Free Inst. Sci. Philadelphia, v. 3, pt. 6, p. 1300, pl. 55, fig. 2.

1927. *Chione* (*Chione*) *craspedonia* Dall. Palmer, Palaeont. Amer., v. 1, No. 5, p. 161, 162. 1929. Palmer, *Ibid*, pl. 43, fig. 28, 36.

Original Description: Dall, 1903.

"Lower Oligocene of Vicksburg and Eocene of Red Bluff, Mississippi; Burns, Schuchert, and Johnson.

"Shell short-ovate or rounded-trigonal, inequilateral, the beaks nearly smooth, low, prosogyrate, situated slightly behind the anterior third; lunule cordate, sharply defined by an incised line, not impressed, nearly smooth; escutcheon elongate, sharply defined by a keel which is more pronounced on the left valve; surface sculptured with small, regular, even concentric lamellae, separated by wider interspaces which are concentrically striated; the lamellae on the anterior two-thirds of the shell frequently show obsolete cross-striation which does not affect the interspaces; anterior slope nearly straight, posterior slope somewhat convex, ends rounded, base convexly arcuate; hinge well developed, the larger cardinals sometimes faintly grooved; adductor scars nearly equal; pallial sinus small, angular; basal and anterior margins minutely crenulate. Length 28, height 24, diameter 14 mm.

"I thought at first that this attractive species might be referred to *Chione s. s.*, but finally decided to put it in this section with a mark of doubt. It is certainly on the border line between the two sections. There is some variation in the closeness of the lamellation, though very little in the general form. The figure given by Conrad of the *Chione mississippiensis* is so remarkably different in outline that, unless Conrad's type was entirely abnormal, no question of their identity could arise."

Discussion: Dall (1903) lists this species from the Red Bluff Formation, but the only specimens found in this work have come from the Forest Hill and Mint Spring Formations.

Type: Holotype 136738 USNM from the Mint Spring Formation, Vicksburg, Mississippi (Plate 48, figure 4).

Occurrence: Mississippi: Forest Hill Formation, locality 75a; Mint Spring Formation, localities 74b, 75a, 99a, 100a, 108b, 110.

Chione (Chione) perbrevisformis n. sp.

Plate 48, figures 10-11; Text Figure 47, 6

Description: Shell moderately inflated, elevated, strongly rounded on the ventral margin; hinge typical for genus; lunule circumscribed by an impressed line and sculptured with concentric lirae which continue over the exterior; escutcheon narrow; exterior sculptured with concentric lirae; anterior slope with every second, third, or fourth lirae heightening near the lunule and intervening lirae terminating or coalescing and terminating behind the lunule; escutcheon ridge with every other lira heightening over crest and intervening lirae terminating before it.

Discussion: This species is similar to *Chione* (*Chione*) *craspedonia* in its exterior sculpture but differs in its smaller size and greater elevation. The species is named for its superficial resemblance to *Pitar* (*Lamelliconcha*) *perbrevis* with which it occurs.

Type: Holotype 340484 USNM from the Byram Formation, locality 106a (Plate 48, figure 11).

Occurrence: Mississippi: Byram Formation, localities 106a, 112c, 116.

Chione (Chione) bainbridgensis Dall

Plate 49, figures 1-5; Plate 60, figure 4; Text Figure 47, 2

1916. *Chione bainbridgensis* Dall, U. S. Natl. Museum, Proc. v. 51, No. 2162, p. 499, pl. 84, fig. 5-6.

1927. *Chione* (*Chione*) *bainbridgensis* Dall. Palmer, Palaeont. Amer., v. 1, No. 5, p. 140-141. 1929. Palmer, *Ibid*, pl. 40, fig. 6, 9.

1937. *Chione* aff. *C. bainbridgensis* Dall. Mansfield, Florida Geol. Survey, Bull. No. 15, p. 269 (in part).

1938. *Chione* cf. *C. spenceri* Cooke. Mansfield, Washington Acad. Sci. Jour., v. 28, No. 3, p. 105, fig. 8. Not *Chione spencer* Cooke, 1919.

1940. *Chione* (*Chione*) *bainbridgensis* Dall. Mansfield, Jour. Paleont., v. 14, No. 3, p. 197-198, pl. 25, fig. 46 (Occurs in the Chickasawhay Limestone).

1974. *Chione bainbridgensis* Dall. May, Miss. Geol. Survey Bull. No. 117, p. 96.

Original Description: Dall, 1916

"Shell small, slightly inequilateral, moderately inflated, thin; beaks small, rather prominent, prosocoelous, with a short lanceolate impressed lunule below them; the escutcheon narrow and more elongated; sculpture of numerous sharp recurved lamellae, somewhat sparser on the beaks but elsewhere uniformly distributed, and more elevated near the anterior end; radial sculpture of numerous fine threads evenly distributed, with narrower interspaces, strong on the front surface of the lamellae and in the interspaces, but wanting on the back or concave side of the lamellae; inner margin of the valves finely crenulated; anterior end of the valves rounded, the base prominently arcuate, the posterior end more pointed; hinge as usual in the genus. Height of somewhat defective valve, about 25; length, 35; diameter (double), 18 mm.

"*Localities*.-Station 7095, on the east bank of Flint River, at the bend near the "Old Factory," about three-fourths of a mile northeast of the railway station at Bainbridge, Georgia. Also at station

7131, at Cherry Chute, 2 3/4 miles below Bainbridge, in hard residual blocks of limestone; and stations 3381, 7074, 7075, 7078, 7079, 7095, 7096, and 7131, at various points on Flint River above and below Bainbridge and within a dozen miles of that town; Cooke and Mansfield, 1914. U.S. Nat. Mus. Cat. No. 166717.

"Each horizon from the Chattahoochee to the recent fauna contains a species of *Chione* of this general type, but distinguished by minor differences from the species in the zones above or below. *Chione woodwardi* Guppy, from the Oligocene of Bowden, Jamaica, is an example of the group."

Discussion of Mansfield, 1940.

"The holotype of *Chione bainbridgensis* Dall is a fragment of the posterior part of the shell, and the paratype is a squeeze of an external mold. The paratype shows the character of the original shell much better than the holotype. My first interpretation of the relationship of the specimens from 3 1/2 miles southeast of Wausau, all of them external molds, was that they were more closely related to *C. spenceri* Cooke from Antigua, Leeward Islands, than to *C. bainbridgensis* Dall. *Chione bainbridgensis* and *C. spenceri* are closely related to each other, but the Antiguan shell is a little lower and more elongate, the beaks are more flattened on their summits, and there is a feeble depression in front of the posterior dorsal border which I have not observed on the specimens from Bainbridge.

"Later collections from Bainbridge made by August F. Foerste are better preserved than Dall's type material. The figured mold of the right valve (U.S.N.M. 498554) is from station 14205a, one-fourth mile north of Perdue Hill, Clarke County, Alabama.

"The species is commonly represented in the Flint River formation at several places near Bainbridge, Ga., in the Suwannee limestone at station 12723, 3 1/2 miles southeast of Wausau, Washington County, and several places cited by Mansfield (1937) under *Chione* aff. *C. bainbridgensis* Dall. Juveniles and incomplete molds from the Tampa limestone are only tentatively referred to *C. bainbridgensis*. The specimens from the Tampa limestone at station 12292, Cherokee Sink, Wakulla County, Florida, may be conspecific with those from the upper Chickasawhay at station 14287, Patton Creek, 1 1/2 miles east of Waynesboro, Miss.

"*Chione bainbridgensis* is widely distributed in the lower part of the Chickasawhay marl in western Alabama and eastern Mississippi."

Discussion: The only well preserved specimens of this species are from the Byram Formation in Mississippi. Elsewhere the species is preserved as molds and casts in various limestone units. The holotype (see Plate 60, figure 4) is a partial, poorly preserved cast from the Flint River Formation in Georgia. This species is characterized by the short radial threads that occur only on the ventral side of the exterior, concentric lamellae.

Type: Holotype 166715 USNM from the Flint River Formation, Flint River, Decatur County, Georgia (Plate 60, figure 4).

Occurrence: Mississippi: Byram Formation, localities 93, 106a, 116; Chickasawhay Limestone, Wayne County. Also occurs in the Flint River Formation in Georgia, the Suwannee Limestone and possibly the Tampa limestone in Florida, and the Chickasawhay Limestone in Alabama.

Subgenus LIROPHORA Conrad, 1863

Chione (Lirophora) victoria Dall

Plate 49, figures 7-9; Text Figure 47, 5

1903. *Chione* (*Lirophora*) *victoria* Dall, Wagner Free Inst. Sci., Philadelphia Trans., v. 3, pt. 6, p. 1293, pl. 55, fig. 17.

1922. *Chione victoria* Dall. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 85 (Check list: in Byram and Mint Spring marls).

1927. *Chione* (*Lirophora*) *victoria* Dall. Palmer, Palaeont. Amer., v. 1, No. 5, p. 170-171. 1929. Palmer, *Ibid*, pl. 47, fig. 35 (Copy Dall).

1940. *Chione* (*Lirophora*) *victoria* Dall. Mansfield, Jour. Paleont., v. 14, No. 3, p. 198 (Compared with *Chione* (*Lirophora*) *perduensis* Mansfield of the Chickasawhay Limestone).

Original Description: Dall, 1903.

"Lower Oligocene of Vicksburg, Mississippi; P. Crutcher and F. Burns.

"Shell ovate, moderately convex, with low, prosogyrate beaks and a small, cordate, striated lunule; the escutcheon is flattened and finely striated; surface sculpture of twenty or more elevated recurved lamellae, more or less depressed and thickened anteriorly, more erect, distant, and higher behind; the only radial sculpture is of faint striation on the ventral side of the lamellae, insufficient to flute them; hinge as usual, the two anterior left and posterior right cardinals grooved distally, the posterior adductor scar larger than the anterior one; the pallial sinus small, sharply angular; interior marginal crenulation fine and regular. Length 24.5, height 20.5, diameter 14.0 mm.

"This interesting species is, as it were, just launched on its career towards the typical *Lirophora*; a trifle might have given it the same impetus towards *Chamelea*."

Discussion: This species is similar to *Chione* (*Lirophora*) *perduensis* Mansfield which is common in the Chickasawhay Limestone in Mississippi and Alabama. It differs in having more closely spaced concentric ribs which are strongly fluted on the posterior.

Type: Holotype 155311 USNM from the Mint Spring Formation, USGS locality 3140 (Plate 49, figure 7).

Occurrence: Mississippi: Red Bluff Formation, locality 35b; Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108b, 110.

Genus CHAMELEA Mörch, 1853

Chamelea mississippiensis (Conrad)

Plate 47, figures 11-12; Plate 48, figures 1-3; Text Figures 46; 47, 1

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 22, 27 (no name).

1848a. *Cytherea Mississippiensis* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 293.
1848b. *Cytherea mississippiensis* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 123, pl. 13, fig. 16.
1854. *Meretrix Mississippiensis* (Conrad). Conrad, Amer. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 30 (List).
1865. *Chione Mississippiensis* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 6 (Catalog).
1866. *Chione mississippiensis* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1903. *Chione mississippiensis* (Conrad). Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 6, p. 1300.
1923. *Chione mississippiensis* (Conrad). Cooke, U. S. Geol. Survey Prof. Paper 133, p. 4.
1927. *Venus mississippiensis* (Conrad). Palmer, Palaeont. Amer., v. 1, No. 5, p. 183-184. 1929. Palmer, *Ibid*, pl. 35, fig. 2, 4, 10; pl. 36, fig. 20 (Copy Conrad).
1945. *Chione* (*Chamelea*) *mississippiensis* (Conrad). Gardner, Geol. Soc. Amer., Memoir 11, p. 125 (Occurs in Oligocene sandstones of Nuevo Léon, Mexico).
1962. *Cytherea mississippiensis* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 76 (Probable holotype 30660. Shell labelled by Conrad?).
1968. *Cytherea mississippiensis* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 66 (Holotype 30660).

Original Description: Conrad, 1848a.

"Subtriangular, ventricose, elevated, with prominent concentric acute ribs, rather distant, and with irregular intervals and fine intermediate lines: posterior margin somewhat curved; basal margin profoundly rounded; summits prominent; inner margin entire. Length 1 1/4. Height the same nearly. Rare."

Discussion of Palmer, 1927.

"In the Cornell Paleontological laboratory there are two specimens in the Vicksburg collection which apparently belong to this species. They represent a young and an adult shell. The shape and sculpture is like that described and figured by Conrad. One specimen is older than that of Conrad and shows the concentric ribs more crowded along the ventral region. The concentric ribs are large and widely spaced. There are fine lines between the ribs. The lunule is large and bounded by a deep impressed line; the inner margin is crenate. Conrad described the inner margin as entire. He may have had a worn specimen. The pallial sinus is narrow and sharply pointed. There are three cardinals, the middle left cardinal is bifid. The rugose area of the nymphs is very narrow and more distinct in the young shell. The adult shell is pointed posteriorly while the young is more rounded. Conrad referred the species to *Chione*. I have placed the species in *Venus* on account of the left, middle bifid cardinal which is characteristic of *Venus* and not *Chione*, as well as the heavy rugose area of the nymph. Several subgenera of *Chione* have the area of the nymph rugose but they do not have the combination of characters as presented by this form. The corrugations on the specimens figured are worn. The young shell is very close to the young of *V. campechiensis*."

Discussion: This species occurs in the Byram Formation and is distinguished from *Chione* (*Chione*) *craspedonia* of the Mint Spring Formation by its: (1) larger, thicker, and more inflated shell, (2) larger hinge, (3) broader escutcheon, and (4) more broadly spaced concentric lamellae.

Type: Holotype 30660 ANSP from the Byram Formation, Vicksburg, Mississippi (Plate 47, fig. 11; Text Figure 47, 1).

Occurrence: Mississippi: Byram Formation, localities 93, 94, 102, 106a, 109, 116. Also occurs in the Oligocene of Nuevo Léon, Mexico.

Order MYOIDA Stoliczka, 1870
Suborder MYINA Stoliczka, 1870
Superfamily MYACEA Lamarck, 1809
Family CORBULIDAE Lamarck, 1818
Subfamily CORBULINAE Gray, 1823
Genus CORBULA Bruguiére, 1797
Subgenus CARYOCORBULA Gardner, 1926

Corbula (Caryocorbula) engonata Conrad
Plate 49, figures 10-11; Plate 50, figures 1-4; Text Figure 48, 1

1829. *Corbula rostrata* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 18 (unpublished manuscript).
1848a. *Corbula engonata* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.
1848b. *Corbula engonata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 12, fig. 30.
1865. *Corbula engonata* Conrad. Conrad, Amer. Jour. Conch., v. 1, No. 1, p. 3 (Catalog).
1866. *Corbula engonata* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).
1898. *Corbula* (*Cuneocorbula*) *engonata* Conrad. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 846-847.
1922. *Corbula engonata* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 81, 84 (Check list: in Byram, Mint Spring, and Red Bluff formations).
1929. *Corbula engonata* Conrad. Cooke, U. S. Natl. Mus., Proc., v. 73, No. 2731, Art. 10, p. 2 (List: occurs in the Alazan Clay, Mexico).
1945. *Corbula* (*Caryocorbula*) *engonata* Conrad. Gardner, Geol. Soc. Amer. Memoir 11, p. 136 (Occurs in the Oligocene of Mexico).
1962. *Corbula engonata* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 8 (Syntypes 30676. Labelled by Conrad).

1968. *Corbula engonata* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 49 (Type 30676).

Original Description: Conrad, 1848a.

"Triangular, inequilateral, small; valves nearly or quite equally convex, and with angular concentric ridges; posterior slope concave; umbonial slope carinated. Length 3-10."

Discussion of Gardner, 1945.

"*Corbula engonata* is a small but rather heavy, transversely elongated species, the right valve a little more inflated than the left and slightly overlapping it along both the lateral and ventral margins. The umbones are broad and flattened and slightly anterior. In front of the umbones the shell is evenly rounded. The rostral angle on both valves is acute from the umbones to the posterior ventral margin. In front of the rostrum, the shell is slightly warped, and the basal margin of the right valve is more sinuous than that of the left. The area behind the rostrum is relatively wide on the right valve and slightly more concave than that in the left. The tooth in the right valve is strong, upturned at its pointed tip, and flattened along its inner face. The left socket is correspondingly deep. The scars of the muscle attachments and of the pallial line and the gutter paralleling the margin of the right valve are distinct. Except in the umbonal region, the surface of both valves is rather strongly and regularly corrugated.

"A right valve, U.S. Nat. Mus. 496455 from U.S.G.S. sta. 13518 (N-10), is 5 millimeters high and 7.7 millimeters wide and differs not at all from the topotypic examples. In Mississippi, *Corbula engonata* is commonly abundant at every horizon from the Red Bluff through the Byram marl. Most of the Mexican material was collected from sandstones referred to the lower marine Oligocene."

Discussion: This species differs from *Corbula (Caryocorbula) densata* Conrad of the Jackson Group in its smaller size, greater elongation, and coarser ribs.

Type: Eight syntypes A-H 30676 from the Vicksburg Group, Vicksburg, Mississippi (Plate 50, figures 1-4).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38, 39, 40, 46; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108b, 110; Byram Formation, localities 93, 94, 102, 106a, 109, 112c, 116.

Subgenus VARICORBULA Grant and Gale, 1931

Corbula (Varicorbula) laqueata Casey

Plate 50, figures 13-20; Plate 62, figure 5; Text Figure 48, 2

1829. *Corbula distorta* Lesueur, Walnut Hills fossil shells, pl. 10, fig. 16 (unpublished manuscript).

1865. *Corbula laqueata* Conrad, Amer. Jour. Conch., v. 1, p. 3 (*nomen nudum*).

1865. *Corbula filosa* Conrad, Amer. Jour. Conch., v. 1, p. 3, 145, pl. 20, fig. 5? (*nomen praeoc*). Not *Corbula filosa* Conrad, 1865, Amer. Jour. Conch., v. 1, p. 137, pl. 10, fig. 7 = *Corbula (Caryocorbula) densata* Conrad of the Jackson Group.

1866. *Corbula laqueata* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (Check list: occurs at Vicksburg. Name only).

1898. *Corbula (Aloidis) perdubia* de Gregorio. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 844 (in part).

1903. *Corbula laqueata* Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 261 (new name for *Corbula filosa* Conrad).

1929. *Corbula laqueata* Casey. Cooke, U. S. Natl. Mus., Proc. v. 73, No. 2731, Art. 10, p. 2 (List: occurs in the Alazan Clay, Mexico).

1945. *Corbula (Varicorbula) laqueata* Casey. Gardner, Geol. Soc. Amer., Mem. 11, p. 130-131 (Possible occurrence in the Oligocene of Mexico).

1968. *Corbula laqueata* "Conrad" Casey. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 60 (Type? 1003).

Description of *Corbula filosa* by Conrad, 1865, p. 145.

"Subtriangular, equilateral, length and height nearly equal; disk concentrically ribbed; ribs imbricated; posterior slope indented; extremity truncated.

"Length 1/4 inch.

"Locality.- Vicksburg, Miss."

Original Description of *Corbula laqueata*: Casey, 1903.

"Differs from the species named *perdubia* by De Gregorio; at least on comparing Vicksburg specimens with those from Red Bluff, I find that the latter form is shorter and differs greatly in sculpture in the umbonal region. The true rugae do not begin for a considerable distance from the beak in the Red Bluff form, this region being smooth or feebly wrinkled, whereas in the Vicksburg species the rugae begin very near the beaks, and the latter are more strongly gyrate. As the Vicksburg species is distinct I would propose the name given to it in manuscript by Conrad. *C. laqueata* is a small species, never materially exceeding 6 mm. in length by 5 in height, the posterior flattened surface feebly delimited, the bounding line being rounded and not carinate; the rugae are comparatively coarse ventrally. It is confined to the upper marl and represented in the lower limestone by a variety having much finer rugae."

Discussion of Gardner, 1945.

"De Gregorio cited no locality, and his figure is not adequate to determine the species. Cossmann in his *Notes complementaires*, 1894, assumed that De Gregorio's type of *perdubia* came from the Claiborne sand; Dall (1898) remarked that "Gregorio's specimens were not located, but probably are Jacksonian;" and Casey refers to the type as a Red Bluff species. De Gregorio's types were in Palermo. Though Conrad twice listed *laqueata*, he neither described nor figured it, so that the name had no standing until Casey identified it with Conrad's preoccupied *filosa* and added a descriptive discussion.

"*Corbula laqueata* resembles a miniature *smithvillensis* from the lower Claiborne. Like other Varicorbulas, it is strongly inequivalve. The right valve is relatively high and trigonal with a full umbonal area incurved and prosogyrate at the tip and overtopping the low and inconspicuous umbone of the subquadrate left valve. The posterior keel is obtuse, and in the right valve a second obscure keel roughly parallels the dorsal margin. The flattened and inrolled tips of the umbones are free from sculpture. At about 2 millimeters on the right valve, a rugose concentric sculpture is initiated which becomes increasingly strong and continues with only a sight change in direction across both keels. The flattened left valve develops only a feeble and distant concentric sculpture which commonly dies out on the obscure posterior keel and is confined to the earlier two thirds of the shell. The later third of the left valve is sculptured only with a few incremental scratches and fortuitous radial threads. The dentition is normal, and the gutter on the interior of the right valve which receives the margin of the left is far within the shell. The dimensions of an average individual from the Byram marl are as follows: Right valve, height, 5.5 millimeters; width, 6.0 millimeters. Left valve of the same individual, height, 3.1 millimeters; width 4.5 millimeters. Casey believed that he could recognize specific differences between the Red Bluff shell for which he retained the name *perdubia* De Gregorio and *laqueata* Conrad, cited from Vicksburg. Our material does not indicate such a distinction.

"The Mexican material is not well preserved but it shows the characteristic outline and sculpture of *laqueata* Casey.

"DISTRIBUTION: Lower marine Oligocene sandstone: ?U.S.G.S. sta. 13510 (M-11)."

Discussion: This species differs from *Corbula* (*Vokesula*) *rufaripa* of the Red Bluff Formation in its more produced posterior margin and in having two or three radial ribs on the left valve. The types for *Corbula laqueata* Conrad, 1865, have been located subsequent to the publications of Moore, 1962, and Richards, 1968. These types, illustrated in Plate 50, figures 13-16, agree with Casey's (1903) holotype which is illustrated in Plate 62, figure 5.

Type: Holotype of Casey, 1903, 1003 ANSP from the Byram Formation, Vicksburg, Mississippi. Five syntypes A-E of Conrad, 1865, 20047 ANSP from the Vicksburg Group, Vicksburg, Mississippi.

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 90, 97, 99a, 100a, 108a, 110; Byram Formation, localities 93, 94, 102, 106a, Vicksburg. Also possibly occurs in the Oligocene of Mexico.

Subgenus VOKESULA Stenzel and Twining, 1957

Corbula (Vokesula) rufaripa n. sp.

Plate 50, figures 5-12

1903. *Corbula perdubia* de Gregorio. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 261. Not *Corbula* (*Neaera*) *perdubia* de Gregorio, 1890, Ann. Geol. et Paleont., livr. 7 et 8, p. 233, pl. 36, fig. 31, 32 = *Corbula compressa* Lea of the Gosport Sand *fide* Harris, 1919.

1946. *Corbula perdubia* de Gregorio, Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 114, pl. 24, fig. 9.

Description: Shell small, elevated, inequivalved with right valve larger; beak prosogyrate; hinge of right valve not outwardly deflected at posterior margin; right valve with umbo inflated and smooth on exterior, remainder of exterior with strong concentric lamellae, area of shell covered by concentric lamellae greatly varied; posterior ridge of varying strength and rounded; exterior of left valve smooth or with weak concentric lamellae.

Discussion: The umbo of the larger right valve in this species is smooth or with faint concentric lamellae. This smooth region of the shell's exterior varies greatly in its areal extent within the species. Some specimens have strong concentric lamellae only near the ventral margin (see Plate 50, figure 9) while others are covered with concentric lamellae except for a small smooth area on the umbo (see Plate 50, figure 8). This species, though variable, differs from *Corbula* (*Varicorbula*) *laqueata* in the following respects: (1) the hinge of the right valve is not outwardly deflected at the posterior margin, (2) the posterior margin is less produced, (3) the umbonal region of the right valve is smooth, and (4) the left valve has weak concentric lamellae and lacks radial ribs. The name refers to the Red Bluff Formation (*rufus* = red; *ripa* = river bank). This species is the dominant fauna element in the *Corbula* bed of the Red Bluff Formation at localities along the Chickasawhay River in Wayne County, Mississippi. A small variation of this species occurs in the Mint Spring Formation (see Plate 50, figure 5).

Type: Holotype 340487 USNM from the Red Bluff Formation, locality 38b (Plate 50, figure 10).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 38b, 39, 40, 46; Mint Spring Formation, locality 99a.

Subfamily PACHYDONTINAE Vokes, 1945

Genus TIZA de Gregorio, 1840

Tiza alta (Conrad)

Plate 51, figures 1-7; Text Figure 48, 3

1829. Lesueur, Walnut Hills fossil shells, pl. 11, fig. 20, 23, 24, 25 (no name).

1848a. *Corbula alta* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.

1848b. *Corbula alta* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 12, fig. 33, 34, 35.

1850. *Corbula alta* Conrad. Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 2, pt. 1, p. 41 (plate explanation), pl. 1, fig. 3.

1865. *Corbula alta* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 3 (Catalog).

1866a. *Corbula alta* Conrad. Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List). *Corbula aliformis* Conrad, *Ibid*, p. 20 (List: Shell Bluff Group, Georgia; Mississippi).

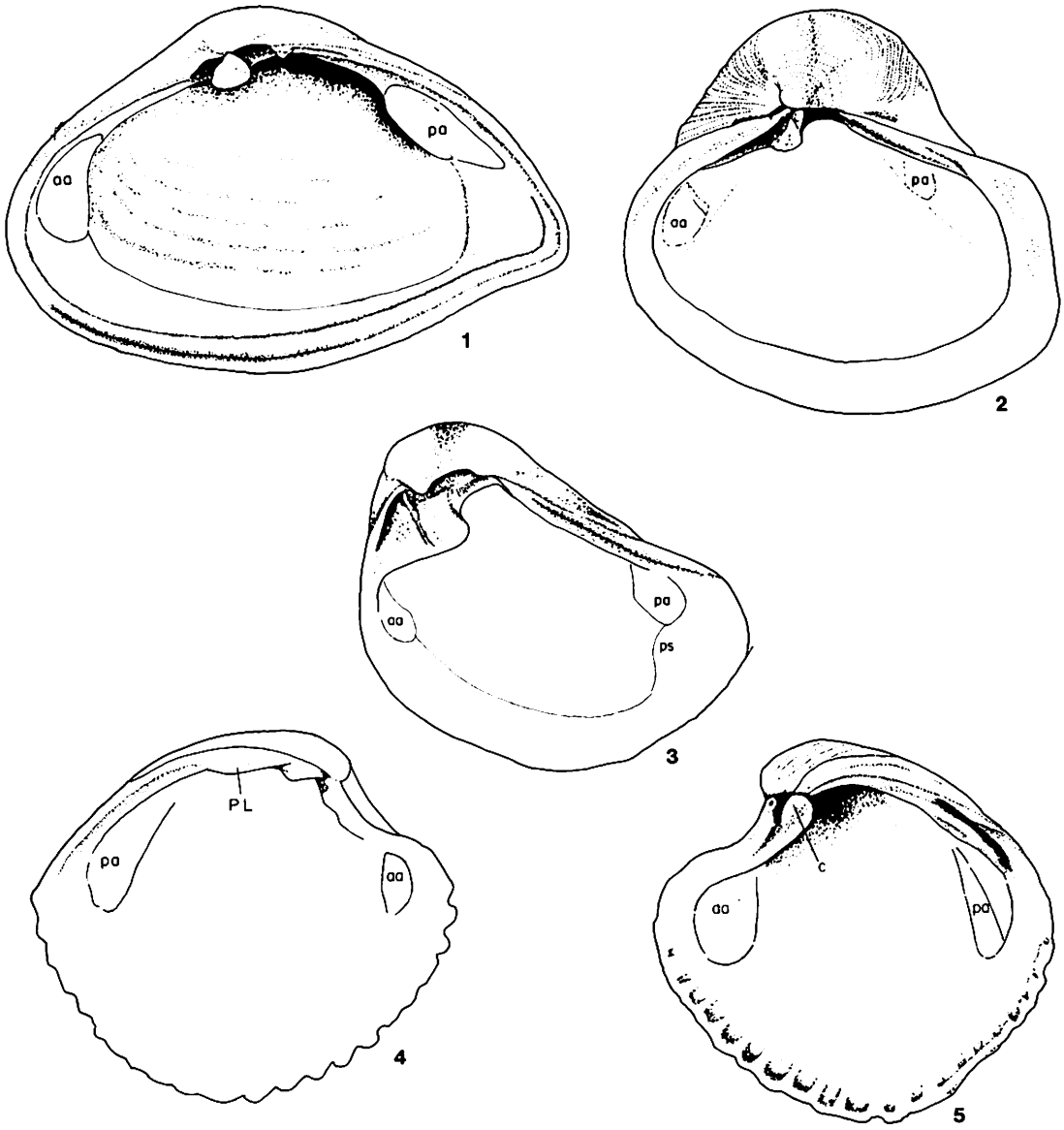


Figure 48 — 1- right valve, *Corbula* (*Caryocorbula*) *engonata* Conrad; 2- right valve, *Corbula* (*Varicorbula*) *laqueata* Casey; 3- right valve, *Tiza alta* (Conrad); 4- left valve, 5- right valve, *Haliris* (*Haliris*) *quadrangularis* (Aldrich). C = cardinal tooth, PL = posterior lateral tooth, aa = anterior adductor muscle scar, pa = posterior adductor muscle scar. Illustrations by Randall Bissell.

1866b. *Corbula aliformis* Conrad. Conrad, Amer. Jour. Conch., v. 2, No. 1, p. 76.
1890. *Corbula (Tiza) amara* de Gregorio, Ann. Geol. et Paleont., livr. 7 et 8, p. 234, pl. 37, fig. 12-14.
1903. *Corbula (Tiza) alta* Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 261. *Corbula (Tiza) aliformis* Conrad. Casey, *Ibid*, p. 261.
1922. *Corbula alta* Conrad. Cooke, U. S. Geol. Survey Prof. Paper 129, p. 84 (Check list: in Byram and Mint Spring marls).
1962. *Corbula alta* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 35 (4 possible syntypes 17362).
1968. *Corbula alta* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 31 (Types 17362).
1969. *Tiza aliformis* (Conrad). Keen *in* Treatise Invert. Paleont., pt. N, v. 2, p. 697, fig. E158, 2.

Original Description: Conrad, 1848a.

"Subtriangular, profoundly elevated, slightly oblique; larger valve ventricose; summit very prominent; umbo broad; hinge plate thick, with large teeth; smaller valve somewhat flattened, angular over the umbonial slope. Length 6-10 nearly. Height 6-10.

"Occurs abundantly about 8 miles N. E. of Vicksburg, and always waterworn."

Description of *Corbula aliformis* by Conrad, 1866b.

"Elongated, oblique, very inequilateral, with a sinuous anterior margin; hinge margin with a linear groove posteriorly; smaller valve unknown.

"*C. alta*, Conrad.- Journ. Acad. Nat. Sciences, 2d Series,Vol. II., pl. 1, fig. 3, (not *C. alta*, 2d Series, Vol. I., pl. 12, fig. 33.)

"This shell belongs exclusively to the Shell Bluff group, and is very distinct from *C alta* of the Vicksburg group."

Discussion of Casey, 1903.

"Under his description of *Corbula aliformis* [*Am. Journ. Conc.*, II, p. 76), Conrad remarks that "this shell belongs exclusively to the Shell Bluff group and is very distinct from *C. alta* of the Vicksburg group." This statement is difficult to comprehend as *C. aliformis* has been found in abundance by Mr. C. W. Johnson in the bluff bordering Mint Spring Bayou, at Vicksburg, at a point only a few feet removed in elevation or horizontal distance from the pocket of sandy clay in which I have taken the true *C alto* plentifully. It is presumable, therefore, that both these species existed contemporaneously in the Lower Vicksburg. They are both completely unknown from the upper Vicksburg marl. There is no reason to suppose that other species of this same subgenus of *Corbula* (*Tiza* De Greg.) may not exist at Vicksburg, and in fact I have a single valve that seems to indicate a third species, much more equilateral than the others."

Discussion: The type specimens of *Tiza alta* are badly worn (see Plate 51, figures 1-4). Conrad's species *Corbula aliformis* actually represents unworn specimens of *Tiza alta*. Water worn specimens of this species far out number unworn specimens and are abundant at some localities in the Mint Spring Formation near Vicksburg, Mississippi. At locality 110, worn specimens of *Tiza alta* comprise a large percentage of the fossil shell content in the Mint Spring Formation and occur with *Donax funerata* Conrad, a near-shore species. The dominance of worn specimens probably indicates a near-shore, high energy environment for this species.

Type: Four syntypes A-D 17362 ANSP from the Mint Spring Formation, Vicksburg, Mississippi (Plate 51, figures 1-4).

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 97, 99a, 100a, 101a, 108b, 110; Byram Formation, locality 112c.

Tiza sp.

Plate 51, figure 8

Discussion: One specimen of this species was found in the Red Bluff Formation. It is less elevated and more acutely produced posteriorly than is *Tiza alta.*

Occurrence: Mississippi: Red Bluff Formation, locality 38b.

Family SPHENIOPSIDAE Gardner, 1928
Genus SPHENIOPSIS Sandberger, 1863

Spheniopsis mississippiensis (Meyer)

Plate 51, figures 9-15

1829? Lesueur, Walnut Hills fossil shells, pl. 11, fig. 18 (no name).
1887. *Mikrola mississippiensis* Meyer, Acad. Nat. Sci. Philadelphia, Proc. 1887, v. 39, p. 53-54, pl. 3, fig. 16, 16a, 16b.
1969. *Cumingia mississippiensis* (Meyer). Keen *in* Treatise Invert. Paleont., pt. N, v. 3, p. 637 (Placed Meyer's genus *Mikrola* in synonymy under *Cumingia*).

Original Description: Meyer, 1887.

"MIKROLA n. gen.

"Minute, subtrigonal, inaequilateral. Anterior side rounded, posterior side attenuated. Ligament in a trigonal pit below the beak. In the right valve this pit is lodged between two compressed cardinal teeth. Left valve without distinctly developed teeth. Muscular impressions oval? Pallial line sinuated behind. Surface concentrically ribbed. Margin entire.

"At first sight the genus has much resemblance to *Spheniopsis*, Sandberger, especially the left valve. But the dentition of the right valve is entirely different, and the genus may even not belong to the *Myidae*. I cannot discover any gaping of the valves.

"Mikrola mississippiensis n. sp.

"Beaks almost obsolete. The concentric ribs of the surface end at the posterior terminal slope. Umbonial part smooth. Red Bluff, Miss.

"I found three double-valves of this species, which varies very much in the size and number of the concentric ribs. While one of the specimens shows only three large and distant concentric ribs, another one is covered by about nine ribs."

Discussion: This very small species is common in the *Corbula* bed of the Red Bluff Formation in Wayne County, Mississippi, and less common in the Mint Spring and Byram Formations.

Type: Two syntypes 645100 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Plate 51, figures 9-10)

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37; Mint Spring Formation, localities 89a, 90; Byram Formation, locality 106a.

Superfamily HIATELLACEA Gray, 1824
Family HIATELLIDAE Gray, 1824
Genus PANOPEA Menard, 1807
Subgenus PANOPEA Menard, 1807

Panopea (Panopea) oblongata Conrad
Plate 52, figures 1, 6

1829. *Panopea elongata* Lesueur, Walnut Hills fossil shells, pl. 8, fig. 19, 20 (unpublished manuscript).
1848a. *Panopaea oblongata* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 290.
1848b. *Panopaea oblongata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 121, pl. 13, fig. 12.
1849. *Panopaea oblongata* Conrad. Lea, Acad. Nat. Sci. Philadelphia, Proc. 1848, v. 4, p. 103 (Catalog).
1854. *Glycimeris elongata* (Conrad). Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 29 (Duplicate *elongata* could be *oblongata*. Not *Panopea elongata* Conrad, 1835).
1898. *Panopea oblongata* Conrad. Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 828.
1940. *Panope oblongata* Conrad. Mansfield, Jour. Paleont., v. 14, No. 3, p. 201 (Compared with *Panope taylorensis* Mansfield).
1945. *Panope oblongata* Conrad. Gardner, Geol. Soc. Amer., Memoir 11, p. 138 (Occurs in the Jackson Group in Texas and Mexico).
1946. *Panope oblongata* Conrad. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, pt. 1, p. 119, pl. 25, fig. 6 (Occurs in the Moodys Branch Fm.; Eocene).
1960. *Panopea oblongata* Conrad. Brann and Kent, Bull. Amer. Paleont., v. 40, No. 184, p. 649.
1962. *Panopaea oblongata* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 81 (Probable holotype 30643; subsequently figured).
1965. *Panopea oblongata* Conrad. Palmer and Brann, Bull. Amer. Paleont., v. 48, No. 218, pt. 1, p. 251 (Occurs in the Vicksburg and Jackson Groups).
1968. *Panopoea* (sic) *oblongata* Conrad. Richards, Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, p. 70 (Holotype 30643).
1977. *Panopea* (*Panopea*) *oblongata* Conrad. Dockery, Miss. Geol. Survey, Bull. No. 120, p. 137, pl. 28, fig. 7, 9 (Occurs in the Moodys Branch Formation; localities 1, 2).

Original Description: Conrad, 1848a.

"Elongated, very inequilateral, ventricose; extremities rounded: umbo prominent, undulated; valves slightly contracted at base in a line with the umbones; valves gaping at both ends. Length 3 1/2.

"Occurs in its original vertical position generally with connected valves, but it is extremely friable and difficult to obtain."

Discussion: This species has a widespread distribution in the Vicksburg and Jackson Groups. Specimens in the Byram Formation at Vicksburg and at locality 106a are commonly preserved in their burrows with the valves articulated and in an upright or living position. Though this species is common, good specimens are difficult to obtain because the large and fragile shell is usually highly fractured due to compaction of the surrounding sediments.

Type: Holotype 30643 ANSP from the Vicksburg Group, Vicksburg, Mississippi (Plate 52, figure 1).

Occurrence: Mississippi: Mint Spring Formation, localities 90, 99a, 108a; common as molds in the Marianna and Glendon Limestones; Byram Formation, localities 93, 102, 106a, 109, 115, 116; Moodys Branch Formation, localities 1, 2, 11. Also occurs in the Upper Eocene of Louisiana, Texas, and Mexico.

Suborder PHOLADINA
H. Adams and A. Adams, 1858
Superfamily PHOLADACEA Lamarck, 1809
Family PHOLADIDAE Lamarck, 1809
Subfamily JOUANNETIINAE Tryon, 1862
Genus JOUANNETIA Des Moulins, 1828
Subgenus PHOLADOPSIS Conrad, 1849

Jouannetia (Pholadopsis) triquetra (Conrad)
Plate 52, figures 5, 7-9; Plate 62, figure 7

1848a. *Pholas triquetra* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 296.
1848b. *Pholas triquetra* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour. 2nd ser., v. 1, pt. 2, p. 127, pl. 13, fig. 3.
1865. *Pholameria triquetra* (Conrad). Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 2 (Catalog).

1866. *Pholameria triquetra* (Conrad). Conrad, Smithsonian Misc. Coll., v. 7, No. 200, p. 28 (List).

1962. *Pholas triquetra* Conrad. Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 105 (Missing. Conrad said he had one valve).

Original Description: Conrad, 1848a.

"Subtriangular, depressed and angulated posterior to the middle, and with an impressed line from beak to base; surface with oblique lines anteriorly, and a few radiating towards the margin; posterior side reflected and with oblique lines meeting the anterior ones at an angle; a few obsolete radiating lines, one more conspicuous than the others, near the margin. Length 6-10. Height 1/2.

"I found one valve only, which occurred on Dr. Smith's plantation."

Discussion: Conrad's (1848b) figure for this species is of an immature right valve similar to those illustrated in Plate 52, figures 7 and 9. This species is a boring clam that selects hard substrates, preferably stiff clay, as sites for boring. Its borings are common in lithified clay clasts (see Plate 52, figure 8) that occur at the basal contact of the Mint Spring Formation, especially at localities along the Chickasawhay River in Wayne County where these clasts locally are so abundant that they must have formed a cobble bottom on the transgressive Mint Spring marine shelf. As the shells are fragile and housed in a rock substrate, unbroken mature specimens are difficult to obtain. One such specimen (see Plate 62, figure 7) with the valves articulated and filled with lithified sediment was found in the Red Bluff Formation. In this specimen, the callum of the left valve overlaps the right valve. According to Ruth D. Turner (personal communication, April, 1982) with the Harvard Museum of Comparative Zoology, this specimen is without question a *Jouannetia*. It is similar to *Jouannetia* (*Pholadopsis*) *pectinata* (Conrad) from the Recent of North America's West Coast.

Type: Holotype missing ANSP from the Vicksburg Group, Vicksburg, Mississippi.

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 39; Mint Spring Formation, localities 74, 75, 100, 117b; Byram Formation, locality 93; Vicksburg Group, Vicksburg, Mississippi.

Family TEREDINIDAE Rafinesque, 1815
Subfamily TEREDININAE Rafinesque, 1815
Genus TEREDO Linné, 1758

Teredo sp.
Plate 52, figures 2-4

Discussion: The calcareous, blunt-ended tubes that occur in the Mint Spring Formation and Marianna Limestone are probably that of the wood-boring clam *Teredo*. The closely packed tubes illustrated in Plate 52, figure 2, have the wood matrix replaced with sediment. Bored lignitized wood fragments are common in the Mint Spring Formation. Where the wood matrix is preserved as lignite the calcareous *Teredo* tubes are leached away, and the bore holes are filled with sediment. The calcareous tubes are only preserved where the wood matrix has decayed and been replaced by sediment.

Occurrence: Mississippi: Mint Spring Formation, localities 99a, 108a; Marianna Limestone, locality 91.

Subclass ANOMALODESMATA Dall, 1889
Order PHOLADOMYOIDA Newell, 1965
Superfamily PHOLADOMYACEA Gray, 1847
Family PHOLADOMYIDAE Gray, 1847
Genus PHOLADOMYA G. B. Sowerby, 1823

Pholadomya sp.
Plate 53, figure 1

Description: Shell large, elevated, highly inflated, gaping at the posterior; anterior margin broadly rounded; posterior not greatly elongate, posterior margin more sharply rounded that the anterior margin; exterior cancellate with radial and concentric ribs.

Discussion: This species is common as molds in the Glendon Limestone at locality 45b. A similar species occurs as molds in the Chickasawhay Limestone but has a more elongate posterior.

Occurrence: Mississippi: Glendon Limestone, locality 45b.

Superfamily PANDORACEA Rafinesque, 1815
Family PERIPLOMATIDAE Dall, 1895
Genus PERIPLOMA Schumacher, 1817

Periploma macneili n. sp.
Plate 53, figures 2-3

Description: Shell large, ovate, fragile, modestly inflated, valves not symmetrical about the hinge; articulated valves somewhat sigmoidal in outline about the hinge with the anterior of the right valve more convex than that of the left and the posterior of the left valve more convex than that of the right; condrophore massive and directed downward; clavicle extended posteriorly in front of posterior adductor muscle scar and terminating at the scar's midpoint; pallial sinus with a broad V-shape; interior smooth or with faint concentric undulations; exterior smooth except for fine concentric growth lines.

Discussion: This species is similar to *Periploma* (*Aelga*) *besshoense* (Yokoyama) from the Miocene of

Japan in its produced sigmoidal outline about the hinge. It differs from this species in lacking an undulating concentric sculpture on the exterior. The name is in honor of the collector of the type F. Stearns MacNeil.

Type: Holotype 340488 USNM from the Mint Spring Formation, USGS locality 14162 (Plate 53, figure 3).

Occurrence: Mississippi: Mint Spring Formation, locality 99a, USGS locality 14162; Byram Formation, locality 94.

Family THRACIIDAE Stoliczka, 1870

Genus THRACIA Sowerby, 1823

Subgenus THRACIA Sowerby, 1823

Thracia (Thracia) vicksburgiana (Dall)

Plate 53, figure 4

1903. *Cyathodonta vicksburgiana* Dall, Wagner Free Inst. Sci. Philadelphia, Trans., v. 3, pt. 4, p. 1526-1527, pl. 57, fig. 27.

Original Description: Dall, 1903.

"Vicksburgian Oligcene, at Vicksburg, Mississippi. Shell elongate, the right valve convex, the anterior end longer, slightly attenuated, and evenly rounded; posterior end shorter, rather abruptly vertically truncated, compressed above with a rounded ridge extending from the beak to the lower posterior angle; beaks low, somewhat recurved, situated at about the posterior third; surface with numerous nearly concentric, subequal ripples, fading out behind the vertical of the beaks and each about one millimetre wide. Length 33.5, height 19.0, diameter of right valve about 6.0 mm.

"A single well-preserved internal cast in a fine-grained limestone is in the collection labelled as from Vicksburg, Mississippi, on the authority of J. B. Marcou. It is more nearly like the average typical *Thracia* in form than are the more recent *Cyathodonta*."

Discussion: One complete, articulated specimen of this species was found in the collections of the U. S. National Museum. This specimen is from the Mint Spring Formation at USGS locality 14071a. Fragments of this very fragile species have been collected from other Mint Spring localities.

Type: Holotype USNM from the Vicksburg Group, Vicksburg, Mississippi.

Occurrence: Mississippi: Mint Spring Formation, localities 89a, 97, USGS locality 14071a; Vicksburg Group, Vicksburg.

Superfamily POROMYACEA Dall, 1886

Family CUSPIDARIIDAE Dall, 1886

Genus CUSPIDARIA Nardo, 1840

Subgenus TROPIDOMYA Dall, 1886

Cuspidaria (Tropidomya?) sp.

Plate 53, figure 9

Discussion: Only one left valve of this species has been found. It resembles *Cuspidaria (Tropidomya) abbreviata* (Forbes) from the Recent of the Mediterranean Sea and Atlantic Ocean in its short, rostrate posterior and in having a radial rib on its posterior shoulder.

Occurrence: Mississippi: Byram Formation, locality 93.

Genus PLECTODON Carpenter, 1864

Plectodon intastriata (Conrad)

Plate 53, figures 5-8

1848a. *Corbula intastriata* Conrad, Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 294.

1848b. *Corbula intastriata* Conrad. Conrad, Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 124, pl. 12, fig. 31.

1865. *Corbula intastriata* Conrad. Conrad, Amer. Jour. Conch., v. 1, pt. 1, p. 3 (Catalog).

1866. *Corbula interstriata* (sic) Conrad. Conrad, Smithsonian Misc. Coll., v. 7., No. 200, p. 28 (List).

1903. *Corbula interstriata* (sic) Conrad. Casey, Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 261 (Appears to be the only known representative of the species. It is like *Corbula gibbosa* of Lea).

1962. *Corbula intastriata* Conrad, Moore, Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 67 (Missing. Cooke, in notebook, found two specimens).

1968. *Corbula intastriata* Conrad. Richards. Acad. Natl. Sci. Philadelphia, Spec. Pub. No. 8, p. 58 (Type 30553).

Original Description: Conrad, 1848a.

"Subtriangular, inflated, rostrated posteriorly; within with fine radiating lines. Length 1/2. Very rare."

Discussion: Conrad's type of this species was broken and incorrectly repaired with the anterior portion reattached to the matrix and the posterior in a reversed position. This repair has been corrected in Plate 53, figure 5, by cutting and reorienting the photograph. Conrad's description of the exterior sculpture should read with fine concentric rather than fine radiating lines.

This species is assigned to the genus *Plectodon* because of its long rostruate posterior and its long, prominent lateral teeth in the right valve. The left valve, which is less common, lacks teeth and has a slightly different exterior sculpture with a beaded radial lira on the posterior area. This species differs

from the typical *Plectodon* in having an exterior sculpture with fine concentric threads rather than a granulated surface. An undescribed species of *Plectodon* in the Tulane University collection from the Chipola Formation in Florida is similar to *P. intastriata* but has a weaker concentric sculpture.

Type: Holotype 20353 ANSP probably from the Mint Spring Formation, Vicksburg, Mississippi (Plate 53, figure 5).

Occurrence: Mississippi: Red Bluff Formation, locality 34b; Mint Spring Formation, localities 89a, 90, 99a, 100a, Vicksburg.

Family VERTICORDIIDAE Stoliczka, 1871

Genus VERTICORDIA Sowerby, 1844

Subgenus VERTICORDIA Sowerby, 1844

Verticordia (Verticordia) dalliana Aldrich

Plate 54, figures 1-7; Plate 55, figures 1-4; Plate 56, figures 1-2; Plate 62, figure 6

1903. *Verticordia Dalliana* Aldrich, Nautilus, v. 16, No. 9, p. 100, pl. 4, fig. 18.

1922. *Verticordia dalliana* Aldrich. Cooke, U. S. Geol. Survey. Prof. Paper 129, p. 85 (Check list: in the Mint Spring and Red Bluff Formations).

1946. *Verticordia dalliana* Aldrich. Harris and Palmer, Bull. Amer. Paleont., v. 30, No. 117, p. 112, pl. 23, fig. 25 (copy from Aldrich).

Original Description: Aldrich, 1903.

"Shell small, rather flat, surface ornamented with sharp curved ribs, in the present specimen thirteen in number, nine on the anterior, then a concave space as if one rib was missing, then two more ribs about the middle of the shell, then a wide concave space and then two more ribs, the last one almost at the margin. Ribs serrating the vental margin. Cardinal tooth strong, erect; lateral tooth long and curved.

"Breadth 2 1/2 mm., height from beak to base 2 mm.

"Only one valve found; it is about the same size as *V. eocense* Langdon. The muscular scars are slightly impressed. Pallial line not perceptible."

Discussion: This species occurs throughout the Vicksburg Group. It is easily recognized by its diagnostic arrangement of exterior radial ribs with eight or nine ribs on the anterior, a broad interspace, two central ribs, a broad interspace, and two posterior ribs, one of which follows the posterior margin. *Verticordia (Verticordia) dalli* Gardner from the Chipola Formation (Alum Bluff Group) in Florida has a similar arrangement or ribs. Specimens of this latter species in the Tulane University collection show a rib arrangement as follows: Left valve with six or seven anterior ribs, a broad interspace, two central ribs, a broad interspace, and two posterior ribs; right valve with seven or eight anterior ribs, a broad interspace, one central rib, a broad interspace, and two posterior ribs.

Type: Holotype 644633 USNM from the Red Bluff Formation, Red Bluff, Mississippi (Plate 62, figure 6).

Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 40; Forest Hill Formation, locality 75a; Mint Spring Formation, localities 89a, 90, 99a, 100a, 108a; Byram Formation, localities 93, 94, 102, 106a, 109.

Genus HALIRIS Dall, 1886

Subgenus HALIRIS Dall, 1886

Haliris (Haliris) quadrangularis (Aldrich)

Plate 56, figures 3-10; Text Figures 48, 4-5

1903. *Verticordia quadrangularis* Aldrich, Nautilus, v. 16, No. 9, p. 101, pl. 4, fig. 22, 23.

Original Description: Aldrich, 1903.

"Shell stout, valves nearly quadrangular, rather thick and globose. Surface with numerous coarse, rounded ribs. Entirely covered with granulations; deeply excavated behind the beaks; possesses both cardinal and lateral teeth. Muscular scars are deeply impressed. Pallial line strongly marked. Internal basal margin showing the ribs.

" Height and breadth equal, 7 mm.

"Several valves were found. This species belongs to the Section *Haliris* Dall. The laterals are more strongly developed than in most forms of this section. It is distinct from *V. mississippiensis* Dall in having fewer and more rounded ribs and a more depressed lunular area."

Discussion: Aldrich (1903) did not give a locality or the stratigraphic horizon for this species. However, from his excellent illustrations it is almost certain to be the species that occurs in the Red Bluff Formation. This is also probable as several other Red Bluff species are described in this same paper.

Type ?

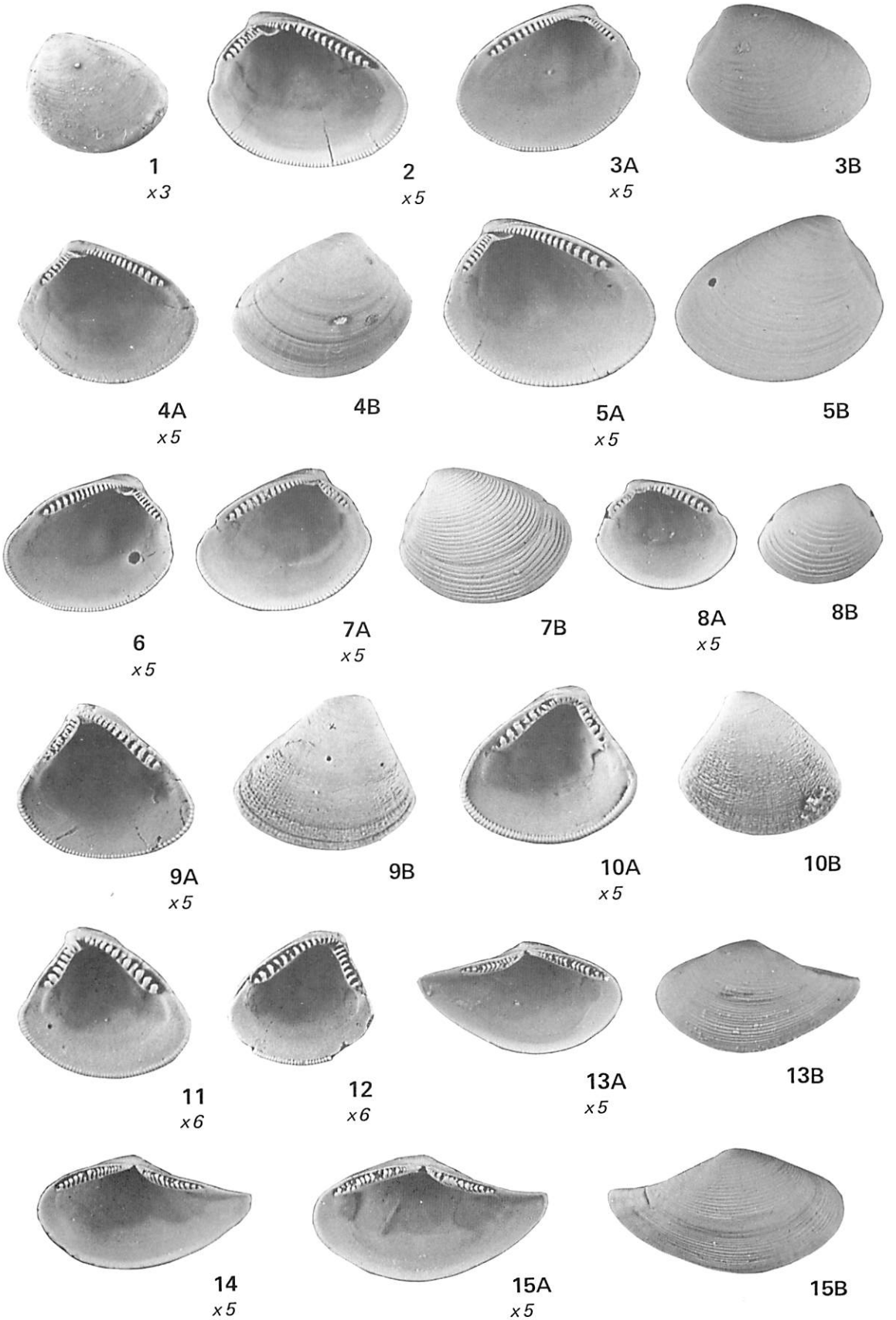
Occurrence: Mississippi: Red Bluff Formation, localities 34b, 37, 40.

PLATE EXPLANATIONS

EXPLANATION PLATE 1

Figure		Page
1-5	**Nucula vicksburgensis** Conrad, 1848	27
	1. Right valve; height 6.7 mm, length 8.2 mm; Vicksburg, Mississippi. Holotype ANSP 30674.	
	2. Left valve; height 5.0 mm, length 6.5 mm, inflation 1.7 mm; Byram Fm., locality 93. MGS 639.	
	3. Right valve; height 4.5 mm, length 6.0 mm, inflation 1.4 mm; Byram Fm., locality 93. MGS 640.	
	4. Left valve; height 4.7 mm, length 5.9 mm, inflation 1.4 mm; Red Bluff Fm., locality 38b. MGS 641.	
	5. Left valve; height 5.5 mm, length 6.9 mm, inflation 1.7 mm; Byram Fm., locality 93. MGS 642.	
6-8	**Nucula tallahalaensis** n. sp.	27
	6. Right valve; height 4.3 mm, length 5.5 mm, inflation 1.6 mm; Byram Fm., locality 93. MGS 643.	
	7. Right valve; height 4.5 mm, length 5.5 mm, inflation 1.5 mm; Byram Fm., locality 93. Holotype USNM 340419.	
	8. Left valve; height 3.0 mm, length 3.8 mm; Byram Fm., locality 93. MGS 644.	
9-12	**Brevinucula pseudopunctata** n. sp.	27-28
	9. Left valve; height 5.0 mm, length 5,8 mm, inflation 1.6 mm; Red Bluff Fm., locality 40. MGS 645.	
	10. Right valve; height 4.6 mm, length 5.2 mm, inflation 1.3 mm; Red Bluff Fm., locality 40. Holotype USNM 340420.	
	11. Left valve; height 3.9 mm, length 4.6 mm, inflation 1.3 mm; Red Bluff Fm., locality 40. MGS 646.	
	12. Right valve; height 3.7 mm, length 4.0 mm, inflation 1.1 mm; Red Bluff Fm., locality 40. MGS 647.	
13-15	**Nuculana akidota** n. sp.	28
	13. Left valve; height 3.7 mm, length 6.6 mm, inflation 1.5 mm; Byram Fm., locality 93. MGS 648.	
	14. Right valve; specimen broken after being photographed; Byram Fm., locality 93. MGS 649.	
	15. Right valve; height 4.1 mm, length 7.8 mm, inflation 1.8 mm; Byram Fm., locality 93. MGS 650.	

Plate 1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10B
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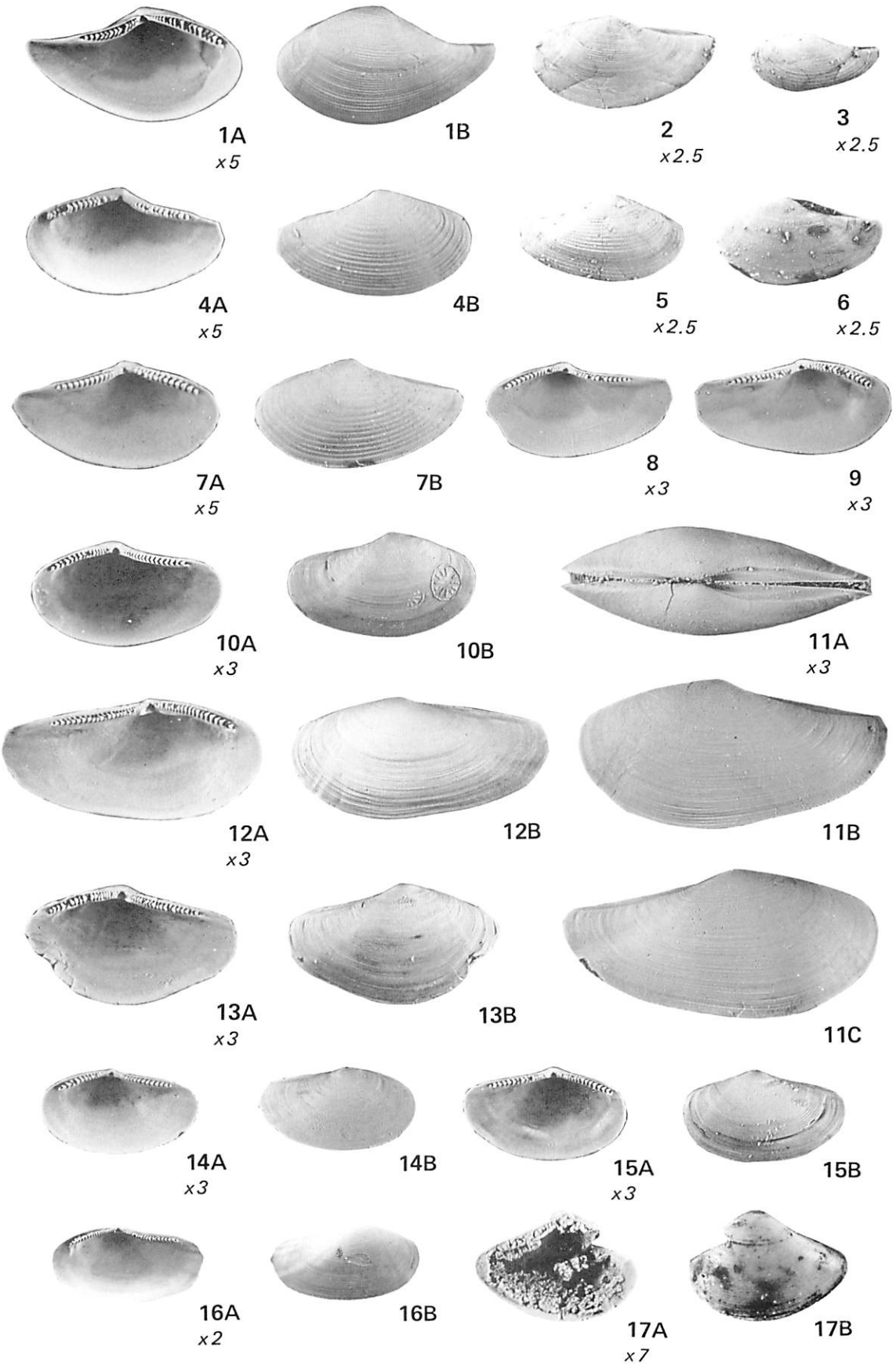
x6
12
x6
13A
x5
13B
14
x5
15A
x5
15B

EXPLANATION PLATE 2

Figure		Page
1	**Nuculana akidota** n. sp.	28
	1. Left valve; height 3.7 mm, length 7.0 mm, inflation 1.6 mm; Byram Fm., locality 93. Holotype USNM 340421.	
2-9,11	**Yoldia serica** Conrad,1848	28-29
	2. Left valve; height 6.3 mm, length 12.5 mm, inflation 2.0 mm; Vicksburg, Mississippi. Syntype A (lectotype), ANSP 30675.	
	3. Left valve; height 4.0 mm, length 8.5 mm; Vicksburg, Mississippi. Syntype E, ANSP 30675.	
	4. Right valve; height 3.4 mm, length 6.2 mm; Byram Fm., locality 106. MGS 651.	
	5. Right valve; height 6.0 mm, length 11.0 mm, inflation 2.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 30675.	
	6. Left valve; height 6.0 mm, length 11.0 mm, inflation 2.2 mm; Vicksburg, Mississippi. Syntype D, ANSP 30675.	
	7. Left valve; height 3.4 mm, length 6.5 mm, inflation 1.1 mm; Byram Fm., locality 106. MGS 652.	
	8. Right valve; height 5.0 mm, length 10.0 mm, inflation 1.4 mm; Mint Spring Fm., locality 99. MGS 653.	
	9. Left valve; height 5.1 mm, length 10.7 mm, inflation 1.6 mm; Mint Spring Fm., locality 99. MGS 654.	
	11. Both valves; height 8.1 mm, length 17.0 mm, inflation of both valves with a 0.8 mm gape 5.7 mm; Mint Spring Fm., locality 99. MGS 656.	
10,12-16	**Yoldia clydoniona** n. sp.	28
	10. Right valve; height 5.5 mm, length 10.2 mm, inflation 2.0 mm, Red Bluff Fm., locality 37. MGS 655.	
	12. Left valve; height 6.6 mm, length 14.3 mm, inflation 2.4 mm; Red Bluff Fm., locality 38b. Holotype USNM 340422.	
	13. Right valve; height 6.5 mm, length 11.4 mm, inflation 2.2 mm; Red Bluff Fm., locality 37. MGS 657.	
	14. Right valve; height 4.6 mm, length 8.5 mm, inflation 1.3 mm; Red Bluff Fm., locality 38b. MGS 658.	
	15. Left valve; height 5.0 mm, length 8.7 mm, inflation 1.9 mm; Red Bluff Fm., locality 37. MGS 659.	
	16. Right valve; height 6.4 mm, length 12.4 mm, inflation 2.1 mm; Red Bluff Fm. USGS locality 5264 = MGS locality 38b. USNM 340423.	
17	**Nuculana triangulata** (Meyer, 1886)	28
	Left valve; height 2.5 mm, length 3.6 mm, inflation 1.0 mm; Red Bluff Fm., Red Bluff, Mississippi. Syntype A (lectotype), USNM 644597.	

Plate 2


1A
x5
1B
2
x2.5
3
x2.5
4A
x5
4B
5
x2.5
6
x2.5
7A
x5
7B
8
x3
9
x3
10A
x3
10B
11A
x3
12A
x3
12B
11B
13A
x3
13B
11C
14A
x3
14B
15A
x3
15B
16A
x2
16B
17A
x7
17B

EXPLANATION PLATE 3

Figure		Page
1	**Arca (Arca) subprotracta** Heilprin, 1882	29-30
	Left valve; height 12.8 mm, length 33.7 mm, inflation 6.7 mm, Vicksburg, Mississippi. Holotype ANSP 30649 (= **Byssoarca protacta** Conrad, 1848).	
2-3,5-6	**Barbatia mississippiensis** (Conrad, 1848)	30
	2. Right valve; height 26.0 mm, length 39.7 mm, inflation 8.0 mm; Vicksburg, Mississippi. Holotype ANSP 30648.	
	3. Right valve; height 20.6 mm, length (shell broken) 31.3 mm, inflation 8.0 mm; Vicksburg, Mississippi. Paratype ANSP 30648.	
	5. Right valve; height 18.3 mm, length 32.0 mm, inflation 6.5 mm; Mint Spring Fm., locality 99. MGS 660.	
	6. Right valve; height 21.8 mm, length 34.5 mm, inflation 7.5 mm; Byram Fm., locality 106. MGS 661.	
4	**Barbatia paradiagona** n. sp.	30-32
	Right valve; height 12.5 mm, length 23.2 mm, inflation 5.0 mm; Mint Spring Fm., locality 99. Holotype USNM 340424.	
7	**Barbatia (Cucullaearca) lima** (Conrad, 1848)	32
	Left valve; height 57.4 mm, length 73.3 mm, inflation 17.5 mm; Vicksburg, Mississippi. Holotype ANSP 30642.	

Plate 3

1A
x 1.5

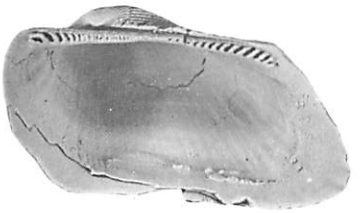
2A
x 2

1B

3
x 1.2

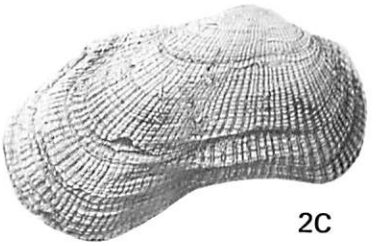
2B
x 1.2

1C

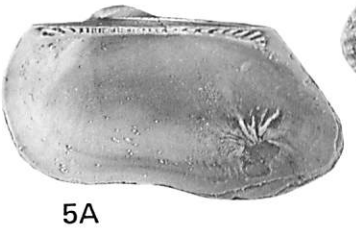


4A
x 2

4B

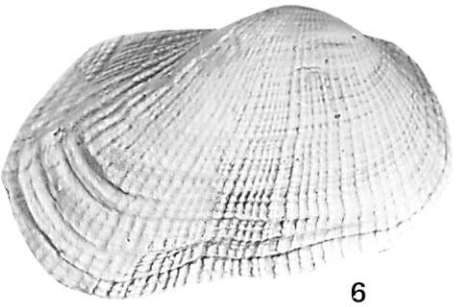


2C

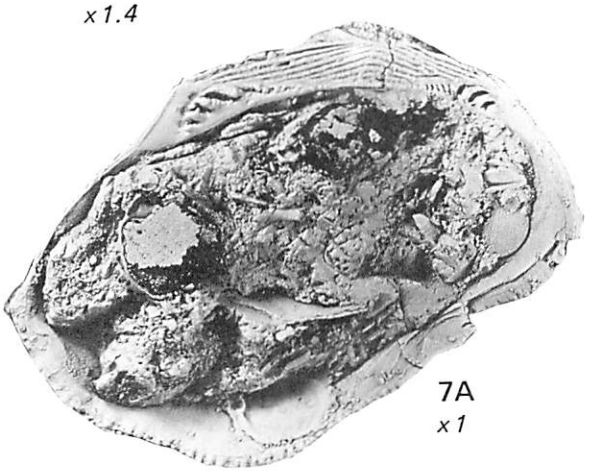


5A
x 1.4

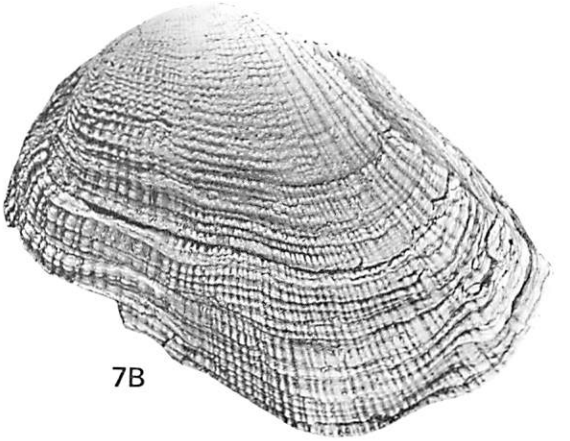
5B



6
x 1.7



7A
x 1

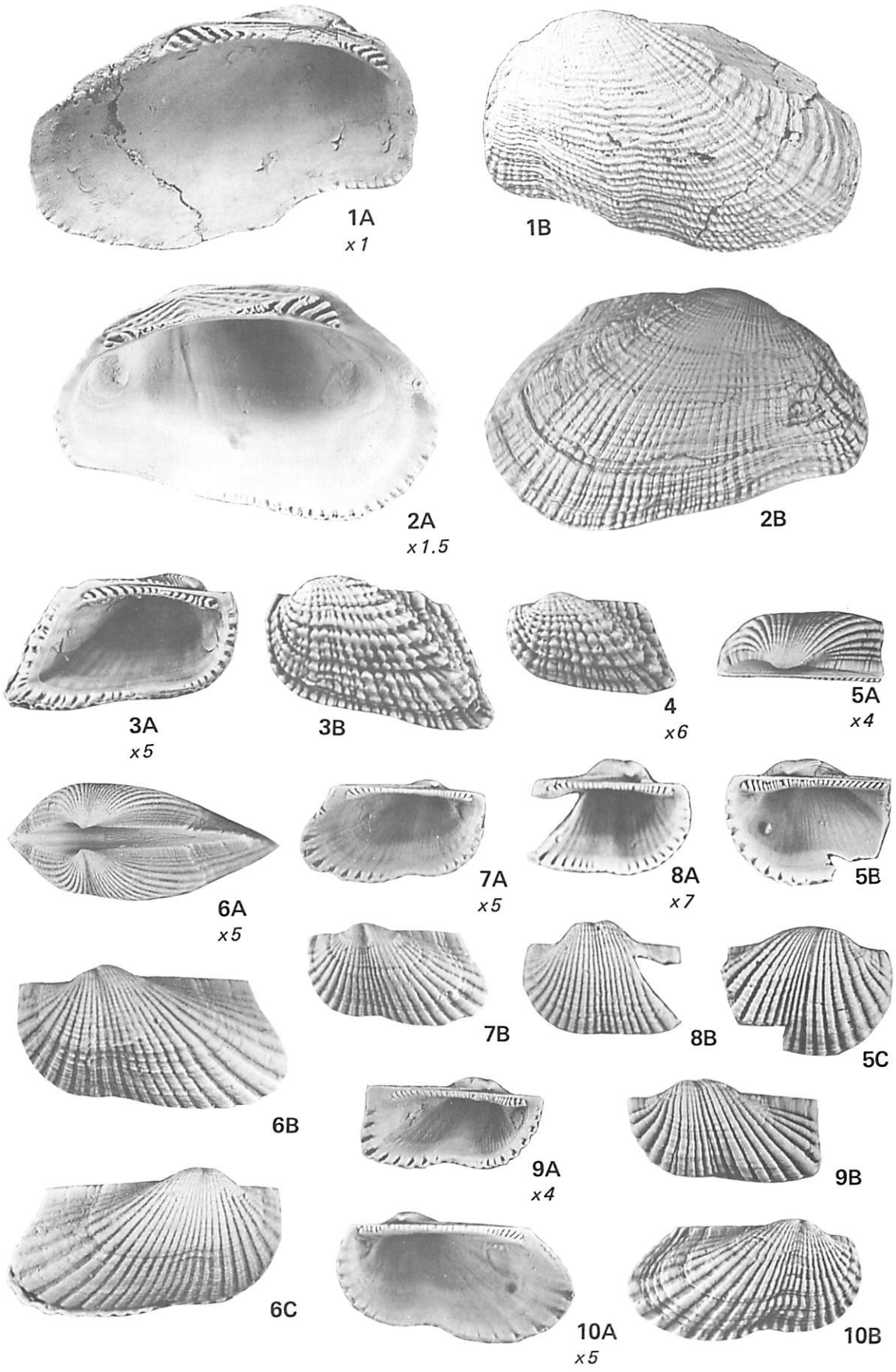


7B

EXPLANATION PLATE 4

Figure		Page
1-2	**Barbatia (Cucullaearca) lima** (Conrad, 1848)	32
	1. Left valve; height 42.4 mm, length 63.2 mm, inflation 15 mm; Vicksburg, Mississippi. Paratype ANSP 30642.	
	2. Right valve; height 28.0 mm, length 41.5 mm, inflation 9.0 mm; Byram Fm., locality 106. MGS 662.	
3-4	**Barbatia paradiagona** n. sp.	30-32
	3. Left valve; height 4.9 mm, length 7.6 mm, inflation 2.1 mm; Red Bluff Fm., locality 40. MGS 663.	
	4. Left valve; height 2.5 mm, length 4.4 mm, inflation 1.1 mm; Red Bluff Fm., locality 40. MGS 664.	
5,8-9	**Scapharca (Scapharca) chordicosta** n. sp.	34
	5. Right valve; height (specimen incomplete) 5.1 mm, inflation 2.6 mm; Byram Fm., locality 93. MGS 665.	
	8. Left valve; height (specimen incomplete) 2.6 mm, inflation 1.3 mm; Mint Spring Fm., locality 99. MGS 668.	
	9. Left valve; height 4.0 mm, length 7.3 mm, inflation 1.8 mm; Byram Fm., locality 93. Holotype USNM 340425.	
6-7,10	**Scapharca (Scapharca) invidiosa** (Casey, 1903)	32-33
	6. Both valves; height 4.6 mm, length 9.2 mm, inflation of both valves 3.9 mm; Red Bluff Fm., locality 35b. MGS 666.	
	7. Left valve; height 3.2 mm, length 5.9 mm, inflation 1.3 mm; Red Bluff Fm., locality 34b. MGS 667.	
	10. Right valve; height 4.0 mm, length 7.6 mm, inflation 1.8 mm; Red Bluff Fm., locality 34b. MGS 669.	

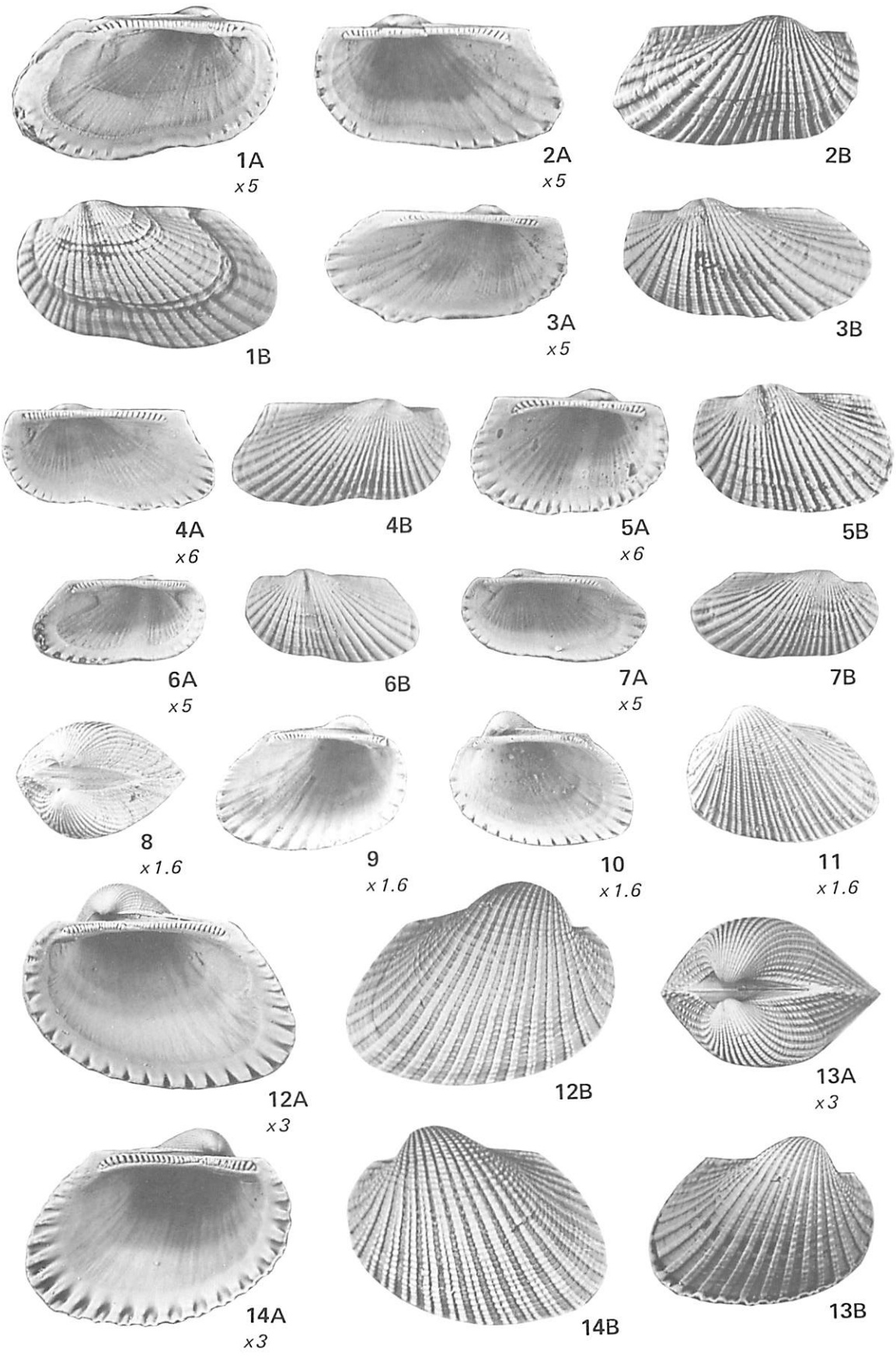
Plate 4


1A
x 1
1B
2A
x 1.5
2B
3A
x 5
3B
4
x 6
5A
x 4
6A
x 5
7A
x 5
8A
x 7
5B
7B
8B
5C
6B
9A
x 4
9B
6C
10A
x 5
10B

EXPLANATION PLATE 5

Figure		Page
1-2	**Scapharca (Scapharca) invidiosa** (Casey, 1903)	32-33
	1. Left valve; height 4.8 mm, length 8.7 mm, inflation 2.0 mm; Red Bluff Fm., locality 37. MGS 670.	
	2. Right valve; height 4.4 mm, length 8.1 mm, inflation 1.9 mm; Red Bluff Fm., locality 34b. MGS 671.	
3-7	**Scapharca (Scapharca) delicatula** (Casey, 1903)	33-34
	3. Left valve; height 4.0 mm, length 8.2 mm, inflation 1.6 mm; Forest Hill Fm., locality 75a. MGS 672.	
	4. Right valve; height 3.0 mm, length 5.8 mm, inflation 1.2 mm; Forest Hill Fm., locality 75a. MGS 673.	
	5. Left valve; height 3.5 mm, length 5.3 mm, inflation 1.5 mm; Forest Hill Fm., locality 75a. MGS 674.	
	6. Left valve; height 2.9 mm, length 5.6 mm., inflation 1.2 mm; Mint Spring Fm., locality 108. MGS 675.	
	7. Right valve; height 2.9 mm, length 6.1 mm, inflation 1.2 mm; Mint Spring Fm., locality 108. MGS 675.	
8-14	**Scapharca (Scapharca) lesueuri** Dall, 1898	34-35
	8. Both valves; height 13.4 mm, length 18.4 mm, inflation of both valves 12.3 mm; Vicksburg, Mississippi. Syntype A (lectotype), ANSP 30682.	
	9. Left valve; height 15.0 mm, length 20.0 mm, inflation 7.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 30682.	
	10. Right valve; height 14.6 mm, length 19.1 mm, inflation 6.2 mm; Vicksburg, Mississippi. Syntype C, ANSP 30682.	
	11. Left valve; height 15.0 mm, length 20.0 mm, inflation 6.7 mm; Vicksburg, Mississippi. Syntype D, ANSP 30682.	
	12. Right valve; height 11.4 mm, length 15.0 mm, inflation 5.2 mm; Byram Fm., locality 112c. MGS 677.	
	13. Both valves; height 9.5 mm, length 12.2 mm, inflation of both valves 8.4; Byram Fm., locality 112c. MGS 678.	
	14. Left valve; height 11.3 mm, length 14.5 mm, inflation 5.3 mm; Byram Fm., locality 112c. MGS 679.	

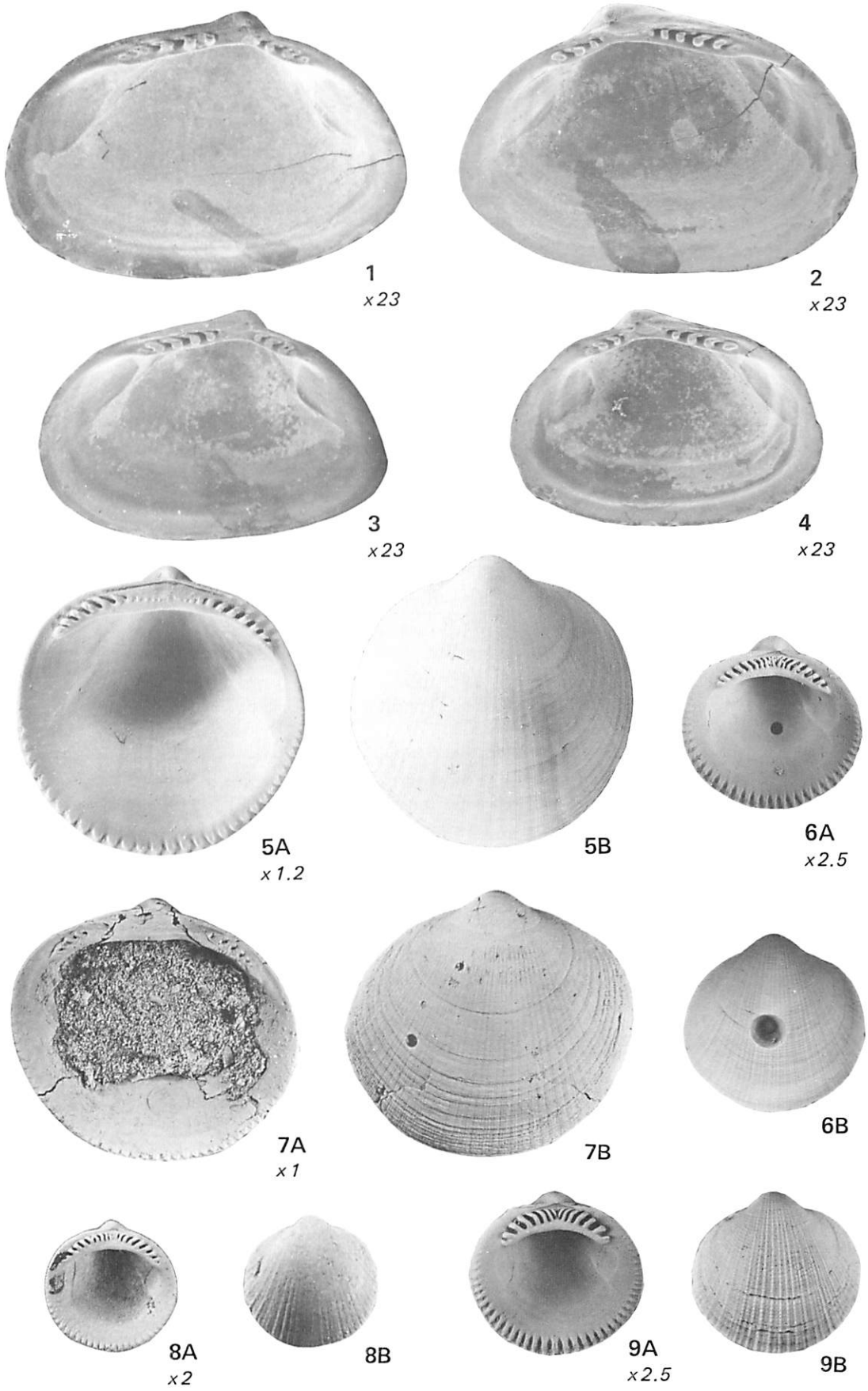
Plate 5


1A
x 5
2A
x 5
2B
1B
3A
x 5
3B
4A
x 6
4B
5A
x 6
5B
6A
x 5
6B
7A
x 5
7B
8
x 1.6
9
x 1.6
10
x 1.6
11
x 1.6
12A
x 3
12B
13A
x 3
14A
x 3
14B
13B

EXPLANATION PLATE 6

Figure		Page
1-4	**Trinacria menthifontis** n. sp.	36
	1. Left valve; height 1.9 mm, length 3.0 mm; Mint Spring Fm., locality 108. Holotype USNM 340426. SEM photograph by E. E. Russell.	
	2. Right valve; height 1.9 mm, length 3.0 mm; Mint Spring Fm., locality 108. MGS 680. SEM photograph by E. E. Russell.	
	3. Left valve; height 1.7 mm, length 2.6 mm; Mint Spring Fm., locality 108. MGS 681. SEM photograph by E. E. Russell.	
	4. Right valve; height 1.6 mm, length 2.3 mm; Mint Spring Fm., locality 108. MGS 682. SEM photograph by E. E. Russell.	
5,7	**Glycymeris suwannensis** Mansfield, 1937	36-37
	5. Left valve; height 40.0 mm, length 39.4 mm, inflation 12.5 mm; Mint Spring Fm., locality 99. MGS 1094. Collected by Andrew W. Rees.	
	7. Right valve; height 44.5 mm, length 47.0 mm, inflation 13.3; Mint Spring Fm., Horton's Mill Creek USGS locality 14203. USNM 340427.	
6,8-9	**Glycymeris mississippiensis** (Conrad, 1848)	37
	6. Right valve; height 14.4 mm, length 14.7 mm, inflation 5.5 mm; Byram Fm., locality 106. MGS 684.	
	8. Left valve; height 10.8 mm, length 11.0 mm, inflation 3.5 mm; Vicksburg, Mississippi. Holotype ANSP 30667.	
	9. Right valve; height 10.8 mm, length 11.3 mm, inflation 4.6 mm; Byram Fm., locality 106. MGS 685.	

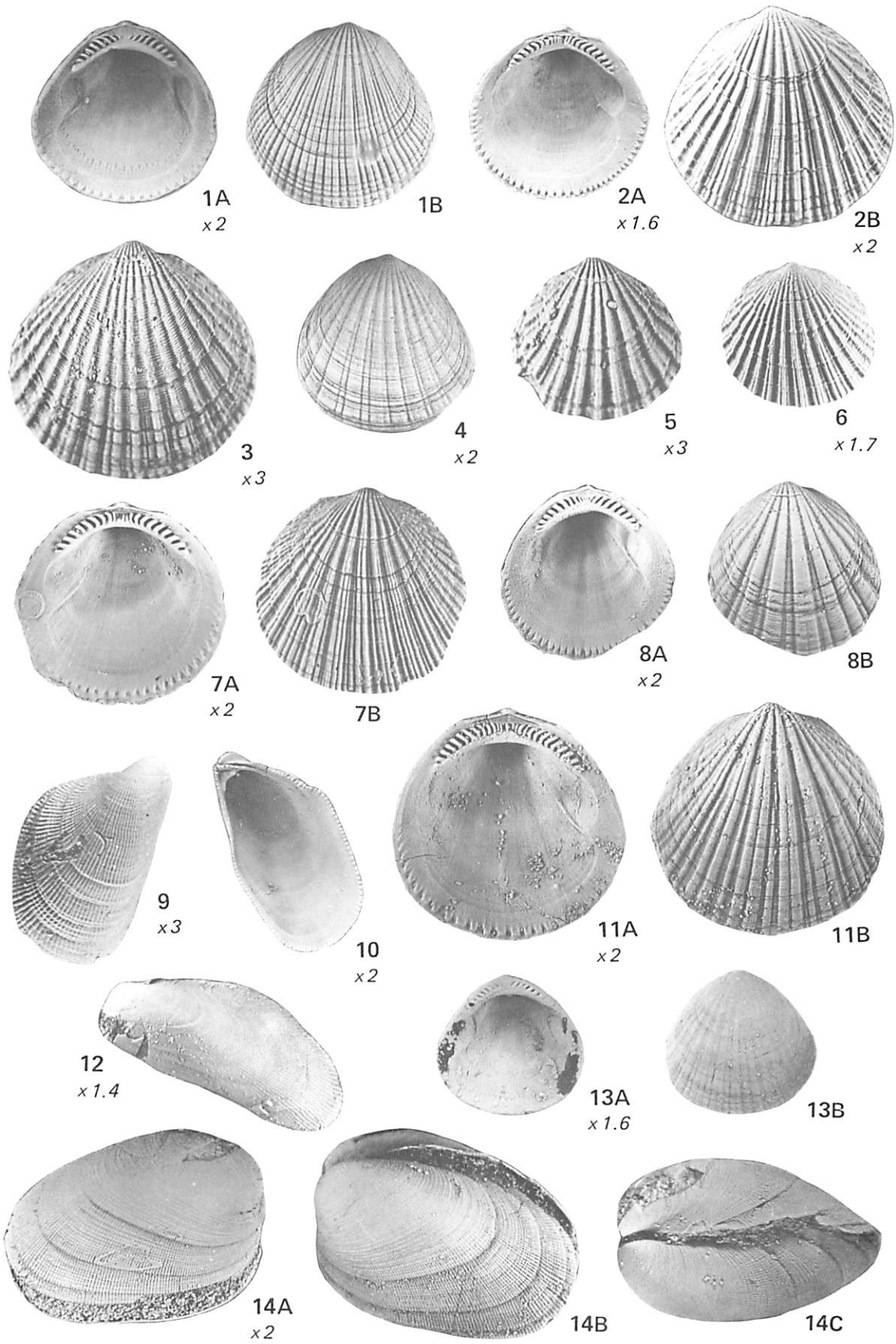
PLATE 6



EXPLANATION PLATE 7

Figure		Page
1,4,8,11,13	**Glycymeris arctatus** (Conrad, 1848)	38
	1. Left valve; height 15.2 mm, length 15.5 mm, inflation 4.5 mm; Byram Fm., locality 115. MGS 686.	
	4. Left valve; height 14.7 mm, length 14.8 mm, inflation 4.0 mm; Byram Fm. , locality 115. MGS 688.	
	8. Right valve; height 14.6 mm, length 14.5 mm, inflation 3.7 mm; Mint Spring Fm., locality 110. MGS 692.	
	11. Right valve; height 19.3 mm, length 19.5 mm, inflation 5.1 mm; Mint Spring Fm., locality 100. MGS 694.	
	13 Right valve; height 15.0 mm, length 15.6 mm, inflation 3.7 mm (specimen is badly worn); Byram Fm., Vicksburg, Mississippi. Holotype 30647 ANSP.	
2-3,5-7	**Glycymeris intercostata** (Gabb, 1860)	37-38
	2. Left valve; height 18.3 mm, length 18.5 mm, inflation 5.1 mm; Red Bluff Fm., USGS locality 15058 = MGS locality 35b. USNM 340428.	
	3. Left valve; height 13.2 mm, length 13.8 mm, inflation 4.0 mm; Mint Spring Fm., locality 75b. MGS 687.	
	5. Right valve; height 9.0 mm, length 9.4 mm, inflation 2.8 mm; Mint Spring Fm., locality 75b. MGS 689.	
	6. Left valve; height 14.0 mm, length 14.7 mm, inflation 4.0 mm; Mint Spring Fm., locality 99. MGS 690.	
	7. Left valve; height 17.2 mm, length 18.0 mm, inflation 4.5 mm; Red Bluff Fm., locality 34b. MGS 691.	
9-10	**Septifer (Septifer) probolus** n. sp.	39
	9. Right valve; height 11.4 mm, length 9.1 mm, inflation 4.0 mm; Red Bluff Fm., locality 40. MGS 693.	
	10. Right valve; height 15.5 mm, length 12.9 mm, inflation 4.3 mm; Red Bluff Fm., locality 35b. Holotype USNM 340429.	
12	**Brachidontes mississippiensis** (Conrad, 1848)	38-39
	Left valve; height 22.6 mm, length 27.7 mm, inflation 5.5 mm; Vicksburg, Mississippi. Holotype ANSP 30646.	
14	**Arcoperna linteata** n. sp.	39-40
	Both valves; height 16.5 mm., length 21.0 mm, inflation of both valves 13.0 mm; Mint Spring Fm., locality 99. Holotype USNM 340431.	

PLATE 7


1A
x 2
1B
2A
x 1.6
2B
x 2
3
x 3
4
x 2
5
x 3
6
x 1.7
7A
x 2
7B
8A
x 2
8B
9
x 3
10
x 2
11A
x 2
11B
12
x 1.4
13A
x 1.6
13B
14A
x 2
14B
14C

EXPLANATION PLATE 8

Figure		Page
1-6	**Crenella fenestra** n. sp.	39

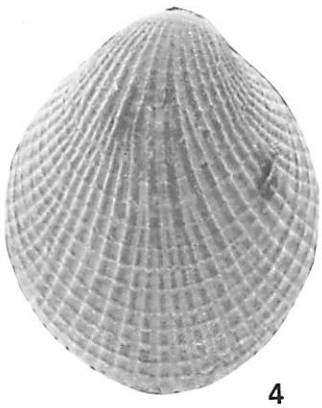
1. Left valve; height 2.6 mm, length 2.0 mm; Mint Spring Fm., locality 108. Holotype USNM 340430. The SEM photographs on this plate were by E. E. Russell.
2. Right valve; height 2.4 mm, length 1.9 mm; Mint Spring Fm., locality 108. MGS 695.
3. Right valve;; height 2.0 mm, length 1.6 mm; Mint Spring Fm., locality 108. MGS 696. Figure 3B is a view below the anterior hinge showing the lamellar and prismatic shell layers.
4. Right valve; height 2.2 mm, length 1.8 mm; Mint Spring Fm., locality 108. MGS 697.
5. Left valve; height 2.2 mm, length 1.8 mm; Mint Spring Fm., locality 108. MGS 698. Figure 5B shows the bifurcation of radial ribs toward the anterior ventral margin.
6. Both valves; height 2.6 mm, inflation of both valves 1.8 mm; Mint Spring Fm., locality 108. MGS 699.

PLATE 8

1
x23

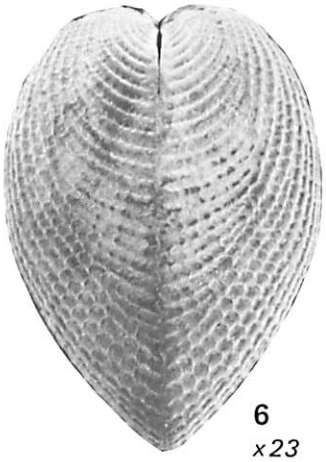
2
x23

3A
x23

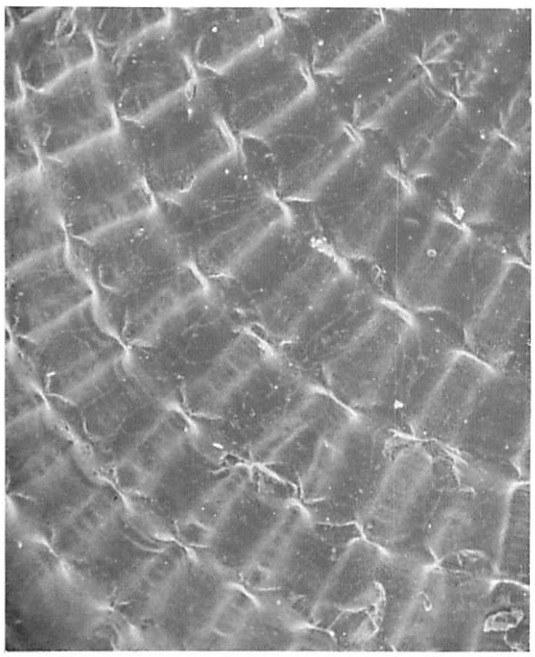


4
x23

5A
x23



6
x23



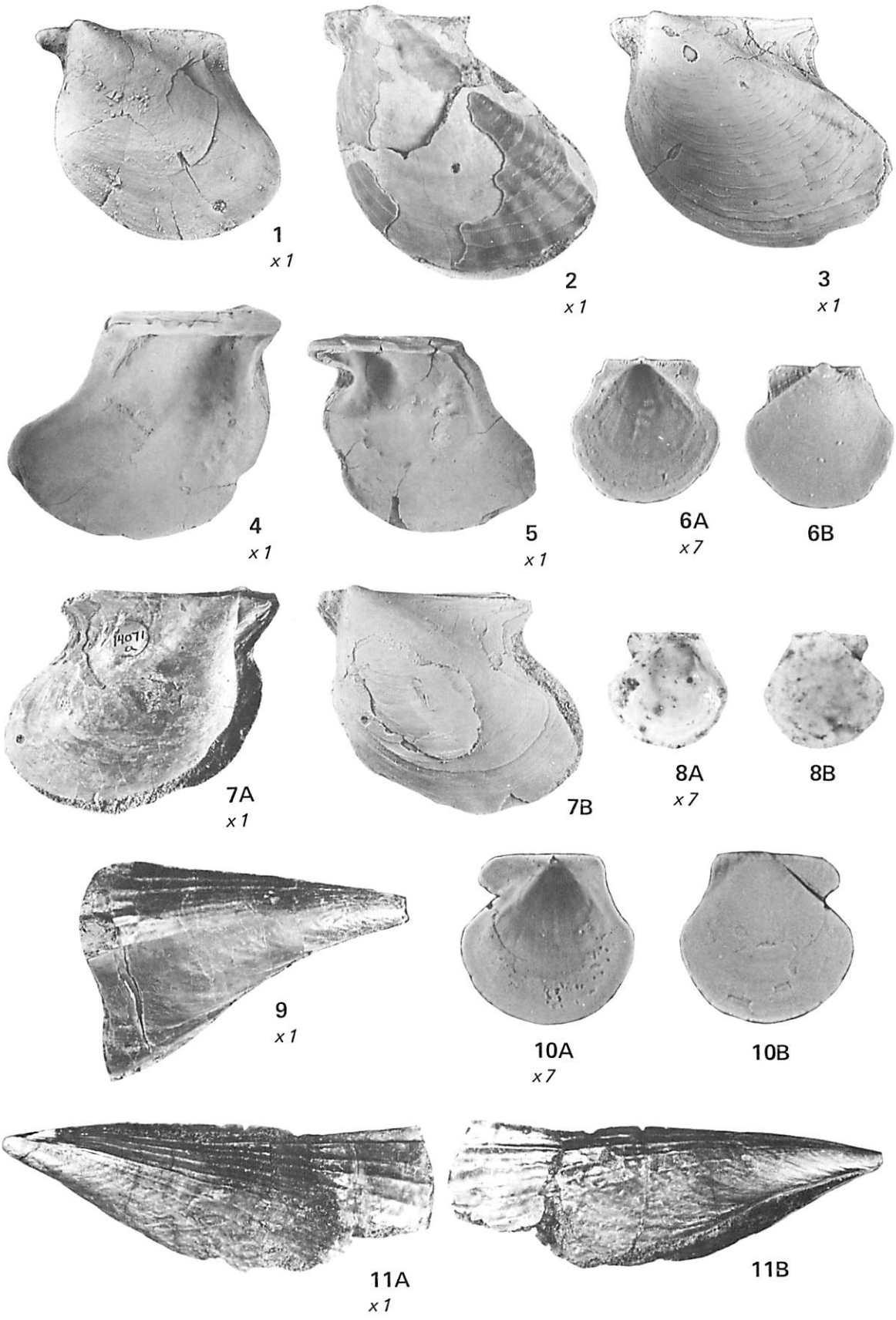
5B
x1,755

3B
x2,340

EXPLANATION PLATE 9

Figure		Page
1-5,7	**Pteria argentia** (Conrad, 1848)	40-42
	1. Left valve; height 37.6 mm, length 39.2 mm, inflation 7.0 mm; Vicksburg, Mississippi. Holotype ANSP 30644.	
	2. Left valve; height 45.0 mm, length 50.0 mm; Mint Spring Fm., locality 100. MGS 683. Radial color bands are visible on the outer shell layer.	
	3. Left valve; height 40.6 mm, length 46.0 mm, inflation 9.1 mm; Mint Spring Fm., USGS locality 14071. USNM 340432. Growth imbrications and radial color bands are visible in the exterior shell layer.	
	4. Left valve; height 41.0 mm, length 46.0 mm, inflation 10 mm; Mint Spring Fm., locality 74b. MGS 700.	
	5. Right valve; height 34.0 mm, length 38.0 mm, inflation 8 mm; Mint Spring Fm., locality 74b. MGS 701.	
	7. Both valves; height 38.0 mm, length 44.0 mm, inflation of both valves 15.5 mm; Mint Spring Fm., USGS locality 14071. USNM 340433.	
6,8,10	**Eburneopecten (Eburneopecten) subminutus** (Aldrich,1903)	42
	6. Left valve; height 3.2 mm; Red Bluff Fm., locality 34b. MGS 702.	
	8. Right valve; height 2.8 mm, length 3 mm; Red Bluff Fm., Mississippi. Syntype 644632 USNM.	
	10. Right valve; height 3.9 mm, length 3.9 mm; Mint Spring Fm., locality 99. MGS 704.	
9,11	**Atrina argentea** (Conrad, 1848)	40
	9. Both valves showing right valve; length (specimen incomplete) 51.0 mm, inflation of both valves 16.0 mm; Byram Fm., locality 106. MGS 703.	
	11. Both valves showing left valve; length (specimen incomplete) 74.0 mm; Mint Spring Fm., locality 99. MGS 705.	

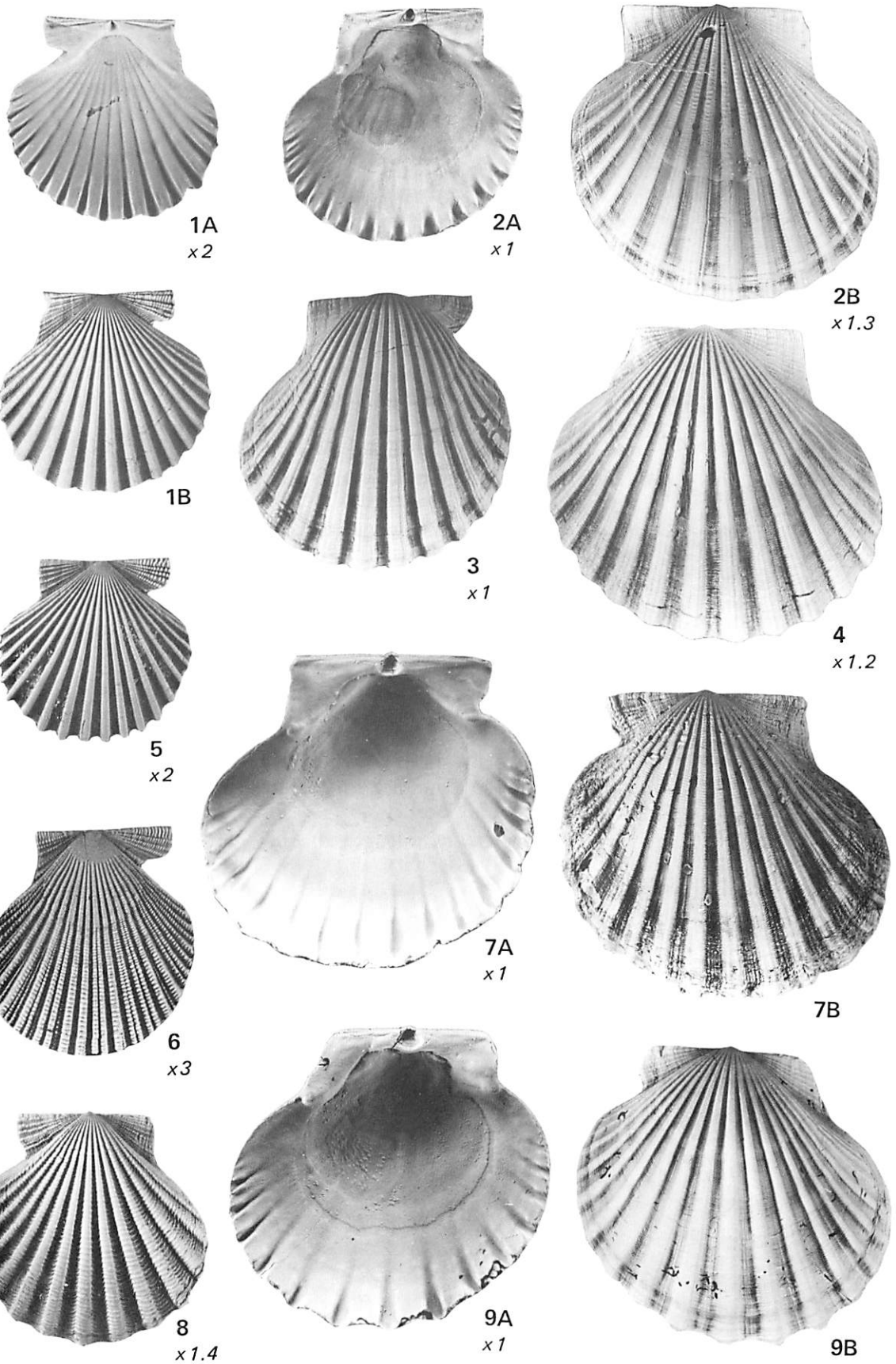
PLATE 9


1
x 1
2
x 1
3
x 1
4
x 1
5
x 1
6A
x 7
6B
7A
x 1
7B
8A
x 7
8B
9
x 1
10A
x 7
10B
11A
x 1
11B

EXPLANATION PLATE 10

Figure		Page
1,5	**Pecten (Pecten) perplanus** Morton 1833	46-47
	1. Right valve; height 17.0 mm, length 17.7 mm, inflation 3.0 mm; Red Bluff Fm., locality 38b. MGS 706.	
	5. Right valve; height 15.0 mm, length 16.3 mm, inflation 3.0 mm; Red Bluff Fm., locality 38b. MGS 709.	
2-4,7-9	**Chlamys (Lyropecten) menthifontis** Glawe, 1970	45
	2. Left valve; height 38.6 mm, length 40.5 mm, inflation 10.5 mm; Mint Spring Fm., locality 99. MGS 1060.	
	3. Right valve; height 46.2 mm, length 45.5 mm, inflation 15.5 mm; Mint Spring Fm., locality 100. MGS 707.	
	4. Left valve; height 41.8 mm, length 44.2 mm, inflation 11.5 mm; Mint Spring Fm., locality 99. MGS 708.	
	7. Left valve; height 50.0 mm, length 53.0 mm, inflation 12.5 mm; Mint Spring Fm., locality 99. MGS 711.	
	8. Left valve; height 27.8 mm, length 27.8 mm, inflation 5.0; Mint Spring Fm., locality 100. MGS 712.	
	9. Left valve; height 47.9 mm, length 50.3 mm, inflation 13.1 mm; Mint Spring Fm., locality 99. MGS 713.	
6	**Chlamys (Aequipecten) cocoana** Dall, 1898	42
	Right valve; height 12.4 mm, length 11.5 mm, inflation 2.0 mm; Red Bluff Fm., locality 38b. MGS 710.	

PLATE 10

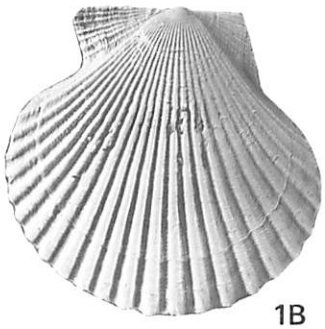


EXPLANATION PLATE 11

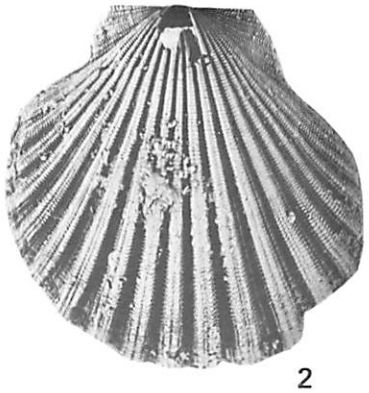
Figure		Page
1	**Chlamys (Aequipecten) redwoodensis** n. sp.	43
	Left valve; height 29.2 mm, length 29.9 mm, inflation 4.6 mm; Bryam Fm., locality 112. Holotype USNM 340434.	
2-3,11	**Chlamys (Lyropecten) menthifontis** Glawe, 1970	45
	2. Left valve; height 39.7 mm, length 39.2 mm, inflation 9.6 mm; Marianna Ls., locality 91. MGS 713.	
	3. Left valve; height 39.0 mm, length 41.5 mm, inflation 9.2 mm; Marianna Ls., locality 91. MGS 714.	
	11. Right valve; height 40.8 mm, length 42.4 mm; Marianna Ls., locality 91. MGS 1061.	
4-5,8-10,12	**Chlamys (Lyropecten) duncanensis** (Mansfield, 1934)	44-45
	4. Left valve; height 32.2 mm, length 34.7 mm, inflation 6.0 mm; Glendon Ls., locality 45, MGS 715.	
	5. Left valve; height 28.0 mm, length 29.6 mm, inflation 6.7 mm; Glendon Ls., locality 92. MGS 1062.	
	8. Left valve; height 26.7 mm, length 27.3 mm, inflation 5.6 mm; Glendon Ls., locality 92. MGS 718.	
	9. Left valve; height 24.6 mm, length 25.5 mm, inflation 4.6 mm; Glendon Ls., locality 45. MGS 719.	
	10. Right valve; height 28.0 mm, length 30.2 mm, inflation 6.0 mm; Glendon Ls., locality 92. MGS 720.	
	12. Right valve; height 26.2 mm, length 27.9 mm, inflation 6.7 mm; Glendon Ls., locality 45. MGS 721.	
6-7	**Pecten (Pecten) byramensis** Gardner, 1945	48-49
	6. Right valve; height 15.5 mm, length 16.0 mm, inflation 4.2 mm; Glendon Ls., locality 45. MGS 716.	
	7. Left valve; height 19.9 mm, length 20.7 mm, inflation 3.4 mm; Glendon Ls., locality 45, MGS 717.	

PLATE 11

1A
x 1.4



1B



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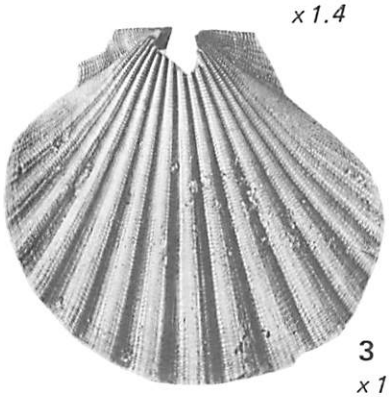

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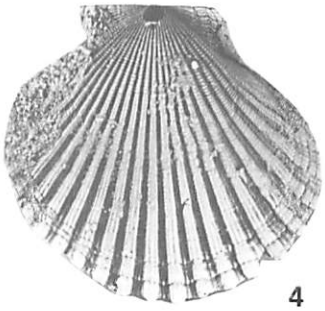

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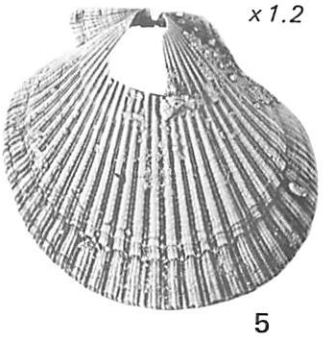

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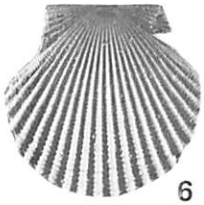

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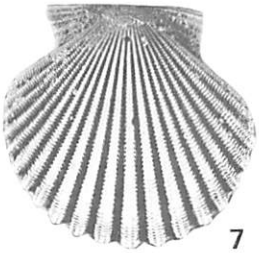

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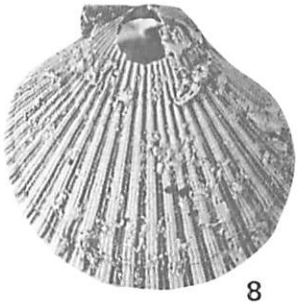

8
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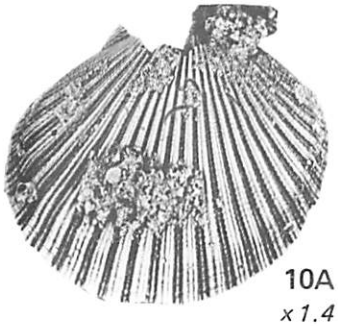
9
x 1.4



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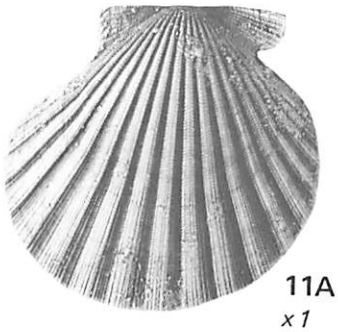

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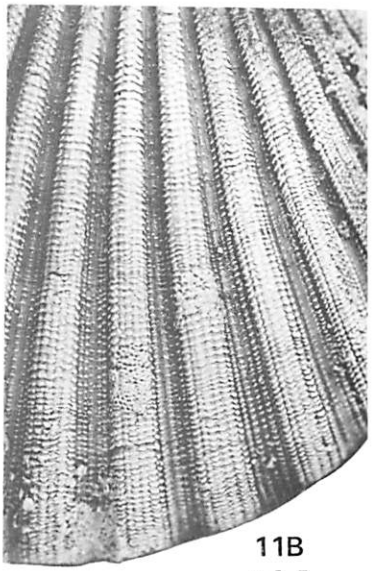

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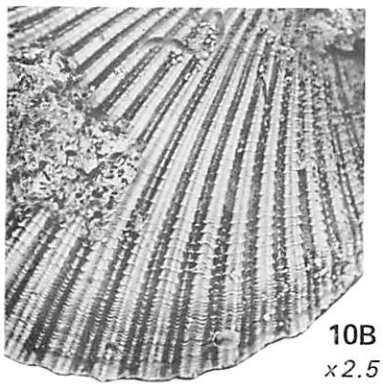

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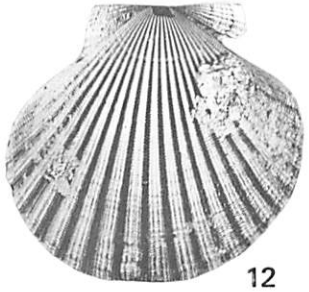
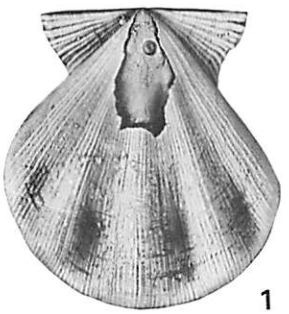


12
x 1.4

EXPLANATION PLATE 12

Figure		Page
1-7	**Chlamys (Anatipopecten) anatipes** (Morton, 1833)	43-44
	1. Left valve; height 19.0 mm, length 17.6 mm, inflation 2.3 mm; Glendon Ls., locality 45. MGS 722.	
	2. Left valve; height 16.0 mm, length 15.6 mm, inflation 1.7 mm; Glendon Ls., locality 45. MGS 723.	
	3. Left valve; height 18.4 mm, length 18.5 mm, inflatin 2.6 mm; Glendon Ls., locality 45. MGS 724.	
	4. Left valve; height 17.0 mm, length 17.0 mm; Glendon Ls., locality 45. MGS 725.	
	5. Right valve; height 24.4 mm, length 23.2 mm, inflation 6.3 mm; Marianna Ls., locality 75c. MGS 726.	
	6. Left valve; length 20.0 mm; Glendon Ls., locality 45. MGS 727.	
	7. Right valve; length 19.5 mm, inflation 4.0 mm; Glendon Ls., locality 45, MGS 728.	
8-9	**Pecten (Pecten) perplanus** Morton, 1833	46-47
	8. Left valve; height 18.5 mm, length 18.7 mm, inflation 2.0 mm; Red Bluff Fm., locality 38b. MGS 729.	
	9. Left valve; height 22.8 mm, length 24.0 mm, inflation 3.2 mm; Red Bluff Fm., locality 38b. MGS 382.	
10-12	**Pecten (Pecten) poulsoni** Morton, 1834	47
	10. Right valve; height 26.7 mm, length 26.5 mm, inflation 9.9 mm; Mint Spring Fm., locality 99. MGS 730.	
	11. Left valve; height 25.8 mm, length 26.9 mm, inflation 3.0 mm; Mint Spring Fm., locality 99. MGS 731.	
	12. Right valve; height 19.7 mm, length 20.4 mm, inflation 7.6 mm; Mint Spring Fm., locality 99. MGS 732.	

PLATE 12



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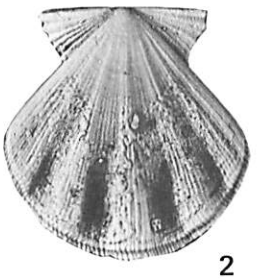

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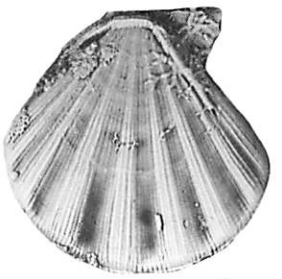
x 2



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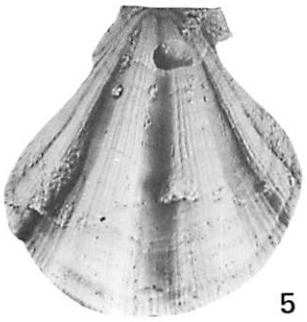

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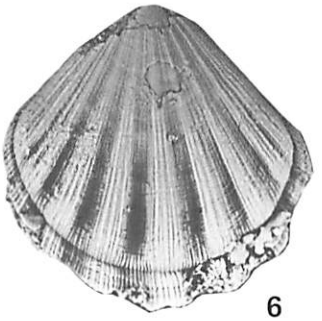

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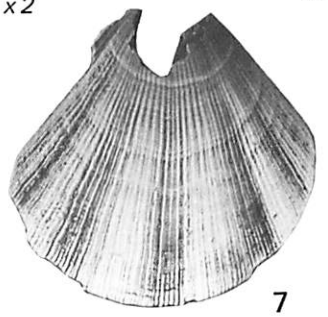

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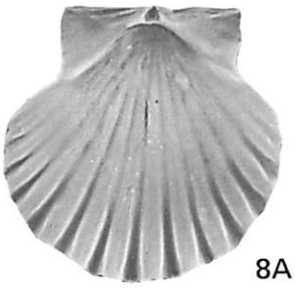

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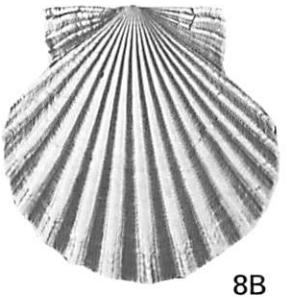

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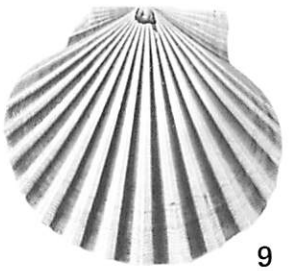
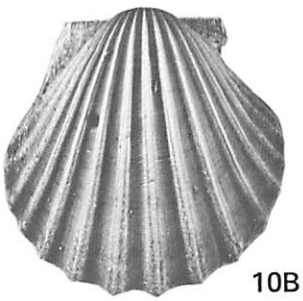


9
x 1.5

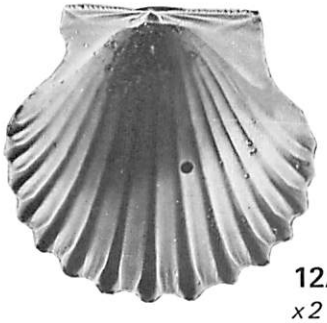
10A
x 1.4



10B

10C

11A
x 1.4



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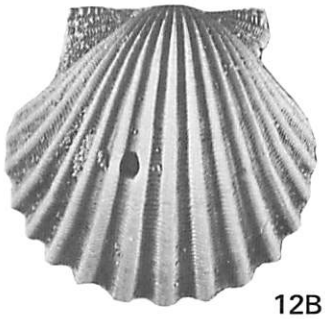

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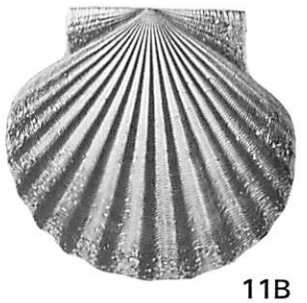
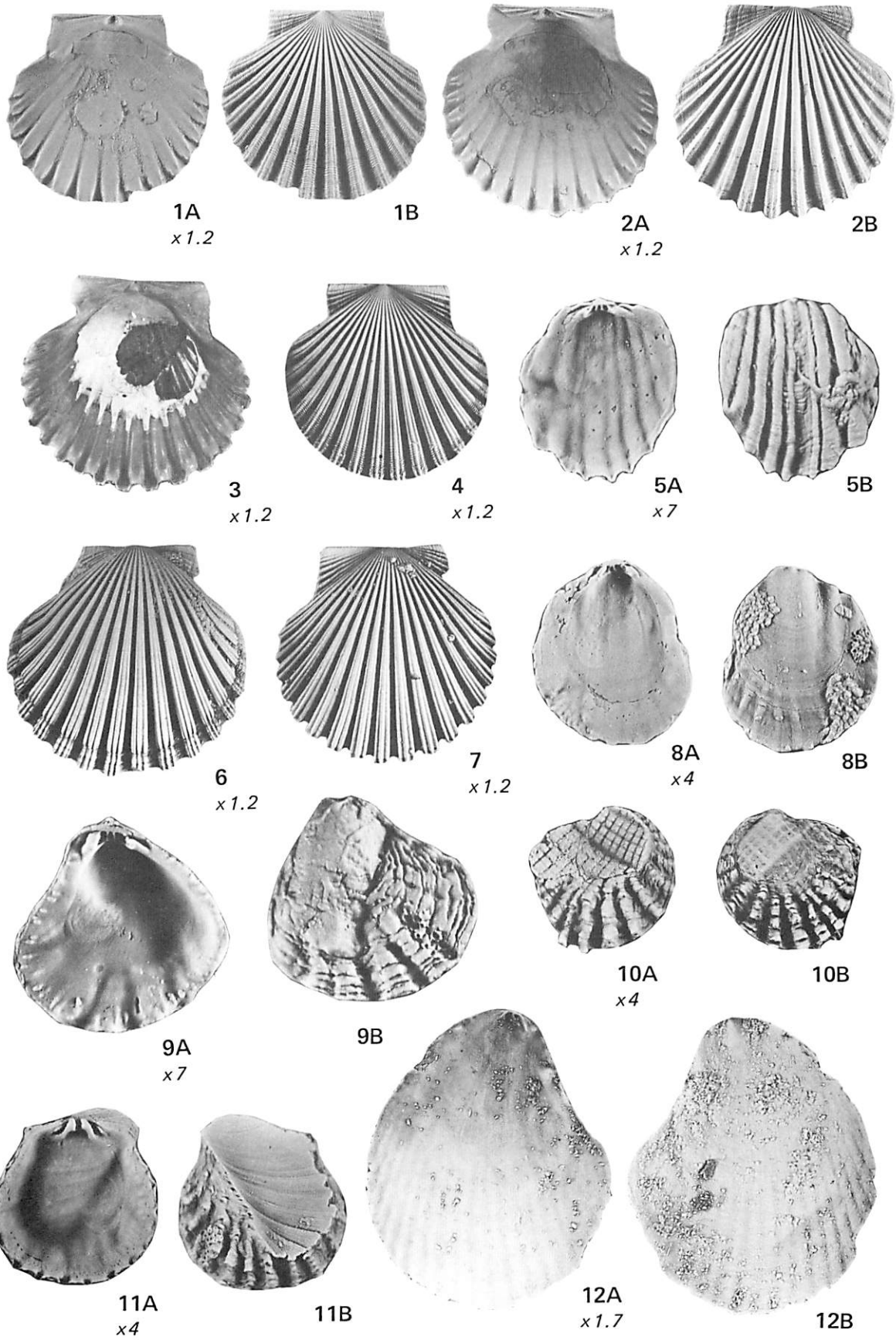


11B

EXPLANATION PLATE 13

Figure		Page
1-4,6-7	**Pecten (Pecten) byramensis** Gardner, 1945	48-49
	1. Left valve; height 26.7 mm, length 28.8 mm, inflation 3.3 mm; Byram Fm., Vicksburg, Mississippi. Paralectotype USNM 370819.	
	2. Right valve; height 29.9 mm, length 31.1 mm, inflation 8.3 mm; Byram Fm., locality 102. Lectotype USNM 370818.	
	3. Right valve; height 29.8 mm, length 32.0 mm, inflation 9.0 mm; Byram Fm., locality 93. MGS 733.	
	4. Left valve; height 27.8 mm, length 29.0 mm, inflation 3.8 mm; Byram Fm., locality 93. MGS 734.	
	6. Right valve; height 33.0 mm, length 34.0 mm, inflation 11.0 mm; Byram Fm., locality 93. MGS 736.	
	7. Right valve; height 30.0 mm, length 30.5 mm, inflation 7.9 mm; Byram Fm., locality 93. MGS 737.	
5,8-11	**Plicatula variplicata** n.sp.	49
	5. Left valve; height 4.2 mm, length 3.9 mm; Byram Fm., locality 93. MGS 735.	
	8. Left valve; height 7.8 mm, length 6.4 mm; Byram Fm., locality 93. MGS 1098.	
	9. Left valve; height 4.9 mm, length 5.0 mm; Red Bluff Fm., locality 34b. MGS 739.	
	10. Both valves, right valve 10A and left valve 10B; height 6.0 mm, length 5.5 mm; Byram Fm., locality 93. MGS 740. The attachment scar of right valve is a negative imprint of a reticulate gastropod. The left valve shows the positive replica of this substrate.	
	11. Right valve; height 7.2 mm, length 6.9 mm, inflation 2.0 mm; Byram Fm., locality 93. Holotype USNM 340435.	
12	**Anomia?** sp.	
	Left valve; height 26.0 mm, length 21.2 mm, inflation-valve is negatively inflated or concave 3.0 mm; Mint Spring Fm., locality 99. MGS 738.	

PLATE 13


1A
x 1.2
1B
2A
x 1.2
2B
3
x 1.2
4
x 1.2
5A
x 7
5B
6
x 1.2
7
x 1.2
8A
x 4
8B
9A
x 7
9B
10A
x 4
10B
11A
x 4
11B
12A
x 1.7
12B

EXPLANATION PLATE 14

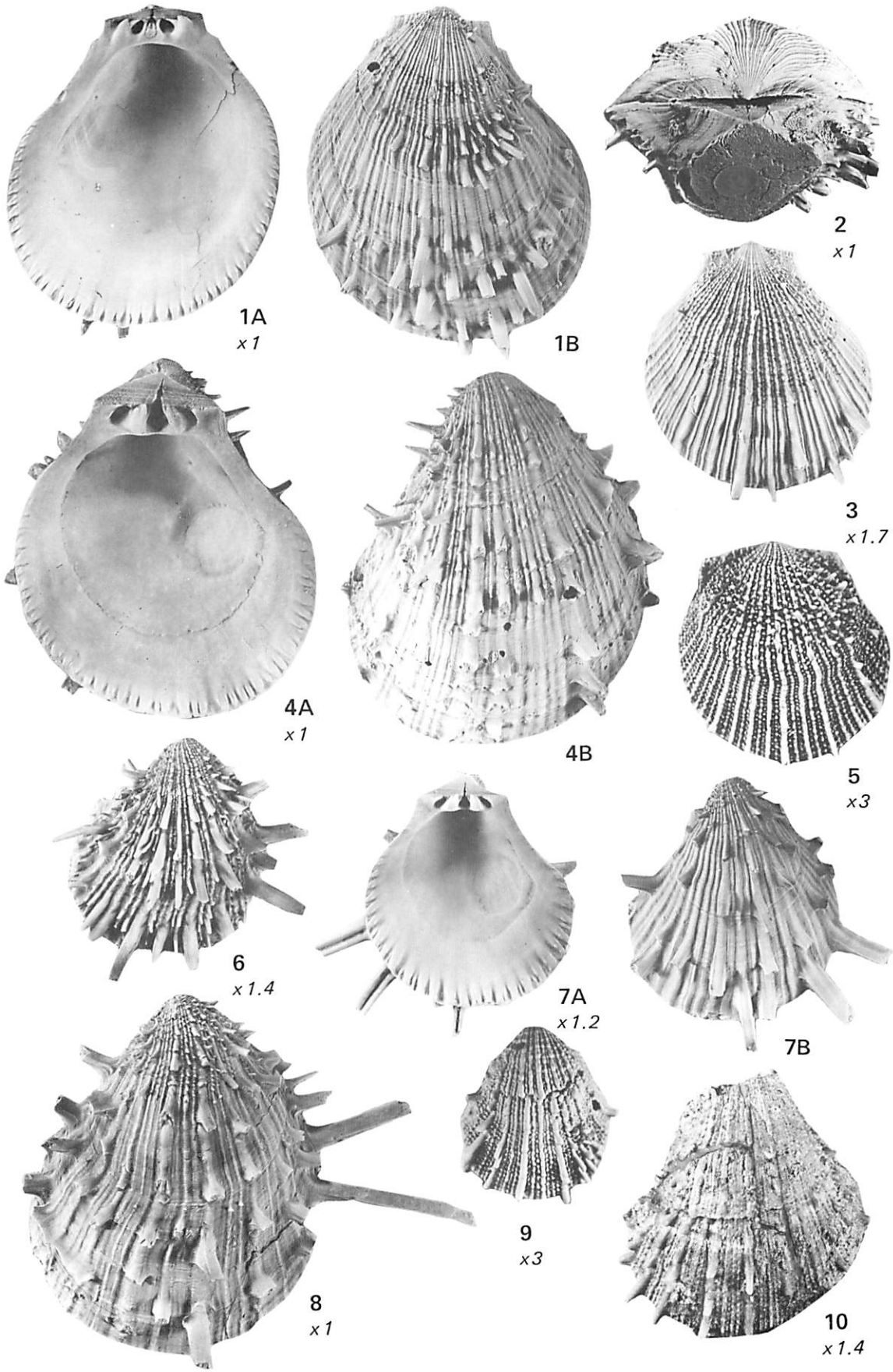
Figure		Page
1-9	**Spondylus (Spondylus) dumosus** (Morton, 1834)	49

1. Left valve; height (not including spines) 54.2 mm, length 48.0 mm, inflation 12.0 mm; Red Bluff Fm., locality 40. MGS 381.
2. Both valves showing hinge; height 59.4 mm, length 51.0 mm, inflation of both valves 35.5 mm; Red Bluff Fm., USGS locality 309. USNM 340436.
3. Left valve; height (not including spines) 34.0 mm, length 31.2 mm, inflation 7.5 mm; Red Bluff Fm., locality 40. MGS specimen 380.
4. Right valve; height 60.8 mm, length 49.6 mm, inflation 18.0 mm; Red Bluff Fm., locality 40. MGS specimen 386.
5. Left valve; height 12.3 mm, length 12.0 mm, inflation 4.2 mm; Red Bluff Fm., locality 38b. MGS 741.
6. Right valve; height (not including spines) 26.5 mm, length (not including spines) 22.4 mm, inflation 7.0 mm; Red Bluff Fm., locality 40. MGS 379.
7. Right valve; height (not including spines) 33.4 mm, length (not including spines) 29.0 mm, inflation 9.0 mm; Red Bluff Fm., locality 40. MGS 384.
8. Right valve; height 59.5 mm, length (not including spines) 48.0 mm, inflation 16.0 mm, Red Bluff Fm., locality 40. MGS 385.
9. Right valve; height 9.5 mm, length 8.5 mm, inflation 3.6 mm; Red Bluff Fm., locality 38b. MGS 742.

10	**Spondylus (Spondylus)** sp.	50

Right valve; height 34.0 mm, length 30.0 mm, inflation 12.3 mm; Marianna Ls., locality 98. MGS 743.

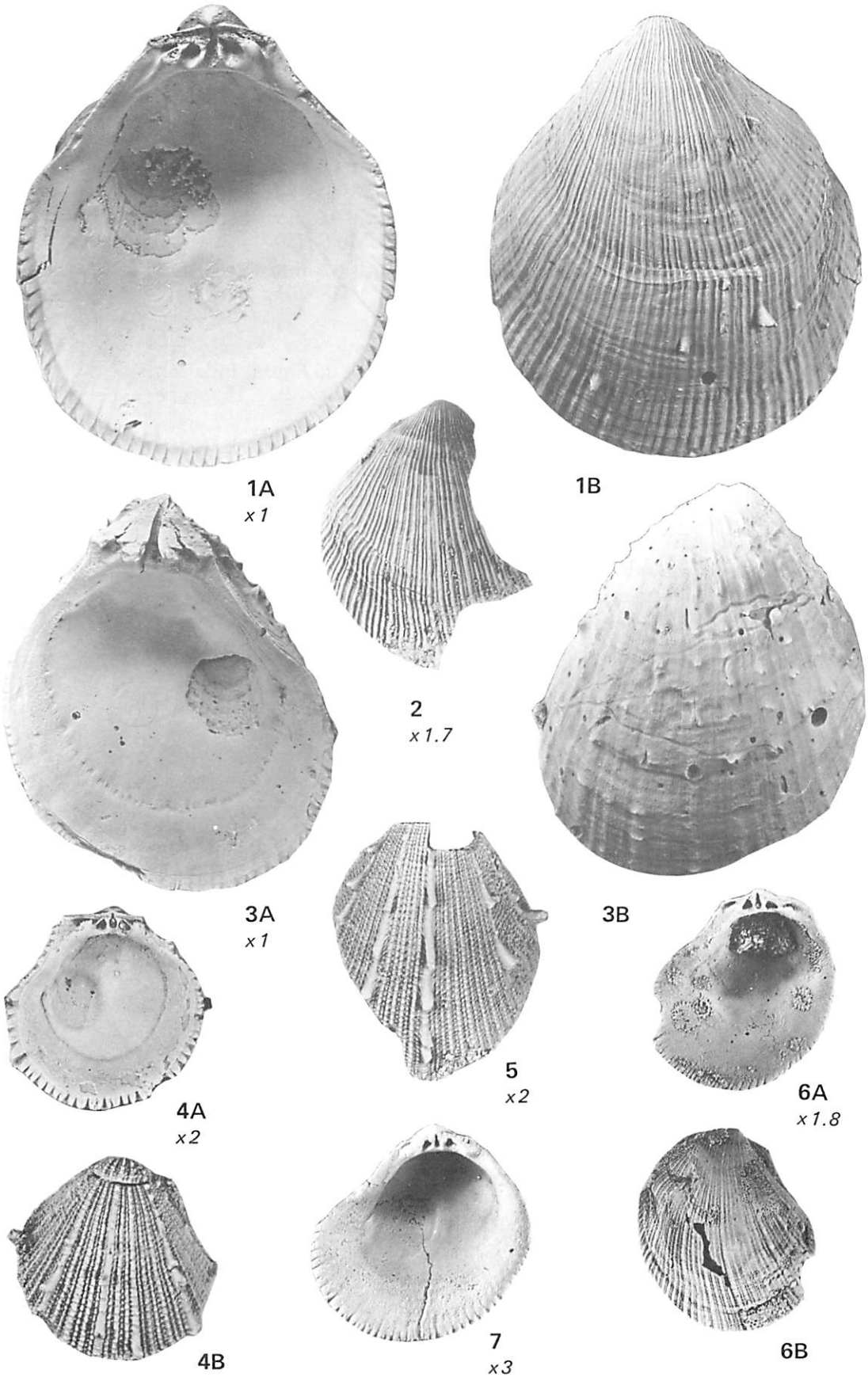
PLATE 14



EXPLANATION PLATE 15

Figure		Page
1-3,6-7	**Spondylus (Spondylus) filiaris** Dall, 1916	50-51
	1. Left valve; height 73.3 mm, length 61.0 mm, inflation 20.5 mm; Mint Spring Fm., USGS locality 6647a (probably = MGS locality 75b) USNM 340437.	
	2. Left valve; height (specimen incomplete) 27.0 mm; Mint Spring Fm., locality 75b. MGS 744.	
	3. Right valve; height 66.5 mm, length 55.0 mm, inflation 22.7 mm; Mint Spring Fm., USGS locality 6647a. USNM 340438.	
	6. Left valve; height 18.9 mm, length 17.0 mm, inflation 5.1 mm; Byram Fm., locality 93. MGS 746.	
	7. Left valve; height 17.5 mm, length 17.3 mm, inflation 5.2 mm; Mint Spring Fm., locality 74b. MGS 747.	
4-5	**Spondylus (Spondylus) granulocostatus** n. sp.	50
	4. Left valve; height 16.7 mm, length 16.4 mm, inflation 6.0 mm; Red Bluff Fm., Pelham Hill, St. Stephens limestone quarry, Washington Co., Alabama. Collected by H. E. and E. H. Vokes. Holotype USNM 340439.	
	5. Right valve; height (incomplete) 22.0 mm; Red Bluff Fm., same locality as figure 4. MGS 745.	

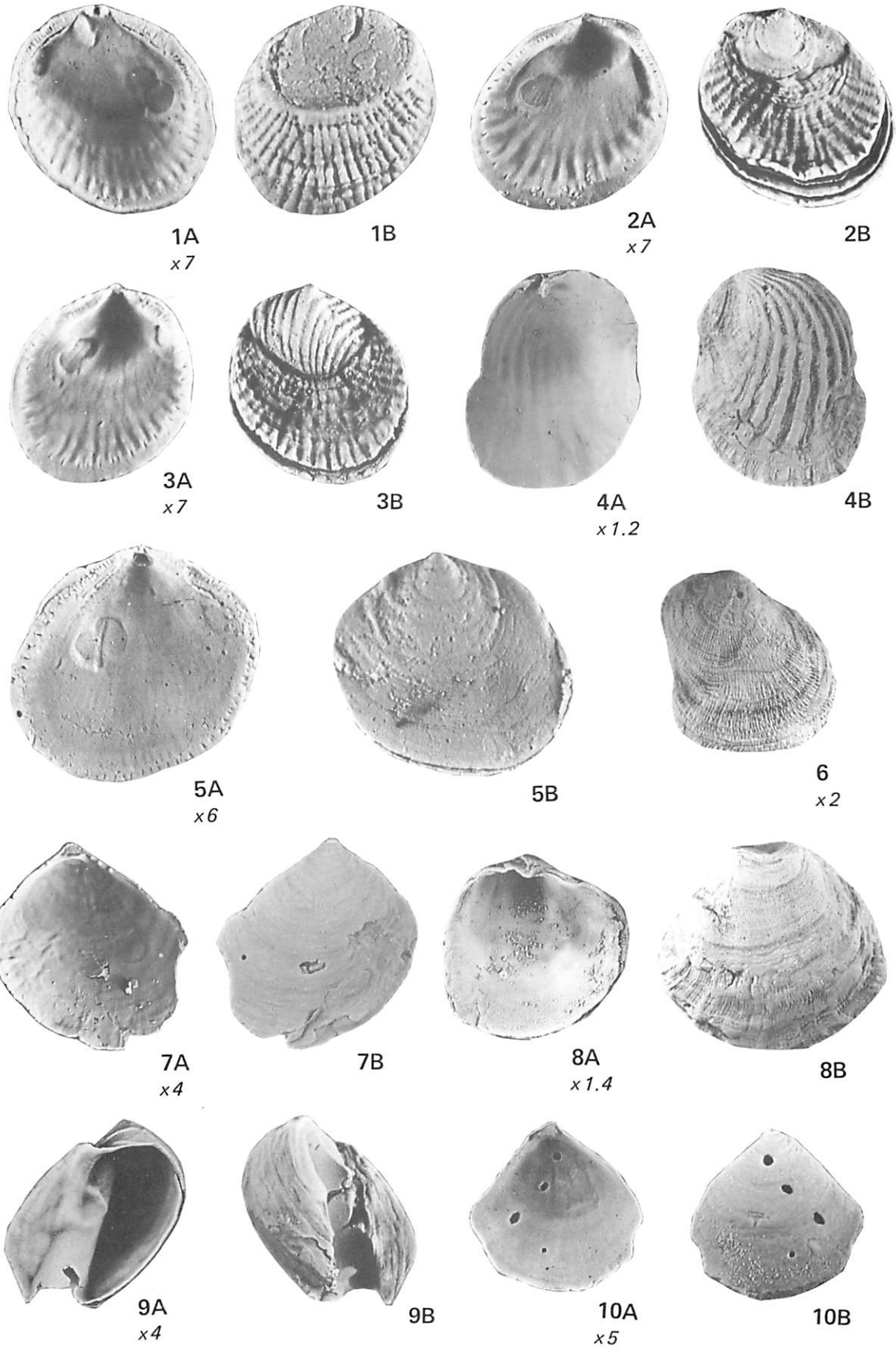
PLATE 15



EXPLANATION PLATE 16

Figure		Page
1-3,5	**Dimya rufaripa** H. E. Vokes, 1979	51-52
	1. Right valve; height 5.0 mm, length 4.6 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 748.	
	2. Left valve; height 4.6 mm, length 4.1 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 749.	
	3. Left valve; height 4.4 mm, length 4.0 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 750.	
	5. Left valve; height 6.3 mm, length 6.3 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 751.	
4,6,8	**Anomia microstriata** n. sp.	52
	4. Left valve; height 29.4 mm, length 25.6 mm, inflation 8.0 mm; Mint Spring Fm., locality 99. Holotype USNM 340440.	
	6. Left valve; height 14.4 mm, length 15.6 mm, inflation 3.8 mm;Mint Spring Fm., locality 99. MGS 752.	
	8. Left valve; height 22.0 mm, length 22.0 mm, inflation 7.0 mm; Mint Spring Fm., locality 100. MGS 1095.	
7,9-10	**Ostrea** sp.	53
	7. Right valve; height 8.5 mm, length 8.2 mm; Byram Fm., locality 93. MGS 754.	
	9. Left valve; height 9.0 mm, length 7.0 mm, inflation 3.2 mm; Byram Fm., locality 93. MGS 753.	
	10. Right valve; height 6.1 mm, length 6.1 mm; Byram Fm., locality 109. MGS 1099.	

PLATE 16

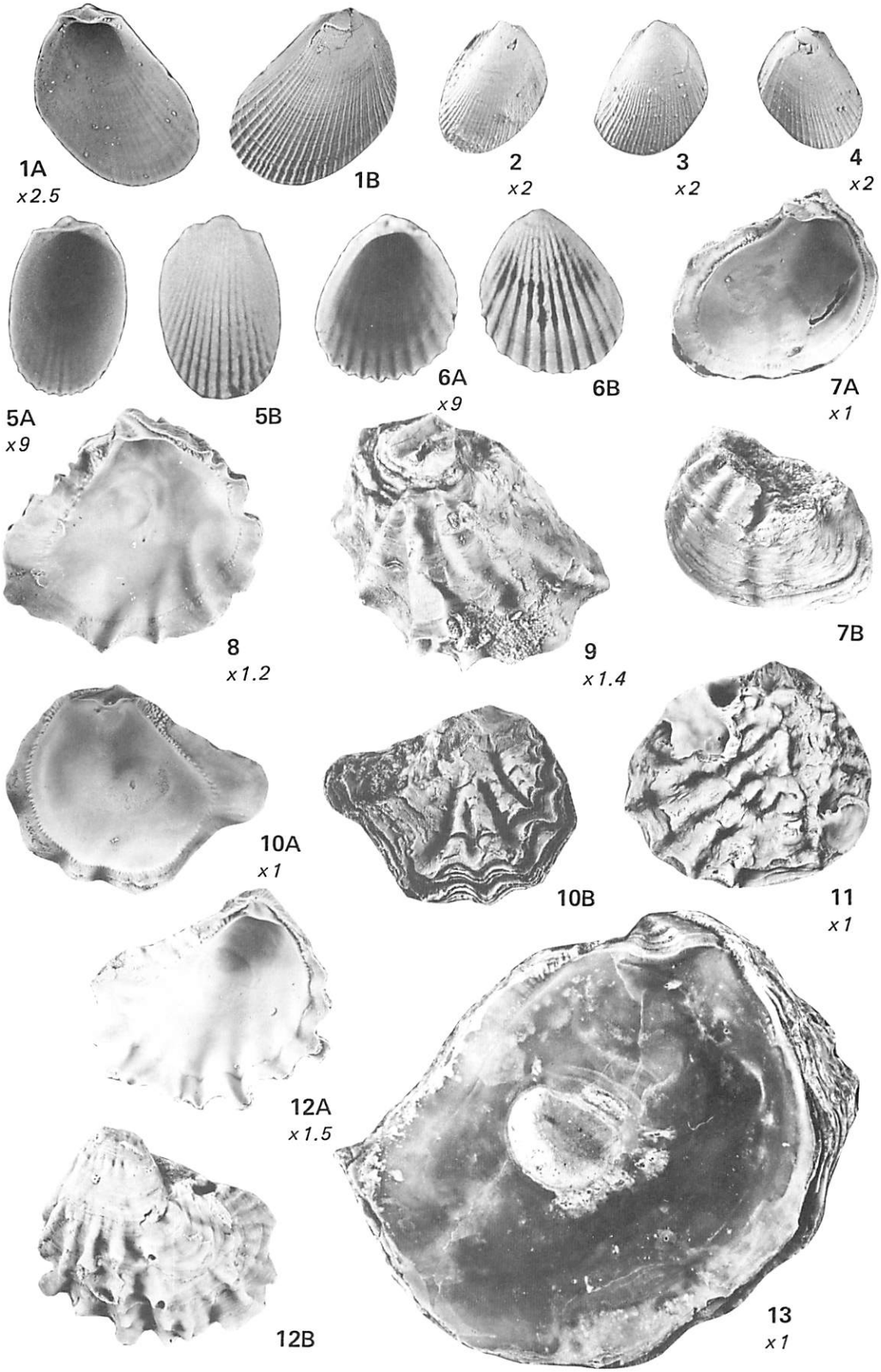


1A x7
1B
2A x7
2B
3A x7
3B
4A x1.2
4B
5A x6
5B
6 x2
7A x4
7B
8A x1.4
8B
9A x4
9B
10A x5
10B

EXPLANATION PLATE 17

Figure		Page
1-5	**Limaria (Limaria) staminea** (Conrad, 1848)	52
	1. Left valve; height 11.8 mm, length 10.8 mm, inflation 2.7 mm; Mint Spring Fm., locality 100. MGS 755.	
	2. Left valve; height 10.5 mm, length 9.6 mm; Vicksburg, Mississippi. Syntype B, ANSP 30656.	
	3. Left valve; height 10.6 mm, length 9.2 mm; Vicksburg, Mississippi. Syntype A, ANSP 30656.	
	4. Right valve; height 9.7 mm, length 8.9 mm; Vicksburg, Mississippi. Syntype C, ANSP 30656.	
	5. Right valve; height 3.3 mm, length 2.2 mm; Byram Fm., locality 94. MGS 756. Young individual.	
6	**Limaria** sp.	53
	Right valve; height 3.0 mm, length 2.7 mm; Forest Hill Fm., locality 75a. MGS 757.	
7-12	**Lopha (Lopha) vicksburgensis** (Conrad, 1848)	53-55
	7. Left valve; height 30.0 mm, length 34.5 mm, inflation 16.0 mm; Vicksburg, Mississippi. Holotype ANSP 30645.	
	8. Left valve; height 33.0 mm, length 38.0 mm, inflation 16.0 mm; Mint Spring Fm., locality 74b. MGS 758.	
	9. Left valve; height 34.3 mm, length 28.2 mm, inflation 9.6 mm; Marianna Ls., locality 42. MGS 391.	
	10. Right valve; height 34.7 mm, length 43.7 mm, inflation 10.7 mm; Byram Fm., locality 93. MGS 759.	
	11. Right valve; height 38.5 mm, length 40.0 mm, inflation 8.2 mm; Byram Fm., locality 106. MGS 760.	
	12. Left valve; height 26.0 mm, length 27.0 mm, inflation 8.7 mm; Red Bluff Fm., locality 40. MGS 383.	
13	**Ostrea paroxis** Lesueur, manuscript	53
	Left valve; height 78.0 mm, length 87.0 mm; Mint Spring Fm., locality 99. MGS 761. Holotype USNM 340441.	

PLATE 17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x2.5
1B
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x2
3
x2
4
x2
5A
x9
5B
6A
x9
6B
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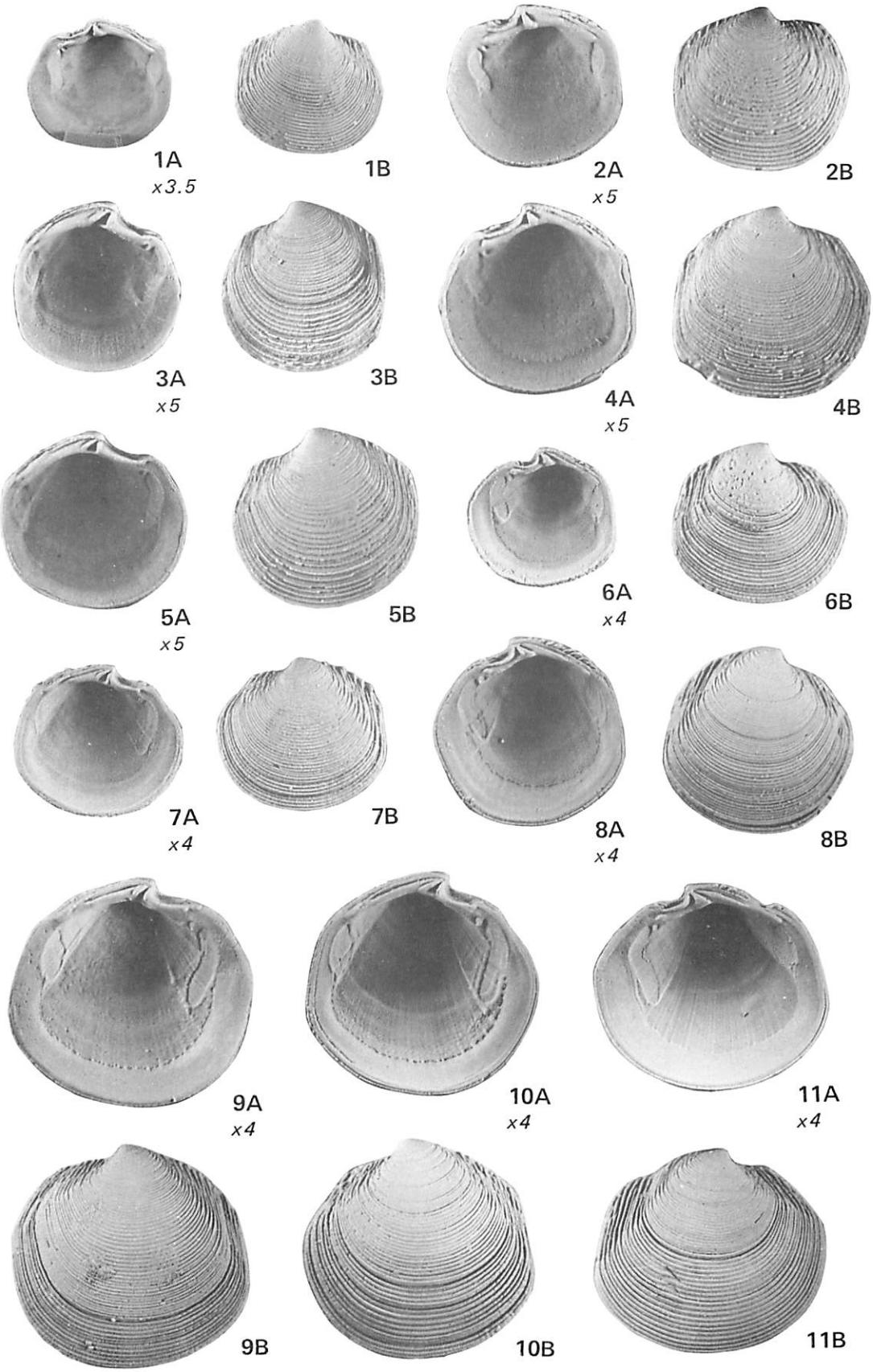
x1
7B
8
x1.2
9
x1.4
10A
x1
10B
11
x1
12A
x1.5
12B
13
x1

EXPLANATION PLATE 18

Figure		Page
1-5	**Myrtea (Myrtea) scopularis** (Casey, 1903)	58
	1. Right valve; height 6.2 mm, length 6.7 mm, inflation 1.8 mm; Red Bluff Fm., Red Bluff, Mississippi. Holotype USNM 481671.	
	2. Right valve; height 5.0 mm, length 5.4 mm, inflation 1.4 mm; Red Bluff Fm., locality 37. MGS 761.	
	3. Left valve; height 5.4 mm, length 5.2 mm, inflation 1.6 mm; Red Bluff Fm., locality 37. MGS 762.	
	4. Right valve; height 6.0 mm, length 5.3 mm, inflation 1.5 mm ; Red Bluff Fm., locality 37. MGS 763.	
	5. Left valve; height 5.7 mm, length 5.9 mm, inflation 1.5 mm; Red Bluff Fm., locality 37. MGS 764.	
6-11	**Myrtea (Myrtea) vicksburgensis** (Casey, 1903)	58-59
	6. Right valve; height 5.4 mm, length 5.9 mm, inflation 1.4 mm; Mint Spring Fm., locality 108. MGS 765.	
	7. Left valve; height 6.0 mm, length 6.7 mm, inflation 1.5 mm; Mint Spring Fm., locality 108. MGS 766.	
	8. Right valve; height 7.5 mm, length 7.5 mm, inflation 1.9 mm; Mint Spring Fm., locality 99. MGS 767.	
	9. Left valve; height 9.1 mm, length 9.6 mm, inflation 2.1 mm; Mint Spring Fm., locality 99. MGS 768.	
	10. Left valve; height 8.9 mm, length 9.3 mm, inflation 2.2 mm; Mint Spring Fm., locality 99. MGS 769.	
	11. Right valve; height 8.1 mm, length 9.3 mm, inflation 1.9 mm; Mint Spring Fm., locality 99. MGS 770.	

PLATE 18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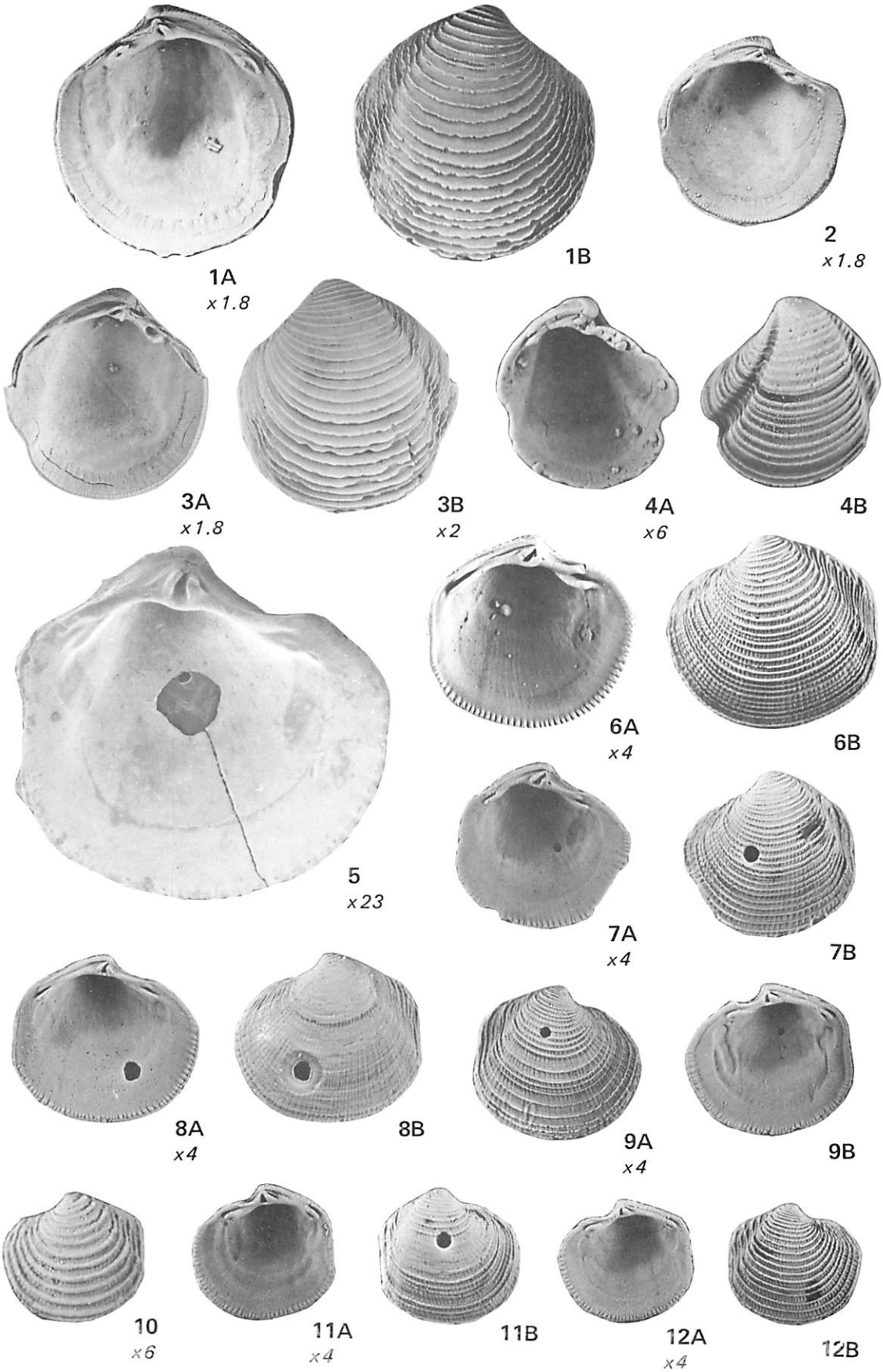
EXPLANATION PLATE 19

Figure		Page
1-3	**Lucina (Lucina) fimbripallium** n. sp.	55
	1. Right valve; height 23.6 mm, length 22.4 mm, inflation 7.9 mm ; Byram Fm., locality 106 . MGS 771.	
	2. Left valve; height 17.4 mm, length 16.6 mm, inflation 6.1 mm; Mint Spring Fm., USGS locality 14071a. Holotype USNM 340442.	
	3. Left valve; height 17.8 mm, length 16.1 mm, inflation 6.1 mm; Byram Fm., locality 106. MGS 772.	
4	**Lucina (Cavilinga) triloba** n. sp.	56-57
	Left valve; height 5.0 mm, length 4.6 mm, inflation 1.8 mm; Mint Spring Fm., locality 99. Holotype USNM 340445.	
5-12	**Lucina (Lucinisca) varisculpta** n. sp.	58
	5. Left valve; height 2.6 mm, length 2.8 mm; Mint Spring Fm., locality 99. MGS 773. SEM photograph by E. E. Russell.	
	6. Left valve; height 7.7 mm, length 8.4 mm, inflation 2.4; Byram Fm., locality 93. MGS 774.	
	7. Left valve; height 6.7 mm, length 7.1 mm, inflation 2.0 mm; Mint Spring Fm., locality 99. MGS 775.	
	8. Left valve; height 6.8 mm, length 7.5 mm, inflation 1.5 mm; Mint Spring Fm., locality 99. MGS 776.	
	9. Right valve; height 6.1 mm, length 6.7 mm, inflation 1.7 mm; Mint Spring Fm., locality 99. Holotype USNM 340446.	
	10. Right valve; height 3.3 mm, length 3.7 mm, inflation 0.9 mm; Mint Spring Fm., locality 108. MGS 778.	
	11. Right valve; height 5.5 mm, length 5.6 mm, inflation 1.6 mm; Mint Spring Fm., locality 99. MGS 779.	
	12. Right valve; height 4.9 mm, length 5.3 mm, inflation 1.3 mm; Mint Spring Fm., locality 99. MGS 780.	

PLATE 19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11A
x 4
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12A
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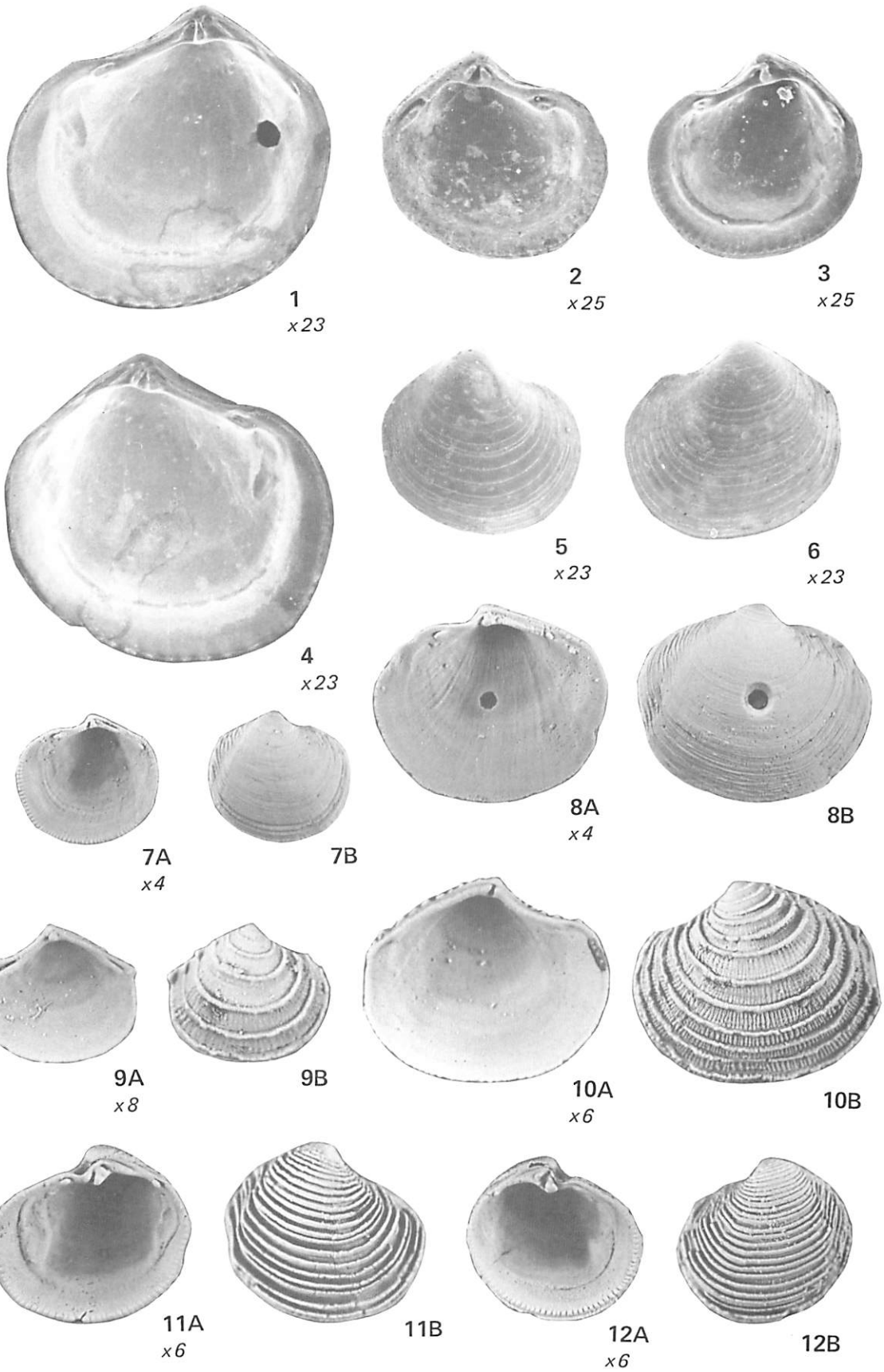
12B

EXPLANATION PLATE 20

Figure		Page
1-7	**Lucina (Parvilucina) posteocurta** n. sp.	56
	1. Right valve; height 2.2 mm, length 2.4 mm; Mint Spring Fm., locality 99. MGS 786. SEM photograph by E. E. Russell.	
	2. Left valve; height 1.4 mm, length 1.5 mm; Byram Fm., locality 106. MGS 781. SEM photograph by E. E. Russell.	
	3. Right valve; height 1.4 mm, length 1.4 mm; Byram Fm., locality 106. MGS 782. SEM photograph by E. E. Russell.	
	4. Left valve; height 2.3 mm, length 2.4 mm; Mint Spring Fm., locality 99. MGS 783. SEM photograph by E. E. Russell.	
	5. Left valve; height 1.4 mm, length 1.5 mm; Byram Fm., locality 106. SEM photograph by E. E. Russell.	
	6. Right valve; height 1.4 mm, length 1.5 mm; Byram Fm., locality 106. SEM photograph by E. E. Russell.	
	7. Right valve; height 5.1 mm, length 5.5 mm, inflation 1.4 mm; Mint Spring Fm., locality 99. Holotype USNM 340443.	
8	**Lucina** sp.	56
	Right valve; height 8.0 mm, length 9.3 mm, inflation 2.3 mm; Mint Spring Fm., locality 99. MGS 1092.	
9-10	**Tellidorella interlacinia** n. sp.	60
	9. Right valve; height 2.7 mm, length 3.0 mm; Mint Spring Fm., locality 90. MGS 787.	
	10. Left valve; height 5.4 mm, length 6.5 mm, inflation 1.5 mm; Mint Spring Fm., locality 90. Holotype USNM 340460.	
11-12	**Lucina (Cavilinga) imbricolamella** n. sp.	56
	11. Right valve; height 4.6 mm, length 5.2 mm, inflation 1.9 mm; Mint Spring Fm., locality 100. Holotype USNM 340444.	
	12. Left valve; height 4.2 mm, length 4.5 mm, inflation 1.6 mm; Mint Spring Fm., locality 100. MGS 788.	

PLATE 20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12A
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EXPLANATION PLATE 21

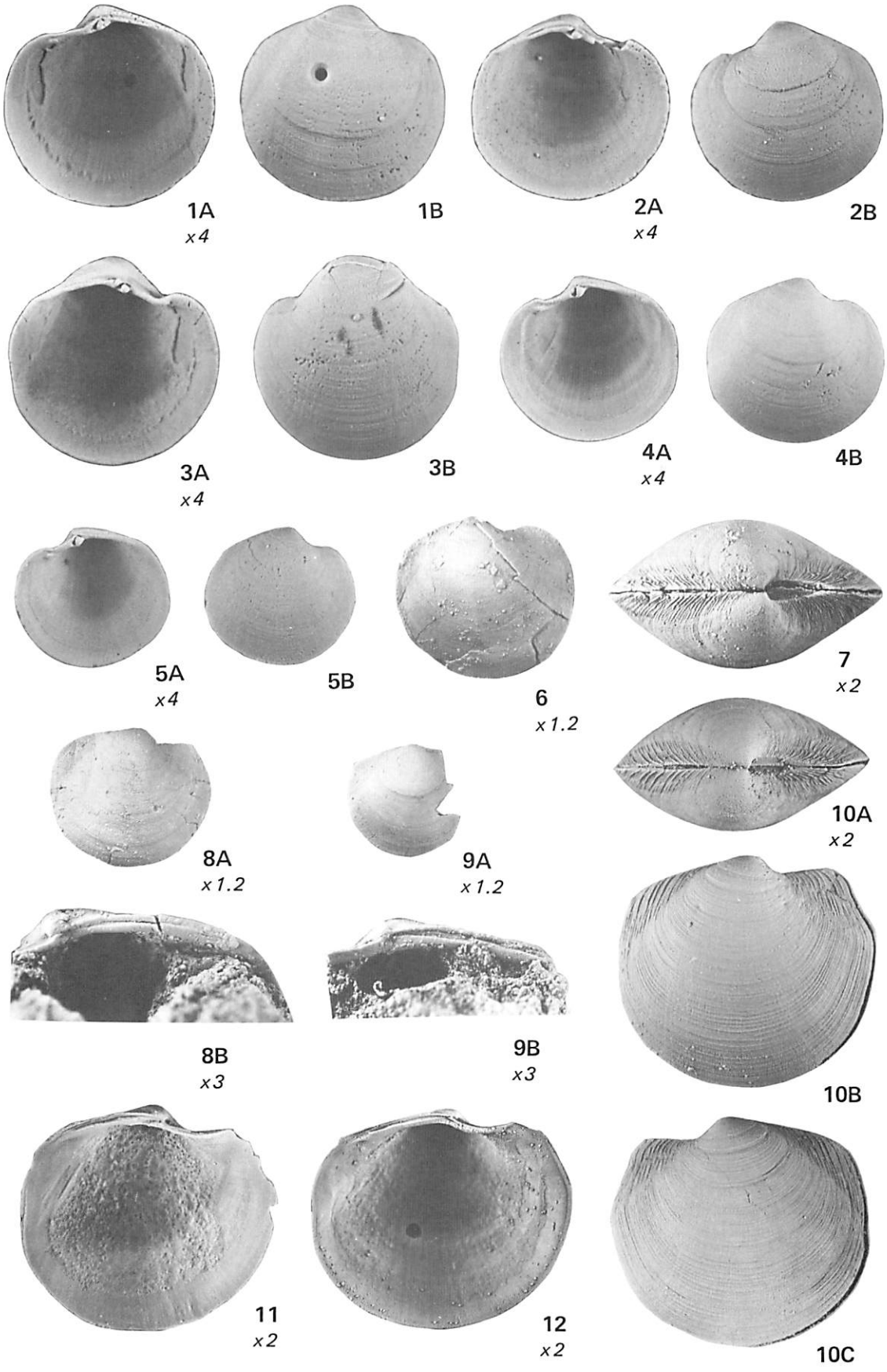
Figure		Page
1-5	**Lucina (Callucina) choctavensis** Meyer, 1886	55-56

1. Right valve; height 8.1 mm, length 8.4 mm, inflation 3.0 mm; Mint Spring Fm., locality 100. MGS 1096.
2. Left valve; height 7.3 mm, length 7.8 mm, inflation 2.8 mm; Mint Spring Fm., locality 100. MGS 789.
3. Left valve; height 8.2 mm, length 8.5 mm, inflation 3.8 mm; Mint Spring Fm., locality 99. MGS 790.
4. Right valve; height 6.6 mm, length 7.2 mm, inflation 2.3 mm; Mint Spring Fm., locality 99. MGS 791.
5. Right valve; height 5.6 mm, length 6.2 mm, inflation 2.0 mm; Mint Spring Fm., locality 100. MGS 792.

6-12	**Anadontia (Anadontia) mississippiensis** (Conrad, 1848)	59-60

6. Right valve; height 22.7 mm, length 25.0 mm, inflation 7.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 30658.
7. Both valves showing hinge; height 19.4 mm, length 23.2 mm, inflation of both valves 12.6 mm; Mint Spring Fm., locality 100. MGS 792.
8. Right valve; height 19.0 mm, length 21.5 mm; inflation 6.0 mm; Vicksburg, Mississippi. Syntype A, ANSP 30658.
9. Right valve (incomplete); height 14.5 mm; Vicksburg, Mississippi. Syntype C, ANSP 30658.
10. Both valves; height 19.2 mm, length 21.3 mm, inflation of both valves 11.0 mm; Mint Spring Fm., locality 99. MGS 794.
11. Left valve; height 19.1, length 21.2 mm, inflation 6.4 mm; Mint Spring Fm., locality 99. MGS 795.
12. Left valve; height 18.3 mm, length 21.5 mm, inflation 6.1 mm; Mint Spring Fm., locality 99. MGS 796.

PLATE 21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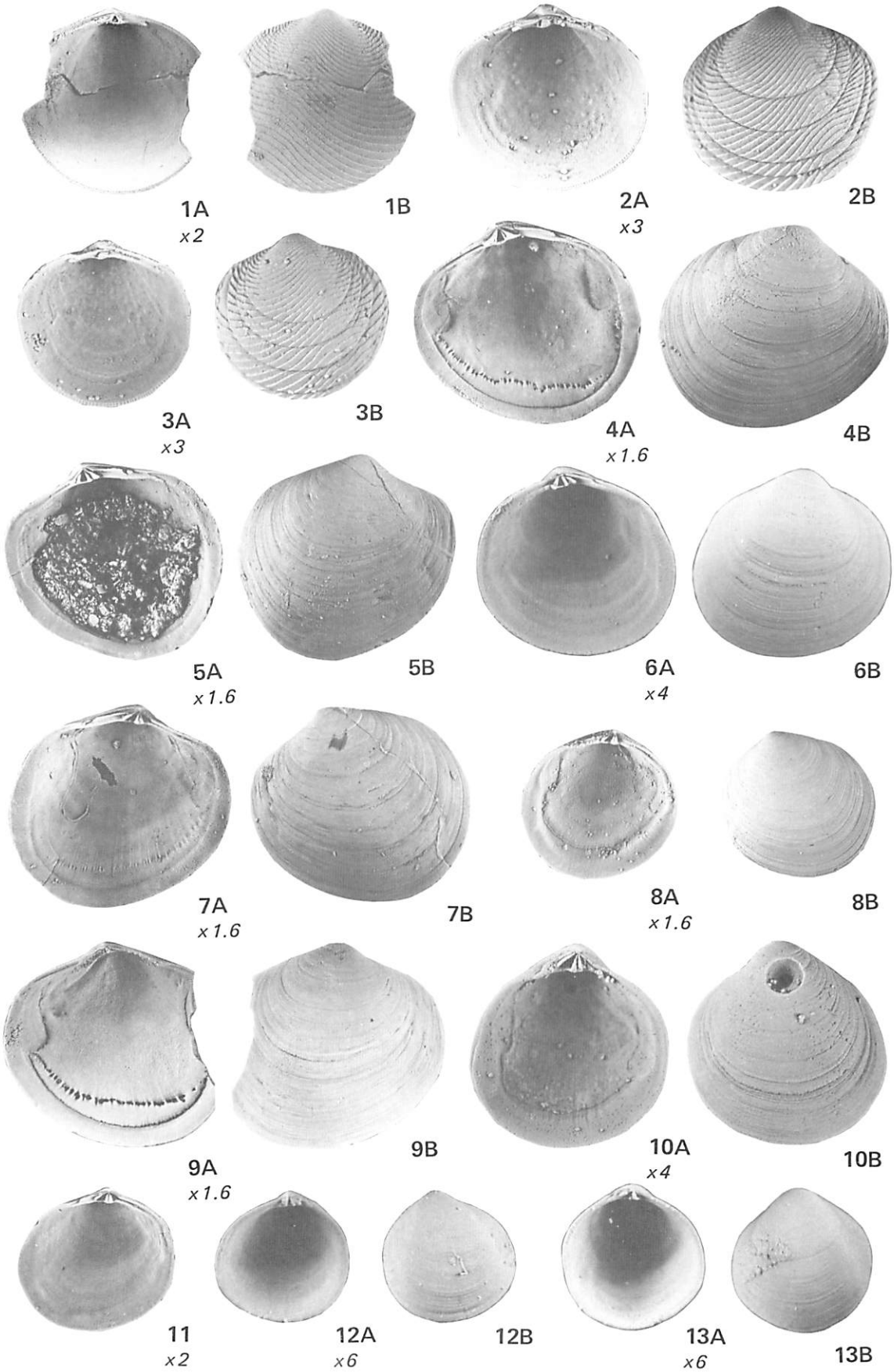
x2
12
x2
10C

EXPLANATION PLATE 22

Figure		Page
1-3	**Divaricella (Divalinga) subrigaultiana** (Meyer, 1886)	60
	1. Right valve (incomplete); height 15.6 mm; Mint Spring Fm., Vicksburg, Mississippi. Holotype USNM 644599.	
	2. Left valve; height 10.2 mm, length 10.9 mm, inflation 3.4 mm; Mint Spring Fm., locality 99. MGS 797.	
	3. Left valve; height 9.1 mm, length 9.6 mm, inflation 3.0 mm; Mint Spring Fm., locality 99. MGS 798.	
4-9,11-13	**Diplodonta (Diplodonta) eburnea** (Conrad, 1848)	60-61
	4. Right valve; height 21.9 mm, length 24.0 mm, inflation 6.6 mm; Byram Fm., locality 93. MGS 799.	
	5. Right valve; height 21.6 mm, length 22.8 mm, inflation 6.2 mm; Byram Fm., locality 93. MGS 800.	
	6. Right valve; height 7.8 mm, length 8.1 mm, inflation 2.6 mm; Mint Spring Fm., locality 99. MGS 801.	
	7. Left valve; height 21.1 mm, length 22.7 mm, inflation 5.8 mm; Byram Fm., locality 93. MGS 802.	
	8. Left valve; height 15.7 mm, length 16.4 mm, inflation 4.0 mm; Byram Fm., locality 108. MGS 803.	
	9. Right valve (specimen incomplete with cardinals missing); height 21.5 mm, inflation 6.5 mm; Mint Spring Fm., locality 100. MGS 804.	
	11. Left valve; height 11.9 mm, length 13.2 mm, inflation 3.1 mm; Byram Fm., locality 93. MGS 806.	
	12. Right valve; height 3.3 mm, length 3.4 mm, inflation 1.0 mm; Mint Spring Fm., locality 108. MGS 807. Young individual.	
	13. Left valve; height 3.7 mm, length 3.7 mm, inflation 1.3 mm; Mint Spring Fm., locality 108. MGS 808. Young individual.	
10	**Felaniella (Felaniella) compacta** n. sp.	61
	Left valve; height 8.3 mm, length 8.1 mm, inflation 2.6 mm; Mint Spring Fm., locality 111. Holotype USNM 340448.	

PLATE 22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x2
12A
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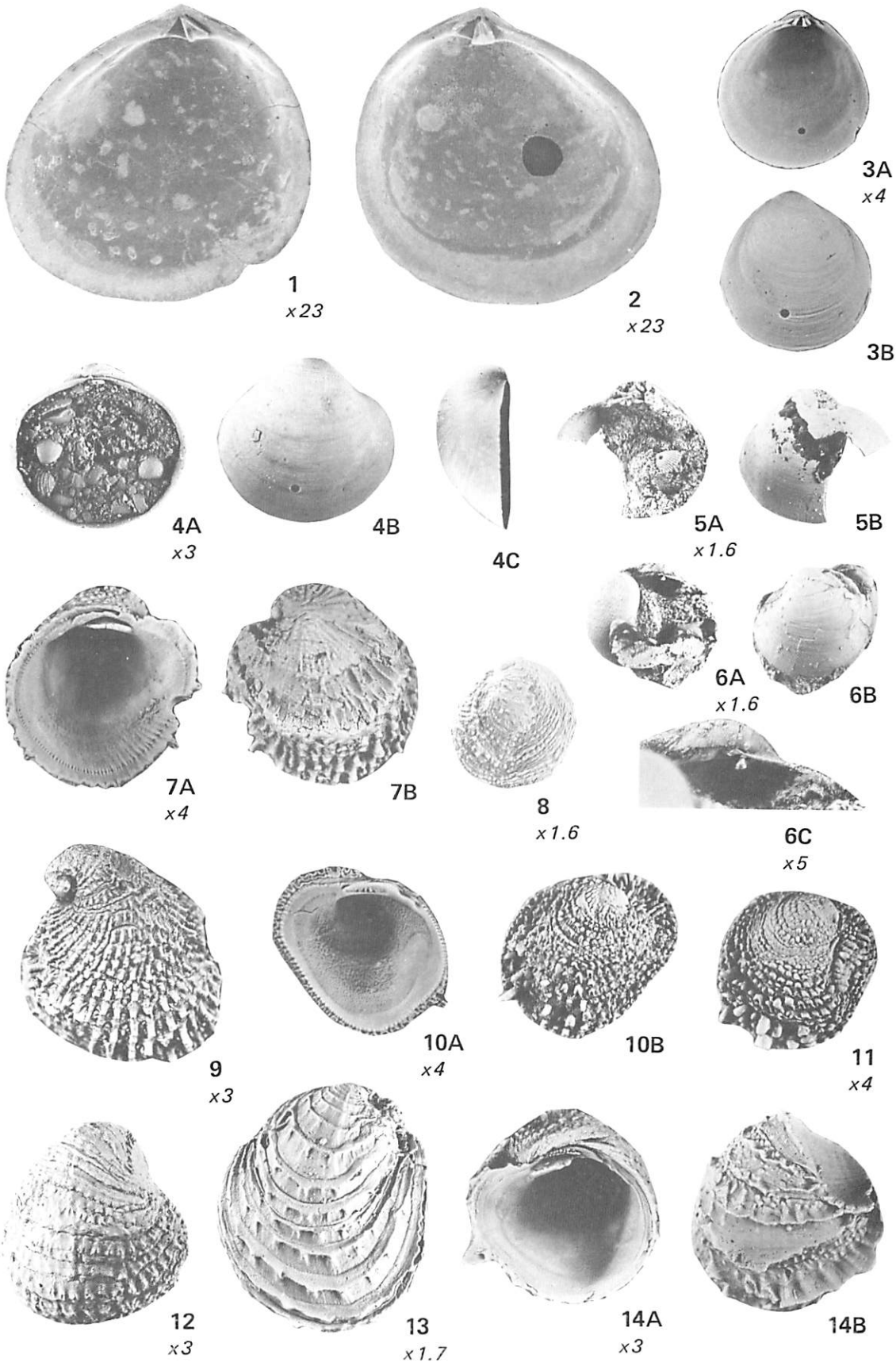
12B
13A
x6
13B

EXPLANATION PLATE 23

Figure		Page
1-3	**Diplodonta (Diplodonta) elatia** n. sp.	61
	1. Left valve; height 2.2 mm, length 2.2; Mint Spring Fm., locality 108. MGS 809. SEM photograph by E. E. Russell.	
	2. Right valve; height 2.2 mm, length 2.3 mm; Mint Spring Fm., locality 108. MGS 810. SEM photograph by E. E. Russell.	
	3. Left valve; height 6.4 mm, length 6.0 mm, inflation 1.7 mm; Byram Fm., locality 93. Holotype USNM 340447.	
4-6	**Timothynus turgida** (Conrad, 1848)	61
	4. Right valve; height 8.9 mm, length 9.5 mm, inflation 3.9 mm; Byram Fm., locality 93. MGS 812.	
	5. Right valve (specimen incomplete); height 14.2 mm, inflation 6.0 mm; Vicksburg, Mississippi. Holotype ANSP 30680.	
	6. Left valve; height 9.7 mm, length 11.0 mm, inflation 4.5 mm; Vicksburg, Mississippi. Paratype ANSP 30681.	
7-12	**Chama (Psilopus) mississippiensis** Conrad, 1848	62
	7. Left valve; height 8.3 mm, length 7.9 mm, inflation 3.2 mm; Byram Fm., locality 93. MGS 813.	
	8. Right valve; height 12.8 mm, length 13.4 mm, inflation 2.5 mm; Vicksburg, Mississippi. Holotype ANSP 30655.	
	9. Left valve; height 12.6 mm, length 10.6 mm, inflation 4.7 mm; Forest Hill Fm., locality 75a. MGS 814.	
	10. Right valve; height 6.8 mm, length 7.1 mm, inflation 2.2 mm; Byram Fm., locality 93. MGS 815.	
	11. Right valve; height 6.5 mm, length 6.7 mm, inflation 2.3 mm; Byram Fm., locality 93. MGS 816.	
	12. Left valve; height 23.0 mm, length 18.4 mm, inflation 10.7 mm; Forest Hill Fm., locality 75a. MGS 817.	
13	**Chama** sp.	62
	Right valve; height 24.3 mm, length 20.2 mm, inflation 8.3 mm; Forest Hill Fm., locality 75a. MGS 1097.	
14	**Chama (Chama) pappiladerma** n. sp.	61-62
	Left valve; height 11.6 mm, length 15.5 mm, inflation 5.5 mm; Red Bluff Fm., locality 37. MGS 818.	

PLATE 23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x1.7
14A
x3
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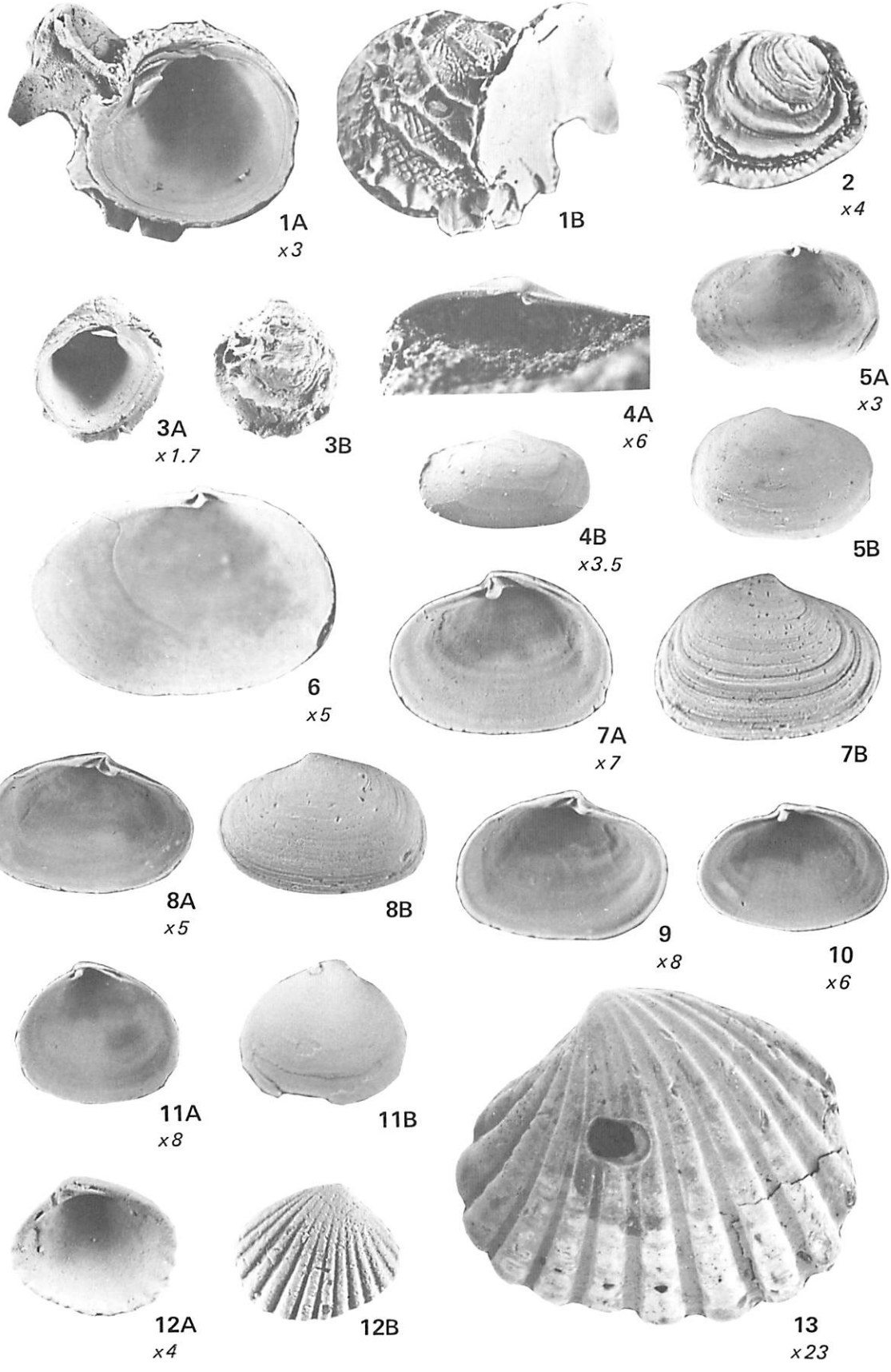
EXPLANATION PLATE 24

Figure		Page
1-3	**Chama (Chama) pappiladerma** n. sp.	61-62
	1. Left valve; height 11.3 mm, length (not including spines) 11.6 mm, inflation 5.6 mm; Red Bluff Fm., locality 37. Holotype USNM 340449.	
	2. Right valve; height 7.0 mm, length (not including spines) 7.5 mm, inflation 2.0; Red Bluff Fm., locality 38b. MGS 819.	
	3. Left valve; height (not including concentric lamina) 13.2 mm, length (not including concentric lamina) 11.7 mm, inflation 6.5 mm; Red Bluff Fm., locality 37. MGS 820.	
4-10	**Sportella oblonga** (Conrad, 1848)	64
	4. Left valve; height (compressed) 4.2 mm, length 7.7 mm, inflation 1.6 mm; Vicksburg, Mississippi. Holotype ANSP 30678.	
	5. Right valve; height 7.0 mm, length 9.8 mm, inflation 2.1 mm; Mint Spring Fm., USGS locality 14071a. USNM 340450.	
	6. Right valve; height 6.3 mm, length 9.3 mm, inflation 1.9 mm; Byram Fm., locality 106. MGS 821.	
	7. Right valve; height 3.7 mm, length 5.0 mm, inflation 0.7 mm; Mint Spring Fm., locality 100. MGS 822.	
	8. Left valve; height 4.5 mm, length 6.7 mm, inflation 1.2 mm; Byram Fm., locality 93. MGS 823.	
	9. Left valve; height 3.5 mm, length 5.1 mm; Byram Fm., locality 93. MGS 824.	
	10. Right valve; height 3.1 mm, length 4.4 mm; Byram Fm., locality 93. MGS 825.	
11	**Bornia tallahalaensis** n. sp.	62
	Right valve; height 3.0 mm, length 3.1 mm; Byram Fm., locality 93. Holotype USNM 340451.	
12-13	**Carditella aldrichi** (Casey, 1903)	64
	12. Right valve; height 5.0 mm, length 5.6 mm, inflation 1.5 mm; Mint Spring Fm., Vicksburg, Mississippi. Holotype USNM 646501.	
	13. Left valve; height 2.4 mm, length 2.9 mm; Mint Spring Fm., locality 108. MGS 826. SEM photograph by E. E. Russell.	

PLATE 24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12A
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12B
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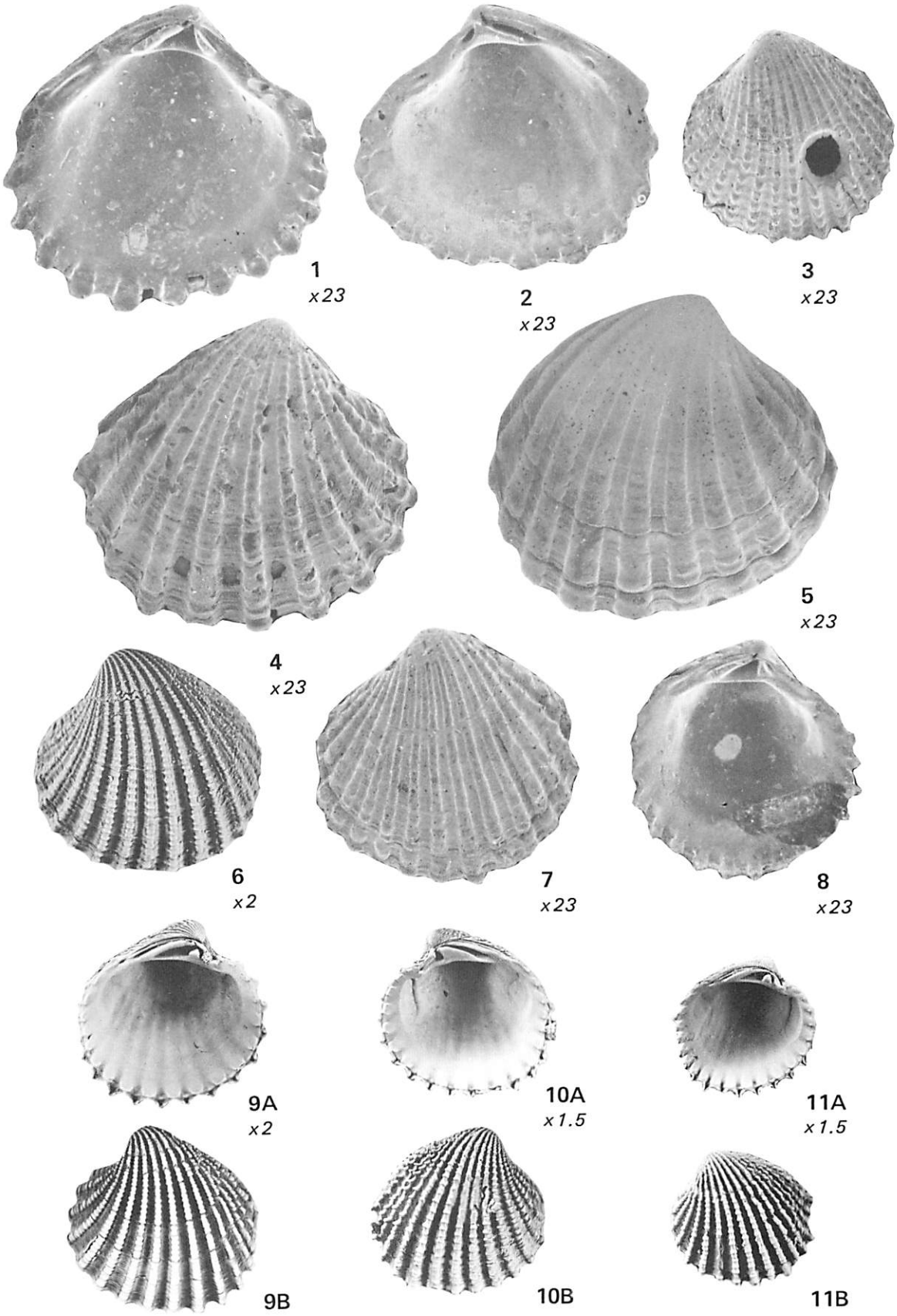
x23

EXPLANATION PLATE 25

Figure		Page
1-5,7	**Carditella aldrichi** (Casey, 1903)	64
	1. Left valve; height 2.3 mm, length 2.4; Mint Spring Fm., locality 108. MGS 827. SEM photograph by E. E. Russell.	
	2. Right valve; height 2.0, length 2.3 mm; Mint Spring Fm., locality 108. MGS 828. SEM photograph by E. E. Russell.	
	3. Left valve; height 1.6 mm, length 1.6 mm; Byram Fm., locality 93. MGS 829. SEM photograph by E. E. Russell.	
	4. Right valve; height 2.3 mm, length 2.6 mm; Mint Spring Fm., locality 108. MGS 830. SEM photograph by E. E. Russell.	
	5. Right valve; height 2.3 mm, length 2.6 mm; Mint Spring Fm., locality 108. MGS 831. SEM photograph by E. E. Russell.	
	7. Left valve; height 1.9 mm, length 2.0 mm; Mint Spring Fm., locality 108. MGS 833. SEM photograph by E. E. Russell.	
6,8-11	**Venericardia (Rotundicardia) carsonensis** Dall, 1903	64-65
	6. Left valve; height 19.1 mm, length 19.3 mm, inflation 6.6 mm; Mint Spring Fm., locality 108. MGS 832.	
	8. Left valve (juvenile); height 1.8 mm, length 1.7 mm; Mint Spring Fm., locality 108. MGS 834. SEM photograph by E. E. Russell.	
	9. Left valve; height 16.2 mm, length 16.2 mm, inflation 6.0; Red Bluff Fm., locality 38b. MGS 373.	
	10. Right valve; height 19.2 mm, length 19.7 mm, inflation 7.1 mm; Red Bluff Fm., USGS locality 14721 = MGS locality 38b. USNM 340452.	
	11. Left valve; height 16.0 mm, length 16.0 mm, inflation 6.0 mm; Red Bluff Fm., USGS locality 14721 = MGS locality 38b. USNM 340453.	

PLATE 25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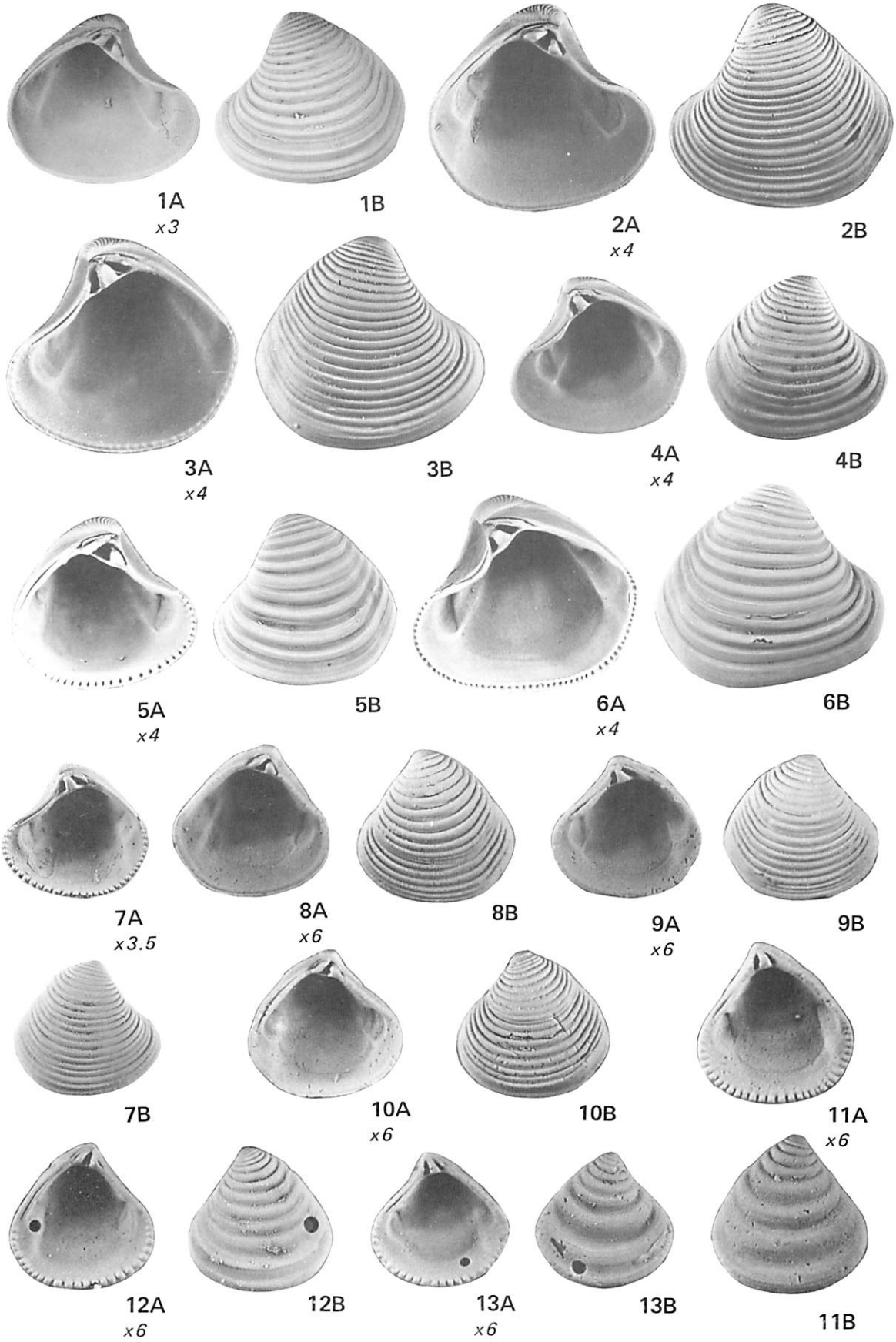
EXPLANATION PLATE 26

Figure		Page
1-7	**Astarte triangulata** Meyer, 1886	65
	1. Left valve; height 9.6 mm, length 10.7 mm, inflation 3.5 mm; Byram Fm., locality 106. MGS 835.	
	2. Left valve; height 8.6 mm, length 9.3 mm, inflation 3.2 mm; Red Bluff Fm., locality 37. MGS 836.	
	3. Right valve; height 9.2 mm, length 9.7 mm, inflation 3.2 mm; Red Bluff Fm., locality 37. MGS 837.	
	4. Right valve; height 6.8 mm, length 7.4 mm, inflation 2.3 mm; Red Bluff Fm., locality 37. MGS 838.	
	5. Left valve; height 7.3 mm, length 7.5 mm, inflation 3.0 mm; Red Bluff Fm., locality 38b. MGS 375.	
	6. Right valve; height 8.7 mm, length 9.7 mm, inflation 3.6 mm; Red Bluff Fm., locality 38b. MGS 376.	
	7. Right valve; height 6.5 mm, length 7.0 mm, inflation 2.2 mm; Red Bluff Fm., Red Bluff, Mississippi. Holotype USNM 644598.	
8-10	**Astarte menthifontis** n. sp.	66
	8. Left valve; height 4.1 mm, length 4.1 mm, inflation 1.4 mm; Mint Spring Fm., locality 99. Holotype USNM 340454.	
	9. Right valve; height 3.7 mm, length 3.8 mm, inflation 1.1 mm; Mint Spring Fm., locality 99. MGS 840.	
	10. Left valve; height 3.9 mm, length 4.1 mm, inflation 1.2 mm; Mint Spring Fm., locality 99. MGS 841.	
11-13	**Astarte planilamella** n. sp.	66
	11. Right valve; height 4.2 mm, length 4.0 mm, inflation 0.9 mm; Mint Spring Fm., locality 108. Holotype USNM 340455.	
	12. Left valve; height 3.9 mm, length 3.7 mm, inflation 0.8 mm; Mint Spring Fm., locality 108. MGS 842.	
	13. Right valve; height 3.6 mm, length 3.7 mm, inflation 0.7 mm; Mint Spring Fm., locality 108. MGS 843.	

PLATE 26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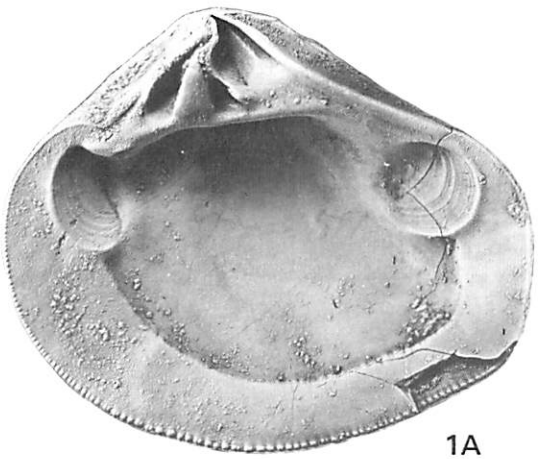
EXPLANATION PLATE 27

Figure		Page
1-4	**Crassatella (Crassatella) mississippiensis** Conrad, 1848	66-67

1. Right valve; height 55.5 mm, length 65.5 mm, inflation 18.5 mm; Byram Fm., Vicksburg, Mississippi. Holotype ANSP 30664.
2. Right valve; height 63.0 mm, length 75.5 mm; Byram Fm., Vicksburg, Mississippi. Paratype B, ANSP 30665.
3. Left valve; height 44.0 mm, length 60.5 mm; Byram Fm., Vicksburg, Mississippi. Paratype C, ANSP 30665.
4. Both valves; height 40.0 mm, length 52.0 mm, inflation of both valves 24.0 mm; Byram Fm., Vicksburg, Mississippi. Paratype D, ANSP 30665.

PLATE 27



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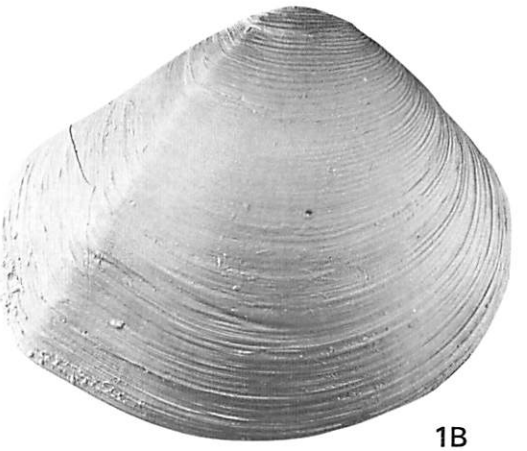
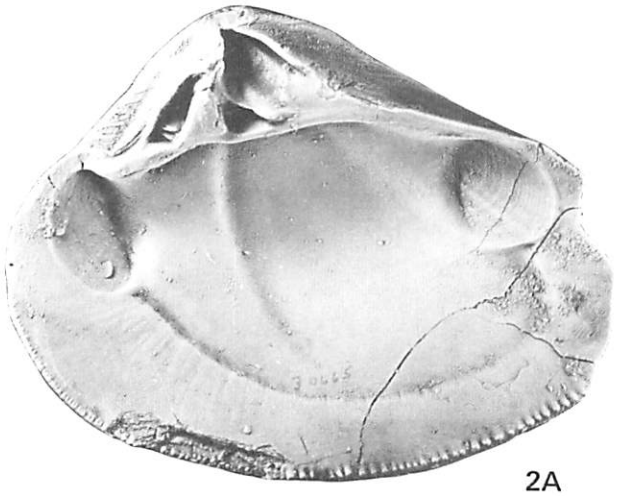
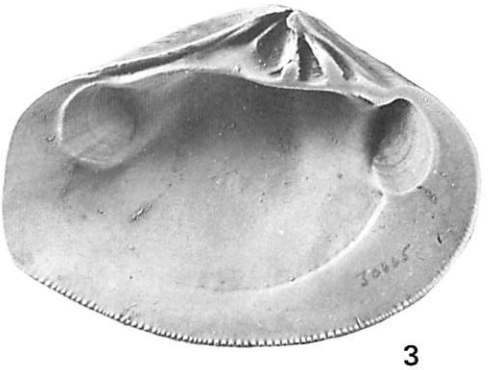


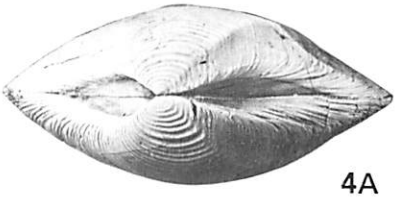
1B



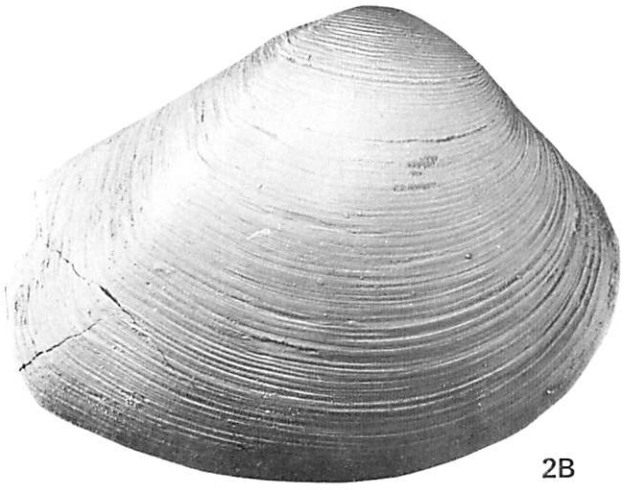
2A
x 1



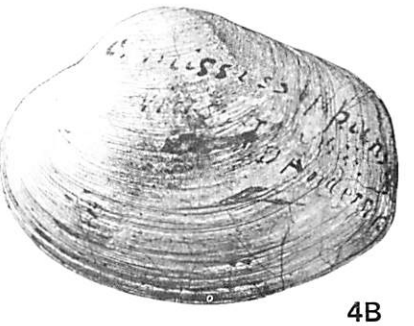
3
x 1



4A
x 1



2B



4B

EXPLANATION PLATE 28

Figure		Page
1-6	**Crassatella (Crassatella) mississippiensis** Conrad, 1848	66
	1. Left valve; height 16.8 mm, length 20.7 mm, inflation 4.1 mm; Byram Fm., locality 109. MGS 844.	
	2. Right valve; height 18.6 mm, length 21.1 mm, inflation 4.5 mm; Byram Fm., locality 109. MGS 845.	
	3. Left valve; height 19.1 mm, length 20.6 mm, inflation 4.8 mm; Byram Fm., locality 93. MGS 846.	
	4. Both valves; height 18.0 mm, length 23.0 mm, inflation of both valves 8.2 mm; Byram Fm., Vicksburg, Mississippi. Paratype E, ANSP 30665.	
	5. Left valve; height 40.0 mm, length 49.1 mm, inflation 15.4 mm; Byram Fm., locality 109. MGS 847.	
	6. Left valve; height 39.5 mm, length 51.1 mm, inflation 13.0 mm; Byram Fm., locality 109. MGS 848.	
7-9	**Crassatella (Crassatella) mississippiensis megacostata** n. subsp. ..	67
	7. Left valve; height 47.1 mm, length 62.7 mm, inflation 15.2 mm; Mint Spring Fm., locality 100. Holotype USNM 340456. MGS 849.	
	8. Right valve; height 50.3 mm, length 61.5 mm, inflation 17.0 mm; Mint Spring Fm., locality 99. MGS 849.	
	9. Right valve; height 36.7 mm, length 47.2 mm, inflation 12.8 mm; Mint Spring Fm., locality 99. MGS 849.	

PLATE 28

1A
x 1.5

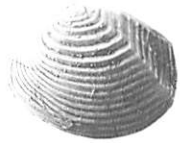
1B

2A
x 1.5

2B

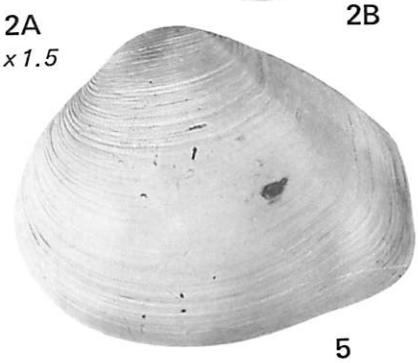
3A
x 1.6

3B

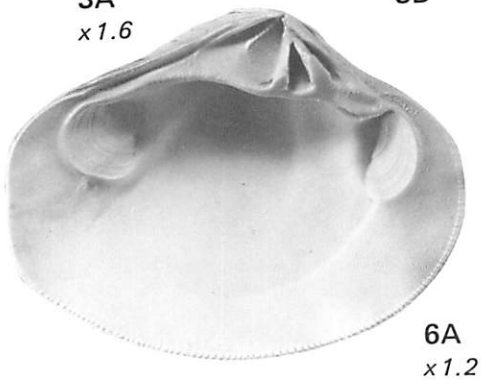


4A
x 1

4B



5
x 1



6A
x 1.2

6B

7A
x 1

7B

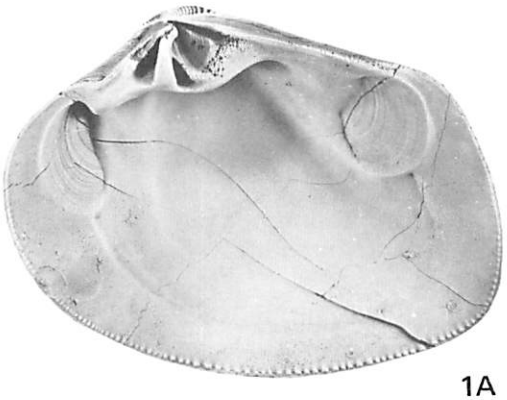
8
x 1

9
x 1

EXPLANATION PLATE 29

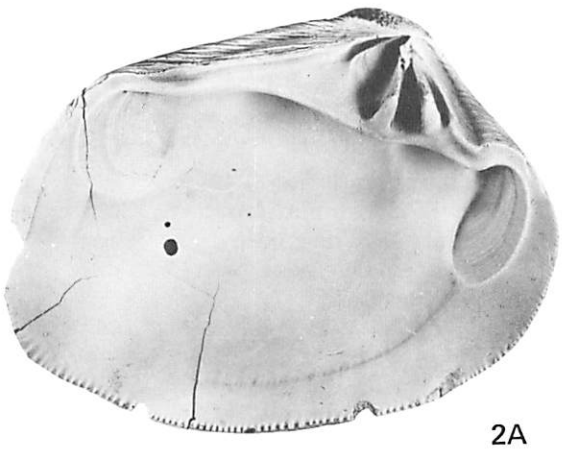
Figure		Page
1-2,4-6	**Crassatella (Crassatella) lirasculpta** n. sp.	67
	1. Right valve; height 50.5 mm, length 63.4 mm, inflation 15.8 mm; Mint Spring Fm., locality 74b. Holotype USNM 340457.	
	2. Left valve; height 58.5 mm, length 70.5 mm, inflation 19.6 mm; Mint Spring Fm., locality 74b. MGS 850.	
	4. Both valves showing hinge; height 63.5 mm, length 76.4 mm, inflation of both valves 40.3 mm; Mint Spring Fm., locality 74b. MGS 851.	
	5. Right valve; height 36.4 mm, length 45.5 mm; Mint Spring Fm., locality 74b, MGS 852.	
	6. Left valve; height 33.0 mm, length 39.6 mm; inflation 9.1 mm; Mint Spring Fm., locality 75b. MGS 853.	
3	**Crassatella (Crassatella) mississippiensis** Conrad, 1848	66
	Both valves showing hinge; height 49.5 mm, length 62.5 mm, inflation of both valves 32.4 mm; Byram Fm., USGS locality 14472. USNM 340458.	

PLATE 29



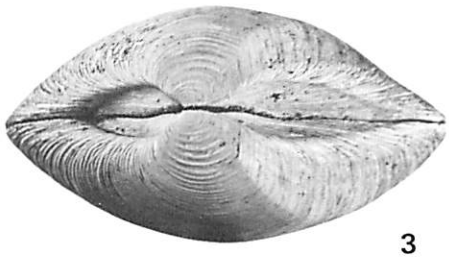
1A
x 1

1B

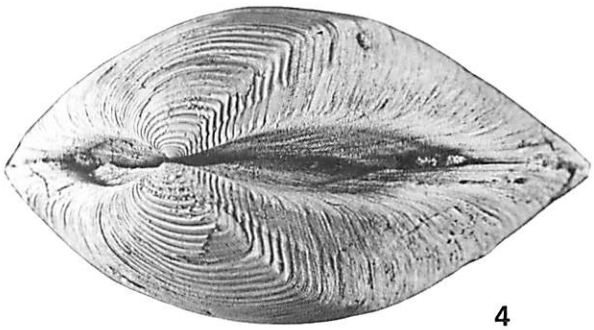


2A
x 1

2B



3
x 1



4
x 1

5
x 1.2

6
x 1.2

EXPLANATION PLATE 30

Figure		Page
1-5	**Crassinella variablis** n. sp.	67-69

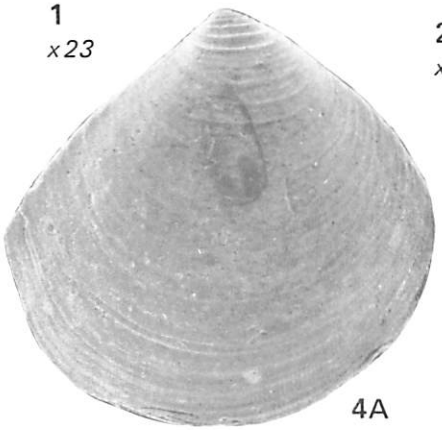
1. Left valve; height 1.4 mm, length 1.6 mm; Byram Fm., locality 106. MGS 854. SEM photograph by E. E. Russell.
2. Right valve; height 1.5 mm, length 1.6 mm; Byram Fm., locality 106. MGS 855. SEM photograph by E. E. Russell
3. Right valve; height 2.1 mm, length 2.2 mm, inflation 0.4 mm; Byram Fm., locality 94. MGS 856. SEM photograph by E. E. Russell.
4. Left valve; height 2.7 mm, length 2.5 mm, inflation 0.5 mm; Byram Fm., locality 94. Holotype USNM 340459. SEM photograph by E. E. Russell. Undulations on this specimen are largely restricted to the umbo. Figure 4B is enlarged x293 to show exterior microsculpture. This microsculpture consists of small scales aligned in longitudinal rows that are out of phase with each other.
5. Left valve; height 2.1 mm, length 2.0 mm, inflation 0.4 mm; Byram Fm., locality 94. MGS 857. Undulations cover the exterior as opposed to figure 4. The microsculpture is shown in figure 5B at an enlargement of x1,170. SEM photograph by E. E. Russell.

PLATE 30

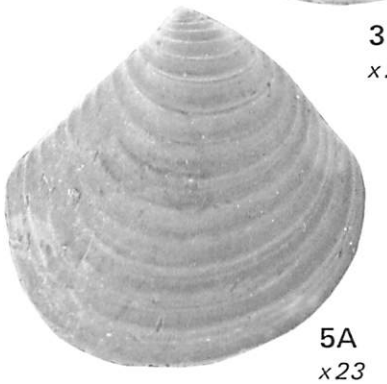
1
x 23

2
x 23

3
x 23

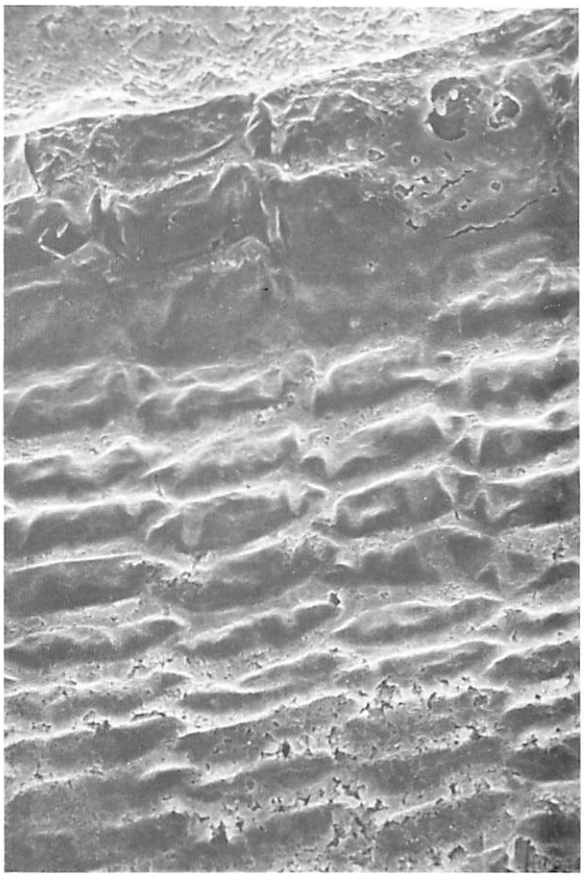


4A
x 28



5A
x 23

4B
x 293

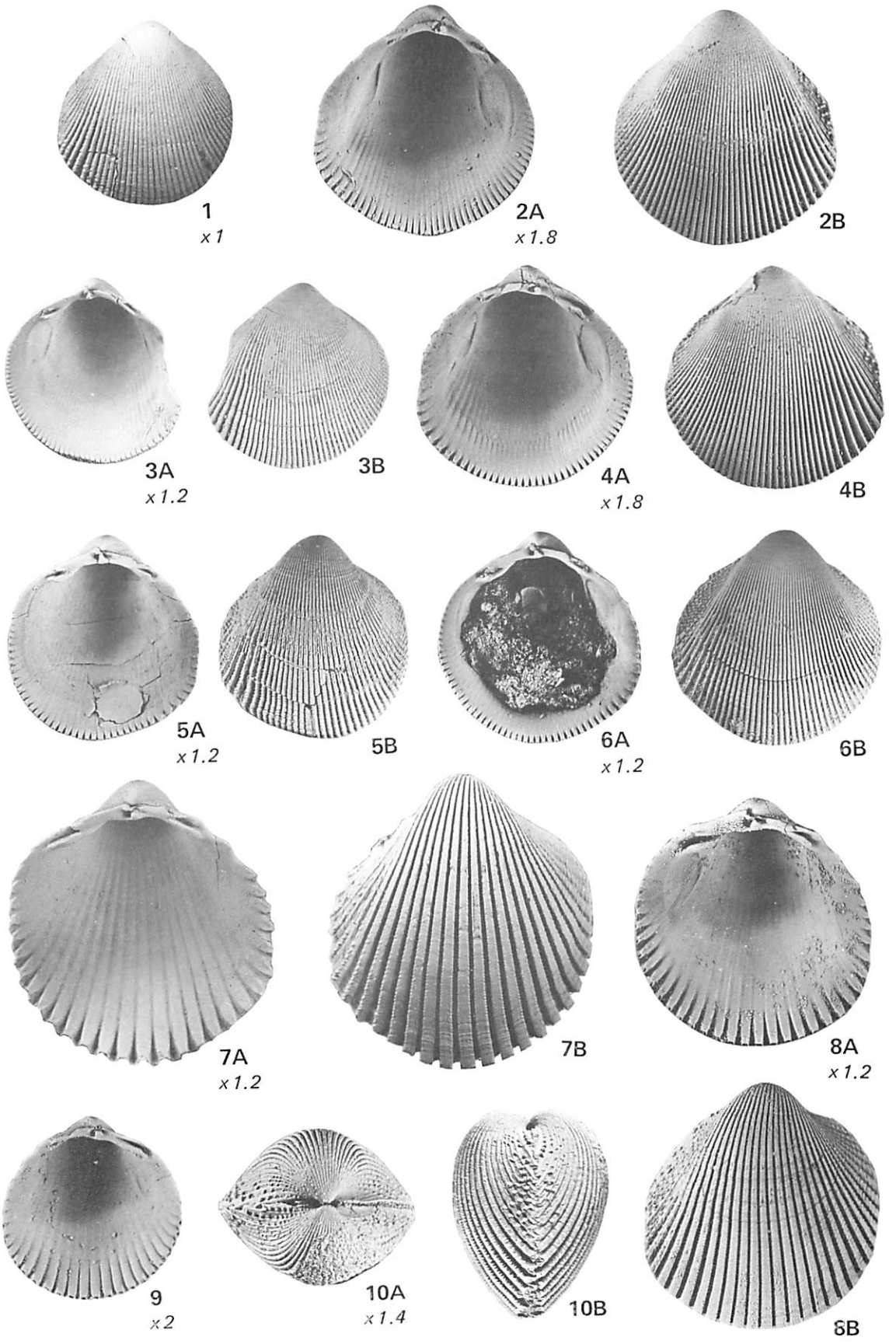


5B
x 1,170

EXPLANATION PLATE 31

Figure		Page
1-6	**Trachycardium eversum** (Conrad, 1848)	70
	1. Right valve; height 30.6 mm, length 30.0 mm, inflation 10.0 mm; number of ribs 54; Vicksburg, Mississippi. Holotype ANSP 30653.	
	2. Left valve; height 22.0 mm, length 20.8 mm, inflation 7.2 mm; number of ribs 59; Byram Fm., locality 93. MGS 858.	
	3. Right valve; height 26.1 mm, length (shell broken) 25.0 mm, inflation 9.0 mm; number of ribs 64; Vicksburg, Mississippi. Paratype ANSP 30654.	
	4. Left valve; height 21.0 mm, length 20.3 mm, inflation 7.1 mm; number of ribs 58; Byram Fm., locality 93. MGS 859.	
	5. Right valve; height 29.1 mm, length 26.4 mm, inflation 11.0 mm; number of ribs 55; USGS locality 14683. USNM 340461.	
	6. Right valve; height 30.0 mm, length 28.9 mm, inflation 10.4 mm; number of ribs 60; Byram Fm., locality 93. MGS 860.	
7-10	**Trachycardium planicostata** n. sp.	70-72
	7. Right valve; height 40.2 mm, length 36.6 mm, inflation 13.7 mm; number of ribs 31; Mint Spring Fm., USGS locality 14071a. Holotype USNM 340462.	
	8. Right valve; height 35.0 mm, length 32.9 mm, inflation 12.5 mm; number of ribs 37; Mint Spring Fm., locality 100. MGS 861.	
	9. Left valve; height 15.6 mm, length 15.0 mm, inflation 5.5 mm; number of ribs 34; Mint Spring Fm., locality 99. MGS 862.	
	10. Both valves showing hinge and posterior side; height 25.4 mm, length 24.4 mm, inflation of both valves 19.3 mm; number of ribs 34; Mint Spring Fm., USGS locality 14071a. USNM 340463.	

PLATE 31

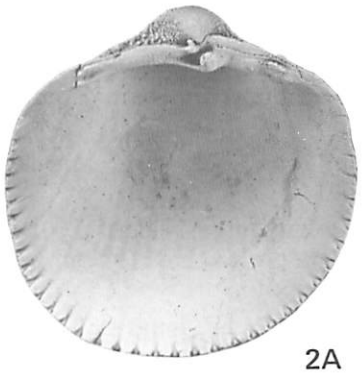

1
x 1
2A
x 1.8
2B
3A
x 1.2
3B
4A
x 1.8
4B
5A
x 1.2
5B
6A
x 1.2
6B
7A
x 1.2
7B
8A
x 1.2
9
x 2
10A
x 1.4
10B
8B

EXPLANATION PLATE 32

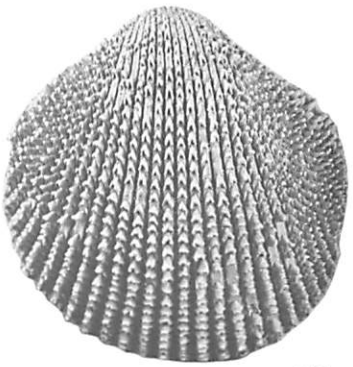
Figure		Page
1-5	**Agnocardia glebosum** (Conrad, 1848)	69-70
	1. Right valve (fragment); height of fragment 27.5 mm; Vicksburg, Mississippi. Holotype ANSP 30650.	
	2. Left valve; height 47.5 mm, length 46.1 mm, inflation 18.4 mm; number of ribs 40. Mint Spring Fm., USGS locality 14071a. USNM 340464.	
	3. Right valve (incomplete); length 25.5 mm, inflation 10.6 mm; number of ribs 38; Byram Fm., locality 93. MGS 863.	
	4. Left valve; height 11.3 mm, length 11.6 mm, inflation 4.7 mm; number of ribs 41; Red Bluff Fm., locality 38b. MGS 864.	
	5. Left valve; height 19.8 mm, length 19.2 mm, inflation 7.4 mm; number of ribs 39; Red Bluff Fm., locality 38b. MGS 865.	
6-8	**Laevicardium leptorimum** n. sp.	74
	6. Left valve; height 11.8 mm, length 11.6 mm, inflation 4.4 mm; Mint Spring Fm., locality 100. Holotype USNM 340466.	
	7. Left valve (incomplete); length 5.1 mm, inflation 1.3 mm; Mint Spring Fm., locality 100. MGS 866.	
	8. Right valve; height 4.4 mm, length 4.2 mm, inflation 1.4 mm; Mint Spring Fm., locality 100. MGS 867.	
9-10	**Trigoniocardia (Americardia) silvacollina** n. sp.	72
	9. Right valve; height 5.6 mm, length 5.5 mm, inflation 1.9 mm; Forest Hill Fm., locality 75a. Holotype USNM 340465.	
	10. Right valve; height 4.6 mm, length 4.8 mm, inflation 1.4 mm; Forest Hill Fm., locality 75a. MGS 868.	

PLATE 32

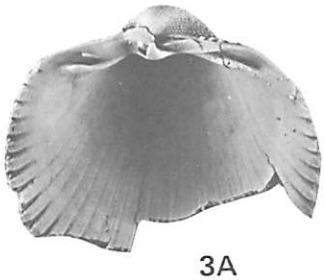
1
x 1.2



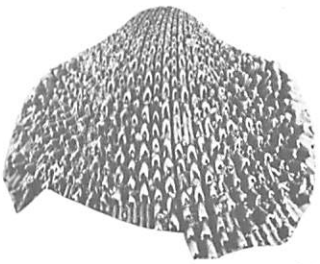
2A
x 1



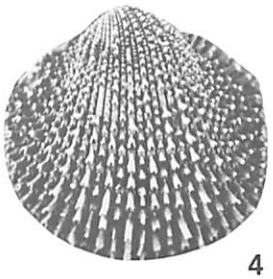
2B



3A
x 1.6

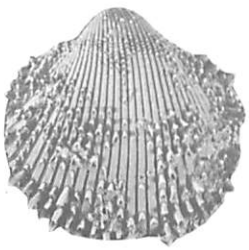


3B



4
x 3

5A
x 1.6



5B

6A
x 3

6B

7A
x 6

7B

8A
x 6

8B

9A
x 6

9B

10A
x 6

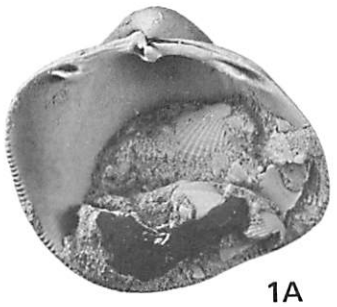
10B

EXPLANATION PLATE 33

Figure		Page
1-12	**Nemocardium (Nemocardium) diversum** (Conrad, 1848)	72-74

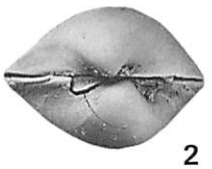
1. Right valve; height 31.0 mm, length 34.6 mm, inflation 11.9 mm; Byram Fm., Vicksburg, Mississippi. Holotype ANSP 30651.
2. Both valves showing hinge; height 20.0 mm, length 21.9 mm, inflation of both valves 10.5 mm; Byram Fm., Vicksburg, Mississippi. Paratype C, ANSP 30652.
3. Left valve; height 29.4 mm, length 33.7 mm, inflation 10.7 mm; Byram Fm., Vicksburg, Mississippi. Paratype B, ANSP 30652.
4. Both valves showing hinge; height 26.3 mm, length 30.0 mm, inflation of both valves 21.0 mm; Byram Fm., locality 109. MGS 869.
5. Both valves showing right valve; height 28.0 mm, length 32.0 mm, inflation of both valves 20.9 mm; Byram Fm., locality 109. MGS 870.
6. Right valve; height 34.6 mm, length 37.0 mm, inflation 13.2 mm; Byram Fm., locality 93. MGS 871.
7. Left valve; height 32.1 mm, length 34.0 mm, inflation 12.4 mm; Byram Fm., locality 93. MGS 872.
8. Right valve; height 20.5 mm, length 21.7 mm, inflation 8.2 mm; Byram Fm., locality 93. MGS 873.
9. Right valve; height 31.4 mm, length 33.0 mm, inflation 12.1 mm; Mint Spring Fm., locality 99. MGS 874.
10. Left valve; height 33.2 mm, length 34.0 mm, inflation 12.6 mm; Mint Spring Fm., locality 99. MGS 875.
11. Left valve; height 30.7 mm, length 34.3 mm, inflation 11.8 mm; Mint Spring Fm., locality 99. MGS 876.
12. Both valves; height 35.5 mm, length 38.7 mm, inflation of both valves 26.5 mm; Mint Spring Fm., locality 99. MGS 877.

PLATE 33

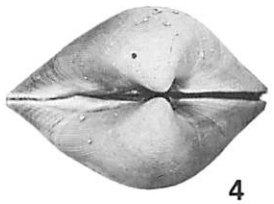


1A
x 1.2

1B

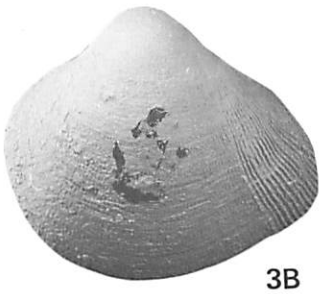


2
x 1.2



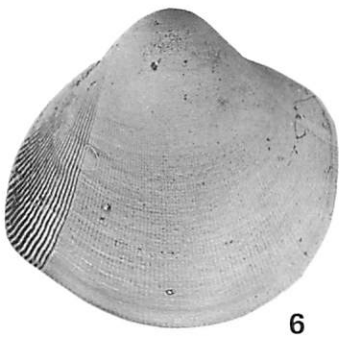
4
x 1

3A
x 1.2



3B

5
x 1



6
x 1.2

7
x 1.2

8
x 1.6

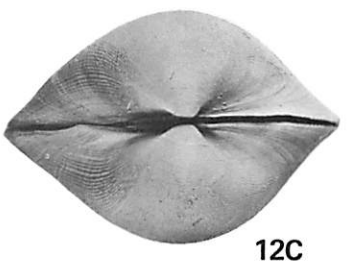
9
x 1.2

10
x 1.2

11
x 1

12A
x 1

12B



12C

EXPLANATION PLATE 34

Figure		Page
1-9	**Nemocardium (Nemocardium) eocenense** (Meyer, 1887)	72

1. Left valve; height 3.5 mm, length 3.6 mm, inflation 1.3 mm; Red Bluff Fm., Red Bluff, Mississippi. Holotype USNM 644605.
2. Left valve; height 10.4 mm, length 11.2 mm, inflation 4.4 mm; Red Bluff Fm., locality 38b. MGS 878.
3. Left valve; height 11.4 mm, length 12.1 mm, inflation 4.7 mm; Red Bluff Fm., locality 38b. MGS 1063.
4. Both valves; height 12.9 mm, length 13.5 mm, inflation 10.6 mm; Red Bluff Fm., locality 38b. MGS 879.
5. Left valve; height 19.7 mm, length 21.4 mm, inflation 8.0 mm; Red Bluff Fm., locality 35b. MGS 880.
6. Right valve; height 17.1 mm, length 18.9 mm, inflation 7.0 mm; Red Bluff Fm., locality 35b. MGS 881.
7. Left valve; height 16.3 mm, length 17.9 mm, inflation 6.4 mm; Red Bluff Fm., locality 35b. MGS 882.
8. Right valve; height 14.2 mm, length 15.0 mm, inflation 5.7 mm; Red Bluff Fm., locality 38b. MGS 883.
9. Left valve; height 18.4 mm, length 18.9 mm, inflation 7.4 mm; Red Bluff Fm., locality 38b. MGS 884.

10-14	**Dinocardium vicksburgensis** (Conrad, 1848)	74-75

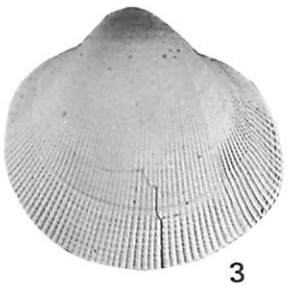
10. Right valve; height 19.3 mm, length 20.4 mm, inflation 7.9 mm; Byram Fm., locality 106. Neotype USNM 340467.
11. Left valve (incomplete); height 20.1 mm, inflation 8.3 mm; Byram Fm., locality 106. MGS 885.
12. Left valve (juvenile); height 2.0 mm, length 2.0 mm; Byram Fm., locality 106. MGS 886. SEM photograph by E. E. Russell.
13. Right valve (juvenile); height 1.2 mm, length 1.2 mm; Byram Fm., locality 106. MGS 887.
14. Right valve (juvenile); height 1.2 mm, length 1.2 mm; Byram Fm., locality 106. MGS 888.

PLATE 34

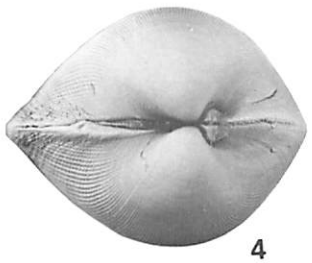
1A
x7

1B

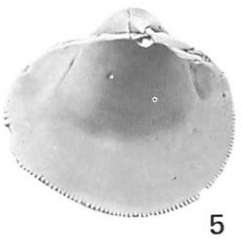
2
x3



3
x3



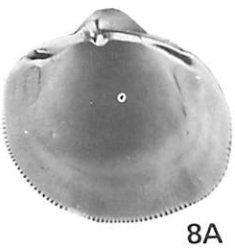
4
x3



5
x1.4

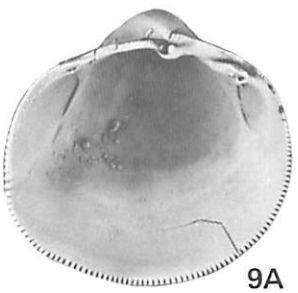
6
x1.4

7
x1.2



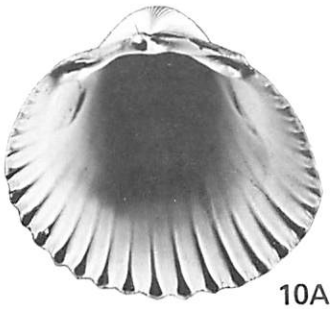
8A
x2

8B

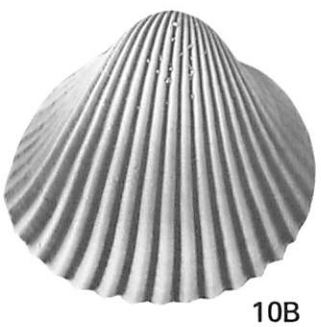


9A
x2

9B



10A
x2



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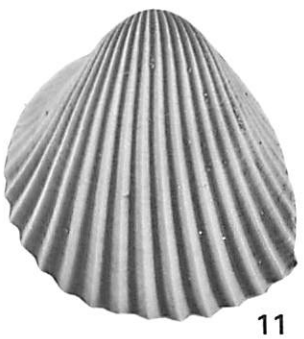
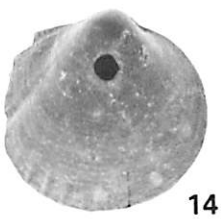


11
x2

12
x23

13
x23

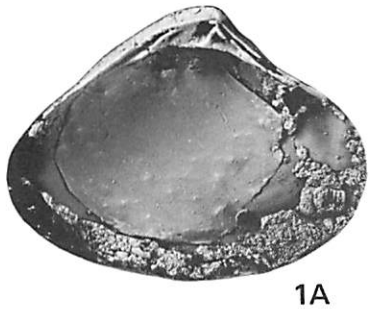


14
x23

EXPLANATION PLATE 35

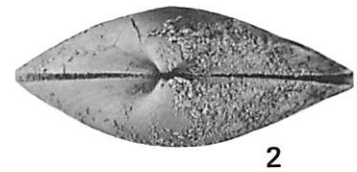
Figure		Page
1-7,9	**Spisula (Mactromeris) mississippiensis** (Conrad, 1848)	76-77
	1. Left valve; height 36.5 mm, length 46.5 mm, inflation 8.0 mm; Vicksburg, Mississippi. Holotype ANSP 30669.	
	2. Both valves showing hinge; height 22.0 mm, length 31.5 mm, inflation of both valves 12.8 mm; Mint Spring Fm., locality 99. MGS 889.	
	3. Left valve; height 25.4 mm, length 34.1 mm, inflation 6.0 mm; Mint Spring Fm., locality 99. MGS 890.	
	4. Right valve; height 19.0 mm, length 26.0 mm, inflation 5.1 mm; Mint Spring Fm., locality 99. MGS 891.	
	5. Left valve; height 34.0 mm, length 52.0 mm; Mint Spring Fm., locality 99. MGS 892.	
	6. Right valve; height 38.5 mm, length 53.0 mm; Mint Spring Fm., locality 100. MGS 893.	
	7. Left valve; height 21.8 mm, length 29.4 mm, inflation 5.5 mm; Mint Spring Fm., locality 99. MGS 894.	
	9. Right valve; height (incomplete) 32.0 mm, length 45.4 mm, inflation 8.0 mm; locality 99. MGS 895.	
8	**Spisula (Symmorphomactra) praetenuis** (Conrad, 1833)	76
	Left valve (incomplete); length 30.0 mm; Moodys Branch Fm., locality 16. MGS 329.	
10	**Spisula funerata** (Conrad, 1848)	75
	Right valve; height 5.7 mm, length 8.3 mm, inflation 2.0 mm; Vicksburg, Mississippi. Holotype ANSP 30668.	

PLATE 35



1A
x 1

1B

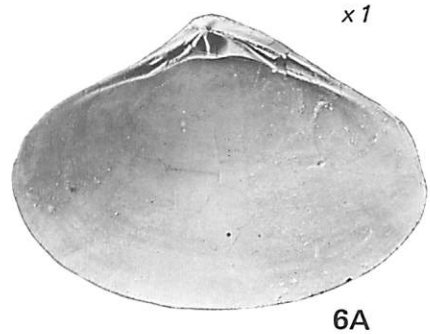


2
x 1.4

5
x 1

3A
x 1.4

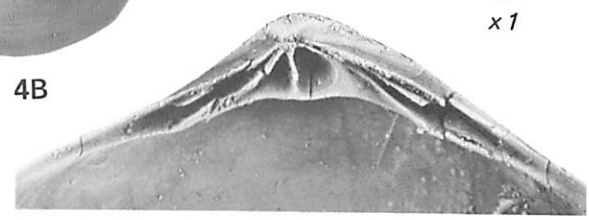
4A
x 1.4



6A
x 1

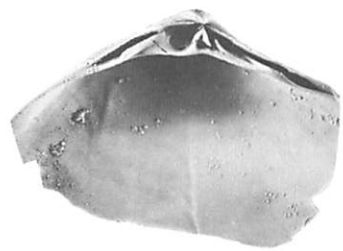
3B

4B



6B
x 2

7
x 1.4

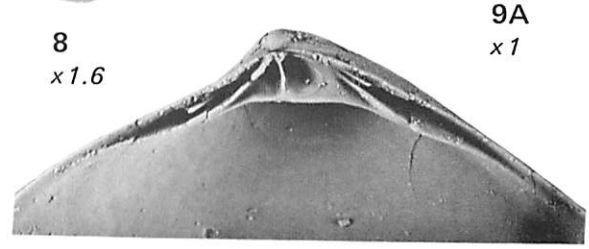


8
x 1.6

9A
x 1

10A
x 3.5

10B

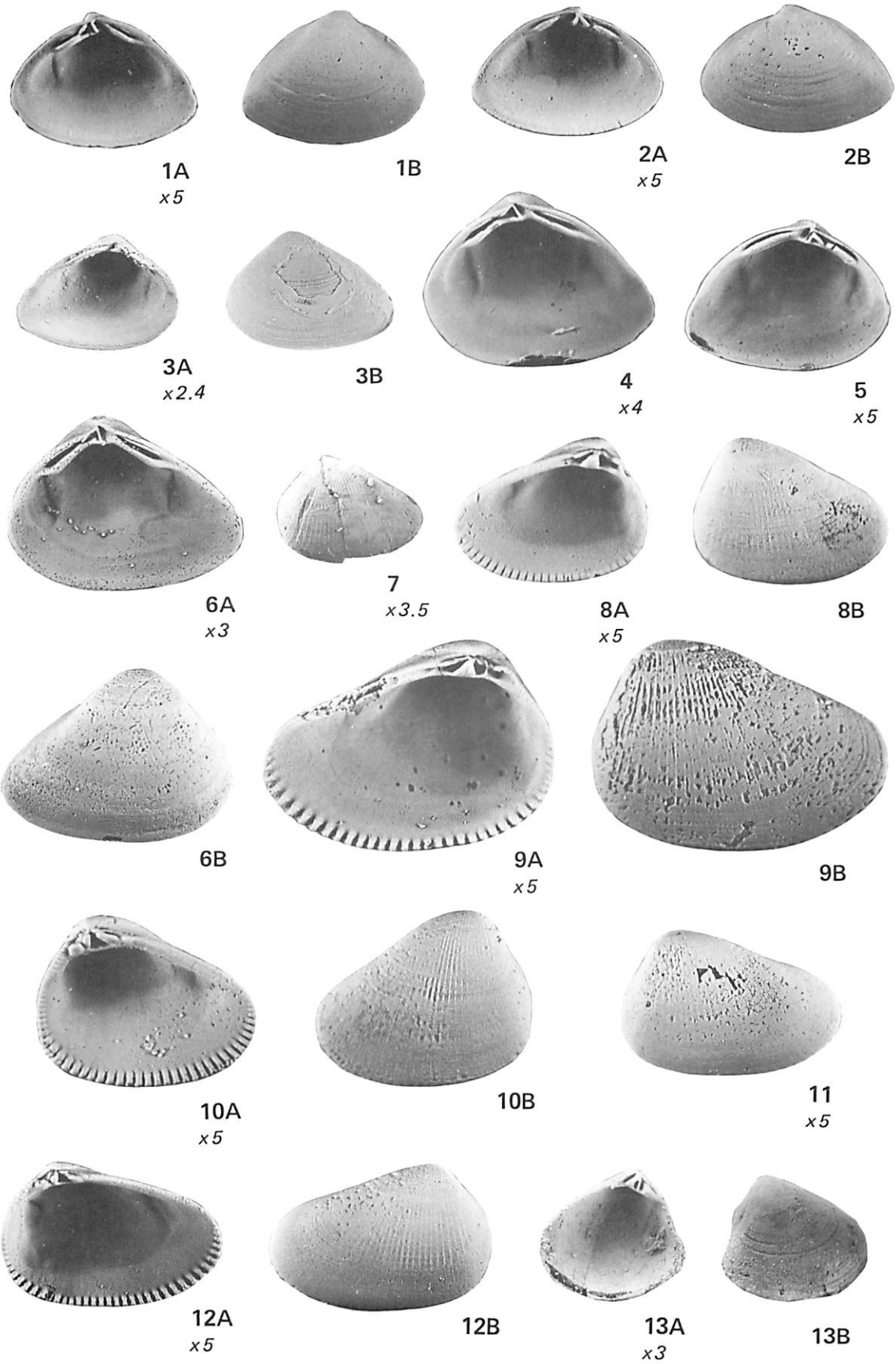


9B
x 2

EXPLANATION PLATE 36

Figure		Page
1-2	**Spisula funerata** (Conrad, 1848)	75
	1. Right valve; height 4.2 mm, length 5.9 mm, inflation 1.3 mm; Byram Fm., locality 106. MGS 896.	
	2. Left valve; height 4.0 mm, length 6.1 mm, inflation 1.1 mm; Byram Fm., locality 106. MGS 897.	
3-6	**Spisula inaequilateralis** (Meyer, 1886)	75
	3. Left valve; height 8.0 mm, length 11.0 mm, inflation 2.7 mm; probably from the Mint Spring Fm., Vicksburg, Mississippi. Holotype 644601 USNM.	
	4. Right valve; height 7.1 mm, length 9.4 mm, inflation 2.5 mm; Forest Hill Fm., locality 75a. MGS 898.	
	5. Left valve; height 5.0 mm, length 6.7 mm, inflation 1.8 mm; Forest Hill Fm., locality 75a. MGS 899.	
	6. Right valve; height 9.5 mm, length 12.8 mm, inflation 3.4 mm; Mint Spring Fm., locality 110. MGS 900.	
7-12	**Donax funerata** Conrad, 1848	79-80
	7. Right valve; height 5.0 mm, length 7.0 mm, inflation 1.5 mm; Vicksburg, Mississippi. Holotype ANSP 30683.	
	8. Right valve; height 4.7 mm, length 6.4 mm, inflation 1.9 mm; Mint Spring Fm., locality 110. MGS 1064.	
	9. Right valve; height 7.1 mm, length 9.8 mm, inflation 2.7 mm; Mint Spring Fm., locality 110. MGS 901.	
	10. Left valve; height 5.8 mm, length 7.2 mm, inflation 2.2 mm; Mint Spring Fm., locality 110. MGS 902.	
	11. Right valve; height 4.8 mm, length 7.2 mm, inflation 1.7 mm; Mint Spring Fm., locality 110. MGS 903.	
	12. Left valve; height 4.8 mm, length 7.3 mm, inflation 1.9 mm; Mint Spring Fm., locality 110. MGS 904.	
13	**Donax** sp.?	80
	Right valve; height 6.9 mm, length 7.8 mm, inflation 2.3 mm; Mint Spring Fm., USGS locality 14163. USNM 340468.	

PLATE 36


1A
x5
1B
2A
x5
2B
3A
x2.4
3B
4
x4
5
x5
6A
x3
7
x3.5
8A
x5
8B
6B
9A
x5
9B
10A
x5
10B
11
x5
12A
x5
12B
13A
x3
13B

EXPLANATION PLATE 37

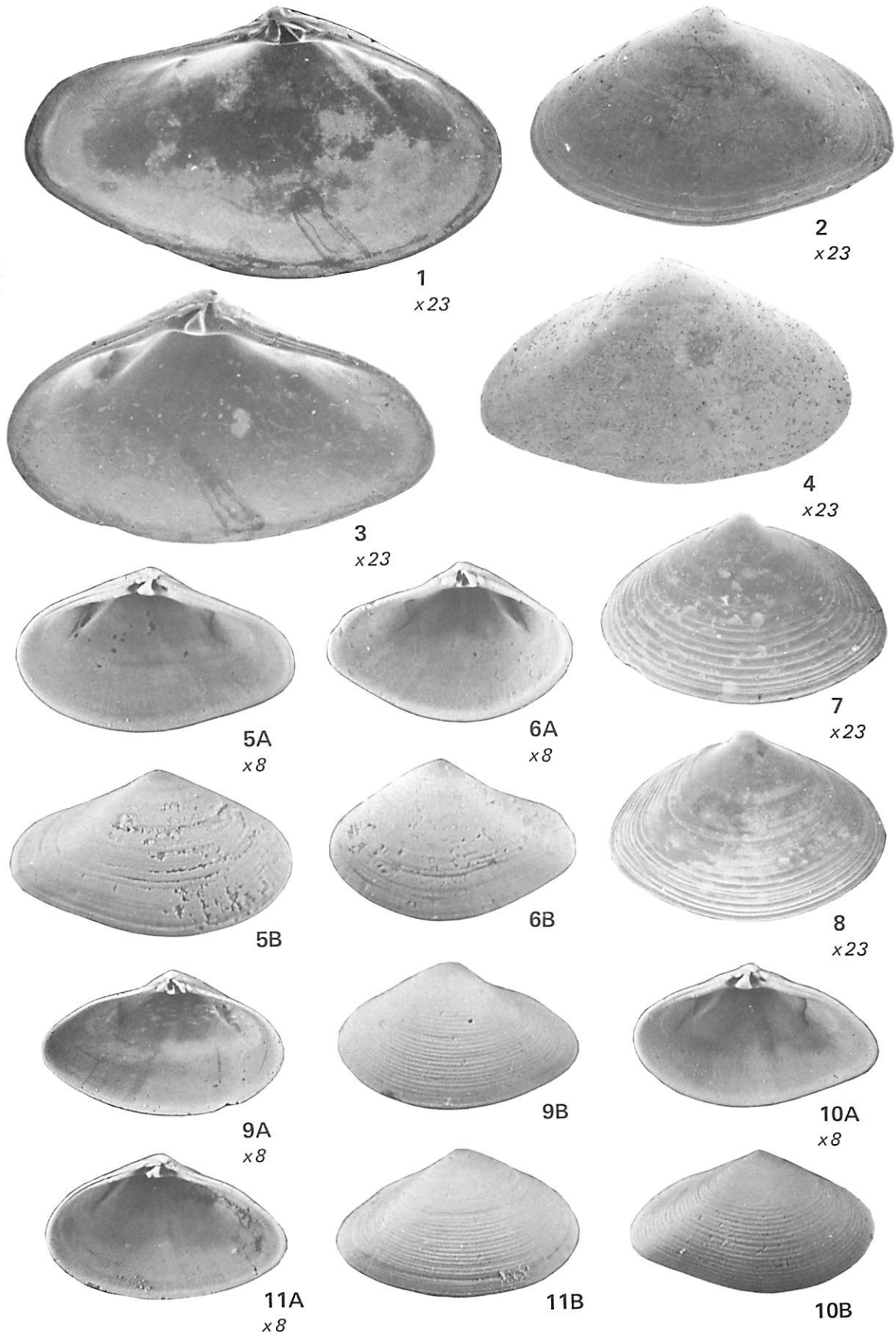
Figure		Page
1-6	**Ervilia exterolaevis** n. sp.	77

1. Left valve; height 2.0 mm, length 3.6 mm; Mint Spring Fm., locality 99. MGS 905. SEM photograph by E. E. Russell.
2. Left valve; height 1.7 mm, length 2.7 mm; Mint Spring Fm., locality 99. MGS 906. SEM photograph by E. E. Russell.
3. Right valve; height 1.9 mm, length 3.2 mm; Mint Spring Fm., locality 99. MGS 907. SEM photograph by E. E. Russell.
4. Right valve; height 1.5 mm, length 2.8 mm; Mint Spring Fm., locality 99. MGS 908. SEM photograph by E. E. Russell.
5. Right valve; height 3.3 mm, length 5.7 mm, inflation 1.1 mm; Forest Hill Fm., locality 75a. Holotype USNM 340469.
6. Left valve; height 3.2 mm, length 5.0 mm, inflation 1.0 mm; Forest Hill Fm., locality 75a. MGS 910.

7-11	**Ervilia lamelloexteria** n. sp.	77

7. Left valve; height 1.4 mm, length 2.1 mm; Byram Fm., locality 106. MGS 911. SEM photograph by E. E. Russell.
8. Right valve; height 1.4 mm, length 2.0 mm; Byram Fm., locality 106. MGS 912. SEM photograph by E. E. Russell.
9. Left valve; height 2.9 mm, length 4.8 mm, inflation 1.0 mm; Byram Fm., locality 93. Holotype USNM 340470.
10. Right valve; height 2.8 mm, length 4.9 mm, inflation 1.0 mm; Byram Fm., locality 93. MGS 914.
11. Right valve; height 2.9 mm, length 4.9 mm, inflation 1.0 mm; Byram Fm., locality 93. MGS 915.

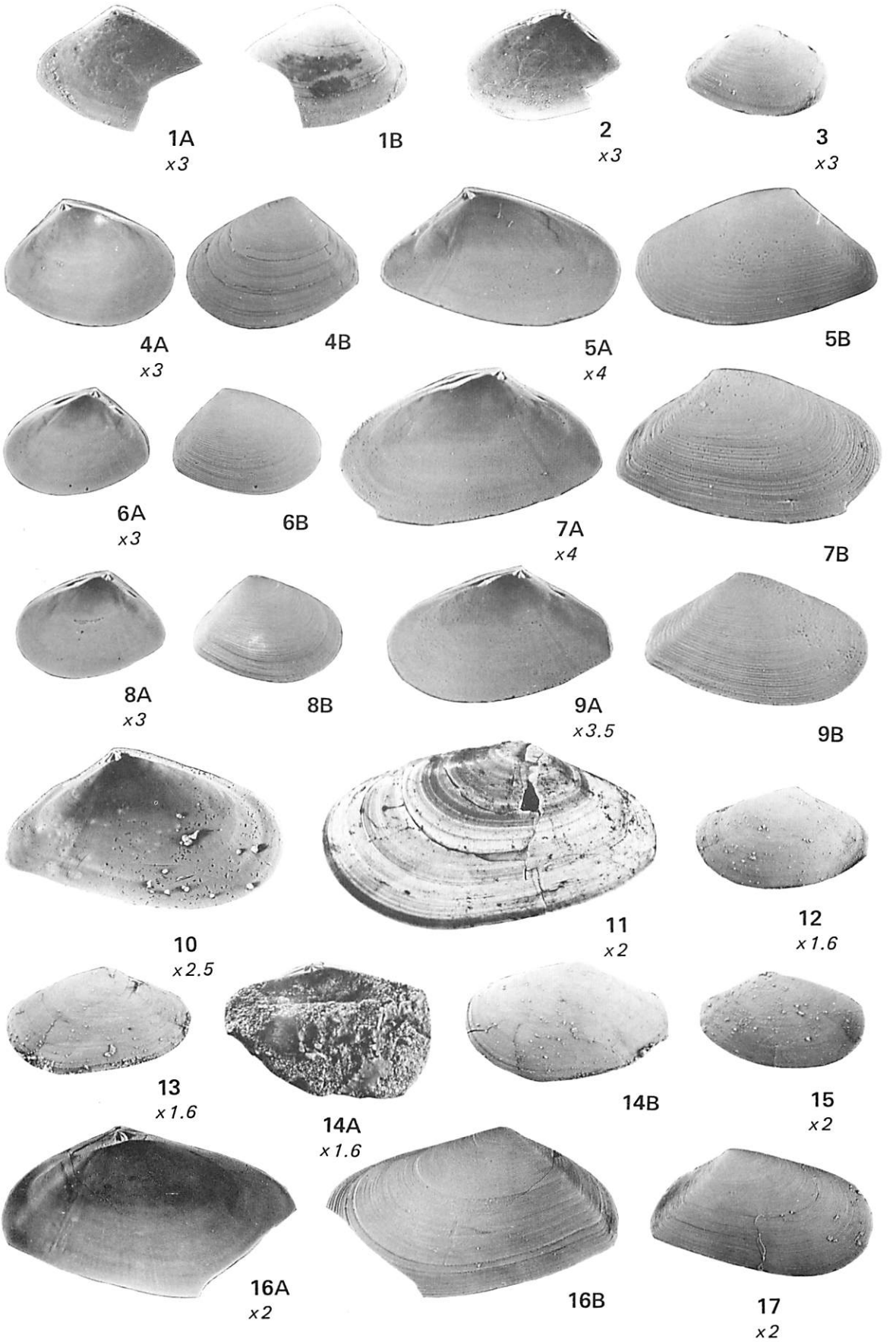
PLATE 37


1
x23
2
x23
3
x23
4
x23
5A
x8
6A
x8
7
x23
5B
6B
8
x23
9A
x8
9B
10A
x8
11A
x8
11B
10B

EXPLANATION PLATE 38

Figure		Page
1-4,6,8	**Tellina vicksburgensis** Conrad, 1848	78
	1. Left valve (incomplete); height 7.0 mm, inflation 1.9 mm; Vicksburg, Mississippi. Syntype A, ANSP 30684.	
	2. Right valve (incomplete); height 6.0 mm, inflation 1.6 mm; Vicksburg, Mississippi. Syntype B, ANSP 30684.	
	3. Right valve; height 5.0 mm, length 8.0 mm; Vicksburg, Mississippi. Syntype C, ANSP 30684.	
	4. Left valve; height 7.2 mm, length 9.5 mm, inflation 1.7 mm; Byram Fm., locality 93. MGS 916.	
	6. Right valve; height 5.8 mm, length 8.1 mm, inflation 1.4 mm; Byram Fm., locality 93. MGS 918.	
	8. Right valve; height 5.8 mm, length 8.2 mm, inflation 1.5 mm; Byram Fm., locality 93. MGS 920.	
5,7,9-10	**Tellina subprotexta** n. sp.	77-78
	5. Left valve; height 5.9 mm, length 10.2 mm, inflation 1.1 mm; Mint Spring Fm., locality 100. Paratype USNM 340473.	
	7. Right valve; height 6.4 mm, length 11.2 mm, inflation 1.3 mm; Mint Spring Fm., locality 100. MGS 919.	
	9. Right valve; height 6.4 mm, length 10.8 mm, inflation 1.3 mm; Mint Spring Fm., locality 108. Holotype USNM 340472.	
	10. Left valve; height 7.1 mm, length 11.8 mm, inflation 1.4 mm; Mint Spring Fm., locality 100. MGS 922.	
11-17	**Tellina serica** Conrad, 1848	78-79
	11. Left valve; height 16.8 mm, length 29.4 mm; Byram Fm., locality 93. MGS 923.	
	12. Left valve; height 11.0 mm, length 19.0 mm; Vicksburg, Mississippi. Syntype A, ANSP 30686.	
	13. Left valve; height 11.0 mm, length 19.5 mm; Vicksburg, Mississippi. Syntype B, ANSP 30686.	
	14. Left valve; height 12.0 mm, length 22.3 mm; Vicksburg, Mississippi. Syntype C, ANSP 30686.	
	15. Right valve; height 10.5 mm, length 18.0 mm; Vicksburg, Mississippi. Syntype D, ANSP 30686.	
	16. Left valve (incomplete); height 15.7 mm, length 20.4 mm, inflation 3.3 mm; Byram Fm., locality 93. MGS 924.	
	17. Right valve; height 10.4 mm, length 18.7 mm, inflation 2.3 mm; Byram Fm., locality 93. MGS 925.	

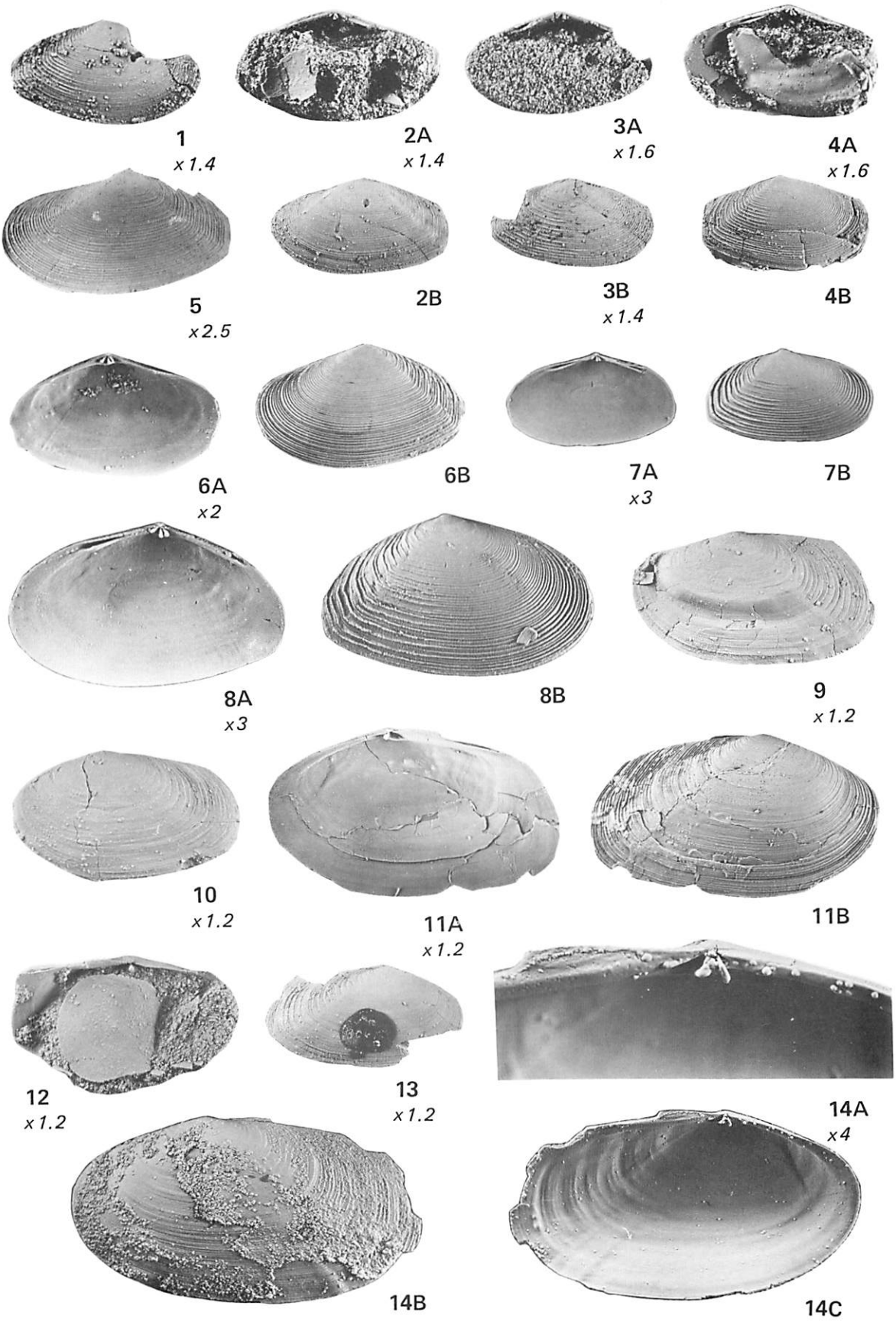
PLATE 38


1A
x3
1B
2
x3
3
x3
4A
x3
4B
5A
x4
5B
6A
x3
6B
7A
x4
7B
8A
x3
8B
9A
x3.5
9B
10
x2.5
11
x2
12
x1.6
13
x1.6
14A
x1.6
14B
15
x2
16A
x2
16B
17
x2

EXPLANATION PLATE 39

Figure		Page
1-8	**Tellina lintea** (Conrad, 1848)	77
	1. Right valve (incomplete); height 12.8 mm, length 23.5 mm, inflation 2.0 mm; Vicksburg, Mississippi. Syntype A, ANSP 30671.	
	2. Left valve; height 11.6 mm, length 22.0 mm, inflation 2.5 mm; Vicksburg, Mississippi. Syntype B, ANSP 30671.	
	3. Right valve; height 11.0 mm, length 20.0 mm, inflation 1.5 mm; Vicksburg, Mississippi. Syntype D, ANSP 30671.	
	4. Right valve; height 11.4 mm, length 20.5 mm, inflation 2.5 mm; Vicksburg, Mississippi. Syntype C, ANSP 30671.	
	5. Left valve; height 8.2 mm, length 15.4 mm; Mint Spring Fm., USGS locality 6647a. USNM 340471.	
	6. Left valve; height 10.7 mm, length 17.9 mm, inflation 2.3 mm; Byram Fm., locality 93. MGS 926.	
	7. Right valve; height 5.0 mm, length 9.2 mm, inflation 1.0 mm; Byram Fm., locality 93. MGS 927.	
	8. Right valve; height 8.9 mm, length 15.3 mm, inflation 2.0 mm; Red Bluff Fm., locality 37. MGS 928.	
9-14	**Gari (Gari) papyria** (Conrad, 1848)	80
	9. Left valve; height 19.6 mm, length 33.7 mm; Vicksburg, Mississippi. Syntype A, ANSP 30672.	
	10. Left valve; height 19.0 mm, length 33.0 mm, inflation 3.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 30672.	
	11. Right valve; height 23.8 mm, length 41.2 mm, inflation 5.4 mm; Byram Fm., locality 93. MGS 929.	
	12. Left valve (incomplete); length 33.0 mm; Vicksburg, Mississippi. Syntype C, ANSP 30672.	
	13. Right valve (incomplete); length 19.5 mm; Vicksburg, Mississippi. Syntype D, ANSP 30672.	
	14. Left valve; height 23.7 mm, length 42.5 mm, inflation 5.3 mm; Mint Spring Fm., locality 99. MGS 930.	

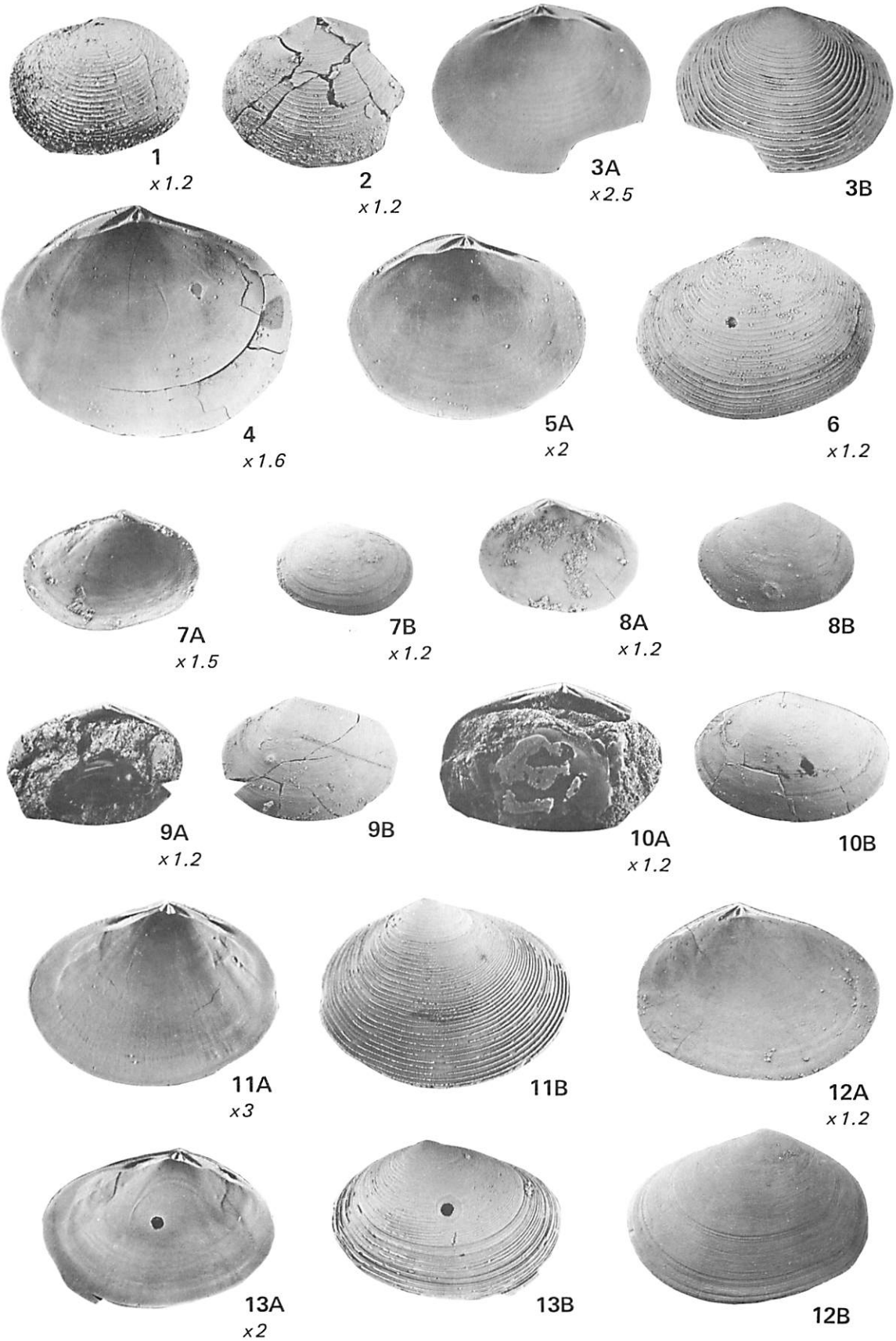
PLATE 39


1
x 1.4
2A
x 1.4
3A
x 1.6
4A
x 1.6
5
x 2.5
2B
3B
x 1.4
4B
6A
x 2
6B
7A
x 3
7B
8A
x 3
8B
9
x 1.2
10
x 1.2
11A
x 1.2
11B
12
x 1.2
13
x 1.2
14A
x 4
14B
14C

EXPLANATION PLATE 40

Figure		Page
1-6	**Semele staminea** (Conrad, 1848)	82-83
	1. Left valve; height 28.0 mm, length 25.2 mm, inflation 4.5 mm; Vicksburg, Mississippi. Syntype A, ANSP 30666.	
	2. Left valve (incomplete); height 21.0 mm, length 24.5 mm; Vicksburg, Mississippi. Syntype B, ANSP 30666.	
	3. Right valve; height 11.0 mm, length 14.4 mm; Byram Fm., locality 106. MGS 931.	
	4. Left valve; height 24.4 mm, length 30.6 mm, inflation 5.5 mm; Mint Spring Fm., locality 100. MGS 932.	
	5. Left valve; height 15.3 mm, length 20.0 mm, inflation 3.6 mm; Mint Spring Fm., locality 100. MGS 933.	
	6. Left valve; height 24.2 mm, length 31.8 mm; Mint Spring Fm., locality 100. MGS 934.	
7-13	**Semele mississippiensis** (Conrad, 1848)	82
	7. Right valve; height 13.3 mm, length 19.4 mm, inflation 3.2 mm; Vicksburg, Mississippi. Syntype A, ANSP 30679 (Syntype of **Amphidesma perovata** Conrad, 1848b).	
	8. Left valve; height 16.0 mm, length 22.3 mm, inflation 3.4 mm; Vicksburg, Mississippi. Syntype C, ANSP 30679 (Syntype of **Amphidesma perovata** Conrad, 1848b).	
	9. Right valve; height 17.3 mm, length 24.2 mm, inflation 4.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 30679 (Syntype of **Amphidesma perovata** Conrad, 1848b).	
	10. Right valve; height 17.5 mm, length 26.5 mm, inflation 3.0 mm; Vicksburg, Mississippi. Holotype ANSP 30677.	
	11. Right valve; height 10.4 mm, length 14.1 mm, inflation 2.2 mm; Byram Fm., locality 93. MGS 935.	
	12. Left valve; height 19.6 mm, length 26.5 mm, inflation 3.9 mm; Mint Spring Fm., USGS locality 14071a. USNM 340474.	
	13. Right valve; height 13.6 mm, length 19.4 mm, inflation 3.2 mm; Byram Fm., locality 93. MGS 936.	

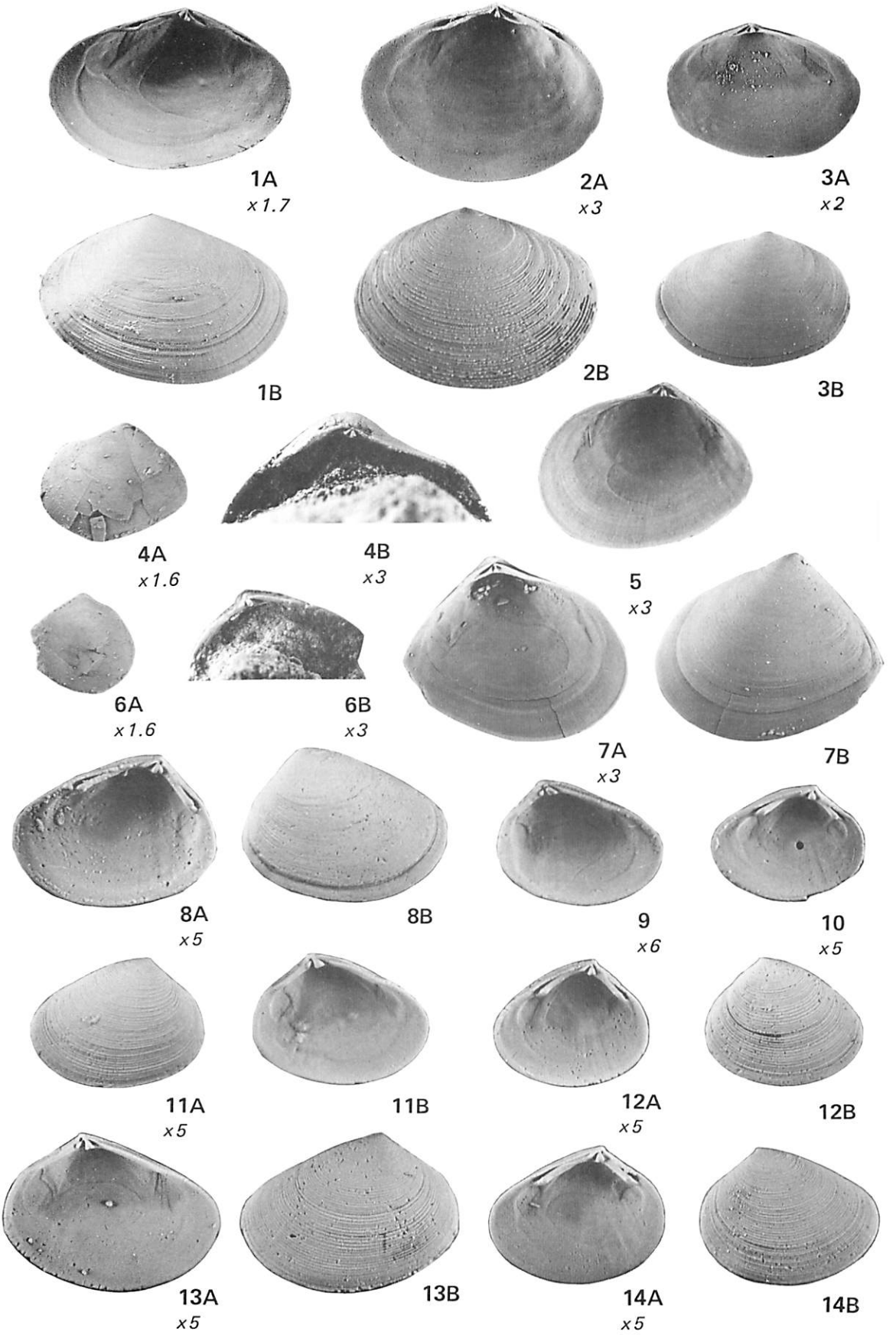
PLATE 40


1
x 1.2
2
x 1.2
3A
x 2.5
3B
4
x 1.6
5A
x 2
6
x 1.2
7A
x 1.5
7B
x 1.2
8A
x 1.2
8B
9A
x 1.2
9B
10A
x 1.2
10B
11A
x 3
11B
12A
x 1.2
13A
x 2
13B
12B

EXPLANATION PLATE 41

Figure		Page
1-3	**Semele mississippiensis** (Conrad, 1848)	82
	1. Right valve; height 17.2 mm, length 25.2 mm, inflation 3.9 mm; Byram Fm., locality 106. MGS 937.	
	2. Right valve; height 10.3 mm, length 14.2 mm, inflation 2.2 mm; Byram Fm., locality 93. MGS 938.	
	3. Left valve; height 11.7 mm, length 16.7 mm, inflation 2.5 mm; Byram Fm., locality 93. MGS 939.	
4-7	**Abra pectorosa** (Conrad, 1848)	83
	4. Left valve; height 12.8 mm, length 15.5 mm, inflation 3.5 mm; Vicksburg, Mississippi. Syntype A, ANSP 30685.	
	5. Right valve; height 9.3 mm, length 12.0 mm, inflation 2.5 mm; Red Bluff Fm., locality 38b. MGS 940.	
	6. Right valve (incomplete); height 10.0 mm, inflation 3.1 mm; Vicksburg, Mississippi. Syntype B, ANSP 30685.	
	7. Left valve; height 10.9 mm, length 12.9 mm, inflation 3.0 mm; Byram Fm., locality 93. MGS 941.	
8-14	**Semelina pilsbryi** (Casey, 1903)	83
	8. Right valve; height 5.0 mm, length 6.7 mm, inflation 1.3 mm; Byram Fm., locality 109. MGS 942.	
	9. Left valve; height 3.3 mm, length 4.4 mm, inflation 0.9 mm; Byram Fm., locality 109. MGS 943.	
	10. Right valve; height 3.8 mm, length 5.0 mm, inflation 0.7 mm; Mint Spring Fm., locality 108. MGS 944.	
	11. Left valve; height 4.2 mm, length 5,8 mm, inflation 1.0 mm; Mint Spring Fm., locality 108. MGS 945.	
	12. Right valve; height 4.1 mm, length 5.1 mm, inflation 0.9 mm; Mint Spring Fm., locality 108. MGS 946.	
	13. Left valve; height 5.2 mm, length 7.1 mm, inflation 1.2 mm; Mint Spring Fm., locality 100. MGS 1065.	
	14. Right valve; height 4.5 mm, length 5.8 mm, inflation 0.9 mm; Mint Spring Fm., locality 100. MGS 947.	

PLATE 41


1A
x 1.7
2A
x3
3A
x2
1B
2B
3B
4A
x 1.6
4B
x3
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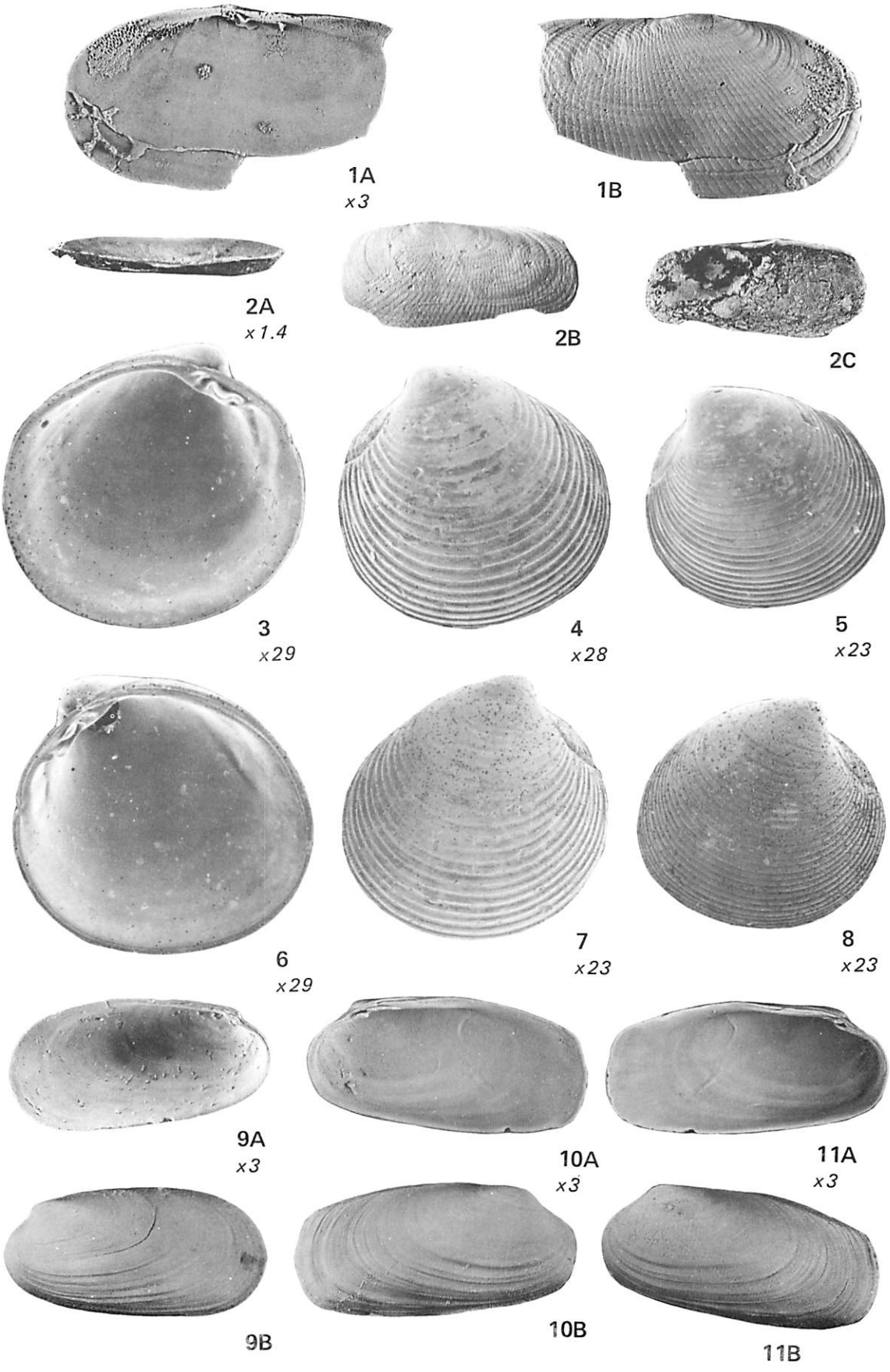
x3
6A
x 1.6
6B
x3
7A
x3
7B
8A
x5
8B
9
x6
10
x5
11A
x5
11B
12A
x5
12B
13A
x5
13B
14A
x5
14B

EXPLANATION PLATE 42

Figure		Page
1-2	**Solecurtus vicksburgensis** Aldrich, 1885	84
	1. Right valve (incomplete); height 15.2 mm, inflation 3.7 mm; Byram Fm., locality 93. MGS 948.	
	2. Left valve; height 13.0 mm, length 28.0 mm, inflation 5.5 mm; Vicksburg, Mississippi. Holotype 644607 USNM.	
3,5-6,8	**Kelliela rufaripa** n. sp.	84
	3. Left valve; height 1.7 mm, length 1.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. Holotype USNM 340475. SEM photograph by E. E. Russell.	
	5. Left valve; height 1.6 mm, length 1.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 950. SEM photograph by E. E. Russell.	
	6. Right valve; height 1.6 mm, length 1.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 951. SEM photograph by E. E. Russell.	
	8. Right valve; height 1.7 mm, length 1.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 953. SEM photograph by E. E. Russell.	
4,7	**Kelliella boettgeri** Meyer, 1886	84
	4. Left valve; height 1.6 mm, length 1.6 mm; Moodys Branch Fm., locality 2. MGS 949. SEM photograph by E. E. Russell.	
	7. Right valve; height 1.9 mm, length 2.0 mm; Moodys Branch Fm., locality 2. MGS 952. SEM photograph by E. E. Russell.	
9-11	**Coralliophaga (Coralliophaga) corrugata** n. sp.	85
	9. Left valve; height 7.2 mm, length 14.6 mm, inflation 2.3 mm; Mint Spring Fm., USGS locality 6647a. Holotype USNM 340476.	
	10. Right valve; height 7.3 mm, length 15.6 mm, inflation 2.9 mm; Mint Spring Fm., locality 99. MGS 954.	
	11. Left valve; height 7.3 mm, length 15.5 mm, inflation 3.0 mm; Mint Spring Fm., locality 99. MGS 955.	

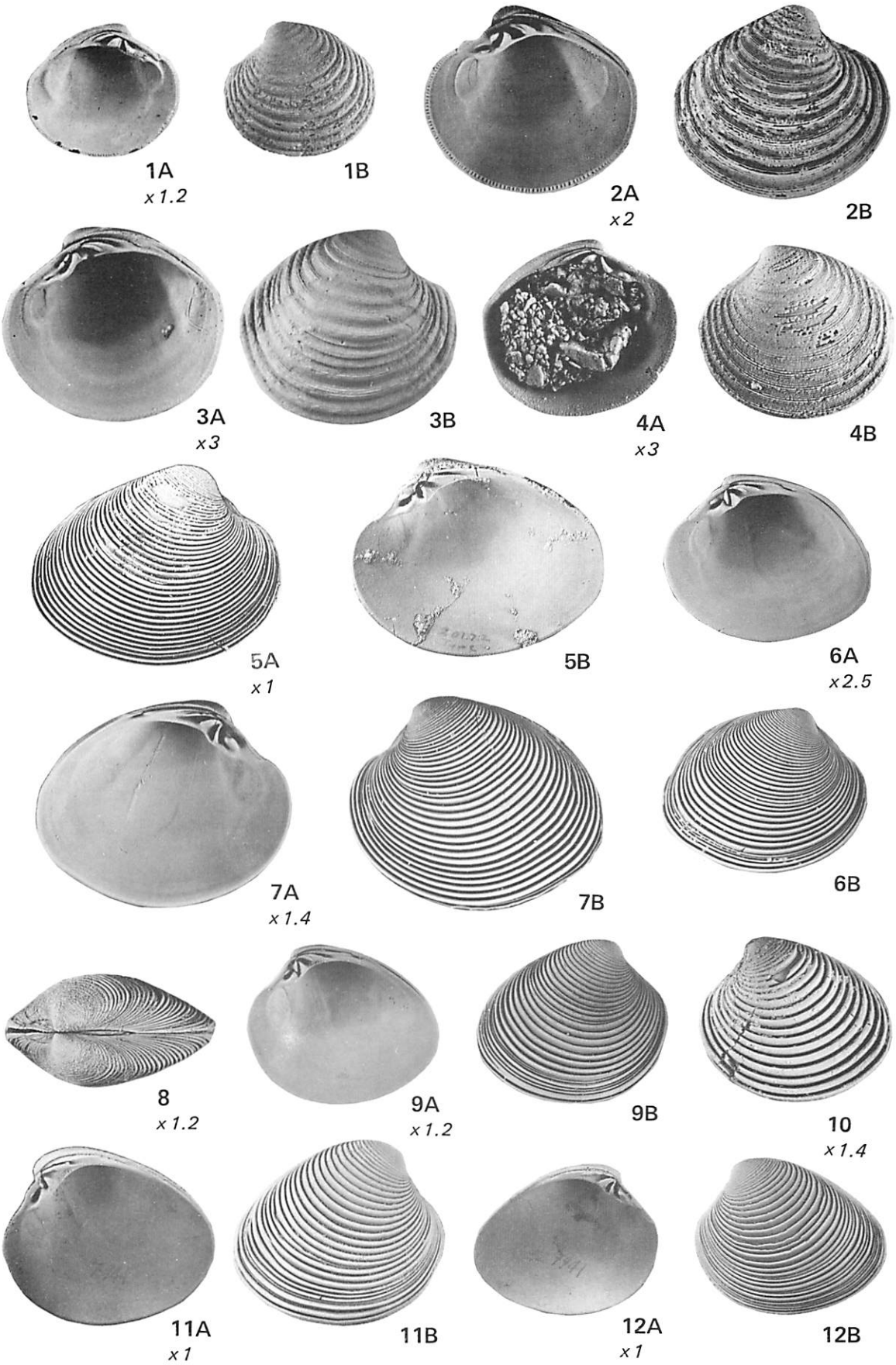
PLATE 42


1A
x3
1B
2A
x1.4
2B
2C
3
x29
4
x28
5
x23
6
x29
7
x23
8
x23
9A
x3
10A
x3
11A
x3
9B
10B
11B

EXPLANATION PLATE 43

Figure		Page
1-4	**Ventricolaria ucuttana** (Dall, 1903)	85
	1. Left valve; height 14.2 mm, length 16.1 mm, inflation 5.0 mm; Red Bluff Fm., Eucutta Creek, Clarke Co., Mississippi. Holotype USNM 136468.	
	2. Right valve; height 16.3 mm, length 12.3 mm, inflation 3.9 mm; Red Bluff Fm., locality 38b. MGS 956.	
	3. Right valve; height 10.9 mm, length 12.3 mm, inflation 3.9 mm; Red Bluff Fm., locality 38b. MGS 957.	
	4. Left valve; height 9.8 mm, length 10.8 mm, inflation 2.9 mm; Byram Fm., locality 93. MGS 958.	
5-7	**Pitar (Lamelliconcha) imitabilis** (Conrad, 1848)	86
	5. Right valve; height 33.5 mm, length 42.0 mm, inflation 10.5 mm; Byram Fm., Vicksburg, Mississippi. Holotype ANSP 20172.	
	6. Right valve; height 11.1 mm, length 13.8 mm, inflation 3.2 mm; Byram Fm., locality 106. MGS 959.	
	7. Left valve; height 25.6 mm, length 30.6 mm, inflation 7.6; Byram Fm., locality 106. MGS 960.	
8-12	**Pitar (Lamelliconcha) protena** n. sp.	86-88
	8. Both valves showing hinge; height 24.2 mm, length 30.3 mm, inflation of both valves 15.8 mm; Mint Spring Fm., USGS locality 14162. USNM 340479.	
	9. Right valve; height 22.5 mm, length 26.8 mm, inflation 6.6 mm; Mint Spring Fm., locality 108. MGS 961.	
	10. Left valve; height 19.5 mm, length 23.0 mm, inflation 5.8 mm; Byram Fm., locality 106. MGS 962.	
	11. Right valve; height 30.2 mm, length 35.0 mm, inflation 10.0 mm; Mint Spring Fm., USGS locality 7941. Holotype USNM 340477.	
	12. Left valve; height 26.0 mm, length 31.6 mm, inflation 8.2 mm; Mint Spring Fm., USGS locality 7941. Paratype USNM 340478.	

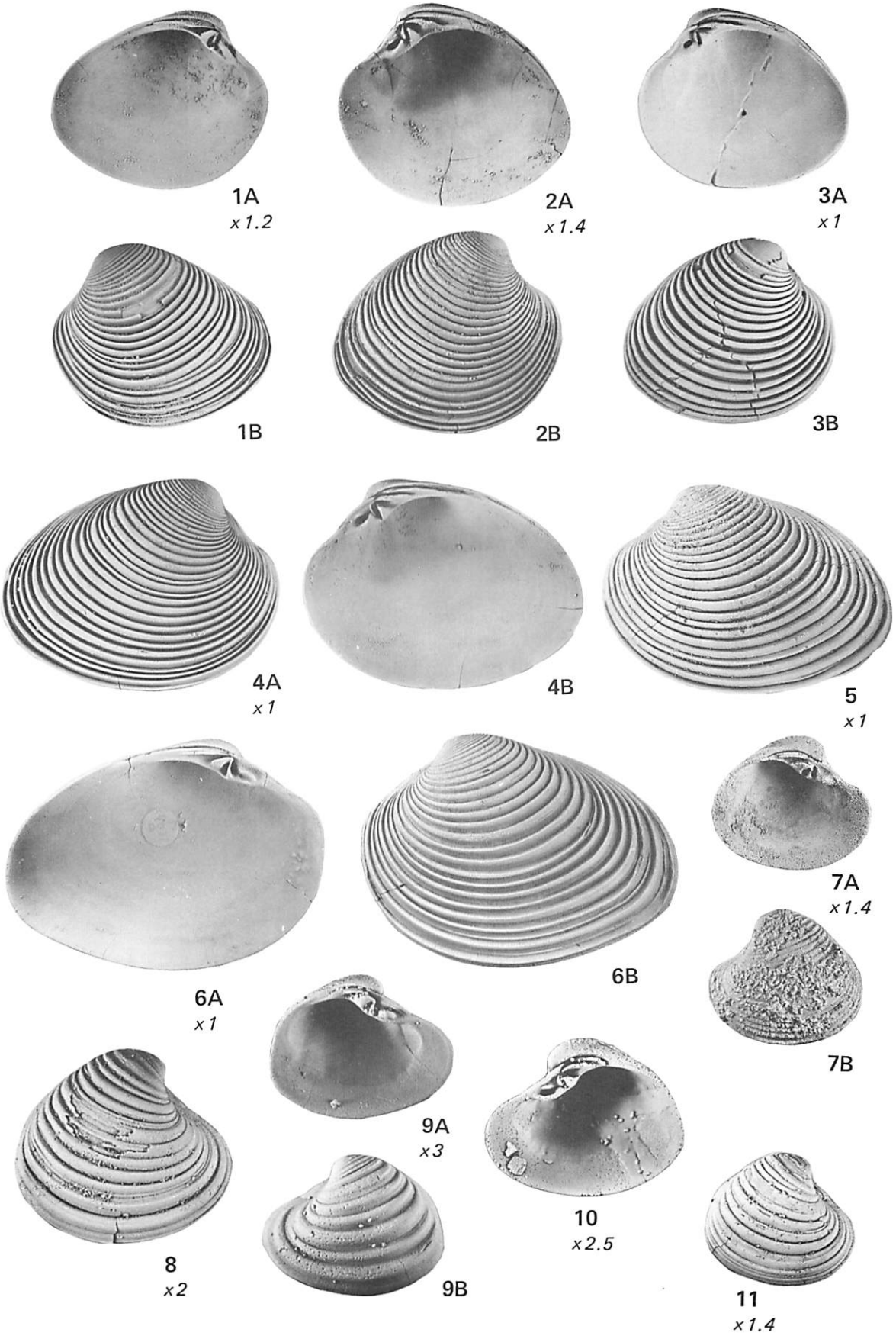
PLATE 43


1A
x 1.2
1B
2A
x 2
2B
3A
x 3
3B
4A
x 3
4B
5A
x 1
5B
6A
x 2.5
7A
x 1.4
7B
6B
8
x 1.2
9A
x 1.2
9B
10
x 1.4
11A
x 1
11B
12A
x 1
12B

EXPLANATION PLATE 44

Figure		Page
1-3	**Pitar (Lamelliconcha) protena** n. sp.	86-88
	1. Left valve; height 26.1 mm, length 30.1 mm, inflation 8.8 mm; Mint Spring Fm., locality 108. MGS 963.	
	2. Right valve; height 24.7 mm, length 28.6 mm, inflation 7.8 mm; Mint Spring Fm., locality 100. MGS 964.	
	3. Right valve; height 31.2 mm, length 36.1 mm, inflation 10.1 mm; Byram Fm., locality 106. MGS 965.	
4-6	**Pitar (Lamelliconcha) megacostata** n. sp.	88
	4. Right valve; height 36.1 mm, length 47.5 mm, inflation 11.1 mm; Mint Spring Fm., locality 99. MGS 966.	
	5. Left valve; height 34.4 mm, length 48.9 mm, inflation 11.1 mm; Mint Spring Fm., locality 99. MGS 967.	
	6. Left valve; height 40.0 mm, length 54.0 mm, inflation 11.9 mm; Mint Spring Fm., USGS locality 14071a. Holotype USNM 340480.	
7	**Pitar (Lamelliconcha) silicifluvia** (Dall, 1916)	88-90
	Left valve; height 16.6 mm, length 19.2 mm, inflation 7.5 mm; Flint River Formation, Flint River, Decatur Co., Georgia, USGS locality 7096. Holotype USNM 166718.	
8-11	**Pitar (Lamelliconcha) calcanea** (Dall, 1903)	88
	8. Right valve; height 17.0 mm, length 18.6 mm, inflation 6.6 mm; Mint Spring Fm., locality 108. MGS 968.	
	9. Left valve; height 8.1 mm, length 10.3 mm, inflation 3.2 mm; Mint Spring Fm., locality 100. MGS 969.	
	10. Right valve; height 11.0 mm, length 13.3 mm, inflation 4.6 mm; Mint Spring Fm., locality 99. MGS 970.	
	11. Right valve; height 16.4 mm, length 18.3 mm, inflation 6.8 mm; Mint Spring Fm., locality 108. MGS 971.	

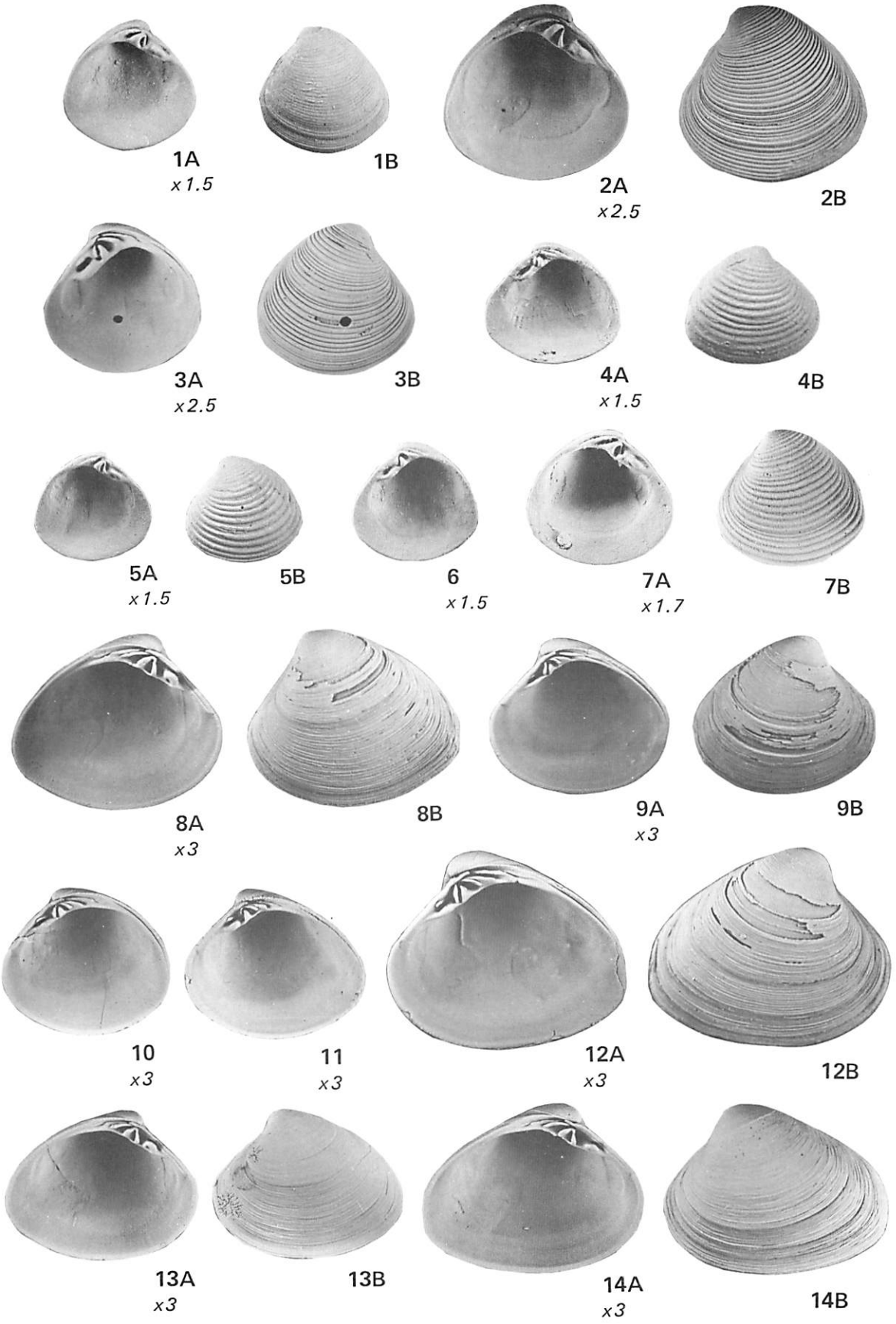
PLATE 44


1A
x 1.2
2A
x 1.4
3A
x 1
1B
2B
3B
4A
x 1
4B
5
x 1
6A
x 1
6B
7A
x 1.4
7B
9A
x 3
8
x 2
9B
10
x 2.5
11
x 1.4

EXPLANATION PLATE 45

Figure		Page
1-3	**Pitar (Lamelliconcha) perbrevis** (Conrad, 1848)	91
	1. Left valve; height 14.5 mm, length 14.5 mm, inflation 5.0 mm; Vicksburg, Mississippi. Holotype ANSP 30657.	
	2. Left valve; height 12.1 mm, length 12.6 mm, inflation 4.4 mm; Byram Fm., locality 106. MGS 972.	
	3. Right valve; height 10.3 mm, length 10.5 mm, inflation 3.7 mm; Byram Fm., locality 106. MGS 973.	
4-7	**Pitar (Lamelliconcha) astartiformis** (Conrad, 1848)	90-91
	4. Right valve; height 13.5 mm, length 15.0 mm, inflation 4.2 mm; Vicksburg, Mississippi. Holotype ANSP 4144.	
	5. Left valve; height 12.0 mm, length 13.0 mm, inflation 3.7 mm; Vicksburg, Mississippi. Paratype B, ANSP 4144.	
	6. Right valve; height 13.5 mm, length 14.0 mm, inflation 4.5 mm; Vicksburg, Mississippi. Paratype C, ANSP 4144.	
	7. Left valve; height 14.1 mm, length 15.1 mm, inflation 4.4 mm; Byram Fm., locality 116. MGS 974.	
8-14	**Pitar aldrichi** n. sp.	91
	8. Left valve; height 9.9 mm, length 11.8 mm, inflation 3.5 mm; Red Bluff Fm., locality 37. MGS 975.	
	9. Right valve; height 8.7 mm, length 10.0 mm, inflation 2.9 mm; Red Bluff Fm., locality 37. MGS 976.	
	10. Right valve; height 8.3 mm, length 9.4 mm, inflation 2.7 mm; Red Bluff Fm., locality 38b. MGS 977.	
	11. Right valve; height 8.5 mm, length 10.1 mm, inflation 3.0 mm; Red Bluff Fm., locality 38b. MGS 978.	
	12. Right valve; height 11.2 mm, length 13.5 mm, inflation 3.9 mm; Red Bluff Fm., locality 37. Holotype USNM 340480.	
	13. Left valve; height 8.4 mm, length 10.6 mm, inflation 2.9 mm; Red Bluff Fm., locality 38b. MGS 979.	
	14. Left valve; height 9.6 mm, length 12.5 mm, inflation 3.6 mm; Red Bluff Fm., locality 38b. MGS 980.	

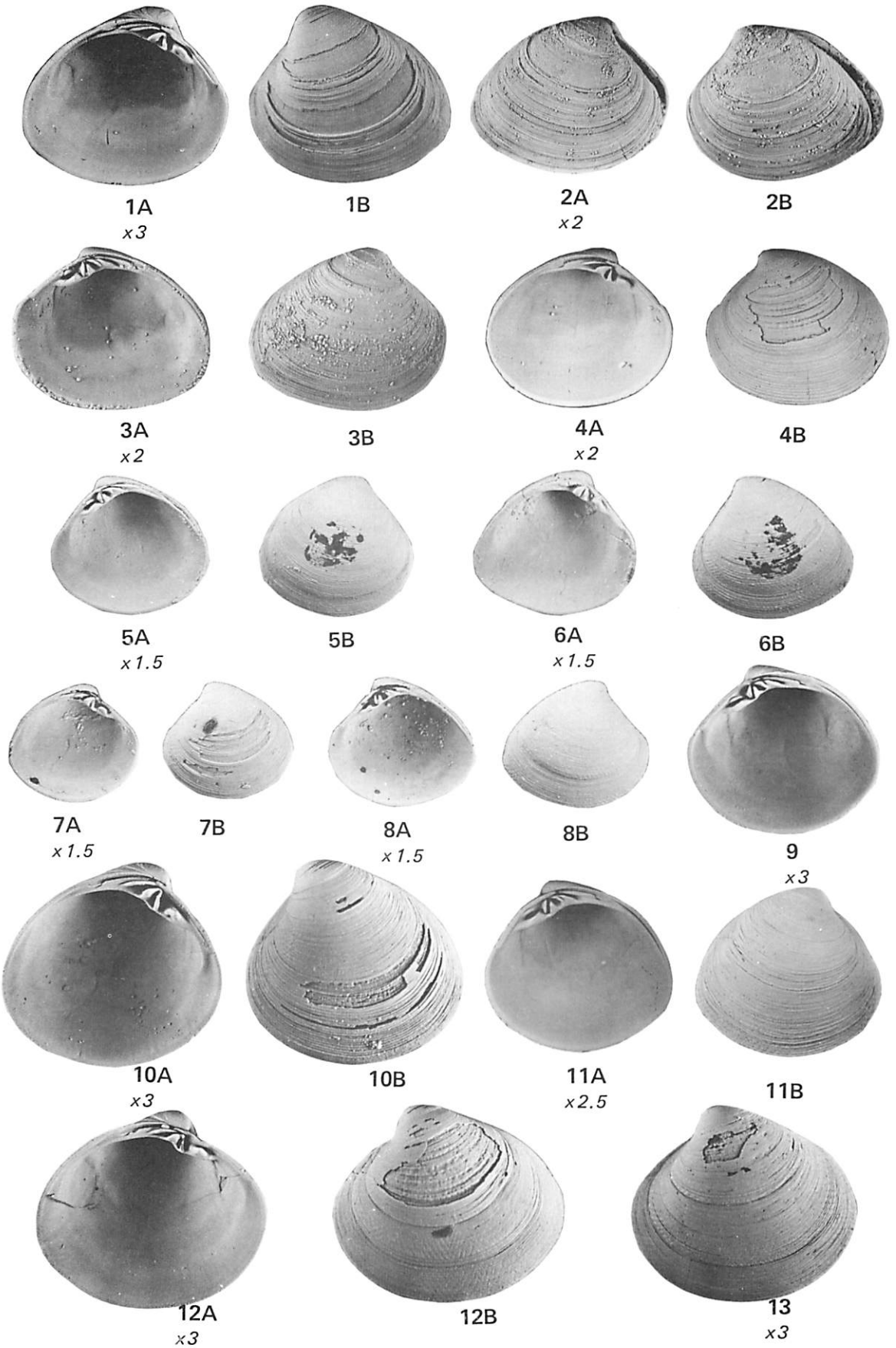
PLATE 45


1A
x 1.5
1B
2A
x 2.5
2B
3A
x 2.5
3B
4A
x 1.5
4B
5A
x 1.5
5B
6
x 1.5
7A
x 1.7
7B
8A
x 3
8B
9A
x 3
9B
10
x 3
11
x 3
12A
x 3
12B
13A
x 3
13B
14A
x 3
14B

EXPLANATION PLATE 46

Figure		Page
1-4	**Pitar aldrichi** n. sp.	91
	1. Left valve; height 9.9 mm, length 11.3 mm, inflation 3.5 mm; Red Bluff Fm., locality 37. MGS 981.	
	2. Both valves; height 16.4 mm, length 19.7 mm; Mint Spring Fm., locality 100. MGS 982.	
	3. Right valve; height 13.8 mm, length 17.0 mm, inflation 4.6 mm; Mint Spring Fm., locality 99. MGS 983.	
	4. Left valve; height 13.4 mm, length 15.6 mm, inflation 4.3 mm; Mint Spring Fm., locality 90. MGS 984.	
5-13	**Pitar (Hyphantosoma) semipunctata** (Conrad, 1848)	85-86
	5. Right valve; height 15.0 mm, length 18.0 mm, inflation 5.0 mm; Vicksburg, Mississippi. Holotype ANSP 30658.	
	6. Left valve; height 16.5 mm, length 18.5 mm, inflation 5.5 mm; Vicksburg, Mississippi. Paratype B, ANSP 30658.	
	7. Left valve; height 13.0 mm, length 15.0 mm, inflation 4.5 mm; Vicksburg, Mississippi. Paratype D, ANSP 30658.	
	8. Right valve; height 14.0 mm, length 12.0 mm, inflation 5.0 mm; Vicksburg, Mississippi. Paratype C, ANSP 30658.	
	9. Right valve; height 9.4 mm, length 10.7 mm, inflation 3.1 mm; Byram Fm., locality 93. MGS 985.	
	10. Left valve; height 11.9 mm, length 12.5 mm, inflation 3.9 mm; Byram Fm., locality 93. MGS 986.	
	11. Right valve; height 11.7 mm, length 12.6 mm, inflation 3.8 mm; Byram Fm., locality 106. MGS 987.	
	12. Left valve; height 11.5 mm, length 13.2 mm, inflation 3.8 mm; Byram Fm., locality 93. MGS 988.	
	13. Left valve; height 11.3 mm, length 12.6 mm, inflation 3.9 mm; Byram Fm., locality 93. MGS 989.	

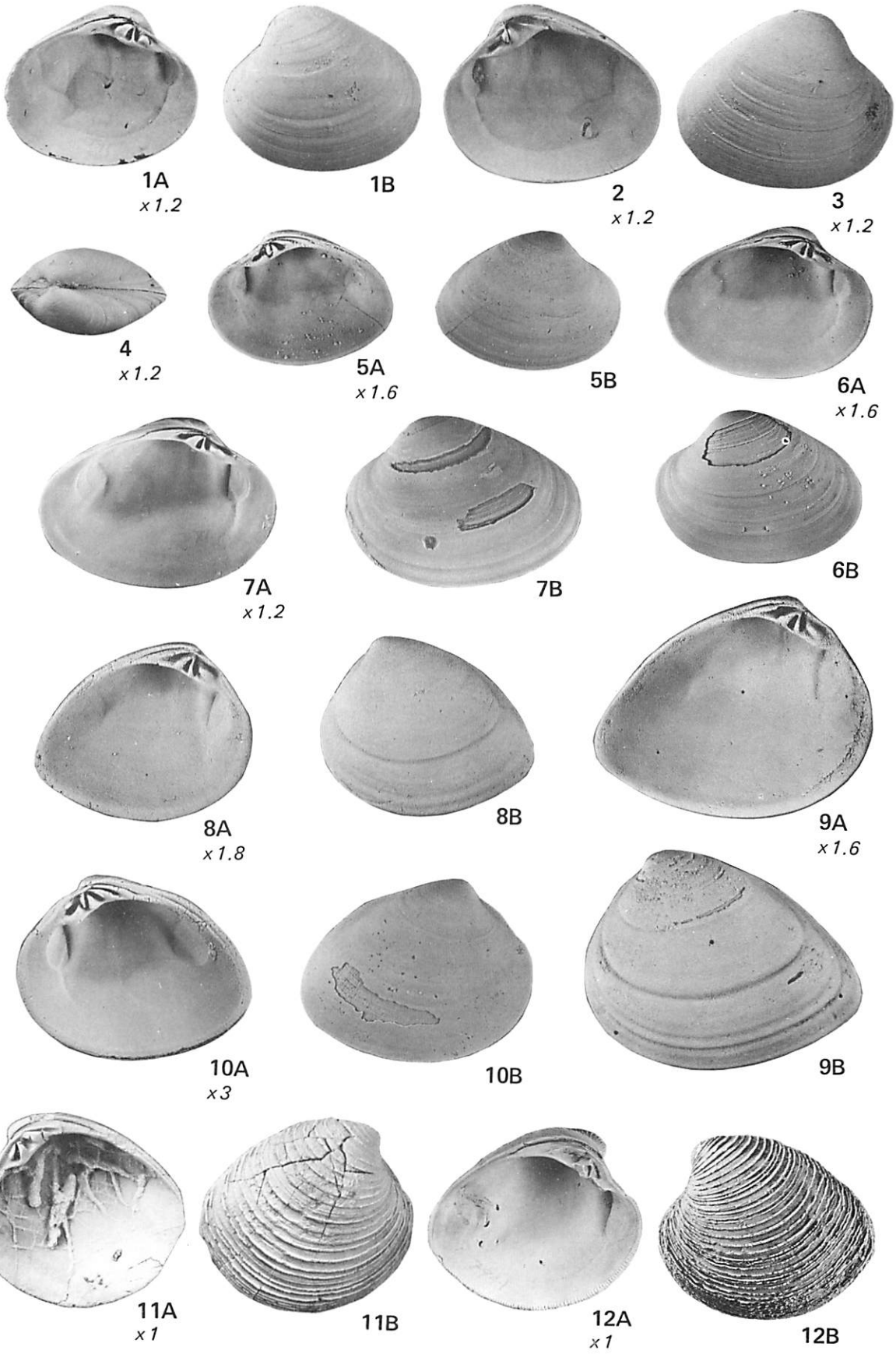
PLATE 46


1A
x3
1B
2A
x2
2B
3A
x2
3B
4A
x2
4B
5A
x1.5
5B
6A
x1.5
6B
7A
x1.5
7B
8A
x1.5
8B
9
x3
10A
x3
10B
11A
x2.5
11B
12A
x3
12B
13
x3

EXPLANATION PLATE 47

Figure		Page
1-7	**Callista (Callista) sobrina** (Conrad, 1848)	91-92
	1. Left valve; height 22.5 mm, length 26.5 mm, inflation 7.6 mm; Vicksburg, Mississippi. Holotype ANSP 30661.	
	2. Right valve; height 24.5 mm, length 30.0 mm, inflation 7.3 mm; Vicksburg, Mississippi. Paratype B, ANSP 30662.	
	3. Right valve; height 24.5 mm, length 30.0 mm, inflation 8.5 mm; Vicksburg, Mississippi. Paratype C, ANSP 30662.	
	4. Both valves showing hinge; height 17.7 mm, length 21.7 mm, inflation of both valves 12.0 mm; Vicksburg, Mississippi. Paratype D, ANSP 30662.	
	5. Right valve; height 14.5 mm, length 19.4 mm, inflation 5.0 mm; Mint Spring Fm., locality 100. MGS 990.	
	6. Left valve; height 16.2 mm, length 21.6 mm, inflation 5.2 mm; Mint Spring Fm., locality 100. MGS 991.	
	7. Left valve; height 23.7 mm, length 33.0 mm, inflation 7.9 mm; Mint Spring Fm., locality 99. MGS 992.	
8-10	**Callista (Callista) goniopisthus** n. sp.	92-94
	8. Left valve; height 16.4 mm, length 20.0 mm, inflation 4.8 mm; Mint Spring Fm., locality 100. MGS 993.	
	9. Left valve; height 23.3 mm, length 28.5 mm, inflation 6.1 mm; Mint Spring Fm., locality 99. Holotype USNM 340482.	
	10. Right valve; height 10.0 mm, length 13.0 mm, inflation 3.0 mm; Mint Spring Fm., locality 89. MGS 994.	
11-12	**Chamelea mississippiensis** (Conrad, 1848)	95-96
	11. Right valve; height 32.0 mm, length 35.0 mm, inflation 9.5 mm; Byram Fm., Vicksburg, Mississippi. Holotype ANSP 30660.	
	12. Left valve; height 31.7 mm, length 36.1 mm, inflation 11.5 mm; Byram Fm., USGS locality 7941. USNM 340486.	

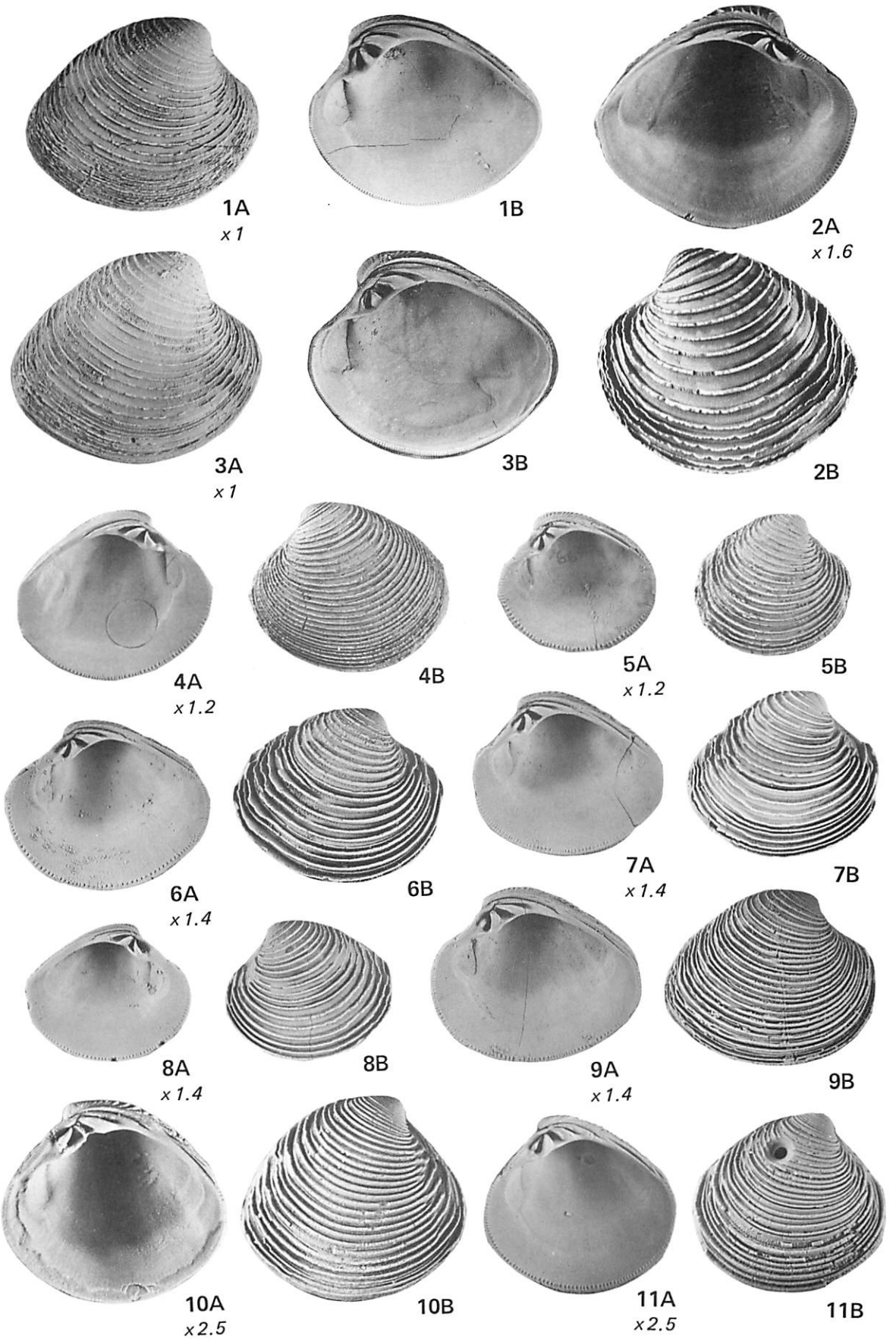
PLATE 47


1A
x 1.2
1B
2
x 1.2
3
x 1.2
4
x 1.2
5A
x 1.6
5B
6A
x 1.6
7A
x 1.2
7B
6B
8A
x 1.8
8B
9A
x 1.6
10A
x 3
10B
9B
11A
x 1
11B
12A
x 1
12B

EXPLANATION PLATE 48

Figure		Page
1-3	**Chamelea mississippiensis** (Conrad, 1848)	95-96
	1. Right valve; height 33.3 mm, length 40.1 mm, inflation 11.0 mm; Byram Fm., locality 106. MGS 995.	
	2. Left valve; height 24.0 mm, length 28.0 mm, inflation 9.0 mm; Byram Fm., locality 116. MGS 996.	
	3. Right valve; height 36.2 mm, length 43.2 mm, inflation 13.5 mm; Byram Fm., locality 106. MGS 997.	
4-9	**Chione (Chione) craspedonia** (Dall, 1903)	94
	4. Left valve; height 20.6 mm, length 25.1 mm, inflation 7.9 mm; Mint Spring Fm., Vicksburg, Mississippi. Holotype USNM 136738.	
	5. Right valve; height 20.0 mm, length 22.3 mm, inflation 6.9 mm; Mint Spring Fm., USGS locality 6647a. USNM 340483.	
	6. Right valve; height 21.7 mm, length 25.5 mm, inflation 7.2 mm; Mint Spring Fm., locality 108. MGS 998.	
	7. Right valve; height 20.3 mm, length 23.5 mm, inflation 6.8 mm; Mint Spring Fm., locality 108. MGS 999.	
	8. Left valve; height 17.3 mm, length 20.1 mm, inflation 5.8 mm; Mint Spring Fm., locality 108. MGS 1000.	
	9. Right valve; height 21.8 mm, length 26.0 mm, inflation 7.4 mm; Mint Spring Fm., locality 108. MGS 1001.	
10-11	**Chione (Chione) perbrevisformis** n. sp.	94
	10. Right valve; height 14.2 mm, length 15.6 mm, inflation 4.8 mm; Byram Fm., locality 106. MGS 1002.	
	11. Right valve; height 12.5 mm, length 13.2 mm, inflation 3.8 mm; Byram Fm., locality 106. Holotype USNM 340484.	

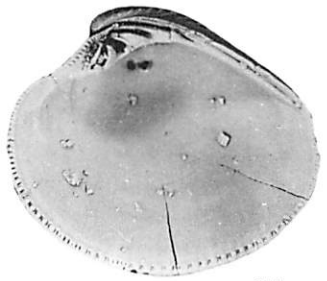
PLATE 48


1A
x 1
1B
2A
x 1.6
3A
x 1
3B
2B
4A
x 1.2
4B
5A
x 1.2
5B
6A
x 1.4
6B
7A
x 1.4
7B
8A
x 1.4
8B
9A
x 1.4
9B
10A
x 2.5
10B
11A
x 2.5
11B

EXPLANATION PLATE 49

Figure		Page
1-5	**Chione (Chione) bainbridgensis** Dall, 1916	94-95
	1. Right valve; height 17.2 mm, length 20.3 mm, inflation 5.8 mm; Byram Fm., locality 106. MGS 1003.	
	2. Left valve; height 28.7 mm, length 32.6 mm, inflation 9.4 mm; Byram Fm., locality 93. MGS 1004.	
	3. Right valve; height 12.9 mm, length 14.5 mm, inflation 4.5 mm; Byram Fm., locality 106. MGS 1005.	
	4. Left valve; height 15.2 mm, length 17.5 mm, inflation 5.6 mm; Byram Fm., locality 93. MGS 1006.	
	5. Left valve; height 24.1 mm, length 28.0 mm, inflation 8.5 mm; Byram Fm., locality 106. MGS 1066.	
6-9	**Chione (Lirophora) victoria** Dall, 1903.	95
	6. Right valve; height 18.9 mm, length 22.8 mm, inflation (thickness is partially due to the lirae) 8.7 mm; Red Bluff Fm., locality 35b. MGS 1007.	
	7. Left valve; height 20.6 mm, length 25.1 mm, inflation 7.9 mm; probably from the Mint Spring Fm., USGS locality 3140. Holotype 155311 USNM.	
	8. Left valve; height 23.6 mm, length 29.3 mm, inflation 8.0 mm; Mint Spring Fm., USGS locality 3723 = MGS locality 108. USNM 340485.	
	9. Both valves; height 16.6 mm, length 20.0 mm, inflation of both valves (thickness is partially due to lirae) 13.1 mm; Mint Spring Fm., locality 99. MGS 1008.	
10-11	**Corbula (Caryocorbula) engonata** Conrad, 1848	96-97
	10. Right valve; height 4.6 mm, length 7.4 mm, inflation 1.7 mm; Mint Spring Fm., locality 108. MGS 1009.	
	11. Left valve; height 4.4 mm, length 7.5 mm, inflation 1.9 mm; Mint Spring Fm., locality 108. MGS 1010.	

PLATE 49



1A
x 2

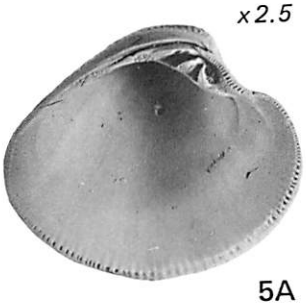
1B

2
x 1.2

3A
x 2.5

3B

4
x 2



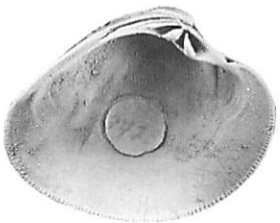
5A
x 1.4

5B

6
x 1.2

7A
x 1.2

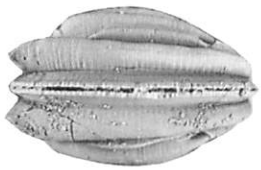
7B



8A
x 1.2

8B

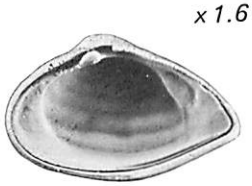
9A
x 1.6



9B

9C

9D



10A
x 4

10B

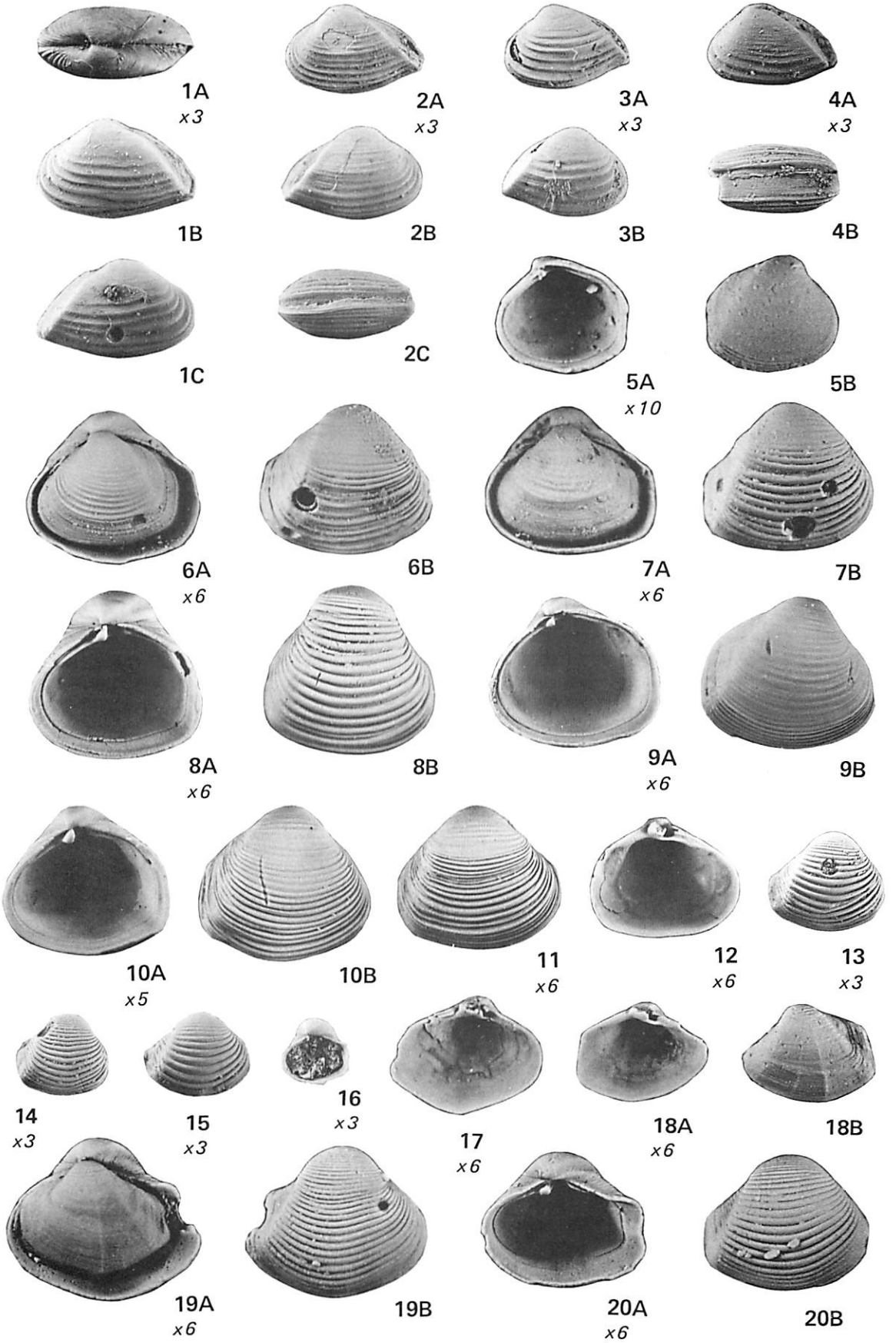
11A
x 4

11B

EXPLANATION PLATE 50

Figure		Page
1-4	**Corbula (Caryocorbula) engonata** Conrad, 1848	96-97
	1. Both valves; height 5.3 mm, length 9.0 mm, inflation of both valves 4.2 mm; Vicksburg, Mississippi. Syntype A, ANSP 30676.	
	2. Both valves; height 5.0 mm, length 8.0 mm, inflation of both valves 4.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 30676.	
	3. Both valves; height 4.7 mm, length 7.1 mm, inflation of both valves 3.5 mm; Vicksburg, Mississippi. Syntype C, ANSP 30676.	
	4. Both valves, 4B with right valve up; height 4.8 mm, length 7.2 mm, inflation of both valves 3.8 mm; Vicksburg, Mississippi. Syntype D, ANSP 30676.	
5-12	**Corbula (Vokesula) rufaripa** n. sp.	98
	5. Right valve; height 2.0 mm, length 2.3 mm; Mint Spring Fm., locality 99. MGS 1011.	
	6. Both valves; height 4.0 mm, length 4.6 mm, inflation of both valves 3.2 mm; Red Bluff Fm., locality 38b. MGS 1012.	
	7. Both valves; height 4.0 mm, length 4.6 mm, inflation of both valves 3.6 mm; Red Bluff Fm., locality 38b. MGS 1013.	
	8. Right valve; height 4.6 mm, length 4.6 mm, inflation 2.2 mm; Red Bluff Fm., locality 34b. MGS 1014.	
	9. Right valve; height 4.1 mm, length 4.7 mm, inflation 1.8 mm; Red Bluff Fm., locality 34b. MGS 1015.	
	10. Right valve; height 5.0 mm, length 5.5 mm, inflation 2.4 mm; Red Bluff Fm., locality 38b. Holotype USNM 340487.	
	11. Right valve; height 3.9 mm, length 4.5 mm, inflation 1.9 mm; Red Bluff Fm., locality 34b. MGS 1016.	
	12. Left valve; height 3.3 mm, length 3.9 mm, inflation 1.5 mm; Red Bluff Fm., locality 34b. MGS 1017.	
13-20	**Corbula (Varicorbula) laqueata** Casey, 1903	97-98
	13. Right valve; height 5.2 mm, length 6.3 mm, inflation 3.2 mm; Vicksburg, Mississippi. Syntype A of Conrad ANSP 20047.	
	14. Right valve; height 4.3 mm, length 5.0 mm, inflation 2.5 mm; Vicksburg, Mississippi. Syntype B of Conrad ANSP 20047.	
	15. Right valve; height 4.6 mm, length 5.6 mm, inflation 3.0 mm; Vicksburg, Mississippi. Syntype C of Conrad ANSP 20047.	
	16. Right valve; height 3.5 mm, length 3.5 mm, inflation 2.0 mm; Vicksburg, Mississippi. Syntype D of Conrad ANSP 20047.	
	17. Left valve; height 3.0 mm, length 4.0 mm, inflation 1.1 mm; Mint Spring Fm., locality 99. MGS 1018.	
	18. Left valve; height 2.5 mm, length 3.4 mm, inflation 1.1 mm; Mint Spring Fm., locality 99. MGS 1019.	
	19. Both valves; height 4.4 mm, length 5.1 mm, inflation of right valve 2.0 mm; Mint Spring Fm., locality 99. MGS 1020.	
	20. Right valve; height 3.6 mm, length 4.2 mm, inflation 1.9 mm; Mint Spring Fm., locality 99. MGS 1021.	

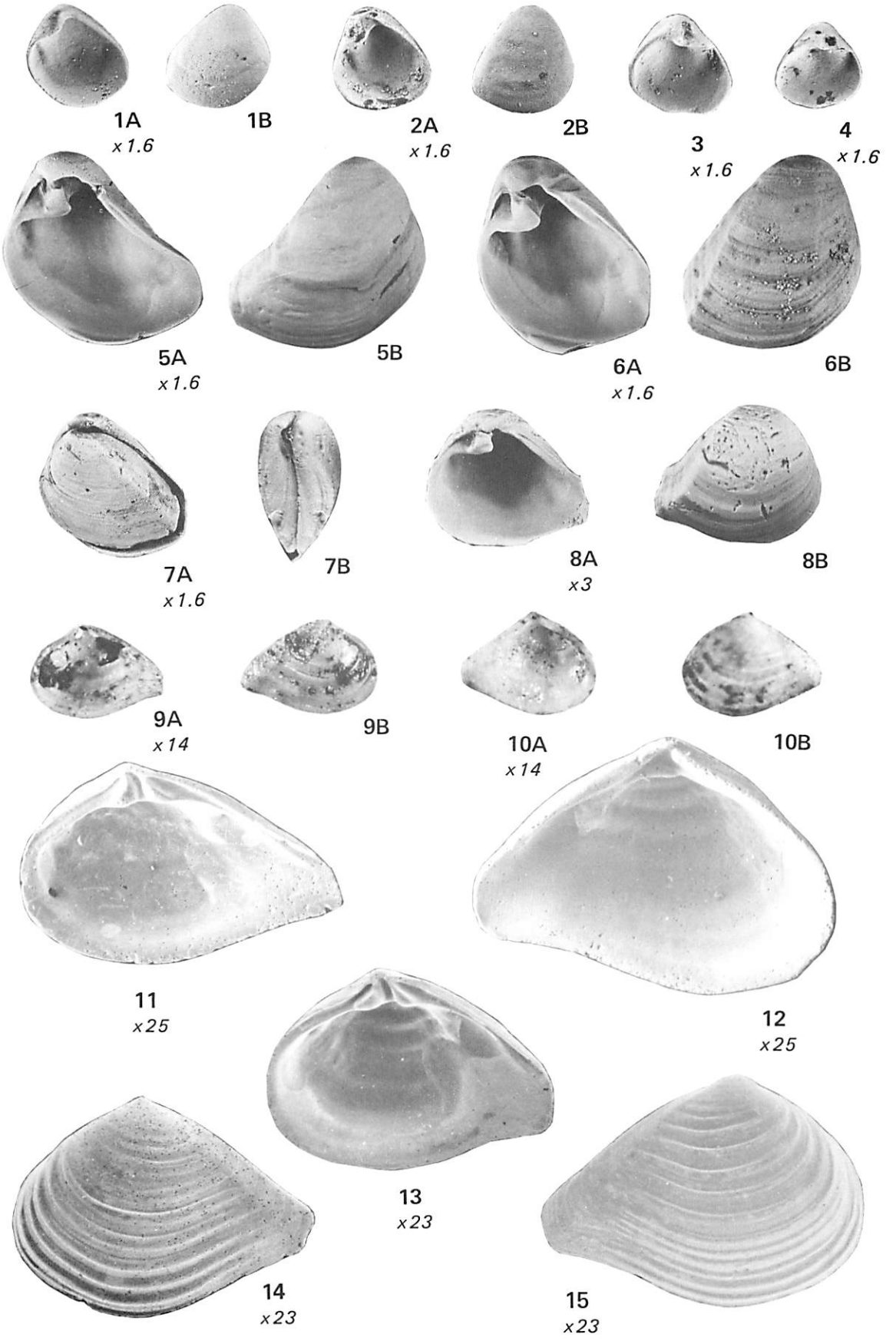
PLATE 50


1A
x3
2A
x3
3A
x3
4A
x3
1B
2B
3B
4B
1C
2C
5A
x10
5B
6A
x6
6B
7A
x6
7B
8A
x6
8B
9A
x6
9B
10A
x5
10B
11
x6
12
x6
13
x3
14
x3
15
x3
16
x3
17
x6
18A
x6
18B
19A
x6
19B
20A
x6
20B

EXPLANATION PLATE 51

Figure		Page
1-7	**Tiza alta** (Conrad, 1848)	98-100
	1. Right valve (badly worn); height 9.2 mm, length 11.3 mm, inflation 4.1 mm; Vicksburg, Mississippi. Syntype A, ANSP 17362.	
	2. Right valve (badly worn); height 9.7 mm, length 11.2 mm, inflation 4.0 mm; Vicksburg, Mississippi. Syntype B, ANSP 17362.	
	3. Left valve (badly worn); height 9.6 mm, length 11.0 mm, inflation 4.4 mm; Vicksburg, Mississippi. Syntype C, ANSP 17362.	
	4. Left valve (badly worn); height 9.0 mm, length 8.6 mm, inflation 4.4 mm; Vicksburg, Mississippi. Syntype D, ANSP 17362.	
	5. Right valve; height 20.9 mm, length 21.6 mm, inflation 9.4 mm; Mint Spring Fm., locality 97. MGS 1022.	
	6. Right valve; height 20.5 mm, length 20.0 mm, inflation 10.2 mm; Mint Spring Fm., locality 100. MGS 1023.	
	7. Both valves; height 15.3 mm, length 16.3 mm, inflation of both valves 9.1 mm; Mint Spring Fm., locality 101. MGS 1024.	
8	**Tiza sp.**	100
	Right valve; height 7.7 mm, length 9.2 mm, inflation 4.0 mm, Red Bluff Fm., locality 38b. MGS 1025.	
9-15	**Spheniopsis mississippiensis** (Meyer, 1887)	100-101
	9. Right valve; height 1.2 mm, length 1.5 mm; Red Bluff Fm., Red Bluff, Mississippi. Syntype USNM 645100.	
	10. Left valve; height 1.3 mm, length 1.6 mm; Red Bluff Fm., Red Bluff, Mississippi. Syntype USNM 645099.	
	11. Right valve; height 1.4 mm, length 2.2 mm, Red Bluff Fm., **Corbula** bed locality 34b. MGS 1026. SEM photograph by Pete Burkes.	
	12. Left valve; height 1.8 mm, length 2.5 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1027. SEM photograph by Pete Burkes.	
	13. Right valve; height 1.5 mm, length 2.2 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1028. SEM photograph by E. E. Russell.	
	14. Left valve; height 1.7 mm, length 2.7 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1029. SEM photograph by E. E. Russell.	
	15. Right valve; height 1.7 mm, length 2.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1030. SEM photograph by E. E. Russell.	

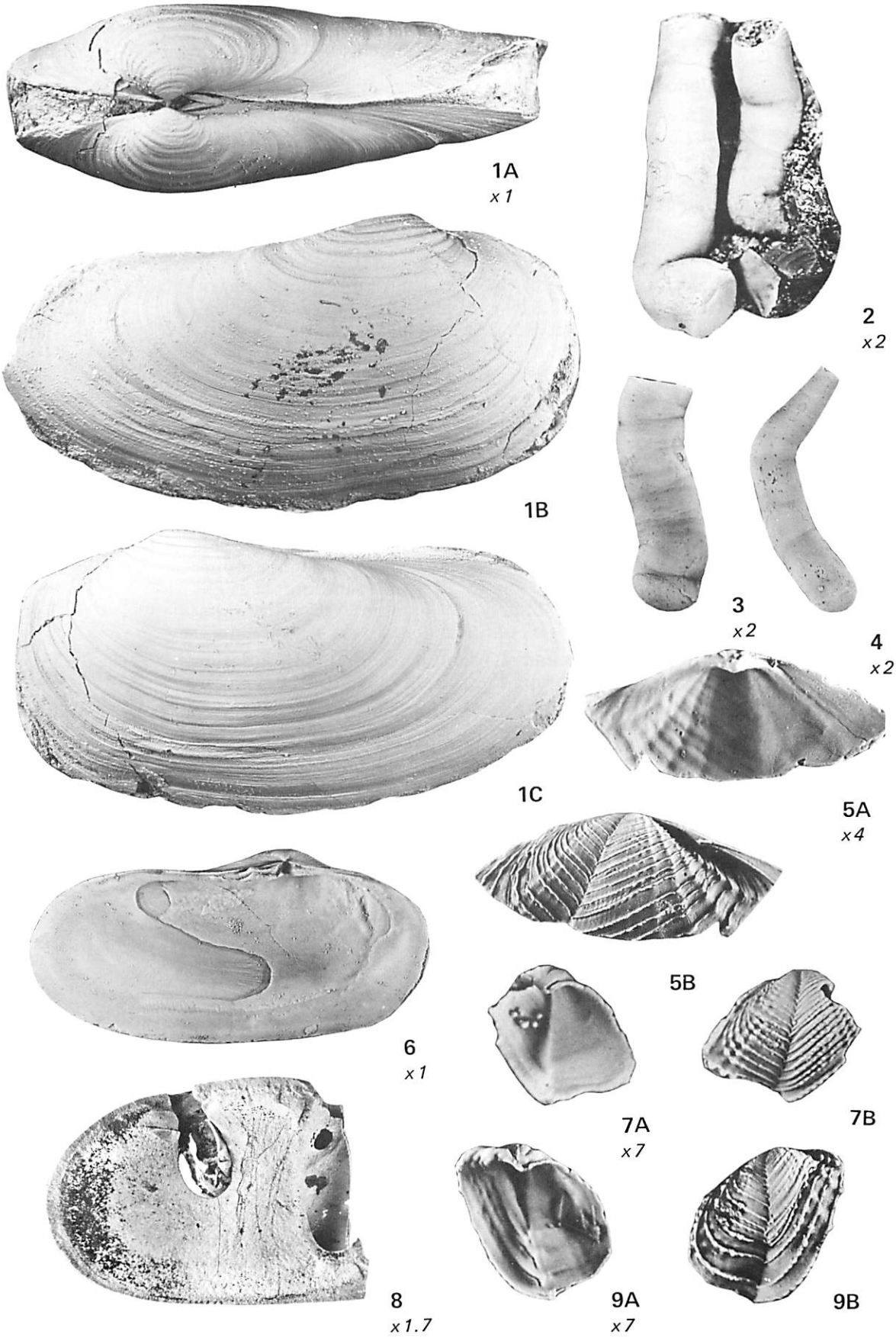
PLATE 51


1A
x 1.6
1B
2A
x 1.6
2B
3
x 1.6
4
x 1.6
5A
x 1.6
5B
6A
x 1.6
6B
7A
x 1.6
7B
8A
x 3
8B
9A
x 14
9B
10A
x 14
10B
11
x 25
12
x 25
13
x 23
14
x 23
15
x 23

EXPLANATION PLATE 52

Figure		Page
1,6	**Panopea (Panopea) oblongata** Conrad, 1848	101
	1. Both valves; height 47.0 mm, length 95.0 mm, inflation of both valves 32.7 mm; Vicksburg, Mississippi. Holotype ANSP 30643.	
	6. Left valve; height 33.4 mm, length 69.5 mm, inflation 12.0 mm; Mint Spring Fm., locality 99. MGS 1034.	
2-4	**Teredo** sp.	102
	2. Length of tube on the left side 25.0 mm, diameter 5.2 mm; Mint Spring Fm., locality 99. MGS 1031.	
	3. Length of tube 20.6 mm, diameter 5.6 mm; Marianna Ls., locality 91. MGS 1032.	
	4. Chord length of tube 21.0 mm, diameter 3.9 mm; Marianna Ls., locality 91. MGS 1033.	
5, 7-9	**Jouannetia (Pholadopsis) triquetra** (Conrad, 1848)	101-102
	5. Right valve (incomplete); length 13.0 mm; Byram Fm., locality 93. MGS 1034.	
	7. Right valve; height 3.1 mm, length 3.9 mm; Mint Spring Fm., locality 100. MGS 1036.	
	8. Length of rock fragment 32.5 mm; two valves are preserved in the middle bore hole; diameter of bore hole 5.0 mm; Mint Spring Fm., locality 74b. MGS 1031.	
	9. Right valve; height 4.0 mm, length 4.2; Red Bluff Fm., locality 34b. MGS 1038.	

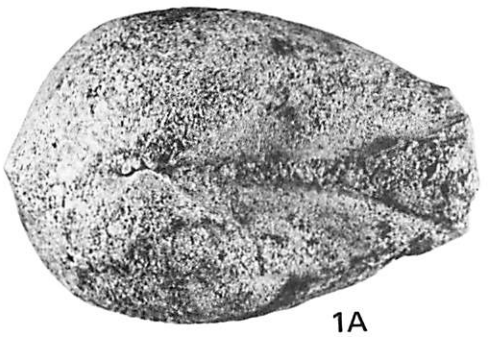
PLATE 52



EXPLANATION PLATE 53

Figure		Page
1	**Pholadomya** sp.	102
	Internal mold of both valves; height 51.0 mm, length 62.5 mm, inflation of both valves 42.0 mm; Glendon Ls., locality 45. MGS 1039.	
2-3	**Periploma macneili** n. sp.	102-103
	2. Right valve; height 23.0 mm, length 26.0 mm, inflation 6.2 mm; Mint Spring Fm., locality 99. MGS 1040.	
	3. Both valves; height 32.3 mm, length 39.0 mm, inflation of both valves 15.5 mm; Mint Spring Fm., USGS locality 14162. Holotype USNM 340488.	
4	**Thracia (Thracia) vicksburgiana** (Dall, 1903)	103
	Both valves; height 21.0 mm, length 35.0 mm, inflation of both valves 9.6 mm; Mint Spring Fm., USGS locality 14071a. USNM 340489.	
5-8	**Plectodon intastriata** (Conrad, 1848)	103-104
	5. Conrad's type was broken and repaired with the anterior portion cemented in a backwards position; in this figure the anterior portion has been placed in its proper position by cutting and rotating the photograph. Right valve; length 9.5 mm, height 5.0 mm; Vicksburg, Mississippi. Holotype ANSP 20353.	
	6. Right valve; height 4.8 mm, length 9.0 mm, inflation 2.0 mm; Mint Spring Fm., locality 90. MGS 1041.	
	7. Right valve; shell broken after being photographed; Mint Spring Fm., locality 99. MGS 1042.	
	8. Left valve; height 2.6 mm, length 3.8 mm, inflation 0.9 mm; Mint Spring Fm., locality 90. MGS 1043.	
9	**Cuspidaria (Tropidomya?)** sp.	103
	Left valve; height 2.5 mm, length 3.3 mm; Byram Fm., locality 93. MGS 1044.	

PLATE 53



1A
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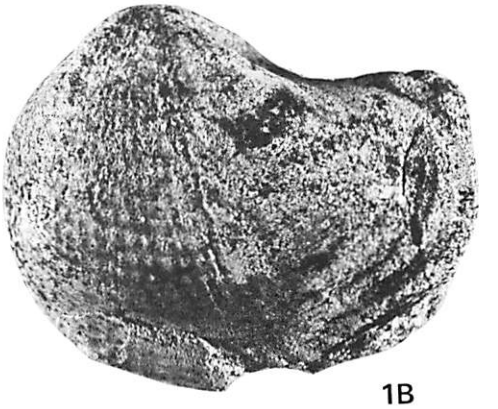
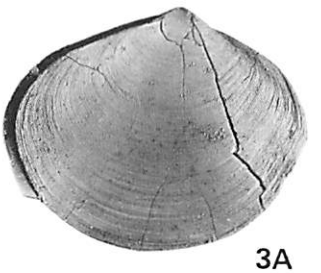


1B

2
x 1.4



3A
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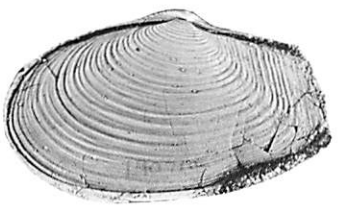
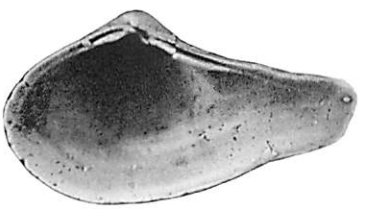
3B



4A
x 1.2

4B

5
x3



6A
x 5

6B

7
x 4

8A
x 7

8B

9A
x 10

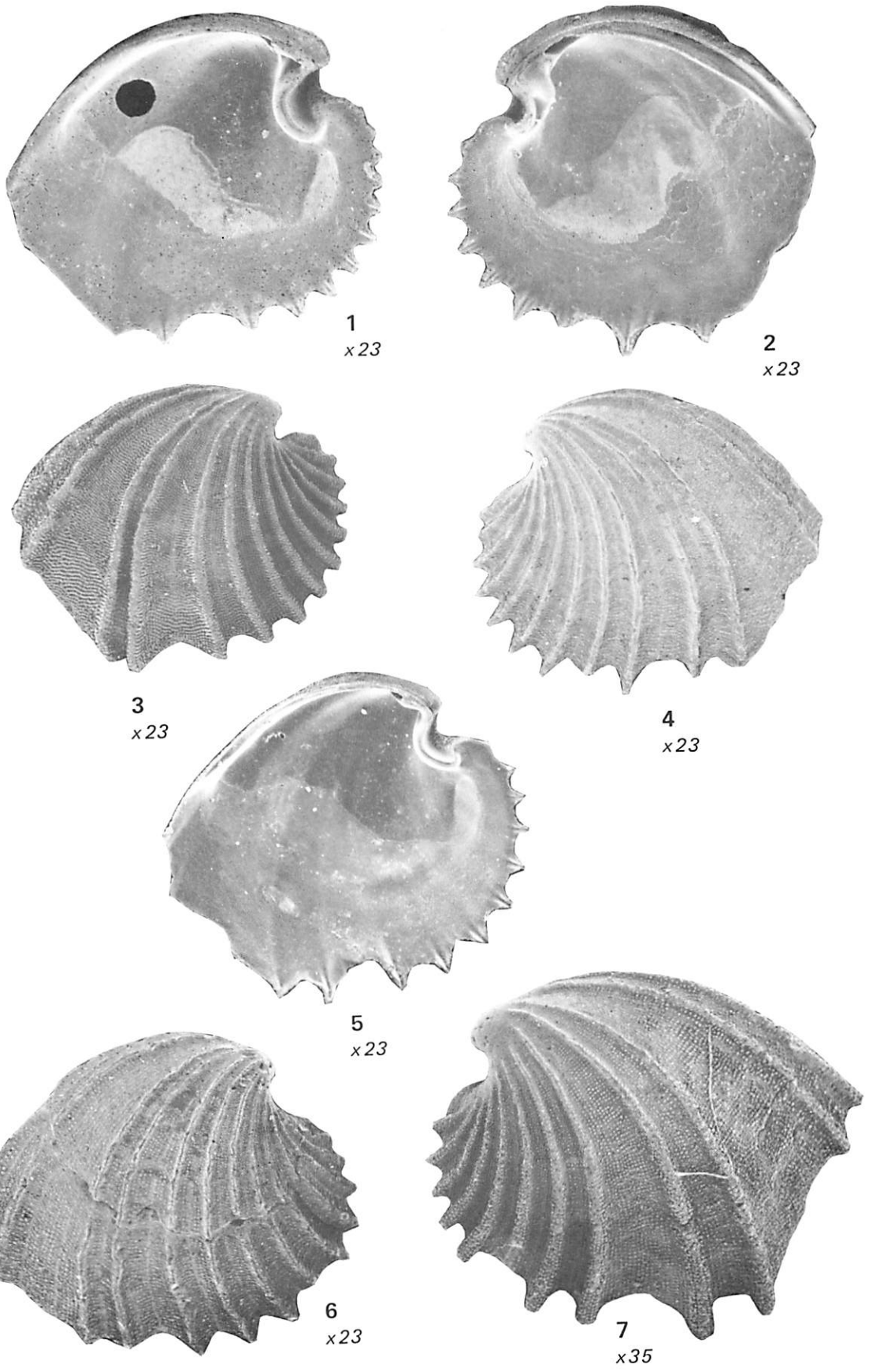
9B

EXPLANATION PLATE 54

Figure		Page
1-7	**Verticordia (Verticordia) dalliana** Aldrich, 1903	104

1. Left valve; height 2.4 mm, length 2.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1045. All SEM photographs on this plate are by E. E. Russell.
2. Right valve; height 2.6 mm, length 2.7 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1046.
3. Right valve; height 2.0 mm, length 2.5 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1047.
4. Left valve; height 2.2 mm, length 2.5 mm; Mint Spring Fm., locality 99. MGS 1048.
5. Left valve; height 2.4 mm, length 2.7 mm; Forest Hill Fm., locality 75a. MGS 1049.
6. Right valve; height 2.5 mm, length 2.8 mm; Mint Spring Fm., locality 99. MGS 1050.
7. Left valve; height 1.8 mm, length 21.1 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1051.

PLATE 54



1 x23

2 x23

3 x23

4 x23

5 x23

6 x23

7 x35

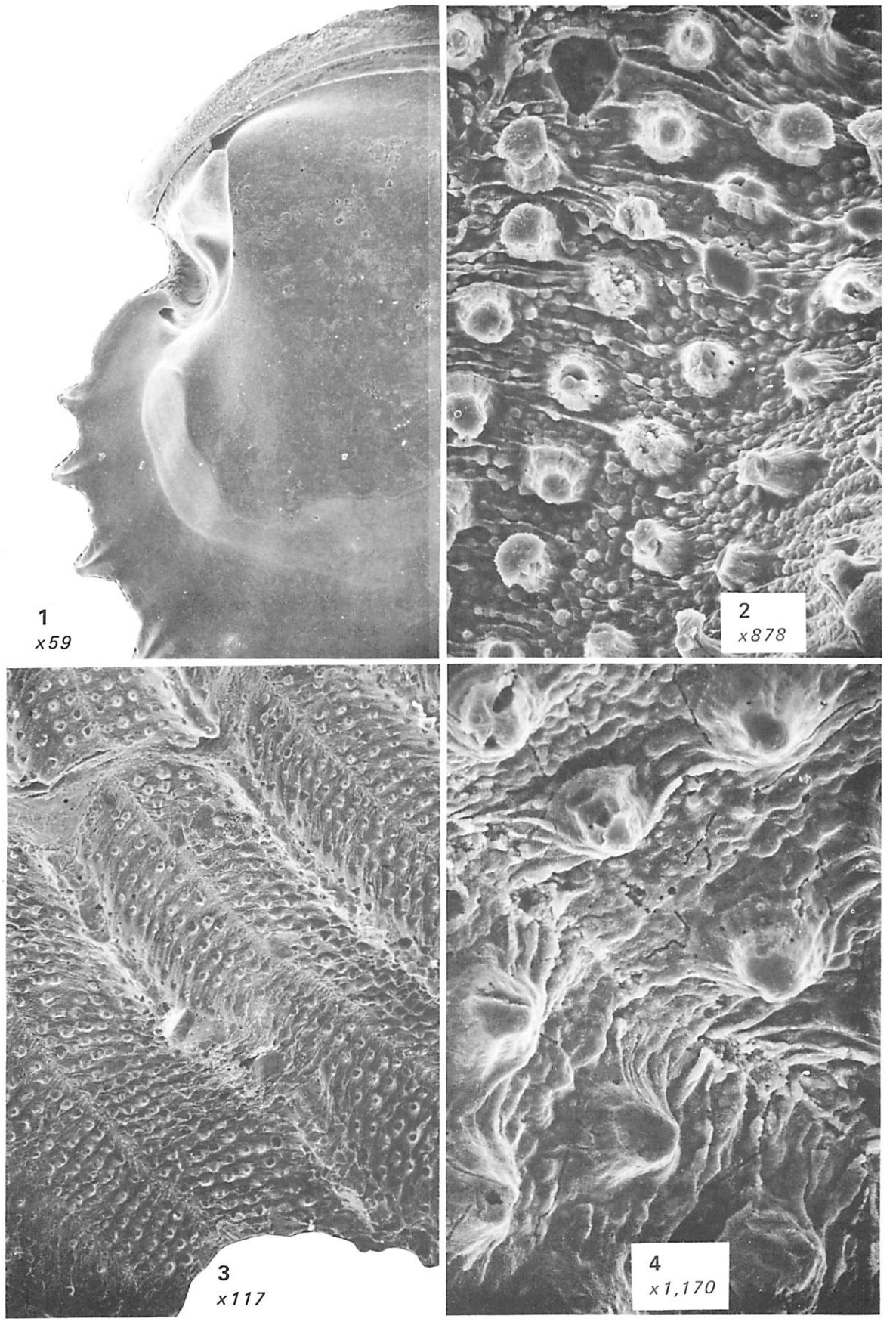
EXPLANATION PLATE 55

Figure		Page
1-4	**Verticordia (Verticordia) dalliana** Aldrich, 1903	104

1. Right valve; height 2.2 mm, length 2.6 mm; Forest Hill Fm., locality 75a. MGS 1052. All SEM photographs on this plate are by E. E. Russell.
2. Exterior microsculpture of specimen illustrated in plate 54, figure 7. Microsculpture consists of radially aligned, flat-topped columns and smaller intervening nodes.

3,4 Exterior microsculpture of specimen illustrated in Plate 54, figure 6.

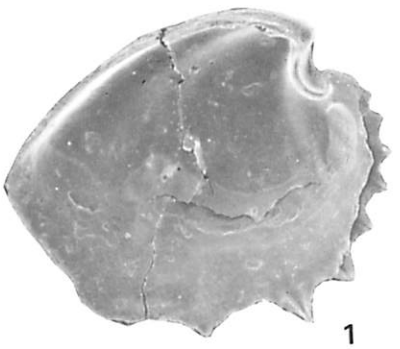
PLATE 55



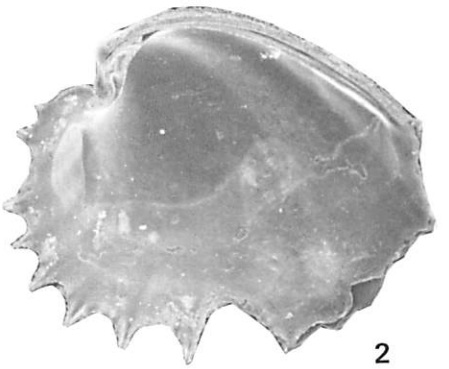
EXPLANATION PLATE 56

Figure		Page
1-2	**Verticordia (Verticordia) dalliana** Aldrich, 1903	104
	1. Left valve; height 1.8 mm, length 2.2 mm; Mint Spring Fm., locality 99. MGS 1053. SEM photograph by E. E. Russell.	
	2. Right valve; height 2.1 mm, length 2.5 mm; Mint Spring Fm., locality 99. MGS 1054. SEM photograph by E. E. Russell.	
3-10	**Haliris (Haliris) quadrangularis** (Aldrich, 1903)	104
	3. Right valve; height 6.6 mm, length 6.7 mm, inflation 3.2 mm; Red Bluff Fm., USGS locality 5264 = MGS locality 38b. USNM 340490.	
	4. Left valve; height 4.5 mm, length 4.9 mm, inflation 1.9 mm; Red Bluff Fm., USGS locality 5264. USNM 340491.	
	5. Right valve; height 5.6 mm, length 5. 7 mm, inflation 2.6 mm; Red Bluff Fm., USGS locality 5264. USNM 340492.	
	6. Left valve; height 6.6 mm, length 7.2 mm, inflation 2.8 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1055.	
	7. Left valve; height 5.8 mm, length 6.2 mm, inflation 2.3 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1056.	
	8. Right valve; height 5.5 mm, length 5.6 mm, inflation 2.4 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1057.	
	9. Left valve; height 5.3 mm, length 5.8 mm, inflation 2.2 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1058.	
	10. Right valve; height 5.3 mm, length 5.5 mm, inflation 2.3 mm; Red Bluff Fm., **Corbula** bed locality 34b. MGS 1059.	

PLATE 56



1
x 23



2
x 23

3A
x 3

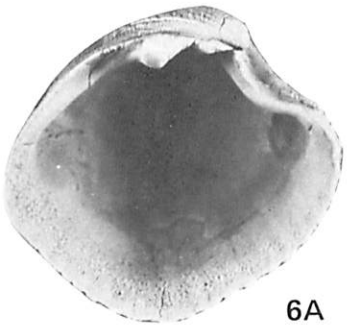
3B

4A
x 3

4B

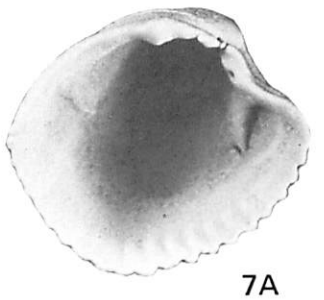
5A
x 3

5B

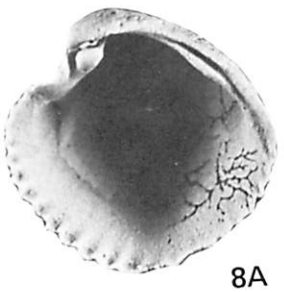


6A
x 6

6B



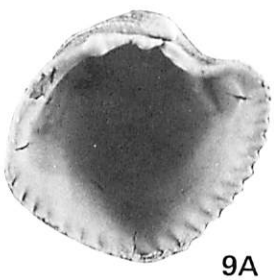
7A
x 6



8A
x 6

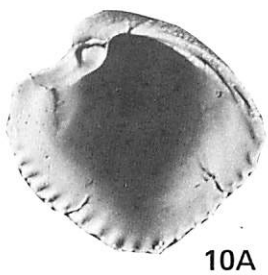
8B

7B



9A
x 6

9B



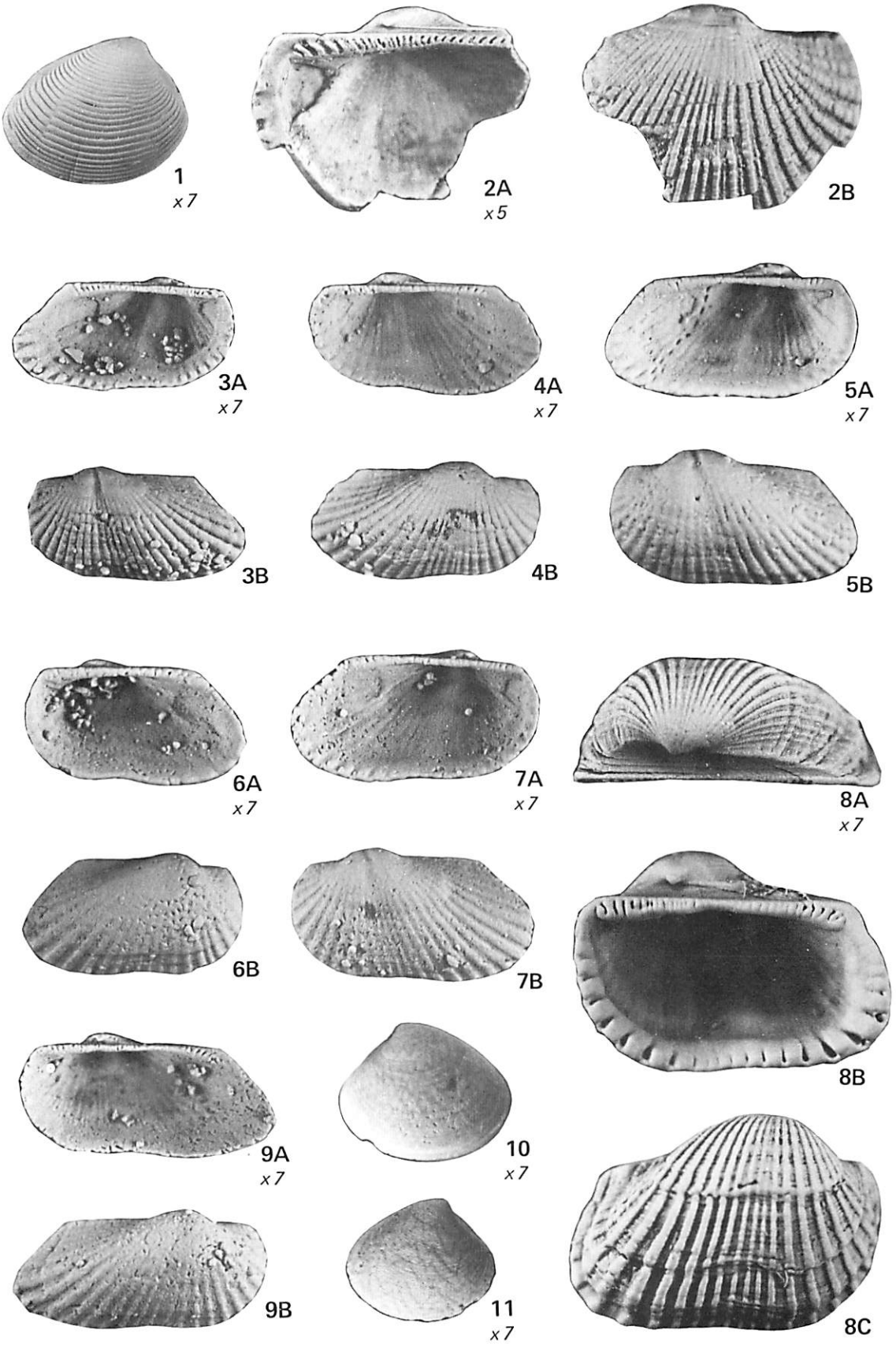
10A
x 6

10B

EXPLANATION PLATE 57

Figure		Page
1	**Nucula tallahalaensis** n. sp.	27
	Left valve; height 3.4 mm, length 4.2 mm, inflation 1.0 mm; Red Bluff Fm., locality 34b. MGS 1067.	
2	**Scapharca (Scapharca) invidiosa** (Casey, 1903)	32-33
	Right valve (incomplete); length of fragment 9.3 mm; Red Bluff Fm., Red Bluff, Mississippi. Holotype ANSP 990.	
3-7, 9	**Scapharca (Scapharca) delicatula** (Casey, 1903)	33-34
	3. Left valve; height 2.5 mm, length 4.9 mm, inflation 1.0 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype A (lectotype), ANSP 997.	
	4. Right valve; height 2.6 mm, length 5.3 mm, inflation 1.1 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype B, ANSP 997.	
	5. Left valve; height 3.0 mm, length 5.7 mm, inflation 1.2 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype C, ANSP 997.	
	6. Right valve; height 2.8 mm, length 5.0 mm, inflation 1.0 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype D, ANSP 997.	
	7. Left valve; height 2.9 mm, length 5.6 mm, inflation 1.0 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype E, ANSP 997.	
	9. Right valve; height 2.8 mm, length 5.8 mm, inflation 1.1 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype F, ANSP 997.	
8	**Scapharca (Scapharca)** sp.	34
	Right valve; height 5.1 mm, length 7.3 mm, inflation 2.9 mm; Red Bluff Fm., locality 37. MGS 1068.	
10-11	**Pitar aldrichi** n. sp.	91
	10. Left valve; height 3.2 mm, length 4.0 mm, inflation 0.9 mm; Mint Spring Fm., locality 99a. MGS 1069. Juvenile showing color pattern.	
	11. Right valve; height 2.8 mm, length 3.5 mm, inflation 0.8 mm; Mint Spring Fm., locality 99a. MGS 1070. Juvenile showing color pattern.	

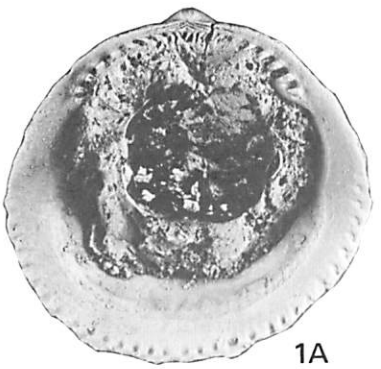
PLATE 57


1
x 7
2A
x 5
2B
3A
x 7
4A
x 7
5A
x 7
3B
4B
5B
6A
x 7
7A
x 7
8A
x 7
6B
7B
8B
9A
x 7
10
x 7
9B
11
x 7
8C

EXPLANATION PLATE 58

Figure		Page
1	**Glycymeris intercostata** (Gabb, 1860)	37-38
	Left valve; height 17.9 mm, length 18.5 mm, inflation 5.5 mm; number of primary ribs 21, total number of ribs at margin 65; locality labeled as Mississippi. Holotype ANSP 31431.	
2-4	**Glycymeris cookei** Dall, 1916	38
	2. Height 12.2 mm, width 13.1 mm; number of ribs 14; Flint River Fm., USGS locality 7075. Syntype C, USNM 166710.	
	3. Height 10.6 mm, width 11.1 mm, inflation 3.6 mm; number of ribs 17; Flint River Fm., USGS locality 7075. Syntype B, USNM 166710.	
	4. Height 13.0 mm, width (incomplete) 13.3 mm; number of primary ribs 12; Flint River Fm., USGS locality 7075. Syntype A, USNM 166710.	
5-6	**Chlamys (Aequipecten) redwoodensis** n. sp.	43
	5. Right valve; height 18.3 mm, width 19.1 mm, inflation 4.0 mm; Forest Hill Fm., locality 75a. MGS 1071.	
	6. Left valve; height 17.1 mm, width 16.7 mm, inflation 3.9 mm; Forest Hill Fm., locality 75a. MGS 1072.	
7-8, 11-12	**Spondylus (Spondylus) filiaris** Dall, 1916	50-51
	7. Fragment of right valve; greatest length 50.3 mm; Mint Spring Fm., locality 74b. MGS 1073.	
	8. Right valve (incomplete); height 50.7 mm; Mint Spring Fm., locality 75b. MGS 1074.	
	11. Incomplete juvenile valve; height 19.4 mm, length 17.2 mm; Flint River Fm., USGS locality 7078. Syntype B, USNM 166712.	
	12. Left valve; height 61.0 mm, width 57.0 mm; Flint River Fm., USGS locality 7078. Syntype A, USNM 166712.	
9	**Anomia microstriata** n. sp.	52
	Left valve; height 32.6 mm, length 30.4 mm; Mint Spring Fm., locality 75b. MGS 1075.	
10	**Arcoperna inflata** Dall, 1916	40
	Right valve; height 14.0 mm, length 17.3 mm, inflation 6.7 mm; Flint River Fm., USGS locality 7096. Holotype USNM 166714.	

PLATE 58



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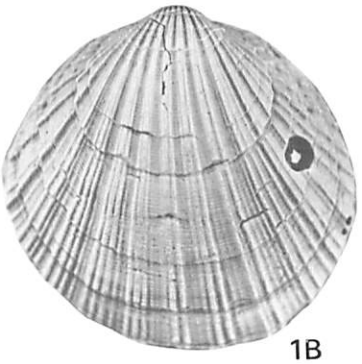
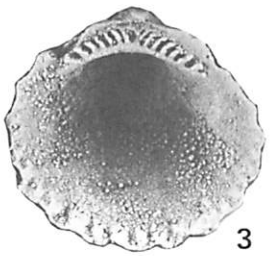


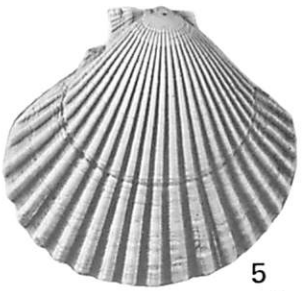
1B

2
x2.5

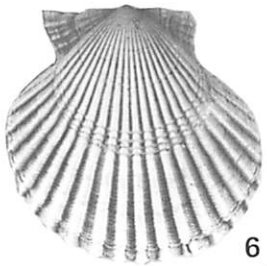


3
x3

4
x2.5



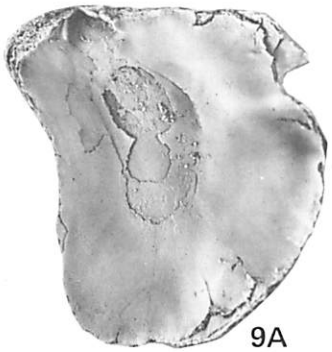
5
x2



6
x2

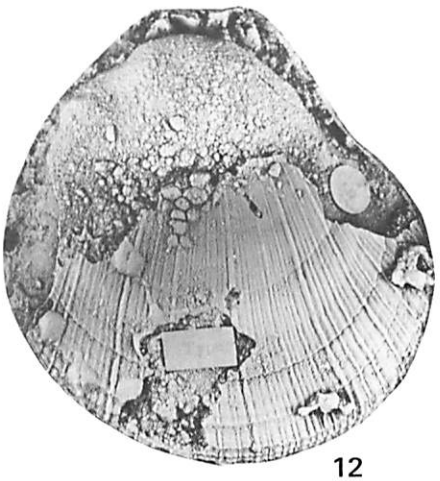
7
x1

8
x1

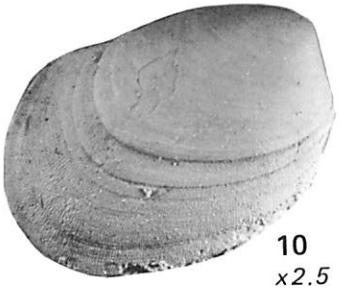


9A
x1.4

9B



12
x1



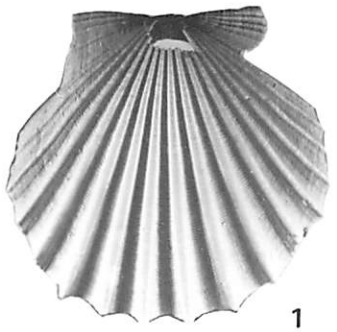
10
x2.5

11
x2

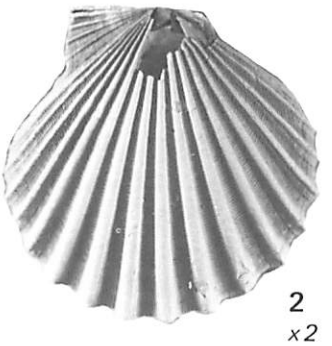
EXPLANATION PLATE 59

Figure		Page
1-7	**Pecten (Pecten) perplanus** Morton, 1833	46-47
	1. Right valve; height 20.4 mm, length 21.0 mm, inflation 4.6 mm; Red Bluff Fm., Pelham Hill at St. Stephens Quarry, St. Stephens, Alabama. MGS 1076.	
	2. Right valve; height 20.7 mm, length 20.8 mm, inflation 5.1 mm; Red Bluff Fm., Pelham Hill at St. Stephens Quarry, St. Stephens, Alabama. MGS 1077.	
	3. Right valve; height 19.3 mm, length 19.7 mm, inflation 4.1 mm; Forest Hill Fm., locality 75a. MGS 1078.	
	4. Right valve; height 21.2 mm, inflation 4.5 mm; Forest Hill Fm., locality 75a. MGS 1079.	
	5. Right valve; height 16.8 mm, length 17.1 mm, inflation 4.6 mm; Red Bluff Fm., Tulane locality 226 = MGS locality 35b. MGS 1080.	
	6. Right valve; height 21.2 mm, length 21.8 mm, inflation 5.5 mm; Red Bluff Fm., locality 38b. MGS 1081.	
	7. Right valve; height 19.5 mm, length 20.2 mm, inflation 4.6 mm; Red Bluff Fm., locality 38b. MGS 1082.	
8-9	**Atrina argentea** (Conrad, 1848)	40
	8. Both valves (fragment); height 24.4 mm, length 26.2 mm, inflation of both valves 14.3 mm; probably from the Byram Fm., Vicksburg, Mississippi. Syntype B, ANSP 10222.	
	9. Both valves (incomplete); height 52.4 mm, length 61.0 mm, inflation of both valves 23.2 mm; probably from the Byram Fm., Vicksburg, Mississippi. Syntype A, ANSP 10222.	
10	**Ostrea paroxis** Lesueur, manuscript	53
	Left valve; height 72.0 mm, length 67.5 mm; Mint Spring Fm., locality 99a. MGS 1083. This left valve has grown around branches of the coral **Archohelia vicksburgensis** (Conrad, 1848). Encrusting both the oyster and coral is the right valve of another **O. paroxis**. Nestled between the two oyster valves is an articulated specimen of **Chama (Psilopus) mississippiensis** Conrad, 1848.	

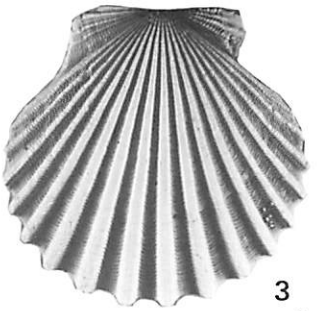
PLATE 59



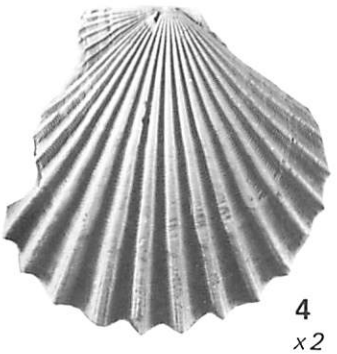
1
x2



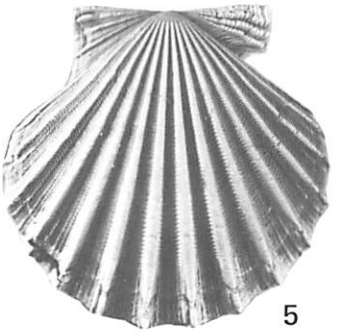
2
x2



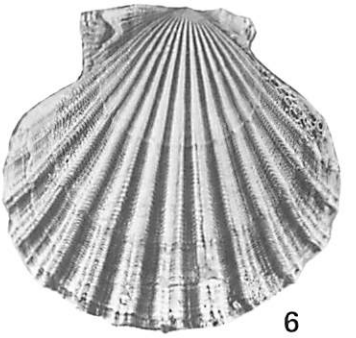
3
x2



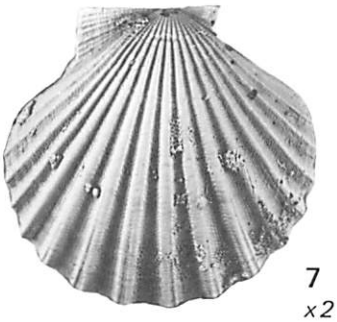
4
x2



5
x2.5



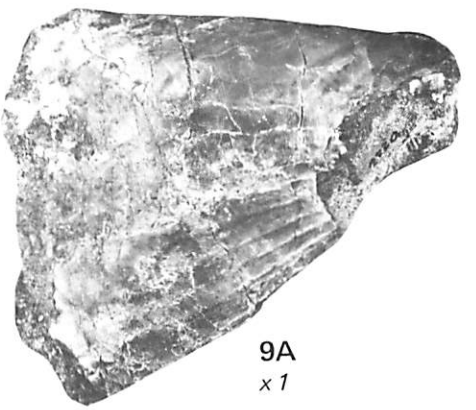
6
x2



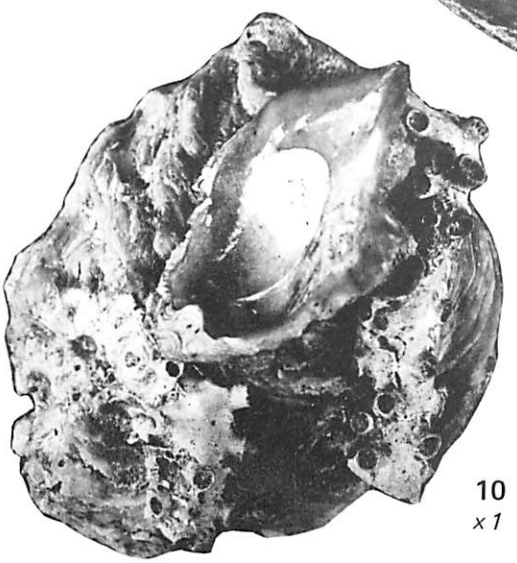
7
x2

8A
x1

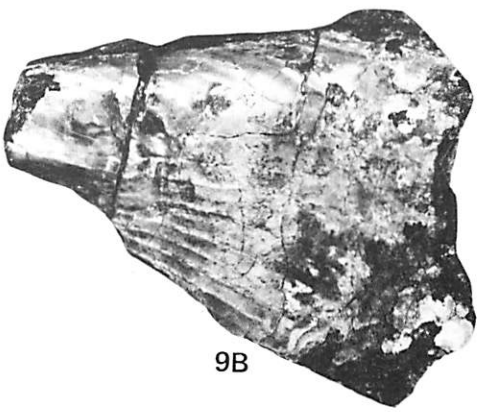
8B



9A
x1



10
x1

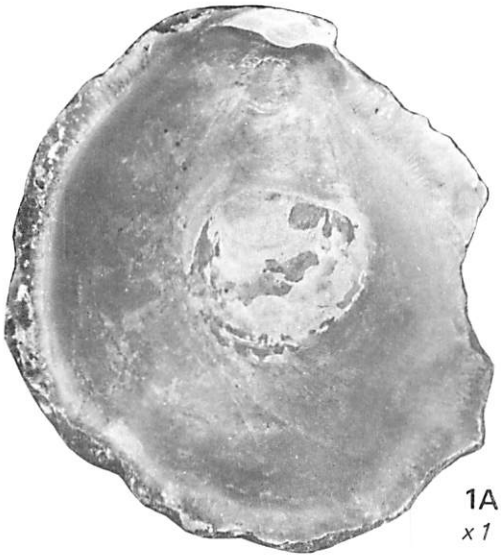


9B

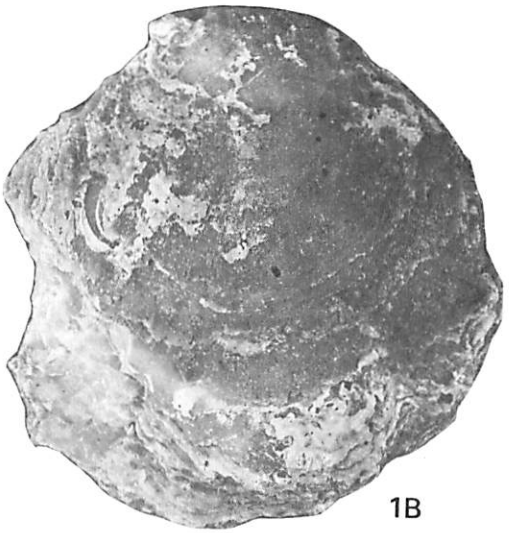
EXPLANATION PLATE 60

Figure		Page
1-3	**Ostrea paroxis** Lesueur, manuscript	53
	1. Right valve; height 71.6 mm, length 67.0 mm, inflation 17.0 mm; Mint Spring Fm., locality 99a. MGS 1084.	
	2. Right valve; height 35.6 mm, length 23.7 mm, inflation 4.4 mm; Mint Spring Fm., locality 75b. MGS 1085.	
	3. Right valve; height 28.4 mm, length 18.3 mm, inflation 3.2 mm; Mint Spring Fm., locality 75b. MGS 1086.	
4	**Chione (Chione) bainbridgensis** Dall, 1916	94-95
	Right valve (fragment of posterior margin); length of fragment 23.7 mm; Flint River Fm., Flint River, Decatur Co., Georgia. Holotype USNM 166715.	
5-7	**Crassatella (Crassatella) paramesus** (Dall, 1916)	67
	5. Latex cast from an external mold of left valve coated by a layer of chalcedony (5A) and a rubber cast after part of the chalcedony layer was chipped away (5B); height 31.0 mm, length 40.0 mm; Flint River Fm., USGS locality 7096. Syntype C, USNM 166715.	
	6. Translucent chalcedony cast of right valve; height 29.0 mm, length 33.8 mm, inflation 9.5 mm; Flint River Fm., USGS locality 7096. Syntype B, USNM 166715.	
	7. Silicified left valve; height 26.7 mm, length (incomplete) 28.0 mm; Flint River Fm., USGS locality 7096. Syntype A, USNM 166715.	

PLATE 60



1A
x 1



1B

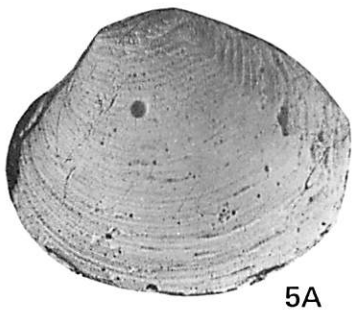
2A
x 1.2

2B

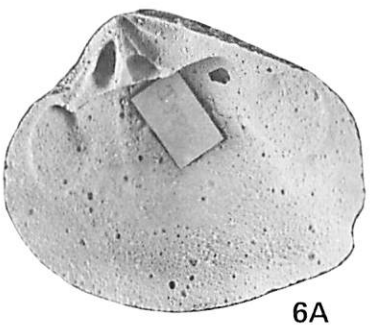
3A
x 1.2

3B

4
x 2

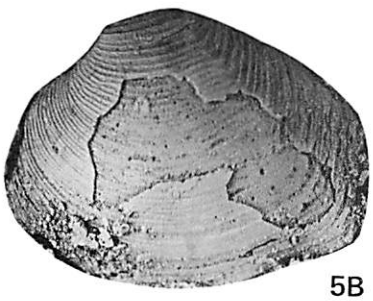


5A
x 1.2

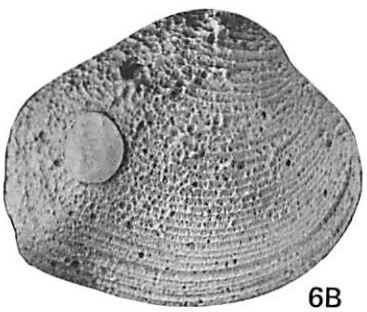


6A
x 1.4

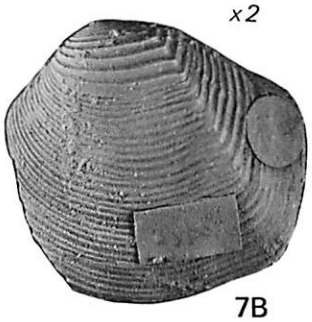
7A
x 2



5B



6B

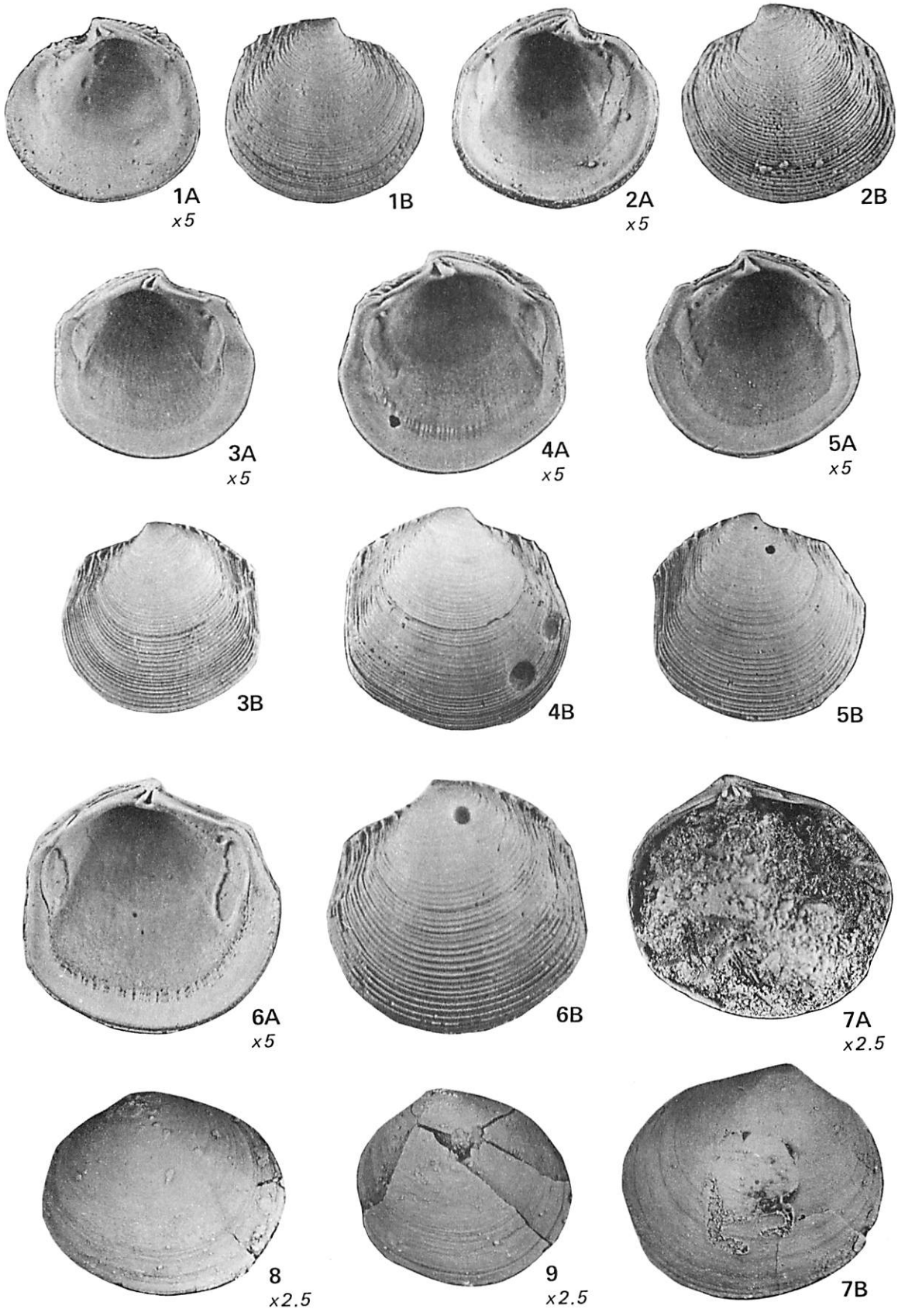


7B
x 1.4

EXPLANATION PLATE 61

Figure		Page
1-2	**Myrtea (Myrtea) vicksburgensis** (Casey, 1903)	58-59
	1. Right valve; height 6.1 mm, length 6.4 mm, inflation 1.4 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype B, ANSP 994.	
	2. Left valve; height 6.5 mm, length 6.9 mm, inflation 1.6 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype A, ANSP 994.	
3-6	**Myrtea (Myrtea) taylorensis** Mansfield, 1940	59
	3. Left valve; height 6.3 mm, length 6.6 mm, inflation 1.5 mm; Chickasawhay Fm., locality 118a. MGS 1087.	
	4. Right valve; height 7.3 mm, length 7.6 mm, inflation 1.9 mm; Chickasawhay Fm., locality 118a. MGS 1088.	
	5. Right valve; height 6.9 mm, length 7.0 mm, inflation 1.5 mm; Chickasawhay Fm., locality 118a. MGS 1089.	
	6. Left valve; height 8.6 mm, length 8.5 mm, inflation 2.0 mm; Chickasawhay Fm., locality 118a. MGS 1090.	
7-9	**Diplodonta (Diplodonta) eburnea** (Conrad, 1848)	60-61
	7. Right valve; height 16.4 mm, length 17.6 mm; Vicksburg, Mississippi. Syntype A (lectotype), ANSP 53836.	
	8. Left valve; height 14.0 mm, length 16.8 mm; Vicksburg, Mississippi. Syntype B, ANSP 53836.	
	9. Left valve; height 14.0 mm, length 14.7 mm; Vicksburg, Mississippi. Syntype C, ANSP 53836.	

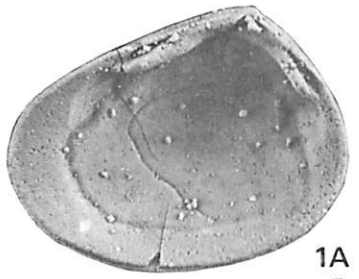
PLATE 61

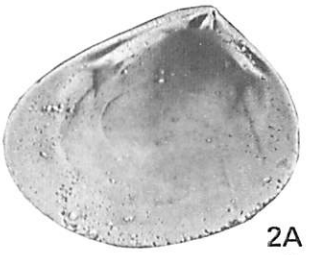

1A
x5
1B
2A
x5
2B
3A
x5
4A
x5
5A
x5
3B
4B
5B
6A
x5
6B
7A
x2.5
8
x2.5
9
x2.5
7B

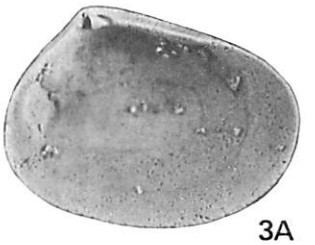
EXPLANATION PLATE 62

Figure		Page
1-3	**Semelina pilsbryi** (Casey, 1903)	83
	1. Right valve; height 6.7 mm, length 8.7 mm, inflation 1.8 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype A, ANSP 1002.	
	2. Right valve; height 6.0 mm, length 7.6 mm, inflation 1.4 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype B, ANSP 1002.	
	3. Left valve; height 6.0 mm, length 8.6 mm, inflation 1.6 mm; Mint Spring Fm., Vicksburg, Mississippi. Syntype C, ANSP 1002.	
4	**Tellina serica** Conrad, 1848	78-79
	Right valve; height 13.2 mm, length 26.1 mm, inflation 3.2 mm; Vicksburg, Mississippi. Holotype for **Abra protexta** Conrad, 1871, ANSP 30704.	
5	**Corbula (Varicorbula) laqueata** Casey, 1903	97-98
	Right valve; height 4.7 mm, length 5.4 mm, inflation 2.6 mm; Byram Fm., Vicksburg, Mississippi. Holotype of Casey ANSP 1003.	
6	**Verticordia (Verticordia) dalliana** Aldrich, 1903	104
	Right valve; height 2.4 mm, length 2.8 mm; exterior with 9 anterior ribs, a broad interspace, 2 medial ribs, a broad interspace, and 2 posterior ribs; Red Bluff Fm., Red Bluff, Mississippi. Holotype, USNM 644633.	
7	**Jouannetia (Pholadopsis) triquetra** (Conrad, 1848)	101-102
	Both valves with callum of left valve overlapping the right valve; height 16.5 mm, length (incomplete) 19.7 mm, inflation 16.0 mm; Red Bluff Fm., locality 39. MGS 1091.	

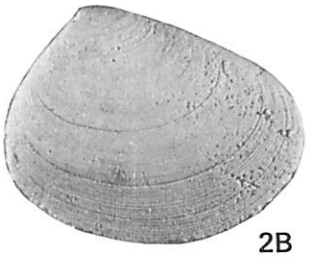
PLATE 62

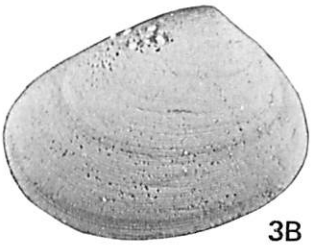

1A
x5

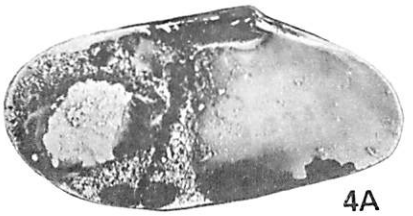

2A
x5

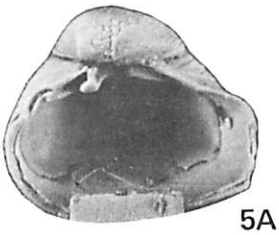

3A
x5


1B

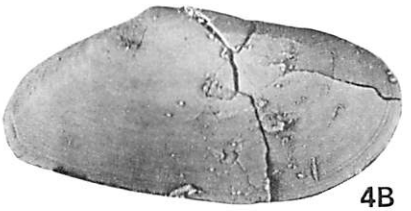

2B


3B


4A
x2


5A
x6


6A
x10


4B


5B


6B


7A
x2.5


7B


7C

APPENDICES

APPENDIX I

CONRAD'S PLATES (1848) ON THE VICKSBURG FAUNA AT VICKSBURG, MISSISSIPPI

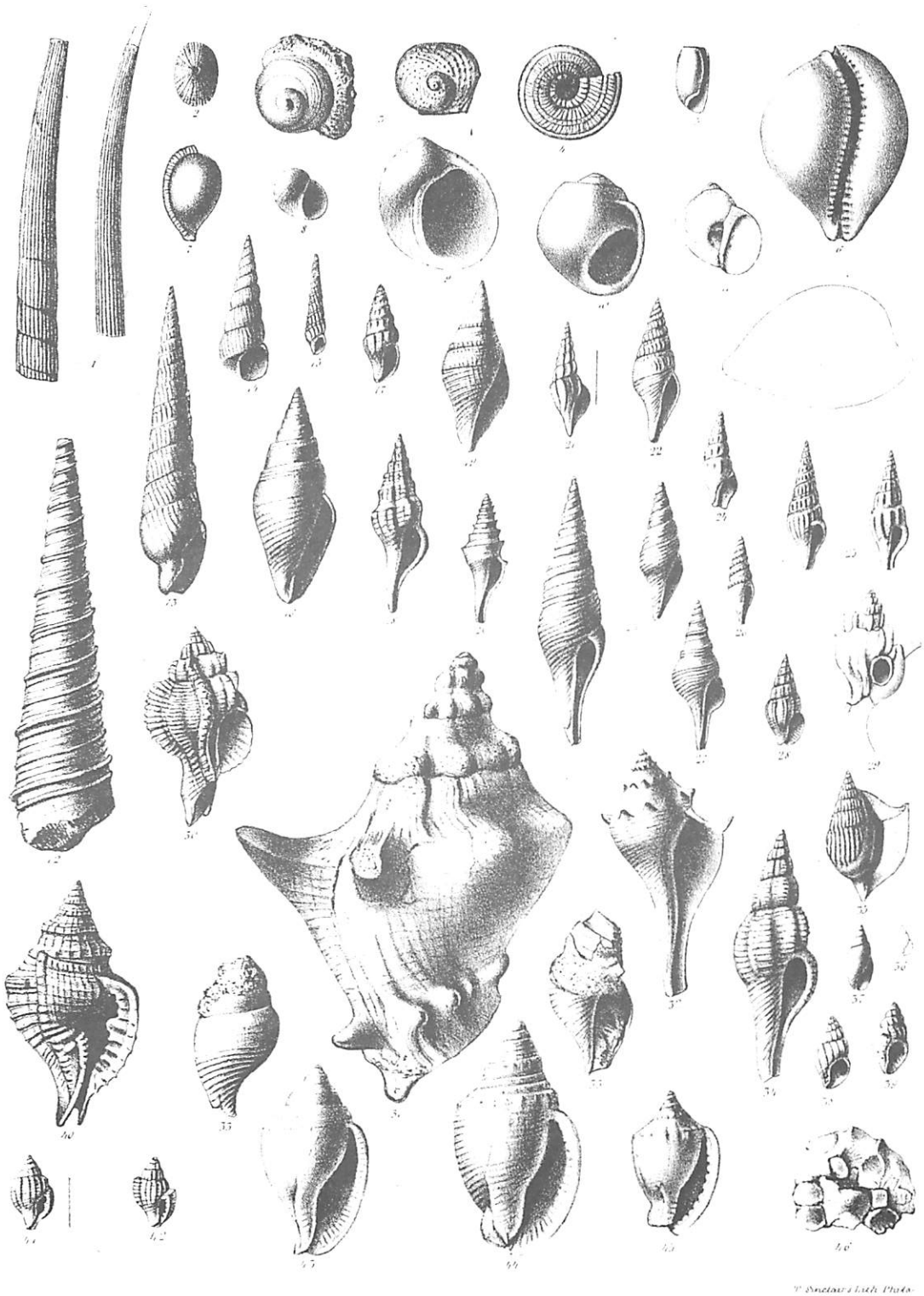
These plates are reprinted from the Journal of the Academy of Natural Sciences of Philadelphia, 2nd series, v. 1, pt. 2, pl. 11-13, by permission of the Academy.

REFERENCE TO PLATE XI.

Fig. 1. *Dentalium mississippiensis.*
2. *Fissurella mississippiensis.*
3. *Infundibulum trochiformis ?*
4. *Solarium triliratum.*
5. *Bulla crassiplica.*
6. *Cypraea sphaeroides.*
7. *Cypraea lintea.*
8. *Narica mississippiensis.*
9. *Sigaretus mississippiensis.*
10. *Natica mississippiensis.*
11. *Natica vicksburgensis.*
12. *Turritella mississippiensis.*
13. *Terebra divisurum.*
14. *Scalaria trigintanaria.*
15. *Terebra tantula.*
16. *Pleurotoma porcellana.*
17. *Pleurotoma mississippiensis.*
18. *Pleurotoma servata.*
19. *Pleurotoma congesta.*
20. *Pleurotoma cristata.*
21. *Pleurotoma tantula.*
22. *Pleurotoma tenella.*
23. *Pleurotoma cochlearis.*

Fig. 24. *Pleurotoma eboroides.*
25. *Pleurotoma abundans.*
26. *Pleurotoma rotaedens.*
27. *Pleurotoma decliva.*
28. *Buccinum mississippiensis.*
29. *Typhis curvirostratus.*
30. *Murex mississippiensis.*
31. *Melongena crassicornuta.*
32. *Fusus spiniger.*
33. *Fusus vicksburgensis*
34. *Fusus mississippiensis.*
35. *Chenopus liratus.*
36. *Ringicula mississippiensis.*
37. *Actaeon andersoni.*
38. *Cancellaria mississippiensis.*
39. *Cancellaria funerata.*
40. *Triton crassidens.*
41. *Triton mississippiensis.*
42. *Triton abbreviatus.*
43. *Cassidaria lintea.*
44. *Cassis caelatura.*
45. *Cassis mississippiensis.*
46. *Phorus humilis.*

UPPER EOCENE

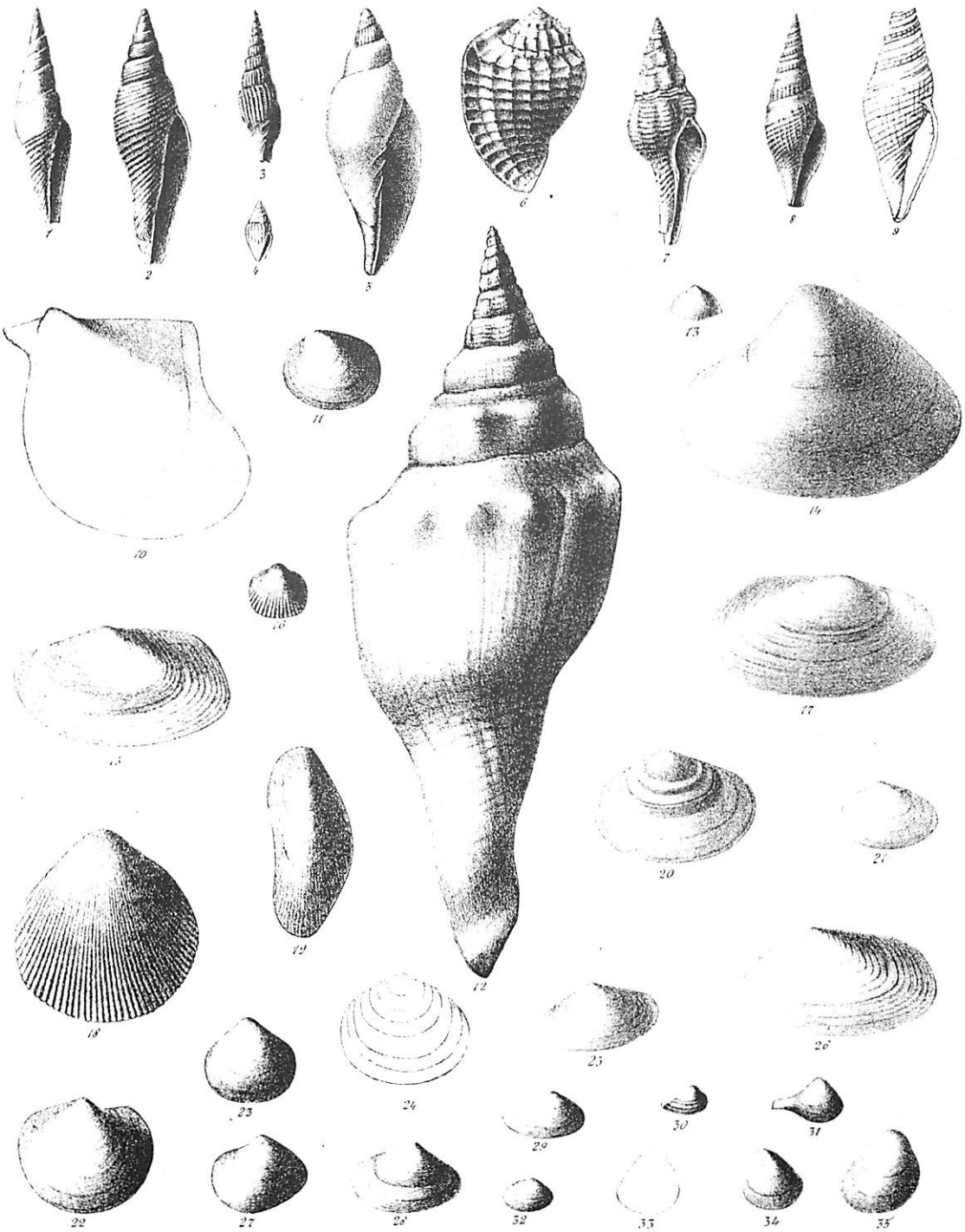


REFERENCE TO PLATE XII.

Fig. 1. *Mitra conquisita.*
2. *Mitra mississippiensis.*
3. *Mitra cellulifera.*
4. *Mitra staminea.*
5. *Caricella demissa.*
6. *Oniscia harpula.*
7. *Turbinella protracta.*
8, 9. *Scobinella caelata.*
10. *Avicula argentea.*
11. *Loripes eburnea.*
12. *Turbinella wilsoni.*
13. *Mactra funerata.*
14. *Mactra mississippiensis.*
15, 17. *Psammobia papyria.*
16. *Cardium vicksburgense.*
18. *Cardium eversum.*

Fig. 19. *Modiola mississippiensis.*
20. *Amphidesma mississippiensis.*
21. *Amphidesma perovata.*
22. *Lucina perlevis.*
23. *Loripes turgida.*
24. *Loripes eburnea.*
25. *Tellina lintea.*
26. *Psammobia.*
27. *Tellina pectorosa.*
28. *Tellina serica.*
29. *Tellina perovata.*
30. *Corbula engonata.*
31. *Corbula intastriata.*
32. *Tellina vicksburgensis.*
33, 34, 35. *Corbula alta.*

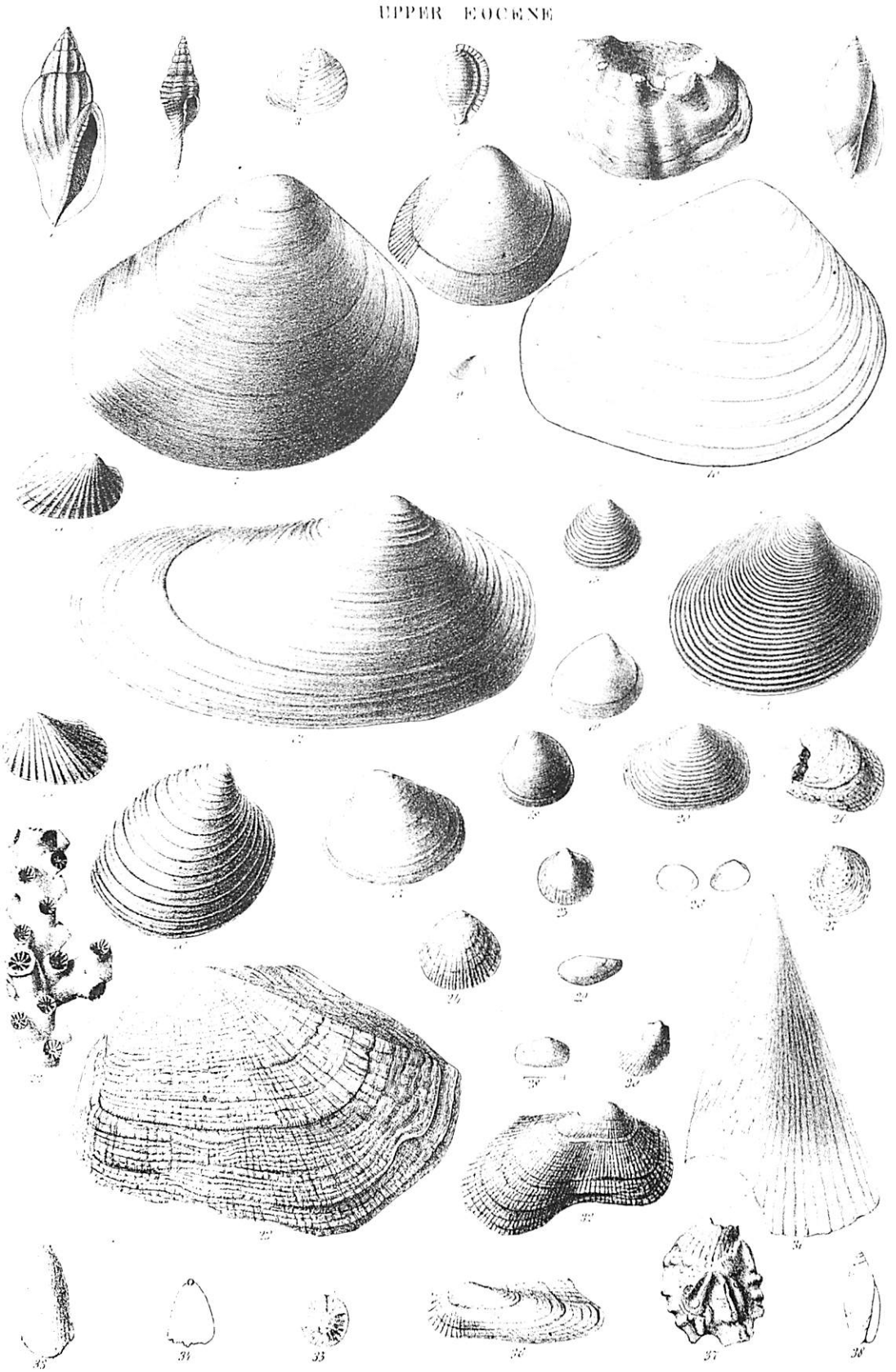
UPPER EOCENE



REFERENCE TO PLATE XIII.

Fig. 1. *Fulgoraria mississippiensis.*
2. *Turbinella perexilis.*
3. *Pholas triquetra.*
4. *Cyprea lintea.*
5. *Ostrea vicksburgensis.*
6. *Oliva mississippiensis.*
7. *Crassatella.*
8. *Cardium diversum.*
9. *Donax funerata.*
10. *Crassatella mississippiensis.*
11. *Arca mississippiensis.*
12. *Panopaea.*
13. *Cytherea astartiformis.*
14. *Cytherea imitabilis.*
15. *Arca mississippiensis.*
16. *Cytherea mississippiensis.*
17. *Cytherea sobrina.*
18. *Cytherea perbrevis.*

Fig. 19. *Cytherea semipunctata.*
20. *Corbis staminea.*
21. *Chama mississippiensis.*
22. *Madrepora mississippiensis.*
23. *Byssoarca lima.*
24. *Pectunculus arctatus.*
25. *Pectunculus mississippiensis.*
26. *Nucula vicksburgensis.*
27. *Chama mississippiensis.*
28. *Kellia oblonga.*
29. *Nucula serica.*
30. *Lima staminea.*
31. *Pinna argentea.*
32. *Byssoarca mississippiensis.*
33, 34, 35. *Turbinolia caulifera.*
36. *Byssoarca protracta.*
37. *Ostrea vicksburgensis.*
38. *Oliva mississippiensis.*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APPENDIX II

LESUEUR'S PLATES (1829) ON THE VICKSBURG FAUNA AT VICKSBURG, MISSISSIPPI

These unpublished plates titled "Lesueur's Walnut Hills fossil shells" are reproduced from prints in the library of the Academy of Natural Sciences of Philadelphia. The incomplete explanations for these plates given below are from Lesueur's manuscripts in the library of the Museum of Natural History in Le Havre, France.

Foraminifera

Lenticulina dorbignya pl. 1, fig. 4
Lenticulina ferrussi pl. 1, fig. 2
Discorbis subglobulosa pl. 1, fig. 8
Orbulites scutella pl. 1, fig. 10
Orbulites mamila pl. 1, fig. 9
Cruciolaria orbicularia pl. 1, fig. 7
Cruciolaria elliptica pl. 1, fig. 16

Anthozoa

Oculina virginea pl. 1, fig. 14

Bryozoa

Cellepora incideus pl. 1, fig. 3
Cupuloporites digitalis pl. 1, fig. 6
Cupuloporites discoides pl. 1, fig. 1

Echinoidea

Echinites fragilis pl. 1, fig. 5

Annelida

Emphitrites dubia pl. 8, fig. 20
(probably the bivalve *Kuphus*)

Scaphopoda

Dentalium prolifera pl. 1, fig. 13
Dentalium fragilis pl. 1, fig. 18

Bivalvia

Panopea elongata pl. 8, fig. 19, 20
Crassatella tellinoides (probably pl. 10, fig. 15)
Corbula distorta pl. 10, fig. 16
Corbula rostrata pl. 10, fig. 18
Tellina minutiffima pl. 10, fig. 11
Lucina lenticularia
Cytherea mortonia pl. 10, fig. 14
Cytherea circulifera pl. 10, fig. 13
Cardita semiradiata pl. 10, fig. 12
Arca bifasciata pl. 10, fig. 8
Arca fragilis pl. 10, fig. 9
Pectunculus minutus pl. 10, fig. 10
Nucula concentrica Say? pl. 10, fig. 7
Pinna radiata pl. 10, fig. 5
Lima parvula pl. 10, fig. 6
Pecten limatula pl. 10, fig. 2, 3
Pecten unicarinata pl. 10, fig. 4
Ostrea pseudofoliata pl. 10, fig. 1
Ostrea paroxis pl. 8, fig. 17

Pteropoda

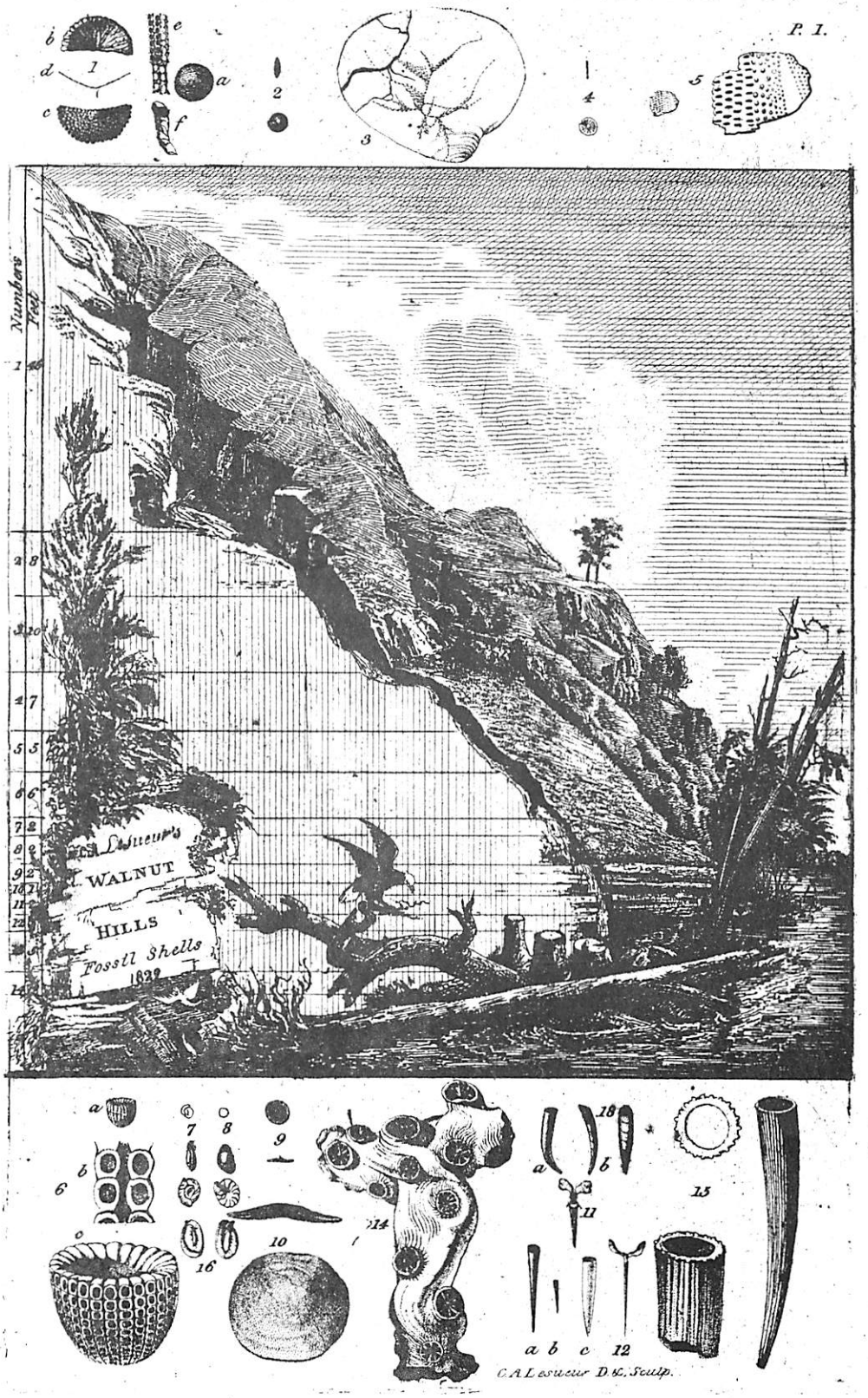
Hyalites daudin pl. 1, fig. 12

Gastropoda

Calyptrocrepidula pl. 6, fig. 11
Bulla oviformis elongata pl. 6, fig. 1
Ampullaria depressa pl. 6, fig. 2
Natica obovata pl. 6, fig. 3
Sigareta striata pl. 6, fig. 4
Naticoides sigarettoides pl. 6, fig. 21
Trochus compressa pl. 6, fig. 6
Solarium denticulata pl. 6, fig. 5
Cerithium undulatum pl. 6, fig. 7
Potamida (=*Potamides*) *cruciata* pl. 8, fig. 10
Phasianellide (=*Phasianella*) *elongata* pl. 6, fig. 19
Pleurotoma costata pl. 6, fig. 8
Pleurotoma undulata pl. 6, fig. 10
Pleurotoma fusiformis pl. 6, fig. 13
Pleurotoma semserricta? pl. 6, fig. 12
Turbinella cliffordia pl. 6, fig. 14
Turbinella eburnea pl. 6, fig. 15
Turbinella rostrata pl. 6, fig. 16
Turbinella obsoleta pl. 6, fig. 18
Buccinum minutissma pl. 8, fig. 9
Fusus brogniartii pl. 6, fig. 17
Ranella ventricofa? pl. 8, fig. 2
Murex coringera pl. 8, fig. 4
Murex tubifera pl. 8, fig. 3
Cassidaria granulata pl. 8, fig. 1
Cassidaria polita pl. 8, fig. 5
Cassidaria bicostata pl. 8, fig. 6
Cassidaria minutiffima
Buccinum circumscripta? pl. 8, fig. 8
Buccinum reticulatum pl. 8, fig. 7
Buccinum? unidentata pl. 6, fig. 22
Mitra sulcofus pl. 8, fig. 11
Mitra pleurotomia
Voluta harpoides pl. 8, fig. 13
Oliva saya pl. 8, fig. 12
Conus nonperditus pl. 8, fig. 16
Conus defrancii pl. 8, fig. 18
Conus peronii pl. 8, fig. 15

Chondrichthyes

Squalus littoralis pl. 2, fig. 8
Squalus rissoi pl. 2, fig. 10
Squalus obscurus pl. 2, fig. 3
Squalus spalanzani pl. 2, fig. 4
Squalus cuvierii pl. 2, fig. 5
Squalus africanus pl. 2, fig. 6
Squalus perlon pl. 2, fig. 9
Raia quadrilobata pl. 2, fig. 11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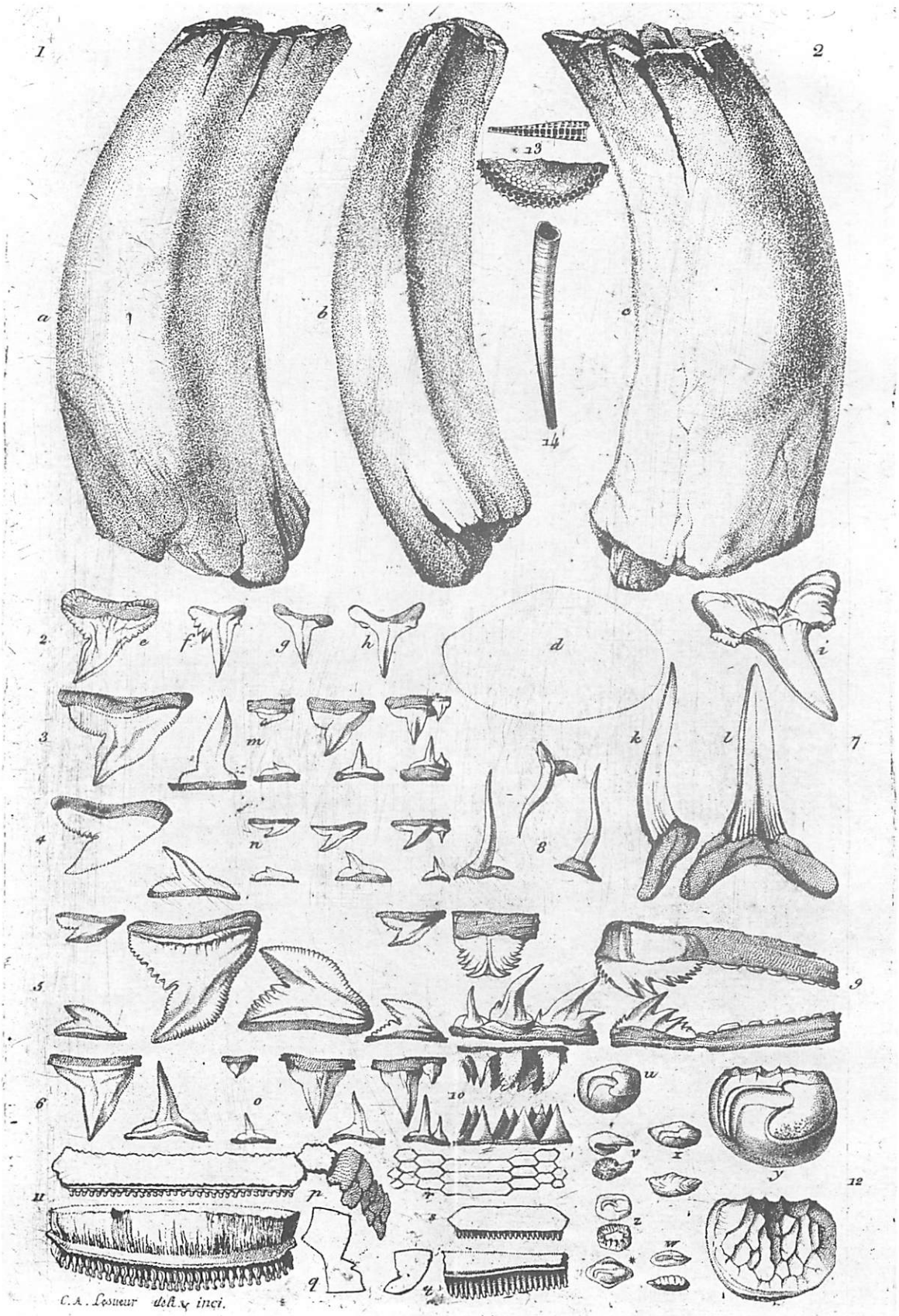
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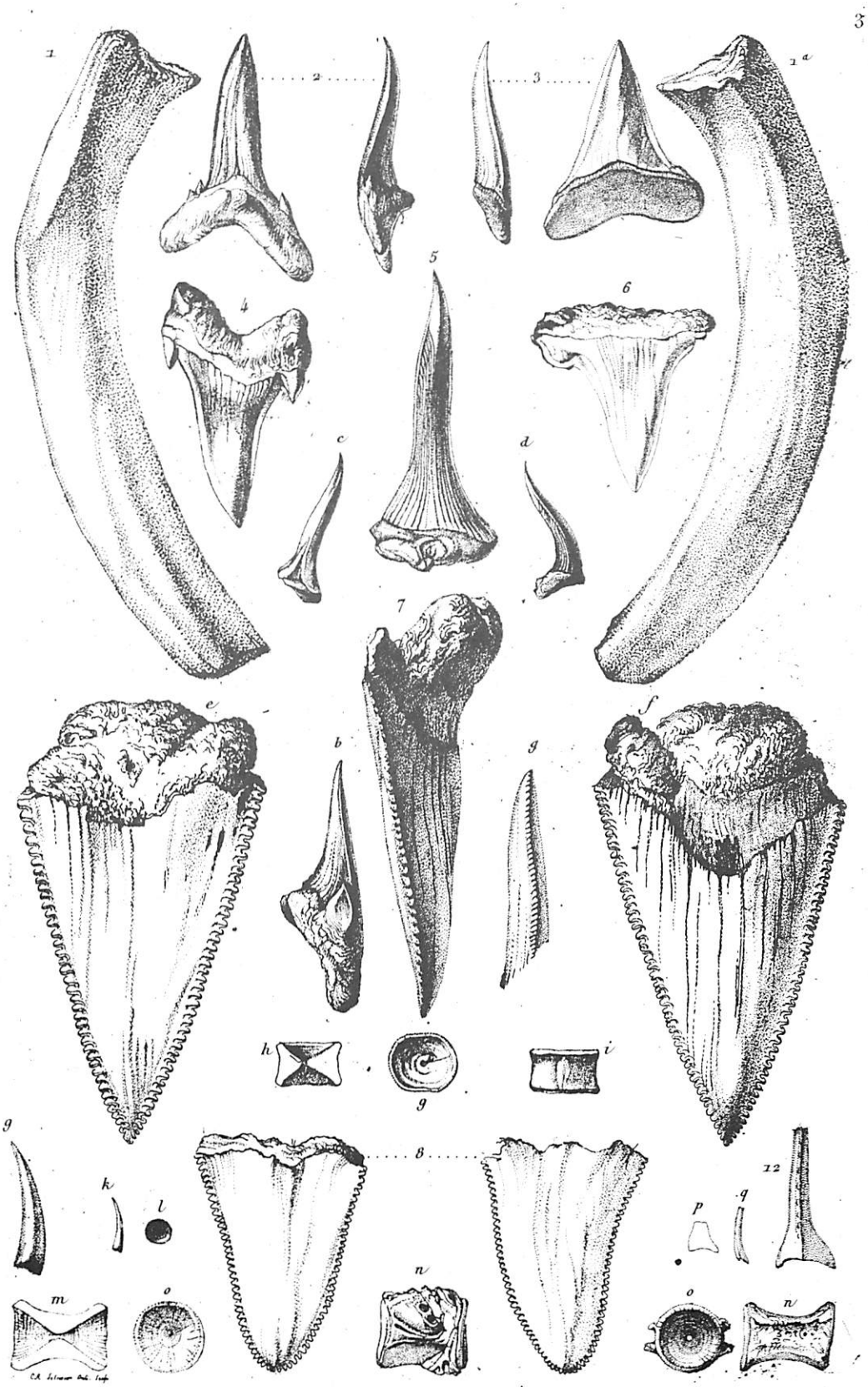
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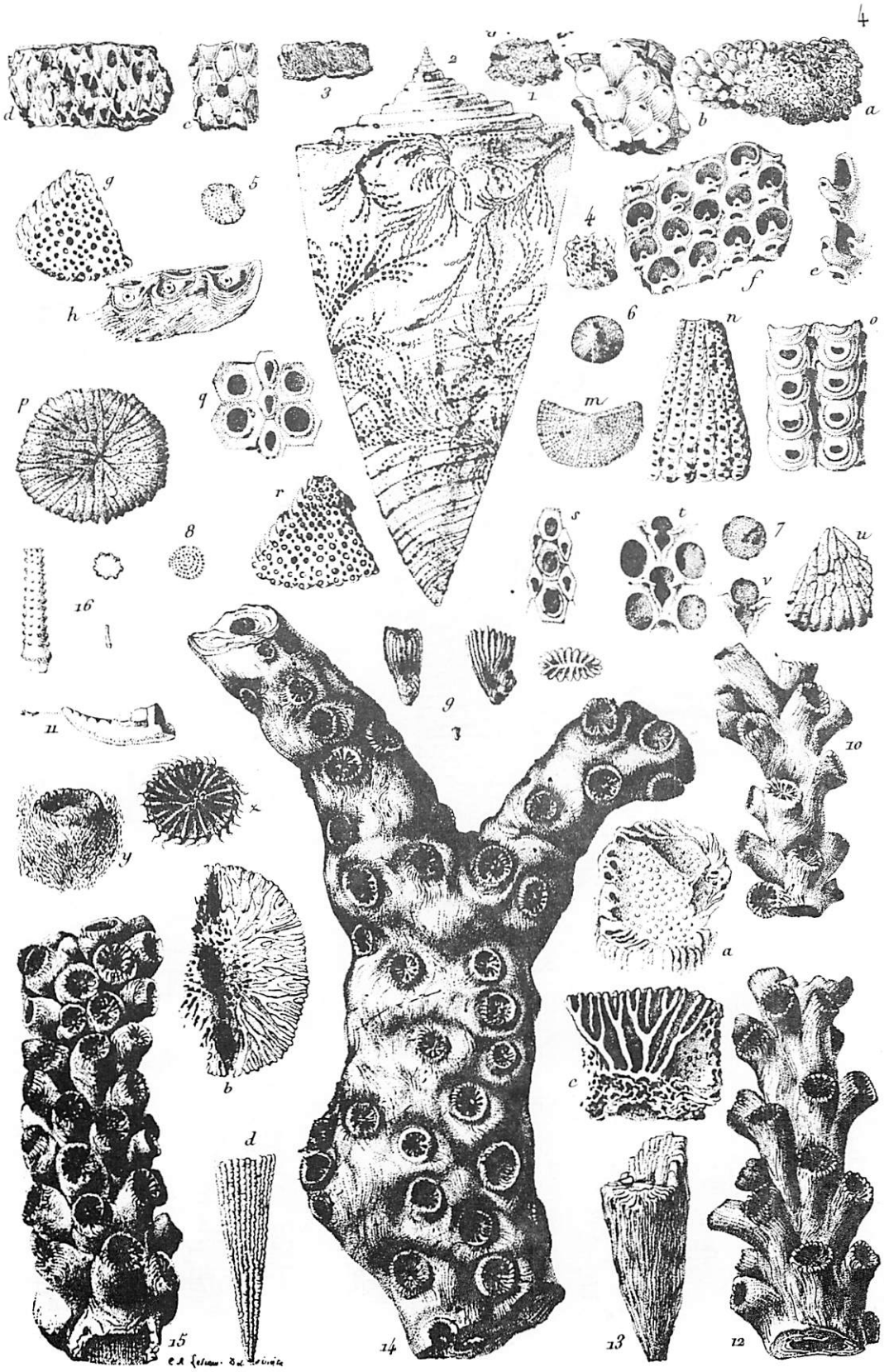
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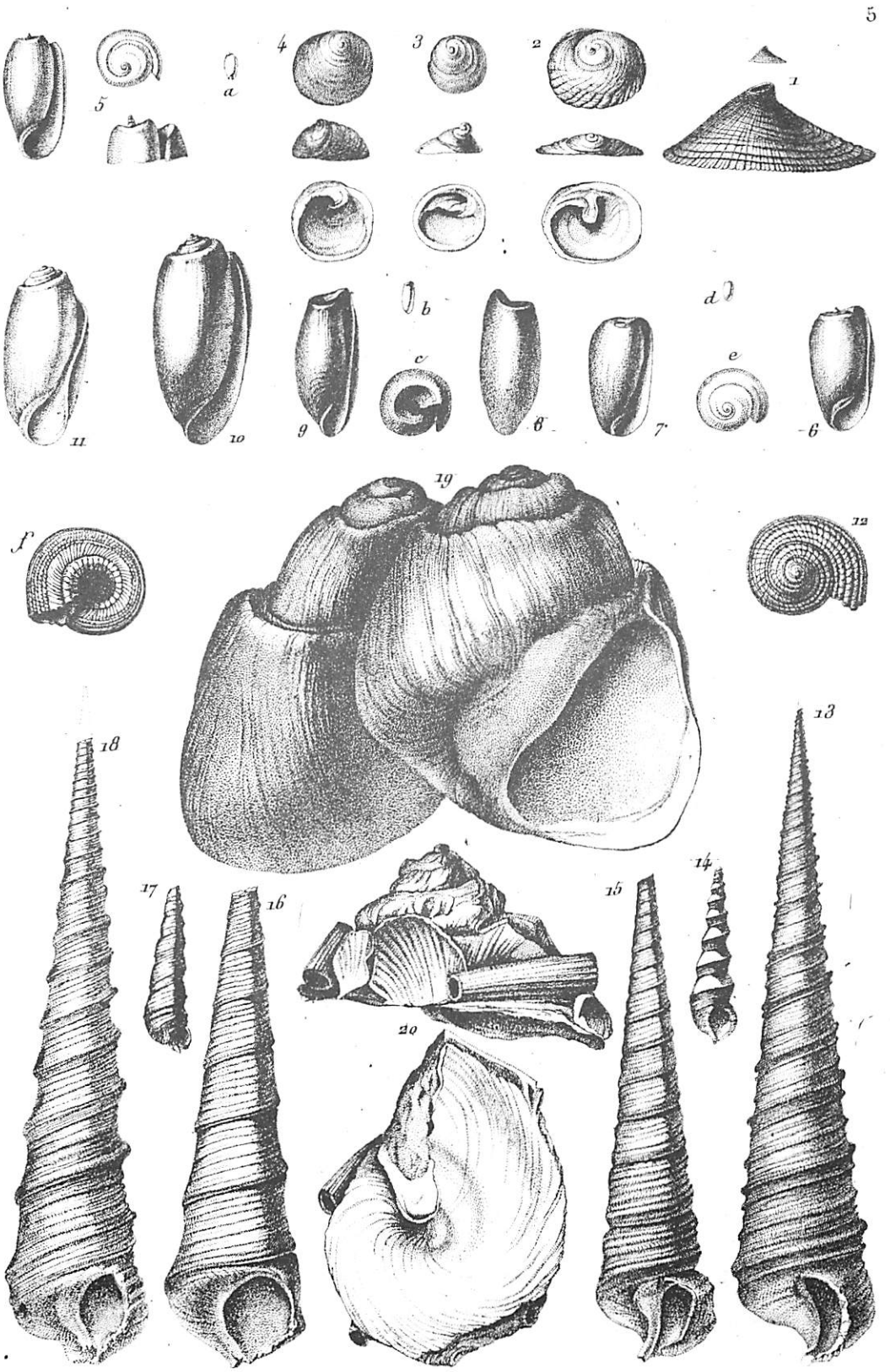
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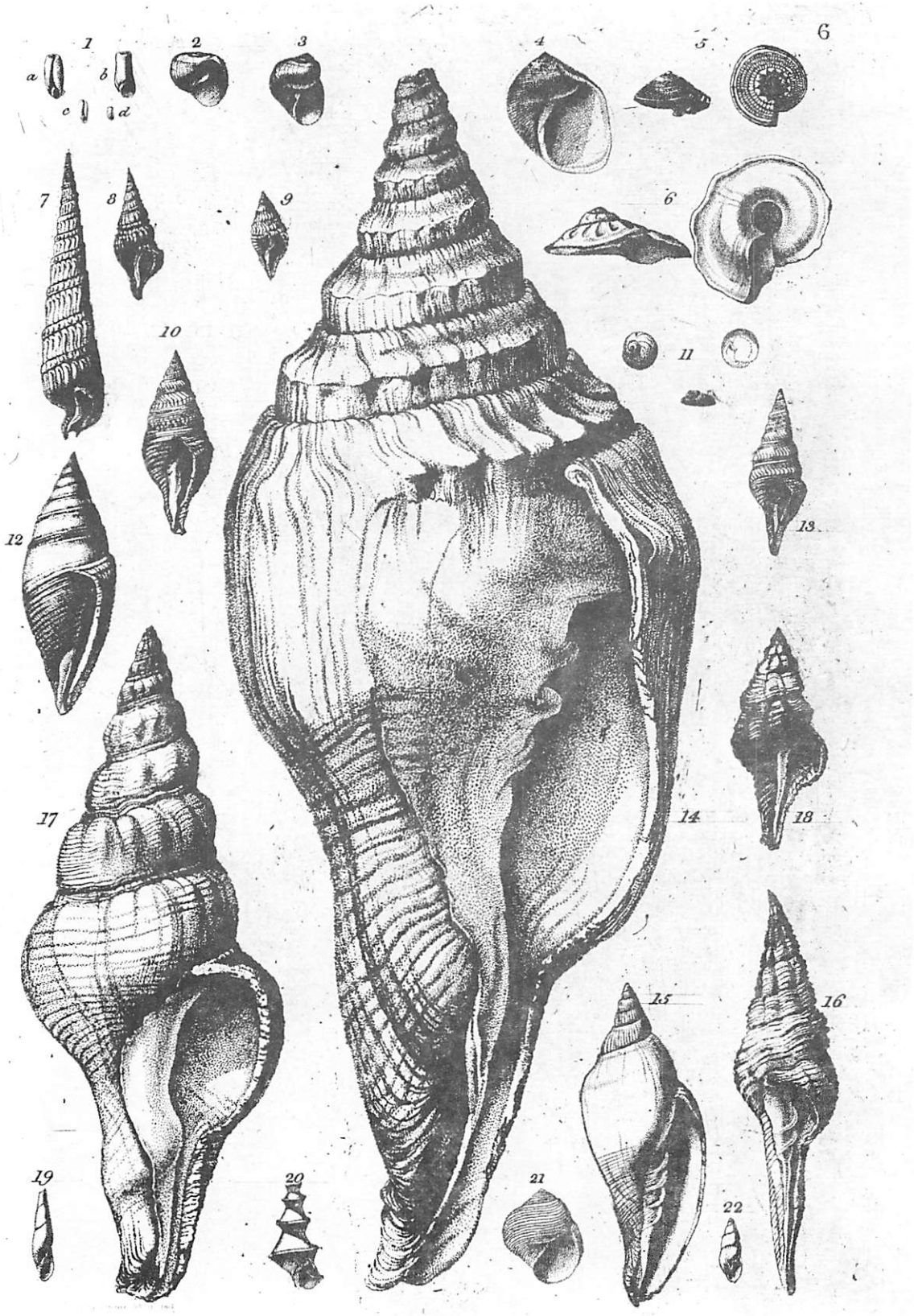
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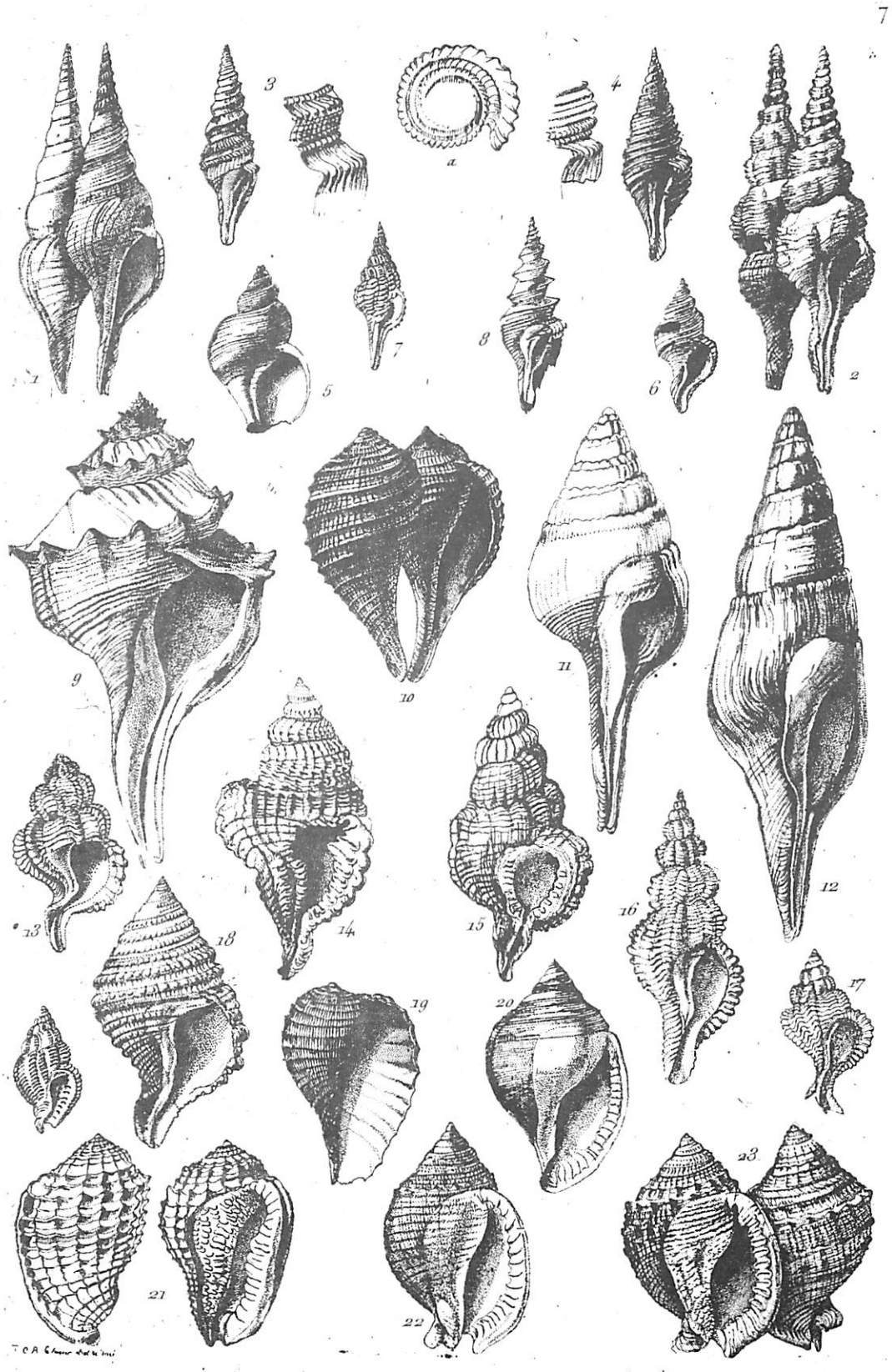
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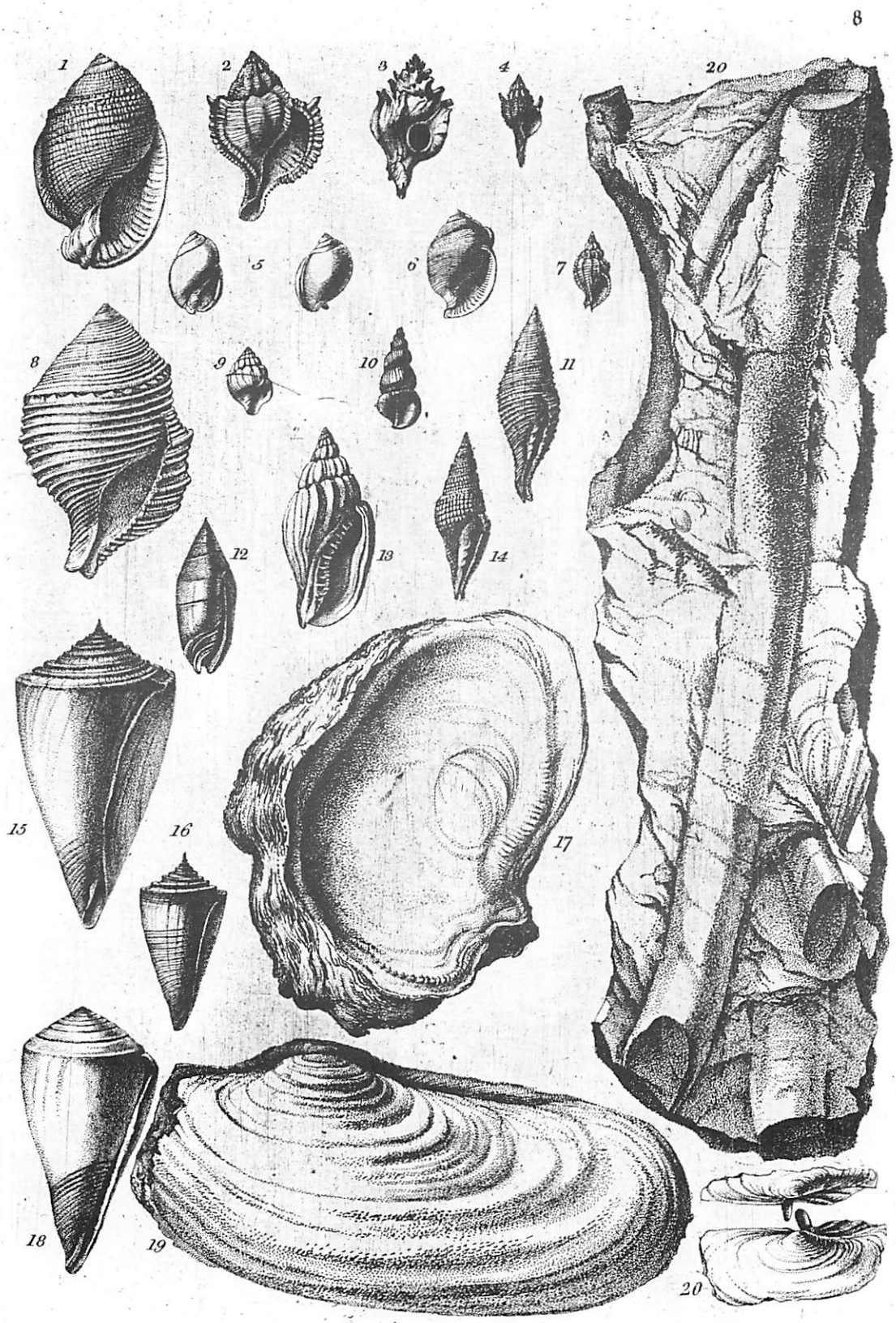
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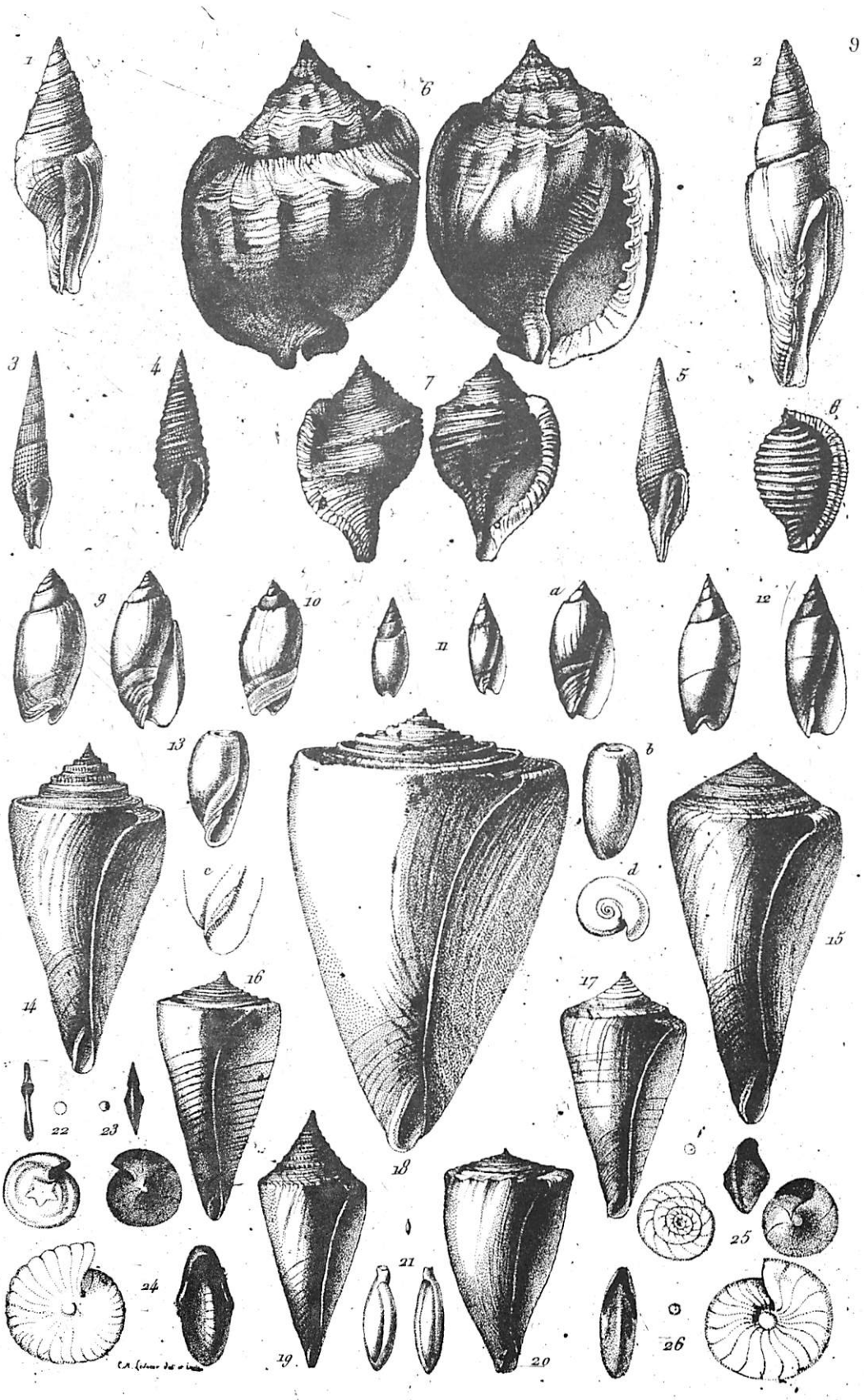
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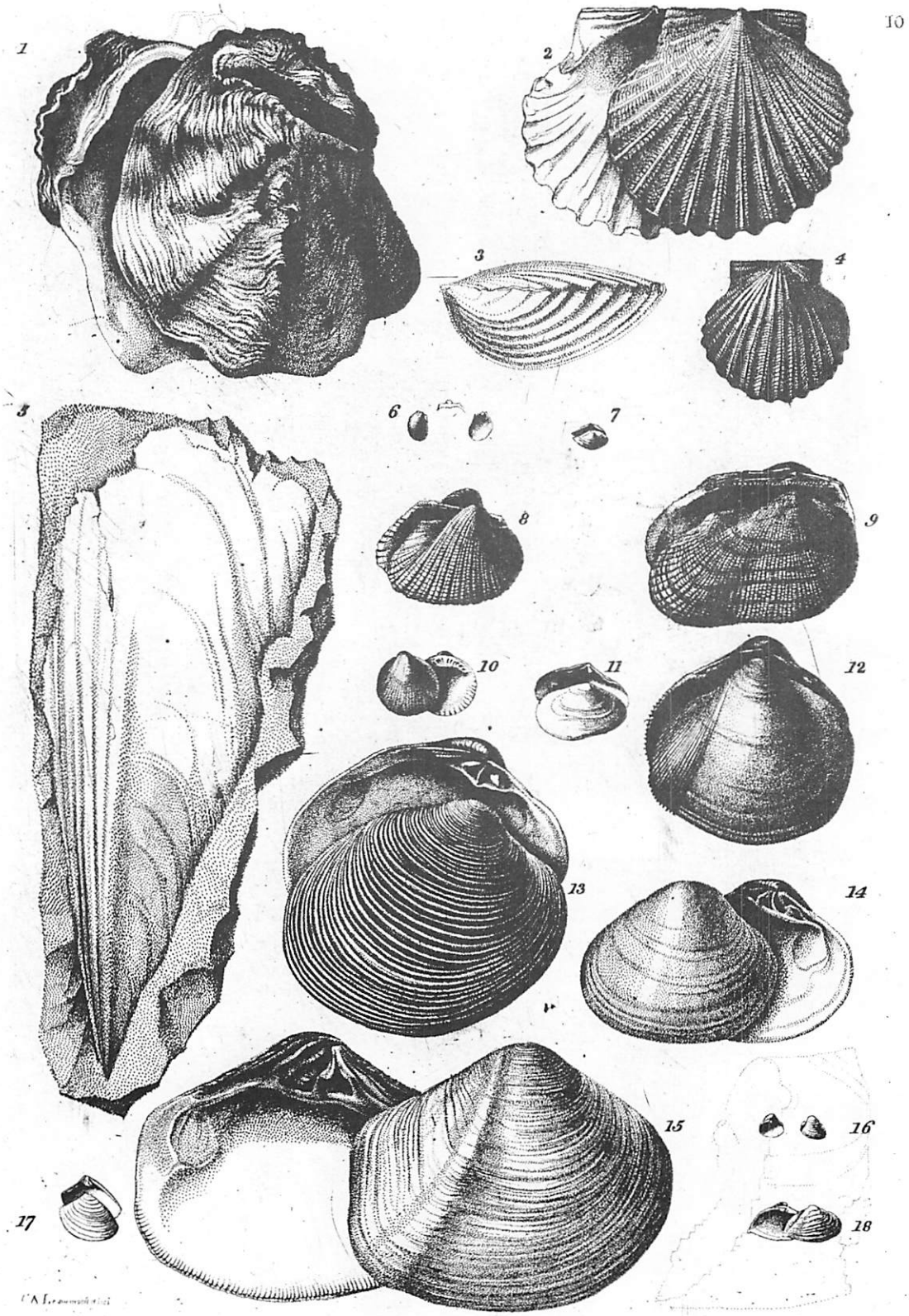
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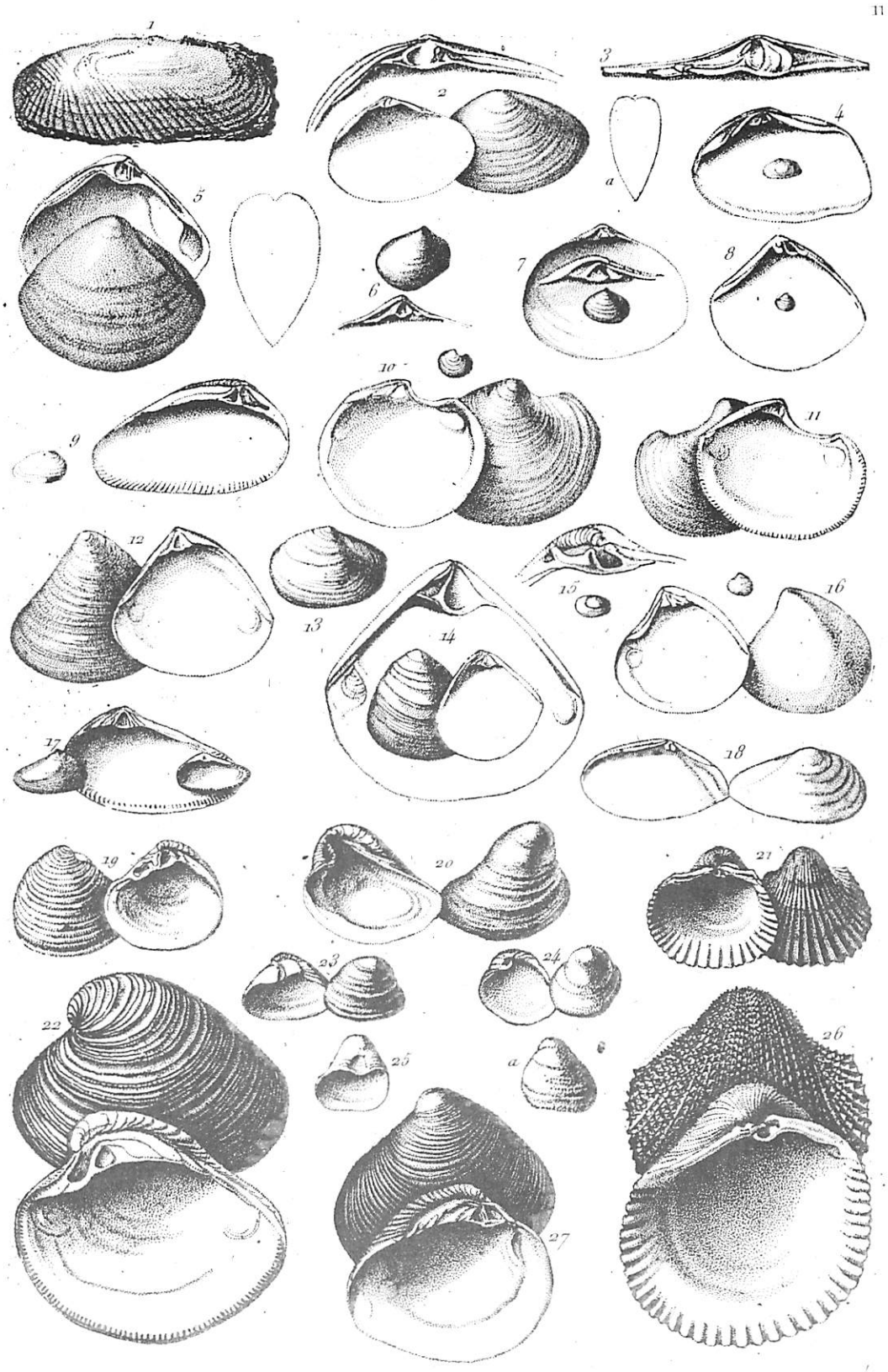
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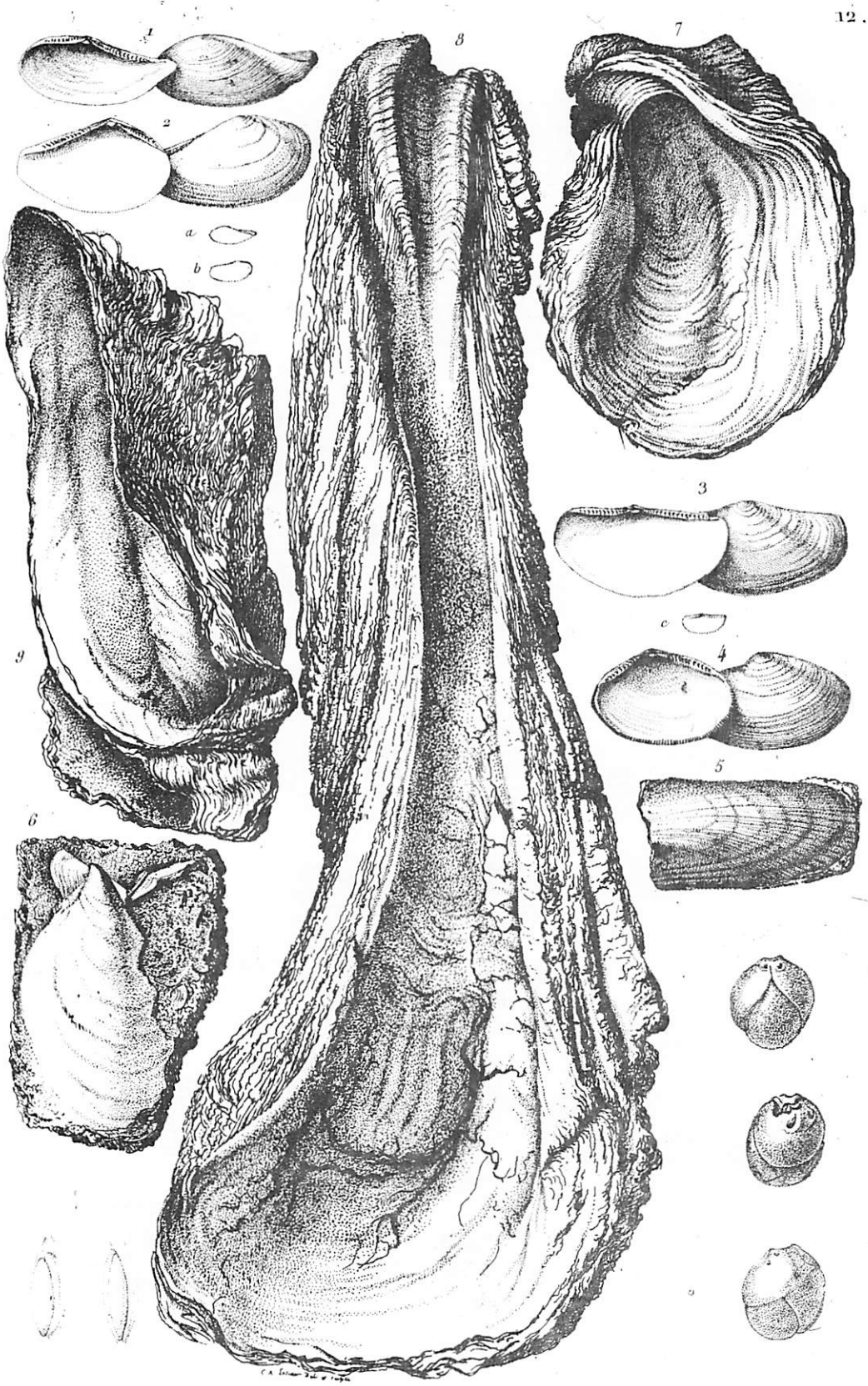
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LOCALITIES

MGS Localities

34. Shubuta Clay, Yazoo Formation (34a) and Red Bluff Formation (34b): 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 (35a) and Red Bluff Formation (35b): Bluff along east bank of the Chickasawhay River; SW/4, SW/4, SW/4, Section 28, 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. Marianna Limestone (45a) and Glendon Limestone (45b): 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.

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 down stream 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 Chickasawhay 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).

USGS Localities

309. Red Bluff Formation: Banks of Chickasawhay River, 1 1/2 to 2 1/2 miles west of Old Red Bluff Station on Mobile and Ohio R.R., Wayne County, Mississippi (Burns).

3140. Vicksburg Group: Vicksburg, Warren County, Mississippi (Philip Crutcher, 1898).

3723. Mint Spring Formation: Mint Spring Bayou, beneath waterfall near National Cemetery, Vicksburg, Warren County, Mississippi (T. W. Vaughan, 1900).

5264. Red Bluff Formation: Chickasawhay River at Hiwannee, Wayne County, Mississippi (T. W. Vaughan, Nov. 8, 1909).

6647a. Mint Spring Formation: Bend in Chickasawhay River about at the northeast corner of the SW/4, SW/4, Section 23, T. 9 N., R. 7 W., about 1 1/4 miles northwest of the mouth of Limestone Creek, 4 miles north of Waynesboro, and 1 1/4 miles southwest of Boyce, Wayne County, Mississippi (W. H. Monroe and F. S. MacNeil, Nov. 1937).

7941. Mint Spring Formation: Glass Bayou, Vicksburg, Warren County, Mississippi (W. C. Clark).

14071. Mint Spring Formation: Bed of Lime Creek, SW/4, NW/4, Section 22, T. 4 N., R. 1 E., about 0.8 mile northwest of Cleary, Rankin County, Mississippi (W. H. Monroe and C. W. Cooke, Oct. 4, 1931). 14071a (W. H. Monroe and F. S. MacNeil, Nov. 1937).

14162. Mint Spring Formation: Bluff just north of Mississippi River Bridge at Vicksburg, Warren County, Mississippi, under high power line (W. H. Monroe and F. S. MacNeil, Nov. 1937).

14163. Mint Spring Formation: Mill Branch or Burke Creek, Section 15, T. 4 N., R. 1 E., about 1.1 miles north of Cleary, Rankin County, Mississippi (W. H. Monroe and F. S. MacNeil, Nov. 1937).

14203. Mint Spring Formation: About 400 feet upstream from locality HMC of 11th Ann. Field Trip Shreveport Geol. Soc. Shells in and above large cobbles at base of "Marianna Limestone." Hortons Mill Creek, about 4 miles north of Waynesboro, Wayne County, Mississippi (F. S. MacNeil and W. C. Mansfield, April 1938).

14683. Vicksburg Group: Road cut on new Highway 61 about 1.6 miles southwest of bridge over Bliss Creek and about 0.6 mile northeast of Kings. Probably in irregular Section 35. Upper bed (F. S. MacNeil, Nov. 1939).

14721. Red Bluff Formation: East bank of Chickasawhay River at Hiwannee, Mississippi (C. W. Cooke and F. S. MacNeil, Sept. 22, 1939).

15058. Red Bluff Formation: Chickasawhay River about 100 yards below bend just north of northeast corner of Section 32, T. 10 N., R. 7 W., Wayne County, Mississippi, about one mile southwest of Hiwannee (F. S. MacNeil, 1941).

REFERENCES CITED

Aldrich, Truman Hemingway, 1886, Preliminary report on the Tertiary fossils of Alabama and Mississippi: Geol. Survey Alabama, Bull. No. 1, pt. 1, p. 15-60, pl. 1-6, tables 1-10.

Aldrich, Truman Hemingway, 1903, New species of Tertiary fossils from Alabama, Mississippi, and Florida: Nautilus, v. 16, No. 9, p. 97-101, pl. 3-4.

Blanpied, Bernerd William (field trip committee chairman), et al., 1934, Stratigraphy and paleontological notes on the Eocene (Jackson Group), Oligocene and Lower Miocene of Clarke and Wayne Counties, Mississippi: Shreveport Geol. Soc. Guidebook 11th Ann. Field Trip, 34 p., 6 pl.

Brann, Doris Colgate, and Lois Schoonover Kent, 1960, Catalogue of the type and figured specimens in the Paleontological Research Institution: Bull. Amer. Paleont., v. 40, No. 184, 996 p., 1 pl.

Bretsky, Sara S., 1976, Evolution and classification of the Lucinidae (Mollusca; Bivalvia): Palaeont. Amer., v. 8, No. 50, 337 p., 9 text fig., 36 pl.

Casey, Thomas Lincoln, 1903, Notes on the Conrad collection of Vicksburg fossils, with descriptions of new species: Acad. Nat. Sci. Philadelphia, Proc. 1903, v. 55, p. 261-283.

Conrad, Timothy Abbott, 1848a, Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi, with an Appendix: Acad. Nat. Sci. Philadelphia, Proc. 1847, v. 3, p. 280-299.

Conrad, Timothy Abbott, 1848b, Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi, with an Appendix: Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 1, pt. 2, p. 111-134, pl. 11-14.

Conrad, Timothy Abbott, 1850, Descriptions of one new Cretaceous and seven new Eocene fossils: Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 2, p. 39-41, pl. 1.

Conrad, Timothy Abbott, 1854, Rectifications of generic names of Tertiary fossil shells: Acad. Nat. Sci. Philadelphia, Proc. 1854, v. 7, p. 29-31.

Conrad, Timothy Abbott, 1854, Fossil Testacea of the Tertiary green-sand and marl-bed of Jackson, Miss., p. 289, pl. 14-17, *in* Wailes, Benjamin Leonard Covington, Report on the agriculture and geology of Mississippi ..., Jackson, Miss., 371 p., 17 pl.

Conrad, Timothy Abbott, 1865, Catalogue of the Eocene and Oligocene Testacea of the United States: Amer. Jour. Conch., v. 1, No. 1, p. 1-35, corrections p. 190.

Conrad, Timothy Abbott, 1866a, Check list of invertebrate fossils of North America. Eocene and Oligocene: Smithsonian Misc. Coll.. v. 7, No. 200, p. 1-41.

Conrad, Timothy Abbott, 1866b, Note on the genus *Gadus* with descriptions of some new genera and species of American fossil shells: Amer. Jour. Conch., v. 2, No. 1, p. 75-78.

Conrad, Timothy Abbott, 1871, Descriptions of new Tertiary fossils, with notes on two genera of Lamellibranchiata: Amer. Jour. Conch., v. 6, No. 3, p. 199-201, pl. 11, 13 in part.

Cooke, Charles Wythe, 1918, Correlation of the deposits of Jackson and Vicksburg ages in Mississippi and Alabama: Washington Acad. Sci., Jour., v. 8, p. 186-198.

Cooke, Charles Wythe, 1922, The Byram Calcareous Marl of Mississippi: U.S. Geol. Survey Prof. Paper 129, p. 79-85.

Cooke, Charles Wythe, 1923, The correlation of the Vicksburg Group: U.S. Geol. Survey Prof. Paper 133, p. 1-9.

Cooke, Charles Wythe, 1926, The Cenozoic fortions, p. 251-297, *in* Adams, George Irving, Charles Butts, Lloyd William Stephenson, and Wythe Cooke, Geology of Alabama: Geol. Survey Alabama Spec. Rept. 14, 312 p., 97 pl.

Cooke, Charles Wythe, 1929, New Vicksburg (Oligocene) mollusks from Mexico: U.S. Natl. Museum, Proc., v. 73, No. 2731, p. 1-11, pl. 1-2.

Cooke, Charles Wythe, 1933, Definition of Cocoa Sand Member of Jackson Formation: Amer. Assoc. Petroleum Geologists, v. 17, No. 11, p. 1387-1388.

Cooke, Charles Wythe, and F. Stearns MacNeil, 1952, Tertiary stratigraphy of South Carolina: U.S. Geol. Survey Prof. Paper 243-B, p. 19-29.

Cooke, Charles Wythe, and Stuart Mossum, 1929, Geology of Florida: Florida Geol. Survey, 20th Ann. Rept. 1927-1928, p. 29-227.

Cossmann, Alexandre Edouard Maurice, 1893, Notes complémentaires sur la faune Éocènique de l'Alabama: Ann. Géol. et Paléont., v. 12, 51 p., 2 pl.

Dall, William Healey, 1898, Tertiary fauna of Florida ...: Wagner Free Inst. Sci., Philadelphia, Trans., v. 3, pt. 4, p. 571-948, p. 23-35.

Dall, William Healey, 1900, *Ibid*, v. 3, pt. 5, p. 949-1217, pl. 37-47.

Dall, William Healey, 1903, *Ibid*, v. 3, pt. 6, p. 1219-1654, pl. 48-60.

Dall, William Healey, 1915, A monograph of the molluscan fauna of the *Orthaulax pugnax* zone of the Oligocene of Tampa, Florida: U.S. Natl. Museum, Bull. No. 90, 173 p., 26 pl.

Dall, William Healey, 1916, A contribution to the invertebrate fauna of the Oligocene beds of Flint River, Georgia: U.S. Natl. Museum, Proc., v. 51, No. 2162, p. 487-524, pl. 83-88.

Delaney, Patrick J. V., 1963, Stratigraphic significance of Vicksburgian Pectinidae: Jour. Paleont., v. 37, No. 6, p. 1265-1271, pl. 178, 1 text fig.

Dockery, David Terrell, III, 1977, Mollusca of the Moodys Branch Formation, Mississippi: Miss. Geol. Survey, Bull. No. 120, 212 p., 28 pl., 23 fig.

Dockery, David Terrell, III, 1980, The invertebrate macropaleontology of the Clarke County, Mississippi, area: Miss. Bureau Geol., Bull. No. 122, 387 p., 82 pl., 36 fig.

Gabb, William More, 1860, Description of new species of American Tertiary and Cretaceous fossils: Acad. Nat. Sci. Philadelphia, Jour., 2nd ser., v. 4, pt. 4, p. 375-406, pl. 67-69.

Gabb, William More, 1862, Description of new species of cretaceous fossils from New Jersey, Alabama and Mississippi: Acad. Nat. Sci. Philadelphia, Proc. 1861, v. 13, p. 318-330.

Gardner, Julia Anna, 1928, The molluscan fauna of the Alum Bluff Group of Florida. Part V. Tellinacea, Solenacea, Mactracea, Myacea, Molluscoidea: U.S. Geol. Survey, Prof. Paper 142-E, p. 185-249, pl. 29-36.

Gardner, Julia Anna, 1945, Mollusca of the Tertiary formations of Mexico: Geol. Soc. Amer., Memoir 11, 332 p., 28 pl.

Glawe, Lloyd N., 1969, *Pecten perplanus* stock (Oligocene) of the Southeastern United States: Geol. Survey Alabama, Bull. No. 91, 179 p., 5 pl., 20 fig., 8 tables.

Glawe, Lloyd N., 1970, *Chlamys menthifontis*, a new pectinid from the Oligocene of Mississippi: Jour. Paleont., v. 44, No. 5, p. 858-866, pl. 121.

Glawe, Lloyd N., 1974, Upper Eocene and Oligocene Pectinidae of Georgia and their stratigraphic significance: Geol. Survey Georgia, Information Circular No. 46, 27 p., 4 pl., 3 fig.

Gregorio, Antoine de, 1890, Monographie de la Faunc-Éocènique de l'Alabama et surtout de celle de Claiborne de l'Etage Parisien (Horizon à *Venericardia planicosta* Lamk.): Ann. Géol. et Paléont., livr. 7 et 8, 316 p., 46 pl.

Harris, Gilbert Dennison, 1919, Pelecypods of the St. Maurice and Claiborne stages: Bull. Amer. Paleont., v. 6, No. 31, 268 p., 59 pl.

Harris, Gilbert Dennison, 1951, Preliminary notes on Ocala bivalves: Bull. Amer. Paleont., v. 38, No. 138, 54 p., 13 pl.

Harris, Gilbert Dennison and Katherine Van Winkle Palmer, 1946, The Mollusca of the Jackson Eocene of the Mississippi Embayment (Sabine River to the Alabama River) Part I. Bivalves and bibliography for parts I and II: Bull. Amer. Paleont., v. 30, No. 117, pt. 1, 206 p., 25 pl.

Heaslip, William Graham, 1968, Cenozoic evolution of the alticostate venericards in Gulf and East Coastal North America: Palaeont. Amer., v. 6, No. 39, p. 51-135, 29 pl., 28 text fig.

Heilprin, Angelo, 1882a, A revision of the cis-Mississippi Tertiary pectens of the United States: Acad. Nat. Sci. Philadelphia, Proc. 1881, p. 416-422.

Heilprin, Angelo, 1882b, A revision of the Tertiary Species of *Arca* of the Eastern and Southern United States: *Ibid*, p. 448-453.

Heilprin, Angelo, 1884, North American Tertiary Ostreidae. App. I., p. 309-316, pl. 62-72, *in* White, Charles A., A review of the fossil Ostreidae of North America; and a comparison of the fossil with the living forms: U.S. Geol. Survey, 4th Ann. Report. 1882-1883, p. 273-473, pl. 34-82.

Hertlein, L. G., 1969, Family Pectinidae Rafinesque, 1815, p. 348-373, text fig. C72-C94, *in* Treatise Invert. Paleont., pt. N. Mollusca 6, Bivalvia, v. 1, 489 p., 301 text fig.

Hilgard, Eugene Woldemar, 1860, Report on the geology and agriculture of the state of Mississippi: Jackson, 391 p., map.

Hopkins, Oliver Baker, 1917, Oil and gas possibilities of the Hatchetigbee Anticline Alabama: U.S. Geol. Survey, Bull. No. 661-H, p. 279-313, pl. 26-29.

Ivey, John B., 1957, Geology and groundwater in the Monroeville area, Alabama: Alabama Geol. Survey, Bull. No. 66, 109 p., 12 pl.

Keen, A. Myra, 1969, Superfamily Myacea Lamarck, 1809, p. 690-699, text fig. E153-E159, *in* Treatise Invert. Paleont., pt. N. Mollusca 6, Bivalve, v. 2, p. 491-951, 309 text fig.

Kellum, Lewis Burnett, 1926, Paleontology and stratigraphy of the Castle Hayne and Trent marls in North Carolina; U.S. Geol. Survey, Prof. Paper 143, 56 p., 11 pl.

Langdon, Daniel W., Jr., 1886, Observations on the Tertiary of Mississippi and Alabama with descriptions of new species: Amer. Jour. Sci., v. 131, 3rd ser., v. 31, No. 183, Art. 20, p. 202-209.

Lea, Henry Carey, 1849, Catalogue of the Tertiary testacea of the United States: Acad. Nat. Sci. Philadelphia, Proc. 1848, v. 4, p. 95-107.

Lesueur, Charles-Alexandre, 1829, Lesueur's Walnut Hills fossil shells, manuscript, 12 pl., first plate dated 1829.

MacNeil, Francis Stearns, 1944, Oligocene stratigraphy of Southeastern United States: Amer. Assoc. Petroleum Geologists, Bull., v. 28, No. 9, p. 1313-1354.

Mansfield, Wendell Clay, 1934, A new species of *Pecten* from the Oligocene near Duncan Church, Washington County, Florida: Wash. Acad. Sci. Jour., v. 24, p. 331-333.

Mansfield, Wendell Clay, 1937, Mollusks of the Tampa and Suwannee limestones of Florida: Florida Geol. Survey, Bull. No. 15, 334 p., 21 pls.

Mansfield, Wendell Clay, 1938, Oligocene faunas from the lower and upper beds on the A. L. Parrish farm, Washington County, Fla.: Washington Acad. Sci. Jour., v. 28, No. 3, p. 93-107, 19 fig.

Mansfield, Wendell Clay, 1940, Mollusks of the Chickasawhay Marl: Jour. Paleont., v. 14, No. 3, p. 171-225, pl. 25-27.

May, James H., 1974, Wayne County geology and mineral resources: Mississippi Geol. Survey, Bull. No. 117, 293 p.

Meyer, Otto, 1885, The genealogy and the age of the species of the southern old-Tertiary. Part I: Amer. Jour. Sci., 3rd ser., v. 29, No. 174, p. 457-468.

Meyer, Otto, 1886, Part II. Contributions to the Eocene paleontology of Alabama and Mississippi, p. 61-85, pl. 1-3, *in* Smith, Eugene Allen, Geol. Survey Alabama, Bull. No. 1, 85 p., 9 pls.

Meyer, Otto, 1887, On invertebrates from the Eocene of Mississippi and Alabama: Acad. Nat. Sci. Philadelphia, Proc. 1887, v. 39, p. 51-56, pl. 3.

Moore, Ellen James, 1962, Conrad's Cenozoic fossil marine mollusk type specimens at the Academy of Natural Sciences of Philadelphia: Acad. Nat. Sci. Philadelphia, Proc. 1962, v. 114, No. 2, p. 23-120.

Moore, Raymond C. (ed.), 1969, Treatise Invert. Paleont., pt. N Mollusca 6, Bivalvia, v. 1 and 2, 951 p., 610 text fig.

Morton, Samuel George, 1833, Supplement to the "Synopsis of the Organic remains of ferruginous sand formation of the United States" contained in vols 17 and 18 of this Journal: Amer, Jour. Sci., 1st ser., v. 23, No. 2, p. 288-294, pl. 5, 8.

Morton, Samuel George, 1834, Synopsis of the organic remains of the Cretaceous group of the United States. Appendix. Catalogue of the fossil shells of the Tertiary formation of the United States, by Timothy A. Conrad: Philadelphia, 88 p., 19 pl., App. p. 1-8.

Morton, Samuel George, 1842, Description of some new species of organic remains of the Cretaceous group of the United States: with a tabular view of the fossils hitherto discovered in this formation: Acad. Nat. Sci. Philadelphia, Jour., 1st ser., v. 8, pt. 2, p. 207-227, pl. 10-11.

d'Orbigny, Alcide Dessalines, 1850, Prodrome de paléontologie stratigraphique universelle des animaux mollusques & rayonnes faisant suite au cours élémentaire de paléontologie et de géologie stratigraphiques. Paris, v. 2, 427 p.

Palmer, Katherine E. Hilton Van Winkle, 1927/1929, The Veneridae of eastern America, Cenozoic and Recent: Palaeont. Amer., v. 1, No. 5, 319 p., 35 text fig. (1927); 45 pl. (1929).

Palmer, Katherine E. Hilton Van Winkle and Doris Colgate Brann, 1965, Catalogue of the Paleocene and Eocene Mollusca of the Southern and Eastern United States. Part I. Pelecypoda, Amphineura, Pteropoda, Scaphopoda, and Cephalopoda: Bull. Amer. Paleont., v. 48, No. 218, pt. 1, 466 p., 3 pl.

Richards, Horace Gardiner, 1968, Catalogue of invertebrate fossil types at Academy of the Natural Sciences of Philadelphia: Acad. Nat. Sci. Philadelphia, Spec. Pub. No. 8, 222 p.

Schenck, Hubert G. and Philip W. Reinhart, 1938, Oligocene arcid pelecypods of the genus *Anadara:* Memoires Musée Royal d'History Naturelle Belgique, 2nd ser., fasc. 14, 73 p., 6 pl.

Shimer, Hervey Woodburn and Robert Rakes Shrock, 1944, Index fossils of North America: New York and London, John Wiley and Sons, Inc., 837 p., 303 pl.

Shreveport Geological Society, 1933, Oligocene and Eocene Jackson formations of Caldwell and Catahoula Parishes, Louisiana: Shreveport Geol. Soc. Guidebook, 10th Annual Field Trip, 20 p., 6 pl.

Tucker-Rowland, Helen Ione, 1936, The Atlantic and Gulf Coast Tertiary Pectinidae of the United States: Amer. Midland Nat., v. 17, p. 985-1017, pl. 5-10. Under H. I. Rowland.

Tucker-Rowland, Helen Ione, 1938, The Atlantic and Gulf Coast Tertiary Pectinidae of the United States. Sec. III Systematic descriptions: Memoires Musée Royal d'History Naturelle Belgique, 2nd ser., fasc. 13, 76 p., 6 pl.

Veatch, Arthur Clifford, 1906, Geology and underground water resources of northern Louisiana and southern Arkansas: U.S. Geol. Survey, Prof. Paper 46, 422 p., 51 pl., 30 text fig., map.

Vokes, Harold Ernest, 1979, Observations on the genus *Dimya* (Mollusca: Bivalvia) in the Cenozoic faunas of the western Atlantic region: Tulane Studies Geol. Paleont., v. 15, No. 2, p. 33-53, 4 pl.

Woodring, Wendell Phillips, 1925, Miocene mollusks from Bowden, Jamaica. Pt. I. Pelecypods and Scaphopods: Carnegie Inst. Washington, Pub. No. 366, 222 p., 28 pl.

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