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THE JACKSON EOCENE OSTRACODA
OF MISSISSIPPI

by

William Jennings Huff

A THESIS
SUBMITTED TO THE FACULTY
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

Approved
April 30, 1960
Carey Cronis
Houston, Texas
April, 1960

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INTRODUCTION

One of the most intensively studied sections in the geologic column is that of the Jackson Eocene in the Mississippi embayment. The volume of significant work resulting from this interest was pointed up by Howe (1947) when he discussed the status of micropaleontology in the eastern Gulf region. He accounted for forty-seven papers on foraminifera and eight papers on ostracoda. Many more have been added in the last decade. Numerous species of other microfaunal groups including comatulids, bryozoa, and otoliths have also been described.

The works on Jackson Eocene stratigraphy are relatively voluminous. This emphasis is readily understood when one considers that these richly fossiliferous strata comprise keys for subsurface correlation in oil wells throughout the entire Gulf coastal area.

In spite of the extensive micropaleontological literature, however, there has been little systematic study of the second most stratigraphically useful microfaunal group -- the ostracoda -- from the type areas of the Jackson group. Many ostracodes have been described from the Jackson or its age equivalents in adjacent states, but for some reason those from the type sections of the Jackson have been neglected. It is the essential purpose of this paper to rectify this neglect and to provide another link in the chain of studies of the important Jackson faunal groups in the eastern Missis-

issippi embayment.

The Jackson group is herewith zoned by means of ostracodes described from the type areas; thus the petroleum paleontologist has been provided with an additional useful tool for stratigraphic correlation. In this paper ninety-nine species of ostracoda have been described and illustrated with twenty-six species and one genus designated as new. The ostracodes of the Jackson group which have been described in previous works, insofar as they are duplicated in this material, have been reclassified, redescribed, and brought up to date in the light of present day knowledge of the ostracoda. The species which are restricted to various stratigraphic units have been noted and listed.

The stratigraphy of the group, as evidenced by the type sections and other sections, has been summarized and relationships to superjacent and subjacent strata noted. The member units of the Yazoo clay formation as designated by Cooke (1933) and Murray (1947) have been correlated across the state, and where possible, the Jackson formations have been correlated with their age equivalents in other states in the Gulf Coast Province. The lack of ostracode literature on the Jackson group in Texas and its apparent age equivalents, the Twiggs clay, Barnwell formation, and the Cooper marl of Georgia and South Carolina, has precluded certain correlation with those areas.

The rich microfauna of the Jackson group in Mississippi

also afforded the opportunity for application to ancient sediments of some of the results of extensive research on modern faunas in present day sedimentary environments. Representative samples were selected from along the Jackson outcrops and prepared for examination by a technique modified from Shepard and Moore (1954) who prepared the method of "coarse fraction analysis." The percentages of the useful and diagnostic constituents were tabulated and the foraminifera and ostracodes were identified. The foraminifera were used as keys to approximate depth zones at the time of deposition, and all the constituents were employed in an attempt to assess the sedimentary environments in the areas of sampling. This study presented much suggestive evidence on the nature of the Jackson depositional cycle in Mississippi.

ACKNOWLEDGEMENTS

The writer wishes to express especial appreciation to Dr. Carey Croneis, The Rice Institute, for his inspiration and encouragement during study at The Rice Institute and for his guidance during this investigation. Especial appreciation is also accorded Mr. Lawrence Reed, President, Texas Gulf Producing Company, for providing The Rice Institute, Geology Department, with the Texas Gulf Producing Company Fellowship which the writer has held during the academic year 1959-60. In addition, especial appreciation is extended to Dr. Stuart E. Levinson, Humble Research Center, Houston, Texas, for giving freely and generously of his time to assist the writer with technical problems involved in this study. He has also been generous in lending the writer his superb collection of Tertiary ostracode literature and allowing the use of the excellent photomicrographic equipment in his department of the Humble Research Center. Especial appreciation is also accorded Dr. Henry V. Howe of Louisiana State University who not only made his excellent ostracode type collection available for study but gave freely and generously of his time to instruct and to advise the writer with respect to Tertiary ostracodes.

In addition, sincere thanks are due the following individuals: Dr. Grover Murray, Dr. Henry V. Howe, Dr. Allan Cheetham, and Mr. Paul Krutak of Louisiana State University for samples; Dr. R. W. Barker and Mr. E. H. Rainwater of

Shell Development Company for samples; Mr. Tracey Lusk, Director, Mississippi State Geological Survey, for samples from borings in Yazoo and Scott Counties, Mississippi; Dr. Paul H. Dunn and Mr. Ernest Russell, Mississippi State University, for samples collected by the school's geology staff; Dr. John F. Burst, Shell Development Company, for his advice, technical assistance, and X-ray diffractograms with respect to the glauconite study; Dr. H. N. Fisk, Director, Humble Research Center, Houston, Texas, for his approval of the use of the photomicrographic equipment at the Humble Research Center; Dr. John J. W. Rogers and Mr. Edward G. Purdy, The Rice Institute, for assistance in the statistical study; Dr. William F. Powell, Pan American Oil Company, for drafting; and Mr. Donald Dalrymple, The Rice Institute, for photomicrographs of glauconite pellets.

Lastly, but not least, the writer wishes to express appreciation to his son, John, for his assistance in collecting the samples and for the photographs of the outcrops; and to his wife, Frances, who not only aided in sample collecting but also was indispensable in the preparation of the manuscript and illustrations.

STRATIGRAPHY

HISTORICAL REVIEW OF THE NOMENCLATURE

The Eocene first was recognized in North America by T. A. Conrad (in Harris, 1897) who referred beds at Ft. Washington, Maryland, to the "London Clay formation." Conrad substituted the terms Upper, Middle, and Lower Tertiary for the nomenclature used by European geologists; and Morton (1833) extended the usage of Conrad's terms to the southeast. Rogers and Rogers (1839) later applied the name "Eocene" to the beds described by Conrad at Ft. Washington.

In 1846 Conrad published faunal lists from the limes of Claiborne, Alabama, the strata at Vicksburg, Mississippi, and the beds on the Ouachita River in Louisiana and referred all of these beds to the Eocene Series. In 1848 he noted that one hundred and three of the species from the Vicksburg beds were distinguishable from those of the previously mentioned localities. He then subdivided the Eocene into a Newer Eocene comprising the Vicksburg and the St. Stephens, Alabama, deposits and an Older Eocene representing the Claiborne, Alabama, beds.

Sir Charles Lyell (1847) noted that fossils from beds at Jackson, Mississippi, were more nearly correlative with those from Claiborne, Alabama, than with the fossils at Vicksburg, Mississippi. He also pointed out that the "Nummulitic" limes of Alabama were younger than those con-

taining Zeuglodon. (Now Basilosaurus cetoides (Owen) of the Yazoo clay formation.)

In 1854 Wailes published color plates of forty species of testacea which were described by Conrad in 1855, who, then, further subdivided the Eocene of the southeast into three groups: Older Eocene, Claiborne; Older Eocene, Jackson; and Newer Eocene, Vicksburg. Hilgard (1860), however, noted that strata exposed at Red Bluff station in Wayne County, Mississippi, separated the Jackson from the overlying Vicksburg beds and in 1866 Conrad referred the Vicksburg deposits to the Oligocene.

Meyer (1885) after much criticism of previous Tertiary stratigraphy reversed the order of Conrad's groups and designated the Claiborne as youngest and the Vicksburg as oldest. Langdon (1886) considered the Jackson Zeuglodon bearing beds as older than the Vicksburg orbitoidal limes of Mississippi and Alabama; but Smith and Johnson (1887) considered the entire white limestone sequence of Alabama, including both Zeuglodon and orbitoidal beds, as a single unit equivalent in age to the Jackson and Vicksburg groups of Mississippi and referred to them as Upper Eocene. Clark (1891) also referred to the Jackson and Vicksburg as stages of the Eocene, as did Harris (1894) who also denoted the "Moodys Branch Beds" as a substage of the Jackson. Dall (1897) correlated the Tertiary of America with that of Europe and distinguished the Jackson as the youngest stage of the Eocene. The terms Marks Mills

beds, Moodys Branch beds, and Zeuglodon beds were used by Dall (1897) as substages of the Jackson.

Lowe (1915) was the first geologist to identify specifically formations within the Jackson group. He recognized the Moodys Branch Green Marls, named for beds along a small tributary to the Pearl River at Jackson, Mississippi; the Yazoo Clay Marl, for clays on the Yazoo River bluffs near Yazoo City, Mississippi; and the Madison sand, for the overlying beds which he described as deltaic sands and clays. Lowe questioned the Jackson age of the latter formation. Hopkins (1916) also questioned the Jackson age of the Madison sand. Cooke (1918) referred the Madison sand to the Oligocene and changed the name to Forest Hill sand because the name Madison was preoccupied. He (Cooke, 1918, p. 187) considered the Jackson a formation and believed that the Moodys Branch marl and the Yazoo clay marl were its members because they "intergrade so much that it seems advisable to consider them members of the same formation." He also considered the Jackson as an equivalent to the Ocala limes east of the Tombigbee River in Alabama.

In 1926 Cooke shortened the names of the Jackson members to Moodys marl member and Yazoo clay member. Lowe (1928), Grim (1928), Stephenson, Logan, and Waring (1928), and Monroe (1931) all used Cooke's nomenclature in describing the Jackson strata. In 1933 Cooke recognized another member of the Jackson, the Cocoa sand, in Choctaw County, Alabama. The

recognition of this additional member was necessitated by the usage developed from a paper by Cushman (1925) that purported to describe foraminifera from the Cocoa Sand of Alabama. Unfortunately, the foraminifera had been collected from clays well above the Cocoa sand as defined by Cooke. Grim (1936) considered the Jackson as a formation but included the Forest Hill sand as a member because of its gradational nature with the underlying Yazoo clay. Cooke (1939) raised the Jackson to group status when he correlated the Moodys Branch formation with the Gosport sand of Alabama. Mellen (1940), however, continued to class the Jackson as a formation with the Forest Hill sand as a member; Bergquist (1942) included the latter as part of his Oligocene-Vicksburg series. In 1945 the United States Geological Survey adopted the names Moodys Branch formation and Yazoo clay formation as subdivisions of the Jackson group (Monroe, 1954).

Subsequently Murray (1947) designated the North Creek clay, the Pachuta marl, and the Shubuta clay as members of the Yazoo clay formation. Murray and Wilbert (1950) have urged that the Jackson be referred to as a stage in the time rock sense in order to free this heterogeneous body of sediments from the purely lithologic connotations involved in the group terminology.

In the present paper the Jackson is referred to as a group because of the well established usage of that nomenclature by the United States Geological Survey, the Missis-

issippi State Geological Survey, and petroleum geologists who have worked in the area studied.

THE JACKSON GROUP IN MISSISSIPPI

Areal Extent

Jackson Eocene deposits in Mississippi crop out in a wedge-shaped northwest-southeast trending band which varies irregularly in width from approximately thirty-one miles wide along the Yazoo River in west central Mississippi to about four miles wide near the Alabama line in the east. The easternmost boundary of the argillaceous Jackson is placed approximately at the Tombigbee River in Alabama where the white limes of the Ocala group begin.

Topographic Expression

The physiography of the outcrop band of Jackson sediments is essentially that of its thicker formation, the Yazoo clay. This formation forms the prairie belt which lies between the North Central and Southern Pine Hills provinces. It is an area generally of low relief with grass as the predominant vegetation. The clay is very amenable to erosion and also to slippage. Morse (1935) has reported landslides in the Yazoo clay affecting railroads, highways, and the city reservoir at Yazoo City, Mississippi. Monroe (1932) has reported large cracks en echelon on the south side of Ware Hill, Rankin County.

Structure

The most notable structural feature affecting the Jackson sediments is the Jackson anticline. This is an elongate dome with a northeast-southwest trending long axis. The dome is about twenty-five miles in length and twenty-three miles in width. The highest point of the dome is in the northeastern section of the city of Jackson. According to Monroe (1954) the strata on the flanks of the structure dip away from the crest of the dome at a nearly constant rate of seventy feet per mile, whereas the dip toward the northeast is approximately fifteen feet per mile. He reports that in some places on the south side of the dome the dip reaches extremes of one hundred fifty to two hundred feet to the mile. Monroe (1954) also mapped some synclines in the Jackson area. The largest is a structural trough southeast of Jackson with a northeast-southwest trending axis extending through Brandon, Mississippi. He refers to this trough as the Brandon syncline.

The Tinsley dome in Yazoo County, Mississippi, is approximately six miles south of Yazoo City, Mississippi, and has a closure of approximately one hundred thirty-five feet in surface expression. It was discovered by Mellen (1940) as a result of his field study of the geology of Yazoo County. This structure determined the location of the first oil field in Mississippi. Other structures in the area include a fault near Sartartia, Mississippi, and small faults in the northeastern section of the county.

On the eastern side of the state, in Clarke and Wayne Counties, Tourtelot (1944) mapped a zone of faults called the Quitman fault zone. The largest of these, the Quitman fault, has an east-west trend approximately across the center of Clarke County through Quitman, Mississippi. It is eleven miles long with the downthrown side to the north and a maximum displacement of one hundred feet at Quitman. Another fault, between Barnett and Pachuta, Mississippi, called the Pachuta fault, is approximately four miles in length and extends westward a short distance into Jasper County. The downthrown side is to the north with about fifty feet of displacement. This fault brings the lower part of the Yazoo clay into contact with the Cockfield formation. The Cocoa sand member is forty feet higher at Barnett, Mississippi, than it is on the south side of Pachuta Creek one half mile to the north.

Another fault, called the Gilbertown fault, extends westward into Wayne County, Mississippi, from near Gilbertown, Alabama. This fault has a large displacement near Gilbertown, but it gradually dies out just within Wayne County. Other small faults also have been mapped in the general area.

THE MOODYS BRANCH FORMATION

General

The Moodys Branch formation is the basal unit of the Jackson group in Mississippi. It has a distinct lithology

and fauna which make it one of the most useful of all Tertiary formations for surface and subsurface mapping.

Lowe (1915) did not subdivide it into smaller units, but E. P. Thomas et al. (1948) measured two mappable units in an outcrop in Jackson, Mississippi, (locality 15, p. 315, appendix) which they described as an upper marl member, four feet in thickness, and a lower green sand, thirteen feet in thickness.

Lithology, Type Sections, and Other Sections

The Moodys Branch is lithologically uniform throughout the state. According to Monroe (1954) the thickness varies considerably in the Jackson, Mississippi, area but averages approximately twenty-five feet. Bergquist (1942) reported varying thicknesses of twelve to twenty feet in Scott County. Lowe (1915) described exposures of thirty-five feet thickness in the bluffs of Garland Creek, Clarke County, Mississippi.

The original type section, in the city of Jackson (locality 16, p. 317, appendix) was defined by Lowe (1915) and redescribed by Monroe (1954, p. 54). It is summarized as follows:

Transition zone with Yazoo clay.

Clay, light yellow to cream colored, calcareous with mollusk impressions, slightly glauconitic and plastic in upper part, and gradational with beds below..... 18 feet

Moodys Branch formation

Yellow to gray, clayey, glauconitic, fossiliferous

sand, with calcareous nodules six feet above the base, and reworked clay pebbles in the basal one foot..... 13 feet

Unconformity..... Alt. 276.5 feet

There is an excellent exposure in the city of Jackson which is generally accepted as the "alternate type" since the original section is on private property and now inaccessible to the public. The alternate section may be summarized as follows:

Upper Marl member

Gray green, sandy, slightly glauconitic, fossiliferous marl..... 3½ feet

Green sand member

Dark blue-green, glauconitic, sandy, fossiliferous marl..... 12 feet

Transition zone

Dark, gray-green, lignitic, clayey sands..... 3 feet

Cockfield formation

The Shreveport Geological Society in 1934 (in Mississippi Geological Society, Sixth Field Trip, 1948, p. 60) measured and described an exposure of Jackson group sediments on Garland Creek, Clarke County, Mississippi, (locality 8, p. 312, appendix) which is summarized as follows:

Yazoo clay formation

Greenish and gray, blocky, calcareous, fossiliferous clay..... 10 feet

Moodys Branch formation

Fossiliferous marly limestone..... 1 foot

Greenish gray, fossiliferous, glauconitic, sandy marl.....	8 feet
Fossiliferous, glauconitic marl with irregularly distributed black shale fragments.....	1 foot
Well-bedded black calcareous shale with thin partings of fossiliferous marl.....	2 feet

Transition zone

Massive lignitic sands and clays with pockets of fossiliferous marl.....	8 feet
Elevation at base of Moodys Branch.....	194 feet

Stratigraphic Relations

The Moodys Branch disconformably overlies the Cockfield formation on a differentially eroded surface. Clay pebbles in the lower one foot of the formation indicate a reworking of the underlying Cockfield. The Moodys Branch grades upward conformably with the overlying Yazoo clay, gradually losing its sand and glauconite, and becomes a calcareous clay. The contact is arbitrarily placed, in the west-central part of the state, in a zone where the sand and glauconite become negligible. Hendy (1948) suggests placing the contact, in the eastern part of the state, at a limestone ledge which is found in some places in the upper calcareous marl. This separates it from the conformably overlying North Creek clay member of the Yazoo clay formation.

The Ostracode Fauna

The Moodys Branch formation contains the most generically diversified ostracode fauna of the Jackson group.

Monsour (1937, p. 93) published a list of foraminifera and ostracodes, without descriptions, from eastern Mississippi. He lists the following species as being restricted to the Moodys Branch formation:

Cytheridea n. sp.
Cytheridea n. sp.
Hemicythere n. sp.
Paracytheridea belhavenensis Howe and Chambers
Brachycythere n. sp.

Green Sand Member

The writer found fifty-nine species of ostracodes in the Green sand member and twenty-four species in the Upper marl member.

The following species were found not to occur above the Green sand member:

Bairdoppilata sp.
Cyamocytheridea hadleyi (Stephenson)
Cytherura semireticulata Blake
Cytherura ultra Blake
Cytherura crami n. sp.
Hemicythere bellula Howe
Hermanites adamsi n. sp.
Hirsutocythere hornotina Howe
Loxoconcha stavensis Blake
Triginglymus debremaeckeri n. sp.

The following species occur commonly to abundantly in the Green sand member but rarely above:

Cushmanidea moodysbranchensis n. sp.

Hermanites morrisoni n. sp.

Triginglymus hyperochus Blake

Tropidocythere tricostata n. gen. n. sp.

The Green sand member is characterized by the abundant occurrence of individuals belonging to the genera Clithrocytheridea, Cyamocytheridea, Absonocytheropteron, and Hemicythere, all of which occur rarely in the overlying clays and marls.

Upper Marl Member

None of the species found in the Upper marl member is exclusive thereto, but two species are first found in this unit and range upward. They are:

Buntonia morsei (Howe and Pyeatt)

Buntonia warneri (Howe and Pyeatt)

YAZOO CLAY FORMATION

General

The Yazoo clay is the younger and by far the thicker formation of the Jackson group in Mississippi. No formal subdivision of the formation into members has been made in the central and west-central areas of outcrops but Mellen (1940) recognized two litho-facies in Yazoo County which he termed simply a lower facies and an upper facies. Bergquist

(1942) used the terms "lower beds" and "upper beds" for the different lithologies and faunas encountered in test hole borings in Scott County.

In the eastern part of the outcrop area, Wayne, Clarke, and Jasper Counties, the formation has been subdivided by Cook (1933) and Murray (1947) into four member units which can be distinguished lithologically. From oldest to youngest they are: North Creek clay member, Cocoa sand member, Pachuta marl member, and Shubuta clay member.

Lithology, Type Sections, and Other Sections

The Yazoo Clay Formation of the West-central Area

The Yazoo clay has a varying lithology and thickness in areal extent across the state. The thickest section is in Yazoo County where Mellen (1940) computed a thickness of approximately five hundred feet from borings and outcrops along the Yazoo River. The lower facies is three hundred fifty feet thick, and the upper facies is one hundred fifty feet thick.

The original type section of the Yazoo clay formation (locality 20, p. 319, appendix) as defined by Lowe (1915) is a bluff on the Yazoo River near the present southern corporate limits of Yazoo City, Mississippi. Most of the section is now under cover except for a few gullies and ravines. This section according to Mellen (1940) exposes approximately one

hundred twenty-five feet of the lower facies above the flood plain of the Yazoo River. From outcrop samples and exposures this section may be approximated as follows:

Calcareous, silty loess, weathering in steep cliffs..50 feet
Citronelle formation (?)

Heavy, cherty, well rounded, iron-stained gravel...20 feet
Yazoo clay formation

Gray to buff, gummy, fossiliferous, weathered clay..120 feet
Under cover of grass to edge of water of the
Yazoo River.....20 feet

Mellen (1940, p. 19) described the lower facies in Yazoo County in general as a "fairly homogeneous, silty, calcareous, fossiliferous, gummy, plastic montmorillonitic clay." He described the upper facies as "relatively pure beds of massive, gummy, non-calcareous montmorillonitic clay; beds of interlaminated silt and silty clay; a thin bed of bentonite, and lentils of limestone." This is the unit in which remains of Basilosaurus cetoides (Owen) are most commonly found.

In the eastern part of the state the thickness of all member units of Cooke and Murray combined probably does not exceed one hundred fifty feet. The lithology varies among the units.

The North Creek Clay Member

Murray (1947, p. 1839) designated exposures on the

western side of North Creek near Rose Hill (Jasper County), Mississippi, SW $\frac{1}{4}$ of Sec. 1, T. 3 N., R. 12 E., as the type Section of the North Creek clay member. He described the section simply as "green or gray, slightly glauconitic, fossiliferous clay with an average thickness of forty feet" Farther east in Clarke County near Pachuta, Mississippi, (locality 9, p. 312, appendix) the North Creek clay is exposed along the banks of Pachuta Creek. In the area sampled there is approximately fifteen to twenty feet of blue-gray to buff, micaceous, slightly glauconitic, fossiliferous clays and silts.

In northeastern Wayne County this member is exposed on the south bank of Shiloh Creek (locality 4, p. 308, appendix) in the SW $\frac{1}{4}$ of Sec. 18, T. 10 N., R. 5 W., and along the banks of Buckatunna Creek near Frost Bridge (locality 2, p. 306, appendix) in the NW $\frac{1}{4}$ of Sec. 23, T. 10 N., R. 5 W. The Shiloh Creek section as summarized from the Guide Book, Sixth Field Trip, Mississippi Geological Society (1948, p. 35) includes "9 feet of bluish-gray, micaceous, fossiliferous sandy silt with claystone concretions below a claystone ledge 1 foot in thickness." The lithology of the exposure along Buckatunna Creek is essentially the same as that exposed on Shiloh Creek.

The Cocoa Sand Member

The type section for the Cocoa sand member was defined

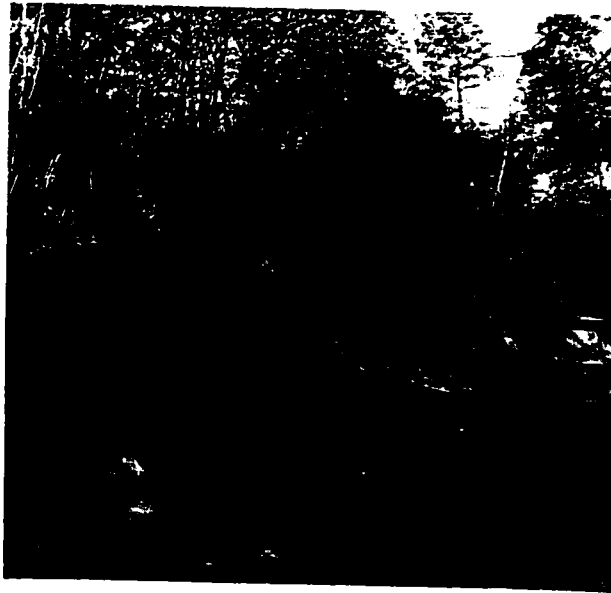


Figure 1. An outcrop of the North Creek clay on the south bank of Pachuta Creek at locality 9.

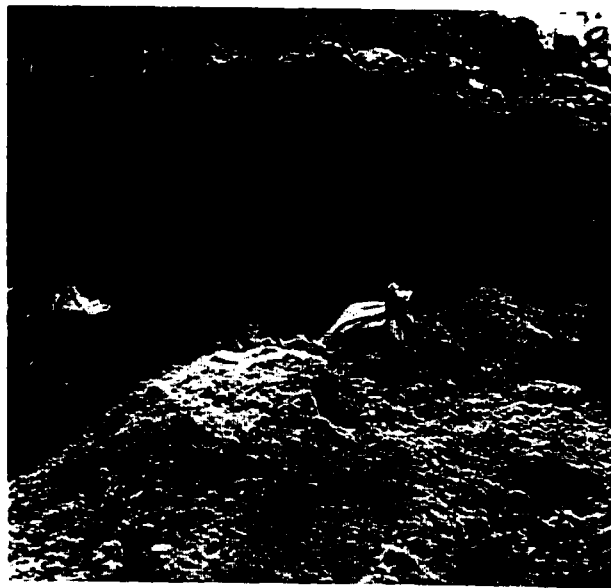


Figure 2. A view of the "Pecten Bryozoan ledge" which marks the contact between the Cocoa sand and the Pachuta marl members at locality 3.

by Cooke (1933) for beds cropping out near the Cocoa, Alabama post office, two and one-half miles east of Melvin, Alabama. This particular exposure is now under cover. Cooke (1933, p. 1388) described the Cocoa sand in Choctaw County, Alabama, as "17-70 feet of fine yellow sand, partly calcareous and argillaceous, with shells in the lower part." At present, the best available exposure of this unit is located on Choctaw County, Alabama, Road 14 at Keyser Hill (locality 1, p.305, appendix). The road cut here exposes approximately fifteen feet of massive, blue-green, fossiliferous, silty sands overlain by a yellowish, colluviated non-fossiliferous sand.

This member is also exposed along the banks of the Chickasawhay River in Clarke County, Mississippi. Approximately two or three feet are exposed above the water level of the river at locality 6 (appendix p.309). The lithology is the same as that noted for locality 1. Hendy (1948) reported that the Shubuta clay member is about fifty feet thick in northeastern Wayne County and about twenty-five feet thick along the Chickasawhay River.

The Pachuta Marl Member

The Pachuta marl member is the "Pecten-Bryozoan" zone of the older literature. The type section was designated by Murray (1947, p. 1839) for exposures on Pachuta Creek one and one-half miles south of Pachuta, Mississippi, which he

described briefly as "6 to 25 feet of buff, gray or white, partially indurated, generally glauconitic, fossiliferous marl." Another exposure of the Pachuta marl is located in northeastern Wayne County (locality 3, p.307, appendix). This section comprises approximately twelve feet of chalky, semi-indurated, limonite stained, fossiliferous, slightly sandy marls between two slabby, weathered, limestone ledges. The Pachuta marl as described in the literature is relatively thin and forms a semi-indurated marl between the underlying silty sands of the Cocoa sand and the overlying clays of the Shubuta. The maximum thickness thus far reported in any measured outcrop section is twelve feet.

The Shubuta Clay Member

According to Hendy (1948, p. 27) the Shubuta clay member ranges in thickness from ninety feet along the Chickasawhay River to approximately thirty-five feet in northeastern Wayne County. He described it generally as "massive, olive green, blocky clays." The type section of the Shubuta clay was designated by Murray (1947, p. 1839) for exposures in gullies near old Highway 45 bridge over Chickasawhay River in Clarke County near Shubuta, Mississippi, (locality 6, p.309, appendix). Stratigraphically, nearly two-thirds of the Yazoo clay formation can be found at this outcrop. From outcrop samples and field observation this section may be approximated as follows:

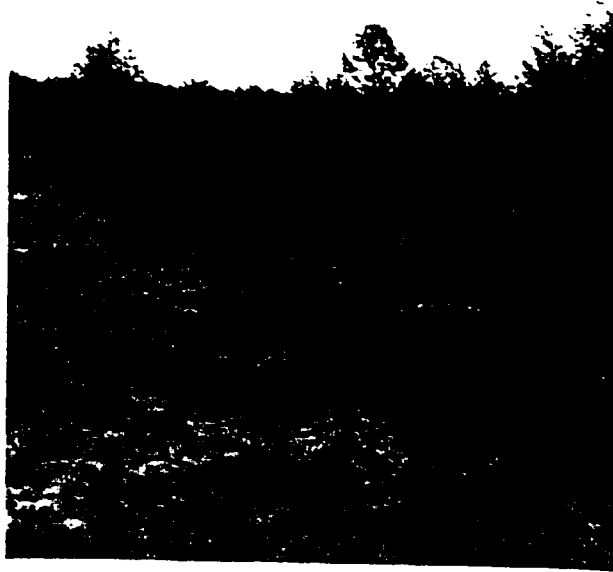


Figure 3. An outcrop of the Pachuta marl member at locality 3.



Figure 4. Gully entrance near the water's edge of Chickasawhay River. (The gully extends eastward up Shubuta Hill exposing the Shubuta clay member at locality 6.)

Red Bluff group

Contact zone under cover of grass and underbrush.

Shubuta clay member

Under cover of grass and slumped..... 10 feet

Buff, weathered, limonite-stained, sticky, calcareous, fossiliferous clays..... 50 feet

Gray to buff, blocky, weathered, fossiliferous, calcareous clays..... 20 feet

Pachuta marl member

Buff, weathering to dirty gray, sandy, glauconitic, semi-indurated marl..... 8 feet

Cocoa sand member

Brownish blue-green, fossiliferous, argillaceous sand..... 2 feet

Water level of Chickasawhay River

Stratigraphic Relations

The contacts between the lower and upper facies of the Yazoo clay in the central and west-central areas of the state are gradational. The contact with the upper facies and the overlying Forest Hill sand is gradational and Mellen (1940, p. 20) considers the beds of "inter-laminated silt and silty clays" as transitional. Contacts between each member unit of the Yazoo clay formation in the eastern area of outcrop are also gradational.

The contact between the North Creek clay and Cocoa sand

is gradational, but the boundary is usually drawn at a sandy clay-stone ledge approximately one foot thick. The Cocoa sand also grades conformably upward into the Pachuta marl and the contact is generally placed at the bottom of a limestone ledge with *Pecten* remains and Bryozoan casts below which is an interval of a few feet of fossiliferous, glauconitic sand. MacNeil (1946, p. 43) states that the Yazoo clay formation extends into Alabama "in two tongues separated by the Cocoa sand, the upper tongue containing Basilosaurus remains and the lower tongue underlain by the Moodys Branch formation." The lower tongue is the North Creek clay. In outcrop, the Cocoa sand disappears in western Clarke County and becomes indistinguishable from the North Creek clay.

The Shubuta clay overlies the Pachuta marl conformably and the contact, in Wayne and Clarke counties, is arbitrarily placed at a limestone ledge above which the clays become blocky and weather to a buff color, instead of the dirty ivory of the Pachuta. MacNeil (1944) described the contact between the Shubuta clay and the overlying Red Bluff as disconformable. In unweathered outcrop Hendy (1948) has noted that the olive green clays of the Shubuta clay contrast with the glauconitic dark gray clays of the Red Bluff. The Red Bluff is treated as the Oligocene age equivalent of the Forest Hill sand in the west-central area of the state.

The Ostracode Fauna

Very few species of ostracodes have been described from the Yazoo clay formation. Bergquist (1942) figured seventeen species from Scott County, all of which, except Cytheromorpha ouachitaensis Howe and Chambers, also occur in the Moodys Branch formation. Monsour (1937) listed several species from outcrops in the eastern part of the state.

The Lower Facies

Thirty-nine species were found by the writer in the lower facies. The following is a list of those species which do not occur above this level in this area. (An asterisk denotes that the species was not found above or below the lower facies in this area.)

*Actinocythereis purii n. sp.

Actinocythereis boldi n. sp.

Buntonia morsei (Howe and Pyeatt)

Clithrocytheridea grigsbyi (Howe and Chambers)

Hermanites dohmi (Howe and Chambers)

Hermanites hysonensis (Howe and Chambers)

*Cytherella sp. Howe and Chambers

Cytherelloidea montgomeryensis Howe

Cytheropteron montgomeryensis Howe and Chambers

Brachycythere watervalleyensis Howe and Chambers

Echinocythereis cf. E. nuda Puri

*Haplocytheridea parki n. sp.

Paracypris franquesi Howe and Chambers

The Upper Facies

Twenty-one species were found in the upper facies. The following species were found to be restricted to this horizon in the west-central area.

Cytherella hannaï Howe and Lea

Haplocytheridea ouachitensis (Stephenson)

Henryhowella howei n. sp.

In the eastern outcrops where member units are designated on lithologic bases, there is also greater diversification of the ostracode fauna. Monsour (1948, p. 6) correlated the faunal zones of Monsour (1937) with Murray's members as follows:

Lenticulina Horizon fauna is found in the Shubuta; the Pecten-Bryozoan fauna is found in the Pachuta; and the fauna of the lower Jackson from the top of the Moodys Branch to the top of the Cocoa sand is found in both the North Creek clay and the Cocoa sand members of Murray's classification.

The North Creek Clay

Forty-seven species were found by the writer in the North Creek clay of which the following species occur very rarely above this level. (An asterisk denotes that the species is exclusive to this unit.)

Cyamocytheridea chambersi (Stephenson)

Cytheromorpha choctawensis n. sp.

Hemicythere reedi n. sp.

Cytheropteron buckatunnaensis n. sp.

*Aglaiocypris northcreekensis n. sp.

The Cocoa Sand

Monsour (1937, p. 93) lists the following species which start in the Moodys Branch and range continuously through the Cocoa sand.

Cytheridea (Clithrocytheridea) caldwellensis Howe and Chambers

Cytheridea (Clithrocytheridea) grigsbyi Howe and Chambers

Cytheridea (Haplocytheridea) n. sp.

Eocytheropteron spurgeonae Howe and Chambers

The writer found fifty species in the Cocoa sand. The following is a list of species which do not occur, or occur rarely, above this member. (An asterisk denotes that the species is restricted to this member.)

Actinocythereis gibsonensis (Howe and Chambers)

Actinocythereis grigsbyi (Howe and Chambers)

Buntonia morsei (Howe and Pyeatt)

*Acuticythereis cocoaensis Krutak

*Cushmanidea serangodes Krutak

Hermanites hysonensis (Howe and Chambers)

Cytheromorpha choctawensis n. sp.

Cytheromorpha calva Krutak

*Eucythere sp. D., (very rare)

Absonocytheropteron carinata Puri

Loxoconcha cocoaensis Krutak

Loxoconcha lenioformis n. sp.

Paracypris franquesi Howe and Chambers (rare)
Paracytheridea belhavenensis Howe and Chambers
*Pseudocytheromorpha sp. (very rare)
*Triginglymus gnythophoreus Krutak
Absonocytheropteron watervalleyensis Krutak
Tropidocythere tricostata n. gen. n. sp.

The Pachuta Marl Member

Monsour (1937, p. 94) listed the following species which do not occur above the "Pecten-Bryozoan" horizon:

Cytherelloidea montgomeryensis Howe
Paracypris franquesi Howe and Chambers
Cytheridea (Clithrocytheridea) garretti Howe and Chambers
Cytheridea (Clithrocytheridea) ehlersi Howe and Stephenson
Cytheridea (Clithrocytheridea) kellumi Howe and Stephenson
Cytheropteron danvillensis Howe and Chambers
Monoceratina alexanderi Howe and Chambers
Monoceratina n. sp.
Cythereis broussardi Howe and Chambers
Cythereis catahoulana Howe and Pyeatt
Cythereis catahoulana var. pyeatti Howe and Chambers
Cythereis hysonensis Howe and Chambers
Cythereis israe lskyi var. morsei Howe and Pyeatt
Cythereis n. sp.
Lococoncha creolensis Howe and Chambers
Cytheromorpha n. sp.
Cytheretta alexanderi Howe and Chambers
Eucythere lowei Howe
Krithe n. sp.

The writer found fifty-five species in the Pachuta marl member. The species which do not occur or occur very rarely above this member are listed as follows. (An asterisk denotes that the species was found only in this member.)

Actinocythereis pachutaensis n. sp.
Brachycythere mississippiensis (Meyer)

Clithrocytheridea caldwellensis (Howe and Chambers)
Clithrocytheridea garretti (Howe and Chambers)
Cushmanidea papula Krutak (rare)
Cyamocytheridea watervalleyensis (Stephenson)
Cytherella sp. Howe and Chambers
Cytherelloidea montgomeryensis Howe
Cytheretta alexanderi Howe and Chambers
Cytheromorpha ouachitaensis Howe and Chambers (rare)
Brachycythere watervalleyensis Howe and Chambers
Eucythere lowei Howe (rare)
*Eucythere sp. A. (very rare)
*Eucythere sp. B. (very rare)
Monoceratina alexanderi Howe and Chambers
Xestoleberis sarsi Howe and Chambers

The Shubuta Clay Member

Forty species were found in the Shubuta clay member of which the following were not found in subjacent strata in this area. (An asterisk denotes that the species is restricted to this member.)

*Buntonia plileri n. sp.
Buntonia donnellyi n. sp.
Cytherella decorata n. sp.
*Eucythere sp. C. (very rare)
Haplocytheridea ehlersi (Howe and Chambers)
Haplocytheridea ouachitensis (Stephenson)

Pterygocythere murrayi Hill

CORRELATIONS

Correlation of the Jackson Group Members in Mississippi

Moodys Branch Formation

Green sand member. - The Green sand member of the Moodys Branch formation is easily correlated across the state both lithologically and paleontologically. The ostracode suites of the Garland Creek area, Clarke County, Mississippi, in the east are almost identical to those at Jackson, Mississippi, in the central part of the state. Only one species, Hermanites adamsi n. sp., was found at Garland Creek which was not present at Jackson.

Upper marl member. - All of the genera and all but two of the species of ostracodes found in the upper marl member are also present in the Green sand member below. The assemblage as a whole, however, of the latter unit, is more analogous to the Yazoo clay formation. This is evidenced by the absence or rare occurrence of species of the genera Clithrocytheridea, Absonocytheropteron, Hemicythere, and some of the species of Hermanites. Moreover, the lithologic change is more discernible at the top of the Green sand member than it is above the upper marl member. For these reasons it is suggested that the latter unit be included in the Yazoo clay formation.

The Yazoo Clay Formation

None of the members of Cooke and Murray, except possibly the Shubuta clay, can be recognized individually by their ostracodes in west-central outcrops. The ostracodes described from the Cocoa sand member are more analogous, as an assemblage, to those of the Moodys Branch formation than to those of the Yazoo clay. The Cocoa sand is a sandy facies somewhat similar to the Moodys Branch and appears to have provided a similar environment for ostracodes, although the foraminifera are distinctive.

A broad age correlation may be drawn between the lower members, i.e. the North Creek clay, Cocoa sand, and the Pachuta marl of the eastern counties, and the lower facies of the west-central area. This is suggested by the following forms which are common to both these horizons and do not occur above them.

Buntonia morsei (Howe and Pyeatt)

Clithrocytheridea grigsbyi (Howe and Chambers)

Hermanites hysonensis (Howe and Chambers)

Cytherella sp. . Howe and Chambers

Cytheromorpha calva Krutak

Brachycythere waternalleyensis Howe and Chambers

Paracypris franquesi Howe and Chambers

The ostracode fauna of the member units is much more diversified and abundant in the eastern area of outcrops and several

species occur there which are not found in the clays of the west-central area. There is a suggestion that the Shubuta clay member may be approximately equivalent in age to the "upper beds" of Bergquist in Scott County. This is evidenced primarily by the common and restricted occurrence in both horizons of Haplocytheridea ouachitensis (Stephenson) and Haplocytheridea ehlersi (Howe and Stephenson). In addition, the individuals of Henryhowella howei n. sp. from the Shubuta clay member and the individuals of that species from the upper beds show more similarity in some details than the individuals from either of these horizons show to conspecific individuals of lower strata. Similarly, the pronounced curvilinear pits and furrows noted on Haplocytheridea montgomeryensis (Howe and Chambers) from the Shubuta clay member are also found on the individuals of that species in the upper beds. These features are not as pronounced in conspecific individuals of Haplocytheridea montgomeryensis from lower strata. An inadequate number of samples from the "upper beds," however, precludes a certain correlation.

Figure 5 summarizes the suggested intrastate correlations of the Jackson group units.

Correlations with Other Upper Eocene Strata

The ostracode assemblage of the Jackson group in Mississippi includes nearly all of the ostracodes described by Howe and Chambers (1935) from the Jackson group of Louisiana.

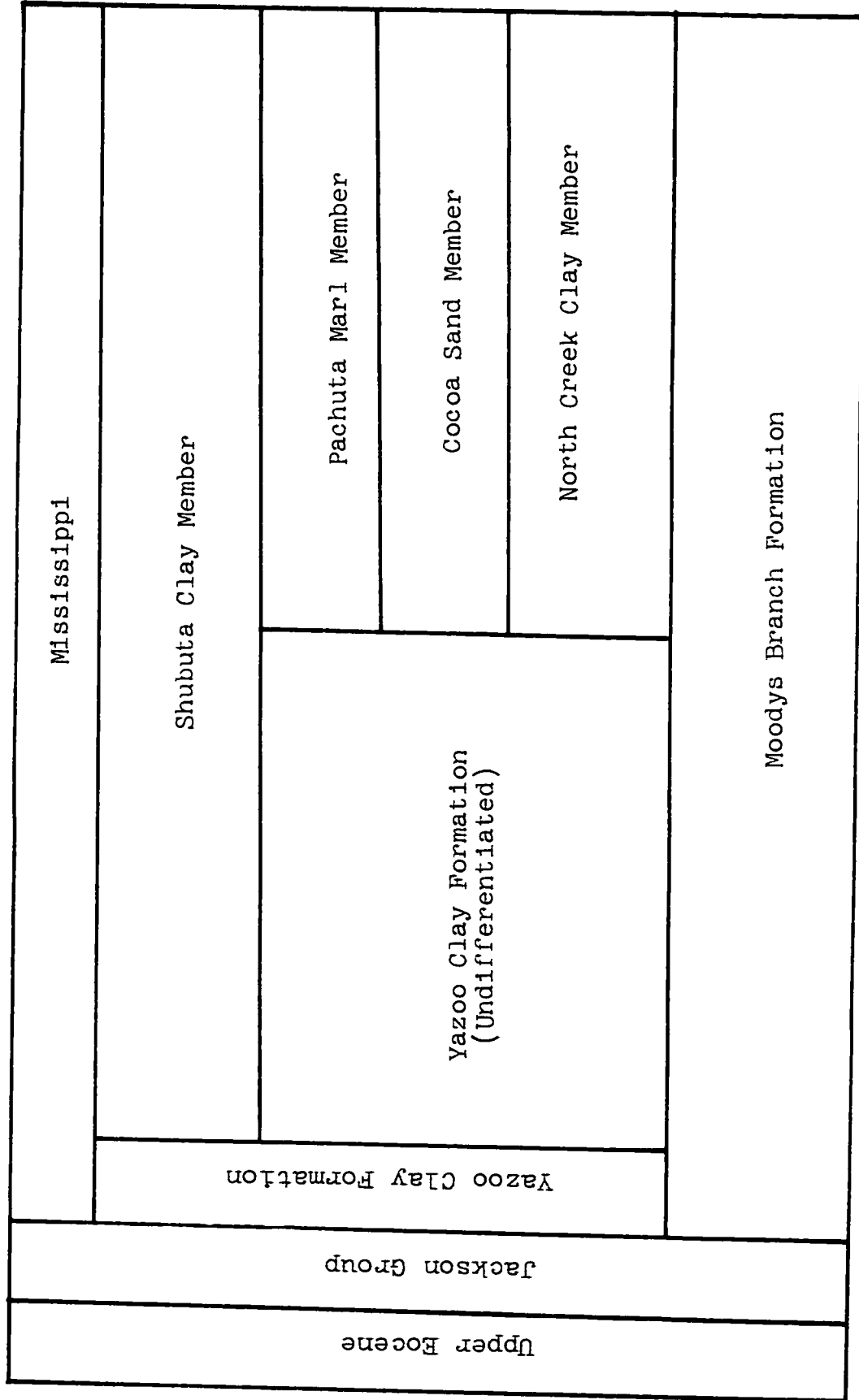


Figure 5. Suggested correlation of formations and members of the Jackson group in Mississippi.

Most of the forms described in Louisiana, however, are from the Lower Jackson and therefore many species found in the Pachuta and Shubuta members of the Yazoo clay formation in Mississippi are not described in the Louisiana assemblage. Monsour (1948, p. 7) suggests that the Shubuta clay member may be missing on the surface in eastern Louisiana and replaced by "approximately fifty feet of nonfossiliferous, locally very silty, non-calcareous clays, lying above the 'Sartartia' bentonite of the Upper Yazoo of Mellen."

Comparisons cannot be drawn with ostracodes of the Jackson of Texas because of a lack of literature on the latter. However, several species have been described from the Weches and Reklaw formations of the Claiborne of Texas which are similar to those in the Jackson of Mississippi. A review of the literature of Stadnichenko (1927), Sutton and Williams (1936), and Stephenson (1944) (1946) indicates that several forms, Clithrocytheridea caldwellensis (Howe and Chambers), Clithrocytheridea garretti (Howe and Chambers), Haplocytheridea montgomeryensis (Howe and Chambers), and Paracypris franquesi Howe and Chambers, are also found in the Claiborne. Many other Claiborne forms are closely related to Jackson species.

A good correlation of species may be made with those of the Moodys Branch in Mississippi and those described by Blake (1950) from the Gosport sand (Claiborne) of Alabama. Blake described twenty-seven forms, eleven of which are conspecific

with Moodys Branch species, and others are closely related. Similar ecological conditions probably prevailed for ostracodes because the Gosport sand represents a sedimentary facies similar to that of the Moodys Branch formation. Indeed, this similarity extends to the megafossils because Cooke (1939) thought, at the time, that the Gosport sand was equivalent in age to the Moodys Branch. This is an example of the dominance of the facies factor over that of the time factor in stratigraphic horizons which are only slightly disparate in geologic age.

In contrast to the close similarity of species to the underlying Gosport of the Claiborne, correlation with the ostracode fauna described by Puri (1957) from the Ocala group in Florida is poor. Although the Ocala is considered to be the age equivalent of the Jackson in Mississippi, only three Ocala forms out of forty that Puri described are conspecific. These are: Cytheretta alexanderi Howe and Chambers, Echinocythereis nuda Puri, and Bythocypris ? gibsonensis Howe and Chambers. The Ocala is essentially a marine limestone in contrast to the arenaceous and argillaceous Jackson sediments of Mississippi. Therefore, ecological conditions were undoubtedly dissimilar for benthonic fauna.

Figure 6 illustrates a generalized correlation of the Jackson group in the Gulf Coast region.

CENOZOIC		TERTIARY		UPPER EOCENE		JACKSON GROUP	
Texas	Louisiana	Mississippi	Alabama	Florida			
Whitsett Formation		Shubuta Clay Member	Shubuta Clay Member				
McElroy Formation		Yazoo Clay Formation	Pachuta Marl Member	Pachuta Marl Member			
Wellborn Sand Formation	Danville Landing Formation		Cocoa Sand Member	Cocoa Sand Member			
Caddell Formation	Caddell Formation	North Creek Clay Member	North Creek Clay Member				
		Moody's Branch Formation	Moody's Branch Formation				
					Ocala Group	Ocala Group	
							Williston Fm. Inglis Fm.
							Crystal River Formation

Figure 6. Generalized correlation of the Jackson group in the Gulf Coast Region. (Tex. after Eargle (1959); La., Miss., and Ala. after Monsour (1948); Fla. after Puri (1957).)

Table 1. Continued

Name of Species	Moody's Branch Formation		Yazoo Clay Formation					
	West Central Area		East and East Central Area					
	Green Sand	Upper Marl	Lower Facies	Upper Facies	North Creek	Cocoa Sand	Faahuta Marl	Shubuta Clay
<i>Brachyoitherer russelli</i>	C	C	R	VR		R	A	A
<i>Brachyoitherer watervalleyensis</i>	C	A	C		C	C	C	
<i>Buntonia donnellyi</i> n. sp.								C
<i>Buntonia shubutensis</i>	C	C	C	C	C	C	C	C
<i>Buntonia morsei</i>		C	C			C		
<i>Buntonia plileri</i> n. sp.								A
<i>Buntonia warneri</i>		VR	R	C	A	C	VR	
<i>Bythocypris gibsonensis</i>	C	A	A	C	C		A	A
<i>Clithrooitheridea oaldwellensis</i>	A	VR			R	C	VR	
<i>Clithrooitheridea garretti</i>	A				R	A	R	
<i>Clithrooitheridea grigsbyi</i>	C		C		A	A	R	
<i>Clithrooitheridea shubutensis</i>	R				VR	A		
<i>Cushmanidea moodysbranchensis</i> n. sp.	C					R		
<i>Cushmanidea papula</i>	R				C	A	VR	
<i>Cushmanidea serangodes</i>					VR	C		
<i>Cyamootheridea chambersi</i>	C				C		VR	
<i>Cyamootheridea hadleyi</i>	C							
<i>Cyamootheridea watervalleyensis</i>	A				R	A	VR	

Table 1. continued

Name of Species	Moody Branch Formation		Yasoo Clay Formation					
	Green Sand	Upper Marl	West Central Area	Upper Faacies	North Creek	Coosa Sand	Fachuta Marl	Shubuta Clay
<i>Cytherella decorata</i> n. sp.							VR	C
<i>Cytherella hanna</i>				R			C	A
<i>Cytherella purdyi</i> n. sp.			C				C	A
<i>Cytherella rogersi</i> n. sp.	C		C	C			R	
<i>Cytherella</i> spp.				R	A		R	
<i>Cytherelloidea montgomeryensis</i>	C	A	A	A	A	C	R	VR
<i>Cytherelloidea ouachitensis</i>	R		R	C				C
<i>Cytheretta alexanderi</i>	C	C	C	C	A	A	R	
<i>Cytheromorpha oalva</i>	VR		C		A	R		
<i>Cytheromorpha choctawensis</i> n. sp.					C	VR	VR	
<i>Cytheromorpha ouachitensis</i>			R	C		R	VR	
<i>Cytheropteron buckatunnaensis</i> n. sp.					A	R		
<i>Cytheropteron danvillensis</i>	R	VR	C	C		VR		
<i>Cytheropteron montgomeryensis</i>	C	C	C	C	C	C	C	C
<i>Cytherura orami</i> n. sp.	R							
<i>Cytherura semireticulata</i>	R				VR			
<i>Cytherura</i> aff. <i>C. ultra</i>	R							
<i>Behinocythereis jacksonensis</i>	A	A	C	C	C	C	C	C

Table 1. continued

Name of Species	Moody's Branch Formation		Yazoo Clay Formation						
	Green Sand	Upper Marl	West Central Area	Upper Facies	Horth Creek	Coosa Sand	Fachuta Marl	Shubuta Clay	
<i>Echinocythereis cf. nuda</i>			C				C	C	
<i>Euocythere lowei</i>	VR			VR	R		R	VR	
<i>Euocythere sp. A.</i>							VR		
<i>Euocythere sp. B.</i>							VR		
<i>Euocythere sp. C.</i>								VR	
<i>Euocythere sp. D.</i>						VR			
<i>Euocythere sp. E.</i>		VR							
<i>Haploocytheridea ehlersi</i>				C				C	
<i>Haploocytheridea montgomeryensis</i>	A	A	A	A	A	A	C	C	
<i>Haploocytheridea ouachitensis</i>				C				C	
<i>Haploocytheridea parki</i> n. sp.			C				R	VR	
<i>Hemioythere bellula</i>	A								
<i>Hemioythere reedi</i> n. sp.	R				R				
<i>Henryhowella florienensis</i>	C	A	A	A	A	C	A	A	
<i>Henryhowella howei</i> n. sp.				A			C	C	
<i>Hermanites adamsi</i> n. sp.	C								
<i>Hermanites dohmi</i>	R	A	C		C	R	C	A	
<i>Hermanites hysonensis</i>	C		C		A	C	VR		

Table 1. continued

Name of Species	Moody's Branch Formation		Yazoo Clay Formation					Shubuta Clay
	Green Sand	Upper Marl	West Central Area		East and East Central Area			
			Lower Facies	Upper Facies	North Creek	Cocoa Sand	Pachuta Marl	
<i>Hermanites morrisoni</i> n. sp.	C		R		VR	R	VR	
<i>Hermanites reglandi</i> n. sp.	C					R		
<i>Virautooothera hornotina</i>	C							
<i>Xonerooothera spurgeonae</i>	C		C	R	A	A	C	
<i>Krithe hiwanneensis</i>							R	C
<i>Loxoonoha ocoosensis</i>			R		C	C		
<i>Loxoonoha oreolensis</i>	C				R	C	VR	VR
<i>Loxoonoha jacksonensis</i>	C	C	C	C	C	C	VR	C
<i>Loxoonoha lenioformis</i> n. sp.					A	C		VR
<i>Loxoonoha stavensis</i>	R							
<i>Monoceratina alexanderi</i>		R					R	
<i>Monoceratina</i> sp. A.							R	R
<i>Monoceratina</i> sp. B.			VR					
<i>Murrayina</i> spp.								VR
<i>Oocultoootheris broussardi</i>	C				VR		R	R
<i>Paracypris franquesi</i>	C	A	C		A	VR		
<i>Paracytheridea belhavenensis</i>	C				R	R		
<i>Pseudoocytheromorpha</i> spp.						VR		

Table 1. continued

Name of Species	Moody's Branch Formation		Yazoo Clay Formation						
	Green Sand	Upper Marl	West Central Area	Lower Facies	Upper Facies	North Creek	Cocoa Sand	Fachuta Marl	Shubuta Clay
<i>Pterygoothyre murrayi</i>								VR	A
<i>Trachyleberidea hiwanneensis</i> n. sp.	VR							A	C
<i>Trachyleberis montgomeryensis</i>	C	A	A	A	C	R	A	C	A
<i>Trachyleberis rossmani</i> n. sp.						A			R
<i>Triginglymus debramaeckeri</i> n. sp.	R								
<i>Triginglymus gnythophoreus</i>						R	C	VR	
<i>Triginglymus hyperoohus</i>	C						VR		
<i>Tropidoocythere trioostata</i> n.gen. n.sp.	C					VR	R		
<i>Xestoleberis sarsi</i>	R					A	R	C	VR

Legend

- A- Abundant (In excess of 16 specimens)
- R- Rare (3 to 6 specimens)
- C- Common (7 to 15 specimens)
- VR- Very rare (1 to 2 specimens)

SEDIMENTARY ENVIRONMENTS

PURPOSE

The abundance of foraminifera and the interesting mineral constituents which were noted in the samples during the study of the ostracodes have prompted this attempt to examine, although summarily, the sedimentation aspects of the Jackson group. It is the purpose of this phase of the report simply to utilize some of the more significant constituents of the samples in an analysis of the probable environments of deposition of the various members of the group.

METHOD OF STUDY

Twenty-three samples were selected from along the strike of the outcrop to represent the various stratigraphic units areally and in vertical sequence. The method of study was a modified version of the coarse fraction procedure of Shepard and Moore (1954). The samples were separated on a U.S. Standard sieve size 120 (.125 mm.) instead of the U.S. Standard sieve size 230 (.026 mm.) as used by Shepard and Moore. Separation on this sieve made available a larger percentage of adult specimens of microfauna and thus facilitated identification of the genera. It was known in advance that the coarse fraction of the clay samples contained a great preponderance of microfauna.

The procedure is outlined as follows:

1. The materials were dried and divided into samples of 60 grams each.
2. Each sample was soaked for four to six hours in a solution of sodium hexametaphosphate and then boiled to insure maximum disaggregation of fine-grained particles.
3. Each sample was then poured through a .125 millimeter (120 U.S. Standard mesh) sieve to separate the coarse fraction (sand and larger sizes) from the fine fraction (very fine sand, silt, and clay).
4. The coarse fraction of each sample was dried and weighed and the percentage by weight of fine fraction and coarse fraction was recorded.
5. Representative portions of the coarse fraction were scattered over a slide for microscopic examination. Five hundred grains were counted, and each genus of foraminifer and ostracode encountered was identified and recorded separately as a representative within its respective group. All other particles counted were also identified and percentages tabulated, by number, in relation to total grains in the count. (See Table 3, appendix, for constituents represented.) Percentages of genera of foraminifera were computed as the percentage each genus represented with respect to the total number of genera of foraminifera in the sample with the foraminiferal constituent as 100%. (See Table 4, appendix.)

An average was then made of the most abundant and diagnostic genera of foraminifera of each stratigraphic unit and is represented diagrammatically by Figs. 7, 11, 12, 13. Similarly, averages were made of the percentages of fine and coarse fraction parts and the constituents of the coarse fraction.

INTERPRETATION OF DATA

Depositional Control

As a background for interpretation of the data presented in this report, some comment should first be made concerning the factors of depositional control of the Jackson sediments and other Tertiary strata in the eastern Mississippi embayment.

The occurrence of marine sedimentary cycles during deposition of Tertiary sediments in the Gulf Coast region is well established in geologic literature. This is evidenced by the works of L. W. Stephenson (1928b), Barton, Ritz, and Hickey (1933), Malkin and Jung (1941) (1948), Bornhauser (1947), Israelsky (1949), Hoppin (1953), and others.

Bornhauser (1947, p. 699) classified marine cycles of the Gulf Coast Tertiary as follows:

Two phase cycle

Transgressive
Regressive

Three phase cycle

Transgressive
Inundative
Regressive

Four phase cycle

Transgressive
Inundative
Regressive
Continental

He relates each cycle to different degrees of time, intensity, and areal spread of diastrophic movement. The Jackson Eocene belongs to the three phase cycle except that in Mississippi a well-developed regressive phase is not shown by the sediments. This phase is evident in Jackson sediments of Texas and other points on the western side of the Mississippi embayment. The lack of a distinct regressive phase of the Jackson cycle in Mississippi is explained by Bornhauser as a result of the presence of a submarine plateau in southeastern Mississippi which existed throughout most of the early and middle Tertiary times. This submarine high created special conditions of sedimentation which resulted in calcareous deposits in that area. The zone of maximum deposition is believed to have shifted farther west toward Louisiana during Jackson time. Bornhauser shows the presence of this high area by isopachous maps of the Midway-Wilcox cycle, Cane River-Sparta cycle, and the Cook Mountain-Cockfield cycle. The Wiggins anticline in southeastern Mississippi is also a subsurface expression of this structure. Bornhauser advances the theory that this high area represents an exten-

sion of the Gulf of Mexico "neutral plate" of Schuchert (1935), which migrated toward the north during early Tertiary time as a result of orogenic movement in the Antilles.

Environmental Analyses

Interpretations of the depositional environments are based on a comparison of the generic assemblages of microfossils with assemblages found on modern sea bottoms. The genera of foraminifera were relied upon primarily because of the great predominance of this group over other microfauna in the statistical study. Mineral constituents were also considered in arriving at the suggested zones of deposition.

The literature used in this survey consisted of reports of investigations by Lowman (1949), Phleger (1951) (1954) (1955) (1956), Phleger and Parker (1951), Phleger and Pierson (1953), Phleger and Lankford (1957), Parker (1954), Todd and Bronniman (1957), Bandy (1954), and Lankford (1959).

The marine environmental zones of this report are the inner sublittoral (0-300 feet) and the outer sublittoral (300-600 feet).

The Moodys Branch Formation

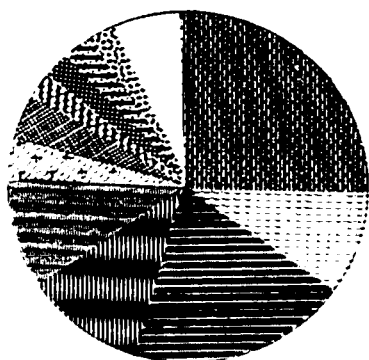
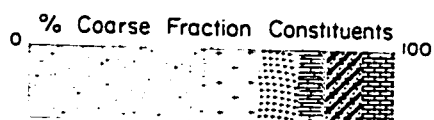
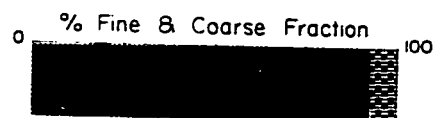
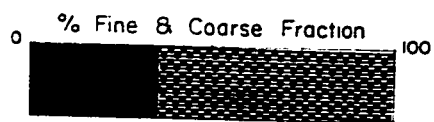
Green sand member. - This member represents the transgressive phase of the Jackson cycle which is evidenced by the clay pebbles in the lower foot of the member which, in

turn, indicate a reworking of part of the underlying Cockfield formation.

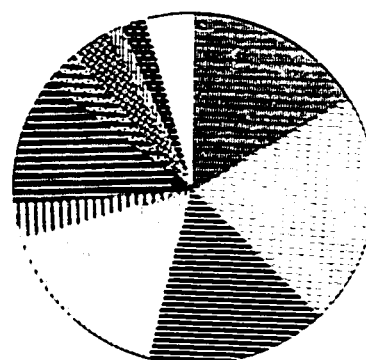
In the samples analyzed there is a diverse marine fauna and a preponderance of coarse materials with high percentages of sand (46%) and glauconite (17%). The genera of foraminifera of the Miliolidae family i.e., Miliola, Massilina, Quinqueloculina, Spiroloculina, and Articulina (Fig. 7-1) form the larger percentage of genera. These forms suggest shallow water depths well within the inner sublittoral zone. The absence of miliammids suggests that the zone of deposition was probably offshore in normal open marine waters instead of in a bay or sound area behind barrier islands. Cushman (1933) considered the foraminiferal suite to be similar to the foraminifera found on the shelf of the present day Indian Ocean.

In the shell fragments constituent of the grain count several bryozoan parts were noted, and also, the megafossils from the Moodys Branch, as described in the literature, include bryozoa, corals, and other sessile benthonic forms indicating reasonably well oxygenated bottom water.

The sand (quartz and feldspar constituent) is medium to coarse size and rounded. The fossils show some evidence of abrasive action in that the delicate features on many specimens are commonly broken in contrast to the well-preserved forms in the overlying clays. The sizable rounded sand constituent, plus the evidence of fossil abrasion, also



Average % of Most Abundant Foraminiferal Genera



Average % of Most Abundant Foraminiferal Genera

1. Moodys Branch Formation Green Sand

2. Moodys Branch Formation Upper Marl

LEGEND

Foraminiferal Genera

- Anomolina
- Articulina
- Bolivina
- Bulimina
- Cassidulina
- Cibicides
- Dentalina
- Discorbis
- Eponides
- Gaudyrina
- Glandulina
- Globigerina
- Globulina
- Hantkenina
- Marginulina
- Massilina
- Miliola
- Nonion
- Nonionella

Other Constituents

- Planulina
- Quinqueloculina
- Reussella
- Robulus
- Siphonina
- Spiroloculina
- Textularia
- Uvigerina
- Others
- Calcareous Aggregates
- Coarse Fraction
- Fine Fraction
- Foraminifera
- Glauconite
- Gypsum
- Mica
- Ostracods
- Quartz & Feldspar
- Shell Fragments

Figure 7. Average percentages of the most abundant foraminiferal genera and other constituents in the Moodys Branch formation.

suggest that deposition may have occurred above wave base in a shallow water, "high energy" zone.

One of the interesting features of mineral constituents of this member is the high percentage of green pelletal material generally classified in field parlance as "glaucinite." To find so copious a quantity of this material in association with abundant and diversified benthos is at first surprising in view of the physical requirements for formation of the mineral generally envisaged by glaucinite investigators. Cloud (1955, p. 490), in a broad outline of the physical limits of glaucinitization, states that it needs "at least slightly reducing conditions (at sites of origin within enclosing sediments, if not the bottom waters)." Because of the abundant occurrence together of both "glaucinite" and benthos in the same facies, a survey was made to determine what relationship, if any, existed between the identifiable benthos (foraminifera and ostracodes) and "glaucinite." Nine samples with 1% or more of glaucinitic pellets were chosen from the material (see Table 3, appendix) and a linear coefficient of correlation was established between percentages of benthos and these pellets. The coefficient was too low (.39) to establish a significant relationship at the 5% confidence level. Further linear coefficients were obtained among three of the major constituents of the samples, i.e. sand, benthos, and "glaucinite." Partial coefficients obtained from the linear coefficients were too small to show

significant relationships. This suggests that the glauconitic pellets may have been formed under conditions not wholly controlled by the same environment in which the fauna flourished.

Krumbein and Garrels (1952) in discussing pH and oxidation-reduction potentials of sediments suggest that the reducing environment may occur below the water-sediment interface. If so, the glauconite may have been formed below the depositional interface with oxidizing conditions prevailing in the faunal environment. The occurrence of the glauconite in the form of fecal pellets and fossil casts (Fig. 8) suggests that it is authigenic.

Another study of the "glauconite" pellets was made in an effort to determine whether or not they varied in composition with changes in the sedimentary environments which were indicated by microfaunal evidence. Burst (1958) (1959) has investigated glauconite and glauconitic materials from sediments rather extensively. He believes that some correlation may exist between the heterogeneous composition of these pellets and their chemical environments which may in turn be reflected in changes of environment in the facies sense. Coincident variability between "glauconite" pellet mineralogy and reconstructed environment has been noted by Feray in 1948 (in Burst 1959 pp. 322, 324) and Burst (1958) (1959). X-ray patterns of "glauconite" pellets which are found at Tertiary unconformities show a close approach to the ordered lattice



1. Fecal pellets



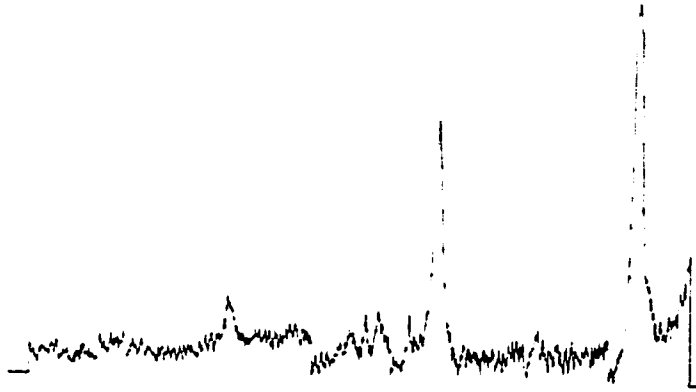
2. Microfossil casts

Figure 8. Examples of commonly occurring fecal pellets and microfossil casts of "glauconite" pellets in member units of the Jackson group in Mississippi.

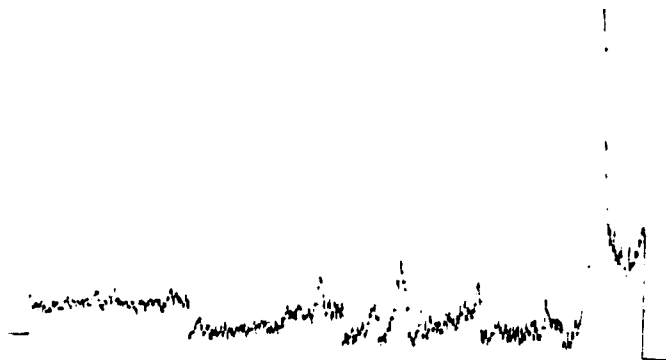
of the mineral glauconite (Fig. 9) whereas "glauconites" from conformable Tertiary sediments show considerable deviation. These conclusions are empirical, however, because no clear reasons can be given as yet to explain these changes.

Cloud's (1955) compilation from the literature shows that past investigations have revealed discrepant conclusions about important specifications of glauconite origin such as temperature, water depth, parent material, and turbulence. Burst (1959, p. 316) suggests that none of the foregoing factors in itself is controlling. He concludes that no particular geological facies can be prescribed for glauconitization "since the process represents an energetic reaction to a systemic combination rather than to any specifically evaluated components within a system." Consequently, Dr. Burst has cautioned the writer (personal communication) to the effect that these pellets should not be used alone to reconstruct sedimentary environments.

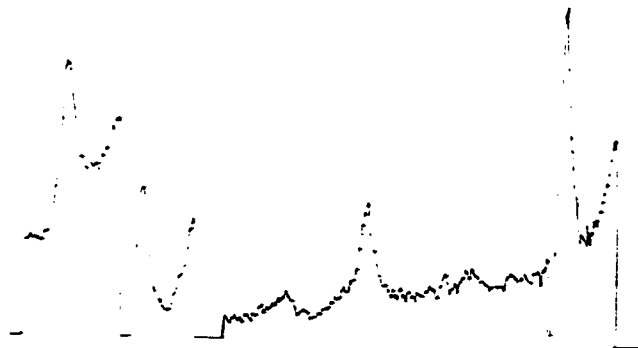
Nevertheless there is a line of reasoning, if accepted, which will indicate, in a general sense, the plausibility of variations of composition of these pellets with facies change. Burst (1959) suggests that the theory of lattice closure by potassium fixation is a more likely generalization to explain glauconite formation than to restrict its origin to the decomposition of biotite or formation of colloidal gel. If the minimum physico-chemical requirements for glauconite genesis are restricted to: (1) the layered silicate lattice, (2) plen-



1. Basal Midway (Guadalupe County, Texas)



2. Nanafalia - Pseudo Buhrstone (Turkey Creek)



3. Mt. Selman formation - Cane River group

Figure 9. X-ray diffractograms illustrating glauconites at Tertiary unconformities.

tiful supplies of iron and potassium, and (3) a favorable environmental oxidation potential, then such diverse origins as mineralization of fecal pellets and biotite transformation are permitted. Takahashi (1939) believes that glauconite may be derived from a number of mother substances.

Burst (1959, p. 316) states the case in effect by saying:

As essentially illite-montmorillonite type clay structures, glauconite may be presumed to have reacted to natural ambient conditions just as the type materials do in controlled experiments. They represent, therefore, an equilibrium product of original crystalline network and impressed chemistry.

Burst points out that several attributes are common to most glauconites, such as consistent values of iron (20-25 percent), potassium (5-8 percent), and Fe^{3+}/Fe^{2+} ratio (5-8). He concludes that a uniform set of conditions must be in effect to some degree in each development. Variations in these conditions can afford correlative features if the departures from the prototype glauconite mineral are not treated as impurities but as normal pelletal components indicative of sedimentary processes during original formation.

Burst also believes that the most conclusive evidence for authigenesis and specific reaction to common environmental conditions is the virtual restriction of the micaceous "glauconite" structures to single layer, monoclinic configurations of dioctahedral lattices. He points up the improbability of a detrital background for the argillaceous material

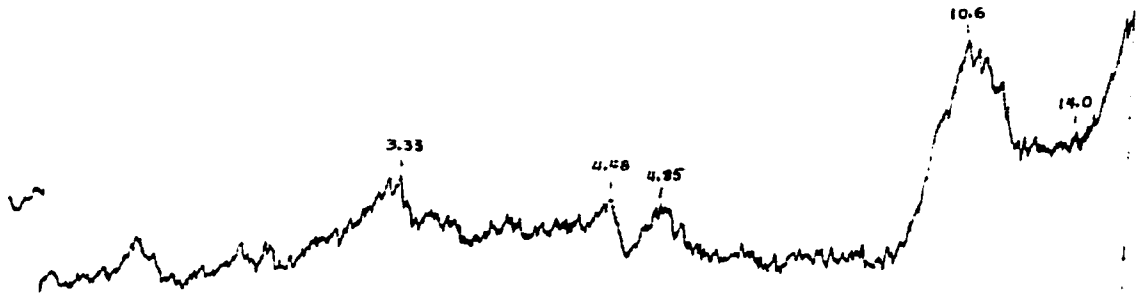
of fecal pellets and fossil casts as requiring an organism which would select only monoclinic dioctahedral crystal fragments from the innumerable diet possibilities on the ocean floor. To obviate these difficulties he proposes a model which envisages degraded layered silicate lattices surrounded by local environments of reduction as nucleation centers to which migrate iron and potassium needed for glauconitization. He states (1959, p. 316) that:

An equilibrium adjustment is effected between pellet and dispersant so that the final pellet mineralogy reflects, to a degree, the environmental chemistry. Pellets deposited from succeeding marine inundations of differing chemical demeanor would express slightly different mineralogies and would, if the inundations were widespread enough, represent important stratigraphic key beds.

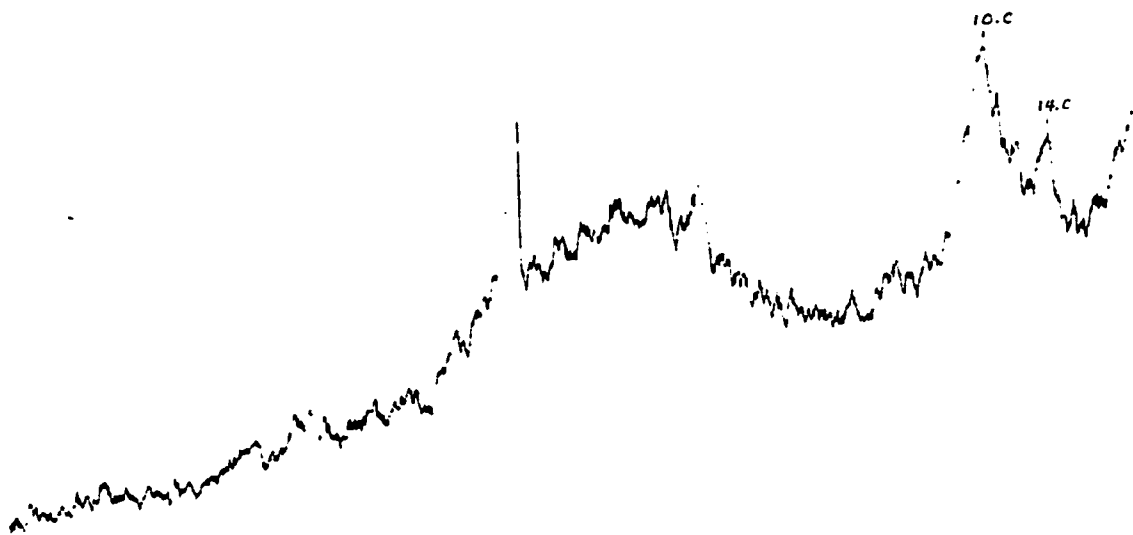
Burst (1959) classifies "glauconite" pelletal materials into four categories: (1) the ordered lattice (which is the mineral glauconite), (2) disordered lattice, (3) interlayered, and (4) mineral mixtures. The first three subdivisions are related to potassium fixed within the crystal lattices. The ordered glauconites approach the potassium content and ordering of muscovite. Disorder (2) of the lattice occurs where more than one out of three potassium atoms is missing. The lower limit of potassium deficiency of the second subdivision overlaps to a degree the mixed layer lattices of the third subdivision. The fourth subdivision is simply a heterogeneous composition containing two or more clay minerals of unrelated structure, irrespective of potassium.

The writer had X-ray diffractograms made for the "glaucanites" of three different horizons which represent three different marine zones of deposition as evidenced by the microfauna. The X-ray diffractogram of "glaucanite" pellets from the green sand member (Fig. 10-1) shows an asymmetrical 10 angstrom peak which would classify these pellets as "disordered glaucanites." They approach more closely, however, the composition of the mineral glaucanite than those of the other horizons (compare with Figs. 10-2, 10-3). This diffraction pattern compares favorably with some "glaucanite" diffraction patterns figured by Feray in 1948 (in Burst, 1959, p. 322) of glaucanites from the "inner-neritic" zone represented in an outcrop of the lower Tyrus member of the Weches formation at Smithville, Texas. Feray's inner-neritic zone would probably compare favorably with the writer's inner sublittoral zone which is postulated for the green sand member of the Moodys Branch formation.

The Upper marl member. - The principal genera of foraminifera of this member are Cibicides, Uvigerina, Bolivina, Quinqueloculina, Siphonina, Textularia, and Eponides (Fig. 7-2) which indicate deposition in deeper water than the underlying green sand. The fine clayey fraction is preponderant. Other mineral constituents include reasonably high percentages of glaucanitic pellets and sand although in considerably smaller amounts than were found in the underlying unit. In the shell fragment constituent,



1. Sample 15b, Moodys Branch formation at locality 15 (untreated)



2. Sample M-1, Basal Yazoo clay (?) (heated to 450°)



3. Sample 3b, Pachuta marl member (untreated)

Figure 10. X-ray diffractograms of glauconites from selected samples of the Jackson group in Mississippi.

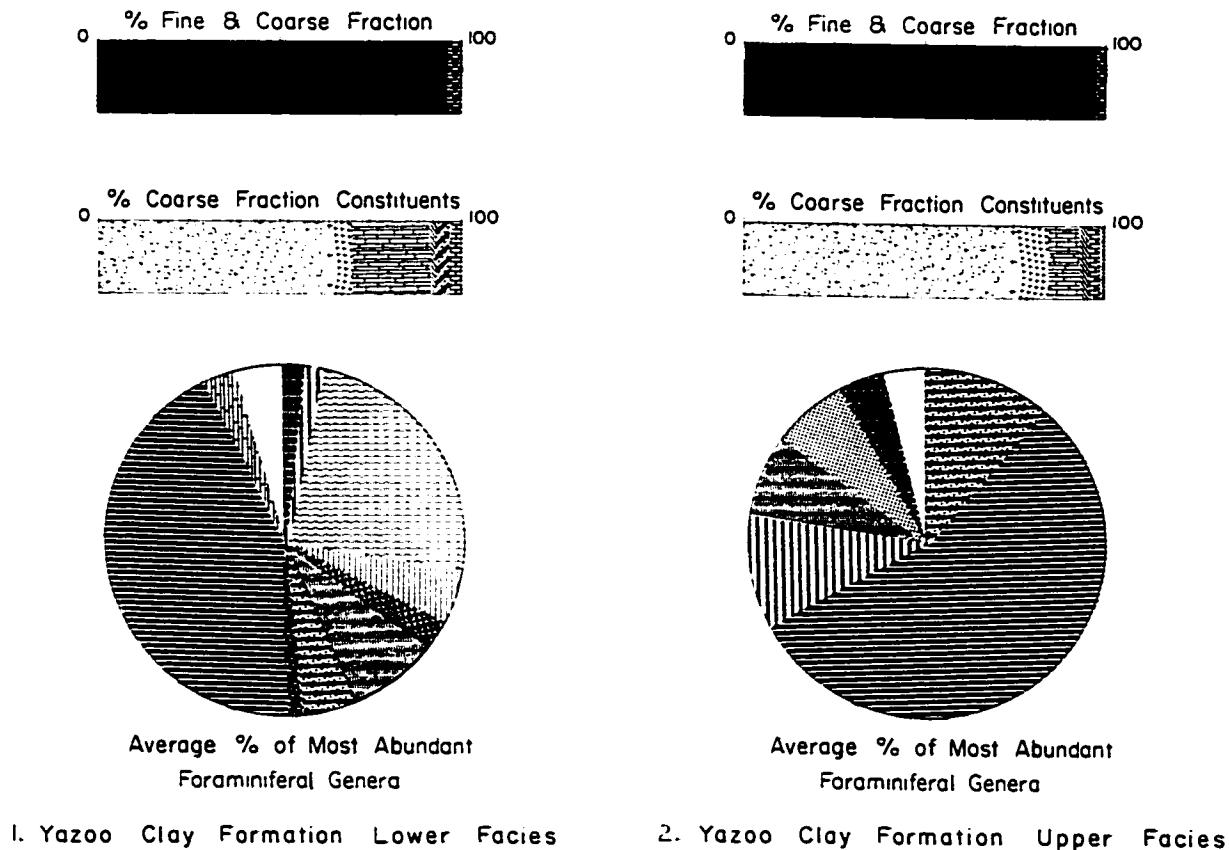
bryozoan fragments and other sessile benthos were observed. This benthos indicates some degree of aerobic conditions. The water was probably quiet, and there is no evidence to indicate high turbidity. This unit probably represents a continuation of deepening of the transgressing sea with rivers bringing in a relatively large portion of fine materials from the source area.

The Yazoo Clay Formation in the West Central Area

The lower and upper facies of this thick sequence of clayey deposits will be considered together because the faunal and mineralogical constituents are similar (Fig. 11).

The great thickness of the Yazoo clay formation and also its lithology and mineral constituents suggest the inundative phase of the Jackson cycle. The samples show clay and silt-size particles in the amount of 97% of the material. Previous work by Grim (1936) and Mellen (1940) and others shows that these clays are calcareous and montmorillonitic. These facts, coupled with the abundant benthonic foraminifera, suggest that the water at the time of deposition was probably alkaline.

The predominant genera of foraminifera are Uvigerina, Cibicides, Siphonina, Bolivina, Textularia, and Globigerina (Fig. 11) which suggest relatively deep water. This formation may have been deposited at depths approximating those of the mid-sublittoral zone. This does not necessarily pre-



LEGEND

Foraminiferal Genera		Other Constituents	
Anomolina	Glandulina	Planulina	Calcareous Aggregates
Articulina	Globigerina	Quinqueloculina	Coarse Fraction
Bolivina	Globulina	Reussella	Fine Fraction
Bulimina	Hantkenina	Robulus	Foraminifera
Cassidulina	Marginulina	Siphonina	Glauconite
Cibicides	Massilina	Spiroloculina	Gypsum
Dentalina	Miliola	Textularia	Mica
Discorbis	Nonion	Uvigerina	Ostracods
Eponides	Nonionella	Others	Quartz & Feldspar
Gaudyrina			Shell Fragments

Figure 11. Average percentages of the most abundant foraminiferal genera and other constituents in the Yazoo clay formation of the west-central area of outcrop.

suppose a considerable distance from shore as though a wide shelf were present. Fairly rapid deposition in a relatively deep zone is suggested by the great thickness of the clays in this area and possibly by the abundant well-developed foraminiferal elements. Bergquist (1942) described 225 species and varieties from Scott County alone. Lankford (1959) has observed in the Mississippi River delta area that, up to a certain point, foraminifera are more abundant in the regions of rapid deposition. He speculates that organic food materials from land may be accumulating more rapidly in these areas.

Some of the samples of the lower facies of the Yazoo clay formation contain high percentages of glauconite. One sample (M-1), questionably from the basal Yazoo clay formation in north Yazoo County, is especially interesting. This sample has a very small percentage of benthonic foraminifera and ostracodes with sand and glauconite comprising 90% of the coarse fraction constituents. The pelletal morphology indicates that they are fecal material, and X-ray diffraction (Fig. 10-2) shows their composition to be a mixture of clay materials. In addition to the 10 angstrom glauconite peak, there is a 14 angstrom peak which is sharpened when heated to 450°C. This suggests that chlorite is present in the mixture. As previously stated, glauconite investigators generally agree that at least "slightly reducing conditions" are necessary for glauconite formation whereas the brucite layers

(Mg_3OH_6) suggest alkaline conditions for the formation of chlorite. There is a possibility, however, that the chlorite may be a mere detrital impurity selected with the "glaucinite" pellets in picking the material. The absence of a well-developed 7 angstrom peak suggests a scarcity of chlorite. The chlorite component may also represent detrital particles of chlorite which were ingested by organisms from the bottom muds along with other clay materials. The glaucinite component of the fecal pellet may have formed subsequently as a result of local reducing conditions which were created by decaying organic materials of the fecal pellet. On the other hand, if the chlorite is authigenic then the bottom environment was probably oxidizing. The chlorite possibly could have formed on the bottom prior to ingestion by the organism with the glaucinite component of the pellet forming subsequently. In brief, if the chlorite component of the pellet is detrital then the question may be raised as to whether or not these heterogeneous pellets reflect the unique impressed chemistry of the environment.

The small percentage of benthonic fauna and the composition of the "glaucinite" pellets of sample M-1 suggest the possibility of a littoral environment. Deposition may have occurred in a small shallow body of marine water in the tidal flat zone which was oxygenated by incoming tides. The water may have contained a concentration of magnesium salts which was too high to be conducive to a typically

abundant and diversified open marine benthos. This is only speculation, however, and no conclusions are reached with respect to the environment of deposition of this sample.

Gypsum is also present as a constituent in some samples of the Yazoo clay formation. This constituent, however, may represent post-diagenetic processes. Monroe (1954) states that gypsum is seldom found below the oxidizing zone which is approximately 30 feet deep. He believes that it was formed by reaction between calcite and sulphuric acid released by disintegration of pyrite. Pyrite and gypsum were concentrated in great quantities in some samples, but because no fossils were present those samples were not included in this survey. No determination was made whether or not the pyrite was authigenic.

In brief, the Yazoo clay formation probably resulted from rapid deposition of clays in a relatively deep (mid-sublittoral) zone. This suggestion is also corroborated, in part, by the observations of Bornhauser (1947) and others that the easternmost end of the Gulf coast geosyncline extended into the Mississippi area during Jackson times.

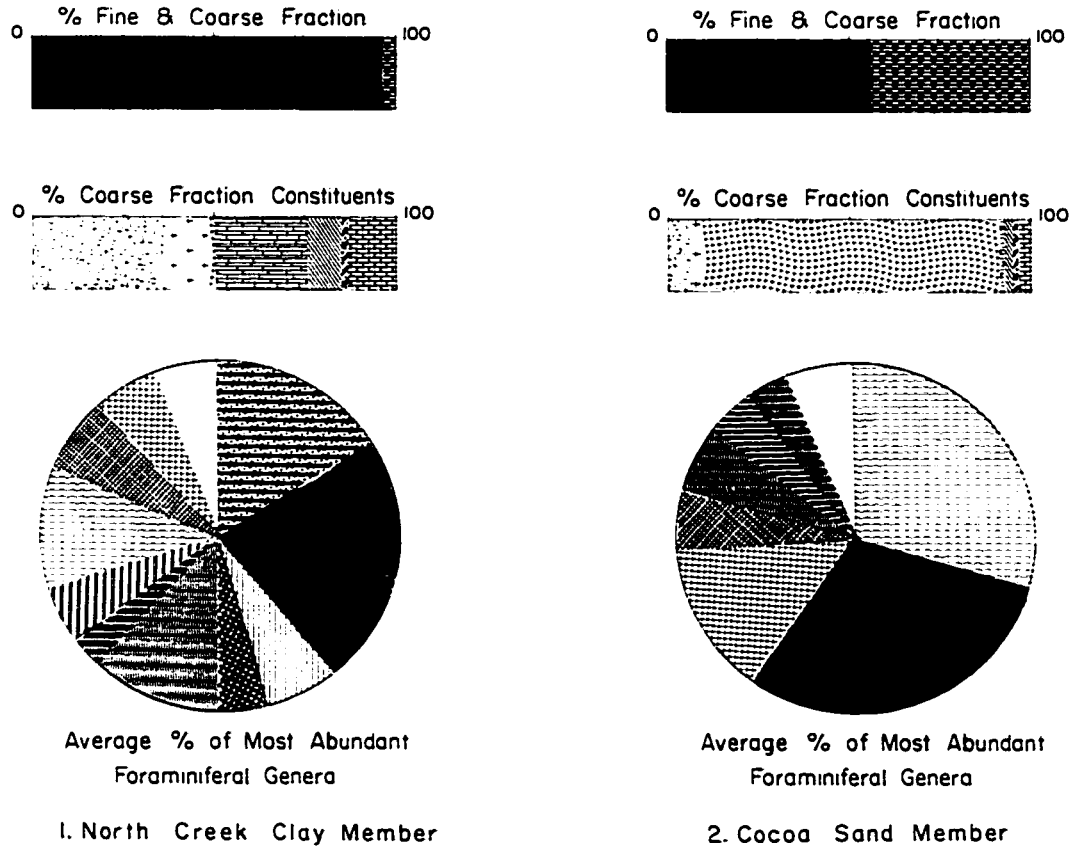
The Yazoo Clay Formation in the Eastern Counties

The North Creek clay member. - The North Creek clay is contemporaneous in age with part of the lower facies of the Yazoo clay formation of the west-central area. The predominant genera of foraminifera are Nonionella, Textularia,

Siphonina, Cibicides, Bolivina, Nonion, and Discorbis (Fig. 12-1). These forms, when compared to Recent forms of the Gulf of Mexico, suggest a depth somewhat intermediate between those of the Moodys Branch and the Yazoo clay formation of the west-central region. They indicate deposition just within the inner sublittoral zone.

The fine fraction constitutes approximately 97% of the samples, and the coarse fraction consists mainly of benthonic foraminifera, ostracodes, shell fragments, and a considerable percentage of mica. Glauconite is also present in some samples. The constituents of the samples suggest deposition in relatively quiet water. Sedimentation in this area may have been influenced by the submarine high area described by Bornhauser (1947) since shoaler water is indicated. The clastic sediments of this member are replaced downdip (Mon-sour, 1948) by shelf-like calcareous deposits similar to those of the Ocala group in Florida.

The Cocoa sand member. - The coarse fraction of this litho-unit of the Yazoo clay formation is relatively large (46.1%). The principal constituent is angular to rounded, fine to medium-size sand. The percentage of benthos is small, but ostracodes are more generically diversified than those of the subjacent and superjacent clays and are similar to those of the Moodys Branch formation. On the other hand, the benthonic foraminifera are dominated by the genera Cibicides, Nonionella, Nonion, Siphonina, and Discorbis



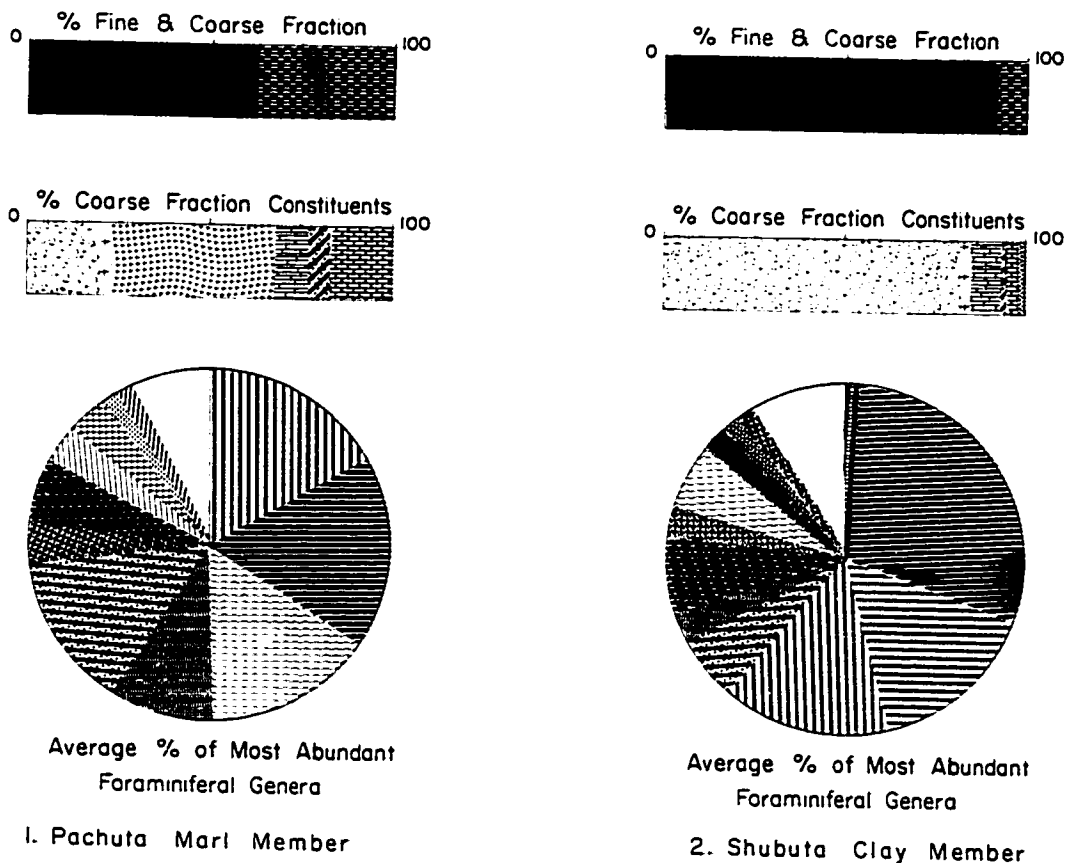
LEGEND

Foraminiferal Genera		Other Constituents	
Anomolina	Glandulina	Planulina	Calcareous Aggregates
Articulina	Globigerina	Quinqueloculina	Coarse Fraction
Bolivina	Globulina	Reussella	Fine Fraction
Bulimina	Hantkenina	Robulus	Foraminifera
Cassidulina	Marginulina	Siphonina	Glauconite
Cibicides	Massilina	Spiroloculina	Gypsum
Dentalina	Miliola	Textularia	Mica
Discorbis	Nonion	Uvigerina	Ostracods
Eponides	Nonionella	Others	Quartz & Feldspar
Gaudyrina			Shell Fragments

Figure 12. Average percentages of the most abundant foraminiferal genera and other constituents in the North Creek clay and Cocoa sand members.

(Fig. 12-2) which suggest depth ranges approximately the same (inner sublittoral) as those of the North Creek clay, and greater than those of the Moodys Branch. The large percentage of sand without an appreciable shoaling may be due to a change of source materials resulting from streams cutting through a sand terrane. A slight rejuvenation of source area by tectonic activity is also a possibility since the source region was the southern Appalachian land area.

The Pachuta marl member. - The Pachuta marl member represents a relatively thin calcareous clay and marly facies. The diagnostic genera of foraminifera (Fig. 13-1) are Globigerina, Uvigerina, Cibicides, Textularia, Siphonina, Robulus, and Eponides with small percentages of Bolivina, Nonion, Marginulina, and Cassidulina. The foraminifera are more diverse and abundant in this member than in those of the underlying stratigraphic members. The genera of foraminifera also suggest somewhat deeper water than the underlying units and near the mid-sublittoral zone. Bryozoa and other sessile benthos are present in the faunal constituents which indicate some degree of oxygenation. The coarse fraction-mineral constituents are predominantly sand, with a considerable percentage of glauconite in some samples. The "glauconites" (Fig. 10-3) were X-rayed and show a mixture of minerals. The presence of both 14 angstrom and 7 angstrom peaks suggests chlorite as a component part of the mineral mixture.



LEGEND

Foraminiferal Genera			Other Constituents
	Anomolina		Glandulina
	Articulina		Globigerina
	Bolivina		Globulina
	Bulimina		Hantkenina
	Cassidulina		Marginulina
	Cibicides		Massilina
	Dentalina		Miliola
	Discorbis		Nonion
	Eponides		Nonionella
	Gaudyrina		Planulina
			Quinqueloculina
			Reussella
			Robulus
			Siphonina
			Spiroloculina
			Textularia
			Uvigerina
			Others
			Calcareous Aggregates
			Coarse Fraction
			Fine Fraction
			Foraminifera
			Glauconite
			Gypsum
			Mica
			Ostracods
			Quartz & Feldspar
			Shell Fragments

Figure 13. Average percentages of the most abundant foraminiferal genera and other constituents in the Pachuta marl and Shubuta clay members.

The chlorite mixture in the glauconitic pellets is not inconsistent with the postulated oxidizing conditions of deposition of the Pachuta marl member. The mixture of glauconite and chlorite in fossil casts and fecal pellets of the Pachuta marl member may have occurred in the same manner as postulated for sample M-1. The significant point here, however, is the distinction between the composition of the "glauconite" pellets in the conformable Pachuta marl unit and the "glauconite" of the Moodys Branch formation which is on one of the Tertiary unconformities. Note that the diffractogram, Fig. 10-1, of Moodys Branch "glauconites" shows a "disordered glauconite" which is more nearly analogous to the pure mineral glauconite than to the "mineral mixture," Fig. 10-3, shown by the diffractogram of the Pachuta marl pelletal material. This comparison further corroborates Dr. Burst's observations of glauconites elsewhere, although no definite explanation can be given as yet for this distinction.

In short, the Pachuta marl member probably represents deposition in a quiet, relatively deep (near mid-sublittoral) shelf-like zone of open marine waters.

The Shubuta clay member. - The diagnostic genera of foraminifera (Fig. 13-2) are Uvigerina, Bulimina, and Globigerina which constitute 60% of the samples with Textularia, Cibicides, and Robulus another 17%, and the remainder comprised of small percentages of Siphonina, Gaudyrina,

Hantkenina, Planulina, Eponides, and others. The fine fraction is very large, and the lithology is essentially identical to the Yazoo clays of the west-central area. The water depths suggested by the foraminifera are in the mid-sublittoral range. This member is the thickest unit of the Yazoo clay on the eastern side of the state and reflects essentially the same environments as previously described for the Yazoo clay formation in the west-central area of outcrop. Presumably the submarine high described by Bornhauser (1947) had subsided considerably in the eastern region during Shubuta times giving rise to more uniform conditions of sedimentation throughout the state.

Grim (1936) and Monroe (1954) have suggested that the Yazoo clay formation was deposited under near shore conditions with a source area supplying fine materials. Fisk (1944) considers it deltaic in nature.

In summary, the genera of foraminifera suggest that the Yazoo clay formation was deposited in relatively deep water (mid-sublittoral) which may have been "near shore" if a wide shelf is not postulated for the west-central area. The theory of relatively deep water in the west-central area is further substantiated by the fact that remains of Basilosaurus cetoides (Owen), a 60-foot Cetacean, are also found in the Yazoo clay formation. The writer believes that all of the Yazoo clay formation of the west-central region, and the Shubuta clay of the eastern region, represent relatively

rapid deposition in the mid-sublittoral depth range.

THE OSTRACODA

PREVIOUS WORK

The first paper to illustrate an ostracode from the Jackson Eocene of the Southeast was written by Otto Meyer in 1887. Cythere mississippiensis Meyer was figured in connection with megafossils which Meyer described from the Tertiary of Alabama and Mississippi. The first paper of note, however, was written by Howe and Chambers (1935) who described the ostracodes of the Jackson Eocene of Louisiana. This was essentially a pioneer paper in initiating a systematic stratigraphic study of Eocene Ostracodes of the Eastern Gulf Coast region. Numerous works have been added since that time, most of which were written by Dr. Henry V. Howe of Louisiana State University and his former students. Numerous papers appeared between the mid-thirties and the beginning of World War II. Interest in ostracodes was probably stimulated during this particular period in response to a need for additional stratigraphic correlation criteria resulting from increased oil exploration in the southeast at the time. During this period several papers appeared which describe or list ostracodes which include one or more species that may be found in the Jackson. These works are by Howe (1934b) (1936), Stephenson, M. B. (1936 (1937) (1938), Monsour (1937, list of species), Bergquist (1942), and Murray and Hussey (1942).

Since World War II the papers in which some ostracodes have been described from the Jackson or its age equivalent

include those by Swain (1946) (1951), Weingest (1949), Sexton (1951), Howe (1951a), and Hill (1954). Puri (1957d) zoned the Ocala group in Florida by means of ostracodes and foraminifera; and some of his other works, although primarily taxonomic, occasionally contain a description of one or more genera or species of Jackson ostracodes. (These include Puri (1952a) (1952b) (1953b) (1953c) (1957c) (1958a) (1958b).)

Contemporaneously with the growth of Jackson ostracode literature many workers were also devoting their attention to the richly fossiliferous underlying Claiborne group. Many species described from the Claiborne are also common to Jackson sediments. Some of the more important Claiborne papers were written by Stadnichenko (1927), Murray (1938), Gooch (1939), Martin (1939), Sutton and Williams (1939), Murray and Hussey (1942), Stephenson, M. B. (1942) (1944a) (1944b) (1946), Swain (1946) (1951), Blake (1950), and Howe (1951b). The older Eocene sediments, i. e. those of the Midway and Wilcox groups, were also being studied and several papers on ostracodes from these horizons are useful to students of the Jackson ostracodes. Some of the more important papers were written by Howe (1934a), Howe and Garrett (1934), Stephenson, M. B. (1938), Alexander (1934), Kline (1943), Harris and Jobe (1951), Cheetham (1952), and Munsey (1953).

In the Atlantic coastal plain region ostracodes of lower to middle Eocene beds have been described by Ulrich (1901),

Jennings (1936), Schmidt (1948), and Swain (1951). W. A. van den Bold has described several species from the Caribbean sediments of Jackson and younger ages. His works include a general report (Bold 1946) on Caribbean ostracoda as well as forms from particular localities and stratigraphic levels. His Paleocene and Eocene papers include a checklist of Cuban ostracodes (Bold 1950), ostracodes from Trinidad (Bold 1957) and the Brasso formation (Bold 1958).

Numerous works describing ostracodes from the Oligocene and Miocene sediments are also helpful to the study of Jackson ostracodes because many forms range upward into these levels. Howe and Law (1936) described the ostracodes from the Vicksburg group of Louisiana and figures several species which also occur in the Jackson. Other papers of importance include the work of Howe and his graduate students (1935), Edwards (1944), Puri (1953a) (1956), McLean (1957), and Swain (1946) (1951).

Although considerable work has been done on the Eocene ostracoda of the Gulf Coast area there is still much virgin territory. For example, in Texas there is essentially no ostracode literature on upper Eocene sediments although there are many papers which describe ostracodes from the Claiborne and subjacent strata. In Mississippi only seventeen species figured by Bergquist from Yazoo clay beds in Scott County have been described and figured directly from Mississippi. Although Monsour (1937) zoned the Jackson in

East Mississippi with foraminifera and ostracodes he published only a fossil list without descriptions and figures. Since Monsour's work the Jackson group has been subdivided into several member units, and ostracode nomenclature has changed considerably. This creates a need for a definitive ostracode work using specimens from the type area of the Jackson formations and members.

DESCRIPTION OF SPECIES

Many problems of taxonomy were encountered during the description of species herein illustrated. Most of the discussion relating thereto has been included under the "Remarks" section after each fossil description. Insofar as the forms are conspecific, ostracodes which were previously described from Jackson strata in Alabama, Mississippi, and Louisiana have been reclassified and redescribed in the light of recent taxonomic knowledge. Several juvenile forms were originally erected as distinct species, and in some cases male and female forms of the same species were misinterpreted as different species. In all instances wherein a study of the forms has disclosed such errors, synonymies have been made with the proper species.

The orientation criteria used in this report is that of van den Bold (1946) which may be stated essentially as follows:

1. The carapace usually has an aerodynamic shape.

- a. If there is a pointed end, in side view, this end is posterior.
 - b. If alae occur, the form is sagittate in dorsal view, and the arrowhead points to the anterior.
 - c. Tubercles, large spines, and similar ornamentations point to the posterior.
2. The posterior end is usually widest in dorsal view, and the anterior end is highest in side view.
 3. If a subcentral tubercle exists, it lies anterior to the middle, and is convex posteriorly.
 4. The denticulation, or terminal series of spines, is stronger and better developed on the posterior end; those on the anterior end are shorter in order not to interfere with locomotion.

Dimorphic determinations were based primarily on the assumption that the carapace of the male is usually more elongate than that of the female. This factor was given little weight, however, if other evidences of female characters, such as a swollen posterior suggesting a brood pouch, were present.

In the event of publication of a paper based on this thesis, or a part thereof, all numbered holotypes, paratypes, hypotypes, and figured specimens will be forwarded to the Henry V. Howe Collection, Louisiana State University, Baton Rouge, Louisiana. Specimen numbers may be changed, however, subject to revision of this thesis for publication. Topotypes and other unnumbered secondary specimens will be retained by the Department of Geology, The Rice Institute.

Order OSTRACODA Latreille

Suborder PLATYCOPA Sars, 1866

Family CYTHERELLIDAE Sars, 1866

Genus CYTHERELLA Jones, 1849

Type Species *Cytherina ovata* Roemer, 1840

Cytherella hannai Howe and Lea, 1936
Pl. I., figs. 1, 2

Cytherella hannai Howe and Lea, in Howe and Law, 1936, La.
Dept. Cons. Geol. Bull. 7, p. 16, pl. 1, figs. 1-5.

Diagnosis. - Carapace smooth with a thin carina around the anterior margin of the left valve. Postero-ventral region of the left valve produced into a strong flange.

Description. - Carapace elongate-ovate in side view. Dorsal and ventral margins straight and parallel in the males, converging slightly toward the posterior in the females. Anterior ends of both males and females evenly rounded; the left valve possesses a thin carina around the anterior margin. Posterior margin obliquely rounded, and in the left valve, the postero-ventral margin is produced into a prominent flange. Greatest height near anterior end; greatest thickness slightly posterior to center. Right valve overlaps the left valve along the dorsal and ventral margins.

On the inside, the valves are shallow and smooth except for a slight depression posterior to center. Muscle scars are twelve to fourteen in number in pinnate arrange-

ment. Other features are characteristic of the genus. Males are more elongate than the females.

Dimensions. - Hypotype no. 5751, a female right valve from the upper Shubuta member at locality 5: length 0.84 mm., width 0.47 mm. Hypotype no. 5752, a female left valve from the upper Shubuta member at locality 5: length 0.83 mm., width 0.44 mm.

Comparisons. - A comparison of the hypotypes with the holotypes, Henry V. Howe collection, indicates that the forms are conspecific. The flange at the postero-ventral margin of the left valve of the holotype, however, is slightly stronger than in the left valve of the foregoing described specimens.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; Shubuta clay member at localities 5 and 6; rarely in the Yazoo clay upper facies at locality 11.

Cytherella decorata n. sp.
Pl. I., figs. 3-8

Diagnosis. - Anterior and posterior ends subequal with the anterior margin evenly rounded. Surface white and glossy with a delicate pattern of small, irregular ridges arranged concentrically with the margins.

Description. - Carapace elongate-ovate in side view and

compressed. Dorsal margin slightly sinuate; ventral margin straight to slightly concave. Anterior margin evenly rounded; posterior margin straight between rounded postero-dorsal and postero-ventral margins. Ends subequal. Greatest thickness at the posterior. In dorsal aspect, the carapace is wedge-shaped with a depressed area slightly posterior to center. Right valve overlaps the left valve along the dorsal, ventral, and anterior margins. Surface of the carapace white, glossy, and ornamented in the centro-ventral and anterior regions by a delicate pattern of small, wavy ridges arranged concentrically with the margins. There is a small subcircular sulcus slightly dorsad to the center of the valve.

On the inside, the valves are shallow with two small subcircular depressions near the posterior end of each valve. Muscle scars consist of ten to twelve small, elongate scars arranged pinnately near the center of the valves. Hingement of the valves is formed by a projecting edge of the dorsal margin of the left valve which fits a groove below the dorsal margin of the right valve. Dimorphism not determined.

Dimensions. - Holotype no. 5753, a complete carapace, from the Shubuta member at locality 6: length 0.74 mm., height 0.40 mm. Paratype no. 5754, a left valve: length 0.70 mm., height 0.36 mm. Paratype no. 5756, a left valve: length 0.70 mm., height 0.36 mm. All paratypes are from the Shubuta clay member at locality 6.

Comparisons. - This species resembles Cytherella pustulosa Keij, 1957, but differs in its lack of knob-like processes which form the concentric ornamentation pattern of that species.

Occurrence. - Occurs in the Shubuta clay member at localities 5 and 6; very rarely in the Pachuta marl member at locality 6.

Cytherella purdyi n. sp.
Pl. I., figs. 9-14

Diagnosis. - Carapace smooth. Anterior evenly rounded; posterior obliquely truncate. Right valve overlaps the left valve strongly around all margins.

Description. - Carapace elongate-subovate in side view. Dorsal margin slightly arched; ventral margin convex. Anterior margin evenly rounded; posterior margin obliquely truncate between rounded postero-dorsal and postero-ventral margins. Greatest height slightly anterior to center; greatest thickness at the posterior. Right valve strongly overlaps the left valve around all margins with the strongest overlap along the dorsal and ventral margins. In dorsal view the valves are wedge-shaped with a slight concavity near the center.

On the inside, the valves are moderately shallow with an elongate depression near the posterior end. Muscle scar pattern consists of several elongate scars in pinnate arrangement near the center of the valves. Forms interpreted as

females are less elongate, with less concavity in the center of the valves when viewed dorsally.

Dimensions. - Holotype no. 5757, a male carapace from the Shubuta clay member at locality 6: length 0.84 mm., height 0.51 mm., thickness 0.39 mm. Paratype no. 5758, a female carapace: length 0.80 mm., height 0.51 mm., thickness 0.39 mm. Paratype no. 5759, a female carapace: length 0.81 mm., height 0.51 mm. All paratypes are from the Shubuta clay member at locality 6.

Comparisons. - This species somewhat resembles Cytherella sylverinica Howe and Law, 1936, from the Vicksburg (Oligocene) Byram marl near Sylverina, Mississippi. The dorsal and ventral margins of the above described species, however, are more strongly arched than C. sylverinica, and also, the right valve does not overlap the left valve as strongly as in the latter.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; Shubuta clay member at localities 5 and 6; and Yazoo clay formation lower facies at locality 12.

Cytherella rogersi n. sp.
Pl. II, figs. 1-3

Diagnosis. - Carapace smooth. Dorsal and ventral margins arched forming a peak near the center of each margin with the dorsal peak the stronger. Anterior margin evenly rounded;

posterior margin obliquely truncate.

Description. - Carapace elongate-subovate in side view. Dorsal and ventral margins arched forming a strong peak near the center of each margin with the dorsal peak the stronger. Anterior margin evenly rounded; posterior margin obliquely truncate between rounded postero-dorsal and postero-ventral margins. Right valve overlaps the left valve along the dorsal and ventral margins. Greatest height at the center; greatest thickness near the posterior in the females, and slightly posterior to center in the males. Surface of the carapace smooth throughout.

On the inside, the valves are shallow with two subcircular depressions at the posterior end. Muscle scars consist of eighteen to twenty elongate scars arranged in a pinnate pattern near the center of the valves. Forms considered as males are thinner in dorsal view with the greatest thickness just posterior to center. In the females the greatest thickness is at the posterior end.

Dimensions. - Holotype no. 5760, a female carapace from the lower facies of the Yazoo clay formation at locality 13: length 0.76 mm., height 0.47 mm. Paratype no. 5761, a male carapace from the same locality: length 0.73 mm., height 0.43 mm.

Comparisons. - This species slightly resembles Cytherella

moremani Alexander, 1929, from the Navarro group (Cretaceous) of Texas, but differs in that the dorsal slope of C moremani is much steeper. Also, the ventral margin is more evenly convex in C moremani than in C rogersi.

Occurrence. - This species occurs in the Moodys Branch formation at localities 8, 15, and 16; the Pachuta marl member at localities 3 and 6; the Yazoo clay formation lower facies at localities 12, 13, 17, 19, and 20; and the Yazoo clay formation upper facies at localities 11 and 14.

Cytherella sp. Howe and Chambers, 1935
Pl. II., figs. 4, 5

Cytherella sp. Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 6, pl. 4, figs. 17, 18; pl. 5, figs. 11, 12.

Cytherella sp. Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 105, pl. 11, fig. 1.

Cytherella sp. Howe and Chambers, in van den Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam, p. 60, pl. 2, fig. 4.

Diagnosis. - Carapace smooth. Dorsal and ventral margins subparallel; anterior and posterior margins evenly rounded. Wedge-shaped in dorsal view.

Description. - Carapace elongate-subovate in side view. Dorsal and ventral margins straight to concave and subparallel. Anterior and posterior margins evenly rounded. Greatest thickness at the posterior. Right valve overlaps the left valve along the dorsal, ventral, and anterior margins.

Surface smooth.

On the inside, the valves are shallow and smooth. Muscle scar pattern consists of several elongate scars in pinnate arrangement near the center of the valves. Dimorphism not determined.

Dimensions. - Hypotype no. 5762 from the North Creek clay member at locality 2; length 0.66 mm., height 0.37 mm.

Comparisons. - A comparison of the above described specimen with the specimens figured by Howe and Chambers 1935 suggests that they are the same species.

Occurrence. - Occurs in the North Creek clay member at localities 1, 2, 4, 7, and 9; rarely in the Pachuta marl member at locality 3; and in the Yazoo clay formation lower facies at locality 20.

Remarks. - Specific classification of the foregoing described form is not attempted because of the lack of identifying features. There are several forms described in the literature which are similar and difficult to distinguish from the above specimen.

Genus CYTHERELLOIDEA Alexander, 1929

Type Species *Cytherella williamsoni* Jones, 1847

Cytherelloidea montgomeryensis Howe, 1934
Pl. II., figs. 6-10

Cytherelloidea montgomeryensis Howe, 1934, Jour. Paleontology, vol. 8, pp. 31-32.

Cytherelloidea montgomeryensis Howe, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 7, 8, pl. 5, fig. 4.

Cytherelloidea montgomeryensis Howe, in Sexton, 1951, Jour. Paleontology, vol. 25, p. 808, pl. 115, fig. 21.

Diagnosis. - Posterior elevated and subtruncate. A low rounded marginal rim encircles the periphery of the valves except at the posterior. Surface ornamented by a ridge which begins slightly above the middle of the raised posterior, loops obliquely around a subcentral pit, and intersects the dorsal margin near center. Another ridge near the ventral margin extends from the elevated posterior to the anterior region.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight to slightly concave in the right valve, concave in the left valve. Ventral margin concave. Anterior margin evenly rounded; posterior margin subtruncate. A low rounded marginal rim encircles the dorsal, ventral, and anterior margins. A deep subcentral pit extends toward the dorsal margin, thence gradually narrows as it continues just below the dorsal rim to the postero-dorsal margin. A rounded ridge starts just above the middle of the elevated posterior border, turns obliquely downward to the center of the valve, curves around the subcentral pit, and emerges at the dorsal margin at a point slightly posterior to center.

A ventral ridge extends longitudinally across the valves from the posterior border to a point near the anterior margin. The valve surface is otherwise smooth.

On the inside, the valves are shallow with two oval-shaped depressions at the posterior end and a rounded sinus in the subcentral area. Muscle scars consist of several scars in pinnate arrangement on the sinus. Hingement consists of a projecting dorsal flange in the left valve which fits a corresponding groove of the right valve. A flange of the right valve overlaps the dorsal concave portion of the left valve. Males are flat, smaller than the females, and, in the males, the marginal rim encircles the entire periphery of the valves. In addition, the ventral ridge does not intersect the posterior border as in the females.

Dimensions. - Hypotype no. 5763, a female right valve from the Cocoa sand member at locality 1: length 0.61 mm., height 0.37 mm. Hypotype no. 5764, a female left valve from the same locality: length 0.57 mm., height 0.31 mm. Hypotype no. 5765, a male right valve from the same locality: length 0.58 mm., height 0.34 mm. Hypotype no. 5766, a male left valve from the Cocoa sand member at locality 1: length 0.54 mm., height 0.31 mm. Hypotype no. 5767, a female right valve from the Pachuta marl member at locality 3: length 0.64 mm., height 0.38 mm.

Comparisons. - The hypotypes were compared with the holo-

type and appear to be the same species.

Occurrence. - Occurs in the Cocoa sand member at localities 1 and 6; Pachuta marl member at locality 6; the Moodys Branch formation at localities 8, 15, and 16; the North Creek clay member at localities 2, 4, 9, and 10; the lower facies of the Yazoo clay formation at locality 18; and very rarely in the Shubuta clay member at locality 3.

Cytherelloidea ouachitensis Howe, 1934
Pl. II., figs. 11-13

Cytherelloidea ouachitensis Howe, 1934, Jour. Paleontology, vol. 8, pp. 32-33.

Cytherelloidea ouachitensis Howe, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 8-9, pl. 5, fig. 3.

Cytherelloidea ouachitensis Howe, in Sexton, 1951, Jour. Paleontology, vol. 25, p. 808, pl. 115, fig. 20.

Cytherelloidea danvillensis Howe, 1934, Jour. Paleontology, vol. 8, p. 31.

Cytherelloidea danvillensis Howe, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 6, 7, pl. 5, figs. 5, 6.

Cytherelloidea danvillensis Howe, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 105, pl. 11, fig. 2.

Cytherelloidea danvillensis Howe, in Sexton, 1951, Jour. Paleontology, vol. 25, p. 808, pl. 115, fig. 20.

Diagnosis. - Posterior region elevated with a steep slope to the posterior margin. A low rim encircles all margins except the posterior. Surface sculptured with a subcentral pit which is nearly enclosed by a rounded ridge with a

branch of the ridge extending to the posterior border. A ridge near the ventral margin extends from the posterior to the anterior region. Males are flat with a rim around the entire periphery. They also possess two concentric ridges, convex ventrally, on the surface of the valves.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight in the right valve; slightly concave in the left valve. Ventral margin straight and parallel to the dorsal margin. Anterior and posterior margins evenly rounded with the posterior region elevated producing a steep slope to the posterior border. A low rounded ridge nearly encircles a deep subcentral pit with a branch of the ridge extending to the top edge of the posterior slope. A ventral ridge extends longitudinally across the carapace from the posterior edge to a point near the anterior margin. A low rounded rim encircles the dorsal, ventral, and anterior margins. The surface of the valves is otherwise smooth.

On the inside, the valves are shallow with two sub-circular pits at the posterior end and a rounded sinus near center. Muscle scars consist of several scars arranged pinnately on the sinus. Hingement consists of a small projecting dorsal flange of the left valve which fits a corresponding groove of the right valve. A small flange of the right valve overlaps the dorsal concave portion of the left valve. Males are smaller, flat, without the elevated

posterior as in the females. In the male the upper surface ridge simply extends around the subcentral pit without branching, and the lower ridge is somewhat concentric with the upper.

Dimensions. - Hypotype no. 5768, a female right valve: length 0.68 mm., height 0.40 mm. Hypotype no 5769, a female left valve: length 0.67 mm., height 0.38 mm. Hypotype no. 5770, a male right valve: length 0.60 mm., height 0.36 mm. All hypotypes are from the upper facies of the Yazoo clay formation at locality 14.

Comparisons. - Comparison of the hypotypes with the holotype indicates that the foregoing described forms should be assigned to the species Cytherelloidea ouachitensis.

Occurrence. - Occurs rarely in the Moodys Branch formation at locality 15; lower facies of the Yazoo clay formation at localities 12, 17, and 19; upper facies, Yazoo clay formation at locality 14; and Shubuta clay member at localities 5 and 6.

Remarks. - The male valve of the above described species was formerly described as Cytherelloidea danvillensis by Dr. Henry Howe, 1934. As a result of a review of his older works he discovered this synonymy and drew it to the attention of the present writer.

Suborder PODOCOPA Sars, 1866

Family CYPRIDIDAE Baird, 1850

Subfamily PONTOCYPRIDINAE G. W. Müller, 1894

Genus ARGILLOECIA Sars, 1866

Type Species *Argilloecia cylindrica* Sars, 1866

Argilloecia yazooensis n. sp.
Pl. II, figs. 14-19

Diagnosis. - Carapace small, subsiliquose, and smooth. Right valve overlaps the left valve strongly along the mid-ventral margin. Dorsal margin arched. Posterior subacute; subovate in end view.

Description. - Carapace small, subsiliquose in side view; subovate in end view. Dorsal margin arched; ventral margin slightly concave to straight. Anterior margin obliquely rounded and slightly upturned at the antero-dorsal margin. Posterior margin narrow, subacute. Right valve overlaps the left valve strongly along the mid-ventral margin and slightly along the dorsal and posterior margins. Greatest thickness at the middle. Surface of the carapace smooth, translucent to transparent.

On the inside, the valves are moderately deep with broad vestibules. Radial pore canals numerous and paired at the anterior end. The line of concretion forms a large U at the anterior. Muscle scars small and difficult to determine but appear to consist of a group of three or more

scars in a vertical row with two scars anterior to them. Hingement of the valves consists of a dorsal bar in the left valve which fits a corresponding groove in the right valve. Dimorphism not determined.

Dimensions. - Holotype no. 5771, a complete carapace from the upper Shubuta clay member at locality 6: length 0.48 mm., height 0.23 mm., thickness 0.18 mm. Paratype no. 5772, a right valve: length 0.46 mm., height 0.21 mm. Paratype no. 5773, a left valve: length 0.46 mm., height 0.19 mm. Paratype no. 5774, a right valve: length 0.47 mm., height 0.23 mm. All paratypes are from the upper Shubuta clay member at locality 6.

Comparisons. - This species is similar to Argilloecia subcylindrica Alexander, 1934, from the Midway (Eocene) of Texas but differs in that the dorsal margin of the above described form is more strongly arched. The carapace is also more ovate in end view than A. subcylindrica. It also differs from A. hiwanneensis Howe and Law, 1937, from the Red Bluff (Oligocene) in that the dorsal margin is more strongly arched and the posterior vestibule is less pronounced.

Occurrence. - Occurs in the North Creek clay member at localities 4, 7, and 9; in the Pachuta marl member at locality 3; Shubuta clay member at locality 6; and the lower

facies of the Yazoo clay formation at localities 12 and 13.

Subfamily CYPRIDINAE G. W. Müller, 1894

Genus AGLAIOCYPRIS Sylvester-Bradley, 1947

Type Species *Aglaia pulchella* Brady, 1868

Aglaiocypris northcreekensis n. sp.
Pl. II, figs. 20-25

Diagnosis. - Carapace elongate, subsiliquose, and smooth. Dorsal margin smoothly arched; ventral margin concave. Anterior slightly upturned at the antero-dorsal margin. Posterior end subacute. On the inside, the valves possess broad deep vestibules.

Description. - Carapace elongate, subsiliquose in side view. Dorsal margin smoothly arched; ventral margin concave. Anterior margin obliquely rounded with a slight upturn in the antero-dorsal part. Posterior end subacute. Surface of the valves smooth. Left valve overlaps the right valve around all margins with the strongest overlap at the dorsal and mid-ventral margins.

On the inside, the valves are moderately deep with broad deep vestibules. Radial pore canals few, short, and occasionally paired. The line of concrescence lies near the outer margin. Muscle scar pattern consists of a vertical row of four small scars with two scars posterior to them. Hingement of the right valve consists of a small projecting

flange near the anterior cardinal angle and a bar below the dorsal margin. Hingement of the left valve consists of a small projecting flange at the anterior cardinal angle which overlaps the right valve flange; and there is a groove below the dorsal margin. Dimorphism not determined with certainty. The wider more compressed forms may be males.

Dimensions. - Holotype no. 5775, a complete carapace from the North Creek clay member at locality 4: length 0.64 mm., height 0.30 mm. Paratype no. 5776, a wide (male?) form: length 0.64 mm., height 0.29 mm. Paratype no. 5777, a right valve: length 0.60 mm., height 0.26 mm. Paratype no. 5778, a left valve: length 0.63 mm., height 0.26 mm. Paratype no. 5779, a left valve: length 0.64 mm., height 0.29 mm. All paratypes are from the North Creek clay member from locality 4.

Comparisons. - This species bears some resemblance to Aglaiocypris enigmatica Keij, 1957, from the Lutetien of France. It differs in the shape of the dorsal margin and also in having an upturned antero-dorsal margin which is not present in A. enigmatica.

Occurrence. - Occurs in the North Creek clay member at localities 1, 2, 4, 7, and 9.

Genus PARACYPRIS Sars, 1866

Type Species Paracypris polita Sars, 1866

Paracypris franquesi Howe and Chambers, 1935
Pl. III., figs. 1-4

Paracypris franquesi Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 10-11, pl. 3, fig. 13; pl. 4, figs. 15, 19.

Paracypris franquesi Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 105, pl. 11, fig. 4.

Paracypris franquesi Howe and Chambers, in van den Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam, p. 66, pl. 1, fig. 16.

Diagnosis. - The angular peak at the anterior cardinal angle and the long acute posterior end are the most diagnostic features.

Description. - Carapace elongate-subpyriform in side view. Anterior margin broadly and obliquely rounded; posterior long and pointed. Dorsal margin arched with an angular peak at the anterior cardinal angle; ventral margin concave. Surface of the carapace smooth. Left valve overlaps the right valve around all margins except at the anterior.

On the inside, the valves are moderately deep with broad deep vestibules. Radial pore canals few and occasionally branched. The line of concrescence lies near the outer margin at the anterior and posterior extremities. Muscle scar pattern consists of a vertical row of four oval-shaped scars with two scars slightly posterior to them. Hingement of the valves consists of a short flange at the anterior cardinal angle of the left valve which fits a corresponding

short groove of the right valve. Dimorphism not determined.

Dimensions. - Hypotype no. 5780, a complete carapace from the North Creek clay member at locality 2: length 0.99 mm., height 0.39 mm. Hypotype no. 5781, a right valve: length 1.01 mm., height 0.36 mm. Hypotype no. 5782, a left valve: length 0.99 mm., height 0.39 mm. Hypotype no. 5783, a right valve: length 0.96 mm., height 0.36 mm. All hypotypes are from the North Creek clay member at locality 2.

Comparisons. - Comparison of the foregoing described forms with the holotype indicates that they are the same species.

Occurrence. - Occurs in the North Creek clay member at localities 1, 2, 4, 9, and 10; Moodys Branch formation at localities 15 and 16; rarely in the Cocoa sand member at locality 6; and the lower facies of the Yazoo clay formation at localities 12, 13, 18, and 19.

Family BAIRDIIDAE, Sars, 1888

Subfamily BAIRDIINAE Sars, 1923

Genus BAIRDIA McCoy, 1844

Type Species *Bairdia curta* McCoy, 1844

Bairdia hiwanneensis Howe and Law, 1936
Pl. III., figs. 5-7

Bairdia hiwanneensis Howe and Law, 1936, La. Dept. Cons. Geol.
Bull. 7, p. 27, pl. 2, fig. 9; pl. 3, fig. 1.

Diagnosis. - Carapace smooth with symmetrically arched dorsal margin. Anterior margin obliquely rounded; posterior margin subacuminate. Left valve overlaps the right valve along the dorsal and ventral margins with the strongest overlap at venter.

Description. - Carapace ovate in side view. Dorsal margin symmetrically arched with the highest point at center. Ventral margin gently convex. Anterior margin obliquely rounded; posterior margin subacuminate. Surface of the carapace smooth. Left valve overlaps the right valve along the dorsal and ventral margins with the strongest overlap at the ventral margin. In dorsal view valves are thickest at the center and taper symmetrically toward the anterior and posterior ends.

On the inside, the valves are deep with broad marginal areas. Radial pore canals few, and widely spaced. The line of concrescence lies approximately midway between the outer and inner margins at the anterior and posterior margins and near the inner margin at the ventral margin. Muscle scars consist of seven or eight scars arranged irregularly in a subcircular pattern near the center of the valves. Hinge-ment consists of a straight bar in the mid-dorsal part of the right valve which fits a corresponding groove in the left valve. Dimorphism not determined.

Dimensions. - Hypotype no. 5784, a complete carapace from

the Shubuta clay member at locality 6: length 0.90 mm., height 0.57 mm.

Comparisons. - Comparison with the holotype indicates that the ostracode just described is Bairdia hiwanneensis.

Occurrence. - Occurs in the Pachuta marl member at locality 3: and the Shubuta clay member at localities 3 and 6.

Bairdia woodwardensis Howe and Law, 1936
Pl. III., figs. 8, 9

Bairdia woodwardensis Howe and Law, 1936, La. Dept. Cons. Geol. Bull. 7, p. 28, pl. 2, figs. 11, 12; pl. 3, figs. 7, 8.

Diagnosis. - Carapace subglobular and smooth. Dorsal margin strongly arched; ventral margin slightly convex. Anterior margin obliquely rounded; posterior margin subacuminate.

Description. - Carapace subglobular in side view. Dorsal margin strongly arched; ventral margin slightly convex. Anterior margin obliquely rounded and denticulate in the ventral part. Posterior margin subacuminate and denticulate along the postero-ventral part. In dorsal view the valves are thickest at the center and taper symmetrically toward the anterior and posterior ends. Left valve overlaps the right valve along the dorsal and ventral margins.

On the inside, the valves are deep with broad marginal areas. Radial pore canals few and widely spaced. The line

of concretion lies well between the inner and outer margins at the anterior and posterior margins, but lies near the inner margin along the ventral margin. Muscle scars consist of eight or more irregularly arranged oval-shaped scars in a subcircular cluster near the center of the valves. Hingement consists of a straight bar at the mid-dorsal part of the right valve which fits a corresponding groove of the left valve. Dimorphism not determined.

Dimensions. - Hypotype no. 5785, a left valve from the Shubuta clay member at locality 6: length 0.99 mm., height 0.66 mm. Hypotype no. 5786, a right valve from the same locality: length 0.97 mm., height 0.57 mm.

Comparisons. - The foregoing described forms deviate slightly from the holotype in that the overlap of the left valve over the right is not quite as strong at the dorsal margin as in the holotype.

Occurrence. - Occurs in the Pachuta marl member at locality 3; Shubuta clay member at localities 3 and 6.

Genus BAIRDOPPILATA Coryell, Sample, and Jennings, 1935

Type Species *Bairdoppilata martyni* Coryell, Sample,
and Jennings, 1935

Bairdoppilata sp.
Pl. III., figs. 10-12

Description. - Carapace heavy, subtriangular in side view.

Dorsal margin strongly arched with the highest point at center. Anterior margin obliquely rounded; posterior subacute. Surface smooth.

On the inside, the valves are deep with broad marginal areas. The line of concrescence lies near the inner margin except at the anterior where it lies well between the inner and outer margins. Muscle scars consist of nine or ten oval-shaped scars arranged irregularly in a subcircular cluster near the center of the valves. Hingement consists of a dorsal bar of the right valve which fits a corresponding groove of the left valve. There is also a taxodont row of cusps at the cardinal angle of the right valve which fits a corresponding row of sockets of the left valve.

Dimensions. - Figured specimen no. 5787, a left valve from the Moodys Branch formation at locality 8: length 1.03 mm., height 0.66 mm. Figured specimen no. 5788, a right valve from the same locality: length 0.99 mm., height 0.56 mm.

Occurrence. - Found only in the Moodys Branch formation at localities 8 and 15.

Remarks. - This species can be distinguished from others described in the literature by the long acute posterior end which has the tip just above the ventral margin. Complete description as a species cannot be made, however, because only a few single valves were found.

Genus BYTHOCYPRIS Brady, 1880

Type Species *Bythocypris reniformis* Brady, 1880

Bythocypris (?) *gibsonensis* Howe and Chambers, 1935
Pl. III., figs. 13-15

Bythocypris (?) *gibsonensis* Howe and Chambers, 1935, La.
Dept. Cons. Geol. Bull. 5, pp. 9, 10, pl. 3, fig. 10;
pl. 4, fig. 3.

Bythocypris (?) *gibsonensis* Howe and Chambers, in Howe and
Law, 1936, La. Dept. Cons. Geol. Bull. 7, p. 26, pl. 1,
figs. 34-37.

Bythocypris (?) *gibsonensis* Howe and Chambers, in Bergquist,
1942, Miss. Geol. Surv. Bull. 49, p. 105, pl. 11, fig. 3.

Bythocypris (?) *gibsonensis* Howe and Chambers, in Swain,
1946, Jour. Paleontology, vol. 20, p. 375, pl. 54, figs.
4a-e.

Bythocypris cf. *gibsonensis* (Howe and Chambers) in van den
Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam,
p. 68, pl. 1, fig. 13.

Bythocypris (?) *gibsonensis* Howe and Chambers, in Puri,
1951, Fla. Geol. Surv. Bull. 38, p. 190, pl. 1, figs.
10-13.

Bythocypris (?) *gibsonensis* Howe and Chambers, in Marianos
and Valentine, 1958, Micropaleontology, vol. 4, p. 365,
pl. 1, figs. 3a-c; text fig. 2.

Diagnosis. - Carapace subreniform and smooth. Dorsal mar-
gin arched with a small peak at the mid-dorsum of the left
valve; ventral margin concave. Left valve overlaps the
right valve along the dorsal and ventral margins.

Description. - Carapace elongate, subreniform in side view.
Dorsal margin strongly arched with a small peak at the mid-
dorsum; ventral margin concave. Anterior margin evenly

rounded; posterior margin narrow and subacute. Surface of the valves smooth. Left valve overlaps the right valve along the dorsal and ventral margins.

On the inside, the valves are deep with broad vestibules. Radial pore canals moderately numerous, short, and straight at the anterior margin, few and widely spaced, and, in some cases, branched, at the posterior margin. The line of concrescence lies near the outer margin at the anterior and posterior extremities. Muscle scars consist of ten to twelve round scars arranged in a subcircular cluster near the center of the valves. Hingement of the valves consists of a small flange at the mid-dorsal part of the right valve which fits beneath a dorsal projection of the left valve. A dorsal projection of the left valve overlaps the right valve along the dorsal and postal slopes. Dimorphism not determined.

Dimensions. - Hypotype no. 5789, a complete carapace from the Pachuta marl member at locality 3: length 0.97 mm., height 0.50 mm., thickness 0.41 mm. Hypotype no. 5790, a right valve: length 0.97 mm., height 0.44 mm. Hypotype no. 5791, a left valve: length 0.97 mm., height 0.46 mm. All hypotypes are from the Pachuta marl member at locality 3.

Comparisons. - The foregoing described forms are slightly larger than the holotype but appear to be the same species.

Occurrence. - Found in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay member at localities 1, 7, and 9; Pachuta marl member at localities 3 and 6; Shubuta clay member at localities 5 and 6; Yazoo clay formation lower facies at localities 12, 13, and 18; and the Yazoo clay formation upper facies at locality 11.

Remarks. - The representatives of this species are larger in the Pachuta and Shubuta members than in the underlying Moodys Branch formation and in the lower and upper facies of the Yazoo clay formation.

Superfamily CYTHERACEA Ulrich and Bassler, 1923

Family BRACHYCYTHERIDAE Puri, 1953

Genus ALATACYTHERE Murray and Hussey, 1942 (emended)

Type Species *Cythereis* (*Pterygocythereis* ?) *alexanderi*
Howe and Law, 1936
(not *Cythereis alexanderi* Morrow, 1934)

Alatacythere ivani Howe, 1951
Pl. IV., figs. 1-3

Cythereis (*Pterygocythereis* ?) *alexanderi* Howe and Law,
1936, La. Dept. Cons. Geol. Bull. 7, pp. 42, 43, pl. 4,
fig. 23; pl. 5, fig. 5.

Alatacythere alexanderi Murray and Hussey, 1942, Jour.
Paleontology, vol. 16, pp. 164-166, 168, 171, pl. 27,
figs. 10, 11; text figs. 1, 2, 10.

Pterygocythereis ? *alexanderi* Stephenson, 1946, in part,
Jour. Paleontology, vol. 20, p. 306.

Alatacythere ivani Howe, 1951, Jour. Paleontology, vol. 25,
p. 538.

Pterygocythereis ivani (Howe) in Hill, 1954, Jour. Paleontology, vol. 28, pp. 814-815, pl. 98, fig. 4a; pl. 97, figs. 4a-b; pl. 99, figs. 3a-e.

Diagnosis. - Carapace large and smooth. Dorsal margin straight with wide blade-like spines. Anterior margin broadly and evenly rounded, compressed, with two rows of flat spines. A long blade-like ala projects from near the ventral margin.

Description. - Carapace large, oblong-quadrate in side view. Dorsal margin straight with a row of thin blade-like spines. Ventral margin sinuate and mostly obscured by a strong projecting ala. Anterior margin broadly and evenly rounded with a marginal rim which is fringed with two rows of flattened spines. Posterior margin evenly rounded, compressed, with four to six strong round spines. Greatest height at the anterior cardinal angle. Surface of the carapace smooth, transparent, with a long blade-like ala projecting from near the ventral margin. A few widely spaced normal pore canals are visible.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals few, straight, and occur singly, or in bundles of two or more, widely spaced. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scar pattern consists of a vertical row of four oval-shaped scars with a small U-shaped scar anterior to them. Hinge of the right valve consists of a small, rounded,

slightly elevated, anterior tooth and a deep postjacent socket connected by a groove to a small, crenulated posterior tooth. Hinge of the left valve consists of an anterior socket and a rounded postjacent tooth connected by a sharp bar to a crenulated posterior socket. Dimorphism not determined.

Dimensions. - Hypotype no. 5792, a right valve from the Pachuta marl member at locality 3: length 0.96 mm., height 0.50 mm. Hypotype no. 5793, a left valve from the same locality: length 0.96 mm., height 0.51 mm.

Comparisons. - The hypotypes were compared with the holotype and found to be essentially identical.

Occurrence. - Occurs in the Pachuta marl member at locality 3; Shubuta clay member at locality 6; and rarely in the Moodys Branch formation at localities 8, 15, and 16.

Genus BRACHYCYTHERE Alexander, 1933

Type Species *Cythere sphenoides* Reuss, 1854

Brachycythere mississippiensis (Meyer), 1887
Pl. IV., figs. 4-6

Cythere mississippiensis Meyer, 1887, Senckenberg., Naturf.,
Gesell. Bericht.

Diagnosis. - Carapace large and inflated; surface coarsely reticulated on the inflated portion. Ventral alae composed of a carinate ridge which branches into two ridges across the centro-ventral slope of the valves. The upper ridge

terminates with a blunt spine. Two smaller ridges, subparallel to the others, are below.

Description. - Carapace large, inflated, elongate-ovate in side view. Dorsal margin slightly arched and sinuate; ventral margin sinuate to slightly convex. Anterior margin broadly and obliquely rounded with a broad rim which is denticulate in the ventral part. Posterior margin straight in the dorsal half, and rounded in the ventral half with three or four large round spines. Surface of the carapace coarsely reticulated in the central inflated area; smooth near the anterior and posterior ends. Normal pore canals are visible in the smooth areas. Ventral alae consists of a carinate ridge which branches into two subparallel ridges, convex ventrally, across the centro-ventral slope of the valves. The upper ridge terminates with a blunt spine, and both ridges terminate approximately one-third the distance from the posterior end. Two smaller ridges, subparallel to the two larger dorsal ridges, appear below them.

On the inside, the valves are deep with broad marginal areas. Radial pore canals numerous, sometimes branched, and occur singly or in bundles of two or more. Muscle scar pattern consists of three oval-shaped scars in a slightly arcuate row on the posterior edge of the muscle pit with two scars just above, and one scar adjacent and just anterior to the middle scar of the vertical row. There is a large heart-shaped scar anterior to the main group. Hinge of the right valve consists of a slightly crenulated, elongate anterior

tooth and a postjacent socket connected by a groove to a crenulated, elongate posterior tooth. Hinge of the left valve consists of a deep anterior socket and a rounded postjacent tooth connected by a bar to a crenulated, elongate posterior socket. Above the bar there is a wide deep groove. Males are more elongate than females.

Dimensions. - Hypotype no. 5794, a male left valve from the Moodys Branch formation at locality 15: length 1.20 mm., height 0.61 mm. Hypotype no. 5795, a male right valve from the same locality: length 1.14 mm., height 0.54 mm.

Comparisons. - This species resembles Brachycythere martini Murray and Hussey, 1942, but differs in carapace outline and the dorsal margin is less strongly arched. The alae on the centro-ventral slope also differ in the two species.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; the Cocoa sand member at localities 1 and 6; and the Pachuta marl member at locality 6.

Brachycythere russelli Howe and Lea, 1936
Pl. IV., figs. 7-9

Brachycythere watervalleyensis Howe and Chambers, 1935, (in part) La. Dept. Cons. Geol. Bull. 5, pl. 3, fig. 4.

Brachycythere russelli Howe and Lea, in Howe and Law, 1936, La. Dept. Cons. Geol. Bull. 7, pp. 41, 42, pl. 2, figs. 30, 31; pl. 3, figs. 23-25.

Brachycythere russelli Howe and Lea, in Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 178, pl. 28, figs. 1, 4, 5, 8; text fig. 1, figs. 19-24; text fig. 2, fig. 1.

Brachycythere russelli Howe and Lea, in Stephenson, 1946, Jour. Paleontology, vol. 20, pp. 333-334, pl. 44, fig. 22; pl. 45, fig. 19.

Brachcythere russelli Howe and Lea, in van den Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam, pp. 107, 108, pl. 8, fig. 8.

Brachcythere russelli Howe and Lea, in Hill, 1954, Jour. Paleontology, vol. 28, p. 812, pl. 97, fig. 1a-b.

Digmocythere russelli (Howe and Lea) Mandelstam, 1958, in Abushik, A. F., Mandelstam, and others, Microfauna CCCP, vol. 9; All-Union Petroleum Sci.-res. Geol. Expl. Inst., Leningrad (VNIGRI) Trans., n.s., No. 115.

Diagnosis. - Carapace large, inflated, and smooth. Dorsal margin broadly arched and merges smoothly with the anterior and posterior margins in the left valve. It is straight with distinctive cardinal angles in the right valve. Ala well developed and extends across the inflated centro-ventral region of the carapace from the anterior margin to a point approximately one-fifth the distance from the posterior.

Description. - Carapace large, inflated, elongate-ovate in side view. Dorsal margin broadly arched in the left valve and merges smoothly with the anterior and posterior margins. It is straight with distinctive cardinal angles in the right valve. Ventral margin slightly convex; anterior margin broadly and obliquely rounded, and denticulate in the ventral half. Posterior margin evenly rounded in the left valve. In the right valve it slopes in a straight line in the dorsal part, but is rounded and denticulate in the ventral part. Greatest height at the center. Surface of the carapace smooth. A strong ala extends across the inflated centro-ventral area and terminates approximately one-fifth the distance from the

posterior end. In some cases a few short spines occur along the posterior edge of the ala.

On the inside, the valves are deep with broad marginal areas. Radial pore canals moderately numerous, occasionally branched, and occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scar pattern consists of a vertical to slightly arcuate row of three oval-shaped scars with two small scars slightly above them. One scar is just anterior to the middle scar of the vertical row. A large heart-shaped scar is anterior to the main group. Hinge of the right valve consists of a blunt, crenulated anterior tooth and a deep, round postjacent socket connected by a crenulated groove to an elongate, crenulated posterior tooth. Hinge of the left valve consists of a deep, crenulated anterior socket and a high, rounded postjacent tooth connected by a bar to a crenulated posterior socket. Above the bar there is a deep, wide groove. Males are more elongate than females.

Dimensions. - Hypotype no. 5797, a female left valve from the Shubuta clay member at locality 6: length 1.27 mm., height 0.79 mm. Hypotype no. 5796, a female right valve from the same locality: length 1.24 mm., height 0.70 mm.

Comparisons. - The hypotypes illustrated are larger than the cotypes but appear to be the same species.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; Pachuta marl member at localities 3 and 6; Shubuta clay member at localities 3, 5, and 6; the Cocoa sand member at locality 1; and rarely in the lower facies of the Yazoo clay formation at locality 12; and the upper facies of the Yazoo clay formation at locality 14.

Remarks. - The individuals belonging to this species are larger in the Pachuta and Shubuta members than in the lower horizons.

Brachythere watervalleyensis Howe and Chambers, 1935
Pl. IV., figs. 10-13

Brachythere watervalleyensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 46, 47, pl. 3, figs. 1, 2, 3, 5, 6 (not fig. 4); pl. 4, fig. 1; pl. 6, fig. 7.

Brachythere watervalleyensis Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 109, pl. 11, figs. 21, 22.

Brachythere watervalleyensis Howe and Chambers, in Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 179, pl. 28, figs. 2, 3; text fig. 2, figs. 5, 6.

Diagnosis. - Carapace smooth to faintly reticulate. Anterior margin broadly and obliquely rounded; posterior straight and slopes steeply in the dorsal part, rounded with a few short spines in the ventral part. A well developed ala extends across the inflated centro-ventral region of the valves and terminates with a short blunt spine approximately one-third the distance from the posterior margin.

Description. - Carapace inflated, elongate-ovate in side view. Dorsal margin slightly arched to sinuate in the left valve, and straight in the right valve. Ventral margin straight to slightly convex. Anterior margin broadly and obliquely rounded with a broad rim which bears several denticles in the ventral half. Posterior margin straight and sloping in the dorsal half; obliquely rounded with three or four spines in the ventral half. Greatest height at the anterior cardinal angle. Surface of the carapace smooth except for a few delicate reticulations in the central inflated area. Several widely scattered normal pore canals are visible. A well developed ala extends across the centro-ventral inflated area and terminates with a short blunt spine about one-third the distance from the posterior margin.

On the inside, the valves are deep with broad marginal areas. Radial pore canals moderately numerous at the anterior margin, few at the posterior. They are sometimes branched, and occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scar arrangement obscure. Hinge of the right valve consists of a small, crenulated cusp at the anterior and a round postjacent socket connected by a crenulated groove to a crenulated cusp at the posterior. Hinge of the left valve consists of a slightly crenulated anterior socket and a small, round postjacent tooth connected by a bar to a large, crenulated socket at the posterior.

There is a wide depressed area between the bar and the dorsal margin. Dimorphism not determined.

Dimensions. - Hypotype no. 5800, a left valve from the North Creek clay member at locality 2: length 0.81 mm., height 0.47 mm. Hypotype no. 5799, a right valve from the same locality: length 0.70 mm., height 0.36 mm. Hypotype no. 5798, a whole carapace from the lower facies of the Yazoo clay formation at locality 18: length 0.81 mm., height 0.46 mm., thickness 0.47 mm.

Comparisons. - This species differs from Brachythere russelli Howe and Lea, in its smaller size and in the terminal spine of the ala.

Occurrence. - This species occurs at all the stratigraphic horizons and at all localities of the Jackson group in Mississippi except the upper Shubuta clay member at locality 6 and the upper facies of the Yazoo clay formation at localities 11 and 14.

Genus PTERYGOCY THERE Hill, 1954

Type Species *Cypridina alata* Bosquet, 1847

Pterygocythere murrayi Hill, 1954
Pl. IV., figs. 14-18

Alatacythere alata (Bosquet) in part, in Murray and Hussey, 1942, Jour. Paleontology, vol. 16, p. 171, pl. 27, figs. 13, 16, 18; text fig. 1, figs. 11-18.

Brachycythere alata (Bosquet) in part, in Stephenson, 1946, Jour. Paleontology, vol. 20, p. 332, pl. 44, figs. 12, 13, 24, 25; pl. 45, fig. 26.

Pterygocythere murrayi Hill, 1954, Jour. Paleontology, vol. 28, pp. 822, 823, pl. 100, figs. 5a-c.

Diagnosis. - Carapace large and pellucid. Dorsal margin gently arched and merges smoothly with the obliquely rounded anterior margin. Posterior margin subtruncate with three or four large spines in the ventral half. A well developed ala projects from the centro-ventral region of the valves and bears a long spine at its apex.

Description. - Carapace large, elongate-ovate in side view. Dorsal margin gently arched; ventral margin sinuate. Anterior margin broadly and obliquely rounded and merges smoothly with the dorsal margin. It is also compressed with a weak marginal rim. A delicate carina extends around approximately the lower three-fifths of the margin. Posterior margin subtruncate with three to four large round spines in the ventral part. Greatest height at the anterior cardinal angle. Surface of the carapace smooth, pellucid, with a few normal pore canals visible. A strong ala projects from the centro-ventral area of the carapace with a long sharp spine at its apex. A small, flat subtriangular spine is also present on the posterior inward swing of the ala.

On the inside, the valves are deep with broad marginal areas. Radial pore canals are moderately numerous, in some

cases bifurcating, and occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scar pattern consists of a vertical row of three oval-shaped scars with one scar just above them. Another scar is slightly anterior to the middle scar of the vertical row. Anterior to the main group there is a large heart-shaped scar with a smaller scar below. Above the main group there is another scar in the vicinity of the eye region. Hinge of the right valve consists of an elongate, stepped, crenulated anterior tooth and a small, round postjacent socket connected by a slightly crenulated groove to an elongate, crenulated posterior cusp. Hinge of the left valve consists of an anterior socket and a rounded postjacent tooth connected by a bar to an elongate, crenulated posterior socket. Above the bar there is a wide deep groove. Dimorphism not determined.

Dimensions. - Hypotype no. 5804, a complete carapace from the Shubuta clay member at locality 6: length 1.10 mm., height 0.60 mm., thickness (between tips of the alae) 0.84 mm. Hypotype no. 5801, a right valve: length 1.09 mm., height 0.54 mm. Hypotype no. 5802, a left valve: length 1.10 mm., height 0.59 mm.

Comparisons. - The hypotypes deviate from the holotype slightly in that the small subtriangular spine on the posterior inward swing of the ala is more weakly developed in the

former.

Occurrence. - Occurs in the Pachuta marl member at locality 3; and Shubuta clay member at locality 6.

Genus ABSONOCYTHEROPTERON Puri, 1957

Type Species *Absonocytheropteron carinata* Puri, 1957

Absonocytheropteron carinata, Puri, 1957
Pl. V., figs. 1-3

Absonocytheropteron carinata Puri, 1957, Fla. Geol. Surv.
Bull. 38, pp. 204-205, pl. 14, figs. 9-12; pl. 15, figs.
9-12.

Diagnosis. - Dorsal margin straight; ventral margin partially obscured by a well developed ala across the centro-ventral region of the carapace. There are six or seven large foramina along the rim of the ala. Surface ornamentation consists of a pattern of two sets of concentric ridges. One set of five ridges is convex toward the anterior, and another set of seven ridges is concave toward the posterior cardinal angle.

Description. - Carapace elongate-ovate in side view. Dorsal margin straight to slightly arched; ventral margin slightly sinuate and partially obscured by a well developed ala across the centro-ventral region. Anterior margin obliquely rounded; posterior margin compressed with the dorsal half slightly concave, and the ventral half rounded. Great-

est height at the anterior cardinal angle. In dorsal view the carapace is subovate and the left valve overlaps the right valve at a point just anterior to the eye tubercles. Surface of the carapace ornamented by two sets of concentric ridges. There is an antero-ventral set of five ridges which is convex toward the anterior margin, and a postero-dorsal set of seven ridges which is concave toward the posterior cardinal angle. Along the rim of the ala there are six or seven large foramina which alternate with rounded pillars.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals few, straight, and widely spaced. The line of concrescence coincides with the inner margin throughout. Muscle scars consist of a vertical row of four, elongate, irregularly shaped scars with two round scars, obliquely arranged, anterior to the upper two scars of the vertical group. There is another subtriangular pattern of three or four round scars just above the main group in the direction of the anterior cardinal angle. Hinge of the right valve consists of a high, rounded anterior tooth and a deep, round postjacent socket connected by a slightly crenulated groove to an elongate posterior tooth. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Hypotype no. 5805, a complete carapace from the Moodys Branch formation at locality 8: length 0.71 mm.,

height 0.40 mm., thickness 0.40 mm. Hypotype no. 5806, a right valve: length 0.73 mm., height 0.41 mm. Hypotype no. 5807, a left valve: length 0.73 mm., height 0.41 mm. All hypotypes are from the same locality.

Comparisons. - No comparison with the holotype has been made, but comparison with hypotypes in the Jackson group collection of Dr. Henry V. Howe, Louisiana State University, indicate the identity of species.

Occurrence. - First described by Puri from the Crystal River formation of the Ocala group in Florida. Occurs in the Moodys Branch formation at localities 3 and 15; and the Cocoa sand member at localities 1 and 6.

Absonocytheropteron watervalleyensis Krutak,* 1960
Pl. V., figs. 4-11

Absonocytheropteron watervalleyensis Krutak,* 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.), Louisiana State University.

Diagnosis. - Carapace inflated, subpyriform, and smooth. A weakly developed ala extends across the inflated centro-ventral region. Hingement holamphidont. Normal pore canals on the inflated portion of the valves are aligned sub-parallel to the ala.

Description. - Carapace inflated in the centro-ventral area; subpyriform in side view. Dorsal margin straight and

slopes toward the posterior. Ventral margin slightly convex and partially obscured by the convexity of the valves in the centro-ventral region. Anterior margin broadly and obliquely rounded; posterior margin narrow and produced into a small caudal process. Left valve overlaps the right valve at the anterior and posterior cardinal angles. Greatest height at the anterior cardinal angle; greatest thickness slightly posterior to center. Surface of the carapace smooth to slightly reticulate with a weakly developed ala across the centro-ventral region. Normal pore canals are visible on the inflated portion of the carapace and are aligned subparallel to the ala.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals moderately numerous, short, and straight at the anterior margin, few and widely spaced at the posterior margin. The line of concrescence lies between the inner and outer margins at the anterior and posterior extremities and lies very near the inner margin along the ventral margin. Muscle scar pattern consists of three oval-shaped scars in a vertical row with one scar just above and another scar just anterior to the middle scar of the row. There is a small cluster of two or three scars anterior to the main group. Hinge of the right valve consists of a large, round anterior tooth and a deep, triangular postjacent socket connected by a wide groove to a somewhat flat, dorsally recurved, posterior tooth. Hinge

of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 5808, a male carapace from the North Creek clay member at locality 1: length 0.77 mm., height 0.39 mm., thickness 0.39 mm. Hypotype no. 5809, a male right valve from the North Creek clay member at locality 1: length 0.77 mm., height 0.38 mm. Hypotype no. 5810, a female carapace from the North Creek clay member at locality 1: length 0.69 mm., height 0.39 mm. Hypotype no. 5811, a female right valve from the Cocoa sand member at locality 1: length 0.70 mm., height 0.39 mm. Hypotype no. 5812, a female left valve from the Cocoa sand member at locality 1: length 0.70 mm., height 0.40 mm.

Occurrence. - Occurs in the North Creek clay member at locality 1; Cocoa sand member at localities 1 and 6.

*Remarks. - The identity of the foregoing species was established by comparison with topotypes provided the writer by Mr. Paul Krutak. The same is true for other species attributed to Krutak which are subsequently described and figured by the writer in this paper. Mr. Krutak's thesis has recently been submitted for publication.

Family BYTHOCYTHERIDAE Sars, 1926

Genus MONOCERATINA Roth, 1928

Type Species *Monoceratina ventrale* Roth, 1928

Monoceratina alexanderi Howe and Chambers, 1935
Pl. V., figs. 12, 13

Monoceratina alexanderi Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, p. 21, pl. 3, fig. 19; pl. 4, fig. 21.

Monoceratina alexanderi Howe and Chambers, in Blake, 1950,
Jour. Paleontology, vol. 24, p. 183, pl. 29, fig. 7.

Diagnosis. - Surface sculptured with a large ventral projection from which four ridges radiate. Two ridges are deflected toward the anterior, and two toward the posterior. The anterior and dorsal margins are paralleled by a high thin ridge which turns downward near the postero-dorsal margin.

Description. - Carapace elongate in side view. Dorsal and ventral margins straight and parallel. Anterior margin obliquely rounded; posterior margin obliquely truncate. Surface of the carapace strongly sculptured by a large ventral projection containing four raised ridges. Two ridges are deflected toward the anterior region and two toward the posterior. A high thin ridge parallels the anterior and dorsal margins and turns downward near the postero-dorsal margin. Another ridge forms a triangular-shaped enclosure in the anterior region. A median sulcus begins at the base of the projection and extends to the dorsal margin.

On the inside, the valves are shallow with broad marginal areas. Musculature and other features obscured by poor preservation. Dimorphism not determined.

Dimensions. - Hypotype no. 5813, a left valve from the Moodys Branch formation at locality 15: length 0.63 mm., height 0.30 mm.

Comparison. - The foregoing specimen is essentially identical to the holotype.

Occurrence. - Occurs rarely in the upper marl of the Moodys Branch formation at locality 15; and the Pachuta marl member at localities 3 and 6.

Monoceratina sp. A.
Pl. V., figs. 14-16

Diagnosis. - Carapace elongate-subovate in outline. Surface smooth except for a few widely scattered pits. A strong ala, tipped with a spine, projects from the centro-ventral region of the valve. There is a small subcircular pit near the anterior inward swing of the ala. Internal features obscure.

Dimensions. - Figured specimen no. 5814, from the Pachuta marl member at locality 3; length 0.74 mm., height 0.40 mm. The other figured specimens are too fragmented for measurement.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; and Shubuta clay member at locality 6.

Remarks. - This species appears to be distinctive and is

probably new. Because of its rare occurrence, however, and the fact that no complete right valves were found, a new species cannot be described.

Monoceratina sp. B.
Pl. V., figs. 18, 19

Remarks. - Only one carapace of this species was found in the lower facies of the Yazoo clay formation at locality 13. It is similar to M. williamsi Stephenson, 1946, from the Weches formation (Claiborne) of Texas, but the two lobes of the inflated centro-ventral region of the figured specimen are more nearly equal than in M. williamsi.

Dimensions. - Figured specimen no. 5815, a complete carapace: length 0.54 mm., height 0.31 mm.

Family LEGUMINOCYHERIDAE n. fam.

Genus ACUTICYTHEREIS Edwards, 1944

Type Species *Acuticythereis laevissima* Edwards, 1944

Acuticythereis cocoaensis Krutak, 1960
Pl. VI., figs. 1-5

Acuticythereis cocoaensis Krutak, 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.), Louisiana State University.

Diagnosis. - Carapace smooth with a few pits widely scattered over the surface. Dorsal margin straight; ventral margin slightly sinuate. Anterior margin obliquely rounded; poste-

rior margin concave in the dorsal part, obliquely rounded in the ventral part.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight; ventral margin slightly sinuate. Both margins converge slightly toward the posterior. Anterior margin broadly and obliquely rounded; posterior margin straight in the dorsal part and obliquely rounded in the ventral part. It is flattened behind a slight swelling in the postero-ventral region. Surface of the carapace smooth and polished with a few widely scattered pits.

On the inside, the valves are deep with broad marginal areas. Radial pore canals are moderately numerous, straight, and closely spaced. The line of concrescence nearly coincides with the inner margin at the ventral and posterior margins but swings outward to a point near the outer margin at the anterior extremity. Muscle scar pattern consists of a vertical row of four oval-shaped scars with two round scars anterior to them. There are also two small round scars just above the main group, and another scar is located approximately midway between the main group and the ventral margin. Hinge of the right valve consists of a high, rounded anterior tooth and a deep postjacent socket connected by a groove to a rounded posterior tooth. Hinge of the left valve complementary. Males are slightly more elongate than females and less inflated in the postero-ventral region.

Dimensions. - Hypotype no. 5817, a female right valve from the Cocoa sand member at locality 1: length 0.73 mm., height 0.34 mm. Hypotype no. 5818, a female right valve: length 0.71 mm., height 0.33 mm. Hypotype no. 5819, a female left valve: length 0.77 mm., height 0.34 mm. Hypotype no. 5820, a male right valve: length 0.73 mm., height 0.30 mm. All hypotypes are from the Cocoa sand member at locality 1.

Comparisons. - This species resembles A. laevissima Edwards, from the Duplin marl of North Carolina. In A. cocoaensis, however, the dorsal margin is straight; it is well arched in A. laevissima.

Occurrence. - Found only in the Cocoa sand member at localities 1 and 6.

Genus BASSLERITES Howe, 1937

Type Species *Basslerites miocenica* Howe, 1935 .

Basslerites sp.
Pl. V., figs. 19, 20

Only one valve was found in the Moodys Branch formation at locality 15. It is figured for reference.

Dimensions. - Figured specimen no. 5816, a right valve: length 0.74 mm., height 0.37 mm.

Family CYTHERETTIDAE Triebel, 1952

Genus CYTHERETTA Müller, 1894

Type Species *Cytheretta subradiosa* (Roemer), 1938

Cytheretta alexanderi Howe and Chambers, 1935
Pl. VI., figs. 6-11

Cytheretta alexanderi Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, pp. 45, 46, pl. 5, figs. 17-21; pl.
6, figs. 27-28.

Cythereis (?) *catahoulana* Howe and Pyeatt, 1935, La. Dept.
Cons. Geol. Bull. 5, pp. 25, 26, pl. 3, fig. 7; pl. 6,
figs. 25, 26.

Cythereis (?) *catahoulana* var. *pyeatti* Howe and Chambers,
1935, La. Dept. Cons. Geol. Bull. 5, pp. 26, 27, pl. 3,
figs. 20, 21.

Cytheretta alexanderi Howe and Chambers, in Bergquist, 1942,
Miss. Geol. Surv. Bull. 49, p. 109, pl. 11, fig. 20.

Cytheretta alexanderi Howe and Chambers, in Blake, 1950,
Jour. Paleontology, vol. 24, p. 177, pl. 30, figs. 1-3.

Cytheretta alexanderi Howe and Chambers, in Puri, 1952, Jour.
Paleontology, vol. 26, pp. 208, 209, pl. 39, fig. 16.

Diagnosis. - Carapace heavy, with obliquely rounded anterior margin and obliquely rounded, upturned posterior margin.

Ornamentation consists of rounded longitudinal ridges and pitted furrows which converge near the posterior end. Internal characteristics normal for the genus.

Description. - Carapace heavy, elongate-ovate in side view. Dorsal margin sinuate. Ventral margin convex in the left valve, sinuate in the right valve. Anterior margin broadly and obliquely rounded; posterior margin concave and upturned

in the dorsal part, obliquely rounded and denticulate in the ventral part. Left valve overlaps the right valve at the ventral margin and cardinal angles. Surface of the carapace ornamented by numerous rounded horizontal ridges which tend to converge at the posterior. There are several coarse pits aligned in the furrows between the ridges.

On the inside, the valves are deep with very broad marginal areas. At the anterior there is a large S-shaped inner margin which is characteristic for the genus. Radial pore canals numerous, long, and wavy. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scars consist of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a massive, blunt anterior tooth and an elongate postjacent socket tapering to a narrow groove which connects it to a large, subovate posterior tooth. Hinge of the left valve consists of a large, deep socket and a rounded postjacent tooth connected by the projecting edge of the dorsal margin to a deep, oval-shaped, posterior socket. The forms which are identified as males are more elongate than the females.

Dimensions. - Hypotype no. 5822, a complete carapace from the Moodys Branch formation at locality 15: length 1.00 mm., height 0.53 mm., thickness 0.49 mm. Hypotype no. 5824, a left valve: length 0.97 mm., height 0.53 mm. Hypotype no.

5823, a left valve molt; length 0.84 mm., height 0.43 mm.
Hypotype no. 5821, a right valve of a young molt: length
0.76 mm., height 0.36 mm.

Comparisons. - The adult hypotypes are essentially identical to the holotype of the species.

Occurrence. - Occurs at all stratigraphic levels in the Jackson group in Mississippi except the Shubuta clay member; it is found rarely in the Pachuta marl member.

Family CYTHERIDEIDAE Sars, 1925

Genus CLITHROCYTHERIDEA Stephenson, 1936

Type Species *Cytheridea* ? *garretti* Howe and Chambers, 1935

Clithrocytheridea caldwellsensis (Howe and Chambers), 1935
Pl. VI., figs. 13-14

Cytheridea (?) *caldwellsensis* Howe and Chambers, 1935, La.
Dept. Cons. Geol. Bull. 5, p. 11, pl. 1, fig. 7; pl. 2,
figs. 4-6.

Cytheridea (*Clithrocytheridea*) *caldwellsensis* (Howe and
Chambers), in Stephenson, 1937, Jour. Paleontology, vol.
11, p. 154, pl. 26, fig. 13.

Clithrocytheridea caldwellsensis (Howe and Chambers), in
Stephenson, 1946, Jour. Paleontology, vol. 20, p. 237,
pl. 42, fig. 13.

Clithrocytheridea caldwellsensis (Howe and Chambers), in
Blake, 1950, Jour. Paleontology, vol. 24, p. 175, pl. 29,
fig. 12.

Diagnosis. - Dorsal margin has small peak at the anterior cardinal angle. Surface sculptured by two, low, rounded,

longitudinal ridges which extend toward the posterior from a low, flat swelling near the anterior end. The subcentral ridge expands into a low flat raised area in the postero-dorsal region. The ventral ridge parallels the ventral margin. Anterior margin obliquely rounded; posterior margin slopes steeply between broadly rounded postero-dorsal and acute postero-ventral margins.

Descriptions. - Carapace elongate, subtrapezoidal in outline. Dorsal margin slightly concave behind a small peak at the anterior cardinal angle; ventral margin slightly sinuate. Anterior margin obliquely rounded with a raised rim. Posterior margin straight in the middle part. It slopes steeply between a broadly rounded postero-dorsal margin and an acute postero-ventral margin. Surface sculptured by two ridges which begin near the anterior end as a low flat swelling and extend to the posterior third of the carapace. The subcentral ridge expands into a flat swelling in the postero-dorsal region. The ventral ridge parallels the ventral margin. A smaller vertical ridge extends downward from the postero-dorsal margin to approximately the middle of the posterior end.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, straight, and occasionally occur in bundles of two, three, or more. The line of concrescence coincides with the inner margin ex-

cept for a slight outward deviation at the anterior extremity. Muscle scar pattern consists of a vertical row of four oval-shaped scars with a small scar anterior to them. There is a large scar still farther anterior to the main group. Hingement of the right valve consists of an elongate, raised crenulated cusp at each cardinal angle connected by a crenulated groove. Hingement of the left valve consists of corresponding crenulated sockets connected by a crenulated bar. Selvage strong. Males are more elongate than females.

Dimensions. - Hypotype no. 5826, a male right valve from the Moodys Branch formation at locality 15: length 0.71 mm., height 0.34 mm. Hypotype no. 5827, a female left valve from the same locality: length 0.69 mm., height 0.35 mm.

Comparisons. - The hypotypes are identical to the holotype except for slightly larger size.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay member at localities 2, 4, and 7; Cocoa sand member at localities 1 and 6; and rarely in the Pachuta marl member at localities 3 and 6.

Remarks. - The specimens of this species are larger in the Moodys Branch formation than in other stratigraphic levels of the Jackson group.

Clithrocytheridea garretti (Howe and Chambers), 1935
Pl. VI., figs. 12, 15-17

Cytheridea (?) garretti Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, p. 14, pl. 1, figs. 4, 5; pl. 2,
figs. 11, 12; pl. 6, figs. 10, 11.

Cytheridea (Clithrocytheridea) garretti (Howe and Chambers),
in Stephenson, 1936, Jour. Paleontology, vol. 10, p. 702,
pl. 94, figs. 5, 6, 10; text figs. 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

Cytheridea (Clithrocytheridea) garretti (Howe and Chambers),
in Stephenson, 1942, Jour. Paleontology, vol. 16, p. 110,
pl. 18, fig. 1.

Clithrocytheridea garretti (Howe and Chambers), in Stephen-
son, 1944, Jour. Paleontology, vol. 18, p. 449, pl. 76,
fig. 1.

Clithrocytheridea garretti (Howe and Chambers), in Stephen-
son, 1946, Jour. Paleontology, vol. 20, p. 327, pl. 42,
fig. 18.

Clithrocytheridea garretti (Howe and Chambers), in Blake,
1950, Jour. Paleontology, vol. 24, p. 175, pl. 29, figs.
9-11.

Diagnosis. - Anterior margin obliquely rounded; posterior margin straight and slopes steeply between rounded postero-dorsal and postero-ventral margins. Surface covered with large pits of various sizes which tend to align longitudinally near the ventral margin.

Description. - Carapace elongate, subtrapezoidal in side view. Dorsal margin slightly concave behind a rounded anterior cardinal angle. Ventral margin straight in the left valve, gently concave in the right valve. Anterior margin obliquely rounded with minute denticulations at the antero-ventral margin. Posterior margin straight in the middle and

slopes steeply between rounded postero-dorsal and postero-ventral margins. Surface of the carapace covered by coarse pits of various sizes and shapes. Near the ventral margin the pits tend to align longitudinally. Numerous normal pore canals are aligned along the rows of pits.

On the inside, the valves are deep with broad marginal areas. Radial pore canals numerous and closely spaced. The line of concrescence coincides with the inner margin except for a slight deviation outward at the anterior. Muscle scars consist of a vertical row of four large scars with a small scar just anterior to them. There is a large scar farther anterior to the main group. Hingement of the right valve consists of a raised crenulated cusp at each cardinal angle connected by a narrow, depressed crenulated groove. The edge of the dorsal margin is sinuously inrolled above the groove. In the left valve there are corresponding crenulated sockets connected by an elevated crenulated bar. Between the bar and the dorsal margin there is a faintly incised line. Selvage strong. Males are more elongate than females but otherwise possess the same features.

Dimensions. - Hypotype no. 5828, a male right valve: length 0.83 mm., height 0.39 mm. Hypotype no. 5829, a male left valve: length 0.86 mm., height 0.41 mm. Hypotype no. 5830, a female left valve: length 0.71 mm., height 0.40 mm. All hypotypes are from the Cocoa sand member at locality 1.

Comparisons. - The hypotypes deviate slightly from the holotype by having some minute denticulations along the anteroventral margin but otherwise appear to be essentially the same.

Occurrence. - Found in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay member at localities 2, 7, and 10; Cocoa sand member at localities 1 and 6; and rarely in the Pachuta marl member at localities 3 and 6.

Remarks. - The specimens of this species are much larger in the Moodys Branch formation than in the higher stratigraphic levels of the Jackson group.

Clithrocytheridea grigsbyi (Howe and Chambers), 1935
Pl. VII., figs. 1-3

Cytheridea grigsbyi Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 15, pl. 1, figs. 2, 3.

Cytheridea (*Clithrocytheridea*) (?) *grigsbyi* (Howe and Chambers), in van den Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam, p. 80, pl. 7, fig. 15.

Clithrocytheridea grigsbyi (Howe and Chambers), in Blake, 1950, Jour. Paleontology, vol. 24, p. 175, pl. 29, figs. 13-15.

Diagnosis. - Surface of the carapace covered with numerous tiny pits. Normal pore canals widely scattered over most of the surface. They are numerous and aligned in parallel longitudinal rows near the ventral margin.

Description. - Carapace elongate-subtriangular in side view.

Dorsal margin arched with a small peak slightly anterior to center. Ventral margin straight to slightly sinuate. Anterior margin broadly and obliquely rounded; posterior margin narrow with sharply rounded postero-ventral part. Surface of the valves covered with numerous tiny pits. Normal pore canals are scattered irregularly over the carapace. They are numerous and aligned in parallel longitudinal rows near the ventral margin.

On the inside, the valves are deep with broad marginal areas. Radial pore canals numerous at the posterior and anterior margins and occur in bundles of two or more, closely spaced. The line of concrescence coincides with the inner margin except at the anterior where it deviates outward slightly. Muscle scar pattern consists of a vertical row of four oval-shaped scars with a small scar anterior to them. There is a larger scar anterior to the main group. Hinge of the right valve consists of an elongate crenulated cusp at each cardinal angle connected by a wide, slightly depressed, crenulated groove. Hinge of the left valve consists of corresponding crenulated sockets connected by a raised crenulated bar. The bar is separated from the edge of the dorsal margin by a groove. Males are more elongate than females, and in the females, the posterior is more nearly equal to the anterior. Young forms in both males and females are triangular in outline.

Dimensions. - Hypotype no. 5831, a male right valve: length 0.80 mm., height 0.43 mm. Hypotype no. 5832, a female left valve: length 0.80 mm. height 0.43 mm. Hypotype no. 5833, a young form: length 0.71 mm., height 0.40 mm. All hypotypes are from the Cocoa sand member at locality 1.

Comparisons. - The hypotypes are nearly identical to the type species. Stephenson 1936, 1937, described three varieties of the above species which are very closely related to the type. He distinguishes Cytheridea (Clithrocytheridea) grigsbyi var. jacksonensis by arrangement of the surface pits on the latter. Cytheridea (Clithrocytheridea) grigsbyi var. chickasawhayana he distinguishes by the smaller and much more closely spaced pits, and Cytheridea (Clithrocytheridea) grigsbyi var. vicksburgensis is distinguished by having a less pronounced depression between the hinge and the dorsal margin than appears in the type.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; North Creek clay member at localities 1, 2, 4, 9, and 10; Cocoa sand member at localities 1 and 6; rare in the Pachuta marl member at locality 3; and in the lower facies of the Yazoo clay formation at localities 12 and 18.

Remarks. - Although this species is larger in the Moodys Branch formation the individuals are more numerous in the

overlying North Creek clay member.

Clithrocytheridea shubutensis (Stephenson), 1937
Pl. VII., figs. 4-7

Cytheridea (*Clithrocytheridea*) *shubutensis* Stephenson, 1937,
Jour. Paleontology, vol. 11, p. 156, pl. 26, fig. 1.

Diagnosis. - Carapace subreniform with large coarse pits on the surface. Dorsal margin arched; ventral margin concave. Highest at anterior cardinal angle.

Description. - Carapace subreniform in side view with the greatest height at the anterior cardinal angle. In dorsal view, it is thickest in the middle. Dorsal margin slightly arched; ventral margin concave. Anterior margin broadly and obliquely rounded; posterior margin slopes steeply to the rounded postero-ventral angle. Surface of the valves covered by coarse deep pits.

On the inside, the valves are moderately deep with moderately broad marginal areas. Radial pore canals numerous, straight, and sometimes occur in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Muscle scars consist of a vertical row of four scars with two scars anterior to them. Hingement of the right valve consists of an elongate crenulated cusp at each cardinal angle connected by a depressed crenulated groove. Above the groove the dorsal margin forms a bar. In the left valve there are corresponding crenulated sockets connected

by an elevated crenulated bar. The bar is separated from the dorsal margin by a small incised line. Selvage strong. Males are more elongate than females.

Dimensions. - Hypotype no. 5834, a female left valve: length 0.70 mm., height 0.36 mm. Hypotype no. 5835, a female right valve: length 0.69 mm., height 0.34 mm. Hypotype no. 5836, a male right valve: length 0.71 mm., height 0.33 mm. Hypotype no. 5837, a male left valve: length 0.69 mm., height 0.31 mm.

Comparisons. - The specimens illustrated are identical to the syntypes. Clithrocytheridea lerichei Keij, 1957, also bears some resemblance to the species just described. C. lerichei, however, is described as having an undulating surface with two inflated areas in the posterior part and a postero-ventral depression which features are not present in C. shubutensis.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; the Cocoa sand member at localities 1 and 6; and very rarely in the North Creek clay member at localities 4 and 7.

Genus CYAMOCYTHERIDEA Oertli, 1956

Type Species *Bairdia punctatella* Bosquet, 1852

Cyamocytheridea chambersi (Stephenson), 1937
Pl. VII., figs. 8-12

Cytheridea (Haplocytheridea) chambersi Stephenson, 1937,
Jour. Paleontology, vol. 11, p. 147, pl. 26, fig. 2; text
figs. 13, 22.

Diagnosis. - Carapace heavy, tumid, subovate, and smooth. Dorsal margin arched with the greatest height slightly anterior to center. Anterior margin broadly rounded; posterior margin evenly rounded and narrower than the anterior.

Description. - Carapace heavy, tumid, subovate in side view. Greatest height slightly anterior to center. Dorsal margin arched; ventral margin straight to slightly convex. Anterior margin broadly rounded and wider in the left valve than in the right. Posterior margin evenly rounded in the left valve, narrower and obliquely rounded in the right valve. Surface of the carapace smooth.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals numerous, short, and closely spaced. The line of concrescence lies between the inner and the outer margins. Muscle scars consist of a vertical row of four oval-shaped scars with two scars anterior to them. Hingement of the right valve consists of an elongate, elevated crenulated cusp at each cardinal angle connected by the depressed crenulated dorsal edge. In the left valve, there is an elongate, depressed crenulated socket at each cardinal angle with a slightly elevated furrow of crenulations between them. This furrow lies between a thin bar on the ventral side and the projecting edge of

the dorsal margin above. Males are more elongate than females.

Dimensions. - Hypotype no. 5838, a female carapace: length 0.61 mm., height 0.38 mm. Hypotype no. 5839, a male carapace: length 0.63 mm., height 0.36 mm. Both hypotypes are from the North Creek clay member at locality 7.

Comparisons. - Hypotypes are essentially the same as the syntypes. This species differs from Bairdia punctatella Bosquet in that the anterior and posterior margins are more nearly equal in the latter.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay member at localities 2, 4, 7, and 9; and very rarely in the Pachuta marl member at locality 6.

Remarks. - Oertli, 1956, who erected the foregoing genus, distinguishes it from Haplocytheridea by the more oval shape of the carapace, position of the line of concrescence, and differences in the arrangement of the middle element of the hingement.

Cyamocytheridea hadleyi (Stephenson), 1937
Pl. VII., figs. 13-16

Cytheridea (Haplocytheridea) hadleyi Stephenson, 1937, Jour. Paleontology, vol. 11, p. 150, pl. 26, fig. 16.

Diagnosis. - Carapace heavy and tumid with coarsely pitted surface. Dorsal margin arched with the highest point slightly anterior to center. Anterior margin broadly rounded; posterior margin narrower and evenly rounded.

Description. - Carapace heavy, tumid, subovate in side view. Dorsal margin arched; ventral margin straight. Anterior margin broadly rounded in the left valve and wider than the right valve. Posterior margin broadly rounded in the left valve, obliquely rounded and narrow in the right valve. Surface of the carapace covered by numerous coarse pits.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals numerous, short, and straight. The line of concrescence lies well within the inner and outer margins. Muscle scars consist of a vertical row of four scars with two scars anterior to them. Hinge of the right valve consists of an elongate, slightly elevated, crenulated cusp at each cardinal angle connected by the depressed, crenulated dorsal edge. In the left valve, there are corresponding crenulated sockets connected by an elevated crenulated groove. The groove lies between a sharp, thin ventral bar and the turned down dorsal edge. Selvage strong. Males are more elongate than females.

Dimensions. - Hypotype no. 5840, a female right valve: length 0.61 mm., height 0.33 mm. Hypotype no. 5841, a male left valve; length 0.64 mm., height 0.33 mm. Hypotype no.

5842, a male right valve: length 0.68 mm., height 0.33 mm. All hypotypes are from the Moodys Branch formation at locality 8.

Comparisons. - This species differs from Cyamocytheridea chambersi (Stephenson) in that the right valve is more triangular in side view and the valves are also covered by coarse pits.

Occurrence. - Found only in the Moodys Branch formation at localities 8, 15, and 16.

Cyamocytheridea watervalleyensis (Stephenson), 1937
Pl. VII., figs. 17-20; Pl. VIII., figs. 1-3

Cytheridea (Haplocytheridea) watervalleyensis Stephenson, 1937, Jour. Paleontology, vol. 11, p. 154, pl. 26, fig. 3.

Diagnosis. - Carapace tumid, heavy, and smooth. Anterior and posterior margins rounded. Greatest height at the center. Numerous normal pore canals are visible on the surface.

Description. - Carapace tumid, heavy, subovate in side view. Greatest height at center. Dorsal margin smoothly arched; ventral margin straight in the right valve, slightly convex in the left valve. Anterior margin broadly and obliquely rounded; posterior margin evenly rounded in the left valve, narrow and obliquely rounded in the right valve. Surface of the carapace smooth with normal pore canals evident, especially near the ventral margin.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals moderately numerous and occasionally paired. In some cases two appear to unite at the line of concrescence. The line of concrescence coincides with the inner margin except for a short distance at the anterior extremity where it swings outward approximately midway toward the outer margin. Muscle scars consist of a vertical row of four scars with two scars, in horizontal alignment, anterior to the middle scar of the vertical row. Hinge of the right valve consists of an elongate crenulated cusp at each cardinal angle connected by the depressed crenulated dorsal edge. In the left valve, there are corresponding crenulated sockets connected by an elevated crenulated groove. The groove lies between a thin ventral bar and the rounded dorsal edge above. Selvage strong. Males are more elongate and less inflated at the posterior than the females.

Dimensions. - Hypotype no. 5843, a male right valve from the Moodys Branch formation at locality 15: length 0.71 mm., height 0.37 mm. Hypotype no. 5844, a male left valve from the same locality: length 0.84 mm., height 0.47 mm. Hypotype no. 5845, a female left valve from the Coccoa sand member at locality 1: length 0.70 mm., height 0.40 mm. Hypotype no. 5846, a male carapace from the same locality: length 0.67 mm., height 0.37 mm. Hypotype no. 5847, a fe-

male carapace from the same locality: length 0.66 mm., height 0.37 mm.

Comparisons. - This species resembles Cyamocytheridea devexa (Lienenklaus) 1905, but is not as symmetrically rounded in outline; the latter is also punctate. C. water-valleyensis also differs from Haplocytheridea bassleri Stephenson, in being less symmetrically rounded and more elongate.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay member at localities 1 and 4; Cocoa sand member at localities 1 and 6; and Pachuta marl member at locality 6.

Remarks. - The individuals of this species are much larger and better developed in the Moodys Branch formation than in the higher stratigraphic levels of the Jackson group.

Genus HAPLOCYTHERIDEA Stephenson, 1937

Type Species Cytheridea montgomeryensis
Howe and Chambers, 1935

Haplocytheridea ehlersi (Howe and Stephenson), 1935
Pl. VIII., figs. 4, 5

Cytheridea ehlersi Howe and Stephenson, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 12, pl. 1, fig. 10; pl. 11, figs. 16, 19, 21.

Cytheridea kellumi Howe and Stephenson, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 16, pl. 1, fig. 11; pl. 2, figs. 13-15.

Cytheridea (Haplocytheridea) ehlersi Howe and Stephenson,
in Stephenson, 1937, Jour. Paleontology, vol. 11, p. 150,
pl. 26, fig. 6.

Diagnosis. - Carapace subpyriform with pitted surface. Dorsal margin gently arched; ventral margin straight to slightly concave. Posterior margin narrow, subacute, with two spines projecting from the end.

Description. - Carapace subpyriform in side view. Dorsal margin gently arched; ventral margin straight to slightly concave. Anterior margin broadly and evenly rounded with six to eight small blunt spines in the ventral part. Posterior margin narrow, subacute, with two spines projecting from the extremity. Surface of the carapace covered by numerous small pits.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals numerous, straight, and occur in bundles of two or more. The line of concrecence coincides with the inner margin except at the anterior and posterior extremities where it swings outward to a point approximately midway between the inner and outer margins. Muscle scars consist of a vertical row of four-oval-shaped scars with a large scar just anterior to them and a smaller scar anterior to the latter. Hinge of the right valve consists of an elongate, thin, slightly elevated, crenulated cusp at each cardinal angle connected by a thin crenulated bar. Hinge of the left valve consists of corres-

ponding crenulated sockets connected by a deep crenulated furrow. The furrow is separated from the dorsal margin by a ridge and a depressed area. Selvage strong. Males are smaller than females; and the posterior of the male is more acute.

Dimensions. - Hypotype no. 5848, a female right valve from the upper Shubuta clay member at locality 5: length 0.81 mm., height 0.41 mm. Hypotype no. 5849, a male left valve from the same locality: length 0.71 mm., height 0.43 mm.

Comparisons. - This species resembles Cytheridea multipunctata Alexander, 1934, but Alexander describes C. multipunctata as being "widest behind the middle," whereas H. ehlersi is widest anterior to center.

Occurrence. - Found in the Shubuta clay member at localities 5 and 6; Yazoo clay formation at localities 14 and 17.

Haplocytheridea montgomeryensis
(Howe and Chambers), 1935
Pl. VIII., figs. 6-9

Cytheridea montgomeryensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 17, pl. 1, fig. 1; pl. 2, figs. 1-3, 7, 9; pl. 6, figs. 17-18.

Cytheridea (Haplocytheridea) montgomeryensis (Howe and Chambers) in Stephenson, 1936, Jour. Paleontology, vol. 10, p. 700, pl. 94, figs. 3, 4, 9; text figs. 1-g, 1-h, 1-j, 1-k.

Cytheridea (Haplocytheridea) montgomeryensis (Howe and Chambers) in Stephenson, 1937, Jour. Paleontology, vol. 11, p. 153.

Cytheridea (Haplocytheridea) montgomeryensis (Howe and Chambers) in Stephenson, 1942, Jour. Paleontology, vol. 16, p. 109, pl. 18, figs. 17, 18.

Cytheridea montgomeryensis (Howe and Chambers) in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 106, pl. 11, fig. 5.

Haplocytheridea montgomeryensis (Howe and Chambers) in Stephenson, 1946, Jour. Paleontology, vol. 20, p. 322, pl. 42, fig. 29.

Haplocytheridea montgomeryensis (Howe and Chambers) in Blake, 1950, Jour. Paleontology, vol. 24, p. 176, pl. 29, fig. 16.

Diagnosis. - Carapace subpyriform and tumid with the tumid portion ornamented by several curvilinear rows of pits. Anterior margin broadly rounded with several spines in the ventral part; posterior margin subacute with one or two spines projecting from the extremity.

Description. - Carapace tumid, subpyriform in side view. Highest point slightly anterior to center. Dorsal margin arched; ventral margin straight to slightly sinuate. Anterior margin broadly rounded with several short spines in the ventral part. Posterior margin narrow and subacute with one or two spines projecting from the extremity. Left valve overlaps the right valve around all margins with the strongest overlap along the ventral margin. The tumid portion of the carapace is ornamented by a series of curvilinear subparallel rows of pits aligned normal to the long axis of the valves. Normal pore canals are visible in transparent specimens.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals numerous, straight, and occasionally occur in bundles at the anterior; they are few at the posterior and are branched. The line of concrecence coincides with the inner margin except at the anterior where it swings outward for a short distance toward the outer margin. Muscle scars consist of a vertical row of four scars with two scars, in horizontal alignment, anterior to them. Hingement of the right valve consists of a slightly elevated, crenulated cusp at each cardinal angle connected by a finely crenulated bar. The bar is separated from the dorsal margin by a faintly incised line. Hinge of the left valve consists of two elongate rows of crenulations at each cardinal angle connected by a crenulated groove. Males are smaller and more acute at the posterior than the females.

Dimensions. - Hypotype no. 5941, a female right valve from the Moodys Branch formation at locality 15: length 0.75 mm., height 0.41 mm. Hypotype no. 5942, a female left valve from the Cocoa sand member at locality 1: length 0.79 mm., height 0.41 mm. Hypotype no. 5943, a male right valve from the same locality: length 0.69 mm., height 0.39 mm. Hypotype no. 5944, a male right valve from the Shubuta clay member at locality 6: length 0.67 mm., height 0.39 mm.

Comparisons. - The hypotypes are essentially identical to

the holotype except for the specimen from the Shubuta clay member. This specimen shows slightly stronger spines on the ventral margin and a more prominent pitted surface on the inflated area.

Occurrence. - Found in all stratigraphic horizons and all localities except locality 5; occurs rarely in the Pachuta marl member.

Remarks. - The North Creek clay member individuals show less pronounced pitting on the surface than the specimens from the other horizons of the Jackson group.

Haplocytheridea ouachitensis Stephenson, 1937
Pl. VIII., figs. 10-12

Haplocytheridea ouachitensis Stephenson, 1937, Jour.
Paleontology, vol. 11, p. 153, pl. 26, fig. 4, text
figs. 25, 26.

Haplocytheridea ehlersi (Howe and Stephenson) in Howe and
Chambers, 1935, (in part) La. Dept. Cons. Geol. Bull. 5,
pp. 12, 13, pl. 2, fig. 19; not pl. 1, fig. 10; pl. 2,
figs. 16, 21.

Diagnosis. - Carapace tumid with a surface which may be smooth or ornamented by four to six vertical, curvilinear, pitted furrows near the center of the valves. Posterior margin subtruncate and slopes steeply between the broadly rounded postero-dorsal and subacute postero-ventral margins.

Description. - Carapace subpyriform in outline. Dorsal margin gently arched; ventral margin slightly convex.

Anterior margin broadly and evenly rounded, occasionally denticulate in the ventral half. Posterior margin subtruncate and slopes steeply between the broadly rounded postero-dorsal margin and the subacute postero-ventral margin. Greatest height at the anterior cardinal angle. Surface of the carapace ornamented with four to six vertical, slightly pitted, curvilinear furrows near the center, occasionally smooth. Normal pore canals numerous and arranged irregularly over the carapace.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals numerous, single, sometimes wavy, and irregularly spaced. The line of concrescence lies approximately midway between the inner and outer margins at the anterior. Muscle scar pattern consists of four oval-shaped scars in a vertical row with two scars, obliquely arranged, anterior to them. Another scar is located approximately midway between the main group and the ventral margin. Hinge of the right valve consists of a crenulated dental area at each cardinal angle connected by a crenulated bar. Hinge of the left valve consists of corresponding elongate, crenulated terminal sockets connected by a crenulated groove which lies below the projecting dorsal margin. Females somewhat more elongate and more inflated at the posterior than the males.

Dimensions. - Hypotype no. 5946, a female right valve from

the upper facies Yazoo clay formation at locality 11: length 0.78 mm., height 0.41 mm. Hypotype no. 5947, a female left valve from the same locality: length 0.80 mm., height 0.43 mm. Hypotype no. 5945, a male left valve from the Shubuta clay member at locality 6: length 0.71 mm., height 0.43 mm.

Comparisons. - This species can be distinguished from others of the genus by the larger smooth area on the valve surface. The curvilinear pitted area is generally confined to the center.

Occurrence. - Occurs in the upper facies of the Yazoo clay formation at localities 11 and 14; and the Shubuta clay member at locality 6.

Haplocytheridea parki n. sp.
Pl. VIII., figs. 13-16

Diagnosis. - Anterior margin broadly and evenly rounded with a rim which bears several denticles in the ventral part. Posterior subtruncate. Surface covered with curvilinear rows of pitted ridges and furrows which are convex anteriorly in the anterior region and convex posteriorly in the posterior region.

Description. - Carapace elongate, subpyriform in side view. Greatest height in the anterior third; greatest thickness slightly posterior to center. Dorsal margin

arched; ventral margin straight to slightly sinuate. Anterior margin broadly and evenly rounded, rimmed with denticles in the ventral part. Posterior margin subtruncate with well rounded postero-dorsal and postero-ventral margins. Surface of the carapace covered with pitted, curvilinear ridges and furrows which are vertical in the center, convex anteriorly in the anterior region, and convex posteriorly in the posterior region.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals numerous, short, and occur in bundles of two or more, irregularly spaced. The line of concrescence lies very near the inner margin along all margins except at the anterior where it swings outward for a short distance toward the outer margin. Muscle scars consist of a vertical row of four oval-shaped scars with three scars above, and two scars, obliquely arranged, directly anterior to the vertical row. There is another scar near the ventral margin. Hingement of the right valve consists of a slightly elevated, crenulated cusp at each cardinal angle connected by a thin crenulated bar. Hinge of the left valve consists of a large crenulated socket at the anterior, a small, elongate crenulated socket at the posterior connected by a slightly crenulated groove. The groove lies below the projecting edge of the dorsal margin. Selvage strong. Males smaller and less inflated at the posterior than females.

Dimensions. - Holotype no. 5948, a female left valve from the lower facies of the Yazoo clay formation at locality 20: length 0.80 mm., height 0.46 mm. Paratype no. 5949, a female right valve: length 0.76 mm., height 0.44 mm. Paratype no. 5950, a male right valve: length 0.74 mm., height 0.44 mm. Both paratypes are from the lower facies, Yazoo clay formation at locality 20.

Comparisons. - This species resembles Haplocytheridea veatchi (Howe and Garret) from the Weches (Claiborne) of Texas, but it differs in carapace outline. In H. parki the anterior and posterior margins of the female are more nearly equal, and in dorsal view there is more taper toward the anterior and posterior ends of the valves.

Occurrence. - Occurs in the lower facies of the Yazoo clay formation at locality 2; Shubuta clay member at locality 6; rarely in Pachuta marl member at locality 3.

Family PARACYTHERIDIDAE Puri, 1957

Genus PARACYTHERIDEA G. W. Müller, 1894

Type Species *Cytheropteron bovettensis* Seguenze, 1880

Paracytheridea belhavenensis Howe and Chambers, 1935
Pl. IX., figs. 1-3

Paracytheridea belhavenensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 18, pl. 5, fig. 9.

Paracytheridea palmerae Stephenson, 1946, Jour. Paleontology, vol. 20, p. 317, pl. 42, fig. 14; pl. 44, fig. 19.

Paracytheridea bastropensis Stephenson, 1947, Jour. Paleontology, vol. 21, p. 579.

Paracytheridea belhavenensis Howe and Chambers, in Blake, 1950, Jour. Paleontology, vol. 24, p. 176, pl. 29, figs. 3, 4.

Diagnosis. - Surface sculptured by a strong sweptback ala which projects from the centro-ventral region. Just above the anterior alar edge there is a ridge enclosed tubercle from which three or four ridges extend in different directions. Remainder of the surface ornamented by small anastomosing ridges or reticulations.

Description. - Carapace elongate-subtriangular in side view. Dorsal and ventral margins straight, and converge slightly toward the posterior. Anterior margin broadly and evenly rounded with a flat, delicate rim. Posterior produced into a long pointed caudal process. A strong, subtriangular swept-back ala, tipped with a spine, projects from the centro-ventral region of the carapace. Just above the anterior alar edge there is a ridge enclosed tubercle from which three or four ridges extend in different directions. A lower anterior ridge extends, subparallel to the alar edge, to the ventral margin; an upper anterior ridge extends toward the anterior cardinal angle. The lower posterior ridge extends downward to the anterior alar edge, and in some specimens, an upper posterior ridge extends for a short distance toward the posterior cardinal angle. The remainder of the carapace is ornamented with small anastomosing ridges. In some specimens it is reticulate. A wide vertical sulcus begins just anterior

to the apex of the ala and extends to the dorsal region. There is a swelling in the postero-dorsal area.

On the inside, the valves are deep with narrow marginal areas. Radial pore canals few and widely spaced. Selvage strong. The line of concrescence coincides with the inner margin throughout. Muscle scars consist of a vertical row of four irregularly shaped scars with two scars anterior to them. Some of the scars are frequently split into two or more smaller scars giving considerable variation to the pattern. Hinge of the right valve consists of a weak crenulated cusp at each cardinal angle connected by a crenulated groove. In the left valve, the hingement consists of anterior and posterior crenulated sockets connected by a minutely crenulated bar. The male valves are more elongate than the females.

Dimensions. - Hypotype no. 5952, a female left valve from the Moodys Branch formation at locality 15: length 0.70 mm., height 0.34 mm. Hypotype no. 5953, a male left valve from the same locality: length 0.71 mm., height 0.33 mm. Hypotype no. 5951, a female right valve from the Moodys Branch formation at locality 8: length 0.67 mm., height 0.36 mm.

Comparisons. - This species is easily distinguished by its distinctive surface ornamentation. The hypotypes were compared with the holotype and appear to be the same species.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay at localities 1, 2, and 7; and Cocoa sand member at localities 1 and 6.

Remarks. - The left valve on cotype slide 1133, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Family CYTHEROPTERONIDAE n. fam.

Genus KONAROCY THERE Krutak, 1960

= Budaia Mehes, 1941 not
Budaia Wells, 1933

Type Species *Cytheropteron bilobatum* Alexander, 1929

Konarocythere spurgeonae (Howe and Chambers), 1935
Pl. IX., figs. 4-6

Eocytheropteron spurgeonae Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, pp. 20, 21, pl. 3, fig. 18; pl. 4,
fig. 2; pl. 6, figs. 12, 13.

Diagnosis. - Carapace tumid with the valves inflated strongly in the centro-ventral region. The convex inflated portion slightly overhangs the ventral margin. Numerous normal pore canals are aligned in subparallel rows across the steep ventral slope.

Description. - Carapace tumid, ovate in side view. Dorsal margin broadly and symmetrically arched; ventral margin convex. Anterior margin evenly rounded and merges smoothly with the dorsal and ventral margins. Posterior margin produced into a short caudal process. Valves strongly inflated

in the centro-ventral region with the convex portion slightly overhanging the ventral margin. Numerous normal pore canals are aligned in parallel rows along the steep ventral slope of the inflated region producing a grooved effect. Surface of the carapace smooth except for a few pits where normal pore canals reach the surface. Some specimens show a tendency to have a few delicate reticulations in the central region.

On the inside, the valves are deep with broad marginal areas. Radial pore canals few and widely spaced. The line of concrescence coincides with the outer margin and the outer edge of the inner lamella lies well within the sharp outer lip. Muscle scars consist of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a slightly elevated single row of crenulations at each cardinal angle connected by a depressed crenulated groove. Hinge of the left valve consists of a depressed double row of crenulations at each cardinal angle connected by a slightly elevated, crenulated bar. Males are more elongate than females, and the dorsal margin is not as strongly arched in the males as in the females.

Dimensions. - Hypotype no. 5955, a female left valve from the Moodys Branch formation at locality 15; length 0.73 mm., height 0.49 mm. Hypotype no. 5954, a male right valve from

the same locality: length 0.77 mm., height 0.43 mm.

Comparisons. - This species is similar to Cytheropteron tumidum Alexander, 1929, but differs in carapace outline, especially at the anterior and posterior ends.

Occurrence. - Found in all stratigraphic levels of the Jackson group in Mississippi except the Shubuta clay member. It is very rare in the upper facies of the Yazoo clay formation at localities 11 and 14.

Remarks. - The generic name Konarocythere was proposed by Krutak, 1960, in lieu of Budaia Mehes, 1941, because the latter was found to be preoccupied by a coral.

Genus CYTHEROPTERON Sars, 1966

Type Species *Cythere latissima* Norman, 1865

Cytheropteron danvillensis Howe and Chambers, 1935
Pl. IX., fig. 7

Cytheropteron danvillensis Howe and Chambers, 1935, La.
Dept. Cons. Geol. Bull. 5, p. 20, pl. 3, fig. 17; pl. 4,
figs. 13, 14.

Diagnosis. - Carapace small. Surface smooth or slightly reticulate. Dorsal margin strongly arched; ventral margin convex. A strong ala along the centro-ventral region of the carapace terminates with a small subtriangular spine slightly posterior to its apex.

Description. - Carapace small, subovate in side view. Dorsal margin strongly arched; ventral margin slightly convex and partially obscured by an ala. Anterior margin narrowly and evenly rounded and merges smoothly with the dorsal and ventral margins. Posterior margin produced into a short caudal process. Surface of the carapace smooth; and in some specimens, there are delicate polygonal reticulations in the posterior region. A strong ala projects from the centro-ventral region and terminates with a small subtriangular spine slightly posterior to its apex.

On the inside, the valves are deep with broad marginal areas. Radial pore canals few and widely spaced. The line of concrescence lies between the inner and outer margins. Muscle scars consist of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a low crenulated cusp at each cardinal angle connected by a depressed crenulated area. Hinge of the left valve consists of an elongate crenulated socket at each cardinal angle connected by an elevated crenulated bar. The bar is separated from the dorsal margin by a narrow groove. Dimorphism not determined.

Dimensions. - Hypotype no. 5956, a right valve from the Shubuta clay member at locality 6: length 0.41 mm., height 0.26 mm.

Comparisons. - This species differs from Cytheropteron

montgomeryensis Howe and Chambers, 1935, in being narrower and has less prominent alae. Surface ornamentation also differs in that C. danvillensis is occasionally reticulated with hexagonal reticulations elongate vertically.

Occurrence. - Found in the lower facies of the Yazoo clay formation at localities 17 and 19; upper facies at locality 14; and rarely in the Moodys Branch formation at locality 15; and Cocoa sand member at locality 1.

Remarks. - The specimen on cotype slide 1131, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Cytheropteron montgomeryensis Howe and Chambers, 1935
Pl. IX., figs. 8-10

Cytheropteron montgomeryensis Howe and Chambers, 1935, La.
Dept. Cons. Geol. Bull. 5, p. 17, pl. 3, figs. 14-16.
pl. 4, figs. 11, 12, 16.

Cytheropteron montgomeryensis Howe and Chambers, in Berg-
quist, 1942, Miss. Geol. Surv. Bull. 49, p. 106, pl. 11,
fig. 6.

Cytheropteron montgomeryensis Howe and Chambers, in van den
Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam,
p. 114, pl. 2, fig. 12.

Diagnosis. - Carapace small with smooth surface. Dorsal margin strongly arched; ventral margin convex. A strong ala has a small spine slightly posterior to its apex with another small subtriangular spine near the terminal point.

Description. - Carapace small, subovate in side view. Dorsal margin strongly arched; ventral margin slightly convex, and partially obscured by the overhang of a prominent ala. Anterior margin narrowly and obliquely rounded and merges smoothly with the dorsal and ventral margins. Posterior margin produced into a short caudal process. Surface of the carapace smooth, occasionally with pits in the posterior region. A strong ala projects from the centroventral region with a small spine near its apex. There is another small subtriangular spine at the terminal point.

On the inside, the valves are deep with broad marginal areas. Radial pore canals few and widely spaced. The line of concrescence lies approximately midway between the inner and outer margins at the anterior extremity but very near the inner margin at other points. Muscle scars consist of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a low crenulated cusp at each cardinal angle connected by a depressed crenulated area. The hinge of the left valve consists of a corresponding elongate crenulated socket at each cardinal angle connected by an elevated crenulated bar. The bar is separated from the dorsal margin by a narrow groove. Dimorphism not determined with certainty but some forms are slightly narrower than others and may be males.

Dimensions. - Hypotype no. 5958, a complete carapace from

the lower facies Yazoo clay formation at locality 17: length 0.49 mm., height 0.30 mm., thickness 0.33 mm. Hypotype no. 5957, a right valve from the same locality; length 0.53 mm., height 0.31 mm. Hypotype no. 5959, a left valve from the North Creek clay member at locality 9: length 0.51 mm., height 0.29 mm.

Comparisons. - Comparison of the hypotypes with the holotype indicates that they are essentially identical. The alar structure with the small spines and the smooth carapace easily distinguish this species from others of the genus.

Occurrence. - Occurs commonly at all stratigraphic horizons of the Jackson group in Mississippi except in the upper facies samples of the Yazoo clay formation.

Remarks. - The specimen on cotype slide 836, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Cytheropteron buckatunnaensis n. sp.
Pl. IX., figs. 11-14

Diagnosis. - Carapace small with delicate reticulations in the central region. Dorsal margin arched; ventral margin convex. A wide rounded ala projects from the centro-ventral region of the valves.

Description. - Carapace small, subovate in side view. Dorsal margin arched; ventral margin slightly convex, and partially obscured by an ala. Anterior margin narrow, evenly rounded, and merges smoothly with the dorsal and ventral margins. Posterior margin produced into a short caudal process. Surface of the valves ornamented by delicate reticulations in the central region. A wide rounded ala projects from the centro-ventral region.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals few and widely spaced. The line of concrescence lies between the inner and outer margins. Muscle scars consist of a vertical row of four elongate scars with two scars, obliquely arranged, anterior to them. Hinge of the right valve consists of a small, crenulated anterior cusp and a crenulated posterior cusp connected by a depressed row of crenulations. The latter lies beneath the projecting edge of the dorsal margin. Hinge of the left valve consists of a small, crenulated anterior socket at each cardinal angle connected by an elevated crenulated bar. Males are slightly more elongate and narrower than females.

Dimensions. - Holotype no. 5960, a female carapace from the North Creek clay member at locality 2: length 0.50 mm., height 0.26 mm., thickness 0.29 mm. Paratype no. 5961, a male right valve: length 0.50 mm., height 0.24 mm. Paratype no. 5962, a male left valve: length 0.49 mm., height 0.26 mm. Para-

types are from the North Creek clay member at locality 2.

Comparisons. - This species differs from the species described previously by the round ala without spines. In dorsal view there is also less inflation of the carapace in the central region.

Occurrence. - Occurs in the North Creek clay member at localities 1, 2, 4, and 7; rare in the Cocoa sand member at locality 6; questionable in the Shubuta clay member at locality 6.

Family CYTHERURIDAE G. W. Müller, 1894

Genus CYTHERURA Sars, 1866

Type Species *Cythere gibba* O. F. Müller, 1785
= *Cythere gibbera* O. F. Müller, 1785

Cytherura semireticulata Blake, 1950
Pl. IX., figs. 17, 18

Cytherura semireticulata Blake, 1950, Jour. Paleontology,
vol. 24, p. 182, pl. 30, figs. 17, 18.

Diagnosis. - Carapace small and alate. Dorsal margin arched; ventral margin straight. Surface ornamented by reticulations and ridges. Two subparallel ridges extend from the anterior side of the ala to the ventral margin. Another small ridge extends in an arc from the ala to a point near the posterior caudal process.

Description. - Carapace small, subovate in side view.

Dorsal margin arched; ventral margin straight. Anterior margin evenly rounded; posterior produced into a sharp caudal process slightly below the middle. A broad alar ridge extends across the centro-ventral area of the carapace obscuring part of the ventral margin. Surface ornamentation consists of a network of reticulations and ridges. Two sub-parallel ridges extend from the anterior side of the ala to the ventral margin. Another small ridge arches back from the ala to a point near the posterior caudal process.

On the inside, the valves are moderately deep with broad marginal areas and broad anterior and posterior vestibules. Radial pore canals few and widely spaced. The line of concrescence coincides with the inner margin. Muscle scars obscured by internal evidence of surface ornamentation. Hingement of the valves consists of a groove below the dorsal margin of the right valve which accommodates the dorsal edge of the left valve. Dimorphism not determined.

Dimensions. - Hypotype no. 5965, a right valve from the Moodys Branch formation at locality 15: length 0.41 mm., height 0.21 mm. Hypotype no. 5966, a left valve from the Moodys Branch formation at locality 8: length 0.43 mm., height 0.23 mm.

Comparisons. - The hypotypes deviate from the syntypes in that the posterior ridge is more prominent in the former.

Occurrence. - Only a few valves were found in the Moodys Branch formation at localities 8 and 15, and one valve in the North Creek clay member at locality 4.

Cytherura aff. *Cytherura ultra* Blake, 1950
Pl. IX., figs. 15, 16

Diagnosis. - Carapace small and alate. Surface ornamented by an anterior ridge which begins near the ala and extends subparallel to the alar rim to the ventral margin. A smaller ridge arches over from the ala to the posterior caudal process. Another ridge extends along the dorsal margin with a branch proceeding downward, convex anteriorly, to the supra alar ridge.

Description. - Carapace small, elongate-subovate in side view. Dorsal and ventral margins straight and parallel. Anterior margin evenly rounded with a fragile marginal rim; posterior produced into a caudal process. There is a strong alar ridge across the carapace which is parallel to and very near the ventral margin. Surface of the carapace ornamented by an intricate network of ridges. An anterior ridge begins near the center of the ala, arches up slightly, and then extends parallel to the anterior edge of the ala to the ventral margin. A similar ridge begins slightly posterior to the center of the ala and arches over to a point near the base of the caudal process. Another ridge extends along the dorsal margin with a branch extending downward, convex anteriorly,

to the supra alar ridge. Small anastomosing ridges may occupy the space between the main ridges. There is a shallow vertical sulcus, barely discernible, near the center of the valves.

On the inside, the valves are moderately deep and have broad marginal areas and broad deep vestibules. Radial pore canals few and widely spaced. The line of concrescence is somewhat obscure. Hinge of the right valve consists of a groove below the dorsal margin of the right valve into which the edge of the dorsal margin of the left valve apparently fits. Dimorphism not determined.

Dimensions. - Figured specimen no. 5963, a right valve from the Moodys Branch formation at locality 15: length 0.43 mm., height 0.21 mm. Figured specimen no. 5964, a left valve from the same formation at locality 8: length 0.40 mm., height 0.21 mm. (Tips of the caudal process broken off.)

Comparisons. - The figured specimens deviate from the types in having small anastomosing ridges in the intervening surface area between the main ridges. The central sulcus is prominent on the type and barely discernible in the figured specimen.

Occurrence. - Occurs rarely in the Moodys Branch formation at localities 8 and 15.

Cytherura crami n. sp.
Pl. IX., figs. 19-21

Diagnosis. - Carapace small and alate. Posterior produced into a sharp caudal process at the middle. Surface reticulated without sculpture.

Description. - Carapace small, elongate-subovate in side view. Dorsal and ventral margins straight and parallel. Anterior margin evenly rounded; posterior margin produced into a sharp caudal process at the middle. A strong alar ridge extends across the carapace parallel to and very near the ventral margin. Surface reticulate. On the inside, the valves are moderately deep with broad marginal areas and broad deep vestibules. Radial pore canals few and widely spaced. The line of concrescence coincides with the inner margin at the anterior and posterior margins. Muscle scars consist of a vertical row of three small oval-shaped scars with a single scar anterior to them. Hingement of the valves consists of the dorsal edge of the left valve which fits a corresponding groove below the dorsal margin of the right valve. Dimorphism not determined.

Dimensions. - Holotype no. 5967, a left valve from the Moodys Branch formation at locality 8: length 0.49 mm., height 0.26 mm. Paratype no. 5968, a right valve: length 0.46 mm., height 0.24 mm. Paratype no. 5969, a left valve: length 0.47 mm., height 0.27 mm.

Comparison. - This species slightly resembles Cytherura byramensis Howe and Law, 1936, from the Byram marl (Oligocene). It differs from the latter in that the dorsal margin is not thickened in the right valve, and also, its ala is not as obliquely arranged with respect to the ventral margin.

Occurrence. - Found rarely in the Moodys Branch formation at localities 8 and 15.

Family EUCYTHERIDAE Puri, 1953

Genus CUSHMANIDEA Blake, 1933

Type Species *Cytheridea seminuda* Cushman, 1906

Cushmanidea papula Krutak, 1960
Pl. IX., figs. 22-27

Cushmanidea papula Krutak, 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.) Louisiana State University.

Diagnosis. - Carapace elongate, subcylindrical. Dorsal margin slightly arched; ventral margin straight to slightly concave. Posterior obliquely rounded to subtruncate. Surface covered by papillae with several rows of small granules arranged concentrically near the anterior margin.

Description. - Carapace elongate in side view, subcircular in end view. Dorsal margin slightly arched with the highest point posterior to center. Ventral margin slightly concave.

Anterior margin broadly and obliquely rounded with numerous small round granules around the margin. Posterior margin obliquely rounded to subtruncate. Greatest thickness near the posterior end. Surface of the carapace papillate with several small round granules aligned in concentric rows near and parallel to the anterior margin.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, long, sometimes bifurcating. The line of concrescence nearly coincides with the inner margin except at the anterior extremity where it swings outward for a short distance. Muscle scars consist of a vertical to slightly arcuate row of four oval-shaped scars with a heart-shaped scar, and a smaller scar below, anterior to the main row. Hingement of the valves consists of three elements. The longest, or anterior element, consists of a flange in the right valve which fits a corresponding groove below a flange of the left valve; the central element consists of a flange in the left valve which fits a groove in the right valve; and the shortest, or posterior element, consists of a simple short flange of the left valve which overlaps a corresponding flange of the right valve. Males are slightly narrower at the anterior end and not as truncate at the posterior as the females.

Dimensions. - Hypotype no. 5970, a female carapace from the Cocoa sand member at locality 1: length 0.81 mm., height

0.31 mm., thickness 0.30 mm. Hypotype no. 5973, a male carapace: length 0.80 mm., height 0.29 mm. Hypotype no. 5971, a female left valve: length 0.86 mm., height 0.31 mm. Hypotype no. 5972, a male right valve: length 0.81 mm., height 0.30 mm. All hypotypes are from the Cocoa sand member at locality 1.

Comparisons. - The herein described species is related to Hemicytherideis curvata (Bosquet) in Keij, 1957, from the Miocene of the Aquitaine Basin in France. In C. papula, however, the dorsal margin is less strongly arched, and the ornamentation near the anterior margin differs considerably from H. curvata.

Occurrence. - Occurs in the Cocoa sand member at localities 1 and 6; the North Creek clay member at localities 1, 2, and 4; very rarely in the Moodys Branch formation at locality 16; and very rarely in Pachuta marl member at locality 6.

Cushmanidea serangodes Krutak, 1960
Pl. X., figs. 1-6

Cushmanidea serangodes Krutak, 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.), Louisiana State University.

Diagnosis. - Carapace heavy, elongate-subreniform. Surface covered with widely spaced coarse pits. Anterior and posterior margins obliquely rounded and subequal. Dorsal margin

arched; ventral margin concave.

Description. - Carapace heavy, elongate-subreniform in side view. Dorsal margin arched; ventral margin concave. Anterior and posterior margins obliquely rounded, subequal. Greatest thickness posterior to center. Surface of the valves covered with deep large pits widely spaced.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous at the anterior margin and occur in bundles of two or more. The line of concrescence nearly coincides with the inner margin except at the anterior extremity where it swings outward for a short distance toward the outer margin. Muscle scar pattern consists of a vertical row of four small scars with a heart-shaped scar, and another scar below, anterior to them. Another spot is visible near the eye region. Hinge-ment of the valves consists of three elements. The longest, or anterior element, consists of a flange in the right valve which fits a corresponding groove below a flange of the left valve; a central element consists of a flange of the left valve which fits a groove in the right valve; and a short posterior element consists of a simple flange of the left valve which overlaps a flange of the right valve. Selvage very strong. Males are less truncate and swollen at the posterior than females.

Dimensions. - Hypotype no. 5975, a female left valve from

the Cocoa sand member at locality 1: length 0.67 mm., height 0.29 mm. Hypotype no. 5974, a male right valve: length 0.66 mm., height 0.24 mm. Hypotype no. 5976, a male right valve: length 0.60 mm., height 0.23 mm. Hypotype no. 5977, a male right valve: length 0.57 mm., height 0.24 mm. Hypotype no. 5978, a male left valve: length 0.63 mm., height 0.26 mm. Hypotype no. 5979, a young female left valve: length 0.57 mm., height 0.24 mm.

Comparisons. - This species can be distinguished from the other species of this genus by its coarse pits with moderately wide spacing and its subequal anterior and posterior margins.

Occurrence. - Occurs in the Cocoa sand member at localities 1 and 6; very rare in the North Creek clay member at locality 2.

Cushmanidea moodysbranchensis n. sp.
Pl. X., figs. 7-11

Diagnosis. - Carapace heavy and large for the genus. Surface smooth. Dorsal margin gently arched; ventral margin concave. Posterior slopes steeply between rounded postero-dorsal and postero-ventral margins.

Description. - Carapace large, heavy, and elongate-subovate in side view. Dorsal margin gently arched; ventral margin concave. Anterior margin broadly and obliquely rounded;

posterior margin slopes steeply between the broadly rounded postero-dorsal margin and the narrowly rounded postero-ventral margin. Greatest height slightly anterior to center; greatest thickness near the posterior end. Surface of the carapace smooth with normal pore canals visible near the ventral margin.

On the inside, the valves are deep with broad marginal areas. Radial pore canals numerous, straight, and occur in bundles of two or more. The line of concrescence coincides with the inner margin except at the anterior extremity where it swings outward for a short distance toward the outer margin. Muscle scar pattern consists of a vertical row of four scars with a V-shaped scar, and another scar below, anterior to them. There is another scar below the main group near the ventral margin, and a large scar near the eye region. Hingement of the valves consists of three elements. The anterior element consists of a flange in the right valve which fits a corresponding groove beneath a flange in the left valve; the central element consists of a flange in the left valve which fits a groove of the right valve; and the posterior element consists of a flange of the left valve which overlaps a similar flange of the right valve. Selvage strong. Males are more elongate, with a more acute posterior margin than the females.

Dimensions. - Holotype no. 5980, a female left valve from

the Moodys Branch formation at locality 8: length 0.80 mm., height 0.37 mm. Paratype no. 5981, a female right valve; length 0.81 mm., height 0.36 mm. Paratype no. 5982, a male right valve: length 0.93 mm., height 0.37 mm. Paratype no. 5983, a male left valve: length 0.91 mm., height 0.37 mm. All paratypes are from the Moodys Branch formation at locality 8.

Comparisons. - The species with nearest affinity to the herein described form is Cytherideis alta Blake, 1950, from the Gosport sand (Claiborne) of Alabama. C. alta is wider at the anterior, less elongate, and the ventral margin appears to be less concave than in C. moodysbranchensis.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; and rarely in the Cocoa sand member at locality 1.

Genus EUCY THERE Brady, 1866

Type Species *Cythere declivis* Norman, 1865

Eucythere lowei Howe, 1936
Pl. X., figs. 12-15

Eucythere lowei Howe, 1936, Jour. Paleontology, vol. 10, pp. 144, 145, figs. 4-6.

Diagnosis. - Surface of the carapace smooth with large normal pore canals. Dorsal margin slants steeply to the subacute posterior. Greatest height at the anterior; greatest thick-

ness at the posterior.

Description. - Carapace subtriangular in outline. Dorsal margin slants steeply downward to the subacute posterior end. Ventral margin slightly concave. Anterior margin broadly and obliquely rounded; greatest height at the anterior cardinal angle; greatest thickness near the posterior end. Carapace smooth with a few large round pore canals. Left valve overlaps the right valve at the anterior cardinal angle.

On the inside, the valves are moderately deep with broad marginal areas which increase in breadth from the posterior to the anterior margins. Radial pore canals few and widely spaced. The line of concrescence lies near the inner margin except at the anterior extremity where it swings outward to a point approximately midway between the inner and outer margins. Muscle scar pattern consists of an oblique row of four small scars with a large crescent-shaped scar anterior to them. Hinge of the right valve consists of a small projection at each cardinal angle between which is a groove. Hinge of the left valve consists of a narrow depression at each cardinal angle with an elongate sharp bar between them. Dimorphism not determined.

Dimensions. - Hypotype no. 5984, a carapace from the North Creek clay member at locality 9: length 0.43 mm., height 0.27 mm. Hypotype no. 5985, a left valve from the same

locality: length 0.43 mm., height 0.26 mm.

Comparisons. - The foregoing described forms are identical to the holotype. This species is easily distinguished from the other species of the genus by the smooth, steep slope of the dorsal margin and the wide normal pore canals which appear at the surface.

Occurrence. - Occurs very rarely in the Moodys Branch formation at locality 15: North Creek clay member at localities 2, 4, and 9; rarely in the Pachuta marl member at locality 3; in the upper facies of the Yazoo clay formation at locality 11; and very rarely in the Shubuta clay member at locality 6.

Remarks. - The left valve on cotype slide 1111, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Eucythere sp. A.
Pl. X., figs. 16, 17

Remarks. - Only one carapace of this species was found in the Pachuta marl member at locality 3. It is similar to E. woodwardensis Howe, 1936, from the Vicksburg (Oligocene) group. Internal features are not observable, however, so an accurate comparison cannot be made. Dimensions of figured specimen no. 5986: length 0.61 mm., height 0.39 mm.

Eucythere sp. B.
Pl. X., figs. 18, 19

Remarks. - Only one carapace of this species was found in the Pachuta marl member at locality 3. It resembles E. brownstownensis Alexander, 1936, from the Midway (Eocene) of Texas but can be distinguished from that species by its larger size and more produced posterior end. Dimensions of figured specimen no. 5987: length 0.66 mm., height 0.37 mm.

Eucythere sp. C.
Pl. X., figs. 20, 21

Remarks. - Only two right valves of this species were found in the middle Shubuta clay member at locality 6. It is related to E. chickasawhayana Howe, 1936, but differs slightly in having a smooth surface and a slightly concave ventral margin. Dimensions of figured specimen no. 5988: length 0.61 mm., height 0.36 mm.

Eucythere sp. D.
Pl. X., fig. 22

Remarks. - Only one right valve of this species was found in the Cocoa sand member at locality 1. This form superficially resembles E. triangulata Puri, 1953, from the Arca facies (Miocene) of Florida but comparison with the type reveals that it is much smaller and shows further differences in outline of the carapace. Dimensions of figured specimen no. 5989: length 0.59 mm., height 0.30 mm.

Eucythere sp. E.
Pl. X., fig. 23

Remarks. - Only one valve of this species was found in the upper marl member of the Moodys Branch formation at locality 16. The large size of the carapace, the delicate and distinctive ornamentation of the surface, distinguish this form from others of the genus. Dimensions of figured specimen no. 5990: length 0.76 mm., height 0.47 mm.

Genus KRITHE Brady, Crosskey, and Robertson, 1874

Type Species *Cythere (Cytherideis) bartonensis* Jones, 1857

Krithe hiwanneensis Howe and Lea, 1936
Pl. X., figs. 24-26

Krithe hiwanneensis Howe and Lea, in Howe and Law, 1936,
La Dept. Cons. Geol. Bull. 7, p. 72, pl. 5, figs. 32-34.

Krithe hiwanneensis Howe and Lea, in van den Bold, 1946,
Utrecht University, J. H. DeBussy, Amsterdam, p. 76, pl. 4,
fig. 20.

Diagnosis. - Surface of the carapace smooth and transparent. Subcircular in end view with a V-shaped depression slightly above the middle.

Description. - Carapace elongate-ovate in outline. Dorsal margin gently arched to straight; ventral margin straight, subparallel to dorsal margin. Anterior margin broadly and obliquely rounded; posterior margin subtruncate. Subcircular in posterior view with a V-shaped depression slightly

above the middle. Carapace smooth and transparent with a few normal pore canals.

On the inside, the valves are deep with broad marginal areas, especially at the anterior. Radial pore canals few and widely spaced. The line of concrescence coincides with the inner margin except at the anterior where it swings toward the outer margin and forms a large mushroom-shaped loop. Muscle scars consist of a vertical row of four elongate-ovate scars with two scars slightly anterior to them. Hingement consists of a short flange in the right valve which fits a corresponding groove of the left valve. Males are more elongate and less dorsally arched than females.

Dimensions. - Hypotype no. 5991, a female right valve from the Shubuta clay member at locality 5: length 0.67 mm., height 0.33 mm. Hypotype no. 5992, a male left valve from the same locality: length 0.67 mm., height 0.30 mm.

Comparisons. - The hypotypes have a slightly less prominent V-shaped depression at the posterior than the holotype.

Occurrence. - Occurs rarely in the Pachuta marl member at locality 2; and commonly in the Shubuta clay member at localities 5 and 6.

Family HEMICYTHERIDAE Puri, 1953

Genus HEMICYTHERE Sars, 1925

Type Species *Cythere villosa* Sars, 1865

Hemicythere bellula Howe, 1951
Pl. XI., figs. 1-4

Hemicythere bellula Howe, 1951, Fla. Geol. Surv. Bull. 34,
pp. 14-15, pl. 3, figs. 12-14.

Diagnosis. - Dorsal margin slightly arched; ventral margin slightly concave. Surface ornamented with coarse reticulations which radiate out from the subcentral tubercle and become coarser near the anterior and posterior margins.

Description. - Carapace subovate in outline. Dorsal margin slightly arched; ventral margin slightly concave. Anterior margin broadly and obliquely rounded with a small raised rim which is minutely denticulate. Posterior margin concave in the dorsal part, narrowly rounded in the ventral part. Surface coarsely reticulated with the reticulations radiating from the subcentral tubercle and becoming coarser near the anterior and posterior margins. Sculpturing consists of a small dorsal ridge just below the posterior cardinal angle and a ventral ridge just across the ventral slope of each valve.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, short, and closely spaced. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of four scars in a slightly arcuate row on the poste-

rior edge of the muscle pit with two scars slightly anterior to them within the pit. Two additional scars, directed obliquely forward and downward, are anterior to the main group. Hinge of the right valve consists of a smooth, round anterior tooth and a postjacent socket connected by a smooth groove to a flat, dorsally incurved, posterior tooth. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Hypotype no. 5993, a complete carapace from the Moodys Branch formation at locality 8: length 0.61 mm., height 0.37 mm. Hypotype no. 5994, a complete carapace: length 0.60 mm., height 0.39 mm. Hypotype no. 5995, a right valve: length 0.60 mm., height 0.37 mm. All specimens are from the Moodys Branch formation at locality 8.

Comparisons. - The hypotypes are essentially identical to the holotype. This species can be distinguished from the others of the genus by the character of the surface reticulations.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15.

Hemicythere reedi n. sp.
Pl. XI., figs. 5-9

Diagnosis. - Carapace elongate-subovate in outline with weakly developed dorsal and ventral ridges. Each ridge ends

with a small blunt projection near the posterior. Surface reticulate.

Description. - Carapace elongate-subovate in outline. Dorsal margin slightly arched; ventral margin slightly concave. Anterior margin broadly and obliquely rounded with a raised rim. Posterior margin slightly concave in the dorsal part and rounded in the ventral part. Greatest height at the anterior cardinal angle; greatest thickness near the center. Surface of the valves reticulate. Dorsal and ventral ridges weakly developed and each terminates with a small blunt projection approximately one-fifth the distance from the posterior end. Normal pore canals occasionally visible near the ventral margin.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, sometimes branched, and closely spaced. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of an arcuate row of four scars on the posterior edge of the muscle pit with two scars just anterior to them within the pit. There are two scars directed obliquely forward and downward anterior to the latter, and two scars just above the main group. Hinge of the right valve consists of a small, round anterior tooth and a postjacent socket connected by a smooth groove to a blunt, round posterior tooth. Hinge of the left valve complementary.

Dimorphism not determined with certainty but the slightly more elongate forms may be the males.

Dimensions. - Holotype no. 5996, a female right valve from the Moodys Branch formation at locality 15: length 0.64 mm., height 0.37 mm. Paratype no. 5998, a female right valve from the North Creek clay member at locality 9: length 0.60 mm., height 0.34 mm. Paratype no. 5999, a female left valve from the same locality: length 0.60 mm., height 0.35 mm. Paratype no. 5997, a male right valve from the same locality: length 0.61 mm., height 0.33 mm.

Comparisons. - This species differs from H. bellula in surface ornamentation and the nature of the dorsal and ventral ridges.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; North Creek clay member at locality 9.

Remarks. - Specimens of this species are larger and better developed in the Moodys Branch formation than in the clays of the North Creek member.

Genus TROPIDOCYTHERE n. gen.

Type Species *Tropidocythere tricostata* n. sp.
Pl. XVII., figs. 19-26

Description of genus. - Carapace subovate to subquadrate in outline. Surface reticulate, pitted, or smooth. Sur-

face sculpturing consists essentially of longitudinally arranged dorsal and median ridges which are joined near the posterior cardinal angle, and a strongly developed ventral ridge which is subparallel to venter. Small transverse connective ridges may also be present. Muscle scar pattern generally consists of a vertical row of four units with two elongate scars comprising the lower two, and two pairs of small round scars comprising the upper two. There are two round scars, directed obliquely forward and downward, anterior to the main group. Splitting may cause a variable pattern in the main group. Hingement holamphidont.

Dimensions. - Adult specimens range: length 0.57 mm. to 0.60 mm., height 0.29 mm. to 0.36 mm.

Comparisons and Remarks. - This genus resembles *Hemicythere* Sars, 1925, in outline of the carapace and hingement but differs considerably in surface sculpturing and differs slightly in muscle scar arrangement. On the other hand, it is similar to *Trachyleberidea* Bowen, 1953, in surface sculpturing but differs considerably in carapace outline and hingement. It is assigned to the Hemicytheridae family primarily because of the carapace shape but also because the muscle scar pattern shows a relationship to that family.

Tropidocythere tricostata n. sp.
Pl. XVII, figs. 19-26

Description. - Carapace subovate in side view. Dorsal margin slightly arched; ventral margin straight to slightly sinuate. Anterior margin broadly rounded with numerous minute denticles below a raised rim. Posterior margin compressed, straight to slightly concave in the dorsal half, rounded with a few blunt spines in the ventral half. Left valve overlaps the right valve at the anterior cardinal angle. Surface of the carapace sculptured as follows: A dorsal ridge arches back irregularly from a point below the center of the dorsal margin to a point near the posterior cardinal angle. From there it curves back to the subcentral tubercle. A well developed ventral ridge parallels the ventral margin from near the antero-ventral margin to a point near the compressed posterior marginal region. Small connective ridges extend obliquely across the space between the larger longitudinal ridges. Normal pore canals are scattered over the carapace.

On the inside, the valves are shallow with moderately broad marginal areas. Radial pore canals numerous, simple, and closely spaced. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four units, with two elongate, irregularly-shaped scars comprising the lower two, and two pairs of small round scars comprising the upper two. There are two scars, directed obliquely forward and downward, anterior to the main row. Two additional scars are above

the main group. Hinge of the right valve consists of a high, pointed anterior tooth and a postjacent socket connected by a smooth groove to a blunt, rounded posterior tooth. Hinge of the left valve complementary. Males are slightly more elongate than females.

Dimensions. - Holotype no. 6000, a female carapace from the Moodys Branch formation at locality 8: length 0.59 mm., height 0.31 mm., thickness 0.30 mm. Paratype no. 6001, a female right valve: length 0.59 mm., height 0.31 mm. Paratype no. 6002, a female left valve: length 0.57 mm., height 0.31 mm. Paratype no. 6003, a female right valve: length 0.57 mm., height 0.31 mm. Paratype no. 6004, a female left valve: length 0.60 mm., height 0.36 mm. Paratype no. 6005, a male right valve: length 0.59 mm., height 0.29 mm. Paratype no. 6006, a female left valve: length 0.57 mm., height 0.31 mm. All paratypes are from the same locality as the holotype.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; rarely in the North Creek clay member at locality 9; and the Cocoa sand member at localities 1 and 6.

Family LOXOCONCHIDAE Sars, 1926

Genus CYTHEROMORPHA Hirschmann, 1909

Type Species *Cythere fuscata* Brady, 1869

Cytheromorpha ouachitaensis Howe and Chambers, 1935
Pl. XI., figs. 10-13

Cytheromorpha ouachitaensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 44, 45, pl. 5, fig. 8; pl. 6, figs. 4, 5.

Cytheromorpha ouachitaensis Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 109, pl. 11, fig. 19.

Diagnosis. - Surface of the carapace ornamented by a sub-reticulate network of pits which are aligned in rows subparallel to the margins.

Description. - Carapace elongate-ovate in outline. Dorsal and ventral margins straight and converge slightly toward the posterior. Anterior margin broadly and evenly rounded with a small rim. Antero-ventral margin extends slightly below the line of the ventral margin. Posterior margin narrowly rounded. Surface of the carapace ornamented by a subreticulate network of pits aligned in rows subparallel to the margins.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals few, straight, and widely spaced. The line of concrescence is indented, and it lies approximately midway between the inner and outer margins. Muscle scars consist of a pattern of four small scars in a vertical row with one round scar anterior to them. Hinge of the right valve consists of a small, round anterior tooth surrounded by a horseshoe-shaped socket which is connected by a groove to a posterior socket with a small tooth on each side. Hinge of the left valve complementary.

Males are more elongate than females.

Dimensions. - Hypotype no. 6007, a male carapace from the Yazoo clay formation at locality 11: length 0.51 mm., height 0.23 mm. Hypotype no. 6008, a female right valve from the same locality: length 0.46 mm., height 0.24 mm.

Comparisons. - Comparison with the holotype indicates that these specimens belong to the species C. ouachitaensis. The character of the surface ornamentation distinguishes this species from others of the genus.

Occurrence. - Occurs rarely in the lower facies of the Yazoo clay formation at locality 18; commonly in the upper facies at localities 11 and 14; rarely in the Cocoa sand member at locality 1; and very rarely in the Pachuta marl member at localities 3 and 6.

Remarks. - The carapace on cotype slide no. 1140, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Cytheromorpha calva Krutak, 1960
Pl. XI., figs. 14-18

Cytheromorpha calva Krutak, 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.)
Louisiana State University.

Diagnosis. - Surface of the carapace smooth and transparent. Dorsal and ventral margins straight and converge slightly

toward the posterior end. Anterior end broadly and evenly rounded with a small rim. The antero-ventral margin extends slightly below the line of the ventral margin. Posterior end narrowly rounded in the ventral part and slightly concave in the dorsal part. Surface of the carapace smooth. In some specimens a few papillae are present on the inflated portion of the carapace.

On the inside, the valves are moderately deep with moderately broad marginal areas. Radial pore canals few, short, and widely spaced. The line of concrescence is indented and lies approximately midway between the inner and outer margins. Muscle scars consist of a slightly oblique row of four elongate scars with one scar anterior to them. Hinge of the right valve consists of a small, round anterior tooth surrounded by a horseshoe-shaped socket which is connected by a groove to a posterior socket with a small tooth on each side. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6009, a male carapace from the North Creek clay member at locality 2: length 0.57 mm., height 0.24 mm. Hypotype 6010, a female right valve: length 0.47 mm., height 0.24 mm. Hypotype no. 6011, a female left valve: length 0.47 mm., height 0.23 mm. All hypotypes are from the North Creek clay member.

Comparisons. - This species can be distinguished from the

other species of the genus by its smooth and transparent surface.

Occurrence. - Occurs in the North Creek clay member at localities 1, 2, 4, 7, and 9; Cocoa sand member at localities 1 and 6; the lower facies of the Yazoo clay formation at localities 12, 13, 17, 18, 19, and 20; and very rarely in the Moodys Branch formation at locality 8.

Cytheromorpha choctawensis n. sp.
Pl. XI., figs. 19-23

Diagnosis. - Surface uneven and covered with a network of delicate reticulations. A small round ridge extends across the centro-ventral region of the valve and ends abruptly in the posterior third of the valve.

Description. - Carapace elongate-ovate in outline. Dorsal margin straight; ventral margin slightly concave. Both margins converge toward the posterior. Anterior margin broadly and evenly rounded; posterior margin narrowly rounded. Surface uneven and covered by an irregular pattern of delicate reticulations. A raised, rounded ridge extends obliquely across the centro-ventral region and ends abruptly approximately one third the distance from the posterior end.

On the inside, the valves are moderately deep with relatively narrow marginal areas. Radial pore canals few, short, and widely spaced. The line of concrescence lies

approximately midway between the inner and outer margins. An acute carina near the edge of the inner margin of the right valve fits a corresponding lip line of the left valve. Muscle scar pattern consists of four elongate scars in a vertical row with one scar anterior to them. Hinge of the right valve consists of a small, round anterior tooth surrounded by a socket which is connected by a smooth groove to a small posterior socket with a small tooth on each side. Hinge of the left valve consists of a small, round anterior socket with a tooth on each side connected by the edge of the dorsal margin to a horseshoe-shaped posterior socket which surrounds a small tooth. Males are more elongate than females.

Dimensions. - Holotype no. 6012, a male left valve from the North Creek clay member at locality 1: length 0.44 mm., height 0.21 mm. Paratype no. 6014, a female right valve: length 0.36 mm., height 0.21 mm. Paratype no. 6013, a male right valve: length 0.44 mm., height 0.23 mm. Paratype no. 6015, a young male carapace: length 0.41 mm., height 0.21 mm. All paratypes are from the same locality as the holotype.

Comparisons. - The surface sculpturing easily distinguishes this species from others of the genus.

Occurrence. - Occurs in the North Creek clay member at

localities 1 and 2; rarely in the Cocoa sand member at localities 1 and 6; and very rarely in the Pachuta marl member at locality 6.

Genus LOXOCONCHA Sars, 1865

Type Species *Cythere rhomboidea* Fischer, 1855

Loxoconcha creolensis Howe and Chambers, 1935
Pl. XI., figs. 24-26

Loxoconcha creolensis Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, pp. 40, 41, pl. 5, fig. 13.

Diagnosis. - Carapace small, ovate, and ornamented with longitudinal rows of coarse pits. Dorsal and ventral margins slightly convex. A weakly developed ala projects downward at the ventral margin.

Description. - Carapace small, ovate in side view. Dorsal and ventral margins slightly convex. Anterior margin broadly and obliquely rounded; posterior margin narrowly rounded with a slight caudal process. Greatest height at the anterior cardinal angle. Surface of the carapace ornamented by coarse pits arranged in longitudinal rows. In the ventral region of the valves there is a small, weakly developed ala which projects slightly below the ventral margin.

On the inside, the valves are moderately deep with fairly broad marginal areas. Radial pore canals few and straight. The line of concrescence lies between the inner

and outer margins at the anterior extremity. Muscle scars consist of a slightly arcuate to vertical row of four scars with a single reniform scar anterior to them. Hinge of the right valve consists of a small, pointed anterior tooth surrounded by a socket which is connected by a groove to a small posterior socket with a tooth on each side. Hinge of the left valve complementary. Dimorphism not determined.

Dimension. - Hypotype no. 6016, a carapace from the Moodys Branch formation at locality 15: length 0.34 mm., height 0.23 mm.

Comparisons. - The hypotype is identical to the holotype. It is distinguishable from other species of the genus essentially by the longitudinal rows of coarse pits on the surface and by its small size. The dorsal margin is slightly more convex than in other species in the Jackson material.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; the North Creek clay member at localities 1, 2, and 4; the Cocoa sand member at localities 1 and 6; very rare in the Pachuta marl member at locality 3; and the Shubuta clay member at locality 6.

Loxoconcha cocoaensis Krutak, 1960
Pl. XI., figs. 27-30

Loxoconcha cocoaensis Krutak, 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.) Louisiana State University.

Diagnosis. - Dorsal margin obscured by a small arched ala which projects above the edge. Ventral margin also obscured by a convex ala which extends obliquely across the centro-ventral region of the valves. Central region of the valves ornamented by rows of moderately coarse pits.

Description. - Carapace small, elongate-subovate in outline. Dorsal margin straight and obscured by a small arched ala which projects above the edge. Ventral margin slightly convex and partially obscured by a convex ala which extends obliquely across the centro-ventral region of the carapace. Anterior margin broadly and evenly rounded; posterior margin produced into a short caudal process. The central region of the carapace is covered by moderately coarse pits which have a tendency to align in longitudinal rows.

On the inside, the valves are moderately deep with relatively broad marginal areas. Radial pore canals few, straight, and widely spaced. The line of concrescence lies between the inner and outer margins. Muscle scars consist of four scars in a slightly arcuate row with one scar anterior to them. Hinge of the right valve consists of a small anterior tooth surrounded by a horseshoe-shaped socket which is connected by a slightly crenulated groove to a small posterior tooth which is curved around a socket. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Hypotype no. 6017, a left valve from the North Creek clay member at locality 4: length 0.41 mm., height 0.24 mm. Hypotype no. 6018, a right valve: length 0.40 mm., height 0.23 mm. Hypotype no. 6019, a right valve: length 0.40 mm., height 0.23 mm.

Comparisons. - This species is easily distinguished by the projecting dorsal and ventral alae and by the pitted surface.

Occurrence. - Occurs in the North Creek clay member at localities 2, 4, 7, and 9; Cocoa sand member at localities 1 and 6; rarely in the lower facies of the Yazoo clay formation at locality 18.

Loxoconcha stavensis Blake, 1950
Pl. XI., figs. 31-32

Loxoconcha stavensis Blake, 1950, Jour. Paleontology, vol. 24, p. 182, pl. 30, figs. 10-12.

Diagnosis. - Dorsal margin straight; ventral margin convex. A small ala projects from the ventral region of the carapace. Surface ornamented by an irregular arrangement of coarse pits.

Description. - Carapace small, subovate in outline. Dorsal margin straight to slightly convex; ventral margin slightly convex. Anterior margin broadly and evenly rounded; posterior margin compressed and produced into a short caudal

process. Surface of the carapace ornamented by coarse pits irregularly arranged. A small ala projects from the inflated postero-ventral part of the carapace.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals few and widely spaced. The line of concrescence lies between the inner and the outer margins. Muscle scars consist of a vertical row of four oval-shaped scars with a single scar anterior to them. Hinge of the right valve consists of a small, round anterior tooth surrounded by a horseshoe-shaped socket which is connected by a slightly crenulated groove to a horseshoe-shaped posterior tooth which surrounds a small socket. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6021, a female right valve from the Moodys Branch formation at locality 15: length 0.44 mm., height 0.26 mm. Hypotype no. 6022, a female left valve from the same locality: length 0.44 mm., height 0.26 mm.

Comparisons. - The hypotypes are identical to Blake's syntypes deposited in the Henry V. Howe Collection, Louisiana State University. This species is distinguished from others of the genus by its irregular arrangement of coarse pits on the surface. The ventral ala is also better developed than in most other species of the genus.

Occurrence. - Occurs rarely in the Modys Branch formation at locality 15. Previously described by Blake, 1950, from the Gosport sand (Claiborne) of Alabama.

Loxoconcha lenioformis n. sp.
Pl. XI., figs. 33-35

Diagnosis. - Dorsal margin straight; ventral margin convex. Surface of the carapace smooth and transparent.

Description. - Carapace small, subovate in outline. Dorsal margin straight; ventral margin convex. Anterior margin broad and evenly rounded; posterior margin produced into a short caudal process. Surface of the carapace smooth and transparent.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals few and widely spaced. The line of concrescence lies between the inner and the outer margins. Muscle scar pattern somewhat obscure but appears to be four scars in a vertical row with one small scar anterior to them. Hinge of the right valve consists of a small, round anterior tooth surrounded by a horseshoe-shaped socket which is connected by a slightly crenulated groove to a small, thin posterior tooth which is curved around a small socket. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Holotype no. 6023, a complete carapace from

the North Creek clay member at locality 2: length 0.44 mm., height 0.27 mm. Paratype no. 6024, a left valve from the same locality: length 0.44 mm., height 0.29 mm.

Comparisons. - This species is distinguished from the other species of the genus by its smooth transparent surface.

Occurrence. - Occurs in the North Creek clay member at localities 2, 4, 7, and 9; the Cocoa sand member at locality 6.

Loxoconcha jacksonensis Howe and Chambers, 1935
Pl. XI., figs. 36-37

Loxoconcha jacksonensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 41, 42, pl. 4, fig. 20; pl. 5, fig. 14; pl. 6, figs. 8, 9.

Loxoconcha jacksonensis Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 109, pl. 11, fig. 18.

Diagnosis. - Dorsal margin straight; ventral margin convex. Surface ornamented by numerous small pits aligned parallel to the margins. Posterior has a distinctive caudal process.

Description. - Carapace small, subovate in outline. Dorsal margin straight; ventral margin convex. Anterior margin broadly and evenly rounded; posterior margin produced into a short caudal process. Surface of the carapace ornamented by numerous small pits arranged in rows parallel to

the margins. There is a weakly developed ala near the ventral part of the carapace.

On the inside, the valves are moderately deep with moderately broad marginal areas. Radial pore canals few, straight, and widely spaced. The line of concrescence lies well between the inner and outer margins at the anterior extremity and lies very near the inner margin at the posterior. Muscle scar pattern consists of a vertical to slightly arcuate row of four oval-shaped scars with a single crescent-shaped scar anterior to them. The hinge of the right valve consists of a small, rounded anterior tooth surrounded by a horseshoe-shaped socket which is connected by a narrow, slightly crenulated groove to a posterior tooth which is curved around a socket. Hinge of the left valve complementary. Males are slightly more elongate than females.

Dimensions. - Hypotype no. 6025, a female carapace from the lower facies of the Yazoo clay formation at locality 18: length 0.50 mm., height 0.30 mm.

Comparisons. - The hypotype is identical to the holotype. It differs from other species of the genus by the rows of fine pits aligned parallel to the margins.

Occurrence. - Occurs commonly in all stratigraphic horizons and all locations of the Jackson group in Mississippi

except that it is very rare in the Pachuta marl member at locality 3.

Family TRACHYLEBERIDAE Sylvester-Bradley, 1943

Genus ACTINOCYTHEREIS Puri, 1953

Actinocythereis gibsonensis (Howe and Chambers), 1935
Pl. XII, figs. 1-4

Cythereis gibsonensis Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, p. 29, pl. 1, fig. 22, pl. 6, figs.
21, 22.

Cythereis gibsonensis Howe and Chambers, in Bergquist, 1942,
Miss. Geol. Surv. Bull. 49, p. 109, pl. 11, figs. 9, 10.

Actinocythereis gibsonensis (Howe and Chambers), in Puri,
1953, Am. Mid. Naturalist, vol. 49, p. 182, pl. 2, figs.
11, 12.

Diagnosis. - Surface ornamentation consists of two rows of vertically tapering spines. A median arcuate row of four spines begins in the anterior region and arches back toward the posterior cardinal angle. A ventral row of five spines begins near the antero-ventral margin and parallels the median row to the posterior region.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight with four or five sharp spines projecting above the edge. Ventral margin straight to slightly sinuate. Both margins gently converge toward the posterior. Anterior margin broadly and obliquely rounded and fringed with a double row of denticles. A low blade-like rim be-

gins at the eye tubercle and parallels the anterior margin to approximately halfway the center where it is followed by sharp vertical spines in the ventral half. Posterior margin pointed and subtriangular with small spines in the dorsal half and larger spines in the ventral half. Surface ornamented by two longitudinal rows of vertically tapering spines. A median arcuate row of four spines begins in the anterior region and arches back toward the posterior cardinal angle. A ventral row of five spines begins near the antero-ventral margin and parallels the median row to the posterior region.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous, in some cases bifurcating, and occur in bundles of two or more. The line of concrescence nearly coincides with the inner margin except at the anterior where it swings outward to a point approximately midway between the inner and outer margins. Muscle scars consist of a vertical row of four oval-shaped scars with two scars anterior to them. Selvage strong. Hinge of the right valve consists of a high, smooth, rounded anterior tooth and a postjacent socket connected by a smooth groove to a smooth, rounded posterior tooth.

Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6026, a female right valve from

the Cocoa sand member at locality 6: length 0.67 mm., height 0.36 mm. Hypotype no. 6027, a female left valve; length 0.71 mm., height 0.40 mm. Hypotype no. 6028, a male left valve: length 0.79 mm., height 0.39 mm. All hypotypes are from the Cocoa sand member at locality 6.

Comparisons. - The hypotypes are identical to the holotype of the species. This species differs from A. exanthemata (Ulrich and Bassler) 1904, by the character of the spines on the surface and the shape of the posterior margin.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; North Creek clay member at localities 1, 2, 4, 7, 9, and 10; Cocoa sand member at localities 1 and 6; and the lower facies of the Yazoo clay formation at localities 17, 19, and 20; the upper facies of the Yazoo clay formation at localities 11 and 14; and rarely in the Pachuta marl member at locality 3.

Remarks. - The left valve on cotype slide no. 807, Henry V. Howe Collection, Louisiana State University, is designated as holotype.

Actinocythereis grigsbyi (Howe and Chambers), 1935
Pl. XII., figs. 5-7

Cythereis grigsbyi Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 30, 31, pl. 1, figs. 17, 18; pl. 2, fig. 20; pl. 6, fig. 6.

Diagnosis. - Surface ornamentation consists of two rows of large rounded nodes. A median row begins in the anterior region and extends back toward the posterior cardinal angle. The two anterior nodes of this row are separated from the others by a shallow arcuate depression. The ventral row, with the nodes slightly elongated normal to the long axis, begins near the antero-ventral margin and parallels the median row to the posterior region.

Description. - Carapace heavy, elongate-ovate in outline. Dorsal margin straight with five or six blunt spines projecting above the edge. Ventral margin straight in the left valve and sinuate in the right valve. Both margins converge slightly toward the posterior. Anterior margin broadly and obliquely rounded with a thick rim which is fringed with a double row of denticles. A blade-like rim begins at the eye tubercle and parallels the anterior margin to approximately the center where it is followed by small blunt spines in the ventral half. Posterior margin rounded with a double row of short blunt spines. Greatest height at the anterior cardinal angle. Surface of the carapace ornamented by two longitudinal rows of elongate nodes. A median row begins near the anterior margin and extends back in the general direction of the posterior cardinal angle. The two anterior nodes of this row are separated from the others by a shallow arcuate depression. A ventral row, with the nodes elongated normal to the

long axis, begins near the antero-ventral margin and parallels the median row to the posterior region.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, straight, and occur in bundles of two or more. The line of concrescence nearly coincides with the inner margin except at the anterior where it swings outward to a point approximately midway between the inner and outer margins. Muscle scars consist of a vertical row of four small scars with two scars anterior to them. Selvage strong with several lip-lines present on the anterior margin. Hinge of the right valve consists of a high, rounded anterior tooth and a post-jacent socket connected by a narrow groove to a rounded posterior tooth. Males are more elongate than females and their dorsal and ventral margins show less convergence toward the posterior.

Dimensions. - Hypotype no. 6030, a female left valve from the Cocoa sand member at locality 1: length 0.71 mm., height 0.43 mm. Hypotype no. 6029, a male right valve from the same locality: length 0.71 mm., height 0.39 mm.

Comparisons. - Comparison with the holotype indicates that the described forms are A. gibsonensis. The vertically elongate nodes of the ventral row and the subcentral arcuate depression on the surface of the valves distinguish this species from others of the genus.

Occurrence. - Occurs in the Cocoa sand member at localities 1 and 6; and the lower facies of the Yazoo clay formation at localities 17, 19, and 20.

Remarks. - The right valve on cotype slide no. 810, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of the species. This species is assigned to the genus *Actinocytheris* because of the distinct alignment of the nodes on the surface.

Actinocytheris purii n. sp.
Pl. XII., figs. 8-11

Diagnosis. - Surface of the valves ornamented by two longitudinal rows of large rounded nodes. A median row, with a large anterior node and two smaller nodes, extends across the central region. A ventral row, with four or five smaller nodes, begins near the antero-ventral margin and parallels the median row to the posterior region. There are one or two nodes between the main rows.

Description. - Carapace heavy, elongate-subovate in side view. Dorsal margin straight with a row of four or five sharp spines projecting above the edge. Ventral margin slightly convex to sinuate. Anterior margin broadly and obliquely rounded with a thick rim which is fringed with a double row of denticles. A small round vertical rim begins at the eye tubercle and parallels the anterior margin for a

short distance with small blunt spines continuing on around the margin. Posterior end pointed, straight in the dorsal part, rounded in the ventral part with several short blunt spines. Greatest height at the anterior cardinal angle. Surface of the valves ornamented by two rows of large round nodes. A median row with a large anterior node and two smaller nodes extends across the central region. A ventral row of four to five smaller nodes begins near the antero-ventral margin and parallels the median row to the posterior region. One, and in some cases, two nodes occur between the main rows.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous and occur in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong with two or three lip-lines visible on the margins of each valve. Muscle scars consist of a vertical row of four small oval-shaped scars on the posterior edge of the muscle pit with two small scars anterior to them. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a strong smooth groove to a large, blunt, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Males have the same characteristics as the females but are more elongate.

Dimensions. - Holotype no. 6031, a female carapace from the

Shubuta clay member at locality 6: length 0.86 mm., height 0.46 mm., thickness 0.43 mm. Paratype no. 6033, a male right valve: length 0.91 mm., height 0.43 mm. Paratype no. 6032, a female left valve: length 0.86 mm., height 0.47 mm. Paratypes are from the same locality as the holotype.

Comparisons. - The size and arrangement of the nodes on the surface of the valves distinguish this species from others of the genus.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; Shubuta clay member at locality 6; and the lower facies of the Yazoo clay formation at localities 12 and 13.

Actinocythereis pachutaensis n. sp.
Pl. XII., figs. 12-16

Diagnosis. - Carapace somewhat compressed with a raised anterior rim. Surface ornamented by two longitudinal rows of nodes. A median row, with a large anterior node and two smaller nodes, extends across the central region. A ventral row, with five small nodes, originates near the antero-ventral margin and parallels the median row to the posterior third of the valves.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight with a row of four or five sharp spines projecting above the edge. Ventral margin straight

to slightly sinuate. Anterior margin broadly and obliquely rounded with a raised rim which is fringed with a double row of denticles. Posterior margin compressed and pointed. It is straight and sloping in the dorsal part and obliquely rounded with several short spines in the ventral part. Greatest height at the anterior cardinal angle. Surface of the carapace ornamented by two longitudinal rows of nodes. A median row, with a large, rounded anterior node and two smaller nodes, extends across the central region. A ventral row, with five small round nodes, begins near the antero-ventral margin and parallels the median row to the posterior third of the valve. There is a small round node between the main rows located just above the second from the anterior node in the ventral row.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous and occur in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong with two or three lip-lines evident on the margins of each valve. Muscle scars consist of a vertical row of four small oval-shaped scars on the posterior edge of the muscle pit with two small scars anterior to them within the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a deep postjacent socket connected by a strong groove to a blunt, round posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Holotype no. 6034, a male carapace from the Pachuta marl member at locality 6: length 0.87 mm., height 0.40 mm. Paratype no. 6035, a female left valve: length 0.77 mm., height 0.40 mm. Paratype no. 6036, a male left valve: length 0.86 mm., height 0.28 mm. Paratype no. 6037, a female right valve: length 0.76 mm., height 0.39 mm. Paratypes are from the same locality as the holotype.

Comparisons. - This species differs from the previously described species by the small closely spaced ventral row of nodes. The valves are also more compressed.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; rarely in the Moodys Branch formation at locality 16; and rarely in the lower facies of the Yazoo clay formation at locality 12.

Actinocythereis nodosa n. sp.
Pl. XII., figs. 17-19; Pl. XIII., figs. 1, 2

Diagnosis. - Surface ornamented by two longitudinal rows of nodes. A median row consists of two large elongate nodes in the central region. A ventral row with five small round nodes, somewhat coalesced, parallels the median row.

Description. - Carapace heavy, elongate-subovate in side view. Dorsal margin straight with four or five short blunt spines projecting above the edge. Ventral margin sinuate. Both margins converge slightly toward the posterior. Anterior

margin broadly and obliquely rounded with a heavy rim which is fringed with a double row of denticles. A row of short vertical spines extends around the anterior from near the eye tubercle to the antero-ventral margin. Posterior margin compressed and pointed. It is straight and sloping in the dorsal part and obliquely rounded with several spines in the ventral part. Surface ornamented by two longitudinal rows of nodes. A median row consists of two large elongate nodes in the central region, and a ventral row, with five small round nodes, somewhat coalesced, parallels the median row.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous and occur in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four small scars on the posterior edge of the muscle pit with two small scars anterior to them within the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a deep postjacent socket connected by a strong groove to a large, blunt, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Holotype no. 6038, a right valve from the Moodys Branch formation at locality 15: length 0.80 mm., height 0.43 mm. Paratype no. 6039, a left valve: length

0.80 mm., height 0.44 mm. Paratype no. 6040, a right valve: length 0.79 mm., height 0.43 mm. Paratype no. 6041, a left valve: length 0.80 mm., height 0.43 mm. All paratypes are from the same locality as the holotype.

Comparisons. - This species slightly resembles Cythereis elmana Stadnichenko, 1927, from the Weches (Claiborne) formation of Texas. They differ in that A. nodosa n. sp. does not possess a rounded ridge near the dorsal margin; the valves are more compressed and the outline of the valves also differs slightly.

Occurrence. - Occurs in the Moodys Branch formation at localities 15 and 16; and very rarely in the lower facies of the Yazoo clay formation at locality 18.

Actinocythereis boldi n. sp.
Pl. XIII., figs. 3-5

Diagnosis. - Surface ornamented by two rows of long, vertically tapering spines. A median row of four spines begins in the anterior region and forms an arc, convex dorsally, across the central region. A ventral row of four spines begins near the antero-ventral margin and nearly converges with the posterior spine of the median row.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight with a row of five sharp swept-back spines projecting above the edge. Ventral margin sinuate

and fringed with a row of short blunt spines. Anterior margin broadly and obliquely rounded and fringed with two rows of denticles. There is a short, vertical, blade-like rim below the eye tubercle which is followed by a vertical row of flat spines on around the margin. Posterior margin compressed and pointed, straight and sloping in the dorsal part, and obliquely rounded with several long, tapering spines in the ventral part. Surface of the valves ornamented by two rows of long, vertically tapering spines. A median row of four spines begins in the anterior region and forms an arc, convex dorsally, across the central region. A ventral row of four spines begins near the antero-ventral margin and nearly converges with the posterior spine of the median row.

On the inside, the valves are shallow with very broad marginal areas. Radial pore canals numerous, long, and occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Muscle scars consist of a pattern of four small scars on the posterior edge of the muscle pit with a U-shaped scar anterior to them within the pit. Hinge of the right valve consists of a small pointed anterior tooth and a postjacent socket connected by a narrow groove to a blunt, rounded, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Holotype no. 6042, a male left valve from the Shubuta clay member at locality 6: length 0.76 mm., height 0.36 mm. Paratype no. 6043, a female right valve from the same locality: length 0.67 mm., height 0.34 mm.

Comparisons. - This species is closely related to Trachyleberis ? davidwhitei (Stadnichenko), 1927, from the Weches (Claiborne) formation of Texas, but comparison with the holotype of T. ? davidwhitei reveals the following differences: The dorsal row of spines on T. ? davidwhitei are coarser; the median row is more prominently arched; the ventral row has five spines instead of four; and the ventral part of the posterior margin does not have the long tapering spines as in A. boldi n. sp.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; North Creek clay member at localities 7 and 9; Cocoa sand member at localities 1 and 6; Pachuta marl member at localities 3 and 6; Shubuta clay member at locality 6; and the lower facies of the Yazoo clay formation at localities 17, 18, 19, and 20.

Remarks. - The swept-back spines along the dorsal margin are delicate, characteristic features of the species, but they occur only in the specimens from the Shubuta clay member in which the microfauna is exceptionally well preserved.

Genus ARCHICYTHEREIS Howe, 1936

Type Species *Cythereis yazooensis* Howe and Chambers, 1935

Archicythereis yazooensis (Howe and Chambers), 1935
Pl. XIII., figs. 6, 7

Cythereis yazooensis Howe and Chambers, 1935, La. Dept. Cons.
Geol. Bull. 5, pp. 38, 39, pl. 1, fig. 6, pl. 4, figs. 29,
30.

Cythereis yazooensis Howe and Chambers, in Bergquist, 1942,
Miss. Geol. Surv. Bull. 49, p. 108, pl. 11, fig. 17.

Diagnosis. - Carapace delicate, smooth and transparent.
Anterior broadly rounded with several flat T-shaped spines
around the border. A small ala with a spine protrudes from
near the ventral margin.

Description. - Carapace delicate, transparent to trans-
lucent, and elongate-subpyriform in outline. Dorsal and
ventral margins straight and converge toward the posterior.
Anterior margin broadly rounded with several flat T-shaped
spines fringing the border. Posterior margin straight and
sloping in the dorsal part, obliquely rounded and spinose
in the ventral part. Greatest height at the anterior car-
dinal angle; greatest thickness slightly posterior to center.
Surface of the carapace smooth. A small ala, tipped with a
spine, protrudes from the centro-ventral region of the valves.

On the inside, the valves are shallow with very narrow
marginal areas. Radial pore canals few and widely spaced.
The line of concrescence coincides with the inner margin.

Muscle scars consist of a vertical row of four scars with a heart-shaped scar anterior to them. Hinge of the right valve consists of a small, slightly crenulated cusp at each of the cardinal angles connected by a narrow groove. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Hypotype no. 6045, a left valve from the Shubuta clay member at locality 6: length 0.77 mm., height 0.44 mm. Hypotype no. 6044, a right valve from the same locality: length 0.70 mm., height 0.34 mm.

Comparisons. - The hypotypes are nearly identical to the holotype.

Occurrence. - Occurs at all localities and stratigraphic horizons of the Jackson group in Mississippi.

Remarks. - Stephenson, 1946, recognized the type species of this genus as a young molt and recommended that the genus be suppressed. This form is undoubtedly a molt as evidenced by the weakly developed hinge structure, the very narrow anterior margin, and the delicate valves. Hundreds of specimens have been studied in association with adult forms, however, and no definitive conclusion can be reached concerning the genus and species to which it belongs. A.yazooensis appears to be a young molt of the type which is basic to a number of genera including Brachycythere, Actinocythereis, and Trachyleberis. Typical forms are described and figured

only because of the stratigraphic usefulness of the fossil. It is very abundant in the Jackson outcrop material, more so, perhaps, than at other levels, therefore it adds to the recognition criteria of this horizon although it cannot itself be regarded as an "index fossil."

The left valve on cotype slide no. 808, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Genus BUNTONIA Howe, 1935

Type Species *Buntonia shubutaensis* Howe, 1935

Buntonia shubutaensis Howe, 1935
Pl. XIII., figs. 8-11

Cythereis (?) *israelkyi* Howe and Pyeatt, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 33, 34, pl. 1, figs. 19-21; pl. 4, figs. 7-9.

Buntonia shubutaensis Howe, 1935. La. Dept. Cons. Geol. Bull. 5, pp. 23, 24, pl. 4, figs. 4, 5; pl. 5, fig. 7.

Pyricythereis israelkyi (Howe and Pyeatt), in Howe and Law, 1936, La. Dept. Cons. Geol. Bull. 7, pp. 65, 66.

Cythereis (?) *israelkyi* Howe and Pyeatt, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 107, pl. 11, fig. 12.

Diagnosis. - Dorsal margin straight and slopes downward to the posterior end. Surface smooth in the anterior region. There are several small longitudinal ribs on the inflated posterior region which are intersected, in some specimens, by transverse riblets.

Description. - Carapace small, subpyriform in side view. Dorsal margin straight and slopes downward to the posterior end. Ventral margin straight to slightly sinuate. Anterior margin broadly and evenly rounded. Posterior margin narrowly rounded, slightly upturned in the postero-dorsal part. Left valve overlaps the right valve strongly at the posterior cardinal angle. Surface of the carapace smooth in the anterior region. There are several small, round, longitudinal ribs on the inflated posterior region which are intersected, in some specimens, by transverse riblets.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, in some cases bifurcating, and they occur in bundles of two or more, closely spaced. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scars consist of a vertical row of four oval-shaped scars with a U-shaped scar anterior to them. Hinge of the right valve consists of a knob-like anterior tooth and a postjacent socket connected by a slightly crenulated groove to a flat, dorsally recurved, posterior tooth. Hinge of the left valve complementary. males are more elongate than females.

Dimensions. - Hypotype no. 6046, a female right valve from the Shubuta clay member at locality 6: length 0.53 mm., height 0.30 mm. Hypotype no. 6047, a female left valve: length 0.53 mm., height 0.31 mm. Hypotype no. 6048, a male

left valve: length 0.56 mm., height 0.30 mm. Hypotype no. 6049, a male right valve: length 0.51 mm., height 0.26 mm. All hypotypes are from the Shubuta clay member at locality 6.

Comparisons. - The described forms have been compared with the cotypes of Cythereis ? israelkyi Howe and Pyeatt, and found to be the same species.

Occurrence. - Occurs commonly at all outcrop localities and all stratigraphic units of the Jackson group in Mississippi.

Remarks. - The left valve on cotype slide no. 1144, Henry V. Howe Collection, Louisiana State University, is selected as holotype of this species.

Buntonia morsei (Howe and Pyeatt), 1935
Pl. XIII., figs. 12-14

Cythereis (?) israelkyi var. morsei Howe and Pyeatt, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 34, 35, pl. 3, figs. 11, 12.

Cythereis (?) israelkyi var. morsei Howe and Pyeatt, in Bergquist, 1942, Miss Geol. Surv. Bull. 49, p. 108, pl. 11, fig. 13.

Diagnosis. - Dorsal margin straight and slopes downward to the posterior end. Surface completely covered by coarse pits which tend to align in parallel rows on the inflated posterior region.

Description. - Carapace small, subpyriform in side view. Dorsal margin straight and slopes downward to the narrow

posterior. Ventral margin slightly convex. Anterior margin broadly and evenly rounded with a small sharp rim. Posterior margin narrowly rounded and upturned slightly at the postero-dorsal part. Greatest height at the anterior cardinal angle; greatest thickness slightly posterior to center. Left valve overlaps the right valve strongly at the anterior cardinal angle. Surface of the carapace covered by coarse pits which tend to align in parallel rows on the inflated posterior region.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, fine, sometimes wavy and bifurcating. They occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Muscle scars consist of a vertical row of four, small oval-shaped scars with a U-shaped scar anterior to them. Hinge of the right valve consists of a small, knob-like anterior tooth and a postjacent socket connected by a narrow, slightly crenulated groove to a flat, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6050, a carapace from the lower facies of the Yazoo clay formation at locality 17: length 0.54 mm., height 0.34 mm. Hypotype no. 6052, a male right valve from the same locality: length 0.56 mm., height 0.27

mm. Hypotype no. 6051, a female left valve from the same locality: length 0.54 mm., height 0.33 mm.

Comparisons. - This species can be distinguished from Buntonia israelskyi Howe and Pyeatt by its surface ornamentation, B. morsei being completely covered with coarse pits in contrast to the rib ornamentation of B. israelskyi.

Occurrence. - Occurs in the Cocoa sand member at localities 1 and 6; the lower facies of the Yazoo clay formation at localities 17, 18, 19, and 20; and the upper marl member of the Moodys Branch formation at locality 16.

Buntonia warneri (Howe and Pyeatt), 1935
Pl. XIII., figs. 15, 16

Cythereis (?) israelskyi var. warneri Howe and Pyeatt, in
Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5,
p. 35, pl. 3, fig. 8.

Diagnosis. - Dorsal margin straight and slopes downward to the narrow posterior. Surface smooth throughout.

Description. - Carapace small, subpyriform in side view. Dorsal margin straight and slopes downward to the narrow posterior. Ventral margin straight to slightly convex. Anterior margin broadly and evenly rounded with a small sharp rim. Posterior margin narrowly rounded and slightly upturned at the postero-dorsal part. Left valve overlaps the right valve at the anterior cardinal angle. There is a small round

sulcus slightly anterior to center. Surface of the carapace smooth throughout.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, fine, occasionally wavy and bifurcating. They occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Muscle scars consist of a vertical row of four, small, oval-shaped scars with a crescent-shaped scar anterior to them. Hinge of the right valve consists of a small, knob-like anterior tooth and a postjacent socket connected by a narrow crenulated groove to a flat, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6053, a female carapace from the North Creek clay member at locality 2: length 0.53 mm., height 0.33 mm. Hypotype no. 6054, a male right valve from the same locality: length 0.56 mm., height 0.29 mm.

Comparisons. - The hypotypes are nearly identical to the holotype. This species is easily distinguished from others of the genus by its smooth surface.

Occurrence. - Occurs commonly in the North Creek clay member at localities 1, 2, 4, 7, 9, and 10; commonly in the Cocoa sand member at localities 1 and 6; and the upper facies

of the Yazoo clay formation at locality 11; rarely in the Pachuta marl member at locality 6; the lower facies of the Yazoo clay formation at locality 13; and the upper marl member of the Moodys Branch formation at locality 15.

Buntonia donnellyi n. sp.
Pl. XIII., figs. 21-23

Diagnosis. - Carapace heavy and large for the genus. Surface of the inflated posterior region ornamented by a delicate pattern of reticulations.

Description. - Carapace heavy, subpyriform in outline. Dorsal margin straight and slopes downward to the posterior. Ventral margin straight to slightly convex. Anterior margin broadly and evenly rounded with a wide rim. Posterior margin narrowly rounded and upturned slightly at the postero-dorsal part. Greatest height at the anterior cardinal angle; greatest thickness slightly posterior to center. The inflated posterior region of the carapace is ornamented by a delicate pattern of polygonal reticulations, remainder of the valve surface smooth. There is a small round sulcus just anterior to center.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, some are wavy, and they occur singly or in bundles of two or more, closely spaced. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a verti-

cal row of four, small, oval-shaped scars with another scar anterior to them. Hinge of the right valve consists of a small, pointed anterior tooth and a postjacent socket connected by a crenulated groove to a flat, dorsally recurved, posterior tooth. Hinge of the left valve consists of a deep anterior socket and a postjacent tooth connected by a crenulated bar to a posterior socket. Males are more elongate and less pyriform in outline than females.

Dimensions. - Holotype no. 6055, a female left valve from the Shubuta clay member at locality 6: length 0.67 mm., height 0.39 mm. Paratype no. 6056, a male right valve: length 0.71 mm., height 0.37 mm. Paratype no. 6057, a female right valve: length 0.64 mm., height 0.37 mm. Paratypes are from the same locality as the holotype.

Comparisons. - This species differs from all the previously described species of *Buntonia* by its large heavy carapace and by the definite reticulated pattern in the inflated posterior region.

Occurrence. - Restricted to the upper Shubuta clay member at locality 6.

Buntonia plileri n. sp.
Pl. XIII., figs. 17-20

Diagnosis. - Dorsal margin straight and slopes downward to the narrow posterior end. The inflated posterior region of

the valves ornamented by subparallel longitudinal rows of small ribs which are occasionally branched. Anterior region may be smooth, reticulate, or ribbed.

Description. - Carapace small, subpyriform in side view. Dorsal margin straight and slopes downward to the narrow posterior end. Ventral margin straight to slightly sinuate. Anterior margin broadly and evenly rounded, somewhat compressed, with a wide rim. Posterior margin narrowly rounded and upturned slightly at the postero-dorsal part. Left valve overlaps the right valve at the anterior cardinal angle. Surface of the carapace ornamented by a pattern of rounded ribs. On the inflated posterior the ribs are longitudinally arranged, subparallel, and in some cases branched. In the postero-dorsal area they are intersected by transverse riblets producing a reticulated effect. The anterior region may be ribbed, semireticulate, or smooth. There is a small round sulcus slightly anterior to center.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, long, in some cases bifurcating; they occur singly or in bundles of two or more, closely spaced. The line of concrecence coincides with the inner margin throughout. Muscle scar pattern consists of four, small, elongate scars in a vertical row with a V-shaped scar anterior to them. Hinge of the right valve consists of a small, knob-like anterior

tooth and a postjacent socket connected by a narrow crenulated groove to a flat, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Holotype no. 6058, a female left valve from the Shubuta clay member at locality 6: length 0.56 mm., height 0.30 mm. Paratype no. 6059, a female right valve: length 0.57 mm., height 0.30 mm. Paratype no. 6060, a male right valve: length 0.57 mm., height 0.26 mm. Paratype no. 6061, a male left valve: length 0.59 mm., height 0.30 mm.

Comparisons. - This species differs from the other species of the genus in the pattern developed by the rib ornamentation on the inflated posterior area. The carapace is also less pyriform and more elongate than others of the genus.

Occurrence. - Occurs in the Shubuta clay member at locality 6.

Genus HERMANITES Puri, 1953, emended, 1955

Type Species *Hermania reticulata* Puri, 1953

Hermanites dohmi (Howe and Chambers), 1935
Pl. XIV., figs. 1-4

Cythereis hysonensis var. *dohmi* Howe and Chambers, 1935, La.
Dept. Cons. Geol. Bull. 5, p. 32, pl. 1, fig. 9.

Cythereis hysonensis var. *dohmi* Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 107, pl. 11, fig. 11.

Diagnosis. - Surface elevated in the postero-central region and smooth. Sculpturing consists of strong parallel dorsal and ventral ridges which sweep up posteriorly to the top of the postero-central elevation and terminate with sharp projections. A transverse ridge extends obliquely across the elevated region and connects to the ends of the dorsal and ventral ridges. Normal pore canals numerous. Subcentral tubercle very prominent.

Description. - Carapace subrectangular in outline. Dorsal margin straight with a hinge-ear at the anterior cardinal angle. Ventral margin straight. Anterior margin broadly rounded and fringed with numerous minute denticles below a raised rim. Posterior margin compressed and pointed in the middle; the dorsal half straight to slightly concave and the ventral half rounded with a few short, blunt spines. Valves are elevated in the postero-central region. Surface sculptured as follows: A strong, short, dorsal ridge begins slightly below and anterior to the center of the dorsal margin and sweeps up posteriorly to the top of the elevated region where it terminates with a strong projection. A ventral ridge begins at the antero-ventral margin and sweeps up posteriorly to the top of the elevated region and also terminates with a strong projection. A transverse ridge extends obliquely across the postero-central region and connects the ends of the dorsal and ventral ridges. Normal pore canals

numerous and give the surface a shallow, pitted effect. Subcentral tubercle prominent.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous, occasionally branched, and occur in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scar pattern consists of four oval-shaped scars in a vertical row on the posterior edge of the muscle pit with one scar anterior to them within the pit. Hingement of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a smooth groove to a blunt, rounded posterior tooth. Hingement of the left valve complementary. Males have the same sculpturing and other features as females but are more elongate.

Dimensions. - Hypotype no. 6062, a female right valve from the Shubuta clay member at locality 6: length 0.61 mm., height 0.33 mm. Hypotype no. 6063, a male left valve from the Moodys Branch formation at locality 15: length 0.56 mm., height 0.30 mm. Hypotype no. 6064, a female carapace from the same locality: length 0.60 mm., height 0.31 mm. Hypotype no. 6065, a female left valve from the same locality: length 0.54 mm., height 0.30 mm.

Comparisons. - The strong dorsal and ventral ridges with their sharp terminal projections and the numerous normal pore canals which are visible on the surface are features

which distinguish this species from others of the genus.

Occurrence. - Occurs at all stratigraphic horizons and outcrop localities of the Jackson group in Mississippi except the upper facies of the Yazoo clay formation at localities 11 and 14.

Remarks. - This species is removed from the genus *Cythereis* and reassigned to *Hermanites* for the following reasons: The hingement is simple holamphidont in contrast to that described by Triebel (1940) for *Cythereis*. Normal pore canals are numerous, whereas none is described for *Cythereis*. The V-shaped antennal scar in the muscle pit as described for *Cythereis* is not apparent in the foregoing described forms.

Hermanites hysonensis (Howe and Chambers), 1935
Pl. XIV., figs. 5-9

Cythereis hysonensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 31, 32; pl. 1, fig. 8; pl. 6, figs. 23, 24.

Diagnosis. - Surface coarsely reticulate, and sculpturing consists of a weakly developed dorsal ridge which forms a small projection near the posterior cardinal angle; a strong ventral ridge which terminates with a small projection in the posterior fourth of the valve; and a transverse ridge which extends irregularly across the slightly elevated posterior region connecting the ends of the dorsal and ventral ridges. A small connective ridge extends to the posterior

cardinal angle.

Description. - Carapace subrectangular in outline. Dorsal margin straight with a small hinge-ear at the anterior cardinal angle. Ventral margin straight to slightly sinuate. Both margins converge slightly toward the posterior. Anterior margin broadly rounded and fringed with numerous minute denticles below a raised rim. Posterior margin pointed, straight to slightly concave in the dorsal half, rounded and denticulate in the ventral half. Surface coarsely reticulate with numerous normal pore canals. Postero-central region slightly elevated. Surface sculptured as follows: A small dorsal ridge begins near the eye tubercle and parallels the dorsal margin to a point near the posterior cardinal angle where it curves back sharply and forms a small projection. On some specimens a small ridge continues to the sub-central tubercle. A strong central ridge begins in the antero-ventral region and parallels the ventral margin to the posterior fourth of the valve where it terminates with a small projection. A transverse ridge extends irregularly across the postero-central region and connects to the ends of the dorsal and ventral ridges. A short ridge extends from the end of the dorsal ridge to the posterior cardinal angle.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous at the anterior,

in some cases branched, and occur in bundles of two or more. Few at the posterior. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four oval-shaped scars on the posterior edge of the muscle pit with one scar anterior to them within the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a smooth groove to a blunt, rounded posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6066, a female right valve from the lower facies of the Yazoo clay formation at locality 12: length 0.60 mm., height 0.33 mm. Hypotype no. 6067, a female left valve from the same locality: length 0.60 mm., height 0.33 mm. Hypotype no. 6068, a male right valve: length 0.61 mm., height 0.31 mm. Hypotype no. 6069, a whole female carapace: length 0.59 mm., height 0.30 mm. Hypotype no. 6070, a complete male carapace from the North Creek clay member at locality 7: length 0.70 mm., height 0.33 mm.

Comparisons. - This species is distinguished by its coarsely reticulated surface and its small dorsal and ventral ridges. The central ridge commonly present between the terminal point of the dorsal ridge and the subcentral tubercle and the short connective ridge at the posterior cardinal angle are also distinguishing features.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; North Creek clay member at localities 2, 7, and 9; Cocoa sand member at locality 1; the lower facies of the Yazoo clay formation at localities 12, 13, and 17; and very rarely in the Pachuta marl member at locality 6.

Remarks. - The left valve on cotype slide no. 812, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species. This species is removed from Cythereis and reassigned to Hermanites because of the holamphidont hingement, normal pore canals, and the muscle scar arrangement.

Hermanites raglandi n. sp.
Pl. XIV., figs. 10-15

Diagnosis. - Surface coarsely reticulate. Postero-central region slightly elevated with a gentle slope to the compressed posterior region. There is a suggestion of weakly developed dorsal and ventral ridges which terminate abruptly at the top of the postero-central elevation.

Description. - Carapace subrectangular in outline. Dorsal margin straight with a small hinge ear; ventral margin straight to slightly sinuate. Both margins converge slightly toward the posterior. Anterior margin broadly rounded and fringed with numerous minute denticles below a raised rim. Postero-central region slightly elevated with a gentle slope

to the compressed posterior marginal area. The posterior margin is pointed in the middle, straight to slightly concave in the dorsal half, and rounded with a few small spines in the ventral half. Surface of the carapace coarsely reticulate. Subcentral tubercle prominent. There is a suggestion of weakly developed dorsal and ventral ridges which terminate abruptly at the top of the postero-central elevation.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous at the anterior, commonly branched, and occur singly or in bundles of two or more, irregularly spaced. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four oval-shaped scars with a scar anterior to them within the pit. In some cases the second scar from the top in the vertical row is split into two scars. Hinge of the right valve consists of a small, rounded anterior tooth and a postjacent socket connected by a groove to a blunt, rounded posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Holotype no. 6071, a female left valve from the Moodys Branch formation at locality 8: length 0.59 mm., height 0.31 mm. Paratype no. 6072, a female right valve: length 0.59 mm., height 0.31 mm. Paratype no. 6075, a female left valve: length 0.60 mm., height 0.33 mm. Paratype no. 6074, a male right valve: length 0.60 mm., height 0.29

mm. Paratype no. 6073, a female carapace: length 0.60 mm., height 0.33 mm.

Comparisons. - This species differs from H. hysonensis in having less prominent dorsal and ventral ridges and in lacking terminal projections at the ends of the ridges. This form also shows some features that are reminiscent of some of the forms assigned to the genus *Murrayina*. It is referred to *Hermanites* because of the elevated postero-central region of the valves and the suggestion of dorsal and ventral ridges. The posterior margin is also slightly more pointed than the typical species assigned to *Murrayina*.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15; and rarely in the Cocoa sand member at localities 1 and 6.

Hermanites morrisoni n. sp.
Pl. XIV., figs. 16-19

Diagnosis. - Surface sculpturing consists of strong parallel dorsal and ventral ridges which sweep up posteriorly to the elevated posterior region where each terminates with a small, blunt projection. A transverse ridge extends obliquely across the elevated posterior region connecting the ends of the dorsal and ventral ridges. Three small sub-parallel ridges extend from the subcentral tubercle to a point near the anterior margin. Large foramina parallel the

principal ridges and the ventral margin.

Description. - Carapace subrectangular in outline. Dorsal margin straight with a hinge ear at the anterior cardinal angle. Ventral margin slightly sinuate. Both margins converge gently toward the posterior. Anterior margin broadly and obliquely rounded and fringed with a row of minute denticles below a strong raised rim. Posterior margin compressed and pointed in the middle; it is straight to slightly concave in the dorsal half and rounded with several short, blunt spines in the ventral half. Surface of the valves elevated in the postero-central region and sculptured as follows: A strong dorsal ridge begins behind and below the eye tubercle and sweeps up posteriorly to the top of the elevated region where it terminates with a small blunt projection. A strong ventral ridge begins at the antero-ventral margin and sweeps up posteriorly, parallel to the dorsal ridge, to the top of the elevated region where it also terminates with a small projection. A transverse ridge extends obliquely across the elevated region and connects the ends of the dorsal and ventral ridges. The posterior slopes gently from the transverse ridge to the compressed marginal region. Subcentral tubercle prominent with three small sub-parallel ridges extending from it to a point near the anterior margin. A small node-like projection lies just behind the subcentral tubercle. Large foramina parallel the ridges

and the anterior margin. Numerous normal pore canals appear on the surface.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous, in some cases branched, and occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a muscle pit with one, perhaps two, small scars anterior to them within the pit. Hinge of the right valve consists of a rounded anterior tooth and a postjacent socket connected by a groove to a blunt, round posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Holotype no. 6076, a female left valve from the Moodys Branch formation at locality 8: length 0.60 mm., height 0.33 mm. Paratype no. 6078, a male right valve: length 0.60 mm., height 0.29 mm. Paratype no. 6079, a female left valve: length 0.60 mm., height 0.33 mm. Paratype no. 6077, a female carapace; length 0.60 mm., thickness 0.33 mm., height 0.33 mm.

Comparisons. - This species resembles Cythereis collei Gooch, 1941, from the Cook Mountain (Eocene) of Louisiana. The sculpturing is very similar, but in C. collei the surface is reticulated in contrast to the conspicuous foramina and normal pore canals in C. morrisoni. In addition, the small node-like projection behind the subcentral tubercle is not described

in C. collei.

Occurrence. - Occurs abundantly in the Moodys Branch formation at localities 8 and 15; rarely in the North Creek clay member at localities 2 and 4; Cocoa sand member at localities 1 and 6; Pachuta marl member at locality 3; and the lower facies of the Yazoo clay formation at localities 12, 13, 17, 19, and 20.

Hermanites adamsi n. sp.
Pl. XV., figs. 12-15

Diagnosis. - Dorsal margin straight and flattened near the anterior cardinal angle. Surface covered with a web-like network of coarse reticulations and elevated in the postero-central region. Moderately strong parallel dorsal and ventral ridges sweep up posteriorly to the elevated region where each terminates with a small node-like projection.

Description. - Carapace subrectangular in outline. Dorsal margin straight and flattened near the anterior cardinal angle. Ventral margin straight. Both margins converge slightly toward the posterior. Anterior margin broadly rounded and fringed with numerous minute denticles below a small raised rim. Postero-central region elevated with a gentle slope to the compressed posterior marginal region. Posterior margin slightly concave in the dorsal half, rounded with several small spines in the ventral half. Surface of

the carapace ornamented with a coarse web-like network of polygonal reticulations. Subcentral tubercle prominent. Surface sculptured as follows: A moderately strong dorsal ridge begins just below and behind the eye tubercle and sweeps back posteriorly to the top of the elevated postero-central region where it terminates with a small blunt projection. A ventral ridge begins at the antero-ventral margin and also sweeps up posteriorly to the top of the elevated region where it also terminates with a small, blunt projection.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous, in some cases branched near the outer margin, and occur singly or in bundles of two or more, irregularly spaced. They occur mostly in the ventral half of the posterior margin. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four oval-shaped scars on the posterior edge of the muscle pit with another small scar anterior to them within the pit. Hinge of the right valve consists of a small, round anterior tooth and a postjacent socket connected by a groove to a small, round posterior tooth. Hinge of the left valve complementary. Dimorphism not determined.

Dimensions. - Holotype no. 6080, a right valve from the Moodys Branch formation at locality 8: length 0.70 mm., height 0.37 mm. Paratype no. 6082, a left valve: length

0.69 mm., height 0.38 mm. Paratype no. 6081, a right valve; length 0.71 mm., height 0.37 mm.

Comparisons. - This species resembles Cythereis ? scutulata Howe, 1951, from the Avon Park limestone of Florida, but differs in the outline of the valves and in the prominence of the dorsal ridge.

Occurrence. - Found only in the Moodys Branch formation at locality 3.

Genus ECHINOCYHEREIS Puri, 1954

Type Species Cythereis garretti Howe and McGuirt, 1935

Echinocythereis jacksonensis (Howe and Pyeatt), 1935
Pl. XIV., figs. 20, 21

Cythereis (?) jacksonensis Howe and Pyeatt, in Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, pp. 35, 36, pl. 1, figs. 23, 24; pl. 4, fig. 31

Cythereis (?) jacksonensis Howe and Pyeatt, in Bergquist, 1942, Miss. Geol. Surv. Bull. 49, p. 108, pl. 11, fig. 14.

Cythereis jacksonensis Howe and Pyeatt, in van den Bold, 1946, Utrecht University, J. H. DeBussy, Amsterdam, p. 89, pl. 10, fig. 7.

Diagnosis. - Carapace tumid, elongate-subovate in outline. Surface reticulo-spinose with the reticles and spines arranged in concentric rows parallel to the margins.

Description. - Carapace tumid, elongate-subovate in side view. Dorsal margin straight; ventral margin slightly sinuate.

Anterior margin broadly and obliquely rounded with a wide rim which is fringed with numerous denticles. Posterior margin straight and sloping in the dorsal half; obliquely rounded and denticulate in the ventral half. Greatest height at the anterior cardinal angle. Greatest thickness posterior to center. Surface of the carapace reticulospinose with the reticles and spines arranged in concentric rows parallel to the margins.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals moderately numerous, in some cases branched, and occur singly or in bundles of two or more, widely spaced. The line of concrescence coincides with the inner margin throughout. Selvage strong, with a prominent lip-line approximately midway between the inner and outer margins on each valve. Muscle scars consist of a vertical row of four scars with two scars anterior to them. Hinge of the right valve consists of a rounded anterior tooth and a postjacent socket connected by a groove to an elongate, rounded posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6083, a female right valve from the Moodys Branch formation at locality 15; length 0.90 mm., height 0.51 mm. Hypotype no. 6084, a male left valve from the same formation at locality 8: length 1.00 mm., height 0.56 mm.

Comparisons. - Comparison of the hypotypes with the holotype indicates the identity of the species. This species is distinguished from others of the genus by the relatively large tumid carapace and the concentric rows of reticles and spines on the surface.

Occurrence. - Occurs commonly in all stratigraphic levels of the Jackson group in Mississippi except the Shubuta clay member and the upper facies of the Yazoo clay formation.

Echinocythereis cf. E. nuda Puri, 1957
Pl. XIV., figs. 22-24

Diagnosis. - Carapace tumid, elongate-subovate in side view. Dorsal margin straight; ventral margin slightly sinuate. Anterior margin broadly rounded with a rim which is fringed with numerous denticles. Greatest height at the anterior cardinal angle. Surface of the valves smooth throughout.

Description. - Carapace tumid, elongate-subovate in side view. Dorsal margin straight; ventral margin slightly sinuate. Anterior margin broadly and obliquely rounded with a rim which is fringed by small denticles. Posterior margin straight to slightly concave in the dorsal half, rounded and denticulate in the ventral half. Greatest height at the anterior cardinal angle; greatest thickness posterior to center. Surface of the carapace smooth.

On the inside, the valves are deep with moderately broad

marginal areas. Radial pore canals are moderately numerous, occasionally bifurcating, and occur singly or in bundles of two or more. Selvage strong. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a rounded anterior tooth, a postjacent socket, and a flat elongate posterior tooth connected by a groove. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6085, a female carapace from the Pachuta marl member at locality 3: length 0.94 mm., height 0.54 mm.

Comparisons. - The figured specimen fits the general description of E. nuda Puri, 1957, from the Ocala group of Florida, but no comparisons were made with the types. This specimen is also identical to E. jacksonensis Howe and Pyeatt except for the smooth surface.

Occurrence. - Occurs in the Pachuta marl member at locality 3; rare in the Shubuta clay member at locality 6; and in the lower facies of the Yazoo clay formation at localities 12, 17, 19, and 20.

Genus HENRYHOWELLA Puri, 1956, emended 1957

Type Species *Henryhowella florienensis* (Howe and Chambers),
1935

Henryhowella floriensis (Howe and Chambers), 1935
Pl. XV., figs. 1-6

Cythereis floriensis Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, pp. 28, 29, pl. 1, fig. 14.

Cythereis deussenii Howe and Chambers, 1935, La. Dept. Cons.,
Geol. Bull. 5, p. 27, pl. 1, fig. 15; pl. 6, figs. 2, 3.

Cythereis floriensis Howe and Chambers, in Bergquist,
1942, Miss. Geol. Surv. Bull. 49, p. 106, pl. 11, fig. 8.

Diagnosis. - Surface reticulo-spinose with two longitudinal spinose ridges as follows: A median ridge extends posteriorly from the subcentral tubercle, and a ventral ridge, subparallel to the median ridge, extends from near the anteroventral margin to a point approximately one-fourth the distance from the posterior end.

Description. - Carapace elongate-subovate in outline. Dorsal margin straight with a row of quadrate spines projecting above the edge. Ventral margin straight. Both margins converge slightly toward the posterior. Anterior margin broadly rounded, with a rim which is fringed by a double row of denticles. Posterior margin pointed and somewhat compressed; it is straight to slightly concave in the dorsal half and rounded with several small spines in the ventral half. Surface reticulo-spinose. There are two longitudinal spinose ridges on the surface as follows: A median ridge extends posteriorly from near the subcentral tubercle to a point approximately one-fifth the distance from the posterior end.

A ventral ridge, subparallel to the median ridge, extends from a point near the antero-ventral margin to a point approximately one-fourth the distance from the posterior end. Subcentral tubercle covered by a thick cluster of small spines and separated from the median ridge by an arcuate row of large reticles.

On the inside, the valves are moderately shallow with broad marginal areas. Radial pore canals numerous, in some cases wavy and branching, and occur singly, or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Two lip-lines are visible on the margins of each valve. Muscle scar arrangement consists of a vertical row of four small scars on the posterior edge of the muscle pit with two small scars anterior to them within the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a smooth groove to a blunt, rounded posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6086, a female right valve from the Shubuta clay member at locality 5: length 0.74 mm., height 0.41 mm. Hypotype no. 6087, a male left valve from the same locality: length 0.81 mm., height 0.40 mm. Hypotype no. 6088, a female right valve from the upper facies of the Yazoo clay formation at locality 11: length 0.60 mm.,

height 0.37 mm. Hypotype no. 6089, a male left valve from the same locality: length 0.70 mm., height 0.37 mm. Hypotype no. 6090, a molt stage from the North Creek clay member at locality 9: length 0.51 mm., height 0.29 mm. Hypotype no. 6091, a male left valve from the upper Shubuta clay member at locality 6: length 0.80 mm., height 0.40 mm.

Comparisons. - Comparison of the hypotypes with the holotype establishes the identity of the species.

Occurrence. - Occurs at all stratigraphic levels and all localities of the Jackson group in Mississippi.

Remarks. - The individuals of this species are better developed in the Shubuta clay and Pachuta marl members than in the Yazoo clay formation sediments in the west.

The left valve on cotype slide no. 806, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Henryhowella howei n. sp.
Pl. XV., figs. 7-11

Diagnosis. - Surface reticulo-spinose with two longitudinal spiny ridges as follows; A median ridge begins near the subcentral tubercle and extends back toward the posterior. A ventral ridge, subparallel to the median ridge, extends from near the antero-ventral margin to a point near the posterior margin. On the male forms the surface pattern is

predominantly reticulate with a spinose ridge suggested only near the ventral margin.

Description. - Carapace heavy, tumid, and elongate-subovate in outline. Dorsal margin straight with a row of quadrate spines projecting above the edge. Ventral margin straight to slightly sinuate and subparallel to the dorsal margin. Greatest height at the anterior cardinal angle. Anterior margin broadly and obliquely rounded with a large rim which is fringed with a double row of denticles. A vertical blade-like rim parallels the anterior margin from the eye tubercle to a point approximately one-third the distance around the margin where a row of blunt, rounded denticles continues on around the margin. Posterior margin pointed, somewhat compressed; it is straight to slightly concave in the dorsal half and rounded with several sharp spines in the ventral half. Surface reticulo-spinose. On the females two longitudinal spinose ridges are present on the central and posterior regions. A median ridge begins near the subcentral tubercle and extends back toward the posterior. A ventral ridge, subparallel to the median ridge, begins near the antero-ventral margin and extends to a point near the posterior margin. An arcuate row of reticles separates the subcentral tubercle from the median row of spines. In the males the carapace is covered by large, shallow, polygonal reticles with spines at the reticle junctions. There is no

discernible lineation of the spines and reticles except near the anterior margin.

On the inside, the valves are moderately deep with broad marginal areas. Radial pore canals numerous, long, in some cases branched, and occur singly or in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong with a lip-line approximately midway between the inner and outer margins. Muscle scars consist of a pattern of four oval-shaped scars in a vertical row on the posterior edge of the muscle pit with a scar anterior to them within the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a groove to a large, blunt, dorsally recurved, posterior tooth. Hinge of the left valve complementary. Males are more elongate than females. In addition, their ornamentation is predominantly reticulate.

Dimensions. - Holotype no. 6092, a female left valve from the Shubuta clay member at locality 6: length 0.93 mm., height 0.54 mm. Paratype no. 6094, a female right valve: length 0.91 mm., height 0.51 mm. Paratype no. 6093, a male right valve: length 0.98 mm., height 0.49 mm. Paratype no. 6095, a male left valve: length 1.01 mm., height 0.54 mm. Paratype no. 6096, a left valve molt: length 0.90 mm., height 0.43 mm. All paratypes are from the same locality as the holotype.

Comparisons. - This species is distinguished from H. florienensis (Howe and Chambers) by its larger size, more tumid valves, and by spinose ridges composed of double rows of spines on many specimens, a feature which is not seen in H. florienensis. The dorsal and ventral margins are also more nearly parallel in H. howei than in H. florienensis.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; Shubuta clay member at locality 6; and the upper facies of the Yazoo clay formation at locality 11.

Genus HIRSUTOCYTHERE Howe, 1951

Type Species *Hirsutocythere hornotina* Howe, 1951

Hirsutocythere hornotina Howe, 1951
Pl. XV., figs. 17, 18

Hirsutocythere hornotina Howe, 1951, Fla. Geol. Surv. Bull. 34, p. 22, pl. 4, figs. 3, 6, 9, 12.

Diagnosis. - Carapace slightly tumid with surface completely covered by spines. Marginal areas very broad with long, straight radial pore canals which extend into the marginal spines.

Description. - Carapace slightly tumid, elongate-ovate in outline. Dorsal margin straight; ventral margin sinuate. Anterior margin broadly and obliquely rounded with a rim which bears numerous short spines. Posterior margin straight to slightly concave in the dorsal half, rounded with several

spines in the ventral half. Greatest height at the anterior cardinal angle; greatest thickness at the middle. Surface of the carapace completely covered by spines. Frequently the sharp tips of the spines are lost in weathered specimens giving the surface a nodose effect.

On the inside, the valves are deep with very broad marginal areas, especially at the anterior. Radial pore canals numerous, long, straight, and extend into the marginal spines. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four oval-shaped scars on the posterior edge of the muscle pit with another scar anterior to them within the pit. Hinge of the right valve consists of a high, pointed anterior tooth and a postjacent socket connected by a groove to a rounded, knob-like posterior tooth. The groove is very narrow in the mid-dorsal part. Hinge of the left valve complementary. Males are slightly more elongate than the females.

Dimension. - Hypotype no. 6097, a female right valve from the Moodys Branch formation at locality 8: length 0.74 mm., height 0.44 mm. Hypotype no. 6098, a male left valve from the same locality: length 0.75 mm., height 0.43 mm.

Comparisons. - The hypotypes are essentially identical to the holotype. The sharp tips of the surface spines, however, are commonly broken off as a result of abrasion.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15.

Genus MURRAYINA Puri, 1953

Type Species *Murrayina howei* Puri, 1953

Murrayina sp.
Pl. XV., fig. 16

Remarks. - Only a single left valve and right valve of this species were found in the upper Shubuta clay member at locality 6. A right valve is figured.

Dimensions. - Figured specimen no. 6099, a right valve: length 0.60 mm., height 0.33 m.

Genus OCCULTOCY THEREIS Howe, 1951

Type Species *Occultocythereis delumbata* Howe, 1951

Occultocythereis broussardi (Howe and Chambers), 1935
Pl. XVI., figs. 1-3

Cythereis broussardi Howe and Chambers, 1935, La. Dept.
Cons. Geol. Bull. 5, pp. 24, 25, pl. 4, fig. 6.

Cythereis broussardi Howe and Chambers, in Bergquist, 1942,
Miss. Geol. Surv. Bull. 49, p. 106, pl. 11, fig. 7.

Diagnosis. - Surface smooth and sculptured as follows: A dorsal ridge extends from just behind the eye tubercle to the posterior cardinal angle. A short ventral ridge extends across the centro-ventral region of the valve and

terminates in the posterior fourth. A prominent node-like swelling is present slightly anterior to center with another node slightly to the posterior.

Description. - Carapace small, elongate-ovate in side view. Dorsal margin straight; ventral margin slightly sinuate. Both margins gently converge toward the posterior end. Anterior margin broadly rounded and fringed with numerous small denticles below a flat raised rim. Posterior margin pointed with a raised rim; it is slightly concave in the dorsal half, rounded with denticles in the ventral half. Greatest height at the anterior cardinal angle. Surface of the carapace smooth except for a pattern of ridges and nodes as follows: A high, rounded, dorsal ridge extends along the dorsal margin from just behind the eye tubercle to the posterior cardinal angle. A short ventral ridge extends across the centro-ventral region. There is a prominent node-like swelling just anterior to the center and another node slightly posterior to center.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals few, and some are branched near the outer margin. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of four small scars in a vertical row with two scars anterior to them. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by

a slightly crenulated groove to a large, rounded posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6100, a whole carapace from the Pachuta marl member at locality 3: length 0.54 mm., height 0.29 mm.

Comparisons. - The hypotype is nearly identical to the holotype.

Occurrence. - Occurs in the Moodys Branch formation at localities 8, 15, and 16; very rare in the North Creek clay member at locality 1; rare in the Pachuta marl member at localities 3 and 6; and the Shubuta clay member at locality 6.

Remarks. - The left valve on cotype slide no. 814, Henry V. Howe Collection, Louisiana State University, is designated as the holotype of this species.

Genus PSEUDOCYTHEROMORPHA Puri, 1957

Type Species *Pseudocytheromorpha elongata* Puri, 1957

Pseudocytheromorpha sp.
Pl. XVI., fig. 4

Remarks. - Only one representative of this genus was found in the Cocoa sand member at locality 1. This specimen slightly resembles *P. elongata* Puri, 1957, from the Crystal

River formation (Ocala group) in Florida, but the carapace is smaller, its sulcus is less prominent, and spines are not present on the anterior and posterior margins as in P. elongata.

Dimensions. - Figured specimen no. 6101; length 0.54 mm., height 0.23 mm.

Genus TRACHYLEBERIDEA Bowen, 1953

Type Species *Cythereis prestwichiana* Jones and Sherborn, 1887

Trachyleberidea hiwanneensis n. sp.
Pl. XVI., figs. 5-12

Diagnosis. - Valves are covered by a web-like network of coarse polygonal reticulations; slightly elevated in the postero-central region. Surface sculpturing consists of dorsal and median ridges which join near the posterior cardinal angle and a ventral ridge which parallels the ventral margin to the top of the elevated postero-central region where it terminates with a small projection.

Description. - Carapace subrectangular in outline. Dorsal and ventral margins straight and converge slightly toward the posterior. Anterior margin broadly and obliquely rounded with six short blunt spines below a raised rim. Posterior margin pointed with a marginal rim, straight to slightly concave in the dorsal half, and rounded with two or three short spines in the ventral half. Left valve overlaps the right

valve strongly just in front of the eye tubercle. Surface of the carapace covered with a web-like network of polygonal reticulations and slightly elevated in the postero-central region. Surface sculptured as follows: A dorsal ridge begins just behind and below the eye tubercle and extends along the dorsal margin to a point near the posterior cardinal angle. From there it curves back sharply and extends across the valve to the subcentral tubercle. A ventral ridge begins at the antero-ventral margin and sweeps up posteriorly to the top of the elevated postero-central region where it terminates abruptly with a small projection.

On the inside, the valves are shallow with moderately broad marginal areas. Radial pore canals numerous, short, and closely spaced. The line of concrescence lies between the inner and outer margins at the anterior extremity. Muscle scar pattern consists of four scars on the posterior edge of the muscle pit with a U-shaped scar anterior to them within the pit. Hinge of the right valve consists of a high, conical anterior tooth and a postjacent socket connected by a groove to a slightly serrate posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Holotype no. 6102, a female carapace from the Shubuta clay member at locality 5: length 0.71 mm., height 0.39 mm., thickness 0.33 mm. Paratype no. 6103, a male right

valve: length 0.67 mm., height 0.33 mm. Paratype no. 6104, a male left valve: length 0.70 mm., height 0.34 mm. Paratype no. 6105, a female right valve: length 0.70 mm., height 0.37 mm. Paratype no. 6106, a female carapace: length 0.64 mm., height 0.33 mm. Paratype no. 6107, a male left valve: length 0.74 mm., height 0.36 mm. All paratypes are from the Shubuta clay member at locality 5.

Comparisons. - This species is similar to Trachyleberidea aranea Jones and Sherborn, as figured by Keij, 1957, but differs in the nature of the surface ornamentation. T. aranea is less angular and the dorsal ridge is shorter. T. aranea has an additional ridge extending from the subcentral tubercle to the anterior margin which is a feature not present in T. hiwanneensis n. sp.

Occurrence. - Occurs in the Pachuta marl member at localities 3 and 6; and the Shubuta clay member at localities 5 and 6; and very rarely in the Moodys Branch formation at locality 8.

Genus TRACHYLEBERIS (?) Brady, 1898

Type Species Trachyleberis scabrocuneata (Brady), 1898

Trachyleberis montgomeryensis (Howe and Chambers), 1935
Pl. XVI., figs. 13-16

Cythereis montgomeryensis Howe and Chambers, 1935, La. Dept. Cons. Geol. Bull. 5, p. 37, pl. 1, figs. 13, 16; pl. 2, figs. 22, 23; pl. 6, figs. 19, 20.

Cythereis quinquespinosa Sutton and Williams, 1939, Jour. Paleontology, vol. 13, p. 566, pl. 63, figs. 10, 11.

Cythereis montgomeryensis Howe and Chambers, in Bergquist, 1942, Miss. Geol. Surv. Bull., 49, p. 108, pl. 11, figs. 15, 16.

Cythereis montgomeryensis Howe and Chambers, in Stephenson, 1944, Jour. Paleontology, vol. 18, pp. 450, 451, pl. 76, fig. 7.

Trachyleberis (?) montgomeryensis (Howe and Chambers), in Puri, 1953, Amer. Mid. Naturalist, p. 176, pl. 1, figs. 4, 5; text figs. A, B.

Diagnosis. - Carapace heavy with the surface covered by large, irregularly arranged, vertically tapering spines. A cluster of spines in the anterior region is separated from the others by an arcuate smooth area. Surface smooth near the anterior and posterior margins.

Description. - Carapace heavy, elongate-subovate in outline. Dorsal margin straight with a row of several sharp spines projecting above the edge. Ventral margin straight to slightly sinuate. Anterior margin broadly and obliquely rounded with a thick heavy rim fringed with a double row of small spines. Posterior margin compressed and pointed; it is straight in the dorsal half, obliquely rounded with several short, blunt spines in the ventral half. Greatest height at the anterior cardinal angle. Surface of the valve ornamented with numerous sharp, irregularly arranged, vertically tapering spines. There is one cluster of spines just anterior to center which is separated from the others by a

wide arcuate smooth area. Surface smooth near the anterior and posterior margins.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous, in some cases branched, wavy, and occur in bundles of two or more. The line of concrescence coincides with the inner margin throughout. Selvage strong. Muscle scars consist of a pattern of four oval-shaped small scars on the posterior edge of the muscle pit with two scars anterior to them near the anterior edge of the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a groove to a large posterior tooth. Hinge of the left valve complementary. Males are more elongate than females.

Dimensions. - Hypotype no. 6109, a male right valve from the Shubuta clay member at locality 6: length 1.01 mm., height 0.50 mm. Hypotype no. 6110, a female left valve from the same locality: length 0.90 mm., height 0.53 mm. Hypotype no. 6108, a female right valve from the Moodys Branch formation at locality 15: length 0.84 mm., height 0.45 mm. Hypotype no. 6111, a female left valve from the same locality: length 0.86 mm., height 0.50 mm.

Comparisons. - This species differs from T. (?) quadrataspinata (Howe and Law) from the Vicksburg (Oligocene) in the large number of quadrate spines around the anterior, ventral, and

posterior margins of the latter.

Occurrence. - Occurs throughout the Jackson group in Mississippi, rarely in the North Creek clay member.

Remarks. - The larger left valve on cotype slide no. 1103, Henry V. Howe Collection, Louisiana State University, is designated as holotype of this species.

Trachyleberis rossmani n. sp.
Pl. XVI., figs. 17-20

Diagnosis. - Carapace heavy with the surface completely covered by irregularly arranged, vertically tapering spines. Two larger spines in the postero-dorsal region project well above the others.

Description. - Carapace heavy, elongate-subovate in outline. Dorsal margin straight with a row of several sharp spines projecting above the edge. Ventral margin straight to slightly convex. Anterior margin broadly and obliquely rounded with a heavy rim which is fringed with a double row of denticles. Posterior margin pointed and slightly compressed; it is straight in the dorsal half and obliquely rounded with several small spines in the ventral half. Greatest height at the anterior cardinal angle. Entire surface of the carapace ornamented by numerous sharp, irregularly arranged, vertically tapering spines. There are also two strong spines, which project above the others, in the

postero-dorsal region.

On the inside, the valves are shallow with broad marginal areas. Radial pore canals numerous, some are wavy, branched, and occur in bundles of two or more. Selvage strong. The line of concrescence coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four oval-shaped scars on the posterior edge of the muscle pit with a U-shaped scar near the anterior edge of the pit. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a narrow groove to a rounded posterior tooth. Hinge of the left valve complementary. Males are identical to the females except that they are more elongate.

Dimensions. - Holotype no. 6112, a complete female carapace from the North Creek clay member at locality 2: length 0.83 mm., height 0.50 mm., thickness 0.36 mm. Paratype no. 6113, a female right valve: length 0.79 mm., height 0.44 mm. Paratype 6114, a male right valve: length 0.89 mm., height 0.43 mm. Paratype no. 6115, a male left valve: length 0.89 mm., height 0.43 mm. All paratypes are from the same locality as the holotype.

Comparisons. - This species differs from T. montgomeryensis (Howe and Chambers), 1935, by the presence of the two large spines in the postero-dorsal region which stand out above the other spines. This is a constant feature displayed by

hundreds of specimens studied. Surface spines are also more numerous, and there is a smaller amount of smooth area near the margins than in T. montgomeryensis.

Occurrence. - Occurs in the North Creek clay member at localities 1, 2, 4, 9, and 10; and the Shubuta clay member at locality 5.

Genus TRINGLYMUS Blake, 1950

Type Species *Tringlymus hyperochus* Blake, 1950

Tringlymus hyperochus Blake, 1950
Pl. XVII., figs. 1-3

Tringlymus hyperochus Blake, 1950, Jour. Paleontology,
vol. 24, p. 181, pl. 30, figs. 4-9.

Diagnosis. - Surface coarsely reticulate with reticles arranged in rows subparallel to the margins. Hingement holamphidont with an additional "anti-slip" tooth projection near the anterior tooth and socket area.

Description. - Carapace elongate-subovate in side view. Dorsal margin straight to slightly concave; ventral margin slightly sinuate and parallel to the dorsal margin. Anterior margin broadly and obliquely rounded and slightly denticulate at the antero-ventral margin. Posterior end evenly rounded in the left valve. In the right valve, it is straight in the dorsal part, rounded and fringed with denticles in the ventral part. Greatest thickness at the

swollen postero-ventral region. Surface of the carapace ornamented by coarse shallow reticulations arranged in rows subparallel to the margins.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals moderately numerous at the anterior margin, straight, and commonly paired. The line of concrescence lies near the inner margin. Muscle scar pattern consists of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a high, rounded anterior tooth and a post-jacent triangular socket connected by a smooth groove to a flat, rounded posterior tooth. Hinge of the left valve consists of a small anterior socket and a blunt, rounded post-jacent tooth connected by a dorsal bar to an elongate, oval-shaped socket. A large subtriangular projection extends downward from just behind the anterior tooth and socket area in both valves. Males are more elongate than females with less regularity of size of the surface reticles. The sub-central tubercle is also more prominent in males than in females.

Dimensions. - Hypotype no. 6116, a female right valve from the Moodys Branch formation at locality 15: length 0.70 mm., height 0.34 mm. Hypotype no. 6117, a male right valve from the same locality: length 0.74 mm., height 0.34 mm.

Comparisons. - Comparison of the hypotypes with the syntypes

indicates the identity of the species.

Occurrence. - Occurs in the Moodys Branch formation at localities 3 and 15; rarely in the Cocoa sand member at locality 1.

Tringlymus gnythophoreus Krutak, 1960
Pl. XVII., figs. 4-9

Tringlymus gnythophoreus Krutak, 1960, "Jackson Eocene Ostracoda from the Cocoa Sand of Alabama," MS Thesis (unpubl.), Louisiana State University.

Diagnosis. - Anterior margin obliquely rounded; posterior margin subtruncate. Surface covered with coarse pits irregularly arranged in the central region; subparallel to the margins in the posterior and ventral regions. Hingement holamphidont with "anti-slip" tooth projection near the anterior tooth and socket region.

Description. - Carapace elongate-subovate in outline. Dorsal and ventral margins straight and parallel. Anterior margin obliquely rounded, slightly compressed, with a wide marginal rim. Posterior margin subtruncate. Surface ornamented by coarse pits irregularly arranged in the central region but subparallel to the margins in the posterior and ventral regions. There are two or three small ridges near and parallel to the anterior margin. Left valve overlaps the right valve at the anterior cardinal angle.

On the inside, the valves are deep with moderately

broad marginal areas. Radial pore canals numerous at the anterior margin, short, and some are branched. They are few and widely spaced at the posterior. The line of concrescence lies very near the inner margin at the posterior and ventral margins but swings outward slightly at the anterior margin. Muscle scar pattern consists of a vertical row of four oval-shaped scars with two scars anterior to them. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a groove to a blunt, rounded posterior tooth. Hinge of the left valve complementary. A subtriangular projection extends downward from a point just behind the anterior tooth and socket area of each valve. Males are more elongate than females.

Dimensions. - Hypotype no. 6118, a female carapace from the Cocoa sand member at locality 1: length 0.63 mm., height 0.29 mm. Hypotype no. 6120, a male right valve: length 0.63 mm., height 0.26 mm. Hypotype no. 6119, a female left valve: length 0.60 mm., height 0.29 mm. All hypotypes are from the Cocoa sand member at locality 1.

Comparisons. - This species differs from T. hyperochus Blake, just described, in possessing a smaller carapace, a more oblique anterior, and in displaying more irregularity of pitting in the central region of the valves. It differs from T. neauphlensis Apostolescu, 1955, from the Lutetian

of the Paris Basin in being much more obliquely rounded and produced at the antero-ventral extremity.

Occurrence. - Occurs in the North Creek clay member at locality 4; Cocoa sand member at localities 1 and 6; and very rarely in the Pachuta marl member at locality 6.

Tringinglymus debremaeckeri n. sp.
Pl. XVII., figs. 10-14.

Diagnosis. - Surface ornamented by delicate, longitudinal, subparallel ridges. Alternating with the ridges are double rows of numerous, small, closely spaced, normal pore canals. Hingement holamphidont with an "anti-slip" tooth projection in the anterior tooth and socket area of each valve.

Description. - Carapace elongate-subovate in outline. Dorsal margin slightly sinuate; ventral margin slightly concave in the middle. Anterior margin broadly and obliquely rounded with a small rim. Posterior margin narrowly rounded with several short denticles. Greatest height at the anterior cardinal angle; greatest thickness posterior to center. Surface of the valves ornamented by delicate longitudinal subparallel ridges. Alternating with the ridges are double rows of small normal pore canals which are numerous and closely spaced. Subcentral tubercle prominent.

On the inside, the valves are moderately deep with very broad marginal areas, especially at the anterior. Radial

pore canals numerous, long, commonly branched, and closely spaced at the anterior margin. Few, occasionally branched, and widely spaced at the posterior margin. The line of concretion coincides with the inner margin throughout. Muscle scar pattern consists of a vertical row of four irregularly shaped scars with two scars anterior to them. Hinge of the right valve consists of a high, rounded anterior tooth and a postjacent socket connected by a groove to a small, blunt posterior tooth. Hinge of the left valve complementary. In both valves there is a small subtriangular projection which extends downward just behind the anterior tooth and socket area. Dimorphism not determined.

Dimensions. - Holotype no. 6121, a complete carapace from the Moodys Branch formation at locality 8: length 0.74 mm., height 0.31 mm. Paratype no. 6123, a right valve: length 0.70 mm., height 0.30 mm. Paratype no. 6122, a left valve: length 0.74 mm., height 0.33 mm. All paratypes are from the same locality as the holotype.

Comparisons. - This species resembles T. tenuistriatus Apostolescu, 1955, from the Lutetian of the Paris Basin but differs from that species in being more elongate, and its dorsal and ventral margins show more convergence toward the posterior. The anterior margin is also more oblique in the antero-ventral part.

Occurrence. - Occurs in the Moodys Branch formation at localities 8 and 15.

Family XESTOLEBERIDAE Sars, 1928

Genus XESTOLEBERIS Sars, 1866

Type Species *Cythere aurantia* Baird, 1838

Xestoleberis sarsi Howe and Chambers, 1935
Pl. XVII., figs. 15-18

Xestoleberis sarsi Howe and Chambers, 1935, La. Dept. Cons.
Geol. Bull. 5, p. 48, pl. 3, fig. 9; pl. 4, fig. 10; pl.
6, fig. 16.

Diagnosis. - Carapace tumid, smooth, somewhat egg-shaped. Dorsal margin strongly arched and tapers to a narrowly rounded anterior end. Posterior subtruncate. Greatest thickness in the middle; greatest height slightly posterior to center.

Description. - Carapace tumid, somewhat egg-shaped in outline. Dorsal margin strongly arched and tapers sharply to a narrowly rounded anterior. Posterior end subtruncate. Greatest height near the middle; greatest thickness slightly posterior to center. Left valve overlaps the right valve along the dorsal margin. Surface of the carapace smooth.

On the inside, the valves are deep with moderately broad marginal areas. Radial pore canals few and widely spaced in the dorsal half of the anterior margin; but they are more numerous in the ventral half. The line of con-

creescence lies near the outer margin at the anterior extremity, obscure elsewhere. Muscle scar pattern consists of a vertical row of four elongate scars with a U-shaped scar anterior to them. A crescent-shaped scar is located below the eye region, and there is a small scar near the ventral margin. Hinge of the right valve consists of an elongate, slightly elevated, crenulated cusp at each cardinal area connected by a depressed crenulated groove. Hinge of the left valve consists of an elongate crenulated socket at the anterior and a short crenulated socket at the posterior connected by a dorsal flange. Males are smaller, more elongate, less tumid, and less truncate at the posterior than the females.

Dimensions. - Hypotype no. 6124, a female carapace from the Moodys Branch formation at locality 15: length 0.60 mm., height 0.41 mm. Hypotype no. 6125, a male carapace from the North Creek clay member at locality 4: length 0.46 mm., height 0.30 mm.

Comparisons. - This species is very similar to Xestoleberis obtusa Lienenklaus, 1900 (as figured and described by Oertli, 1956), but differs slightly in that X. sarsi is more evenly rounded at the posterior. Oertli also describes pits on the surface of X. obtusa.

Occurrence. - Occurs in the Moodys Branch formation at

locality 15; and in the North Creek clay member at localities 1, 2, 4, 7, and 9; rarely in the Cocoa sand member at localities 1 and 6; the Pachuta marl member at localities 3 and 6; and very rarely in the Shubuta clay member at locality 6.

Remarks. - The female left valve on cotype slide 833, Henry V. Howe Collection, Louisiana State University, is selected as the holotype of this species.

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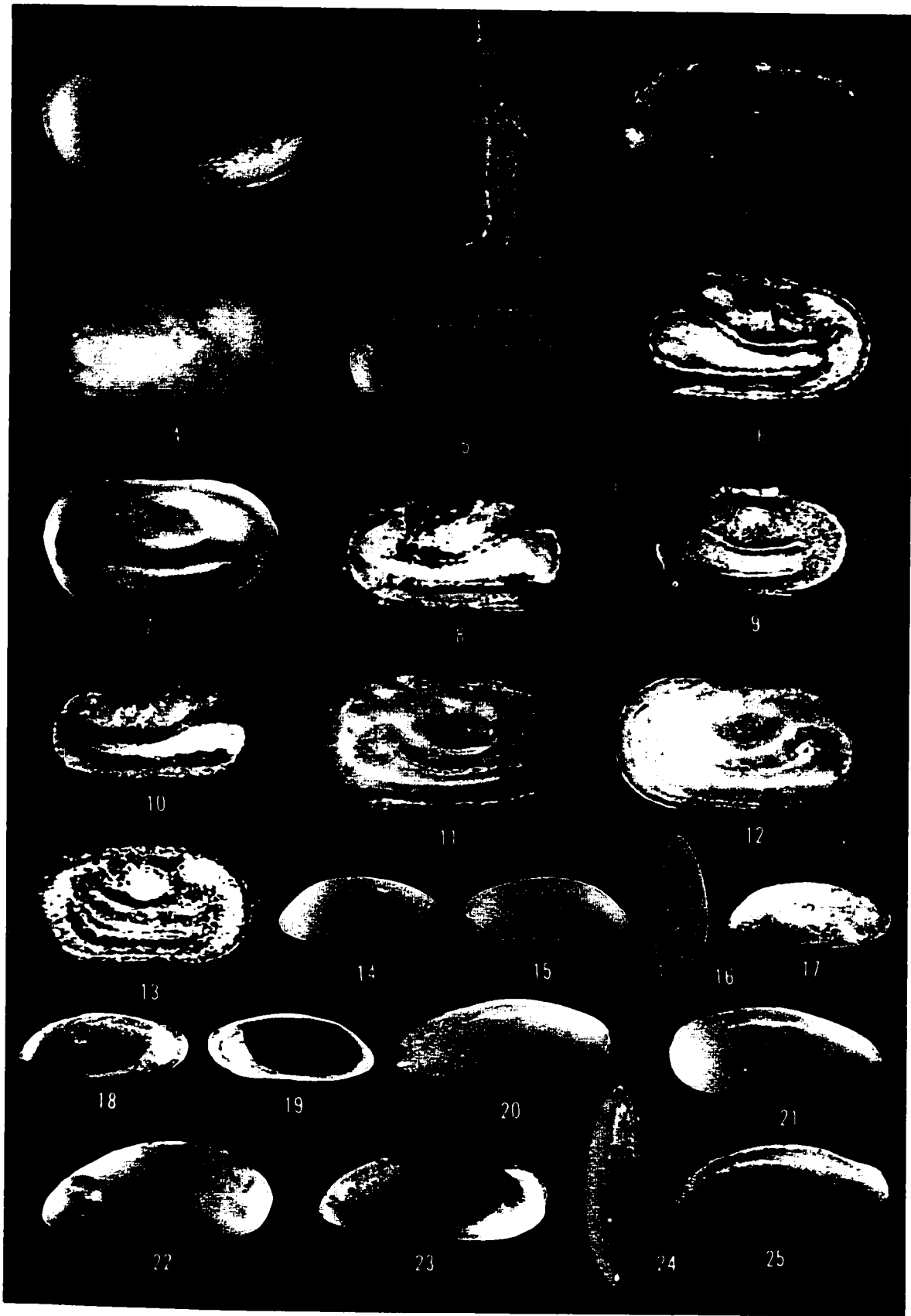


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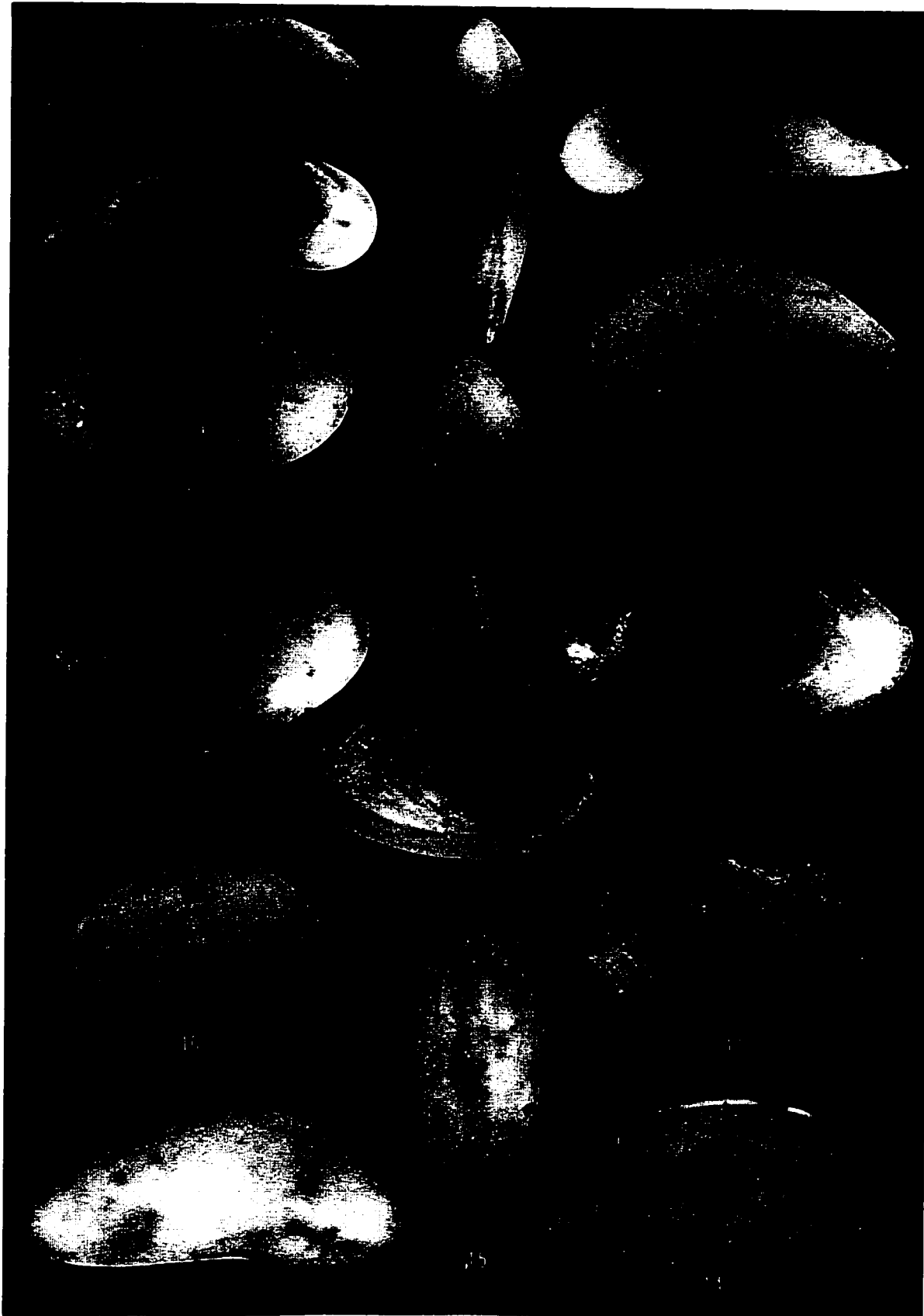


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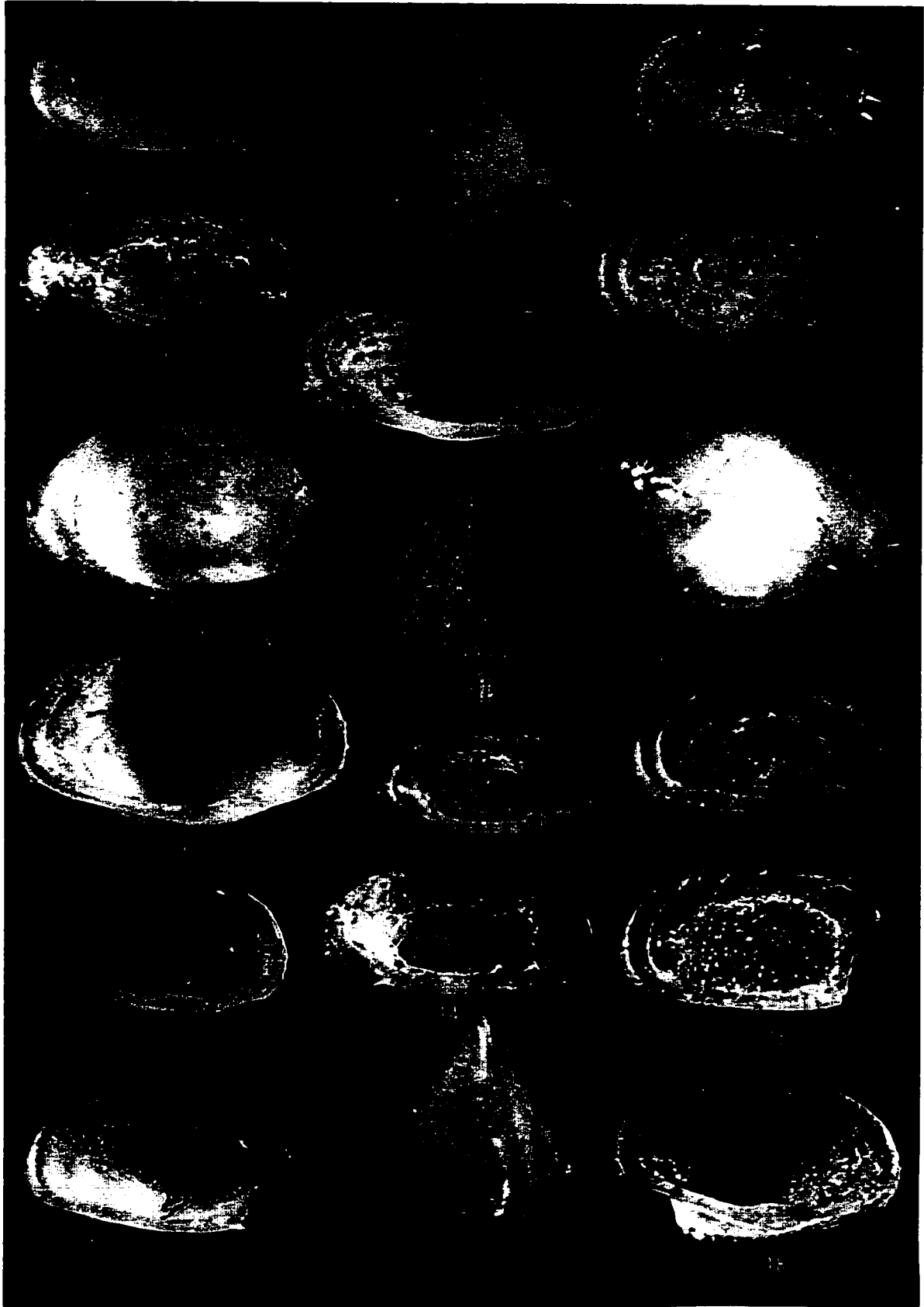


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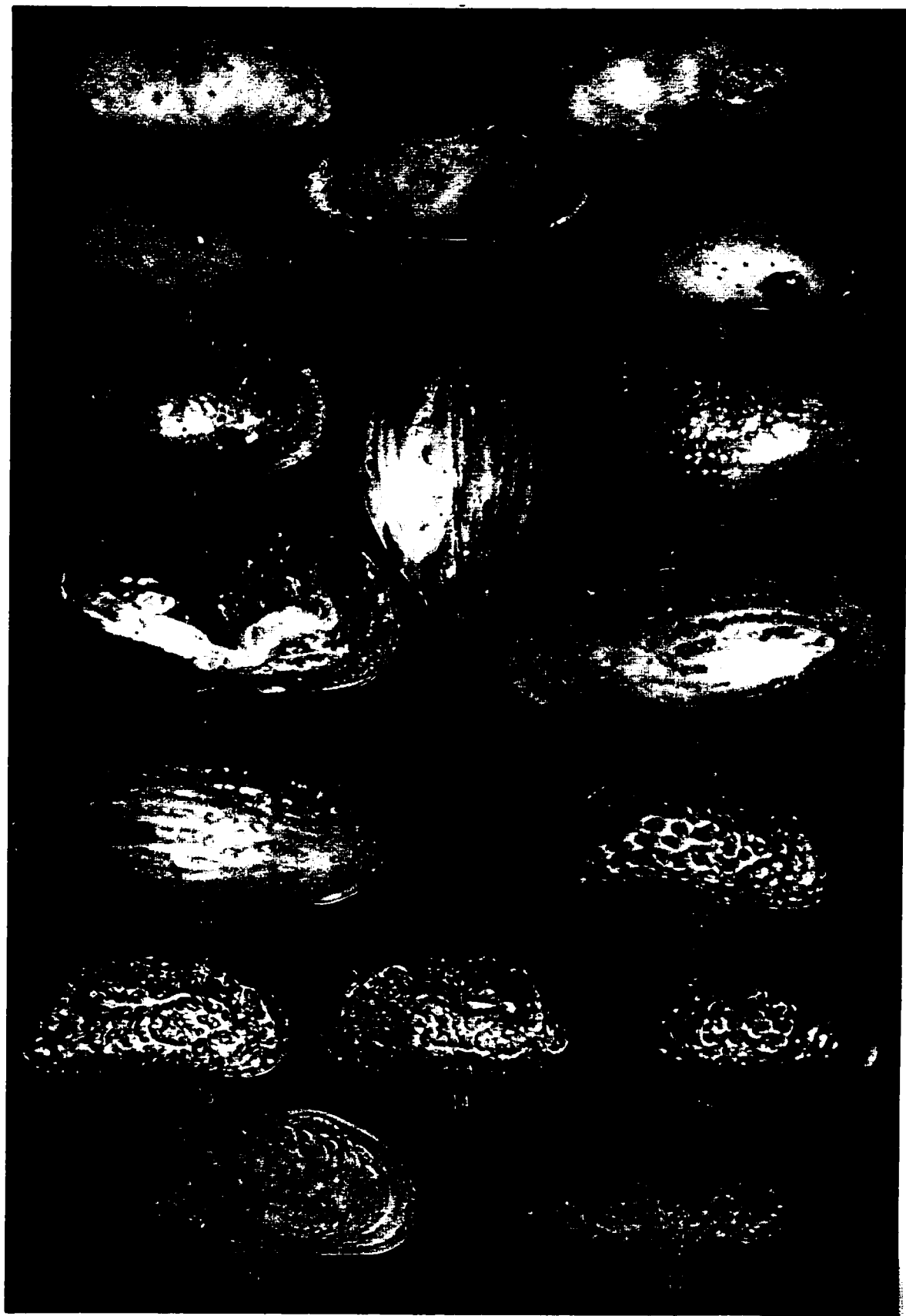


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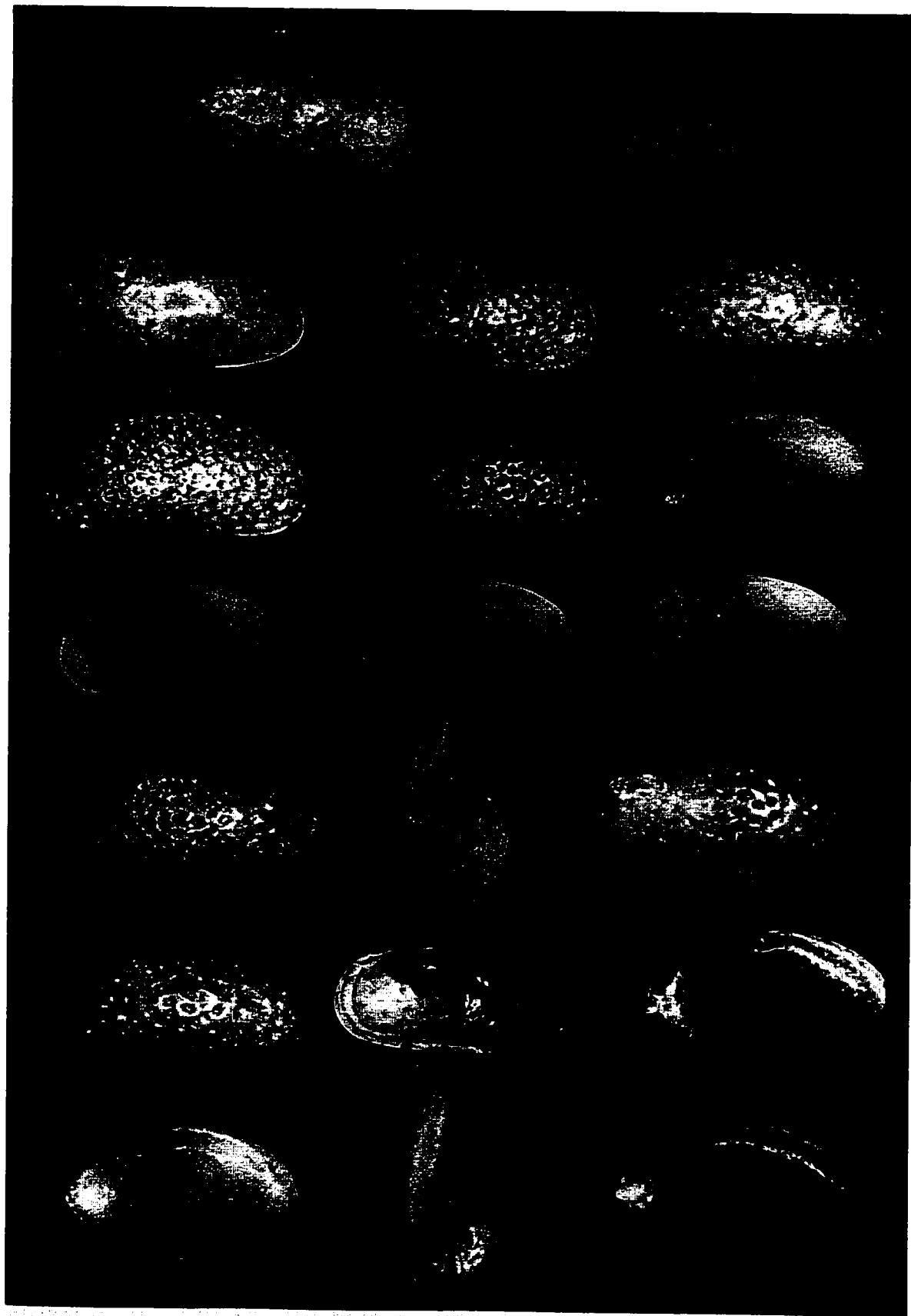


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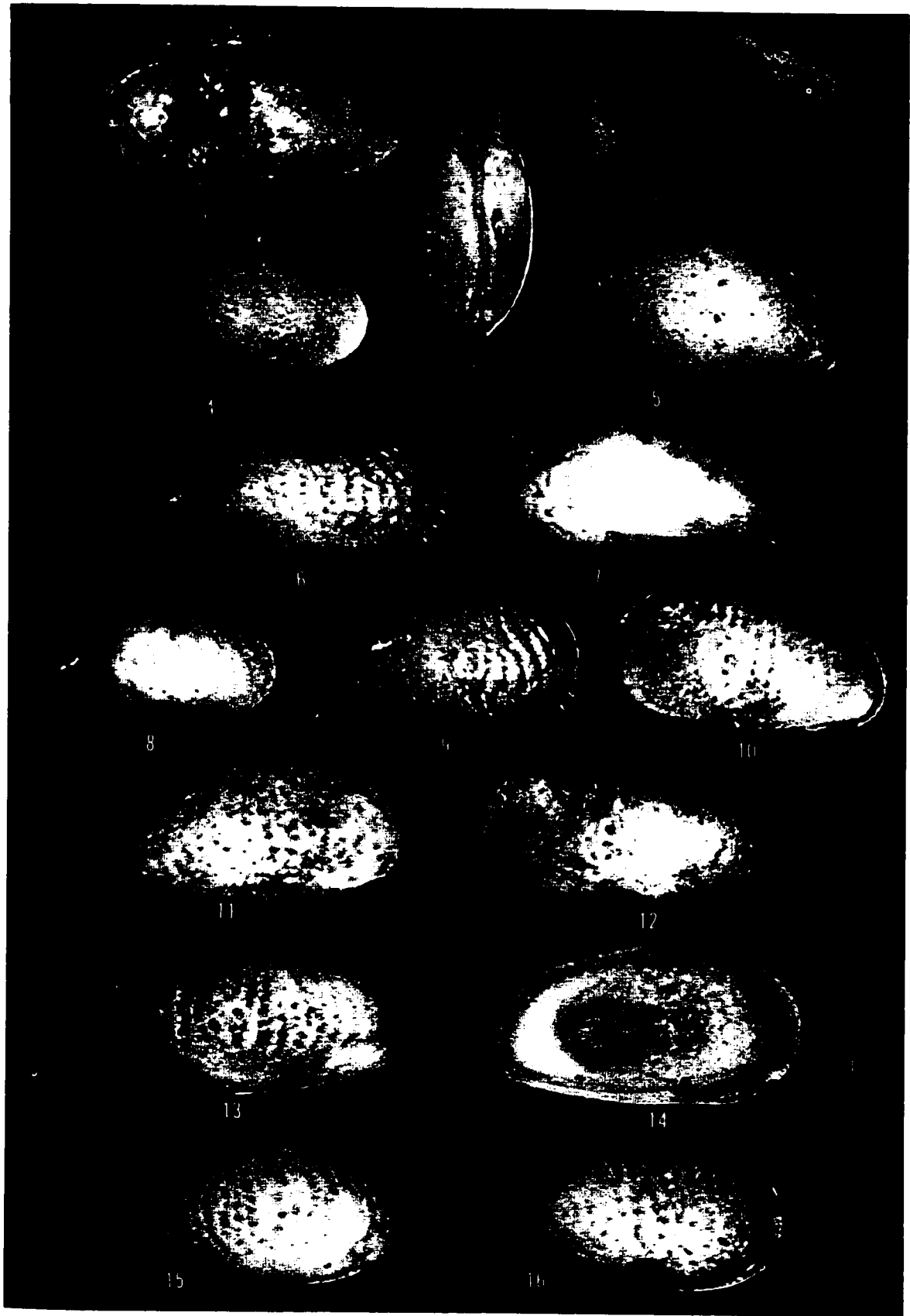


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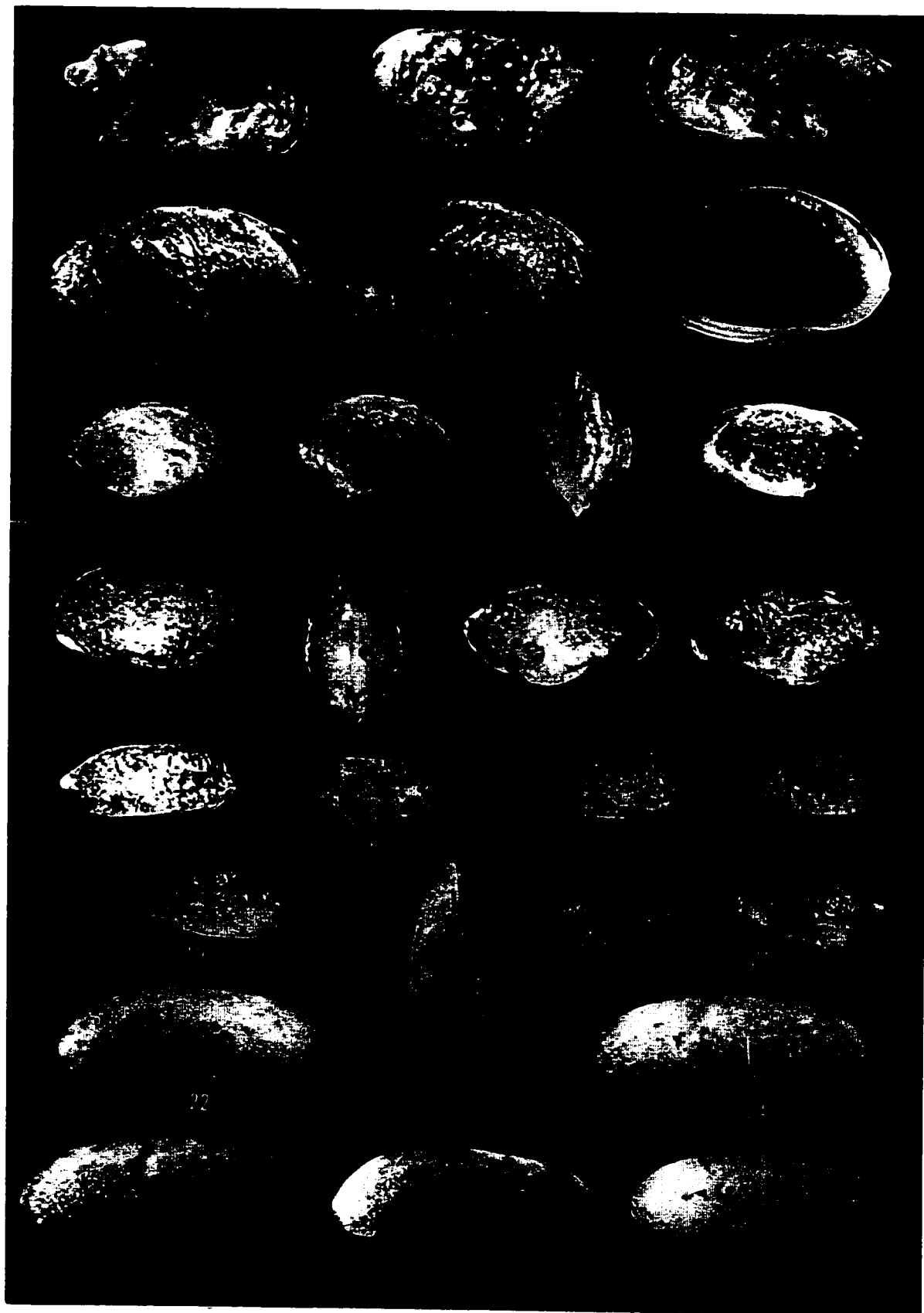


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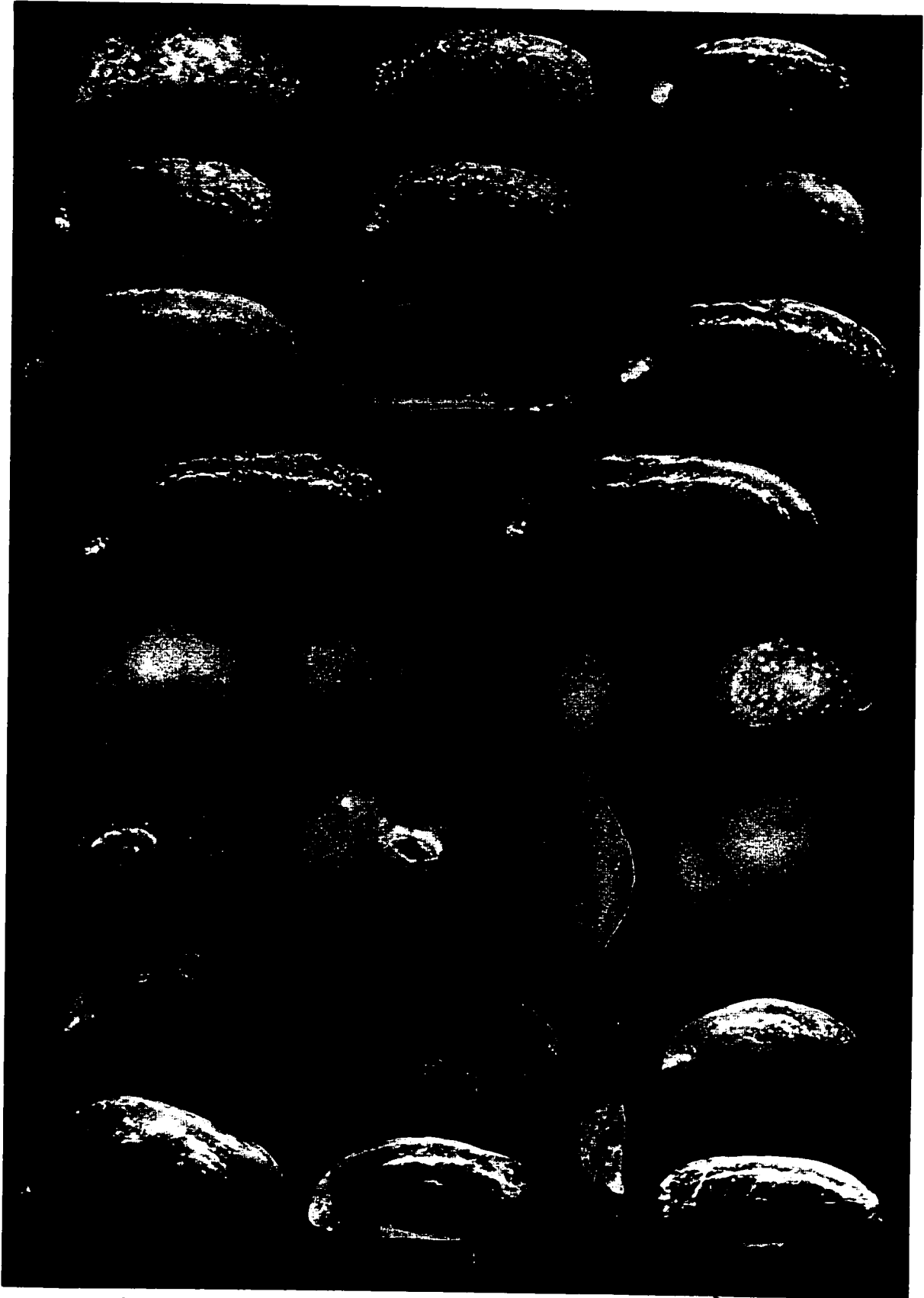


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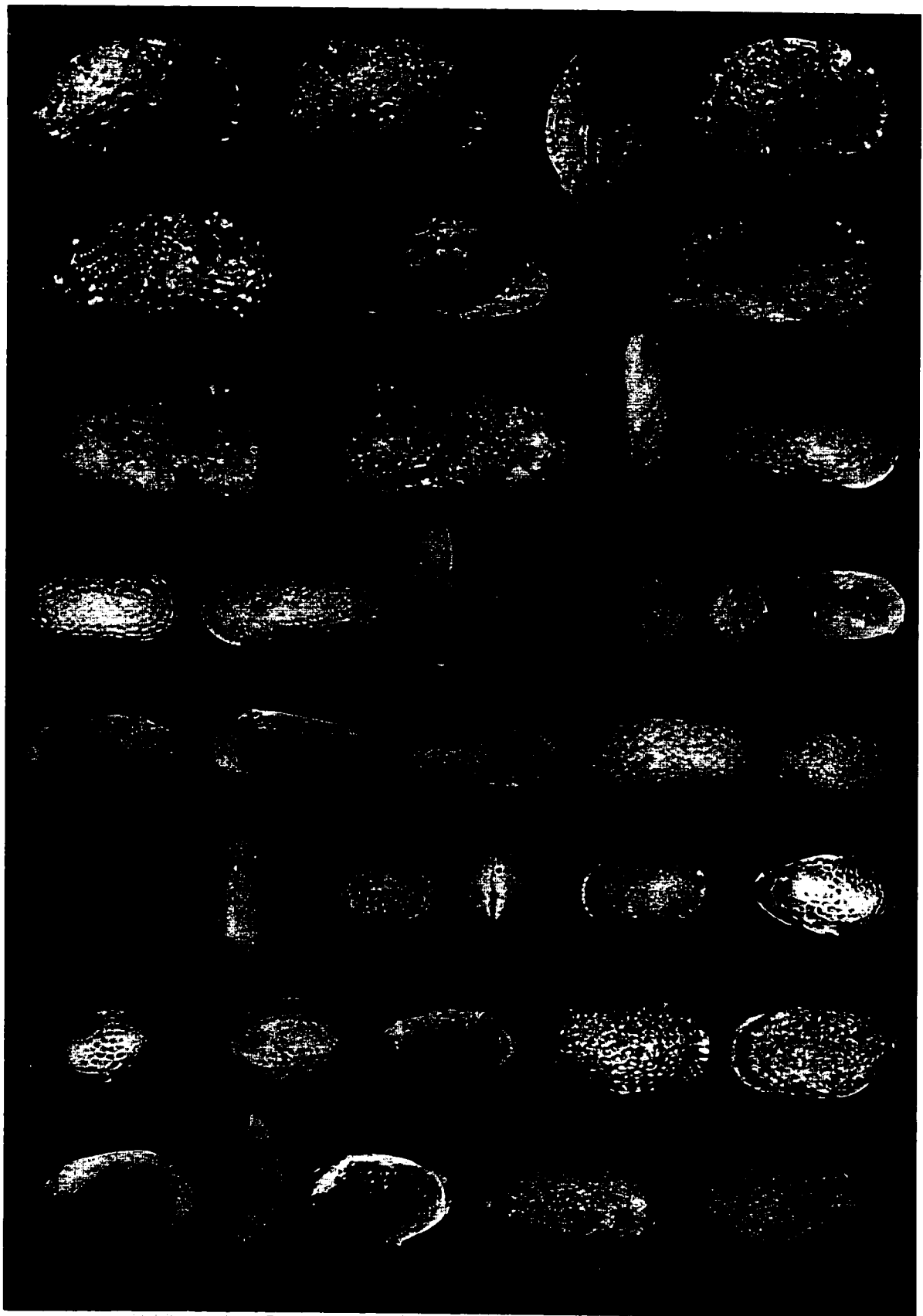


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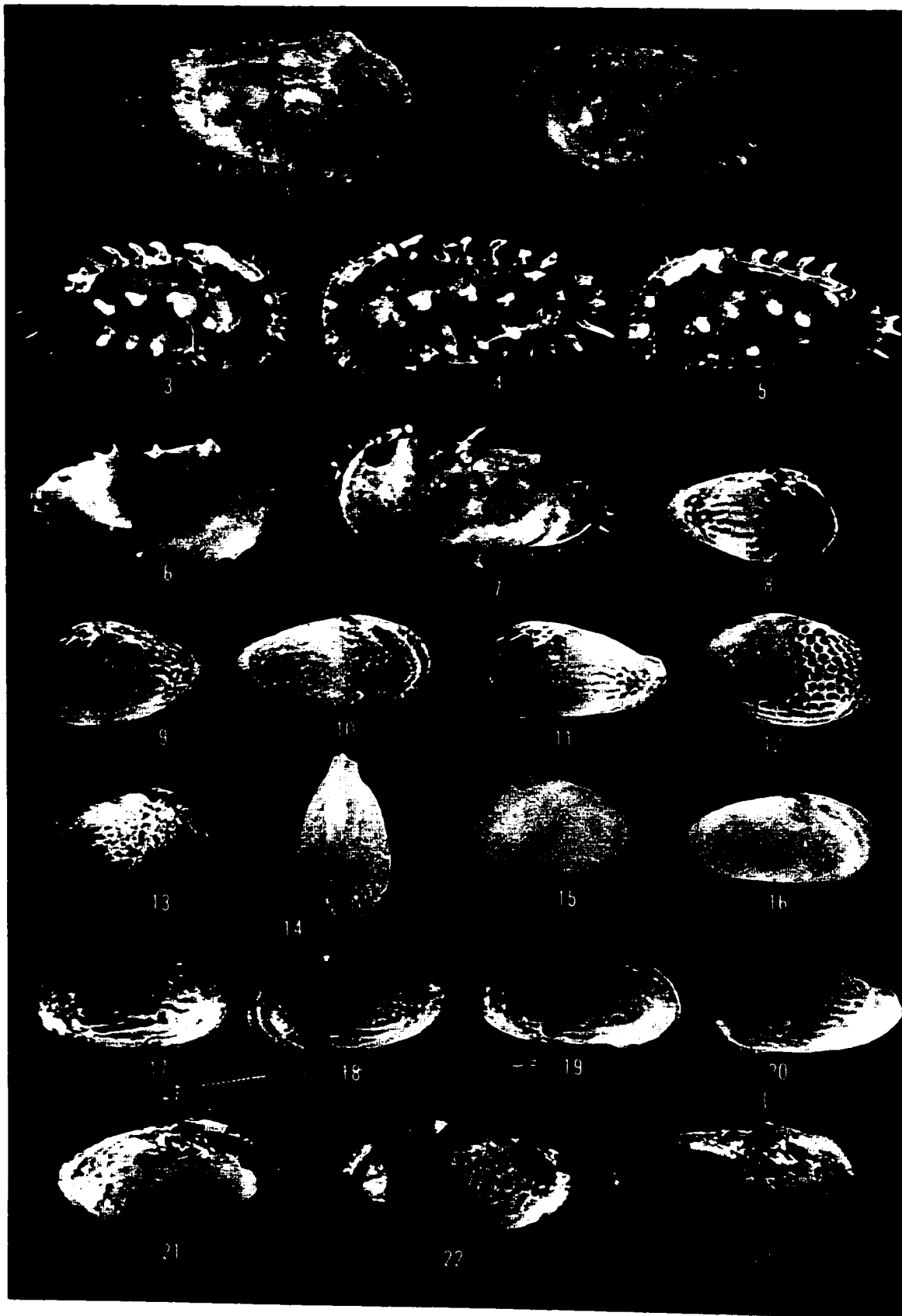


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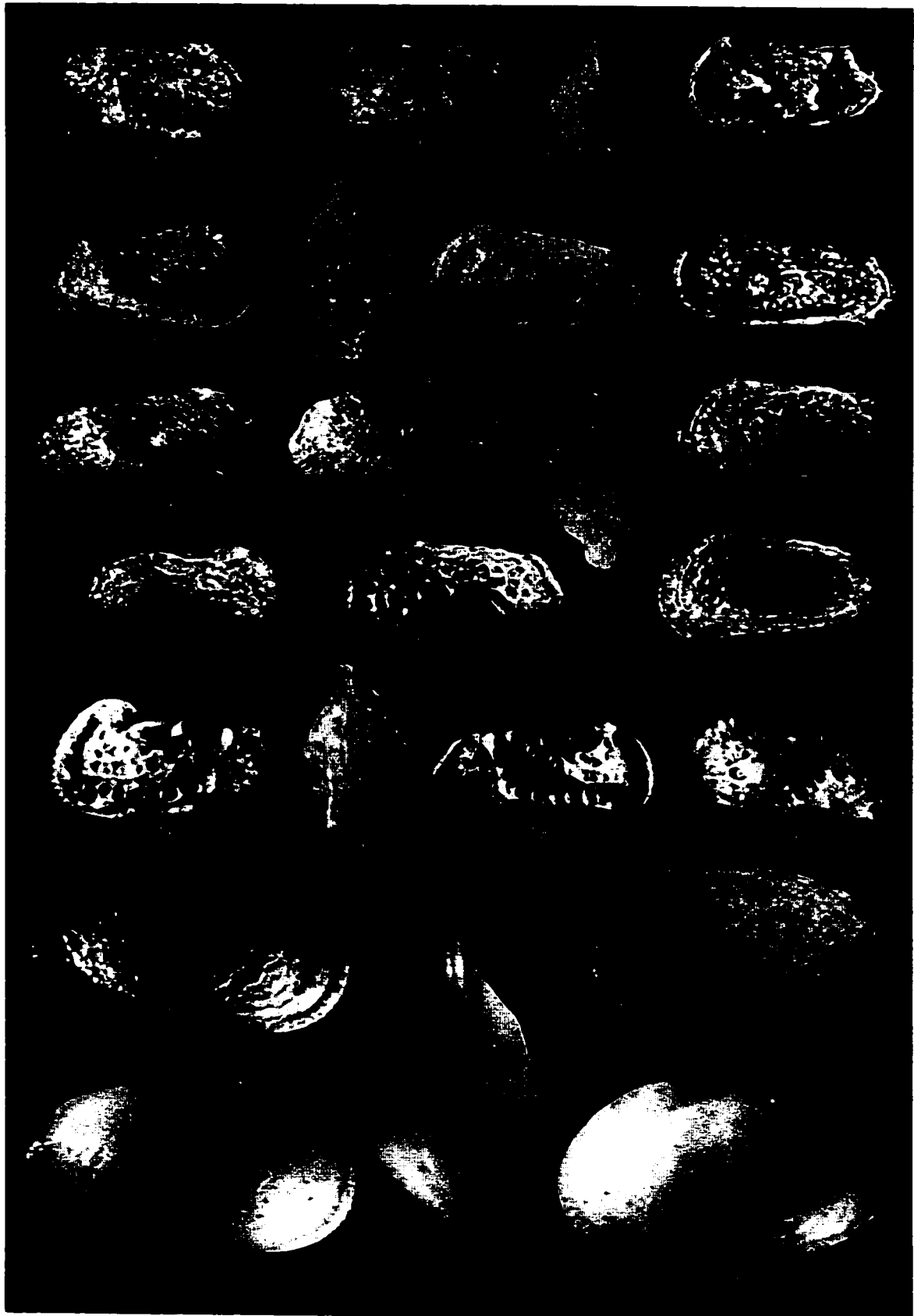


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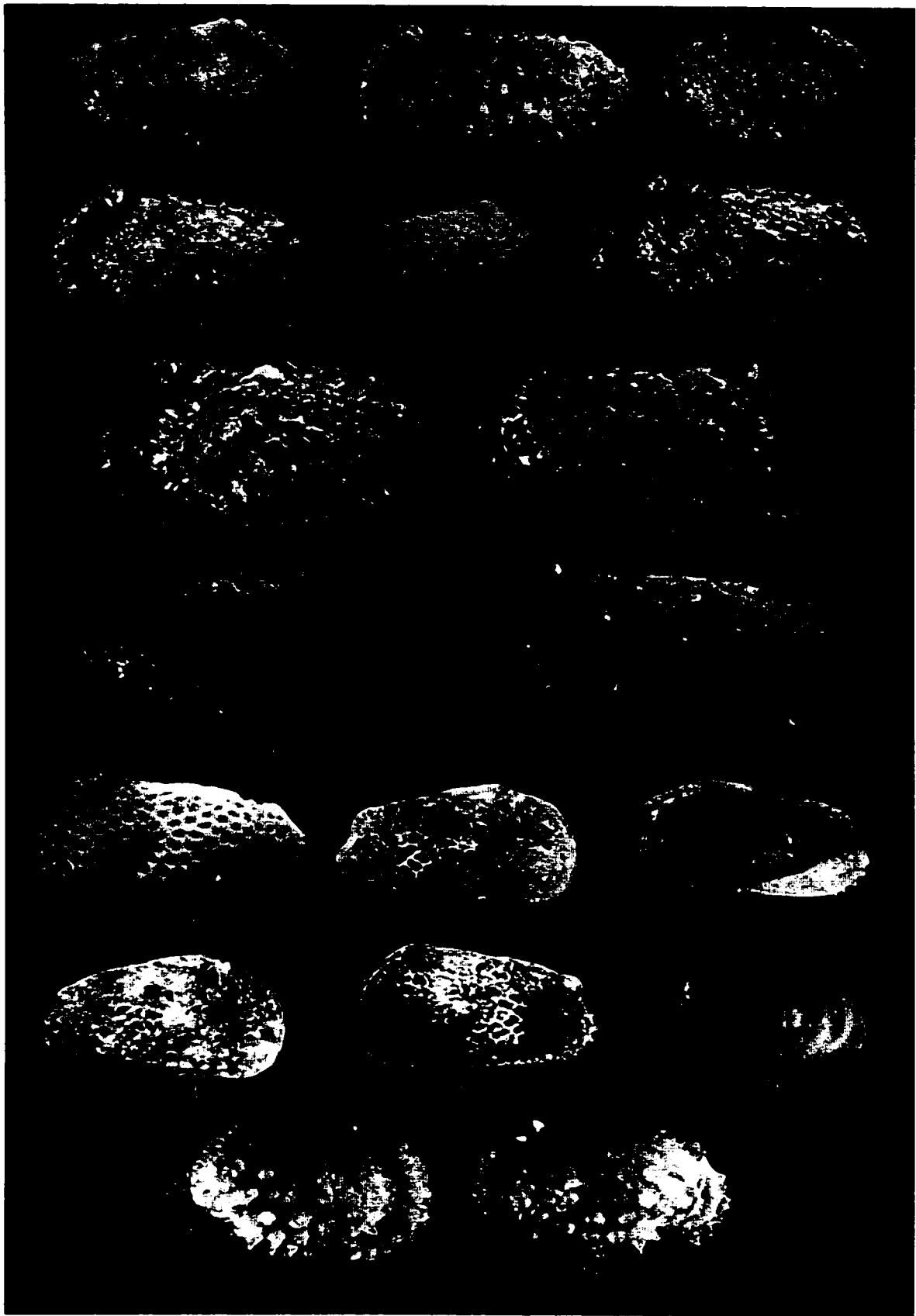


Plate XV. Jackson Eocene Ostracoda of Mississippi

Explanation of Plate XV.

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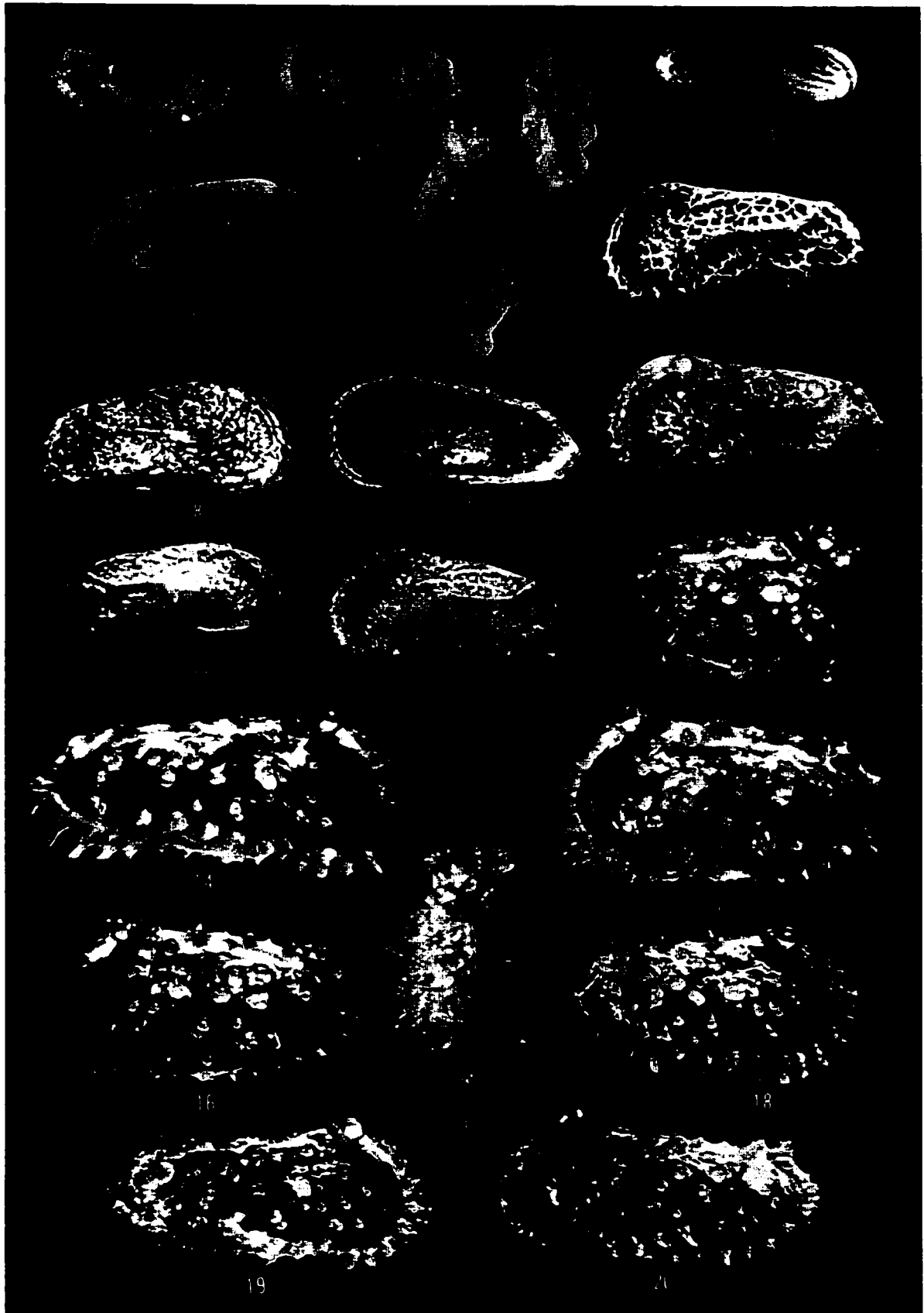


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Explanation of Plate XVI.

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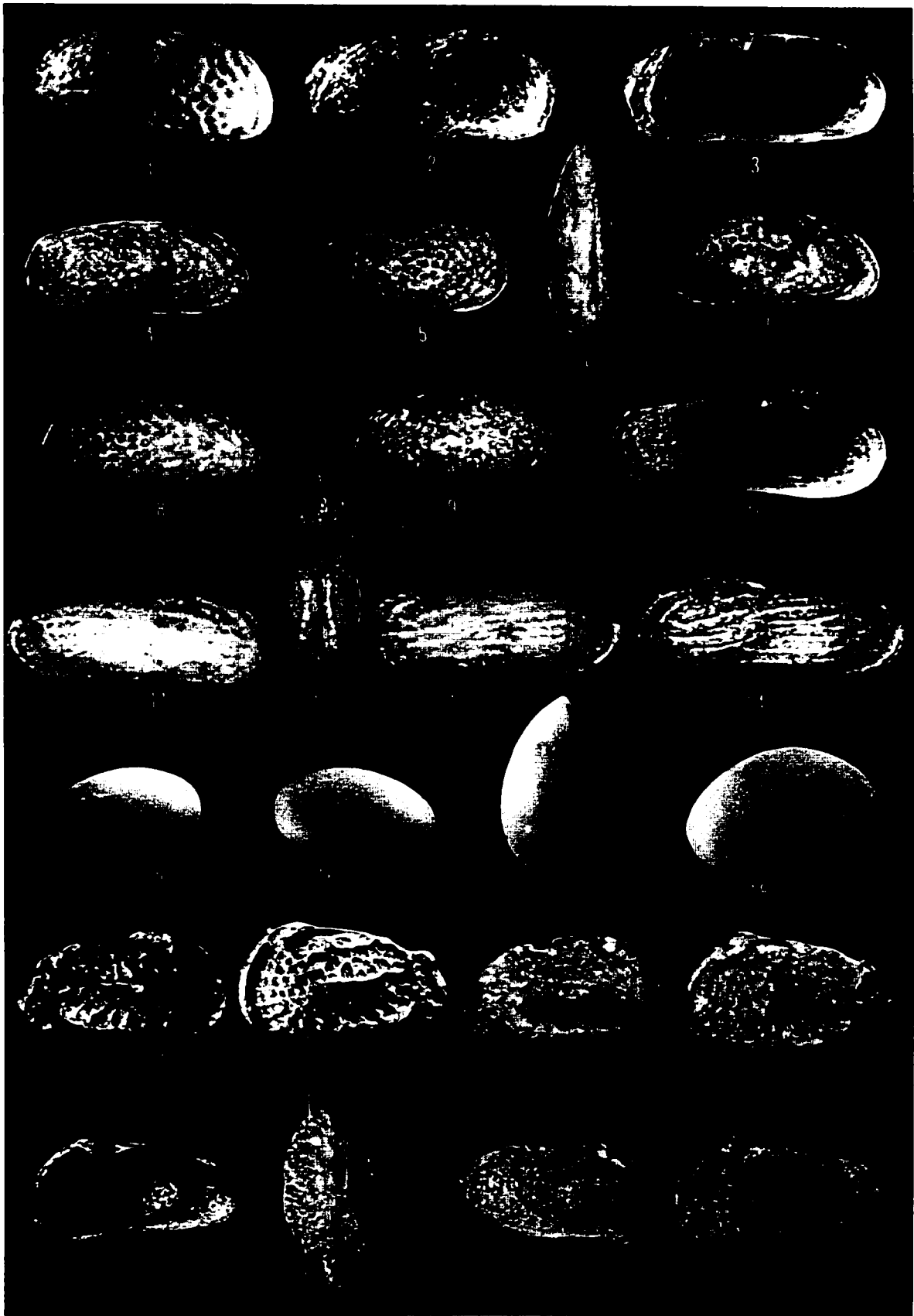


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Explanation of Plate XVII.

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CONCLUSIONS

The following conclusions have been reached as a result of this study:

1. The Jackson group sediments in Mississippi contain a rich and diversified ostracode fauna which is useful for surface and subsurface correlation.
2. The individual members of the Yazoo clay formation designated by Cooke (1933) and Murray (1947) in the eastern counties of Mississippi can be distinguished by their respective ostracodes.
3. The North Creek clay, Cocoa sand, and Pachuta marl members cannot be distinguished individually by their respective ostracodes in the west central area of the state. A broad age equivalency may be established, however, between these units and the litho unit (lower facies) of Mellen (1940). A correlation between the "upper beds" of Bergquist (1942) in the west central area of the state and the Shubuta clay member in the eastern area of the state is suggested by their ostracodes.
4. The Green sand member of the Moodys Branch formation is correlative without any appreciable change in ostracode fauna throughout the entire area of its outcrop in Mississippi.
5. The Upper marl member of the Moodys Branch formation is

more nearly analogous to the Yazoo clay formation faunally and lithologically than to the Green sand member of the Moodys Branch formation, and therefore, it should be included as the basal part of the Yazoo clay formation.

6. The good correlation of the Moodys Branch formation ostracoda of Mississippi with those of the Gosport sand (Claiborne) of Alabama and the relatively poor correlation with the ostracoda of the Ocala group in Florida suggest that the facies factor may be more important than the time factor if the age discrepancies of the strata involved are small.
7. The Moodys Branch formation was the transgressive phase of the Jackson cycle and it represents deposition in a shallow water, near shore region within the inner sublittoral zone.
8. The Yazoo clay formation in the west central area represents the inundative phase of the Jackson cycle and also indicates rapid deposition in relatively deep water in the mid-sublittoral depth range.
9. The North Creek clay, Cocoa sand, and Pachuta marl members in the eastern counties represent deposition on a shelf area at depths within the inner sublittoral zone and at depths which were shoaler than the depths at which the Yazoo clay formation of the west central area was deposited. Sedimentation in the eastern area during

- deposition of these members may have been affected by the southeastern plateau described by Bornhauser (1947).
10. The evidence of this report tends to corroborate Bornhauser's (1947) suggestion that a distinct regressive phase of the Jackson cycle is missing in this area and that the axis of deepest water deposition was farther west in Louisiana.
 11. Evidence of this report corroborates the observation of Burst (1959) that mineralogy of heterogeneous "glauconite" pellets from formations on Tertiary unconformities differs considerably from the mineralogy of "glauconite" pellets from the conformable sediments.

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APPENDIX

LOCALITIES AND DESCRIPTIONS OF SAMPLES

Locality 1. - Keyser Hill, Alabama. Located 0.1 miles west of Gilbertown, Alabama, on Alabama farm road No. 14.

Large road cut through a hill.

Yazoo Clay formation

North Creek Clay member

- a. Collected by Paul Krutak 21 feet above bridge.
Gray-green, blocky, fossiliferous, calcareous clay.
- b. Collected by Paul Krutak 31 feet above bridge.
Gray-green, fossiliferous, calcareous clay.

Cocoa Sand member

- c. Collected from fresh material on south bank of road near ditch level approximately 200 feet east of hill top. Blue-green, fossiliferous, fine grained, argillaceous sand.
- d. Collected from south bank of road cut approximately 3 feet higher than (c) above. Blue-green, fossiliferous, fine grained, argillaceous sand.
- e. Collected from south bank of road cut 3 feet higher than (d) above. Blue-green, fossiliferous, fine grained, argillaceous sand.
- f. Collected from south bank of road cut 2 feet higher than (e) above. Blue-green, fossiliferous, fine grained, argillaceous sand.
- g. Collected from south bank 3 feet higher than (f)

above. Blue-green, fossiliferous, fine grained, argillaceous sand.

- h. Collected from south bank of road cut, just below colluviated buff sand. Blue-green, weathers buff, micaceous, fossiliferous, fine grained sand.

Remainder of outcrop consists of medium to coarse grained buff, non-fossiliferous, colluviated sand.

Locality 2. - Frost Bridge-Bucatumna Creek locality.

Bridge over Bucatumna Creek 5 miles west of Izney, Alabama, on old Izney, Alabama, Waynesboro, Mississippi, dirt road.

In NW $\frac{1}{4}$ of Sec. 23 T. 10 N., R. 5 W., Wayne County, Mississippi.

Yazoo Clay formation

North Creek Clay member

- a. Collected from edge of water on east bank at a sharp bend in the creek 200 yards upstream north of the bridge. Gray-green, micaceous, fossiliferous, calcareous clay.
- b. Collected from same place as (a) above, but 5 feet higher on creek bank. Gray-green, micaceous, fossiliferous, calcareous clay.
- c. Collected from east bank of creek 3 feet above water, 125 yards upstream north of bridge. Gray-green, micaceous, fossiliferous, calcareous clay.
- d. Collected from the same location as (c) above except 3 feet higher on the bank. Gray-green, fossiliferous,

micaceous, calcareous clay.

Locality 3. - Frost Bridge Road Y locality. This outcrop is located between road forks 0.5 mile west on a dirt road from Frost Bridge over Bucatunna Creek as described in locality 2 above. Samples were collected from gullies in a pasture.

Yazoo Clay formation

Pachuta Marl member

- a. Collected approximately 4 feet above a limestone ledge with Pectens. Creamy buff, chalky, weathered, fossiliferous marl.
- b. Collected approximately 3 feet above a thin indurated limestone ledge and approximately 5 feet above (a) above in transition zone to Shubuta clay member. Creamy buff, chalky, weathered, fossiliferous marl.
- c. Collected by geology staff, Mississippi State University. Light buff, creamy, fossiliferous marl with calcareous lumps.
- d. Collected by Gene Martin and designated as Sample 19A. Washed material consists of sand, mica, some glauconite, calcareous nodules, young pectens, bryozoa, many foraminifera and ostracodes.

Shubuta Clay member

- e. Collected by geology staff, Mississippi State University. Buff to gray, lumpy, iron stained, calcareous, fossiliferous clay.

Locality 4. - Shiloh Creek location. Bridge over Shiloh Creek on Mathersville-Frost Bridge dirt road 3 miles north-east of location 3 described above. SW $\frac{1}{4}$, Sec. 18, T. 10 N., R. 5 W., Wayne County, Mississippi.

Yazoo Clay formation

North Creek Clay member

- a. Collected from fresh material at the edge of the water on the south bank of the creek 75 feet downstream from bridge. Gray-green, fossiliferous, micaceous, fine grained, sandy clay.
- b. Collected 2 feet higher than (a) above. Gray-green, fossiliferous, fine grained, sandy clay.
- c. Collected by Gene Martin 3 feet below a claystone ledge approximately 100 feet downstream from the bridge on the south bank of the creek.

Locality 5. - Chickasawhay River north of Hiwannee, Mississippi. SW $\frac{1}{4}$ Sec. 28, T. 7 N., R. 10 W., Wayne County, Mississippi.

Yazoo Clay formation

Shubuta Clay member

- a. Collected by E. H. Rainwater from the edge of

Chickasawhay River north of Hiwannee, Mississippi.
Designated as "Cocoa Sand of Cushman." Blocky,
blue-green, fossiliferous clay near water's edge.

Locality 6. - Shubuta Hill locality. Samples were collected from a large gully which begins on the north side of Chickasawhay River Bridge on old U. S. Highway 45. The gully extends eastward up a long hill parallel to and just north of the highway and approximately along the line of the NW $\frac{1}{4}$ of Sec. 10, T. 10 N., R. 7 W., Clarke County, Mississippi.

Yazoo Clay formation

Cocoa Sand member

- a. Collected from edge of water at intersection of the gully and stream on north side beneath the bridge. Blue-green, fine grained, fossiliferous, micaceous sand.
- b. Collected by E. H. Rainwater from edge of Chickasawhay River. Blue-green, fine grained, fossiliferous sand.

Pachuta Marl member

- c. Collected by Dr. Alan Cheetham from the "Pecten Bryozoan" zone. Louisiana State University Museum number 240. Light creamy-gray, semi-indurated, slightly sandy, glauconitic, fossiliferous marl.
- d. Collected by E. H. Rainwater from the "Pecten Bryozoan" bed. Washed material consists of abundant

foraminifera, ostracodes, some bryozoa, with traces of glauconite and sand.

- e. Collected several yards up the gully from the edge of the river and approximately 10 feet above the water. Weathered gray, sandy, slightly glauconitic, fossiliferous marl.

Shubuta Clay member

- f. Collected approximately 15 feet higher than (e) above. Weathered buff, blocky, fossiliferous, calcareous clay.
- g-1. Collected approximately 10 feet higher than (f) above. Gray to buff, fossiliferous, blocky clay.
- g-2. Collected one foot above (g-1) above where clay changes color from gray to buff, to limonite stained buff, blocky, calcareous clay.
- h. Collected by geology staff, Mississippi State University, 49 feet above the base of the Shubuta Clay. Light gray to buff, weathered, flaky, calcareous, fossiliferous clay.
- i. Collected by geology staff, Mississippi State University. (Probably upper Shubuta.) Much weathered, buff to gray, blocky, calcareous, fossiliferous clay.
- j. Collected by geology staff, Mississippi State University. (Exact Shubuta level undetermined.) Gray to buff, blocky, fossiliferous clay.

- k. Collected from ditch level in gully approximately 15 feet higher than (g-2) above. Weathered gray to buff, blocky, highly fossiliferous clay.
- l. Collected from ditch level in gully approximately 20 feet higher than (k) above. Weathered buff, blocky, sticky, fossiliferous, calcareous clay.
- m. Collected from near ditch level in gully approximately 15 feet higher than (l) above. Weathered buff, blocky, sticky, fossiliferous, calcareous clay. Remainder of the gully under cover of undergrowth and grass.
- n. Collected by E. H. Rainwater 15 feet below the base of the Red Bluff Clay. Washed material consists almost exclusively of microfossils, mostly foraminifera, with a small percentage of ostracodes.

Locality 7. - Garland Creek locality. In a large meander of Garland Creek at the edge of a field 3 miles northeast of Shubuta, Mississippi, and 0.9 mile north of the "Hanging Bridge" across Chickasawhay River on a dirt road.

Yazoo Clay formation

North Creek Clay member

- a. Collected 15 feet above the water in the south bank of the creek near a large bend. Blue-gray, micaceous, fossiliferous clay.

Locality 8. - Locality J-GC of Shreveport Geological

Society. South bank of Garland Creek 0.2 mile from bridge over Garland Creek, approximately in the northwest corner of Sec. 28, T. 1 N., R. 16, E.

Moodys Branch formation

Greensand member

- a. Collected by Dr. Henry V. Howe. Washed material consists of abundant foraminifera, ostracodes, glauconite, sand, mica, and many young forms of megafossils.
- b. Collected by Charles Stuckey, Union Oil Company of California. Dark green, sandy, glauconitic, fossiliferous marl.
- c. Collected by Charles Stuckey. Dark green, sandy, glauconitic, fossiliferous marl.

Locality 9. - Pachuta Creek locality. Samples were collected along the south bank of Pachuta Creek beginning approximately 0.5 mile downstream east of U. S. Highway 11 bridge over Pachuta Creek south of Pachuta, Mississippi, at corporate limits. SW $\frac{1}{4}$ Sec. 3, T. 10 N., R. 16 E.

Yazoo Clay formation

North Creek Clay member

- a. Collected at edge of water on south bank of Pachuta Creek a few yards downstream from a large hairpin meander of the creek located approximately 0.5 mile downstream and east of the bridge. Light gray-

- green, fossiliferous, calcareous clay.
- b. Collected at edge of water a few yards upstream from the hairpin meander of (a) described above. Gray-green, fossiliferous, calcareous clay.
 - c. Collected at same place as (b) above except 10 feet higher on creek bank. Gray-green to buff, fossiliferous, calcareous clay.
 - d. Collected from south bank of creek 3 feet above edge of the water, and approximately 200 yards farther upstream west of (c) above. Light gray to buff, somewhat weathered, fossiliferous, calcareous clay.
 - e. Collected from the edge of the water approximately 100 yards downstream east of U. S. Highway 11 bridge over Pachuta Creek. Light gray to buff, blocky, fossiliferous, calcareous clay.

Locality 10. - North Creek Clay type area. Located 3.3 miles south of Rose Hill, Jasper County, Mississippi, on state highway 18.

- a. Sample designated as LSU Geology Museum No. 205. Collected by Dr. Grover E. Murray. Light, creamy-buff, somewhat weathered, fossiliferous marl.

Locality 11. - Test hole J-27, Mississippi State Geological Survey. Located on U. S. Government property in SW $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 15, T. 5 N., R. 6 E., Scott County, Mississippi.

Yazoo Clay formation

Upper beds

- a. Collected from a zone 12.6 feet in thickness

described as greenish-gray, fossiliferous clay;
weathered tan in upper 2 feet.

Locality 12. - Test hole J-86 Mississippi State Geological Survey. Located on U. S. Government property (NW $\frac{1}{4}$, NW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 25, T. 8 N., R. 6 E., Scott County, Mississippi), 30 feet west of road at a point $\frac{1}{4}$ mile south of Forkville fire tower.

Yazoo Clay formation

Lower beds

- a. Sample S-4 of Mississippi State Geological Survey.
Collected from a zone 13.8 feet in thickness described as grayish tan, fossiliferous clay with chalky lime and brown streaks.
- b. Sample S-5 of Mississippi State Geological Survey.
Collected from a zone 25.2 feet in thickness described as fossiliferous, greenish-gray, somewhat pyritiferous clay; glauconitic in lower part.

Locality 13. - Test hole J-89 Mississippi State Geological Survey. Located on R. C. Baker property (near edge of NE $\frac{1}{4}$, SE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 23, T. 7 N., R. 6 E., Scott County, Mississippi). On slope north of barn, 20 feet east of fences and 75 yards northwest of house. Ostrea trigonalis beds 3 feet above hole.

Yazoo Clay formation

Lower beds

- a. Sample S-1 of Mississippi State Geological Survey.

Collected from a zone 6.2 feet in thickness described as light tan fossiliferous clay.

- b. Sample S-2 of Mississippi State Geological Survey. Collected from a zone 27.3 feet in thickness described as greenish-gray, crumbly, highly fossiliferous clay.
- c. Sample SP2B of Mississippi State Geological Survey. Collected from lower part of zone described in (b) above.

The microfauna of samples (b) and (c) above is very analogous to the upper marl of the Moodys Branch formation. This is probably the transition zone.

Locality 14. - Test hole J-91 of Mississippi State Geological Survey. Located on Will Miles property at western edge of SW $\frac{1}{4}$, NW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 16, T. 5 N., R. 7 E. In gully on hillside north of road, $\frac{1}{4}$ mile east of Robinson Creek, Scott County, Mississippi.

Yazoo Clay formation

Upper ? beds

- a. Sample S-3 of Mississippi State Geological Survey. Collected from a zone described as 6 feet of smooth, unweathered, greenish-gray, fossiliferous clay.

Locality 15. - Riverside Park, Jackson, Mississippi. The outcrop is located in a ravine at the eastern edge of Riverside Park approximately 1.5 miles east of Bailey Junior High School in Jackson, Mississippi.

Moodys Branch formation

Greensand member

- a. Collected one foot above contact between Moodys Branch (Greensand) and underlying Cockfield formation. Dark green, sandy, glauconitic, fossiliferous marl.
- b. Collected one foot higher than (a) above. Dark green, sandy, glauconitic, fossiliferous marl.
- c. Collected 4 feet higher than (b) above. Dark green, glauconitic, sandy, fossiliferous marl.
- d. Collected 4 feet higher than (c) above. Green, slightly sandy, glauconitic, fossiliferous marl.
- e. Collected by geology staff, Mississippi State University. Dark green, glauconitic, fossiliferous marl.
- f. Collected by geology staff, Mississippi State University. Dark green, glauconitic, sandy, fossiliferous marl.
- g. Collected by geology staff, Mississippi State University. Dark green, glauconitic, sandy, fossiliferous marl.

Upper Marl member

- h. Collected approximately one foot above contact between the Upper Marl member and underlying Greensand member. Light gray-green, semi-indurated, fossiliferous sandy marl.

Locality 16. - Old Moodys Branch formation type section, Jackson, Mississippi. Located 250 feet south of junction of Hazel and Poplar streets in Jackson.

Moodys Branch formation

Greensand member

- a. Collected by Karl Young and given to the writer by Dr. Henry V. Howe. Washed material consists of abundant foraminifera, ostracodes, sand, mica, glauconite, bryozoa, and numerous fragments of mollusks.
- b. Collected by Karl Young and given to the writer by Charles Stuckey. Dark green, sandy, glauconitic fossiliferous marl.

Upper Marl member

- c. Collected by Dr. R. W. Barker. Washed material consists of abundant foraminifera, ostracodes, slight traces of sand and glauconite, calcareous lumps, bryozoa, and fragments of megafossils.

Locality 17. - Test hole C-4, Mississippi State Geological Survey, Yazoo County. Located approximately 4 miles south of Yazoo City, Mississippi. Probably in NE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 7, T. 11 N., R. 2 W., Yazoo County, Mississippi.

Yazoo Clay formation

Lower facies

- a. Sample C-7, Mississippi State Geological Survey.

Collected from a depth of 58.7 feet in a zone described as plastic, tough, calcareous, non-gypsiferous clay with marine fossils.

- b. Sample C-9, Mississippi State Geological Survey.

Collected from a depth of 77.7 feet in a zone described as plastic, tough, silty, calcareous, non-gypsiferous, bluish-gray clay with marine fossils.

- c. Sample C-11, Mississippi State Geological Survey.

Collected from a depth of 91.7 feet from a zone described as plastic, tough, very silty, calcareous, non-gypsiferous, bluish-gray clay with marine fossils.

- d. Sample C-12, Mississippi State Geological Survey.

Collected from a depth of 101.7 feet from a zone described as semi-plastic, very silty, hard calcareous, non-gypsiferous, bluish-gray clay.

Locality 18. - Test hole C-8, Mississippi State Geological Survey. Located on Seward property in $N\frac{1}{2}$, $SW\frac{1}{4}$, Sec. 19, T. 13 N., R. 1 W., near Zelleria Station, Mississippi, in Yazoo County.

Yazoo Clay formation

Lower facies

- a. Sample C-2 Mississippi State Geological Survey.

Collected from a depth of 20.9 feet from a zone described as semi-plastic, calcareous, light grayish-yellow clay.

- b. Sample C-3, Mississippi State Geological Survey.
Collected from a depth of 30.6 feet from a zone described as semi-plastic, light bluish-gray, calcareous, very silty clay with marine fossils.

Locality 19. - Test hole C-13 of Mississippi State Geological Survey. Located 200 feet east of Highway 3, 0.5 mile south of Perry Creek bridge just south of the valley in SE $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 3, T. 10 N., R. 3 W., Yazoo County, Mississippi.

Yazoo Clay formation

Lower facies

- a. Sample C-1, Mississippi State Geological Survey.
Collected from a depth of 20.4 feet from a zone described as plastic, silty, gypsiferous, light gray, calcareous clay with lime nodules grading into bluish-gray clay below with marine fossils.
- b. Sample C-4, Mississippi State Geological Survey.
Collected at a depth of 49 feet from a zone described as plastic, tough, silty, calcareous, non-gypsiferous, bluish-gray clay with marine fossils.

Locality 20. - Yazoo Clay formation type section. Located on east bluff of Yazoo River near southern corporate limits of Yazoo City, Mississippi.

Yazoo Clay formation

Lower facies

- a. Collected from the east bank of a road cut approximately 5 feet above the road level. Weathered gray-buff, fossiliferous, calcareous clay.
- b. Collected from a small gully approximately 25 feet above road level. Weathered buff, blocky, slightly fossiliferous, calcareous clay.
- c. Collected from a small gully in a ravine approximately 75 feet above the road level. Weathered grayish-buff, fossiliferous, calcareous clay.
- d. Collected from a small ravine approximately 100 feet above the road level. Weathered grayish-buff, silty, calcareous, slightly fossiliferous clay.
- e. Collected near location of (d) above, but 25 feet higher up the ravine. Weathered grayish-buff, limonite stained, silty, slightly fossiliferous, calcareous clay.

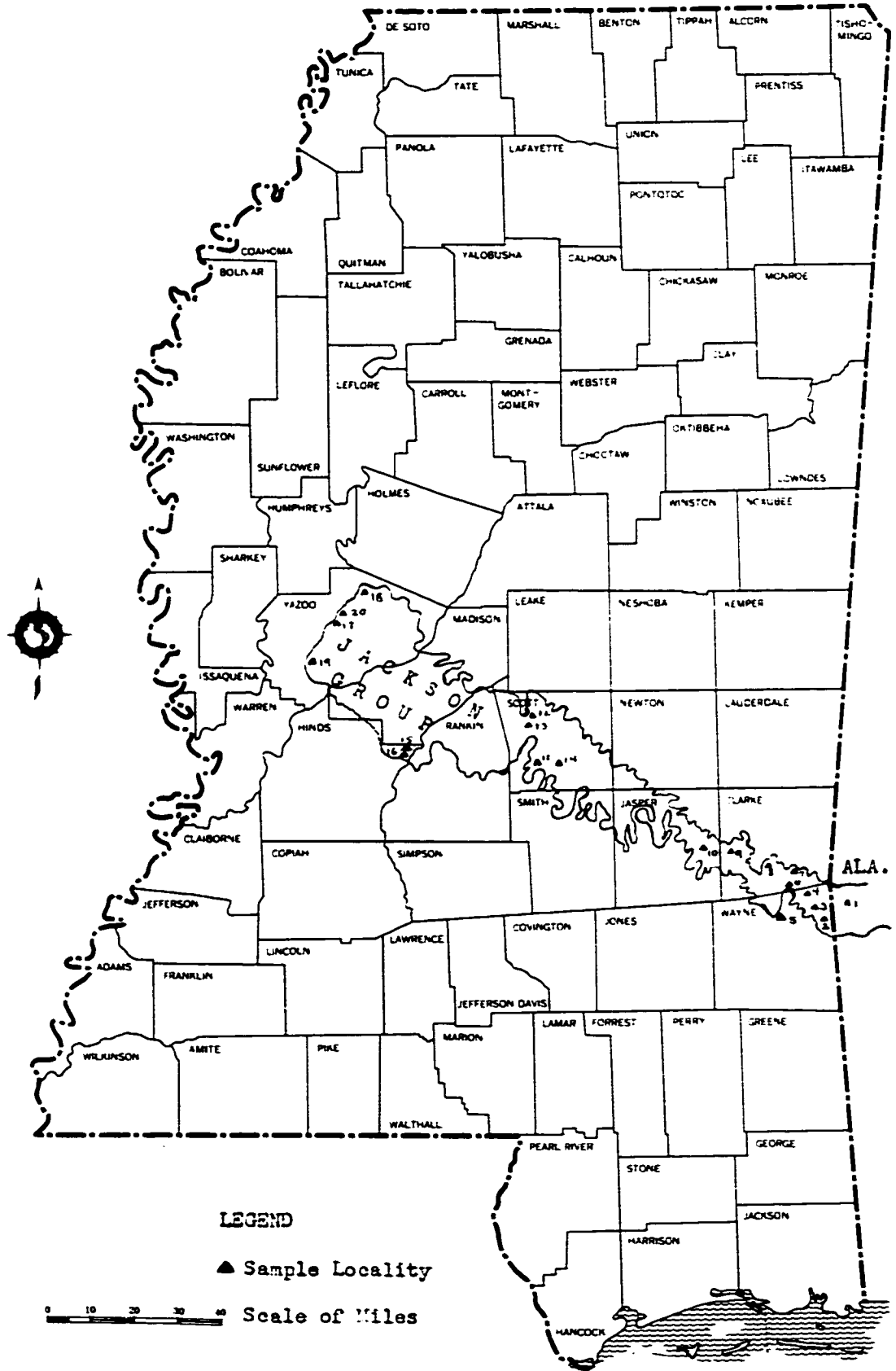


Figure 14. Sketch map of Jackson Eocene group in Mississippi and localities of samples.

Table 3. Percentages of Fine and Coarse Fractions and Coarse Fraction Constituents

Sample Number	Fraction	% Fine Fraction	% Coarse Fraction	% Foraminifera	% Ostracodes	Feldspar	% Quartz and Aggregates	% Calcareous	% Mica	% Glauconite	Fragments	% Shell	% Gypsum
NC 1a		96.5	3.5	38.4	10.1	Trace	16.4	2.5			32.4		
NC 2b		96.0	4.0	30.02	7.6	1.4	17.8	26.2		1.0	15.8		
NC 4b		95.75	4.25	39.93	15.00	3.15	18.93	17.53			5.91		
NC 9b		98.25	1.75	33.0	17.8	Trace	41.2	1.2		Trace	6.4		
NC 10a		98.75	1.25	45.8	12.0	Trace	34.4	2.4		4.2	1.2		
CS 1c		62.33	37.67	5.8	3.0	81.8	4.0	1.6		0.8	3.0		
CS 6a		55.5	44.5	5.0	2.4	82.8		6.8			3.0		
PM 3b		70.4	29.6	24.0	3.4	36.4	6.0	Trace		10.0	20.0		
PM 6e		55.33	44.67	15.6	2.6	53.4	14.2			3.6	10.4		
SC 6f		83.33	16.67	90.0	2.0	Trace	Trace			2.05	5.2		
SC 6g-1		87.5	12.5	87.8	3.8		6.0			1.2	1.2		
SC 6L		97.84	2.16	70.44	2.3		22.1				1.14	4.4	
SC 6m		95.5	4.5	86.16	2.34		4.87				4.1	2.53	
MBM 15b		35.33	64.67	16.4	3.20	46.0	0.8	0.6		17.0	16.0		
MBM 15h		92.33	7.67	49.0	13.40	12.2	7.0	0.6		9.8	7.8		
YCL 12b		95.33	4.67	71.6	5.2	2.0	17.0			3.0	1.2	Trace	
YCL 17a		95.33	4.67	46.2	0.6		43.4			0.4	9.4		
YCL 17d		97.84	2.16	91.4	1.8	Trace	4.4	0.8		0.4	1.0		
YCL 18b		90.33	9.67	22.3	3.3	28.57	30.6			13.0	21.4	Trace	
YCL 19b		98.00	2.00	70.8	1.0		26.0	1.6		0.4	Trace		
YCL 20a		98.00	2.00	77.4	4.2	0.6	14.8	1.8			1.20		
YCU 11a		97.17	2.83	73.37	3.15	8.67	9.87	1.38		Trace	1.97	0.8	
M-1		53.66	46.34	2.2		4.0	6.6			47.8	1.6		

LEGEND

NC-North Creek Clay
 M-1-? Basal Yazoo Clay
 YCL-Yazoo Clay Lower Facies
 YCU-Yazoo Clay Upper Facies
 CS-Cocoa Sand
 PM-Pachuta Marl
 SC-Shubuta Clay
 MBM-Moody's Branch

Table 4. Distribution of Foraminifera Genera in Selected Samples of the Jackson Group

Locality → Genera of Foraminifera	NC	NC	NC	NC	NC	CS	CS	PM	PM	SC	SC	SC	SC	MBM	MBM	YCL	YCL	YCL	YCL	YCL	YCL	YCU	MI
	1a	2b	4b	9b	10a	1c	6a	3b	6a	6f	6g1	6L	6m	15b	15h	12b	17a	17d	18b	19b	20a	11a	
Angulogerina								1.6			0.4				0.5								
Anomalina					0.9							2.4			2.0	0.3	2.2	1.1	0.6	1.8	1.3		
Articulina														2.5									
Bitubulogenenna	0.5			1.2																			
Bolivina	14.4	3.3	3.0	7.9	5.6		4.0	2.5	5.1	0.9	2.5	1.1	0.6	1.2	15.9	8.9		8.6	5.1	8.3	0.3	0.8	9.1
Bulimina			0.5					0.8		19.1	18.2	18.3	6.1			0.6		0.9		0.9			
Buliminella	0.5																						
Calleria								0.8		0.9	0.4	1.6	6.0										
Cassidulina								1.6	1.3						1.2	0.3		0.4		1.4			
Cibicides	9.3	16.7	10.0	10.3	11.8	27.5	32.0	13.3	16.6	2.7	3.2	1.6	20.3	9.7	21.6	25.7	4.7	17.1	16.6	22.7	12.9	0.5	36.3
Dentalina			0.5						1.3	1.8	1.9	0.7	1.1										0.3
Discorbis	12.3	12.6	7.0	4.2	0.9	3.4	8.0	0.8															0.3
Entosolenia			1.0		0.4									1.2	0.5								
Epistomina											0.4	2.7	1.1										
Eponides	1.3			0.6	0.4			4.2	5.1	1.1	2.5	0.5	0.2	2.5	3.3	5.0		2.8	3.8	0.8	2.3	0.3	
Fronicularia																		0.2	0.6				
Gaudryna										2.8	1.9		7.0										
Glandulina	3.1	1.3	3.0	3.6	10.9																		
Globigerina	0.5	15.3	6.5	2.4	2.6			29.1	3.8	16.8	14.1	18.7	11.9		3.6	3.1	0.4	0.9	4.5	0.3	0.8	11.0	
Globularia										2.0		2.2	0.2								0.3		
Globulina								0.8		0.2				3.7		0.8		0.2			0.3		
Gumbulina																							
Guttulina								0.8	1.3	0.2								0.4	0.4	0.6			
Gyroldina																0.3		0.4			0.3		
Hantkenina								0.8		2.6	2.5	4.9	0.2								0.3		
Lagena					1.3			0.8													0.3		
Margulina		0.7																					
Massilina								1.6	1.3	0.6	0.6	0.5	2.5			0.3							7.0
Miliola										0.4	2.7	0.3	1.1	10.9	0.5	0.3				0.3			0.8
Nodosaria										0.4	0.2												
Nonion		12.0	5.0	3.0	8.2	20.6	8.0	1.6	5.1					1.2									
Nonionella	10.8	22.0	32.5	23.1	29.2	27.5	32.0											0.8	0.8	1.9		0.8	18.2
Pianulina											0.9		5.4	2.4						1.3		1.0	
Polymorphina		0.7	1.0	0.6			4.0																
Pullenia																							
Quinqueloculina	4.6		8.0			6.9						0.7	0.2				0.3						
Russelia												0.3		19.5	12.2	8.4	0.4	1.3	2.7	1.5			
Robulus	0.5	0.7						6.6	3.8	4.0	3.8	4.6	5.4			2.0	2.5	1.3	0.2	4.5	0.9		9.1
Rotalia								0.8		0.4		0.3				2.0	2.5	1.3	0.2	4.5	0.9		4.3
Saracenaria										0.4							0.3		0.6				
Sigmamorphina				0.6					1.3					1.2	16.3		0.8	0.4				1.0	
Siphonina	3.9	9.3	8.5	22.4	16.5	10.3	4.0	12.5	6.4	4.8	0.6	4.6	1.1	8.5		9.8	0.8	10.8	8.4	17.3	5.7	7.8	27.3
Spiroloculina														2.5									
Textularia	35.5	5.3	13.5	15.8	9.6	3.4		4.2	24.3	8.2	7.9	5.9	1.5	2.5	4.1	2.8	1.3	10.7	5.7	4.3	3.1	11.6	
Triloculina	1.9																		0.6				
Uvigerina					1.3		8.0	14.2	21.8	28.2	33.4	18.9	35.7	1.2	16.3	29.3	44.8	44.2	42.3	37.8	58.2	55.4	

LEGEND

- MBM - Moodys Branch Formation
- M-1 - ? Basal Yazoo Clay
- YCL - Yazoo Clay Lower Facies
- YCU - Yazoo Clay Upper Facies
- NC - North Creek Clay Member
- CS - Cocoa Sand Member
- PM - Pachuta Marl Member
- SC - Shubuta Clay Member

$\frac{25}{75}$ - Percentage of Foraminifera Genera