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# ROCKS AND FOSSILS COLLECTED FROM MISSISSIPPI GRAVEL

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## INTRODUCTION

This is a guide to rocks and fossils that can be found in Mississippi's gravels. Gravel is defined as an accumulation of rounded, water-worn, stones. Stones are rocks (composed of one or more minerals) larger than 2 mm in size that have been transported by natural processes from their parent bedrock. As most "bedrock" in Mississippi is not rock but compacted clays and sands, the state's gravel deposits were transported from the rocky terrains of other states. Stones from these terrains were carried to the state by ancient rivers. Some stones contain marine fossils, the imprints or hard remains of ancient sea creatures. These fossils are evidence of past oceans that covered North America some three hundred million years ago.

## MISSISSIPPI'S GRAVEL RESOURCES

Sand and gravel are important for economic and industrial growth and rank first in sales among Mississippi's eight industrial commodities. In 1990, Mississippi ranked 27th of the 50 sand and gravel producing states. In that year, 66 companies operated 118 mines in 36 counties. The output was 13 million short tons valued at 46 million dollars (White et al., 1990). According to a compilation of surface mining permits (Hawkins, 1995), 44 counties have permitted gravel pits; these are shown in Figure 1.

Gravel producing counties and formations are designated by the symbol G on the state geologic map in Figure 1. Distinct gravel provinces can be seen on this map. In the northeastern part of the state, gravel is mined from the Cretaceous-age Tuscaloosa Group and from the Tombigbee River Alluvial Plain in which the Tuscaloosa gravels have been redeposited. It is also mined in high-level terrace deposits of the Tennessee River. In the southern part of the state, gravel is found in the Pliocene to Pleistocene-age Citronelle Formation. A belt of Pleistocene-age gravel underlies the loess belt of western Mississippi. These gravels contain an abundance of petrified wood.

So, where did the gravel in your driveway or school yard come from? Because gravel is expensive to transport, it probably came from a nearby gravel pit. Locate your driveway or school on the map in Figure 1 and find the closest symbol G nearby. If you live in DeSoto County in northwestern Mississippi, your gravel probably came from the pre-loess gravels of that county. If you live in Hinds County in west-central Mississippi, your gravel may have come from either the loess-belt gravels of Hinds, Madison, Yazoo, or Warren counties or from the Citronelle gravels of Copiah County. In northeastern Mississippi, the likely source is the Tuscaloosa Group or the Tombigbee River alluvium. The probable source in southern Mississippi is the Citronelle Formation.

## AGE AND ORIGIN OF MISSISSIPPI'S GRAVELS

Some explanation about geologic ages is in order here. Geologic ages are periods of time, which are based on the presence or absence of certain fossils. The oldest fossils are

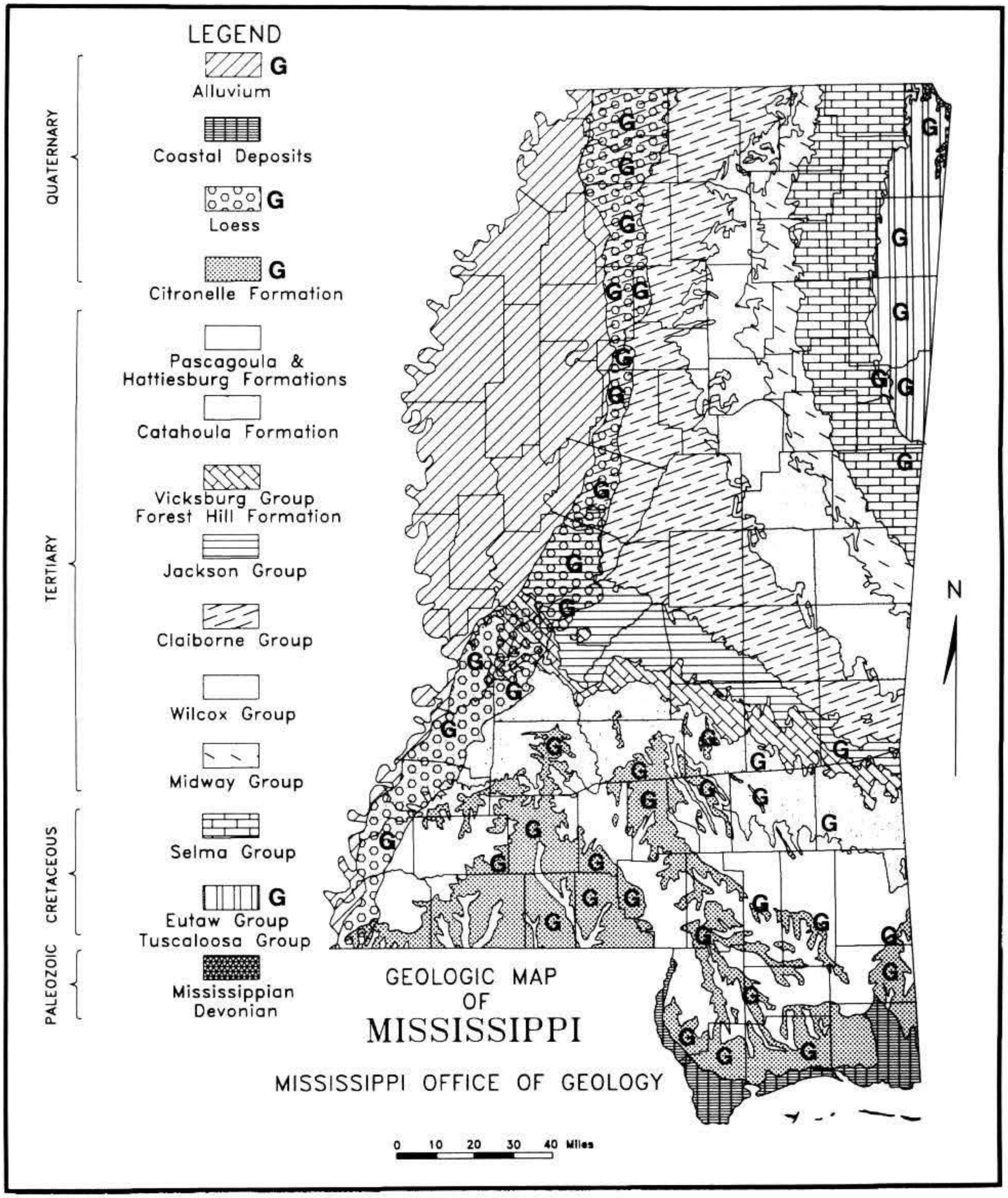


Figure 1. Geologic Map of Mississippi as digitized and produced by David Thompson. Geologic horizons containing gravel are designated by the symbol G under the legend. This symbol also indicates gravel-producing counties on the map.

from the Paleozoic Era, an era whose name means old (Paleo) life (zoic). Fossils of this age include a segmented arthropod called a trilobite. If you find a fossil trilobite in a rock, it is of Paleozoic age. The next era, the Mesozoic Era (Meso - middle; zoic - life), was a time of dinosaurs. A dinosaur bone is clear evidence of a Mesozoic age. The greatest diversity of mammals lived in the Cenozoic Era (Ceno - recent; zoic - life), which continues to the present. Most mammal fossils indicate a Cenozoic age. Below is an outline of geologic time. The duration of periods measured in spans of millions of years were published by Stanley (1987). These numbers are constantly being refined and may be different on other geologic time charts. However, the succession of periods is always the same.

| ERA | PERIOD | DURATION IN MILLIONS OF YEARS |
|---|---|---|
| Cenozoic (Recent Life) | Quaternary | 0-1.8 Ma ago |
| | Tertiary | 1.8-65 Ma |
| Mesozoic (Middle Life) | Cretaceous | 65-144 Ma |
| | Jurassic | 144-213 Ma |
| | Triassic | 213-248 Ma |
| Paleozoic (Old Life) | Permian | 248-286 Ma |
| | Pennsylvanian | 286-320 Ma |
| | Mississippian | 320-360 Ma |
| | Devonian | 360-408 Ma |
| | Silurian | 408-438 Ma |
| | Ordovician | 438-505 Ma |
| | Cambrian | 505-590 Ma |

Mississippi's gravels are stream-transported pebbles from eroded rocks of Paleozoic age. Most fossils found in these gravels are of Devonian or Mississippian age and are between 320 and 408 million years old. The geologic map in Figure 1 shows rocks of that age only in the northeastern corner of the state. While these rocks were partly the source of gravel in the Tuscaloosa Group, the Citronelle and loess-belt gravels came from Paleozoic rocks outside of the state. Figure 2 shows probable source areas from which the state's gravels were derived according to R. P. Self (1993).

The oldest gravel deposits in Mississippi are in the 86 to 90 million year old Tuscaloosa Group. Pliocene to Pleistocene gravel deposits of the Citronelle Formation are between 1 and 2 million years old, and the loess belt deposits are about a million years old or less. These gravels contain petrified wood that is the same age as that of the ancient river deposits. This wood is much younger than the Paleozoic pebbles with which they are found.

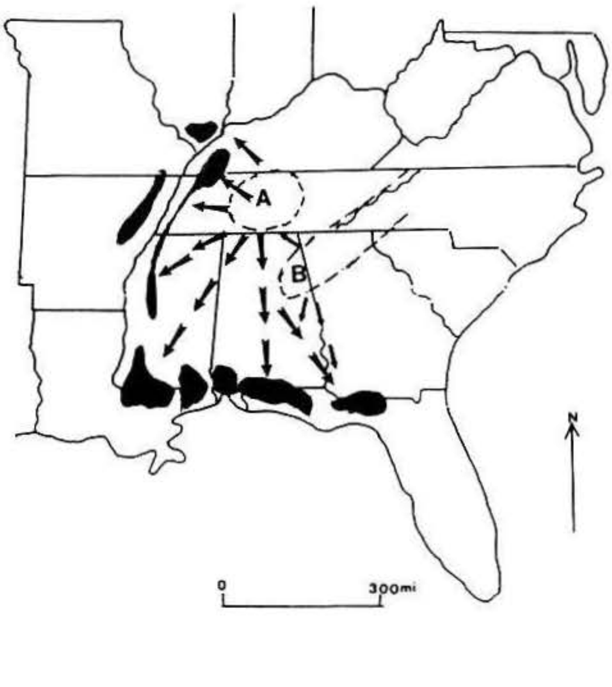


Figure 2. Source areas for Paleozoic pebbles found in Mississippi's gravels. Source area A is the Nashville Dome. Source area B includes metamorphic rocks of the Appalachian Mountains and Piedmont. Arrows indicate the direction of stream transport, and black areas indicate gravel deposits. This figure is copied from R. P. Self (1993).

## ROCKS AND LAPIDARY STONES: PLATE 1

No precious gemstones are found in Mississippi. However, semiprecious stones found in the state's gravels, such as the agate in figure 9 of Plate 1 and the carnelian in figure 12, were precious in ancient times. Native agates grace the silver bracelet in figures 1-6. This bracelet was once owned by Benjamin Leonard Covington Wailes (1797-1862) of Washington, Mississippi, near Natchez. Wailes was a planter, naturalist, teacher at Jefferson College, and first President of the Mississippi Historical Society. He was employed by the Mississippi Geological Survey soon after its creation and published the first report by the Survey in 1854 on the state's geology.

It is likely that Wailes' bracelet contains cut stones from the Natchez area. It features four agates, a fossil tabulate coral, and petrified wood, and is evidence that Mississippi's early naturalists found the state's gravels to be just as interesting as do collectors of all ages today. The bracelet is now owned by Wailes' great-great-grandson, Mr. Segrest Wailes, and was first illustrated by Bograd and Dockery in the December 1990 issue of *Mississippi Geology*. As illustrated by this bracelet, a lapidary rock from Mississippi can be defined as any cut stone that will take a polish. This definition eliminates soft and porous rocks.

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## EXPLANATION OF PLATE 1

Lapidary Stones

Figures 1-6. This silver bracelet was once owned by B. L. C. Wailes and includes four agates (figures 1 and 4-6), petrified wood with agate filling small irregular spaces (figure 2), and a fossil tabulate coral (figure 3). It is enlarged 1.5x and is actually about 150 mm long with each stone being about 25 mm by 19 mm.

Figure 7. **Oolitic Chert**. As a child, I thought this aggregate of tiny spheres was petrified fish eggs. However, the spheres are not fossils. They were once carbonate particles called ooids that formed at the bottom of a shallow tropical sea like that surrounding the modern Bahama Islands. These sediments hardened to form an oolitic limestone. When this limestone was replaced by chert, it was hard enough to survive the stream transport to Mississippi. Oolitic cherts have an interesting texture that adds to the beauty of a cut stone. Height 15.4 mm and width 29.1 mm as shown.

Figure 8. **Geode**. Geodes are crystal-lined cavities such as the one in this agate. While not generally used as a lapidary stone, they make interesting specimens for a rock collection. Quartz crystals line geodes in Mississippi gravels. While agate layers form from relatively rapid mineral (silica) deposition, quartz crystals grow more slowly as fluid minerals are used up inside the cavity. Height 55.5 mm and width 62.0 mm as shown.

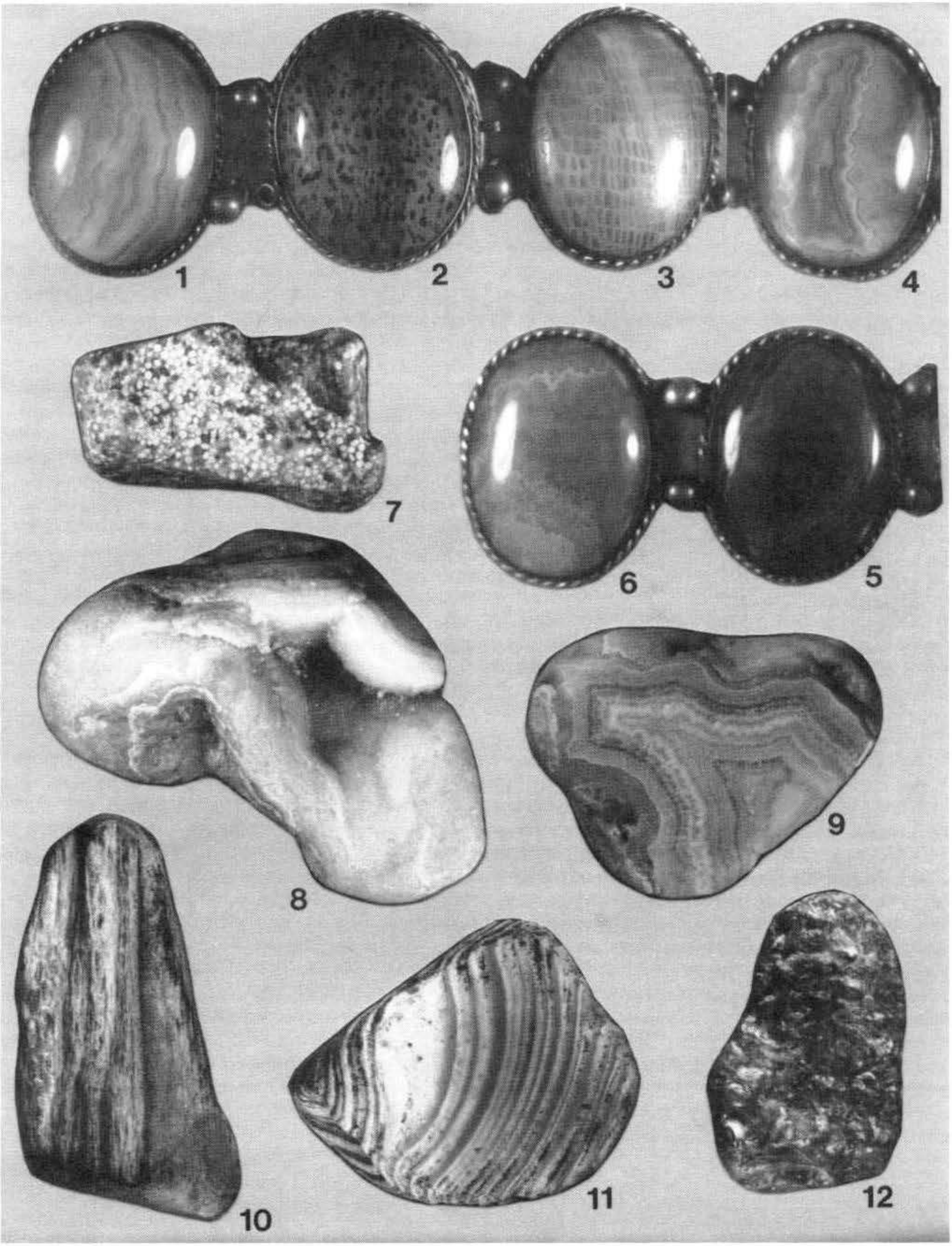
Figure 9. **Agate**. Mississippi agates such as this one generally consist of gray and brown wavy bands. However, some may be purple, red, or white. Agate was a precious stone in ancient times. It was commonly engraved and placed in special gold rings that were used to seal official documents. Height 31.5 mm and width 41.8 mm as shown.

Figure 10. **Petrified Wood**. Petrified wood is often replaced by the silicate mineral chalcedony. Often the wood grain is beautifully preserved. Such stones have a wood-like texture when cut. Height 54.2 mm and width 28.3 mm as shown.

Figure 11. **Banded Chert**. Chert often preserves sedimentary structures from the original limestone that it replaced. Here sediment layers have alternate dark and light colors that make for an interesting pattern when cut. Height 35.5 and width 44.4 as shown.

Figure 12. **Carnelian**. Carnelian is a red, translucent, silicate that was prized as a gemstone in ancient times. It is rare in Mississippi gravels. Height 32.0 mm and width 22.0 mm as shown.

# PLATE 1



**ROCK MEASUREMENTS**. To determine size and shape, calipers are generally used to measure three dimensional objects such as rocks. However, simple measurements can be made using the millimeter grid in Figure 3 and a ruler. Each increment on this grid is 2 mm long. Place the flat side of the rock on the grid with the long axis parallel to the vertical lines. Then position the rock so that the left side just touches the grid's left edge and its base touches the bottom. Line a straight edge horizontally across the top to find the length of the rock's long axis in millimeters. Then measure vertically down from the right side to find the length of the intermediate axis in millimeters. These measurements are useful in defining a pebble's shape as described below.

**SHAPE**. The well-rounded rocks in figures 1-8 of Plate 2 show wear from stream transport and illustrate the four categories of pebble shapes defined by Zingg in 1935 (see Krumbein and Sloss, 1963). These are the spheroid (figure 5), disk (figures 1-2, 6-8), roller (figure 3), and blade (figure 4). To determine the shape, a pebble must be measured along three perpendicular axes, which are defined as the longest, shortest, and intermediate axes. In a perfect spheroid all three axes are the same length. A disk is a flattened spheroid with the long and intermediate axes of similar length and the short axis less than two thirds the length of the intermediate axis. A roller is an elongate spheroid with the short and intermediate axes of similar length and the long axis more than a third longer than the intermediate axis. A blade is a flattened roller with the long axis greater than a third longer than the intermediate axis, which is greater than a third longer than the short axis. All the rocks illustrated in Plate 2 have their long and intermediate axes parallel to the page and the short axis perpendicular to it.

**ROCK TYPES**. Rocks shown in Plate 2 include quartzite (figures 1,4), clear quartz crystal (figures 2-3), chert (figures 5,7-9), and milky quartz (figure 6).

**MIMETOLITHS**. Mimetoliths as defined by Dietrich (1989) are rocks that mimic other objects in their shape. A type of mimetolith named here a natural cameo formed as softer areas wore away leaving more resistant areas in relief. Figure 7 of Plate 2 is a nearly circular disk with a raised rim and irregular profile in the center. Figure 8 is a disk with a central dome that mimics a fried egg. A face was noted by the writer in the tabulate coral illustrated in figure 9. A little pencil work was needed to bring it out; this is considered as cheating by the editor.

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## EXPLANATION OF PLATE 2

Pebble Shape, Rock Types, and Mimetoliths

Figure 1. **Quartzite Disk**. This quartzite is a metamorphic rock with interlocking angular quartz crystals. Height 50.4 mm and width 59.2 mm as shown; thickness 10.0 mm.

Figure 2. **Quartz Crystal Disk**. Quartz crystal is rare in gravel. This one was found by Mike Bograd in the reworked Citronelle gravels of Turkey Creek east of Dentville in Copiah County. Height 34.4 mm, width 47.0 mm ; thickness 17.0 mm.

Figure 3. **Quartz Crystal Roller**. This roller is the product of a six-sided quartz crystal (prism) tumbling in the bed load of a stream until its crystal facies are rounded off. It was collected from the Citronelle Formation near Florence. Height 27.3 mm and width 56.0 mm as shown; thickness 22.2 mm.

Figure 4. **Quartzite Blade**. This blade is from high-level Tennessee River terrace gravels in Tishomingo County where blades and rollers are common. These gravels are stained brown by an outer coat of iron oxide. Height 37.0 mm and width 77.3 mm as shown; thickness 15.5 mm.

Figure 5. **Chert Spheroid**. Well-formed spheroids are rare in gravel. This pebble from the Tennessee River terraces of Tishomingo County is a fine example. It has the intermediate axis about five sixths the length of the long axis. These dimensions would be equal in a perfect sphere. Height 29.6 mm and width 36.6 mm as shown; thickness 28.4 mm.

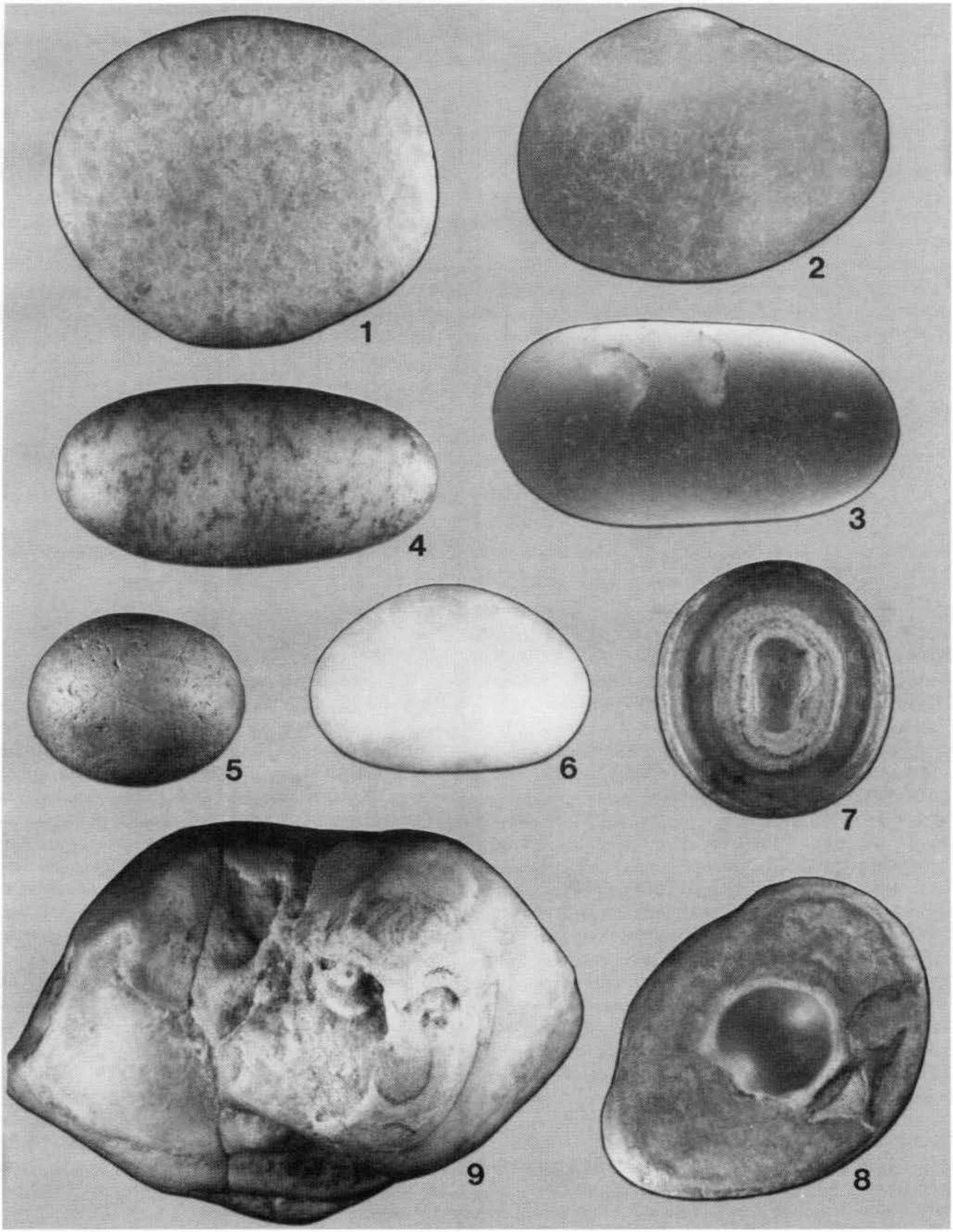
Figure 6. **Milky Quartz Disk**. This kidney-bean shaped disk is the perfect shape for a "worry rock," according to "worry rock" specialist Mike Bograd. A "worry rock" is a smooth stone carried in the pocket by those who like to fidget with such things to relieve stress. Height 23.0 mm and width 34.3 mm as shown; thickness 10.0 mm.

Figure 7. **Cameo Chert Disk**. Softer parts of this disk have worn away to reveal an irregular central figure and a raised rim. Height 26.3 mm and width 24.0 mm; thickness 8.4 mm.

Figure 8. **Cameo Chert Disk**. This mimetolith with its hard dome-shaped center mimics a fried egg. Height 46.0 mm and width 47 mm as shown; thickness 13.7 mm.

Figure 9. **Tabulate Coral Mimetolith**. This mimetolith once sat on our assistant director's desk. In passing, I could see a face with one eye closed and one opened. It required a little pencil work for others to see it. Height 69.3 mm and width 104.0 mm as shown.

# PLATE 2



## INTERESTING ROCKS AND RARE FOSSILS: PLATE 3

Many times a collector will find an interesting rock that looks like an Indian artifact. Archeologists call such stones IR's, an abbreviation for interesting rocks. These are not artifacts but have natural features that look manmade. The laminated cherts in figures 1 and 2 of Plate 3 and the rocks with holes in figures 5 and 6 are such objects. The laminations in figure 1 form lines that are so precise and regularly spaced that they appear to have been carefully crafted. The concentrically laminated chert in figure 2 looks like a petrified egg roll (another mimetolith).

Holes in stones such as those in figures 5 and 6 of Plate 3 occur naturally but are occasionally mistaken for Indian beads or pendants. Figures 3 and 4 of Plate 3 are two views of a quartz mimetolith that looks like a petrified tooth such as a human back molar.

Plate 3 also contains two common corals (figures 10-11), a rare trilobite (figure 7), and a rare goniatite (figures 8-9). Trilobites are extinct segmented arthropods distantly related to, and somewhat resembling, the horseshoe crab. They became extinct at the end of the Paleozoic Era; therefore, we know that the figured pebble was originally a Paleozoic rock. Goniatites were a special kind of ammonite that lived in the late Paleozoic. Their planispirally coiled shells were divided into chambers like that of their living relative, the chambered *Nautilus*. The *Nautilus* is the last living relative of a ancient group of squid-like animals bearing a protective outer shell.

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## EXPLANATION OF PLATE 3

Interesting Rocks and Rare Fossils

Figure 1. **Horizontally Laminated Chert**. The laminae of this chert pebble preserve the thinly-bedded sedimentary structure of the original limestone. Each lamina may represent sediment deposited in a day by the rising and falling tide, or, where sedimentation is slow, may represent the seasonal deposition of a yearly cycle. Height 40.0 mm and width 46.9 mm as shown; thickness 14.0 mm.

Figure 2. **Concentrically Laminated Chert**. The precise concentric laminations of this stone are probably of organic origin and are most likely that of an oncolite. Oncolites are algal structures that roll freely with the currents on the sea floor. As they roll, oncolites add additional layers of fine sediment to their exterior. Height 29.5 mm and width 39.0 mm as shown; thickness 23.5 mm.

Figures 3-4. **Quartz Mimetolith**. These are top and side views of a quartz mimetolith that resembles a human tooth (back molar). Height (figure 4) 14.1 mm and width 12.4 mm; thickness 9.6 mm.

Figures 5-6. **Rocks With Holes**. These chert pebbles have natural holes where softer regions have worn through. Figure 5: height 43.2 mm and width 38.7 mm as shown; thickness 11.9 mm. Figure 6: height 49.7 mm and width 42 mm as shown; thickness 12.4 mm.

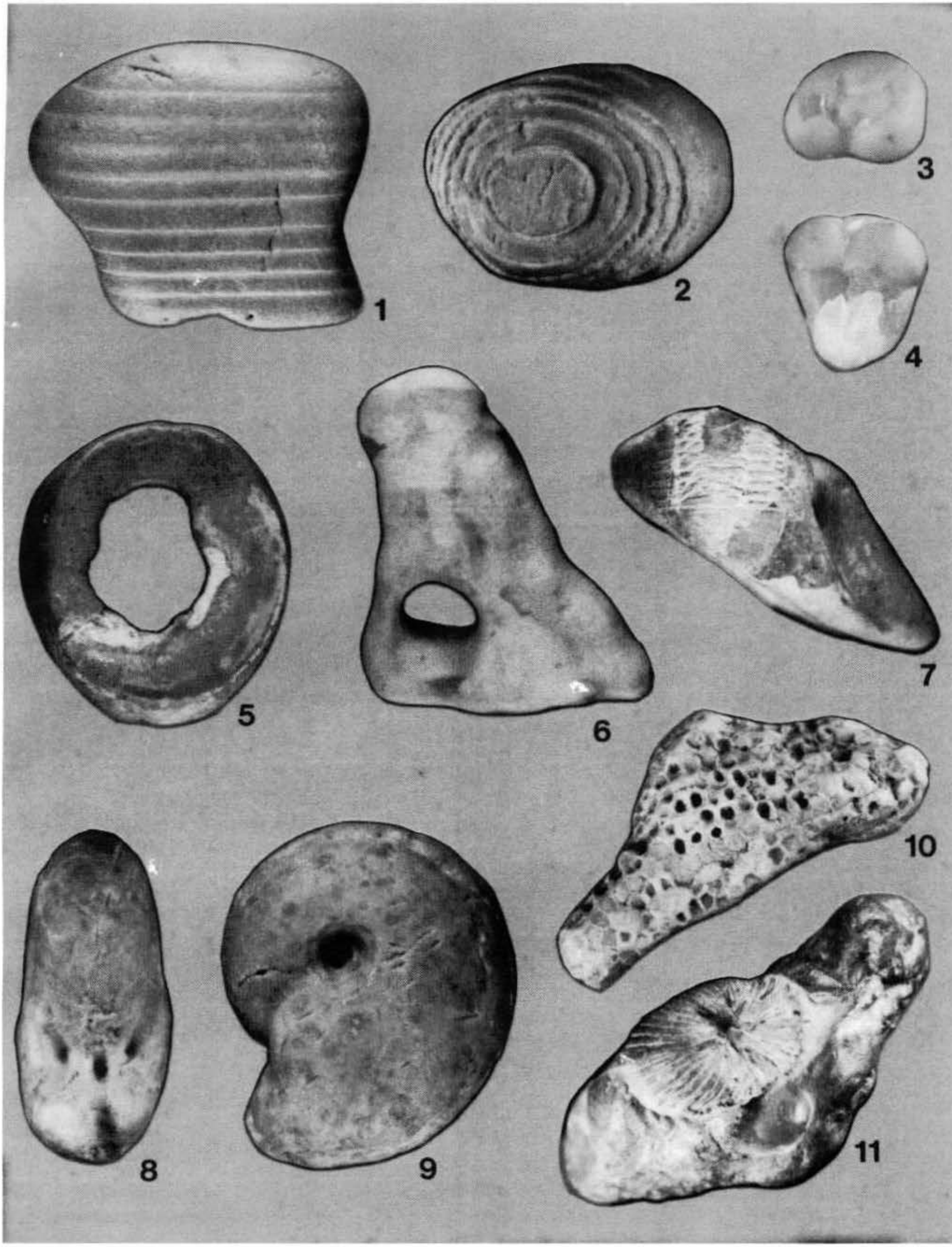
Figure 7. **Trilobite**. Trilobites are very rare in gravel, making this one a prize find. The head of this specimen is missing, leaving only the horizontal thoracic segments and the smooth tail section called the pygidium. Reconstructed width of trilobite 14.4 mm, actual width as shown 12.0 mm, actual length as shown 15.0 mm. Long axis of stone 41.0 mm, intermediate axis 25.0 mm, and short axis 13.7 mm.

Figures 8-9. **Goniatite**. This goniatite is the only one known by the writer to have been found in Mississippi's gravels. It was collected by Tom E. Cooksey from Perry Creek at Tinsley, Mississippi. Height (figure 9) 39 mm and width 34 mm as shown; thickness 18.3 mm; greatest diameter 41.2 mm.

Figure 10. **Tabulate Coral**. Long axis 53.7 mm, intermediate axis 25.0 mm, short axis 16.5 mm.

Figure 11. **Solitary Rugose Coral**. Only the internal mold of this rugose coral remains, and the septal positions are marked by incised lines. Greatest diameter of coral as shown 16.0 mm. Long axis of stone 49.0 mm, intermediate axis 22.4 mm, short axis 22.4 mm.

## PLATE 3



## FOSSIL CORALS: PLATE 4

Corals belong to the Phylum Anthozoa, which also includes soft-bodied animals such as the sea anemone, jellyfish, and the microscopic *Hydra*. Corals are the reef builders of modern oceans and contributed to reefs in the ancient past. Two groups of corals are found as fossils in Mississippi's gravels. These are the tabulate corals and the rugose corals. Both have colonial forms in which individuals are housed in elongate conical chambers called corallites. The collective corallites of the colony form the corallum.

Tabulate corals are colonial corals composed of small corallites. These corallites are generally tightly packed and have polygonal sides as seen from the top. In side view, they consist of long tubes partitioned by platforms called tabulae from which their name was derived.

Rugose corals have large corallites that are characterized by radial partitions called septa. They may form solitary individuals or be packed in colonies. Both tabulate and rugose corals are extinct.

Modern corals are of the Order Scleractinia. These superficially resemble the septate rugose corals. They differ in that the rugose corals have septa arranged in quadrants, while the septa of scleractinian corals have a six-fold symmetry. Sometimes the quadrate symmetry can be seen in fossil rugose corals from Mississippi such as the specimen in figure 6. In this figure, a structure at the base called the cardinal fossula separates the two cardinal quadrants. The opposite quadrants (facing the viewer) are the counter quadrants.

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## EXPLANATION OF PLATE 4

Fossil Corals

Figure 1. **Tabulate Coral**. This coral is shown in side view, exposing the length of the corallites and the placement of the tabulae. Height 34.0 mm and width 29.0 mm as shown.

Figure 2. **Tabulate Coral**. This coral has large polygonal corallites as show in top view. It could easily be mistaken for a fossil wasp nest. Height 25.2 mm and width 38.7 mm as shown.

Figure 3. **Tabulate Coral**. This coral is composed of hexagonal corallites that form a honeycomb structure. Height 44.3 mm and width 28.5 mm as shown.

Figure 4. **Solitary Rugose Coral**. This concave septate pit is called the calyx. The coral's tentacles and mouth extended from this pit. Height 45.5 mm and width 39.1 mm as shown.

Figure 5. **Solitary Rugose Coral**. This coral is nearly complete from its tapered base to the calyx. The concentric wrinkles on the sides are called rugae and gave rise to the group's name Rugosa, meaning wrinkled. Height 41.2 mm and width 29.6 mm as shown.

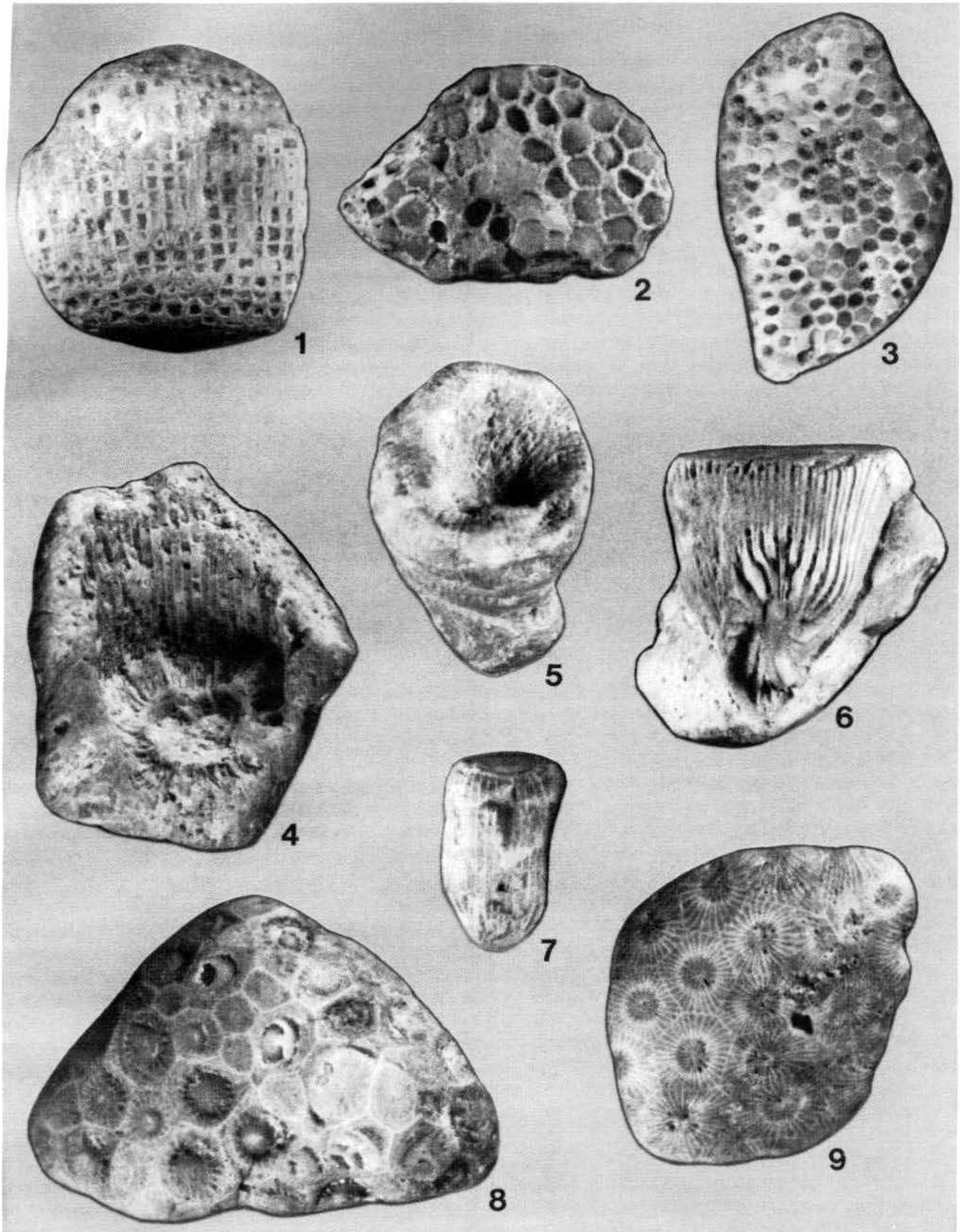
Figure 6. **Solitary Rugose Coral**. All that remains of this coral is the lithified sediment that filled its interior. Such fossils are called internal molds. The prominent structure at the base is a filled space called the cardinal fossula and marks the division of the cardinal quadrants. Facing the viewer are the opposite quadrants called the counter quadrants. These quadrants show the order of septa appearance and the alternating sequence of major and minor septa. Height of rock 34.0 mm and width 36.7 mm as shown.

Figure 7. **Solitary Rugose Coral**. Barrel-shaped fossils like this one are the worn remnants of solitary rugose corals and are common in Mississippi's gravels. Septa are visible along the coral's length and radiate from the center. Height 17.8 mm and width 10.4 mm as shown.

Figure 8. **Colonial Rugose Coral**. Colonial rugose corals differ from tabulate corals in their large corallites and in their prominent septa. Height 34.3 mm and width 51.5 mm as shown.

Figure 9. **Colonial Rugose Coral**. The identification of fossil corals to their scientific names demands considerable expertise. This task is especially hard for those corals found in gravel, because their original formation and location are unknown. However, the characteristic species figured here with its hexagonal (six-sided) corallites is almost certainly the Devonian coral *Hexagonaria*. Worn specimens such as this one commonly wash up on the shores of Lake Michigan at Petoskey, Michigan, and are called Petoskey stones. Height 27.7 mm and width 27.7 mm as shown.

# PLATE 4



## FOSSIL BRACHIOPODS AND BRYOZOANS: PLATE 5

Even though they appear very different, the phyla Brachiopoda and Bryozoa, along with the soft-bodied phyla Phoronida and Entoprocta, are thought to be related. They all possess a food-catching organ called a lophophore, which places them in an informal group called the lophophorates. The lophophore is a circular or horseshoe-shaped fold around the mouth that bears numerous ciliated tentacles. In the brachiopods, the lophophore is housed between the two shells, called valves, that enclose the animal. The extinct brachiopod Order Spiriferida had a spiral lophophore with an internal support called the spiralium. This support can be seen in figures 3 and 4 of Plate 5 where the outer shell is worn away. The spiralium in figure 4 tapers toward the ends and belongs to a long-hinged spirifer like that in figure 2.

Bryozoa are colonial animals with small individuals called zooids housed in a mineralized cell called a zooecium. The extinct bryozoan Order Cryptostomata contained fenestrate bryozoans with delicate fronds as shown in figures 7-9 of Plate 5. In this order, the zooecia often formed slender parallel branches joined by crossbars called dissepiments. The fenestrate pattern of this group is best seen in figure 8.

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## EXPLANATION OF PLATE 5

Brachiopods and Bryozoans

Figure 1. **Spirifer Brachiopod**. This fossil is the exterior mold of a long-hinged spirifer brachiopod. The central trough marks the valve's central fold and identifies it as the brachial valve, the valve supporting the brachidium. Height of stone 34.5 mm and width 53.0 mm as shown.

Figure 2. **Spirifer Brachiopod**. This fossil is the internal mold of a long-hinged spirifer brachiopod. The central fold identifies it as the brachial valve. Height of stone 39.5 mm and width 46.5 mm as shown.

Figure 3. **Spirifer Brachiopod**. This specimen reveals the internal structure of the brachiopod including the spiralium. Height of stone 21.3 mm and width 23.7 mm as shown.

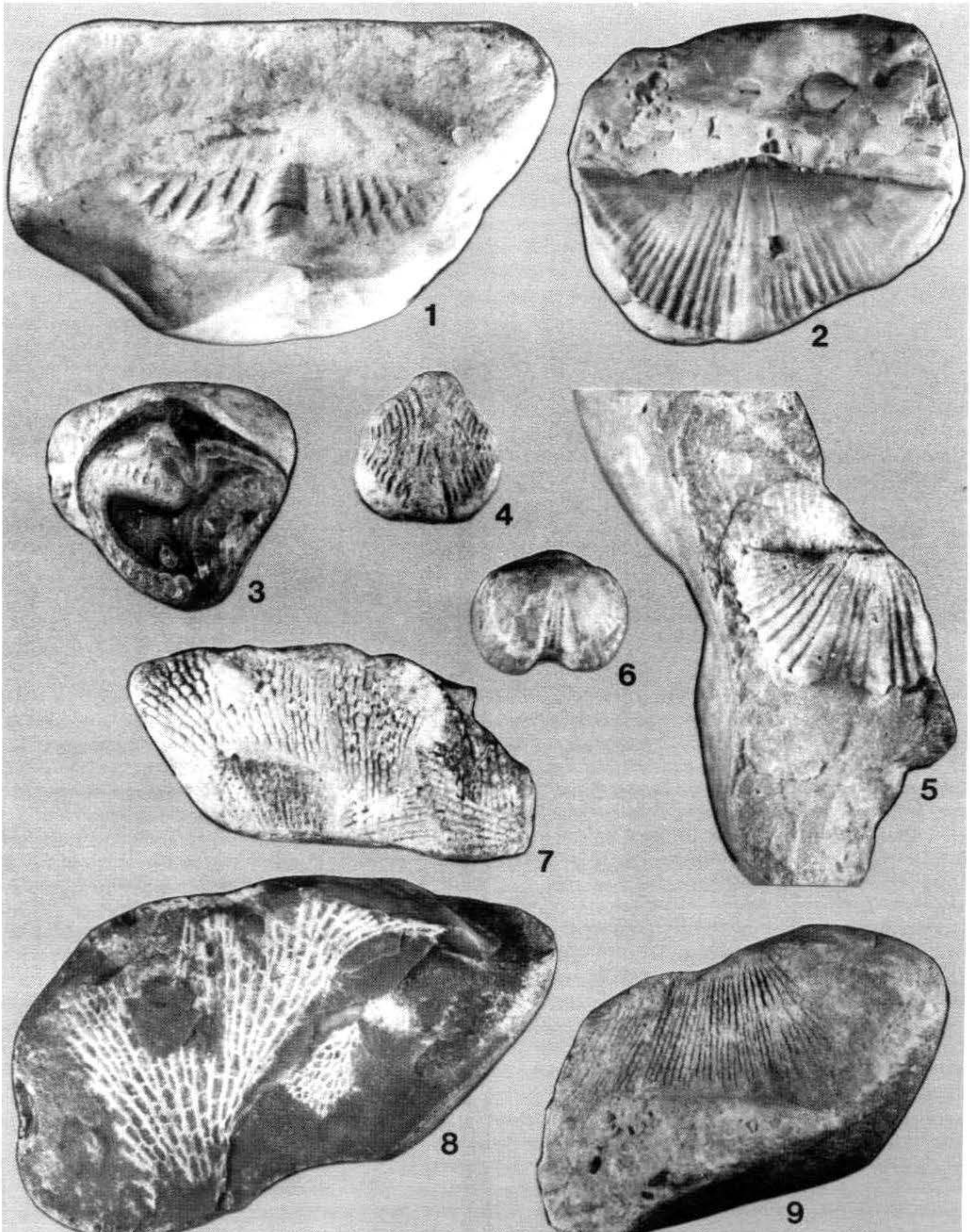
Figure 4. **Spirifer Brachiopod**. All that remains of this long-hinged spirifer is the spiralium, which tapers to the left and right away from the central fold. Height 13.2 mm and width 12.6 mm as shown.

Figure 5. **Spirifer Brachiopod**. This fossil is the internal mold of the pedicle valve of a long-hinged spirifer brachiopod. This valve supported a stalk called the pedicle that attached the brachiopod to the sea floor. It has a central trough called a sulcus rather than a fold. Height of stone 53.0 mm and width 37.0 mm as cropped and shown.

Figure 6. **Orthid Brachiopod**. This small fossil brachiopod has both valves and resembles *Platystrophia*, a genus in the Order Orthida. Height 10.5 mm and width 13.6 mm as shown.

Figures 7-9. **Cryptostome Bryozoans**. The fenestrate pattern is produced by slender branches containing small colonial animals and connecting crossbars called dissepiments. These branches and dissepiments are commonly preserved only as an intersecting grid of incised lines. This structure seems more plant-like than anything belonging to an animal. My first science fair project in elementary school consisted of an aquarium with plastic dinosaurs among a field of rocks with fossil bryozoans. In a recreation of the ancient environment, I took the bryozoans to be terrestrial ferns. Little did I know (nor did the judges) that my Mesozoic dinosaurs were drowning on a Paleozoic sea floor. Figure 7: height 17.3 mm and width 36.5 mm as shown. Figure 8: height of stone 37.0 mm and width 56.0 mm as shown. Figure 9: height of stone 38.0 mm and width 45.0 mm as shown.

## PLATE 5



## FOSSIL CRINOIDS: PLATE 6

Crinoids are perhaps the most common fossils found in chert gravel. The crinoid's main body called the calyx has an upward-facing mouth surrounded by flexible tentacle-like arms. This body is attached to the sea floor by a long segmented stalk called the column and a root or bulb-like attachment. Crinoids are commonly called sea lilies because of their superficial resemblance to a flower. They belong to the Phylum Echinodermata, which also contains echinoids, such as sand dollars and sea urchins, and starfish. Like echinoids and starfish, crinoids have a pentamerous or five-fold symmetry. This is evident in the central opening, called the lumen, of some column segments such as the five-pointed star in figure 8 of Plate 6. Figure 7 shows a similar star in side view where the column has dissolved, leaving an internal mold of the column's axial canal. Some columns have round lumen such as the segments in figure 9. Another interesting feature of the column is the jointed appendage called a cirrus (plural cirri). The attachment scar of a single cirrus is seen in figure 4.

Crinoid column segments were once so abundant that they formed crinoidal limestones made up almost exclusively of broken column parts. Figure 1 of Plate 6 was such a limestone that was later replaced by chert. The largest column segment from Mississippi gravel known to the writer is shown in figures 5-6.

Fossil crinoid calyxes are rare in gravel. Figure 11 of Plate 6 shows an external mold of arms extending from a calyx. The best fossil calyx known to the writer from Mississippi gravel was a more complete external mold than the above. The collector wished to keep the fossil so a molding clay cast was made of the specimen. This cast is illustrated in figure 10 and shows the arms and their fine pinnules.

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## EXPLANATION OF PLATE 6

Crinoids

Figure 1. **Crinoidal Chert**. This chert pebble is composed exclusively of crinoid column segments. Height 25.5 mm and width 36.5 mm.

Figure 2. **Crinoid Column**. This column contains 8 articulated plates, called ossicles, and has a round lumen and axial canal. The canal in this specimen is open through the column, giving the appearance of an Indian bead. Height 11.7 mm and width 10.0 mm.

Figure 3. **Crinoid Column**. The 6 ossicles of this column are partially separated. Height 16.4 mm and width 10.0 mm.

Figure 4. **Crinoid Column**. This column contains 10 ossicles and an attachment scar for an articulated appendage called a cirrus. Height 13.9 mm and width 12.4 mm.

Figures 5-6. **Crinoid Column**. This column contains 6 ossicles and is the largest known by the writer to have been found in Mississippi gravel. Height (figure 5) 12.5 mm and width 22.7 mm.

Figure 7. **Crinoid Column**. This is the internal mold of the column's axial canal. Extending from the canal are sediment-filled gaps that once separated 7 ossicles. Length of column 11.5 mm. Height of stone 23.8 mm and width 39.9 mm as shown.

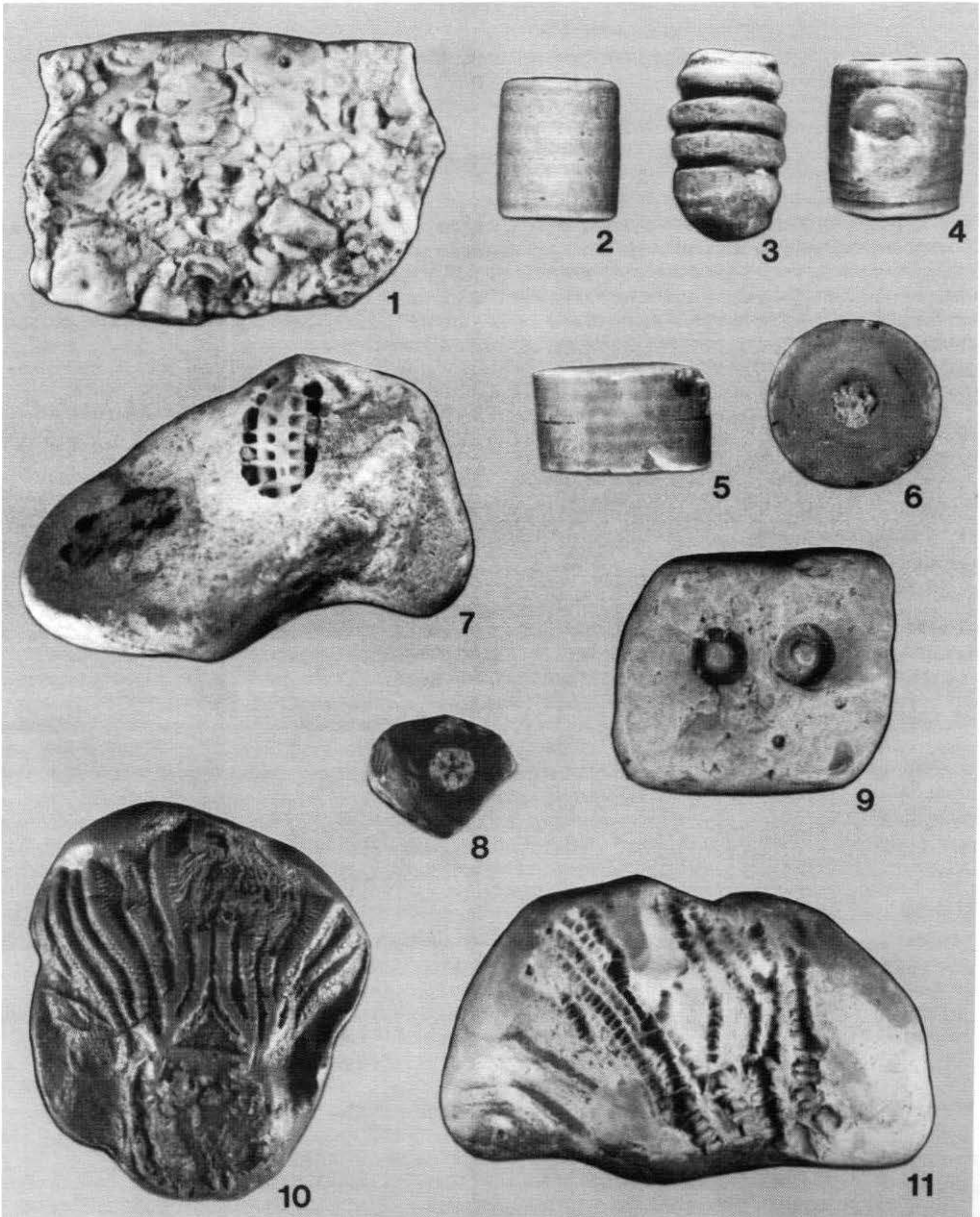
Figure 8. **Crinoid Column**. This small column has a lumen shaped like a five-point star and illustrates the crinoid's pentamerous symmetry. This column is enclosed in a polished red chert called jasper. Diameter of column 4.0 mm. Height of stone 10.5 mm and width 12.8 mm as shown.

Figure 9. **Crinoid Columns**. The external molds of these twin columns both have round lumen that stand in relief. They appear as two owl-like eyes staring at the viewer. Height of stone 28.6 mm and width 33.2 mm as shown.

Figure 10. **Crinoid Calyx**. This is a modeling clay cast of an external mold shown to the writer. It shows the fine detail of the arrangement of ossicles in the arms and the attachment of fine pinnules. Height of cast 43.0 mm and width 36.0 mm as shown.

Figure 11. **Crinoid Arms**. This external mold shows the wedge-shaped arrangement of ossicles in the arms. Height of stone 26.6 mm and width 43.3 mm as shown.

# PLATE 6



**LABELS**: The following labels may be photocopied and cut out for use in the egg-carton collections.

Specimen No. ______________________
Identification: ______________________
Locality: ______________________
Formation: ______________________
Collector: ______________________
Date Collected: ______________________

Specimen No. ______________________
Identification: ______________________
Locality: ______________________
Formation: ______________________
Collector: ______________________
Date Collected: ______________________

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Specimen No. ______________________
Identification: ______________________
Locality: ______________________
Formation: ______________________
Collector: ______________________
Date Collected: ______________________

## MAKING A ROCK AND FOSSIL COLLECTION

**SPECIMEN LABELING**: Making a rock and fossil collection is more than placing rocks in a shoe box. Each find should be labeled with certain important information such as: A specimen number, the rock or fossil's identification, where it was found (its locality), the geologic formation it came from (if known), the collector, and the date collected. This information is best recorded at the time the specimens are collected and before it is forgotten. A specimen number written on the rock in pencil is helpful in case the label and specimen are accidentally separated. Detailed locality information can be continued on the back of the label. Rocks without labels have no scientific value. Often, important museum specimens are thrown away for lack of a label. Sample labels for the goniatite in Plate 3 and the quartz disk in Plate 2 follow.

Specimen No. ________________
Identification: Goniatite
Locality: Tinsley, Miss.
Formation: Loess Belt Gravels
Collector: Tom E. Cooksey
Date Collected: Unknown

Specimen No. ________________
Identification: Quartz disk
Locality: Dentville, Miss.
Formation: Citronelle Fm.
Collector: Michael B. E. Bograd
Date Collected: Oct. 4, 1987

**THE EGG-CARTON COLLECTION**: A convenient collecting concept of John Davis of St. Andrews Middle School is the egg-carton collection. The compartments of the egg carton provide spaces for a collection of twelve labeled rock and fossil specimens. Egg-carton collections should include twelve different items without duplication. These items may include rock types such as agate, banded chert, or milky quartz, shape types such as spheroid, disk, roller, or blade, or different fossils such as tabulate coral, rugose coral, bryozoan, brachiopod, or crinoid.

**JUDGING THE EGG-CARTON COLLECTION**: The most important criteria for judging the egg-carton collection is the accurate labeling of the specimens. A score of 50 points is given for a collection of twelve specimens with correct labels showing the information above. Unknown is an

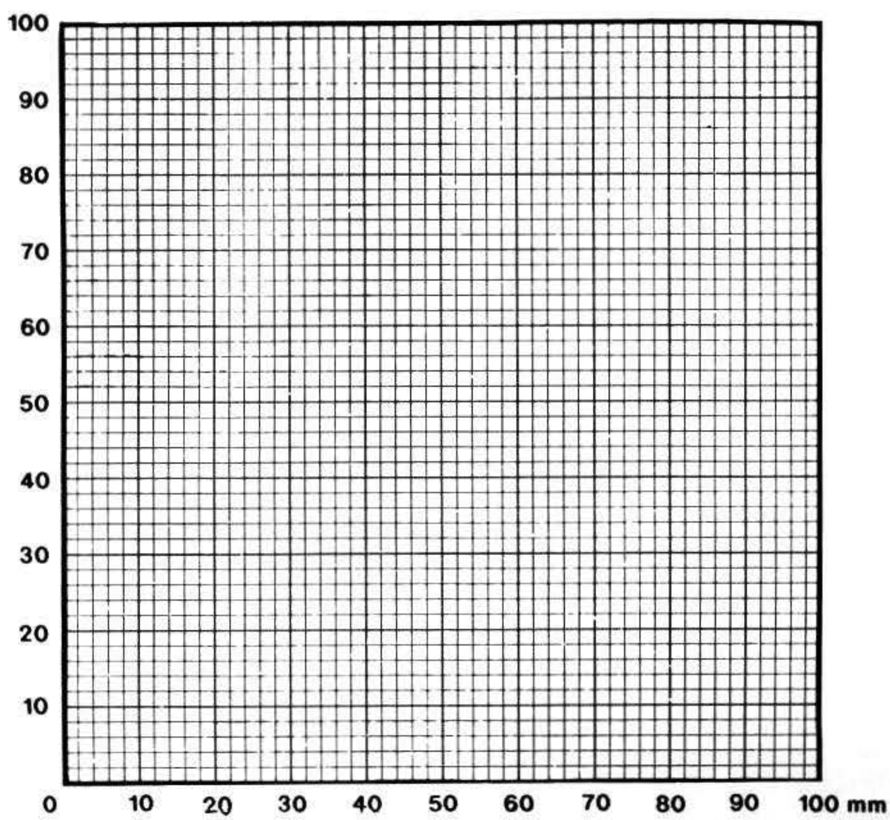


Figure 3. Grid in millimeters. Each light line marks a 2 mm increment, and each heavy line marks a 10 mm, or one centimeter, increment.

acceptable answer for all but the identification and locality. A score of 16 points is given for label neatness. A score of 24 points is given for collection diversity with 2 points awarded for each different specimen. A score of 10 points is given based on the rarity of the rocks and/or fossils. A bonus of up to 10 points is awarded for any rare specimen donated upon request to the Mississippi Office of Geology reference collection. The collector will be credited if the specimen is used in a publication.

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## NEW PUBLICATION AVAILABLE FROM THE OFFICE OF GEOLOGY

## CHEMICAL DATA AND ELECTRICAL RESISTIVITY VALUES (RW'S) DETERMINED FROM ANALYSES OF PRODUCED FORMATION WATERS FROM OIL AND GAS WELL TESTS IN MISSISSIPPI

The Mississippi Office of Geology announces the availability of Report of Investigations 3, "Chemical Data and Electrical Resistivity Values (Rw's) Determined from Analyses of Produced Formation Waters from Oil and Gas Well Tests in Mississippi," by Rick L. Ericksen.

Report of Investigations 3 is a compilation of chemical analyses and electrical resistivity (Rw) data obtained for 303 samples of produced waters from oil well tests in Mississippi published by the Bureau of Mines in Report of Investigations 6167 (Hawkins et al., 1963), now out of print, and approximately 950 additional chemical analyses and/or electrical resistivity (Rw) data which have been obtained during the 30 years since that report was published. In Report 6167, chemical analyses and resistivity values of produced waters in Mississippi were restricted to oil wells located within the Mississippi Interior Salt Basin and the Wilcox trend. Data contained within this report also include formation water produced by natural gas wells. Included are chemical and/or electrical resistivity data for fluid(s) produced from oil and gas tests located in an additional 22 previously unreported counties. The data set included over 2,800 laboratory determinations of the mineral constituents and/or electrical resistivities of formation samples from wildcat test wells and 241 oil, gas-condensate, and gas fields in Mississippi. In addition to these data the report lists, where available, the API number, operator, fee name, location, formation, producing zone, and the depth from which the water was produced.

The data are presented in several different forms for ease of use. The locations of the samples are shown on a series of maps with sources and specific well locations where possible. In addition to the published report, data contained therein are currently available on 3.5 inch diskette in both DBASE IV, a database format, and QUATTRO PRO, a spreadsheet format, for data manipulation and/or increased accessibility for the user. Sample location maps are stored in AutoCAD files which are available upon request. Additional software file formats (e.g. Excel, Reflex, Symphony, Lotus 1-2-3, Paradox, etc.) are also available.

Report of Investigations 3 may be purchased from the Office of Geology at Southport Center, 2380 Highway 80 West, Jackson, for $15.00 per copy. Mail orders will be accepted when accompanied by payment ($15.00, plus $3.00 postage and handling for the first copy and $1.00 for each additional copy). Send mail orders (with check or money order) to:

Office of Geology
P. O. Box 20307
Jackson, MS 39289-1307

# SUBJECT GUIDE TO RECENT PUBLICATIONS OF THE MISSISSIPPI OFFICE OF GEOLOGY

Michael B. E. Bograd
Mississippi Office of Geology

## INTRODUCTION

This report is an annotated guide to selected recent publications of the Mississippi Office of Geology, the state geological survey. Most of the publications mentioned here were published in the 1990s. A few publications of the late 1980s are included to illustrate the wide range of topics and types of publications available to the public from the Mississippi Office of Geology. These publications cover a diversity of topics and reflect the current research and expertise of our staff. They also show the agency's response to areas of public interest that require geologic information.

The majority of recent works fall under five major categories: Coastal Geology, Environmental Geology, Geologic Mapping, Paleontology, and Petroleum Geology. Coastal Geology is a relatively recent enterprise of the Mississippi Office of Geology. It was undertaken to study beach and land loss along the Mississippi Gulf Coast and possible remediation. Environmental Geology is the application of geologic principles to environmental concerns, ranging from hazards such as earthquakes and landslides to protection of ground-water quality through the proper siting of sanitary landfills and other waste disposal facilities. Geologic Mapping is traditionally the basic function of a state geological survey. Maps are made of the state, of counties, and individual quadrangles. Paleontology, the study of fossils, has been a topic of research since the inception of the state's geological survey. It is useful in mapping geologic formations, but also plays an important part in satisfying public interest when new fossil sites are uncovered by construction. Petroleum Geology has been an important study since the discovery of oil at Tinsley in 1939, though publication on the subject goes back to 1919 at this agency. Oil and gas resources are important to the state's economy and tax revenues.

All of the publications included here are still in print and are available from the Map and Publication Sales Office (see Ordering Instructions at end). A list of publications is available from this office free of charge. A great many additional titles are cited in this list, including older publications that may be out of print. Out of print publications are available for use in the agency library and at other research and university libraries around the country.

## PUBLICATION SERIES

The reader will notice that the publications highlighted in this article were published in a variety of series. The complete list of series includes Bulletins, our flagship series; Reports of Investigations, with technical reports of research into specialized subjects; Circulars, with either collections of data or non-technical summaries of various geological issues; Environmental Geology Series, with reports intended to assist decision-makers and the general public in issues relating to land-use planning and living with nature; Pamphlets, with educational information about the geology of Mississippi; Cross Sections, showing subsurface stratigraphy and structural features; Maps and Charts, such as the state geologic map and the Stratigraphic Column of Mississippi; Open-File Reports, with technical reports and maps on a variety of topics; and the quarterly journal *Mississippi Geology*. For the benefit of the Office of Geology staff and prospective authors outside the agency, a summary of the publication series and the type of report suitable for each is found in the September 1989 issue of *Mississippi Geology* (Bograd, 1989).

A brief explanation of the Open-File Report series may be in order here as several of the titles listed are in this series. The reader will notice that many titles are oil and gas papers resulting from research funded by grants from the Minerals Management Service and other sources. The series name may imply that these might be summaries or collections of data in a file that may be consulted by the public. Actually these are citable, complete publications. The reports and maps in this series are "published" in-house with the use of plotters, photocopiers, and reproduction services. Many titles are on technical subjects of important but narrow interest, with expected initial sales and distribution of up to 100 copies. The expense of typesetting and offset printing would not be justified, but the information may be of great use to some segment of the geological community and so is made available in this format. At this writing, plans are nearing completion for the purchase of a plotter to be used for, among other things, printing geologic quadrangle maps at 1:24,000. A number of quadrangles have been mapped and digitized (which allows easy update, compilation, and printout). Current plans call for many geologic quadrangles to be published in the Open-File Report series.

## COASTAL GEOLOGY

The Office of Geology established a Coastal Geology Section in 1990. This section has studied the geology and active geologic processes of erosion, accretion, and sediment transport along the Mississippi coast and offshore islands. This work has been presented in many talks and posters at scientific meetings and through a number of publications such as the following examples.

Bulletin 130, "Belle Fontaine, Jackson County, Mississippi: Human History, Geology, and Shoreline Erosion," edited by Stephen M. Oivanki

Bulletin 130 contains introductory and concluding statements by Stephen M. Oivanki, who compiled and edited the bulletin, and four papers about the Belle Fontaine area of coastal Jackson County. Dr. Klaus J. Meyer-Arendt of Mississippi State University contributed a paper on the history of human settlement of the "Island of Belle Fontaine." Dr. Ervin G. Otvos of the Gulf Coast Research Laboratory joined Oivanki in a report on the geologic framework, erosion history, and physical setting of the Belle Fontaine area. Dr. Joseph N. Suhayda of Louisiana State University prepared a report on the development of a shoreline evolution model and evaluation of erosion control alternatives. Cathy Z. Hollomon of the Mississippi Bureau of Marine Resources summarized the government's role in coastal management in Mississippi.
1994, $10.00

Circular 5, "Bibliography of Mississippi Gulf Coast Geology and Related Topics," by Stephen M. Oivanki, Michael B. E. Bograd, and Ervin G. Otvos

Circular 5 is a compilation of the scientific literature about the geology of the Mississippi Gulf Coast, the barrier islands, and the Mississippi Sound. The bibliography serves as the starting point for future research in this important and geologically dynamic part of the state. The subject index assists researchers in getting started with their projects.
1993, $4.00

## ENVIRONMENTAL GEOLOGY

Environmental geology is the application of geologic principles and knowledge to problems created by man's occupancy and exploitation of the physical environment (Bates and Jackson, 1987). The publication listed here deals with widespread problems in central Mississippi caused by an expansive (swelling) clay.

Circular 1, "Yazoo Clay: Engineering Aspects and Environmental Geology of an Expansive Clay," by Curtis W. Stover, Ross D. Williams, and Charles O. M. Peel

This circular contains information about the nature and extent of Yazoo Clay, construction problems, engineering tests, and methods of preventing problems. The non-technical publication is intended to provide information to homebuyers, homebuilders, and the general public.
1988, $2.00

## GEOLOGIC MAPPING

The traditional role of a state geological survey has always been the mapping of the surface geology of the state. Geologic maps are used for a wide range of purposes, including exploration for economic mineral resources and water resources, environmental applications such as proper siting of municipal and hazardous waste facilities, road building, agriculture and forestry, and outdoor recreation. The basic map available is the "Geologic Map of Mississippi," scale 1:500,000, 1969, $4.00. Although this map has been in print since 1969, our job is by no means finished. For one thing, this map is out of date and known to be in error in several places; thus, it needs to be updated. Secondly, there is great demand for detailed geologic maps, at the scale 1:24,000 or larger. Detailed maps are needed for site-specific work on issues related to the geology. With 840 quadrangles required to cover the state at this scale, and only a few sheets mapped at this scale, there is clearly much work to be done. The Office of Geology is actively pursuing this work, with four geologic mapping projects under way at this writing. These projects are preparing geologic quadrangles at the scale 1:24,000; these maps will be made available for sale at this scale in the Open-File Report series.

For decades the Office of Geology / Mississippi Geological Survey has been mapping surface geology county by county. The product has been a county geologic report published in the Bulletin series with a geologic map enclosed. County bulletins have been produced for half of the state's counties. The most recent is listed here.

Bulletin 127, "Tishomingo County Geology and Mineral Resources," by Robert K. Merrill and others

This publication describes the stratigraphy, water resources, and economic geology of Mississippi's northeasternmost county. Tishomingo County is unique in Mississippi in that it contains the only exposures of Paleozoic rocks, which are much older than the rocks elsewhere in Mississippi. The report brought our agency's stratigraphic terminology for these rocks into line with regional usage. The introductory pages summarize Tishomingo County's geography, history, physiography, topography, drainage, and the geology of two scenic state parks. Then follow descriptions of the geologic units found at the surface in the county and sections on structural geology and economic geology. Other reports in the bulletin are "Mineralogy and Petrography of Selected Tishomingo County Formations" by Dr. Delbert E. Gann and "Water Resources of Tishomingo County" by Stephen P. Jennings.
1988, $12.00

## PALEONTOLOGY

Paleontology is the study of the life of past geological ages. It is important to the successful mapping of surface and subsurface geologic units in the search for mineral deposits. The first example given here is a technical report on the fossil snails that are used to correlate Upper Cretaceous sediments, while the second is an educational circular and field guide to the shark teeth and other vertebrate fossils found at the very fossiliferous Frankstown site in northeastern Mississippi.

Bulletin 129, "The Streptoneuran Gastropods, Exclusive of the Stenoglossa, of the Coffee Sand (Campanian) of Northeastern Mississippi," by David T. Dockery III

Bulletin 129 reports on a hundred species of gastropods from the Upper Cretaceous deposits of Lee County, Mississippi. These fossils are among the best preserved gastropods of their age known anywhere. The text describes the age, depositional environment, and stratigraphy of the Coffee Sand; it then reviews gastropod classification. Next is a systematic description of the Coffee Sand gastropods, illustrated with 42 plates. This publication is much sought after by professional paleontologists around the world. The excellent figures on the plates are of immense help to geologists and amateur collectors in identifying the fossil gastropods they find in the Cretaceous deposits of northeastern Mississippi.
1993, $15.00

Circular 4, "A Guide to the Frankstown Vertebrate Fossil Locality (Upper Cretaceous), Prentiss County, Mississippi," by Earl M. Manning and David T. Dockery III

Construction of the Highway 45 bypass around Frankstown in 1991 exposed an abundance of shark teeth and other fossils that lived in the sea that covered the area during the Campanian Epoch of the Cretaceous Period about 75 million years ago. These fossils attracted collectors from all over Mississippi and other states. Booneville High School obtained a National Science Foundation grant to utilize the site as a laboratory for teaching their students about natural history. The collecting expedition by the students was filmed and broadcast nationally on the ABC Sunday evening news (June 16, 1991).

Circular 4 was developed from a handbook prepared for high school students to use in studying their fossil collections and learning about geology. The authors have written the text to be interesting and educational for the non-scientist and also of use to the professional scientist wishing to identify most vertebrate fossils likely to be found in the Cretaceous of Mississippi. Earl Manning has many years experience as a vertebrate paleontologist at the American Museum of Natural History and the Louisiana State University Museum of Geoscience. Dr. Dockery is chief of the Surface Geology Division of the Mississippi Office of Geology. The vertebrate fossils are illustrated in 12 plates by professional artist David White.
1992, $4.00

## PETROLEUM GEOLOGY

Petroleum geology deals with the geologic occurrence of oil and natural gas in the subsurface. The Office of Geology has an active research program in the petroleum geology of the state; some of the recent publications are listed below.

Chart entitled "Significant Oil and Gas Pools and Formations of Mississippi," by Rick L. Ericksen and Sandra Dowty

This chart presents the oil and gas producing formations of the state in columnar form by geologic age and group. The number of fields is given for each of the producing formations. Also given are the first productive pool and field of first production, the significant zones or pools for each formation, the dominant reservoir lithology, and a type field for each zone. This chart is particularly useful for those directly involved in the oil and gas industry as well as landowners and others interested in oil and gas production within the state. The size of the chart is 11.2 x 34.5 inches.
1992, $2.00

Open-File Report 20, "A Geologic Report on the Feasibility of Large-Quantity Brine Disposal in the Richton Dome Area," prepared by the staff of the Department of Environmental Quality

Open-File Report 20 results from a cooperative project by several geologists and geohydrologists on the staff of the Department of Environmental Quality's Offices of Geology, Pollution Control, and Land and Water Resources. This report is the result of Mississippi's attempt to obtain a Strategic Petroleum Reserve crude oil storage facility. It has information on Wilcox Group stratigraphy and sand characteristics. Current industry practices of injection of large quantities of salt brine (>30,000 barrels per day per well) are documented, and demonstrate the ability of Wilcox sands to accept the large volumes of brine generated during the creation and operation of a salt dome cavern storage facility. Two stratigraphic cross sections of the Wilcox Group at the Richton Dome area, a reference map, and several well logs are included.
1995, $15.00

Open-File Report 21, "Regional Geologic Framework of the Cretaceous, Offshore Mississippi," by A. John Warner

Open-File Report 21 is a study of the deeply buried Cretaceous rocks beneath coastal Mississippi and the state-owned offshore waters. This study briefly discusses 15 Cretaceous formations, presents paleogeographic maps for the Selma and Hosston formations, and includes regional correlations. The report, with 40 pages and one plate in the back pocket, was completed as a research project funded by a grant from the Minerals Management Service of the U. S.

Department of the Interior.
1994, $8.00

Open-File Report 22, "Regional Jurassic Geologic Framework and Petroleum Geology, Coastal Mississippi and Adjacent Offshore State and Federal Waters," by Rick L. Ericksen and Stanley C. Thieling

Open-File Report 22 is a study of the deeply buried Jurassic rocks beneath coastal Mississippi and the state-owned offshore waters. The report includes color core photographs from Catahoula Creek Field, the only Jurassic producing area of coastal Mississippi; a discussion of Jurassic production of Mississippi; and x-ray powder diffraction patterns and color photomicrographs of Jurassic mudlog show zones from the Chevron #1 Mississippi Sound Block 57 well. A structure map of the Petit Bois Island area and a log correlation section are included. The report, with 102 pages and two plates in the back pocket, was completed as a research project funded by a grant from the Minerals Management Service of the U. S. Department of the Interior.
1994, $20.00

Open-File Report 23, "Regional Geologic Framework of the Miocene, Coastal and Offshore Mississippi," by Stephen D. Champlin, S. Cragin Knox, and T. Markham Puckett

Open-File Report 23 is a study of the Miocene sediments of the Mississippi coastal area and state-owned offshore waters. The Mississippi coastal and offshore Miocene is compared to the Miocene sediments of the adjacent Alabama coastal and offshore areas which produce gas from a number of shallow fields. The report, with 109 pages and two plates in the back pocket, was completed as a research project funded by a grant from the Minerals Management Service of the U. S. Department of the Interior.
1994, $10.00

Open-File Report 40, "The Petroleum Geology of Independence Field (Frio), Wilkinson and Amite Counties, Southwestern Mississippi," by Stephen D. Champlin

Open-File Report 40 is a study of the history, stratigraphy, structure, hydrocarbon trapping mechanisms, reservoir parameters, and gas production of Independence Field, which is centrally located in the shallow Frio gas trend of southwestern Mississippi. In addition to discussions of the listed topics the report includes three structure maps, a sand isopach map, a type log for the field, annual gas production data on individual wells in the field, and two structural cross sections. The report, with 36 pages and two plates in the back pocket, was completed as a research project by the Energy Section of the Mississippi Office of Geology.
1995, $10.00

Open-File Report 41, "The Petrophysical Attributes of Cretaceous Reservoirs of Southern Mississippi and Adjacent State Waters," by Rick L. Ericksen

Open-File Report 41 is a study of the Cretaceous-age sediments in the coastal counties of Mississippi. The report includes averaged log-derived porosity and conventional core data from wells in the three oil and gas fields (Ansley, Kiln, and Waveland) located in Hancock County, Mississippi. The trapping mechanism(s) and reservoir characteristics of each field are discussed. In addition to discussions of these topics, the report includes a structure map, four isopach maps, seven tables containing data on each productive reservoir found in the three fields, and one table containing the range of average porosities for potential Cretaceous reservoirs anticipated within the study area. The report, with 38 pages and one plate in the back pocket, was completed as a research project funded by a grant from the Minerals Management Service of the United States Department of the Interior.
1995, $10.00

Report of Investigations 3, "Chemical Data and Electrical Resistivity Values (Rw's) Determined from Analyses of Produced Formation Waters from Oil and Gas Well Tests in Mississippi," by Rick L. Ericksen

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1995, $15.00

## ORDERING INSTRUCTIONS

All of the publications mentioned in this article are available from the Office of Geology at the Map and Publication Sales Office at Southport Center, 2380 Highway 80 West, Jackson, Mississippi. Southport Center is near the intersection of Highway 80 and Ellis Avenue in southwest Jackson. The telephone number is 601-961-5523. A list of publications is free on application. If you wish to order by mail, please contact the office for prepayment instructions and current postage and handling rates. The mailing address is:

Mississippi Office of Geology
P. O. Box 20307
Jackson, MS 39289-1307

### REFERENCES CITED


Bates, Robert L., and Julia A. Jackson, editors, 1987, Glossary of geology, third edition: American Geological Institute, p. 216.

Bograd, Michael B. E., 1989, Publication series of the Mississippi Bureau of Geology: Mississippi Geology, v. 10, no. 1, p. 10-11.


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## NEW PUBLICATION AVAILABLE FROM THE OFFICE OF GEOLOGY

## THE PETROPHYSICAL ATTRIBUTES OF CRETACEOUS RESERVOIRS OF SOUTHERN MISSISSIPPI AND ADJACENT STATE WATERS

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Open-File Report 41 may be purchased from the Office of Geology at Southport Center, 2380 Highway 80 West, for $10.00 per copy. Mail orders will be accepted when accompanied by payment ($10.00 per copy, plus $3.00 postage and handling for the first copy and $1.00 for each additional copy). Send mail orders (with check or money order) to:

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Jackson, MS 39289-1307

An up-to-date index of *Mississippi Geology* is available from the Office of Geology. Open-File Report 15, "Current Index to *Mississippi Geology*," compiled by Michael B. E. Bograd, is available for $2.00 ($2.50 by mail) from the Office of Geology, P. O. Box 20307, Jackson, MS 39289.

**MISSISSIPPI GEOLOGY**
Department of Environmental Quality
Office of Geology
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Mississippi Geology is published quarterly in March, June, September and December by the Mississippi Department of Environmental Quality, Office of Geology. Contents include research articles pertaining to Mississippi geology, news items, reviews, and listings of recent geologic literature. Readers are urged to submit letters to the editor and research articles to be considered for publication; format specifications will be forwarded on request. For a free subscription or to submit an article, write to:

**Editor, Mississippi Geology**
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Editors: Michael B. E. Bograd and David Dockery