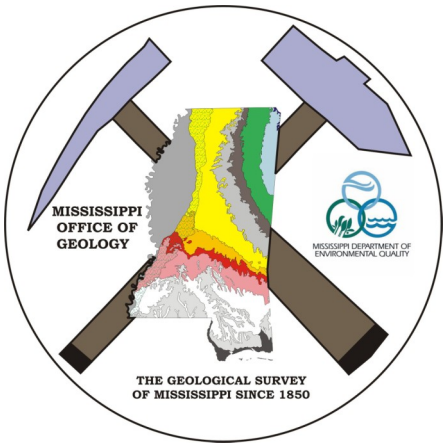
VOLUMES 5-6
2008-2009

JUST GEOLOGY

FROM THE PAGES OF ENVIRONMENTAL NEWS

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY



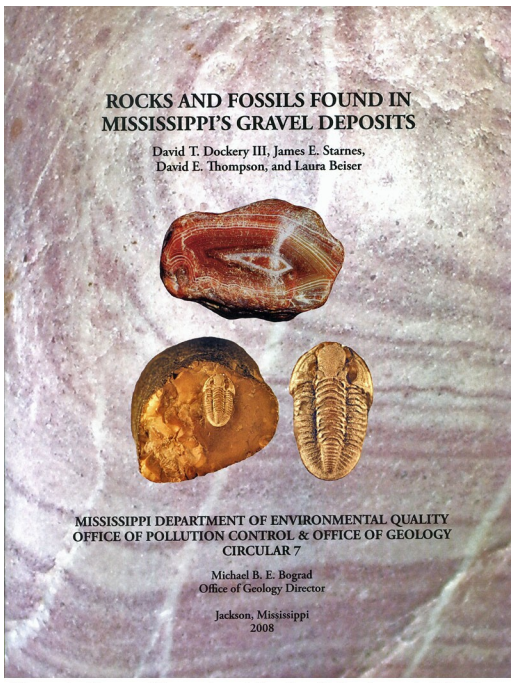


Figure 1. Cover of the rock and fossil guidebook created for the first Children's Educational Fair held on April 2-4, 2008.

Figure 8. Jim May points to the location they are standing on his geologic map in the Wayne County geology bulletin to show that he correctly mapped the limestone newly exposed in the area. Looking at the map is Emmett Adams (front) and Wylie Poag, with David Williamson at right. Picture (Kodachrome slide) taken on July 28, 1975.

VOLUME 5, 2008

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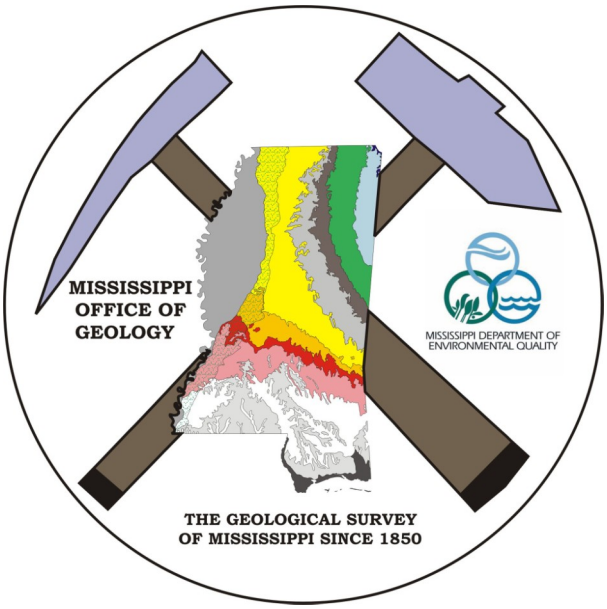
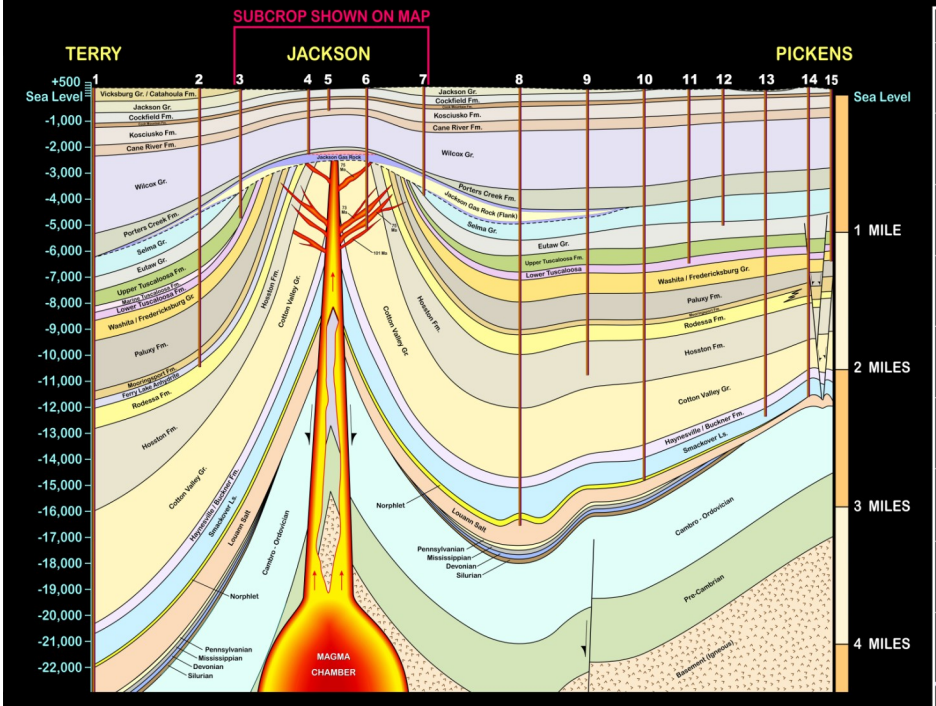
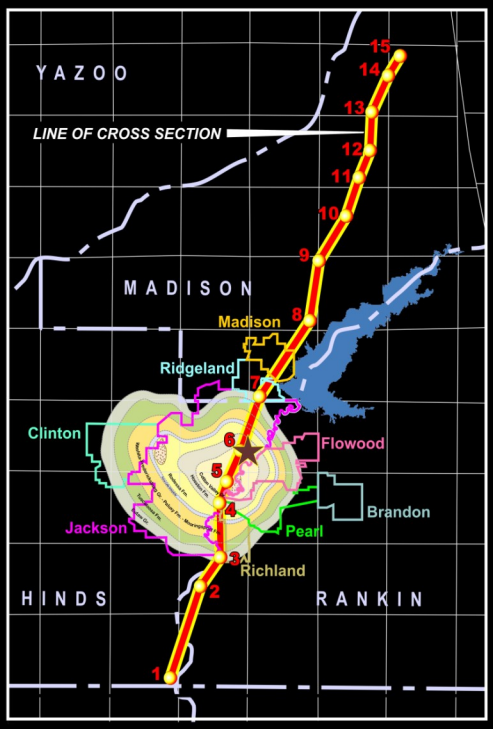


Figure 1. Right innominate (right pelvis) and left femur (left thigh bone) of the protocetid whale *Georgiacetus* from the Archusa Marl Member on the Chickasawhay River south of Quitman in Clarke County, Mississippi. Picture (digital CD #53) taken by George Phillips on July 15, 2008.

NORTH-SOUTH CROSS SECTION



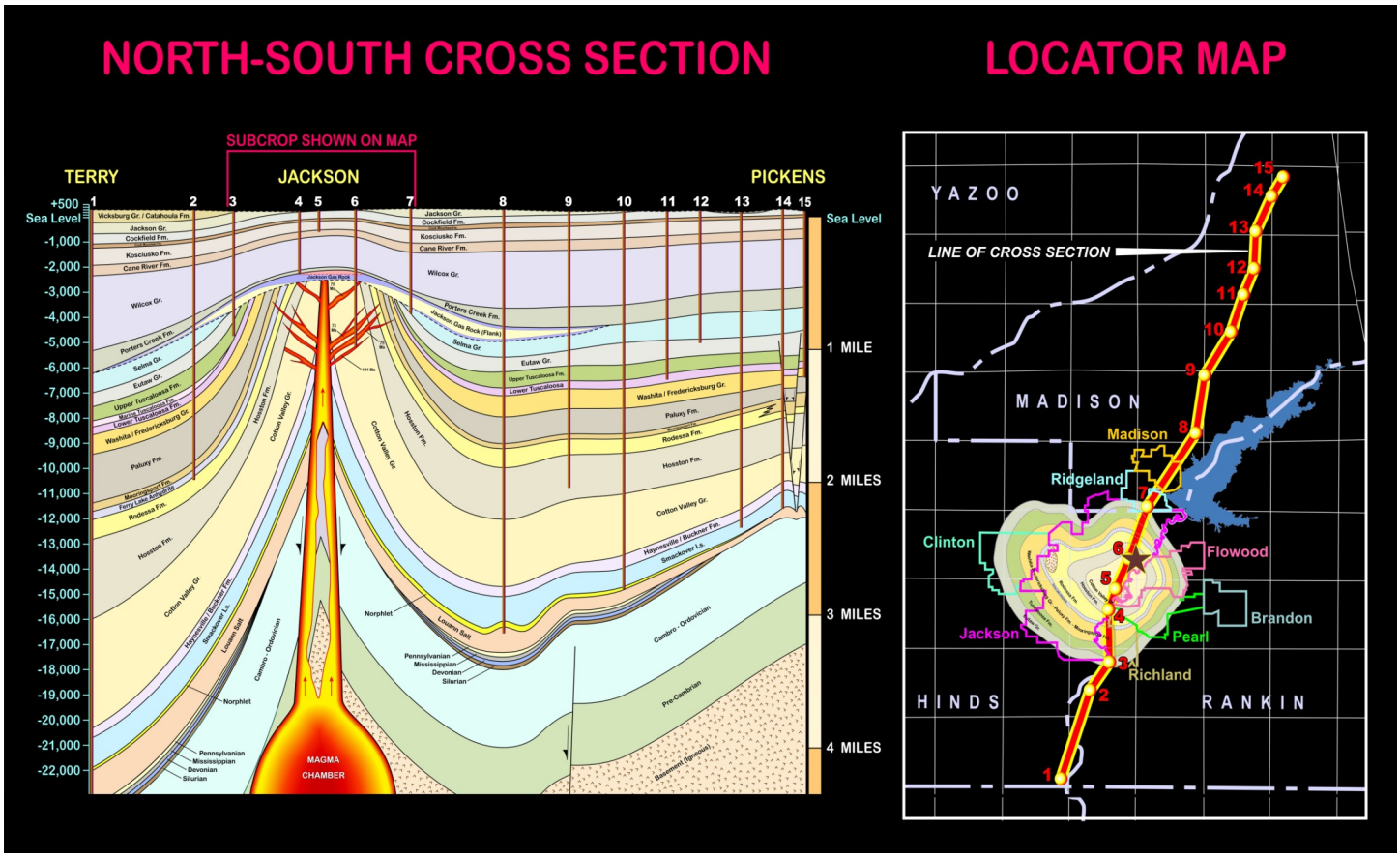
LOCATOR MAP



OFFICE OF GEOLOGY CROSS SECTION OF JACKSON DEFINES INACTIVE VOLCANO

By David Dockery

What do we really know about the volcano under Jackson, Mississippi? Though the geologic structure called the Jackson Dome has been known since about 1860, it was not until gas was discovered at Jackson in the 1930's that drilling rigs penetrated volcanic rocks beneath the city. In the 1950's, oil exploration geologists taking a course on "The Geology of Mississippi" at Millsaps College constructed a cross section from the oil field at Pickens to just south of Jackson. This cross section was improved with new drilling data in 1997, in a publication by the Office of Geology. This year a cooperative effort between the Office of Geology and Vision Exploration staff (geologist Steve Walkinshaw and graphic artist Candy Goolsby) produced the best illustration to date of the volcano beneath Jackson. The locator map shows a north-south cross section extending from Pickens, through Jackson, and south to Terry, where a deep oil exploration well penetrated some four and a half miles of rock. The top of the volcanic vent reaches to within half a mile of the surface beneath Jackson and disrupts the surrounding formations. Well number 8 of the cross section once produced over 2.5 million cubic feet of carbon dioxide per day—a gas derived from the ancient volcano. The once flat-lying Cotton Valley Group was pushed upward over 10,000 feet by a rising plume of molten rock. All of this upheaval is now buried beneath sediments of Tertiary age, though even these Tertiary formations dome upward above the buried volcano, indicating more recent movement of the structure. Based on the stratigraphy and the radiometric ages of igneous rocks encountered in wells, the volcano was most active 75 million years ago and has been extinct for the last 70 or so million years.



ON THE ROAD WITH FOSSILS

By David Dockery

The Fossil Road Show at the Mississippi Museum of Natural Science is a take-off on the very popular Antiques Road Show produced by PBS. James Starnes and I were two of several specialists who identified rocks and fossils brought in by the public. This was made more difficult in that many things that were brought to us were not found in Mississippi but were purchased and came from far away places such as the Atlas Mountains of Morocco. We had to identify these fossils with the cameras rolling and at the same time had to encourage young children to speak up about their rocks and fossils so that we and the camera recordings could hear their voices. Another facet of the film production was a filming session with a young host named Alyssa, who asked questions on site at the fossil locality below the museum known as Fossil Gulch. She didn't just ask questions. She looked into the camera, all microphoned-up, with wide eyes and a dramatic flare and said something like "WOW, WE'RE AT A FOSSIL SITE THAT'S 38 MILLION YEARS OLD!" Then she turned to me and asked, "WHAT KIND OF FOSSILS CAN WE FIND HERE?" That question, and our time at the site, led to two scientific discoveries. Answering the question I listed such things as shark teeth, fossil clams called bivalves, fossil snails called gastropods, and the internal shells of squids called *Belosaepia*. The last item came off the top of my head even though I knew of only two such specimens from the Jackson area. After filming the session the producer asked for pictures of the fossils I had mentioned to use as "pop ups" in the film. George Phillips of the Museum of Natural Science took the pictures for me and sent the picture of the *Belosaepia* to various squid experts. One said it was the best fossil specimen he'd ever seen, and another asked to publish it as a new species. Also, while at the site, I was showing the producer the fossil shells sticking out of the hillside when I recognized the edge of an uncommon cowrie shell. When I dug the shell out with my keys, I found it to be a new species of the genus *Sulcocypraea*, a fact later confirmed by a cypraeid expert in France. Thus, our involvement with the Fossil Road Show film led to the identification of two new fossil molluscan species.

New species of a fossil cuttlebone of a *Belosaepia*-like squid from the Moodys Branch Formation at Jackson

A new species of the cowrie shell *Sulcocypraea* found during filming of the Fossil Road Show

OFFICE OF GEOLOGY DRILL CREW

The Office of Geology's drill crew has obtained a sterling reputation for professionalism, dedication, and innovation in the field all while working in relative obscurity. Following is an interview with John Marble who oversees the drill crew as a component of his role managing the Environmental Geology Division.

1. What is the mission of the drill crew for the Office of Geology?

Our job is to collect subsurface geologic samples in support of the many programs at MDEQ. We drill testholes for the STATEMAP program that drives our Surface Mapping Division at the Office of Geology. These testholes are drilled at specific locations picked by our geologists in areas being actively mapped. The total depth of these holes range from shallow (approximately 350'-400') and others are somewhat deeper (700'-900'). Some of these holes are simply drilled and the cuttings are laid out, preserved, and archived to be used in conjunction with wireline logs secured in the testholes. This allows geologists to relate the samples to a particular wireline log response and thus correlate those log responses to other wireline logs in the study area. Some of the more important holes are cored. In this process we can retrieve a two inch diameter core, ten feet long. This "undisturbed" geologic sample gives geologists a unique look at the texture, structures, and other subtle attributes that may otherwise be missed in cuttings. These cores become incredibly important when a facies change is suspected, when a contact with an overlying or underlying formation is extremely subtle, or more information is needed to determine the environment in which the geologic material was deposited. We also drill testholes and complete monitor wells for the Office of Land and Water Resources. Their geologists are deeply involved in a study of the alluvial aquifer in the Mississippi Delta. Data gathered from this study will allow for a better use of this valuable water resource by farmers and aquaculture businesses in the region. We have in the past drilled testholes and completed monitor wells for the Office of Pollution Control. These holes are normally very shallow (less than 100') and are designed for site specific needs.

2. What is their focus and why is it important for the Office of Geology and the State of Mississippi?

The focus of the drill crew is to obtain these subsurface geologic samples as accurately and as safely as possible. These detailed samples allow geologists to better map geologic formations and thus construct the most accurate maps possible. These maps lead directly to a better understanding of the state's many aquifers, the recharge areas of these aquifers, possible building hazards, areas where liquefaction may occur during earthquakes, and areas where landslides may be prone to occur.

3. Who makes up the crew and what equipment do they use? What type of education and training do they have?

Our lead driller is Trey Magee from McComb and the backup driller is Archie McKenzie from Tylertown. The crew uses a Failing 1500 Holemaster rig purchased by the then named Mississippi Geological Survey in 1965. The rig is mounted on an International truck which allows us easy access to very small drilling sites. They also use a water truck needed to transport water to the drill site to make up drilling muds. This truck is also an International fitted with a 1,000 gallon water tank. It also transports the drill pipe necessary for drilling operations. Both Trey and Archie are graduates of the drilling school at Southwest Mississippi Community College in Summit. This unique school has provided some of our best employees of which Trey and Archie are tops.

4. What other drilling work is done? What about water wells and research?

We cannot drill water wells for individuals in the state. The testholes we do drill for other agencies, however, does give us a remarkable opportunity to better map the aquifers from which groundwater is withdrawn. These testholes and the data gathered from them allows for better siting of water well locations, better understanding of the quality of the potential aquifer, and better estimates of the rate at which the aquifer will produce. This in turn allows engineers to do much more detailed design work for the water systems, which in turn should reduce the costs to the end users.

5. Do they do work for other offices at MDEQ? What about other state agencies or universities or anyone else?

In addition to those entities mentioned in the first response, we have drilled numerous testholes for the Mississippi Mineral Resources Institute at Ole Miss. We have also constructed seismic monitoring holes in north Mississippi, central Mississippi and in the Jackson area in conjunction with Ole Miss and Millsaps College.

6. Any bizarre stories involving angry landowners or disturbed wildlife?

Although we have a "right to access" in Mississippi, we, to my knowledge, have never used it . Our method of operation requires us to get written permission of the landowners before any drilling begins. As a result, we usually have a great relationship with the landowners. In some cases we have gone back to spread out the discarded samples and fill in some ruts, but nothing that has resulted in an outraged landowner. Since our drilling operation is so small, we do not impact wildlife to a great degree. We are usually on location and gone within a week's time and therefore no permanent change to any habitat happens. The only funny story that comes to mind happened on a testhole drilled near Corinth. It was during deer season, and the landowner was very interested in our start time or when we would be on location. After more talking, it became apparent he wanted to climb up in the rig's derrick and use the "monkey board" as a temporary tree stand. Seems as if we were in a great place for deer crossing.

7. How does research of this type benefit the average Mississippian?

As alluded to above, our focused research allows us to better map geologic formations resulting in a better understanding of aquifers, recharge areas of subsurface aquifers, potential building hazards such as swelling clays, areas of potential liquefaction during earthquakes, and areas that might have potential for landslides. The benefit to Mississippians is almost immeasurable. If we can better map an aquifer's extent, then the expense of drilling dry holes is somewhat mitigated. If we know the approximate thickness of the aquifer, we can better plan the most effective rate at which the water source can be produced. The more we know about the aquifers, the better engineers can design wells and thus cut down on unnecessary equipment. This all results in cost savings for those end users of the individual water systems. The more we know about the extent of the recharge areas of the underground aquifers the more we can possibly prevent some type of pollution from entering the groundwater supply. For example, if we know where a recharge area is for a particular groundwater supply, we might not want to put a landfill, or a wood treatment plant, or any other type plant that might discharge a potential contaminant on that particular property. If we can map areas prone to have low soil pH or swelling clays, we could possibly help engineers and architects design better foundations for buildings. If we can map geologic formations that may be prone to landslides or liquefaction during earthquakes, better building codes might help limit damage.

The drill crew's reputation extends out of the Office of Geology and has earned them appreciation for their diligent work. Charlotte Byrd in the Office of Land and Water Resources relies on the crew for her research: "A lot of my work here at MDEQ has been doing geohydrological type research on the alluvial aquifer in the Delta. Geology's drill crew has drilled many stratigraphic holes for me in this area. They make my job as the on-site geologist much easier by making sure I have all the samples I need. The data we've been able to collect has been invaluable in helping us understand the alluvial aquifer system in the Delta. Archie and Trey have been a part of the drill crew for most of this activity, and I must add that they are, in my opinion, some of the best we could ever want to do this important job."

For more information about the drill crew or the Office of Geology's Environmental Geology Division, go to: http://www.deq.state.ms.us/MDEQ.nsf/page/Geology_environmental?OpenDocument.

Early Primate Fossils Found at Meridian, Mississippi

By Dr. David T. Dockery, III, Office of Geology

Generally when we think of the Primate Family we think of ourselves. People are new-comers to the family. The first people are believed to have lived in Africa and to have migrated at various times during the Pleistocene Ice Age to Europe, Asia, Australia, the Pacific islands, and North America. Anthropologists who wish to search for the oldest human fossil remains do so in Africa.

People are equipped with extra-large brains and hands that can grip tools and build things like houses, roads, bridges, cities, and spacecraft that can explore our local universe. But, before we become too proud, we should look into the eyes of the other primates, such as the apes, monkeys, or lemurs, and see their human-like baby faces. Like us, other primates have forward-facing eyes, specially designed for depth perception. Behind those eyes are bigger than average brains, capable of problem solving and human-like emotions. Their hands look like ours with opposable thumbs and even fingernails (and toenails), rather than claws or hooves like most other animals have. With all this said, it is no small matter that one of the earliest known primate fossils is a new species found at Meridian, Mississippi. The species was named *Teilhardina magnoliana* after the Magnolia State by Chris Beard of the Carnegie Museum of Natural History.

Figure 1. Artist reconstruction of *Teilhardina magnoliana*, an early primate from the T4 sand at the Red Hot Truck Stop locality at Meridian, Mississippi (DVD #57).

Chris Beard, winner of a $500,000 MacArthur *genius award* in 2000 for his work on early primates, caused considerable debate among scientists when he claimed his new species from Meridian to be the second oldest known primate fossil occurrence. I was interviewed by a Pittsburgh newspaper and by a writer for the Carnegie Museum of Natural History concerning Chris' new primate species. The debate about this species was such that Google asked me to weigh in on the discussion (I didn't even know that Google did that kind of thing). One reason that Meridian is such a strange place for the second oldest known primate occurrence is because the oldest known primate fossils were found in China.

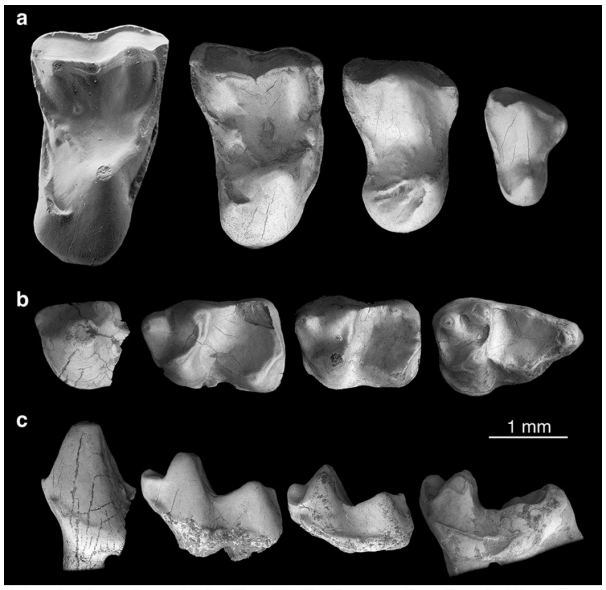


Figure 2. Composite partial dentition of *Teilhardina magnoliana* from the T4 sand in the upper Tuscahoma Formation at the Red Hot Truck Stop locality in Meridian, Mississippi (DVD #57). Plate is Figure 1 from Beard (March 11, 2008: PNAS).

Teilhardina magnoliana was characterized in a Carnegie Museum of Natural History press release as a tiny primate weighing approximately 28 grams or about one ounce. Like other small primates it was an "acrobatic leaper and proficient climber, and it probably ate insects, fruits, sap and gum." The discovery in Meridian has generated much national media attention this year. The *Pittsburgh Tribune Review* (March 4, 2008) described *T. magnoliana* as a wide-eyed primate small enough to fit in the palm of a child's hand. The *Boston Globe's* website (March 3, 2008) said the animal was so tiny that one could loll in a tablespoon. *The New York Times* (March 4, 2008) cited Beard as saying it was about the size of the pygmy mouse lemur of Madagascar, the tiniest living primate. The paper also cited Peter Wilf, a paleobotanist at Penn State who studied fossil leaves at the Meridian site, as describing the ancient landscape in which the primate lived as "a subtropical forest of shrubs and tall trees, flowering plants and ferns, sassafras and sumac." *The San Diego Union-Tribune* (March 6, 2008) compared the appearance of *T. magnoliana* with that of "the big-eyed tarsiers of Southeast Asia or a small monkey." Based on the numerous press accounts, one can see that Mississippi is a happening place for paleontology and for scientific research.

PICTURE OF THE MONTH

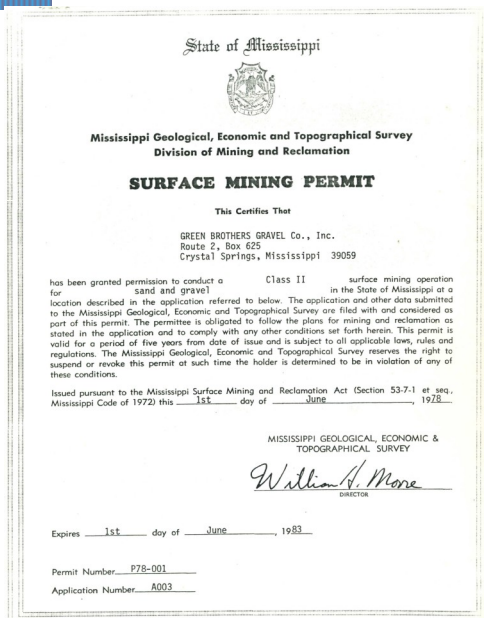
I. E. Gresham and grandson beside a recently-quarried *Lepidodendron* log in the Hartselle Sandstone at the Gresham Quarry in Tishomingo County. Picture by Ed Blake taken on June 3, 1966.

The First Mine Permit in Mississippi

Thirty Years of Successful Mine Regulation and Reclamation

by Michael B. E. Bograd and Ken McCarley, Office of Geology

The first surface mining law in Mississippi was passed by the Legislature during the 1977 session, but did not become effective until April 15, 1978. Responsibility for the Mississippi Surface Mining and Reclamation Act was given to the Mississippi Geological Survey (the former name of the MDEQ Office of Geology). Upon passage of the law, Geological Survey staff began writing regulations to implement the law, designing forms, and creating a filing system and other procedures; the latter were set up by Dot Polen. The original team of David Ray Williamson, J. Jackson Harper, and Michael Bograd toured mines throughout the state for sand and gravel, clay, bentonite, limestone, and fill dirt. They also met with industry representatives and held informational meetings for the mining community. Regulations implementing the act were adopted by the Geological Survey Board on October 11, 1977, also effective April 15, 1978.



State of Mississippi

Mississippi Geological, Economic and Topographical Survey
Division of Mining and Reclamation

SURFACE MINING PERMIT

This Certifies That

GREEN BROTHERS GRAVEL Co., Inc.
Route 2, Box 625
Crystal Springs, Mississippi 39059

has been granted permission to conduct a Class II surface mining operation for sand and gravel in the State of Mississippi at a location described in the application referred to below. The application and other data submitted to the Mississippi Geological, Economic and Topographical Survey are filed with and considered as part of this permit. The permittee is obligated to follow the plans for mining and reclamation as stated in the application and to comply with any other conditions set forth herein. This permit is valid for a period of five years from date of issue and is subject to all applicable laws, rules and regulations. The Mississippi Geological, Economic and Topographical Survey reserves the right to suspend or revoke this permit at such time the holder is determined to be in violation of any of these conditions.

Issued pursuant to the Mississippi Surface Mining and Reclamation Act (Section 53-7-1 et seq., Mississippi Code of 1972) this 1st day of June, 1978

MISSISSIPPI GEOLOGICAL, ECONOMIC & TOPOGRAPHICAL SURVEY

William A. Moore
DIRECTOR

Expires 1st day of June, 1983

Permit Number P78-001

Application Number A003

First surface mining permit issued June 1, 1978.

Heyward Carter Green of Green Brothers Gravel Company informed the staff of his intention to apply for the first surface mining permit. His company applied for a five-acre expansion of an existing (grandfathered) mine for sand and gravel in Copiah County. The application was received two days after the effective date of the law, and the first Mississippi surface mine permit (P78-001) was issued on June 1, 1978. The permit was valid for five years, but mining was soon completed. An initial release of 80 percent of the performance bond was granted in 1979, and the final 20 percent of the bond was released on October 13, 1982.

Ken McCarley standing on the edge of the reclaimed first permitted mine in Mississippi, October 3, 2008. The volunteer pines have grown since the revegetation timber was harvested.

Recently MDEQ Office of Geology staff visited the site of this first permit. Ken McCarley and Michael Bograd were shown the site by Andy Donahoe of Green Brothers Gravel Company. The reclamation remains successful, thirty years after the successful launch of Mississippi's surface mining regulation.

The 1977 Mississippi surface mining law was "progressive" for its time in that it regulated mines for all materials, which other states at that time did not do. As noted in its title, the law emphasized the reclamation of land following mining. Later in 1977 the federal government passed the Surface Mining Control and Reclamation Act (SMCRA), which pertained only to coal and lignite mines. In 1979, the Mississippi Legislature passed the Mississippi Surface Coal Mining and Reclamation Act to remove coal and lignite from the original state law and establish the more stringent requirements for governing coal and lignite mines under federal oversight. In 2002, the mining law was amended to close some glaring loopholes, including mining in streams and being able to start mining after submitting an application for the permit.

Today the Office of Geology administers two surface mining laws, one for coal and lignite mines, and one for sand, gravel, clay, and all other materials that are mined in the state. There are 768 surface mining permits on file covering over 32,000 acres of mining. Annually the Office of Geology sees on average approximately 2,000 acres reclaimed.

THE MAP AND PUBLICATION SALES OFFICE

By Michael B. E. Bograd, Office of Geology

Brenda Cook in the Map and Publication Sales Office

Do you need to know if a proposed waste disposal facility is on an aquifer recharge area? Are you concerned about desiccation sinkholes in the Delta? Do you want to identify some fossils you found in northeastern Mississippi? Do you need a topographic map to plan a hunting or fishing trip? If so, the place to start is the Map and Publication Sales Office.

The Map and Publication Sales Office of the MDEQ Office of Geology is located on the ground floor of the 700 North State Street building in Jackson. This office in its present and former locations has been selling publications of the Mississippi Geological Survey / Office of Geology since 1907. These maps and publications have the answers to the questions posed above, plus more information about the geology and mineral resources of Mississippi. Since at least the 1960s the office has carried all of the topographic map products for Mississippi that are produced by the U.S. Geological Survey.

Office of Geology Publications

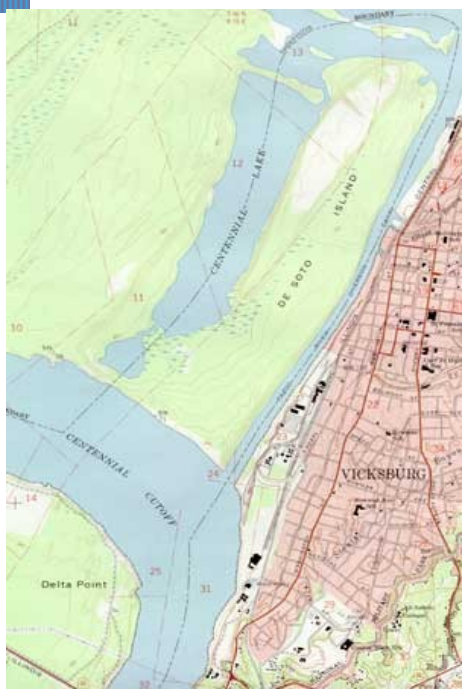
The Office of Geology publishes the state geologic map, which is the starting point for any inquiry about the geology, mineral resources, water resources, engineering geology, or geologic hazards of Mississippi. County geologic maps have been published at a scale of about 1:125,000 for nearly half the counties in county geologic bulletins. In recent years, the results of our geologic mapping activities have been published as geologic quadrangles at the scale of 1:24,000. More than 100 of these geologic quadrangles are available.

Other reports published by the Mississippi Geological Survey / Office of Geology cover such topics as stratigraphy of various parts of the state, geology of state parks and the Vicksburg National Military Park, clay resources, agricultural lime, clays suitable for light-weight aggregate, loess deposits, oil and gas resources, and fossils. The series of publications include bulletins, information series, environmental geology series, reports of investigations, circulars, cross sections, and various maps and charts. Take a look at the List of Publications to get an idea of what is available from the agency.

As geology is the basis of the environment, these maps and publications on the geology of Mississippi provide essential information for many projects and responsibilities of the staff of MDEQ and its stakeholders. The maps and publications are available for very reasonable prices.

Topographic Maps

The Map and Publication Sales Office stocks the latest version of each of the 840 topographic quadrangles that cover the state. The scale of these maps is 1:24,000, or one inch equals 2,000 feet. These maps sell for $6.00 each. Smaller scale topographic maps are available as well, and cost $7.00 each. The 1:100,000-scale maps cover 30 minutes of latitude by 60 minutes of longitude and have contours at 5, 10, or 20 meter intervals. The 1:250,000-scale maps cover 1 degree of latitude by 2 degrees of longitude, with a contour interval of 50 or 100 feet. The state topographic map of Mississippi is at a scale of 1:500,000, with a contour interval of 200 feet.



Mississippi River at Vicksburg map

Sales of topographic maps are down from previous years, probably due to the availability of scanned images of topographic maps online. Some of these online images are of poor resolution, but seem to meet the needs of many map users. But if you need or prefer a paper map, you can purchase one during business hours or order by mail (with prepayment of cost plus shipping).

Location and Contact Information

The Map and Publication Sales Office is managed by Brenda Cook. The direct telephone number is 601-961-5523, and she also answers calls to the Office of Geology main number, 601-961-5500. Call her for questions about maps and publications or for assistance with ordering by mail.

Street Address:
700 North State Street
Jackson, MS 39202

Mailing Address for Inquiries:
Office of Geology
P.O. Box 2279
Jackson, MS 39225-2279

Mailing Address for Orders:
MDEQ – Accounts Receivable
P.O. Box 2339
Jackson, MS 39225-2339

A List of Publications is available in hard copy and online at
http://www.deq.state.ms.us/MDEQ.nsf/page/Geology_list_of_publications?OpenDocument

FOSSIL WHALES WITH LEGS

By David T. Dockery III, Office of Geology

Ever since Dr. Philip Gingerich of the University of Michigan discovered hind legs on the ancient whale *Basilosaurus isis* at a site in the Egyptian desert 95 miles southwest of Cairo, I've been looking to find hind legs on a Mississippi *Basilosaurus*. Gingerich's discovery was reported in the July 12, 1990, edition of the *New York Times* and the following day was the subject of a joke by Johnny Carson on the Tonight Show. Now the MDEQ Office of Geology in conjunction with the Mississippi Museum of Natural Science is excavating a Mississippi fossil whale with hind legs. This specimen is much like that of a *Georgiacetus* displayed in the Georgia Southern University Museum. We have recovered the whale's right innominate (right pelvis) and most of the left femur (left thigh bone) along with 18 vertebrae.

Figure 1. Right innominate (right pelvis) and left femur (left thigh bone) of the protocetid whale *Georgiacetus* from the Archusa Marl Member on the Chickasawhay River south of Quitman in Clarke County, Mississippi. Picture (digital CD #53) taken by George Phillips on July 15, 2008.

Figure 2. Side view of mounted specimen of the protocetid whale *Georgiacetus vogtlensis* from the McBean Formation in Georgia as displayed at the Georgia Southern University Museum. Image was made available by Debbie Gleason of the Georgia Southern Museum (DVD #57).

Figure 3. Excavation cut expanded in search of addition *Georgiacetus* bones in the Archusa Marl Member on the Chickasawhay River south of Quitman in Clarke County, Mississippi. Picture (digital CD #54) taken on July 17, 2008.

Figure 4. Excavation of a block of Archusa Marl containing two vertebrae of the protocetid whale *Georgiacetus* at a site on the Chickasawhay River south of Quitman in Clarke County, Mississippi. Picture (digital CD #54) taken on July 17, 2008.

WINTER/SPRING
2009

JUST GEOLOGY

FROM THE PAGES OF ENVIRONMENTAL NEWS

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

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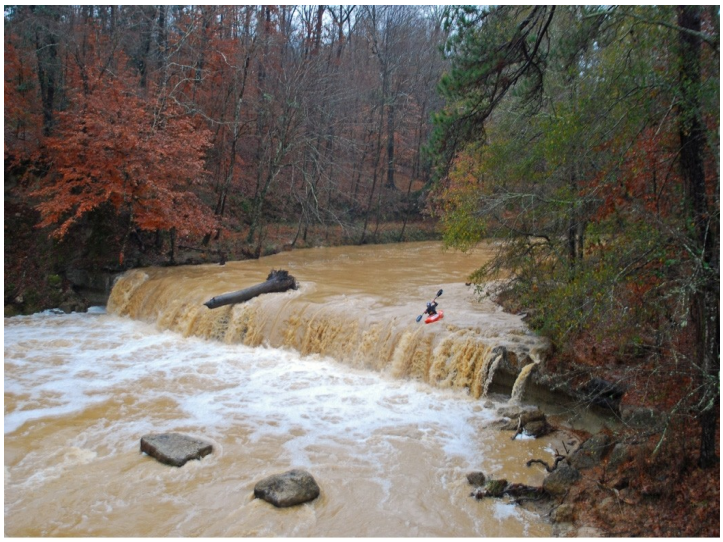
THE GEOLOGICAL SURVEY OF MISSISSIPPI SINCE 1850

The fossil crab *Avitelmessus grapsoideus* from the Coon Creek Tongue of the Ripley Formation in Union County. Specimen was for sale at the 1983 Gem and Mineral Rock Show in Jackson, Mississippi. Picture (color negative 516-7) taken on February 26, 1983.



Andria Davis paddling over a waterfall on Owens Creek in Claiborne County during high flow associated with the rain and snow storm of December 11, 2008. The picture (digital) was taken by Leland Davis.

Ken Davis standing on the top ledge of a waterfall over sandstone ledges in the Catahoula Formation on Owens Creek in the NW/4, Section 20, T. 13 N.,R. 5 E., Claiborne County. Picture (color negative 526-24) taken on September 14, 2004.

EARTHQUAKE AWARENESS IS VITAL

By Michael B. E. Bograd, Office of Geology

This morning (January 9) I watched a report on television about a magnitude 4.5 earthquake that had struck southern California. The reporter stated that the earthquake had been felt 50 miles from the epicenter. A magnitude 4.5 earthquake occurring in or around Mississippi would likely crack walls and topple chimneys in the epicentral area and be felt 150 miles away. As a reminder, the last week in January is Earthquake Awareness Week. The January issue of the Mississippi Emergency Management Agency newsletter has a good article on earthquake awareness.

The Central United States Earthquake Consortium (CUSEC) Web site has excellent tips on what you should do before an earthquake, during an earthquake, and after an earthquake. See http://www.cusec.org/earthquake-safety/what-to-do-in-an-earthquake.html. Among things you should do before an earthquake are strap down your water heater, brace tall furniture that could topple on small children, and create a family emergency communications plan where everyone knows what to do. During an earthquake you should drop, cover, and hold. That means you should drop to the floor, cover your head or take cover under sturdy furniture, and hold onto the furniture and hold your position until the shaking stops. After an earthquake you should check for injuries and damage, shut off the gas and water to your building if there are leaks, and be prepared for aftershocks.

Mississippi is susceptible to damaging earthquakes. The greatest risk is from the New Madrid Seismic Zone of northeastern Arkansas, northwestern Tennessee, and southeastern Missouri. Earthquakes are recorded there every few days. In the winter of 1811-1812, a series of thousands of earthquakes in the NMSZ included several shocks strong enough to be felt throughout what is now Mississippi and cause damage in the northern half. Distant earthquakes from other sources have affected Mississippi as well. The 1964 Alaska earthquake caused water levels in wells to fluctuate in Mississippi. The 1886 earthquake in Charleston, South Carolina, caused people to run out of the city hall in Vicksburg.

Earthquakes have occurred within Mississippi, as indicated on the accompanying map. There is a diffuse grouping in northwestern Mississippi and a tight cluster in Clarke County. The strongest known earthquake with an epicenter in Mississippi was the December 16, 1931, event in the Batesville-Charleston area (magnitude 4.7, maximum intensity VI-VII, damage in the epicentral area, felt over 65,000 square miles in five states). The next strongest Mississippi event was on June 4, 1967, near Greenville (magnitude 3.8, maximum intensity VI, felt over 25,000 square miles in four states). What was probably our third strongest event was February 1, 1955, in Gulfport (maximum intensity V, felt along the Coast).

To learn more about earthquakes in Mississippi, visit the Office of Geology's Map and Publication Sales Office and pick up a copy of Fact Sheet 1 (updated June 2008). Single copies are free, and 50 cents if ordered by mail.

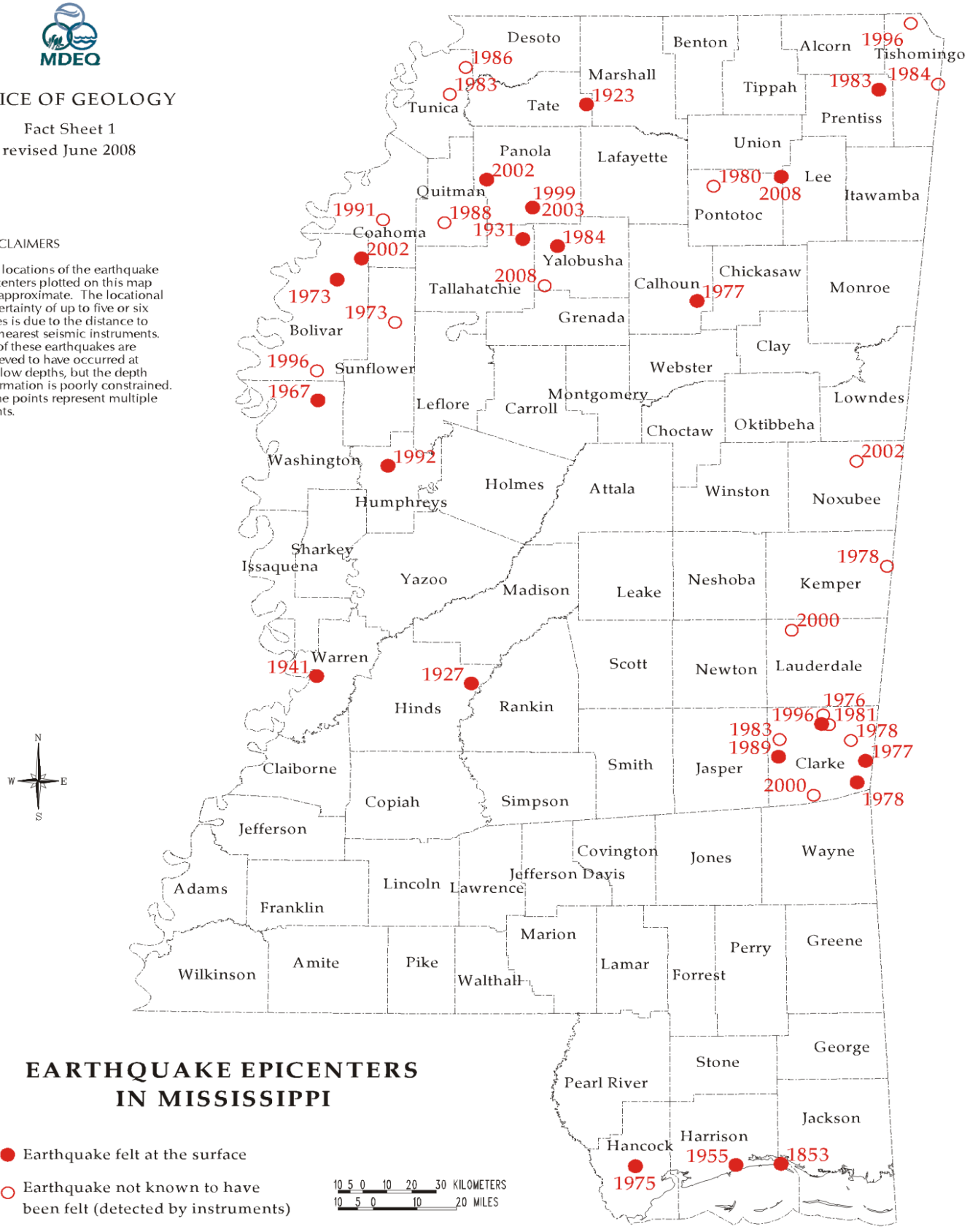
MDEQ

OFFICE OF GEOLOGY

Fact Sheet 1
revised June 2008

DISCLAIMERS

The locations of the earthquake epicenters plotted on this map are approximate. The locational uncertainty of up to five or six miles is due to the distance to the nearest seismic instruments. All of these earthquakes are believed to have occurred at shallow depths, but the depth information is poorly constrained. Some points represent multiple events.



N
W E
S

EARTHQUAKE EPICENTERS IN MISSISSIPPI

- Earthquake felt at the surface
- Earthquake not known to have been felt (detected by instruments)

10 5 0 10 20 30 KILOMETERS
10 5 0 10 20 MILES

GIS by Barbara Yassin

DEAD ZONES, FOSSIL CRABS, TOYOTA, ... AND UPPER MANAGEMENT?

By David T. Dockery III, Office of Geology

The fossil crab *Avitelmessus grapsoideus* from the Coon Creek Tongue of the Ripley Formation in Union County. Specimen was for sale at the 1983 Gem and Mineral Rock Show in Jackson, Mississippi. Picture (color negative 516-7) taken on February 26, 1983.

Dead zones are not scary places without cell-phone reception, but, as explained by Richard Ingram in his article on "addressing Gulf hypoxia," in the August 2008 MDEQ newsletter, are regions of oxygen-depleted water on the sea floor. Anoxic conditions occur seasonally in certain near-shore, marine waters and are responsible for killing the bottom fauna, including crabs and other invertebrates unable to escape. A seasonal dead zone occurs in the north-central Gulf of Mexico due to the decay of algae after algal blooms fed by nutrients from the Mississippi River. Runoff of agricultural fertilizers contributes to these blooms, expanding the dead zone. However, dead zones have existed throughout Earth history and are recorded in Mississippi by the fossil crab beds in the state's Cretaceous section. Here fossil crabs occur as phosphatic internal molds or as complete crabs with legs and claws attached. Fossil crabs from Mississippi have been sold by commercial fossil dealers at high-end prices ranging from $500 to $2,000 (see first picture).

James Starnes and Alice Perry collecting fossil crabs and other fossils from a borrow pit in the Ripley Formation at Blue Springs, Mississippi, near the new Toyota Plant. The picture (digital) was taken on September 8, 2008.

The Mississippi Office of Geology in cooperation with the Mississippi Museum of Natural Science salvaged fossil crab remains from the Ripley Formation at Blue Springs, Mississippi, in September of 2008, where an interchange was under construction for the new Toyota Plant. By the way, did you know that our Executive Director Trudy Fisher and Alice Perry, Environmental Projects Coordinator, are fossil collecting enthusiasts? Which brings me to the second picture and this observation: Buying a fossil crab on credit—$500; collecting fossil crabs while on the job—priceless!

FOSSILS, SEWAGE, AND HIGH WATER

By David T. Dockery III, Office of Geology

Repair work on a 7-foot-diameter leaky sewer line crossing Town Creek in Jackson uncovered fossil seashells, corals, shark teeth, and other marine fossils from the 38-million-year-old Moodys Branch Formation. The Surface Geology Division is working to salvage some of the fossils from this excavation, which was begun at a time of low water on the Pearl River and its Town Creek tributary, but now is threatened by backwater flooding from the rising waters of the Pearl. Flood waters have already claimed one box cut along the sewer line, including the huge steel trench box that protected the highwalls from collapse. Fortunately, the planned cut of the sewer line at this excavation had not occurred. Another box cut at a higher elevation made an incision into the sewer line at 10 o'clock and 2 o'clock, removing the top as is shown in the first picture below. The second picture was taken after the rain and snow storm of December 11, which contributed to the sewage backup into the lower portion of the box cut. The storm event was also responsible for flooding on the Pearl River, which at this writing is a possible threat to the excavation. In the midst of such dire circumstances, James Starnes is collecting fossil seashells within the excavation between the rising sewage water below and the rising river water above.

Box cut to the Jackson sewer line near the east end of Rankin Street adjacent to Town Creek. The line was cut at 10 o'clock and 2 o'clock to insert a liner that will protect the concrete pipe from the corrosive effects of sewer gas. The picture (digital) was taken by James Starnes on December 5, 2008, a time of low water on the Pearl River.

Backed up sewage is rising in the box cut below, while flood waters of the Pearl River are rising outside of the protective levee around the construction site. Between the rising sewage and rising river, James Starnes is collecting fossil seashells excavated from the Moodys Branch Formation. The picture (digital) was taken on December 17, 2008.

THE MIOCENE OF MISSISSIPPI, A FAMILY AFFAIR

By David T. Dockery III, Office of Geology

Ken Davis and James Starnes of the Surface Geology Division have been mapping the Miocene of southern Mississippi for a number of years at a scale of 1:24,000, one 7.5-minute quadrangle at a time. The lowest and oldest formation of the Miocene sequence in Mississippi is the Catahoula Formation. Sandstone and quartzite ledges in the Catahoula Formation are responsible for waterfalls and white-water streams in south-central Mississippi. In the first picture below, Ken Davis is standing above a waterfall on Owens Creek in Claiborne County at low flow. Ken's son Leland and daughter-in-law Andria are professional kayak paddlers. The second picture below was taken by Leland of his wife Andria paddling over the Owens Creek waterfall at high flow after the snowstorm of December 11, a storm that left Claiborne County wet and neighboring Copiah County covered in snow. Andria ran the waterfall not just once but three times that day. Other white-water adventures can be seen on Leland's website: rivergypsies.com.

Ken Davis standing on the top ledge of a waterfall over sandstone ledges in the Catahoula Formation on Owens Creek in the NW/4, Section 20, T. 13 N.,R. 5 E., Claiborne County. Picture (color negative 526-24) taken on September 14, 2004.

Andria Davis paddling over a waterfall on Owens Creek in Claiborne County during high flow associated with the rain and snow storm of December 11, 2008. The picture (digital) was taken by Leland Davis.

100 YEAR OLD COAL MINES IN MISSISSIPPI?

By Stan Thieling, Office of Geology

Many Mississippians are surprised to hear that there is a coal (lignite) mine in Mississippi. It just isn't the kind of thing we think of as being here; maybe Alabama, but not here. There really is a 5,900 acre surface coal mine in Choctaw County, five miles north of Ackerman, and it has been in operation for nearly ten years.

6' x 8' x 11' deep dry, vertical air shaft at Russell, Lauderdale County

An even greater surprise would be finding out that 100 years ago there were a number of lignite mines around the state. Granted, these mines were very small and short lived, but some did exist.

Because of the poor environmental history of the mining industry in general, and the coal mining industry in particular, beginning in 1977, as part of the Surface Mining Control and Reclamation Act (SMCRA), Congress authorized the Office of Surface Mining Reclamation and Enforcement (OSM) to assess a per-ton production fee on all present-day coal mines. The funds generated by this fee are to be used to reclaim environmental problems at historic coal mines. Historic coal mines are those which existed before 1977 and did not have a reclamation bond under SMCRA.

Mississippi was the third state to gain primacy from OSM under SMCRA, which happened in 1980. Primacy is the authority to regulate coal mining within the state. This authority includes the ability to establish an Abandoned Mine Land (AML) program. Although Mississippi had primacy in 1980, the first coal mining permit was not applied for until 1997 and issued until 1998. The AML funds generated by production at this mine were reserved for Mississippi by OSM. Mississippi's AML plan was approved by OSM in September 2007; DEQ received the first AML grant beginning in February 2008. This initial AML grant was to do research and assemble an inventory of abandoned coal mine sites which would be eligible for reclamation by DEQ under this grant.

Publications by the Office of Geology's in-name predecessors, the Bureau of Geology and the Geological Survey, have published references to lignite in Mississippi as far back as the 1850s. Reports of lignite mining go back to the early 1900s. There apparently was a time in the very late 1800s and early 1900s when a boom period existed for attempts at coal mining within Mississippi. Records from the Department of Archives and History tell a story of a number of somewhat shady "investment" schemes. Unsuspecting investors may have been scammed when promoted and promised mining never materialized. However, a number of legitimate companies did exist and attempted to establish successful, commercial mines. Some of the companies involved include the Mississippi Oil and Gas Co-operative Joint Stock Company, the Meridian Fertilizer Company, and the Gulf, Mobile, & Northern Railroad.

Partially flooded underground mine near Louisville, Winston County

Vertical air shafts into former underground coal mines have been found east of Meridian at Russell and near Ackerman. Much searching has not found the entrance to either of these mines, indicating that they have probably collapsed. Collapse would not be too surprising considering that the "roof" of each mine would have been made of clay, not rock. An underground mine still exists near Louisville. No air shaft has been found, but the entrance to the mine is still open. A part of the mine "roof" at the entrance has collapsed, creating a dam which has trapped rain and ground water, flooding the floor of the mine. The size of these mines is unknown, but all are believed to be small by modern standards, likely less than 1-2 acres. However, at least one was large enough to have been described as using "room and pillar mining," a common method still used today. One small surface coal mine is well known locally at Reform. Covering about a half acre, it is still used today as a fishing pond.

It is DEQ's intent, given landowner permission, to reclaim these sites to eliminate hazardous situations. The air shafts are 11 and 23 feet deep with vertical walls. Anyone accidentally falling into one of them would be trapped if they were alone. The remainder of the roof of the mine near Louisville could collapse at any time and crush or trap anyone in it. Fishing in the shallow surface mine near Reform is not planned to be disturbed.

10' x 11' x 23' deep flooded vertical air shaft near Ackerman, Choctaw County

MISSISSIPPI AND THE GREAT "CARBON BURP" 55.5 MILLION YEARS AGO

By David T. Dockery III, Office of Geology

Linda van Roij, a Dutch graduate student at Utrecht University, standing on the grounds of the Mississippi Museum of Natural Science among fossiliferous boulders from the Bashi Formation, which were transported to the museum from just above the Paleocene-Eocene boundary in Meridian, Mississippi. The picture (digital) was taken on November 14, 2008.

The 55.5-million-year-old Paleocene-Eocene boundary was a time marked by the sudden release of methane from gas hydrates on the sea floor, informally referred to as the "Carbon Burp," which changed the composition of globally distributed carbon isotopes. It was followed by a geologically-brief, 170,000-year episode of global warming (of 5-8° C) in both low- and high-latitude regions. Associated with this warming event were biological crises on land and sea, including migrations, extinctions, new species, and the acme zone (or algal bloom) of the marine dinoflagellate *Apectodinium*, a mobile blue-green alga. Today algal blooms of the dinoflagellate species *Alexandrium fundyense* and *Karenia brevis* cause the fish-killing red tides of the North American East Coast and of the Florida coast, respectively. *Apectodinium* was found to be abundant at the Paleocene-Eocene boundary section behind the old Red Hot Truck Stop at Meridian, Mississippi, and was recently found by Professor Appy Sluus of Utrecht University (Netherlands) to be abundant at this boundary in the Mississippi Office of Geology #1 Harrell core from Lauderdale County, based on his examination of core samples previously collected for pollen study by Guy Harrington of the University of Birmingham, England. To pinpoint the Paleocene-Eocene boundary in the Harrell core (one of many such cores archived in the Office of Geology's core and sample library at its North West Street building), Dr. Sluus sent his graduate student Linda van Roij, on short notice, to Mississippi to sample the core at 15 cm intervals. Linda arrived in Jackson on November 12 and departed on November 21, 2008. While here, Linda traveled also to the Geological Survey of Alabama (on the campus of the University of Alabama), where she sampled the Paleocene-Eocene boundary interval in the St. Stephens core from the St. Stephens quarry in Washington County, Alabama. The climate history preserved in Mississippi's sedimentary rocks is important in the study of current global warming trends.

THE SIXTH ANNUAL FOSSIL ROAD SHOW, MISSISSIPPI MUSEUM OF NATURAL SCIENCE

David T. Dockery III, Mississippi Office of Geology

Figure 1. Ronnie Taylor shows the 38-million-year-old brontothere leg bone he found in the Moodys Branch Formation in Yazoo County.

The sixth annual Fossil Road Show was held at the Mississippi Museum of Natural Science (MMNS) on Saturday March 7, from 9:00 a.m. to 3:00 p.m. MDEQ staff who helped with this event were David Dockery and James Starnes of the Office of Geology and Robert Seyfarth of the Office of Pollution Control. Other fossil experts staffing tables were George Phillips (MMNS) with the assistance of Ed Washington, Dr. Gary Stringer (Geology Professor, University of Louisiana at Monroe), Dr. Renee Clary (Geology Assistant Professor, Mississippi State University), and John Davis (retired science teacher St. Andrew's Episcopal School). Also staffing tables as both exhibitors and assistants with fossil identifications were Jeff McCraw (discoverer of a new fossil whale in Clarke County) and his daughter Melissa, and Joy Rushing of the Mississippi Gem and Mineral Society. With so many experts and assistant experts, no one person should have been overwhelmed with customers. Even so, I found myself at times with two or three people deep, wanting their rocks and fossils identified. I understood how a bank teller must feel, trying to give adequate time to each customer while a line is waiting. Then the children came in from digging in the fossil sand pile on the museum grounds. Each proudly dumped their bags of sand, clay chips, and fossils on my cloth-covered table to be identified. One parent apologized at her child's mess and tried to clean it up. I told her not to worry--I didn't care because the table didn't really belong to me. Soon I had the dirtiest table at the Fossil Road Show, a badge of honor that I had done my job.

Many interesting fossils were brought in at the Fossil Road Show. I offered one lady to trade our razzle-dazzle, in-color, rocks-and-fossils guide book for one of her gravel fossils. She said, "Thanks, but I'd rather keep my rock." One man had a fossil leg bone, which I told him looked like that of a ground sloth (I'm not a bone expert). He said it wasn't. Then I asked him what it was. He said he didn't know. I asked if he didn't know what it was, how did he know it wasn't a sloth bone. A little befuddled he answered that he just knew it wasn't that. Then I realized who he was and what the bone was that he was holding. This bone was not one of the more common Pleistocene mammal bones; it was a rare 38-million-year-old Eocene brontothere (a large land mammal) leg bone found in the Moodys Branch Formation (a marine formation better known for fossil whales) in Yazoo County. I had written about this find in the text of *The Geology of Mississippi*. Now I could take a picture of both the bone and the collector, Ronnie Taylor, who had been invited to bring the bone to the Fossil Road Show so that the museum could make a cast of it. Perhaps the most memorable event of the Fossil Road Show was meeting Dr. Harold H. Caver, a retired dentist from Jackson, who gave the account of how he and his friend William Hollingsworth discovered the Fossil Gulch locality while in the 8th grade at Enochs Junior High School in west Jackson in the spring of 1937. When his science teacher, Ruth Blackburn, saw the fossils they found, she asked that they take her and Dr. G. L. Harrell of Millsaps College (one of the professors for whom Sullivan- Harrell Hall was named) to the site. The rest is geology history as many Millsaps classes and many geological field trips have been to the site over the years. The site is now on the nature trail at the Mississippi Museum of Natural Science.

THE SIXTH ANNUAL FOSSIL ROAD SHOW, MISSISSIPPI MUSEUM OF NATURAL SCIENCE CONT.

Figure 2. Peter Kuchirka, a museum volunteer, watches as children touch a 70-million-year-old dinosaur leg bone recently found at Blue Springs, Mississippi.

Figure 3. Robert Seyfarth shows his Pleistocene mammal collection from Natchez, Mississippi, to parents and young children.

Figure 4. James Starnes draws the crowd's interest when he identifies an arrowhead from Hinds County, Mississippi, as a 9,500-year-old Dalton point.

Figure 5. Dr. Harold Caver (left) tells Michael Bograd (center) and Dr. Gary Stringer (right) how he found the Fossil Gulch locality in 1937 while in the eighth grade at Enochs Junior High School in west Jackson.

ENGINEERING GEOLOGY, THE YAZOO CLAY, AND THE SAINTS

By David T. Dockery III, Office of Geology

The selection of Millsaps College as a training camp for the New Orleans Saints has been a thrill for many sports fans and a boost to the college. To accommodate the Saints' summer practice needs, the college contracted to expand their lower playing field adjacent to Woodrow Wilson Avenue. Dirt-moving work began in the spring and summer of 2007, and the field was expanded by cutting the toe of the hillside that separated the upper and lower playing fields. This work was done at a time of significant drought, which masked the problem of subsurface drainage from the upper field. A two-meter-high retaining wall, consisting of 2,000 pound concrete blocks fitted together like LEGO toys, was placed at the base of the cut hillside above a foundation of crushed limestone. Figure 1 shows a disturbing sight in the freshly cut hillside; the three cut benches in the picture consist of a red terrace sand in the upper bench and weathered Yazoo Clay in the lower two benches. The terrace sand underlying the upper football field could not drain through the clay below but only out the hillside. The underlying Yazoo Clay is the infamous, swelling, foundation destroying, road buckling, wall splitting, bane of the Jackson area. The Mississippi Office of Geology has published an environmental atlas of the Jackson area, containing geologic maps showing the surface outcrop of the Yazoo Clay. These maps are a must for prospective home buyers or builders. Once the retaining wall at Millsaps was built, it was backfilled with the excavated expansive Yazoo Clay and terrace sand.

Figure 2 shows the spectacular failure of the retaining wall after the return of winter rains. While the wall held together, it did not stay put. At the top of the picture is the slump scarp, which threatened the filming tower and the upper field, and below is the slump's toe, which rose some five feet high from the edge of the lower playing field. With the manicured grass surface, the toe looks like a roll of carpet. Before the Saints arrived for training camp, the displaced retaining wall needed to be rebuilt and the practice field repaired. The geotechnical firm of Burns Cooley Dennis, Inc., was employed to design a new retaining wall. Figure 3 shows the drilling of a hole through the slump to determine the base of the failure surface or shear plane. Once the depth of the failure surface was known, the wall had to be removed block by block, as shown in the fourth picture. Figure 5 shows a construction-schedule conference with concerned representatives from the college, the construction firm, the engineering firm, and the Saints.

The design of the new wall required: (1) a significant crushed limestone keyway, extending below the failure surface, to lock the surface in place, (2) lower and upper retaining walls, (3) a sand chimney to drain the upper playing field, (4) foundation-quality fill material, and (5) geogrid plastic to bind the fill as a unit. Figure 6 shows the emplacement of fill and geogrid behind the upper wall. Figure 7 shows the new retaining walls upon completion. The moral of this event can be summed up in a comment overheard from one of the workers reinstalling the irrigation system; the first system was taken out when the main line was ruptured by the slump. The worker (see Figure 8) said, "I'm doing the same thing I did last year." Put in terms of a carpenter's adage: Neglect geologic (soil) testing and build twice; do geologic testing and build once.

Figure 1. Excavation for a new football field at Millsaps College in Jackson, Mississippi. The lower two tiers in the foreground consist of weathered Yazoo Clay. The upper tier is terrace sand, which drapes over the Yazoo Clay of the bottom tiers in the distant hillside. The crushed limestone floor is the foundation for a retaining wall. Extra stone is placed at the base of a small slump in the foreground. Picture (digital CD #41) taken on May 23, 2007.

Figure 2. Slump in Yazoo Clay pushed the retaining wall up and out as seen from the new football field at Millsaps College in Jackson, Mississippi. The slump scarp cuts near the observation tower of the upper field, and the toe is elevated in front of the retaining wall like a roll of carpet. Picture (digital CD #42) taken on January 31, 2008.

Figure 3. Millsaps geology students watch as an auger rig drills a hole to determine the base of the slump block adjacent to the new football field at Millsaps College. Picture (digital CD #42) taken on February 20, 2008.

Figure 4. Excavation of slump block and removal of the tilted retaining wall. Each concrete block in the wall weighs 2,000 pounds and is fastened by dome and socket joints. Removed blocks are stacked in the foreground for reassembly later. Picture (digital CD #42) taken June 4, 2008.

Figure 5. Onsite conference concerning contruction schedule for the retaining wall between the Saints' football training fields at Millsaps College. From left to right are Danny Neely (Millsaps College), Mike Early (Clear River Construction [CRC]), Jeb Boney (CRC), Terry Ashburn (New Orleans Saints), Mike Bolton (Burns Cooley Dennis), Kendrick Schetter (Millsaps), Dr. Todd Rose (Millsaps), and Nick Travis (President, CRC). Picture (digital CD #46) taken on June 17, 2008.

Figure 6. Layers of geogrid fabric and soil are placed behind the upper retaining wall at Millsaps College. The geogrid fabric ties the layers into a coherent block that resists the fractures and shearing responsible for slope failures. Picture (digital CD #47) taken on July 2, 2008.

Figure 7. New retaining wall at Millsaps College completed in time for the Saints' summer football camp. The upper wall was extended from 205 to 300 feet to the east (left) of the stairs.

Figure 8. James Bridgforth, holding fossil oyster excavated from irrigation trench, Jared Meyers (right), and Rob Anders on trenching tractor, all with Lakeland Irrigation. James reported, "I'm doing the same thing I did last year." The main line of the first system was taken out by the slump. Picture (digital CD #47) taken on July 1, 2008.

THE SECOND ANNUAL MISSISSIPPI CHILDREN'S EDUCATIONAL FAIR

By David T. Dockery III, Office of Geology

The second annual Mississippi Children's Educational Fair, sponsored by the Mississippi Children's Museum and the Junior League of Mississippi, was held at the state Agricultural Museum on April 1-3, 2009. As happened last year, the Mississippi Department of Environmental Quality had two tents, a gravel tent and a volcano tent, through which some 3,600 fifth-graders in groups of 100 cycled through every fifteen minutes. Again this year the fair theme was a *Wizard of Oz* wonderland experience. In the gravel tent, students could search through freshly dumped gravel and have their finds identified by geologist Michael Bograd assisted by Laura Beiser. Also helping with the "stay in school" message were Shirley Trigg, Donetta McCullum, Gwen Braddy, and Roy Nelson. The volcano tent featured posters and a fifteen-minute PowerPoint presentation by James Starnes and David Dockery on geology, careers in geology, dinosaurs, and the volcano buried beneath Jackson.

Figure 1. Fifth-grade students in the yellow group watch as Flowood firemen rush to save accident victims from a staged car wreck at the second annual Children's Educational Fair at the Mississippi Agricultural Museum. Picture (digital) taken on April 2, 2009.

While our tents certainly captivated the interests of children, we had some very hard acts to follow. All events revolved around education and different career opportunities. The first event of each day featured several professions and involved a head-on collision with two or three wrecked cars, billowing smoke, and badly injured mannequins. Before the smoke cleared, police and sheriff cars raced in with sirens blaring as the first responders. They were followed by the loud horns and sirens of fire trucks and ambulances. Firemen with the "jaws of life" ripped open doors and cut off roof tops to free victims while paramedics prepared the stretchers, IV lines, and oxygen tanks. If this were not enough, in the midst of heroic efforts by firefighters the beating sound of helicopter blades could be heard just before the air-rescue craft appeared above the tree line, circled the area, and landed beside the wrecked cars. At one event when it was clear that the majestic Air Care helicopter was coming for "us," I overheard a mesmerized teacher tell her colleague, "I'm not believing this!" The victims were removed from the wreckage and airlifted from the site. The crash event was conducted three times each day with newly arranged wrecked cars and motorcycles; two helicopters were used on Friday.

The second hard act to follow was in the large tent that separated the two geology tents. This tent had a courtroom setting and showcased the legal profession with a cast of six actors and three stand-ins. The case was a mock trial of the wicked witch (following the *Wizard of Oz* theme), who was responsible for a car crash involving Dorothy, Toto, and the Straw Man. All lines were in rhyme, and the trial seemed very real. Testifying on her behalf, the wicked witch claimed that she always had the right of way in Munchkin City. All the students served as jurors with stick paddles, having "guilty" on one side and "not guilty" on the other. A large cheer of approval sounded each time the judge counted the votes and declared the witch guilty.

Figure 2. The University of Mississippi Medical Center's Air Care helicopter arrives to transport victims of a mock wreck scene at the second annual Children's Educational Fair at the Mississippi Agricultural Museum. Picture (digital) taken on April 2, 2009.

Figure 3. Students hold their voting paddles as they hear the testimony of the wicked witch in a case entitled "Munchkin City vs. Elmira Gulch." Picture (digital) taken on April 2, 2009.

Figure 5. Michael Bograd identifies rocks and fossils for students in the gravel tent, showing them illustrations from a rock and fossil guide book (Mississippi Office of Geology, Circular 7, entitled *Rocks and Fossils Found in Mississippi's Gravel Deposits*). Picture (digital) taken on April 3, 2009.

Against these contending events, the gravel tent held its own as children hurried to find treasures among the many rocks. Crowds of children gathered around Michael Bograd as he identified their rocks and fossils and showed them pictures of their finds in a rock and fossil guide book. The volcano tent also had enthusiastic children, many who raised their hands that they wanted to be geologists and that they liked fossils and dinosaurs. The children often asked if the volcano under Jackson would erupt, a question that led James Starnes to add a volcano drill to each talk. James demonstrated the drill and told the children that, in case of an eruption, they were to raise their hands high above their heads; once all hands were raised, he instructed the children to scream, "AHHHHHH!" I always feared that James might end up screaming alone, but every group joined in with gusto, and the cheer was an instant success, giving our tent some parity with the excitement of the mock trial next door.

Figure 4. Students raise their hands with questions and answers as James Starnes presents a PowerPoint presentation on geology and the Jackson Dome at the second annual Children's Educational Fair at the Mississippi Agricultural Museum. Picture (digital) taken on April 2, 2009.

MISSISSIPPI'S GIANT SNAKES

By David T. Dockery III,

Office of Geology

Snake vertebrae from left to right: (1) *Palaeophis virginianus* from the Bashi Formation at Meridian, Mississippi, (2) *Pterosphenus schucherti* from the Moodys Branch Formation at Jackson, Mississippi, (3) *Pterosphenus schucherti* from the Yazoo Clay at Cynthia, Mississippi, and (4) a recent large python vertebra.

The February 5, 2009, issue of *Nature* published a new species of giant boid snake from the Paleocene Cerrejón Formation (58-60 million years old) in Colombia, South America. The new species *Titanoboa cerrejonensis* was estimated to have a body length of 13 meters (43 feet) and a weight of 1,135 kilograms (2,500 pounds), making it the largest known snake. Authors of the new species estimated that for such a large snake to survive the minimum mean annual temperature would have to be between 30° and 34°C or between 86° and 93°F; today's mean annual temperature for central Mississippi is 65°F. This estimate is consistent with the hypotheses of a hot Paleocene tropical belt. *Yahoo News* (February 4, 2009) described the fossil snake as weighing more than a bison and as measuring longer than a city bus. The largest known living python measured almost 30 feet, some 13 feet shorter than the Paleocene giant snake. *BBC News* (February 4, 2009) reported that at its greatest width, the ancient snake would have come up to a person's hips. Fossils of this titanic Colombian snake were collected from one of the world's largest open-pit coal mines.

Mississippi has four fossil boid snake species of Early and Late Eocene age that are related to the giant snake of Paleocene age reported from Colombia. These snakes didn't crawl up from South America; they were sea snakes that swam in during times of rising sea levels. The four species include: (1) the very small *Palaeophis casei* from the T4 sand of the upper Tuscahoma Formation, (2) the medium-size (about 40 inches in length) *Palaeophis littoralis*, also from the T4 sand, (3) the giant species *Palaeophis virginianus* from the Bashi Formation, and (4) the giant species *Pterosphenus schucherti* from the Moodys Branch and Yazoo formations. The large vertebrae illustrated here from left to right are *Palaeophis virginianus* from the Bashi Formation at Gallagher Creek in Meridian, Mississippi, *Pterosphenus schucherti* from the Moodys Branch Formation at Town Creek in Jackson, *Pterosphenus schucherti* from the Yazoo Clay at Cynthia, and a vertebra of a recent large python. The large fossil snake vertebrae from Mississippi are estimated to have come from snakes that were about 18 feet long and weighed about 70 pounds. Unlike humans who possess amphicoelous vertebrae with the centrum concave on both the anterior and posterior ends, snakes are procoelous with the centrum having a concave joint (cotyle) on the anterior end and convex joint (condyle) on the posterior end. Thus the snake vertebrae illustrated are arranged with the anterior ends facing to the right.

A BEAUTIFUL SHELL, *PTERYNOTUS BURNSII* FROM THE EARLY OLIGOCENE OF MISSISSIPPI

By David T. Dockery III, Office of Geology

French paleontologist Dieder Merle requested photographs of a certain fossil muricid species from Mississippi that was so beautiful we thought MDEQ newsletter readers might like to see it as well (Figure 1). Muricids are a group of marine gastropods (snails) with thickened or varicate outer lips. The positions of previous lips in the growth series can be seen as varices on the spire and body whorl. A Mediterranean species, *Murex brandaris,* produced the purple dye used in royal garments of the Roman Era and in garments dating back to the ancient Phoenicians in the city of Tyre, who produced a color known variously as Tyrian purple, royal purple, imperial purple, or imperial dye. One of Apostle Paul's first Christian converts in Phillipi, a leading city of Macedonia, was a woman named Lydia, who was a seller of purple fabrics (Acts 16:14).

In the muricid genus *Pterynotus*, the varices are especially prominent, extending outward like wings, thus the name *Ptery* (from the Greek *pteryx* for wing) and *notus* (from the Greek *noto* for mark). The species *Pterynotus burnsii* figured here is from the Early Oligocene Red Bluff Formation at its type locality at Red Bluff on the Chickasawhay River in Wayne County, Mississippi. Only two complete specimens of this species are known. The first specimen found was the holotype of the species, which was named by T. H. Aldrich in the molluscan journal *Nautilus* in January of 1894 (v. 7, no. 9, p. 96-99, plate 4). The species was named in honor of Frank Burns, who collected fossils in Mississippi for W. H. Dall of the U. S. National Museum (USNM) and shipped them to the USNM by the "wagon loads of barrels." Frank Burns collected the first specimen of *Pterynotus burnsii* from U. S. Geological Survey locality 315 in the Red Bluff Formation on Carson's Creek in Wayne County (collection date unknown but before 1894).

The second specimen of this species was appropriately found by Dr. Emily H. Vokes, a world-renowned muricid expert, who was also Head of the Earth Science Department at Tulane University and my dissertation committee chairperson. She and her husband, Dr. Harold Vokes, were a few steps ahead of me while walking along the base of a vertical bluff at the type Red Bluff locality (figures 2 and 3) one morning in late November (24th or 25th) of 1978, when she happened upon the freshly exposed shell in almost perfect condition. Dr. Vokes was quite excited to say the least. Many years later, when Dr. Emily Vokes announced her plans to retire at the end of 1996, it was decided that Tulane's considerable collections of mollusks would be divided between the U.S. National Museum and the University of Florida Museum at Gainesville, Florida. After her retirement, I wrote Dr. Vokes a letter (dated May 12, 1997) thanking her for chert-gravel fossils she sent and ended the letter with this hint: "And, while I'm thinking about it—you may have plans to take some of your beautiful Mississippi Oligocene fossils home with you, but, if they need another home, keep us in mind." About a month later I received a package from Dr. Vokes; it was about the right size. I opened it and found a note that said "Merry Christmas." Wrapped inside was the specimen of *Pterynotus burnsii*.

Dr. Vokes' *Pterynotus burnsii* specimen found another new home when the Mississippi Office of Geology assisted with the creation of a display entitled "Stories in Stone." This display debuted on March 3, 2000, with the opening of the Mississippi Museum of Natural Science's new building at LeFleur's Bluff State Park. One glass case at the front of the display contained fossils of Oligocene age. It was in this case that Dr. Vokes' specimen of *Pterynotus burnsii* was placed for all to see (Figure 4). Removing the shell from its case to make the pictures in Figure 1 was like a jewelry heist, which required a team of two to remove screws and to lift the glass cover with hand-held suction devices.

Figure 1. *Pterynotus burnsii* (Aldrich, 1894) collected by Dr. Emily Vokes from the Red Bluff Formation at the type locality at Red Bluff on the Chickasawhay River in Wayne County, Mississippi. Picture (digital, DVD #57) taken by George Phillips on March 6, 2009.

Figure 2. Norm Frederiksen collecting a sample of the basal Red Bluff Formation just above the contact with the Shubuta Clay Member of the Yazoo Formation at the type locality of the Red Bluff Formation at Red Bluff on the Chickasawhay River in Wayne County, Mississippi. Picture (slide 59-17) taken on March 25, 1979.

Figure 3. David Dockery (left) and Dr. Harold Vokes (right) walking out of the type Red Bluff locality on the Chickasawhay River in Wayne County, Mississippi. Picture (Ektachrome slide; process date: January 1979) taken by Dr. Emily Vokes during Thanksgiving break in late November (24th or 25th) of 1978.

Figure 4. Oligocene fossils on display (case #3) at the Mississippi Museum of Natural Science in Jackson, including mollusk shells, shark teeth, fish scales, sting ray tail and teeth, heart urchins, sand dollars, corals, manatee ribs, and petrified palm. Picture (digital DVD #17) taken by Gil Ford Photography in July of 2002. *Pterynotus burnsii* specimen highlighted in white box at left center.

THE DOGWOOD FESTIVAL SLUMP

David T. Dockery III, Office of Geology

The east entrance to Dogwood Festival Mall off of Highway 25 in Flowood, Mississippi, was cut into the east valley wall of the Pearl River flood plain with a rather steep slope. The Rankin County geology map by Wilbur Baughman and the unpublished Jackson SE 7.5-minute quadrangle map by David Thompson show this valley wall to be composed of Yazoo Clay in the lower slope up to an elevation of 350 feet above sea level with a terrace-sand deposit capping the hill top at 350 feet and above. Since the construction of the mall's east entrance, the slope has failed three times, the most recent failure occurring in February of 2009 (Figure 1). The 2009 slump event tore up a section of the road, curb, and storm drain, and required a permanent fix. In April of 2009 the failed soil of the slump was excavated (Figure 2) down to the unweathered Yazoo Clay bedrock (Figure 3) and removed. During and after dirt removal, (1) the cut was terraced, (2) a French drain was installed in the base of the cut and connected to the repaired storm drain, (3) the cut was lined with geotextile (also called geo-fabric) held in place with metal pins, (4) the cut was backfilled with a sand chimney and fill, using a sand with less than 4% silt (or a greater than 96% pure sand) (Figure 4), (5) a retaining wall was installed with layers of geogrid and sand packed behind it, and (6) the sand chimney/fill was covered with fill dirt and top soil (Figure 5). Other than the sodding of the surface, the slump repair was largely completed in May of 2009.

The almost pure river sand used as fill for the slump repair came from a pit in a terrace deposit south of the Super Wal-Mart on Highway 25. In Figure 6, a thick cross-bed set can be seen in the wall of this sand pit; similar sedimentary structures can be found in the point bars of modern rivers. Terrace sand is mined in several places along Highway 25 where it occurs at elevations between 350 and 400 feet above sea level and higher. This sand is usually of a reddish color and contains a greater silt and clay content than the sand shown in Figure 6. For a time, the 350-400-foot terrace sand composed a scenic butte at the entrance of Northwest Rankin Middle School (Figure 7), a setting that looked more like an arid scene from the desert Southwest. This butte has been subsequently mined out.

Figure 1. Michael Bograd inspects road damage caused by a slump along a steep slope on the east side of the east entrance to Dogwood Festival on Highway 25 in Flowood, Mississippi. Picture (digital DVD #59) taken on February 27, 2009.

Figure 2. Excavation of slump on the east side of the east entrance to Dogwood Festival on Highway 25 in Flowood, Mississippi. Picture (digital CD #59) taken on April 20, 2009.

Figure 3. Unweathered Yazoo Clay in the bottom of excavation to remove slumped material along the east entrance for Dogwood Festival on Highway 25 in Flowood, Mississippi. Picture (digital DVD #59) taken on April 20, 2009.

Figure 4. Slump excavation is sealed in fabric and backfilled and compacted with a 96 % pure grade of sand. Dogwood Festival can be seen in the upper right. Picture (DVD #59) taken on May 1, 2009.

Figure 5. Slump repair near completion with the storm drain repaired, the retaining wall in place, and the sand fill covered with fill dirt. Picture (DVD #59) taken on May 18, 2009.

Figure 6. Sand pit in Flowood, Mississippi, operated by A & A Excavating Contractors, Inc.--the source of the fill sand for the Dogwood Festival slump repair. Sedimentary structures such as cross bedding can be seen in the pit's highwalls. Picture (digital DVD #59) taken on May 8, 2009.

Figure 7. Terrace sand deposit at the entrance of Northwest Rankin Middle School at 5805 Highway 25 in Rankin County. Here the top of the terrace sand is about 400 feet above sea level. Picture (digital CD #35) taken on March 23, 2007.

LIFE MEASURED IN DAYS OF SNOW COVER

David T. Dockery III, Mississippi Office of Geology

The Office of Geology recently scanned some 250 slides of the Mississippi Petrified Forest taken by the Schabilion family from 1956 to 1983 and loaned to us by their granddaughter Deborah Shoemaker. Most slides were labeled by month and year and many were taken on days with snow cover. Meteorological records were consulted to give a calendar date for pictures depicting snow, a task that was harder than imagined. After giving up on Google, I contacted the National Weather Service at Jackson where Joanne Culin graciously provided snow records for the City of Jackson from 1963 to the present. Snow is uncommon in the Jackson area, and snow cover is even less common. Only a modest number of snow-cover days have marked the lives of Jacksonians (including me) over the last fifty years, two of which were recorded in the slides of the Mississippi Petrified Forest. For those of you with unlabeled snow pictures, the following snow records and personal recollections may serve as forensic tools in finding the days your pictures were taken.

Figure 1. David, Fluffy, and Gwin Dockery on Manila Drive in north Jackson after the February 13-14, 1960, snowfall. Picture (scanned print) taken on February 14, 1960.

1. A snowstorm on February 13-14 in 1960 covered Jackson in six inches of snow (Figure 1); cold weather (as cold as 0º F) kept the snow on the ground, at least in shady areas, for about a week and froze ponds so that my friends and I could skate on them with our shoes. The ice would crack when a skater made a hard fall but never broke through. Neighborhood kids blocked my street Manila Drive in north Jackson with a wall of rolled snow, keeping cars out. The February 13-14 snowstorm holds the "Greatest 24 Hour Snowfall" record for the month of February for Jackson.

2. The winter of 1963-1964 had three snowfalls that produced greater than an inch of snow in the Jackson area, with 1.3 inches falling on December 20, 1963, 1.8 inches on December 31, 1963, and 1.5 inches on January 16, 1964. The greatest of these storms was one known as the New Year's Eve 1963 Snowstorm, which began on New Year's Eve in 1963 and continued into New Year's Day of 1964 (Figure 2). This snowstorm blanketed much of the southeastern United States in snow and set snowfall records, including a 5-inch snowfall in New Orleans, the greatest New Orleans snowfall of the century. I remember 1963 as the year of the almost white Christmas with snow just before and just after Christmas. Janice Alewine (Office of Geology) best remembers the December 20th snowstorm; her first child Michael was born just after the snow started to fall.

Figure 2. Snow on the "Old Timer," a petrified log at stop 6 on the nature trail in the Mississippi Petrified Forest at Flora, Mississippi. Picture (slide) taken on January 1, 1964, after the New Year's Eve 1963 Snowstorm.

Figure 3. Snow in the Mississippi Petrified Forest at Flora, Mississippi. Picture (slide) taken on March 23, 1968 (the first day of spring), after a six-inch snowfall.

3. A first-day-of-spring snowfall on March 22-23, 1968, covered the Mississippi Petrified Forest at Flora in six inches of snow (Figure 3); 5.3 inches of snow fell in Jackson. This snowstorm holds the "Greatest 24 Hour Snowfall" and the "Maximum Monthly Snowfall" records for the month of March.

4. Two snowfalls occurred in January of 1977, one on January 18 dropped 2 inches of snow and one on January 30-31, 1977, dropped by various accounts 3.3 to 5.8 inches of snow in Jackson.

5. The snowstorm of January 13, 1982, covered Jackson in 5.5 inches of snow (Figure 4). In Figure 5 taken on January 14, the little girl of the first picture taken in 1960 (my sister) is now married and has a daughter (Brooke) of her own. Her husband Frank is trying to hit me with a snowball! Office of Geology Director Michael Bograd remembered taking an over-long walk with his family through a heavy snowfall on the 13th when he had a "Dr. Zhivago experience"--a movie scene came to mind of the doctor hiking through a Russian blizzard to escape the communists.

6. The snowfall of February 1, 1985, dropped 1.4 inches of snow at Jackson.

7. The snowfall of April 2-3, 1987, dropped 1.1 inches of snow at Jackson and set snowfall records for both the "Greatest 24 Hour Snowfall" and "Maximum Monthly Snowfall" in the month of April.

Figure 4. Mary Dockery and Linnie and Tom Shirley having coffee in the Shirley's backyard on Manila Drive in north Jackson after 5.5 inches of snow fell on January 13, 1982. Picture (color negative 451-28) taken on January 14, 1982.

Figure 5. From left to right, Brooke, Gwin, and Frank Wyatt at their home on Old Canton Road in north Jackson after the January 13 snowstorm. Picture (color negative 452-2) taken on January 14, 1982.

Figure 6. Mossy Grove in northwestern Hinds County after the December 14, 1997, snow. Picture (color negative 433-22A) taken on December 14, 1997.

8. The snowfall of March 12, 1993, dropped 1.6 inches of snow at Jackson.

9. The snowfall of December 14, 1997, caught weather forecasters by surprise and defied computer models when a heavy snowfall covered northeastern Louisiana, central Mississippi, and extreme western Alabama. Snowfall in Jackson was recorded at 4.8 inches, but as much as 8 inches of snow was common in the Jackson-Vicksburg metro area (Figure 6).

10. The snowfall of December 31, 2000, the largest snow since the December 14, 1997, snowstorm, recorded one inch of snow at Jackson but with greater amounts in surrounding areas (Figure 7).

11. The snowfall of December 11, 2008, produced a snow cover that just missed Jackson, while laying down a comma-shaped swath of snow cover from New Orleans, Louisiana, to Pearl, Mississippi, and northward as shown in Figure 8. Only 0.9 inches of snowfall was recorded in Jackson, none of which lasted long as subsequent rainfall melted it away. In New Orleans it was the heaviest snow since the New Year's Eve 1963 snowstorm—enough snow for Tulane students to build snowmen on campus.

Figure 7. John Marshall (top of hill) and Melanie Marshall (on sled) at Mossy Grove in northwestern Hinds County. Picture (color negative 466-21) taken on January 1, 2001.

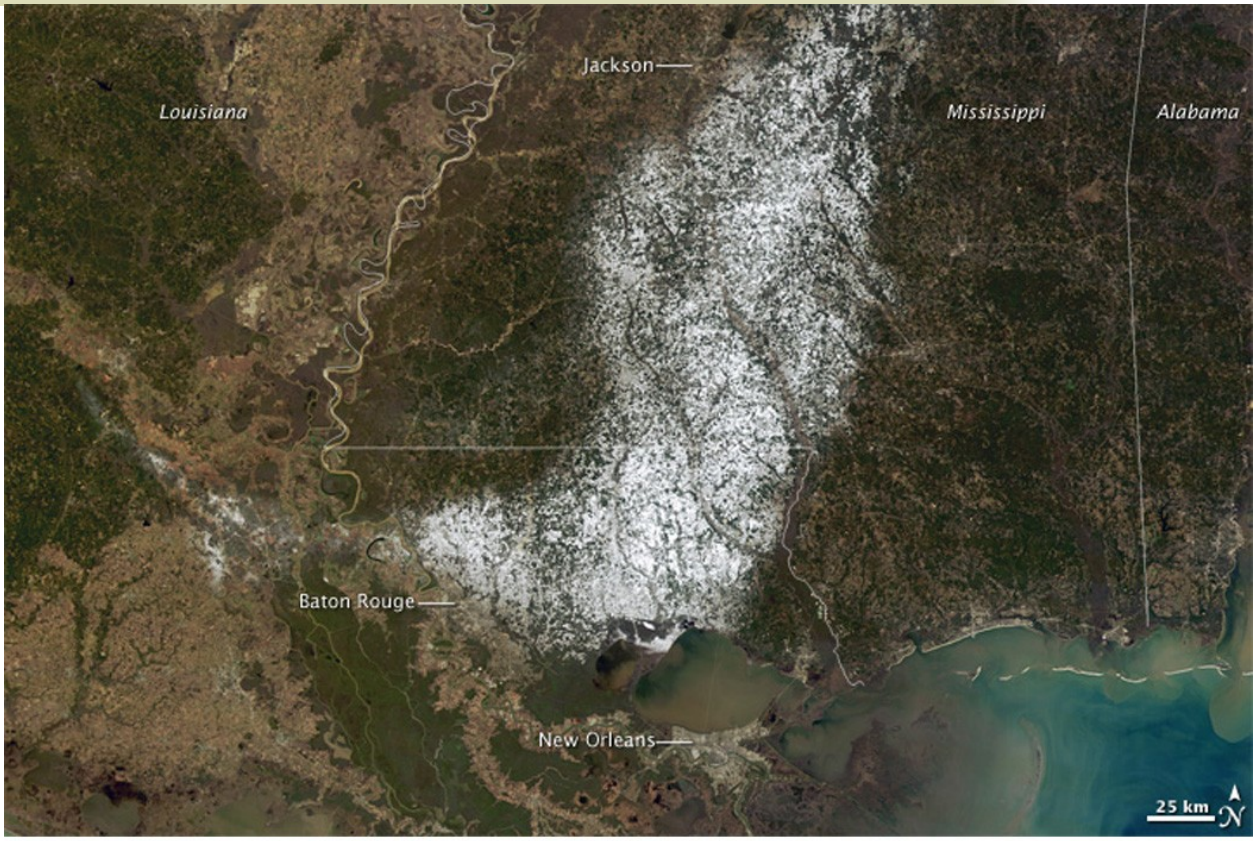


Figure 8. NASA image of snow cover in Louisiana and Mississippi from the December 11, 2008, snowstorm. Picture taken on December 12, 2008.

Table 1. Snow in Jackson, Mississippi, from 1963 to the present measured in inches. Data was provided by Joanne Culin of the National Weather Service in Jackson, Mississippi. This 46-year record shows only 11 days of snowfall with accumulations greater than one inch.

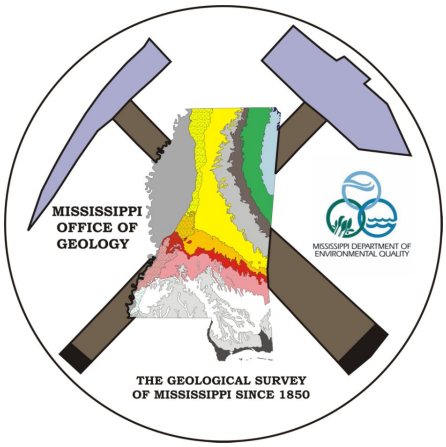
Date	Snow	Date	Snow	Date	Snow
12-20-1963	1.3	1-30-1977	2.7	12-9-1989	0.1
12-31-1963	1.8	1-31-1977	0.5	1-18-1992	0.2
1-16-1964	1.5	1-14-1978	0.1	3-12-1993	1.6
2-23-1968	3.6	1-19-1978	1.0	12-18-1996	0.7
3-22-1968	5.0	3-4-1978	0.1	12-14-1997	4.8
3-23-1968	0.3	1-12-1982	0.3	1-27-2000	0.4
12-20-1973	0.3	1-13-1982	5.5	12-31-2000	1.0
11-28-1976	0.2	1-14-1982	0.5	1-19-2008	0.5
1-2-1977	0.1	1-3-1985	0.3	3-7-2008	0.2
1-3-1977	0.3	2-1-1985	1.4	12-11-2008	0.9
1-9-1977	0.2	4-2-1987	0.5	3-1-2008	0.2
1-18-1977	2.0	4-3-1987	0.6		

SUMMER
2009

JUST GEOLOGY

FROM THE PAGES OF ENVIRONMENTAL NEWS

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY



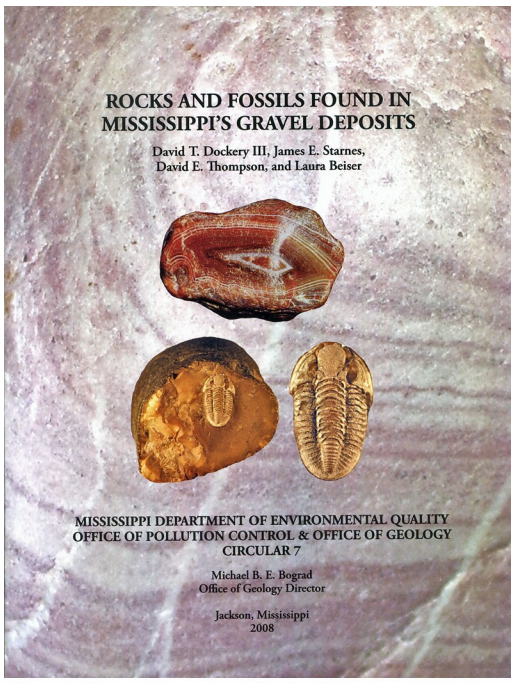


Figure 1. Cover of the rock and fossil guidebook created for the first Children's Educational Fair held on April 2-4, 2008.

Figure 8. Jim May points to the location they are standing on his geologic map in the Wayne County geology bulletin to show that he correctly mapped the limestone newly exposed in the area. Looking at the map is Emmett Adams (front) and Wylie Poag, with David Williamson at right. Picture (Kodachrome slide) taken on July 28, 1975.

THE FIRST CHILDREN'S EDUCATIONAL FAIR

By David T. Dockery III, Office of Geology

The Department of Environmental Quality and the Office of Geology (OG) worked with the Mississippi Children's Museum Partners, the Junior League of Jackson, and others in the creation of the first Children's Educational Fair held at the State Agricultural Museum on April 2-4, 2008. This three-day fair was to include some 1,500 students per day from schools around the state, who would be exposed to different careers and a strong stay-in-school message. Plans called for the OG to staff two tents, a "gravel tent" where children could collect rocks and fossils from Mississippi gravel, and a "volcano tent" where children would be given a PowerPoint presentation on geology and the buried volcano under Jackson, Mississippi.

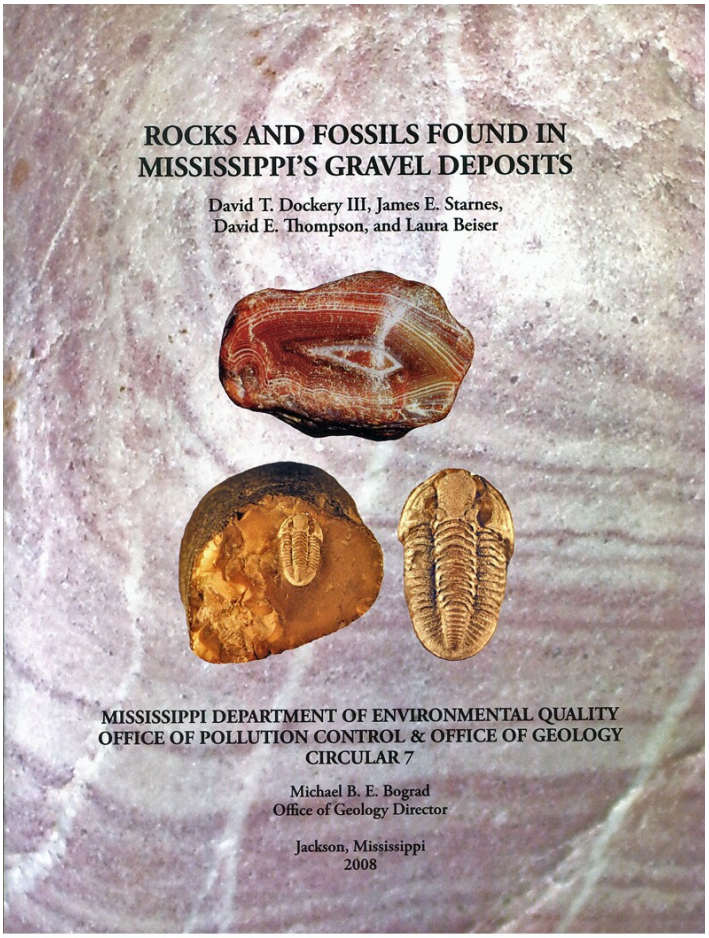


Figure 1. Cover of the rock and fossil guidebook created for the first Children's Educational Fair held on April 2-4, 2008.

Available resources for the "gravel tent" included two guidebooks on "rocks and fossils found in gravel" published in the June 1995 and December 1996 issues of the OG's quarterly journal *Mississippi Geology*. These black-and-white issues had been reprinted multiple times and had been given as handouts in numerous science-teacher workshops. The Children's Educational Fair's "gravel tent" was seen as an opportunity to print a new guidebook in color. This was done in cooperation with Laura Beiser and the Office of Pollution Control, who helped develop a guidebook with a message concerning "Nonpoint Source Pollution," "Storm Water Pollution," and "protecting the environment around mine sites" (i.e., such as gravel pits). Some 8,000 copies of the 25-page color guidebook were printed (as Circular 7 in the OG's publication series) by Quality Printing, who did an excellent job with the layout and color pictures. Copies of the book were given to teachers as they accompanied their classes to collect rocks and fossils in the gravel tent. Circular 7 is now available in the OG Publication Sales office for $5 each (Figure 1).

A second collaboration with Steve Walkinshaw and Candy Goolsby of Vision Exploration produced a cross section through Jackson, Mississippi, showing upturned strata and igneous intrusions associated with the buried volcano beneath the city (Figure 2). The new cross section was in color and showed the geology in greater detail that did its black and white predecessor. Steve and Candy also produced a PowerPoint presentation on geology and the buried Jackson volcano to be used in the "volcano tent." The rock and fossil guidebook and the new Jackson Dome cross section (and related graphics) were valuable legacies of the first Children's Educational Fair.

Michael Bograd, James Starnes, Laura Beiser, and others helped children identify their rocks and fossils in the gravel tent (figures 3-5). Students cycled through the geology tents at about one hundred every fifteen minutes. They were moved in regiments by their teachers and Junior League workers. Some Jackson area high school students took the school day off and came in "Wizard of Oz" costumes to help in the different tents; the high-school girls were generally dressed as "good witches" and the guys as "straw men" or "tin men." The State Superintendent of Education (now the Commissioner of the State Institutions of Higher Learning), Dr. Hank Bounds, and other dignitaries toured the various activities to see what the students were experiencing.

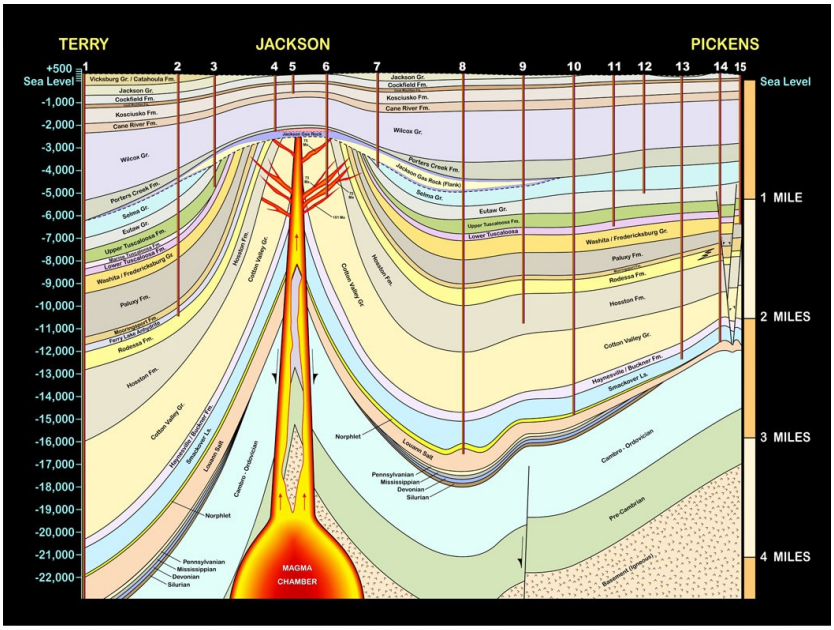


Figure 2. North-south cross section of the Jackson Dome and buried volcano created by Steve Walkinshaw and Candy Goolsby of Vision Exploration for the first Children's Educational Fair held on April 2-4, 2008.

I worked in the volcano tent with Mike Beiser of the Office of Pollution Control. Though a biologist by profession, Mike was a good speaker and did most of our PowerPoint presentations. I perked up in my "presentation willingness" on Friday, April 4, when a class from Weir, Mississippi, came in with a student teacher who had grown up in my church. Then the fourth-grade classes of Galloway Elementary School in Jackson entered our tent. Galloway was the school where my wife Mary taught before her recent retirement--both the teachers and many of the students in the Galloway group knew her. Galloway was the fourth and last group of students who came into our tent that morning. It was in the middle of the Galloway presentation that Hinds County Sheriff deputies broke up the classes and ordered everyone to move out of the tents and into wooden buildings on the Agricultural Museum campus. A tornado warning had been issued for neighboring Madison County. OG staff moved our posters and equipment out of the tents and into the buildings; I took the laptop computer and projector, which was on loan from Vision Exploration, to my truck.

Figure 3. James Starnes tells students what they can find when they look for rocks and fossils in the gravel tent. Picture (digital, DVD #60) taken by Brad Mayo on April 3, 2008.

When the tornado warning was extended to Hinds County, deputies ordered students out of the museum's wooden buildings and into the more substantial Agricultural Museum building. This was no small task for over a thousand students. State Superintendent Hank Bounds took on the role of general as the students were organized in regiments and marched, school by school, to the metal Agricultural Museum, where they were packed into the museum's interior like sardines. Many were seated in and around farm implements and crop-duster airplanes. I lingered outside to watch the coming storm and entered the building at the approach of the wall cloud and the green-tinted down-draft behind it. Deputies ordered everyone away from windows with the threat of arrest. There were rumors that a tornado touched down on the state fair grounds to the south, but by this time the real storm was blowing down trees along County Line Road and heading east into north Jackson. At the Agricultural Museum, the wind picked up and the lights went out to the screams of a thousand fifth-grade students sitting in total darkness. Then the hail hit the building's metal roof, sounding as if a dump truck had just dumped a full load of gravel on top of us. Just north of the museum, hail-laden wind damaged 75 new cars at Watson Quality Ford, blowing the windows out of most of them, and damaged the roofs of two motels, ripping a large hole in one roof. There was extensive straight line wind damage just south of the storm track and extending to the vicinity of the Agricultural Museum.

Figure 4. Michael Bograd helps students to identify the rocks and fossils they found in the gravel tent at the Children's Educational Fair. Picture (digital, DVD #60) taken by Brad Mayo on April 3, 2008.

Figure 5. Students show their rock and fossil finds contained within labeled zip-lock plastic bags at the Children's Educational Fair. Picture (digital, DVD #60) taken by Brad Mayo on April 3, 2008.

James Starnes took a picture in the Agricultural Museum foyer (Figure 6) after the lights went out and just before deputies ordered people to move into the interior of the building with the students and teachers. James recounted that once the students calmed down, following the initial moments of terror, the next thing heard in the darkness was a request to use the bathroom. This was followed by more of the same. James and the teachers led students in convoys through the darkness by the lights of their cell phones. Then James had to lend his cell phone to students so they could see inside the bathroom. I remember seeing cell phone lights everywhere and lines of children holding on to each other and weaving through crowds on their way to the bathroom. This went on for a couple of hours until the storm passed and a line of busses formed to take the children and teachers home. Leaving Jackson was another problem as many streets were blocked with trees and debris.

Figure 6. Junior League members Tammy Pearson (at left) and June Stone (at right, in her healthy-fruit suit and big hands) in the foyer of the Agricultural Museum just after the lights went out during the April 4 Jackson tornado. Students are in the museum's interior space. Picture (digital) taken by James Starnes on April 4, 2008.

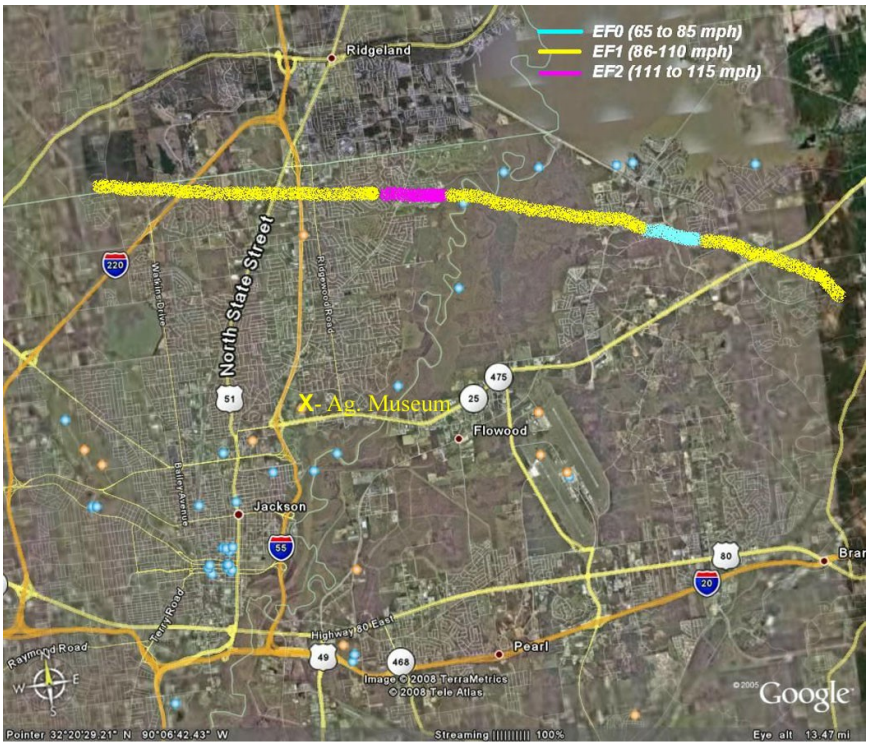


Figure 7. Storm track of the April 4, 2008, tornado through northern Jackson, according to the National Weather Service Forecast Office, Jackson, Mississippi, as posted on noaa.gov. X marks the location of the State Agricultural Museum. The tornado damage track began at the intersection of Livingston and County Line Road at 12:29 p.m. Central Daylight Time (CDT) and ended along Vine Drive in Rankin County between Highway 25 and Highway 471 at 12:42 p.m. CDT.

The first Children's Educational Fair, the "Wizard of Oz" theme, the students and Junior League volunteers in costume, the various careers presented, and the stay-in-school message were all memorable learning experiences for Mississippi fifth-grade students, but the one thing they will never forget is the Jackson tornado of April 2008. It was reportedly the third most costly disaster to hit the city (Figure 7) since Sherman burned Jackson to the ground in the spring of 1863 and since the Easter Flood of 1979.

FILMING *SIMPLY SCIENCE AT THE FOSSIL ROAD SHOW*

By David T. Dockery III, Office of Geology

Libby Hartfield, Director of the Mississippi Museum of Natural Science (MMNS), her husband Paul, George Phillips, vertebrate paleontologist with MMNS and Associate Director of the film *Simply Science at the Fossil Road Show*, and James Starnes of the Office of Geology are seated at an optional black-tie supper in Atlanta, Georgia, Saturday, June 27 at the 35th Annual Southeast Regional Emmy Awards as the announcer is about to reveal the winner in the Health and Science Division. It will either be *Simply Science at the Fossil Road Show* by Mississippi Public Broadcasting or *Fire Ecology* by Georgia Public Broadcasting. All evening media personalities have been sweating the award outcomes for their divisions. The envelope is opened, and the announcer says "The winner for the Health and Science Division goes to …." (Figure1).

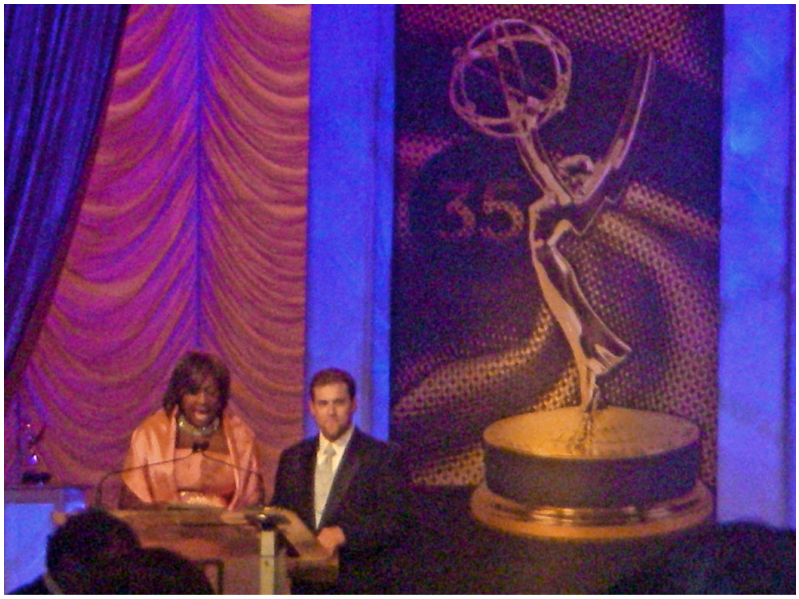


Figure 1. Announcer at the 35th Annual Southeast Regional Emmy Award Ceremony about to give the winner in the Health and Science Division. Picture (digital, DVD#60) taken by James Starnes on June 27, 2009.

Figure 2. Cameraman Chris Gordon cleans the camera lens as film editor Ron McDougald holds the tripod, while shooting the Simply Science segment at Fossil Gulch in LeFleurs Bluff State Park. Picture (digital DVD #60) taken on February 28, 2008.

Earlier: *Simply Science at the Fossil Road Show* was filmed at the fifth annual Fossil Road Show, held at the MMNS on March 1, 2008, an event featured in the August 2008 issue of *Environmental News* (page 4). Assistant producer George Phillips requested my help in explaining the fossil site called Fossil Gulch located in a deep gully behind the museum. This site contains an exposure of the Moodys Branch Formation, a 38-million-year-old marine sand full of fossil seashells. Filming at Fossil Gulch was done on the afternoon of February 28 before the Fossil Road Show and on the morning of April 3 after the show.

Figure 3. Simply Science hostess Alyssa Pennington holding the shell of a fossil oyster named *Pycnodonte trigonalis*, which she found while filming the Fossil Road Show segment at Fossil Gulch in LeFleurs Bluff State Park. Picture (digital, DVD #60) taken on February 28, 2008.

The Fossil Gulch segment was coached but not scripted (Figure 2). There were many retakes as film hostess Alyssa Pennington (Figure 3) asked questions, and I answered questions about the site. Alyssa was enthusiastic and a good sport when producer Rick Klein (Figure 4) asked us to do retakes (sometimes several retakes). Each time she maintained her poise and eye contact, but behind those eyes I could tell that her mind was busy recrafting what she was about to say. One question concerned the kinds of fossils that could be found at the site. As I thought of various things, I inadvertently mentioned a rare fossil cuttlefish (the internal shell of a variety of squid), which we had in our collections but which had never been published.

Figure 4. Rick Klein (right) carries the camera tripod up a steep cliff as the camera crew gathers equipment after filming on site at Fossil Gulch in LeFleurs Bluff State Park. Picture (digital DVD #60) taken on February 28, 2008.

Figure 5. New species of a *Belosaepia*-related sepiid from the Moodys Branch Formation at Town Creek in Jackson, Mississippi. The specimen was collected during a visit by Luc Dolin and Cyrille Dolin in September of 1981. Picture (digital DVD #56) taken by George Phillips on April 14, 2008.

Figure 6. New species of *Sulcocypraea* from the Moodys Branch Formation at Fossil Gulch at LeFleurs Bluff State Park in Jackson, Mississippi. The specimen was found during a filming session for the Fossil Road Show on April 3, 2008. Picture (digital composite, DVD #56) taken by George Phillips on April 11, 2008.

Producer Rick Klein wanted pictures of everything I mentioned for use as "pop ups" in the final production. George Phillips took pictures of the fossils and sent a picture of the fossil cuttlefish (Figure 5) to Patricia Weaver of the North Carolina Museum of Natural Science, a fossil-cuttlefish expert. Patricia has since submitted a paper for publication in which she names the fossil as both a new genus and species. Another important outcome of the film was a find I made while showing the fossil shells embedded in the gully walls. I saw the end of a rare cowry shell, which I dug out with my truck keys. The shell was a new species of the genus *Sulcocypraea*, a fact later confirmed by French cypraeid expert Luc Dolin, who examined digital images of the fossil (Figure 6).

Figure 7. Cameras roll as Earl Manning identifies fossil shark teeth at the Fifth Annual Fossil Road Show. In the background at far right is film hostess Alyssa Pennington talking to her mother. Picture (digital, DVD #60) taken on March 1, 2008.

During the day of the Fossil Road Show, MPB producer Rick Klein and his staff filmed sessions in which children brought their fossils to the experts to be identified. These experts included George Phillips of MMNS, Earl Manning, a recent Ph.D. graduate in vertebrate paleontology from Tulane University (figure 7-8), Dr. Gary Stringer, a geology professor at the University of Louisiana at Monroe, John Davis, a retired science teacher at St. Andrew's Episcopal School, and James Starnes and myself of MDEQ. The children were generally shy, and sometimes their parents seemed to be the ones most interested in the rocks and fossils. When the cameras came to my table, I was blessed to have a young man with a nice fossil trilobite and with an imaginative and rather catastrophic explanation as to how his fossil became a fossil. I couldn't hear everything he said in his soft voice, so I could only answer by saying, "Well, that's very interesting." When I asked him what he wanted to be when he grew up, he said he wanted to be "a scientist."

Figure 8. Mississippi Public Broadcasting producer Rick Klein stands behind the scene as vertebrate paleontologist Earl Manning holds a recent shark jaw while identifying fossil shark teeth at the Fifth Annual Fossil Road Show. Picture (digital, DVD #60) taken on March 1, 2008.

Figure 9. Producer Rick Klein (beside cameraman in black shirt) and others get a laugh as James Starnes bids his guest farewell with a wet handshake after using a water bottle to show the colors of an agate during filming of the Fossil Road Show. Picture (digital, DVD #60) taken on March 1, 2008.

In one filming session, James Starnes used a water bottle to liberally douse a young lady's agate specimens, which she had collected from gravel. Once wet the agates had a polished appearance, and the colors were more brilliant than when dry. James enthusiastically explained that agates were semiprecious stones. At the end of the film session, James thanked the young lady for bringing her agates and extended his water-drenched hand in a "good-bye" handshake, after which he apologized for the wet hand (Figure 9).

Children were also filmed digging fossils from a fossil-bearing sand pile on the museum grounds. This sand had been hauled to the museum some years before from an excavation of the Bashi Formation at a bridge entrance to the Super Wal-Mart in Meridian, Mississippi. The Bashi sand contained fossil shark teeth, ray teeth, sawfish rostral denticles, fish teeth, and seashells. One child was filmed holding up a shark tooth she found; she claimed it was the biggest ever. The camera had to zoom in to show the tiny shark tooth pinched between her thumb and finger.

Now back to the 35th Annual Southeast Regional Emmy Awards at Atlanta: The announcer opens the envelope and says, "The winner of the Health and Science Division goes to … Georgia Outdoors for *Fire Ecology* by Georgia Public Broadcasting." RATS! We thought *Simply Science at the Fossil Road Show* was a sure winner. The first inkling of a real challenge came when James Starnes and George Phillips were collecting fossils the day before in eastern Alabama near the Georgia line. The landowner had seen *Fire Ecology* and said it was really good and that the program had taken 9 months to produce (as compared to about 3 months for Simply Science). The second inkling came at the awards ceremony. Greater Atlanta Metro television stations and producers were sweeping the awards in almost all categories. Seated at the tables next to the Mississippi delegation were eight couples representing an Atlanta television station; all eight were Emmy Awards winners that night. So, in view of the tough competition, congratulations to Mississippi Public Broadcasting and all those involved (Figure 10) for their Emmy-nominated film *Simply Science at the Fossil Road Show*.

Figure 10. Left to right, George Phillips, Libby Hartfield, and James Starnes at the 35th Annual Southeast Regional Emmy Awards. Picture (digital, DVD #60) taken by Paul Hartfield on June 27, 2009.

INSTITUTIONAL HISTORY CAPTURED IN KODACHROME

David T. Dockery III, Mississippi Office of Geology

Figure 1. The noonday sun photographed from the driveway of 4550 Manila Drive in Jackson, Mississippi. Picture (Kodachrome slide) taken in September of 1970.

I began work with the Mississippi Geological Survey as summer-time help in 1968 as a driller's helper in drilling test holes for the Rankin County geology bulletin. My summer work continued until I finished graduate school and was hired fulltime in the summer of 1978. Photography has always been an important aspect of my job, even when working as a "sunbeam," as the summer help was called. Our publications were illustrated in black and white, and for this purpose the Survey's laboratory was turned into a darkroom for processing film and prints taken of fossils and field exposures. Many field pictures were taken also with 64-ASA Kodachrome and 100-, 200-, or 400-ASA Ektachrome color slide film and with Kodacolor or equivalent color negative film. Now MDEQ's Dallas Baker is requesting pictures that document the department's history. The Office of Geology (MOG) was ready for this occasion with a captioned image file of some 1,300 scanned slides and color negative films (created to use in a book on *The Geology of Mississippi*), some 800 scanned slides from the Geological Survey of Alabama, and 250 scanned slides from the Mississippi Petrified Forest. In the scanning process, color negatives were sometimes found to have a green or blue tint due to age and required much work in Photoshop to be of use, but even Photoshop could not bring back their original brilliance. Certain slide films had also changed in color and needed a little digital doctoring, but the Kodachrome slides were found to be in good condition.

Kodachrome film had a good reputation for its high resolution, lack of "graininess," and as a good archive film before I first used it in 1970. Its fame was even more enhanced by Paul Simons' 1973 song *Kodachrome*. Consider the following verse:

Kodachrome

They give us those nice bright colors

They give us the greens of summers

Makes you think all the worlds a sunny day, oh yeah

I got a Nikon camera

I love to take a photograph

So mama don't take my Kodachrome away

Like Paul, by 1970 I was armed with my Nikon camera and Kodachrome film. In searching for my earliest Kodachrome slide for use in the article, I didn't find the greens of summer. The earliest Kodachrome slide I found was a picture of the noonday sun! Why would I have done that?--Probably because I could. Kodachrome is a daylight film, and my Nikon camera had a shutter speed of 1000th of a second and a 55 mm macrolens with an f/stop down to f/32. On May 30, 1984, I once again took a picture of the sun, this time with my Nikon camera and a 135 mm lens and, of course, Kodachrome film. It was a day when geologists with Mississippi Geological Survey joined astronomy buffs at Flint Creek Water Park near Wiggins to see an annular eclipse of the sun (Figures 2-3). Figure 3 is a composite of eight pictures I took with the 135 mm lens (not a telescope) just before, during, and after the moment of total eclipse.

Figure 2. Astronomy buffs with a video camera projecting image of solar eclipse to a screen shaded inside a cardboard box at Flint Creek Water Park. Picture (Kodachrome slide) taken with a 135 mm lens focused on the screen with the eclipse image on May 30, 1984.

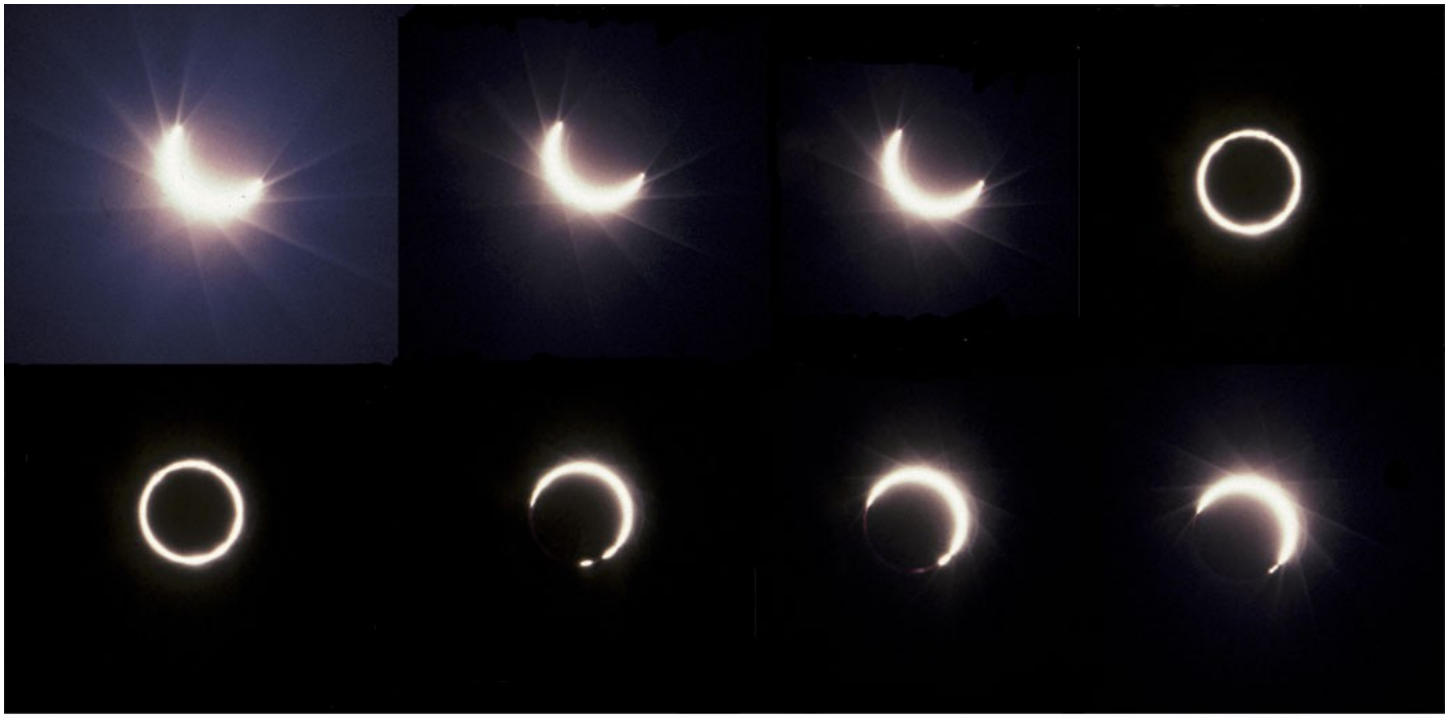


Figure 3. Progression of the 1984 annular eclipse of the sun taken at Flint Creek Water Park with a 135 mm lens. Picture (Kodachrome slide composite) taken on May 30, 1984.

I used Kodachrome film in Figure 4 to capture my experience as a driller's helper in Smith County in the hot summer of 1971. Figures 5-8 record an important field trip to east-central Mississippi led by Wylie Poag, an internationally known expert on the Chickasawhay and Paynes Hammock formations of Mississippi and Alabama, and Jim May, who wrote the Wayne County geology bulletin. More recently in 2002, Wylie Poag distinguished himself in publishing the finding of a meteor crater under Chesapeake Bay in the journal *Geology*. The field-trip pictures show even small details such as fossil shells littering the ground at a site in Newton, Mississippi (Figure 5), and the varied colors of the strata at that same Newton site (Figure 6). In Figure 7, Wylie Poag is showing one of his fossil sites in the Chickasawhay Formation at Waynesboro, Mississippi, while, in Figure 8, Jim May is pointing to his Wayne County Geologic Map to show that he had correctly mapped the geology at the site where they are standing.

Figure 4. Randy Warren (driller at left), Ed Luper (geologist in middle), and Jim May (geologist at right) drilling test holes in Smith County, Mississippi. Picture (Kodachrome slide) taken in August of 1971.

Figure 5. Jim May (left) and Wylie Poag (right) looking at fossil shells in the Cook Mountain Formation near the intersection of I-20 and Highway 15 at Newton, Mississippi. Picture (Kodachrome slide) taken on July 28, 1975.

Figure 6. Emmett Adams (left) and Jim May (right) looking for fossil shark teeth in the Cook Mountain Formation near the intersection of I-20 and Highway 15 in Newton, Mississippi. Picture (Kodachrome slide) taken on July 28, 1975.

Figure 7. Jim May (left), Emmett Adams (middle-top), and Wylie Poag (right) collecting a sample of the Chickasawhay Formation on Taylor Creek at Highway 45 in Waynesboro, Mississippi. Picture (Kodachrome slide) taken on July 28, 1975.

Figure 8. Jim May points to the location they are standing on his geologic map in the Wayne County geology bulletin to show that he correctly mapped the limestone newly exposed in the area. Looking at the map is Emmett Adams (front) and Wylie Poag, with David Williamson at right. Picture (Kodachrome slide) taken on July 28, 1975.

The Eastman Kodak Company announced on June 22, 2009, that it was ending the production of Kodachrome film, citing declining demand. Only one certified Kodak facility remains that processes Kodachrome film in the United States; this facility will continue processing the film until the end of the year. Over its 74-year run from 1935 to 2009, Kodachrome film has been appreciated in the archival and professional market for its color accuracy and dark-storage longevity. This film was used by photographer Steve McCurry when in 1984 he took the well-known portrait of Sharbat Gula, the "Afghan Girl," which appeared on the cover of the June 1985 issue of the *National Geographic Magazine*. It also appeared on the magazine's April 2002 cover, where the editor billed it as "the most famous picture in our magazine's 114-year history." The girl's sea-green haunting eyes attracted the world's attention to the plight of Afghan women and helped create the National Geographic Girl's Education and Training Center in Kabul, which opened in October of 2002.

A year before Steve McCurry took his famous portrait of the "Afghan Girl," I took my Nikon camera and Kodachrome film on a fossil-collecting expedition to France, where, using a 135 mm portrait-suitable lens, I also took a picture of a green-eyed subject. It was not a portrait of a French girl, but of a school teacher of Dutch-Bohemian-English descent, my wife Mary, holding her bag of fossils beside a Scottish thistle (the national emblem of Scotland) at the famous Le Guépelle locality (Figure 9). I focused the 135 mm lens on Mary and the thistle, leaving the background a little hazy and giving the picture a three dimensional appearance. Last year an international petition was sent out to save the Le Guépelle site from encroaching development. For 200 years, Le Guépelle had been an important collecting site for fossils of the Late Eocene Bartonian Stage. When a French colleague (Luc Dolin) sent the petition to me, I was ready with a signature and a picture.

Figure 9. Mary Dockery standing beside a Scottish thistle (the national emblem of Scotland) with her fossil collecting bag at a Bartonian Eocene sand pit at Le Guépelle, France. Picture (Kodachrome slide) taken with a 135 mm lens on July 17, 1983.

THE PETRIFIED LOG AT DANFORTH CHAPEL, UNIVERSITY OF SOUTHERN MISSISSIPPI

David T. Dockery III, Office of Geology

The first time I saw the 65-foot-long petrified log beside Danforth Chapel on the campus of the University of Southern Mississippi, I was impressed that a petrified log of such length had been found and wondered where it came from. Then I tried to imagine how it was possible to transport it to campus in one piece. Over the last twenty years or so the log has become such a part of campus that students and faculty walk by hardly noticing it. They sit on it, meet beside it, and mill around it without thinking, "Hey, there's a sixty-five-foot-long petrified log on campus!" Although there is a bronze plaque dated October 3, 1987, commemorating "The Chapel Place" adjacent to the front of the chapel (not seen in figures 5-6), there is nothing explaining the history of the log. With no commemorative plaque, perhaps one might think it's always been there--after all, the log is petrified; it could have occupied its spot before the campus was built. Perhaps the vortex of busy sidewalk thoroughfares was built around the log. With continued faculty turnover, the institutional knowledge about this log is vanishing. Some of the log's history might have been lost had it not been for the photographic record and recollections of retired biology professor Dr. Sam Rosso. Dr. Rosso allowed the Mississippi Office of Geology to scan his slides of the log's excavation and preparation for transport to the USM campus.

Figure 1. Building a cradle of drill stems and straps under a 65-foot-long petrified log in a sand and gravel pit near Ovett in Jones County, Mississippi. Picture (slide) taken by Sam Rosso in September of 1987.

Figure 2. Crane lifts a 65-foot-long petrified log from a sand and gravel pit near Ovett in Jones County. Picture (slide) taken by Sam Rosso in September of 1987.

One interesting aspect of the USM petrified log is the commitment of faculty and private individuals who acquired the log and moved the log to the campus. The log was found during mining operations in a terrace deposit near the town of Ovett in Jones County in 1987, where it was sighted by Richard Moore of the Science Education Department. Moore took USM professors Sam Rosso, Bobby Irby, David Patrick, and graduate student Clifton Eakes to see the log. Bobby Irby convinced University President Dr. Aubrey K. Lucas to buy the log, after which Irby and Sam Rosso convinced the landowner Mr. Johnson to sell the log to USM rather than to make a roadside display of it. A faculty committee was established to acquire and move the petrified log. Dr. Lucas obtained the funds from private contributions to make the move happen.

Figure 3. Crane lowering 65-foot-long petrified log on to a flatbed trailer for transport to the University of Southern Mississippi. Picture (slide) taken by Sam Rosso in September of 1987.

Figure 4. 65-foot-long petrified log from a sand and gravel pit near Ovett in a drill stem and metal strap cradle, resting on a flatbed trailer for transport to the University of Southern Mississippi. Picture (slide) taken by Sam Rosso in September of 1987.

Figure 5. Petrified walnut-like hardwood beside Danforth Chapel on the campus of the University of Southern Mississippi. The log was donated in September of 1987 and came from a sand and gravel pit in a terrace deposit near Ovett in Jones County. Picture (digital CD #21) taken on May 10, 2007.

The USM petrified log was moved to the campus in September of 1987 in the following phases. A trench was dug around the log by faculty and students (a party that included Sam Rosso, his daughter Kim, and Clifton Eakes) so that welders could construct a cradle of drill stem and metal straps beneath the log to support its weight for transport (Figure 1). Next a crane was hired to lift the log from its resting place to the bed of a flatbed trailer (figures 2-4). Once on campus, the log was lifted from the trailer and placed in its present resting place next to Danforth Chapel (figures 5-6). Biological examinations of the fossil wood indicated the log was that of a walnut-like hardwood.

Figure 6. View along the length of the petrified log beside Danforth Chapel on the campus of the University of Southern Mississippi. Picture (digital CD #49) taken on May 10, 2007.

HOUSE CONSERVATION COMMITTEE TOURS COAL MINE

By Representative John Mayo, Chairman, House Conservation and Water Resources Committee

The Red Hills Mine recently hosted Chairman John Mayo and the Mississippi House Conservation and Water Resources Committee for a tour of their facility in Choctaw County. MDEQ staff helped coordinate the tour and accompanied the House members. The Office of Geology, housed within MDEQ, is the state agency responsible for regulating the mine. Following is a narrative from Representative Mayo detailing the tour:

Members of the House Conservation Committee and State Senator Robert Jackson at the Red Hills Mine

The Conservation and Water Resources Committee considers bills on a number of things. Mines and Sewers (separate issues) are two of them.

Recently, the committee took a trip to Mississippi's currently only operating coal mine on 5,900 permitted acres in Choctaw County near Ackerman and 10 miles south of Eupora.

I was taken aback by the scope of the project both from a mine the likes of which I have never seen before, and the reclamation processes the company uses to return the land to as near its original topography as possible.

The company operating the mine works on several hundred acres at a time, and as you can imagine it is strip mining. There are six layers of coal in this deposit. Each layer is 1.5 to 4 feet thick and in between layers there may be 10 to 30 feet of dirt that needs to be removed.

Several sedimentation ponds ring the property to capture any run-off water that might get into the nearby streams. These ponds may be disposed of later, but the largest one will be retained as a post-mining recreational pond.

The mine works with OSM, DEQ, and the local land owners to reclaim what they have already mined. When digging out the dirt, the mine separates it into a pile suitable for growing things and another for underlying fill. Where the original land may have been hilly and eroded, the reclaimed land remains hilly, but more gentle slopes are planted with grasses to prevent erosion. The company may, after the grasses take hold, replant the property in whatever was there before. But, the landowner also has the option of requiring specific types of trees to be planted. Since this area was all mixed woods, most landowners seem to be opting for loblolly pine. The landowner usually has full access to his land after OSM and DEQ have made their final inspections---about 5 to 8 years after filling the strip back.

The coal mine has a single customer—a coal fired generating plant. On a 24/7 schedule, the plant consumes the equivalent of 110 railroad car loads PER DAY of coal. 160 to 200 ton trucks take the coal from mine to hopper on the edge of the mine. The coal goes from hopper, to conveyor belt, to crushers, to conveyor belt, to furnace. The plant burns the coal at a high temperature, recovers any by products, and sends steam out the smokestacks.

Among the things we were told—truck tires cost $25,000 each. Last year when a worldwide shortage occurred, the company was forced to buy 6 tires for $1.2 million. Some are purchased from China and Russia.

The pictures show the members of the committee who went, the drag line, the length of the pit currently opened, and a picture of an area in the foreground that has been reclaimed, in the middle a part being filled in, and the background is the open pit. What is awesome is the dragline is so large, most of us thought it was one quarter to a half mile away from where we stood---it was over a mile and the pit was two miles long. The dragline is electric and (are you ready for this?) powered by AN EXTENSION cord connected to a dedicated substation which buys power from the plant the mine feeds.

MISSISSIPPI PALEO ART

By David T. Dockery III, Office of Geology

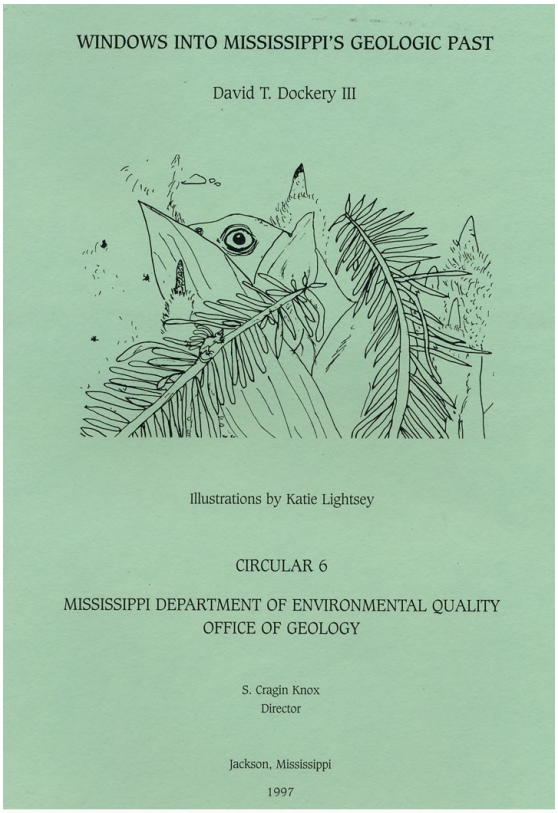


Figure 1. Cover of *Windows into Mississippi's Geologic Past* with cover illustration by Katie Lightsey.

The November 2003 issue of the *National Geographic Magazine* (*Behind the Scenes* section) recognized American artist Charles R. Knight (1874-1953) as "The Father of Paleo Art," noting that fifty years after his death his pioneering techniques of reconstructing ancient animals by building scale modes of bone, muscles, and skin are still used by illustrators today. Some of today's paleo artists are Mississippians, such as Steve Peterson, who painted the dinosaur in the "Stories in Stone" display at the Mississippi Museum of Natural Science based on a scale model he made. Steve has also made scale models of several other ancient animals. Then there is Katie Lightsey, who during her fifth and sixth grade years at St. Andrew's Episcopal Middle School illustrated the ancient scenes in our science-teachers-educational-resource book *Windows into Mississippi's Geologic Past*. Referred to simply as *Windows*, the book was created as a teaching aid for geology and as a coloring book with Katie's drawings. I was introduced to Katie's paleo art by her science teacher, John Davis. John Davis had been instrumental in starting a series of science-teacher workshops sponsored by MDEQ; *Windows* was written for those workshops.

Figure 2. Katie Lightsey, file picture from the Marketing Department of Cooke, Douglass, Farr, Lemons Architects & Engineers.

Katie's paleo art was drawn while *Windows* was being written. I would write fictional accounts of ancient times in Mississippi, and Katie would draw a picture to accompany the story. She did not shy away from scenes of one ancient beast devouring another. When I asked John Davis how she could depict such a scene so graphically, he smiled and answered, "Fifth-graders love that kind of stuff; the more blood and guts, the better." I asked, "Even the girls?" John answered, "Especially the girls." Three thousand copies of *Windows* were printed by Hederman Brothers Printing in their new building near St. Andrew's Middle School. On February 12, 1997, during the press run, we arranged a field trip so that Katie's class could see the printing process. Katie was able to get her first copy "hot off the press." For many years since, St. Andrew's has purchased an annual supply of *Windows* for use as a text book.

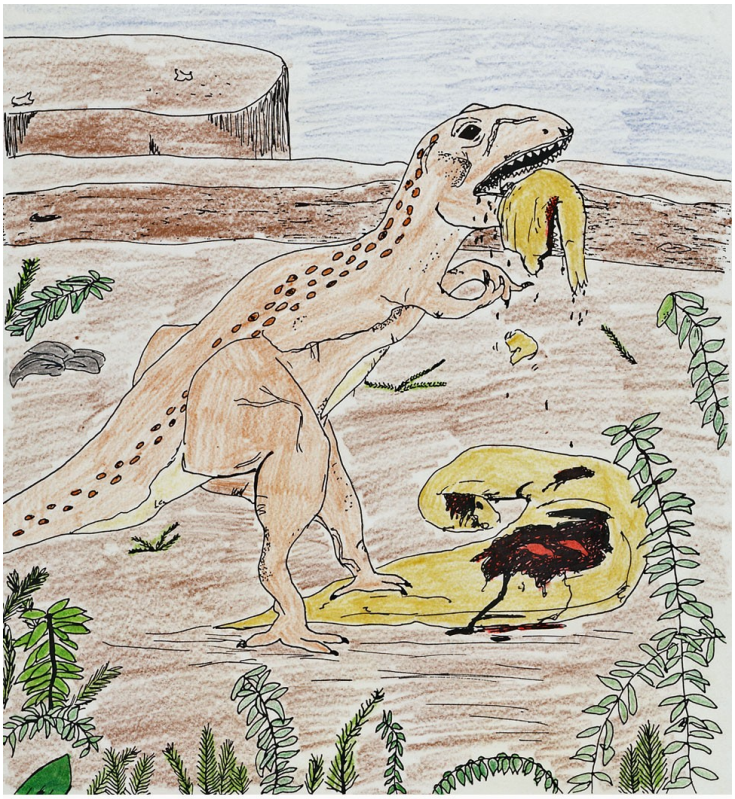


Figure 3. First Place: Color rendition by St. Andrew's student Derek Gleason of the Late Cretaceous volcanic island at Jackson, Mississippi, 79 million years ago, where a brown tyrannosaur is eating a yellow sauropod dinosaur.

The publication of *Windows* and the field trip were our last contact with Katie. Then last week we noticed in the *Jackson Free Press*' Chick issue that one of their favorite chicks was a recent graduate of Mississippi State University who was now working as an architect in Jackson. Her name was Katie Lightsey. Was this our young artist grown up?--she was! Katie's love for art and encouragement from her father, an accountant, led her to pursue a career in architecture. The *Jackson Free Press* writer noted that, while other girls were playing with Barbie, Katie was redecorating Barbie's house and building walls of her own with the cardboard from pizza boxes. Katie's firm Cooke, Douglass, Farr, Lemons Architects & Engineers is the company that renovated MDEQ's new buildings (tearing out and building walls like Katie with her pizza boxes). When I mentioned that to Katie, she answered, "I hope you like the facility. This truly is a small world in which we live."

We took the occasion of Katie's pick as a favorite chick to ask her to make a momentary change from artist to art critic. We asked her to judge among the color renditions of her work made by John Davis' St. Andrew's Middle School students and by Jackie Stevens' Northeast Lauderdale Middle School students as sent to us during the 1996-1997 school year while the writing and illustrating of *Windows* was in progress. Katie's first place prize goes to St. Andrew's student Derek Gleason for his color rendition of the king of beasts, a tyrannosaur, devouring a sauropod dinosaur in the rocky crater of the Jackson volcanic island in the Late Cretaceous 79 million years ago.

Figure 4. Second Place: Color rendition by St. Andrew's student Lindsey Byers of the Late Jurassic shoreline of southern Mississippi 160 million years ago, where a scavanged, dead and withered sauropod lies beside the great salt sea of the Mississippi Interior Salt Basin.

Figure 5. Third Place: Color rendition by Northeast Middle School (Jackie Stevens class) student Florenzia Ortiz, daughter of an exchange pilot from Argentina, of the Middle Paleocene in Meridian, Mississippi, 60 million years ago. The picture is a composite scene of the Rocky Mountains in the background and a river flood plain in Mississippi in the foreground. Animals include a pantodont (the largest mammal of the time) at water's edge, snakes, a crocodile, and a turtle.

Second place goes to St. Andrew's student Lindsey Byers for her color rendition of a dried up and partly decayed sauropod dinosaur at the edge of the great Late Jurassic salt sea that once covered southern Mississippi 160 million years ago. Even though this dinosaur died for lack of fresh water, the artist dramatized the scene with tinges of blood. Third place goes to Northeast Middle School (Lauderdale County, Mississippi) student Florenzia Ortiz for her color rendition of the Garden-of-Eden-like Middle Paleocene scene (complete with snake in a tree) at Meridian, Mississippi, 60 million years ago. This is the scene in which the reportedly second oldest known primate *Teilhardina magnoliana* lived as featured on page 5 of the October 2008 issue of *Environmental News*. Honorable mention goes to St. Andrew's student Jordan Hailey for his color rendition of a Triassic rift basin at Lake, Mississippi, 220 million years ago. The red-mouthed, green, flying pterosaur and the bold green, blue, and brown landscape and green dinosaurs make a foreboding scene.

Figure 6. Honorable Mention: Color rendition by St. Andrew's student Jordan Hailey of a Triassic rift basin at Lake, Mississippi, 220 million years ago. A green, red-mouthed pterosaur flies over green dinosaurs.

THE FRENCH CONNECTION–*VENERICARDIA PLANICOSTA*

By David T. Dockery III, Office of Geology

The marine Eocene formations of the Gulf Coastal Plain in Mississippi and Alabama and in the Paris Basin of France have some of the most diverse and best preserved molluscan faunas (seashells) in the world. One conspicuous guide fossil (a fossil restricted to a certain interval of geologic time) in common between the Eocene formations of Mississippi and France is the large clam *Venericardia planicosta* Lamarck, 1801. Lamarck's type specimen for this species came from the Middle Eocene beds (Lutetian) at Grignon, France. North American variations of *Venericardia planicosta* have been subdivided into numerous species based shell morphology but also seemingly based on their stratigraphic occurrence; still the planicostate venericard shells from Jackson and Claiborne Bluff, Alabama, look very much like those of the time-equivalent Bartonian Eocene beds of France (figures 1-2).

Figure 1. *Venericardia planicosta* from the Late Eocene (Bartonian) of Baron, France, at left and *Venericardia apodensata* from the Late Eocene Moodys Branch Formation at Town Creek in Jackson, Mississippi, on right. Picture (digital CD #61) taken on September 3, 2009.

Figure 2. Specimens of *Venericardia planicosta* from the Bartonian Eocene of Baron, France, on left and of *Venericardia apodensata* from the Bartonian Eocene (Moodys Branch Formation) at Town Creek in Jackson, Mississippi, on right. Picture (digital CD #61) taken on September 3, 2009.

Figure 3. Erin Fenlon (left) and Michelle Schneider (right) trudging through kudzu west of Meridian, Mississippi, to collect Early Eocene fossil shells. Picture (digital, CD #61) taken on August 21, 2009.

Planicostate venericards are guide fossils to the Eocene Epoch, an epoch named by British lawyer and geologist Charles Lyell in volume 3 of his *Principles of Geology* (1833). The name Eocene, a name meaning "early life," was the earliest of Lyell's threefold division of the Tertiary (Eocene, Miocene, and Pliocene). Since the time of Lyell's publication, the Eocene section of the Tertiary Period has been divided into three epochs, which from oldest to youngest are the Paleocene, Eocene, and Oligocene epochs. Planicostate vernicards do not occur in the Oligocene as they became extinct at the Eocene-Oligocene boundary. When Lyell toured North America with his wife Mary in 1841-1842 and in 1845-1846, he came to lecture, to explore, and to improve on his geology textbook *Principles of Geology*. One of Lyell's goals on his 1845-1846 trip was to visit fossil localities in the "Deep South" in order to see if his Tertiary epochs held true in America as they did in Europe.

On March 13, 1846, Lyell met with Colonel Benjamin L. C. Wailes at Wailes' home in Washington, Mississippi, near Natchez. There Lyell saw Wailes' collection of fossil bones from Mammoth Ravine near Washington and his fossil seashells from Vicksburg, Mississippi. From Natchez, Lyell and his wife Mary traveled by steamboat to Vicksburg, where, on the morning of March 20, 1846, Lyell made his own collection of fossil shells. That afternoon, Lyell left Mary in Vicksburg and took a train to Jackson. As was his custom when traveling through the villages of France, Lyell went to a druggist and asked if anyone was interested in geology. The druggist introduced him to Dr. Gist, who lived upstairs and who had read Lyell's *Principles of Geology*. Within ten minutes of the time he had stepped off the train, Lyell was collecting fossil shells in the bed of a small stream (Town Creek) with Dr. Gist. Lyell recognized the fossil shells at Jackson to be more like those of the Eocene shells at Claiborne Bluff in Alabama than like those he had collected at Vicksburg. He then concluded that the fossiliferous bed at Jackson was older and lower in the section than the fossil beds on the Mississippi River at Vicksburg, and that the strata dipped westward from Jackson to Vicksburg (now a proven fact).

Figure 4. From left to right, Michelle Schneider, Erin Fenlon, and James Starnes carrying sample bags loaded with sediment and fossil shells from the Early Eocene Bashi Formation exposed in the bed of Sowashee Creek west of Meridian. Picture (digital CD #61) taken on August 21, 2009.

Figure 5. Michelle Schneider, Erin Fenlon, and James Starnes in the gradational zone between the Moodys Branch Formation and the overlying Yazoo Clay on Town Creek in Jackson, Mississippi. Picture (digital CD #61) taken on August 21, 2009.

On August 21 and 22 of this year, Erin Fenlon, a graduate student at the University of Wisconsin at Madison, and her friend and helper Michelle Schneider, a student in kinesiology at the University of Minnesota at Twin Cities, drove to Mississippi to collect Eocene fossils at Meridian (figures 3-4), Jackson (Figure 5), and Techeva Creek in Yazoo County (figures 6-9). They collected fossil shells of all kinds but were particularly interested in the planicostate venericards (Figure 7). The occasion of their long trip to Jackson brings up an interesting point. I've noticed a trend in students and professors here focusing their research outside the state, while students from other states and countries flock to Mississippi to do their research. The result of this trend is that some of the most knowledgeable people about Mississippi geology live elsewhere.

Figure 6. The contact of the Moodys Branch Formation and the overlying Yazoo Clay is exposed in the bank of Techeva Creek in Yazoo County at the seam between the bench and vertical slope at left. Picture (digital CD #61) taken on August 22, 2009.

Figure 7. A shell of the planicostate venericard *Venericardia apodensata* exposed in the Moodys Branch Formation in the bed of Techeva Creek in Yazoo County (keys for scale). Picture (digital CD #61) taken on August 22, 2009.

Figure 8. Collecting sediment samples from the Creola Member of the upper Cockfield Formation on Techeva Creek in Yazoo County below the creek's often water-moccasin-infested overhanging limbs. Picture (digital CD #61) taken on August 22, 2009.

Figure 9. Michelle Schneider (left) and Erin Fenlon (right) experiencing the local Yazoo County culture at a store in Benton, Mississippi, after a day of fossil collecting. Picture (digital, CD #61) taken on August 22, 2009.

THE GLENDON REGOLITH AND THE NEW BRANDON HIGH SCHOOL

By David T. Dockery III, Office of Geology

The *Rankin County News* published an article on page 3A of its Wednesday, January 21, 2004, edition with the headline "Yazoo Clay Found on Brandon High School Site." This news added another element to the controversy over the school board's site selected for the new high school. An issue of concern from a geologic standpoint was that the swelling clay found at the site could not have been the Yazoo Clay. The geologic map in the Rankin County geology bulletin published in 1971 showed the higher elevations of the site to be on the limestone of the Vicksburg Group and the lower elevations to be on the sands and clays of the Forest Hill Formation. The top of the Yazoo Clay was more than a hundred feet below the site. Oddly enough, one reason given for rejecting an alternative site was that the site was underlain by limestone. A few soil borings had been made at the new site, but only in the lower elevations (in the Forest Hill Formation). Additional borings recommended by the engineering firm were not made.

Prompted by the newspaper article, Steve Jennings, a Rankin County resident who worked for the Office of Land and Water Resources at the time, invited me to go with him to see the bedrock geology of the new Brandon High School construction site. We visited the site on January 28, 2004, and found boulders of the Glendon Limestone (the upper limestone of the Vicksburg Group) along the roadside. These boulders had been moved during the site preparations made by the previous owner. In walking over the graded site surface, areas of lighter colored soil indicated the presence of limestone pinnacles below. The site was underlain by karst remnants of limestone surrounded by a matrix of expansive residual clay. Similar occurrences of weathered Glendon Limestone were known in the Brandon area and elsewhere in Rankin and Hinds counties.

Figure 1. Backhoe excavating pinnacles of limestone, at the request of MDEQ geologists, from swelling clays in the Glendon regolith under the graded foundation for the new Brandon High School. This soil proved unsuitable as foundation material and was removed at a considerable cost overrun. Picture (digital CD #44) taken by Stephen Jennings on January 28, 2004.

Figure 2. Backhoe excavating pinnacles of limestone, at the request of MDEQ geologists, from swelling clays in the Glendon regolith under the graded foundation for the new Brandon High School. This soil proved unsuitable as foundation material and was removed at a considerable cost overrun. Picture (digital CD #44) taken by Stephen Jennings on January 28, 2004.

Figure 3. Boulders of Glendon Limestone excavated from the site of the new Brandon High School where foundation problems were found associated with the weathered limestone. Picture (color negative 540-23A) taken on March 8, 2005.

Regolith is the geologic term for the weathered bedrock beneath the soil horizon. The Glendon Limestone and its associated regolith are present across the formation's outcrop belt in Mississippi from Vicksburg to north of Waynesboro, and from there continuing across Alabama into the panhandle of Florida. Locally, expansive clays of this regolith may cause foundation problems. A variety of expansive clay called bentonite was mined from the Glendon Limestone in Smith County for many years.

During our visit to the high school site, Steve Jennings asked a trackhoe operator to dig beneath an area that appeared to be weathered limestone. A large mass of Glendon Limestone was found just below the surface (figures 1-2). Eventually, the Glendon regolith layer had to be removed from the site and replaced with suitable foundation material at a cost overrun estimated at four million dollars. The cost of the Rankin County geology bulletin, along with its geologic map, was just three dollars. Though this bulletin is now out of print, it can be viewed for free at the MDEQ library. Figure 3 shows a field of limestone boulders, which had to be removed from beneath the High School foundation before the school could be built. Figure 4 is a picture of the Hinds Community College (Rankin County Campus) Physical Geology Class (fall of 2009) on a field trip to an outcrop of the Marianna Limestone and overlying Glendon Limestone on Highway 18 about 3.5 miles west of Brandon High School.

Figure 4. Hinds Community College (Rankin County Campus) Physical Geology Class (fall semester 2009) on a field trip to an exposure of the Marianna Limestone and overlying Glendon Limestone on Highway 18 about 3.5 miles west of the Brandon High School. Picture (digital CD #61) taken on August 25, 2009.

FALL 2009

JUST GEOLOGY

FROM THE PAGES OF ENVIRONMENTAL NEWS

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

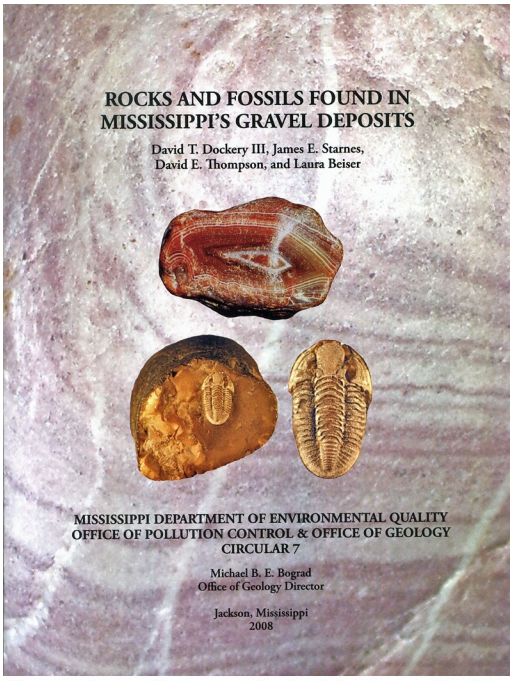


Figure 1. Cover of the rock and fossil guidebook created for the first Children's Educational Fair held on April 2-4, 2008.

Figure 8. Jim May points to the location they are standing on his geologic map in the Wayne County geology bulletin to show that he correctly mapped the limestone newly exposed in the area. Looking at the map is Emmett Adams (front) and Wylie Poag, with David Williamson at right. Picture (Kodachrome slide) taken on July 28, 1975.

CORING THE RED HOT TRUCK STOP LOCALITY

By David T. Dockery III and David E. Thompson, Office of Geology

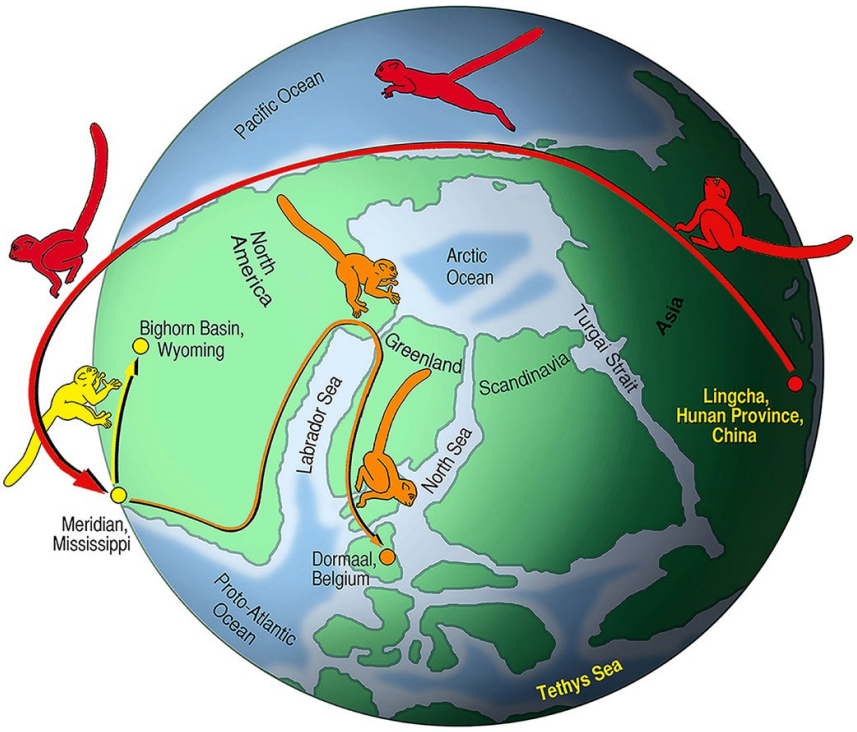


Illustration: Mark A. Klingler / Carnegie Museum of Natural History

Figure 1. Migration route of early primates 55.5 million years ago from China, around the eastern Pacific and northern Gulf of Mexico margin to Meridian, Mississippi, and then north to Wyoming and east to Belgium by way of the North American east coast and Greenland (according to Beard, 2008).

It's not often that we set up our Failing 1500 drill rig and drill a 263-foot core hole next to a busy store, but that's what we did this September on the Mattiace Company property beside the Super Wal-Mart in Meridian, Mississippi. A core at this site was requested by Chris Beard of the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, and by Guy Harrington of the University of Birmingham in Birmingham, United Kingdom. Beard's interest in the core concerned the position of the Paleocene-Eocene boundary in relationship to the T4 sand at the top of the Tuscahoma Formation. It was from the T4 sand that Beard named a new species of early primate *Teilhardina magnoliana*, a species Beard believed to be the second oldest known primate (see *Early Primate Fossils Found at Meridian, Mississippi* on page 5 of the October 2008 MDEQ newsletter). If Beard's hypothesis is true, then early primates migrated from China, the site of the earliest known primate, across Alaska, to Mississippi, and then on to Wyoming and to Europe (Figure 1). One test of the age of *T. magnoliana* is to find how close it is to the Paleocene-Eocene boundary, a boundary with a published absolute age of about 55.5 million years old.

Harrington's interest in the Red Hot Truck Stop core concerns changes in regional flora across the Paleocene-Eocene boundary based on fossil pollen in the core. Harrington published the palynology (ancient flora based on fossil pollen) of the Harrell core, a test hole six miles south-southwest of the Red Hot Truck Stop locality (Figure 2). Based on the presence of a carbon isotope excursion typical of the Paleocene-Eocene (P-E) boundary at the base of the Paleocene-Eocene Thermal Maximum (PETM), Harrington was able to identify the P-E boundary in the Harrell core at 122 meters (400 feet); this pick was some 29 meters higher than that of Ellwood and others (2009, in press), who studied the magnetic susceptibility of the Harrell core and placed the P-E boundary at about 150.8 meters (494.6 feet). The Paleocene-Eocene Thermal Maximum was the warmest period of earth history after the extinction of the dinosaurs at the end of the Cretaceous Period (see *Mississippi and the Great Carbon Burp 55.5 Million Years Ago* on page 14 of the February 2009 issue of the MDEQ newsletter). Marine sediments of this age contain the acme zone of the dinoflagellate *Apectodinium*, which is found in the glauconitic sands of the uppermost Tuscahoma Formation at Meridian.

Figure 2. Guy Harrington (left) and his Ph.D. student Phil Jardine (right) from the University of Birmingham at Birmingham, United Kingdom, at the Office of Geology core storage facility on North West Street in Jackson sampling the Harrell core for fossil pollen and carbon isotopes. Picture (digital DVD #63) taken on May 13, 2008.

The T4 sand of the Tuscahoma Formation was first discovered by Gerard Case in 1979 while he was looking for the famous shark-tooth-bearing marine exposures of the Bashi Formation at the Red Hot Truck Stop locality. Without a native guide, Case began excavating at the first fossiliferous bed he came to and discovered a fossiliferous lens at the top of the Tuscahoma Formation, which other collectors had walked over for years as they climbed higher up the outcrop to collect from the Bashi Formation. Chris Beard of the Carnegie Museum of Natural History noted tiny mammal teeth in Case's collection deposited at the Yale Peabody Museum, and with the help of Case and a field crew from Carnegie made a larger excavation of the site in November of 1990.

Four other excavations followed in April of 1991, March of 1992, September of 1994 (Figure 3), and November of 2000. The latter excavation was aided with the help of a trackhoe and showed the T4 Sand to extend southward into the outcrop but to be truncated to the west and thus restricted in areal extent. Melissa Hendricks, a writer for the *Johns Hopkins Magazine*, was present to cover the excavation as the lead excavator Chris Beard (a PhD alumnus of Johns Hopkins) had recently received a $500,000 MacArthur Foundation "genius" award for his work with fossil primates (Figure 4). Melissa's article on the dig appeared in the April 2001 issue of *Johns Hopkins Magazine* and featured not only Beard's work with primates but the Meridian excavation site and local culture. The importance of the Red Hot Truck Stop Local Fauna was summed up in a quote from Beard, "The Paleocene/Eocene boundary has been relatively well sampled in the fossil record from Wyoming, Paris, Belgium, South England, Portugal. Now we're filling in what happened in the southeastern U.S."

Figure 3. Chris Beard excavating the T4 sand at the top of the Tuscahoma Formation at the Red Hot Truck Stop locality in Meridian, Mississippi. In the excavation face above are Early Eocene fossil-leaf-bearing clays of the Bashi lowstand deposit. Picture (Kodachrome slide 270-5) taken on September 28, 1994.

Due to international interest and to aid his own geologic mapping work, David Thompson made arrangements to core the Red Hot Truck Stop section at the closest possible spot above the outcrop. The fossil locality in the Bashi Formation at the Red Hot Truck Stop has been a popular field trip and fossil collection site since about 1950. When plans were made to build a Super Wal-Mart at the site, the developer, the Mattiace Company (working with the Mississippi Office of Geology), agreed to save the fossil site and built the access bridges and parking lot around it. Thompson's drill site was on Mattiace Company property adjacent to the Super Wal-Mart (our thanks to Sandy Hearron and the Mattiace Company for allowing us to drill). The core hole, formally named the "Mississippi Office of Geology #1 Wal-Mart," began on Monday September 14 and was completed to a depth of 263 feet by 5:00 p.m. the next day (coring the complete depth).

Figure 4. Melissa Hendricks, writing on Chris' excavation for the Johns Hopkins Magazine, and Chris Beard, vertebrate paleontologist and recipient of the MacArthur Foundation "genius" award in 2000, with a field trip for a local school to collect fossils among Bashi boulders removed from the Super Wal-Mart construction site. Picture (slide 344-16) taken on November 13, 2000.

Figure 5. Box 29 (left) and box 30 (right) of the Harrell core as sampled by Guy Harrington. The Tuscahoma-Bashi contact is marked at 389.5 feet in box 29 and the Paleocene-Eocene boundary is marked at 399 feet 10 inches in box 30. Pictures (digital composite DVD #63) taken by Guy Harrington on May 13, 2008.

Core recovery had a limited success in the sandy intervals, which were easily washed away in the drilling process. Drilling began in a gray clay at the base of the Hatchetigbee Formation; the hard concretionary zone at the top of the Bashi Formation was encountered at a depth of 18 feet. The ten-foot-sand section below that was not recovered in the core, but the fine-grained glauconitic sand and silt of the upper Tuscahoma Formation were recovered beginning at a depth of 28 feet. In the Harrell core, carbon isotope studies placed the Paleocene-Eocene boundary at the base of a fine-grained, glauconitic sand interval in the upper Tuscahoma Formation (Figure 5). This boundary in the Wal-Mart core, based on a preliminary examination, appeared to be at 48 feet below the surface and some 30 feet below the horizon of Beard's new primate species in the T4 sand at the top of the Tuscahoma Formation.

Figure 6. All that was recovered from the fourth core at 43-53 feet was the 53-foot sample in the core catcher. The bluish gray, glauconitic fine sand and silt is typical of upper Tuscahoma Formation at Meridian in the section containing the PETM. Picture (digital DVD #63) taken on September 14, 2009.

Figures 6-10 are pictures taken of the coring process. During the drilling of this core hole and the previous one, I noticed how "relatively" polite driller Trey Magee was while barking instructions to the new crew member, and "Brett Favre-look-alike," Jonathan McKinnon (Figure 10). I told Trey that when I (Dockery) was a driller's helper, the driller dog-cussed me. Trey immediately responded, "You must have been a pretty sorry driller's helper." *So that's it; I always thought it was the ornery driller*. At least today we are ably staffed and ready to drill. Figure 11 is a picture of the iconic Red Hot Truck Stop sign, which, during the demolition of the truck stop, was spared as a Meridian landmark and as a reminder of the famous fossil site nearby.

Figure 7. David Thompson positions the fifth core from 53-63 feet, which had a full ten feet of recovery. Jonathan McKinnon at upper left is attaching a new drill stem to the hoist cable, while Trey Magee (center) and Archie McKenzie (right) are operating the drill rig. Picture (digital DVD #63) taken on September 14, 2009.

Figure 8. Possible position of the Paleocene-Eocene boundary at 58 feet between the bluish-gray glauconitic sand at right and the lavender-colored clay at left. Picture (DVD #63) taken on September 14, 2009.

Figure 9. Core hole location on the west side of the Super Wal Mart store in Meridian, Mississippi. Picture (digital DVD #63) taken on September 15, 2009.

Figure 10. Trey Magee at left and new drill-crew member and "Brett Favre-look-alike" Jonathan McKinnon at right. Picture (digital DVD #63) taken on September 15, 2009.

Figure 11. The Red Hot Truck Stop is gone but the sign was saved as a landmark when the surrounding property was purchased as a site for the new Super Wal-Mart. Picture (digital DVD #63) taken on September 15, 2009.

B. L. C. WAILES, MISSISSIPPI'S RENAISSANCE MAN

By David T. Dockery III, Office of Geology

Figure 1. Campus of Jefferson College at Washington, Mississippi. Picture (digital) was taken on July 14, 2009.

The Clarion-Ledger entitled Benjamin Leonard Covington Wailes (1797-1862) the "Renaissance Man" in its August 1, 1978, edition, noting that Wailes was a naturalist, the first president of the Mississippi Historical Society (the progenitor of the Mississippi State Department of Archives and History), the author of the *Report on the Agriculture and Geology of Mississippi* (1854), and served as a teacher and trustee of Jefferson College (Figure 1). The museum at Jefferson College has a nice display of Wailes and his work, including an enlarged portrait and the four plates of fossil shells from Jackson, Mississippi, published in his book on the geology of Mississippi (Figure 2). On July 14 of this year, I gave a noon talk at the Jefferson College Museum on "Wailes' Fossil Whales," a title created by museum director Robin Persons. In the audience were two Wailes descendants, Sim C. Callon, Jr., of Natchez, a descendant of B. L. C. Wailes' daughter Ellen, and Mary Margaret Wailes Brosset of Shreveport, Louisiana.

Sim C. Callon (Figure 3) and his brother, the late John Callon, were the founders of Callon Oil & Gas Company, which later became Callon Petroleum Company. According to Alan Cockrell's book *Drilling Ahead*, the Callon brothers eventually drilled or participated in over 1,000 wells, expanding from Mississippi to the rest of North America and the Gulf of Mexico. It seems appropriate that descendants of Mississippi's first native geologist would launch a successful oil and gas industry.

B. L. C. Wailes wrote the first book on the geology of Mississippi, a book that could more correctly be titled "The Agriculture and Natural History of Mississippi." This work was enhanced by Wailes' association with the leading naturalists and scientists of his time. Some of these associations included Charles Lyell, J. Louis Agassiz, Joseph Henry, Joseph Leidy, Benjamin Silliman, Timothy A. Conrad and, of great importance, a family friendship B. L. C.'s father Levin Wailes fostered with John J. Audubon.

Figure 2. The B. L. C. Wailes exhibit at the Jefferson College Museum in Washington, Mississippi. An enlargement of the Audubon charcoal sketch of Wailes is opposite Wailes' drawings of fossil Eocene shells from Jackson, Mississippi. Picture (digital) was taken on July 14, 2009.

Figure 3. Left to right are Sim C. Callon, Jr., of Natchez, David Dockery of Clinton, and Mary Margaret Wailes Brosset of Shreveport, Louisiana, standing in front of B. L. C. Wailes' home in Washington, Mississippi. Sim and Mary are cousins and descendants of B. L. C. Wailes. Picture (digital) taken on July 14, 2009.

Levin Wailes (1768-1847) was appointed by President Monroe as Surveyor General South of Tennessee, at which time Levin moved from Maryland to Georgia in 1792 where B. L. C. Wailes was born in 1797. Lured by the promise of new lands in Mississippi, Levin and his two sons moved to the town of Washington (capital of the Mississippi Territory and State from 1802-1821) in Adams County in 1807; his pregnant wife Eleanor joined them later. In 1810, Levin accepted an appointment as register of the Opelousas, Louisiana, land office. It was at this time that John J. Audubon was a guest at the Wailes' Opelousas home. B. L. C. Wailes and his brother Edmund Howard Wailes accompanied and assisted Audubon in his bird observations and collecting excursions throughout the countryside. These young brothers shared Audubon's passion for his work, and Audubon grew very fond of them.

When the family then moved to Adams County, Mississippi, B. L. C. Wailes continued to assist Audubon; Wailes collected the oriole nest for Audubon's Orchard Oriole painted on April 12, 1822. The nest came from the Propinquity Plantation just outside Washington, where B. L. C. and his bride lived from 1820-1823. Levin Wailes arranged a post for Audubon as a drawing instructor at Elizabeth Female Academy, chartered in 1819 near Washington. Audubon held this post for six weeks from mid-May to early July of 1822. At this time Audubon drew four charcoal portraits of Levin and his wife Eleanor Davies Wailes (Figure 4) and their sons B. L. C. Wailes (Figure 5) and Edmund Howard Wailes. The portrait of B. L. C. Wailes was missing and thought to have been lost in a house fire until a niece of Wailes' son Dr. L. A. Wailes found it in an old Covington family Bible at the doctor's home in New Orleans.

An attack of yellow fever on July 8, 1822, ended Audubon's association with the Elizabeth Academy. Audubon began painting in oil at Natchez in December of 1822. On February 15, 1823, Audubon advertised in the *Mississippi State Gazette* to paint oil portraits at $50 or miniatures at $30. It was probably around this time that Audubon painted the miniature portraits on ivory of B. L. C. Wailes and his wife Rebecca (figures 6-7). In late August of 1823, Audubon suffered a second attack of yellow fever, and left Natchez on a steamer for New Orleans on September 30, 1823.

Figure 4. Charcoal portraits of Levin Wailes and his wife Eleanor Davies Wailes, the parents of B. L. C. Wailes, as drawn by John J. Audubon in 1822.

Figure 5. Charcoal portrait of B. L. C. Wailes drawn by John J. Audubon in 1822. This drawing was thought to be lost until found in the Covington family Bible. Fold seams are visible in the portrait. Picture (digital CD #61) taken on August 28, 2009.

Wailes' connection with the Mississippi Geological Survey began shortly after pressure from the state's geological society and from planters prompted the Mississippi legislature to pass a law on March 5, 1850, authorizing a geological and agricultural survey of the state. Wailes applied for the job of State Geologist to Augustus Baldwin Longstreet, president of the young University of Mississippi. However, the job was awarded by the trustees to Dr. John Millington, a professor at the university since 1848. With his teaching responsibilities, Millington was unable to undertake a state-wide survey. The trustees later elected Wailes to do the survey at a meeting at the state house in Jackson on January 15, 1852. Wailes accepted the job and traveled to the University of Mississippi to meet with the trustees and with Dr. Millington, the first State Geologist and the person to whom Wailes was to make monthly reports on his progress.

It was at this time in January of 1852 that Wailes began a daily journal, which he continued for the next ten years until his death in 1862. This record was inscribed in thirty-six small books, numbered from 1 to 36. Eight of these books, numbers 1- 4 and 10-13, are at the Mississippi Department of Archives and History at Jackson. The remaining twenty-eight books were for many years in possession of Mrs. Ellen Wailes Brandon (Mrs. Charles G. Brandon) of Natchez, Mississippi, who transferred them to the library of Duke University, Durham, North Carolina.

Mrs. Brandon inherited the diaries and other family items from her uncle, B. L. C.'s youngest son Dr. Leonard A. Wailes (Figure 8). Dr. L. A. Wailes graduated from Jefferson Medical College in Philadelphia, Pennsylvania, in the class of 1861 and practiced medicine in New Orleans. Having no children, he passed family treasures down to his niece Ellen Wailes Brandon (Aunt Nell), who had no children. Aunt Nell divided her family things among her nieces and nephews, including Cornelius Segrest Wailes, the husband of Mrs. Jimmie Kathleen Dennis Wailes.

Figure 6. Audubon miniature portraits of B. L. C. Wailes and his wife Rebecca Susanna Magruder Covington Wailes painted at around 1823 by John J. Audubon.

Figure 7. Caliper shows the original Wailes miniature portrait to be 2.69 inches (68.2 mm) high. Picture (digital) taken on August 14, 2009.

Figure 8. A daguerreotype photograph of B. L. C. Wailes and his son Leonard A. Wailes.

We are thankful to Mrs. Jimmie Wailes (Figure 9) for allowing us to photograph the Audubon charcoal and miniature portraits of B. L. C. Wailes, a daguerreotype photograph of Wailes and his son Leonard A. Wailes, and a bracelet Wailes had cut from pebbles collected from gravel in the Natchez area (Figure 10). The miniature portrait in oil of B. L. C. Wailes (Figure 6) was painted on a thin oval of ivory that was only 68.2 mm high by 54.5 mm wide. Wailes recorded in his diary that he had stones ("agates") cut and set in New York City in late August and September of 1854, while overseeing the printing of his book *Report on the Agriculture and Geology of Mississippi* by J. B. Lippincott, Grambo, & Company (publisher for E. Barksdale, state printer) in Philadelphia, Pennsylvania. Wailes wrote on September 5, 1854: "Called on the lapidaries and obtained the agates etc. left to be cut. Some of them proved to be very fine, others disappointing to expectations, proving very inferior." The total cost of cutting and polishing the stones for the bracelet and a ring was $13.00, and the cost of mounting six of them was $6.50.

B. L. C. Wailes was elected to the Mississippi Hall of Fame in 1981. A portrait of Wailes painted by his great-great-great niece Eleanor Greaves (based on the charcoal drawing and miniature portrait by Audubon) was unveiled at the Old Capitol Building on June 24, 1990. At that time twenty-nine descendants of B. L. C.'s father Levin Wailes attended the unveiling (Figure 11).

Mrs. Jimmie Wailes' son Butch called Saturday, October 10, 2009, to tell us his mother had passed. My wife Mary and I had spent several Friday afternoons and one Thursday afternoon with Mrs. Jimmie Wailes going through her family archives. We borrowed and copied family documents, photographed old pictures, and visited around her kitchen table. She is greatly missed by her family and friends (Mrs. Jimmie Dennis Wailes: April 15, 1921—October 10, 2009).

Figure 9. Mrs. Jimmie Wailes, wife of the late Segrest Wailes, at her home. Picture (digital CD #61) taken on September 4, 2009.

Figure 11. Twenty-nine descendants of Levin Wailes at the debut of the B. L. C. Wailes portrait painted by Wailes' great-great-great niece Eleanor Greaves for the Old Capitol Building's Hall of Fame. Picture (scanned print) was taken at the portrait's unveiling on June 24, 1990.

BACK TO THE MOON

By David T. Dockery III, Office of Geology

Figure 1. Pat Gaspard (left) and Vicki Bess (right), with the Visitor Center of the Stennis Space Center, standing behind models of the Ares I (left) and Ares V (right) rockets on display in Jackson, Mississippi. Picture (digital) taken on August 13, 2009.

The new Orion Crew Exploration Vehicle made a stop at the Mississippi Museum of Natural Science in Jackson on Thursday, August 13, 2009, in its route from the Kennedy Space Center in Florida to the Stennis Space Center on the Mississippi coast and then to Houston, Texas, by way of a detour to Jackson. Vicki Bess and Pat Gaspard with the Visitor Center at the Stennis Space Center accompanied the Orion vehicle to Jackson to explain its role in the next lunar mission. In Figure 1, Vicki and Pat are standing behind models of the next generation of rockets that will carry our astronauts to the moon. Orion and a crew of four astronauts will be carried into earth orbit by the smaller rocket, Ares I, on the left. This rocket is equipped with a "launch abort system" to save the astronauts should something go wrong during the launch. The Alrair lunar lander and the Earth departure stage will be carried into Earth orbit by the larger rocket, Ares V, on the right, the heavier payload requiring much more fuel. The astronauts will dock with the lander in orbit before continuing their mission to the moon. Two young astronauts, Reeves and Ryan Fisackerly (Figure 2), came to see the Orion vehicle dressed in NASA flight suits, which their parents purchased from the Smithsonian Museum Gift Shop.

Figure 2. Ryan (left) and Reeves (right) Fisackerly dressed in their NASA commander suits with the Orion Crew Exploration Vehicle on the trailer some distance behind them during its stop at Jackson, Mississippi. Picture (digital) taken on August 13, 2009.

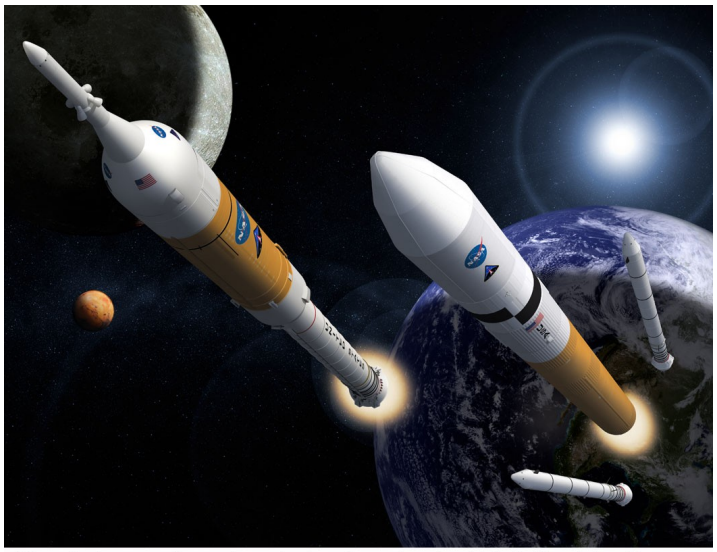


Figure 3. A concept image shows the Ares I crew launch vehicle (left) and Ares V cargo launch vehicle. Picture (digital) from NASA.

The Stennis Space Center will be responsible for rocket propulsion testing for the upper stage of Ares I and Ares V, and the main stage of Ares V. The Ares V rocket will stand 360 feet tall and be able to lift more than 286,000 pounds to low Earth orbit. The Orion vehicle arrived in Jackson, showing the wear and tear from its own testing. This Orion vehicle and the Ares I and Ares V rockets will replace the space shuttle, which will be retired in 2010 (Figure 3).

PRECIOUS OPAL: MISSISSIPPI'S FIRST GEMSTONE

By James E. Starnes, Office of Geology

Mississippi has been endowed with extremely rich fossil deposits dispersed throughout much of the exposed geological section. Many of Mississippi's unique geological treasures adorn local personal collections and professional collections in museums as far away as Japan. Though the interest in Mississippi's geology by collectors and scientists is mainly in excellently preserved fossil specimens, many coarse-grained, aggregate-bearing deposits such as the Citronelle and Pre-loess gravels are regularly combed for semi-precious stones such as agate, carnelian, jasper, clear quartz, and fossil palm. Until recently, no precious stones have been reported from Mississippi.

Rough Mississippi Opal

In neighboring Louisiana, small-scale mining of gem-quality opal has been done in the basal Fleming Formation (Catahoula Formation equivalent in Mississippi) of Vernon Parish, Louisiana, near the Texas border for over a hundred years. The vibrantly colored opal cements coarse-grained sand into hard sandstone and quartzite which were fashioned into gemstones and once sold to Tiffany's of New York. Much of the Louisiana Opal on the market today can be credited to recent prospecting by Ben F. Stevens, whose mine is closed at present. ("**Louisiana Opal-The One That Dares To Be Different**" by Ben F. Stevens, 1999)

Recent detailed geological mapping of the Catahoula Formation in Claiborne County by the Mississippi Office of Geology's (Mississippi Geological Survey) Surface Geology Division under a United States Geological Survey (USGS) Statemap Grant led to the discovery of another precious opal deposit much like the Louisiana locality. The material was first tested for gem quality by the Mississippi Gem and Mineral Society's artisans, Janie Hand, Joy Rushing, and Donnie Chandler. The exquisitely crafted stones show brilliant flashes of fire, ranging in color from green to red.

A 7.5 minute geological map of the area was published by the Office, but no specific details on the location of the outcrop(s) are being divulged to protect it from being raided before it can be completely studied by scientists and accessed by the landowner(s). The site is sensitive, not only because of the precious opal it contains, but also the pre-historic artifacts that have been found in association with the site. These artifacts include pottery, artifacts made from local chert gravel, and artifacts of Catahoula quartzite (some of which are opalescent).

Because of the amount of volcanic ash that was deposited in the Catahoula Formation, a number of quartzite-bearing exposures can be found along its outcrop belt in central and western Mississippi. Therefore, it is entirely possible that other exposures of the Catahoula Formation, as well as other quartzite-bearing formations, such as the Hattiesburg and Tallahatta, in Mississippi may contain precious opal deposits that have yet to be discovered.

MISSISSIPPI GULF COAST GEM AND MINERAL SOCIETY SHOW

MDEQ Office of Geology display

The 19th annual Magnolia State Gem, Mineral, and Jewelry Show sponsored by the Mississippi Gulf Coast Gem and Mineral Society was held at the Jackson County Fairground's Civic Center Building in November. James Starnes, with the Office of Geology and the author of the previous page's article on opal, loaned them samples of the state's first gemstone. The opal display was a big hit with those attending the show. The Mississippi Gulf Coast Gem and Mineral Society focuses on public education as well as fossil and mineral specimen displays at some Mississippi Welcome Centers.

Polished Mississippi Opal

Gemstones at the show

GLOBAL COOLING

By David T. Dockery III, Office of Geology

The title "Global Cooling" is not a revisionist reaction to "Global Warming," but it is a well known geologic fact that the earth has cooled over the last 38 million years, climaxing with the continental ice sheets of Pleistocene Epoch. Even with the present warm trend, the earth is still much cooler than it was in the Eocene Epoch, when there was little ice at the poles and sea level was much higher. The Late Eocene sea of the Jackson Group, a group named for its type locality at Town Creek in Jackson, Mississippi (Figure 1), extended into Arkansas and into western Tennessee north of Memphis (Figure 2). Fossil seashells from the 38-million-year-old basal formation of the Jackson Group, the Moodys Branch Formation, contains a great diversity of some 300 molluscan species (more than can be found off the Mississippi coast today) with many tropical forms. Fossil seashells (Figure 3) are so well preserved in the Moodys Branch Formation that the oxygen isotopes within their shell layers can be read as thermometers of the ancient seawater temperature in which the shell lived.

Figure 1. The Moodys Branch formation exposed at Town Creek in Jackson, Mississippi, (MGS locality 1) before the construction of a sewer line across the site. A railroad bridge and the South State Street bridge appear in the background. Picture (Kodachrome slide 155-5) taken in September of 1970.

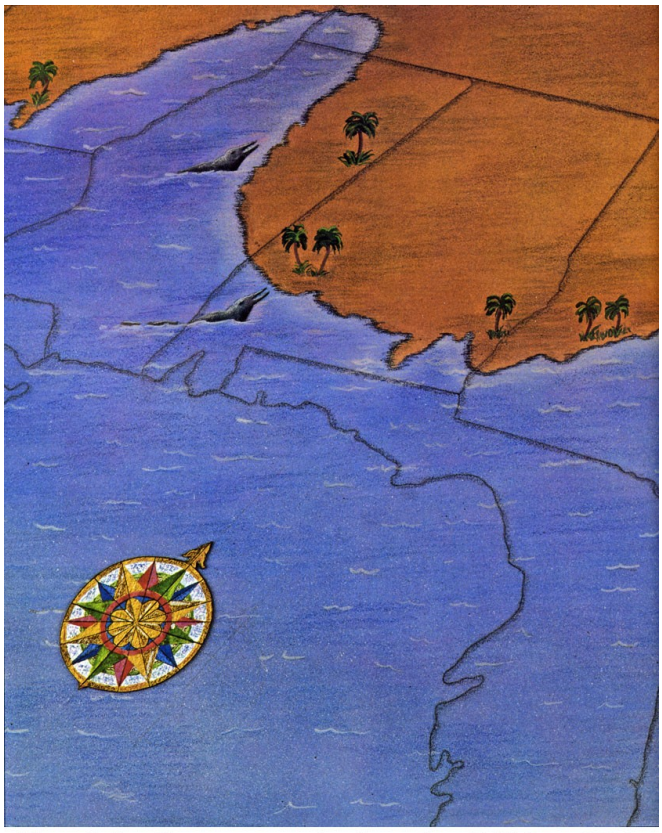


Figure 2. Late Eocene sea covering the northern Gulf Coastal Plain about 38 million years ago. Picture (scanned image) from *Alabama Heritage*, spring 1989, p. 14.

Atmospheric oxygen has three stable isotopes (isotopes that do not undergo radioactive decay): ^{16}O (99.76%), ^{17}O (0.04%), ^{18}O (0.2%). The oxygen isotope ratios ($^{18}O/^{16}O$) of the calcium carbonate ($CaCO_3$) in fossil shells are inversely proportional to growth temperature. Thus, oxygen isotope ratios can be used as a "paleothermometer." Measuring oxygen isotopes in successive growth bands gives a continuous record of seawater temperatures through the seasons. Cone shells of the genus *Conus* are especially useful for this purpose as their spires reveal a complete record of shell growth. Modern cones are noted for immobilizing prey using a modified tooth and poison gland containing neurotoxins; the tooth is launched in a harpoon-like action, and the paralyzed prey is drawn back into the cone's mouth. Human fatalities have occurred from cone bites.

Figure 3. *Conus tortilis* from the Moodys Branch Formation at Town Creek (MGS locality 1) in Jackson, Mississippi, showing pits along spire where shell samples were taken for oxygen isotope analyses. Picture (digital CD #53) taken by George Phillips on July 15, 2008.

Takuro Kobashi and his professor Ethan Grossman in the Department of Geology and Geophysics at Texas A&M University (along with this writer and Linda Ivany of Syracuse University) published the oxygen isotopes of cone shells from the Moodys Branch Formation at Jackson in *Paleoceanography* (2004). The findings of this study agreed with studies Ivany had previously published on the oxygen isotopes of fossil fish ear bones (otoliths) of conger eels from the Jackson and Vicksburg groups (Figure 4). Ivany et al. (2000) and Ivany et al. (2003) also documented an increase in seasonality across the Eocene-Oligocene boundary in the oxygen isotopes of fossil otoliths. While similar summer sea-water temperatures were obtained for Eocene and Oligocene otoliths, the Oligocene winters were colder, and thus limited the ranges of tropical taxa. This was the beginning of a cooling trend that continued to the Pleistocene ice age.

Figure 4. Linda Ivany (far right) and crew collecting otoliths from the Mint Spring Formation at Mint Spring Bayou in the Vicksburg National Cemetery (with a National Park collecting permit). The Mint Spring Formation is in the undercut below the lower ledge of the Glendon Limestone and softer underlying Marianna limestone. Picture (slide 353-5) taken on May 18, 2002.

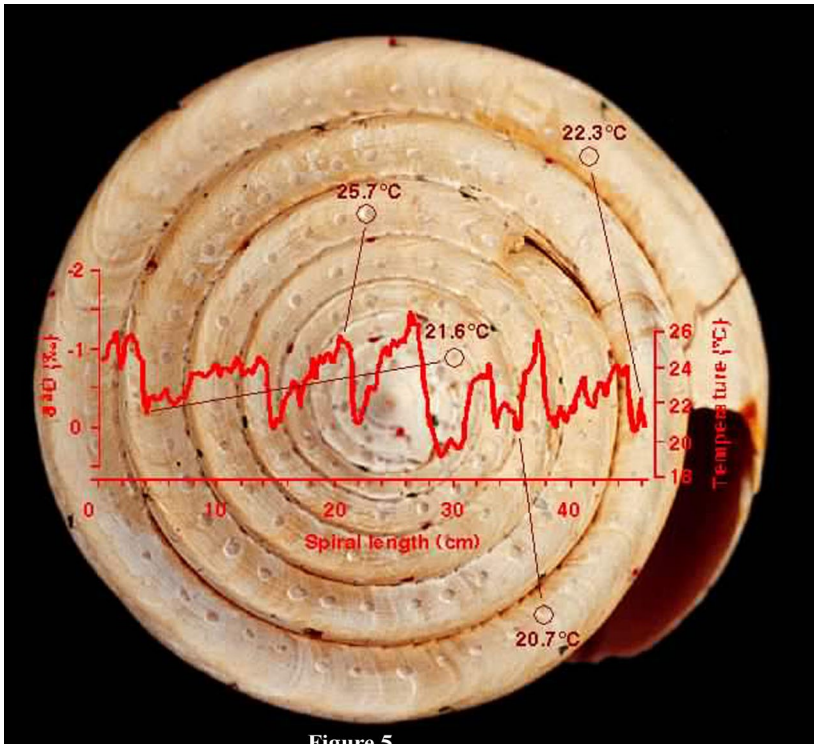


Figure 5
By sampling around the whorls of this *Conus* shell from the Moodys Branch Formation, Mississippi, Kobashi et al. (2001, Geology) have produced an oxygen isotopic record of seasonal temperature change for the Eocene. The authors have used isotopic analyses of *Conus* and other mollusks to demonstrate winter and summer cooling from the mid-Eocene through the early Oligocene, and to argue for warm low-latitude temperatures in the Eocene. Image by Takuro Kobashi and Ethan Grossman.

Figure 5 shows a graph of oxygen isotope ratios of an Eocene *Conus* shell (reported as $\delta^{18}O$). The shell was sampled along the spire (at the sites of the tiny drill holes) to produce an isotopic record for the entire life of the organism. Note that the $\delta^{18}O$ values record about eight years of growth. Seawater temperatures average about 19°C (67° F) to 23°C (73°F), a range much less than that of modern seawater in the northern Gulf of Mexico. Thus, seasonality has increased since Eocene time due to colder winter temperatures.

So why has the Earth cooled over the last 38 million years? Ice ages are not common in Earth history and have occurred only about every two hundred million years. In order for continental ice sheets to form, large continental masses must have moved (by continental drift) to cold places as they have today. Antarctica has the largest ice sheet and is over the south pole and is almost completely within the Antarctic Circle; North America, Greenland, Europe, and Asia have enclosed much of the Arctic Ocean. Greenland lies largely within the Arctic Circle and has the second largest ice sheet, which is up to 10,000 feet thick.

Another reason for cooling was found partly as a result of strontium isotope research done in Mississippi. Strontium isotope ratios ($^{87}Sr/^{86}Sr$) in the world's oceans have changed over time due to the variable contributions of light isotopes produced by vulcanism on the sea floor and heavy isotopes produced by weathering of bedrock on the continents. At times of greater exposure of continental rocks such as in mountain ranges, the oceans acquire a heavier strontium isotope ratio. Weathering of mountain rock also takes carbon dioxide from the atmosphere and sequesters it in the weathering products of soils and sediments, thus lowering the level of greenhouse gases and cooling the planet. Today's world is particularly mountainous due to the continental collision between India and Asia and the uplift of the Himalayan Mountains and the Tibetan Plateau, a process that has increased bedrock exposures over the last 38 million years.

The history of ocean strontium isotopes ratios can be found in the fossil shells of the Jackson and Vicksburg groups and the Chickasawhay and Paynes Hammock formations of Mississippi. I assisted Tim Denison and others with Mobil Research and Development Corporation in Dallas, Texas, in sampling the strontium isotopes in Eocene and Oligocene calcitic shells of oysters and pectens from Mississippi. The lowest $^{87}Sr/^{86}Sr$ ratio value Denison and others found in Cenozoic seawater was 0.707592±15 for the 38-million-year-old shells of the Moodys Branch Formation. This ratio increased in the shells of successively younger formations to a high of 0.70787±7 in the 28-million-year-old Paynes Hammock Formation. The present-day sea water $^{87}Sr/^{86}Sr$ ratio is 0.7091 (Figure 6).

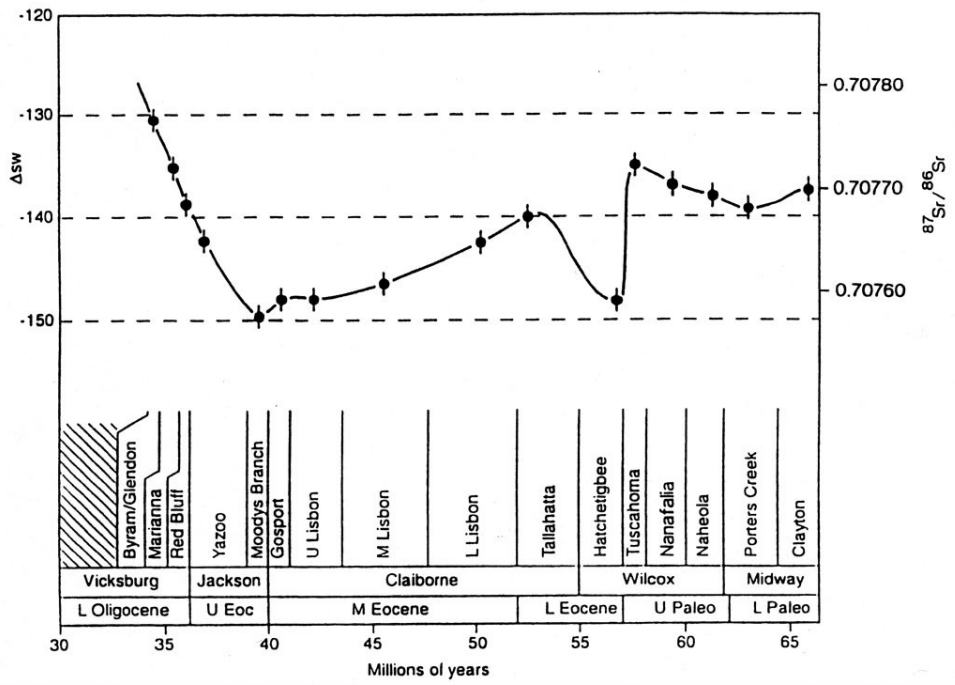


Figure 6. Strontium isotope ratios for the Gulf Coastal Plain Paleogene section as determined from the calcitic shells of oysters and pectens by Denison and others.

The initial time of cold winters and Global Cooling occurred near the Eocene-Oligocene boundary, which coincides with the boundary between the Jackson Group and the overlying Vicksburg Group. Global cooling is blamed for the extinction of many tropical species at this boundary. Columbia University Press, in their "Critical Moments in Paleobiology and Earth History Series," published a volume on global cooling with the subtitle "Paradise Lost."

During the present ice age of the last 2 million years, a time called the Pleistocene Epoch, glaciers have advanced and retreated over 20 times, often blanketing much of North America in ice. Today's climate is actually a warm interval between periods of glaciation. The most recent period of glaciation lasted 100,000 years and reached its height approximately 20,000 years ago. During this time thick sheets of ice covered Canada and the northern United States.

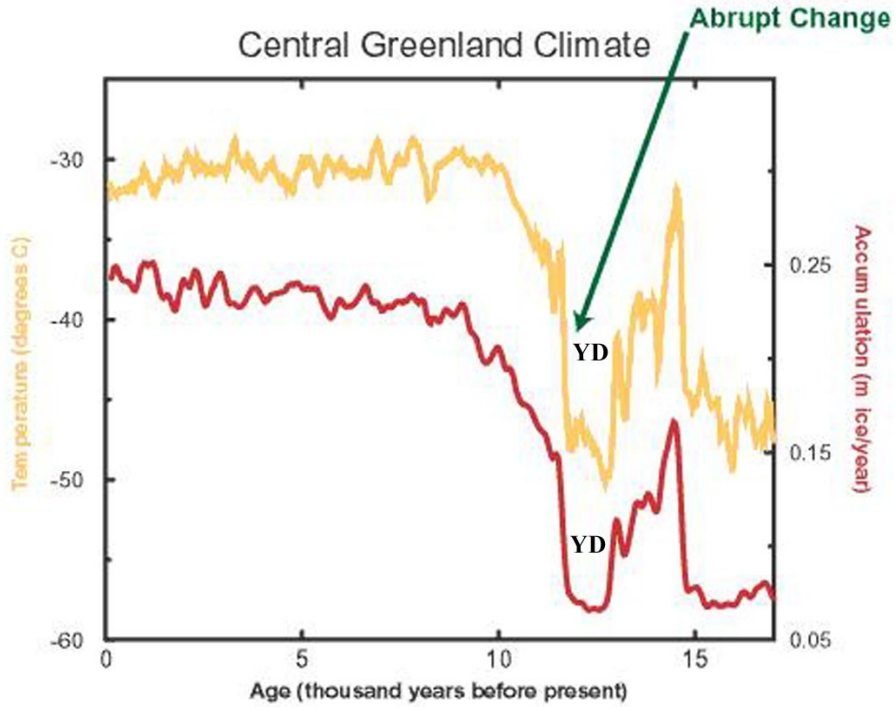


Figure 7. The yellow curve gives the temperature in degrees C for central Greenland over the last 18,000 years. The red curve gives the accumulation of ice in meters per year over the same time period. YD designates the Younger Dryas glacial period. This diagram was published online by the Lamont-Doherty Earth Observatory.

During the Pleistocene, glacial periods were long lived while interglacial periods were relatively short, lasting on the average only about 12 thousand years. The present interglacial period, called the Holocene, has already lasted over 11 thousand years but would have been on the order of 15 thousand years long if not for a climatic glitch 12,800 years ago that sent the planet back into a thirteen-hundred-year-long ice age. This ice age is known as the Younger Dryas (from 12,800 to 11,500 years ago). At about this time, central Mississippi was covered by a boreal forest (like that of northern Minnesota), as is evidenced by spruce pollen (more than 10,000 years old) found by the U. S. Corps of Engineers in the Pearl River alluvial sediments, during their coring of the Pearl River flood plain for the proposed Shoccoe dam project in Leake County.

Figure 8. Lois Nettleton as Norma in "The Midnight Sun," from the Wikipedia.

One alarming aspect about the climate change 12,800 years ago is that it occurred over a period of ten years or less (Figure 7). This rapid climate change was the inspiration for Kim Stanley Robinson's novel *Fifty Degrees Below*, for Art Bell and Whitley Strieber's book *The Coming Global Superstorm*, for John Christopher's novel *The World in Winter*, and for the 2004 apocalyptic science-fiction film *The Day After Tomorrow*. If the initial Younger Dryas climate event happened again today, the next ice age would come in our lifetime. Such an apocalyptic scenario would be much worse than the disasters forecasted for global warming. The unpredictability of what's to come, whether too hot or too cold, brings to mind an episode of the *Twilight Zone* entitled *The Midnight Sun*, which originally aired on television on November 17, 1961. In this episode, the earth's elliptical orbit has changed, and the planet is spiraling inward towards the sun. New York City is largely deserted as the population has moved north, leaving Norma (Figure 8) and her landlord Mrs. Bronson behind in the heat of a sun so bright that daylight continues to midnight. The situation changes in the last scene when a feverishly sick Norma awakens from her delirium to an earth that is actually spiralling away from the sun into the darkness and coldness of space; Norma's doctor leaves her bedside to move his family south. From her sick bed, Norma says to her landlord, "Isn't it wonderful to have darkness, and coolness?" Mrs. Bronson dreadfully replies, "Yes, my dear, it's….wonderful."